RCA Victor

SERVICE NOTES

for

1935

Broadcast Radio Receivers

All-Wave Radio Receivers

Phonograph Combination Instruments

Miscellaneous Service Information

Service Division

RCA Manufacturing Company, Inc.

Camden, N. J., U. S. A.

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INTRODUCTION

The Instruction Books and Service Notes contained herein are for the radio receiver and phonograph combination models sold by the RCA Manufacturing Co., Inc., during the year 1935. This information has been compiled by the Service Division for RCA Victor Distributors and Dealers for use by their personnel in conjunction with the servicing and replacing of parts in the instruments listed.

Proper operation of any radio receiver is dependent upon correct service methods and replacement of defective parts. We earnestly recommend that you follow the instructions given, use the equipment recommended and replace defective parts with genuine RCA Victor Factory Tested Replacement Parts. Your Distributor will be glad to obtain any part or service equipment mentioned in this book and give you every possible assistance in the performance of your work.

Printed in U. S. A.

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Service Notes

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Why RCA Victor Instruments Are Easily Serviced

The Model Shop

OF VITAL interest to every RCA Victor Dealer and Service Engineer is the RCA Victor Model Shop. It is pictorially presented here for the first time.

There are two primary functions of the Model Shop. Here every new RCA Victor receiver, every new test instrument is born. Drawings for new merchandise come from the Engineering Staff and, after careful study, the first 100 units are turned out by hand. If there is anything in the blue printed specifications that proves impractical under actual shop conditions, it is quickly disclosed and the Engineering Staff is called for consultation and necessary change.

But the actual construction of new circuits, new or improved use of tubes, new merchandise, is only the beginning of the activities of the Model Shop. When the hand-made sets are completed, they are housed in dull, drab-looking cabinets having the exact acoustical properties of the cabinets designed for the receivers —"Greys," they are called—and are shipped to all points of the compass, to every section of the United States, but only to RCA Victor Field Engineers. These men put the new receivers through their paces in every conceivable way.

In the very shadow of the most powerful broadcasting stations, all new receivers are given the acid test for performance. On the burning plains of Texas, they must perform with the

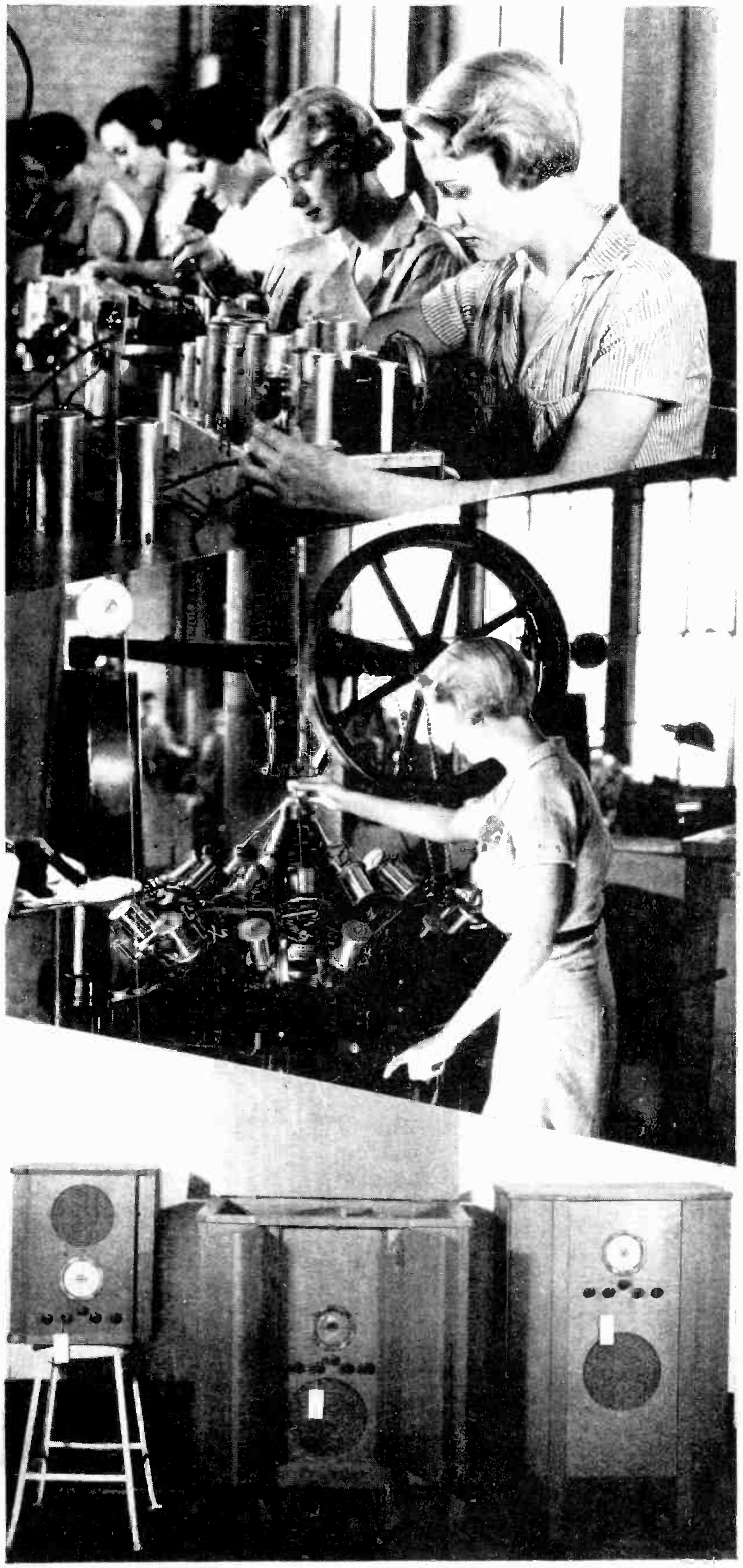
same fidelity of tone that characterizes their performance in the highest points of the Rockies. Each RCA Victor Field Engineer virtually lives with the new instrument while it is in his possession, and finally returns it with his report and recommendations. Again the Model Shop tests the returned receivers; gives careful consideration to every recommended change. Then when the Engineers are satisfied that the receiver is the finest that can be produced, blueprints and hand-made, field-tested sets are turned over to the production department, and a new RCA Victor is on its way to hundreds of thousands of homes.

Practically every operation in the manufacture of a radio set is performed in the Model Shop, and all of them by hand. Semi-automatic machinery is used in coil-winding, braiding, etc., but for the most part, every operation is a hand operation. And yet the Model Shop occupies only a small section of one floor in one of the many RCA Victor buildings.

The construction of new receivers from blueprints is but one of the two major functions of the Model Shop. Indeed, it is the primary function. But no less important to the RCA Dealer and Service Engineer is the fact that in this shop the work of the Service Engineer is constantly being simplified. Behind all this there is but one objective—to make the work of the Service Engineer less complicated, to make it easier for the Engineer to make repairs and replacements on RCA Victor sets.

Here our own staff of Field

Engineers comes frequently, and from every quarter of the globe. With them, they bring the ideas they have personally developed while making field tests of the Grey-housed models. And with these ideas they go to work. Every facility of the shop is at their command. The Engineering Laboratory, with its costly, modern, scientific equipment, is open to the visiting Field Engineer. A work bench is assigned, tools are provided and here the RCA Field Engineer proceeds to build into the set personally the changes that he believes will prove most helpful to the army of Service Engineers. But that does not mean always that the recommended changes will be made. It develops sometimes that what might be gained by such changes is more than lost in other ways. But conferences of engineers and countless tests demonstrate the practicability of any suggested plan. Every suggested change or improvement is given careful consideration. That improvements are constantly being made is attested by photographs on the following page, which illustrate the ease with which all parts of the typical RCA Victor chassis may be reached by the Service Engineer, as compared with the intricate job of getting at the older models.



KEY TO ADJACENT VIEWS

Upper Left: Aligning Gang Tuning Capacitators

Center Left: General View of Electrical Laboratory

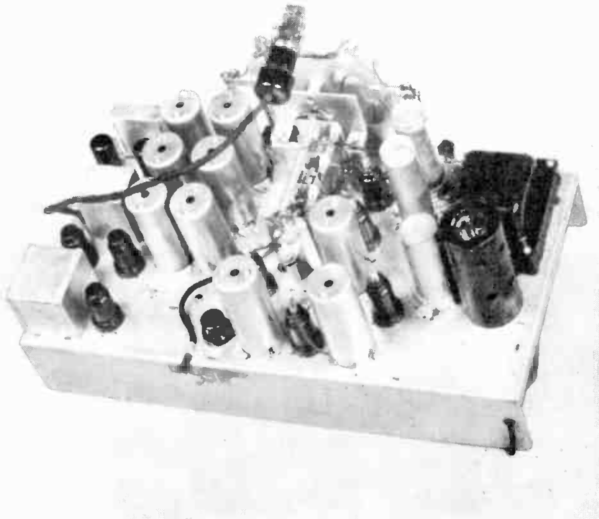
Bottom Left: Impregnating R F Coil Assemblies

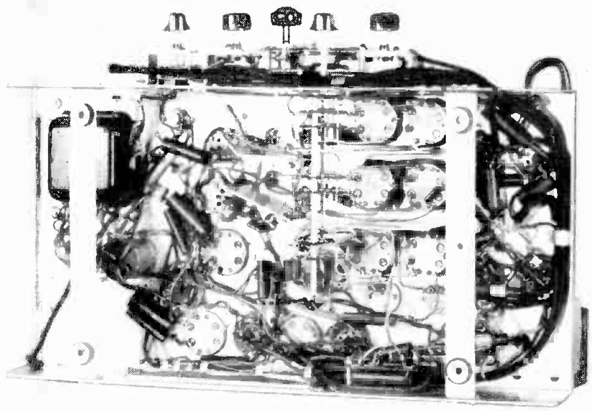
Upper Right: Model Shop. Main Production Line

Center Right: Shielding a Braided Cable

Bottom Right: Grey Cabinets, housing hand-made chassis for field tests

These pictures show how the RCA Model Shop simplifies the Radio Service Engineer's problems





Year after year RCA Victor simplifies and makes easier the sale and servicing of RCA Victor instruments, attachments and parts . . . Daily, the Model Shop is striving to make easier and more profitable the work of the Service Engineer.

RCA

Regulated Power Unit

TMV-118-B

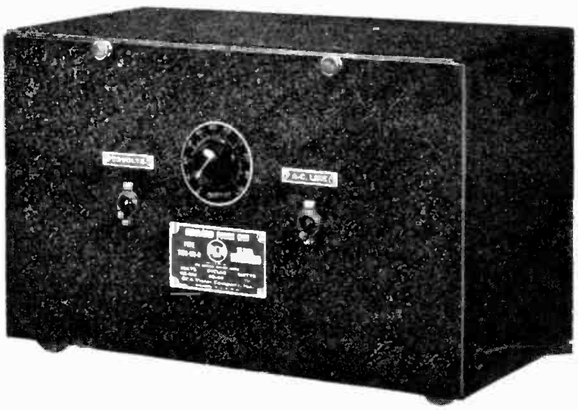
A Constant Source of "B" Voltage

FOR

Designers, Development Laboratories, Electrical Laboratories, Experimenters, Engineers, Manufacturing Tests, Production Inspection, Physical Laboratories, School Demonstration Rooms, Scientific Service Organizations, Universities, etc., etc.

Supplies pure D.C. voltage without ripples . . . Automatically compensates for variation in load and in line voltage

The RCA Regulated Power Unit, No. 9560



Front view of RCA Regulated Power Unit shows accessible controls for 90-volt tap and a. c. line

A Constant "B" Supply

The RCA Regulated Power Unit is a product of our research engineering department, designed to meet the demands of our factory, test and engineering departments for self-regulated voltage power source for its test equipments.

RCA Victor, like other recognized manufacturers in the radio industry, tests and re-tests its products many times during their orderly movement from the design laboratories to final completion.

Nearly every type of test apparatus employs vacuum tubes and the plate or "B" voltage supplied to these tubes must not vary. If the apparatus is to be depended upon for any degree of accuracy, the test load on the tube must be constant. Batteries or other forms of unregulated "B" voltage supply devices have failed to meet these requirements.

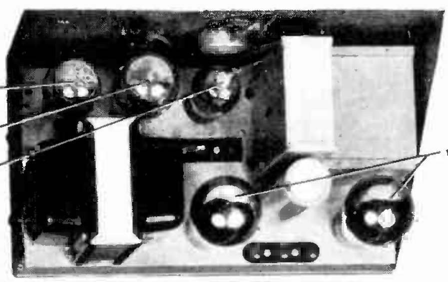
The RCA Regulated Power Unit has answered demands for this service so successfully in our own factories and laboratories that it is certain to assume definite leadership when its performance and possibilities become known to others. It will be found particularly valuable for—

1. Permanent installations of vacuum tube voltmeters, standard signal generators, beat frequency oscillators, field intensity meters, and comparable devices where it is necessary to have an automatically regulated "B" supply available.

2. Design laboratories which need a source of B current to use in the development of detector circuits, I. F. circuits, A. V. C. circuits or other portions of a receiver prior to the design of the power supply for the complete equipment.

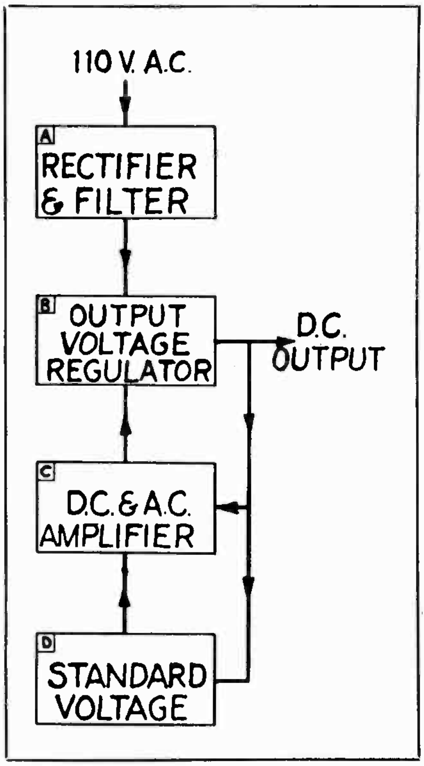
3. Test voltage services which must remain constant under varying conditions of line voltage or load.

4. Many scientific service organizations which operate on a scale comparable to that of the engineering laboratories of radio manufacturers. By means of the RCA Regulated S. P. U. they may isolate portions of circuits and study suspected difficulties independently instead of being forced to rely upon the associated power supply. Those who serve a territory where battery receivers are still in use will find the Regulated S. P. U. to be helpful in meeting the test requirements of varied circuits.



Power Unit from top with hinged cover removed to show compact design and sturdy construction

The RCA Regulated Power Unit



Block Diagram Regulated Power Unit

Circuit Description . . .

The block diagram at the left illustrates the method whereby the performance shown in the curves on page 4 is obtained. The Regulated Power Unit consists of a conventional rectifier and filter (A) and a means of governing the amplitude of this rectified voltage which is delivered to the output binding posts.

The regulator (B) which in this device is a tube, is placed in series with the output terminal. As the regulation is varied, the output voltage is changed so that the tube functions as an automatic rheostat, holding the d. c. output voltage constant with either variable line voltage, variable load current, or both. Reference to the diagram on this page shows that the d. c. output voltage is also balanced against a standard voltage (D) which in this case is a tube. The balanced voltage is applied to the grid of a d. c. amplifier (C). If the line voltage or load current is varied, the difference in voltage between the standard voltage at (D) and the output voltage will appear across the grid of the d. c. amplifier (C).

This amplified difference voltage is caused to actuate the regulator (B) by applying it to the grid of this tube. Thus any variations in the d. c. output voltage are amplified and the regulator (B) attempts to readjust to hold a constant difference between the output voltage and the standard voltage (D).

The block diagram indicates that the unit (C) is both a d. c. and an a. c. amplifier. Should any a. c. be present at the d. c. output terminals it is amplified by the unit (C), impressed on unit (B) in reversed phase and so tends to cancel.

In the Regulated Power Unit the standard voltage (D) is an 874 glow tube. A portion of the output voltage through the use of a potentiometer is compared with this voltage. By varying the position of the potentiometer arm the d. c. output regulated voltage may be varied.

Specifications

TUBES—RCA 80, Rectifier; RCA 2A3, Voltage Regulator; RCA 57, D. C.-A. C. Amplifier; RCA 874, Voltage Standard; RCA 874, Regulator for 90-Volt Tap.

The RCA Regulated Power Unit will deliver voltages between 135 volts and 180 volts d. c. at a current drain between 10 m. a. and 80 m. a. with line voltages of 110 volts ± 10% or 120 volts ± 10% with **a load voltage variation of not over** 2%. As illustrated by the curves on page 4, even higher voltages may be obtained at reduced current drains.

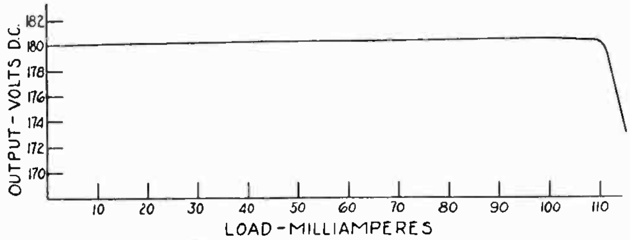
In addition, the RCA Regulated Power Unit will deliver both 90 volts and 135 volts for operation of equipment such as the TMV-180 RCA Signal Generator Type TMV-180 which required both of these voltages. The 90-volt tap will deliver up to 20 m. a. at 90 volts, while the output from the main section is 40 m. a. at 135 volts.

Net Price, F. O. B. Camden **$39.50** (With Tubes)

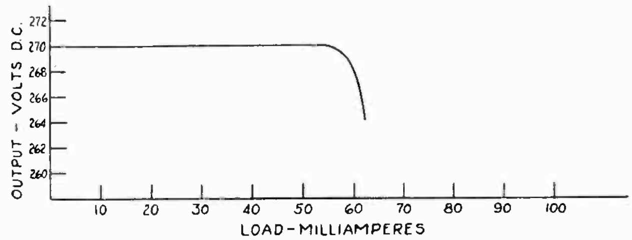
THE RCA PARTS DIVISION, Camden, N. J.

Performance Data—RCA Regulated Power Unit

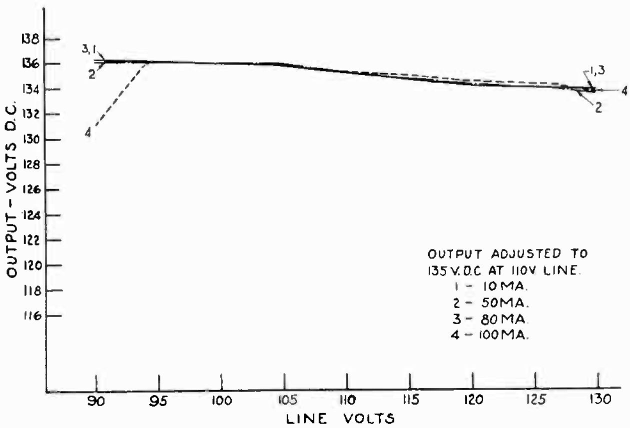
The accompanying curves indicate the remarkable regulation constancy of the RCA Regulated Power Unit under varying load conditions. Note the negligible variation in output voltage under operating fluctuations more severe than are usually encountered on most power circuits.



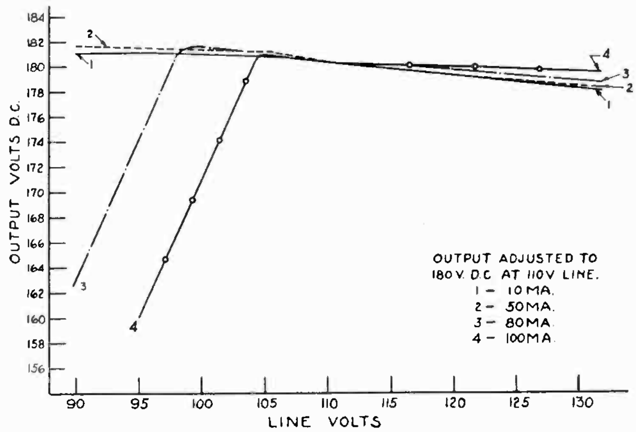
VOLTAGE REGULATION VS. LOAD
WITH CONSTANT LINE VOLTAGE (110 V. - 60~)



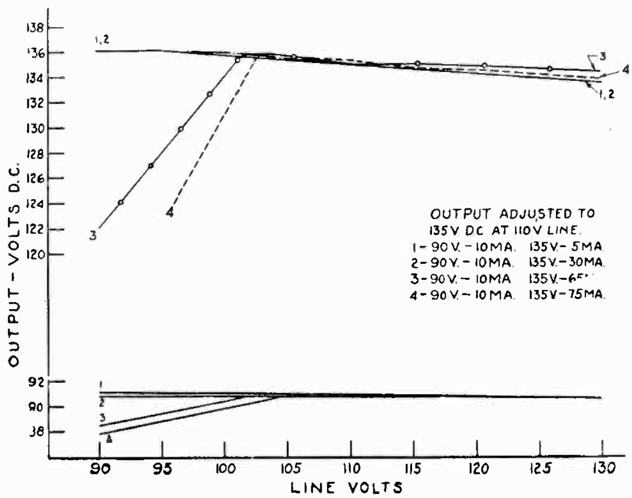
VOLTAGE REGULATION VS. LOAD
WITH CONSTANT LINE VOLTAGE (110 V. - 60~)



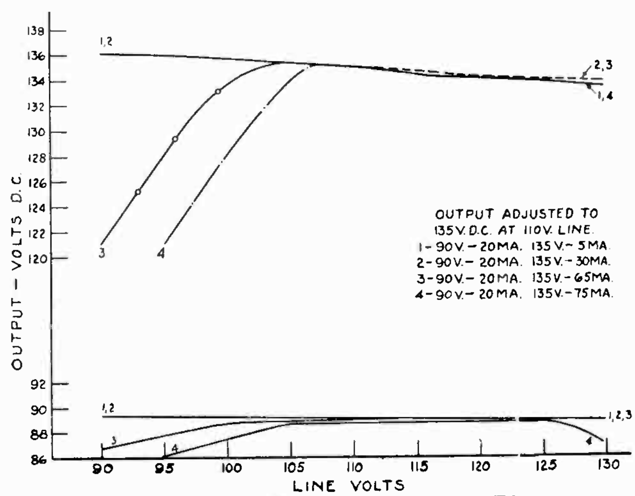
VOLTAGE REGULATION VS. LINE VOLTS



VOLTAGE REGULATION VS. LINE VOLTS



VOLTAGE REGULATION VS. LINE VOLTS



VOLTAGE REGULATION VS. LINE VOLTS

RCA Tools and Accessories

The following tools and accessories are useful for servicing Radio Receivers, Combinations and Short-Wave Instruments of all types and manufacture.

Alignment Tool

Stock No. 4160 **Net Price $0.60**

The Stock No. 4160 Alignment Tool is a bakelite shaft combination screwdriver and socket wrench. The metal screwdriver bit is so shaped that the increase in capacity caused by its touching a trimmer screw is offset by the reduction in inductance caused by its shape. This is very important when making adjustments on all-wave receivers where the screwdriver must be inserted through the end of the coil. The socket end fits the main tuning capacitor trimmer adjustment screws used on numerous RCA Victor Receivers. The bakelite shaft is 7/32" diameter, which gives entrance to 1/4" holes, used on older model Radiola receivers.

Fibre Screwdriver

Stock No. 11890 **Net Price $0.38**

The Stock No. 11890 fibre screwdriver is especially useful in making tuning capacitor trimmer adjustments in circuits which are critical and which might be misaligned if a metal tool were used. It is made of hard fibre and either end may be used in making adjustments.

Riveting Punch

Stock No. 10987 **Net Price $0.50**

The Stock No. 10987 Riveting Punch is a special metal punch for use with a riveting anvil. The punch may be used with the rivets usually used on radio receivers and permits the service man to make a factory type repair, instead of using machine screws to replace rivets. The punch is 5/16" in diameter and 5 1/2" long.

Riveting Anvil

Stock No. 10988 **Net Price $0.70**

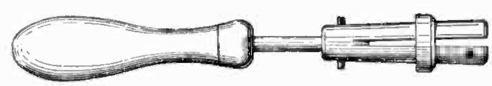
The Stock No. 10988 Off-Set Riveting Anvil is a special anvil that permits riveting in places ordinarily inaccessible. It is to be used in conjunction with a riveting punch such as Stock No. 10987. The Anvil is 5/16" in diameter and 3 1/2" long.

Tuning Wand

Stock No. 6679 **Net Price $1.10**

The Stock No. 6679 Tuning Wand is a special alignment tool which makes possible the checking of alignment in all-wave receivers without disturbing the adjustment of the trimmer capacitors. The tool consists of a bakelite rod having a brass cylinder at one end and a special finely divided iron core at the other end. Inserting the brass cylinder into a coil lowers its inductance, while inserting the iron increases the inductance. From this it is evident that before adjusting trimmers, the adjustment may be checked by inserting each end of the wand into the coil. Proper adjustment is evidenced by a reduction in output with either end of the wand inserted into the coil.

Knurled Nut Wrench



Stock No. 10982 **Net Price $1.20**

The Stock No. 10982 Knurled Nut Wrench is a special wrench designed for tightening or removing the knurled nuts such as are used with toggle type switches. These nuts are ordinarily impossible to remove or tighten without marring. The wrench will hold a nut from 5/8" to 1/2" diameter The overall length is 8 1/2".

Off-Set Screwdrivers

Stock No. 3064
Net Price $0.50

Stock No. 2930
Net Price $0.50

The Stock Nos. 3064 and 2930 Off-Set Screwdrivers are useful for making adjustments to remote control units and other small screws that are inaccessible with an ordinary screwdriver. The No. 3064 screwdriver is 2 1/2" long while No. 2930 has an overall length of 4 3/8".

Socket Wrench

Stock No. 10983 **Net Price $1.80**

The Stock No. 10983 Socket Wrench is a special flexible end socket wrench designed for adjusting the alignment screws of the 1929 and 1930 Victor Receivers, Models R-32, R-35, etc. The overall length is 8 3/4".

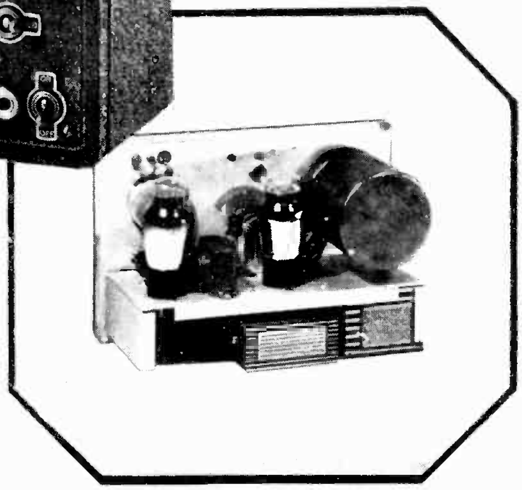
TEST OSCILLATOR

Type TMV-97-C

NET PRICE

$34.50

STOCK No. 9595



NEW

A

Laboratory Instrument for Service Engineers

No longer must you content yourself with a Test Oscillator having high leakage, poor calibration, unsymmetrical modulation or any of the usual undesirable features of most oscillators. The new RCA Test Oscillator overcomes these and all other features heretofore considered unavoidable in instruments of this type. While this new instrument retains the general appearance of its predecessors, its performance and flexibility have been improved to the point where it definitely gives laboratory type performance.

★ **90 KC. to 25,000 KC.** Frequency range covers all r-f and i-f alignment points of all receivers. Eight overlapping bands.

★ **High Output.** Check the table at the bottom of this page for the high output voltages available from this instrument.

★ **Low Leakage.** Copper shielding and scientific design give low leakage at the minimum output position.

★ **Oscillograph Jack.** Single circuit jack across tuning capacitor facilitates connection of Frequency Modulator for oscillograph operation.

★ **Frequency Meter.** Phone jack and switching gives operation as heterodyne frequency meter; useful for checking the unknown frequency of stations or oscillators.

COMPARE THESE R. F. OUTPUT VOLTAGES

Range—KC.	Switch at Low Position		Switch at High Position
	Minimum	Maximum	Max. Volts
	Less Than		
90– 200	1 Microvolt	2 Millivolts	0.2
200– 400	1 Microvolt	2 Millivolts	0.2
400– 800	1 Microvolt	2 Millivolts	0.2
800– 1500	1 Microvolt	2 Millivolts	0.2
1500– 3100	5 Microvolts	1 Millivolt	0.1
3100– 6800	10 Microvolts	1 Millivolt	0.1
6800–14000	20 Microvolts	1 Millivolt	0.1
14000–25000	40 Microvolts	1 Millivolt	0.1

FEATURES

FREQUENCY RANGE

The output frequency range extends from 90 KC. to 25,000 KC. by means of eight overlapping bands. This range covers all radio frequency and intermediate frequency line-up points of *all* receivers. The frequency range is covered entirely by the fundamental frequency of the oscillator, no harmonics being used.

MODULATION

A separate tube modulates the radio frequency output with a 400 cycle sine-wave voltage. Compare on your oscillograph this modulation with your present oscillator. There is a panel switch for operating the oscillator either with or without modulation. A panel jack permits applying an external modulating frequency voltage such as a beat frequency oscillator or phonograph output to the R.F. signal.

OSCILLOGRAPH OPERATION

Convenient operation with the RCA Oscillograph and the RCA Frequency Modulator is accomplished by a sweep circuit jack and operation without modulation. This is a very important feature because of the increasing popularity of the oscillograph method of circuit alignment.

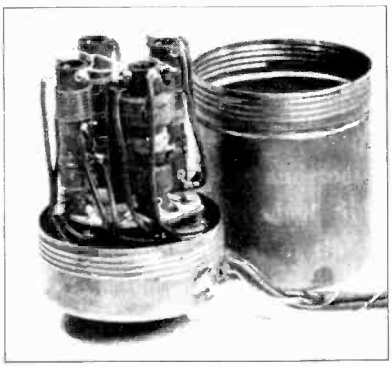
HETERODYNE FREQUENCY METER

By plugging in a pair of headphones in the modulation jack, and placing the modulation switch at the unmodulated position, the modulator tube operates as a detector and the zero beat method of frequency checking may be used. This is very useful to amateur operators for checking the frequency of an unknown transmitting station.

R. F. OUTPUT VOLTAGES

A two-position toggle switch combined with a new variable attenuator circuit provides two ranges of output R.F. voltages. The switch gives approximately a 100:1 ratio of voltage change. The minimum range of the high position overlaps the maximum range of the low position, thereby giving a continuous variation over the entire range. The approximate minimum and maximum ranges are given on the reverse page.

MINIATURE MAGIC BRAIN



The heart of the improved test oscillator is the shielded coil and switch assembly, similar to the famous RCA Victor MAGIC BRAIN. This unit includes eight coils and an eight-position rotary switch, all compactly mounted in a drawn copper container. High efficiency and low leakage give an output r-f voltage adjustable over a wide range.

DIAL

A variable vernier dial having an adjustable ratio of from 6:1 to 20:1 speed reduction is used to facilitate tuning. The dial reads directly in frequency, no curves normally being required.

CALIBRATION

The direct reading dial is guaranteed accurate $\pm 3\%$. However, a blank card and frame on the back of the oscillator permits individual calibration when desired. Individual factory calibration is available at an additional charge of $5.00. Such calibration covers all bands and is accurate to $\pm\frac{1}{2}$ of 1%.

CIRCUIT

A tuned grid, plate modulated circuit is used which gives good stability over a wide range of voltage and climatic conditions.

RADIOTRONS

Two RCA-30 Radiotrons are required and included with all Test Oscillators. One functions as the R.F. oscillator and the other as the A.F. modulator.

SIZE

Height, 8½ inches (including raised handle); case alone, 6½ inches; width, 9¾ inches; depth, 4½ inches.

WEIGHT

Five pounds, including batteries.

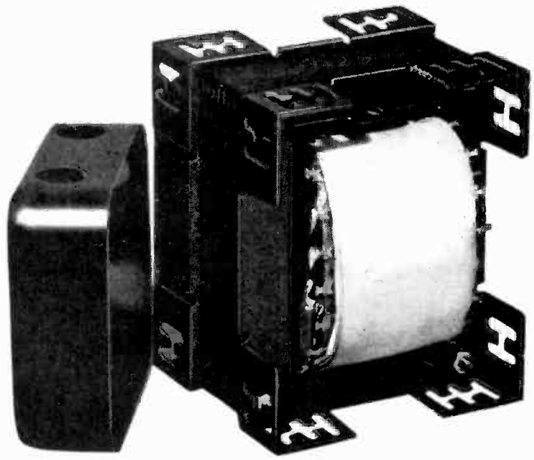
CASE

The entire oscillator is enclosed in a black crinkle finish lacquered aluminum case provided with a leather handle.

ORDER FROM YOUR RCA PARTS DISTRIBUTOR

RCA PARTS DIVISION

RCA MANUFACTURING CO., INC., CAMDEN, NEW JERSEY, U. S. A.



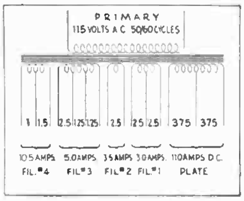
Universal Power Transformers

No longer is it necessary to "send away" for transformers for any make of radio receiver. RCA Universal Transformers for *all makes* of radio receivers from 1927 to 1937 have been perfected . . . even anticipating future receiver design.

FOR 10-12-TUBE SETS

Stock No. 9551

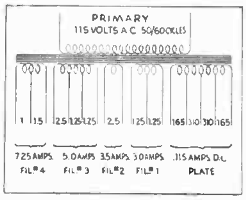
List Price, $6.00



FOR ALL CLASS B SETS

Stock No. 9552

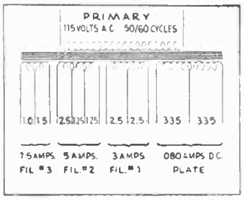
List Price, $6.50



FOR 5-9-TUBE SETS

Stock No. 9553

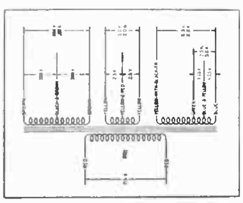
List Price, $4.75



FOR 4-TUBE SETS

Stock No. 9556

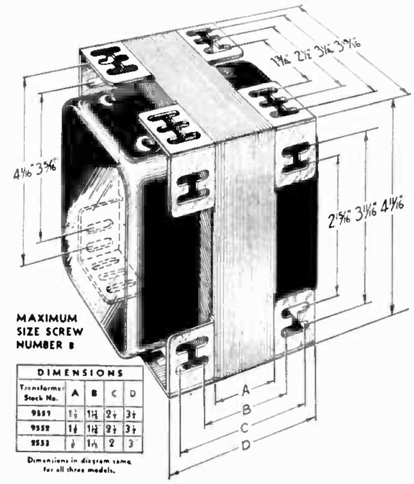
List Price, $2.06



Specifications

Slotted in every conceivable position for quick attachment anywhere, "H" type holes are provided in the mounting lugs differently spaced on opposite surfaces to allow maximum flexibility in mounting. Only four types are needed for the large 12-tube jobs down to the 4-tube midgets. RCA Universal Transformers present the solution to one of the Service Engineer's most annoying problems.

Terminals are provided to allow ample flexibility for adapting the transformer to any receiver circuit. Plenty of windings are available to meet the requirements of any circuit. RCA Universal Transformers in four types fit all sets from 1927 to 1937.



Check and Triple Check the Uniform High Quality of RCA Universal Transformers » » » » »

THE old adage, "You can't tell what a book contains by looking at its covers," applies with equal force to Universal Transformers. No Service Engineer can tell how a transformer has been constructed by looking at it, nor can he tell how accurately it has been tested and checked.

In preparing to manufacture and market a Universal Transformer, RCA determined that the Universal Transformer must in every way square itself with the RCA reputation for high quality parts and replacements. It must be able to "take it" under any and all service conditions that might arise. And the RCA Universal Transformer can.

In the RCA production, line testing and inspection is the order of the day. Primary windings are checked for shorted turns. The high voltage plate is tested for center-tap and the total windings for shorted turns. Each separate filament winding is tested for shorted turns. All this testing is done before any of the component units are assembled.

Next comes impregnation. The primary and high voltage windings are heated to the temperature of the bath before immersion to assure uniform penetration. Impregnation is accomplished in vacuum tanks which remove air and moisture from the insulation and seal it.

The units are then assembled and tests are made for voltage ratio between primary and all other windings before the core is installed. The core is then applied and tests are made for core loss and exciting current.

At this stage of production every single part has been tested separately and then collectively.

After final assembly of all the parts, the transformers are tested all over again for primary watts input and primary exciting current. And then they are tested again—this time automatically on a traveling test belt, with all possibilities of human error removed—under conditions more severe than ever developed in actual service.

Transformers that meet the exacting specifications of each of these many tests and inspections are considered worthy of the RCA name and are sold with the RCA guarantee.

OUTPUT INDICATOR

Stock No. 4317

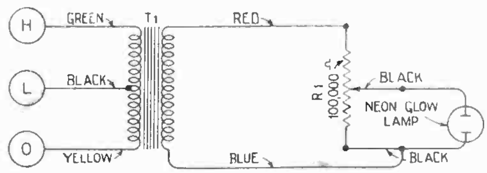
No Longer Need You "Peak" Receivers by Ear. Get an RCA Output Indicator

High Sensitivity
No burn-outs in normal use
Has three impedances
Use it on any receiver
Sturdy and foolproof
No delicate parts
For use with any oscillator
Attractive bakelite case

The RCA Output Indicator is a small, compact, visual output indicator designed for use with an oscillator when aligning radio receivers. The instrument consists of a tapped step-up transformer, a potentiometer, a glow tube and three binding posts for connecting the output of the receiver to the transformer. Three input impedances are available, namely, 0.6 ohm, 1.5 ohms and 4 ohms, which cover practically all receivers manufactured.

The instrument is used by connecting it across the leads of the input to the voice coil of the loudspeaker. The speaker may or may not be connected, as desired by the user. So connected, the glow tube will glow when a signal is impressed on the output indicator. The glow of this lamp is very sensitive, following variations in frequency and intensity. Naturally, this provides a very sensitive indicator for adjusting trimmer capacitors to their optimum position.

The entire mechanism is housed in an attractive die-cast bakelite case.



SPECIFICATIONS

Dimensions	**5⅜" x 2⅞" x 2⅜"**
Weight	**13 Ounces**
Case	**Die-cast moulded bakelite**
Lamp Rating	**50–60 volts breakdown**
Transformer Rating	**80:1 (maximum)**
Input Impedances	**O to H, 4 ohms, O to L, 1½ ohms, H to L, .6 ohm**
Potentiometer Resistance	**100,000 ohms**

NET PRICE $4.00

You can save *time* and *money*

RCA Cabinet Refinishing Kit

YOU won't call in the cabinet refinisher nearly so often after you get the RCA Cabinet Refinishing Kit. Of course you can't do every refinishing job with it, but you can do most of them—saving time and money on every job. It's the little touch-up jobs that occur most often anyhow. Someone in the shop lays a hammer on the cabinet; a button on the truck driver's coat scratches it in delivery; or perhaps it has been marred in home demonstrations or while on display in the dealer's store. But whatever the cause, you have the remedy at hand for use.

1	Can Refco Oil
1	Can Valvoline
1	Can Tripoli
1	Assortment Sand Paper
1	Assortment Stick Shellac
2	Pkgs. Aniline Stain Powders
1	Touch-up Brush
1	Spatula
1	Rubbing Block
1	Instruction Sheet

The RCA Cabinet Refinishing Kit does not contain all the material you will need for every job. For example, it does not contain lacquer, or a lamp for heating the spatula. But things like that are obtainable anywhere. Only the hard-to-obtain things have been included; the items you would have to run all over town to get, if obtainable at all.

Packed in a durable leatherette case, measuring 9½" x 4½" x 2¼", it opens like a purse. Stock No. 9546. Net to Service Engineers $2.90.

ORDER FROM YOUR RCA PARTS DISTRIBUTOR

Modernizing Phonographs

The

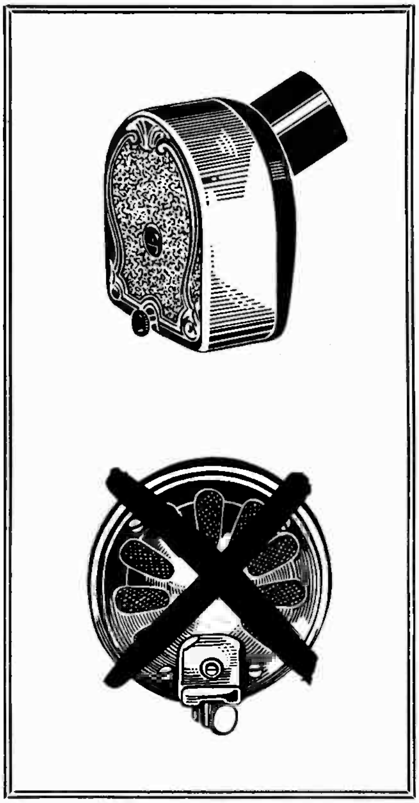
1935 Money-Maker

for

Service Engineers

▼

RCA Phonograph Modernization Kits



THE phonograph is coming back into its own. The amazing technical perfection of "Higher Fidelity" Recording has revitalized interest in recorded music. The introduction of low-priced Bluebird Records has brought recorded music within the reach of all.

Old Victrolas, talking machines of all descriptions are being modernized by alert Service Engineers, who realize a handsome profit from every sale.

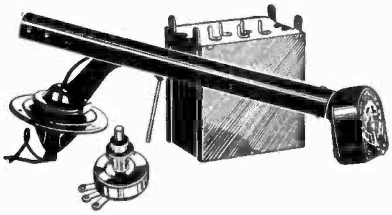
The modernization of phonographs is the Service Engineer's job, **his opportunity** for 1935. He alone in the entire industry gets into the home under conditions favorable to the promotion of this new and profitable phase of home entertainment.

PACKAGE		CONTENTS							
Stock No.	List Price	Pickup Arm With Escutcheon		Pickup		Volume Control		Input Trans.	
		No.	Type	No.	Imped-ances	No.	Resist-ance	No.	Works Into
11099	$12.10	10779	Straight	10781	200	10795	500	10414	RCA-26
11075	10.80	8858	Straight	7394	20	6225	60	7445	General
11076	10.54	11102	Inertia	6474	700	6475	5000	None	RCA-57
11080	13.10	11091	Inertia	6335	7	6355	200000	7529	RCA-56
11100	5.85	6592	Midget	6592	2450	6590	5000	None	RCA-77

To make his work easy; to simplify his purchases of parts, the kits described on this and the next page are presented and are available at RCA Parts Distributors. Write to RCA Parts Division, Camden, N. J., for booklet, "Phonograph Modernization."

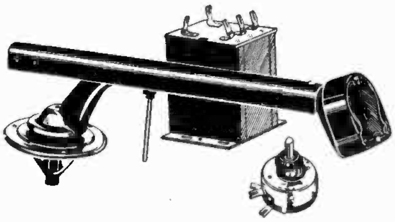
ORDER FROM YOUR RCA PARTS DISTRIBUTOR

RCA Phonograph Modernization Kits



RCA
Phonograph Modernization Kit
Stock No. 11099

Contents: 200-ohm Pickup, Straight Type Pickup Arm, 500-ohm Volume Control, and Input Transformer. List price, $12.10.

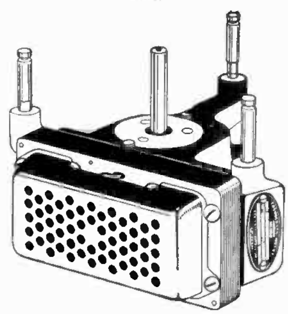


RCA Phonograph Modernization Kit
Stock No. 11075

Contents: 20-ohm Pickup, Straight Type Pickup Arm, 60-ohm Volume Control, and Input Transformer. List price, $10.80.

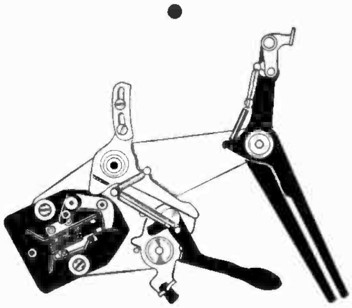
Stock No. 3599

MOTOR MOUNTING ASSEMBLY (not illustrated), comprising one screw, one washer and one lock washer. This unit contains the three sets necessary for mounting the Stock No. 8989 Motor on the motor board. List price, $.30.



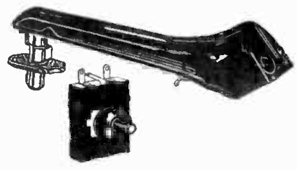
Stock No. 8989

MOTOR complete, for 60 cycles, 115 volts. This is the same sturdy motor used in the highest quality of phonographs and combinations made by the RCA Victor Company. List price, $18.52.



Stock No. 3391

MOTOR BOARD SUSPENSION SPRING ASSEMBLY (not illustrated), comprising 1 bolt, 1 top spring, 1 bottom spring, 2 cap washers, 1 C washer and 1 nut. Recommended for mounting a motor board for Stock No. 8989 in a cabinet. Specially tuned springs prevent vibration being transmitted mechanically to the pickup and spoiling reproduction. Four sets required. List price, 4 sets, $2.00.

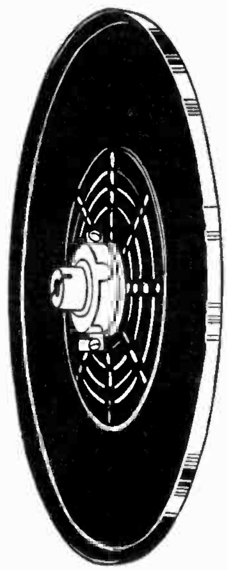


RCA
Phonograph Modernization Kit
Stock No. 11100

Contents: A 2450-ohm Midget Pickup and 5000-ohm Volume Control. For inexpensive installations where space is limited. Usually used with Stock No. 9038 Motor, shown directly below at right. List price, $5.85.

RCA Phonograph Modernization Kit
Stock No. 11076

Contents: 700-ohm Pickup, Inertia Type Pickup Arm, 5000-ohm Volume Control. Due to high impedance of pickup, no input transformer is included. List price, $10.50.

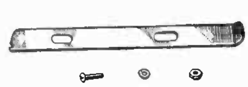


Stock No. 8948

TWO SPEED TURNTABLE. Fits shaft of Stock No. 8989 Motor (shown above). This turntable adds distinction to your work and gives it the stamp of modern workmanship. It is the same turntable used in RCA Victor Combinations to play both standard (78 R.P.M.) and long-playing (33⅓ R.P.M.) recordings. List price, $5.50.

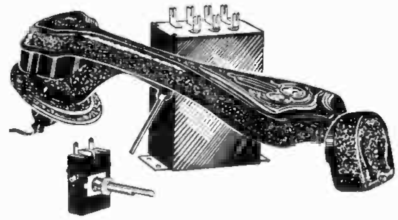
Stock No. 7180

AUTOMATIC ECCENTRIC BRAKE (left) to stop the turntable at the end of a record having an eccentric groove. To be used with Kits Nos. 11099 and 11075 (Pickup arms of the "straight type"). List price, $2.60.



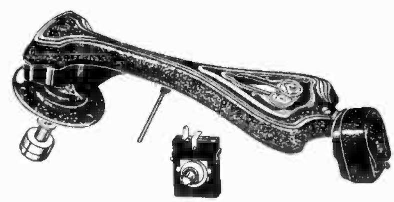
Stock No. 11106

The SHIFT LEVER used to change the speed of the turntable (8948) from standard to long playing. Not included with 8948. List price, $.98.



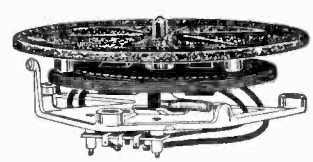
RCA
Phonograph Modernization Kit
Stock No. 11080

Contents: 7-ohm Pickup, Inertia Type Pickup Arm, 20,000-ohm Volume Control, and Input Transformer. List price, $13.10.



Stock No. 3813

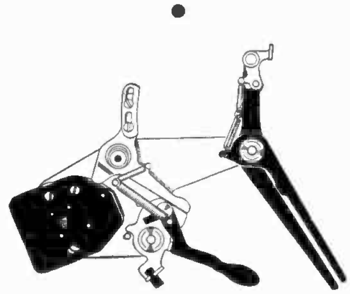
MOTOR MOUNTING ASSEMBLY (not illustrated), comprising one metal bushing, two rubber bushings, one flat washer, one lock washer and one nut. Three sets required to mount Stock No. 9038 Motor (above). List price, 3 sets, $1.68.



Stock No. 9038

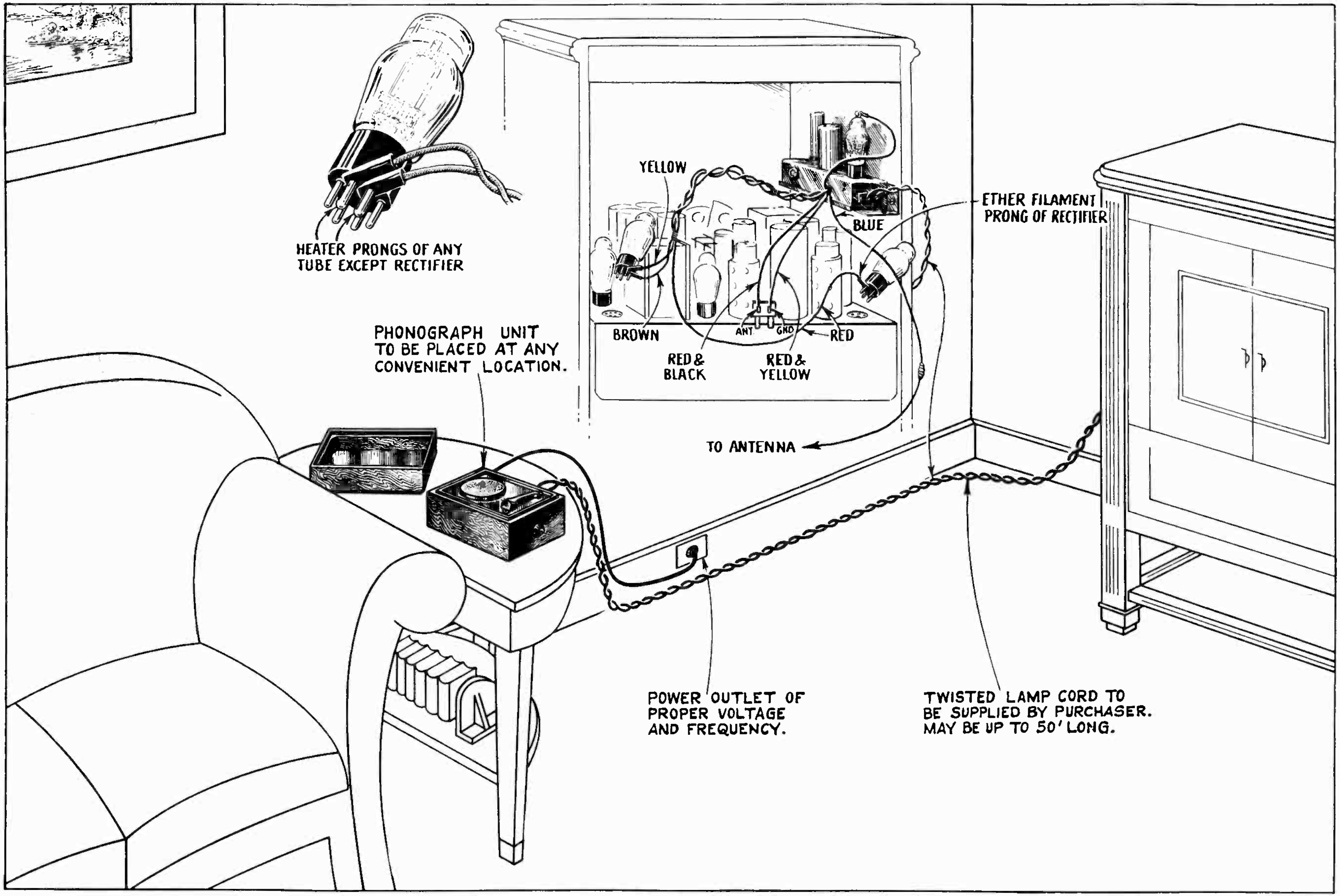
SYNCHRONOUS TYPE MOTOR WITH TURNTABLE — 115 volts, 60 cycles. Although this motor is not self-starting, it serves the purpose admirably where cost is a factor. Where space is limited this unit fits in easily. Plays either 10 or 12-inch records at standard speed. List price, $8.00.

This is the sturdy motor and turntable used in the RCA Victor Record Player. Its small size, light weight and low price make it ideal for portable equipment or for permanent installations in which either cost or space is the main consideration.



Stock No. 6896

AUTOMATIC ECCENTRIC BRAKE to stop turntable at end of record having an eccentric groove. To be used with Kits Nos. 11075 and 11099 (Pickup arms of the inertia type). List price, $2.50.



Typical Installation of R-93 and RK-24 Phonograph Oscillator

A miniature *Broadcast Station*

for every receiver...profits for Service Engineers!

SHOW YOUR customers how to broadcast records to themselves with the RCA Phonograph Oscillator. Possessing all the appeal of a distinct novelty, but with RCA practicability and durability built in, the RCA Phonograph Oscillator will prove popular with Service Engineers and receiver owners.

RCA Phonograph Oscillator

For the Service Engineer: For the Service Man the RCA Phonograph Oscillator does two things. It makes additional profits for him through the sale of additional equipment and solves one of his toughest problems in phonograph modernization work. The output from the pickup coil modulates the oscillator which is coupled to the antenna of the receiver. This modulated signal is tuned in on the receiver just like any broadcasting station.

Only a few minutes are required to attach the RCA Phonograph Oscillator. No struggle is involved to get the grid bias right; no circuit changes to make; no impedance matching. Just a few simple connections are necessary, for which directions are supplied with the equipment.

For the Receiver Owner: The RCA Phonograph Oscillator provides a miniature broadcasting station for every receiver-owning home. Its fidelity of record reproduction is limited only by the qualities of the receiver to which it is attached. It enables the owner to hear his favorite artists whenever he wants and as often.

With the rapidly reviving interest in record reproduction, and low-priced Bluebird records now within the reach of all, a tremendous field for profits awaits the alert Service Man.

This unit presents one more RCA profit maker for Service Engineers—one more trouble saver. Watch for the announcements of new, interesting, money - making, labor - saving devices that RCA Parts Division Engineers are developing now. Keep in touch with your RCA Parts Distributor.

Stock No. 9554, List Price,** (without tube) **$7.75

ORDER FROM YOUR RCA PARTS DISTRIBUTOR

Here's more about that money-making Oscillator RK-24

THE RK-24 Phonograph Oscillator is a small broadcast band oscillator unit designed for use with the RCA Victor Record Player (Model R-93), it may be attached to radio sets of all kinds and types. In addition to its primary use with the R-93, it may be used also for attaching any type of magnetic pickup to any type of receiver with slight modifications (usually the inclusion of an input transformer).

The primary purpose of the RK-24 Phonograph Oscillator is to insure proper phonograph reproduction within the limits of the receiver in all cases, avoiding the necessity of any circuit changes. No longer is the Service Engineer worried with the problems involved in overcoming avoidance of hum, distortion in the audio system and other factors that invariably occur.

FOOL-PROOF CONSTRUCTION

The unit is of simple design and fool-proof construction, and may be attached to practically any set by one unskilled in the art of radio service. Suitable leads with special contacts are provided for obtaining filament and plate power for the oscillator unit, so that internal wiring to the chassis is not necessary.

Of unusual interest is its ability, through the use of the RCA-6A7 or 2A7 tubes, to be used with receivers having either 2.5-volt heater type tubes or 6.3-volt heater type tubes. *For this reason it is sold without tube.* This adaptability makes it possible to operate the RK-24 Oscillator with practically all radio sets of the AC type manufactured during the last five years.

A TRANSMITTING STATION

The RK-24 is actually a miniature transmitting station, modulated with the output of the phonograph pickup. As the frequency range of the pickup is usually equal to or better than the transmission range of the ordinary broadcasting station and there is no intervening factor such as fading and distortion due to transmission, the phonograph quality will, in practically all cases, be that obtained with the very best possible local broadcasting stations to which the receiver may be tuned.

For this reason, one will know in advance that the phonograph reproduction quality will be limited only by the capabilities of the receiver to which it is attached

The simplicity of connections is such that it usually takes about five minutes to install.

A TRANSFERABLE UNIT

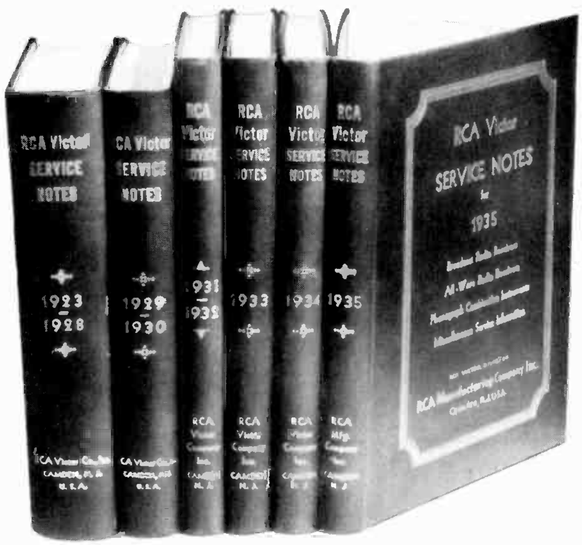
The RK-24 may be removed from one receiver to another very quickly and easily. Optimum results will be obtained in all cases. Avoidance of any switching requirements in the radio chassis proper, as well as any circuit changes, such as changing of detector tube bias to operate them as audio amplifiers and lack of sufficient audio gain, are all eliminated through the use of the RK-24 Oscillator.

We believe this oscillator fills a long-felt need often expressed by service men modernizing old phonographs, or service men attaching electric phonographs to ordinary radio sets. It also opens up a new field due to the simplicity of its connections, and the assured results obtained.

ELECTRICAL SPECIFICATIONS

Tuning Range..........1400–1700 Kilocycles
Type of Oscillator Circuit...Hartley Oscillator
Type of Modulation
Suppressor Grid Modulation
Input Voltage ....0.3 Volt
Output Impedance.................30 Ohms
Heater Current
1.0 Ampere (2.5 V.), 0.3 Ampere (6.3 V.)
Plate Current...2.0 Milliamperes at 250 Volts

All RCA Victor Service Notes
. . . Now in Six Bound Volumes



This library contains complete service information, drawings and price lists 1923-1935

So immediate was the acceptance of the bound volumes of RCA Victor Service Notes for 1931-32 and 1933; so strong was the demand that four more volumes have been compiled. There are now six bound volumes included in the RCA Victor Service Library.

The six volumes cover all RCA or Victor models produced from 1923 to 1936 except old Victrola instruments that did *not* contain a radio receiver. Complete replacement parts lists are provided for all models issued since 1929.

When the Service Engineer wants technical information on any RCA Victor model, he turns to the index of his bound volume; a moment later diagrams, parts lists and prices and service notes are lying *flat* on the table before him.

Service Engineers who use the volumes regard them as their "Business Bible," not alone for the diagrams and drawings but for the time saving service information, conveniently arranged for every RCA Victor receiver. Schematic drawings can be obtained elsewhere, but the technical information is not so readily found.

In addition, each volume will contain other valuable information such as impedance, inductance and capacity charts, and other data peculiar to the receivers described therein.

A limited edition is being published and to make sure of copies for yourself, we suggest that you place your order now.

★ NET PRICE ★
$1.00 PER VOLUME

F. O. B. CAMDEN, N. J.

ORDER FROM YOUR RCA PARTS DISTRIBUTOR

CONTENTS

1923-28

1929-30

1931-32

1933

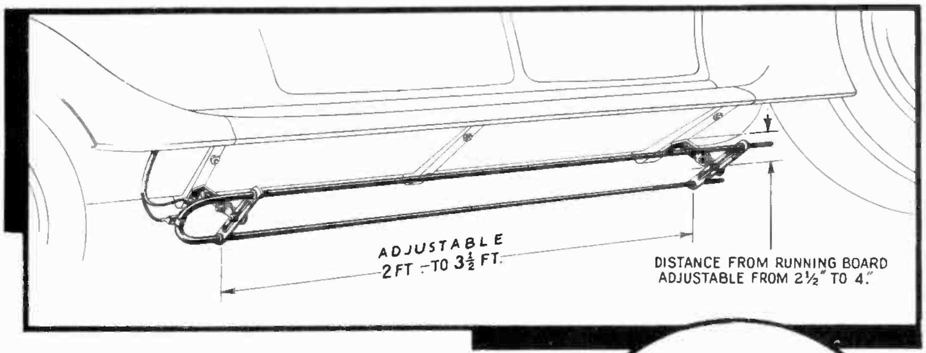
1934

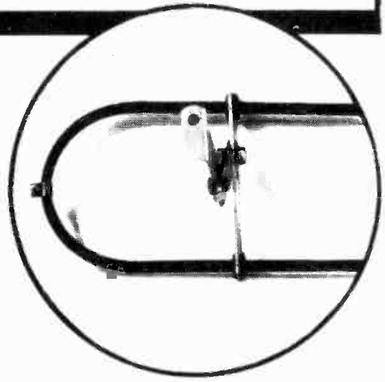
DI-POLE AUTO ANTENNA

LIST PRICE

$2.60

STOCK No. 9605





A "SET-UP" FOR THE SERVICE ENGINEER

Steel top autos plus this new noise-reducing running board antenna means profits for you

Cash in on the new steel-top automobiles without antennas. Install the new noise-reducing RCA Di-Pole Antenna on any car and guarantee improved results. As sensational in the automotive field as the famous RCA World-Wide Antenna is in the home reception field.

The new RCA Noise-Reducer Auto Antenna is an entirely new development in automobile antenna design. It's easily and quickly installed on any car, gives efficient pickup from stations, and eliminates all ignition-noise pickup by the antenna. Its low price ensures a ready sale to any automobile radio purchaser.

SPECIFICATIONS

OPERATING PRINCIPLE

Signals are picked up by the antenna acting as a counterpoise and the car acting as an antenna. Decreasing the distance from the antenna to the road increases signal pickup. Noise from nearby sources such as ignition interference is eliminated by cancellation effects caused by the shape of the antenna.

CONNECTIONS

A machine screw at the center of the bend in the rod is provided for attaching the shielded antenna lead from the receiver.

MOUNTING

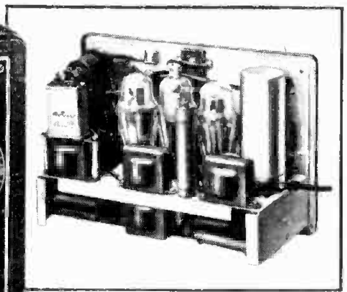
Two universal type brackets are provided for attaching to the running board by means of the bolts normally used on the car. The height of the antenna may be quickly adjusted by the brackets to insure road clearance.

ORDER FROM YOUR RCA PARTS DISTRIBUTOR

UNIMPRINTED—50 Copies Free to All RCA Parts Distributors
ADDITIONAL UNIMPRINTED COPIES—25 Cents per 100
YOUR 3-LINE IMPRINT HERE—100 Copies—50 Cents
Each Additional 100 Copies—35 Cents • ALL COPIES POSTPAID

Again . . . RCA LEADS WITH THE NEW . . .

UNIVERSAL A. C. BRIDGE



STOCK NO. 9600

NET PRICE

$49.65

COMPLETE
With All Tubes and Standards

Speed up your work with this new RCA Universal Bridge. You can make accurate measurements (at 1,000 CPS) of the three basic properties of all electrical devices—inductance, capacity and resistance—quickly and easily. Has built-in precision standards.

MEASURES

- INDUCTANCE . . . 100 Microhenries to 10 Henries
- CAPACITY . . 10 Micro-microfarads to 10 Microfarads
- RESISTANCE . . . . 1 Ohm to 1 Megohm

Accuracy . . . 5% Overall at Full Scale

for
SERVICE ENGINEERS
•
EXPERIMENTERS
•
LABORATORY WORKERS
•
MANUFACTURERS

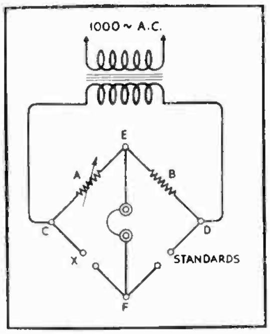
The new RCA Universal Bridge is the latest item of Test Equipment offered by the RCA Parts Division for the simplification and quick analysis of service or laboratory problems. This bridge gives a quick and accurate check of inductance, capacity and resistance over extremely wide ranges. These ranges include the low values that ordinary resistance and capacity meters do not check. The only additional equipment needed is a headphone for use as a null indicator.

While many laboratories are able to make measurements of inductance, resistance and capacitance, very few are permanently set up to cover the extremely wide ranges of the RCA Universal Bridge. A small portable bridge, having such wide ranges with built-in standards, is an extremely useful piece of apparatus, regardless of other equipment available.

In the Service Field, the necessity for making measurements of inductance, capacity and resistance arises every day. The addition of the RCA Universal Bridge to a service engineer's equipment lessens his work and increases the accuracy of observations.

THEORY OF OPERATION

The Wheatstone Bridge is a device whereby the value of an unknown resistor, capacitor or inductor may be measured by comparison with known standards. A bridge operates on the principle of a balanced parallel impedance network, measurements being obtained through the use of known standards and ratios.



The diagram shows a parallel impedance network whereby an unknown may be connected in series with a known standard and a variable ratio arm A connected in series with a fixed arm B. A source of 1,000-cycle A.C. is connected at points C and D, while a headphone is connected to points E and F to indicate a balance. Such a balance is indicated when no sound is heard in the telephones, this indicating that the ratio of arm A to B is identical with that of the unknown to the standard. By calibrating the dial of variable arm A, the value of the unknown may be read directly from the dial. By properly choosing the value of the standards, the various ranges are multiples of the basic range of 1 to 10.

Working on the principle of impedance and using an A.C. source of voltage for obtaining a balance, the bridge is equally adaptable to measuring resistance, capacity and inductance. However, it should be noted that resistance measurements are accurate only when no inductance is present in the circuit, as the bridge has no means of distinguishing any of the components of impedance. *Therefore, it is not suitable for measurement of the D.C. resistance of coil windings.*

Another important property of a bridge is that as the ratios increase there is less voltage present for operating the null indicator (headphones). To overcome this, a two-stage audio amplifier, tuned to 1,000 cycles, is provided to increase this voltage to a suitable value for any balance.

ORDER FROM YOUR RCA PARTS DISTRIBUTOR

Form 334

RCA PARTS DIVISION

RCA MANUFACTURING CO., Inc., CAMDEN, NEW JERSEY, U. S. A.

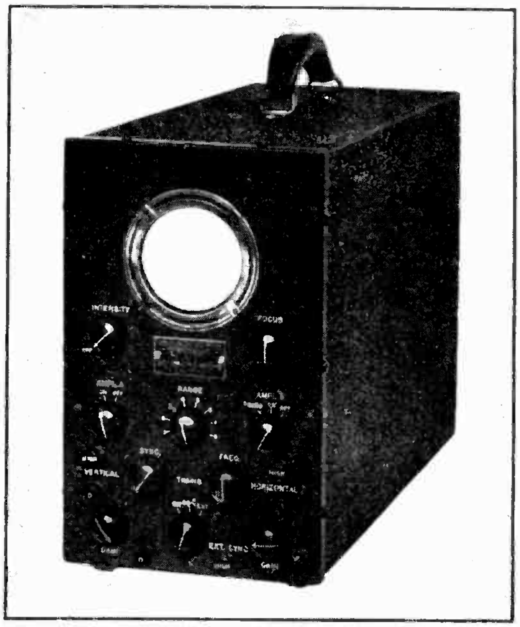
A Radio Corporation of America Subsidiary

Complete .. Portable .. A-C Operated!

CATHODE RAY OSCILLOGRAPH

Stock No. 9545

$84.50 *With RCA Tubes, Including RCA-906 Cathode Ray Tube*



Complete ...

The RCA Cathode Ray Oscillograph Type TMV-122-B, is complete in every essential requirement for immediate use. It includes two power supplies (one for the Cathode Ray Tube and one for the amplifier), vertical and horizontal amplifiers, saw-tooth frequency generator and six tubes, including the RCA-906 Cathode Ray Tube (3-inch).

2 Volts per Inch ...

Through the use of two wide-frequency-range high-gain amplifiers, the sensitivity is guaranteed at 2 volts D. C. per inch for both vertical and horizontal deflection. The amplifiers have flat frequency characteristics between 20 and 90,000 cycles ± 10 per cent. The amplifier gain is approximately 40.

20-15,000 Cycles ...

A linear saw-tooth timing frequency oscillator with a special synchronizing circuit is an integral part of the RCA Oscillograph. The frequency range extends from 20 to 15,000 cycles and permits the examination of a single cycle up to 15,000 cycles or the examination of six cycles up to the limit of the amplifier—90,000 cycles. Suitable switching is provided so that either the internal timing oscillator or an external source of frequency may be connected to the plates through the amplifier. The binding posts may be connected directly to the plates for operation above 90,000 cycles with a sensitivity of 75 volts per inch.

Beam Centering ...

Two screwdriver adjustments are provided for centering the beam on the fluorescent screen. This may be required because of changes in geographical location or variations in tubes and circuit constants.

• For Service Engineers

Visual alignment of tuned circuits, "flat-topping" I. F. circuits, measuring hum and checking distortion in audio amplifiers are but few of the problems which are easily solved through the use of the RCA Cathode Ray Oscillograph. A visual presentation of practically all alternating current circuit functions may be quickly and easily made.

• For Amateurs and Experimenters

The RCA Cathode Ray Oscillograph enables the amateur to monitor percentage modulation, to check modulated waveform for distortion and examine the phase shift in audio amplifiers. Through its use the experimenter may easily and quickly arrive at the solution of the most difficult problem.

• For High Schools and Universities

Now every high school and university may easily give students the benefit of visual presentation of alternating current phenomena through the use of an oscillograph. Studies of alternating current wave shapes and demonstrations of the effects of changing constants in circuits may be quickly and easily made.

• For Radio Dealers

The RCA Cathode Ray Oscillograph gives the Radio Dealer an instrument for comparison of receiver characteristics and for making extremely effective window displays. Selling-up from a low-priced instrument to a higher-priced one is much easier when the eye as well as the ear can note the difference in performance.

• For Manufacturers

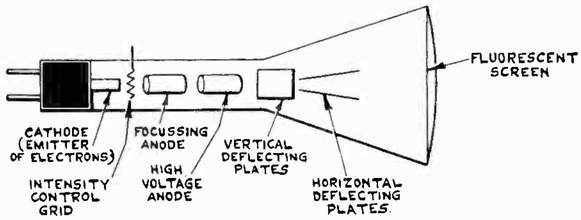
The RCA Cathode Ray Oscillograph is a valuable instrument either for receiver development or production testing. Better engineering and quicker and better tests are a direct result of its use in the manufacturing field.

A Quality Product from the RCA Parts Division

How the Cathode Ray Oscillograph Works

The Cathode Ray Oscillograph is a new device in the field of service equipment and its functioning may not be fully understood by all service engineers. Actually, its operation is extremely simple, it being merely a voltmeter that also records time. The following explanation covers the essential fundamental functions of the device. A thorough explanation is included in the instruction book which accompanies all instruments and which may be obtained from your nearest RCA Parts Distributor for a nominal charge.

THE RCA CATHODE RAY TUBE



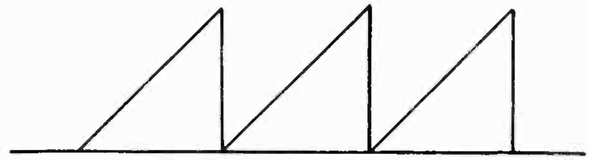
The heart of the Cathode Ray Oscillograph is the Cathode Ray Tube, a development of RCA Engineers to its present practical form. The Cathode Ray tube has often been called the "Electron Gun," as this describes its functions. The illustration shows an elementary diagram of the tube.

For the purpose of understanding the action of the "electron gun," one may consider the cathode as emitting electrons which are accelerated by the high voltage anodes and which strike the fluorescent screen at the end of the tube, thereby creating light. The course of the electrons is controlled by the two sets of deflecting plates, one for horizontal deflection and one for vertical deflection. The amount of deflection, which controls the location of the light-spot on the screen, is a direct function of the voltage at any particular instant on the deflecting plates.

From the foregoing it is seen that a pattern of light may be traced on the screen by the simultaneous application of voltages to the horizontal and vertical deflecting plates. If this action is repeated twenty or more times per second, the retentive power of the eye is such that the tracing will not be discernible and the entire pattern will be seen.

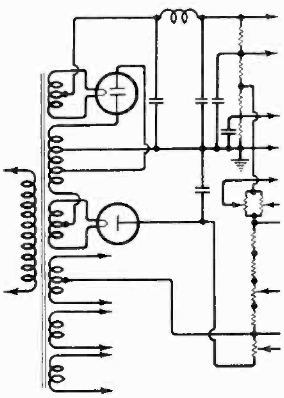
Focusing of the light beam on the fluorescent screen is accomplished by adjusting the voltage on the anode nearest the cathode. The intensity of light is controlled by the negative voltage applied to the grid.

THE SAW-TOOTH OSCILLATOR



The external voltage under test is always connected to the vertical deflecting plates. However, unless some means is provided for moving the beam simultaneously in a horizontal direction, a beam rising and falling vertically will be obtained. As this would merely give an indication of the maximum voltage available, a means must be provided for simultaneously deflecting the beam horizontally. For this, the so-called variable frequency "saw-tooth" oscillator is necessary. The "saw-tooth" refers to the wave shape of the oscillator and is required because of the necessity for having the horizontal deflection increase in a linear manner and then abruptly return to zero and again shift across the screen. The frequency of the oscillator must have a definite relationship to the frequency of the voltage under test. For example, to examine one cycle, the saw-tooth oscillator must be the exact frequency of the voltage under test. If the saw-tooth oscillator is one-half of the frequency of the voltage under test, then two cycles will be shown on the screen at one time.

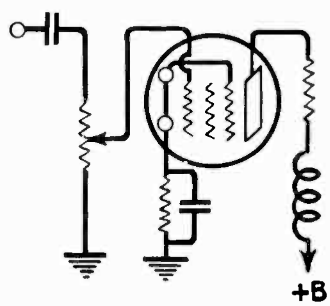
With the saw-tooth oscillator provided in the TMV-122-B the minimum number of cycles for the highest frequency is six, being obtained when a 90,000-cycle voltage is observed with the saw-tooth oscillator at 15,000 cycles. Higher frequencies may be examined by connecting directly to the vertical plates and using an external timing oscillator.



POWER SUPPLY

The high voltage anode of the Cathode Ray Tube requires 1000 volts DC for proper operation. Also DC voltages are required for the amplifier. The RCA-879 rectifier is used in a half-wave rectifying circuit for providing the necessary anode voltage for the RCA-906. The RCA-80, connected in a full-wave rectifying circuit, provides plate and grid voltages for the two RCA-57 amplifiers. While a single transformer is used for both rectifiers, individual filter circuits are provided. The transformer is over-size to prevent stray magnetic leakage that would otherwise affect the operation of the Cathode Ray Tube.

AMPLIFIERS



The sensitivity of the Cathode Ray Tube is such that a voltage of 75 is required for either a vertical or horizontal deflection of one inch. Because many voltages used in radio circuits are very small, an amplifier has been provided for each set of deflecting plates. Both amplifiers use an RCA-57 tube and have a high gain and wide frequency range. The gain is approximately 40 and the frequency range is 20 to 90,000 cycles ±10%.

Designing an amplifier circuit of such wide frequency range is a difficult engineering problem. Its solution greatly increases the flexibility of the equipment.

Specifications

Focusing

A special circuit with adjustable control on the front panel provides a means of accurately focusing the light beam on the screen.

Illumination

The light intensity is such that photographs may be easily made with ordinary commercial equipment. No hood is required.

Sensitivity

The sensitivity is guaranteed at two volts per inch. This feature gives large images for small input voltages.

Sweep Circuit

A linear saw-tooth oscillator, adjustable from 20 to 15,000 cycles, is provided. A special circuit provides a positive means for synchronizing this oscillator with the voltage under test. Binding posts are provided so that an external synchronizing voltage source also may be used.

Amplifiers

Two wide frequency range amplifiers are provided, one for horizontal and one for vertical deflection. The amplifiers are linear from 20 cycles to 90 kilocycles ±10%. The gain is approximately 40.

Centering Adjustments

Two screwdriver adjustments are provided at the rear of the case for both vertical and horizontal beam centering adjustment.

Radiotrons Used

1 RCA-906, 1 RCA-879, 1 RCA-885, 1 RCA-80, 2 RCA-57; total 6.

Power Supply

Complete AC operation from 110–120-volt lines. Power consumption 50 watts.

Size

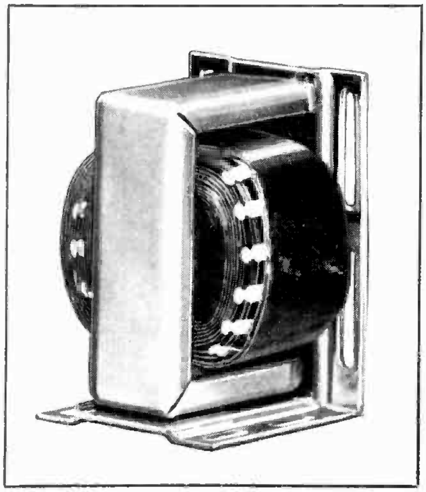
Height 12¼ inches (less handle), width 7 9/16 inches, length 17¼ inches.

Weight

39 pounds.

STOCK No. 9545 **NET PRICE $84.50**

UNIVERSAL OUTPUT TRANSFORMER

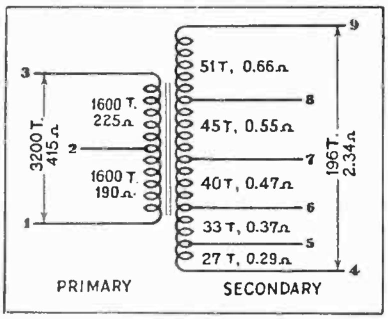


FOR OUTPUT TRANSFORMER REPLACEMENT IN ALL SETS

Stock No. 7852 **$1.95** List Price

(Subject to the Usual Trade Discounts)

- One transformer for exact matching of all output tubes (either single or push-pull) to all dynamic loudspeakers. (Covers voice-coil impedances from 1 ohm to 15 ohms.)
- Universal mechanically as well as electrically. Angle bracket with slots for easy mounting on either chassis or loud-speaker frame.
- Wide frequency range—30 to 10,000 cycles. No distortion caused by mis-match of tubes or speaker.
- Silicon steel core eliminates possibility of damage from mechanical shock or from temporary electrical overload.
- Tinned soldering terminals for quickly attaching tube and speaker leads.
- Baked varnish impregnation gives protection against normal climatic conditions.
- Low net price insures adequate profit with minimum investment.



SCHEMATIC CIRCUIT

SPECIFICATIONS

Size—Standard Model—2¾" x 2¼" x 2".
Cased Model—2¾" x 2⅜" x 3".

Voice Coil Impedances—1 to 15 Ohms.

Primary Load Impedances—1,000 to 20,000 Ohms.

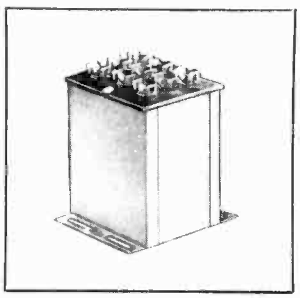
Maximum Working Potential—500 Volts.

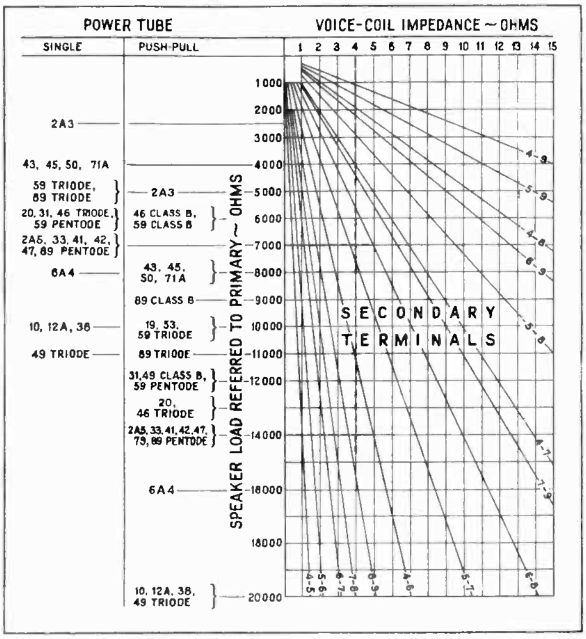
Maximum Plate Current (each tube)—55 Milliamperes.

Frequency Range—30 to 10,000 Cycles.

SPECIAL IMPREGNATED MODEL

For those extreme tropical conditions of high temperature and humidity, RCA has provided a special cased model of the Universal Output Transformer, having vacuum wax impregnated windings and complete potting in an asphalt compound for protection. The case is cadmium plated and fitted with a bakelite terminal board. Stock No. 7853—List Price, $2.42.



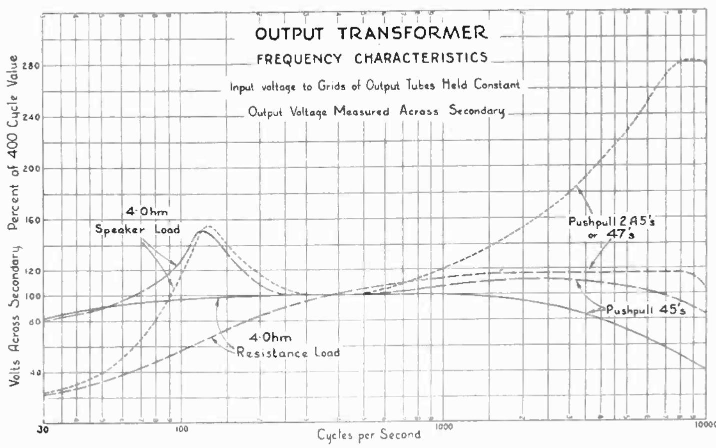


CONNECTING THE RCA UNIVERSAL OUTPUT TRANSFORMER

Terminal Numbers 1, 2 and 3 designate the primary start, mid-tap and finish, respectively, while terminals 4 to 9 indicate the various secondary taps in sequence. Always use the full primary winding either for a single-ended or push-pull power stage. In the former case, connect the plate to terminal 1 and the plate supply to terminal 3. For push-pull circuits, connect the plates to terminal Numbers 1 and 3 and the plate supply to terminal 2. A reference to the chart quickly shows the proper secondary terminal for the various combinations of speaker impedances and output tubes.

FREQUENCY RANGE OF RCA UNIVERSAL OUTPUT TRANSFORMER

The accompanying chart shows the transformer frequency range with various types of tubes and a 4-ohm speaker load. Obviously maximum undistorted output will be obtained at frequencies where the voice-coil impedance is at optimum value for the transformer ratio employed. When matching to mid-range is correct, best results will be ensured in that range. However, if matched to a higher than rated impedance, a decreased mid-range will result, but an improvement at the higher frequencies will be obtained. Often this is desirable to compensate for amplifier deficiencies, etc.



ORDER FROM YOUR RCA PARTS DISTRIBUTOR

Check your frequency

. . . ACCURATELY! WITH THE RCA

PIEZO-ELECTRIC CALIBRATOR

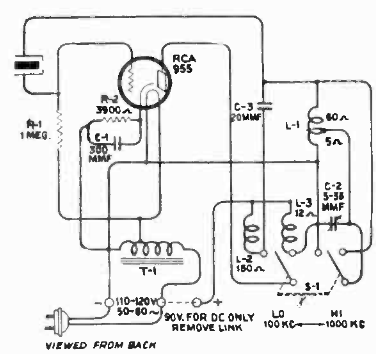
STOCK No. 9572

Give precision to your work by calibrating receivers, test oscillators and laboratory apparatus with the RCA Crystal Calibrator. It enables you to do a better job, guarantee the accuracy of your calibration and command a higher price for your work. . . A crystal oscillator, properly ground and accurately calibrated, maintains a more constant frequency than any other device known. The RCA Piezo-Electric Crystal Calibrator, which is a special crystal oscillator with two frequency modes, each having prolific harmonics, is an ideal standard for all accurate calibration work. Use it for better work.

NET PRICE **$29.95** COMPLETE WITH CRYSTAL, TUBE and POWER SUPPLY

CHECKS FREQUENCIES FROM:—

100 KC TO 20,000 KC IN 100 KC STEPS
1000 KC TO 50,000 KC IN 1000 KC STEPS
GUARANTEED ACCURACY 0.05 PERCENT OF 100 KC AND 1000 KC



Schematic Diagram

INDIVIDUAL CRYSTAL CALIBRATION AND TEMPERATURE AT WHICH MADE, FURNISHED WITH EACH INSTRUMENT. ACCURACY—2 PARTS IN 1 MILLION.

Schematic diagram of RCA Piezo-Electric Calibrator showing values of parts and internal connections.

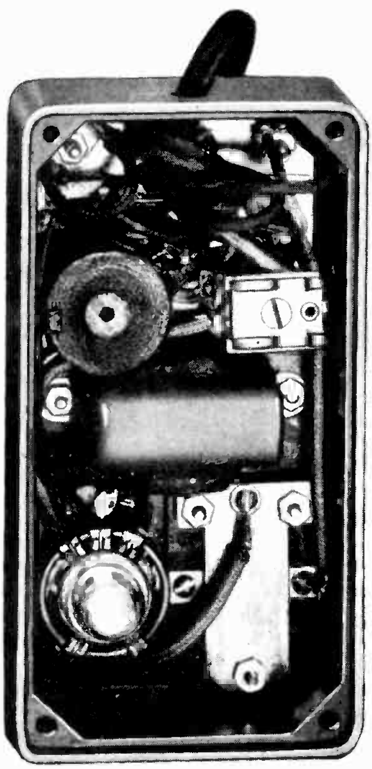
OPERATION . . . .

The RCA Piezo-Electric Crystal Calibrator is placed in operation by inserting the power plug into a 110-120 volt, 50-60 cycle A-C line. The Frequency Selector Switch is then set either at "Hi" or "Lo", depending on whether the fundamental frequency of 1000 Kc or 100 Kc is desired. The Calibrator should then be placed adjacent to the receiver which may be tuned for the desired harmonic.

On the higher harmonics of 100 Kc, the 1000 Kc steps should be used as reference points. For example, a calibration point such as 15.5 megacycles is determined by first locating the 15 or 16 megacycle point and then counting forward or backward by 100 Kc steps.

When calibrating test oscillators, harmonics of the lower oscillator frequencies should be used to beat against harmonics of the Calibrator. For example, the 10th harmonic of 360 Kc on the oscillator to be calibrated will give a beat with the 3600 Kc signal from the Calibrator; likewise, the 10th harmonic of 370 Kc will give a beat with the 3700 Kc Crystal Calibrator signal. Interpolation between the 360 and 370 Kc points will give a 365 Kc point on the oscillator to be calibrated if it is desired to calibrate closer than 10 Kc.

This same procedure will apply to other devices for which an accurate calibration is desired



SPECIFICATIONS

Fundamental Frequencies . .	100 Kc and 1000 Kc
Accuracy of Calibration . .	$\pm 0.05\%$
Temperature Coefficient . .	20 Cycles per 1000 Kc per °C
Radiotron Used .	One RCA-955 (Acorn Type)
Power Required .	110-120-Volt, 50-60 Cycle A-C (90-135-Volt D-C plate supply may be connected externally for unmodulated operation if desired)
Power Consumption .	2 Watts
Controls	Hi-Lo Toggle Switch
Size	5½" x 3⅞" x 2⅝"
Weight	1 lb. 3 oz.

ORDER FROM YOUR RCA PARTS DISTRIBUTOR

Form 299

RCA PARTS DIVISION

RCA MANUFACTURING CO., Inc., CAMDEN, NEW JERSEY, U. S. A.

A Radio Corporation of America Subsidiary

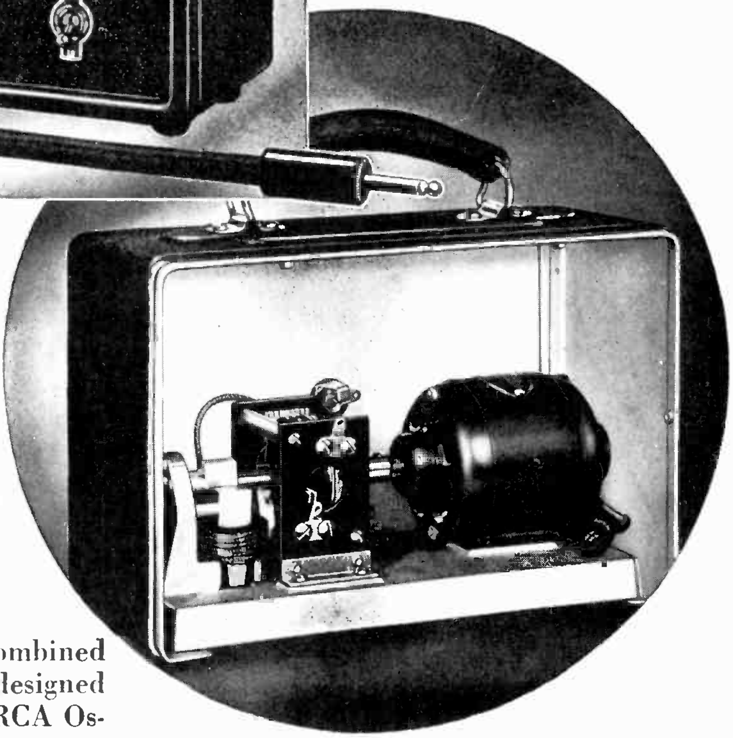
RCA Frequency Modulator

—FOR ALIGNING RECEIVERS WITH YOUR RCA OSCILLOGRAPH

$27.50

NET PRICE

STOCK No. 9558



- **LOW PRICE**
- **SMALL SIZE**
- **LIGHT WEIGHT**

THE RCA FREQUENCY MODULATOR is a combined motor-driven capacitor and a-c generator designed primarily for aligning circuits with the RCA Oscillograph and the RCA Test Oscillator.

For visual alignment of r-f and i-f circuits in superheterodyne radio receivers with an oscillograph, it is necessary to have an r-f signal of varying frequency connected to the circuit under test and to generate an a-c synchronizing voltage simultaneously with such frequency variation.

The three conditions necessary for visual alignment are:

✱ The unmodulated r-f signal frequency variation must slightly exceed the resonant frequency of the circuit under test.

✱ The variation of this unmodulated r-f signal must be at a greater rate than that discernible to the eye so that a flicker will not result.

✱ The r-f oscillator sweeping frequency must be synchronized with the horizontal "saw-tooth" sweeping frequency of the oscillograph.

The RCA Frequency Modulator and a test oscillator, such as RCA Test Oscillator Stock No. 9595, satisfy these three conditions.

A QUALITY PRODUCT FROM THE RCA PARTS DIVISION

FEATURES

TWO PURPOSES—The RCA Frequency Modulator functions both as a sweep capacitor and as an A.C. impulse synchronizing generator.

TWO RANGES—The RCA Frequency Modulator has two sweep capacity ranges, one of 25 to 70 mmfd. and one of 15 to 37 mmfd. A two-position toggle switch on the front panel permits choice of either range during operation.

BALANCED CAPACITOR—The sweep capacitor rotor is divided into two equal sections, which are mounted 180° apart on the shaft, thereby giving a perfect balance at all angles of rotation.

25 SWEEPS PER SECOND—25 sweeps per second in each direction eliminate all possibility of screen flicker of the projected curve.

IMPULSE GENERATOR—To properly synchronize the curve on the cathode ray tube screen, a synchronizing voltage is necessary. Such a voltage is provided in the RCA Frequency Modulator by having a small A.C. generator driven from the sweep capacitor shaft.

PEAKED WAVE-FORM—The output of the impulse generator has a very peaked wave-form instead of the usual sine wave of A.C. generators. Such a wave-form gives a very positive means of synchronizing the horizontal "saw-tooth" oscillator of the cathode ray oscillograph with the output of the receiver under test.

OUTPUT BINDING POSTS—Two binding posts are provided for connecting the synchronizing voltage to the Cathode Ray Oscillograph.

SPECIFICATIONS

SWEEP CONDENSER—Two sections — High range, 25 to 70 mmfd. Low range, 15 to 37 mmfd. Panel switch for paralleling these sections when the high range is desired.

CONNECTING CABLE—14-in. low-capacity connecting cable with plugs at each end.

GENERATOR FREQUENCY—Two cycles per revolution permit positive synchronizing for double-sweep alignment.

GENERATOR VOLTAGE—1.5 volts minimum.

MOTOR—Repulsion induction type—1550 R.P.M.

PANEL CONTROLS—"Hi-Lo" capacity switch, "On-Off" switch, output binding posts and single-circuit jack.

SIZE—Height 8½ inches (including raised handle), case alone 6½ inches, width 9¾ inches, depth 4½ inches.

WEIGHT—5¼ pounds.

CURRENT CONSUMPTION—25 watts.

ORDER FROM YOUR RCA PARTS DISTRIBUTOR

RCA PARTS DIVISION

RCA MANUFACTURING CO., INC. CAMDEN, NEW JERSEY, U. S. A.

New

RCA RK-40 ANTENNA

List Price $5.50

STOCK NO. 9631

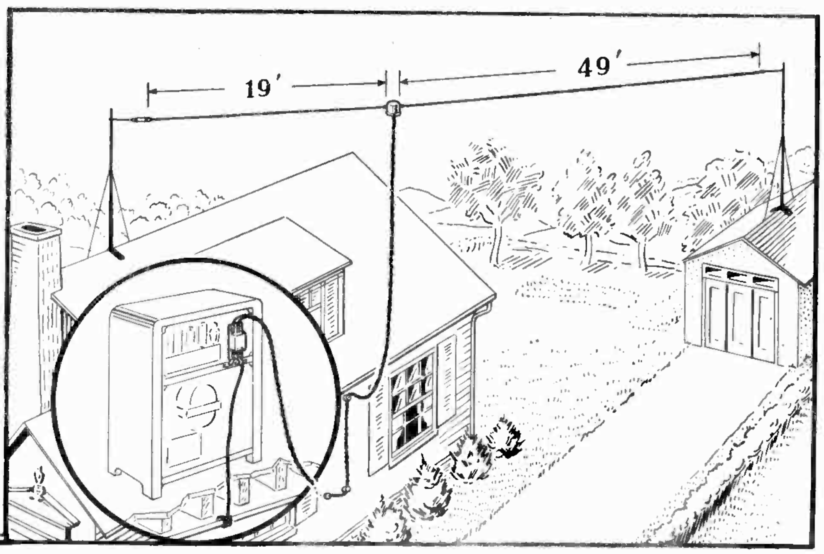
A scientific all-wave antenna system for receivers of all types and manufacture. Complete, ready to install. No assembling or parts required for installation.

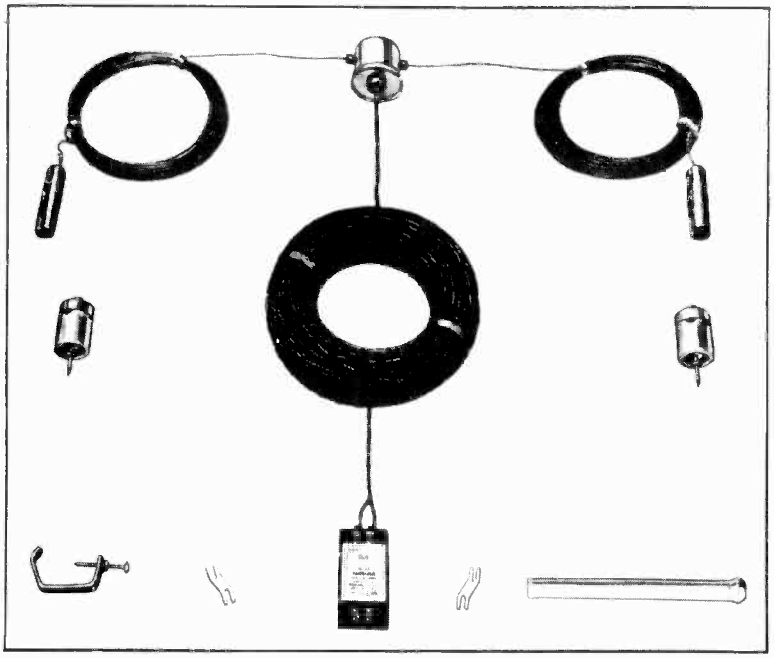
FACTORY ASSEMBLED • EASILY INSTALLED

The new RCA RK-40 Antenna is a simplified antenna system designed to reduce the time and labor required for antenna installation in the most difficult of lccations. It is merely necessary to attach each end to supports and make connections to the receiver. The time and money saved by installing this easily erected antenna means more business and more profits for you. The low price enables you to sell it to customers of more modest incomes. RCA design means more signals for your customers and better acceptance everywhere. Cash in on this improved, easily erected RCA Antenna by recommending it to your customers.

HOW IT WORKS

The RCA RK-40 Antenna consists of a special doublet, a transposed transmission line, an antenna junction box and a receiver coupling unit. The antenna acts as an efficient pick-up medium, giving high signal strength over an extremely wide frequency range. The transmission line efficiently conveys this energy from the antenna to the receiver, while the receiver coupling unit matches the transmission line to the input receiver circuits. Such a system gives adequate coverage of all short- and long-wave broadcast bands and presents a minimum in installation work in conjunction with its erection.





HERE'S WHAT YOU GET

1 Antenna Assembly comprising:
(a) Antenna Wire Coil 19 feet long with Strain Insulator attached. (b) Antenna Wire Coil 49 feet long with Strain Insulator Attached. (c) Transmission Line Coil of special two conductor insulated cable 75 feet long. (d) Hermetically Sealed Junction Box to which the two antenna wires and the transmission line are connected.

2 Receiver Coupling Unit with two links for attachment to "Ant." and "Gnd." terminals or clips on radio receiver.

3 Two Nail-on Porcelain Knob Insulators for carrying transmission line on side of building or other supporting surface.

4 Porcelain-tube Lead-in Insulator for entrance of transmission line into building.

5 Ground Clamp for attachment of ground wire to water pipe or to stake driven 5 to 8 feet into the soil.

ORDER FROM YOUR RCA PARTS DISTRIBUTOR

RCA PARTS DIVISION

RCA MANUFACTURING CO., Inc., CAMDEN, NEW JERSEY, U. S. A.

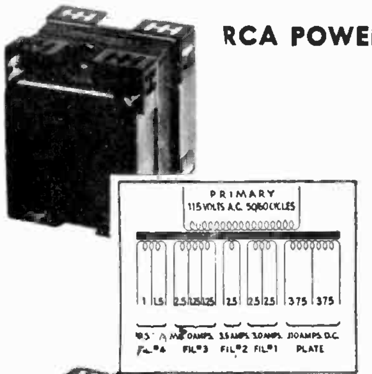
A Radio Corporation of America Subsidiary

PARTS AND RCA ACCESSORIES

Use RCA Parts with All Receivers

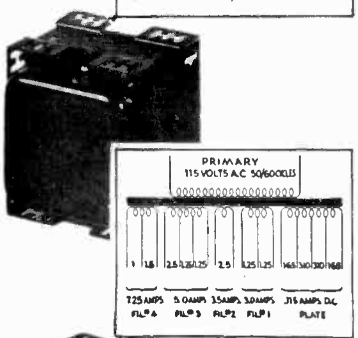
RCA POWER TRANSFORMERS

10-12 TUBE SETS



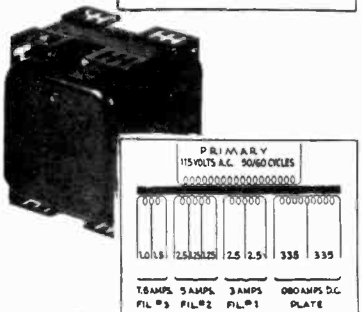
A heavy-duty transformer capable of handling the largest of standard receivers. Heavy core, high voltage plate winding, removeable end-bells and rugged construction make this a transformer capable of meeting the most severe requirements. Stock No. 9551 . **List Price $6.00**

CLASS B SETS



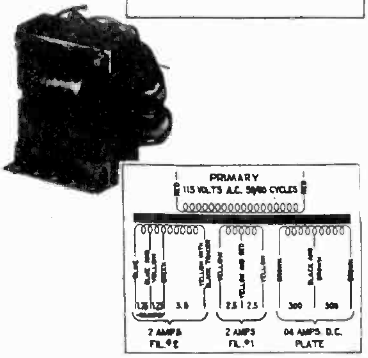
Exceptionally high (475/475) voltage plate winding and high current carrying capacity make this a transformer suitable for Class "B" output amplifiers. Good regulation and the usual RCA features make this an exceptional value. Stock No. 9552 . **List Price $6.50**

5-9 TUBE SETS



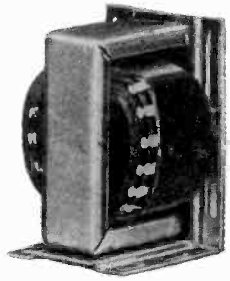
The most popular of the RCA Universal Transformers because it fits the greatest number of receivers. A quality transformer you can use on receivers of many types and manufacture. Stock No. 9553. . . . . **List Price $4.75**

4-TUBE SETS



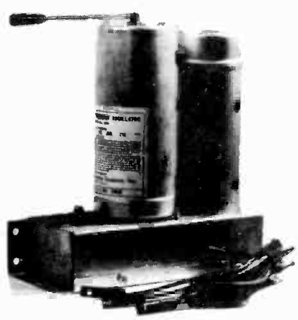
A high quality small transformer for midget four-tube receivers. Incorporates the high quality features needed for a transformer of this type. Stock No. 9556. . . . . . **List Price $2.06**

RCA UNIVERSAL OUTPUT TRANSFORMER



The RCA Universal Output Transformer is designed for exact matching of all output tubes (either single or push-pull) to all dynamic loudspeakers having voice coil impedances from 1 to 15 ohms. Stock No. 7852 has a baked varnish impregnation which gives protection against normal climatic conditions. Stock No. 7853 is a special impregnated model for extreme tropical conditions.
Stock No. 7852. **List Price $1.95**
Stock No. 7853. **List Price $2.42**

THE RCA BEAT OSCILLATOR



The RCA Beat Oscillator is designed to be used for the best reception of continuous wave signals on either short wave or broadcast type receivers. Covers all i-f frequencies from 415 kc. to 700 kc. Includes easily installed connectors. Requires 1 RCA-58 or 1 RCA-6D6 (not included). Stock No. 9606. . . . . **Net Price $7.50**

RCA PHONOGRAPH OSCILLATOR

The RCA Phonograph Oscillator may be used to connect any type of magnetic pickup to any type of receiver without making internal connections. Functions on the principle of a miniature broadcasting station and may be tuned in from 1400 kc. to 1700 kc. on the receiver. Uses 1 RCA-2A7 or RCA-6A7 (not included). Stock No. 9554. . **List Price $7.75**

RCA SERVICE NOTES

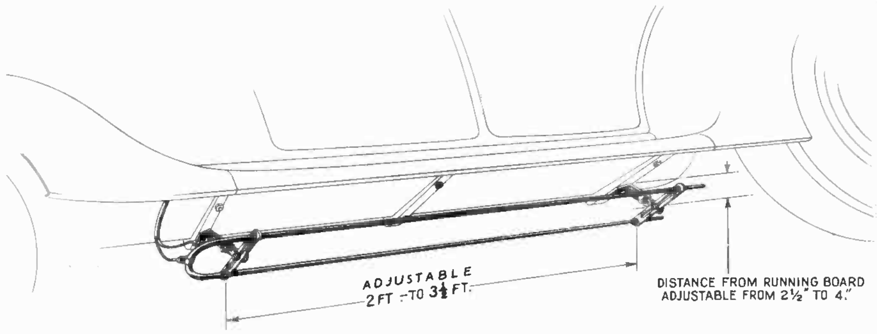
The six bound volumes of RCA Victor Service Notes cover all RCA or Victor models produced from 1923 to 1936. Complete replacement parts list are provided for models issued since 1929. **Net Price $1.00** per volume F. O. B. Camden, N. J.

RCA MANUFACTURING CO., INC. PARTS DIVISION

RCA RK-40 ANTENNA

The RCA RK-40 Antenna is a simplified antenna system designed to reduce the time and labor required for antenna installation in the most difficult of locations. It is merely necesasry to attach each end to supports and make connections to the receiver. The time and money saved by installing this easily erected antenna means more business and more profits for you. The low price enables you to sell it to customers of more modest incomes. RCA design means more signals for your customers and better acceptance everywhere. Cash in on this improved, easily erected RCA Antenna by recommending it to your customers.

Stock No. 9631. . . . . **List Price $5.50**

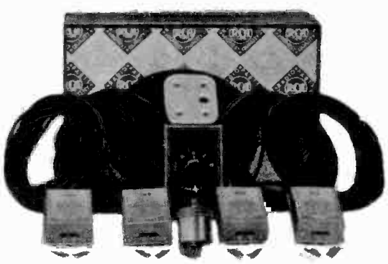


RCA DI-POLE AUTO ANTENNA

The RCA Noise-Reducer Di-Pole Auto Antenna is an entirely new development in automobile antenna design. It's easily and quickly installed on any car, gives efficient pickup from stations and eliminates all ignition noise pickup by the antenna. It is as sensational in the automotive field as the famous RCA World-Wide Antenna is in the home field. Its low price insures a ready sale to any automobile radio purchaser. Works with any set.

Stock No. 9605. . . . . **List Price $2.60**

RCA DELUXE STORE ANTENNA



The RCA DeLuxe Store Antenna rèduces man-made static on both short-wave and standard programs, besides picking up weak foreign stations seldom heard on ordinary antennas. You can demonstrate all-wave sets in your store, when the prospect's interest is high.

By means of a unique switching arrangement, the antenna may be instantly connected to any one of four receivers merely by rotating a selector switch knob. Helps you to compare sets and "sell-up" from low-price models.

Stock No. 9580. . . . . **Net Price $10.80**

RCA WORLD-WIDE ANTENNA KIT OF ESSENTIAL PARTS

For dealers, service engineers, or experimenters, who may prefer to buy standard parts locally, the Kit of Essential Parts of the RCA World-Wide Antenna System is provided. All the advantages of the standard Kit may be obtained by the use of this Kit plus antenna wire, insulators, etc., purchased locally. A special instruction sheet discusses results obtained with different lengths of antenna wire and different types of installations.

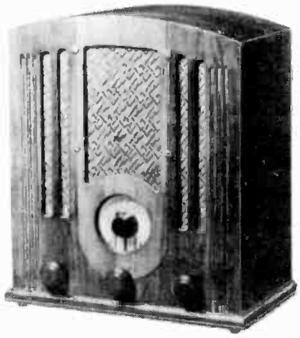
Contents of Kit: 1 Roll Transmission Line (80 feet). 1 Receiver-Coupling Transformer. 1 Crossover Insulator. Stock No. 9550. . . . . . **List Price $5.00**

ANTENNA SYSTEMS

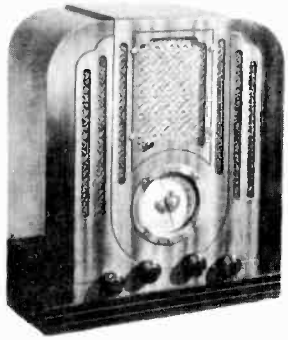
RCA PARTS DIVISION

RCA MANUFACTURING COMPANY, INC.
CAMDEN, NEW JERSEY, U.S.A.
Distributors in Principal Cities

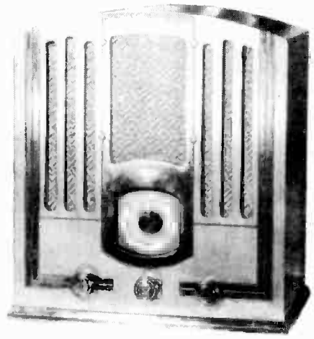
T A B L E   M O D E L S



MODEL 103



MODEL 117



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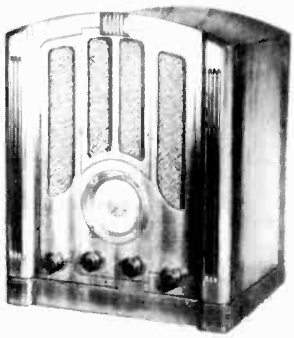

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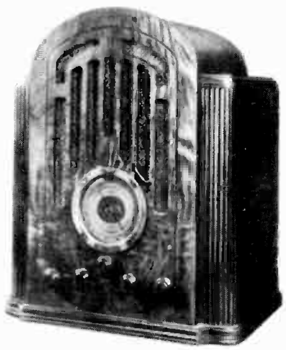

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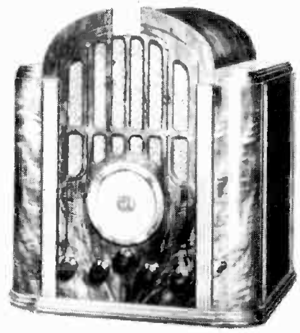

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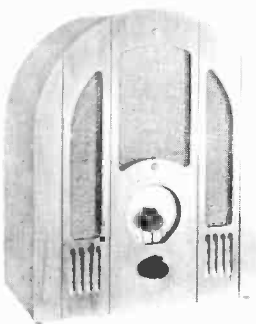

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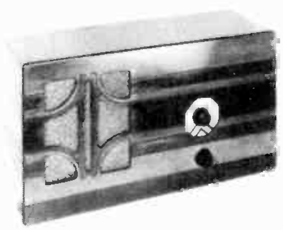

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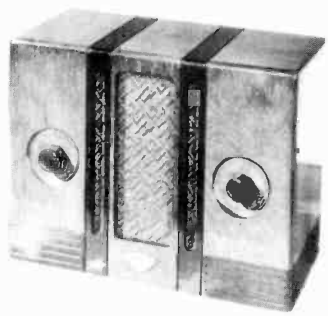

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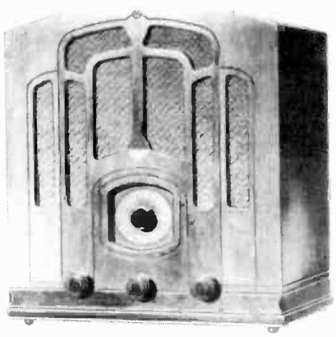

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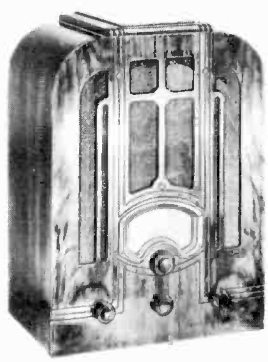

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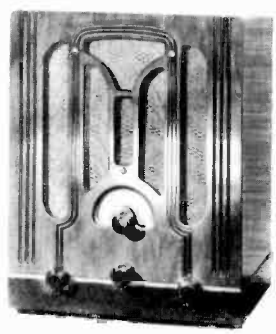
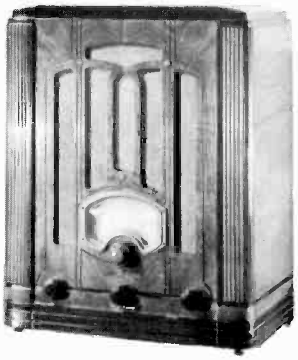


MODEL T 6-9

TABLE MODELS



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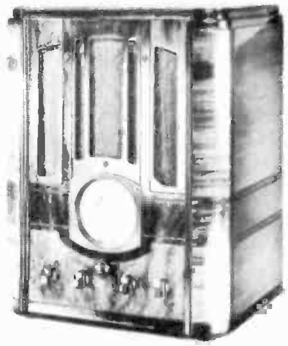
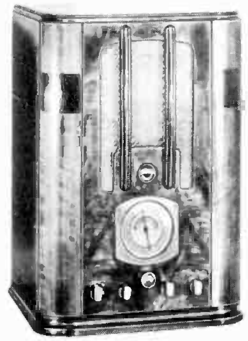


MODELS T 8-14 & T 8-16



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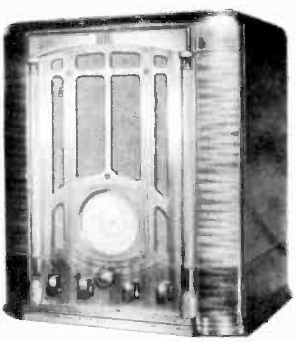

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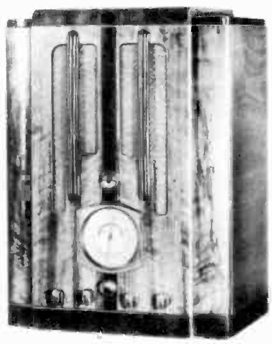
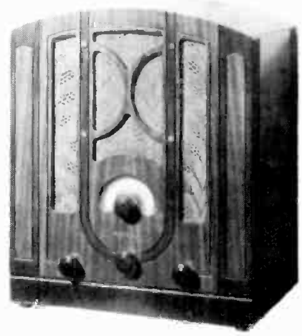
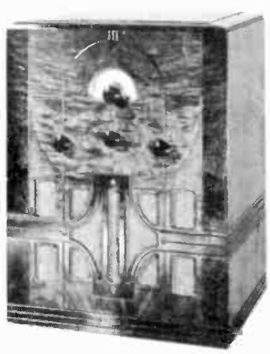


MODEL T 11-8



MODEL BT 6-3

MODEL BT 6-5



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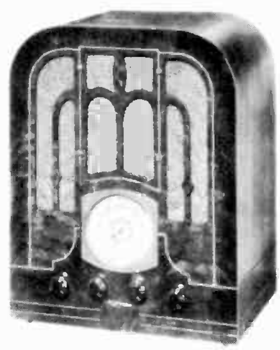
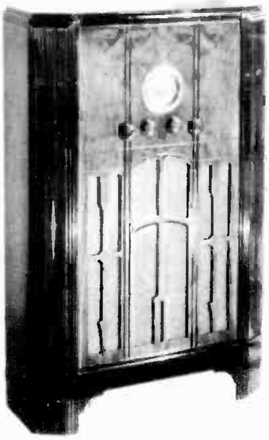


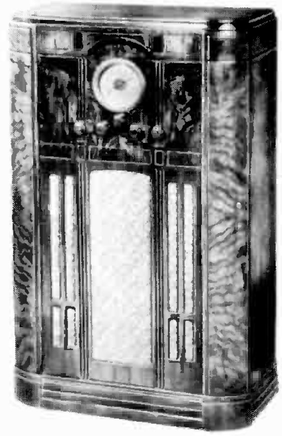
MODEL BT 7-8

CONSOLE MODELS



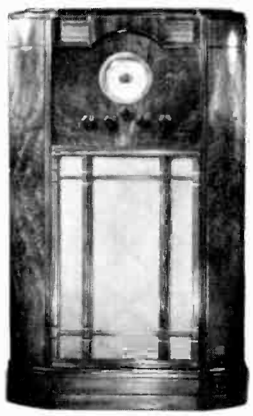
MODEL 214

MODEL 225

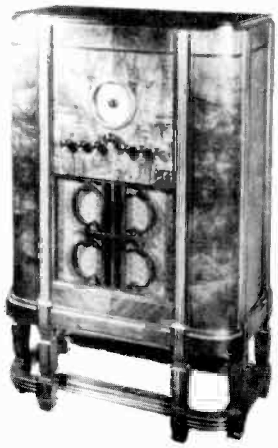


MODEL 226

MODEL 242



MODEL 243



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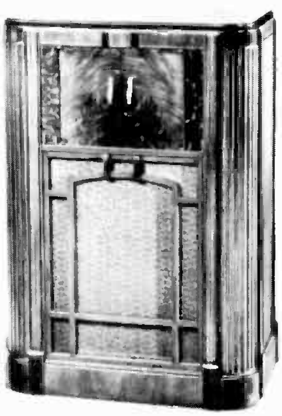

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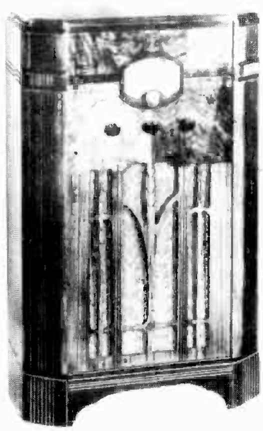
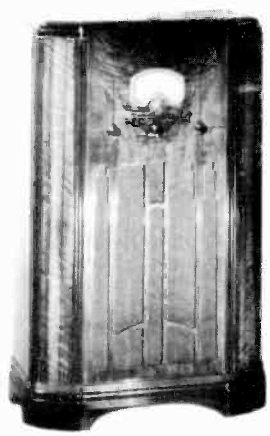


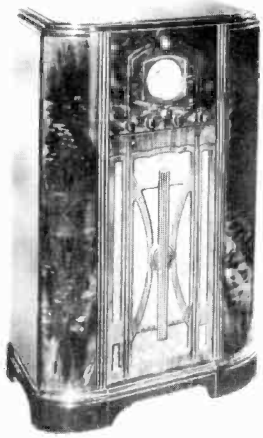
MODEL C 6-2



MODEL C 7-6

CONSOLE MODELS

MODELS C 8-15 & C 8-17



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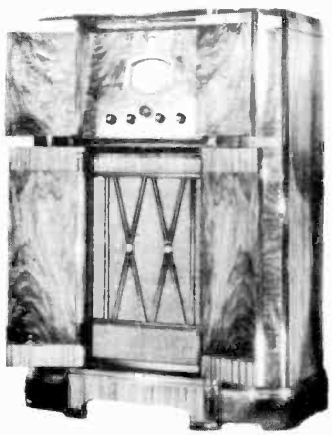
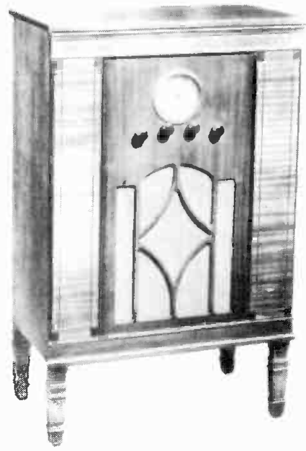
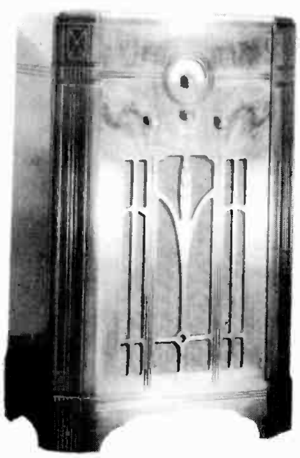
MODEL C 13-2



MODEL C 15-3

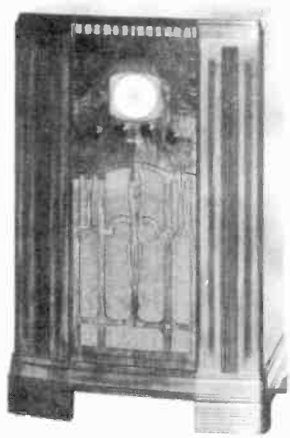


MODEL 236 B



MODEL BC 6-4

MODEL BC 6-6



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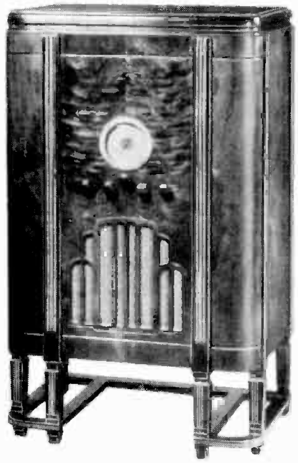
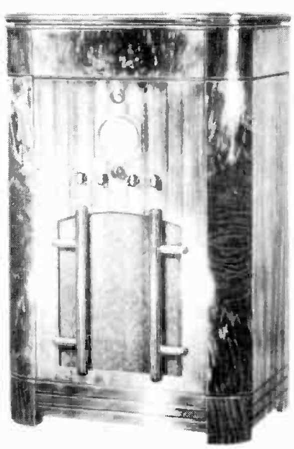


MODEL 342

MODEL D 7-7

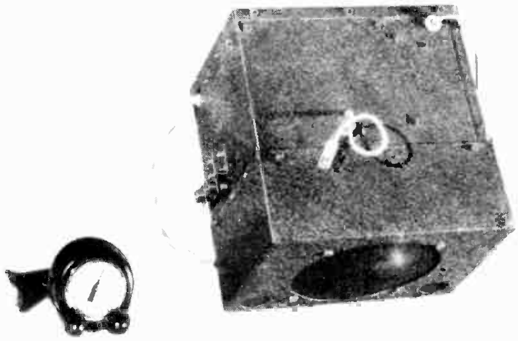
MODEL D 22-1



MODEL D 9-19

MODEL D 11-2

AUTOMOBILE RECEIVERS, RECORD PLAYERS & AMATEUR RECEIVER



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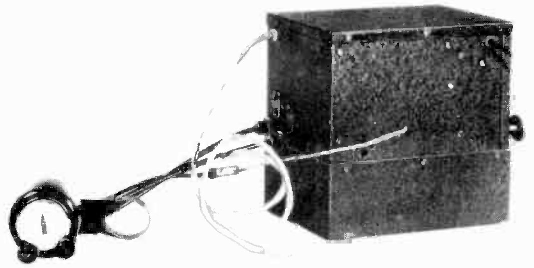

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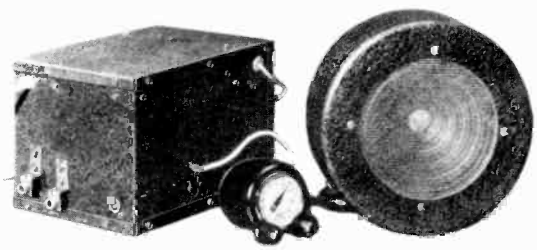

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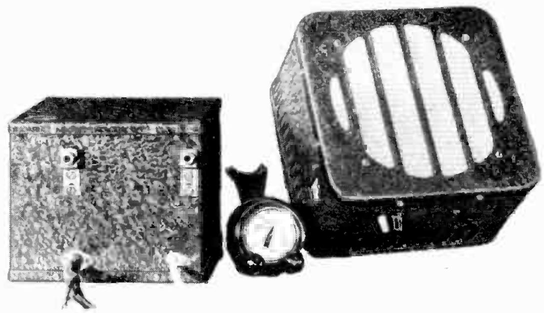
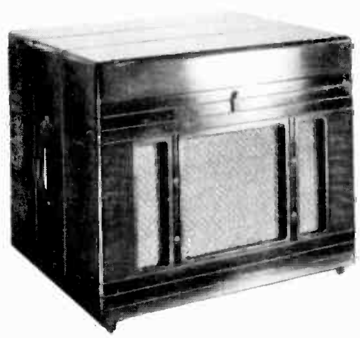


MODEL M-109

MODEL R-93



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Revised January, 1936

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Brand Models Without RCA Victor Equivalents

WR-8	Westinghouse WR-6 Chassis with Clock in Columnaire Cabinet.
WR-8-R	Westinghouse WR-6-R Chassis modified for Vertical operation in Columnaire Cabinet.
K-82	G. E. K-62 in Clock Cabinet.
J-88	G. E. J-82 with Manual Motor Board.
H-91	G. E. H-51 (Modified) in Clock Cabinet.
H-91-R	G. E. H-51-R (Modified) in Clock Cabinet.
J-109	G. E. J-100 Chassis and Automatic Motor Board.
JZ-826	G. E. JZ-822 in Console Cabinet.
JZ-828	G. E. J-88 with Short-Wave Adaptor.

NOTE: RCA Victor Models Without Brand Equivalents are not Listed

NOTICE

ALL PRICES QUOTED IN THIS BOOK ARE SUBJECT TO CHANGE WITHOUT NOTICE

RCA Victor Model M-101

Five-Tube, Superheterodyne Automobile Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Power Supply	6.3 Volts (Storage Battery)
Current Consumption	5.8 Amperes
Tuning Range	540 KC. to 1600 KC.
Maximum Power Output	3.5 Watts (Audio)
Undistorted Power Output	1.75 Watts (Audio)
Loudspeaker Size and Type	6-Inch Electrodynamic
Pilot Lamp	Mazda No. 50, 6–8 Volts
Radiotron Complement	(1) RCA-6D6 R.F. Amplifier (2) RCA-6A7 Oscillator and First Detector (3) RCA-6D6 I.F. Amplifier (4) RCA-6B7 Second Detector, A.F. Amplifier and A.V.C. (5) RCA-41 Power Output
Alignment Frequencies	175 KC. (I.F.); 1400 KC. (R.F.); 600 KC. (R.F.)

PHYSICAL SPECIFICATIONS

Height	9 Inches
Width	9 Inches
Depth	6 Inches
Operating Controls	(1) Station Selector (2) Volume Control–Battery Switch

GENERAL DESCRIPTION

This receiver represents the results of thorough development, design, and substantial manufacture. Noteworthy technical improvements have been applied in achieving marked advantages of installation, operation, and efficiency of performance.

New engineering features incorporated in this instrument are: the inclusion of ignition suppression means within the circuits of the receiver; a "plug-in" type of synchronous rectifier-vibrator for obtaining high voltage plate supply; and a "stream-lined" control unit.

The receiver is compactly constructed without sacrifice of electrical efficiency. Mounting supports consist of three ¼-inch studs, which lessen the dangers of the set vibrating as a unit, but rather maintaining the same rigidity as the structure to which it is attached.

The main operating controls are located on the remote-control unit, which normally mounts on the steering column.

The tonal quality of this receiver is especially notable. Its uniformly efficient loudspeaker is mounted in such a manner as to obtain the correct baffle area, while further desired acoustic qualities are produced by proper placement of vent holes and logical mechanical layout of the speaker and receiver housing. The design of the r-f circuits, a-f circuits and loudspeaker is based on the relation of each to the over-all response; the desired fidelity balance resulting from the total effect of the combined system.

DESCRIPTION OF ELECTRICAL CIRCUIT

The electrical arrangement of the receiver is pictured in the schematic of Figure 2. A corresponding wiring layout is shown in Figure 3, where the actual physical relations of parts and coding of conductors are given.

Five Radiotrons are used, forming the total tube complement around which the superheterodyne circuit is built. In sequence, there is an r-f stage, a dual first detector-oscillator stage, a single i-f stage, a second detector-audio amplifier-a.v.c. stage, and a pentode output stage. Five tuned circuits operate upon the desired signal to strengthen its magnitude and reject the undesired signals and interference.

Current for operation of the receiver is obtained from a standard 6.3 volt storage battery. This current is filtered through several chokes and by-passed to ground by a number of capacitors before being applied to the Radiotron filaments and the high voltage conversion unit. The number and arrangement of the filter elements are such as to gain a very great reduction in the amount of interference conducted into the r-f circuits by the current supply wiring.

The following describes the functions of the various stages of the receiver: Beginning at the antenna circuit, there is a special transmission line and "noise filter" circuit, which, in conjunction with the tuned input system, acts selectively to the entire broadcast range and drastically attenuates signals and interference outside the limits of the band (540–1600 kc.). These properties of the filter circuit and minimizing of primary to secondary capacity coupling in first r-f transformer cause a very great reduction of the ignition noise present when the car is in operation. The ground of the input coil does not appear at the usual point on the chassis frame, but instead is extended as part of the antenna transmission line lead-in to the outer termination of the shield, where it grounds to the frame of the car. This arrangement prevents r-f disturbances which are circulating in the car frame (ground) from becoming mutual to the receiver input. The characteristics of the transmission line section of the antenna lead-in are such as to favor the operation of the noise filter. Its distributed capacitance due to length, conductor sizes, insulation, etc., is of such value as to operate with the inductance and capacitance elements of the input system to obtain a "band-pass" filtering effect. The filter has an acceptance band between 540 kc. and 1600 kc., and sharply defined cut-off below and above these two limits. It is generally possible, because of this input arrangement, to dispense with the usual spark-plug and distributor suppressors without encountering substantial ignition interference on latest types of cars.

The signal is passed from the input coil by transformer action to the r-f stage control grid. An RCA-6D6 at this point performs the function of an r-f amplifier, its super-control property being adapted as means of preventing cross-modulation and securing a wide range of volume control. The first (front) section of the tuning condenser is connected to sharply tune the secondary of the antenna coupling transformer.

A second r-f coupling transformer transmits the signal to the following receiver stage, which comprises a combination first detector and local oscillator. The secondary inductance of this transformer is tuned by the second (center) section of the variable capacitor and connects to the detector grid of the RCA-6A7 Radiotron. By proper arrangement of the several elements within this tube, a local oscillator system is established, which generates the correct frequency and causes it to mix with the incoming signal. The difference frequency beat (i-f) of these two combined signals is amplified by the tube and transferred by a closely coupled transformer to the intermediate frequency amplifier tube, an RCA-6D6. Both windings of this i-f transformer are tuned by trimmers. The second i-f transformer which joins the RCA-6D6 tube to the second detector stage has only one trimmer, that being in shunt with its primary winding.

The RCA-6B7 second detector stage receives the i-f signal on its diode plates. Detection takes place as a result of the rectifying action of the diodes and develops a current through resistors R7 and R17. The d-c voltage drop in the resistance R7 plus R17 is used for automatically regulating the control grid bias of the r-f and first detector stage, and thus the amplification becomes dependent upon the signal strength. This process (a.v.c.) compensates for fading signals and reduction of signals due to change of antenna direction and shielding effects of buildings, bridges, etc. A smaller portion of the d-c voltage obtained by detection is tapped from the juncture of R7 and R17 and carried to the control grid of the i-f stage. This likewise furnishes automatic volume control.

The audio and d-c components of the detected signal are selected from the manual volume control resistor (R17) by its movable arm, and applied to the control grid of the RCA-6B7; amplification results and the signal passes on to the power output stage. The d-c applied to the grid prevents overload as the volume control is advanced. A resistance-capacitance coupling system conveys the signal from the second detector stage to the RCA-41 output tube.

The power amplifier stage delivers to the loudspeaker a high level audio signal. Correct matching relations between the speaker and output stage are maintained by the output transformer.

Heater connections of the Radiotrons are wired multiple, and supplied through a carefully filtered system. One heater terminal of each tube is grounded.

High voltage for plate and bias supply is generated by inversion, transformation and mechanical rectification; these three functions occurring in the "synchronous rectifier-vibrator." This vibrator is adapted for convenient removability by having its base constructed for "plug-in" mounting. Simple means are provided for correcting the vibrator input to agree with the ground polarity of the car by having the vibrator reversible. The vibrator may be inserted in two possible positions. As normally shipped, it is plugged in to operate with "positive" car ground. On a car having "negative ground," it will be necessary to withdraw the vibrator, rotate the unit 180 degrees and re-insert into the new position.

SERVICE DATA

The general mechanical layout of the receiver is judiciously arranged to facilitate tests, adjustments and repairs that may become necessary. All pertinent information needed for proper servicing is presented by the schematics, wiring diagrams and the text of this booklet. Resistor and capacitor values are shown adjacent to their respective parts on the diagrams. Note that d-c resistances are given for all inductive coils and windings.

LINE-UP ADJUSTMENTS

As in all standard receivers, this instrument must be in correct electrical alignment in order to obtain maximum efficiency and best quality of performance. The circuits should be re-aligned after each major servicing or repair operation, and whenever there are positive indications that the adjustments have deviated

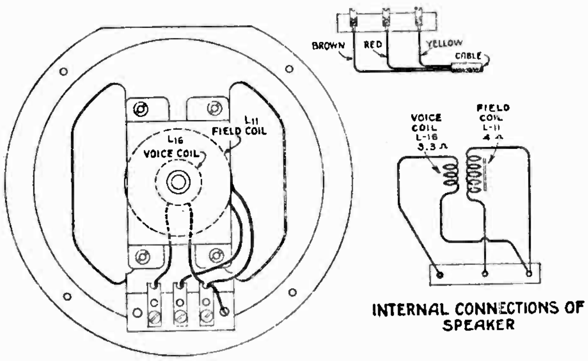

Figure 1—Loudspeaker Wiring

from normal by ordinary usage. These indications will be present together and will have the nature of low sensitivity, poor tone quality, and irregular double-peaked tuning.

The important requirements in re-adjusting the line-up trimmers are the use of proper oscillator and indication equipment and adherence to a definite procedure. Certain standard service instruments, useful for receiver adjustments, have been devised and made available by the manufacturer of this receiver. These are illustrated and described on page 2.

(1) PREPARATORY DETAILS

(a) Dial Calibration—The tuning-condenser flexible shaft operates the dial pointer through a gear mechanism within the control unit. To adjust their mechanical relations so that accurate scale calibration obtains:—Rotate the station selector knob until the variable tuning capacitor is at full mesh, which will carry the dial pointer to its minimum frequency position; then remove the tuning knob, loosen the set screw in the bushing and rotate the bushing until the pointer sets exactly opposite the last radial line at the low frequency end of the scale. (The line referred to is the second one counter-clockwise of the 550 kc. mark.)

(b) General Procedure—The "Output Indicator" should be attached to the voice coil circuit of the loudspeaker, and for each adjustment, the oscillator output increased until a noticeable registration or glow occurs on the indicator. The signal from the oscillator should be held as low as possible consistent with getting a good indication, with the receiver volume control set at its maximum position. This method of procedure prevents the automatic volume control from affecting the adjustments.

(2) I. F. ADJUSTMENTS

Three trimmers are provided in the i-f system, two on the first transformer and one on the second transformer. The locations of the adjustment screws are shown in Figure 4.

(a) Tune the "Full Range Oscillator" to 175 kc. and connect its output to the first detector control grid and chassis ground. Tune the station selector to a point where no signals are received.

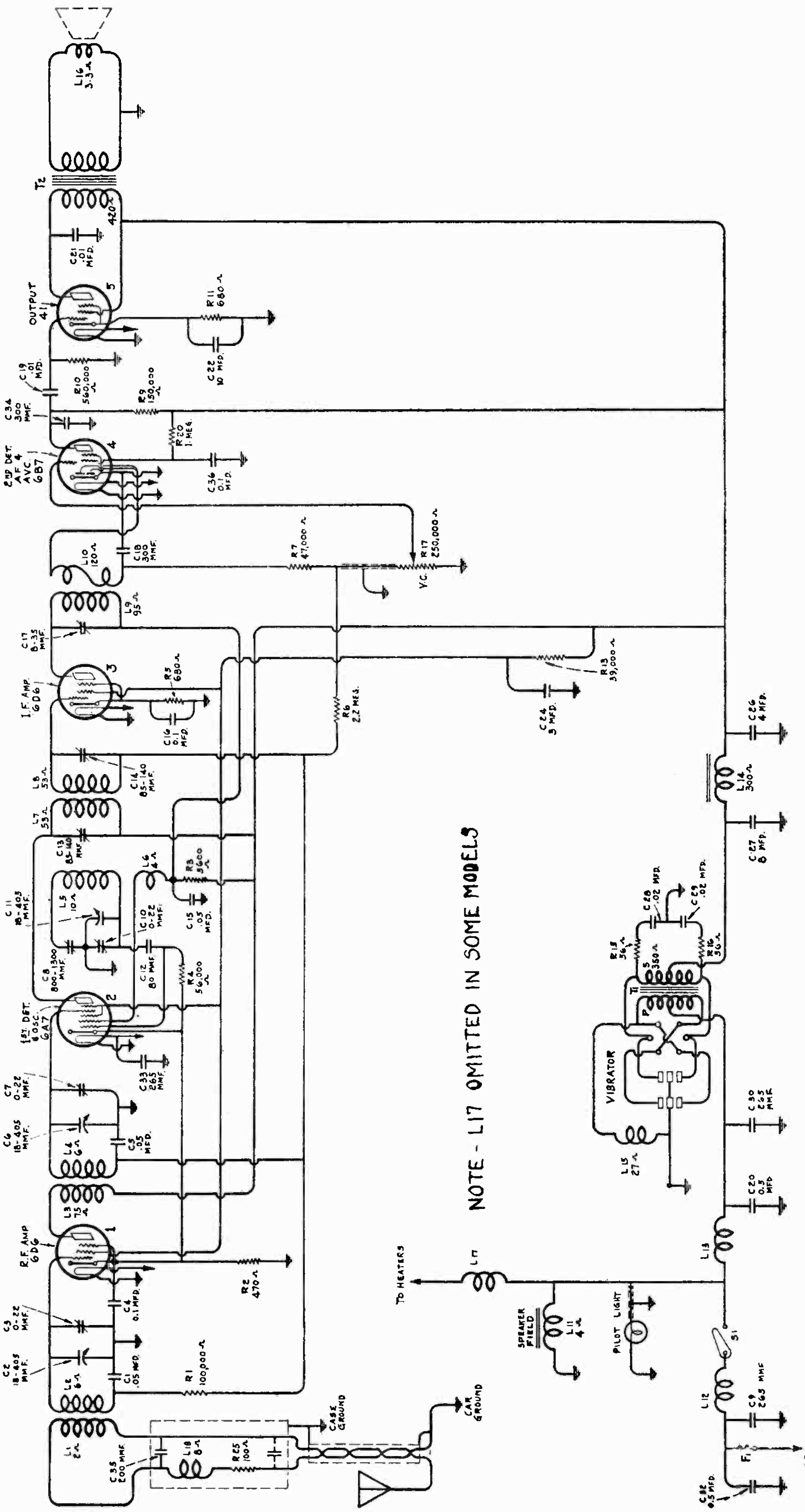

Figure 2—Schematic Circuit Diagram

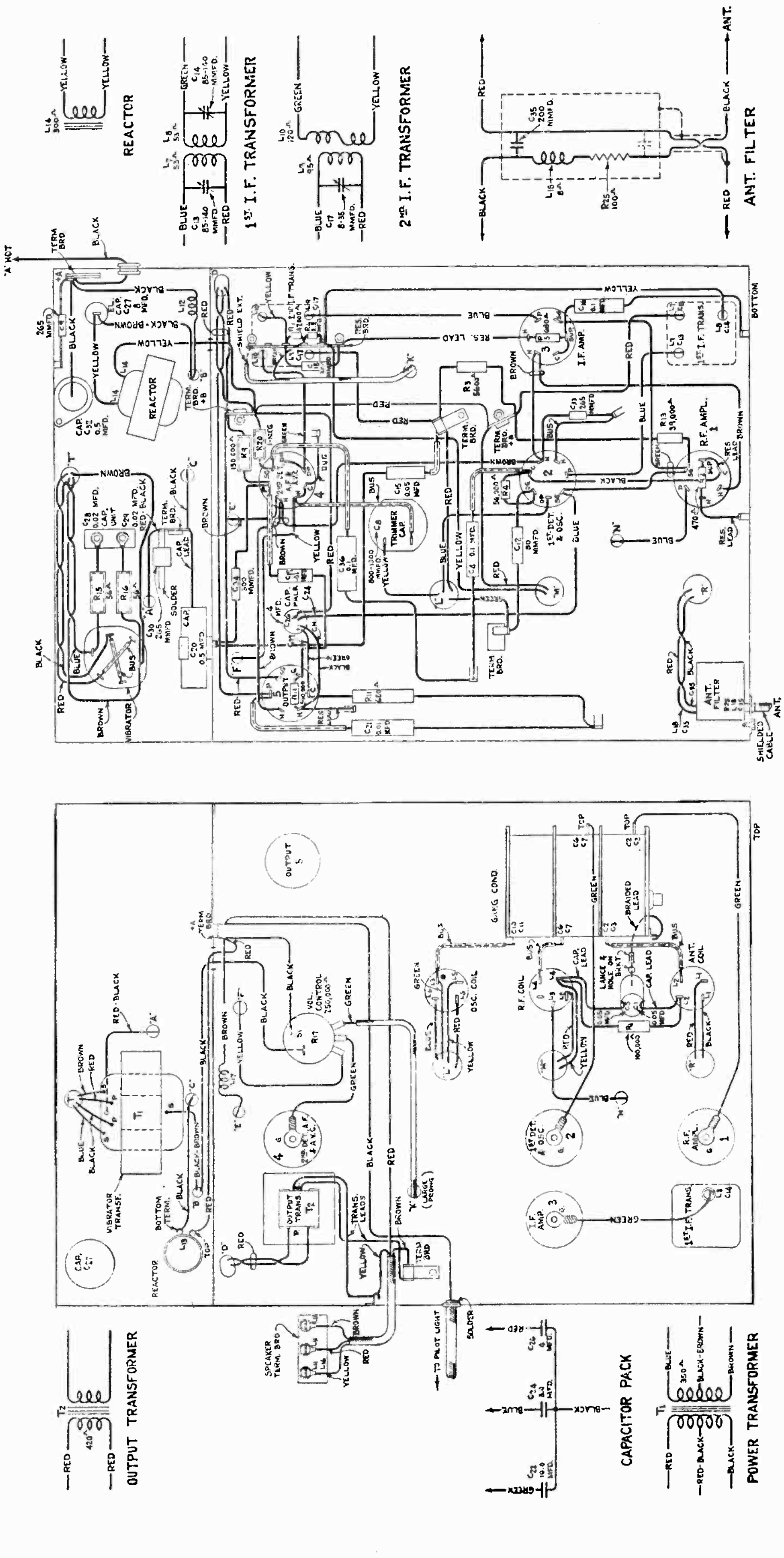

Figure 3—Chassis Wiring Diagram

(b) Tune each of the trimmer capacitors, C17, C14 and C13, in order. C17 should be set for maximum (peak) output. C14 and C13 should be roughly adjusted for maximum output and then carefully "trimmed" so that a flat-topped response is obtained. This may be checked by shifting the external oscillator frequency through a range two kilocycles each side of 175 kc. and noting whether or not the receiver output remains substantially constant.

(3) R. F. DETECTOR AND OSCILLATOR ADJUSTMENTS

Three high-frequency adjusting capacitors are provided for alignment at 1400 kc., and one trimmer is used for the low frequency line-up at 600 kc. The "Full Range Oscillator" should be connected to the antenna-ground input at the outer end of the lead-in shield through a 300-ohm series resistance in the antenna side.

(a) Tune the external oscillator to a frequency of 1400 kc. and turn the station selector knob until the dial pointer is at the 1400 kc. scale marking.

(b) Adjust the oscillator trimmer, C10; the detector trimmer, C7; and the r-f trimmer, C3, for maximum (peak) receiver output.

(c) Set the external oscillator to a frequency of 600 kc. and rotate the station selector until this signal is accurately tuned on the receiver. Adjust the oscillator trimmer C8, simultaneously rocking the tuning condenser slowly through the signal until the maximum obtainable output results from the two combined operations. This adjustment should be made irrespective of dial calibration.

(d) Recheck the adjustment of the 1400 kc. oscillator trimmer, as in (b), to correct any reflective errors caused by the procedure of (c).

RADIOTRONS

Under ordinary usage within the ratings specified for voltage supply, tube life will be consistent with that obtained in other applications. Their deterioration and approach to failure is usually evidenced by noisy or intermittent operation, loss of sensitivity and distorted tone quality.

It is not feasible to test the Radiotrons in the receiver sockets, due to likelihood of errors being caused by the associated circuits. Their removal and check with standard tube-testing apparatus is therefore advisable.

In this receiver the Radiotrons are compactly placed and snugly fitted into tight-gripping sockets to protect against vibration and to insure positive electrical connections. They should be withdrawn by exerting a direct pull on the tube.

To replace the tubes having the form-fitting shields, attach the shield to the tube and orient the grid lead opening in proper relation to the tube base, and insert the tube into its socket so that the shield clamps slide into their correct position on the outer surface of the shield.

CIRCUIT VOLTAGES

The voltages indicated at the socket contacts on Figure 4 will serve to assist in analyzing defective circuit conditions. The values specified should hold within $\pm 20\%$ when the receiver is normally operative. They are actual operating values and do not take into account inaccuracies due to voltmeter resistance. A meter having a multiplier of at least 1000 ohms per volt should be used, and the amount of circuit resistance shunted by the meter resistance duly considered when the two are comparable.

SYNCHRONOUS RECTIFIER-VIBRATOR

The vibrator power unit used in this receiver is of rugged design and construction. It has been carefully adjusted by means of special equipment to insure quiet operation over an extensive period of life. No adjustments should be attempted on a vibrator suspected to be in defective condition, but a renewal installed. A convenient plug-in base is provided for effecting a quick replacement.

SPEAKER CONE ALIGNMENT

In the event the cone coil becomes misaligned, it will be necessary to correct its position by an adjustment provided on the speaker assembly. A small round-head brass screw installed on pole piece adjacent to the terminal strip is used to clamp the cone coil mounting. To center the cone, loosen the screw and insert a small 1/16" rod or nail into the hole next to the screw and pry the coil mounting into the position giving normal speaker operation. The screw should then be retightened.

TUNING CONDENSER DRIVE

Smooth control should be obtained over the entire tuning range of the variable condenser. If there is any irregularity noticed, the following corrective steps should be taken:

Check the action of the gear mechanism for presence of binding or backlash at every point within the tuning range. A bind may be due to improper mesh between the small pinion gear and large gears on the rotor shaft. To correct such a condition, remove the coupling on the pinion of the tuning gear, insert a screw-driver through the hole in the case and loosen the two screws holding gear plate. The mesh of the gears should be adjusted to a position which gives smooth operation.

Gear back-lash is prevented by the compression spring between the large gears on the rotor shaft. To check for this back-lash, rotate the pinion slowly in both directions, observing the free gear (on rotor shaft) carefully to determine if it shifts without turning the rotor.

MISCELLANEOUS SERVICE HINTS

If back-lash is apparent, the large gear assembly should be removed and the free gear moved (against the spring compression) 2 to 3½ teeth in relation to the fixed gear and the assembly slid in place on the shaft and in mesh with the pinion. The set screws should then be securely tightened.

(a) The grounding of the outer end of the antenna lead shield is quite critical, in that ignition interference may be minimized by selecting the proper point of attachment to the car frame, determined by experiment for each individual installation.

(b) In some cars, ignition interference may be introduced through lack of antenna lead shielding. In such cases, a shield should be placed over the exposed section of antenna lead and carried as near as possible to the actual antenna. It should be solidly grounded.

(c) Interference in the form of a grating scratch may arise from static collecting on the front wheels of some cars due to road surface friction in dry weather. The insulation caused by the grease of the wheel hub enables this action to develop. A number of devices are available through automotive supply dealers which are designed to eliminate this type of trouble. They all serve to form a grounding tie between the hub and the axle, and thus drain the static to the frame of the car (ground).

(d) If the flexible tuning shaft is installed so that it protrudes through the insulating coupling at the receiver end and makes intermittent contact with the metal of the pinion gear, some r-f disturbance will result. The shaft should therefore be inserted into the coupling just far enough to be properly secured by the set screw.

(e) The screws holding the chassis to the case must all be in place and tightly installed, inasmuch as they appreciably affect the ground resistance of the assembly and will consequently have a bearing on the amount of ignition noise received.

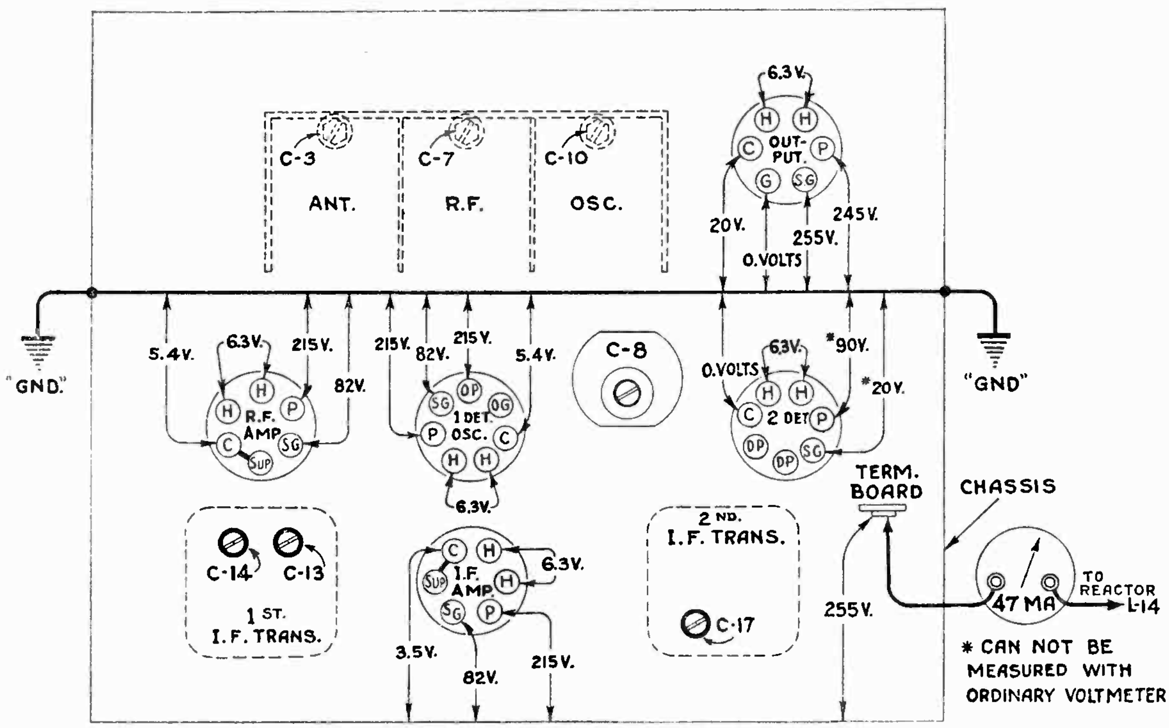

Figure 4—Trimmer Locations and Radiotron Socket Voltages to Ground

(Measured at 6.6 volts battery supply—Volume Control Maximum—No Signal)

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4993	Bumper—Rubber bumper—Used under variable condenser bracket assembly—Package of 5	$0.25
4244	Cap—Grid contact cap—Package of 5	.20
4955	Capacitor—Adjustable capacitor (C8)	.48
5021	Capacitor—80 mmfd. (C12)	.22
5078	Capacitor—265 mmfd. (C9, C30, C33)	.24
4248	Capacitor—300 mmfd. (C18, C34)	.22
4882	Capacitor—.01 mfd. (C21)	.20
4858	Capacitor—.01 mfd. (C19)	.25
4791	Capacitor—0.1 mfd. (C4, C16)	.24
4885	Capacitor—0.1 mfd. (C36)	.28
4886	Capacitor—.05 mfd. (C15)	.20
5019	Capacitor—.5 mfd. (C32)	.42
4960	Capacitor—.5 mfd. (C20)	.46
4961	Capacitor—8.0 mfd	1.28
4964	Capacitor pack—Comprising two .02 mfd. capacitors (C28, C29)	1.02
5016	Capacitor pack—Comprising two .05 mfd. capacitors (C1, C5)	.26
4958	Capacitor pack—Comprising one 3. mfd., one 10. mfd. and one 4. mfd. capacitors (C22, C24, C26)	1.34
5020	Clamp—Metal clamp with screw—For antenna filter shielded cable—Package of 5	.14
5074	Clamp—Radiotron shield clamp	.14
4950	Coil—Antenna coil (L1, L2)	.74
4968	Coil—Choke coil (L12)	.14
4969	Coil—Choke coil (15 turns—approximately 23 inches—length) (L17)	.14
6967	Coil—Oscillator coil (L5, L6)	.52
6966	Coil—R. F. coil (L3, L4)	.80
4948	Condenser—3-gang variable tuning condenser (C2, C3, C6, C7, C10, C11)	3.81
4954	Filter—Antenna filter (L18, C35, R25)	1.46
4972	Lead—Power lead with male section of connector—Chassis end	.20
7766	Lead—Power lead with clip and female section of fuse connector	.30
4966	Lead—Single connector dial lamp lead—With female section of connector—Chassis end	30
4962	Reactor (L14)	.88
4963	Reactor (L13)	.38
5034	Resistor—56 ohms—Carbon type—½ watt (R15, R16)—Package of 5	1.00
5030	Resistor—470 ohms—Carbon type—¼ watt (R2)—Package of 5	1.00
5031	Resistor—680 ohms—Carbon type—¼ watt (R5)—Package of 5	1.00
5026	Resistor—680 ohms—Carbon type—1 watt (R11)—Package of 5	1.10
5175	Resistor — 5600 ohms — Carbon type — ½ watt (R3)—Package of 5	1.00
5176	Resistor — 39,000 ohms — Carbon type — 1 watt (R13)	.22
5132	Resistor — 47,000 ohms — Carbon type — 1/10 watt (R7)—Package of 5	$0.75
5029	Resistor — 56,000 ohms — Carbon type — ¼ watt (R4)—Package of 5	1.00
3118	Resistor — 100,000 ohms — Carbon type — ¼ watt (R1)—Package of 5	1.00
5027	Resistor — 150,000 ohms — Carbon type — ¼ watt (R9)—Package of 5	1.00
5035	Resistor — 560,000 ohms — Carbon type — ¼ watt (R10)—Package of 5	1.00
3033	Resistor—1 megohm—Carbon type—¼ watt (R20)—Package of 5	1.00
5131	Resistor—2,200,000 ohms—Carbon type—1/10 watt (R6)—Package of 5	.75
5129	Ring—Radiotron shield ring—Package of 5	.10
3584	Ring—Retaining ring for antenna, r-f, or oscillator coils—Package of 5	.40
3623	Shield—Antenna, r-f, or oscillator coil shield	.30
4953	Shield—First intermediate frequency transformer shield	.24
4956	Shield—Second intermediate frequency transformer shield	.30
5037	Shield—Radiotron shield	.15
4946	Socket—6-contact Radiotron socket	.18
4959	Socket—6-contact vibrator socket	.18
4947	Socket—7-contact Radiotron socket	.18
4951	Transformer—First intermediate frequency transformer (L7, L8, C13, C14)	1.26
4952	Transformer—Second intermediate frequency transformer (L9, L10, C17)	1.76
4957	Transformer—Output transformer (T2)	1.18
7859	Transformer—Vibrator transformer (T1)	2.02
7857	Vibrator—Complete (L15)	5.64
5018	Volume control (R17, S1)	1.00
	CONTROL BOX ASSEMBLIES	
4987	Bezel—Station selector dial bezel	.42
7865	Box—Control box—Complete	3.86
7864	Bracket—Mounting bracket and rear section of control box housing	.30
4988	Crystal—Station selector dial crystal	.38
4989	Dial—Station selector dial	.20
4981	Gear—18-tooth intermediate drive gear	.15
4978	Gear—Indicator drive gear and shaft	.42
7862	Housing—Front section of control box housing	.28
7863	Housing—Center section of control box housing	.32
4990	Indicator—Station selector (pointer) indicator	.10
4985	Knob—Station selector or volume control knob—Package of 5	.62
4991	Lamp—Dial lamp—Package of 5	.74
7866	Plate—Bearing plate assembly—Comprising plate, gear and shaft, volume control shaft, station selector shaft, pinion and spring	1.22
4986	Screw—Oval fillister head machine screw—Fastens bracket and center section of control box housing—Package of 5	.25

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
5042	Screw—No. 8-32-⅛-inch headless set-screw for station selector or volume control shaft—Package of 10	$0.25
4983	Shaft—Station selector drive shaft	.16
4979	Shaft—Volume control drive shaft	.16
4984	Socket—Dial lamp socket	.16
4982	Spring—Holding spring for station selector or volume control knob—Package of 10	.26
4980	Spring—Tension spring—Package of 5	.15
5011	Strap—Control Box Mounting Strap	.25
	FLEXIBLE SHAFT ASSEMBLIES	
5000	Bracket—Volume or tuning condenser flexible shaft bracket—Bracket mounted on housing	.30
4994	Nut—Knurled locking nut for condenser drive or volume control flexible shafts	.10
7854	Shaft—Tuning condenser—Flexible (steering column) drive shaft—31⅜ inches long	1.08
7856	Shaft—Volume control or tuning condenser—Flexible (dash mounting) drive shaft—9$\frac{5}{16}$ inches long	.58
7855	Shaft—Volume control—Flexible (steering column) shaft—28⅞ inches long	1.00
	REPRODUCER ASSEMBLIES	
4970	Cable—3-conductor reproducer cable	1.02
9602	Cone—Reproducer cone (L16)	.75
9576	Housing—Reproducer housing—Top cover of receiver	1.08
9577	Reproducer—Complete (L11, L16)	4.32
4995	Screw—Reproducer mounting screw—Package of 10	.15
	HOUSING ASSEMBLIES	
7868	Case — Receiver housing assembly — Complete	1.76
7869	Cover—Bottom cover of receiver housing assembly	$0.32
4999	Screw—No. 8-¼-inch slotted hex head self-tapping screw—Used to assemble housing—Package of 5	.12
	MISCELLANEOUS PARTS	
4287	Body—Antenna connector body—Package of 10	.40
4289	Body—Fuse connector body—Package of 10	.35
5188	Cable—Two conductor antenna cable approximately 40¾ in. long with male section of connector	.40
4288	Cap—Antenna or fuse connector cap—Package of 10	.36
5025	Capacitor—0 5 mfd. generator capacitor	.40
6516	Connector—Fuse connector complete	.16
3466	Connector—Antenna lead-in connector	.16
4973	Coupling—Tuning condenser shaft coupling	.30
4974	Coupling—Volume control shaft coupling	.36
4286	Ferrule—Antenna or fuse connector ferrule and bushing—Package of 10	.38
5023	Fuse—15-ampere—Package of 5	.40
4290	Insulator—Fuse connector insulator—Package of 10	.35
4975	Lead—Dial lamp lead—Control box end	.38
3903	Screw—No. 8-32-3/16-inch headless set-screw for couplings—Package of 20	.36
4284	Spring—Antenna or fuse connector spring—Package of 10	.30
4992	Stud—Receiver mounting stud and nuts—Package of 3	.22
5064	Stud—Variable condenser bracket mounting assembly comprising one stud, one bushing, one washer, and one lockwasher	.12
5024	Suppressor—Distributor suppressor	.38

RCA Victor Model 103

Four-Tube, Two-Band, Superheterodyne A. C. Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage Rating	105–125 Volts
Frequency Ratings	25–60 or 50–60 Cycles
Power Consumption	40 Watts at 115 Volts
Number and Type of Radiotrons	1 RCA-6A7, 1 RCA-6F7, 1 RCA-41, 1 RCA-1V—Total 4
Tuning Frequency Ranges	540–1500 K. C. and 1600–3500 K. C.
Intermediate Frequency	460 K. C.
Maximum Undistorted Output	1.9 Watts
Maximum Output	3 Watts
Line-up Frequencies	460 K. C., 600 K. C. and 1400 K. C.

PHYSICAL SPECIFICATIONS

Over-All Dimensions

Height	13⅜ Inches
Width	11½ Inches
Depth	7¼ Inches
Weight	Approximately 14 Pounds
Weight Packed for Shipment	Approximately 16 Pounds
Number of Controls	Four

GENERAL DESCRIPTION

This receiver is a four-tube Superheterodyne, incorporating such special features as an electro-dynamic loudspeaker, wide range of tuning, a two-position tone control and illuminated dial. Unusually efficient performance is obtained from the characteristics of the Superheterodyne circuit, including high sensitivity, good selectivity and pleasing tone quality. Four operating controls of the knob type, all appearing on the front of the cabinet, are provided.

DESCRIPTION OF ELECTRICAL CIRCUIT

The first stage is a combined detector and oscillator using an RCA Radiotron 6A7. The two functions are obtained through means of individual tuned circuits. On the detector tuning coil a tap is made, so that a portion of the coil can be short-circuited by switch contacts and thus extend the tuning of the receiver to the higher frequency range. The oscillator second harmonic is used to produce the intermediate frequency for the upper tuning range. The oscillator circuit is arranged to have the low-frequency trimmer capacitor attached in series with the inductance, permitting accuracy in its adjustment to be easily secured, and to give a more uniform sensitivity over the tuning range.

In the following stage, the I. F. amplification and final detection take place in the dual-purpose RCA 6F7. The input section of this tube constitutes a screen-grid I. F. amplifier, with the output elements arranged to perform as a triode detector.

One RCA-41, a Pentode type, is employed in the audio output stage.

The rectifying unit consists of an RCA-1-v, a cathode-type, half-wave tube. Its high voltage is supplied from the power transformer secondary, which is a single winding tapped at various points for furnishing heater current to all Radiotrons of the receiver. The heater of the RCA-41 stage and the pilot lamp are supplied by one section of the secondary winding; and the remaining three heaters are connected series to receive supply from a 19-volt section of the same winding.

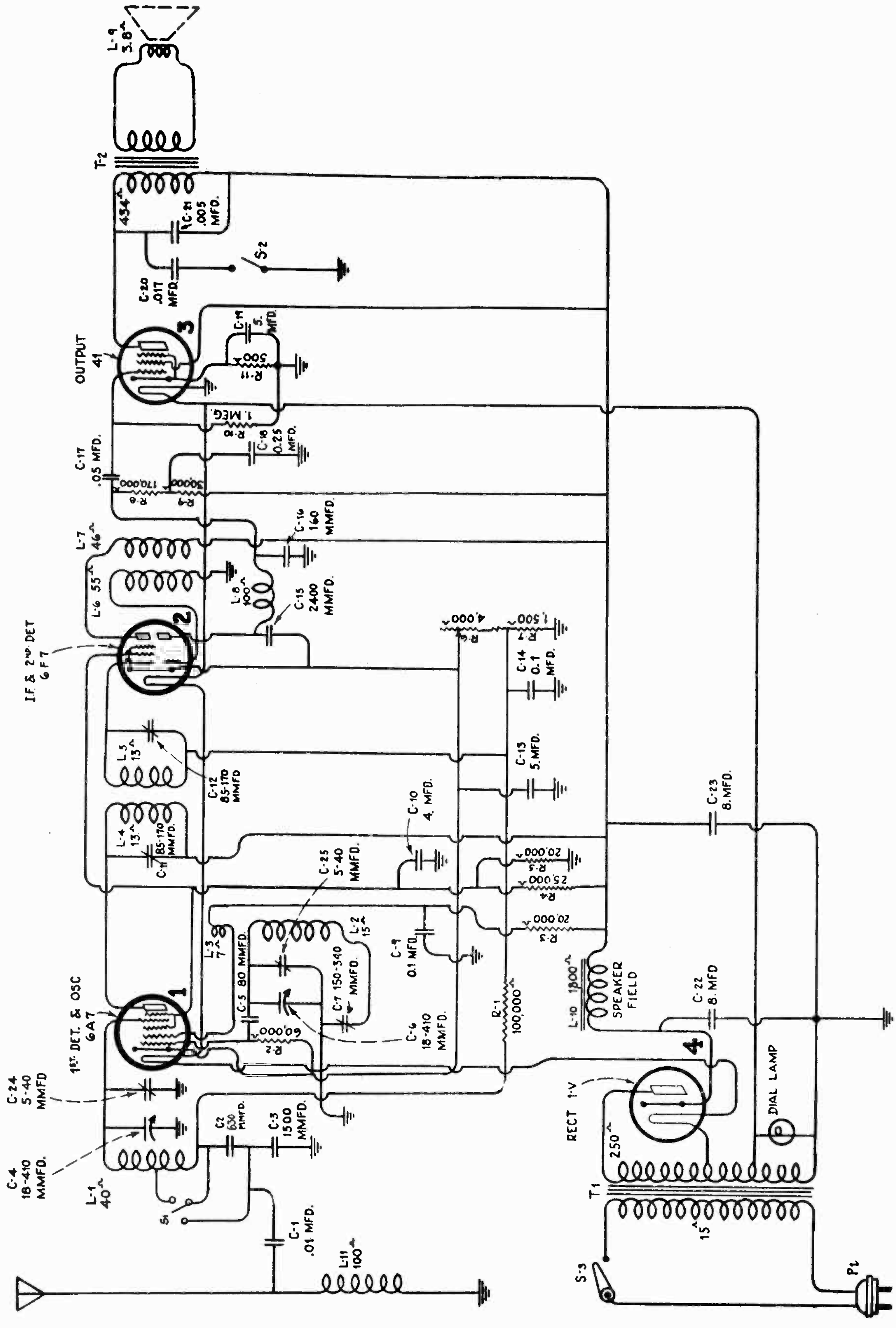

Figure 1—Schematic Circuit Diagram

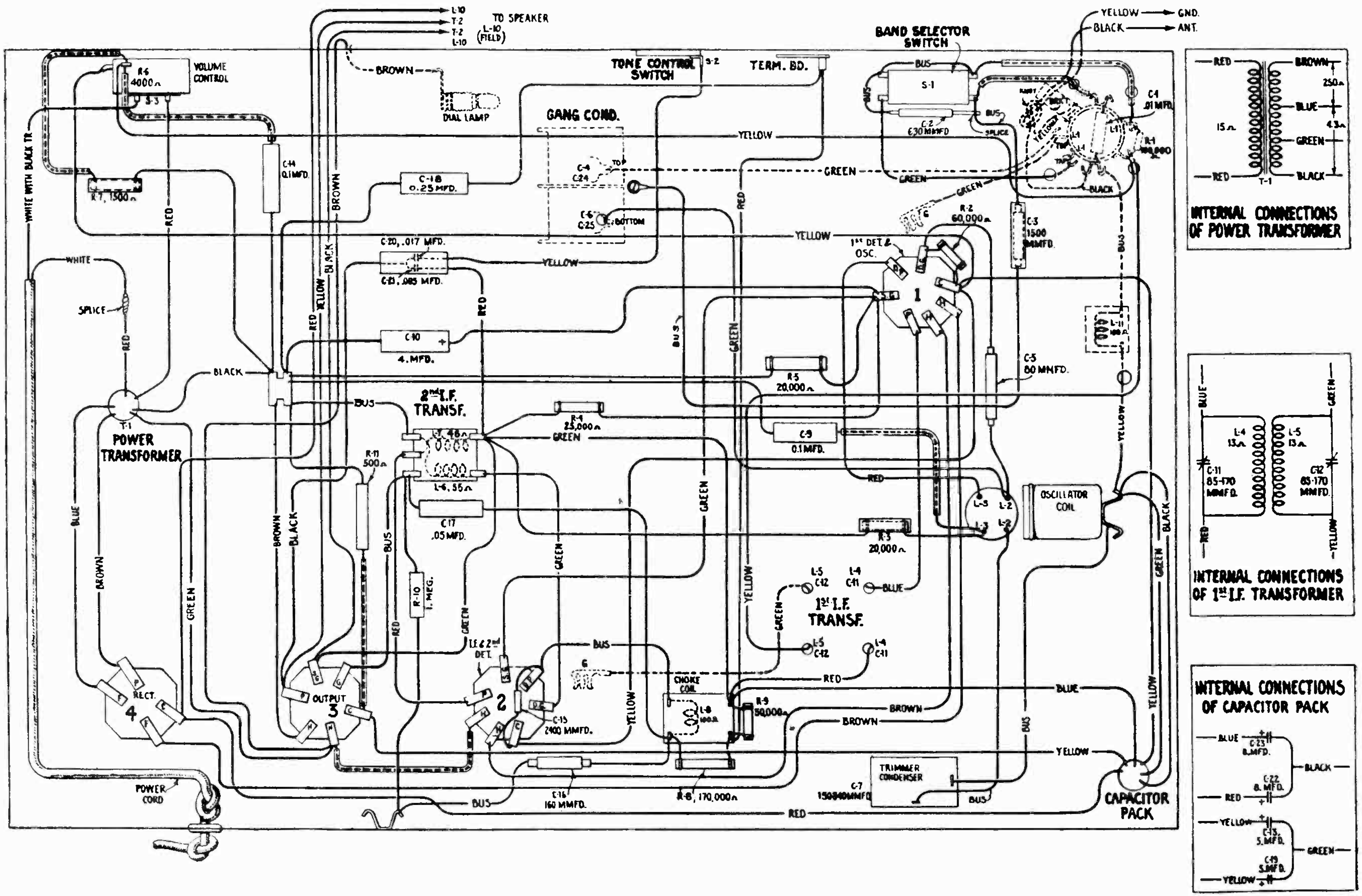

Figure 2—Chassis Wiring Diagram

SERVICE DATA

(1) ALIGNMENT PROCEDURE

Locations of the alignment condensers are indicated on Figure 3. There are five adjustments necessary. Before attempting to align the receiver, the antenna must be disconnected to obviate any interference that may be caused by pickup on a local station. The adjusting should then be performed in order as follows:

(a) *First I. F. Transformer*—Connect the output of an external oscillator, which is set to produce a 460 KC. signal, from the RCA-6A7 detector grid to chassis-ground. Tune the primary and secondary trimmers C-11 and C-12, respectively, for maximum receiver output.

(b) *Receiver Oscillator and Detector*—Two adjustments are provided. The first is accomplished by feeding a 1400 KC. signal from an external oscillator into the antenna-ground terminals. Set the tuning dial at 1400, and adjust the two trimmers of the tuning condenser for maximum receiver output. For the second oscillator adjustment, a signal of 600 KC. is required from the external source, fed into the antenna-ground connections. The trimmer for this frequency appears on the rear of the chassis. Adjust this trimmer, simultaneously rocking the tuning condenser through the signal, until maximum receiver output is obtained. Reading of the dial should fall within reasonable limits of accuracy at the 600 KC. point.

(2) VOLTAGE READINGS

In Figure 3, voltage values from tube contacts to ground are shown. They are the actual operating values and should be checked with the tubes in place. The table of Figure 4 lists the operating voltages and currents, referred to cathode, and measurable by means of a socket adaptor or set analyzer.

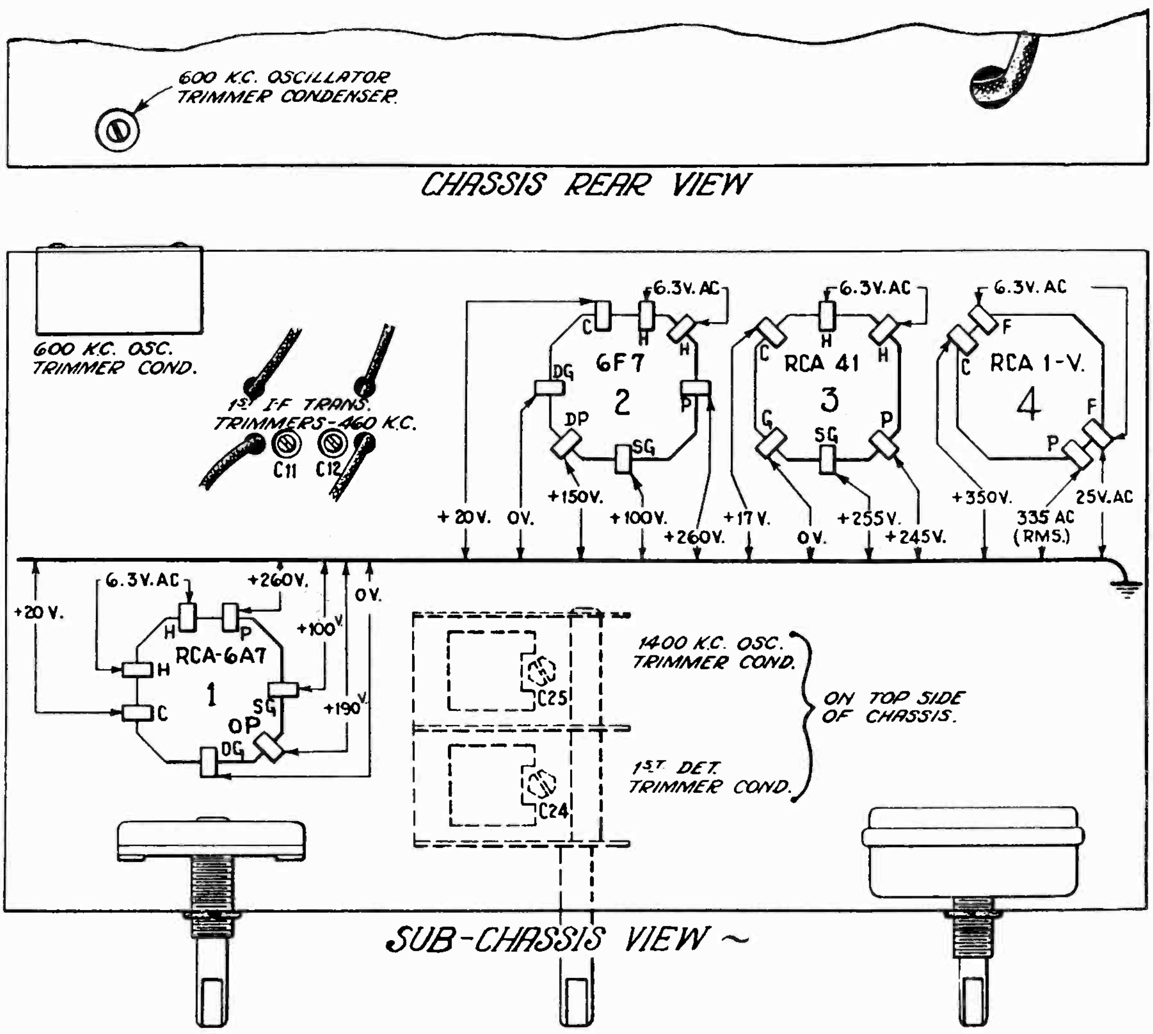

Figure 3—Line-Up Capacitor Locations and Miscellaneous Voltages at Radiotron Sockets, 120-Volt, 60-Cycle Line—Volume Control at Maximum—No Signal

RADIOTRON SOCKET VOLTAGES—BETWEEN ELEMENTS

120-Volt, 60-Cycle Line—Maximum Volume Control Setting—No Signal

Radiotron No.		Cathode to Control Grid, Volts D. C.	Cathode to Screen Grid, Volts D. C.	Cathode to Plate, Volts D. C.	Plate Current, M. A.	Heater or Filament, Volts
RCA-6A7	First Detector	1.25	70	235	2.5	6.3
	Oscillator	—	—	180	3.5	
RCA-6F7	I. F.	1.25	70	235	5.5	6.3
	Second Detector	19.0	—	145*	0.4	
RCA-41 Output		17.0	240	230	26.5	6.3
RCA-1-V Rectifier		—	—	335 R.M.S.	50.0	6.3

*Actual voltage cannot be measured with ordinary voltmeter.

Figure 4—Voltage Analysis Table

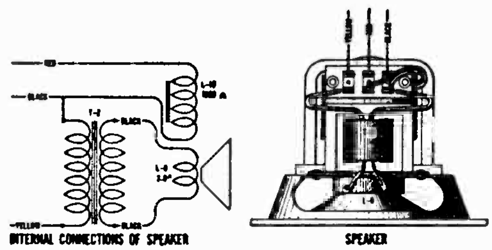

Figure 5—Loudspeaker Wiring

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
2747	Cap—Contact cap—Package of 5	$0.50
4000	Capacitor—Adjustable capacitor (C7)	.78
4887	Capacitor—0.0025 mfd. (C15)	.18
3701	Capacitor—0.01 mfd. (C1)	.30
4886	Capacitor—0.05 mfd. (C17)	.20
4885	Capacitor—0.1 mfd. (C14)	.28
4835	Capacitor—0.1 mfd. (C9)	.28
3597	Capacitor—0.25 mfd. (C18)	.40
3459	Capacitor—80 mmfd. (C5)	.44
3865	Capacitor—160 mmfd. (C16)	.30
3933	Capacitor—630 mmfd. (C2)	.32
3873	Capacitor—1500 mmfd. (C3)	.30
6832	Capacitor—4.0 mfd. (C10)	.85
6787	Capacitor—Comprising one 0.005 mfd. and one 0.017 mfd. capacitors (C20, C21)	.30
6661	Capacitor pack—Comprising two 5.0 mfd. and two 8.0 mfd. capacitors (C13, C19, C22, C23)	2.70
6666	Coil—Antenna coil (L1, C1, R1)	1.08
4018	Coil—Choke coil (L11)	.90
3857	Coil—Detector choke coil (L8)	.90
6664	Coil—Oscillator coil (L2, L3)	.94
6660	Condenser—2-gang variable condenser (C4, C6, C24, C25)	2.78
4890	Dial—Station selector dial	.58
4085	Knob—Station selector knob—Package of 5	.60
4884	Insulator—Radiotron Socket Insulator	.10
4132	Knob—Volume control, tone control or range switch knob—Package of 5	.55
3886	Reflector—Dial light reflector	.30
3632	Resistor—500 ohms—Carbon type—1 watt (R11)—Package of 5	1.10
3047	Resistor—1,500 ohms—Carbon type—½ watt (R7)—Package of 5	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R2)—Package of 5	1.00
6114	Resistor—20,000 ohms—Carbon type—1 watt (R3, R5)—Package of 5	1.10
3889	Resistor—25,000 ohms—Carbon type—3 watt (R4)	$0.25
3077	Resistor—30,000 ohms—Carbon type—½ watt (R9)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R1)—Package of 5	1.00
3869	Resistor—170,000 ohms—Carbon type—½ watt (R8)—Package of 5	1.00
3076	Resistor—1 megohm—Carbon type—½ watt (R10)—Package of 5	1.00
3584	Ring—Oscillator coil retaining ring—Package of 5	.40
4087	Screw—Chassis mounting screw and washer—Package of 4	.22
6665	Shield—Oscillator coil shield and mounting bracket	.34
4104	Shield—Radiotron shield	.20
3858	Socket—Dial lamp socket and bracket	.26
4784	Socket—4-contact Radiotron socket	.15
4785	Socket—6-contact Radiotron socket	.15
4787	Socket—7-contact Radiotron socket	.15
6668	Switch—Range switch (S1)	.58
6669	Switch—Tone control switch (S2)	.50
9464	Transformer—Power transformer—105-125 volts—50-60 cycles (T1)	3.20
9465	Transformer—Power transformer—105-125 volts—25-40 cycles	4.38
9466	Transformer—Power transformer—200-250 volts—50-60 cycles	3.28
6662	Transformer—First intermediate frequency transformer (L4, L5, C11, C12)	2.34
6663	Transformer—Second intermediate frequency transformer (L6, L7)	1.06
6667	Volume control (R6, S3)	1.58
	REPRODUCER ASSEMBLIES	
9548	Coil assembly—Comprising field coil, magnet and cone support (L10)	3.08
9588	Cone—Reproducer cone (L9)—Package of 5	3.55
9547	Reproducer complete	5.45
4803	Transformer—Output transformer	1.45

RCA VICTOR MODELS M-104 AND M-108

Five-Tube, Superheterodyne Automobile Receivers

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Power Supply	6.3 Volts (Storage Battery)
Current Consumption	5.8 Amperes
Tuning Range	540 KC. to 1600 KC.
Maximum Power Output	3.5 Watts (Audio)
Undistorted Power Output	1.75 Watts (Audio)
Loudspeaker Size and Type	6 Inch–Electrodynamic
Pilot Lamp	Mazda No. 50, 6–8 Volts
Radiotron Complement	(1) RCA-6D6 RF. Amplifier (2) RCA-6A7 Oscillator and First Detector (3) RCA-6D6 IF. Amplifier (4) RCA-6B7 Second Detector, AF. Amplifier and AVC. (5) RCA-41 Power Output
Alignment Frequencies	175 KC. (IF.); 1400 KC. (RF.); 600 KC. (RF.)

PHYSICAL SPECIFICATIONS

Receiver Case Dimensions	*Model M-104*	*Model M-108*
Height	9 Inches	6⅛ Inches
Width	9 Inches	9 Inches
Depth	6 Inches	6½ Inches

Loudspeaker Case Dimensions (Model M-108)	Diameter 9 Inches Depth . . . 3¼ Inches
Operating Controls	(1) Station Selector (2) Volume Control–Battery Switch (3) Speech Control

GENERAL DESCRIPTION

These two automobile receivers represent the results of thorough development, design, and substantial manufacture. Noteworthy technical improvements have been applied in achieving marked advantages of installation, operation, and efficiency of performance.

Model M-104 is a single unit receiver; containing the radio chassis, power conversion adjunct and loudspeaker all in one housing. Model M-108 is a double-unit receiver, utilizing a chassis and its power conversion equipment similar to the M-104, assembled together in one case, with its loudspeaker mounted individually in a separate case.

New engineering features incorporated in these instruments are: the inclusion of ignition suppression means within the circuits of the receiver; a "speech control" switch for improving reproduction of a continuous program of talking; a "plug-in" type of synchronous rectifier-vibrator for obtaining high voltage plate supply; and a "stream-lined" control unit.

The receivers are compactly constructed without sacrifice of electrical efficiency. Mounting supports consist of three ¼ inch studs, which lessen the dangers of the set vibrating as a unit, but rather maintaining the same rigidity as the structure to which it is attached.

The main operating controls are located on the remote control unit which normally mounts on the steering column. A subordinate "speech control" is mounted on the receiver case.

DESCRIPTION OF ELECTRICAL CIRCUIT

The electrical arrangement of the receiver is pictured in the schematic of Figure 2. A corresponding wiring layout is shown in Figure 3, where the actual physical relations of parts and coding of conductors are given.

Five Radiotrons are used, forming the total tube complement around which the superheterodyne circuit is built. In sequence, there is an r-f stage, a dual first detector–oscillator stage, a single i-f stage, a second detector–audio amplifier–a.v.c. stage, and a pentode output stage. Five tuned circuits operate upon the desired signal to strengthen its magnitude and reject the undesired signals and interference.

Current for operation of the receiver is obtained from a standard 6.3 volt storage battery. This current is filtered through several chokes and by-passed to ground by a number of capacitors before being applied to the Radiotron filaments and the high voltage conversion unit. The number and arrangement of the filter elements is such as to gain a very great reduction in the amount of interference conducted into the r-f circuits by the current supply wiring.

The following details elaborate the functions and features of the various stages of the receiver:

Starting at the antenna, an r-f signal is impressed across a special transmission line, which in conjunction with a "noise filter," acts selectively to the entire standard broadcast range and drastically attenuates signals and interference outside the limits of the band (540–1600 kc.). Instead of the ground for the antenna input coil appearing at the usual point on the chassis frame, the low end of the coil is extended as part of the transmission line to the outer termination of the antenna lead-in shield, where it grounds to the frame of the car. With this arrangement, the r-f disturbances circulating in the car frame (ground) do not become mutual to the receiver input. The transmission line section of the antenna lead-in also has characteristics favorable to the operation of the "noise filter." Its length, conductor sizes, insulation, etc., are precisely designed to have a critical capacitance (represented by dotted lines on schematic), which resonates with the inductance of the input system to produce a band-pass filter having an acceptance band between 540 kc. and 1600 kc., and sharply defined cut-off below and above these two limits. By using this antenna filter system and minimizing capacity coupling between primary and secondary of antenna coupling transformer, it is generally possible to dispense with the usual spark plug and distributor suppressors, without encountering serious interference on latest types of cars.

The signal is passed from the input coil by transformer action to the r-f stage control grid. An RCA-6D6 at this point performs the function of an r-f amplifier, its super-control property being adapted as means of preventing cross-modulation and securing a wide range of automatic volume control. The first (front) section of the tuning condenser is connected to sharply tune the secondary of the antenna coupling transformer.

A second r-f coupling transformer transmits the signal to the following receiver stage, which comprises a combination first detector and local oscillator. The secondary inductance of this transformer is tuned by the second (center) section of the variable capacitor and connects to the detector grid of the RCA-6A7 Radiotron. By proper arrangement of the several elements within this tube, a local oscillator system is established, which generates the correct frequency and causes it to mix with the incoming signal. The difference frequency beat (i-f) of these two combined signals is detected by the tube and transferred by a closely coupled transformer to the intermediate frequency amplifier tube, an RCA-6D6. Both windings of this i-f transformer are tuned by trimmers. The second i-f transformer which joins the RCA-6D6 tube to the second detector stage has only one trimmer, that being in shunt with its primary winding.

The RCA-6B7 second detector stage receives the i-f signal on its diode plates. Detection takes place as a result of the rectifying action of the diodes and develops a current through resistors R7 and R17. The d-c voltage drop in the resistance R7 plus R17 is used for automatically regulating the control grid bias of the r-f and first detector stage, and thus the amplification becomes dependent upon the signal strength. This process (a.v.c.) compensates for fading signals and reduction of signals due to change of antenna direction and shielding effects of buildings, bridges, etc. A smaller portion of the d-c voltage obtained by detection is tapped from the juncture of R7 and R17 and carried to the control grid of the i-f stage. This likewise furnishes automatic volume control.

The audio and d-c components of the detected signal are selected from the manual volume control resistor (R17) by its movable arm, and applied to the control grid of the RCA-6B7; amplification results and the signal passes on to the power output stage. The variable d-c applied to the grid prevents overload. A resistance-capacitance coupling system conveys the signal from the second detector stage to the RCA-41 output tube. In this coupling arrangement, a "speech" control is used for shorting capacitor C34, the effect in the open position being attenuation of the lower frequencies and consequent improvement of speech intelligibility. The circuit composed of R21 and C37 effects the proper fidelity balance.

The power amplifier stage delivers to the loudspeaker a high level audio signal. Correct matching relations between the speaker and output stage are maintained by the output transformer.

Heater connections of the Radiotrons are wired multiple, and supplied through a carefully filtered system. One heater terminal of each tube is grounded.

High voltage for plate and bias supply is generated by inversion, transformation and mechanical rectification; these three functions occurring in the "synchronous rectifier-vibrator." This vibrator is adapted for convenient removability by having its base constructed for "plug-in" mounting. Simple means are provided for correcting the vibrator input to agree with the ground polarity of the car by having the vibrator reversible. The vibrator may be inserted in two possible positions. As normally shipped, it is plugged in to operate with "positive" car ground. On a car having "negative ground," it will be necessary to withdraw the vibrator, rotate the unit 180 degrees and re-insert into the new position.

SERVICE DATA

The general mechanical layout of the receiver is judiciously arranged to facilitate tests, adjustments and repairs that may become necessary. All pertinent information needed for proper servicing is presented by the schematics, wiring diagrams and the text of this booklet. Resistor and capacitor values are shown adjacent to their respective parts on the diagrams. Note that d-c resistances are given for all inductive coils and windings.

LINE-UP ADJUSTMENTS

As in all standard receivers, this instrument must be in correct electrical alignment in order to obtain maximum efficiency and best quality of performance. The circuits should be re-aligned after each major servicing or repair operation, and whenever there are positive indications that the adjustments have deviated

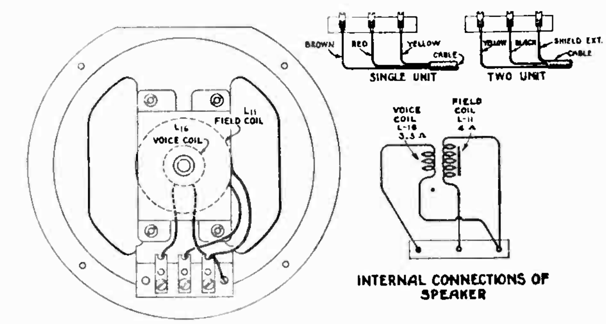

Figure 1—Loudspeaker Wiring

from normal by ordinary usage. These indications will be present together and will have the nature of low sensitivity, poor tone quality, and irregular double-peaked tuning.

The important requirements in re-adjusting the line-up trimmers are the use of proper oscillator and indication equipment and adherence to a definite procedure. Certain standard service instruments, useful for receiver adjustments, have been devised and made available by the manufacturer of this receiver. These are illustrated and described on page 2.

(1) PREPARATORY DETAILS

(a) Dial Calibration—The tuning-condenser flexible shaft operates the dial pointer through a gear mechanism within the control unit. To adjust their mechanical relations so that accurate scale calibration obtains:—Rotate the station selector knob until the variable tuning capacitor is at full mesh, which will carry the dial pointer to its minimum frequency position; then remove the tuning knob, loosen the set screw in the bushing and rotate the bushing until the pointer sets exactly opposite the last radial line at the low frequency end of the scale. (The line referred to is the second one counter-clockwise of the 550 kc. mark.)

(b) General Procedure—The "Output Indicator" should be attached to the voice coil circuit of the loudspeaker, and for each adjustment, the oscillator output increased until a noticeable registration or glow occurs on the indicator. The signal from the oscillator should be held as low as possible consistent with getting a good indication, with the receiver volume control set at its maximum position. This method of procedure prevents the automatic volume control from affecting the adjustments.

(2) I. F. ADJUSTMENTS

Three trimmers are provided in the i-f system, two on the first transformer and one on the second transformer. The locations of the adjustment screws are shown in Figure 4.

(a) Tune the "Full Range Oscillator" to 175 kc. and connect its output to the first detector control grid and chassis ground. Tune the station selector to a point where no signals are received.

(b) Tune each of the trimmer capacitors, C17, C14 and C13, in order. C17 should be set for maximum (peak) output. C14 and C13 should be roughly adjusted for maximum output and then carefully "trimmed" so that a flat-topped response is obtained. This may be checked by shifting the external oscillator frequency through a range two kilocycles each side of 175 kc. and noting whether or not the receiver output remains substantially constant.

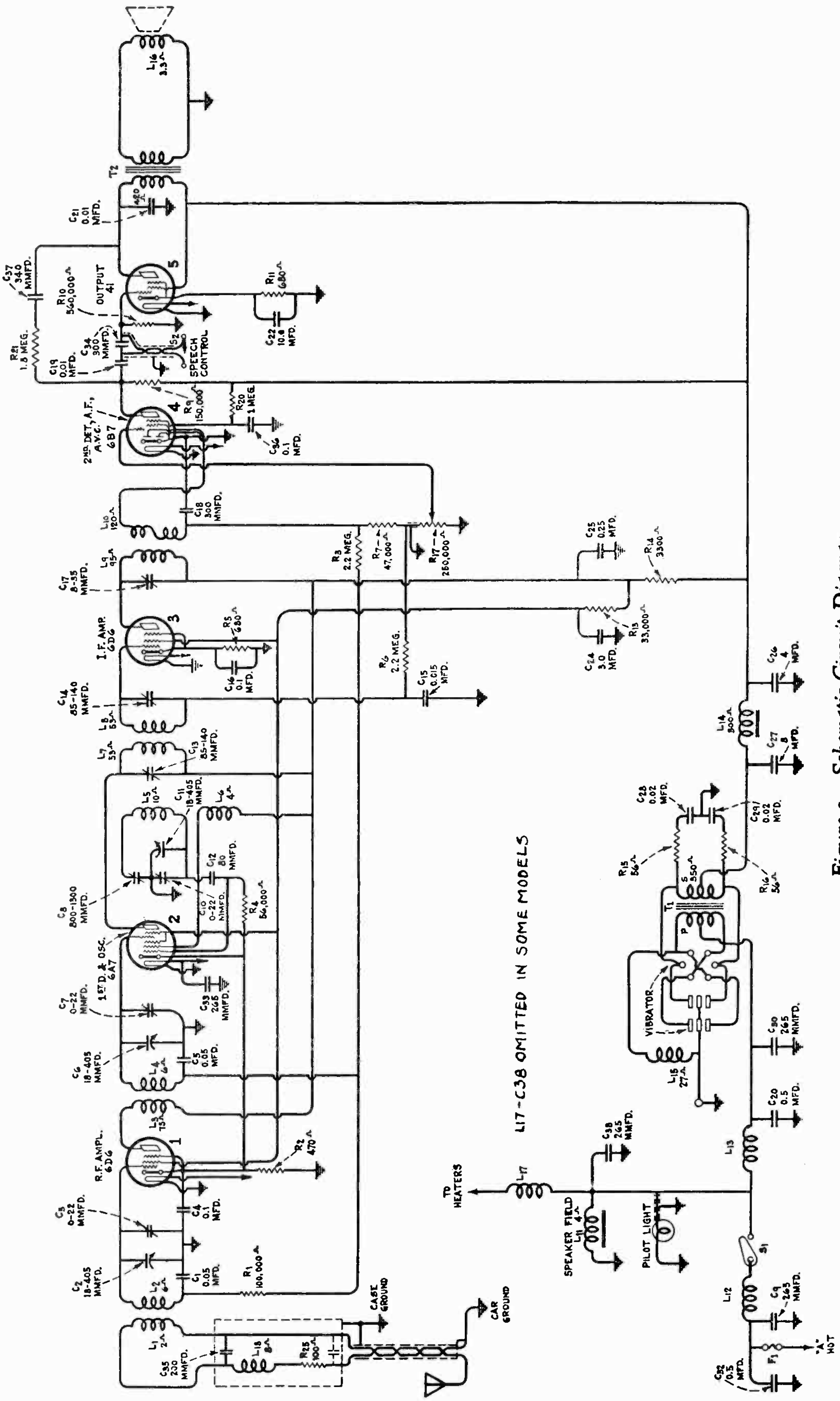

Figure 2—Schematic Circuit Diagram

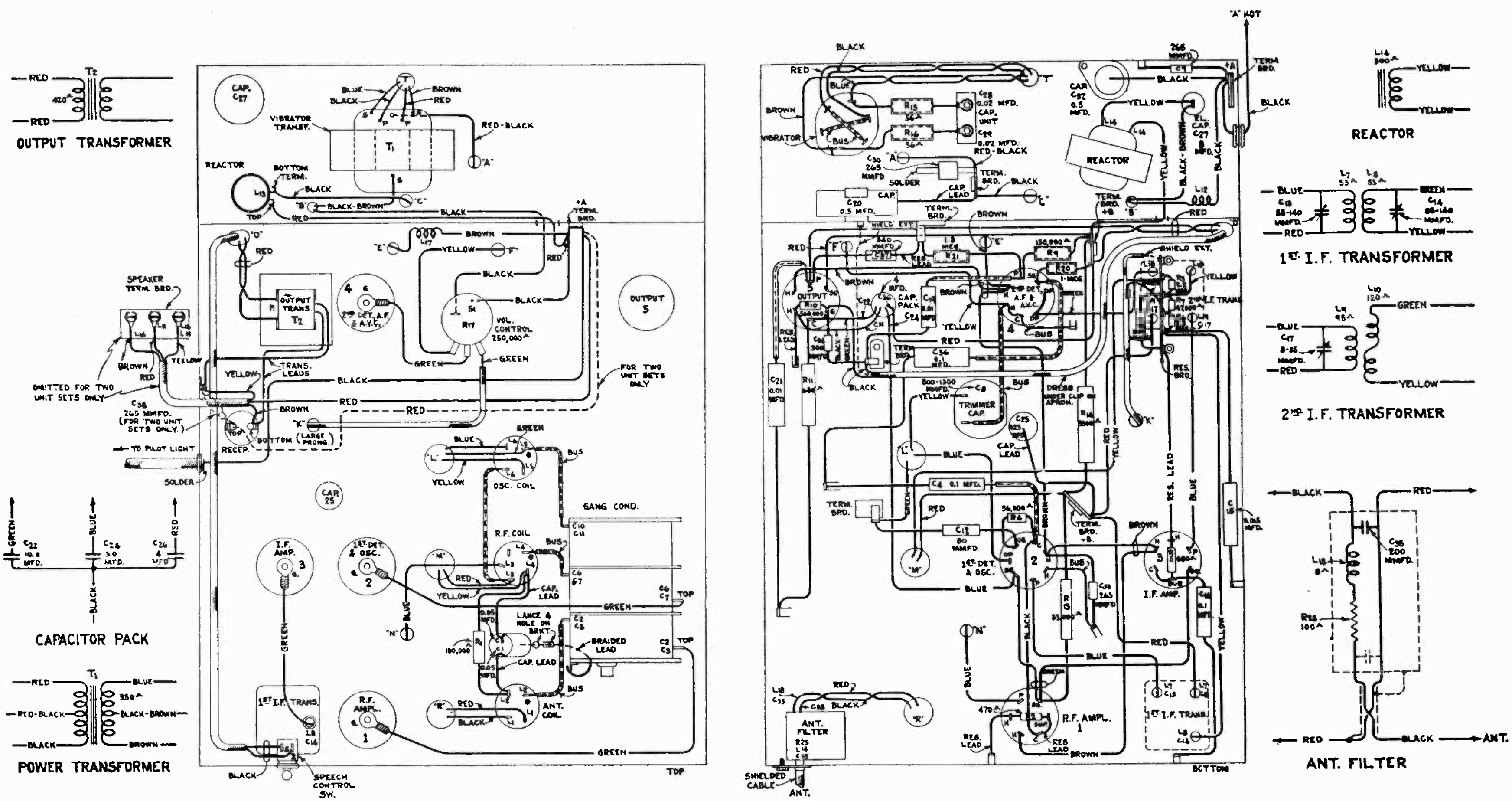

Figure 3—Chassis Wiring Diagram

(3) R. F. DETECTOR AND OSCILLATOR ADJUSTMENTS

Three high-frequency adjusting capacitors are provided for alignment at 1400 kc., and one trimmer is used for the low frequency line-up at 600 kc. The "Full Range Oscillator" should be connected to the antenna-ground input at the outer end of the lead-in shield through a 300-ohm series resistance in the antenna side.

(a) Tune the external oscillator to a frequency of 1400 kc. and turn the station selector knob until the dial pointer is at the 1400 kc. scale marking.

(b) Adjust the oscillator trimmer, C-10; the detector trimmer, C7; and the r-f trimmer, C3, for maximum (peak) receiver output.

(c) Set the external oscillator to a frequency of 600 kc. and rotate the station selector until this signal is accurately tuned on the receiver. Adjust the oscillator trimmer C8, simultaneously rocking the tuning condenser slowly through the signal until the maximum obtainable output results from the two combined operations. This adjustment should be made irrespective of dial calibration.

(d) Recheck the adjustment of the 1400 kc. oscillator trimmer, as in (b), to correct any reflective errors caused by the procedure of (c).

RADIOTRONS

Under ordinary usage within the ratings specified for voltage supply, tube life will be consistent with that obtained in other applications. Their deterioration and approach to failure is usually evidenced by noisy or intermittent operation, loss of sensitivity and distorted tone quality.

It is not feasible to test the Radiotrons in the receiver sockets, due to likelihood of errors being caused by the associated circuits. Their removal and check with standard tube-testing apparatus is therefore advisable.

In this receiver the Radiotrons are compactly placed and snugly fitted into tight-gripping sockets to protect against vibration and to insure positive electrical connections. They should be withdrawn by exerting a direct pull on the tube.

To replace the tubes having the form-fitting shields, attach the shield to the tube and orient the grid lead opening in proper relation to the tube base, and insert the tube into its socket so that the shield clamps slide into their correct position on the outer surface of the shield.

CIRCUIT VOLTAGES

The voltages indicated at the socket contacts on Figure 4 will serve to assist in analizing defective circuit conditions. The values specified should hold within $\pm 20\%$ when the receiver is normally operative. They are actual operating values and do not take into account inaccuracies due to voltmeter resistance. A meter having a multiplier of at least 1000 ohms per volt should be used, and the amount of circuit resistance shunted by the meter resistance duly considered when the two are comparable.

SYNCHRONOUS RECTIFIER-VIBRATOR

The vibrator power unit used in this receiver is of rugged design and construction. It has been carefully adjusted by means of special equipment to insure quiet operation over an extensive period of life. No adjustments should be attempted on a vibrator suspected to be in defective condition, but a renewal installed. A convenient plug-in base is provided for effecting a quick replacement.

SPEAKER CONE ALIGNMENT

In the event the cone coil becomes mis-aligned, it will be necessary to correct its position by an adjustment provided on the speaker assembly. A small round-head brass screw installed on pole piece adjacent to the terminal strip is used to clamp the cone coil mounting. To center the cone, loosen the screw and insert a small 1/16" rod or nail into the hole next to the screw and pry the coil mounting into the position giving normal speaker operation. The screw should then be retightened.

TUNING CONDENSER DRIVE

Smooth control should be obtained over the entire tuning range of the variable condenser. If there is any irregularity noticed, the following corrective steps should be taken:

Check the action of the gear mechanism for presence of binding or backlash at every point within the tuning range. A bind may be due to improper mesh between the small pinion gear and large gears on the rotor shaft. To correct such a condition, remove the coupling on the pinion of the tuning gear, insert a screw-driver through the hole in the case and loosen the two screws holding gear plate. The mesh of the gears should be adjusted to a position which gives smooth operation.

Gear back-lash is prevented by the compression spring between the large gears on the rotor shaft. To check for this back-lash, rotate the pinion slowly in both directions, observing the free gear (on rotor shaft) carefully to determine if it shifts without turning the rotor.

If back-lash is apparent, the large gear assembly should be removed and the free gear moved (against the spring compression) 2 to 3½ teeth in relation to the fixed gear and the assembly slid in place on the shaft and in mesh with the pinion. The set screws should then be securely tightened.

MISCELLANEOUS SERVICE HINTS

(a) The grounding of the outer end of the antenna input lead is quite critical, in that ignition interference may be minimized by selecting the proper point of attachment to the car frame, determined by experiment for each individual installation.

(b) In some cars, ignition interference may be introduced through lack of antenna lead shielding. In such cases, a shield should be placed over the exposed section of antenna lead and carried as near as possible to the actual antenna. It should be solidly grounded.

(c) Interference in the form of a grating scratch may arise from static collecting on the front wheels of some cars due to road surface friction in dry weather. The insulation caused by the grease of the wheel hub enables this action to develop. A number of devices are available through automotive supply dealers which are designed to eliminate this type of trouble. They all serve to form a grounding tie between the hub and the axle, and thus drain the static to the frame of the car (ground).

(d) If the flexible tuning shaft is installed so that it protrudes through the insulating coupling at the receiver end and makes intermittent contact with the metal of the pinion gear, some r-f disturbance will result. The shaft should therefore be inserted into the coupling just far enough to be properly secured by the set screw.

(e) The screws holding the chassis to the case must all be in place and tightly installed, inasmuch as they appreciably affect the ground resistance of the assembly and will consequently have a bearing on the amount of ignition noise received.

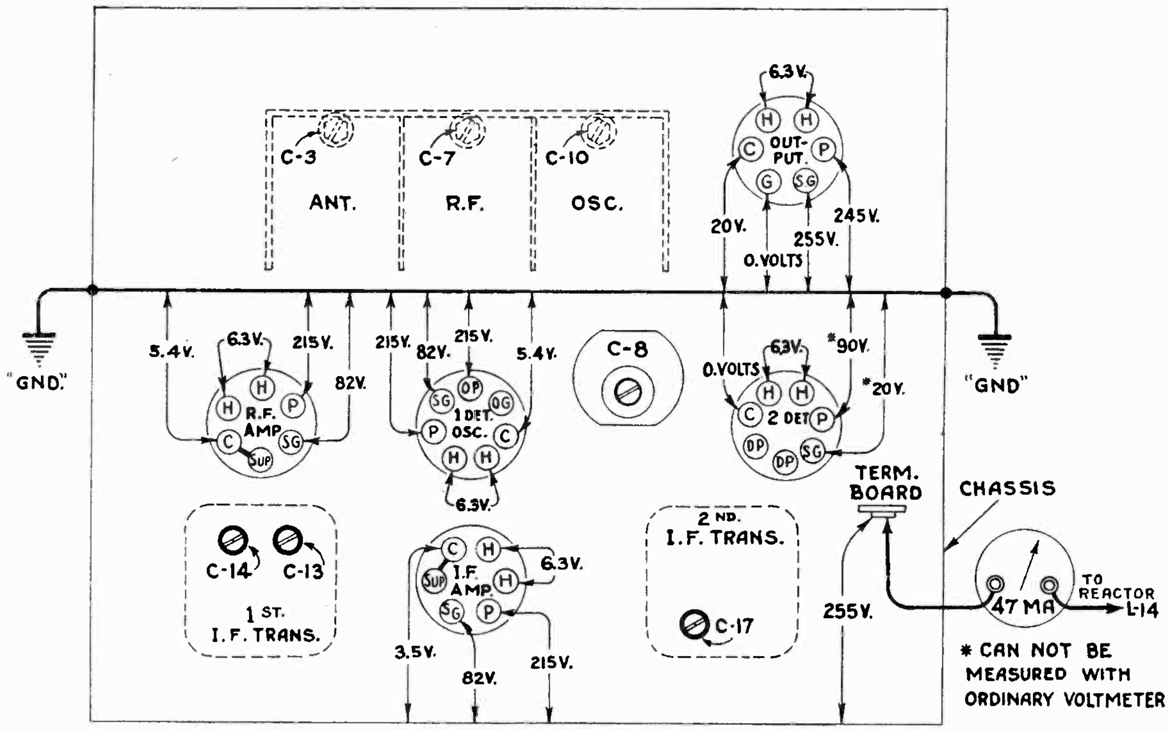

Figure 4—Trimmer Locations and Radiotron Socket Voltages to Ground
(Measured at 6.6 volts battery supply—Volume Control Maximum—No Signal)

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4993	Bumper—Rubber bumper—Used under variable condenser bracket assembly—Package of 5	$0.25
4965	Cable—2-conductor shielded—Approximately 17 inches long—To speech control switch	.36
4244	Cap—Grid contact cap—Package of 5	.20
4955	Capacitor—Adjustable capacitor (C8)	.48
5021	Capacitor—80 mmfd. (C12)	.22
5078	Capacitor—265 mmfd. (C9, C30, C33, C38)	.24
3981	Capacitor—300 mmfd. (C34)	.30
4248	Capacitor—300 mmfd. (C18)	.22
5022	Capacitor—340 mmfd. (C37)	.20
4882	Capacitor—.01 mfd. (C21)	.20
4883	Capacitor—.01 mfd. (C19)	.20
4791	Capacitor—0.1 mfd. (C4, C16)	.24
4885	Capacitor—0.1 mfd. (C36)	.28
4792	Capacitor—.015 mfd. (C15)	.22
4967	Capacitor—.25 mfd. (C25)	.46
5019	Capacitor—.5 mfd. (C32)	.42
4960	Capacitor—.5 mfd. (C20)	.46
4961	Capacitor—8.0 mfd. (C27)	1.28
4964	Capacitor pack—Comprising two .02 mfd. capacitors (C28, C29)	1.02
5016	Capacitor pack—Comprising two .05 mfd. capacitors (C1, C5)	.26
4958	Capacitor pack—Comprising one 3. mfd., one 10. mfd. and one 4. mfd. capacitors (C22, C24, C26)	1.34
5020	Clamp—Metal clamp with screw—For antenna filter shielded cable—Package of 5	.14
4950	Coil—Antenna coil (L1, L2)	.74
4968	Coil—Choke coil (L12)	.14
4969	Coil—Choke coil (15 turns—approximately 23 inches—length) (L17)	.14
6967	Coil—Oscillator coil (L5, L6)	.52
6966	Coil—r-f coil (L3, L4)	.80
4948	Condenser—3-gang variable tuning condenser (C2, C3, C6, C7, C10, C11)	3.81
4954	Filter—Antenna filter (L18, C35, R25)	1.46
4972	Lead—Power lead with male section of connector—Chassis end	.20
7766	Lead—Power lead with clip and female section of fuse connector	.30
4966	Lead—Single connector dial lamp lead—With female section of connector—Chassis end	.30
4962	Reactor (L14)	.88
4963	Reactor (L13)	.38
5034	Resistor—56 ohms—Carbon type—½ watt (R15, R16)—Package of 5	1.00
5030	Resistor—470 ohms—Carbon type—¼ watt (R2)—Package of 5	1.00
5031	Resistor—680 ohms—Carbon type—¼ watt (R5)—Package of 5	1.00
5026	Resistor—680 ohms—Carbon type—1 watt (R11)—Package of 5	1.10
5032	Resistor—3300 ohms—Carbon type—2 watts (R14)	.22
5033	Resistor — 33,000 ohms — Carbon type — 1 watt (R13)—Package of 5	1.10
5132	Resistor — 47,000 ohms — Carbon type — 1/10 watt (R7)—Package of 5	$0.75
5029	Resistor — 56,000 ohms — Carbon type — ¼ watt (R4)—Package of 5	1.00
3118	Resistor — 100,000 ohms — Carbon type — ¼ watt (R1)—Package of 5	1.00
5027	Resistor — 150,000 ohms — Carbon type — ¼ watt (R9)—Package of 5	1.00
5035	Resistor — 560,000 ohms — Carbon type — ¼ watt (R10)—Package of 5	1.00
3033	Resistor—1 megohm—Carbon type—¼ watt (R20)—Package of 5	1.00
5028	Resistor—1.8 megohm—Carbon type—¼ watt (R21)—Package of 5	1.00
5131	Resistor—2,200,000 ohms—Carbon type—1/10 watt (R3, R6)—Package of 5	.75
5129	Ring—Radiotron shield ring—Package of 5	.10
3584	Ring—Retaining ring for antenna, r-f, or oscillator coils—Package of 5	.40
3623	Shield—Antenna, r-f, or oscillator coil shield	.30
4953	Shield—First intermediate frequency transformer shield	.24
4956	Shield—Second intermediate frequency transformer shield	.30
5037	Shield—Radiotron shield	.15
4946	Socket—6-contact Radiotron socket	.18
4959	Socket—6-contact vibrator socket	.18
4947	Socket—7-contact Radiotron socket	.18
5001	Switch—Speech control switch (S2)	.66
4951	Transformer—First intermediate frequency transformer (L7, L8, C13, C14)	1.26
4952	Transformer—Second intermediate frequency transformer (L9, L10, C17)	1.76
4957	Transformer—Output transformer (T2)	1.18
7859	Transformer—Vibrator transformer (T1)	2.02
7857	Vibrator—Complete (L15)	5.64
5018	Volume control (R17, S1)	1.00
	CONTROL BOX ASSEMBLIES	
4987	Bezel—Station selector dial bezel	.42
7865	Box—Control box—Complete	3.86
7864	Bracket—Mounting bracket and rear section of control box housing	.30
4988	Crystal—Station selector dial crystal	.38
4989	Dial—Station selector dial	.20
4981	Gear—18-tooth intermediate drive gear	.15
4978	Gear—Indicator drive gear and shaft	.42
7862	Housing—Front section of control box housing	.28
7863	Housing—Center section of control box housing	.32
4990	Indicator—Station selector (pointer) indicator	.10
4985	Knob—Station selector or volume control knob—Package of 5	.62
4991	Lamp—Dial lamp—Package of 5	.74
7866	Plate—Bearing plate assembly—Comprising plate, gear and shaft, volume control shaft, station selector shaft, pinion and spring	1.22
4986	Screw—Oval fillister head machine screw—Fastens bracket and center section of control box housing	.25

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
5042	Screw—No. 8-32-3/8-inch headless set-screw for station selector or volume control shaft—Package of 10	$0.25
4983	Shaft—Station selector drive shaft	.16
4979	Shaft—Volume control drive shaft	.16
4984	Socket—Dial lamp socket	.16
4982	Spring—Holding spring for station selector or volume control knob—Package of 10	.26
4980	Spring—Tension spring—Package of 5	.15
5011	Strap—Control box mounting strap	.25
	FLEXIBLE SHAFT ASSEMBLIES	
5000	Bracket—Volume or tuning condenser flexible shaft bracket—Bracket mounted on housing	.30
4994	Nut—Knurled locking nut for condenser driv or volume control flexible shafts	.10
7854	Shaft—Tuning condenser—Flexible (steering column) drive shaft—31⅜ inches long	1.08
7856	Shaft—Volume control or tuning condenser—Flexible (dash mounting) drive shaft—9 5/16 inches long	.58
7855	Shaft—Volume control—Flexible (steering column) shaft—28⅞ inches long	1.00
	REPRODUCER ASSEMBLIES	
4970	Cable—3-conductor reproducer cable (M104)	1.02
5079	Cable—2-conductor shielded—With pin tips—for M108	.86
7965	Coil—Reproducer field coil (L11)	1.48
9602	Cone—Reproducer cone (L16)	.75
9576	Housing—Reproducer housing—Top cover of Receiver for M104	1.08
7873	Housing—Reproducer housing complete for M108	2.10
5133	Pin—Large and small contact pins for reproducer cable—Package of 10	.35
9577	Reproducer—Complete (L11, L16)	4.32

Stock No.	Description	List Price
4995	Screw—Reproducer mounting screw—Package of 10	$0.15
4977	Socket—Reproducer cable pin socket	.18
11345	Stud—Reproducer housing mounting stud assembly—For Model 108	.35
	HOUSING ASSEMBLIES	
7868	Case — Receiver housing assembly — Complete (M104)	1.76
7869	Cover—Bottom cover of receiver housing assembly (M104 and M108)	.32
7870	Cover—Top cover of receiver housing assembly (Model M108)	.26
4999	Screw—No. 8–¼-inch slotted hex head self-tapping screw—Used to assemble housing—Package of 5	.12
	MISCELLANEOUS PARTS	
4287	Body—Antenna connector body—Package of 10	.40
4289	Body—Fuse connector body—Package of 10	.35
5188	Cable—Two-conductor shielded antenna cable—approx. 40¾″ long—with male section of connector	.40
4288	Cap—Antenna or fuse connector cap—Package of 10	.36
4293	Capacitor—0.5 mfd. ammeter capacitor	.60
5025	Capacitor—0.5 mfd. generator capacitor	.40
6516	Connector—Fuse connector complete	.16
4973	Coupling—Tuning condenser shaft coupling	.30
4974	Coupling—Volume control shaft coupling	.36
4286	Ferrule—Antenna or fuse connector ferrule and bushing—Package of 10	.38
5023	Fuse—15-ampere—Package of 5	.40
4290	Insulator—Fuse connector insulator—Package of 10	.35
4976	Lead—Antenna lead assembly	.16
4975	Lead—Dial lamp lead—Control box end	.38
3903	Screw—No. 8-32-3/16-inch headless set-screw for couplings—Package of 20	.36
4284	Spring—Antenna or fuse connector spring—Package of 10	.30
4992	Stud—Receiver mounting stud and nuts—Package of 3	.22
5024	Suppressor—Distributor suppressor	.38

RCA VICTOR MODEL M-109

"De Luxe," Seven-Tube Superheterodyne Automobile Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Power Supply	6.3 Volts (Battery)
Current Consumption	7.2 Amperes
Tuning Range	540 KC. to 1600 KC.
Maximum Power Output	6.0 Watts (Audio)
Undistorted Power Output	3.5 Watts (Audio)
Loudspeaker	8 inch, Electrodynamic
Pilot Lamp	Mazda No. 50, 6–8 Volts
Radiotron Complement	(1) RCA-6D6 R.F. Amplifier (2) RCA-6A7 Oscillator and First Detector (3) RCA-6D6 I.F. Amplifier (4) RCA-6B7 Second Detector, A.F. Amplifier and A.V.C. (5) RCA-76 A.F. Amplifier (6) RCA-6A6 Power Output (7) RCA-84 Rectifier
Alignment Frequencies	175 KC. (i-f), 1400 KC. (r-f and osc.), 600 KC. (osc.)

PHYSICAL SPECIFICATIONS

	Receiver	*Loudspeaker*
Height	6⅛ Inches	8⅝ Inches
Width	7⅜ Inches	8⅝ Inches
Depth	7 Inches	5⅜ Inches

This "De Luxe" Auto Receiver is a ruggedly constructed, two-unit assembly. The six-tube receiver chassis is contained in a substantial case which is separate from that housing the large electro-dynamic loudspeaker and power unit. Each unit is constructed very compactly to simplify mounting. The compactness is engineered in such a manner as to maintain efficiency of electrical performance.

A newly designed control unit is attached by the usual method through flexible drive shafts to the receiver chassis. No external wiring other than the pilot light supply connects to the remote-control. The principal drive shafts are easily adaptable to practically any location chosen for the receiver unit. A combination volume control-power switch and the tuning control appear on the remote-control unit. A continuously variable high-frequency tone control is mounted on the speaker unit.

Equipment provided for inversion of the regular storage-battery supply to the high voltage required for plate and grid potentials consists of a combination vibrator and tube-rectifier unit. The assembly is installed within the loudspeaker housing, and its output conducted to the receiver chassis through a double shielded cable. This separated layout of power-supply unit and receiver chassis minimizes disturbances likely to be introduced from proximity of the two, in combined assemblies.

The necessity for use of suppressor resistors on the ignition system of modern cars has been eliminated in the design of this receiver. A selective "noise filter" system at the receiver input and a systematic wiring layout account for the reduction of ignition noise without the use of the suppressors.

DESCRIPTION OF ELECTRICAL CIRCUIT

The electrical arrangement of the receiver is shown in the schematic of Figure 3. A corresponding wiring layout is shown in Figure 4, where the actual physical relations and coding of conductors are given.

The tube line-up in the superheterodyne circuit consists of seven Radiotrons. In sequence, there is an r-f stage, a dual first detector and oscillator stage, a single i-f stage, a combined second detector-audio amplifier-a.v.c. stage, an audio driver stage, a push-pull power output stage, and a full-wave rectifier. There are five circuits which are tuned to the signal desired, to strengthen its magnitude and reject undesired signals and interference.

The following describes the functions of the various stages of the receiver: Beginning at the antenna circuit, there is a special transmission line and "noise filter" circuit, which, in conjunction with the tuned input system, acts selectively to the entire broadcast range and drastically attenuates signals and interference outside the limits of the band (540–1600 kc.). These properties of the filter circuit and minimizing of primary to secondary capacity coupling in first r-f transformer cause a very great reduction of the ignition noise present when the car is in operation. The ground of the input coil does not appear at the usual point on the chassis frame, but instead is extended as part of the antenna transmission line lead-in to the outer termination of the shield, where it grounds to the frame of the car. This arrangement prevents r-f disturbances which are circulating in the car frame (ground) from becoming mutual to the receiver input. The characteristics of the transmission line section of the antenna lead-in are such as to favor the operation of the noise filter. Its distributed capacitance due to length, conductor sizes, insulation, etc., is of such value as to operate with the inductance and capacitance elements of the input system to obtain a "band-pass" filtering effect. The filter has an acceptance band between 540 kc. and 1600 kc., and sharply defined cut-off below and above these two limits. It is generally possible, because of this input arrangement, to dispense with the usual spark-plug and distributor suppressors without encountering substantial ignition interference on latest types of cars.

After passing through the input filter the signal is applied by transformer action to the control grid of the r-f stage. An RCA-6D6 at this point performs the function of an r-f amplifier, its super-control property being adapted as means of preventing cross-modulation and securing a wide range of volume control. The first (front) section of the tuning condenser is connected to sharply tune the secondary of the antenna coupling transformer.

A second r-f coupling transformer transmits the signal to the following receiver stage, which comprises a combination first detector and local oscillator. The secondary inductance of this transformer is tuned by the second (center) section of the variable capacitor and connects to the detector grid of the RCA-6A7 Radiotron. The local oscillator circuit is established by mutual arrangement of the several elements within this tube. Here the incoming signal is mixed with the local oscillator frequency. The difference frequency **beat (i. f.)** of these two combined signals is detected by the tube and transferred by a closely coupled transformer to the intermediate-frequency amplifier tube, an RCA-6D6. Both windings of this i-f transformer are tuned by trimmers. The second i-f transformer which joins the RCA-6D6 to the second detector stage has only one trimmer, that being in shunt with its primary winding.

The RCA-6B7 second detector stage receives the i-f signal on its diode plates. Detection takes place as a result of the rectifying action of the diodes and develops a current through the resistors R7 and R10. The d-c voltage drop across the resistance R7 plus R10 is used for automatically regulating the control grid bias of the r-f and first detector stages. The amplification thus becomes dependent upon the signal strength. This process (a.v.c.) compensates for fading signals and tendency toward reduction of signals due to change of antenna direction and shielding effect of buildings, etc. A smaller portion of the d-c voltage obtained by detection is tapped from the juncture of R7 and R10 and is carried to the control grid of the i-f stage. This likewise furnishes automatic volume control, but in a smaller degree.

The audio and d-c components of the detected signal are selected from the resistor R10 by its movable arm and applied to the control grid of the RCA-6B7. The d-c obtained from the signal and applied to the grid prevents overload as the volume control is advanced. Amplification results and the signal passes on to the audio-driver stage. The RCA-76 Radiotron used as an a-f amplifier is resistance-capacitance coupled to the detector stage output. Its plate is matched to the power output stage by a transformer.

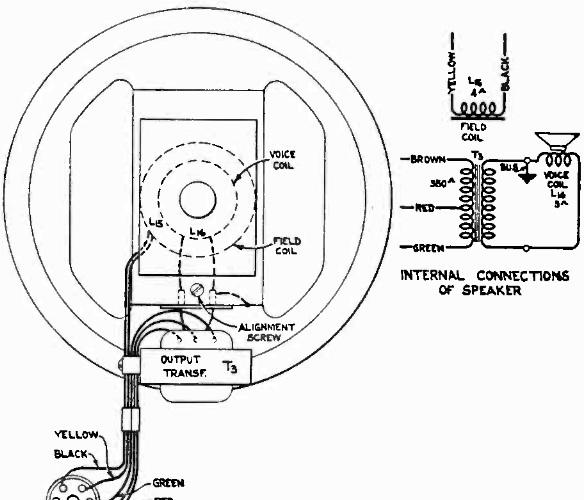

Figure 1—Loudspeaker Wiring

The output stage utilizes an RCA-6A6 tube which performs as a push-pull type. It delivers a high level-high quality signal to the remote loudspeaker unit.

The power supply system consists of a mechanical vibrator for interrupting the d-c from the battery in order to transform the current to high voltage, which in turn is rectified by a full-wave tube, an RCA-84. The vibrator used is adapted for convenient removability **by having** its base constructed for "plug-in" mounting.

SERVICE DATA

The general mechanical layout of this receiver is judiciously arranged to facilitate any tests, repairs or adjustments that may become necessary. All information needed for proper servicing is presented by the schematics, wiring diagrams and text of this booklet.

LINE-UP ADJUSTMENTS

Maximum efficiency and best quality of performance can only be obtained when the receiver circuits are in correct alignment. The circuits should be realigned after each major service operation and whenever there are positive indications that the adjustments have deviated from normal by ordinary usage.

A definite procedure must be adhered to in re-adjusting the line-up trimmers. Proper oscillator and indication equipment are also required. Certain standard service instruments, useful for receiver adjusting, have been devised and made available by the manufacturer of this receiver. These are illustrated and described on Page 2.

Preparatory Details

(a) **Dial Calibration**—The tuning condenser flexible shaft engages a gear system within the control unit which actuates the dial pointer. To adjust the mechanical relations of the variable condenser and the dial pointer so that accurate calibration is obtained:—rotate the station selector knob until the variable capacitor is at full mesh, which will carry the dial pointer to its minimum frequency position; then remove the tuning knob, loosen the set screw in the bushing and rotate the bushing until the pointer sets exactly opposite the last radial line at the low-frequency end of the scale. (The line referred to is the second one counter-clockwise of the 550 kc. marking.)

(b) **General Procedure**—The "Output Indicator" should be attached to the voice coil or speaker input circuit; and for each adjustment, the oscillator output increased until a noticeable registration or glow occurs on the indicator. The signal from the oscillator should be held as low as possible consistent with getting a good indication, with the receiver volume control at its maximum position. This method of procedure prevents the automatic volume control from affecting the adjustments.

I-F Adjustments

Three trimmers are provided in the i-f system. Two are located on the first i-f transformer, and one on the second i-f transformer. Their physical positions are

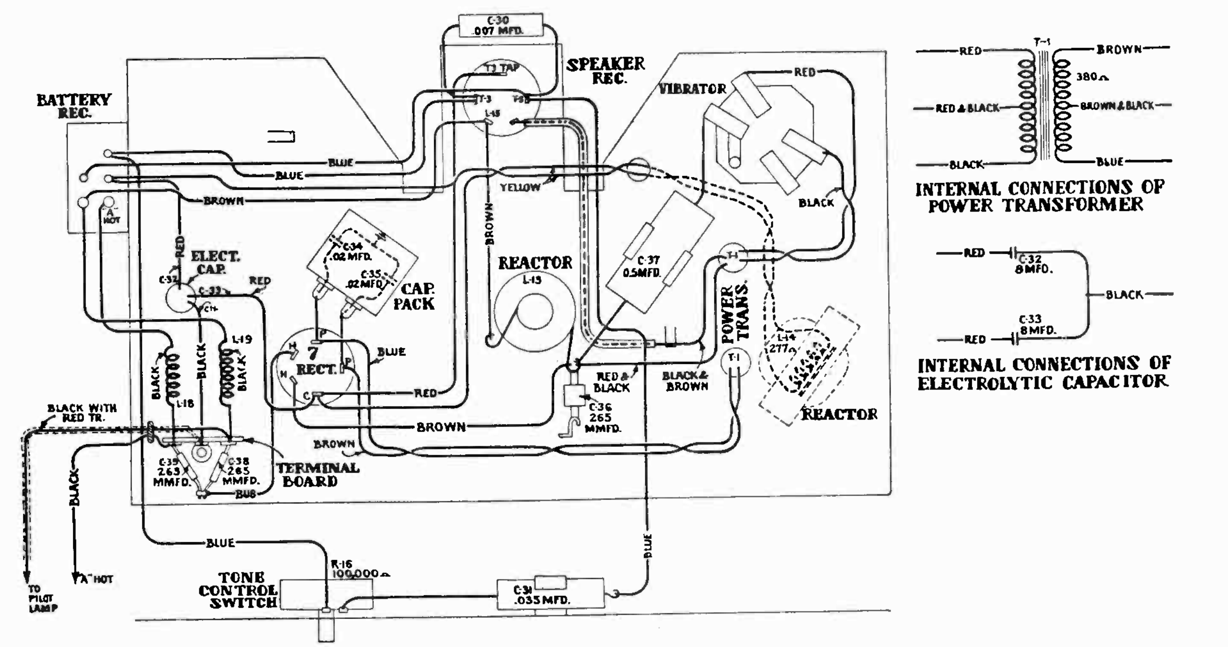

Figure 2—Power Unit Wiring

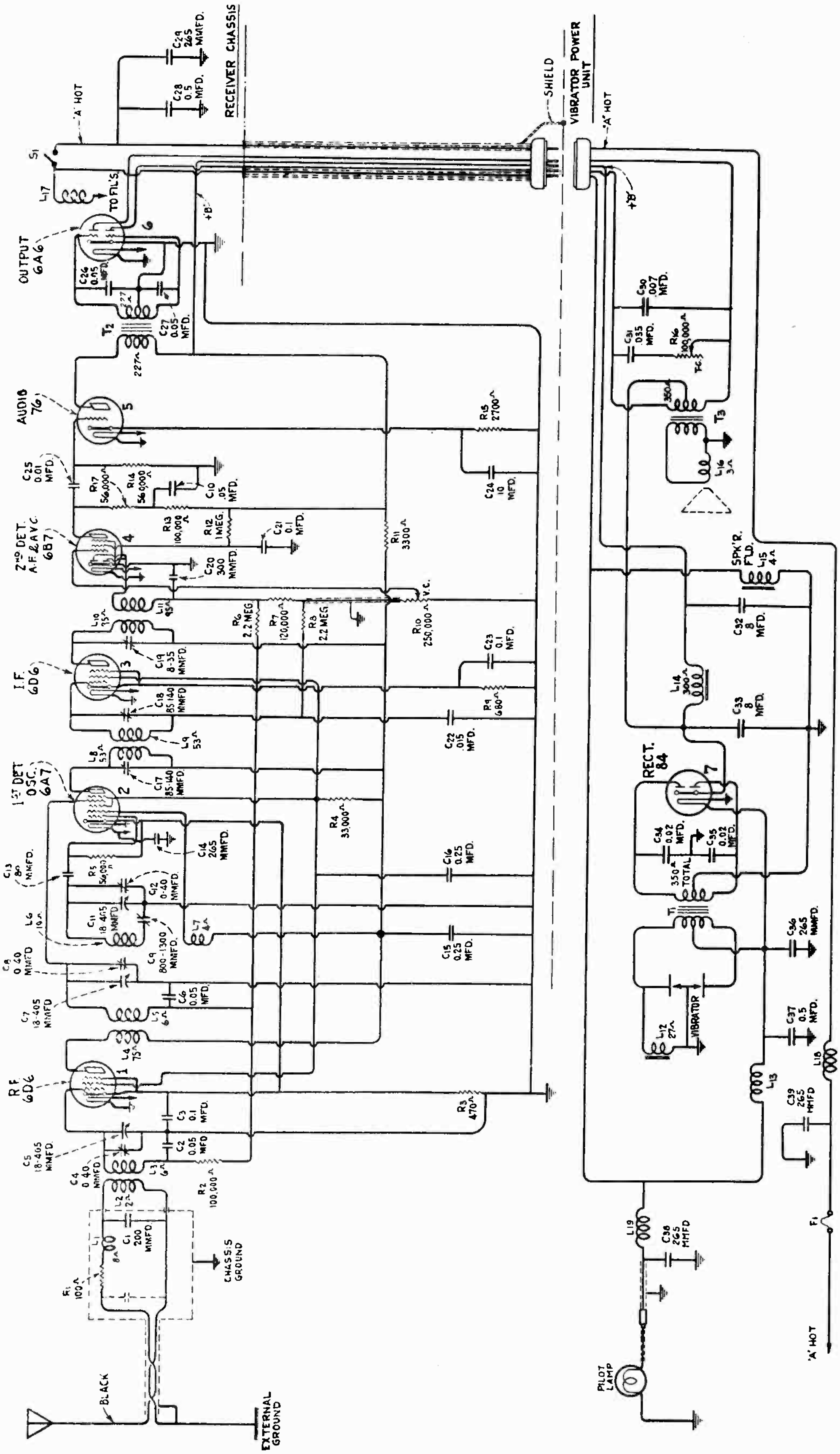

Figure 3—Schematic Circuit Diagram

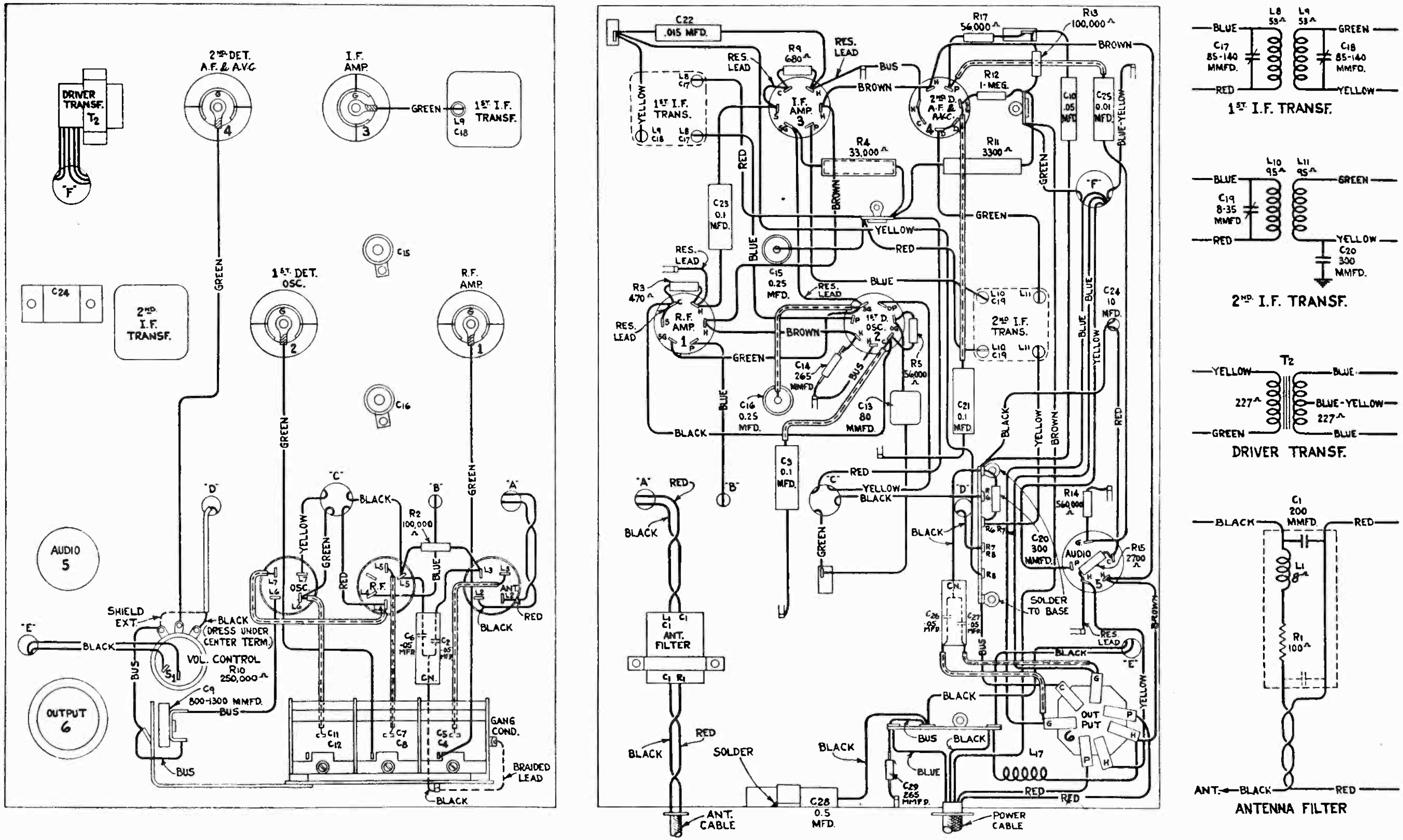

Figure 4—Chassis Wiring Diagram

shown in Figure 5. To correct their alignment proceed as follows:

(a) Connect the output of the "Full Range Oscillator" to the first detector grid and ground, and adjust its frequency to 175 kc. Tune the station selector to a point where no signals are received.

(b) Tune each of the trimmer capacitors C19, C18 and C17 in order. C19 should be set for maximum (peak) output. C18 and C17 should be roughly adjusted for maximum output and then carefully "trimmed" so that a flat-topped response is obtained. This may be checked by shifting the external oscillator frequency through a range two kilocycles each side of the 175 kc. and noting whether or not the receiver output remains substantially constant.

R. F., Detector and Oscillator Adjustments

Three adjustments are used at the high-frequency end of the tuning range. They are located on the gang condenser as shown by the diagram of Figure 5. One trimmer (C9) is used in the oscillator circuit for alignment at 600 kc., it being located as shown in Figure 5.

The external oscillator should be connected to the antenna-ground input at the outer end of the lead-in shield through a 300-ohm resistor in the antenna side. Tuning should be done as follows:

(a) Adjust the frequency of the external oscillator to 1400 kc. and turn the station selector until the dial pointer is at the 1400 kc. marking.

(b) Tune the oscillator high-frequency trimmer, C12, the detector trimmer C8 and the r-f trimmer C4 for maximum receiver output.

(c) Set the external oscillator to a frequency of 600 kc. and rotate the station selector until this signal is accurately tuned. Then adjust the oscillator trimmer C9, simultaneously rocking the tuning condenser slowly through the signal until maximum obtainable output results from the two combined operations. This adjustment should be made irrespective of dial calibration.

(d) Recheck the adjustment of the 1400 kc. oscillator trimmer (C12) as in (b) to correct any reflective errors caused by the procedure of (c).

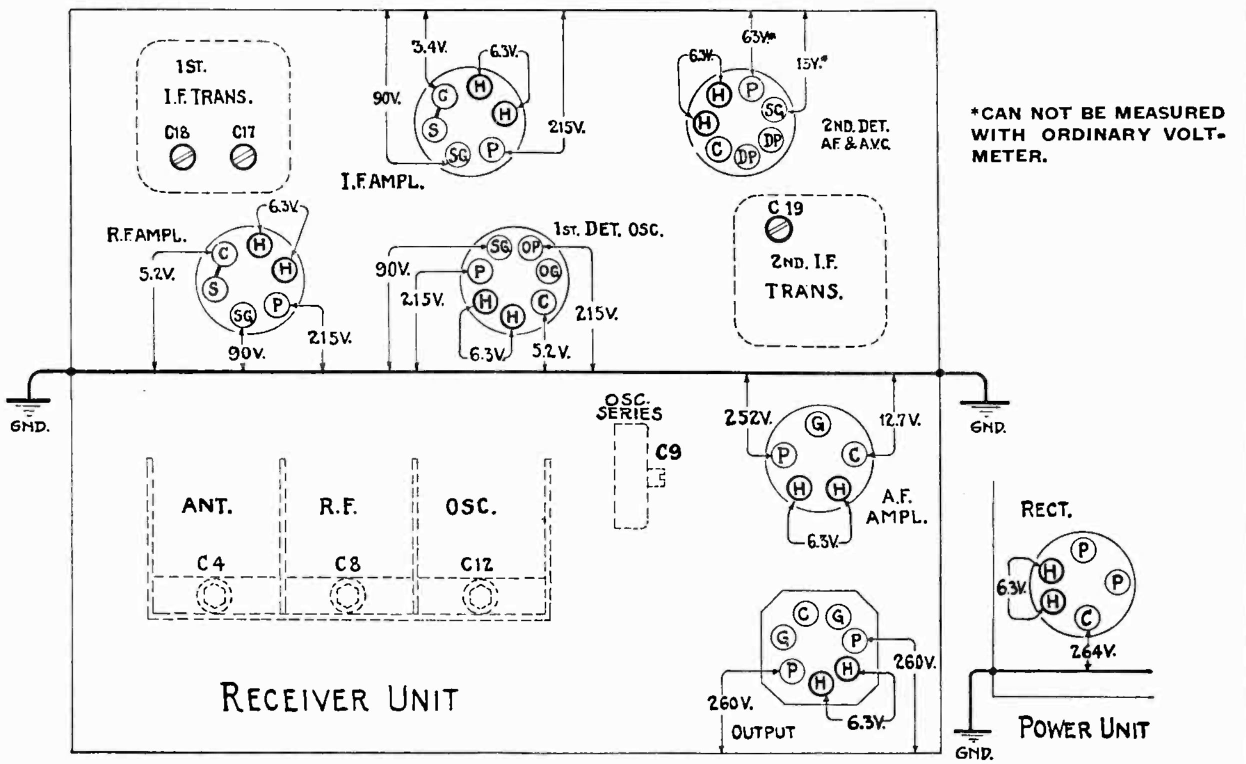

Figure 5—Trimmer Locations and Radiotron Socket Voltages to Ground
(Measured at 6.6 volts battery—Volume Control Maximum—No Signal)

Radiotrons

Under ordinary usage within the ratings specified for voltage supply tube life will be consistent with that obtained in other applications. Their deterioration and approach to failure is usually evidenced by noisy or intermittent operation, loss of sensitivity and distorted tone quality.

It is not feasible to test the Radiotrons in the receiver sockets due to likelihood of errors being caused by the associated circuits. Their removal and check with standard tube testing apparatus is therefore advisable.

Tuning Condenser Drive

The coupling of the flexible drive shaft to the variable tuning condenser is through a worm-gear arrangement. Figure 6 shows the two gears and their

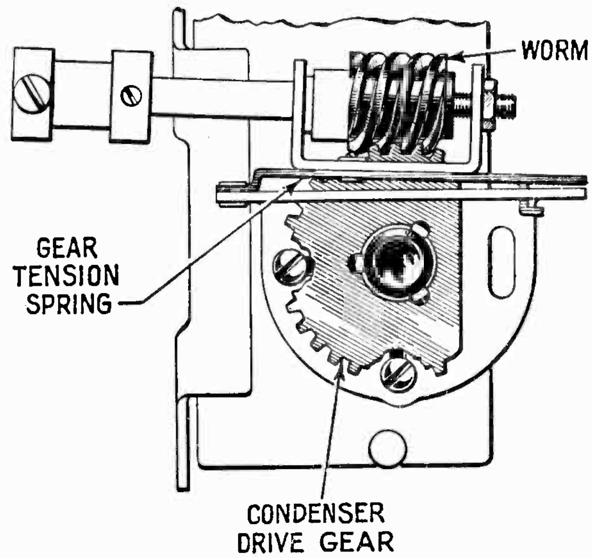

Figure 6—Condenser Drive Mechanism

positions. Smooth operation should be obtained over the entire tuning range. The presence of binding or backlash may cause irregularity in the tuning. To correct these conditions, it will be necessary to remove the chassis from the case and the following procedure applied:—Loosen the two screws behind the condenser drive gear which clamp the worm-gear support plate, and shift the plate upward or downward to change the degree of gear mesh and tension of the spring as required for smooth operation. The screws should then be carefully re-tightened.

Pilot Lamp

A novel type of mounting is provided for the pilot lamp. It consists of a miniature socket attached to a heavy screw which threads into the case of the control unit. The head of this screw is accessible from the underside of the control unit and may be removed with a large screwdriver whenever it becomes necessary to replace the pilot lamp. The power switch should be turned to "off" in order to prevent blowing the fuse if the lamp socket should come in contact with the grounded control case.

Power Unit Interrupter

The mechanical interrupter used in combination with a tube rectifier in the power unit is constructed so as to be conveniently exchanged. Its base is of the "plug-in" type. The adjustments of this device have been correctly set during manufacture by means of special equipment. They should therefore be left undisturbed. In cases of faulty operation, a renewal should be installed.

Speaker Cone Alignment

In the event the cone coil becomes mis-aligned, it will be necessary to correct its centering by an adjustment provided on the speaker assembly. The coil is supported by an external spider. Two round-head brass screws secure its mounting. To center the cone, loosen these two screws and insert a small rod or nail into the hole adjacent to one of these screws and pry the cone mounting into the position which gives normal operation.

Miscellaneous Service Hints

1. The grounding of the outer end of the antenna lead shield is quite critical in that ignition interference may be minimized by selecting the proper point of attachment to the car frame, determined by experiment for each individual installation.

2. In some cars, ignition interference may be introduced through lack of sufficient shielding on the antenna lead-in. In such cases, a shield should be placed over the exposed section of lead and carried as near to the antenna as possible. It should be solidly grounded.

3. Interference in the form of a grating scratch may arise from static collecting on the front wheels of the car due to road surface friction in dry weather. The insulation caused by the grease of the wheel hub enables this action to develop. A number of devices are available through automotive supply dealers which are designed to eliminate this type of trouble. They all serve to form a solid grounding tie between the hub and the axle, and thus drain the static to the frame of the car (ground).

4. The screws holding the chassis to the case must all be in place and tightly installed, inasmuch as they appreciably affect the ground resistance of the assembly and will consequantly have a bearing on the amount of ignition noise received.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4993	Bumper — Rubber bumper for condenser mounting bracket—Package of 5	$0.25
4955	Capacitor — Adjustable trimmer capacitor (C9)	.48
4246	Capacitor—80 mmfd. (C13)	.24
5078	Capacitor—200 mmfd. (C14, C29)	.24
4248	Capacitor—300 mmfd. (C20)	.22
4792	Capacitor—0.015 mfd. (C22)	.22
4882	Capacitor—0.01 mfd. (C25)	.20
4886	Capacitor—0.05 mfd. (C10)	.20
4885	Capacitor—0.1 mfd. (C21)	.28
4841	Capacitor—0.1 mfd. (C3, C23)	.22
4967	Capacitor—0.25 mfd. (C15, C16)	.46
4011	Capacitor—0.5 mfd. generator capacitor	.60
5054	Capacitor—10 mfd. (C24)	1.80
4243	Capacitor pack—Comprising two 0.05 mfd. capacitors (C2, C6, C26, C27)	.35
5074	Clamp—Radiotron shield clamp	.14
4950	Coil—Antenna coil (L3, L4)	.74
5142	Coil—Choke coil (L17)	.15
6967	Coil—Oscillator coil (L6, L7)	.52
6966	Coil—R.F. coil (L4, L5)	.80
5061	Condenser—3-gang variable tuning condenser (C4, C5, C7, C8, C11, C12)	3.68
5018	Volume control (R10)	1.00
5163	Filter—Antenna filter (R1, C1, L1)	1.45
5062	Gear—Condenser drive gear—Located on condenser drive shaft	.12
5030	Resistor—Carbon type—¼ watt—470 ohms (R3)—Package of 5	1.00
5031	Resistor—680 ohms—Carbon type—¼ watt (R9)—Package of 5	1.00
5144	Resistor — 2700 ohms — Carbon type — ¼ watt (R15)—Package of 5	1.00
5147	Resistor — 3300 ohms — Carbon type — 1 watt (R11)	.22
5033	Resistor — 33,000 ohms — Carbon type — 1 watt (R4)—Package of 5	1.10
5029	Resistor—56,000 ohms—Carbon type—¼ watt (R5, R17)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R2, R13)—Package of 5	1.00
5035	Resistor—560,000 ohms—Carbon type—¼ watt (R14)—Package of 5	1.00
3033	Resistor—1 megohm—Carbon type—¼ watt (R12)—Package of 5	1.00
3584	Ring—Antenna, r-f, or oscillator coil retaining ring—Package of 5	$0.40
5129	Ring—Radiotron shield ring—Package of 5	.10
4953	Shield—First intermediate frequency transformer shield	.24
4956	Shield—Second intermediate frequency transformer shield	.30
5037	Shield—Radiotron shield	.15
5058	Socket—5-contact Radiotron socket	.18
4946	Socket—6-contact Radiotron socket	.18
4947	Socket—7-contact Radiotron socket	.18
5060	Socket—7-prong Radiotron output socket	.20
5064	Stud—Variable condenser bracket mounting assembly—Comprising one stud, one bushing, one washer and one lockwasher	.12
5057	Transformer—Driver transformer (T2)	1.00
5055	Transformer—First intermediate frequency transformer (L8, L9, C17, C18)	1.32
5056	Transformer—Second intermediate frequency transformer (L10, L11, C19)	1.42
5063	Worm—Condenser drive worm gear	.54
	POWER UNIT ASSEMBLIES	
5078	Capacitor—200 mmfd. (C36, C38, C39)	.24
5148	Capacitor—0.007 mfd. (C30)	.20
5073	Capacitor—0.035 mfd. high-frequency tone control capacitor (C31)	.44
4490	Capacitor—0.5 mfd. (C37)	.62
5070	Capacitor pack—Comprising two 0.02 mfd. capacitors (C34, C35)	.74
5069	Capacitor pack—Comprising two 8 mfd. capacitors (C32, C33)	1.76
5075	Clamp—Mounting clamp for capacitor—Stock No. 4490	.08
5068	Cup—Grounding cup	.10
4693	Clamp—Mounting clamp for capacitor—Stock No. 5069	.15
5143	Coil—Choke coil (L18, L19)	.15
5072	Tone control (R16)	.82
4132	Knob—Tone control knob—Package of 5	.55
7778	Reactor—Filter reactor (L13)	.45
5066	Reactor—Filter reactor (L14)	.88
5071	Receptacle—Power cable plug female receptacle—5-contact—Female section	.20
6980	Socket—4-contact vibrator socket	.20

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
5058	Socket—5-contact Radiotron socket or reproducer plug receptacle	$0.18
5065	Transformer—Power transformer (T1)	2.48
5067	Vibrator—Complete (L12)	3.66
	CABLE ASSEMBLIES	
4976	Cable—Antenna lead assembly—Single-conductor with male section of antenna connector	.16
7766	Cable—Power lead with clip and female section of fuse connector—To ammeter	.30
5059	Cable—Main power cable—Complete—With male section of connector plug, fuse connector and fuse, ammeter clip and female section of pilot light cable connector	1.50
5150	Cap—Cap for power cable plug	.22
5149	Plug—Power cable plug—Less cap	.20
	FLEXIBLE SHAFT ASSEMBLIES	
5000	Bracket—Flexible drive shaft connection bracket—Mounted on housing	.30
4973	Coupling—Tuning condenser flexible drive shaft coupling	.30
5141	Coupling—Volume control flexible drive shaft coupling	.36
3903	Screw—No. 8-32-3/16" headless set screw for flexible drive shaft coupling—Package of 20	.36
7855	Shaft—Tuning condenser or volume control flexible drive shaft—Approximately 28⅛" long	1.00
	CONTROL BOX ASSEMBLIES	
4987	Bezel—Station selector dial bezel	.42
7865	Box—Control box—Complete	3.86
7864	Bracket—Mounting bracket and rear section of control box housing	.30
4988	Crystal—Station selector dial crystal	.38
4989	Dial—Station selector dial	.20
4981	Gear—18-tooth intermediate drive gear	.15
4978	Gear—Indicator drive gear and shaft	.42
7862	Housing—Front section of control box housing	.28
7863	Housing—Center section of control box housing	.32
4990	Indicator—Station selector (pointer) indicator	.10
4985	Knob—Station selector or volume control knob—Package of 5	.62

Stock No.	Description	List Price
4991	Lamp—Dial lamp—Package of 5	$0.74
7866	Plate—Bearing plate assembly—Comprising plate, gear and shaft, volume control shaft, station selector shaft, pinion and spring	1.22
4986	Screw—Oval fillister head machine screw—Fastens bracket and center section of control box housing	.25
5042	Screw—No. 8-32-⅛" headless set screw for station selector or volume control shaft—Package of 10	.25
4983	Shaft—Station selector drive shaft	.16
4979	Shaft—Volume control drive shaft	.16
4984	Socket—Dial lamp socket	.16
4982	Spring—Holding spring for station selector or volume control knob—Package of 10	.26
4980	Spring—Tension spring—Package of 5	.15
5011	Strap—Control box mounting strap	.25
	REPRODUCER ASSEMBLIES	
9597	Coil—Field coil (L15)	2.62
9598	Cone—Reproducer cone (L16)—Package of 5	3.90
9596	Reproducer—Complete	8.00
4995	Screw—Reproducer mounting screw—Package of 10	.15
5090	Transformer—Output transformer (T3)	2.62
	MISCELLANEOUS ASSEMBLIES	
4244	Cap—Grid contact cap—Package of 5	.20
4293	Capacitor—0.5 mfd. ammeter capacitor	.60
5025	Capacitor—0.5 mfd. generator capacitor	.40
7871	Case—Complete—With top and bottom cover—Less screws	3.28
7952	Cover—Bottom cover of receiver case—Less screws	.35
7953	Cover—Top cover of receiving case—Less screws	.35
5023	Fuse—15-ampere—Package of 5	.40
4985	Knob—Station selector or volume control knob—Package of 5	.62
4999	Screw—No. 8-¼" slotted hex-head self-tapping screw—Package of 5	.12
5037	Shield—Radiotron shield	.15
4992	Stud—Receiver mounting stud, nut and washer—Package of 3	.22
5024	Suppressor—Distributor suppressor	.38
5067	Vibrator—Complete	3.66

RCA Victor Models 117 and 214

Five-Tube, Two-Band, A. C. Superheterodyne Receivers

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage and Frequency Ratings	105–125 Volts, 50–60 Cycles 105–125 Volts, 25–60 Cycles 105–125/195–250 Volts, 50–60 Cycles
Power Consumption	80 Watts
Radiotrons and Functions	(1) RCA-6A7 First Detector and Oscillator (2) RCA-6D6 I.F. Amplifier (3) RCA-6B7 Second Detector, Audio Amplifier, A.V.C. (4) RCA-41 Power Output (5) RCA-80 Rectifier
Tuning Frequency Ranges	540 to 1720 KC. and 2250 to 6850 KC.
Alignment Frequencies	460 KC. (I.F.), 1720 KC. (R.F. and Oscillator) and 600 KC. (Oscillator)
Undistorted Output	1.75 Watts
Maximum Output	3.5 Watts
Loudspeaker	Electrodynamic

PHYSICAL SPECIFICATIONS

	Model 117	*Model 214*
Height	16 Inches	37¼ Inches
Width	13¼ Inches	23 Inches
Depth	9¼ Inches	9½ Inches

The chassis employed in these two receivers are identical. Such distinctions as:—Short-wave reception — Superheterodyne circuit — Diode detection — Automatic volume control—Resistance coupled audio —Tone control—Airplane selector dial—and Electrodynamic speaker, characterize the design.

Particular mounting methods are used for supporting the chassis to the cabinet to exclude undesirable microphonic reaction between the speaker, and the Radiotrons and the variable tuning capacitor plates.

Antenna-ground screw terminals are used to simplify and insure positive connection of the input leads. The terminals are also arranged to permit convenient mounting of a "Double-Doublet" antenna transformer available from the manufacturer of these receivers for use with the highly efficient "World-Wide" antenna.

Additional service convenience is incorporated by use of a plug-connector attachment in the cable joining chassis to loudspeaker. This method allows the service man to remove the receiver from the cabinet without disturbing the speaker.

DESCRIPTION OF ELECTRICAL CIRCUIT

Five Radiotrons are associated in combination with a Superheterodyne circuit. Two of the Radiotrons are applied so as to obtain plural functions, thereby gaining more than the adequate results normally expected of a five-tube receiver. In the first stage of the circuit an RCA-6A7 pentagrid converter tube is employed as detector and local oscillator, the related external high-frequency circuits consisting of a tuned antenna transformer with a short-wave tap, and a three-winding oscillator coil assembly with changeover switches ganged to the antenna transformer s-w switch. Within the first detector tube, mixing of the signal and oscillator voltages is accomplished through electron coupling, the i-f appearing in the plate circuit.

The i-f system operates at 460 kc. as the basic frequency. The presence of the natural period transformer

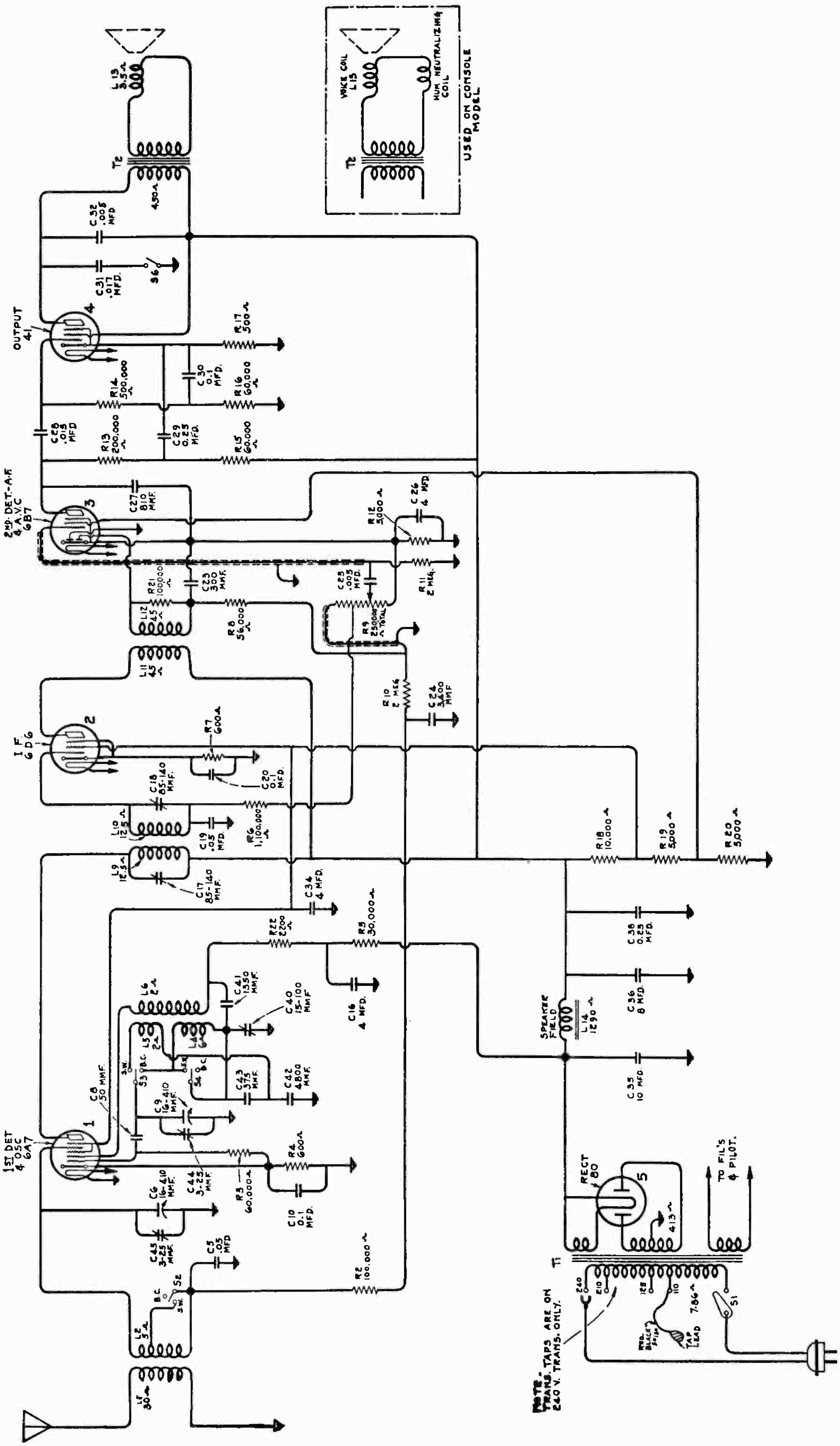

Figure 1—Schematic Circuit Diagram

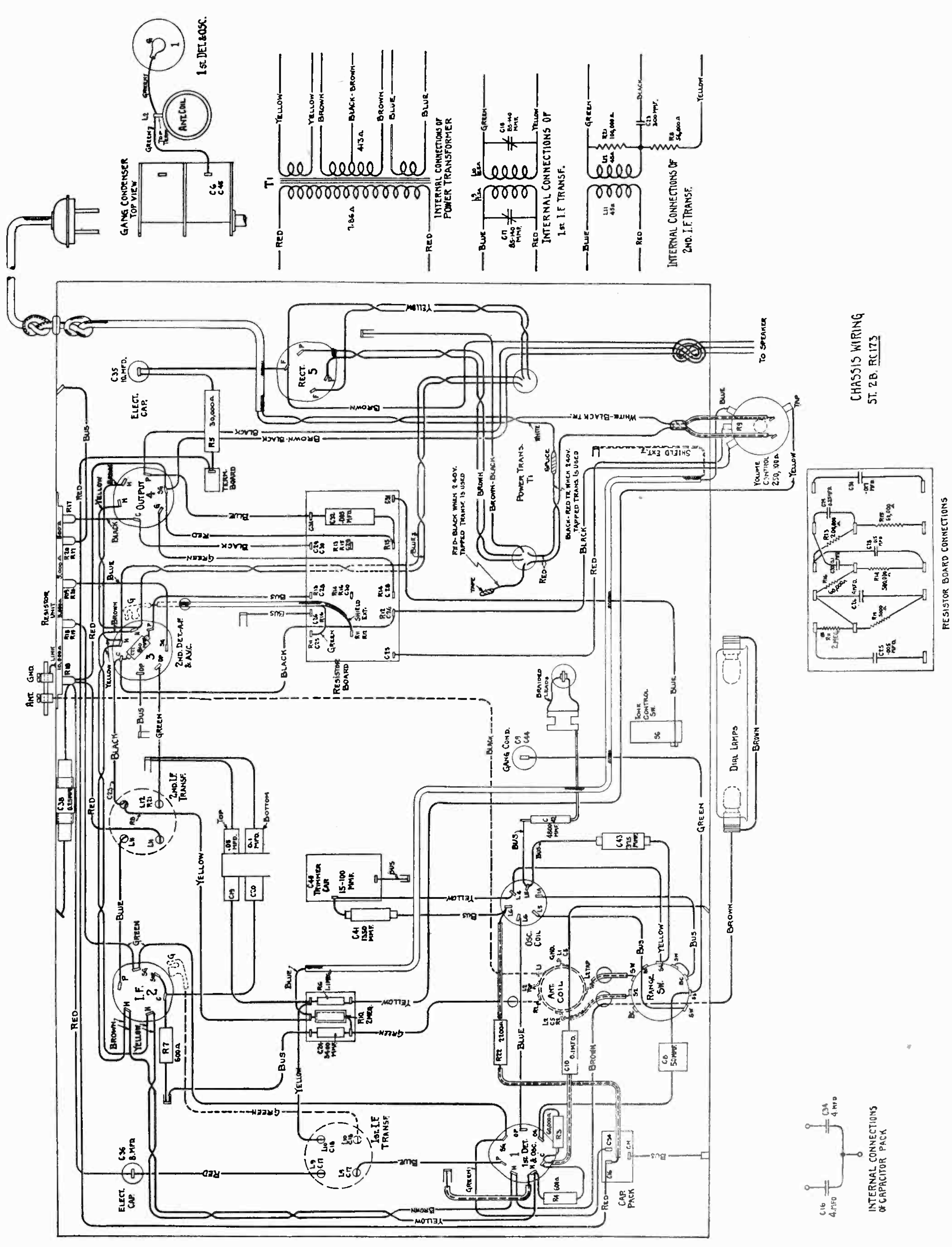

Figure 2—Chassis Wiring Diagram

at the i-f output should be especially noted. Its use minimizes the number of line-up adjustments.

The combined second detector-audio amplifier-a.v.c. stage utilizes an RCA-6B7, a duplex-diode pentode Radiotron. One diode connects directly to ground, the other is used for detection. Part of the detected signal is filtered to remove the audible fluctuations and is applied to the first and second stages as a means of providing automatic volume control. The audio component of the detected signal is amplified by the RCA-6B7 and conveyed to a resistance-capacitance coupling network.

A power amplifier pentode, RCA-41, is used in the output stage and is coupled by a transformer to the low impedance voice coil of the speaker.

Full-wave rectification is employed in the power-supply stage. The speaker field winding serves in the filter circuit as a reactor.

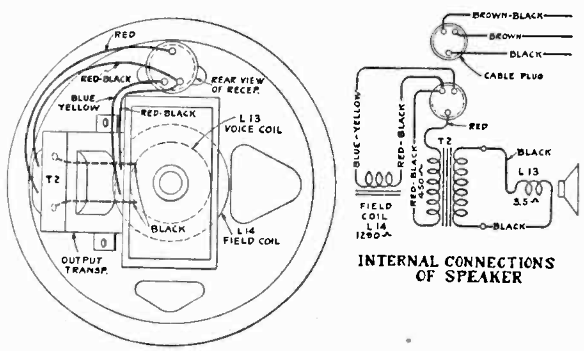

Figure 3—Loudspeaker Wiring (Table Model)

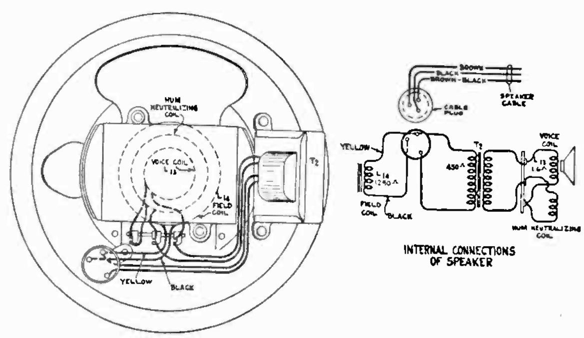

Figure 4—Loudspeaker Wiring (Console Model)

SERVICE DATA

(1) Line-Up Capacitor Adjustments

This receiver must be in correct electrical alignment in order to obtain maximum efficiency and best quality of performance. The circuits should be realigned after each major service or repair operation, and whenever there are positive indications that the adjustments have deviated from normal by ordinary usage. These indications will be present together and will have the nature of: low sensitivity, poor tone quality and irregular double-peaked tuning.

A definite procedure must be applied in readjusting the line-up trimmers. The proper oscillator and indication equipment must also be used. Certain standard service instruments, which are useful for receiver adjustment, have been designed and made available by the manufacturer of this receiver. These are illustrated and described on page 2.

(2) I-F Tuning Adjustments

There are two i-f transformers associated in the intermediate amplifier system. The first of these transformers is tuned by accessible trimmers. The second transformer has a natural tuning inherent to its design. To obtain the correct alignment, proceed as follows:

(a) Short circuit the antenna and ground terminals and tune the receiver so that no signal is received. Set the volume control to its maximum position. Ground the receiver.

(b) Connect the output of the test oscillator between the first detector control grid and chassis ground. Attach an indicating meter, such as is illustrated on page 2, to the speaker circuit.

(c) Place the external oscillator into operation at 460 kc. Adjust the output so that a slight registration occurs on the output indicator. The output should be set at as low a value as will give a convenient indication during adjustment; this requirement is important in that the a.v.c. action is voided by such a method. Adjust the secondary and primary trimmers (C18 and C17) of the first i-f transformer for maximum receiver output.

R-F and Oscillator Adjustments

Three trimmers are provided, two for adjustment at 1720 kc. and one for oscillator line-up at 600 kc. No adjustments are required on the short-wave bands. Locations of the trimmers are shown on Figure 5. They should be adjusted in the following manner:

(a) Connect the output of the modulated Full Range Oscillator to the antenna and ground terminals of the receiver. Check the position of the dial pointer. It should set exactly on the radial line, adjacent to the dial reading of 540 when the tuning capacitor plates are at full mesh. After correcting the dial pointer, place the receiver in operation and set the selector at 1720 kc., advance the volume control to maximum and turn the range switch to its broadcast position.

(b) Adjust the frequency of the external oscillator to 1720 kc. and regulate its output until a perceptible indication appears on the output indicator. This indication should be held at a minimum during the adjustments. The trimmers C44 and C45 should then be tuned to the point giving peak receiver output.

(c) Retune the test oscillator, setting its frequency to 600 kc. Turn the receiver selector control to the point where the incoming oscillator signal is received best. *This point will not always be exactly at 600 on the dial.* Then adjust the low-frequency trimmer C40, simultaneously rocking the tuning capacitor slowly through the signal until maximum receiver output results from these combined operations. This adjustment must be made irrespective of dial calibration. It is advisable to repeat the 1720 kc. adjustment of the oscillator trimmer C44 in order to correct for any change caused by the tuning of C40.

Radiotron Socket Voltages

The various normal operating voltages are given on Figure 5. As specified, they are referred to the chassis ground. Accuracy of measurements will be a function of the internal resistance of the voltmeter used. It is advisable to employ a meter having at least 1000 ohms per volt, and for each reading use the highest range which will give an acceptably accurate reading. General deviations from the values given, due to line voltage difference, should not be taken as indicating a defective condition. The erratic departure from normal of a single value or group of values should form the basis of circuit diagnosis.

Code Interference

In certain localities near to high-powered radiotelegraph stations operating at frequencies in the vicinity of 460 kc., slight code interference may be present. This adverse condition usually occurs over the entire tuning range, the strength of the interference not being affected by changing the station selector. A shielded wave trap, such as Part No. 4539, is adaptable for suppressing interference of this type. It should be connected in series with the antenna lead at the receiver, with its *green* lead to the antenna, and its *yellow* lead to the antenna terminal. The trap must be accurately tuned to the interfering signal. The shield of the trap should be securely grounded to the receiver chassis.

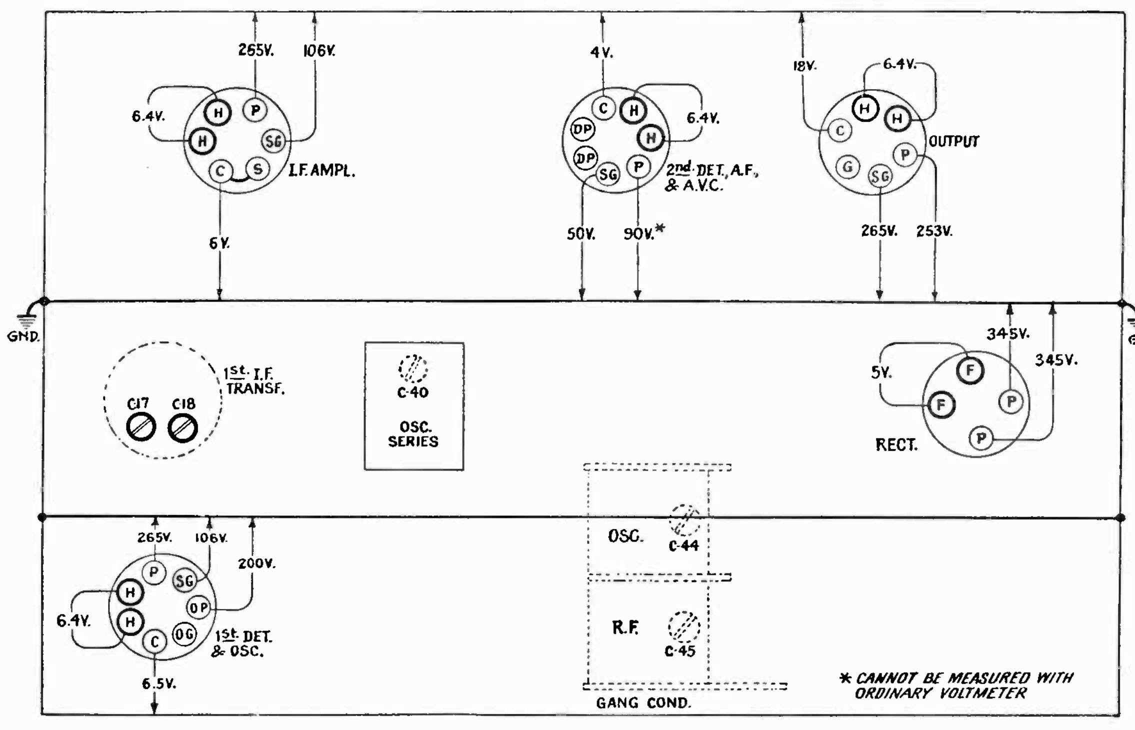

Figure 5—Trimmer Locations and Radiotron Socket Voltages
(Measured at 115 volts line supply—Maximum Volume Control—No Signal)

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4379	Board—Terminal board—Engraved "ANT-GND"	$0.20
5043	Bracket—First I.F. transformer mounting bracket	.10
4880	Bracket—Tone control switch mounting bracket	.12
4427	Bracket—Volume control mounting bracket	.18
4244	Cap—Grid contact cap—Package of 5	.20
3861	Capacitor—Adjustable capacitor (C40)	.78
4442	Capacitor—50 mmfd. (C8)	.22
4913	Capacitor—375 mmfd. (C43)	.20
5044	Capacitor—810 mmfd. (C27)	.20
4914	Capacitor—1350 mmfd. (C41)	.24
4881	Capacitor—3400 mmfd. (C24)	.20
4912	Capacitor—4800 mmfd. (C42)	.38
4793	Capacitor—0.005 mfd. (C25)	.20
4868	Capacitor—0.005 mfd. (C32)	.20
4792	Capacitor—0.015 mfd. (C28)	.22
4906	Capacitor—0.017 mfd. (C31)	.25
4836	Capacitor—0.05 mfd. (C5, C19)	.30
4791	Capacitor—0.1 mfd. (C10, C20)	.24
4841	Capacitor—0.1 mfd. (C30)	.22
3597	Capacitor—0.25 mfd. (C29, C38)	.40
3796	Capacitor—4.0 mfd. (C26)	.60
4428	Capacitor—8.0 mfd. (C36)	1.05
7790	Capacitor—10.0 mfd. (C35)	1.05
7589	Capacitor pack—Comprising two 4.0 mfd. capacitors (C16, C34)	1.64
4358	Clamp — Capacitor mounting clamp for capacitors—Stock Nos. 7790 and 4428	.15
4903	Coil—Antenna coil (L1, L2, R2, C5)	1.58
4902	Coil—Oscillator coil (L4, L5, L6)	1.22
4896	Condenser—2-gang variable tuning condenser (C6, C9, C44, C45)	3.48
4790	Volume control (R9, S1)	1.40
5045	Lead—Single conductor—Shielded lead from volume control to resistor (R10)	.20
3218	Resistor—600 ohms—Carbon type—¼ watt (R4, R7)—Package of 5	1.00
5185	Resistor — 2200 ohms — Carbon type — ½ watt (R22)—Package of 5	1.00
4436	Resistor — 5000 ohms — Carbon type — ¼ watt (R12)—Package of 10	2.00
2240	Resistor — 30,000 ohms — Carbon type — 1 watt (R5)	.22
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R3, R15, R16)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R2)—Package of 5	1.00
3116	Resistor—200,000 ohms—Carbon type—¼ watt (R13)—Package of 5	1.00
6186	Resistor—500,000 ohms—Carbon type—¼ watt (R14)—Package of 5	1.00
4783	Resistor — 1,100,000 ohms — Carbon type —¼ watt (R6)—Package of 5	1.00
6242	Resistor — 2 megohms — Carbon type — ¼ watt (R10, R11)—Package of 5	1.00
4721	Resistor — Tapped resistor — one 10,000 ohms, two 5,000 ohms and one 500 ohms sections (R17, R18, R19, R20)	.88
3584	Ring—Oscillator coil retaining ring—Package of 5	.40
5049	Screw—First I.F. transformer clamp screw—No. 6-32-$\frac{1}{16}$" set screw—Package of 5	.10
4908	Shield—Second I.F. transformer shield	.45
5186	Shield—First I.F. transformer shield	.28
3623	Shield—Oscillator coil shield	.30
3782	Shield—Second detector Radiotron shield	.26
3942	Shield—First Detector and output Radiotron shield	.18
7487	Shield—I.F. Radiotron shield	$0.25
3858	Socket—Dial lamp socket assembly	.26
4784	Socket—4-contact Radiotron socket	.15
4785	Socket—6-contact Radiotron socket	.15
4786	Socket—6-contact Radiotron socket	.15
4787	Socket—7-contact Radiotron socket	.15
4904	Switch—Range switch (S2, S3, S4)	.75
5052	Switch—Tone control switch (S6)	.30
4900	Transformer—First intermediate frequency transformer (L9, L10, C17, C18)	2.25
4901	Transformer—Second intermediate frequency transformer (L11, L12, R8, R21, C23)	1.50
4898	Transformer—Power transformer—105–125 volts—25–50 cycles	5.55
4897	Transformer—Power transformer—105–125 volts—50–60 cycles (T1)	3.98
4899	Transformer—Power transformer—105–125 200–240 volts—40–60 cycles	4.05
	CONDENSER DRIVE ASSEMBLIES	
5048	Dial—Station selector dial	.38
5046	Drive—Tuning condenser drive assembly—Complete	1.04
4475	Indicator—Station selector (indicator) pointer	.18
4340	Lamp—Station selector dial lamp—Package of 5	.60
3943	Screen—Translucent screen for dial light—Package of 2	.18
5047	Shaft—Condenser drive shaft	.22
3858	Socket—Station selector dial lamp socket	.26
	REPRODUCER ASSEMBLIES (CONSOLE MODEL)	
9579	Coil—Field coil (L14)	2.10
9533	Cone—Reproducer cone—Mounted and centered on metal housing (L13)	3.50
5118	Connector—3-contact male connector plug for reproducer	.25
5119	Connector—3-contact female connector plug for reproducer cable	.25
9578	Reproducer—Complete	6.58
4818	Transformer—Output transformer (T2)	2.15
	REPRODUCER ASSEMBLIES (TABLE MODEL)	
4915	Cable—3-conductor reproducer cable	.50
9587	Coil—Field coil, magnet and cone support (L14)	2.18
9588	Cone—Reproducer cone (L13)—Package of 5	3.55
5118	Connector—3-contact male connector plug for reproducer	.25
5119	Connector—3-contact female connector plug for reproducer cable	.25
9586	Reproducer—Complete	5.95
4893	Transformer—Output transformer (T2)	1.48
	MISCELLANEOUS ASSEMBLIES	
6755	Bezel—Metal bezel for station selector dial glass	.50
6707	Glass—Station selector dial glass	.20
4449	Knob—Package of 5	.60
6708	Ring—Retaining ring for dial glass—Package of 5	.44
4917	Screw—Chassis mounting screw and washer (for table model)—Package of 4	.15
5178	Screw—Chassis mounting screw assembly (for console model)—Package of 4	.15

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SUPPLEMENT
TO
RCA VICTOR MODELS 118 AND 211
SERVICE NOTES

Recently manufactured receivers of Models 118 and 211 contain a number of modifications in circuit and assembly. These changes appear in the following data and on the schematic and wiring diagrams. The major items affected are the speaker cable connection, type of Radiotron in output stage, band switch and voltage divider system.

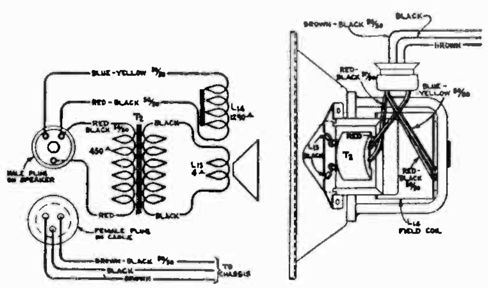
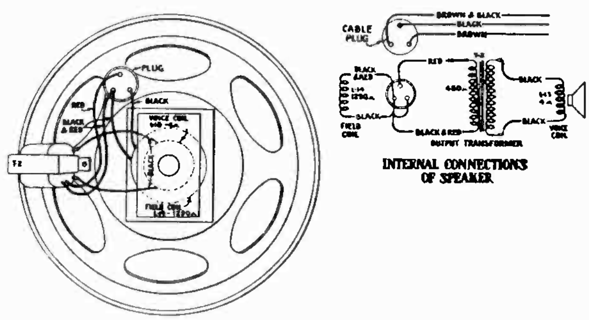


Table Model Loudspeaker Wiring



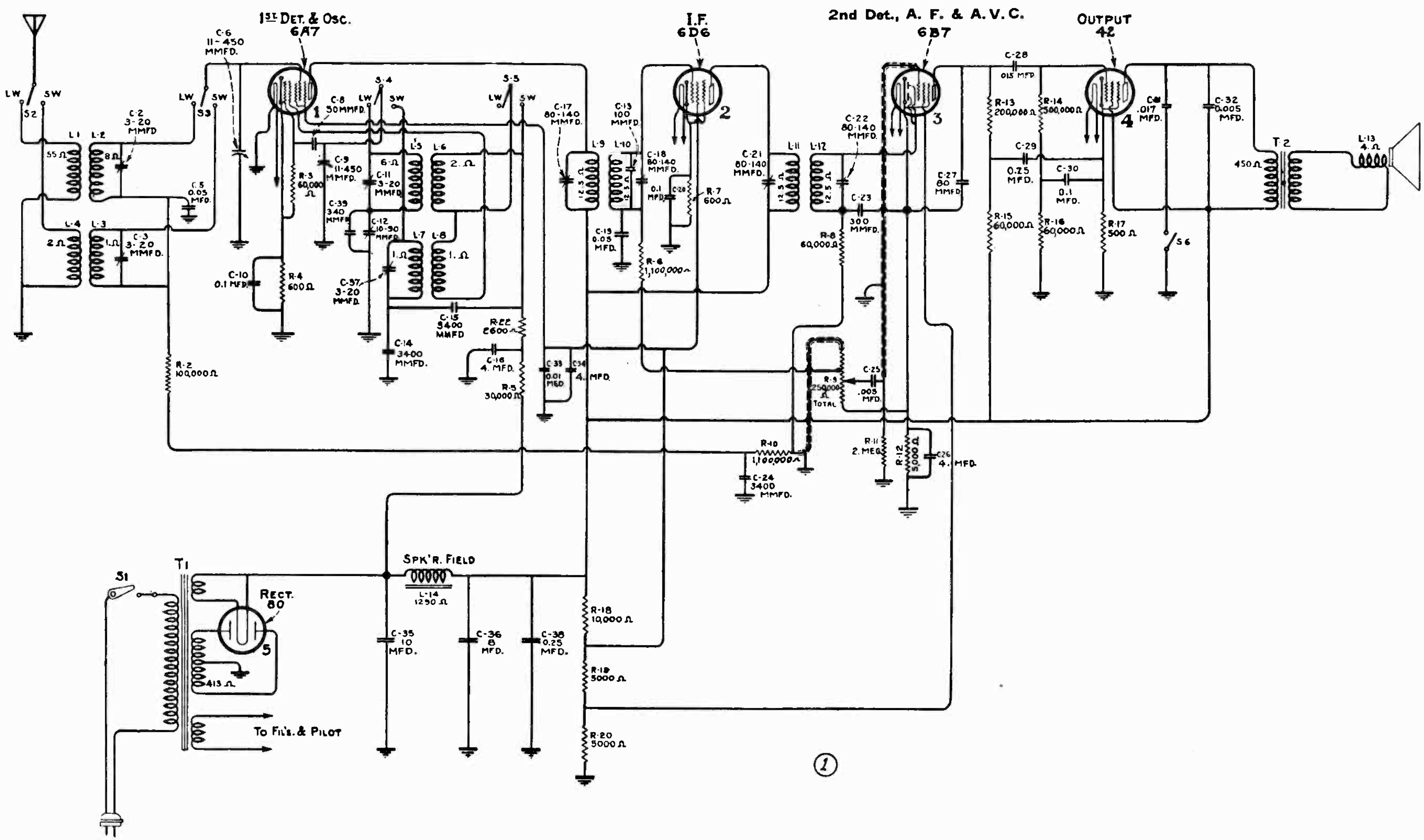
Console Model Loudspeaker Wiring

RADIOTRON SOCKET VOLTAGES

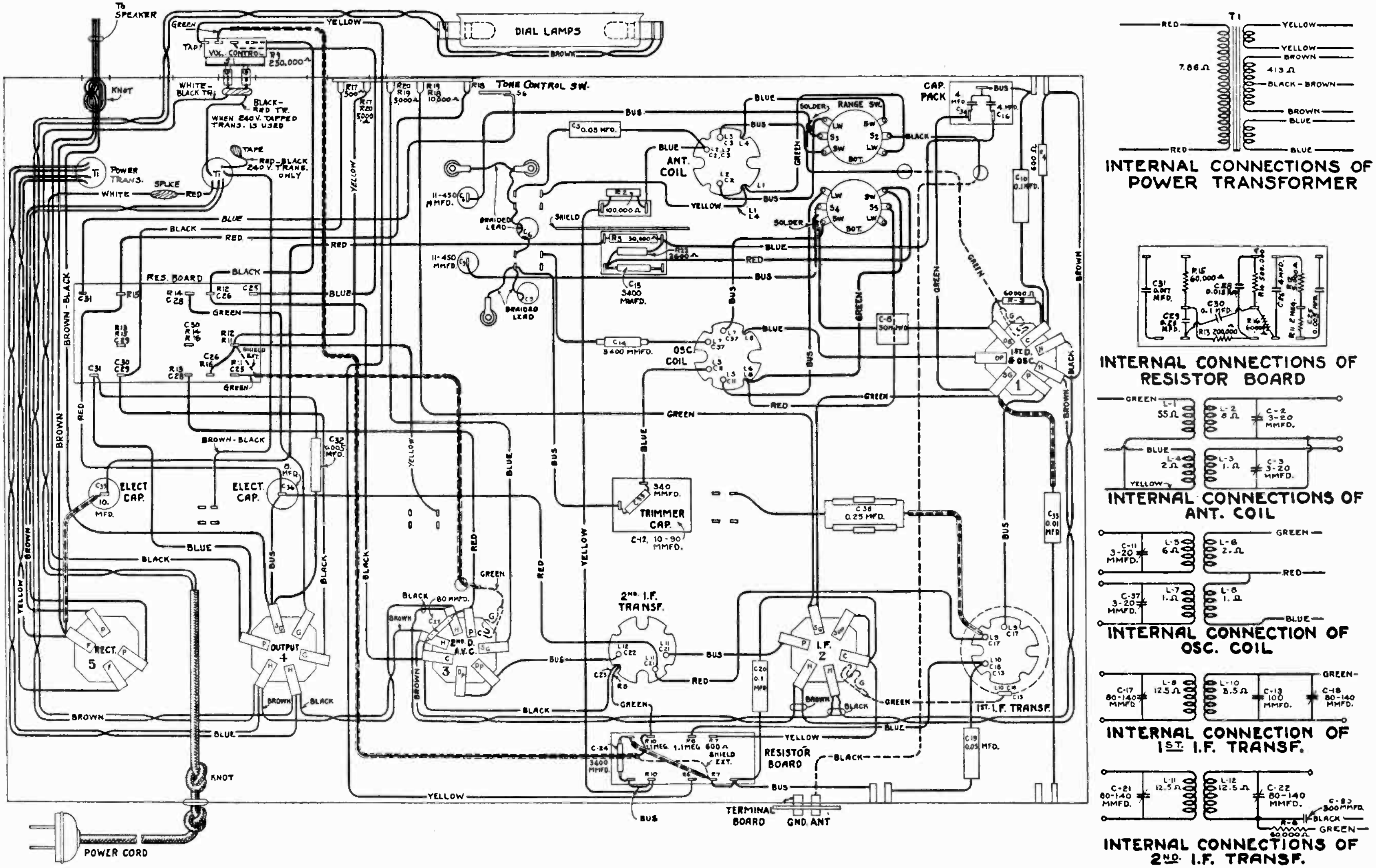
115-Volt, A. C. Line—Maximum Volume Control—No Signal

Radiotron		Cathode to Ground Volts, D. C.	Screen Grid to Ground Volts, D. C.	Plate to Ground Volts, D. C.	Plate Current, M. A.	Heater Volts, A. C.
RCA-6A7	Detector	6.0	105	265	3.5	6.3
	Oscillator		—	220	4.5	
RCA-6D6 I. F.		6.0	105	265	9.0	6.3
RCA-6B7 2nd Det.		3.0	50*	90*	0.7	6.3
RCA-42 Power		16.5	265	245	30.0	6.3
RCA-80 Rectifier		—	—	690 (Plate to Plate)	64.0	5.0

*Voltage calculated from 265V+B.



Schematic Circuit Diagram
Model 118 and Model 211 (1935 Production)



Wiring Diagram
Model 118 and Model 211 (1935 Production)

REPLACEMENT PARTS—Models 118 and 211 (1935 Production)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4379	Board—Terminal board—Two terminals and link—Engraved "ANT-GND"	$0.20
4880	Bracket—Tone control mounting bracket	.12
4427	Bracket—Volume control mounting bracket	.18
4244	Cap—Grid contact cap	.20
3861	Capacitor — Adjustable capacitor — 10-100 mmfd. (C12)	.78
4793	Capacitor—0.005 mfd. (C25)	.20
4868	Capacitor—0.005 mfd. (C32)	.20
4883	Capacitor—0.01 mfd. (C33)	.20
4792	Capacitor—0.015 mfd. (C28)	.22
4752	Capacitor—0.017 mfd. (C31)	.26
4836	Capacitor—0.05 mfd. (C5, C19)	.30
4442	Capacitor—50 mmfd. (C8)	.22
4509	Capacitor—80 mmfd. (C27)	.15
4791	Capacitor—0.1 mfd. (C10, C20, C30)	.24
3597	Capacitor—0.25 mfd. (C29, C38)	.40
4811	Capacitor—340 mmfd. (C39)	.25
4439	Capacitor—3400 mmfd. (C14)	.35
4881	Capacitor—3400 mmfd. (C15, C24)	.20
3796	Capacitor—4.0 mfd. (C26)	.60
4428	Capacitor—8.0 mfd. (C36)	1.05
7790	Capacitor—10.0 mfd. (C35)	1.05
7589	Capacitor pack—Comprising two 4.0 mfd. capacitors (C16, C34)	1.64
4358	Clamp — Electrolytic capacitor mounting clamp	.15
5087	Coil—Antenna coil (L1, L2, L3, L4, C2, C3)	1.86
5089	Coil—Oscillator coil (L5, L6, L7, L8, C11, C37)	1.90
4504	Condenser—2-gang variable tuning condenser (C6, C9)	2.78
4788	Insulator—Radiotron socket insulator—Package of 5	.20
3708	Resistor—600 ohms—Carbon type—¼ watt (R4, R7)—Package of 5	1.00
4812	Resistor — 2600 ohms — Carbon type — ¼ watt (R22)—Package of 5	1.00
4436	Resistor — 5000 ohms — Carbon type — ¼ watt (R12)—Package of 10	2.00
2240	Resistor — 30,000 ohms — Carbon type — 1 watt (R5)	.22
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R3, R8, R15, R16)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R2)—Package of 5	1.00
3116	Resistor—200,000 ohms—Carbon type—¼ watt (R13)—Package of 5	1.00
6186	Resistor—500,000 ohms—Carbon type—¼ watt (R14)—Package of 5	1.00
4783	Resistor—1,100,000 ohms—Carbon type—¼ watt (R6, R10)—Package of 5	1.00
6242	Resistor — 2 megohms — Carbon type — ¼ watt (R11)—Package of 5	1.00
4721	Resistor—Tapped resistor—One 10,000 ohm, two 5,000 ohm and one 500 ohm section (R17, R18, R19, R20)	.88
4521	Shield—Antenna, r-f or oscillator coil shield	.42
3942	Shield—First detector-oscillator Radiotron shield	.18
7487	Shield—I.F. Radiotron shield	.25
3782	Shield—Second detector Radiotron shield	.26
4784	Socket—4-contact Radiotron socket	.15
4785	Socket—6-contact output Radiotron socket	.15
4786	Socket—6-contact i-f Radiotron socket	.15
4787	Socket—7-contact Radiotron socket	.15
5088	Switch—Range switch (S2, S3, S4, S5, SW, LW)	1.35
5052	Switch—Tone control switch (S6)	.30
4431	Transformer—First intermediate frequency transformer (L9, L10, C13, C17, C18)	2.28
4433	Transformer—Second intermediate frequency transformer (L11, L12, C21, C22, C23, R8)	$2.15
9512	Transformer—Power transformer—105-125 volts—25-40 cycles	6.58
9513	Transformer—Power transformer—105-250 volts—40-60 cycles	4.85
9511	Transformer—Power transformer—105-125 volts—50-60 cycles	4.78
4429	Volume control (R9, S1)	1.40
	DRIVE ASSEMBLIES	
10194	Ball—Steel ball for condenser drive assembly—Package of 20	.25
4422	Clutch—Condenser drive clutch assembly complete	1.00
4474	Dial—Station selector dial (table model)	.76
4450	Dial—Station selector dial (console model)	.52
4434	Drive—Tuning condenser drive assembly	2.42
4340	Lamp—Dial lamp—Package of 5	.60
4363	Pointer—Station selector pointer (console model)	.18
4475	Pointer—Station selector pointer (table model)	.18
3943	Screen—Translucent screen for dial lamps—Package of 2	.18
3529	Socket—Dial lamp socket	.32
	REPRODUCER ASSEMBLIES (TABLE MODEL)	
4915	Cable—3-conductor reproducer cable—Complete with 3-contact female connector plug	.50
9587	Coil—Field coil magnet and cone support (L14)	2.18
9588	Cone—Reproducer cone (L13)—Package of 5	3.55
5118	Connector—3-contact male connector plug for reproducer	.25
5119	Connector—3-contact female connector plug for reproducer cable	.25
9586	Reproducer—Complete	5.95
4893	Transformer—Output transformer (T2)	1.48
	REPRODUCER ASSEMBLIES (CONSOLE MODEL)	
9590	Coil—Field coil magnet and cone support (L14)	4.20
8935	Cone—Reproducer cone (L13)—Package of 5	5.25
9589	Reproducer—Complete	8.20
4892	Transformer—Output transformer (T2)	1.30
	MISCELLANEOUS ASSEMBLIES	
6840	Escutcheon—Station selector escutcheon—Console model	.56
6706	Escutcheon—Station selector escutcheon—Table model	.42
6614	Glass—Station selector dial glass—Console model	.30
6707	Glass—Station selector dial glass—Table model	.20
4449	Knob—Station selector, range switch, tone control switch or volume control knob—Package of 5	.60
6615	Ring—Spring retaining ring for dial glass—Console model—Package of 5	.34
6708	Ring—Spring retaining ring for dial glass—Table model—Package of 5	.44
4685	Screw—Chassis mounting screw assembly—Comprising four screws, four spacers, four lockwashers, four washers and eight cushions (for console model)	.40
4446	Screw—Chassis mounting screw assembly—Comprising four screws, four spacers, four lockwashers, four washers and eight cushions (for table model)	.28

RCA VICTOR MODEL 119

Five-Tube, Two-Band, A. C. Superheterodyne Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage and Frequency Ratings	105–125 Volts, 50–60 Cycles 105–125 Volts, 25–60 Cycles 105–125/195–250 Volts, 50–60 Cycles
Power Consumption	80 Watts
Radiotrons and Functions	(1) RCA-6A7, First Detector and Oscillator (2) RCA-6D6, I.F. Amplifier (3) RCA-6B7, Second Detector–Audio Amplifier–A.V.C. (4) RCA-41, Power Output (5) RCA-80, Rectifier
Tuning Frequency Ranges	540 KC. to 1720 KC. and 1600 KC. to 3500 KC.
Alignment Frequencies	460 KC. (I.F.), 1720 KC. (R.F. and Oscillator) 600 KC. (Oscillator)
Undistorted Output	1.75 Watts
Maximum Output	3.5 Watts
Loudspeaker	6-Inch, Electro-Dynamic

PHYSICAL SPECIFICATIONS

Height	15 Inches
Width	13⅝ Inches
Depth	8⅜ Inches

This model contains a five-tube chassis, shock mounted into a table-type cabinet. The superheterodyne type of circuit is used, with such features of design as: Automatic volume control, diode detection, two-point tone control, illuminated full-vision dial scale, resistance-coupled audio system, electrodynamic loudspeaker, and other important points of improvement.

Service convenience has been an especial requirement in the layout and construction of this receiver. A plug-connector attachment is used in the chassis to speaker cable which will allow ready removal of either unit without disturbing the other. Trimmer adjustments are located at accessible points, and their number reduced to the least that is consistent with efficient operation.

ELECTRICAL CIRCUIT

Five Radiotrons are associated in combination with a superheterodyne circuit. Two of the Radiotrons are applied so as to obtain plural functions, thereby gaining more than the adequate results normally expected of a five-tube receiver. In the first stage of the circuit, an RCA-6A7 pentagrid converter tube is employed as an r-f amplifier and local oscillator, the related external high-frequency circuits consisting of a tuned antenna transformer with a short-wave tap. The oscillator second harmonic is used for the short-wave position. Within the first detector tube, mixing of signal and oscillator voltages is accomplished through electron coupling, the i-f appearing in the plate circuit.

The i-f system operates at 460 kc. as the basic frequency. The presence of the natural period transformer at the i-f output should be especially noted. Its use minimizes the number of line-up adjustments.

The combined second detector—audio amplifier—a.v.c. stage, utilizes an RCA-6B7, a duplex-diode pentode Radiotron. One diode connects directly to ground, the other is used for detection. Part of the detected signal is filtered to remove the audible fluctuations and is applied to the first and second stages as a means of providing automatic volume control. The audio component of the detected signal is amplified by the RCA-6B7 and conveyed to a resistance-capacitance coupling network.

A power-amplifier pentode, RCA-41, is used in the output stage and is coupled by a transformer to the low impedance voice-coil of the speaker.

Full-wave rectification is employed in the power-supply stage. The speaker field winding serves in the filter circuit as a reactor.

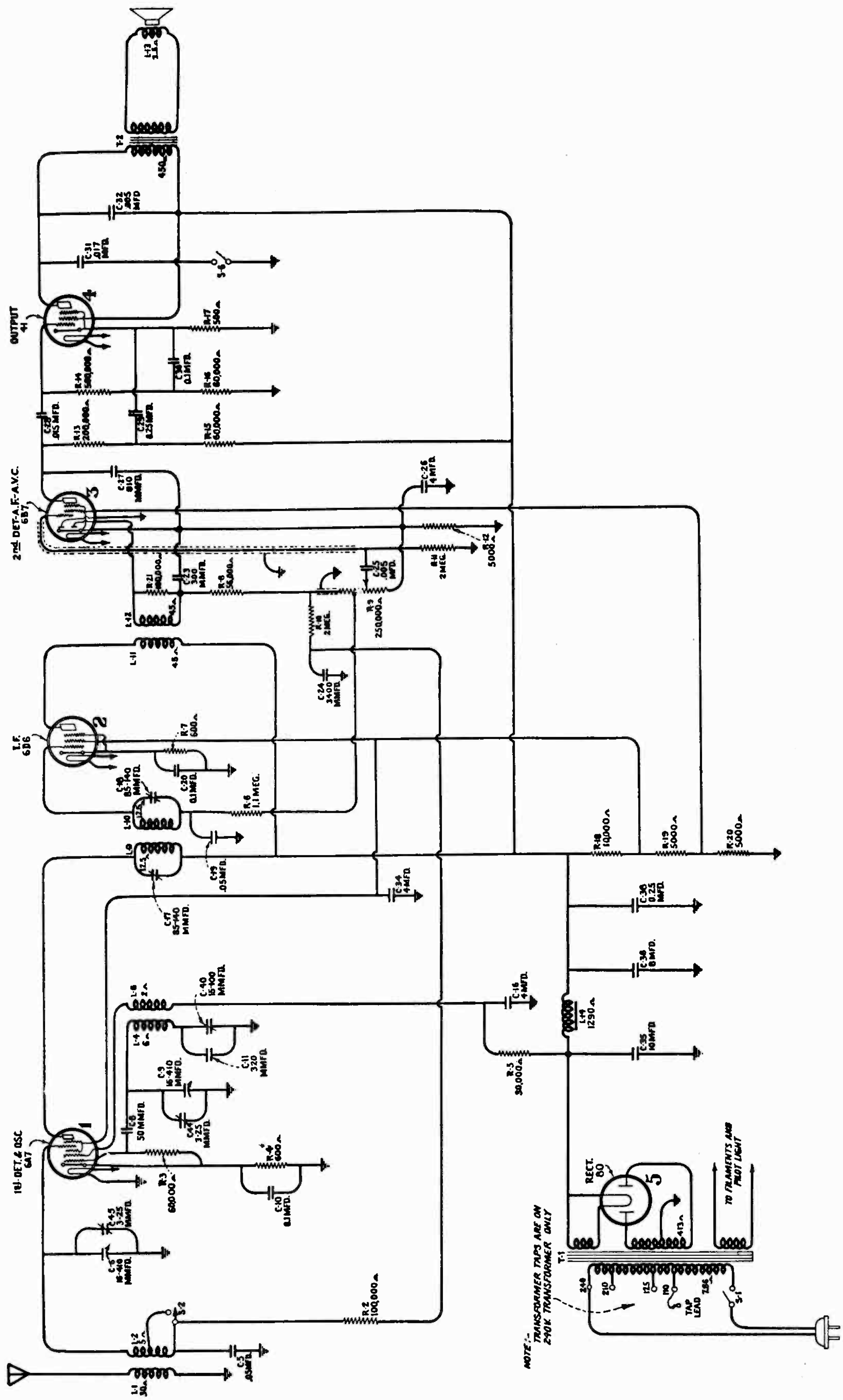


Figure 1—Schematic Circuit Diagram

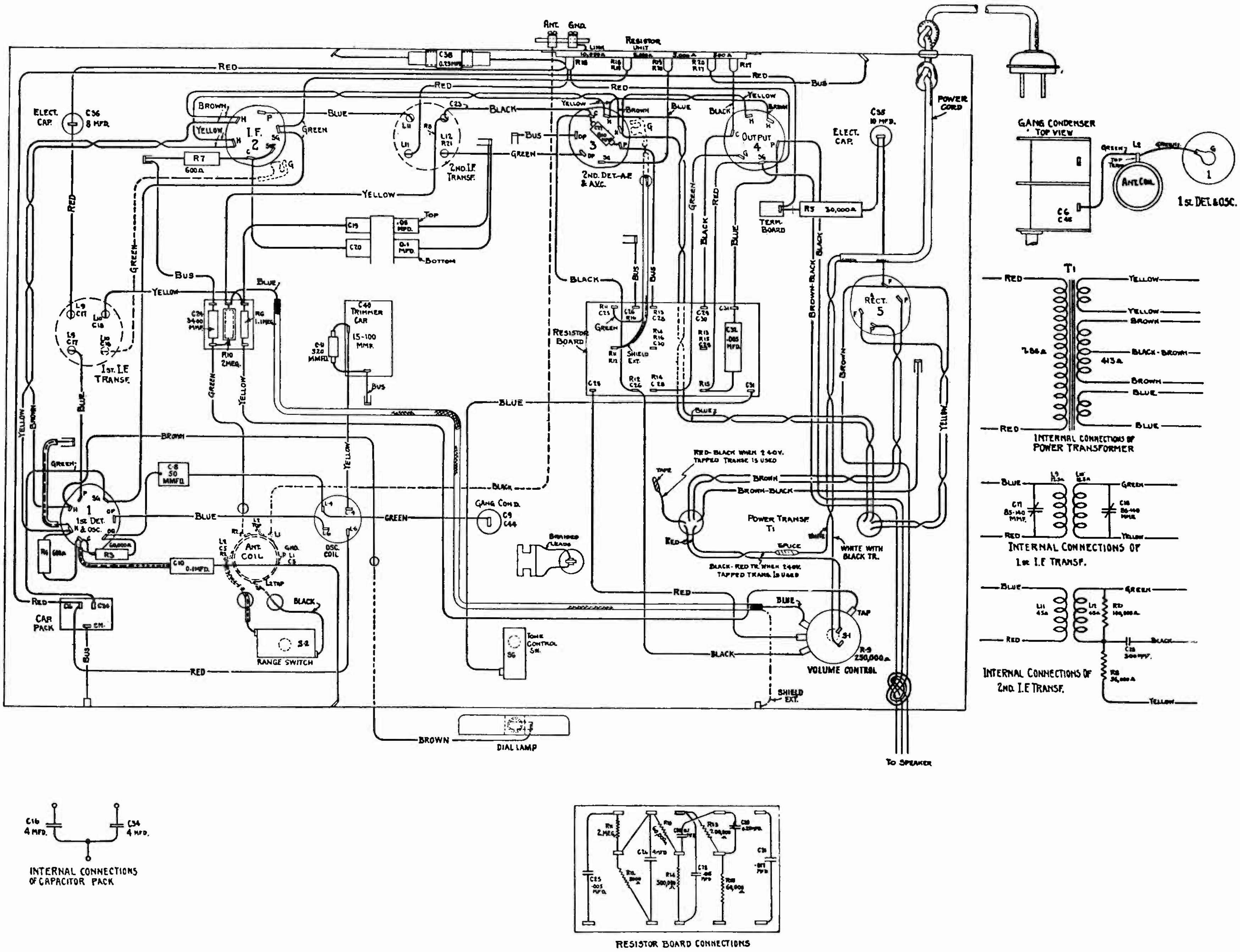


Figure 2—Chassis Wiring Diagram

SERVICE DATA

(1) Line-Up Capacitor Adjustment:

This receiver must be in correct electrical alignment in order to obtain maximum efficiency and best quality of performance. The circuits should be realigned after each major service or repair operation, and whenever there are positive indications that the adjustments have deviated from normal by ordinary usage. These indications will be present together and will have the nature of: low sensitivity, poor tone quality and irregular double-peaked tuning.

A definite procedure must be applied in readjusting the line-up trimmers. The proper oscillator and indication equipment must also be used. A number of standard service instruments, which are useful for receiver adjustments, have been designed and made available by the manufacturer of this receiver. These are illustrated and described on page 2.

(2) I-F Tuning Adjustments:

There are two i-f transformers associated in the intermediate amplifier system. The first of these transformers is tuned by accessible trimmers. The second transformer has a natural tuning inherent to its design and does not require adjustment. To obtain the correct alignment proceed as follows:

(a) Short circuit the antenna and ground terminals and tune the receiver so that no signal is received. Set the volume control to its maximum position. Ground the receiver.

(b) Connect the output of the test oscillator between the first detector control grid and chassis ground. Attach an indicating meter, such as is illustrated on page 2, to the speaker circuit.

(c) Place the external oscillator into operation at 460 kc. Adjust the output so that a slight registration occurs on the output indicator. The output should be set at as low a value as will give a convenient indication during adjustment; this requirement is important in that the a.v.c. action is voided by such a method. Adjust the secondary and primary trimmers (C18 and C17) of the first i-f transformer for maximum receiver output.

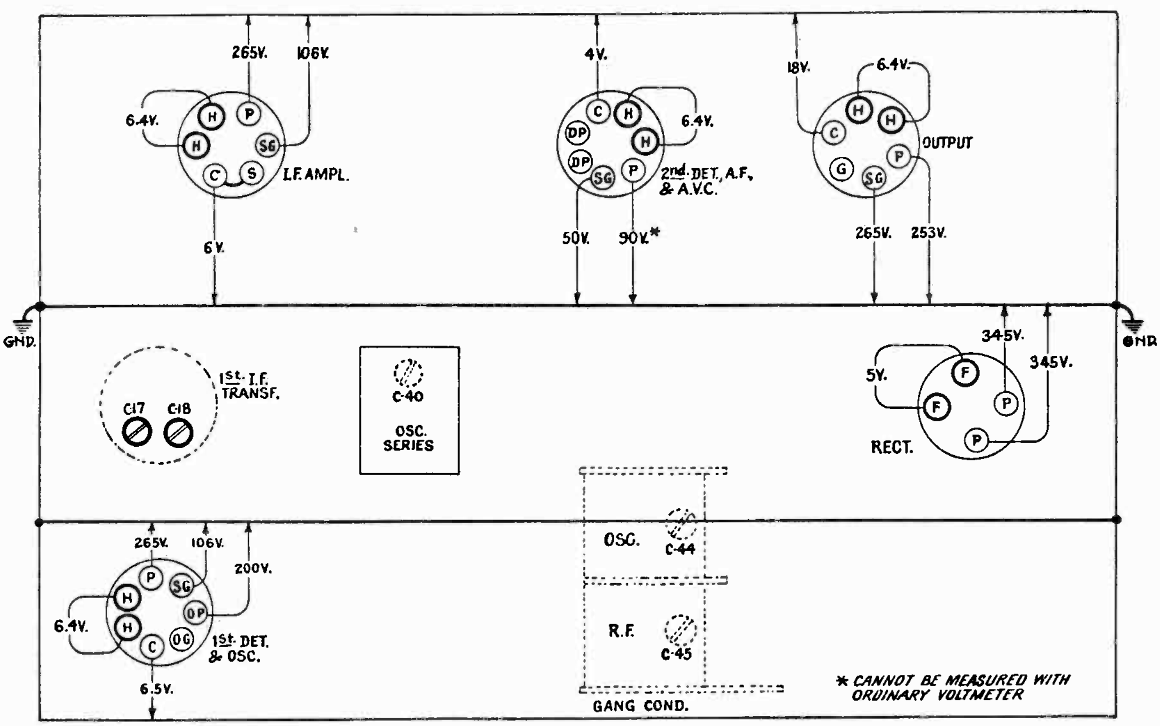


Figure 3—Trimmer Locations and Radiotron Socket Voltages (Measured at 115 volts A. C. Supply—Maximum Volume Control—No Signal)

R. F. and Oscillator Adjustments:

Three trimmers are provided, two for adjustment at 1720 kc. and one for oscillator line-up at 600 kc. No adjustments are required on the short-wave bands. Locations of the trimmers are shown on Figure 3. They should be adjusted in the following manner:

(a) Connect the output of the modulated Full Range Oscillator to the antenna and ground terminals of the receiver. Check the position of the dial pointer. It should set exactly on the radial line, adjacent to the dial reading of 540 when the tuning capacitor plates are at full mesh. After correcting the dial pointer, place the receiver in operation and set the selector at 1720 kc., advance the volume control to maximum and turn the range switch to its broadcast position.

(b) Adjust the frequency of the external oscillator to 1720 kc. and regulate its output until a perceptible indication appears on the output indicator. This indication should be held at a minimum during the adjustments. The trimmers C44 and C45 should then be tuned to the point giving peak receiver output.

(c) Re-tune the test oscillator, setting its frequency to 600 kc. Turn the receiver selector control to the point where the incoming oscillator signal is received best. *This point will not always be exactly at 600 on the dial.* Then adjust the low-frequency trimmer, C40, simultaneously rocking the tuning capacitor slowly through the signal until maximum receiver output results from these combined operations. This adjustment must be made irrespective of dial calibration. It is advisable to repeat the 1720 kc. adjustment of the oscillator trimmer C44, in order to correct for any change caused by the tuning of C40.

Radiotron Socket Voltages

The various normal operating voltages are given on Figure 3. As specified, they are referred to the chassis ground. Accuracy of measurements will be a function of the internal resistance of the voltmeter used. It is advisable to employ a meter having at least 1000 ohms per volt, and for each reading use the highest range which will give an acceptably accurate reading. General deviations from the values given, due to line voltage difference, should not be taken as indicating a defective condition. The erratic departure from normal of a single value or group of values should form the basis of circuit diagnosis.

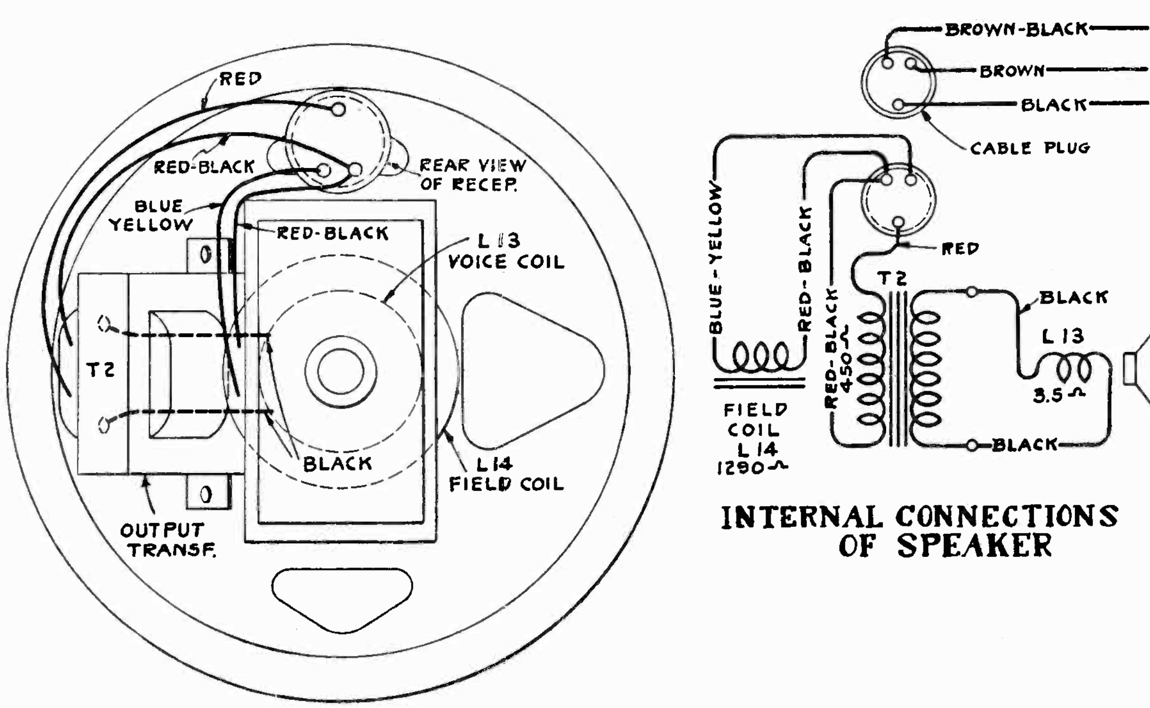


Figure 4—Loudspeaker Wiring

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4379	Board—Terminal board—Engraved "ANT-GND"	$0.20
4244	Cap—Contact cap	.20
3861	Capacitor—Adjustable capacitor (C40)	.78
5094	Capacitor—50 mmfd. (C8)	.20
5151	Capacitor—320 mmfd. (C11)	.20
5044	Capacitor—810 mmfd. (C27)	.20
4881	Capacitor—3400 mmfd. (C24)	.20
4793	Capacitor—0.005 mfd. (C25)	.20
4868	Capacitor—0.005 mfd. (C32)	.20
4792	Capacitor—0.015 mfd. (C28)	.22
4906	Capacitor—0.017 mfd. (C31)	.25
4836	Capacitor—0.05 mfd. (C5, C19)	.30
4841	Capacitor—0.1 mfd. (C10, C20, C30)	.22
3597	Capacitor—0.25 mfd. (C29, C38)	.40
3796	Capacitor—4.0 mfd. (C26)	.60
4428	Capacitor—8.0 mfd. (C36)	1.05
7790	Capacitor—10.0 mfd. (C35)	1.05
7589	Capacitor pack—Comprising two 4.0 mfd. capacitors (C16, C34)	1.64
4358	Clamp—Capacitor mounting clamp for Stock No. 4428 and No. 7790	.15
5051	Coil—Antenna coil (L1, L2, C5, R2)	1.28
5050	Coil—Oscillator coil (L4, L6)	.56
4896	Condenser—2-gang variable tuning condenser (C6, C9, C44, C45)	3.48
3708	Resistor—600 ohms—Carbon type—¼ watt (R4, R7)—Package of 5	1.00
4436	Resistor—5000 ohms—Carbon type—¼ watt (R12)—Package of 10	2.00
2240	Resistor—30,000 ohms—Carbon type—1 watt (R5)	.22
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R3, R15, R16)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R2)—Package of 5	1.00
3116	Resistor—200,000 ohms—Carbon type—¼ watt (R13)—Package of 5	1.00
6186	Resistor—500,000 ohms—Carbon type—¼ watt (R14)—Package of 5	1.00
4783	Resistor—1,100,000 ohms—Carbon type—¼ watt (R6)—Package of 5	1.00
6242	Resistor—2 megohms—Carbon type—¼ watt (R10, R11)—Package of 5	1.00
4721	Resistor—Tapped resistor—One 500 ohm, two 5,000 ohm, and one 10,000 ohm sections (R17, R18, R19, R20)	.88
3584	Ring—Oscillator coil retaining ring	.40
3623	Shield—Oscillator coil shield	.30
3942	Shield—First Detector and output Radiotron shield	$0.18
3782	Shield—Second Detector Radiotron shield	.26
7487	Shield—I.F. Radiotron shield	.25
5186	Shield—First I.F. transformer shield	.28
4908	Shield—Second I.F. transformer shield	.45
3858	Socket—Dial lamp socket	.26
4784	Socket—4-contact Radiotron socket	.15
4785	Socket—6-contact Radiotron socket	.15
4786	Socket—6-contact Radiotron socket	.15
4787	Socket—7-contact Radiotron socket	.15
5053	Switch—Range switch (S2)	.50
4905	Switch—Tone control switch (S5)	.30
4900	Transformer—First intermediate frequency transformer (L9, L10, C17, C18)	2.25
4901	Transformer—Second intermediate frequency transformer (L11, L12, C23, R8, R21)	1.50
4898	Transformer—Power transformer—105-125 volts—25-50 cycles	5.55
4897	Transformer—Power transformer—105-125 volts—50-60 cycles (T1)	3.98
4899	Transformer—Power transformer—105-125/200-240 volts—40-60 cycles	4.05
4429	Volume control (R9, S1)	1.40
	REPRODUCER ASSEMBLIES	
4915	Cable—3 conductor reproducer cable—Complete with 3-contact female connector	.50
9587	Coil—Field coil, magnet and cone support (L14)	2.18
9588	Cone—Reproducer cone (L13)—Package of 5	3.55
5118	Connector—3-contact male connector for reproducer cable	.25
5119	Connector—3-contact female connector for reproducer cable	.25
9586	Reproducer—Complete	5.95
4893	Transformer—Output transformer (T2)	1.48
	MISCELLANEOUS ASSEMBLY	
5111	Dial—Station selector dial scale	.32
4132	Knob—Station selector knob—Package of 5	.55
4449	Knob—Volume control, range switch, or tone control knob—Package of 5	.60
4340	Lamp—Station selector dial lamp—Package of 5	.60
4909	Pointer—Station selector pointer	.15
3886	Reflector—Station selector dial reflector	.30
4917	Screw—Chassis mounting screw—Comprising one screw, and one washer—Package of 4	.15

RCA VICTOR MODELS 125 AND 225

Six-Tube, Two-Band, A. C. Receivers

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage and Frequency Ratings	105–125 Volts, 50–60 Cycles 105–125 Volts, 25–60 Cycles 105–125/200–250 Volts, 50–60 Cycles
Power Consumption	85 Watts
Radiotrons and Functions	(1) RCA-6A7 Oscillator and First Detector (2) RCA-6D6 I.F. Amplifier (3) RCA-6D6 I.F. Amplifier (4) RCA-6B7 Detector A.F. Amplifier and A.V.C. (5) RCA-41 Power Output (6) RCA-80 Rectifier
Tuning Frequency Ranges	540 KC.–1720 KC. and 5400 KC.–18,000 KC.
Alignment Frequencies	460 KC. (I.F.), 600 KC. (Osc.), 1720 KC. (Osc. and Det.) and 18,000 KC. (Osc. and Det.)
Undistorted Output	1.75 Watts
Maximum Output	3.5 Watts

PHYSICAL SPECIFICATIONS

	Model 125	*Model 225*
Height	17 7/16 Inches	38 Inches
Width	14 8/16 Inches	24 5/8 Inches
Depth	10 5/16 Inches	11 1/4 Inches

These six-tube, two-band receivers employ identical chassis assemblies, which are designed for frequency coverage of the standard broadcast band and the more important short-wave bands now in use for trans-oceanic broadcast work.

A variable ratio drive is used in combination with an "airplane" type dial to simplify the accurate tuning necessary for proper reception of the short-wave signals. An automatic volume control system is incorporated in the circuits of the receiver which stabilizes the output when atmospheric fluctuations cause fading. This feature is of prime importance when receiving short-wave signals.

Reproduction of good quality is obtained from a pentode output tube operating into a uniformly efficient loudspeaker. Tone control is provided in the power output stage so that by operating a double throw switch, the high frequency response may be reduced by a predetermined amount.

DESCRIPTION OF ELECTRICAL CIRCUIT

The circuit embodied in this receiver is of the superheterodyne type. Its layout is shown schematically in Figure 3. Two ranges of tuning are provided by two separate sets of coils. A tuned transformer is employed to couple the antenna system into the first detector tube which is an RCA-6A7. This tube also serves, by the coordinate arrangement of its elements, to generate the local oscillation required for superheterodyne operation. The local oscillation is modulated with the incoming signal by the mutual effect of the tube elements on the electron flow. The difference beat frequency of these two signals is amplified by this same tube and delivered to the i-f amplifier system. There are two Radiotron 6D6 tubes used for i-f amplification. Three transformers intercouple these tubes. The primaries and secondaries of two of these transformers are resonated to the intermediate frequency (460 kc.). The third i-f transformer has no adjustable capacitors; its natural tuning is such as to obtain the desired selectivity and efficiency. Diode detection is performed in an RCA-6B7 tube, a duplex diode pentode. The signal from the i-f system is applied to one of the diodes of the tube, where detection takes place. The remaining diode is tied solidly to ground.

A voltage having the character of an audio wave superimposed upon a constant d-c is developed by the detection process across the manual volume control resistor R14. The d-c portion of this voltage, which is dependent upon the strength of the carrier of the signal being received, is used to automatically regulate the control grid bias voltages of the first-detector and the i-f amplifier stages. Maximum control is used on the detector and first i-f, while a reduced amount of control is applied to the second i-f. A portion of the audio component of the detected voltage appearing across the manual volume control is carried through the variable arm and a blocking condenser to the control grid of the RCA-6B7, which simultaneously functions to provide audio amplification. The audio signal is conducted from the detector—a-f amplifier—a.v.c. stage to the power-output tube through a resistance-capacitance network. At this point there is provision for changing the audio response of the receiver, so that proper results will be obtained in both the long-wave and the short-wave bands. As shown on the schematic, the switch S7 operates so that for long-wave reception the resistor R25 and condenser C32 are in series with the plate resistor R17, while for short-wave reception the resistor-condenser combination is shorted out. The output tube delivers a high-level high-quality signal to the electro-dynamic loudspeaker through an efficiently designed matching transformer. A two-point tone control consisting of a small capacitor and a single pole switch is connected in the plate circuit of the RCA-41 output tube.

Direct current voltages required are obtained from a full-wave rectifier system. The electro-dynamic speaker receives its magnetization current from the rectifier tube, an RCA-80. It is connected into the circuit so that it will function as a reactor for filtering of the plate currents.

SERVICE DATA

(1) Line-Up Adjustments

Maximum efficiency and best quality of performance will only be obtained when the circuits are in proper alignment. "Trimmer" capacitors are provided at accessible locations on the receiver chassis for accurately realigning the circuits when they have deviated from normal. Incorrect alignment is usually evidenced by low sensitivity, poor quality and irregular double-peaked tuning.

It is important in re-adjusting the line-up trimmers to use proper oscillator and indicator apparatus. Certain standard service instruments, which are useful in making these adjustments, have been devised and made available to the service man by the manufacturer of this receiver. They are illustrated and described on page 2.

Preliminary Tests

Before making any adjustments, it is wise to determine the correctness of the existing alignment. This may be done by supplying a signal to the circuit (r-f, oscillator or i-f) from the "Full-Range Oscillator," and inserting the "Tuning Wand" into the coils involved. The "Tuning Wand" consists of a bakelite rod having a brass cylinder attached to one end, and a small core of finely divided iron compacted into the opposite end. By inserting the brass cylinder end into the center of a particular coil, through the opening provided in the top of the shield as shown in Figure 1, the inductance of the coil is lowered, and therefore, the resonant frequency is increased. Placing the other end (iron filing core) into the coil raises the inductance and conversely decreases the resonant frequency. Thus it is apparent, that if the circuits are in exact resonance with the standard signal of the "Full-Range Oscillator," the insertion of either end of the wand will cause a reduction of receiver output; whereas if the circuits

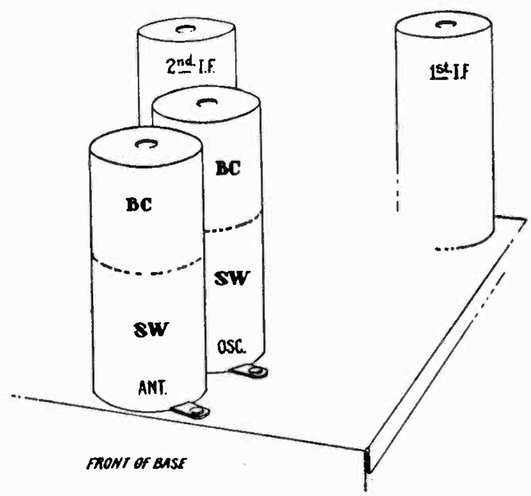


Figure 1—Locations of Coils

are not in tune or resonance with the incoming signal, one end will bring about an increase of the signal, and the other end will cause a decrease. When an increase in signal is obtained with the iron filled end of the wand, an increase of the inductance and decrease in frequency of resonance is indicated. The trimmer condenser associated with the circuit under test will therefore require adjustment so as to increase its capacitance. The reverse occurs when a gain in signal is obtained when using the brass cylinder end of the wand.

Changes Indicated By Wand

Wand	*Signal*	*Trimmer*
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

The following procedure should be applied:

I-F Tuning Adjustments

The four i-f trimmer screws shown on Figure 2 must be tuned to 460 kc., as explained below:

(a) Short circuit the antenna and ground terminals of the receiver to prevent external signal pick-up. Set the volume control to maximum and attach a good ground connection to the receiver.

(b) Feed the test oscillator output to the control grid of the first-detector. Connect an output indicator to the voice coil circuit. Regulate the oscillator output control so that a slight indication occurs on the indicating instrument.

(c) Adjust the secondary and primary trimmers of the second i-f transformer for maximum (peak) output. Then tune the first i-f transformer in a similar manner. The oscillator output should be maintained at as low a level as will give a good output indication. This will keep the signal from being affected by the a.v.c. action of the receiver. A slight improvement in line-up may be obtained by repeating the above procedure, since there is an interlocking effect between the several tuned circuits.

R-F and Oscillator Adjustments

The trimmer capacitor locations for the r-f and oscillator stages are indicated on Figure 2. Their adjustments should be performed as follows:

(a) Attach the oscillator output to the antenna-ground terminals of the receiver.

(b) Check the dial pointer and correct its position if necessary. It should be coincident with the dial marking adjacent to 540 when the gang condenser plates are in full mesh.

(c) With the external oscillator tuned to 1720 kc., and its output adjusted for the critical minimum at full volume control, set the station selector to the 1720 scale marking. Turn the range switch to its right position and adjust the trimmers C10 and C1 on Figure 2 to give

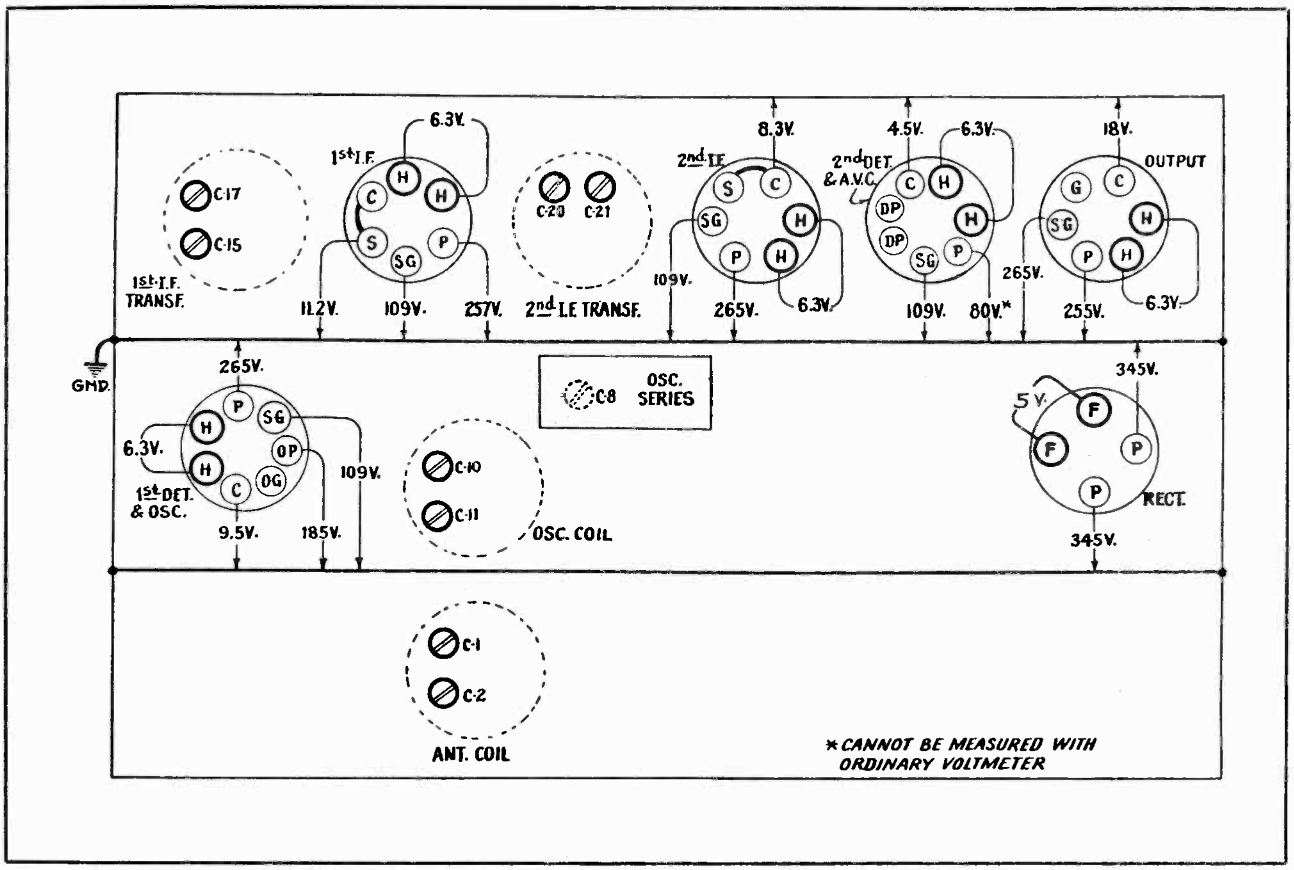


Figure 2—Trimmer Locations and Radiotron Socket Voltages to Ground
(Measured at 115-volt A.C. Supply—Maximum Volume Control—No Signal)

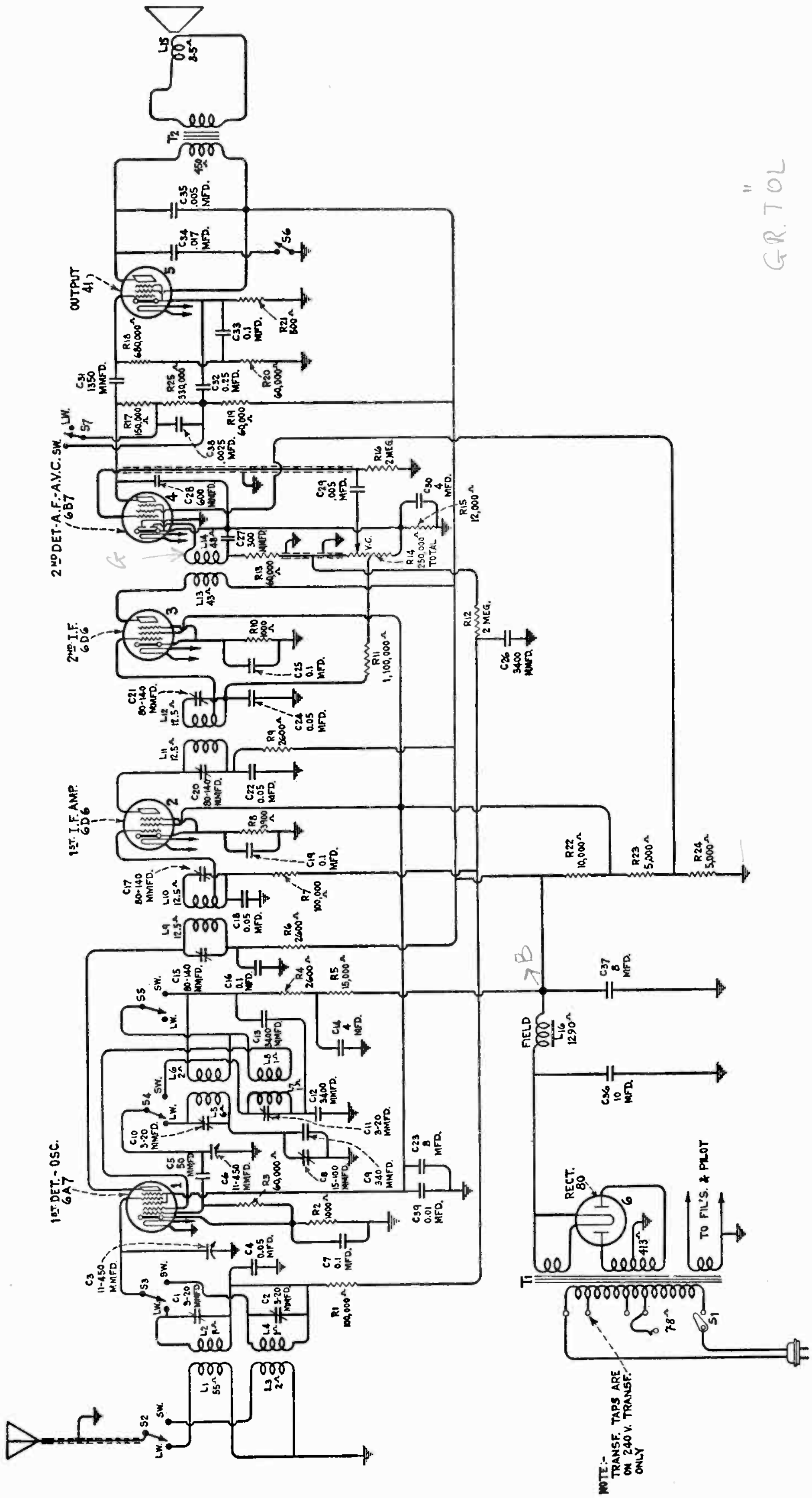


Figure 3—Schematic Circuit Diagram

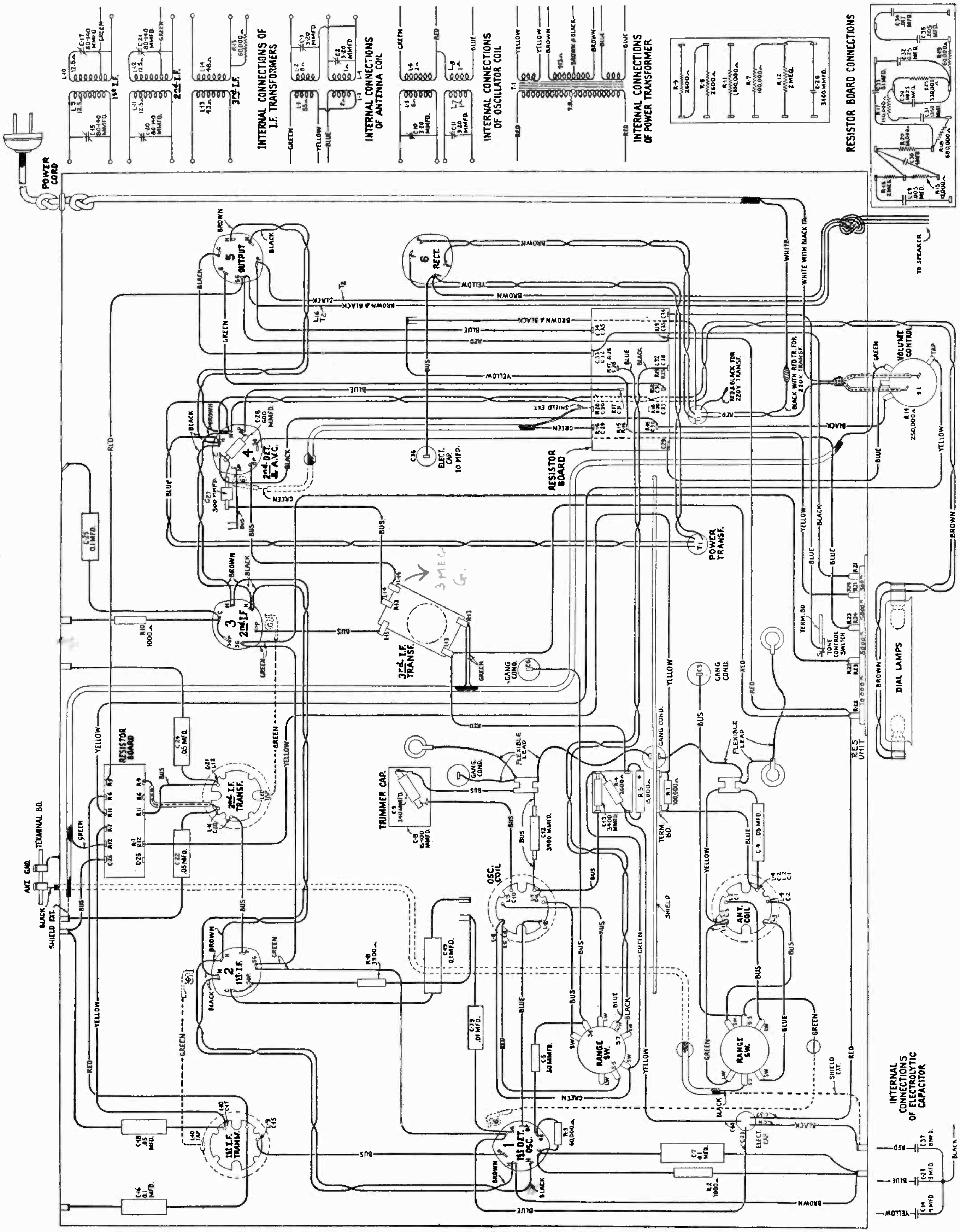


Figure 4—Chassis Wiring Diagram

maximum (peak) receiver output. Then shift the oscillator frequency to 600 kc., and tune in this signal on the receiver. Adjust the oscillator trimmer, C8, simultaneously rocking the tuning condenser slowly through the signal until the maximum output obtainable results from the two combined operations. The dial calibration should be disregarded for this adjustment. The oscillator trimmer C10 should be retuned at 1720 kc. to correct for any change caused by the 600 kc. adjustment.

(d) Turn the receiver range switch to its left (short-wave) position and set the station selector at the 18 megacycle dial marking. Tune the test oscillator to 18,000 kc. and regulate its output to produce a noticeable indication at the receiver output. Adjust C2 and C11 of the antenna and oscillator coils for maximum receiver output. There will be two positions of the trimmers which give maximum signal. On the oscillator, the position of minimum capacitance is correct; whereas the position of maximum capacitance is proper on the antenna trimmer. The latter should be made while slowly rocking the variable tuning condenser through the signal.

It is important in making the foregoing adjustments to have the receiver operating at maximum sensitivity and using as low an input as will give an accurate output indication. This procedure will obviate the broadness of tuning apparent from the effect of automatic volume control.

(2) Circuit Voltages

Refer to Figure 2. The voltages indicated at the various socket contacts are measured to the chassis.

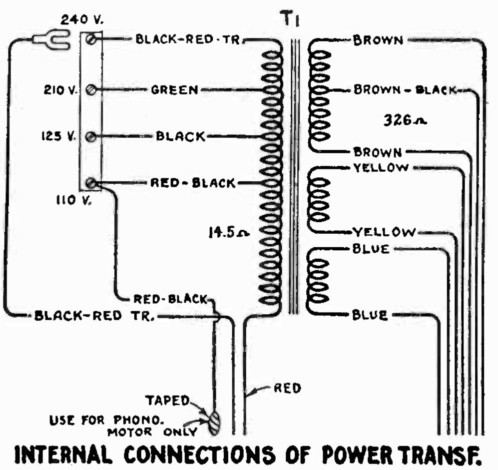


Figure 5—Universal Transformer Connections

They represent the values which apply to a receiver in normal operating condition at the specified supply voltage. At other voltages, a consistent difference will be perceptible for all readings. Such a general deviation, due to line voltage, should not be judged as a sign of defective circuit conditions, but rather the erratic measurement used as a basis for the circuit analysis.

Accuracy of the voltage measurements will be a function of the internal resistance of the voltmeter used. It is advisable to employ a meter having at least 1000 ohms per volt and for each reading use the highest range which will give an acceptably accurate reading.

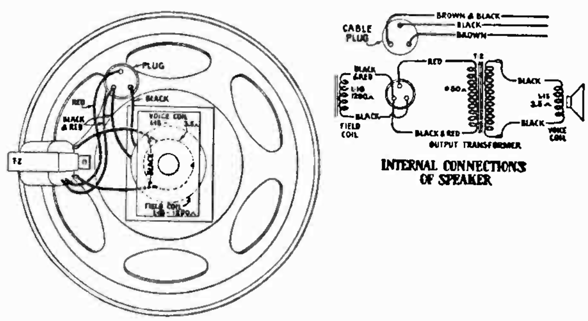


Figure 6—Loudspeaker Wiring—Console Model

(3) Code Interference

In certain localities near to high-powered radiotelegraph stations operating at frequencies in the vicinity of 460 kc., slight code interference may be present on both bands of the receiver. This adverse condition usually occurs over the entire tuning range of each band, and is not affected by change of tuning. To overcome this interference, a shielded wave trap, such as part No. 4539, should be installed. This trap consists of a parallel resonant circuit, tuned by two trimmer capacitors. It should be connected in series with the antenna input lead at the receiver. The connections should be arranged so that a minimum of exposed (unshielded) lead is left between the trap and the band switch or the shielded input lead of the receiver. The trap is mountable by means of two holes provided in the chassis between the first i-f transformer shield and the oscillator coil shield. The can of the trap should be securely grounded. The trimmers must be accurately tuned to suppress the undesired station.

(4) 220-Volt Transformer Connections

The 220–110 volt, 50–60 cycle transformer furnished with some instruments has taps for a variety of voltages. These taps are located on the transformer assembly, and are accessible without removing the chassis from the cabinet. A schematic of the transformer with colors of its leads is shown in Figure 5.

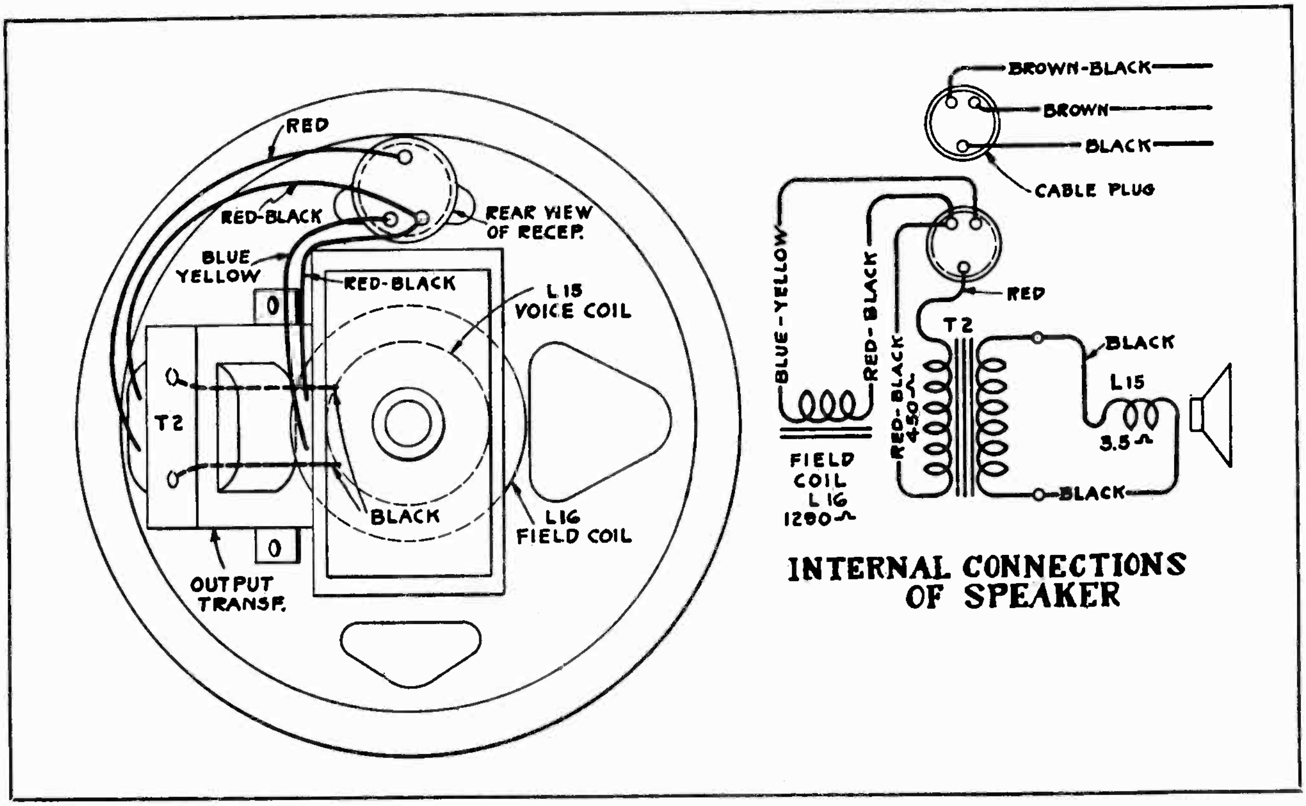


Figure 7—Loudspeaker Wiring—Table Model

RADIOTRON SOCKET VOLTAGES

(Referred to ground)

Maximum Volume Control—No Signal—115 Volts A. C. Input

Radiotron		Place to Ground Volts, D.C.	Screen Grid to Ground Volts, D.C.	Cathode to Ground Volts, D.C.	Plate Current	Heater Volts
RCA-6A7	Oscillator	185	—	—	4.5	—
	Detector	265	109	9.5	1.6	6.3
RCA-6D6 First I.F.		257	109	11.2	2.2	6.3
RCA-6D6 Second I.F.		265	109	8.3	6.6	6.3
RCA-6B7 Second Det.		80*	109	4.5	0.3	6.3
RCA-41 Power		255	265	18.0	30.0	6.3
RCA-80 Rectifier		345/345	—	—	68.0	5.0

*Calculated from +B.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4880	Bracket — Tone control switch mounting bracket	$0.12
4427	Bracket—Volume control mounting bracket	.18
4358	Bracket—Electrolytic capacitor bracket for capacitor No. 7790	.15
4693	Bracket—Electrolytic capacitor bracket for capacitor No. 5101	.15
3861	Capacitor—Adjustable trimmer capacitor (C8)	.78
5094	Capacitor—50 mmfd. (C5)	.20
3981	Capacitor—300 mmfd. (C27)	.30
4811	Capacitor—340 mmfd. (C9)	.25
4210	Capacitor—600 mmfd. (C28)	.25
5115	Capacitor—1350 mmfd. (C31)	.25
4439	Capacitor—3400 mmfd. (C12)	.35
4881	Capacitor—3400 mmfd. (C13, C26)	.20
5107	Capacitor—0.0025 mfd. (C38)	.16
4793	Capacitor—0.005 mfd. (C29)	20
4868	Capacitor—0.005 mfd. (C35)	.20
4906	Capacitor—0.017 mfd. (C34)	.25
4883	Capacitor—0.01 mfd. (C39)	.20
4836	Capacitor—0.05 mfd. (C4, C18, C24)	.30
4886	Capacitor—0.05 mfd. (C22)	.20
4841	Capacitor—0.1 mfd. (C7, C19, C25, C33)	.22
4885	Capacitor—0.1 mfd. (C16)	.28
3597	Capacitor—0.25 mfd. (C32)	.40
3796	Capacitor—4.0 mfd. (C30)	.60
7790	Capacitor—10.0 mfd. (C36)	1.05
5101	Capacitor pack—Comprising two 8. mfd. and one 4. mfd. sections (C14, C23, C37)	2.14
5087	Coil—Antenna coil (L1, L2, L3, L4, C1, C2)	1.86
5089	Coil—Oscillator coil (L5, L6, L7, L8, C10, C11)	1.90
4504	Condenser—2-gang tuning condenser (C3, C6)	2.78
5104	Lead—Shielded—Single conductor—From range switch to antenna terminal board	.30
5106	Lead—Shielded—2-conductor—From volume control to third I.F. transformer and resistor board	.40
5112	Resistor—1000 ohms—Carbon type—¼ watt (R2, R10)—Package of 5	1.00
4812	Resistor—2600 ohms—Carbon type—¼ watt (R4, R6, R9)—Package of 5	1.00
5113	Resistor—3900 ohms—Carbon type—¼ watt (R8)—Package of 5	1.00
5109	Resistor—12,000 ohms—Carbon type—¼ watt (R15)—Package of 5	$1.00
5114	Resistor — 15,000 ohms — Carbon type — 1 watt (R5)	.72
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R3, R19, R20)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R1, R7)—Package of 5	1.00
5027	Resistor—150,000 ohms—Carbon type—¼ watt (R17)—Package of 5	1.00
5108	Resistor—330,000 ohms—Carbon type—¼ watt (R25)—Package of 5	1.00
5110	Resistor—680,000 ohms—Carbon type—¼ watt (R18)—Package of 5	1.00
4783	Resistor—1,100,000 ohms—Carbon type—¼ watt (R11)—Package of 5	1.00
6242	Resistor—2 megohms—Carbon type—¼ watt (R12, R16)—Package of 5	1.00
4721	Resistor—Tapped—One 500, one 10,000 and two 5000 ohm sections (R21, R22, R23, R24)	.88
4521	Shield—Antenna, I.F. or oscillator coil shield	.42
3942	Shield—First detector and output Radiotron shield	.18
3782	Shield—Second detector Radiotron shield	.26
7487	Shield—I.F. Radiotron shield	.25
4784	Socket—4-contact Radiotron socket	.15
4785	Socket—6-contact Radiotron socket	.15
4786	Socket—6-contact Radiotron socket	.15
4787	Socket—7-contact Radiotron socket	.15
4379	Strip — Terminal strip — Engraved "ANT-GND"	.20
5100	Switch—Range switch (S2, S3, S4, S5, S7)	1.20
5052	Switch—Tone control switch (S6)	.30
9512	Transformer—Power transformer—105-125 volts—25-40 cycles	6.58
9513	Transformer—Power transformer—105-125/210-240 volts—40-60 cycles	4.85
9511	Transformer—Power transformer—105-125 volts—50-60 cycles (T1)	4.78
5102	Transformer—First intermediate frequency transformer (L9, L10, C15, C17)	1.98
5103	Transformer—Second intermediate frequency transformer (L11, L12, C20, C21)	1.98
5105	Transformer—Third intermediate frequency transformer (L13, L14, R13)	1.65
4429	Volume control (R14, S1)	1.40

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	CONDENSER DRIVE ASSEMBLIES	
4450	Dial—Station selector dial—Console model	$0.52
4474	Dial—Station selector dial—Table model	.76
4434	Drive—Tuning condenser drive assembly—Complete	2.42
4475	Indicator—Station selector (pointer) indicator—Table model	.18
4363	Indicator—Station selector (pointer) indicator Console model	.18
4340	Lamp—Dial lamp—Package of 5	.60
3943	Screen—Translucent screen for dial light—Package of 2	.18
3529	Socket—Dial lamp socket	.32
	REPRODUCER ASSEMBLIES TABLE MODEL	
4915	Cable—3-conductor reproducer cable	.50
9587	Coil—Field coil, magnet and cone support (L16)	2.18
9588	Cone—Reproducer cone (L15)—Package of 5	3.55
5118	Plug—3-contact plug—Male section for reproducer cable	.25
5119	Plug—3-contact plug—Female section for reproducer	.25
9586	Reproducer—Complete	5.95
4893	Transformer—Output transformer (T2)	1.48
	REPRODUCER ASSEMBLIES CONSOLE MODEL	
4915	Cable—3-conductor reproducer cable	.50
9590	Coil—Field coil, magnet and cone support (L16)	4.20
8935	Cone—Reproducer cone (L15)—Package of 5	$5.25
5118	Plug—3-contact plug—Male section for reproducer cable	.25
5119	Plug—3-contact plug—Female section for reproducer cable	.25
9589	Reproducer—Complete	8.20
4892	Transformer—Output transformer (T2)	1.30
	MISCELLANEOUS ASSEMBLIES	
6755	Bezel—Station selector dial escutcheon bezel—Table model	.50
6840	Bezel—Station selector dial escutcheon bezel—Console model	.56
6707	Glass—Station selector dial glass—Table model	.20
6614	Glass—Station selector dial glass—Console model	.30
4449	Knob—Station selector, volume control, band switch or tone control knob—Package of 5.	.60
6708	Ring—Spring retaining ring for dial glass—Table model—Package of 5	.44
6615	Ring—Spring retaining ring for dial glass—Console model—Package of 5	.34
4446	Screw—Chassis mounting assembly—Comprising four screws, four spacers, eight cushions, four washers and four lockwashers—For table model	.28
5184	Screw—Chassis mounting assembly—Comprising one screw, one spacer, two cushions, one washer and one lockwasher—Package of 4—For console model	.28

RCA VICTOR MODELS 128-E AND 224-E

Six-Tube, Three-Band A. C. Receivers

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage Rating.................105–125 Volts and 100–130/195–250 Volts (Double Range Transformer)
Frequency Rating...50–60 Cycles
Power Consumption...85 Watts (All Frequencies)
Type and Number of Radiotrons....2 RCA-6D6, 1 RCA-6A7, 1 RCA-6B7, 1 RCA-41, 1 RCA-80—Total, 6

Tuning Frequency Range.................................
- Band A— 140 K. C.– 410 K. C.
- Band B— 540 K. C.– 1720 K. C.
- Band C—5400 K. C.–18,000 K. C.

Line-Up Frequencies...............175 K. C., 410 K. C., 460 K. C., 600 K. C., 1720 K. C., 18,000 K. C.
Maximum Undistorted Output...1.9 Watts
Maximum Output...3.5 Watts

PHYSICAL SPECIFICATIONS

	Model 128-E	Model 224-E
Height	$20\frac{5}{32}$ Inches	41 Inches
Width	$16\frac{3}{4}$ Inches	$24\frac{1}{2}$ Inches
Depth	$11\frac{17}{16}$ Inches	$12\frac{1}{8}$ Inches

This six-tube, three-band A. C. super-heterodyne receiver is of the "all-wave" type and has a tuning range of from 140 K. C. to 410 K. C., 540 K. C. to 1720 K. C., and 5400 K. C. to 18,000 K. C. This tuning range includes all of the important short-wave broadcasting, standard broadcasting and European broadcasting bands. Excellent sensitivity, selectivity and tone quality, together with a number of important operating features, make this an outstanding receiver of its type.

Operating features include a full vision "airplane" type dial, double-ratio vernier drive, high frequency tone control, three-position band switch with visual band indicator on dial and an automatic volume control. High tonal fidelity is realized by adequate power output, 1.9 watts undistorted, and well designed reproducer units.

DESCRIPTION OF ELECTRICAL CIRCUIT

The general circuit arrangement consists of an R. F. stage, a combined oscillator and first detector, an I. F. stage, a combined second detector and automatic volume control and a single Pentode output stage. An RCA-80 rectifier, together with a suitable filtering system, provides plate and grid voltages for all tubes and field excitation for the loudspeaker. Figure 1 shows the schematic circuit diagram, Figure 2 the chassis wiring, and Figures 3 and 4 the loudspeaker wiring.

The signal enters the receiver through a shielded antenna lead and is applied to the grid of the R. F. tube through the antenna coupling transformer. The secondary of this transformer is tuned to the signal frequency by means of one unit of the gang-capacitor. The output of this stage is transformer coupled to the grid circuit of the first detector, which is also tuned to the signal frequency by a unit of the gang-capacitor.

Combined with the signal in the first detector is the local oscillator, which is always at a 460 K. C. frequency difference (higher) from the signal frequency. A separate coil system and the third unit of the gang-capacitor are used in this circuit.

In conjunction with these three tuned circuits, it is well to point out that three different groups of tuned circuits are used, one for each tuning band. A three-position selector switch is provided for selecting the band in which the desired signal is located. In addition to selecting the desired coil system, additional groups of contacts are provided for short-circuiting the Band A coils when using Band B and the Band B coils together with the Band A oscillator coil when using Band C.

The output of the first detector, which is the I. F. signal (460 K. C.), is fed directly through two tuned circuits to the grid of the I. F. amplifier stage. The I. F. stage, which utilizes Radiotron RCA-6D6, uses two transformers, which consist of four tuned circuits, all of which are tuned to 460 K. C.

The output of the I. F. amplifier is then applied to the diode electrodes of the RCA-6B7, which is a combined second detector, automatic volume control and A. F. amplifier. The direct current component of the rectified signal produces a voltage drop across resistor R-12. The full voltage drop constitutes the automatic bias voltage for the R. F. while a tap is provided for

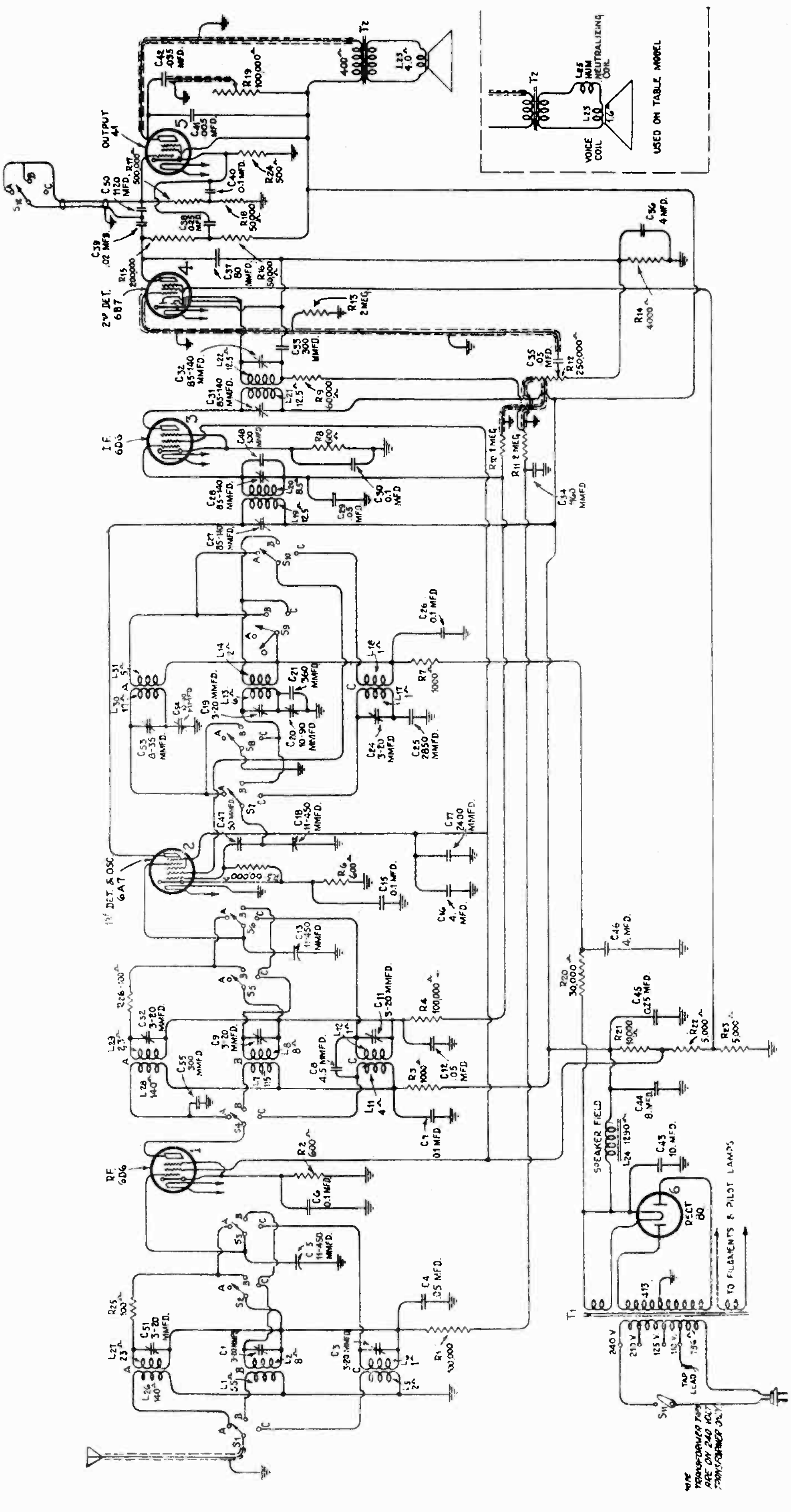


Figure 1—Schematic Circuit Diagram

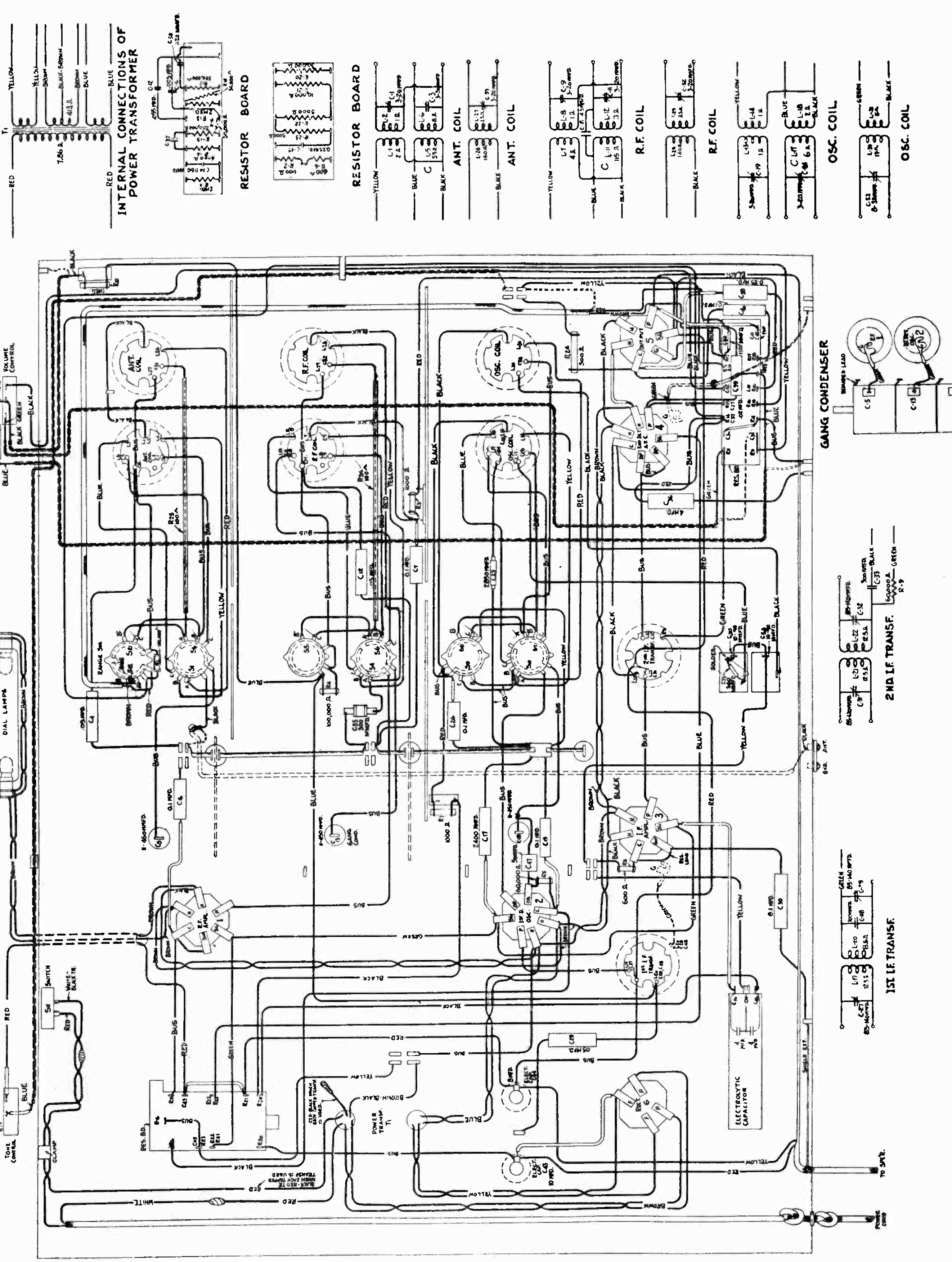


Figure 2—Chassis Wiring Diagram

the first detector and I. F. voltage. These automatic bias voltages for the R. F. first detector and I. F. give the automatic volume control action of the receiver. The volume control selects the amount of audio

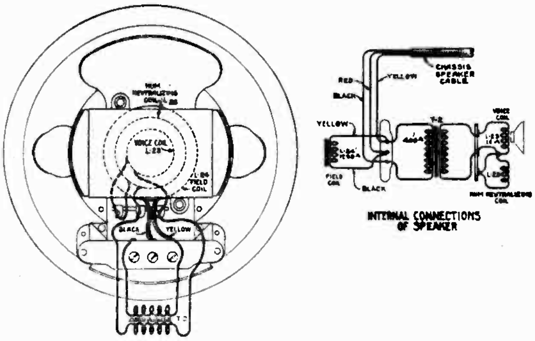


Figure 3—Table Loudspeaker Wiring

voltage that is applied to the grid of the RCA-6B7 and thereby regulates the audio output of the entire receiver.

The output of the RCA-6B7 is resistance coupled to the grid of the RCA-41 tube, which is the power output amplifier. This tube is operated as a Pentode and provides high audio gain and satisfactory output power. The plate circuit of the output stage is matched to the cone coil of the reproducer by means of a step-down transformer.

It should be noted that a small capacitor, C-50, is connected in series with C-39 during operation on Band C. This reduces the lower frequency output on this band which insures better operation.

The tone control consists of a variable resistor and fixed capacitor connected in series across the primary of the output transformer. At the minimum resistance position of the variable resistor, maximum attenuation of the high audio frequencies is obtained.

Plate and grid voltages for all tubes are supplied from the output of the rectifier-filter system. An RCA-80 is used as a rectifier and a suitable network of capacitors and resistors gives the necessary filtering and voltages. The loudspeaker field is used as a filter reactor.

(1) LINE-UP PROCEDURE

The line-up procedure of this receiver is somewhat involved and it is important that these instructions be carefully followed when making adjustments. Properly aligned, this receiver has outstanding performance; improperly aligned, it may be impossible to receive signals on all bands.

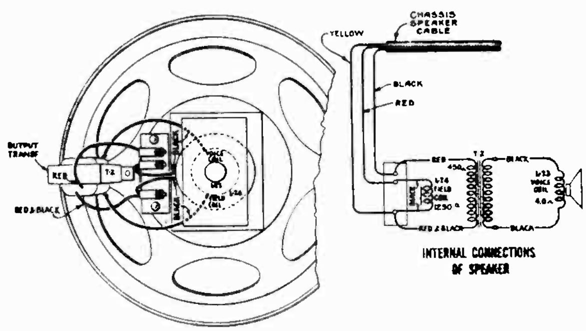


Figure 4—Console Loudspeaker Wiring

Equipment

To properly align this receiver, proper test equipment must be used. This consists of a modulated R. F. oscillator having proper frequency range, an

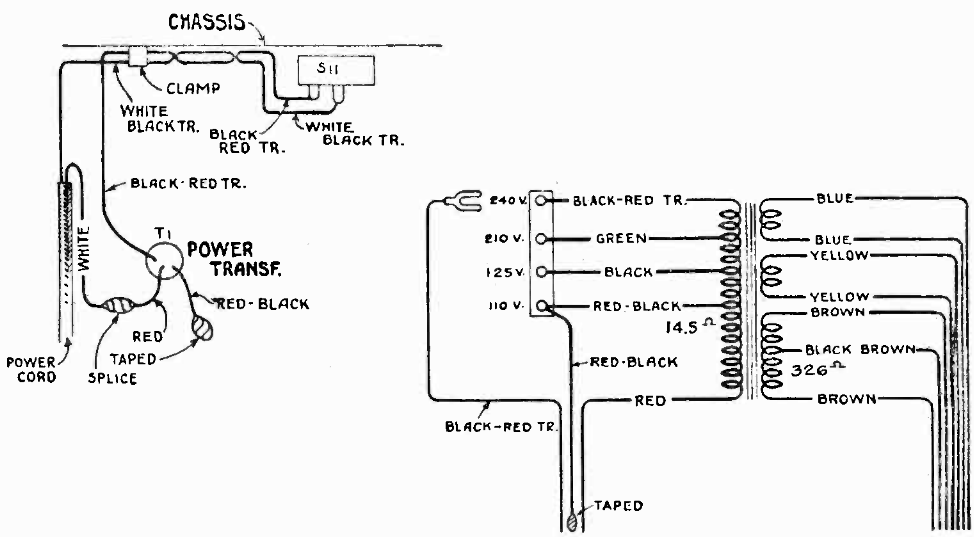


Figure 5—Universal Transformer Connections

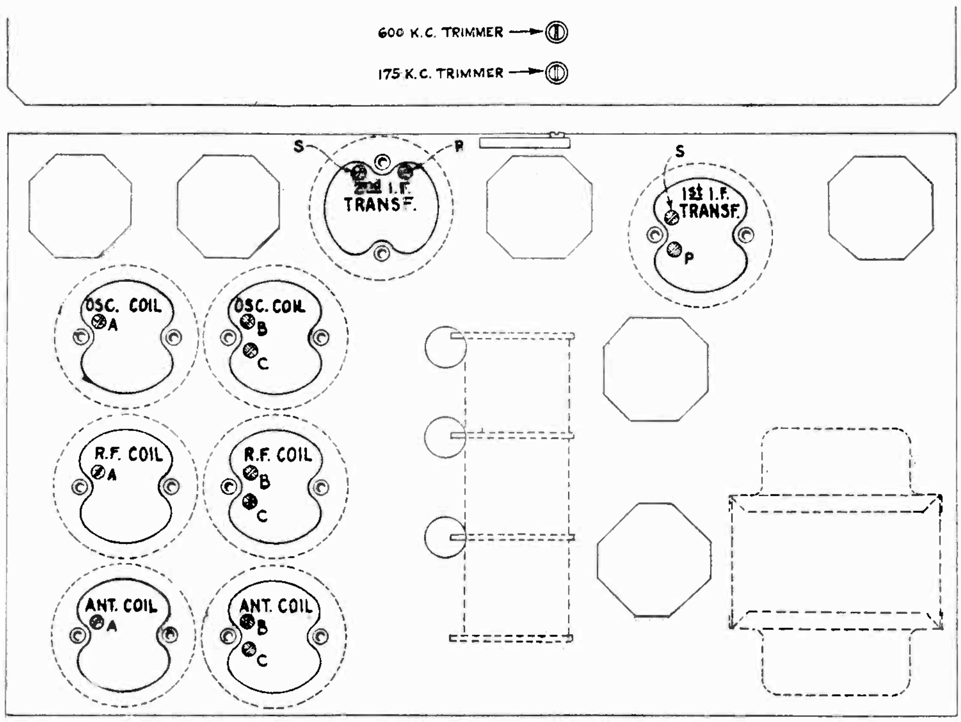
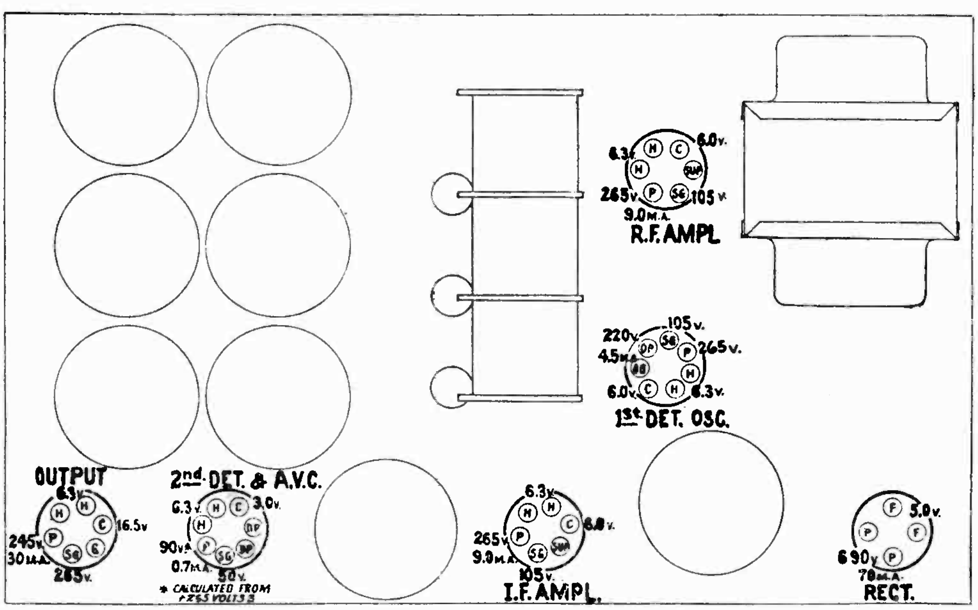


Figure 6—Location of Line-Up Capacitors



ALL VOLTAGES ARE TO GROUND

Figure 7—Tube Socket Voltages

output indicator, an alignment tool and a tuning wand. These parts, which are shown on page 11, have been developed by the manufacturer of this receiver for use by service men to duplicate the original factory adjustments.

Checking with Tuning Wand

Before making any R. F., oscillator or first detector adjustments, the accuracy of the present adjustments may be checked by means of the tuning wand (Stock No. 6679). The tuning wand consists of a bakelite rod having a brass cylinder at one end and a special finely divided iron insert at the other end. Inserting the cylinder into the center of a coil lowers its inductance, while inserting the iron end increases its inductance. From this, it is seen that unless the trimmer adjustment for a particular coil is perfect at alignment frequencies, inserting one end of the wand may increase the output of a particular signal. A perfect adjustment is evidenced by a lowering of output when either end of the wand is inserted into a coil.

The shields over the R. F. coil assembly have a hole at their top for entrance of the tuning wand. The location of the various coils inside of the shield is shown in Figure 8. An example of the proper manner of using the tuning wand would be to assume the external oscillator were set at 1720 and the signal tuned in, and the output indicator should be connected across the voice coil of the loudspeaker. Then the tuning wand would be inserted, first one end and then the other end, into the top of the three transformers at the left of the R. F. assembly, facing the front of the chassis. A perfect adjustment of the trimmer would be evidenced by a reduction in output when each end of the wand is inserted in each of the three transformers. If one end—for example, the iron end—when inserted in one coil caused an increase in output, then that circuit is low. An increase in the trimmer capacitance would be the proper remedy.

(2) I. F. TUNING CAPACITOR ADJUSTMENTS

This receiver has one I. F. stage that employs two transformers in conjunction with four adjustable capacitors. These capacitors may require adjustment, being tuned to 460 K. C.

A detailed procedure for making this adjustment follows:

(a) Connect the output of an external oscillator tuned to 460 K. C. between the first detector grid and ground. Connect the output indicator across the voice coil of the loudspeaker.

(b) Place the oscillator in operation at 460 K. C. Place the receiver in operation and adjust the station selector until a point is reached (Band B) where no signals are heard and turn the volume control to its maximum position. Reduce the oscillator input until a slight indication is obtained in the output indicator.

(c) Refer to Figure 6. Adjust each trimmer of the I. F. transformers until a maximum output is obtained. Go over the adjustments a second time.

This completes the I. F. adjustments. However, it is good practice to follow the I. F. adjustments with the R. F. and oscillator adjustments due to interlocking which always occurs.

(3) R. F., OSCILLATOR AND FIRST DETECTOR ADJUSTMENTS

Four R. F., oscillator and first detector adjustments are required in Bands "A" and "B." Three are required in Band "C."

To properly align the various bands, each band must be aligned individually in the order given. This is "A," "B" and "C." The preliminary set-up requires the external oscillator to be connected between the antenna and ground terminals of the receiver and the output indicator must be connected across the voice coil of the loudspeaker. The volume control must be at its maximum position and the input from the oscillator must be at the minimum value possible to get an output indication under these conditions. In the high frequency bands, it may be necessary to disconnect the oscillator from the receiver and place it at a distance in order to get a sufficiently low input to the receiver.

The dial pointer must be properly set before starting any actual adjustments. This is done by turning the variable capacitor until it is at its maximum capacity position. One end of the pointer should point exactly at the horizontal line at the lowest frequency end of Band "A," while the other end should point to within 1/64 inch of the horizontal line at the highest frequency end of Band "A."

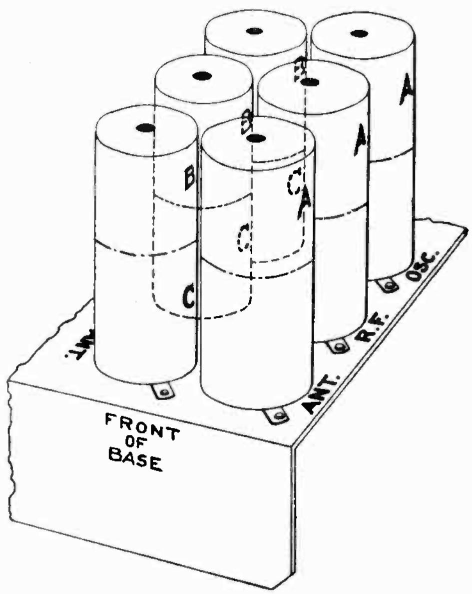


Figure 8—Location of Coils in Shields

Figure 6 shows the location of the trimmers for each band. Care must be exercised to merely adjust the trimmers of the band under test.

Band "A"

(a) Set the Band Switch at "A."

(b) Tune the external oscillator to 410 K. C., set the dial pointer at 410 K. C. and adjust the oscillator detector and R. F. trimmers for maximum output.

(c) Shift the external oscillator frequency to 175 K. C. Tune in the 175 K. C. signal irrespective of scale calibration and adjust the series trimmer, marked 175 K. C. on Figure 6, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 410 K. C. as described in (b).

Band "B"

(a) Set the Band Switch at "B."

(b) Tune the external oscillator to 1720 K. C., set the pointer at 1720 K. C. and adjust the oscillator, detector and R. F. trimmers for maximum output.

(c) Shift the external oscillator frequency to 600 K. C. Tune in the 600 K. C. signal, irrespective of scale calibration, and adjust the series trimmers, located on rear apron of chassis, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 1720 K. C. as described in (b).

Band "C"

(a) Set the Band Switch at "C."

(b) Tune the external oscillator to 18,000 K. C., set the pointer at 18 M. C. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacitor from minimum to maximum.

(c) Check for the image signal, which should be received at approximately 17,080 K. C. on the dial. It may be necessary to increase the external oscillator output for this check.

(d) Reduce the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal disappears. The first detector circuit is then aligned with the oscillator circuit and the RCA-6A7 tube is blocked. Then increase the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal is peaked for maximum output.

(e) The antenna trimmer should now be peaked for maximum output. It is not necessary to rock the main tuning capacitor while making this adjustment.

(4) POWER TRANSFORMER CONNECTIONS

The 220-volt power transformer furnished with some instruments includes taps for operating on 110-volt lines. Figure 5 shows the schematic circuit of the transformer and the proper voltage to be applied to the various taps. The taps are located on the power transformer assembly and are accessible without removing the chassis from the cabinet.

(5) VOLTAGE READINGS

The following voltages are those at the various tube sockets while the receiver is in operating condition. No allowance has been made for currents drawn by the meter, and if low-resistance meters are used, such allowances must be made:

RADIOTRON SOCKET VOLTAGES

115-Volt A. C. Line—No Signal—Volume Control Maximum

Radiotron Number		Cathode to Ground, Volts, D. C.	Screen Grid to Ground, Volts, D. C.	Plate to Ground, Volts, D. C.	Plate Current, M. A.	Heater Volts, A. C.
RCA-6D6—R. F.		6.0	105	265	9.0	6.3
RCA-6A7	Det.	6.0	105	265	3.5	6.3
	Osc.	—	—	220	4.5	
RCA-6D6—I. F.		6.0	105	265	9.0	6.3
RCA-6B7—2nd Detector		3.0	50	90*	0.7	6.3
RCA-41—Power		16.5	265	245	30.0	6.3
RCA-80—Rectifier		—	—	690 (RMS)	70.0	5.0

*Voltage calculated from 265 V. + B.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4427	Bracket—Volume control or tone control mounting bracket	$0.18
2747	Cap—Contact cap—Package of 5	.50
3861	Capacitor — Adjustable trimmer capacitor (C20)	.78
4442	Capacitor—50 mmfd. (C47)	.22
4662	Capacitor—80 mmfd. (C37)	.28
3981	Capacitor—300 mmfd. (C55)	.30
4413	Capacitor—360 mmfd. (C21)	.22
4634	Capacitor—1120 mmfd. (C50)	.35
4515	Capacitor—1160 mmfd. (C34)	.22
4670	Capacitor—2250 mmfd. (C14)	.30
4523	Capacitor—2400 mmfd. (C17)	.26
4524	Capacitor—2850 mmfd. (C25)	.35
4435	Capacitor—0.02 mfd. (C39)	.25
4518	Capacitor—0.05 mfd. (C35)	.52
4417	Capacitor—0.05 mfd. (C4, C12, C29)	.25
3877	Capacitor—0.1 mfd. (C40)	.32
4415	Capacitor—0.1 mfd. (C6, C15, C30)	.30
4645	Capacitor—0.1 mfd. (C7, C26)	.25
3597	Capacitor—0.25 mfd. (C38, C45)	.40
4525	Capacitor—4.0 mfd. (C36)	.70
4428	Capacitor—8.0 mfd. (C44)	1.05
7790	Capacitor—10.0 mfd. (C43)	1.05
4692	Capacitor pack—Comprising one 0.035 mfd. and one 0.005 mfd. capacitors (C41, C42)	.30
7589	Capacitor pack—Comprising two 4.0 mfd. capacitors (C16, C46)	1.64
4358	Clamp — Electrolytic capacitor mounting clamp	.15
4734	Coil—Antenna coil "A" (L26, L27, C51)	3.05
7803	Coil—Antenna coil "B & C" (L1, L2, L5, L6, C1, C3)	1.82
4751	Coil—Detector coil "A" (L28, L29, C52)	2.38
7805	Coil—Detector coil "B & C" (L7, L8, L11, L12, C8, C9, C11)	2.15
7807	Coil—Oscillator coil "B & C" (L13, L14, L17, L18, C19, C24)	1.62
4733	Coil—Oscillator coil "A" (L30, L31, C53)	3.05
7801	Condenser—3-gang variable tuning condenser (C5, C13, C18)	4.42
4340	Lamp—Dial lamp—Package of 5	.60
3632	Resistor—500 ohms—Carbon type—1 watt (R24)—Package of 5	1.10

Stock No.	Description	List Price
3218	Resistor—600 ohms—Carbon type—¼ watt (R2, R6, R8)—Package of 5	$1.00
4370	Resistor — 1000 ohms — Carbon type — ¼ watt (R3, R7)—Package of 10	2.00
3997	Resistor — 4000 ohms — Carbon type — ¼ watt (R14)—Package of 5	1.00
6318	Resistor—10,000 ohms (R21)	.80
3114	Resistor—50,000 ohms—Carbon type—¼ watt (R16, R18)—Package of 5	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R5)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R1, R4)—Package of 5	1.00
3116	Resistor—200,000 ohms—Carbon type—¼ watt (R15)—Package of 5	1.00
6186	Resistor—500,000 ohms—Carbon type—¼ watt (R17)—Package of 5	1.00
3033	Resistor—1 megohm—Carbon type—¼ watt (R10)—Package of 5	1.00
6242	Resistor — 2 megohms — Carbon type — ¼ watt (R11, R13)—Package of 5	1.00
3413	Resistor — 5000 ohms — Carbon type — ½ watt (R22, R23)—Package of 5	1.00
4513	Resistor — 30,000 ohms — Carbon type — 3 watts (R20)	.25
4521	Shield—Antenna R. F. or oscillator coil shield	.42
4145	Shield—First detector or output Radiotron shield	.30
4103	Shield—I. F. amplifier Radiotron shield	.20
6955	Shield—R. F. amplifier Radiotron shield	.25
3782	Shield—Second detector Radiotron shield	.26
3529	Socket—Dial lamp socket	.32
3859	Socket—4-contact Radiotron socket	.30
6676	Socket—6-contact output Radiotron socket	.40
7485	Socket—6-contact Radiotron socket	.40
3572	Socket—7-contact Radiotron socket	.38
4379	Strip—Antenna terminal engraved "ANT-GND"	.20
4684	Switch—Operating switch (S11)	.45
4728	Switch—Range switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10)	4.32
4517	Tone control (R19)	.90
4431	Transformer — First intermediate frequency transformer (L19, L20, C27, C28, C48)	2.28
4433	Transformer—Second intermediate frequency transformer (L21, L22, C31, C32, C33, R9)	2.15

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price	Stock No.	Description	List Price
9511	Transformer—Power transformer—105–125 volts—50–60 cycles (T1)	$4.78		REPRODUCER ASSEMBLY TABLE MODEL	
9512	Transformer—Power transformer—105–125 volts—25–40 cycles	6.58	4526	Cable—3-conductor—Reproducer cable	$0.32
9513	Transformer—Power transformer—105–250 volts—40–60 cycles	4.85	9579	Coil—Field coil (L24)	2.10
4519	Volume control (R12)	1.25	9533	Cone—Reproducer cone mounted and centered on housing	3.50
			7818	Reproducer complete	6.58
			4818	Transformer—Output transformer (T2)	2.15
	DRIVE ASSEMBLIES			REPRODUCER ASSEMBLY CONSOLE MODEL	
4362	Arm—Band indicator operating arm	.28	4473	Board—Terminal board assembly	.26
10194	Ball—Steel ball for condenser drive assembly—Package of 20	.25	9460	Coil—Field coil, magnet and cone support (L24)	6.00
4422	Clutch—Clutch drive assembly for variable condenser drive	.88	8935	Cone—Reproducer cone (L23)—Package of 5	5.25
4510	Drive—Tuning condenser drive assembly	2.42	9527	Reproducer—Complete	8.00
4361	Indicator—Band indicator (celluloid)	.12	4472	Transformer—Output transformer (T2)	1.40
4732	Scale—Station selector dial scale	.40		MISCELLANEOUS ASSEMBLY	
3943	Screen—Dial light screen (celluloid)—Package of 2	.18	4677	Bezel—Station selector dial (escutcheon) bezel	.56
3993	Screw—Number 6-32-5/32 square head set screws for band indicator operating arm—Package of 10	.25	6614	Glass—Station selector dial glass	.30
4669	Screw—Number 8-32-5/32 set screw for variable condenser drive assembly—Package of 10	.25	4520	Indicator—Station selector indicator pointer	.18
4377	Spring—Band indicator and arm tension spring—Package of 5	.25	4449	Knob—Station selector, volume control, tone control, range switch or operating switch knob—Package of 5	.60
4378	Stud—Band indicator operating arm stud—Package of 5	.25	4678	Ring—Dial glass retaining ring—Package of 5	.34
			4527	Screw—Chassis mounting screw assembly comprising 4 spacers, 4 screws, 4 lock-washers, 4 washers, 8 cushions—For table model	.40
			4685	Screw—Chassis mounting screw assembly—Comprising 4 spacers, 4 screws, 4 lock-washers, 4 washers and 8 cushions—For console model	.40
			4632	Screw—Number 8-32-7/16 headless set screw for knobs—Package of 10	.25

Amateur Communications Receiver

(For A-C Power Supply)

Model ACR-136

OPERATING INSTRUCTIONS
AND
SERVICE NOTES

"All-Wave" Range
540 to 18000 Kilocycles

AMATEUR RADIO SECTION

RCA Victor Division

RCA Manufacturing Company, Inc.

Camden, N. J., U. S. A.

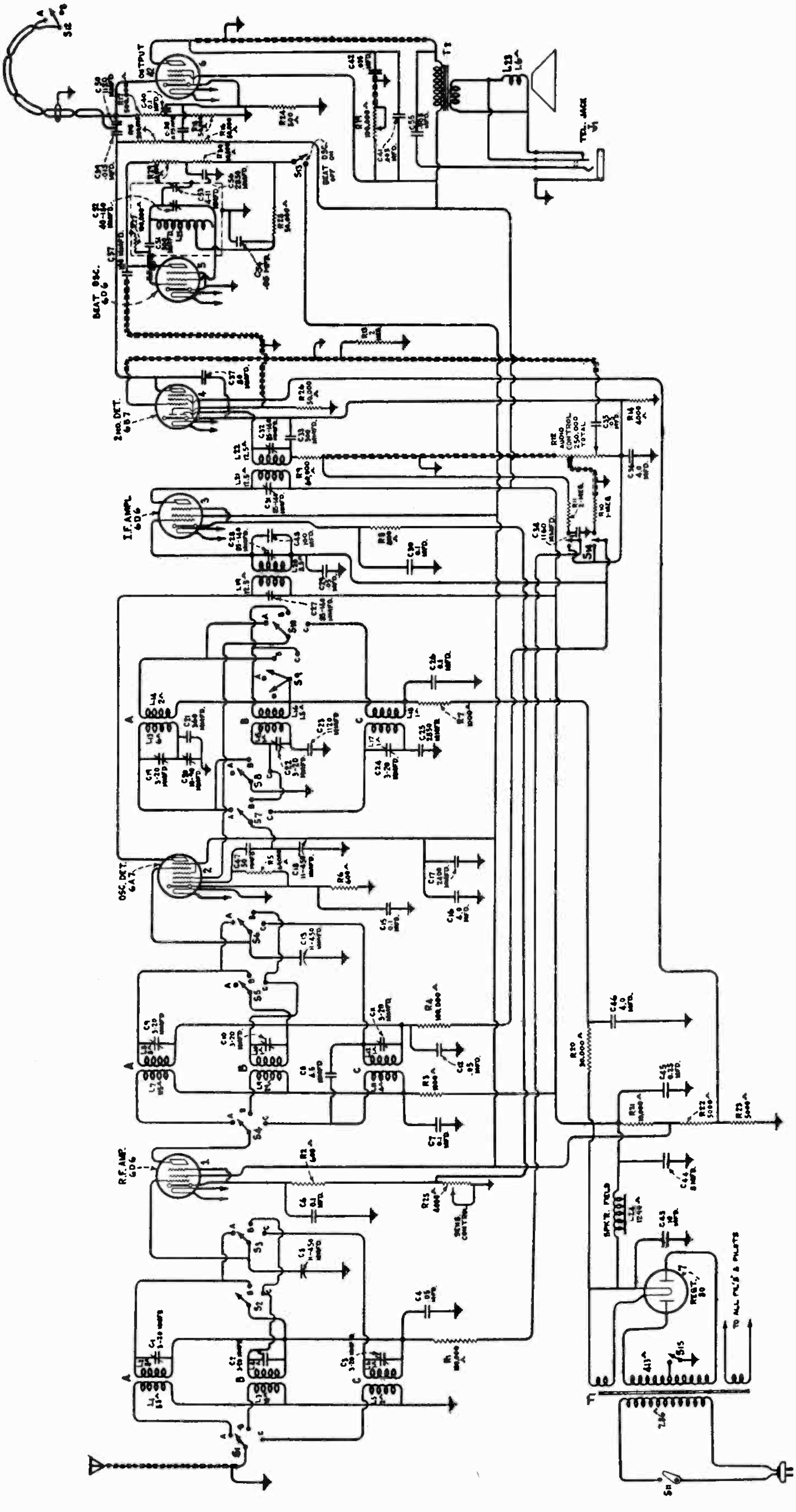


Figure 1—Schematic Circuit Diagram

Amateur Communications Receiver

Seven-Tube, Three-Band A-C Superheterodyne

Important—(Installation Notice)

The chassis of this receiver is flexibly mounted on rubber cushions, but for shipment is clamped rigidly to the instrument case. At installation, loosen the four screws on bottom of case, remove the metal clamp from beneath each screw and re-tighten sufficiently to compress each adjacent rubber cushion approximately one-eighth inch.

Part I

OPERATING INSTRUCTIONS

Electrical Specifications

Circuit—Superheterodyne with beat-frequency oscillator for C-W reception, automatic volume control and pentode output stage.

Tuning Range—540 to 18000 kilocycles, as follows:

Band	Limits (kc.)	Services
A	540–1720	Standard Broadcast–Police Calls
B	1720–5400	Amateur–Police Calls–Aviation
C	5400–18000	Amateur–S-W Broadcast–Aviation

Intermediate Frequency—460 kilocycles.

Power Output—1.75 watts (undistorted); 3.5 watts (maximum).

Loudspeaker—Electrodynamic (voice-coil impedance 4 ohms).

Tubes—2 RCA-6D6 (R-F and I-F Amplifiers), 1 RCA-6A7 (Oscillator and 1st Detector), 1 RCA-6D6 (Beat Oscillator), 1 RCA-6B7 (2nd Detector, A.V.C. and A-F Amplifier), 1 RCA-42 (Output), and 1 RCA-80 (Rectifier). See diagram on label inside cabinet lid for locations of tubes, tube shields and grid leads.

Power-Supply Ratings—See rating symbol on chassis.

Symbol	Voltage	Frequency (cycles)
A	105–125	50–60
B	105–125	25–60
C	100–130/195–250	50–60

As shipped from factory, instruments rated "C" are connected for 225–250 volts unless prominently specified otherwise on chassis. Any of these, however, can be converted for operation at 100–117, 117–130 or 195–225 volts when required. (See A-C Line Voltages in Part II.)

Power Consumption—85 watts.

Antenna Requirements

For amateur and other short-wave reception, the importance of a good antenna installation cannot be exaggerated. Signals of this class are apt to be weak, seldom much above the noise level under average atmospheric conditions. Irrespective of the degree of perfection of the receiver, therefore, an efficient antenna is prerequisite to reliable reception.

Because of its *noise-reducing* and pronounced directional properties, the *doublet-type* antenna has enjoyed considerable popularity. A single doublet, however, is restricted in frequency coverage to the same extent as the conventional single-wire antenna, a given length being very satisfactory at certain frequencies but relatively poor at others. For best results, the use of a special antenna system or of multiple antennas of the single-wire or doublet-type is essential.

The new *double-doublet* antenna system offers a practical solution to this problem. It consists essentially of *two* doublet antennas having different lengths and therefore different resonance characteristics, interconnected so that one will compensate for the weak points of the other throughout the intervening frequency range. An excellent antenna of this type, intended particularly for radio amateurs and other experimenters, is now available in the form of a convenient accessory kit known as No. 9550.

Except for omission of the antenna wire and a few other readily-procurable items, this kit is identical to the No. 9500-A—a complete kit recommended for use with the new "all-wave" receivers for home entertainment. In the latter, the doublet lengths are correct to embrace the short-wave broadcasting bands at 16, 19, 25, 31 and 49 meters. Different lengths of course should be used to insure best results over any other frequency range. With each No. 9550 kit are furnished concise instructions for computing doublet lengths and for altering the system to suit individual requirements.

Operation

Controls

All controls except the beat oscillator frequency adjustment are located upon the front panel and identified insofar as necessary by adjacent markings.

Power Switch and Sensitivity Control—The POWER switch is combined with a SENSITIVITY control and operates at the counter-clockwise end of rotation. When the knob is turned clockwise from latter extremity, the switch closes initially to apply power to receiver and continued rotation increases the sensitivity of receiver gradually to a maximum. Sensitivity is controlled by variation of the grid-bias voltage applied to the r-f and i-f amplifiers. In operation, this control may be employed to provide "silent tuning" between station settings. It is particularly advantageous, however, as an auxiliary volume control when the automatic volume control action of the receiver is removed.

Tone Control—Next in order to the right is a TONE control for attenuation of the higher frequencies, *full-range* reproduction being obtained with the knob turned fully clockwise. Under adverse weather conditions, static interference generally will be reduced to an appreciable extent by restricting the audio-response range. The control circuit consists of a variable resistor in series with a fixed capacitor and is connected across the primary of the output transformer.

Beat Oscillator Switch—The C. W. OSC. switch, located immediately to the right of the tone control, serves to interrupt plate and screen grid supply voltages to the beat-frequency oscillator stage. Thus, that stage can be rendered inoperative at any time, but, since the filament remains heated continuously, is ready for instantaneous operation.

Beat Oscillator Frequency Control—To provide manual control of the output frequency over a limited range on each side of the "zero-beat" position, a midget variable air capacitor is connected across the main tuning capacitor for the beat oscillator stage. Such adjustment is made inside the case upon lifting the lid, the small capacitor being located inside a shield at the rear left-hand corner of the chassis and operated by means of a horizontal rod pivoted from the top of that shield.

Tuning Control—The knob directly beneath the dial is the main tuning control. This knob when set inward affords a drive ratio of 10:1 for rapid adjustment and, when pulled out, engages a secondary drive with a ratio of 50:1 for precise tuning—a valuable feature for short-wave work.

Range Switch—The following knob to the right is a RANGE switch for selecting any of the three bands whose frequency limits are tabulated under "Electrical Specifications." A visual band indicator operates in conjunction with this knob, the band letters corresponding to the various switch positions appearing in sequence through a small opening in the lower half of the dial.

Volume Control—The VOLUME control is connected in the audio-frequency circuit and increases the output level with clockwise rotation.

Automatic Volume Control Switch—On the extreme right-hand end of the front panel is the A.V.C. control—a switch for eliminating automatic volume control action to obtain best reception of slow-speed code transmission.

Stand-by Switch—The toggle switch located on the front panel is connected in the plate circuit of the rectifier stage. When thrown to the left, all plate and screen grid voltages are removed, but the filament supply is unaffected, leaving the receiver "warmed-up" so that operation can be resumed instantaneously. Amateurs will find this switch highly advantageous for silencing the receiver during "sending" periods.

Phone Jack—The phone jack on the front panel at the extreme left-hand end permits quick substitution of headphones for reception of extremely weak signals. When a phone plug is inserted in this jack, it simultaneously short-circuits the voice coil of the electrodynamic loudspeaker and connects the phones through a small capacitor across the plate circuit of the power output stage. Since the loudspeaker field is employed as a filter for the rectifier stage, that unit still forms an active part of the circuit when using headphones.

Dial

The dial of this instrument incorporates a mechanical band-spread system particularly suited to amateur or other work where a fine degree of resetability is required. In addition to the three main scales calibrated directly in frequency (kilocycles or megacycles), two arbitrary scales are available for precision logging. These are known as the *vernier* and *vernier index* scales, the former being fully circular at the outside of the dial and the latter semi-circular at the center of the dial.

It will be observed that the *vernier* scale is graduated from "0" to "100" and traversed by the long single-ended pointer. On the other hand, the *vernier index* scale is graduated from "0" to "9" and traversed by the short double-ended pointer used for the main frequency scales. The longer pointer makes one complete revolution for each unit of travel of the shorter pointer on the *vernier index* scale. Thus, any station may be logged accurately with three digits; for example, if the *vernier index* reading is between "3" and "4" and the *vernier* reading is "72," then the log number is "372." The index number is always the lower of the two numbers between which the pointer is located.

In logging stations by this method, the band *letter* also must be named. For the above example, therefore, the full log number would be "A-372," "B-372," or "C-372," depending upon the setting of the range switch. As mentioned under "Controls," the band letter is visible through a small opening near the bottom of the dial.

In circuits where the tuning capacitor covers a relatively wide frequency range, the advantage of mechanical band spreading over the well-known electrical method lies in the greater uniformity of separation obtainable throughout that range and in the convenience of single-control tuning. With electrical band spreading, it is general practice to connect small variable capacitors in parallel with the main tuning (tank) capacitors. If such a system were employed, the various "amateur" channels could not be spread as uniformly since for a given frequency change, the travel of the band-spreading capacitors would be far less at the high-frequency end of the scale than at the low-frequency end; in other words, band-spread action would be very effective for the "amateur" channels at 40 meters (band C) and 160 meters (band B) but relatively poor for the two remaining channels at 20 meters (band C) and 80 meters (band B). In addition to this fundamental defect, there would be required at least one additional dial and the probability of error in reading or resetting would be greatly increased. The direct-reading frequency scale of this receiver obviously is possible only with a single tuning control and should be found very convenient.

Beat Oscillator

The beat-frequency oscillator embodied in this receiver is of the electron-coupled type, known to afford excellent frequency stability. Its primary purpose, of course, is to enable the reception of c-w (continuous-wave) telegraph signals, but it also may be used to advantage in locating regular broadcast or other modulated forms of transmission by the "birdie" method. Although the latter practice usually will be unnecessary because of the high sensitivity of this receiver, it may be found expedient in cases where the signal strength is very low or the carrier is not modulated continuously.

For c-w reception, it is customary to adjust the oscillator frequency to a value one or two kilocycles above or below the intermediate frequency of the receiver. Thus, all carriers to which the receiver can be tuned will be heard at *exact* resonance as notes of the same pitch since the beat or separation frequency will be constant throughout the entire tuning range. The pitch, of course, may be varied at will by changing the output frequency of the oscillator, either to satisfy personal preference or to eliminate interfering signals. Best intelligibility and greater apparent volume due to the inherent sensitivity characteristic of the human ear will result using a moderately low-pitch or beat frequency in the order of 500 to 1000 cycles, but *audio-image* interference will decrease with ascending pitch.

Audio-image interference is an effect entirely distinct from that commonly referred to in superheterodynes by the term "image-frequency response." By the latter is meant interference set up by an incoming carrier on the same side of the desired carrier as the *radio-frequency* oscillator but removed by *exactly* twice the receiver intermediate frequency. Such interference in this receiver is rendered negligible through the use of a pre-selector or radio-frequency amplifier stage.

When using the beat oscillator, interference of the same pitch as the desired signal can be produced by any continuous-wave signal which upon passing through the receiver is converted to an intermediate frequency on the same side of the receiver intermediate frequency as the beat oscillator but removed by *exactly* twice the separation of the beat oscillator. In this case, the interfering signal would be a *true* audio image. If one merely visualizes the sharp selectivity curve of the superheterodyne, he will observe at once that the attenuation offered by the tuned circuits of the receiver to such *image* responses will increase very rapidly as the oscillator separation is widened.

It should be appreciated in relation to the preceding paragraph that interference signals can be encountered not only at the *audio-image* frequency but at any frequency above or below the beat oscillator frequency at a separation within the audio range. Such beat notes ordinarily will be distinguishable from that of the desired signal because of the dissimilarity of pitch. In cases where both sound almost alike, confusion between the desired and undesired signals can practically always be eliminated by shifting the setting of the beat oscillator.

If a beat note of approximately the same pitch as the desired signal is heard, the interfering signal must be either near the frequency of resonance or near the *audio-image* frequency. For the first condition, best discrimination will be obtained using a fairly low pitch frequency on the opposite side of zero beat from the interfering frequency. Use of a relatively low pitch is recommended since for a given small frequency separation, say 100 cycles, two notes will be much more discernible in the region of 500 cycles than at 1500 cycles. When the interfering signal is at or near the *audio-image* frequency, however, two alternatives are possible. The oscillator frequency either can be adjusted to zero beat with the frequency of interference or swung through zero beat with the desired signal to some value on the opposite side of i-f resonance.

As an example to illustrate the latter alternatives, suppose that with the receiver tuned to a station the beat oscillator is adjusted to one kilocycle *above* the intermediate frequency and that an interfering signal is present at 1900 cycles above i-f resonance (100 cycles below the *audio-image* frequency). Thus, the desired signal will produce a one kilocycle note and the interfering signal a note of 900 cycles, these tones being sufficiently close that the former probably would not be readily discernible. By increasing the oscillator frequency 900 cycles, however, the desired signal would be heard as a 1900 cycle note and the undesired signal heterodyned to zero frequency. On the other hand, the oscillator frequency could be changed to a point on the opposite side of i-f resonance so that the desired signal would again be heard as a one kilocycle note. The interfering signal then would produce a note of 2900 cycles and so should cause no confusion.

Tuning

The r-f amplifier, oscillator and first detector circuits of this superheterodyne are tuned by a three-gang variable capacitor and thus controlled from a single knob. Tuning is even simpler than with the ordinary broadcast receiver because of the dual-ratio *vernier* drive system used in conjunction with the gang capacitor as mentioned under "Controls." For regular broadcasting and "amateur" phone stations, proceed as follows:

1. Turn Power Switch "on" and advance Sensitivity Control fully clockwise for *maximum* sensitivity.

2. Select position of Range Switch at which the band letter visible through small opening in dial corresponds to that frequency scale which includes the desired station or channel.

3. Set Standby and A.V.C. Switches "on" and Beat Oscillator Switch "off."

4. Advance Volume Control (clockwise) until background noise is heard.

5. Push tuning knob "in" and rotate short pointer to approximate setting of desired station, then pull knob "out" and adjust to the exact center of carrier.

6. Decrease volume as necessary and adjust Tone Control for preferred quality of reproduction.

If several moderately strong stations are available, silent tuning *between station settings* may be obtained by turning Sensitivity Control counter-clockwise until background noise (at any point on dial where no signal is heard) *just* disappears. Obviously, weak or distant stations *below* the noise level will not be received after this adjustment.

As noted heretofore, the beat oscillator may be used to advantage in locating weak, modulated signals. It should be tuned for this purpose exactly to the intermediate frequency of the receiver so that an audio-frequency note of ascending pitch will be obtained on each side of every incoming carrier. To adjust the beat oscillator in this manner, simply tune the receiver accurately to any carrier of suitable strength, then turn the Beat Oscillator Switch "on" and swing the small horizontal rod (inside the case) in either direction until "zero beat" is obtained. It follows then, of course, that any other carrier will be tuned to exact resonance when the gang or tuning capacitor is adjusted for "zero beat" and that weak signals will be heard almost as well as those of greater strength because of the heterodyne "whistle" produced while passing through resonance.

For c-w (code) reception, the tuning procedure is the same as for modulated signals except that the beat oscillator performs a definite rather than incidental function. It is set not *at* the intermediate frequency, but slightly *above* or *below* so as to provide an audio-frequency beat note when the receiver is tuned to resonance with any carrier. The gang capacitor, therefore, should be adjusted to the center of the carrier by listening to the "swish" or "key clicks" before turning "on" the Beat Oscillator Switch. Always adjust the pitch with the horizontal rod—never by means of the tuning control knob.

Short-Wave Reception

The short-wave broadcast facilities of this instrument may be used to greatest advantage by keeping in mind the usual variations in behavior with frequency of transmission and the time standards observed at different longitudes. In general, such reception is most satisfactory at the highest frequencies when the major portion of the transmission path is in daylight, and the lowest frequencies when the reverse is true.

Unreliable service from distant short-wave stations ordinarily is attributable either to fading or to the so-called "skip effect" encountered when the sky wave is reflected back to earth at a point beyond the radius of the local or ground wave. The latter component travels a relatively short and uniform distance (perhaps 35 miles at 19 meters and 75 miles at 49 meters), whereas the return point of the sky wave is extremely variable, increasing in distance from the transmitter from day to night and from summer to winter as well as with frequency. Obviously, reception in the intervening of "skip-distance" region will be either impossible or very erratic, such conditions existing usually over a range of from 25 to 400 miles at 49 meters and from 400 miles to infinity at 19 meters.

The program schedules listed on the accompanying chart are given with respect to both Eastern Standard and Greenwich Mean times, either of which is readily convertible to time standards observed at other longitudes.

Part II
SERVICE NOTES

Circuit Description

Before attempting to align or otherwise adjust this receiver, it is advisable to form a general knowledge of the circuit arrangement. A schematic diagram of the complete circuit is shown in Figure 1 (frontispiece). Figure 2 illustrates the arrangement of wiring which interconnects the radio chassis, loudspeaker and front-panel controls while the wiring layout of the radio chassis independently is detailed in Figure 3.

A signal upon entering the receiver passes through a shielded lead to the antenna coupling transformer, the secondary of which is tuned by one section of the three-gang variable capacitor, and is thence impressed upon the grid of the r-f amplifier—a stage of pre-selection used primarily for reducing image-frequency interference to a negligible value. The output of this stage is transformer coupled to the grid circuit of the first detector which also is tuned to the signal frequency by the second unit of the gang capacitor.

As in all superheterodynes, the first detector is actually a mixer stage, combining the incoming r-f carrier with an unmodulated sinusoidal voltage produced by a local oscillator. The oscillator plate circuit, being tuned by the third section of the gang capacitor, maintains a constant frequency difference from the transmitted signal throughout the entire tuning range. Thus, a difference or *beat* frequency is developed when any signal is received which is the same at each position of exact resonance. In this receiver, the functions of the first detector and oscillator are performed by a single tube.

It should be noted at this point that the three tuning ranges are obtained through a coil-selector system in conjunction with the one three-gang variable capacitor. Three sets of coils, each set consisting of three coils, are employed and with each shift of the range switch, a different and complete coil set is substituted. In addition to selecting the desired coil set, other contacts are provided on the range switch to short-circuit the coil set for band A when operating in band B and the coil set for band B together with the oscillator coil for band A when operating in band C. This practice prevents the occurrence of "dead spots" in bands B and C because of absorption effects in coil sets A and B which (when untuned) have natural periods within the range of the next higher-frequency band.

The beat frequency set up in the first detector carries the same modulation as the original r-f signal and is commonly termed the *intermediate* frequency. Since this intermediate frequency is constant for all r-f carriers, the next (i-f amplifier) stage utilizes fixed tuning. Its grid circuit is coupled to the first detector through a transformer, both windings of which are tuned to the intermediate frequency (460 kilocycles) by means of independent adjustable capacitors. A similarly-tuned transformer is used to couple the output of this amplifier to the second detector, making a total of four capacitors for adjustment during alignment.

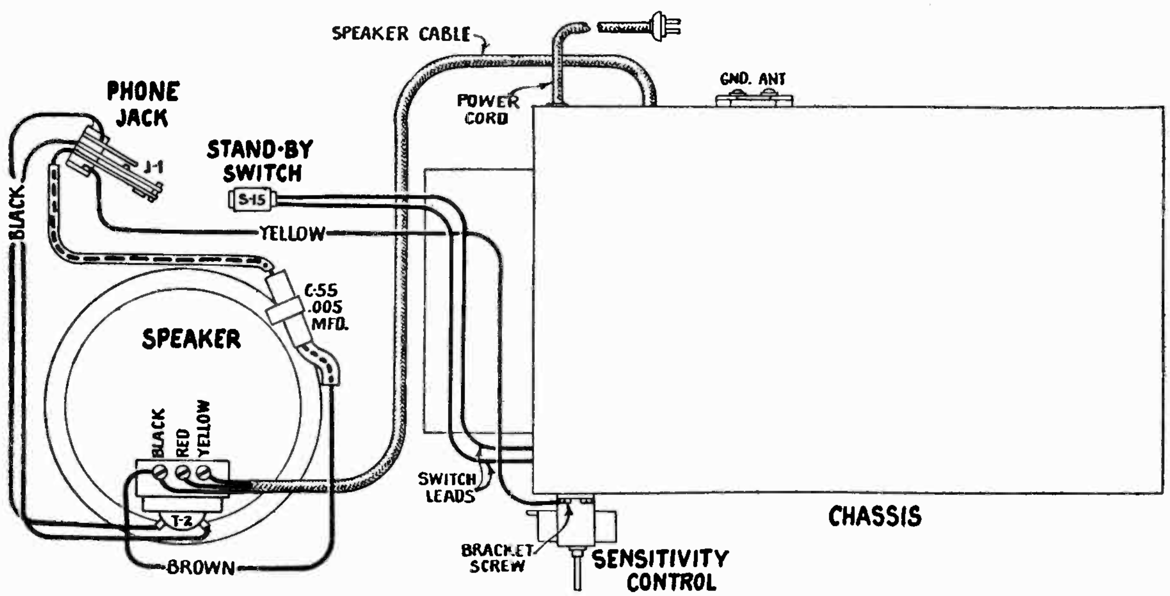


Figure 2—Assembly Wiring Diagram

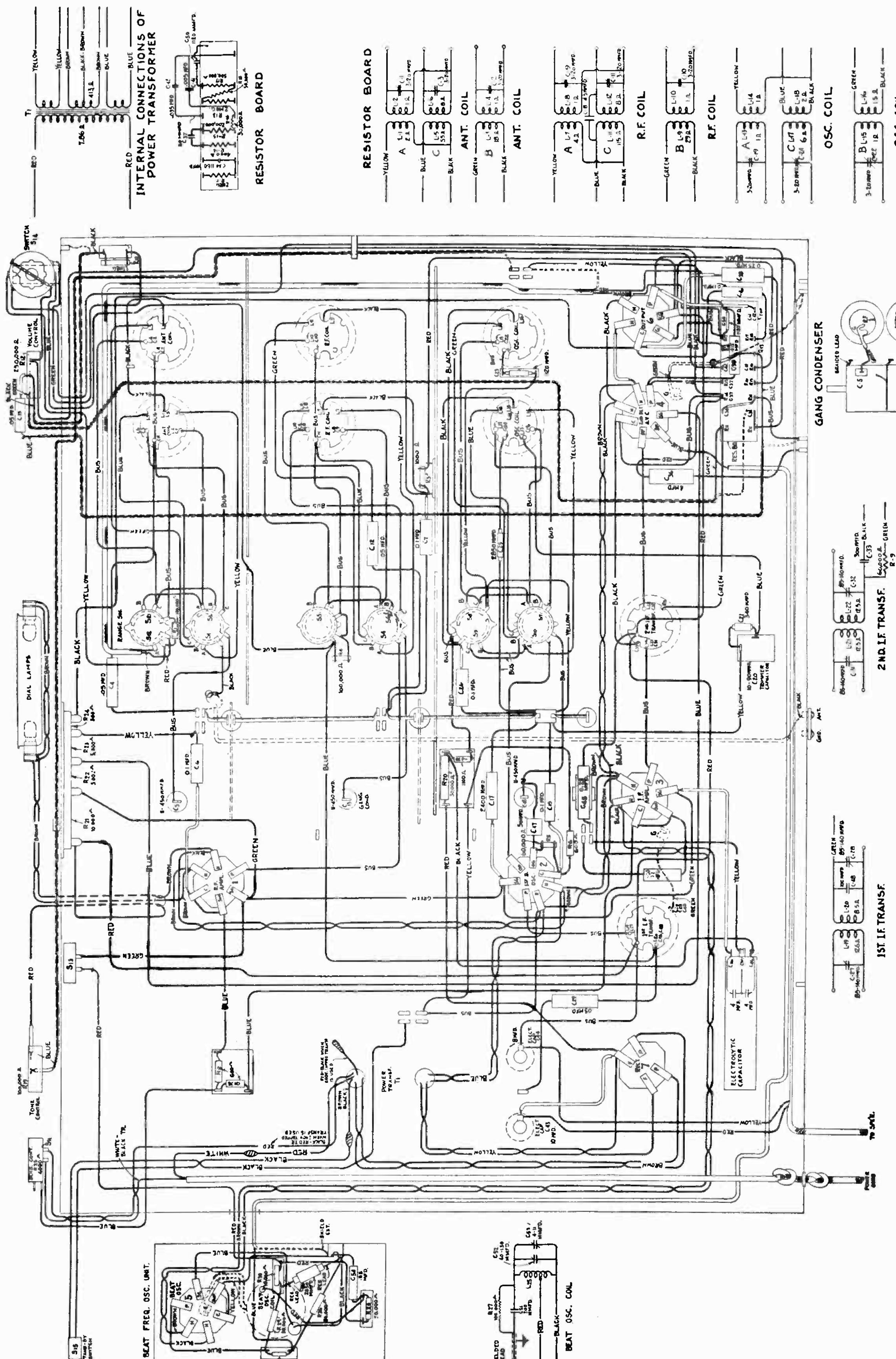


Figure 3—Chassis Wiring Diagram

The incoming (i-f) amplifier signal and the frequency generated by the beat oscillator for c-w reception are applied independently to the diode plate elements contained in the second detector tube and are combined therein to produce an audio-frequency note which can be heard readily in the loudspeaker or phones. As mentioned in the foregoing section, the variable capacitor operated by the horizontal rod inside the case is actually a *vernier* control which permits adjustment of the oscillator output frequency over a very limited range on either side of the signal intermediate frequency. It is effectively connected in parallel with the main tuning capacitor for the oscillator stage (likewise a variable air-dielectric unit accessible for adjustment by means of a screwdriver through an opening in bottom of case). Both capacitors together with the oscillator tuning coil are contained inside a single shield.

In addition to serving as a detector for both c-w and modulated signals, the second detector stage also performs functions of audio-frequency amplification and automatic volume control. The volume control resistor is connected as a series element in the diode detector circuit and so has developed across it a negative d-c potential of an amplitude that varies directly in accordance with the strength of the original r-f carrier. By returning this potential or portions thereof to the grids of the r-f amplifier, first detector and i-f amplifier, **these tubes are biased in** varying degree to compensate for fluctuations in field strength (fading) and for extreme changes of r-f input when tuning. The switch in this circuit permits elimination of the automatic volume control feature by removing all variable bias from the aforementioned tubes.

The audio-frequency component of the detected signal is fed through the arm of the volume control to the control grid of the tube for amplification. Resistance coupling is used between the pentode plate and the power output stage which also is connected as a pentode for high-power amplification. The plate circuit of the output stage is matched to the cone coil of the electrodynamic loudspeaker through a step-down (output) transformer.

A tone control circuit consisting of a variable resistor and a fixed capacitor in series is connected across the primary of the output transformer. The sensitivity control is a variable resistor common to the cathode circuits of the r-f and i-f amplifiers for alteration of self-bias produced by the combined plate currents for those tubes.

All power voltages are obtained from a full-wave rectifier and filter system connected to the a-c line. The loudspeaker field coil is excited from this system and serves therein as a filter reactor.

A-C Line Voltages

As noted under Electrical Specifications in Part I, this receiver is manufactured in three a-c line ratings designated as A, B and C, respectively. The first two models (A and B) cover a single-voltage range (105 to 125 volts), whereas the third or "C" model is operable in either of four ranges (100 to 117, 117 to 130, 195 to 225 and 225 to 250), three taps being provided on the primary of the power transformer. Internal connections of the transformer are shown in Figure 4. All taps are brought out to a terminal board on the top of the transformer and may be interchanged without removing the chassis from its case.

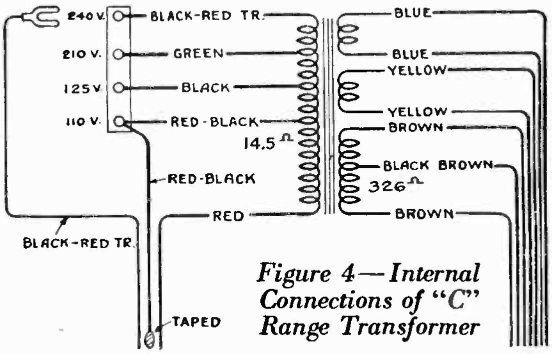


Figure 4—Internal Connections of "C" Range Transformer

Tube Voltages

The following voltages are normal at the tube sockets when the receiver is operating at 115 volts a-c line, with no incoming r-f signal, with the volume and sensitivity controls at "maximum" (both turned fully clockwise), and with the automatic volume control switch turned to the "on" position. Such voltages, of course, were measured with high-resistance meters. If low-resistance meters are used in checking, therefore, allowances must be made for meter-current drain. See Figure 5.

Radiotron Type Number	Cathode to Ground (Volts)	Screen Grid to Ground (Volts)	Plate to Ground (Volts)	Plate Current (M. A.)	Heater Volts
RCA-6D6 (R-F Amplifier)	6.0	105	265	9.0	6.3
RCA-6A7 (1st Detector)	6.0	105	265	3.5	6.3
RCA-6A7 (Oscillator)	—	—	220	4.5	
RCA-6D6 (I-F Amplifier)	6.0	105	265	9.0	6.3
RCA-6D6 (Beat Oscillator)	—	50*	40*	—	6.3
RCA-6B7 (2nd Detector)	3.0	50	90*	0.7	6.3
RCA-42 (Output)	16.5	265	245	30.0	6.3
RCA-80 (Rectifier)	—	—	690 (r-m-s) Plate to Plate	70.0 Total	5.0

*** Difficult to measure—Calculated from 265 Volts (+B).**

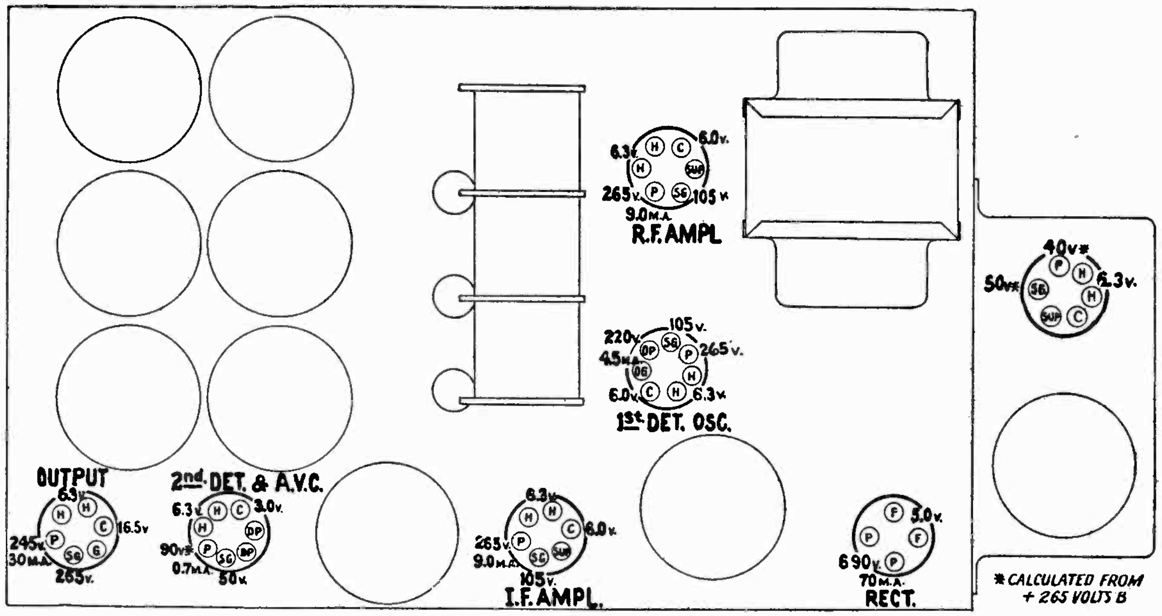


Figure 5—Tube Voltages

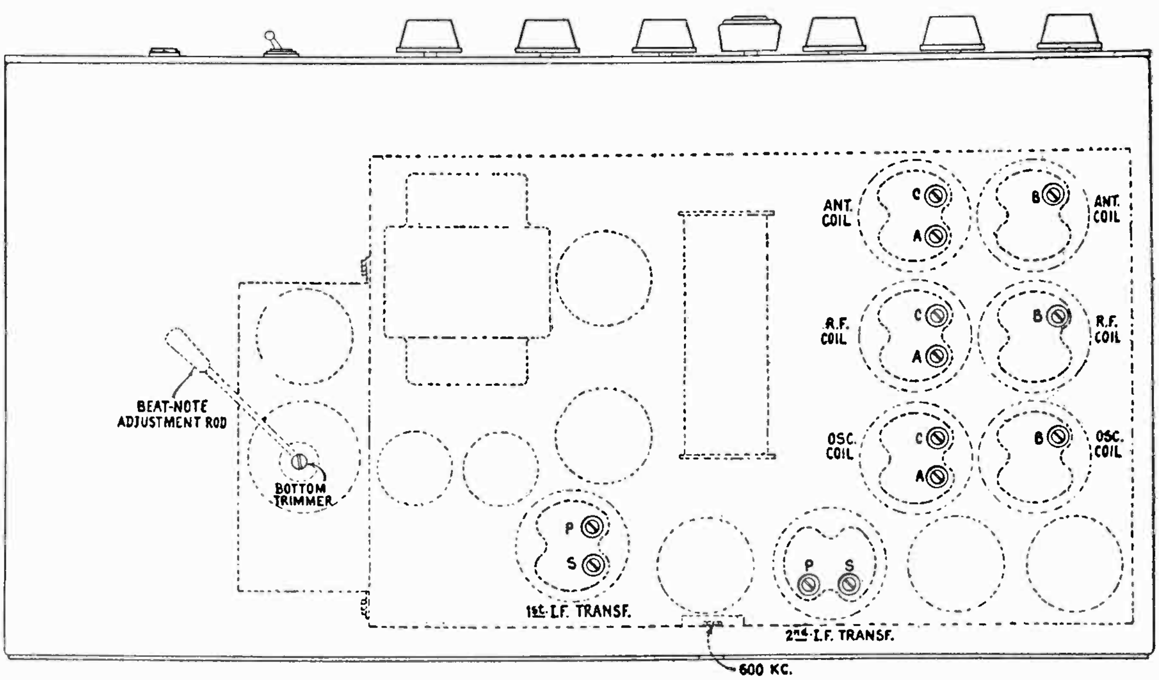


Figure 6—Locations of Trimmers (viewing bottom of case)

Alignment Procedure

This receiver, of course, was aligned at the factory, but should be checked regularly (preferably once every six months) to insure best possible results. Adjustments when necessary can be performed easily since all trimmer capacitors are accessible through openings in the external case as shown in Figure 6. If desired, however, the chassis can be withdrawn upon removal of the front panel and four mounting screws.

Equipment

Good equipment is prerequisite to satisfactory alignment. A modulated r-f oscillator having an adequate frequency range such as No. 9595, an output meter or simply an output indicator such as No. 4317, and a non-metallic screwdriver such as No. 4160 are three very necessary items. The process can be greatly facilitated through use of tuning wand No. 6679. The parts to which these numbers apply were designed by the manufacturer of this receiver for use by its authorized servicemen. Such parts, however, can be purchased by radio amateurs or engineers through the regular commercial channels.

I-F Alignment

Both the primary and the secondary circuits of the two coupling transformers for the i-f stage are tuned. Thus, four trimmers may require adjustment to the nominal intermediate frequency—460 kilocycles. To effect these adjustments, refer to Figure 6 and proceed as follows:

1. Connect a modulated oscillator so that its output is impressed between the grid of the first detector and ground.

2. Connect an output indicator across the voice coil of the loudspeaker or an output meter across the secondary of the output transformer with the loudspeaker voice coil open-circuited.

3. Remove the antenna lead-in connection from the rear (ANT-GND) terminal board. Apply power to receiver, turn volume and sensitivity controls fully clockwise (for maximum output) and set tuning control to any point in band A where no signal is received.

4. Place the oscillator in operation at 460 kilocycles and adjust its output control to a position just sufficient to actuate the output meter or indicator.

5. Adjust each of the four trimmer capacitors in turn for maximum output, reducing the input from the oscillator in order to maintain a suitable reading at all times. It will be advisable to go over these adjustments again to make certain that each circuit is exactly peaked rather than merely approximately correct. When an i-f alignment has been made, always follow with the r-f adjustments, as an interlocking effect is usually incurred.

R-F Alignment

The r-f amplifier, oscillator and first detector stages include a total of four trimmers in band A and totals of three trimmers each in bands B and C. These bands should be aligned individually and in alphabetical sequence. Care must be used to avoid disturbing the adjustments of trimmers not involved in the band under test. Nominal line-up frequencies for band A are 600 and 1720 kilocycles, while bands B and C are aligned at 5160 and 18000 kilocycles, respectively. For these adjustments, refer to Figure 6 and proceed as follows:

1. Check setting of dial pointer and adjust if necessary. With tuning capacitor plates fully meshed, one end of the pointer should point exactly toward

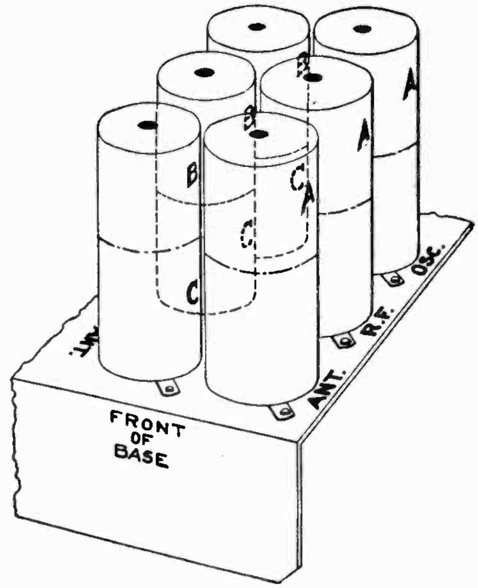


Figure 7—Locations of R-F Coils

the horizontal line at the low-frequency end of band A while the other end should point to within 1/64 inch of the horizontal line at the high-frequency end of that band.

2. Connect a modulated oscillator to the antenna (ANT) and ground (GND) terminals of the receiver.

3. Connect an output indicator across the voice coil of the loudspeaker or an output meter across the secondary of the output transformer with the loudspeaker voice coil open-circuited.

4. Apply power to receiver and turn volume and sensitivity controls fully clockwise (for maximum output).

5. Set range switch at "A":

(a) Adjust oscillator series capacitor (accessible from rear of case) to approximately the center of its range.

(b) Place test oscillator in operation at 1720 kilocycles, set dial pointer at 1720 kilocycles and adjust the three trimmers designated by the letter "A" (Figure 6) for maximum output.

(c) Shift test oscillator frequency to 600 kilocycles and tune receiver to this signal irrespective of the actual dial reading, then adjust the oscillator series trimmer (accessible through opening in rear of case) for maximum output while rocking the tuning capacitor.

(d) Re-adjust at 1720 kilocycles as described in (b).

6. Set range switch at "B":

(a) Tighten the r-f amplifier and first detector trimmers to afford approximately three-quarters of their maximum capacitance—that is, screwed inward three-quarters of the total travel.

(b) Shift test oscillator frequency to 5160 kilocycles, set dial pointer at 5160 kilocycles and adjust oscillator trimmer for maximum output. Set the trimmer at the first peak obtained while increasing the capacitance from "minimum" position.

(c) Check for the image signal at approximately 4240 kilocycles on dial (increasing the test oscillator output if necessary) in order to make certain that the oscillator trimmer is adjusted correctly in accordance with paragraph (b).

(d) Reset dial to 5160 kilocycles and reduce the capacitance of the first detector trimmer until signal disappears. (At this setting, the detector is tuned to the same frequency as the oscillator and the RCA-6A7 tube is blocked.) Now, increase the trimmer capacitance while rocking the tuning capacitor until maximum output is attained.

(e) Adjust the r-f amplifier trimmer for maximum output. It is not necessary to rock the tuning capacitor during this adjustment.

7. Set range switch at "C":

(a) Follow the same procedure as for band B (6) except use a test frequency of 18000 kilocycles and check for the image signal at 17,080 kilocycles.

During these adjustments, always leave the *sensitivity* and *volume* controls of the receiver at "maximum." To maintain a suitable output, reduce the test-oscillator input as necessary. In the high-frequency bands, it may be found necessary to disconnect the test oscillator and place it at an appreciable distance from the receiver.

Tuning Wand—This tool permits checking the accuracy of r-f alignment without disturbing any of the trimmer adjustment screws. It consists of a bakelite rod with a brass cylinder at one end and iron laminations at the other end. An opening is provided in the top surface of each shield in the r-f assembly (see Figure 7) for inserting the wand. Obviously, the inductance of any coil will be lowered when the brass end is inserted and will be raised upon insertion of the iron end. The trimmer setting is correct when the output at alignment frequencies is decreased alike by each end of the wand. If either end causes an increase in output, it is evident that the associated trimmer requires adjustment.

REPLACEMENT PARTS

Stock No.	DESCRIPTION	List Price
	RECEIVER ASSEMBLIES	
4427	Bracket—Volume control or tone control mounting bracket	$0.18
4244	Cap—Contact cap—Package of 5	.20
3861	Capacitor — Adjustable trimmer capacitor (C20)	.78
4442	Capacitor—50 mmfd. (C47)	.22
4662	Capacitor—80 mmfd. (C37)	.24
4811	Capacitor—340 mmfd. (C21)	.25
4412	Capacitor—1120 mmfd. (C23)	.25
4515	Capacitor—1160 mmfd. (C34)	.22
4634	Capacitor—1120 mmfd. (C50)	.35
4523	Capacitor—2400 mmfd. (C17)	.26
4524	Capacitor—2850 mmfd. (C25)	.35
4792	Capacitor—.015 mfd. (C39)	.22
4518	Capacitor—.05 mfd. (C35)	.52
4836	Capacitor—.05 mfd. (C4, C12, C29)	.30
4841	Capacitor—.1 mfd. (C6, C15, C30, C40)	.22
4885	Capacitor—.1 mfd. (C7, C26)	.28
3597	Capacitor—.25 mfd. (C38, C45)	.40
4525	Capacitor—4.0 mfd. (C36)	.70
4428	Capacitor—8 mfd. (C44)	1.05
7790	Capacitor—10 mfd. (C43)	1.05
4692	Capacitor pack—Comprising one 0.035 mfd. and one 0.005 mfd. capacitors (C41, C42)	.30
7589	Capacitor pack—Comprising two 4. mfd. capacitors (C16, C46)	1.64
4358	Clamp — Electrolytic capacitor mounting clamp	.15
4808	Coil—Antenna coil "Band B" (L3, L4, C2)	1.92
7803	Coil—Antenna coil "Band A-C" (L1, L2, L5, L6, C1, C3)	1.82
4815	Coil—Detector coil "Band B" (L9, L10, C10)	1.80
7805	Coil—Detector coil "Band A-C" (L7, L8, L11, L12, C8, C9, C11)	2.15
7807	Coil—Oscillator coil "Band A-C" (L13, L14, L17, L18, C19, C24)	1.62
4807	Coil—Oscillator coil "Band B" (L15, L16, C22)	1.85
7801	Condenser—3-gang variable tuning condenser (C5, C13, C18)	4.42
4340	Lamp—Dial lamp—Package of 5	.60
3218	Resistor—600 ohms—Carbon type—¼ watt (R2, R6, R8)—Package of 5	1.00
4834	Resistor—1100 ohms—Carbon type—¼ watt (R3, R7)—Package of 5	1.00

Stock No.	DESCRIPTION	List Price
3997	Resistor—4000 ohms—Carbon type—¼ watt (R14)—Package of 5	$1.00
3114	Resistor—50,000 ohms—Carbon type—¼ watt (R16, R18)—Package of 5	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R5)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R1, R4)—Package of 5	1.00
3116	Resistor—200,000 ohms—Carbon type—¼ watt (R15)—Package of 5	1.00
6186	Resistor—500,000 ohms—Carbon type—¼ watt (R17)—Package of 5	1.00
4783	Resistor—1,100,000 ohms—Carbon type—¼ watt (R10)—Package of 5	1.00
6242	Resistor — 2 megohms — Carbon type — ¼ watt (R11, R13)—Package of 5	1.00
2210	Resistor — 30,000 ohms — Carbon type — 1 watt (R20)	.22
4721	Resistor—Tapped resistor, one 10,000 ohms, two 5000 ohms, and one 500 ohms section (R21, R22, R23, R24)	.88
4521	Shield—I. F. transformer shield	.42
4742	Shield—Antenna R. F. or oscillator coil shield	.40
3942	Shield—First detector or output Radiotron shield	.18
7487	Shield—I. F. amplifier Radiotron shield	.25
4705	Shield—R. F. amplifier Radiotron shield	.30
3782	Shield—Second detector Radiotron shield	.26
3529	Socket—Dial lamp socket	.32
4784	Socket—4-contact Radiotron socket	.15
4786	Socket—6-contact output Radiotron socket	.15
4785	Socket—6-contact Radiotron socket	.15
4787	Socket—7-contact Radiotron socket	.15
4379	Strip—Antenna terminal engraved "ANT-GND"	.20
4684	Switch—Oscillator switch (S13)	.45
4728	Switch—Range switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S12)	4.32
4810	Tone control (R19)	1.30
4431	Transformer — First intermediate frequency transformer (L19, L20, C27, C28, C48)	2.28
4433	Transformer—Second intermediate frequency transformer (L21, L22, C31, C32, C33, R9)	2.15
9511	Transformer—Power transformer—105-125 volts, 50-60 cycles (T1)	4.78
9512	Transformer—Power transformer—105-125 volts, 25-40 cycles	6.58
9513	Transformer—Power transformer—105-250 volts—40-60 cycles	4.85
4809	Volume control (R12)	1.45

REPLACEMENT PARTS (Continued)

Stock No.	DESCRIPTION	List Price
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm........	$0.28
10194	Ball—Steel ball for variable condenser drive assembly—Package of 20...............	.25
4422	Clutch—Tuning condenser drive clutch assembly—Comprising drive shaft, balls, ring, spring and washers assembled.......	.88
4724	Dial—Station selector dial................	.40
7799	Drive—Variable tuning condenser drive assembly complete......................	2.45
4364	Gear—Spring gear assembly complete with hub pinion, gear cover and spring........	.96
4361	Indicator—Band indicator—Celluloid.......	.12
4520	Pointer—Station selector main pointer—Large.	.18
4725	Pointer—Station selector vernier pointer—Small..............................	.22
3993	Screw—No. 6-32-5/32" square head set screw for variable condenser drive assembly—Package of 10.........................	.25
4377	Spring — Band indicator and arm tension spring—Package of 5..................	.25
4360	Stem—Pointer stem assembly.............	.35
4378	Stud—Band indicator operating arm stud—Package of 5.........................	.25
	OSCILLATOR ASSEMBLIES	
2747	Cap—Contact cap—Package of 5...........	.50
3640	Capacitor—.05 mfd. (C54)................	.25
3794	Capacitor—100 mmfd. (C57)..............	.30
4524	Capacitor—2850 mmfd. (C56).............	.35
5029	Coil—Beat coil—Oscillator assembly—Complete (R27, C51, C52, C53, L25)..........	7.28
8077	Handle—Beat oscillator adjustment handle—Complete with knob....................	.50
3381	Resistor—10,000 ohms—Carbon type—1/4 watt (R30)—Package of 5...............	$1.00
3114	Resistor—50,000 ohms—Carbon type—1/4 watt (R26, R28, R29)—Package of 5......	1.00
6955	Shield—Oscillator Radiotron shield.........	.25
7485	Socket—6-contact Radiotron socket........	.40
	REPRODUCER ASSEMBLY	
4448	Board—Terminal board assembly..........	.25
9531	Coil—Field coil, magnet and cone support (L24)...............................	2.75
9492	Cone—Reproducer cone (L23)—Package of 5.	3.70
9514	Reproducer—Complete....................	6.00
4505	Transformer—Output transformer (T2).....	1.55
4447	Shield—Terminal board shield.............	.18
	MISCELLANEOUS ASSEMBLY	
4757	Bezel—Station selector dial (escutcheon) bezel.	.82
6614	Glass—Station selector dial glass...........	.30
11314	Grille—Grille cloth and screen assembly for speaker	.18
4823	Knob—Station selector knob—Package of 5..	.75
4132	Knob—Volume control, tone control, sensitivity control, oscillator switch, range switch or AVC switch knob—Package of 5.	.55
6615	Ring—Dial glass retaining ring—Package of 5.	.34
3943	Screen—Translucent screen for dial light—Package of 2.........................	.18
4613	Screw — Number 8-32-7/16" headless set screw for knobs—Package of 10..........	.25
4726	Rheostat—Sensitivity control rheostat (R25, S11)................................	1.42
4756	Jack—Phone jack (J1)....................	1.44
4758	Switch—Standby switch (S15).............	.95
4727	Switch—AVC control switch (S14).........	1.44

RCA VICTOR MODELS 143, 242 AND 243

Eight-Tube, Four-Band, A. C., Superheterodyne Receivers

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage and Frequency Ratings	105–125 Volts, 50–60 Cycles 105–125 Volts, 25–60 Cycles 100–130/195–250 Volts, 50–60 Cycles
Power Consumption	Approximately 130 Watts
Number and Type of Radiotrons	2 RCA-6D6, 1 RCA-6A7, 1 RCA-75, 1 RCA-76, 2 RCA-42, 1 RCA-5Z3—Total, 8
Tuning Frequency Ranges	Band "X"— 140 KC– 410 KC Band "A"— 540 KC– 1720 KC Band "B"—1720 KC– 5400 KC Band "C"—5400 KC–18,000 KC
Alignment Frequencies	175 KC, 410 KC, 460 KC, 600 KC, 1720 KC, 5160 KC, 18,000 KC
Maximum Undistorted Output	Approximately 4 Watts
Maximum Output	Approximately 5 Watts

PHYSICAL SPECIFICATIONS

	Model 143	*Model 242*	*Model 243*
Height	20 3/16 Inches	41½ Inches	41 Inches
Width	17⅞ Inches	26 Inches	25 Inches
Depth	14 1/32 Inches	14 Inches	14½ Inches

These eight-tube, four-band receivers which employ identical chassis assemblies, are designed for "all-wave reception," with a continuous tuning range between 140KC. and 18,000 KC. A narrow interruption occurs in the region of 500 KC. This extensive range of tuning permits a listener to receive international broadcasting, police calls, amateur transmissions, aircraft communication, and various other radio-telephone and telegraph signals, as well as providing excellent reception of the standard broadcast stations.

The exceptional sensitivity, selectivity and tonal quality combine with the high output capacity (4 watts undistorted) to form a receiver of outstanding ability. Cabinet design is based on the performance characteristics of the receiver chassis and speaker, so as to obtain a greater uniformity of over-all sound response.

Special design features incorporated to facilitate operation are the use of: an "airplane dial," a double-ratio vernier tuning drive, a visual band indicator, and a "second hand" dial pointer for accurate indication and logging of short-wave stations. Other important details of design include: automatic volume control, sensitivity control, a large loudspeaker unit, and external terminals for phonograph connection.

DESCRIPTION OF ELECTRICAL CIRCUIT

The general circuit arrangement consists of an r-f stage, a combined oscillator and first detector stage, an i-f stage, a second detector, audio amplifier and A.V.C. stage, a second audio amplifier stage, and a push-pull pentode power output stage. Rectification of voltages used for the plate and grid circuits is effected by an RCA-5Z3, which also supplies magnetization current for the loudspeaker field. The filtering system includes the inductance of the speaker field, and several electrolytic capacitors.

The operation of the receiver may be visualized by study of the schematic circuit of Figure 1. An r-f signal from the antenna enters the input stage through a shielded lead and is applied to the control grid of the RCA-6D6 by the secondary of the antenna coupling transformer. Either of the four antenna transformers may be selected by the associated band switch contacts, depending on the frequency of the signal desired. From the selectivity afforded by the tuned coupling transformer and the magnification caused by the r-f amplifier stage, the signal attains a high value in respect to noise. Under this condition, it is introduced through another tuned transformer coupling system to the control grid of the RCA-6A7 first detector tube. At this juncture, the heterodyning between the signal and the local oscillator produces the i-f or beat frequency. The local oscillator frequency is derived from a circuit attached to several elements of the RCA-6A7 Radiotron, which are so constructed and interrelated as to mix the two input frequencies and detect their i-f beat. Tuning of the local oscillator is done by a third group of coils and the third unit of the gang condenser. The frequency generated by the oscillator is maintained 460 KC. above the incoming signal frequency by the inherent design of the circuit.

The i-f signal from the output of the first detector stage is admitted through the additional selectivity of the first intermediate transformer to the i-f amplifier tube, an RCA-6D6. Here it is boosted by the gain of the tube, and again tuned by the second i-f transformer of the plate circuit. The magnitude of the signal at this point has reached a value convenient for detection. It is therefore impressed upon the RCA-75 second detector diode plates, which perform the detection process. The d-c voltage across resistor R-32 is used for automatic volume control of the r-f stage. A lower resistance tap is taken off resistor R-32 for automatic control of the grid bias of the first detector and i-f stages. Audio voltage developed across resistor R-32 as a result of the diode detection is conducted through the variable arm (volume control) of R-32 to the control grid of the RCA-75. After amplification by the RCA-75, the audio signal is transmitted by a resistance-capacitance coupling network to the audio amplifier stage, and thence by means of transformer coupling to the grids of the push-pull, power output stage. A high-frequency tone control consisting of a resistor and condenser in series is connected between these two grids to render possible reduction of noise and side-band interference. Maximum reduction of "highs" is obtained at the minimum resistance setting of the control, which corresponds to an extreme counter-clockwise position of the control knob. The RCA-42 output tubes are matched into the circuit for Class "A" operation. The high-quality output obtained is transferred to the loudspeaker by the step-down transformer.

In the power supply system, an RCA-5Z3 full-wave rectifier of the high-vacuum type furnishes d-c for the bias and plate voltages required. The loudspeaker field is connected into the filter stage of the rectifier output circuit to serve as a reactor. Two 10-mfd. electrolytic capacitors operate in conjunction with the field winding.

SERVICE DATA

(A) LINE-UP PROCEDURE

The method of aligning this receiver is somewhat involved. It is therefore important that the following instructions be observed when making the various adjustments if maximum performance is to be attained. When properly aligned, efficient operation results; otherwise a tendency toward distorted quality and low sensitivity may be expected.

(1) Equipment. A first-class alignment job can only be accomplished by use of the correct test and measuring apparatus. The manufacturer of this "All-Wave" receiver has developed and produced a number of instruments for such a purpose, which will enable a service technician to duplicate the original factory adjustments. A "Full-Range" or "All-Wave" i-f and r-f oscillator is available, and should be used as the source of standard signals at the several line-up frequencies. Visual indication of output is very desirable. It may be accurately obtained by use of the standard neon type "Output Indicator." Two tools are needed, namely: a "Tuning Wand" for preliminary checking of alignment, and a combination insulated screw-driver and insulated socket wrench for correcting alignment.

(2) Preliminary Tests. Before making any adjustments, it is wise to determine the correctness of the existing alignment. This may be done by supplying a signal to the circuit (r-f, oscillator or i-f) from the Full-Range Oscillator and inserting the Tuning Wand into the coils involved. The Tuning Wand consists of a bakelite rod having a brass cylinder attached to one end, and a small core of finely divided iron compacted into the opposite end. By inserting the brass cylinder end into the center of a particular coil through the opening provided in the top of the shield, shown in Figure 2, the inductance of the coil is lowered and therefore the resonant frequency is increased. Placing the other end (iron filing core)

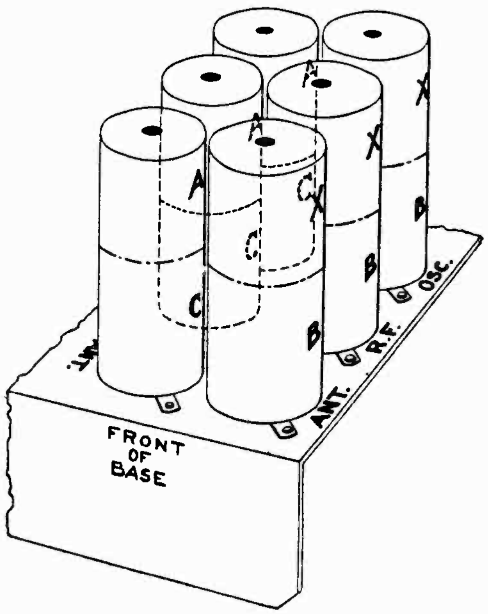


Figure 2—Location of Coils in Shields

into the coil raises the inductance and conversely decreases the resonant frequency. Thus it can be seen that if the circuits are precisely tuned to the standard signal of the Full-Range Oscillator, the insertion of

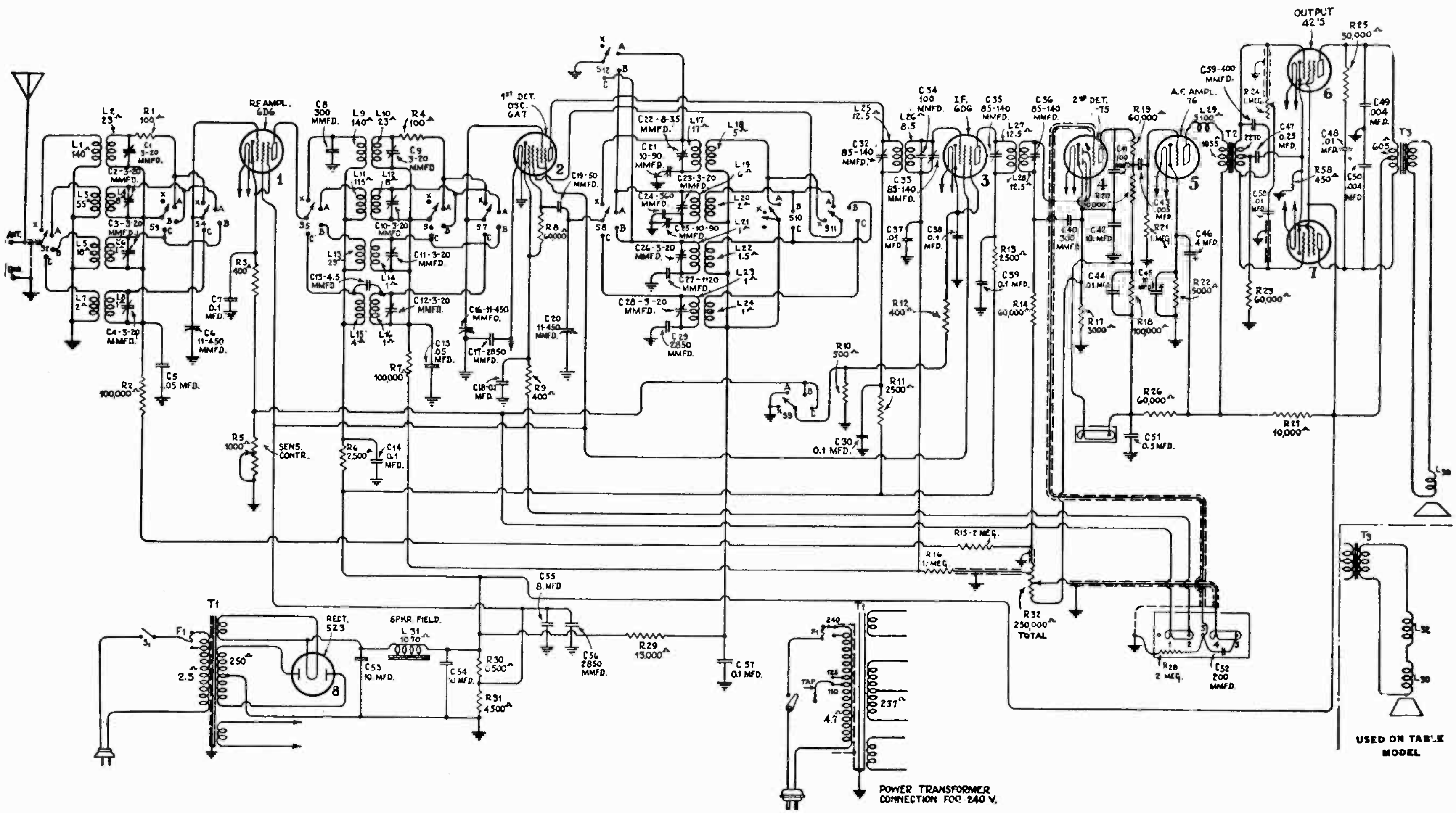


Figure 1—Schematic Circuit Diagram—Sensitivity Control Change with Band Position
Models 143 and 242 (1934 Production)

either end of the wand will cause a reduction of the receiver output; whereas, if the circuits are not in tune or resonance with the incoming signal, one end will bring about an increase of the signal and the other end will cause a decrease. When an increase in signal is obtained with the iron-filled end of the wand, an increase of the inductance and decrease in frequency of resonance is indicated. The trimmer condenser associated with the tuned circuit under test will therefore require adjustment so as to increase its capacitance. The reverse occurs when a gain in signal is obtained when using the brass cylinder end of the wand.

(3) I. F. Tuning Capacitor Adjustments. In this receiver there is a single i-f stage, including two coupling transformers. Trimmer condensers are used across both the primary windings and secondary windings, making a total of four adjustments. Each trimmer is designed for aligning its coil to 460 KC., the established i-f for this receiver. Adjustment of the i-f circuits should be performed in the following manner:

(a) Connect the output of the Full-Range Oscillator, which is tuned to deliver a signal of 460 KC., to the first detector grid and chassis-ground. Attach the output indicator across the voice coil circuit of the loudspeaker.

(b) With the receiver in operation, set the station selector to a point in band "A" where no signals are heard, and advance the volume control to its maximum position. Adjust the external oscillator to produce a level convenient for indication at the receiver output.

(c) Adjust each i-f trimmer, shown in Figure 3, with an Alignment Tool until maximum receiver output is obtained.

(4) R-F, Oscillator and First Detector Tuned Circuit Alignment. Whenever the i-f line-up is corrected, it will be necessary to re-align r-f circuits preceding the first detector tube, as the correct operation of the receiver depends on the interlocking of the two.

The four tuning bands of the receiver entail a multiplicity of adjustments. Each band must be aligned individually. The output indicator should be retained across the receiver voice coil circuit, and the Full-Range Oscillator connected to the antenna-ground terminals. Volume and sensitivity controls should both be advanced to their maximum positions, and the external oscillator output regulated so as to be as low as possible consistent with obtaining a good indication at the receiver output indicator. In the higher-frequency bands, it may become necessary to disconnect the oscillator from the antenna-ground terminals and move it a short distance away from the receiver in order to reduce the signal level to a convenient value.

It is essential to set the dial pointer of the tuning mechanism in relation to the dial scale before any electrical adjustments are made. This is done by turning the station selector until the tuning condenser plates are in full mesh, and setting one end of the pointer exactly opposite the horizontal line at the low frequency end of the scale for band "A." The other end of the pointer should fall within 1/64 inch of the horizontal line at the high-frequency end of the same scale.

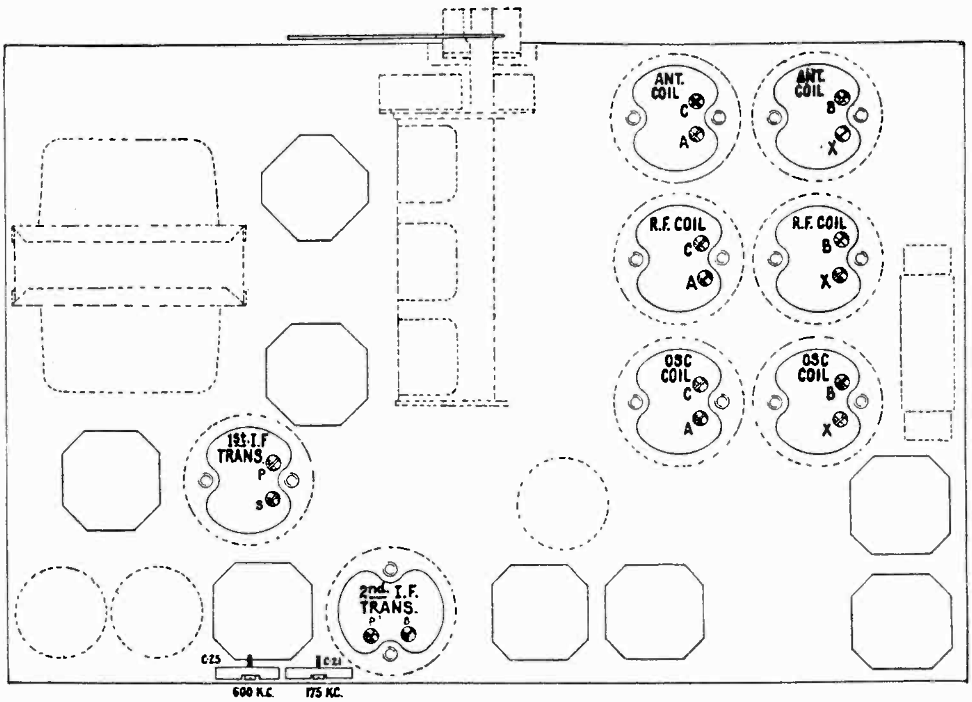


Figure 3—Location of Trimmer Capacitors

The trimmer locations for each band are shown by Figure 3. They should be adjusted in the following manner:

Band "X"

(a) Set the receiver band switch to "X" and turn the station selector so that the pointer is at the 410 KC. marking.

(b) Tune the Full-Range Oscillator to produce a signal of 410 KC.

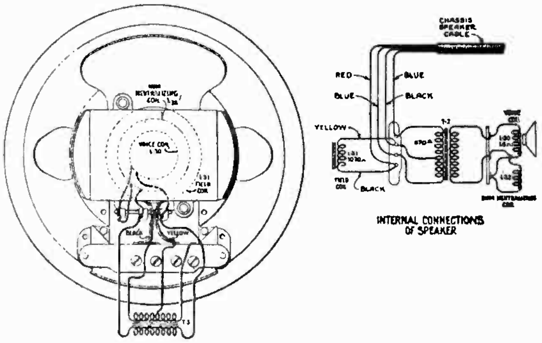


Figure 4—Table Loudspeaker Wiring

(c) Adjust the r-f, first detector and oscillator trimmers of band "X" coils for maximum receiver output.

(d) Shift the input signal frequency to 175 KC. and tune the station selector so that this signal is received *in the vicinity of* the 175 KC. marking on the dial scale. Adjust the 175 KC. oscillator trimmer, found on the rear apron of the chassis, simultaneously rocking the tuning condenser through the signal, until maximum receiver output is obtained. The dial calibration should fall within reasonable limits of accuracy at the 175 KC. point.

Band "A"

(a) Set the receiver band switch to "A" and turn the station selector so that the pointer is at the 1720 KC. marking.

(b) Tune the Full-Range Oscillator to produce a signal of 1720 KC.

(c) Adjust the r-f, detector and oscillator trimmers of band "A" coils for maximum receiver output.

(d) Change the external oscillator frequency to 600 KC. and turn the station selector so that this signal is received *in the vicinity of* 600 KC. marking on the dial scale. Then adjust the 600 KC. oscillator trimmer, found on the rear apron of the chassis, simultaneously rocking the tuning condenser through the signal, until maximum receiver output is obtained. The dial calibration should fall within reasonable limits of accuracy at the 600 KC. point. The adjustment at 1720 KC. should be rechecked and corrected as in (a), (b) and (c) above.

Band "B"

(a) Set the receiver band switch to "B" and turn the station selector so that the pointer is at the 5160 KC. marking.

(b) Tune the Full-Range Oscillator to produce a signal of 5160 KC.

(c) Adjust the oscillator trimmer of band "B" coil for maximum receiver output. This trimmer should be left at the first peak obtained when increasing it from minimum to maximum capacitance.

(d) Check for image signal which will be received at 4240 KC. if the oscillator trimmer is correctly set in accordance with (c).

(e) Return the station selector to 5160 KC., and adjust the detector and r-f trimmers of band "B" coils for maximum receiver output.

Band "C"

(a) Set the receiver band switch to "C" and turn the station selector so that the dial pointer is at the 18 megacycle marking.

(b) Tune the Full-Range Oscillator to produce a signal of 18,000 KC.

(c) Adjust the oscillator trimmer of band "C" coil for maximum receiver output. This trimmer should be left at the first peak obtained when increasing it from minimum to maximum capacitance.

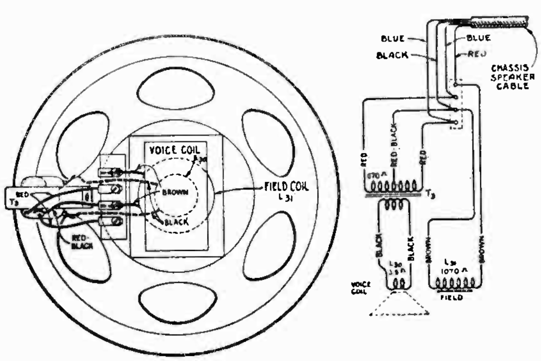


Figure 5—Console Loudspeaker Wiring

(d) Check for image signal by turning the station selector to the 17,080 KC. dial marking.

(e) Return the station selector to 18,000 KC. and reduce the capacity of the detector trimmer, while rocking the tuning condenser, until a point is reached where the signal disappears. *The first detector tuning is then at the oscillator frequency, causing the RCA-6A7 tube to block.* The trimmer should then be increased in capacity, while rocking the tuning condenser, until the point of maximum receiver output is reached.

(f) Leaving the station selector at the point determined by the adjustment of (e), adjust the antenna transformer trimmer of band "C" for maximum receiver output.

(B) POWER TRANSFORMER INPUT CONNECTIONS

A Universal type of power transformer is used on some models of this receiver to permit operation from 220-volt, 50–60 cycle power supply, as well as being arranged to take supply from 110 volts, 50–60 cycles.

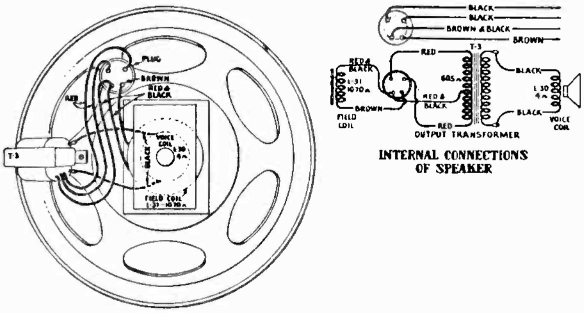


Figure 6—Console Loudspeaker Wiring— With Cable Plug

Figure 13 shows the schematic connections and wiring layout. Accessibility of the various taps is provided by a terminal strip mounted on the rear of the chassis.

(C) MAGNETIC PICKUP CONNECTIONS

A terminal board is mounted at the rear of the chassis as a provision for phonograph input. Several schemes of attaching a pickup to the receiver are shown in Figure 12. These diagrams are self-explanatory. Care should be observed to keep wiring completely shielded and away from the a-c wiring and transformers to prevent hum induction.

(D) FIDELITY LINK

It will be noted that a small link is mounted on the rear apron of the chassis, which is normally closed on table models and open on the console models. The low-frequency output of the receiver is increased when the link is opened.

(E) SOCKET VOLTAGES

The table shown below gives the operating voltages of the receiver as they appear at the socket contacts. They are referred to the chassis-ground. The values specified are the actual operating constants and do not take into account any inaccuracies that may be caused by currents drawn by the voltmeter

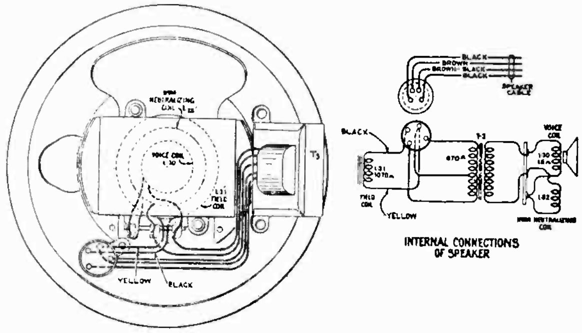


Figure 7—Table Loudspeaker Wiring— With Cable Plug

used for the measurements. In checking the voltages, a voltmeter having as high resistance multiplier as available should be used. The tubes must be in their respective sockets and the power-supply voltage adjusted to 120 volts. The volume control and sensitivity controls should be at their maximum positions, and the station selector tuned to a point where no signal is received.

RADIOTRON SOCKET VOLTAGES

120-Volt A.C. Line—Maximum Volume and Sensitivity—No Signal

Radiotron No.		Cathode to Ground Volts, D. C.	Screen Grid to Ground Volts, D. C.	Plate to Ground Volts, D. C.	Cathode Current, M. A.	Heater Volts, A. C.
RCA-6D6 R. F.		4.2	110	272	10.5	6.3
RCA-6A7	Oscillator	—	—	225	11.4	6.3
	1st Detector	4.6	110	282		
RCA-6D6 I. F.		4.2	110	272	10.5	6.3
RCA-75 2nd Det.		1.2	—	170*	0.4	6.3
RCA-76 A. F.		14.0	—	252	2.8	6.3
RCA-42 Power		22.0	295	290	24.5	6.3
RCA-42 Power		22.0	295	290	24.5	6.3
RCA-5Z3 Rectifier		—	—	768/384 R. M. S.	110.0	5.0

***Cannot be measured with ordinary voltmeter.**

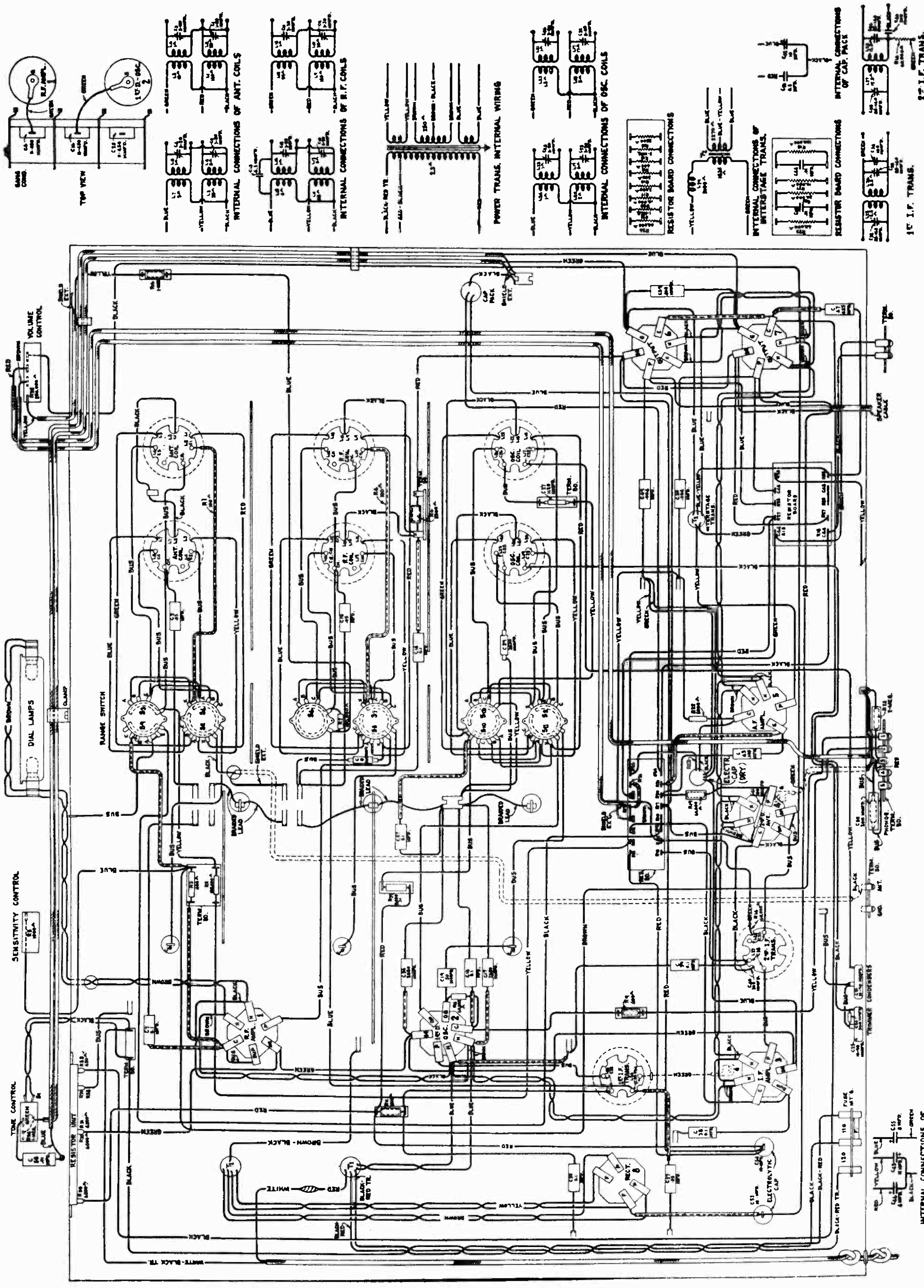


Figure 8—Wiring Diagram—Sensitivity Control Change with Band Position—Models 143 and 242 (1934 Production)

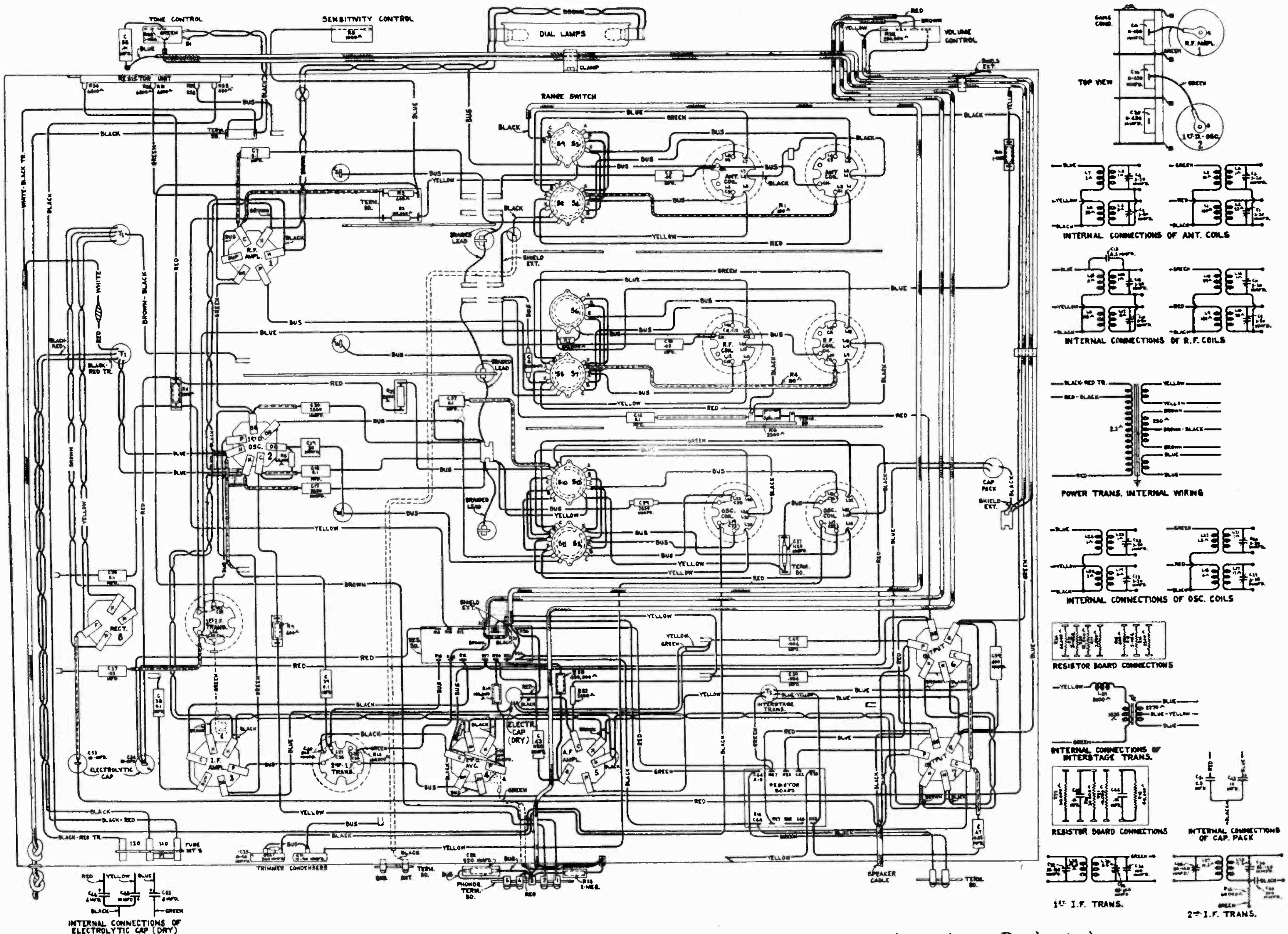


Figure 9—Wiring Diagram—Fidelity Change with Band Position—Models 143 and 242 (1934 Production)

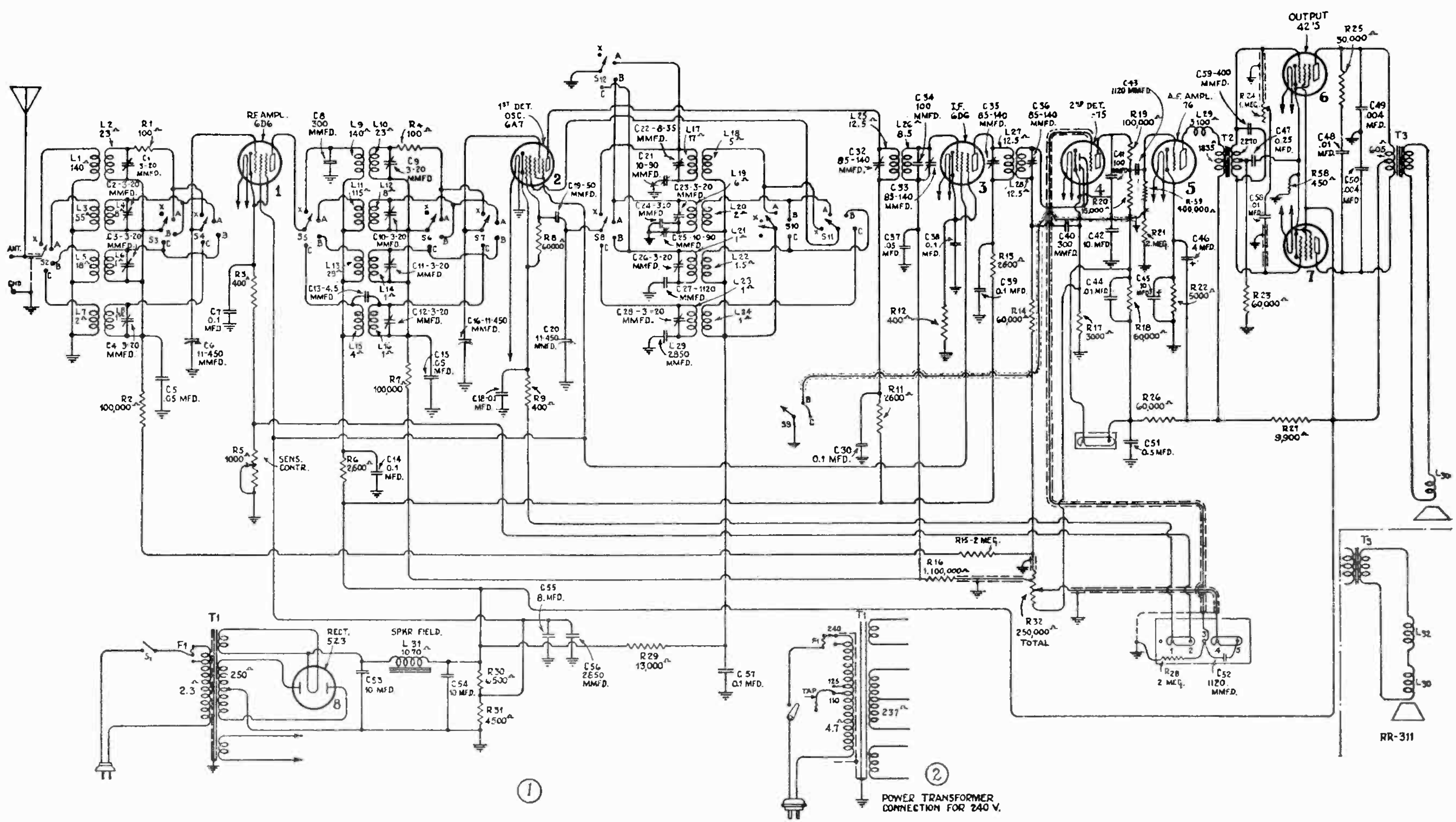


Figure 10—Schematic Circuit Diagram—Models 143, 242 and 243 (1935 Production)

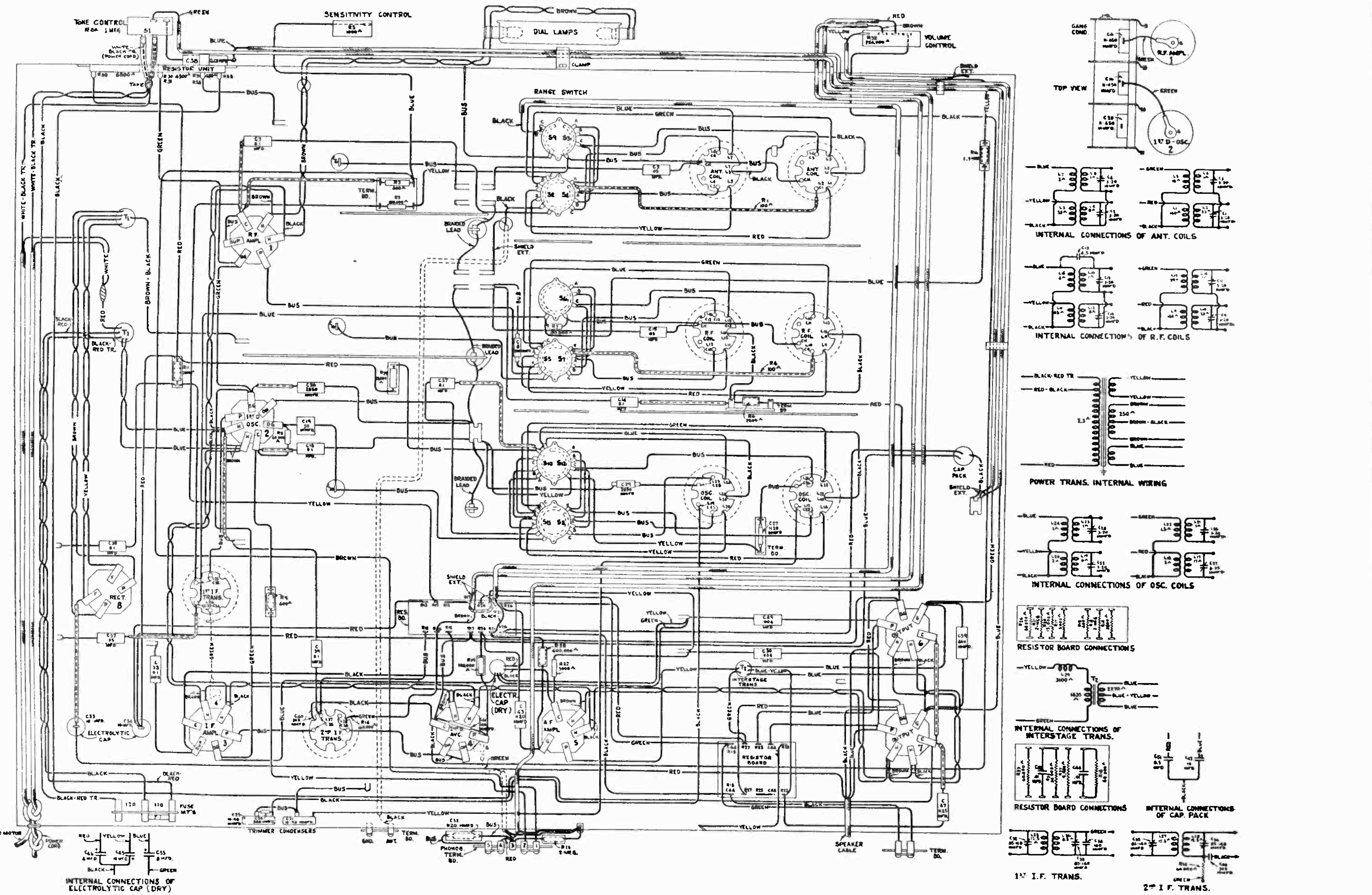


Figure 11—Chassis Wiring Diagram
Models 143, 242 and 243 (1935 Production)

FOR PLUG TYPE SPEAKER CABLE
BROWN REPLACES RED
BLACK REPLACES BLUE
BR-BL REPLACES BLACK

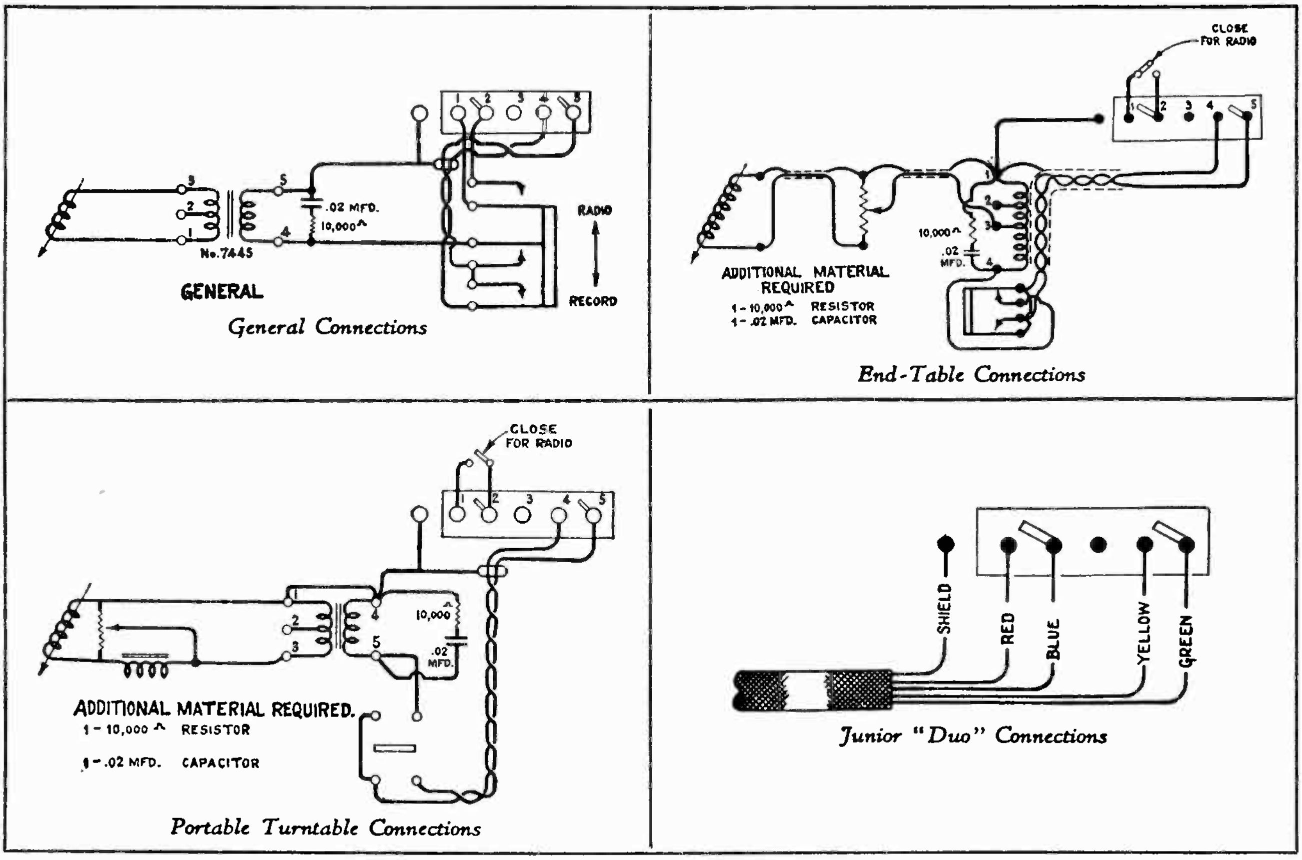


Figure 12—Magnetic Pickup Connections—Place Range Switch in A or X position during record reproduction for models with fidelity switching

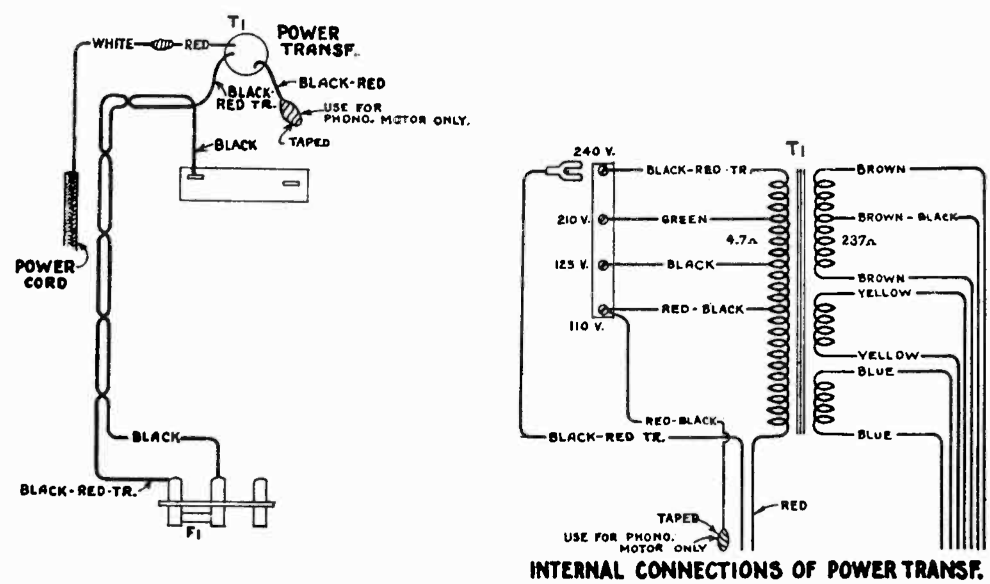


Figure 13—Universal Power Transformer Connections

REPLACEMENT PARTS—Models 143 and 242 (1934 Production)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4632	Board—Terminal board—Two terminals and link—For changing fidelity	$0.25
4379	Board—Antenna terminal board	.20
4427	Bracket—Volume control, tone control or noise suppressor mounting bracket	.18
4244	Cap—Contact cap—Package of 5	.20
3861	Capacitor — Oscillator trimmer capacitor (C21, C25)	.78
4633	Capacitor—50 mmfd. (C19)	.25
4635	Capacitor—100 mmfd. (C41)	.25
4697	Capacitor—200 mmfd. (C52)	.35
3937	Capacitor—300 mmfd. (C8)	.34
4413	Capacitor—360 mmfd. (C24)	.22
4183	Capacitor—400 mmfd. (C59)	.26
4412	Capacitor—1120 mmfd. (C27)	.25
4409	Capacitor—1120 mmfd. (C43)*	.35
4634	Capacitor—1120 mmfd. (C52)*	.35
4524	Capacitor—2850 mmfd. (C29)	.35
4615	Capacitor—2850 mmfd. (C17, C56)	.34
4628	Capacitor—0.004 mfd. (C49, C50)	.28
6512	Capacitor—0.005 mfd. (C43)	.28
3787	Capacitor—0.01 mfd. (C48)	.30
4212	Capacitor—0.01 mfd. (C44)	.30
4624	Capacitor—0.01 mfd. (C58)	.54
3888	Capacitor—0.05 mfd. (C37)	.25
4417	Capacitor—0.05 mfd. (C5, C15)	.25
3877	Capacitor—0.1 mfd. (C38)	.32
4415	Capacitor—0.1 mfd. (C18)	.30
4645	Capacitor—0.1 mfd. (C7, C14, C30, C39, C57)	.25
3750	Capacitor—0.25 mfd. (C47)	.36
7790	Capacitor—10 mfd. (C53, C54)	1.05
4619	Capacitor pack—Comprising one 0.5 mfd., one 10 mfd. capacitor (C42, C51)	1.44
4626	Capacitor pack—Comprising one 4 mfd., one 10 mfd. and one 8 mfd. capacitor (C45, C46, C55)	2.82
4358	Clamp—Electrolytic capacitor clamp—For capacitor stock No. 7790	.15
4693	Clamp—Electrolytic capacitor clamp—For capacitor stock No. 4626	.15
7810	Coil—Antenna coil "PB-LW" (L1, L2, L5, L6, C1, C3)	2.10
7803	Coil—Antenna coil "B.S.W." (L3, L4, L7, L8, C2, C4)	1.82
7808	Coil—Detector coil "P.B.-L.W." (L9, L10, L13, L14, C9, C11)	$2.05
7805	Coil—Detector coil "B.-S.W." (L11, L12, L15, L16, C10, C12, C13)	2.15
7807	Coil—Oscillator coil "B.-S.W." (L19, L20, L23, L24, C23, C28)	1.62
7809	Coil—Oscillator coil "P.B.-L.W." (L17, L18, L21, L22, C22, C26)	1.70
7801	Condenser—3-gang variable tuning condenser (C6, C16, C20)	4.42
4371	Cover—Fuse mount cover	.15
4631	Cover—Terminal strip cover	.15
10907	Fuse—3-ampere—Package of 5	.40
3376	Mount — Fuse mount — 105-125-volt instrument	.40
4604	Mount—Fuse mount for 200-250-volt instrument	.35
4625	Resistor—Wire wound resistor—Comprising one 6500-ohm-4500-ohm and 450 section (R30, R31, R58)	.70
3704	Resistor—400 ohms—Carbon type—¼ watt —Package of 5 (R9, R3, R12)	1.00
4622	Resistor—500 ohms—Carbon type—¼ watt —Package of 10 (R10)	2.00
4338	Resistor — 2500 ohms — Carbon type — ¼ watt—Package of 10 (R6, R11, R13)	2.00
4242	Resistor — 3000 ohms — Carbon type — ¼ watt—Package of 5 (R17)	1.00
4436	Resistor — 5000 ohms — Carbon type — ¼ watt—Package of 10 (R22)	2.00
3381	Resistor—10,000 ohms—Carbon type—¼ watt (R20)—Package of 5	1.00
3998	Resistor—15,000 ohms—Carbon type—¼ watt—Package of 5 (R20)	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt—Package of 5 (R8, R18*, R19, R23, R26)	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt—Package of 5 (R2, R7, R18, R19*)	1.00
3619	Resistor—400,000 ohms—Carbon type—¼ watt (R59)—Package of 5	1.00
3033	Resistor — 1 megohm — Carbon type — ¼ watt—Package of 5 (R16, R21)	1.00
6242	Resistor — 2 megohms — Carbon type — ¼ watt—Package of 5 (R15, R21,* R28)	1.00
3078	Resistor—10,000 ohms—Carbon type—½ watt—Package of 5 (R27)	1.00
4623	Resistor—13,000 ohms—Carbon type—½ watt—Package of 10 (R29)	2.00
2240	Resistor—30,000 ohms—Carbon type—1 watt (R25)	.22
4418	Resistor—100 ohms—Flexible type—Package of 10 (R1, R4)	1.50
4618	Rheostat—Sensitivity control (R5)	1.25

* R18—60,000 ohms—Some models.
* R19—100,000 ohms—Some models.

* R20—15,000 ohms—Some models.
* R21—2 megohms—Some models.
* C52—1120 mmfd.—Some models.

REPLACEMENT PARTS—Models 143 and 242 (1934 Production) Continued

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
7800	Shield—Antenna, detector or oscillator coil shield	$0.45
4627	Shield—First detector—Oscillator Radiotron shield	.36
7488	Shield—First detector—Oscillator Radiotron shield top	.20
4452	Shield—I. F. amplifier Radiotron shield	.35
4629	Shield—I. F. amplifier Radiotron shield top	.15
4663	Shield—Oscillator coil wiring shield—Shields oscillator coil wiring from R. F. coil—Complete with terminal board, clamp and resistor	.32
4664	Shield—Oscillator wiring shield—Shields oscillator coil wiring from R. F. coil—Complete with terminal strip and resistor	.36
4630	Shield—R. F. amplifier—Radiotron shield	.36
4665	Shield—R. F. coil wiring shield with two resistors and terminal board	.50
3529	Socket—Dial lamp socket	.32
3859	Socket—4-contact Radiotron socket	.30
7484	Socket—5-contact Radiotron socket	.35
7485	Socket—6-contact Radiotron socket	.40
3572	Socket—7-contact Radiotron socket	.38
4617	Switch—Range switch (S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12)	3.32
4616	Tone control (R24, S1)	1.28
4431	Transformer—First intermediate frequency transformer (L25, L26, C32, C33, C34)	2.28
9505	Transformer—Power transformer—105–125 volts—50–60 cycles (T1)	6.35
9506	Transformer—Power transformer—105–125 volts—25–40 cycles	8.90
9507	Transformer—Power transformer—105–250 volts—40–60 cycles	6.40
4433	Transformer—Second intermediate frequency transformer (L27, L28, C35, C36, C40, R14)	2.15
4620	Transformer and reactor—Interstage transformer and reactor (T2, L29)	2.98
4519	Volume control (R32)	1.25
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball for variable condenser drive assembly—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—Comprising drive shaft, balls, ring, spring and washers assembled	1.00
7799	Drive—Variable tuning condenser drive complete	2.45
4364	Gear—Spring gear assembly complete with hub, pinion, gear, cover and spring	$0.96
4704	Indicator—Band indicator—Celluloid	.12
4367	Indicator—Station selector vernier pointer—Small	.15
4520	Indicator—Station selector main pointer—Large	.18
3943	Screen—Translucent screen for dial light—Package of 2	.18
3993	Screw—No. 6–32–5–32" square head set screw for band indicator operating arm or condenser drive—Package of 10	.25
4377	Spring — Band indicator and arm tension spring—Package of 5	.25
4360	Stem—Station selector pointer stem	.35
4378	Stud—Band indicator operating arm stud—Package of 5	.25
	REPRODUCER ASSEMBLY (TABLE MODEL)	
9534	Coil—Field coil (L31)	1.90
9533	Cone—Cone mounted and centered on housing (L30)	3.50
9532	Reproducer complete	7.50
9535	Transformer—Output transformer (T3)	1.50
	REPRODUCER ASSEMBLY (CONSOLE MODEL)	
4636	Cable—4-conductor—Reproducer cable	.50
9537	Coil—Field coil magnet and cone support (L31)	3.85
8969	Cone—Reproducer cone—Package of 5 (L30)	6.35
9536	Reproducer complete	8.40
4637	Transformer—Output transformer (T3)	1.50
	MISCELLANEOUS PARTS	
4677	Bezel—Metal bezel (escutcheon) for station selector dial	.56
4621	Dial—Station selector dial	.65
6614	Glass—Station selector dial glass	.30
4449	Knob—Station selector, volume control, tone control, noise suppressor rheostat on range switch knob—Package of 5	.60
4340	Lamp—Dial lamp—Package of 5	.60
4678	Ring—Retaining ring for dial glass—Package of 5	.35
4446	Screw assembly—Chassis mounting screw assembly—Comprising four screws, four lockwashers, four washers, four spacers and eight cushions	.28
4613	Screw—No. 8–32–1/16" headless set screw for knobs—Package of 10	.25

REPLACEMENT PARTS—Models 143, 242 and 243 (1935 Production)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4632	Board—Terminal board—Two terminals and link—For changing fidelity	$0.25
4379	Board—Antenna terminal board	.20
4427	Bracket—Volume control, tone control or noise suppressor mounting bracket	.18
4244	Cap—Contact cap—Package of 5	.20
3861	Capacitor — Oscillator trimmer capacitor (C21, C25)	.78
4633	Capacitor—50 mmfd. (C19)	.25
4635	Capacitor—100 mmfd. (C41)	.25
4248	Capacitor—300 mmfd. (C8)	.22
4811	Capacitor—340 mmfd. (C24)	.25
4183	Capacitor—400 mmfd. (C59)	.26
4412	Capacitor—1120 mmfd. (C27)	.25
4409	Capacitor—1120 mmfd. (C43)	.35
4634	Capacitor—1120 mmfd. (C52)	.35
4524	Capacitor—2850 mmfd. (C29)	.35
4615	Capacitor—2850 mmfd. (C56)	.34
4628	Capacitor—0.004 mfd. (C49, C50)	.28
3787	Capacitor—0.01 mfd. (C48)	.30
4212	Capacitor—0.01 mfd. (C44)	.30
4624	Capacitor—0.01 mfd. (C58)	.54
4836	Capacitor—0.05 mfd. (C5, C15, C37)	.30
4791	Capacitor—0.1 mfd. (C7, C18, C38)	.24
4885	Capacitor—0.1 mfd. (C14, C30, C39, C57)	.28
4840	Capacitor—0.25 mfd. (C47)	.30
7790	Capacitor—10 mfd. (C53, C54)	1.05
4619	Capacitor pack—Comprising one 0.5 mfd., one 10 mfd. capacitor (C42, C51)	1.44
4626	Capacitor pack—Comprising one 4 mfd., one 10 mfd. and one 8 mfd. capacitor (C45, C46, C55)	2.82
4358	Clamp—Electrolytic capacitor clamp—For capacitor Stock No. 7790	.15
4693	Clamp—Electrolytic capacitor clamp—For capacitor Stock No. 4626	.15
7810	Coil—Antenna coil "Band B-X" (L1, L2, L5, L6, C1, C3)	2.10
7803	Coil—Antenna coil "Band A-C" (L3, L4, L7, L8, C2, C4)	1.82
7808	Coil—Detector coil "Band X-B" (L9, L10, L13, L14, C9, C11)	2.05
7805	Coil—Detector coil "Band A-C" (L11, L12, L15, L16, C10, C12, C13)	2.15
7807	Coil—Oscillator coil "Band A-C" (L19, L20, L23, L24, C23, C28)	1.62

Stock No.	Description	List Price
7809	Coil—Oscillator coil "Band X-B" (L17, L18, L21, L22, C22, C26)	$1.70
4806	Condenser—3-gang variable tuning condenser (C6, C16, C20)	5.64
4371	Cover—Fuse mount cover	.15
4631	Cover—Terminal strip cover	.15
10907	Fuse—3-ampere—Package of 5	.40
3376	Mount — Fuse mount — 105–125-volt instrument	.40
4604	Mount—Fuse mount for 200–250-volt instrument	.35
4625	Resistor—Wire wound resistor—Comprising one 6500-ohm–4500-ohm and 450 section (R30, R31, R58)	.70
3704	Resistor—400 ohms—Carbon type—¼ watt (R3, R9, R12)—Package of 5	1.00
4812	Resistor — 2600 ohms — Carbon type — ¼ watt (R6, R11, R13)—Package of 5	1.00
4242	Resistor — 3000 ohms — Carbon type — ¼ watt (R17)—Package of 5	1.00
2871	Resistor — 5000 ohms — Carbon type — ¼ watt (R22)—Package of 5	1.00
3998	Resistor—15,000 ohms—Carbon type—¼ watt (R20)—Package of 5	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R8, R18, R23, R26)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R2, R7, R19)—Package of 5	1.00
3619	Resistor—400,000 ohms—Carbon type—¼ watt (R59)—Package of 5	1.00
4783	Resistor—1,100,000 ohms—Carbon type—¼ watt (R16)—Package of 5	1.00
6242	Resistor — 2 megohms — Carbon type — ¼ watt (R15, R21, R28)—Package of 5	1.00
3078	Resistor—10,000 ohms—Carbon type—½ watt (R27)—Package of 5	1.00
4623	Resistor—13,000 ohms—Carbon type—½ watt (R29)—Package of 10	2.00
2240	Resistor—30,000 ohms—Carbon type—1 watt (R25)	.22
4418	Resistor—100 ohms—Flexible type (R1, R4)—Package of 10	1.50
4618	Rheostat—Sensitivity control (R5)	1.25
4742	Shield—Antenna, detector or oscillator coil shield	.40
4627	Shield—First detector—Oscillator Radiotron shield	.36
6956	Shield—First detector—Oscillator Radiotron shield top	.15
4452	Shield—Second detector—"A.V.C." Radiotron shield	.35
4629	Shield—Second detector—"A.V.C." Radiotron shield top	.15

REPLACEMENT PARTS—Models 143, 242 and 243 (1935 Production) Continued

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
3950	Shield—I. F. amplifier Radiotron shield	$0.26
4521	Shield—I. F. transformer shield	.42
4663	Shield—Oscillator coil wiring shield—Shields oscillator coil wiring from R. F. coil—Complete with terminal board, clamp and resistor	.32
4664	Shield—Oscillator wiring shield—Shields oscillator coil wiring from R. F. coil—Complete with terminal strip and resistor	.36
4630	Shield—R. F. amplifier—Radiotron shield	.36
4665	Shield—R. F. coil wiring shield with two resistors and terminal board	.50
3529	Socket—Dial lamp socket	.32
4784	Socket—4-contact Radiotron socket	.15
4814	Socket—5-contact Radiotron socket	.15
4786	Socket—6-contact Radiotron socket	.15
4787	Socket—7-contact Radiotron socket	.15
4617	Switch—Range switch (S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12)	3.32
4813	Tone control (R24, S1)	1.42
4431	Transformer—First intermediate frequency transformer (L25, L26, C32, C33, C34)	2.28
9505	Transformer—Power transformer—105–125 volts—50–60 cycles (T1)	6.35
9506	Transformer—Power transformer—105–125 volts—25–40 cycles	8.90
9507	Transformer—Power transformer—105–250 volts—40–60 cycles	6.40
4433	Transformer—Second intermediate frequency transformer (L27, L28, C35, C36, C40, R14)	2.15
4620	Transformer and reactor—Interstage transformer and reactor (T2, L29)	2.98
4809	Volume control (R32)	1.45

DRIVE ASSEMBLIES

Stock No.	Description	List Price
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball for variable condenser drive assembly—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—Comprising drive shaft, balls, ring, spring and washers assembled	1.00
7799	Drive—Variable tuning condenser drive complete	2.45
4827	Gear—Spring gear assembly complete with hub, pinion, gear, cover and spring	1.25
4704	Indicator—Band indicator—Celluloid	.12
4367	Indicator—Station selector vernier pointer—Small	.15
4520	Indicator—Station selector main pointer—Large	.18
3943	Screen—Translucent screen for dial light—Package of 2	.18
3993	Screw—No. 6–32–5/32" square head set screw for band indicator operating arm or condenser drive—Package of 10	.25
4377	Spring — Band indicator and arm tension spring—Package of 5	$0.25
4722	Pinion — Vernier pointer pinion — Station selector pointer stem	.18
4378	Stud—Band indicator operating arm stud—Package of 5	.25

REPRODUCER ASSEMBLY (TABLE MODEL)

Stock No.	Description	List Price
5038	Cable—4-conductor—Reproducer cable with female connector plug	.60
9534	Coil—Field coil (L31)	1.90
9533	Cone—Cone mounted and centered on housing (L30)	3.50
5039	Connector—4-prong male connector for reproducer cable	.25
5040	Connector—4-contact female connector for reproducer cable	.25
9593	Reproducer complete	7.50
9535	Transformer—Output transformer (T3)	1.50

REPRODUCER ASSEMBLY (CONSOLE MODEL)

Stock No.	Description	List Price
5038	Cable—4-conductor—Reproducer cable with female connector plug	.60
9591	Coil—Field coil magnet and cone support (L31)	4.00
8969	Cone—Reproducer cone (L30)—Package of 5	6.35
5039	Connector—4-prong male connector for reproducer	.25
5040	Connector—4-contact female connector for reproducer cable	.25
9592	Reproducer complete	8.00
5041	Transformer—Output transformer (T3)	1.40

MISCELLANEOUS PARTS

Stock No.	Description	List Price
4677	Bezel—Metal bezel (escutcheon) for station selector dial	.56
4621	Dial—Station selector dial	.65
6614	Glass—Station selector dial glass	.30
4449	Knob—Station selector, volume control, tone control, noise suppressor rheostat on range switch knob—Package of 5	.60
4340	Lamp—Dial lamp—Package of 5	.60
4678	Ring—Retaining ring for dial glass—Package of 5	.35
4446	Screw assembly—Chassis mounting screw assembly—Comprising four screws, four lockwashers, four washers, four spacers and eight cushions—For table model	.28
4613	Screw—No. 8–32–7/16" headless set screw for knobs—Package of 10	.25

RCA VICTOR MODELS 226 AND 128

Six-Tube, Three-Band, A. C. Superheterodyne Receivers

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage and Frequency Ratings	105–125 Volts, 50–60 Cycles 105–125 Volts, 25–60 Cycles 100–130/195–250 Volts, 50–60 Cycles
Power Consumption	Approximately 80 Watts
Number and Type of Radiotrons	2 RCA-6D6, 1 RCA-6A7, 1 RCA-6B7, 1 RCA-42, 1 RCA-80—Total, 6
Tuning Frequency Range Limits	Band "A"— 540 K. C.– 1,720 K. C. Band "B"—1,720 K. C.– 5,400 K. C. Band "C"—5,400 K. C.–18,000 K. C.
Alignment Frequencies	460 K. C., 600 K. C., 1,720 K. C., and 18,000 K. C.
Maximum Undistorted Output	1.75 Watts
Maximum Output	3.5 Watts

PHYSICAL SPECIFICATIONS

	Model 226	*Model 128*
Height	39 Inches	20¼ Inches
Width	24 Inches	16¾ Inches
Depth	12 Inches	11 7/16 Inches

These receivers, both of which employ the same chassis, are manufactured from a design that includes such requirements as "all-wave" reception, high sensitivity, good selectivity and pleasing tone quality. The tuning ranges listed above cover the standard broadcasting band, and extend into the shorter wave regions for reception of foreign and trans-oceanic broadcast signals.

Uniform tonal quality is realized from the output of these instruments. With the efficiently designed reproducer units, and the amplification system supplying them, more than adequate volume may be obtained; the undistorted limit of output being 1.75 watts.

Special operating features used on this chassis include a "full vision-airplane dial," a dual-ratio vernier drive, a high frequency tone control, automatic volume control, and a visual indicator for the three-position band switch.

DESCRIPTION OF ELECTRICAL CIRCUIT

The general circuit arrangement consists of an R. F. stage, a combined oscillator and first detector, an I. F. stage, a combined second detector—audio amplifier—AVC Stage, and a single Pentode output stage. An RCA-80 rectifier, together with a suitable filtering system, provides plate and grid voltages for all tubes and field excitation for the loudspeaker. Figure 3 shows the schematic circuit diagram, Figure 4 the chassis wiring, and Figures 7 to 10 the loudspeaker wiring.

The signal enters the receiver through a shielded antenna lead and is applied to the grid of the R. F. tube through the antenna coupling transformer. The secondary of this transformer is tuned to the signal frequency by means of one unit of the gang-capacitor. The output of this stage is transformer coupled to the grid circuit of the first detector, which is also tuned to the signal frequency by a unit of the gang-capacitor. Combined with the signal in the first detector is the local oscillator, which is always at a 460 K. C. frequency difference (higher) from the signal frequency. A separate coil system and the third unit of the gang-capacitor are used in this circuit.

In conjunction with these three tuned circuits, it is well to point out that three different groups of tuned circuits are used, one for each tuning band. A three-position selector switch is provided for selecting the band in which the desired signal is located. In addition to selecting the desired coil system, additional groups of contacts are provided for short-circuiting the preceding lower frequency R. F. and detector coils and the two preceding oscillator coils. This is to prevent "dead" spots due to the absorption effects caused by the coils, the natural period of which, with tuning capacitor disconnected, fall in the next higher frequency band.

The output of the first detector, which is the I. F. signal (460 K. C.), is fed directly through two tuned circuits to the grid of the I. F. amplifier stage. The I. F. stage, which utilizes Radiotron RCA-6D6, has two transformers, which consist of four tuned circuits, all of which are tuned to 460 K. C.

The output of the I. F. amplifier is then applied to the diode electrodes of the RCA-6B7, which cause detection. The direct current component of the rectified signal produces a voltage drop across resistor R-12. The full voltage drop constitutes the automatic bias voltage for the R. F., while a tap is provided for the first detector and I. F. voltage. These automatic bias voltages for the R. F. first detector and I. F. give the automatic volume control action of the receiver. The volume control arm selects the amount of audio voltage that is applied to the grid of the RCA-6B7 and thereby regulates the audio output of the entire receiver.

The output of the RCA-6B7 is introduced to the RCA-42 output tube through the resistance-capacitance coupling network. By inspection of the schematic, it may be seen that band switch contacts are arranged to affect the frequency response of this coupling system by changing the total value of the capacitance. The purpose of such change with band position is to make possible the desired fidelity on the short-wave bands, and to maintain the utmost fidelity on the regular broadcast band.

In the power output stage, the RCA-42 is operated as a Pentode amplifier. It provides high audio gain and good quality. The usual step-down plate transformer is used for matching the tube to the cone coil of the loudspeaker.

The tone control consists of a variable resistor and fixed capacitor connected in series across the primary of the output transformer. At the minimum resistance position of the variable resistor, maximum attenuation of the high audio frequencies is obtained.

Plate and grid voltages for all tubes are supplied from the output of the rectifier-filter system. An RCA-80 is used as a rectifier and a suitable network of capacitors and resistors gives the necessary filtering and voltages. The loudspeaker field is used as a filter reactor.

(1) LINE-UP PROCEDURE

Properly aligned, this receiver performs outstandingly; improperly aligned, there may be a tendency towards low sensitivity and distorted quality of reproduction. Inasmuch as the line-up procedure is more or less involved, it is important that these instructions be carefully followed.

Equipment

To align this receiver, proper test equipment must be used. Such consists of a modulated R. F. oscillator having proper frequency range, an output indicator, an alignment tool and a tuning wand. These parts, shown on page 2, have been developed by the manufacturer of this receiver for use by service men to duplicate the original factory adjustments.

Checking with Tuning Wand

Before making any R. F., oscillator or first detector adjustments, the accuracy of the existing adjustments may be checked with a tuning wand (Stock No. 6679). This wand consists of a bakelite rod having a brass cylinder at one end and a special finely divided iron insert at the other end. Inserting the cylinder into the center of a coil lowers its inductance, while inserting the iron end increases its inductance. From this, it is seen that unless the trimmer for a particular coil is properly aligned, the wand may increase the output of the receiver. A perfect adjustment is evidenced by a lowering of output when either end of the wand is inserted into a coil.

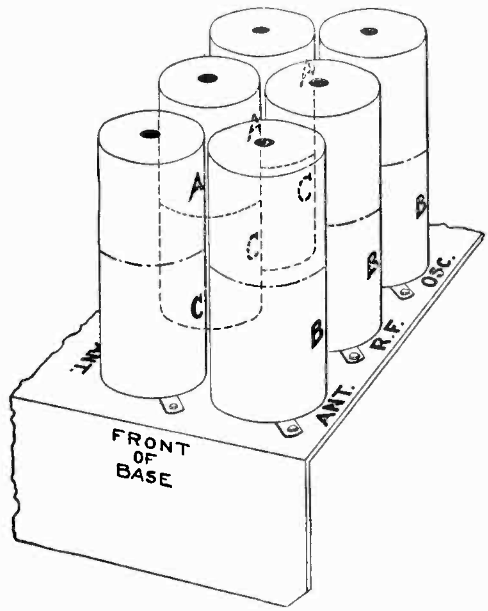


Figure 1—Location of Coils in Shields

The shield over each R. F. coil assembly has a hole at its top for entrance of the tuning wand. The location of the various coils inside of their shields is shown in Figure 1. An example of the proper manner of using the tuning wand would be to assume the external oscillator were set at 1,720, the signal tuned in, and the output indicator connected across the voice coil of the loudspeaker. Then the tuning wand should be inserted, first one end and then the other end, into the top of the three transformers at the left of the R. F. assembly, facing the front of the chassis. A perfect adjustment of the trimmer would be evidenced by a reduction in output when each end of the wand is inserted into each of the three transformers. If one end —for example, the iron end—when inserted in one coil caused an increase in output, then that circuit is high. An increase in the trimmer capacitance would be the proper remedy.

(2) I. F. TUNING CAPACITOR ADJUSTMENTS

Although this receiver has one I. F. stage, there are two transformers, each having two adjustable capacitors requiring adjustment. The transformers are all peaked, being tuned to 460 K. C.

A detailed procedure for making this adjustment follows:

(a) Connect the output of an external oscillator operating at 460 K. C. between the first detector grid and ground. Connect the output indicator across the voice coil of the loudspeaker.

(b) Place the receiver in operation and adjust the station selector until a point is reached (B and A) where no signals are heard and turn the volume control to its maximum position. Reduce the oscillator output until a slight indication is obtained in the receiver output indicator.

(c) Refer to Figure 2. Adjust the trimmers of the I. F. transformers until a maximum output is obtained. Go over the adjustments a second time.

This completes the I. F. adjustments. It is good practice to follow the I. F. adjustments with the R. F. and oscillator adjustments due to interlocking which always occurs between the two.

(3) R. F. OSCILLATOR AND FIRST DETECTOR ADJUSTMENTS

Four R. F., oscillator and first detector adjustments are required in band "A." Three are required in bands "B" and "C."

To properly align the various bands, each must be aligned individually in the order given. This is "A," "B" and "C." The preliminary set-up requires that the external oscillator be connected between the antenna and ground terminals of the receiver and the output indicator be connected across the voice coil of the loudspeaker. The volume control must be at its maximum position and the output of the oscillator must be at the minimum value possible to get an output indication under these conditions. In the high frequency bands, it may be necessary to disconnect the oscillator from the receiver and place it at a distance in order to get a sufficiently low input to the receiver.

The dial pointer must be properly set before starting actual adjustments. This is done by turning the variable capacitor until it is at its maximum capacity position. One end of the pointer should point exactly at the horizontal line at the lowest frequency end of band "A," while the other end should point to within 1/64 inch of the horizontal line at the highest frequency end of band "A."

Figure 2 shows the location of the trimmers for each band. Care must be exercised to only adjust the trimmers in the band under test.

Band "A"

(a) Set the band switch at "A."

(b) The oscillator series capacitor, located on the rear apron of the chassis, should be set at about the center of its range.

(c) Tune the external oscillator to 1,720 K. C., set the pointer at 1,720 K. C. and adjust the oscillator, detector and R. F. trimmers for maximum output.

(d) Shift the external oscillator frequency to 600 K. C. Tune in the 600 K. C. signal, irrespective of scale calibration, and adjust the series trimmers, located on rear apron of chassis, for

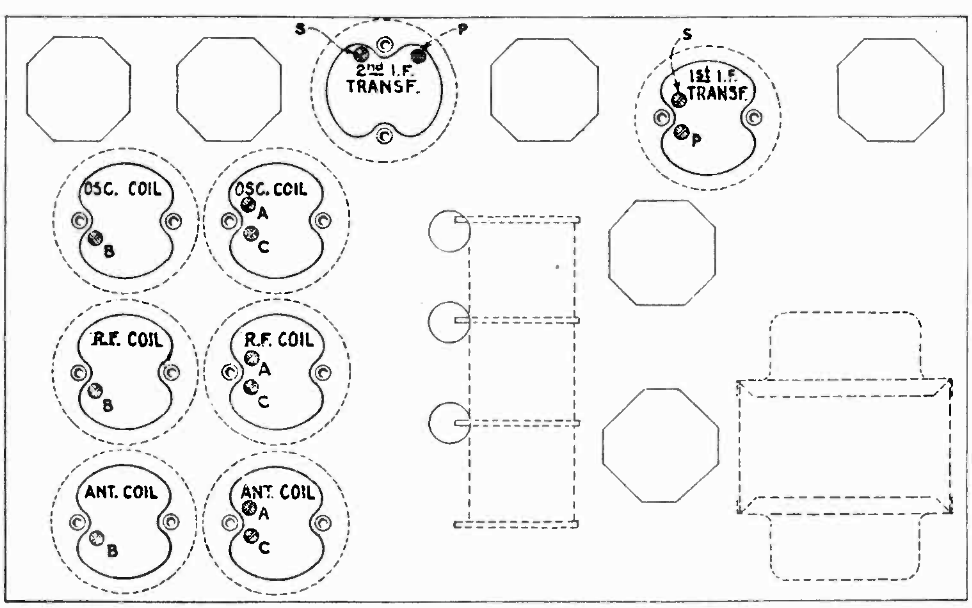


Figure 2—Location of Line-up Capacitors

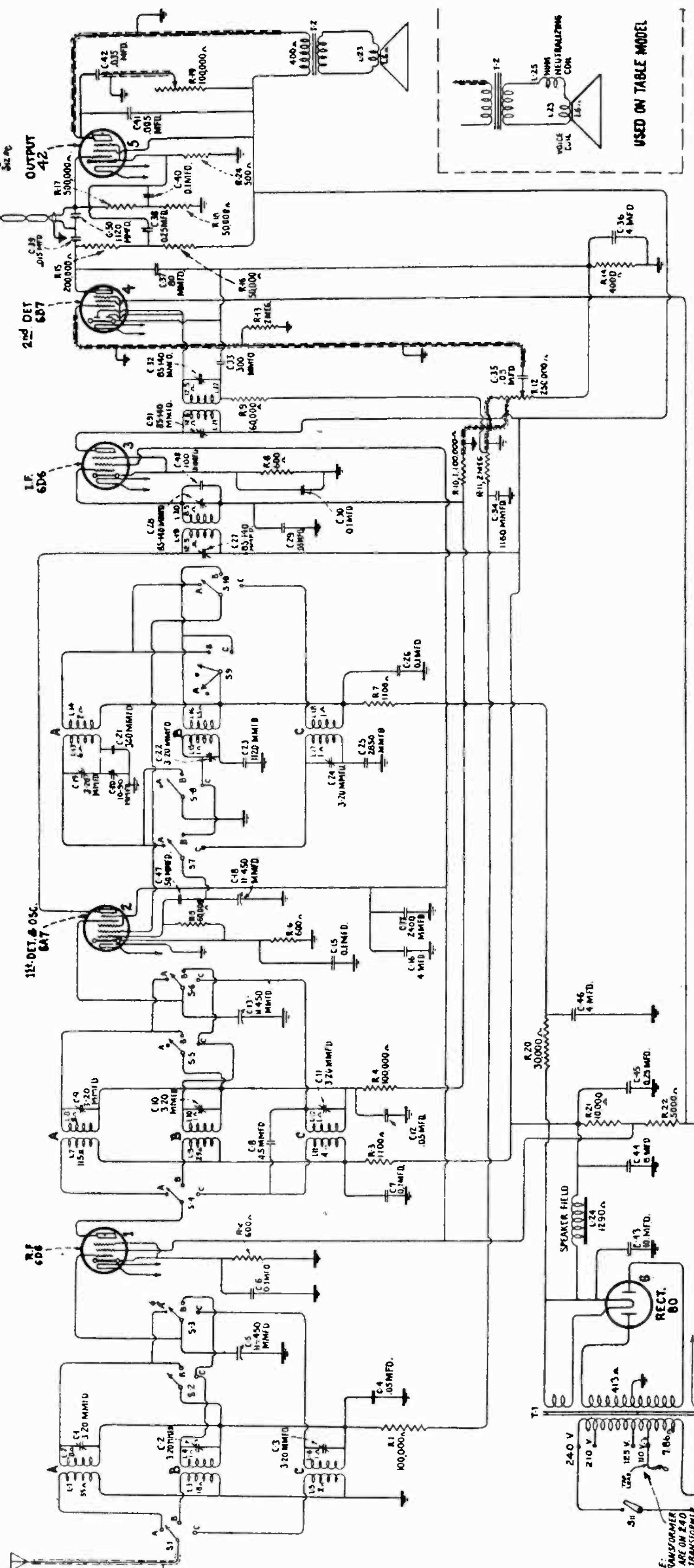
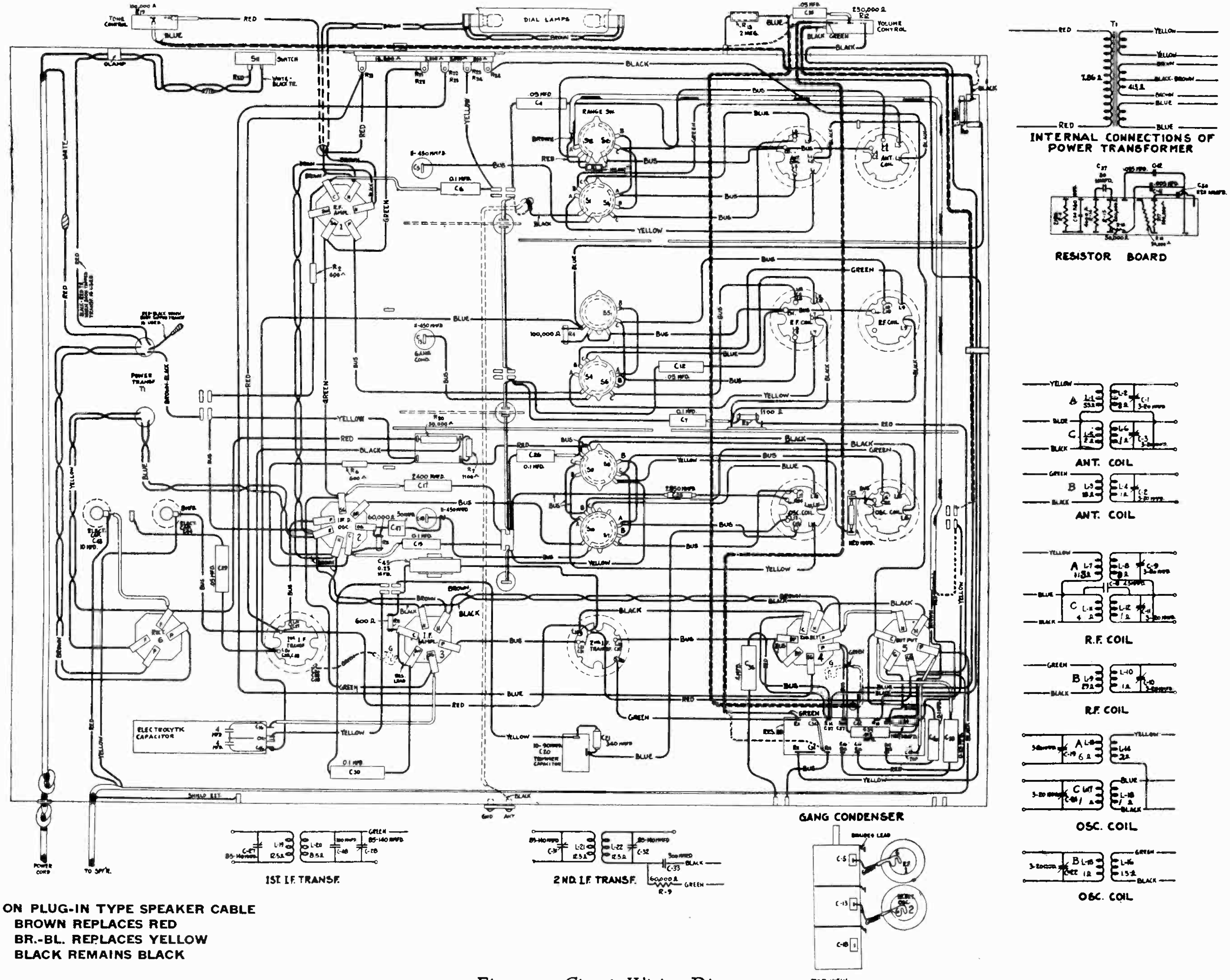


Figure 3—Schematic Circuit Diagram



ON PLUG-IN TYPE SPEAKER CABLE
BROWN REPLACES RED
BR.-BL. REPLACES YELLOW
BLACK REMAINS BLACK

Figure 4—Circuit Wiring Diagram

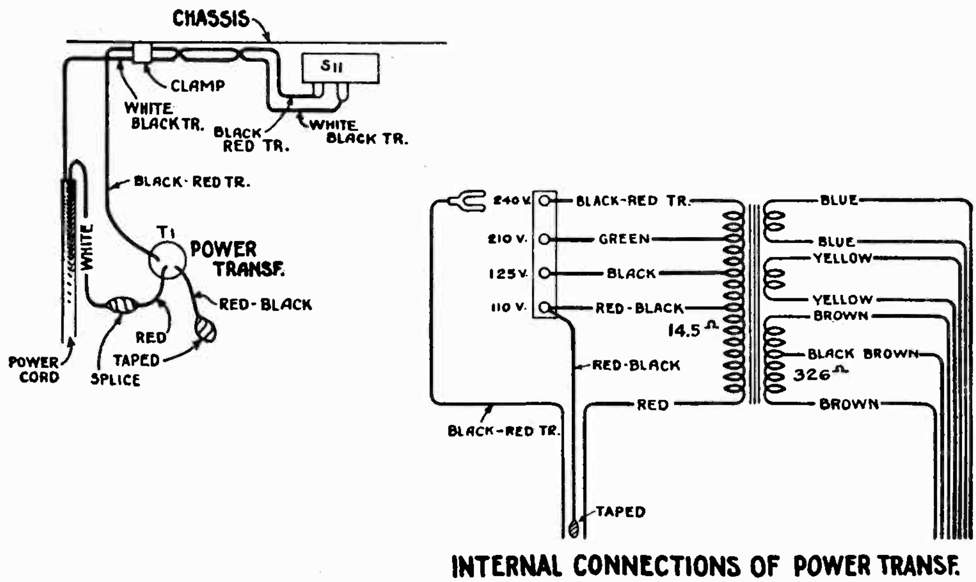
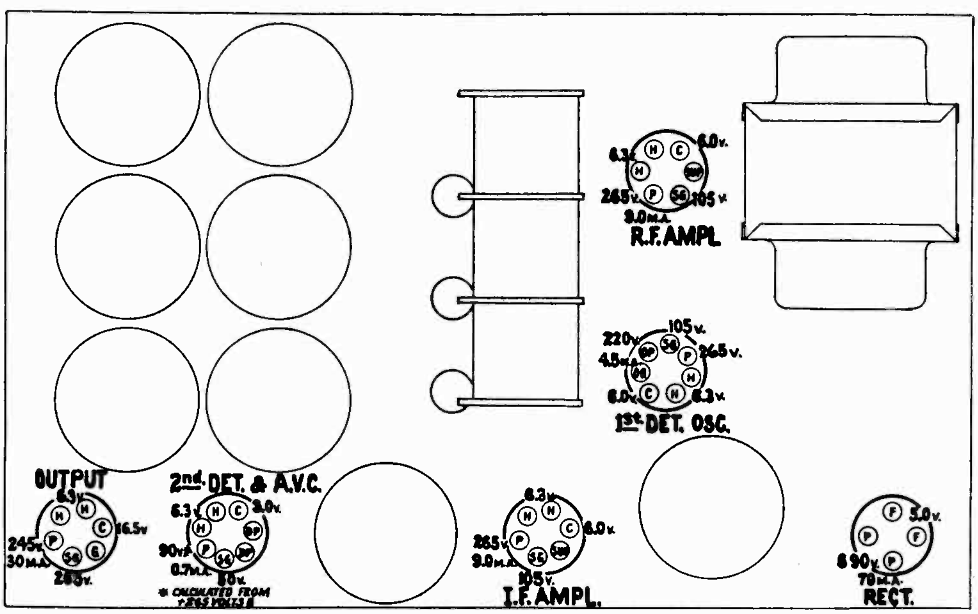


Figure 5—Universal Transformer Connections (50–60 Cycles)



ALL D. C. VOLTAGES ARE TO GROUND

Figure 6—Tube Socket Voltages

maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 1,720 K. C. as described in (c).

Band "B"

(a) Set the band switch at "B."

(b) The detector and antenna trimmers should first be tightened to approximately ¾ maximum capacity (turned ¾ inch).

(c) Tune the external oscillator to 5,160 K. C., set the pointer at 5,160 K. C. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacitor from minimum to maximum.

(d) Check for the image signal, which will be received at approximately 4,240 K. C. on the dial, if the trimmer is set properly in accordance with (c). It may be necessary to increase the external oscillator output for this check.

(e) Reduce the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal disappears. *The first detector circuit is then aligned with the oscillator circuit and the RCA-6A7 tube is blocked.* Then increase the capacity of the detector trimmer, while rocking

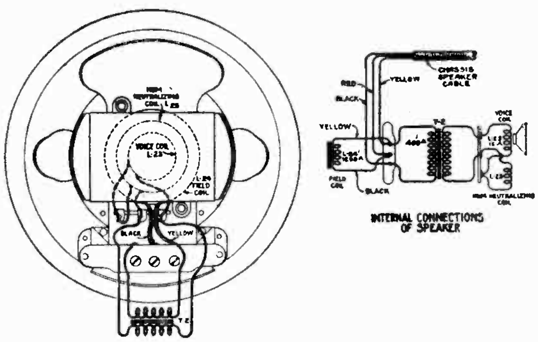


Figure 7—Table Loudspeaker Wiring (without cable plug)

the tuning capacitor, until the signal is peaked for maximum output.

(f) The antenna trimmer should now be peaked for maximum output. It is not necessary to

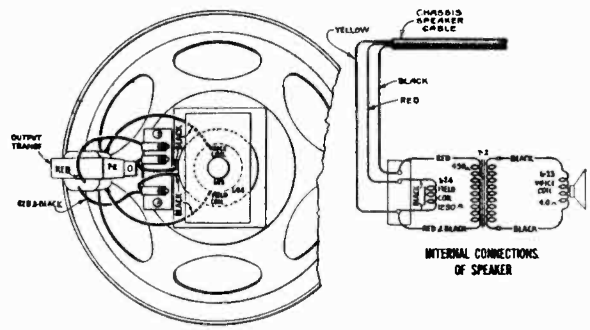


Figure 8—Console Loudspeaker Wiring (without cable plug)

rock the main tuning capacitor while making this adjustment.

Band "C"

(a) Set the band switch at "C."

(b) The detector and antenna trimmers should first be tightened to approximately ¾ maximum capacity (turned ¾ in.)

(c) Tune the external oscillator to 18,000 K. C., set the pointer at 18 M. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacitor from minimum to maximum.

(d) Check for the image signal, which will be received at approximately 17,080 on the dial, if (c) has been properly done. It may be necessary to increase the external oscillator output for this check.

RADIOTRON SOCKET VOLTAGES

115-Volt A. C. Line—No Signal—Volume Control—Maximum

Radiotron Number		Cathode to Ground Volts, D. C.	Screen Grid to Ground, Volts, D. C.	Plate to Ground, Volts, D. C.	Plate Current, M. A.	Heater Volts, A. C.
RCA-6D6—R. F.		6.0	105	265	9.0	6.3
RCA-6A7	Det.	6.0	105	265	3.5	6.3
	Osc.	—	—	220	4.5	
RCA-6D6—I. F.		6.0	105	265	9.0	6.3
RCA-6B7—2nd Detector		3.0	50	90*	0.7	6.3
RCA-42—Power		16.5	265	245	30.0	6.3
RCA-80—Rectifier		—	—	690 (RMS)	70.0	5.0

*Voltage calculated from 265 V. + B.

(e) Reduce the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal disappears. *The first detector circuit is then aligned with the oscillator circuit and the RCA-6A7 tube is blocked.* Then increase the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal is peaked for maximum output.

(f) The antenna trimmer should now be peaked for maximum output. It is not necessary to rock the main tuning capacitor while making this adjustment.

(4) VOLTAGE READINGS

The voltages specified are those at the various tube sockets while the receiver is in operating condition. No allowance has been made for currents drawn by the meter, and if low-resistance meters are used, such allowances must be made.

(5) POWER TRANSFORMER CONNECTIONS

The 220-volt power transformer furnished with some instruments includes taps for operating on 110-volt lines. Figure 5 shows the schematic circuit of the transformer and the proper voltage to be applied to the various taps. The taps are located on the power transformer assembly and are accessible without removing the chassis from the cabinet.

(6) VARIATIONS OF MODEL 128

This Service Note does not apply in complete detail to the original six-tube chassis employed in Model 128 during 1934 production. The modifications found on the present chassis do not affect the general service procedure, but rather account for certain minor changes in wiring layout. Notice should be taken that the power output stage uses an RCA-42 instead of the original RCA-41.

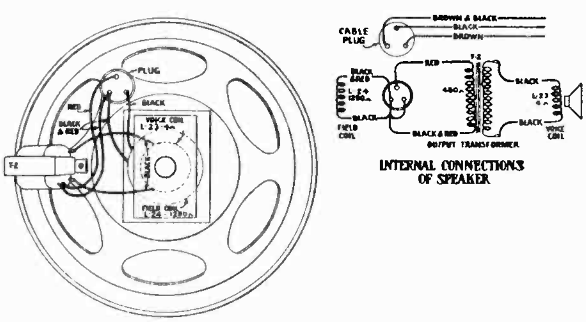


Figure 9—Console Model Loudspeaker (with cable plug)

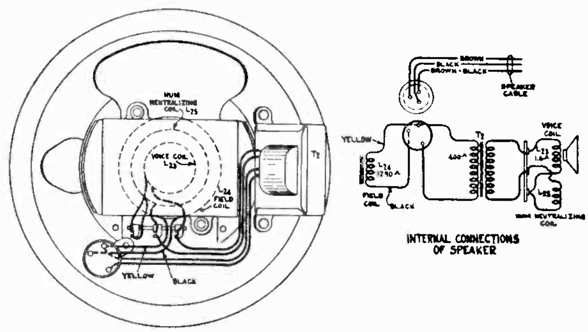


Figure 10—Table Model Loudspeaker Wiring (with cable plug)

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4427	Bracket—Volume control or tone control mounting bracket	$0.18
4244	Cap—Contact cap—Package of 5	.20
3861	Capacitor — Adjustable trimmer capacitor (C20)	.78
5094	Capacitor—50 mmfd. (C47)	.20
4662	Capacitor—80 mmfd. (C37)	.24
4811	Capacitor—340 mmfd. (C21)	.25
4412	Capacitor—1120 mmfd. (C23)	.25
4515	Capacitor—1160 mmfd. (C34)	.22
4634	Capacitor—1120 mmfd. (C50)	.35
4523	Capacitor—2400 mmfd. (C17)	.26
4524	Capacitor—2850 mmfd. (C25)	.35
4792	Capacitor—.015 mfd. (C39)	.22
4518	Capacitor—.05 mfd. (C35)	.52
4836	Capacitor—.05 mfd. (C4, C12, C29)	.30
4841	Capacitor—.1 mfd. (C6, C15, C30, C40)	.22
4885	Capacitor—.1 mfd. (C7, C26)	.28
3597	Capacitor—.25 mfd. (C38, C45)	.40
4525	Capacitor— 4.0 mfd. (C36)	.70

Stock No.	Description	List Price
4428	Capacitor—8 mfd. (C44)	$1.05
7790	Capacitor—10 mfd. (C43)	1.05
4692	Capacitor pack—Comprising one 0.035 mfd. and one 0.005 mfd. capacitors (C41, C42)	.30
7589	Capacitor pack—Comprising two 4. mfd. capacitors (C16, C46)	1.64
4358	Clamp—Electrolytic capacitor mounting clamp	.15
4808	Coil—Antenna coil "Band B" (L3, L4, C2)	1.92
7803	Coil—Antenna coil "Band A-C" (L1, L2, L5, L6, C1, C3)	1.82
4815	Coil—Detector coil "Band B" (L9, L10, C10)	1.80
7805	Coil—Detector coil "Band A-C" (L7, L8, L11, L12, C8, C9, C11)	2.15
7807	Coil—Oscillator coil "Band A-C" (L13, L14, L17, L18, C19, C24)	1.62
4807	Coil—Oscillator coil "Band B" (L15, L16, C22)	1.85
7801	Condenser—3-gang variable tuning condenser (C5, C13, C18)	4.42
4340	Lamp—Dial lamp—Package of 5	.60
3218	Resistor—600 ohms—Carbon type—¼ watt (R2, R6, R8)—Package of 5	1.00

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
4834	Resistor—1100 ohms—Carbon type—¼ watt (R3, R7)—Package of 5	$1.00
3997	Resistor—4000 ohms—Carbon type—¼ watt (R14)—Package of 5	1.00
3114	Resistor—50,000 ohms—Carbon type—¼ watt (R16, R18)—Package of 5	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R5)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R1, R4)—Package of 5	1.00
3116	Resistor—200,000 ohms—Carbon type—¼ watt (R15)—Package of 5	1.00
6186	Resistor—500,000 ohms—Carbon type—¼ watt (R17)—Package of 5	1.00
4783	Resistor—1,100,000 ohms—Carbon type—¼ watt (R10)—Package of 5	1.00
6242	Resistor — 2 megohms — Carbon type — ¼ watt (R11, R13)—Package of 5	1.00
2240	Resistor — 30,000 ohms — Carbon type — 1 watt (R20)	.22
4721	Resistor—Tapped resistor, one 10,000 ohms, two 5000 ohms, and one 500 ohms section (R21, R22, R23, R24)	.88
4521	Shield—I. F. transformer shield	.42
4742	Shield—Antenna R. F. or oscillator coil shield	.40
3942	Shield—First detector or output Radiotron shield	.18
7487	Shield—I. F. amplifier Radiotron shield	.25
4705	Shield—R. F. amplifier Radiotron shield	.30
3782	Shield—Second detector Radiotron shield	.26
3529	Socket—Dial lamp socket	.32
4784	Socket—4-contact Radiotron socket	.15
4786	Socket—6-contact output Radiotron socket	.15
4785	Socket—6-contact Radiotron socket	.15
4787	Socket—7-contact Radiotron socket	.15
4379	Strip—Antenna terminal engraved "ANT-GND"	.20
4684	Switch—Operating switch (S11)	.45
4728	Switch—Range switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S12)	4.32
4810	Tone control (R19)	1.30
4431	Transformer — First intermediate frequency transformer (L19, L20, C27, C28, C48)	2.28
4433	Transformer—Second intermediate frequency transformer (L21, L22, C31, C32, C33, R9)	2.15
9511	Transformer—Power transformer—105–125 volts, 50–60 cycles (T1)	4.78
9512	Transformer—Power transformer—105–125 volts, 25–40 cycles	6.58
9513	Transformer—Power transformer—105–250 volts—40–60 cycles	4.85
4809	Volume control (R12)	1.45

DRIVE ASSEMBLIES

Stock No.	Description	List Price
4362	Arm—Band Indicator operating arm	.28
10194	Ball—Steel ball for condenser drive assembly—Package of 20	.25
4422	Clutch—Clutch drive assembly for variable condenser drive	1.00
4510	Drive—Tuning condenser drive assembly	2.42
4704	Indicator—Band indicator (celluloid)	.12
3943	Screen—Dial light screen (celluloid)—Package of 2	.18
3993	Screw—Number 6-32-5/32 square head set screws for band indicator operating arm—Package of 10	.25
4669	Screw—Number 8-32-5/32 set screw for variable condenser drive assembly—Package of 10	.25
4377	Spring—Band indicator and arm tension spring—Package of 5	.25
4378	Stud—Band indicator operating arm stud—Package of 5	.25

REPRODUCER ASSEMBLY
TABLE MODEL

Stock No.	Description	List Price
4526	Cable—3-conductor—Reproducer cable with spade terminals	$0.32
5085	Cable—3-conductor reproducer cable with female connector	.45
9579	Coil—Field coil only	2.10
9533	Cone—Reproducer cone mounted and centered on housing	3.50
5118	Connector—3-contact male connector for reproducer	.25
5119	Connector—3-contact female connector for reproducer cable	.25
7818	Reproducer complete—For use with chassis having reproducer cable with spade terminals	6.58
9578	Reproducer complete—For use with chassis having cable with connector	6.58
4818	Transformer—Output transformer	2.15

REPRODUCER ASSEMBLY
CONSOLE MODEL

(For use with chassis having reproducer cable with spade terminals)

Stock No.	Description	List Price
4473	Board—Terminal board assembly	.26
4526	Cable—3-conductor with spade terminals	.32
9460	Coil—Field coil, magnet and cone support (L24)	6.00
8935	Cone—Reproducer cone (L23)—Package of 5	5.25
9527	Reproducer—Complete	8.00
4472	Transformer—Output transformer (T2)	1.40

REPRODUCER ASSEMBLY
CONSOLE MODEL

(For use with chassis having reproducer cable with connector)

Stock No.	Description	List Price
5085	Cable—3-conductor reproducer cable complete with female connector	.45
5118	Connector—3-contact male connector for reproducer	.25
5119	Connector—3-contact female connector for reproducer cable	.25
9590	Coil—Field coil, magnet and cone support (L24)	4.20
8935	Cone—Reproducer cone (L23)—Package of 5	5.25
9589	Reproducer complete	8.20
4892	Transformer—Output transformer (T2)	1.30

MISCELLANEOUS ASSEMBLY

Stock No.	Description	List Price
4677	Bezel—Station selector dial (escutcheon) bezel	.56
4661	Dial—Station selector dial	.62
6614	Glass—Station selector dial glass	.30
4520	Indicator—Station selector indicator pointer	.18
4449	Knob—Station selector, volume control, tone control, range switch or operating switch knob—Package of 5	.60
4678	Ring—Dial glass retaining ring —Package of 5	.34
4446	Screw—Chassis mounting screw assembly comprising 4 spacers, 4 screws, 4 lockwashers, 4 washers, 8 cushions—For table model	.28
4945	Screw—Chassis mounting screw assembly—Comprising 4 spacers, 4 screws, 4 lockwashers, 4 washers and 8 cushions—For console model	.50
4613	Screw—Number 8-32-7/16 headless set screw for knobs—Package of 10	.25

RCA Victor Model 236-B

Seven-Tube, Superheterodyne Battery Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Type and Number of Radiotrons	1 RCA-1C6, 2 RCA-34, 2 RCA-30, 1 RCA-32, 1 RCA-19—Total, 7
Total "A" Battery Current	0.68 Ampere
Maximum "B" Battery Current	21 M. A.
Tuning Range	540 K. C.–1720 K. C.
Maximum Undistorted Output	1.2 Watts
Maximum Output	2.2 Watts
Line-up Frequencies	460 K. C., 600 K. C. and 1720 K. C.

PHYSICAL SPECIFICATIONS

Height	40½ Inches
Width	25⅛ Inches
Depth	13 15/16 Inches

This seven-tube, battery operated Superheterodyne receiver provides excellent reception of standard-wave broadcasting stations. High sensitivity, excellent selectivity and good fidelity characterize this receiver. Outstanding features include a permanent magnet dynamic type loudspeaker, two-point tone control, Class "B" output stage, vernier drive and excellent mechanical construction. The chassis is unusually accessible for repair or replacement of parts. A fuse in the "B" battery lead provides protection for the Radiotrons in event of short circuits or wrong battery connections. Figure 1 shows the schematic diagram, while Figure 2 shows the chassis wiring.

DESCRIPTION OF ELECTRICAL CIRCUIT

The circuit is of the superheterodyne type and consists of a combined oscillator-detector stage, two I. F. amplifying stages, a combined second detector and automatic volume control, a two-stage audio amplifier and a Class "B" output stage. A two-pole operating switch opens the "+A" and "+B" battery leads when the switch is turned to the "off" position.

The signal enters the receiver through a shielded antenna lead and is applied through the antenna transformer to the grid circuit of the first detector which also serves as the local oscillator for producing a signal, 460 K. C. higher in frequency than the incoming signal. The combined signals after passing through the first detector produce the I. F. signal.

The I. F. amplifier uses two RCA-34 Radiotrons in conjunction with three transformers. Two of the transformers are tuned very accurately to the I. F. frequency (460 K. C.) by means of suitable trimmer capacitors. The third transformer is untuned and couples the output of the second stage to the input of the second detector, an RCA-30, the plate of which is grounded.

Automatic volume control action is obtained from the voltage drop of a portion of the rectified signal across resistor R-9. The voltage drop constitutes the automatic bias voltage for the first detector and I. F. stages and thereby gives the automatic volume control action of the receiver.

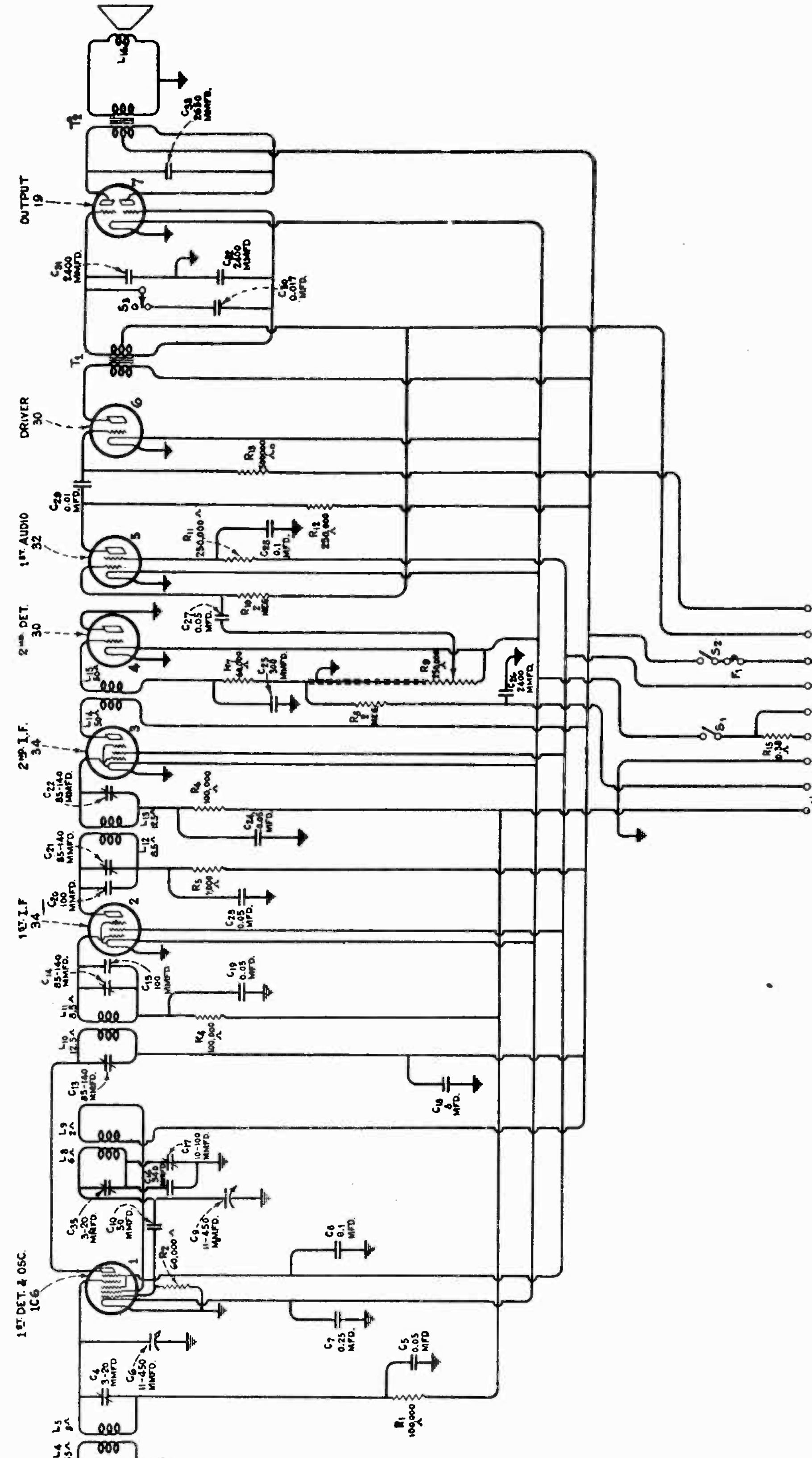


Figure 1—Schematic Circuit Diagram

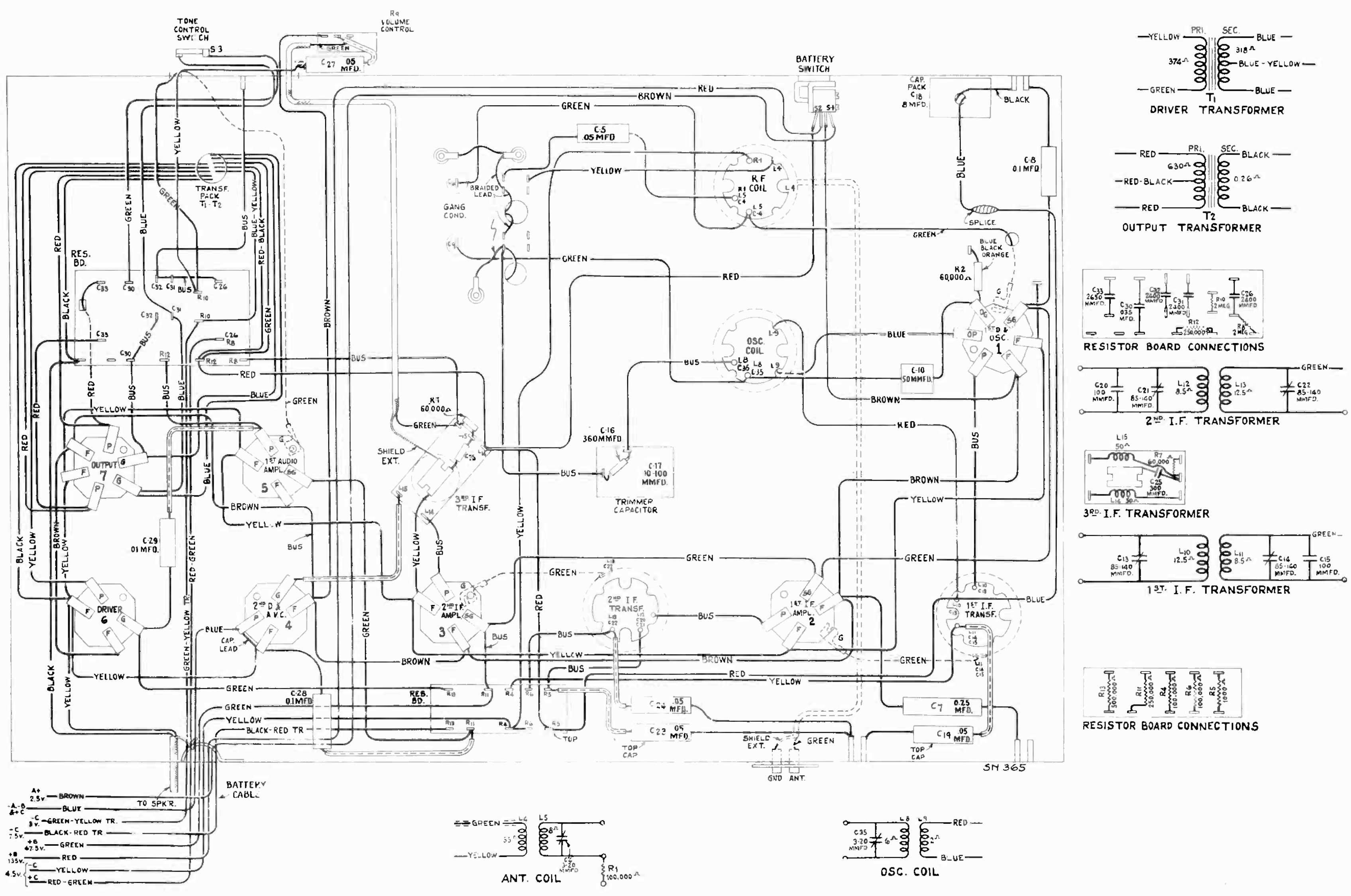


Figure 2—Chassis Wiring Diagram

The volume control selects the desired amount of audio signal from the drop across R-9 and applies it to the grid circuit of the first audio stage, RCA-32.

The output of the first audio stage is resistance coupled to the grid circuit of the RCA-30 driver stage, which is transformer coupled to the Class "B" output stage. The output stage utilizes the twin amplifier Radiotron RCA-19, which has two separate sets of elements and eliminates the necessity of having two separate tubes for a Class "B" output stage. The plate circuit of this tube is transformer coupled to the cone coil of the permanent magnet dynamic loudspeaker.

Plate, grid and filament voltages are supplied by individual batteries. Two +A leads are provided, one permitting operation on a 2-volt storage cell; and the other used for operation on a 2.5-volt "Eveready Air Cell."

SERVICE DATA

(1) Line-Up Capacitor Adjustments

To properly align this receiver, it is essential that a modulated R. F. oscillator of suitable frequency range such as Stock No. 9050, an output indicator, Stock No. 4317, and an alignment tool, Stock No. 4160, be available. Figure 4 shows the location of the various line-up capacitors.

I. F. Tuning Adjustments

The I. F. amplifier comprises two stages which have three transformers. The third transformer is untuned so that only a total of four tuned circuits are used. Refer to Figure 4 and proceed as follows:

(a) Short-circuit the antenna and ground terminals and tune the receiver so that no signal is heard. Set the volume control at maximum and connect a ground to the ground terminal.

(b) Connect the test oscillator output between the first detector control grid and chassis ground. Connect the output indicator across the voice coil of the loudspeaker and adjust the oscillator output so that, with the receiver volume control at maximum, a slight glow is obtained in the output indicator.

(c) Adjust the secondary and primary of the first and then the second I. F. transformers until a maximum deflection is obtained. The third transformer is untuned and does not require adjusting. Keep the oscillator output at a low value so that only a slight glow is obtained in the output indicator at all times. Go over these adjustments a second time, as there is a slight interlocking of adjustments. This completes the I. F. alignment.

R. F. and Oscillator Adjustments

The important points to remember are the need for using the minimum oscillator output to obtain an indication in the output device with the volume control at its maximum position and the manner of obtaining the proper high-frequency oscillator and detector adjustments.

The R. F. line-up capacitors are located at the bottom of the coil assemblies instead of their usual position on the gang capacitor. They are all accessible from the bottom of the chassis except the 600 K. C. series capacitor, which is accessible from the top of the chassis. Proceed as follows:

(a) Connect the output of the oscillator to the antenna and ground terminals of the receiver. Check the position of the dial pointer when the tuning capacitor plates are fully meshed. It should be coincident with the radial line adjacent to the dial reading of 540.

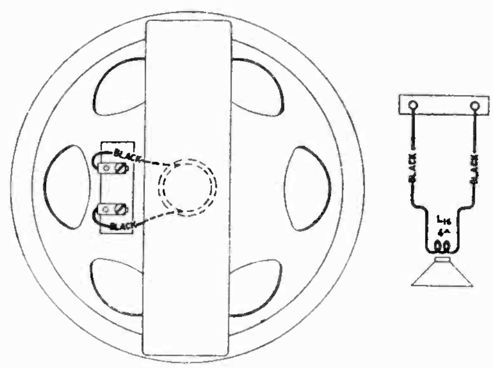


Figure 3—Loudspeaker Wiring

(b) Then set the Test Oscillator at 1720 K. C., the dial pointer at 1720, and adjust the oscillator output so that a slight glow will be obtained in the output indicator when the volume control is at its maximum position. Adjust the two trimmers under the two R. F. coils, see Figure 4, until a maximum output is obtained. Then shift the Test Oscillator frequency to 600 K. C. The trimmer capacitor, accessible from the top of the chassis, should now be adjusted for maximum output while rocking the main tuning capacitor back and forth through the signal. Then repeat the 1720 K. C. adjustment.

(2) Voltage and Current Measurements

Voltage and current values listed in the following table and indicated at the Radiotron socket contacts on Figure 4 form a reference basis for test of the receiver. It is to be noted that all voltages are given with respect to chassis-ground, excepting those appearing across the filaments (F-F). The values shown are obtainable when the receiver is in normal operating condition. They do not take into account inaccuracies caused by current consumed in the voltmeter used for the tests; the lower the voltmeter resistance, the lower the degree of accuracy. Allowances must therefore be made, dependent upon the type of test instrument used, for the loading effect of the voltmeter on the circuit.

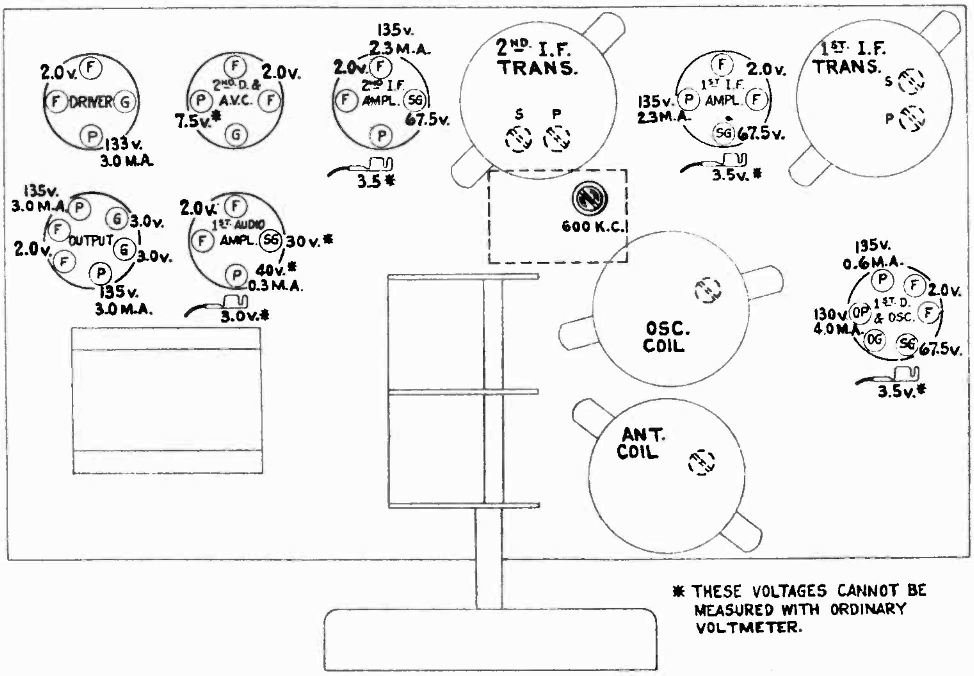


Figure 4—Line-Up Capacitor Locations and Voltage Values at Socket Contacts

RADIOTRON SOCKET VOLTAGES

Volume Control at Maximum—No Signal—135 Volt "B" Battery—4.5 and 7.5-Volt Bias Batteries

Radiotron No.		Control Grid to Ground	Screen Grid to Ground	Plate to Ground	Plate, M. A.	Filament Volts
RCA-1C6	1st Detector	3.5*	67.5	135	0.6	2.0
	Oscillator	—	—	130	4.0	
RCA-34—I. F.		3.5*	67.5	135	2.3	2.0
RCA-34—I. F.		3.5*	67.5	135	2.3	2.0
RCA-30—Detector AVC		—	—	—	—	2.0
RCA-32—Audio		3.0*	30*	40*	0.3	2.0
RCA-30—Driver		7.5*	—	133	4.0	2.0
RCA-19—Power		3.0	—	135	3.0	2.0

*These voltages cannot be measured with ordinary voltmeter.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
2747	Cap—Contact cap—Package of 5	$0.50
4498	Capacitor—8 mfd. (C18)	1.25
4442	Capacitor—50 mmfd. (C10)	.22
3981	Capacitor—300 mmfd. (C25)	.30
4413	Capacitor—360 mmfd. (C16)	.22
2749	Capacitor—2400 mmfd. (C26)	.35
4801	Capacitor—2400 mmfd. (C31, C32)	.50
4529	Capacitor—2650 mmfd. (C33)	.32
4858	Capacitor—0.01 mfd. (C29)	.25
4518	Capacitor—0.05 mfd. (C27)	.52
4836	Capacitor—0.05 mfd. (C5, C19, C23, C24)	.30
4906	Capacitor—0.017 mfd. (C30)	.25
4791	Capacitor—0.1 mfd. (C8, C28)	.24
4840	Capacitor—0.25 mfd. (C7)	.30
3861	Capacitor — Adjustable trimmer capacitor (C17)	.78
4796	Coil—Antenna coil (L4, L5, R1, C4)	2.30
4800	Coil—Oscillator coil (L8, L9, C35)	1.90
4504	Condenser—2-gang variable tuning condenser (C6, C9)	2.78
4370	Resistor—1,000 ohms—Carbon type—¼ watt—Package of 10 (R5)	2.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R2, R7)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R1, R4, R6)—Package of 5	1.00
3744	Resistor—250,000 ohms—Carbon type—¼ watt (R11, R12)—Package of 5	1.00
6186	Resistor—500,000 ohms—Carbon type—¼ watt (R13)—Package of 5	1.00
6242	Resistor — 2 megohms — Carbon type — ¼ watt (R8, R10)—Package of 5	1.00
4521	Shield—Antenna, oscillator or I. F. transformer shield	.42
7487	Shield—Second detector Radiotron shield—"AVC"	.25
3942	Shield—First detector and oscillator Radiotron shield	.18
3056	Shield—First I. F., second I. F., first audio Radiotron shield—Package of 2	.40
4794	Socket—4-contact Radiotron socket	.15
4784	Socket—4-contact audio amplifier—Radiotron socket	.15
4786	Socket—6-contact detector-oscillator Radiotron socket	.15
4785	Socket—6-contact output Radiotron socket	.15
4799	Switch—Tone control switch (S3)	.62
4431	Transformer—First intermediate transformer (L10, L11, C13, C14, C15)	2.28
7840	Transformer — Second intermediate transformer (L12 L13, C20, C21, C22)	2.35
4538	Transformer—Third intermediate frequency transformer (L14, L15)	$2.15
4533	Transformer pack—Audio transformer pack—Comprising driver and output transformer (T1, T2)	3.98
4535	Volume control (R9)	1.40
	REPRODUCER ASSEMBLIES	
4541	Cable—2-conductor reproducer cable	.38
9432	Cone—Reproducer cone (L16)	1.88
7820	Magnet—Cone housing and magnet assembly	8.98
7819	Reproducer complete	12.18
4234	Rivet—Cone mounting rivet—Package of 100	.66
	DRIVE ASSEMBLY	
4996	Dial—Station selector dial	.75
4798	Drive—Variable tuning condenser drive assembly complete	1.50
4363	Pointer—Station selector pointer	.18
4669	Screw—No. 8-32-5/32 square head set screw for condenser drive—Package of 10	.25
4997	Shaft—Condenser drive shaft	.28
	MISCELLANEOUS ASSEMBLIES	
4895	Bezel—Metal bezel (escutcheon) and crystal for station selector drive	.55
4289	Body—Fuse connector body—Package of 10	.35
7867	Cable—8-conductor battery cable complete	.78
4288	Cap—Fuse connector cap—Package of 10	.36
6516	Connector—Fuse connector complete	.16
4286	Ferrule—Fuse connector ferrule and bushing—Package of 10	.38
3748	Fuse—0.5 ampere—Package of 5	.40
4290	Insulator—Fuse connector insulator—Package of 10	.35
4449	Knob—Station selector, volume control, tone or battery switch knob—Package of 5	.60
4644	Resistor—0.38 ohms—Flexible type—Filament series (R15)—Package of 5	.80
4638	Screw—Chassis mounting screw assembly—Comprising eight cushions, four screws, four washers, four lockwashers and four spacers	.52
3238	Screw—6-40-1⅞" knurled head—Set screw for operating switch knob No. 3088—Package of 10	.25
4613	Screw—8-32-¼₆" headless set screw for station selector volume control, tone control or range switch knob—Package of 10	.25
4284	Spring—Fuse connector spring—Package of 10	.30
4797	Switch—Operating switch	1.50
4285	Washer—Fuse connector insulating washer—Package of 10	.22

RCA VICTOR MODELS 262 AND 263

Ten-Tube, Five-Band A. C. Superheterodyne

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage Ratings	105–125 Volts
Frequency Ratings	25–60 Cycles and 50–60 Cycles
Power Consumption	130 Watts at 125 Volts, 50 Cycles; 130 Watts at 125 Volts, 25 Cycles
Number and Type of Radiotrons	2 RCA-6D6, 1 RCA-6A7, 2 RCA-76, 1 RCA-85, 2 RCA-42, 2 RCA-80—Total, 10
Tuning Frequency Ranges	Band X— 140 KC– 410 KC Band A— 540 KC– 1720 KC Band B— 1720 KC– 5400 KC Band C— 5400 KC–18,000 KC Band D—18,000 KC–36,000 KC
Line-up Frequencies	175 KC, 410 KC, 460 KC, 600 KC, 1720 KC, 5160 KC, and 18,000 KC
Maximum Undistorted Output	7 Watts
Maximum Output	14 Watts

PHYSICAL SPECIFICATIONS

	Model 262	*Model 263*
Height	42½ Inches	42⅞ Inches
Width	27 Inches	29 Inches
Depth	14½ Inches	16⅝ Inches

This ten-tube, five-band, all-wave superheterodyne radio receiver is an instrument in which most of the important modern radio developments have been incorporated. Wide tuning range, excellent sensitivity and selectivity and a large undistorted output contribute to the realization of outstanding performance in all major requirements. The extremely wide tuning range (140 KC to 36,000 KC except for a break between 410 KC and 540 KC) covers every broadcasting, police, aviation and amateur band used throughout the world.

Important new operating features include an "airplane" type dial with band indicator, a "second" hand for vernier tuning and "band spread," a double-ratio vernier drive and the usual sensitivity and volume control.

A high degree of tonal fidelity is obtained through the use of a high gain, high output, low distortion audio amplifier and a large 10-inch electro-dynamic loudspeaker. The high and low frequency tone controls provide a method whereby the frequency characteristic may be altered for adverse operating conditions such as static, station hum, etc.

DESCRIPTION OF ELECTRICAL CIRCUIT

The general circuit arrangement consists of an R. F. stage, a combined oscillator and first detector, an I. F. stage, a combined second detector, and audio amplifier stage and AVC, a push-pull audio driver stage and a push-pull Pentode output stage. Plate and grid voltages are supplied by a heavy duty rectifier stage combined with a suitable filtering stage, of which the loudspeaker field is a part. Figure 3 shows a typical schematic circuit diagram.

The signal enters the receiver through a shielded antenna lead and is applied to the grid of the R. F. tube through the antenna coupling transformer. The secondary of this transformer is tuned to the signal frequency by means of one unit of the gang-capacitor. The output of this stage is transformer coupled to the grid circuit of the first detector, which is also tuned to the signal frequency by a unit of the gang-capacitor.

Combined with the signal in the first detector is the local oscillator signal, which is always at a 460 KC frequency difference (higher) from the signal frequency. A separate coil system and the third unit of the gang-capacitor are used in the oscillator circuit.

In conjunction with these three tuned circuits it is well to point out that five different groups of tuned circuits are used, one group for each tuning band. A five-position selector switch is provided for selecting the band in which the desired signal is located. In addition to selecting the desired coil system, additional groups of contacts are provided for short-circuiting

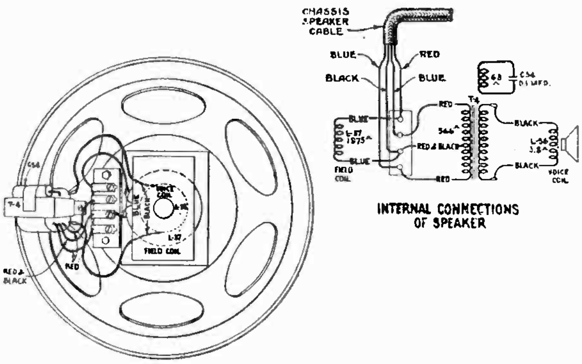


Figure 1—Loudspeaker Wiring—Without Plug

the preceding lower frequency R. F. and detector coils and the two preceding oscillator coils. This is to prevent "dead" spots due to absorption effects caused by the coils, the natural period of which, without the gang-capacitor connected, falls in the next higher frequency band. This gang-switch also has additional contacts for changing the fidelity in the various bands.

The sensitivity control adjusts the residual bias voltage for the R. F. and first detector stages, thereby controlling the overall sensitivity of the receiver.

The output of the first detector, which is the I. F. signal (460 KC), is fed directly through two tuned circuits to the grid of the I. F. amplifier stage. The I. F. stage, which utilizes Radiotron RCA-6D6, uses two transformers, which consist of four tuned circuits, all of which are tuned to 460 KC.

From the output of the I. F. amplifier, the signal is applied to the input of the second detector stage, which consists of an RCA-85 Radiotron, a duplex-diode triode type. This tube performs the functions of a detector, audio amplifier, and automatic volume control. These functions take place in the following sequence. The signal is detected by one of the diodes of the tube; the resulting current develops a voltage across the series combination of resistors, R-32 and R-17. This voltage is composed of a direct current voltage, upon which an audio wave is superimposed. The d. c. portion of the voltage is filtered by the resistor and capacitor system through capacitor C-39 and resistor R-15 and used to automatically regulate the control grid bias of the first R. F. stage. A smaller portion of the d. c. component in the detected signal is secured from across R-17 alone and used for automatic control of the first detector and I. F. stages. Filtering for this part of the control system is obtained from R-16 and C-35. The audio component of the detected signal across resistor R-17 is introduced to the control grid of the RCA-85 through the wiper arm of R-17 and the capacitance, C-44. Manual volume control action is obtained from this element of the circuit. Resistor R-34 and capacitor C-43 form a tone compensating circuit which improves apparent quality of reproduction at low volume settings.

The signal on the control grid of the RCA-85 controls the plate of the tube and its output circuit. At this point the tone control network is included. Provision is made for regulating both the high and low frequency limits of response. Coupling to the grids of the RCA-76 driver stage is accomplished through a transformer.

In the intermediate audio or driver stage of the receiver, there are two RCA-76 Radiotrons, a triode type, connected to operate push-pull. The bias of the control grids is obtained from a resistor common to the cathode return circuits. This resistor is shown as R-25 on the schematic.

The driver stage is transformer coupled to the output stage, which consists of two Radiotrons, RCA-42, connected in push-pull. A feature of the output stage is the use of fixed bias, which reduces distortion and increases the available output. This is accomplished by the use of the drop across R-29, which carries the entire DC output from the rectifier. Naturally the output stage uses but a portion of the total rectified

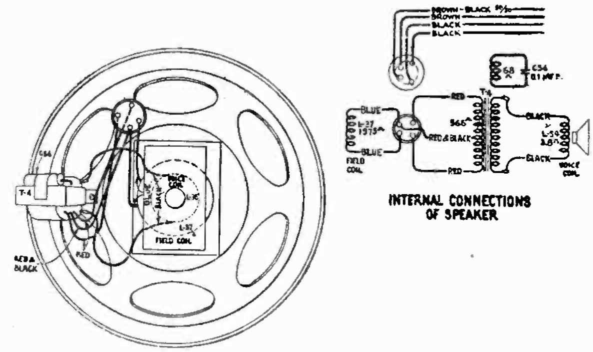


Figure 2—Loudspeaker Wiring for Plug-In Type

current and current variations in it have but little effect on the drop across the resistor.

At this point, it should be noted that an additional group of contacts on the selector switch provides a means whereby the fidelity is changed for the various frequency bands. Two changes, one for Bands X and A and one for Bands B, C and D, are made. The change is made in order to provide the utmost in tonal quality on Band X and A while reducing the low frequency output on Bands B, C and D. Such low frequency reduction insures the best possible results on these bands.

The output of the power stage is coupled through a step-down transformer to the voice coil of the loudspeaker. A separate winding, which is shunted by a capacitor, has been provided in this transformer which adds to the very sharp, high-frequency cut-off of the entire audio system. This greatly reduces the reproduction of any high-frequency interchannel interference or other disturbance of a high-frequency character which is outside of the useful musical range.

The loudspeaker employed is constructed to be appropriate to the design of the circuit and the acoustic characteristics of the cabinet, in obtaining the over-all high quality of reproduction. It is fully capable of handling the unusual power level obtainable from the amplifier, and converting it into clear and faithfully natural sound. The speaker mechanism is of the electro-dynamic type, having a low impedance moving coil, which drives a ten-inch diameter cone. On some models of the 262 and 263, a new method of connection is used on the speaker cable, which is a four-wire cord connector. This scheme of connection makes for ease in removing the chassis from the cabinet for servicing. The plug-in type of speaker wiring is shown in Figure 2, and the type with a terminal strip shown by Figure 1.

In the Schematic Circuit Diagram of Figure 3, the useful electrical constants are specified adjacent to the resistors, capacitors, transformers and coils. Their actual physical locations and the wiring layout of the chassis are given by the diagram of Figure 4. The R. F. and first detector assembly, which is individually removable from the chassis, is shown in the layout of Figure 5.

SERVICE DATA

(1) LINE-UP PROCEDURE

The line-up procedure for these receivers is somewhat involved and it is important that these instructions be carefully followed when making adjustments. Properly aligned, they have outstanding performance, otherwise, poor reception may be experienced.

Equipment

To align this receiver, proper test equipment must be used. This consists of a modulated R. F. oscillator having proper frequency range, an output indicator, an alignment tool and a tuning wand. These parts have been developed by the manufacturer of this receiver for use by service men to duplicate the original factory adjustments.

Checking with Tuning Wand

Before making any R. F., oscillator or first detector adjustments, the accuracy of the present adjustments may be checked by means of the tuning wand (Stock No. 6679). The tuning wand consists of a bakelite rod having a brass cylinder at one end and a special finely divided iron insert at the other end. Inserting the cylinder into the center of a coil lowers its inductance, while inserting the iron end increases its inductance. From this, it is seen that unless the trimmer adjustment for a particular coil is correctly adjusted, inserting one end of the wand may increase the output of a particular signal. A perfect adjustment is evidenced by a lowering of output when either end of the wand is inserted into a coil.

The shields over the R. F. coil assembly have a hole at their top for entrance of the tuning wand. The location of the various coils inside of the shield is shown in Figure 6. An example of the proper manner of using the tuning wand would be to assume the external oscillator were set at 1720 KC and the signal tuned in. The output indicator should be connected across the voice coil of the loudspeaker. Then insert the tuning wand, first one end and then the other end, into the top of the three transformers at the left of the R. F. assembly, facing the front of the chassis. A perfect adjustment of the trimmer would be evidenced by a reduction in output when either end of the wand is inserted in each of the three transformers. If one end—for example, the iron end—when inserted in one coil caused an increase in output, then that circuit is out of alignment. An increase in the trimmer capacitance would be the proper remedy.

(2) I. F. TUNING CAPACITOR ADJUSTMENTS

There is one I. F. stage, with two I. F. transformers in the receiver. A total of four adjustable capacitors are used, two on each transformer. The transformers are both peaked at 460 KC.

A detailed procedure for making this adjustment follows:

(a) Connect the output of an external oscillator tuned to 460 KC between the first detector grid and ground. Connect the output indicator across the voice coil of the loudspeaker.

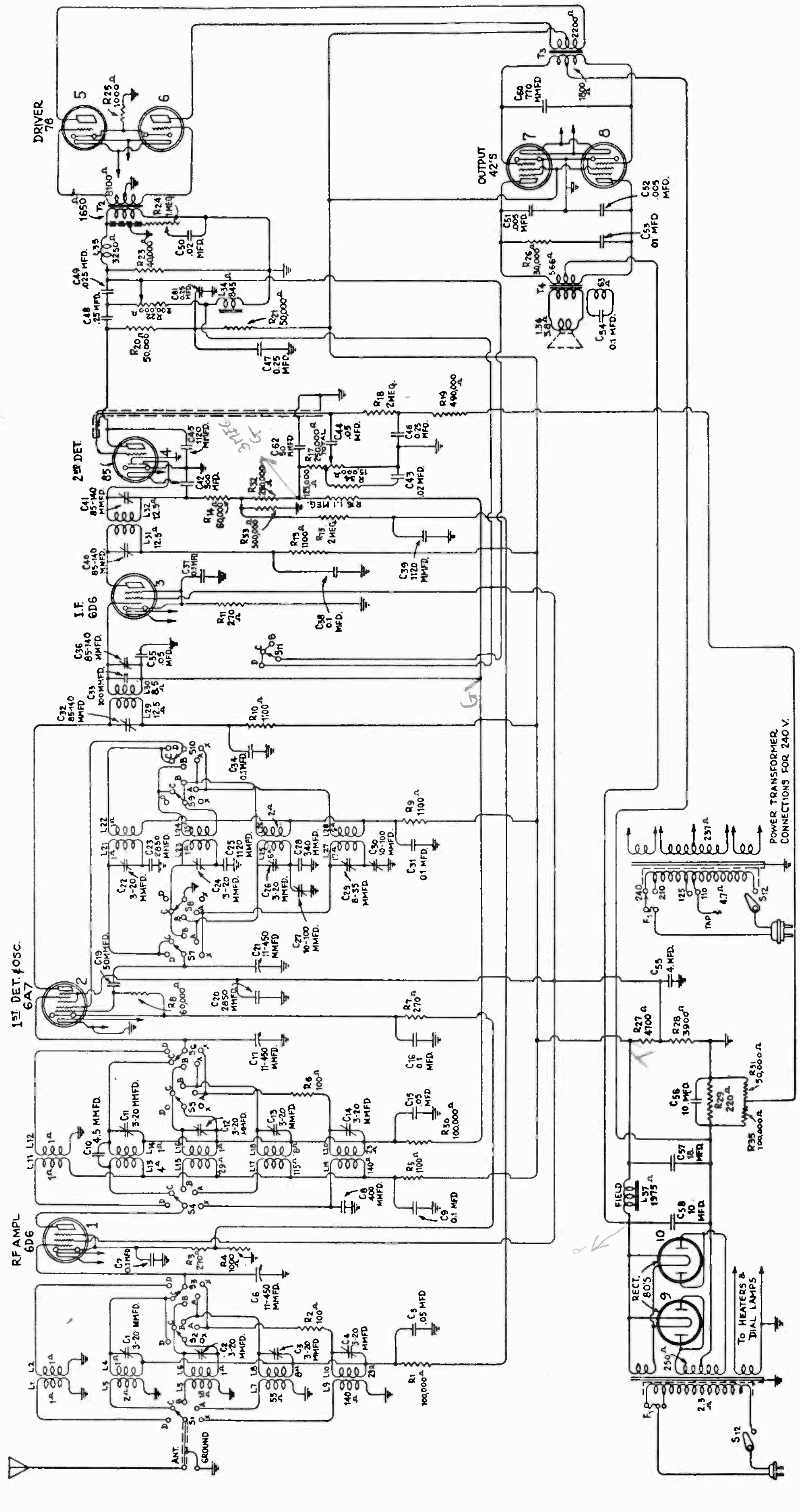


Figure 3—Schematic Circuit Diagram (1935 production 262 and 1935 production 263)

R21 4700 ohms

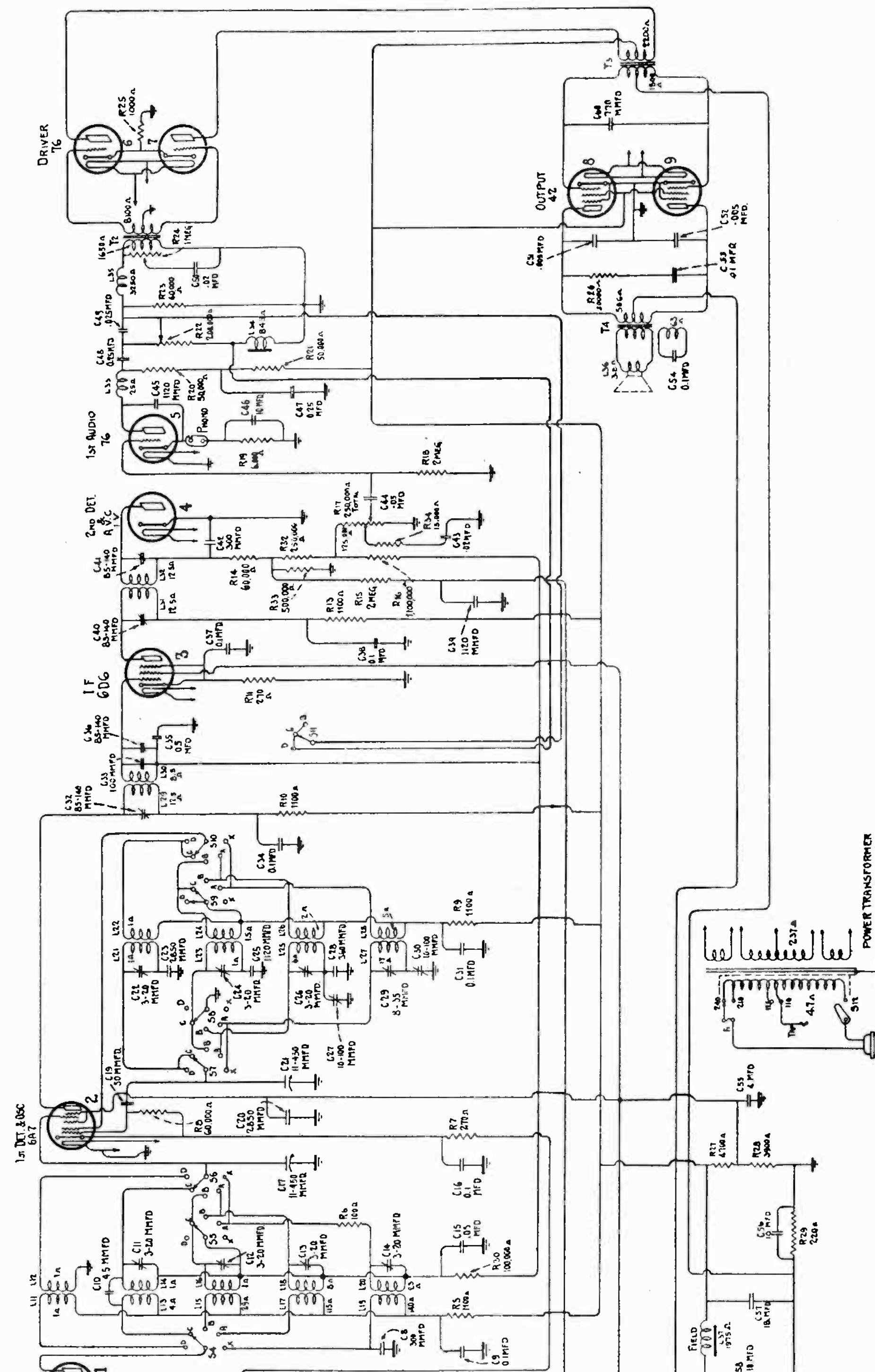


Figure 3A—Schematic Circuit Diagram (late 1934 production 262 and late 1934 production 263)

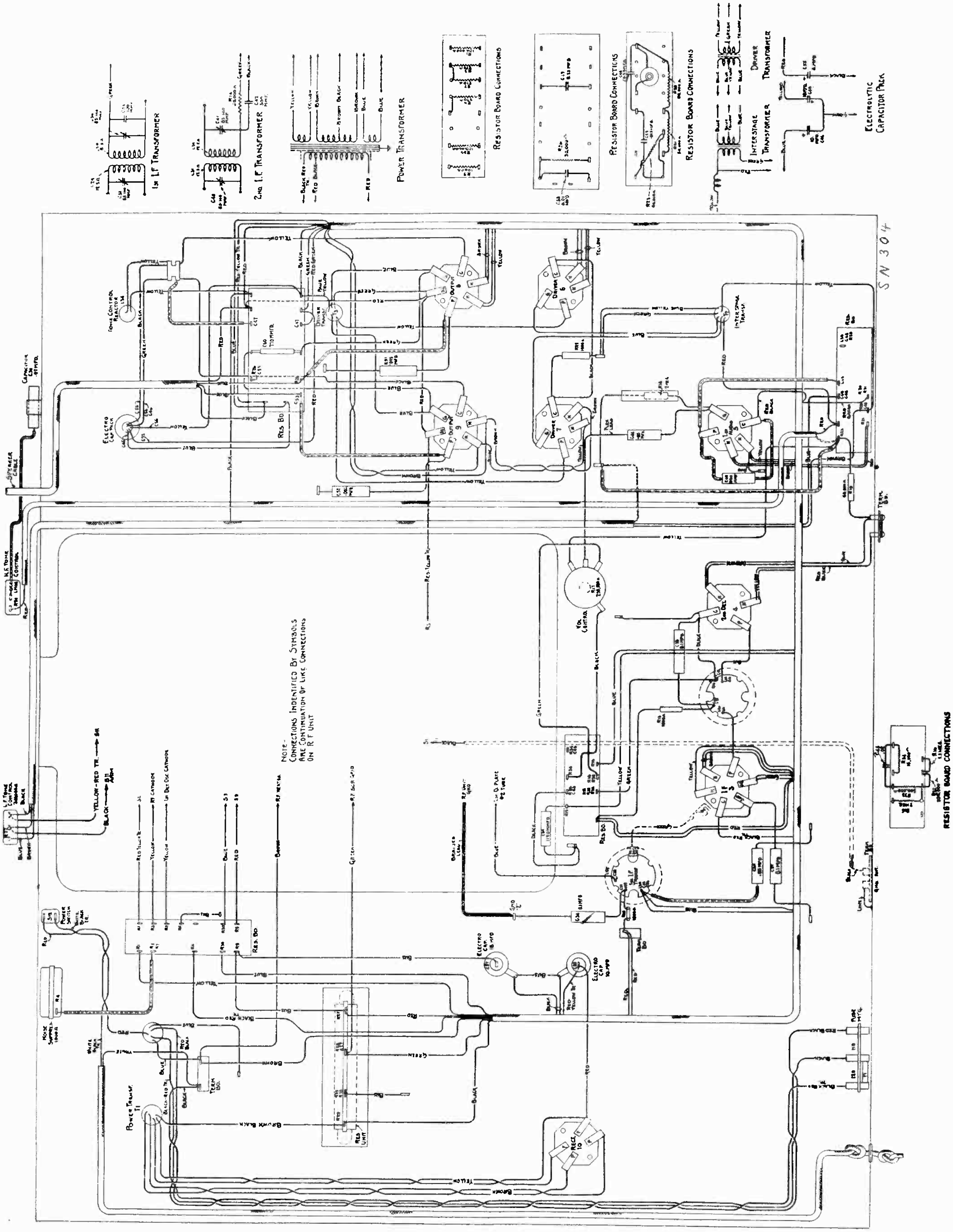


Figure 4.1—Chassis Wiring Diagram (late 1934 production 262 and late 1934 production 263)

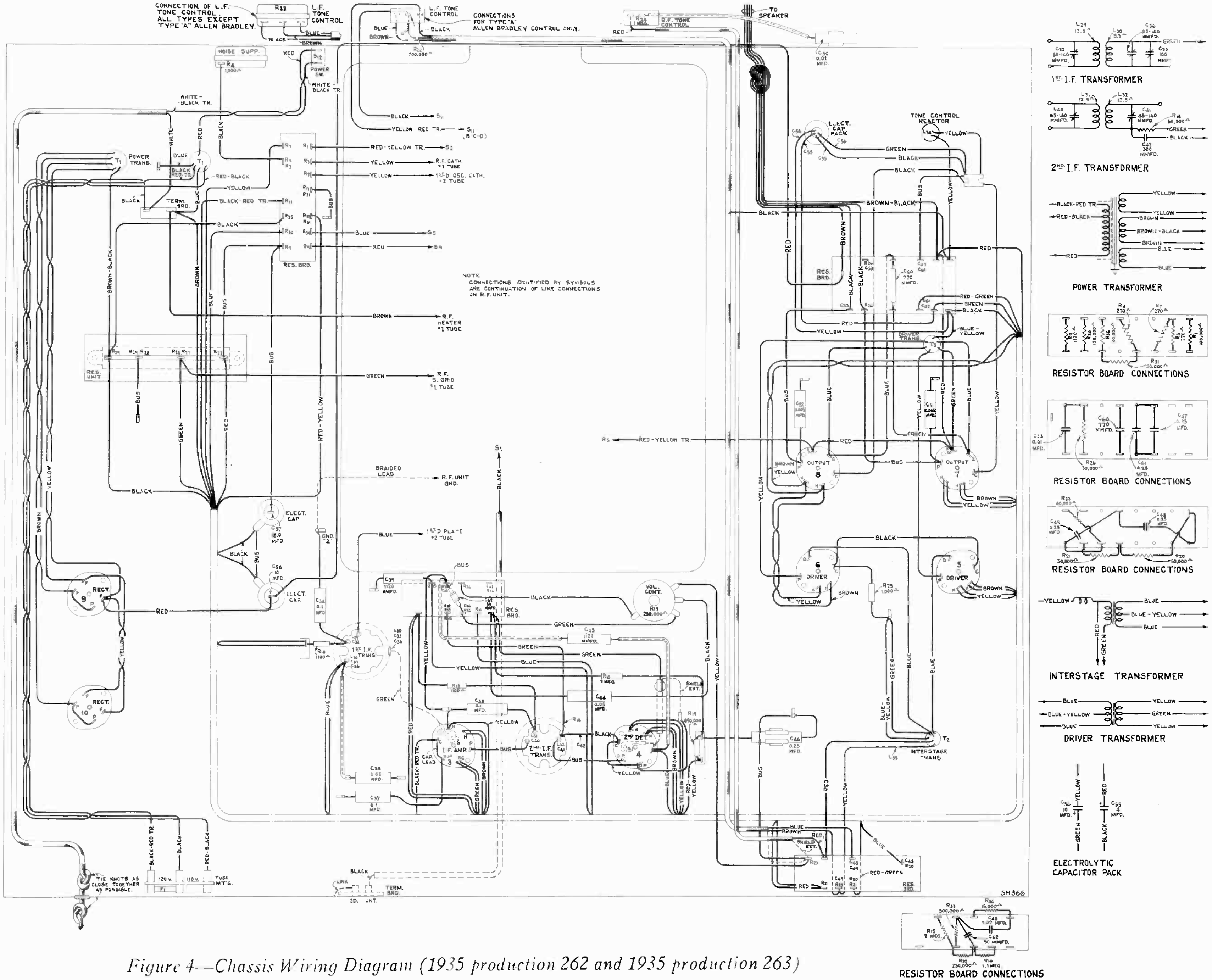


Figure 4—Chassis Wiring Diagram (1935 production 262 and 1935 production 263)

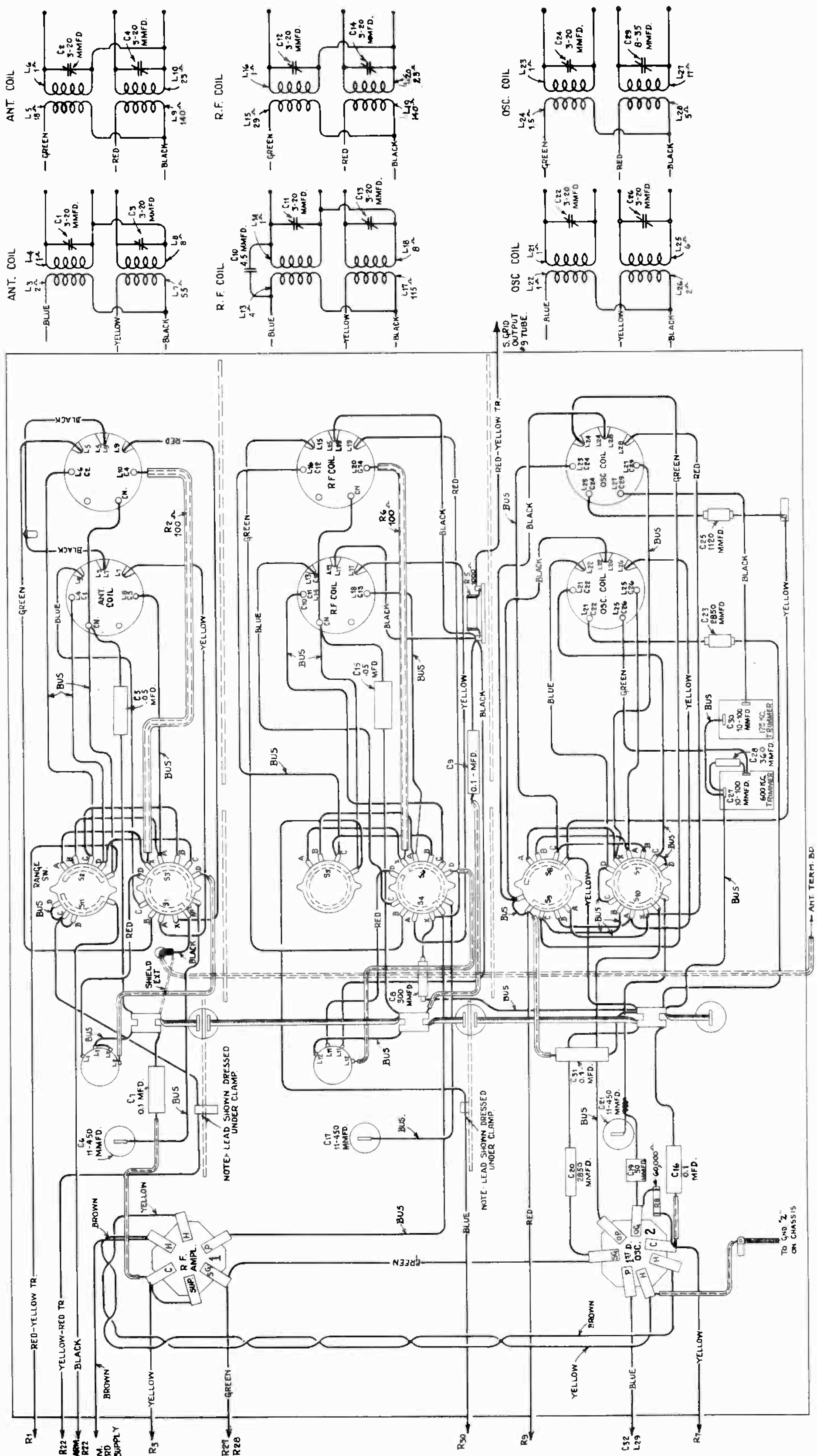


Figure 5—R. F. Unit Wiring Diagram

(b) Place the oscillator in operation at 460 KC. Place the receiver in operation and adjust the station selector until a point is reached (Band A) where no signals are heard and turn the volume control to its maximum position. Reduce the oscillator input until a slight indication is obtained in the output indicator.

(c) Refer to Figure 7. Adjust each trimmer of the I. F. transformers until a maximum output is obtained. Go over the adjustments a second time.

This completes the I. F. adjustments. However, it is good practice to follow the I. F. adjustments with the R. F. and oscillator adjustments due to interlocking which always occurs.

(3) R. F. OSCILLATOR AND FIRST DETECTOR ADJUSTMENTS

Four R. F., oscillator and first detector adjustments are required in Bands "A" and "X." Three are required in Bands "B" and "C." None are required in Band "D."

To properly align the various bands, each band must be aligned individually. The preliminary set-up requires the external oscillator to be connected between the antenna and ground terminals of the receiver and

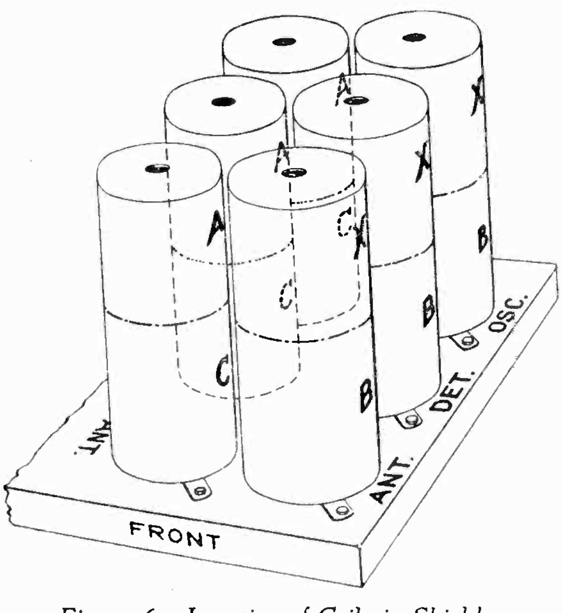


Figure 6—Location of Coils in Shields

the output indicator across the voice coil of the loudspeaker. The volume control must be at its maximum position and the input from the oscillator must be at the minimum value possible to get an output indication under these conditions. In the high-frequency **bands**, it may be necessary to disconnect the oscillator from the receiver and place it at a distance in order to get a sufficiently low input to the receiver.

The dial pointer must be properly set before starting any actual adjustments. This is done by turning the variable capacitor until it is at its maximum capacity position. One end of the pointer should be toward the horizontal line at the lowest frequency end of Band "A," while the other end should point to within 1/64 inch of the horizontal line at the highest frequency end of band "A."

Figure 7 shows the location of the trimmers for each band. Care must be exercised to only adjust the trimmers in the band under test.

Band "X"

(a) Set the band switch at "X."

(b) Tune the external oscillator to 410 KC, set the pointer at 410 KC and adjust the oscillator, detector and R. F. trimmers for maximum output.

(c) Shift the external oscillator to 175 KC. Tune in the 175 KC signal irrespective of scale calibration and adjust the series trimmer marked 175 KC on Figure 7, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 410 KC as described in (a).

Band "A"

(a) Set the band switch at "A."

(b) Tune the external oscillator to 1720 KC, set the pointer at 1720 KC and adjust the oscillator, detector and R. F. trimmers for maximum output.

(c) Shift the external oscillator to 600 KC. Tune in the 600 KC signal irrespective of scale calibration and adjust the series trimmer, marked 600 KC on Figure 7, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 1720 KC as described in (a).

Band "B"

(a) Set the band switch at "B."

(b) Tune the external oscillator to 5160 KC, and set the pointer at 5160 KC. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacitor from minimum to maximum.

(c) Check for the image signal, which will be received at approximately 4240 on the dial if the oscillator trimmer has been set correctly in accordance with paragraph (b).

It will probably be necessary to increase the external oscillator output for this check.

(d) Reset the dial to 5160 KC and peak the antenna and detector trimmers for maximum output.

Band "C"

(a) Set the band switch at "C."

(b) Tune the external oscillator to 18,000 KC, and set the pointer at 18 M. C. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacity from minimum to maximum.

(c) Check for the image signal, which should be received at approximately 17,080 on the dial. It may be necessary to increase the external oscillator output for this check.

(d) Reduce the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal disappears. The first detector circuit is then aligned with the oscillator circuit and the RCA-6A7 tube is blocked. Then increase the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal is peaked for maximum output.

(e) The antenna trimmer should now be peaked for maximum output. It is not necessary to rock the main tuning capacitor while making this adjustment.

Band "D"

No adjustments are required for Band "D."

(4) MAGNETIC PICKUP CONNECTIONS

A convenient point for attachment of a phonograph turntable exists at the RCA-85 second detector stage, where such an input may be connected between the control grid cap and ground. A switching arrangement should be provided for disconnecting or shorting the antenna input to prevent the reception of radio signals when the record adjunct is being used. It will be necessary to provide an external volume control for the phonograph. The wiring should be well shielded to prevent "hum" pickup.

(5) ADJUSTMENT OF DIAL VERNIER MECHANISM

A small vernier indicator is provided for giving a simple means of band spread. Under normal conditions, adjustment of this mechanism will not be required. However, in event the initial adjustment is not satisfactory or adjustment is required because of replacement, the following procedure should be used:

(a) Remove the chassis from the cabinet to a place convenient for work.

(b) Check the tension on the vernier hand by pushing it in a counter-clockwise direction. There should be tension against such a push. If

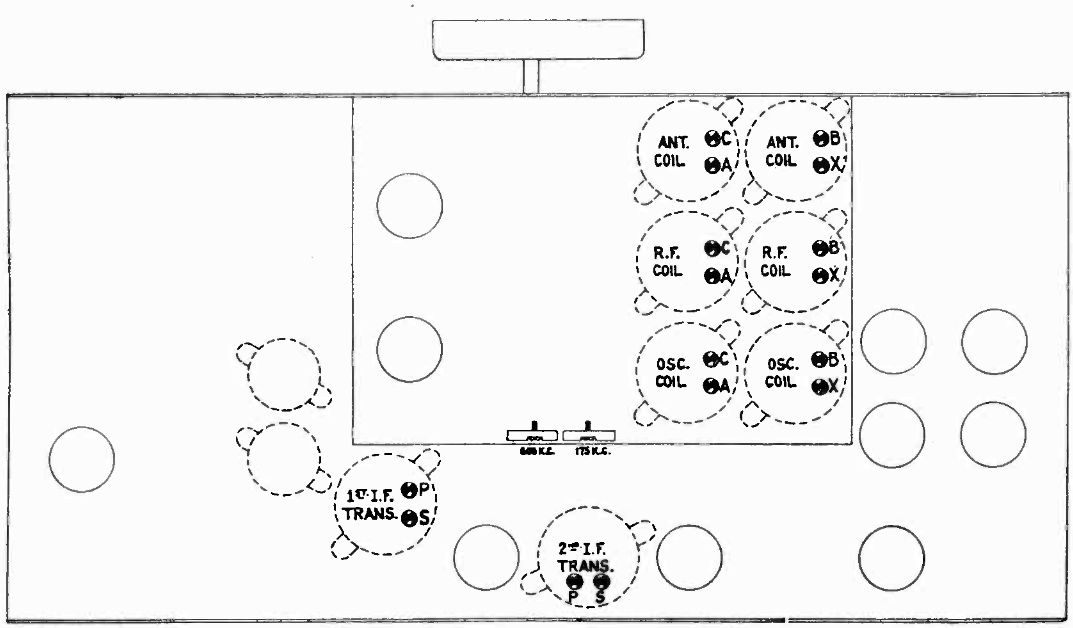


Figure 7—Location of Trimmer Capacitors

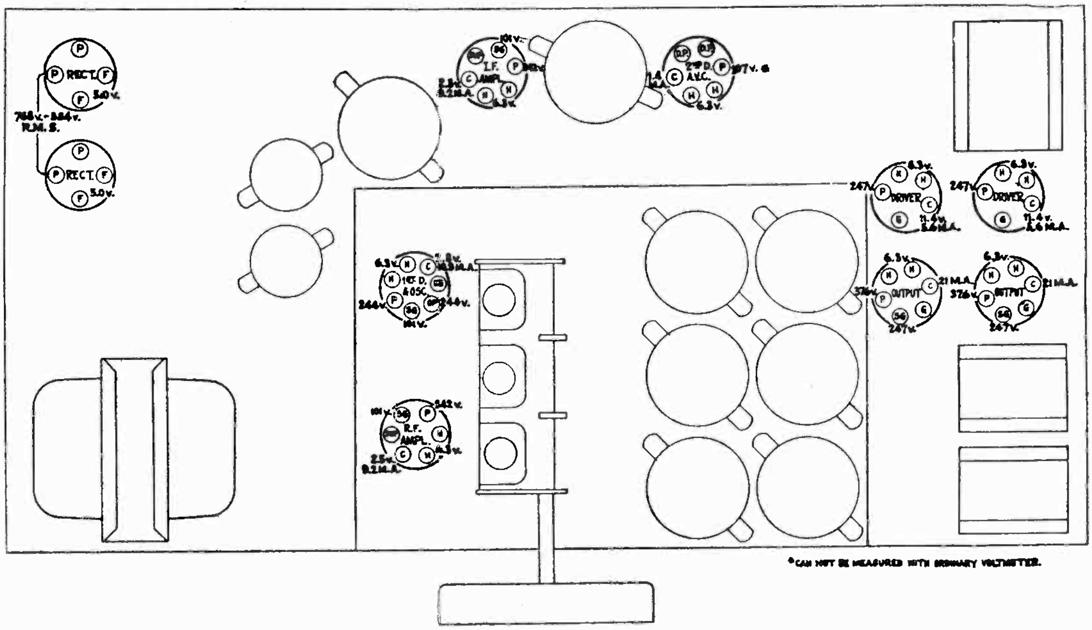


Figure 8—Radiotron Socket Voltages

RADIOTRON SOCKET VOLTAGES

120-Volt A. C. Input—Volume and Sensitivity Controls Maximum—Band Switch at "A"—No Signal

Radiotron Type and Purpose		Cathode to Ground Volts, D. C.	Screen Grid to Ground Volts, D. C.	Plate to Ground Volts, D. C.	Cathode Current, M. A.	Heater Volts, A. C.
RCA-6D6—R. F.		2.5	101	242	9.2	6.3
RCA-6A7	Detector	2.8	101	244	10.9	6.3
	Oscillator	—	—	244		
RCA-6D6—I. F.		2.5	101	242	9.2	6.3
RCA-85—2nd Det. AVC		0	—	107*	1.4	6.3
RCA-76—Driver		11.4	—	247	5.6	6.3
RCA-76—Driver		11.4	—	247	5.6	6.3
RCA-42—Power		0	247	376	21.0	6.3
RCA-42—Power		0	247	376	21.0	6.3
RCA-80—Rectifier		—	—	768/384 R. M. S.	56.0	5.0
RCA-80—Rectifier		—	—		56.0	5.0

*Cannot be measured with ordinary voltmeter.

this tension does not exist, the action of the hand may be erratic and possibly fail to return to the same position for a particular station.

(c) Pull off the long hand with a pair of long-nose pliers.

(d) Straighten the lugs that hold the dial in place. Then remove the dial "vernier" hand and stem gear together.

(e) Then remove the "vernier" hand from the stem gear.

(f) Turn the dial to each extreme and to its center position and check the backlash of the back gear (closest to reflector). There should be definite backlash in each direction at each of these three positions.

(g) If this backlash is not obtained, it will be necessary to re-adjust the position of the gears. Loosen the lock-screw located above the central set of gears and move the adjoining gear assembly in or out of mesh as required.

(h) After making sure there is backlash at the three check points mentioned, turn the outside gear in a clockwise direction 1½ turns. Hold it at this position and replace the stem gear.

(i) Turn the dial throughout its range. If the gears become noisy, move the gear further toward the reflector edges described in (g).

(j) Replace the dial scale, making sure the hole clears the spindle.

(k) Replace the vernier hand. It should point at zero when the tuning capacitor is fully meshed.

(l) Replace the large hand. One end of the pointer should point exactly at the horizontal line at the lowest frequency end of Band "A" when the tuning capacitor is fully meshed.

The above covers the proper manner of making adjustments, assuming all parts are in normal condition. Of course, if any part is defective, it must be replaced. The spring gear may be checked by turning it until the spring is tight and unwinding it slowly. It should unwind 4¼ turns.

(6) HUM INDUCTION

In chasses of early manufacture (models with a type-76 or 1-v second detector), a slight "buzz" or "hum" will often be encountered. In order to reduce this interference the following steps should be taken:

(1) Remove the connections of the *red with yellow tracer* lead from the 10 mfd. electrolytic capacitor (C-56) and from the lug on the resistor board where it terminates. In place of this conductor, install a new one that will be outside of the chassis cable, carried along the front side of the chassis, similar to the *red* lead connecting the corresponding points on the wiring diagram of Figure 4.

(2) Connect the grounding lead from the second detector cathode to a ground point nearer the detector socket.

(3) The secondary leads of the interstage transformer connecting to the driver stage, should be kept away from the heater prongs and heater wiring. It is desirable to shorten these leads as much as possible.

(4) It is important that the heater leads of the audio stages of the receiver be carefully twisted.

(7) VOLTAGE READINGS

The voltages given on the preceding page are those at the various tube sockets while the receiver is in operating condition. No allowance has been made for currents drawn by the meter, and if low-resistance meters are used, such allowances must be made. Figure 8 shows a diagram in which the various voltages at the tube contacts are shown.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4372	Bracket—Bass tone control mounting bracket	$0.20
4683	Bracket — Treble tone control mounting bracket	.25
4406	Bracket—Volume control mounting bracket	.25
4416	Capacitor—50 mmfd. (C62)—Package of 5	1.25
3794	Capacitor—100 mmfd.—Located on first I.F. transformer (C33)	.30
3981	Capacitor—300 mmfd.—Located on second I. F. transformer (C42)	.30
4668	Capacitor—770 mmfd. (C60)	.30
4409	Capacitor—1120 mmfd. (C39, C45)	.35
4838	Capacitor—0.005 mfd. (C51, C52)	.20
3787	Capacitor—0.01 mfd. (C53)	.30
3639	Capacitor—0.02 mfd. (C43)	.25
4652	Capacitor—0.02 mfd. (C50)	.60
4836	Capacitor—0.05 mfd. (C35)	.30
4694	Capacitor—0.05 mfd. (C44)	.30
3765	Capacitor—0.025 mfd. (C49)	.34
4835	Capacitor—0.1 mfd. (C38)	.28
4841	Capacitor—0.1 mfd. (C34, C37)	.22
3597	Capacitor—0.25 mfd. (C46, C47, C61)	.40
3702	Capacitor—0.25 mfd. (C48)	.42
7790	Capacitor—10. mfd. (C58)	1.05
7788	Capacitor—18 mfd. (C57)	1.10
4831	Capacitor pack—Comprising one 10. mfd. and one 4. mfd. capacitor (C55, C56)	2.40
4420	Clamp—Antenna lead clamp and screw—Package of 10	.40
4358	Clamp—Mounting clamp for capacitor—Stock No. 7788 or No. 7790	.15
7806	Coil—First audio plate choke (L33)	.30
4371	Cover—Fuse mount cover	.15
10907	Fuse—3 amperes—Package of 5	.40
3376	Mount—Fuse mount—105–125 volt operation	.40
4604	Mount—Fuse mount for 200–250 volt operation	.35
7784	Reactor—Tone control reactor (L34)	1.30
6135	Resistor—270 ohms—Carbon type—¼ watt (R3, R7, R11)—Package of 5	1.00
4687	Resistor—1000 ohms—Carbon type—½ watt (R25)—Package of 10	2.00
4834	Resistor—1100 ohms—Carbon type—¼ watt (R9, R10, R13)—Package of 5	1.00
4833	Resistor—490,000 ohms—Carbon type—¼ watt (R19)—Package of 5	1.00
3998	Resistor—15,000 ohms—Carbon type—¼ watt (R34)—Package of 5	1.00
6143	Resistor—40,000 ohms—Carbon type—¼ watt (R23)—Package of 5	1.00
3114	Resistor—50,000 ohms—Carbon type—¼ watt (R31)—Package of 5	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R14)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R1, R30, R35)—Package of 5	1.00
3744	Resistor—250,000 ohms—Carbon type—¼ watt (R32)—Package of 5	$1.00
6186	Resistor—500,000 ohms—Carbon type—¼ watt (R33)—Package of 5	1.00
4783	Resistor—1,100,000 ohms—Carbon type—¼ watt (R16)—Package of 5	1.00
6242	Resistor — 2 megohms — Carbon type — ¼ watt (R15, R18)—Package of 5	1.00
3594	Resistor—50,000 ohms—Carbon type—½ watt (R20, R21)—Package of 5	1.00
2240	Resistor — 30,000 ohms — Carbon type — 1 watt (R26)	.22
4649	Resistor—Flat type—Total resistance 8820 ohms—Divided as follows: one 220 ohms, one 3,900 ohms and one 4,700 ohms section (R27, R28, R29)	1.05
7804	Rheostat—Sensitivity control rheostat (R4)	1.30
4656	Screw—Volume control mounting assembly—Comprising one bushing, one washer, one shakeproof washer and one nut	.18
4452	Shield—Second detector A.V.C. Radiotron shield	.35
3683	Shield—Second detector—A.V.C. Radiotron shield top	.20
4453	Shield—I. F. Radiotron shield	.32
4742	Shield—Intermediate frequency transformer shield	.40
4784	Socket—4-contact rectifier Radiotron socket	.15
4814	Socket—5-contact driver Radiotron socket	.15
4786	Socket—6-contact I. F. amplifier—Second detector—"A.V.C." or output Radiotron socket	.15
4686	Strip—"ANT-GND" terminal strip—Two terminals and link	.20
7796	Switch—Operating switch (S12)	.62
4829	Tone control—Bass tone control (R22)	1.00
4830	Tone control—Treble tone control (R24)	1.00
7841	Transformer—Audio transformer pack comprising interstage transformer and reactor (T2, L35)	4.05
4431	Transformer—First intermediate frequency transformer (L29, L30, C32, C33, C36)	2.28
4433	Transformer—Second intermediate frequency transformer (L31, L32, C40, C41, C42)	2.15
7832	Transformer—Driver transformer (T3)	2.85
9505	Transformer—Power transformer—105–125 volts—50–60 cycles (T1)	6.35
9506	Transformer—Power transformer—105–125 volts—25–40 cycles	8.90
9507	Transformer—Power transformer—105–250 volts—40–60 cycles	6.40
4832	Volume control (R17)	1.25
	R. F. UNIT ASSEMBLIES	
4244	Cap—Contact cap—Package of 5	.20
4646	Capacitor—4.5 mmfd. (C10)	.20
4633	Capacitor—50 mmfd. (C19)	.25
4842	Capacitor—400 mmfd. (C8)	.24
4811	Capacitor—340 mmfd. (C28)	.25

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
4412	Capacitor—1,120 mmfd. (C25)	$0.25
4524	Capacitor—2,850 mmfd. (C23)	.35
4615	Capacitor—2,850 mmfd. (C20)	.34
4836	Capacitor—0.05 mfd. (C5, C15)	.30
4841	Capacitor—0.1 mfd. (C7, C16)	.22
4835	Capacitor—0.1 mfd. (C9, C31)	.28
3861	Capacitor—Adjustable capacitor (C27, C30)	.78
4420	Clamp—Antenna lead clamp and screw—Package of 10	.40
4410	Coil—Antenna coil—Band "D" (L1, L2)	.70
7803	Coil—Antenna coil—Band B-C (L3, L4, L7, L8, C1, C3)	1.82
7810	Coil—Antenna coil—Band X-B (L5, L6, L9, L10, C2, C4)	2.10
7805	Coil—Detector coil—Band A-C (L13, L14, L17, L18, C11, C13)	2.15
7808	Coil—Detector coil—Band X-B (L15, L16, L19, L20, C12, C14)	2.05
4421	Coil—Detector coil—Band D (L11, L12)	.70
7807	Coil—Oscillator coil—Band A-C (L21, L22, L25, L26, C22, C26)	1.62
7809	Coil—Oscillator coil—Band X-B (L23, L24, L27, L28, C24, C29)	1.70
4806	Condenser—3-gang variable tuning condenser (C6, C17, C21)	5.64
4340	Lamp—Dial lamp—Package of 5	.60
4834	Resistor — 1100 ohms — Carbon type — ¼ watt (R5)—Package of 5	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R8)—Package of 5	1.00
4418	Resistor—100 ohms—Flexible type (R2, R6)—Package of 10	1.50
4656	Screw—Chassis mounting screw assembly—Comprising one bushing, one washer, one shakeproof washer, and one nut (four sets required to mount chassis)	.18
4742	Shield—Antenna, detector or oscillator coil shield	.40
3682	Shield—First detector-oscillator Radiotron shield	.22
3683	Shield—Radiotron shield top	.20
4235	Shield—R. F. amplifier Radiotron shield	.24
3529	Socket—Dial lamp socket	.32
4786	Socket—6-contact R. F. amplifier Radiotron socket	.15
4787	Socket — 7-contact first detector-oscillator Radiotron socket	.15
7836	Switch—Range switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11)	3.05
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball for variable condenser drive assembly—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—Comprising drive shafts, balls, ring, spring and washers—Assembled	.88
4455	Dial—Station selector dial	.60
7799	Drive—Variable tuning condenser drive assembly complete	$2.45
4827	Gear—Spring gear assembly complete with hub, pinion, gear cover and spring	1.25
4704	Indicator—Band indicator—Celluloid lettered —D. C. B. A. X.	.12
4360	Pinion—Vernier pointer pinion	.35
4363	Pointer—Station selector main (large) pointer	.18
4367	Pointer—Station selector vernier (small) pointer	.15
3943	Screen—Celluloid screen for dial light—Package of 2	.18
3993	Screw—No. 6-32-5/32" square head set screw for band indicator operating arm or variable condenser drive—Package of 10	.25
4377	Spring—Band indicator and arm tension spring—Package of 5	.25
4378	Stud—Band indicator operating arm stud—Package of 5	.25
	CABLE ASSEMBLIES	
5084	Cable—Main cable	1.35
5083	Cable—4-conductor—Reproducer cable	.60
4655	Cable—Shielded cable—From low-frequency tone control to resistor boards	.58
5039	Plug—4-contact male plug for reproducer cable	.25
5040	Plug—4-contact female plug for reproducer cable	.25
	REPRODUCER ASSEMBLY	
4645	Capacitor—0.1 mfd.—Located on output transformers (C54)	.25
9583	Coil—Field coil, magnet and cone support (L37)	5.20
8969	Cone—Reproducer cone (L36)—Package of 5	6.35
9582	Reproducer—Reproducer complete	9.00
6999	Screen—Dust (cloth) screen—Package of 6	.12
5080	Transformer—Output transformer and capacitor (T4, C54)	1.60
	MISCELLANEOUS PARTS	
4677	Bezel—Metal bezel (escutcheon) for station selector dial glass	.56
6614	Glass—Station dial glass	.30
3829	Knob—Bass or treble tone control, volume or sensitivity control range switch or operating switch knob—Package of 5	1.10
4657	Knob—Knob station selector knob—Package of 5	.65
4678	Ring—Retaining ring for dial glass—Package of 5	.34
4119	Screw—8-32-¼" headless set screw for knob —Stock No. 4657—Package of 20	.38
4393	Screw—8-32-5/16" headless set screw for knob—Stock No. 3829—Package of 10	.25

RCA VICTOR MODEL 322-E

Six-Tube, Three-Band A. C. Radio-Phonograph

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage Rating	105–125 Volts and 105–130/200–250 Volts (Double Range Transformer)
Frequency Rating	50 and 60 Cycles
Power Consumption	130 Watts (60 Cycles)
Type and Number of Radiotrons	2 RCA-6D6, 1 RCA-6A7, 1 RCA-6B7, 1 RCA-41, 1 RCA-80—Total, 6
Tuning Frequency Range	Band A— 140 K. C.– 410 K. C. Band B— 540 K. C.– 1720 K. C. Band C—5400 K. C.–18000 K. C.
Line-up Frequencies	175 K. C., 410 K. C., 460 K. C., 600 K. C., 1720 K. C., 18000 K. C.
Maximum Undistorted Output	1.9 Watts
Maximum Output	3.5 Watts
Pickup Impedance at 1000 Cycles	7 Ohms
Type of Tone Arm	Inertia
Turntable Speed	78 R. P. M. Only

PHYSICAL SPECIFICATIONS

Height	42⅛ Inches
Width	23⅝ Inches
Depth	15 Inches

This six-tube, three-band A. C. radio-phonograph combination instrument combines the performance of the all-wave chassis and the perfected manual phonograph mechanism. Outstanding world-wide radio performance and unusual musical record quality characterize this instrument.

The receiver is of the "all-wave" type and has a tuning range of from 140 K. C. to 410 K. C., 540 K. C. to 1720 K. C. and 5400 K. C. to 18,000 K. C. This tuning range includes all of the important short-wave broadcasting, standard broadcasting and European broadcasting bands. Excellent sensitivity, selectivity and tone quality, together with a number of important operating features, make this an outstanding receiver of its type.

Operating features include a full-vision "airplane" type dial, double-ratio vernier drive, high-frequency tone control, three-position band switch with visual band indicator on dial, and an automatic volume control. High tonal fidelity is realized by adequate power output, 1.9 watts undistorted, and a well-designed reproducer unit. The record-reproducing facilities make use of the audio amplifier and loudspeaker of the receiver.

DESCRIPTION OF ELECTRICAL CIRCUIT

RADIO

The general circuit arrangement consists of an R. F. stage, a combined oscillator and first detector, an I. F. stage, a combined second detector, first audio stage and automatic volume control and a single Pentode output stage. An RCA-80 rectifier, together with a suitable filtering system, provides plate and grid voltages for all tubes and field excitation for the loudspeaker. Figure 1 shows the schematic circuit diagram, Figure 2 the chassis wiring, and Figure 3 the loudspeaker wiring.

The signal enters the receiver through a shielded antenna lead and is applied to the grid of the R. F. tube through the antenna coupling transformer. The secondary of this transformer is tuned to the signal frequency by means of one unit of the gang-capacitor. The output of this stage is transformer coupled to the grid circuit of the first detector, which is also tuned to the signal frequency by a unit of the gang-capacitor.

Combined with the signal in the first detector is the local oscillator, which is always at a 460 K. C. frequency difference (higher) from the signal frequency. A separate coil system and the third unit of the gang-capacitor are used in this circuit.

In conjunction with these three tuned circuits, it is well to point out that three different groups of tuned circuits are used, one for each tuning band. A three-position selector switch is provided for selecting the

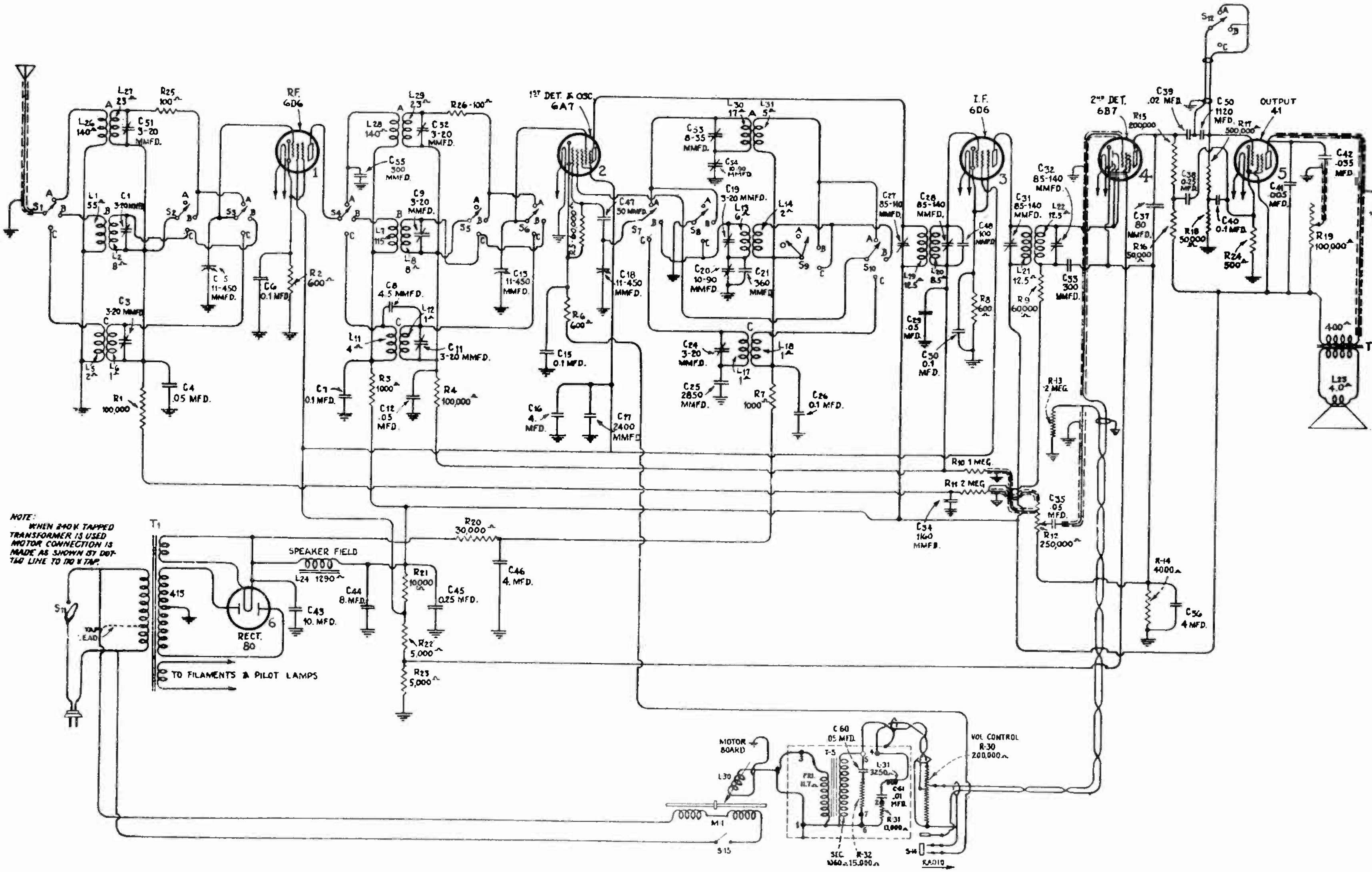


Figure 1—Schematic Circuit Diagram—Some models may have R-32 comprised of two resistors, one internal (4000-ohm) and one external (10,000-ohm)

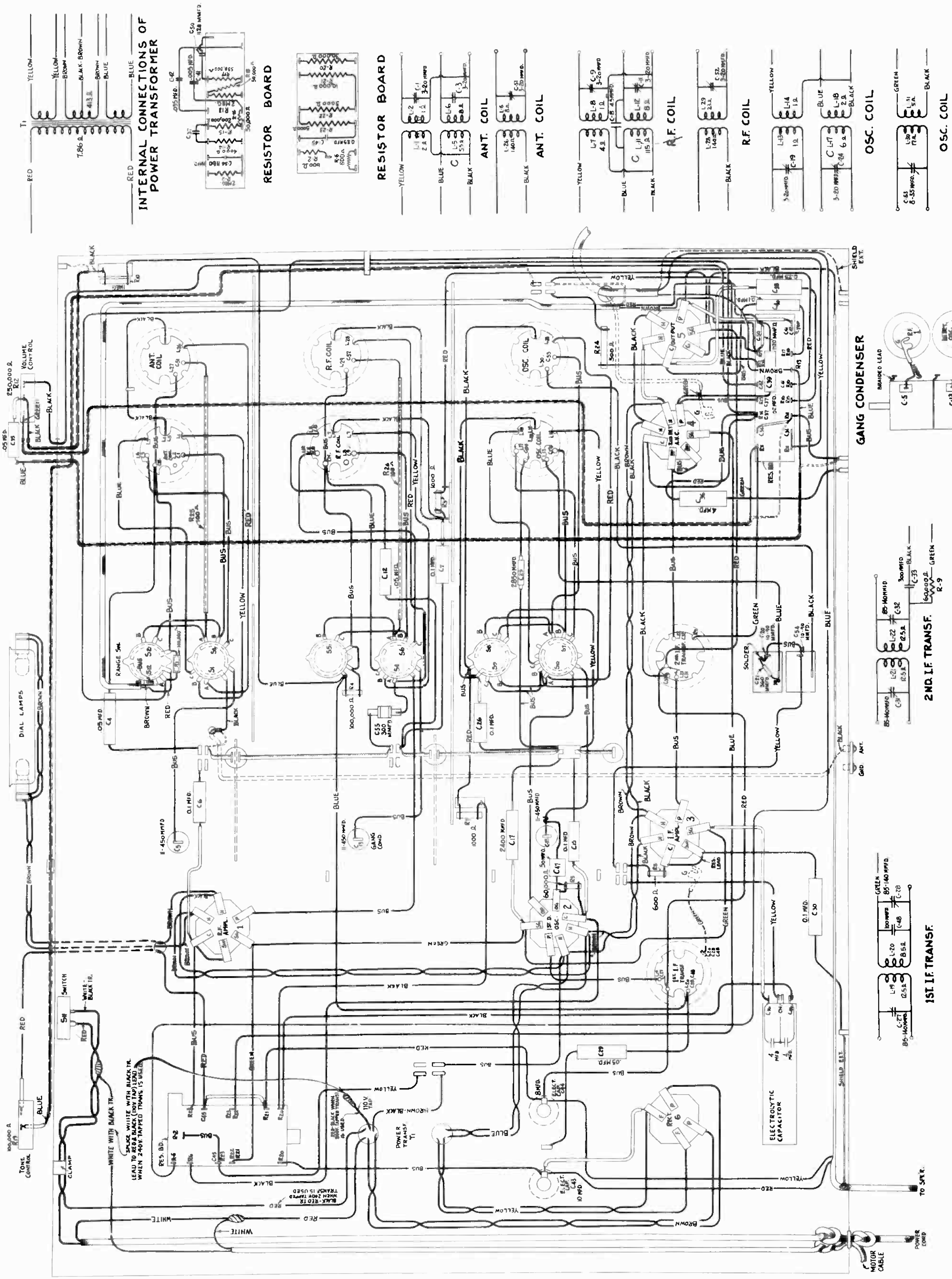


Figure 2—Chassis Wiring Diagram

band in which the desired signal is located. In addition to selecting the desired coil system, additional groups of contacts are provided for short-circuiting the Band A coils when using Band B and the Band B coils together with Band A oscillator coil when using Band C.

The output of the first detector, which is the I. F. signal (460 K. C.), is fed directly through two tuned circuits to the grid of the I. F. amplifier stage. The I. F. stage, which utilizes Radiotron RCA-6D6, uses two transformers, which consist of four tuned circuits, all of which are tuned to 460 K. C.

The output of the I. F. amplifier is then applied to the diode electrodes of the RCA-6B7, which is a combined second detector, A. F. amplifier and automatic volume control. The direct current component of the rectified signal produces a voltage drop across resistor R-12. The full voltage drop constitutes the automatic bias voltage for the R. F., while a tap is provided for the first detector and I. F. voltage. These automatic bias voltages for the R. F., first detector and I. F. give the automatic volume control action of the receiver. The volume control selects the amount of audio voltage that is applied to the grid of the RCA-6B7 and thereby regulates the audio output of the entire receiver.

The output of the RCA-6B7 is resistance coupled to the grid of the RCA-41 tube, which is the power output amplifier. This tube is operated as a Pentode and provides high audio gain and satisfactory output power. The plate circuit of the output stage is matched to the cone coil of the reproducer by means of a stepdown transformer.

It should be noted that a small coupling capacitor C-50 is connected in series with C-39 during operation on band C. This is to reduce the low-frequency output on this band, which ensures better operation. During record reproduction it is important that the band switch be at the A or B position.

The tone control consists of a variable resistor and fixed capacitor connected in series across the primary of the output transformer. At the minimum resistance position of the variable resistor, maximum attenuation of the high audio frequencies is obtained.

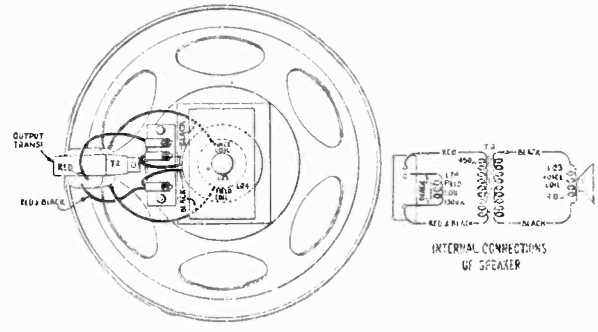


Figure 3—Loudspeaker Wiring

Plate and grid voltages for all tubes are supplied from the output of the rectifier-filter system. An RCA-80 is used as a rectifier and a suitable network of capacitors and resistors gives the necessary filtering and voltages. The loudspeaker field is used as a filter reactor.

PHONOGRAPH

The phonograph facilities consist of the standard perfected manual motor-board assembly, audio amplifier of the receiver and the loudspeaker.

A low-impedance pickup, a compensated input system consisting of a transformer, record volume control and compensation network are connected to the input of the audio section of the RCA-6B7. The circuit functions from this point to the loudspeaker are identical with that of the audio output from the detector during radio operation. The radio receiver is made inoperative during record reproduction by opening the cathode circuit of the RCA-6A7.

SERVICE DATA

(1) LINE-UP PROCEDURE

The line-up procedure of this receiver is somewhat involved and it is important that these instructions be carefully followed when making adjustments. Properly aligned, this receiver has outstanding performance; improperly aligned, it may be impossible to receive signals on all bands.

Equipment

To properly align this receiver, proper test equipment must be used. This consists of a modulated R. F. oscillator having proper frequency range, an output indicator, an alignment tool and a tuning wand. These parts, which are shown on page 14, have been developed by the manufacturer of this receiver for use by service men to duplicate the original factory adjustments.

Checking with Tuning Wand

Before making any R. F., oscillator or first detector adjustments, the accuracy of the present adjustments may be checked by means of the tuning wand (Stock No. 6679). The tuning wand consists of a bakelite rod having a brass cylinder at one end and a special finely divided iron insert at the other end. Inserting the cylinder into the center of a coil lowers its inductance, while inserting the iron end increases its inductance. From this, it is seen that unless the trimmer adjustment for a particular coil is perfect at alignment frequencies, inserting one end of the wand may increase the output of a particular signal. A perfect adjustment is evidenced by a lowering of output when either end of the wand is inserted into a coil.

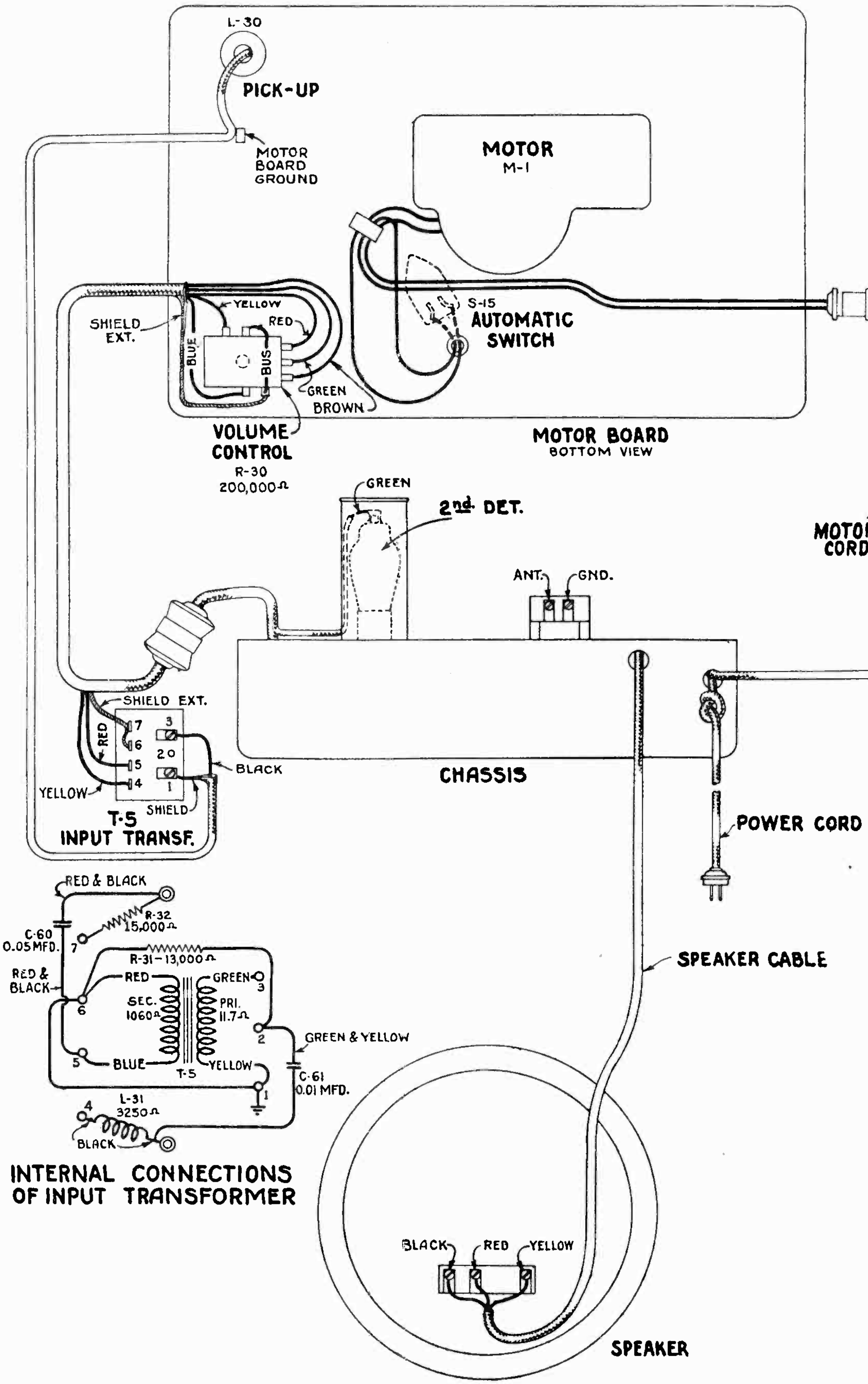


Figure 4—Assembly Wiring Diagram—Some models may have R-32 consisting of a 4000-ohm resistor with an additional 10,000-ohm resistor substituted for the jumper between terminals 6 and 7 of the input transformer.

The shields over the R. F. coil assembly have a hole at their top for entrance of the tuning wand. The location of the various coils inside of the shield is shown in Figure 5. An example of the proper manner of using the tuning wand would be to assume the external oscillator were set at 1720 and the signal tuned in, and the output indicator should be connected across the voice coil of the loudspeaker. Then the tuning wand would be inserted, first one end and then the other end, into the top of the three transformers at the left of the R. F. assembly, facing the front of the chassis. A perfect adjustment of the trimmer would be evidenced by a reduction in output when each end of the wand is inserted in each of the three transformers. If one end—for example, the iron end—when inserted in one coil caused an increase in output, then that circuit is low. An increase in the trimmer capacitance would be the proper remedy.

(2) I. F. TUNING CAPACITOR ADJUSTMENTS

This receiver has one I. F. stage, which uses two transformers. The transformers are all peaked at 460 K. C.

A detailed procedure for making this adjustment follows:

(a) Connect the output of an external oscillator tuned to 460 K. C. between the first detector grid and ground. Connect the output indicator across the voice coil of the loudspeaker.

(b) Place the oscillator in operation at 460 K. C. Place the receiver in operation and adjust the station selector until a point is reached (band B) where no signals are heard and turn the volume control to its maximum position. Reduce the oscillator input until a slight indication is obtained in the output indicator.

(c) Refer to Figure 6. Adjust each trimmer of the I. F. transformers until a maximum output is obtained. Go over the adjustments a second time.

This completes the I. F. adjustments. However, it is good practice to follow the I. F. adjustments with the R. F. and oscillator adjustments due to interlocking which always occurs.

(3) R. F. OSCILLATOR AND FIRST DETECTOR ADJUSTMENTS

Four R. F., oscillator and first detector adjustments are required in bands "A and B." Three are required in band "C."

To properly align the various bands, each band must be aligned individually. The preliminary set-up requires the external oscillator to be connected between the antenna and ground terminals of the receiver and the output indicator must be connected across the voice coil of the loudspeaker. The volume control must be at its maximum position and the input from the oscillator must be at the minimum value possible to get an output indication under these conditions. In the high-frequency band, it may be necessary to disconnect the oscillator from the receiver and place it at a distance in order to get a sufficiently low input to the receiver.

The dial pointer must be properly set before starting any actual adjustments. This is done by turning the variable capacitor until it is at its maximum capacity position. One end of the pointer should point exactly at the horizontal line at the lowest frequency end of band "B," while the other end should point to within 1/64 inch of the horizontal line at the highest frequency end of band "B."

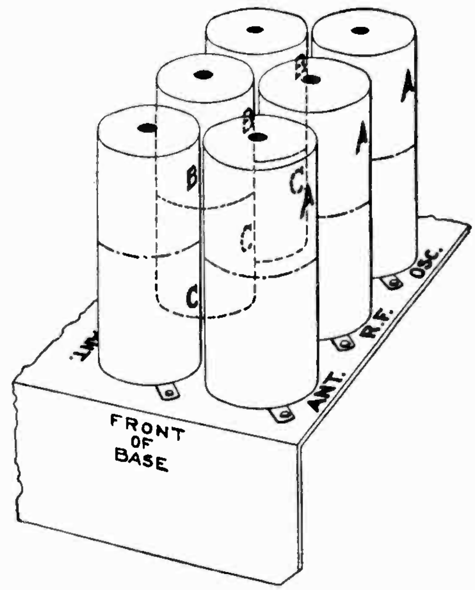


Figure 5—Location of Coils in Shields

Figure 6 shows the location of the trimmers for each band. Care must be exercised to merely adjust the trimmers in the band under test.

Band "A"

(a) Set the Band Switch at "A."

(b) Tune the external oscillator to 410 K. C., set the dial pointer at 410 K. C. and adjust the oscillator, detector and R. F. trimmers for maximum output.

(c) Shift the external oscillator frequency to 175 K. C. Tune in the 175 K. C. signal irrespective of scale calibration and adjust the series trimmer, marked 175 K. C. on Figure 6, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 410 K. C. as described in (b).

Band "B"

(a) Set the Band Switch at "A."

(b) Tune the external oscillator to 1,720 K. C., set the pointer at 1,720 K. C. and adjust the oscillator, detector and R. F. trimmers for maximum output.

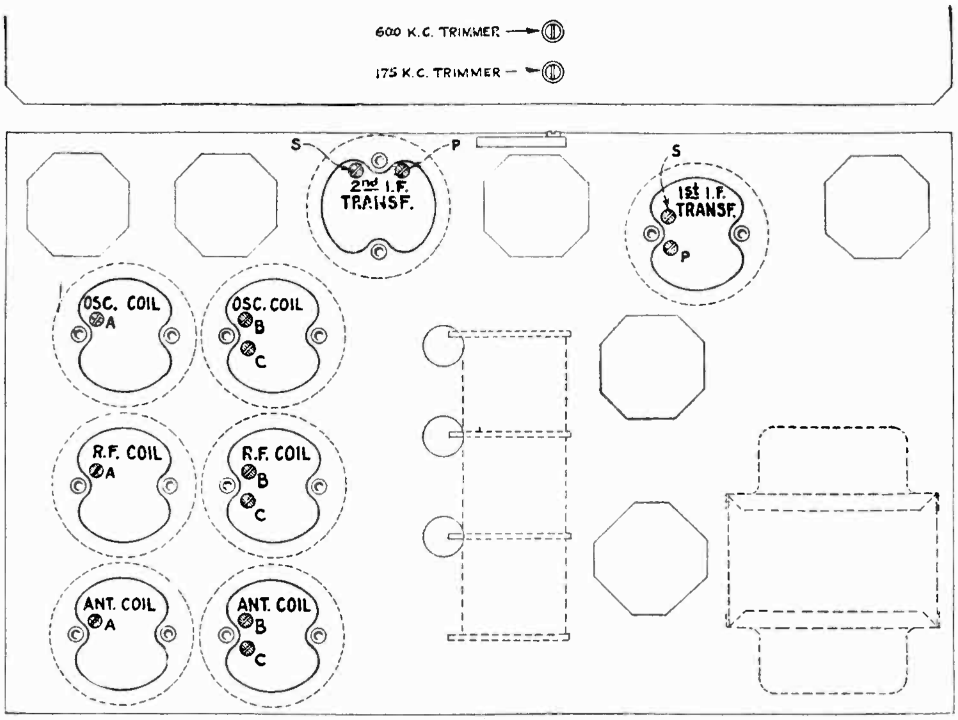


Figure 6—Location of Line-up Capacitors

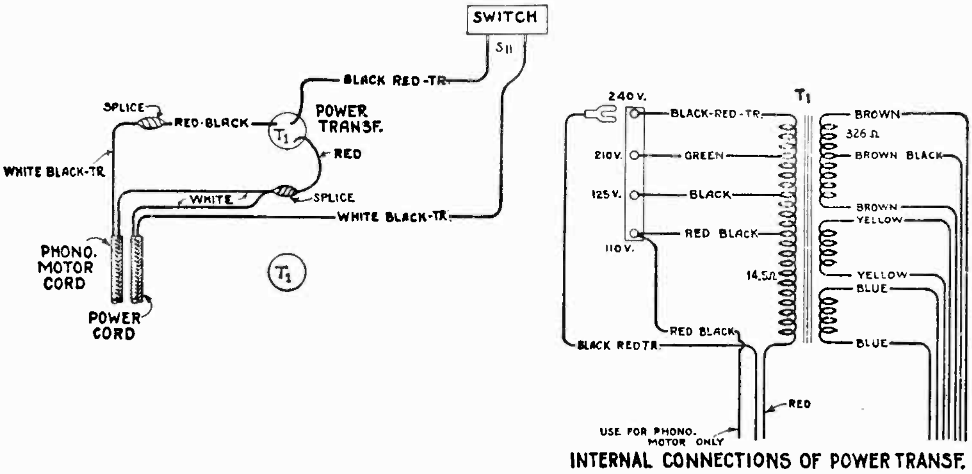


Figure 7—Universal Power Transformer Connections

(c) Shift the external oscillator frequency to 600 K. C. Tune in the 600 K. C. signal, irrespective of scale calibration, and adjust the series trimmers, located on rear apron of chassis, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 1,720 K. C. as described in (b).

Band "C"

(a) Set the Band Switch at "C."

(b) Tune the external oscillator to 18,000 K. C., and set the pointer at 18 M. C. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacitor from minimum to maximum.

(c) Check for the image signal, which should be received at approximately 17,080 on the dial. It may be necessary to increase the external oscillator output for this check.

(d) Reduce the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal disappears. The first detector circuit is then aligned with the oscillator circuit and the RCA-6A7 tube is blocked. Then increase the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal is peaked for maximum output.

(e) The antenna trimmer should now be peaked for maximum output. It is not necessary to rock the main tuning capacitor while making this adjustment.

(4) POWER TRANSFORMER CONNECTIONS

The 220-volt power transformer furnished with some instruments includes taps for operating on 110-volt lines. Figure 6 shows the schematic circuit of the transformer and the proper voltage to be applied to the various taps. The taps are located on the power transformer assembly and are accessible without removing the chassis from the cabinet.

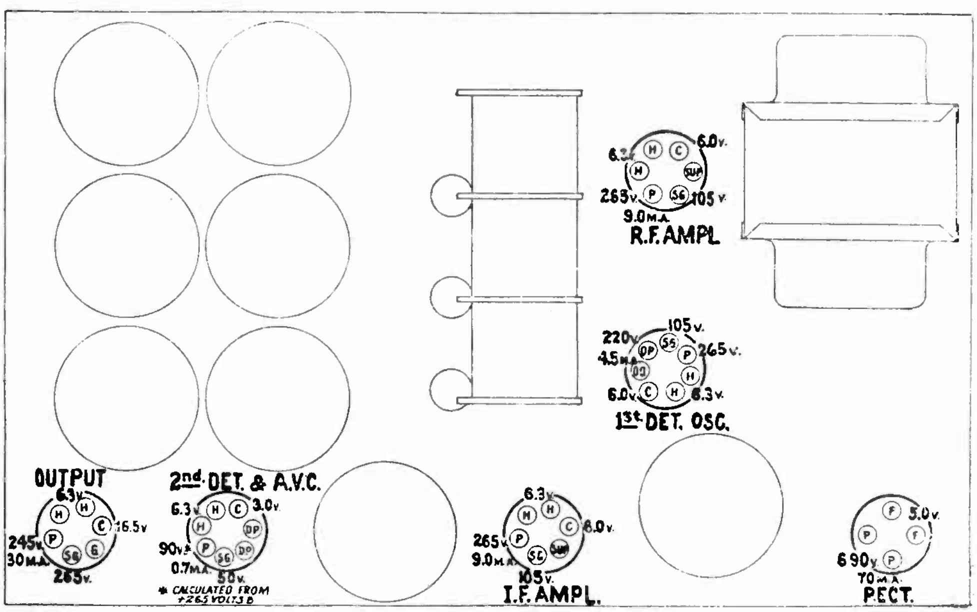
(5) VOLTAGE READINGS

The voltages on page 10 are those at the various tube sockets while the receiver is in operating condition. No allowance has been made for currents drawn by the meter, and if low-resistance meters are used, such allowances must be made. Figure 8 shows the actual voltage at each socket contact.

(6) SERVICE DATA ON MAGNETIC PICKUP

The Magnetic Pickup used in this combination instrument is of a new design with an improved frequency range. While in physical appearance it is similar to that of the older type, details of construction are considerably different. It consists essentially of a chromium steel magnet, two thin pole pieces, a mechanism support and bracket, a coil, and an armature that is damped by means of an anchored damping block.

The use of the anchored damping block eliminates any bad peaks in the frequency range. The frequency-response characteristic is substantially flat from 50 to 5,000 cycles.



ALL D. C. VOLTAGES ARE TO GROUND

Figure 8—Tube Socket Voltages

In assembling, it may be desirable to check the armature air gap by means of a small Feeler Gauge. This air gap should be .009" on each side of the armature. However, a little practice with the needle in place will quickly disclose whether or not the armature is centered.

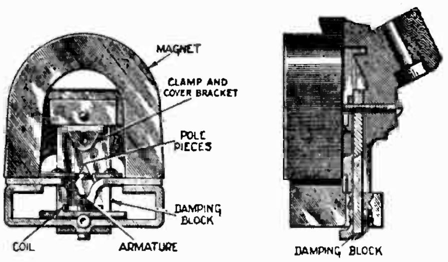


Figure 9—Details of Magnetic Pickup

(7) REPLACING MAGNET COIL, PIVOT RUBBERS, ARMATURE OR DAMPING BLOCK

In order to replace a defective coil or the hardened pivot rubbers (see Figure 9), it is necessary to proceed as follows:

(a) Remove the pickup cover by removing the center holding screw and needle screw.

(b) Remove the pickup magnet and the magnet clamp by pulling them forward.

(c) Unsolder the coil leads and remove the mechanism assembly from the back plate by releasing the two mounting screws and the damping block clamping screw.

(d) Remove screws A and B, Figure 10, and then remove the mechanism assembly from the pole pieces.

(e) The coil or the front pivot rubber may now be removed and replaced. If it is desired to replace the rear pivot rubber, then the end of the armature soldered to the mechanism support must be unsoldered and the damping block removed. The rear pivot rubber now may be replaced. After putting the pivot rubbers in place a new damping block should be fastened to the armature as outlined in instructions on replacing the damping block.

(f) The mechanism should now be reassembled, except for the magnet, which must be magnetized. After being magnetized, the mechanism—with the pole pieces upward—should be placed so that the magnet may be slid from the magnetizer onto the pole pieces without breaking physical contact. After placing the pole pieces on the magnet, the entire assembly should be remagnetized thoroughly, being careful not to change the polarity obtained by the initial magnetization.

RADIOTRON SOCKET VOLTAGES

115 Volt A. C. Line—No Signal—Volume Control Maximum

Radiotron Number		Cathode to Ground, Volts, D. C.	Screen Grid to Ground, Volts, D. C.	Plate to Ground, Volts, D. C.	Plate Current, M. A.	Heater Volts, A. C.
RCA-6D6—R. F.		6.0	105	265	9.0	6.3
RCA-6A7	Det.	6.0	105	265	3.5	6.3
	Osc.	—	—	220	4.5	
RCA-6D6—I. F.		6.0	105	265	9.0	6.3
RCA-6B7—2nd Detector		3.0	50	90*	0.7	6.3
RCA-41—Power		16.5	265	245	30.0	6.3
RCA-80—Rectifier		—	—	690 (RMS—P to P)	70.0	5.0

*Voltage calculated from 265 v. + B.

(g) After assembling to the mechanism, the entire assembly should be fastened to the back plate by means of the screws provided, making sure the damping block is securely clamped. At the same time, the metal dust cover must be placed in position.

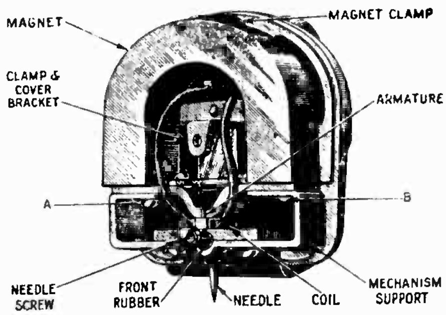


Figure 10—Pickup Nomenclature

(h) After remagnetizing, it is necessary to correctly center the armature. This may be done quite accurately by feeling its play after the needle is inserted. A little practice will quickly show which way an adjustment is necessary to have the armature centered properly. The adjustment is made by loosening screws A and B (Figure 10), and sliding the mechanism slightly in relation to the pole pieces.

(i) The cover may be now replaced over the entire assembly, and the pickup returned to the tone arm.

(8) REPLACING THE DAMPING BLOCK

If it is desired to replace the damping block, it may be done in the following manner:

(a) Disassemble the pickup as described under the preceding section.

(b) Remove the armature entirely by unsoldering it at its joint with the mechanism support.

(c) Remove the damping block from the armature and clean the bushing for holding the damping block with emery paper.

(d) Insert the armature through the new block so that it occupies the same position as that of the old. Also ascertain that the block is in correct vertical alignment with the armature. It will be noted that the hole in the damping block is somewhat smaller than the diameter of the armature. This is done so that a snug fit will be obtained.

(e) After properly locating the damping block, a soldering iron should be applied to the armature so that the block will melt slightly at its point of contact with the armature. A special tip, constructed as shown in Figure 11, will prove desirable for fusing the block in place. The iron should be applied long enough to slightly melt the block and cause a small bulge on both sides, but should not be applied long enough to cause any bubbling. The pickup should then be reassembled as described in the preceding section.

Only rosin core solder should be used for soldering the coil leads in the pickup. Also rosin core solder should be satisfactory for resoldering the end of the spring in the hole in the mechanism, since both these parts have been previously tinned. In case the parts are not well tinned, it will be necessary to scrape the end of the spring and the hole in the mechanism until bright. These parts may now be tinned by using as a flux a water solution of zinc chloride (commonly called acid flux). After tinning, dip the parts in water to wash off the acid flux and thereby prevent serious subsequent corrosion. After making sure that the pivot rubbers and damping block are properly in place,

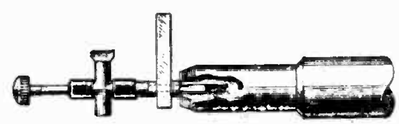


Figure 11—Special Soldering-Iron Tip

as described under (e) above, the armature may now be soldered in place in the mechanism by using rosin core solder, since the parts are now tinned. Care must be exercised to get the needle hole perfectly square with respect to the mechanism, or otherwise it will be difficult if not impossible to center the armature in the air gap as explained under (h), section (7).

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No	Description	List Price
	RECEIVER ASSEMBLIES	
4427	Bracket—Volume control or tone control mounting bracket	$0.18
4729	Cable—2-conductor shielded—From range switch to resistor board	.20
2747	Cap—Contact cap—Package of 5	.50
3861	Capacitor — Adjustable trimmer capacitor (C20)	.78
4442	Capacitor—50 mmfd. (C47)	.22
4662	Capacitor—80 mmfd. (C37)	.24
4413	Capacitor—360 mmfd. (C21)	.22
4634	Capacitor—1120 mmfd. (C50)	.35
4515	Capacitor—1160 mmfd. (C34)	.22
4670	Capacitor—2250 (C14)	.30
4523	Capacitor—2400 mmfd. (C17)	.26
4524	Capacitor—2850 mmfd. (C25)	.35
4435	Capacitor—.02 mfd. (C39)	.25
4518	Capacitor—.05 mfd. (C35)	.52
4417	Capacitor—.05 mfd. (C4, C12, C29)	.25
3877	Capacitor—.1 mfd. (C40)	.32
4415	Capacitor—.1 mfd. (C6, C15, C30)	.30
4645	Capacitor—.1 mfd. (C7, C26)	.25
3597	Capacitor—.25 mfd. (C38, C45)	.40
4525	Capacitor—4.0 mfd. (C36)	.70
4428	Capacitor—8 mfd. (C44)	1.05
7790	Capacitor—10 mfd. (C43)	1.05
4692	Capacitor pack—Comprising one 0.035 mfd. and one 0.005 mfd. capacitors (C41, C42)	.30
7589	Capacitor pack—Comprising two 4. mfd. capacitors (C16, C46)	1.64
4358	Clamp—Electrolytic capacitor mounting clamp	.15
4734	Coil—Antenna coil "A" (L26, L27, C51)	3.05
7803	Coil—Antenna coil "B & SW" (L1, L2, L5, L6, C1, C3)	1.82
4751	Coil—Detector coil "A" (L28, L29, C52)	2.38
7805	Coil—Detector coil "B & SW" (L7, L8, L11, L12, C8, C9, C11)	2.15
7807	Coil—Oscillator coil "B & SW" (L13, L14, L17, L18, C19, C24)	1.62
4733	Coil—Oscillator coil "A" (L30, L31, C53)	3.05
7801	Condenser—3-gang variable tuning condenser (C5, C13, C18)	4.42
4340	Lamp—Dial lamp—Package of 5	.60
3632	Resistor—500 ohms—Carbon type—1 watt (R24)—Package of 5	1.10
3218	Resistor—600 ohms—Carbon type—¼ watt (R2, R6, R8)—Package of 5	1.00
4370	Resistor—1000 ohms—Carbon type—¼ watt (R3, R7)—Package of 10	2.00
3997	Resistor—4000 ohms—Carbon type—¼ watt (R14)—Package of 5	1.00
6318	Resistor—10,000 ohms (R21)	.80
3114	Resistor—50,000 ohms—Carbon type—¼ watt (R16, R18)—Package of 5	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R5)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R1, R4)—Package of 5	1.00
3116	Resistor—200,000 ohms—Carbon type—¼ watt (R15)—Package of 5	1.00
6186	Resistor—500,000 ohms—Carbon type—¼ watt (R17)—Package of 5	$1.00
3033	Resistor—1 megohm—Carbon type—¼ watt (R10)—Package of 5	1.00
6242	Resistor — 2 megohms — Carbon type — ¼ watt (R11, R13)—Package of 5	1.00
3413	Resistor—5000 ohms—Carbon type—½ watt (R22, R23)—Package of 5	1.00
4513	Resistor — 30,000 ohms — Carbon type — 3 watt (R20)	.25
4521	Shield—Antenna R. F. or oscillator coil shield	.42
3942	Shield—First detector or output Radiotron shield	.18
7487	Shield—I. F. amplifier Radiotron shield	.25
4705	Shield—R. F. amplifier Radiotron shield	.30
3782	Shield—Second detector Radiotron shield	.26
3529	Socket—Dial lamp socket	.32
3859	Socket—4-contact Radiotron socket	.30
6676	Socket—6-contact output Radiotron socket	.40
7485	Socket—6-contact Radiotron socket	.40
3572	Socket—7-contact Radiotron socket	.38
4379	Strip—Antenna terminal engraved "ANT GND"	.20
4684	Switch—Operating switch (S11)	.45
4728	Switch—Range switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10)	4.32
4517	Tone control (R19)	.90
4431	Transformer — First intermediate frequency transformer (L19, L20, C27, C28, C48)	2.28
4433	Transformer—Second intermediate frequency transformer (L21, L22, C31, C32, C33, R9)	2.15
9511	Transformer—Power transformer 105–125 volts, 50–60 cycles (T1)	4.78
9512	Transformer—Power transformer 105–125 volts, 25–40 cycles	6.58
9513	Transformer—Power transformer—105–250 volts—40–60 cycles	4.85
4519	Volume control (R12)	1.25
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball for condenser drive assembly—Package of 20	.25
4422	Clutch—Clutch drive assembly for variable condenser drive	.88
4732	Dial—Station selector dial	.40
4510	Drive—Tuning condenser drive assembly	2.42
4704	Indicator—Band indicator (celluloid)	.12
4520	Indicator—Station selector indicator pointer	.18
3943	Screen—Dial light screen (celluloid)—Package of 2	.18
3993	Screw—Number 6-32-5/32" square head set screws for band indicator operating arm—Package of 10	.25
4669	Screw—Number 8-32-5/32" set screw for variable condenser drive assembly—Package of 10	.25
4377	Spring—Band indicator and arm tension spring—Package of 5	.25
4378	Stud—Band indicator operating arm stud—Package of 5	.25

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	MOTOR ASSEMBLIES	
4577	Connector—Male section two-prong motor connector plug	$0.30
8989	Motor—105-125 volts—60 cycle motor complete	18.52
8990	Motor—105-125 volts—50 cycle motor complete	18.52
8991	Motor—105-125 volts—40 cycle motor complete	23.36
8992	Motor—105-125 volts—25 cycle motor complete	23.36
8993	Rotor and shaft—For 105-125 volt—60 cycle motor	7.00
8995	Rotor and shaft—For 105-125 volt—50 cycle motor	7.00
8999	Rotor and shaft—For 105-125 volt—25 cycle motor	8.00
8994	Spindle—Turntable spindle with fibre gear for 60 cycle motor	4.75
8996	Spindle—Turntable spindle with fibre gear for 50 cycle motor	4.75
9001	Spindle—Turntable spindle with fibre gear for 25 cycle motor	5.50
3817	Stud—Motor mounting stud—Package of 3	.18
3398	Motor mounting—Spring and washer assembly—Comprising 2 cup washers, 4 springs and 1 "C" washer	.48
	PICKUP AND ARM ASSEMBLIES	
7842	Arm—Pickup arm complete, less escutcheon and pickup	4.75
3417	Armature—Pickup armature	.72
6346	Back—Pickup housing back	.45
3385	Coil—Pickup coil (L30)	.50
3386	Cover—Pickup cover	.56
3521	Cover—Magnetic pickup back cover	.18
3418	Cushions—Pickup rubber cushions—Comprising one damper and two spacer cushions and one damper bushing—5 sets	1.10
3516	Damper assembly—Comprising one upper and one lower damper, one upper bushing and one lower bearing—Located in bottom of pickup base	.14
3390	Escutcheon—Pickup arm escutcheon complete with mounting rivets	.46
6335	Pickup—Pickup unit complete	4.00
3389	Rod—Automatic brake trip rod with lock nut—Package of 5	.40
3387	Screw assembly—Pickup mounting screw assembly comprising one screw, one nut and one washer—10 sets	.40
3388	Screw—Pickup needle holding screw—Package of 10	.60
3419	Screw—Pickup cover mounting screw—Package of 10	.40
	REPRODUCER ASSEMBLY	
4473	Board—Terminal board assembly	.26
9460	Coil—Field coil, magnet and cone support (L24)	6.00
8935	Cone—Reproducer cone (L23)—Package of 5	5.25
9527	Reproducer—Complete	8.00
4472	Transformer—Output transformer (T2)	1.40
	SWITCH ASSEMBLIES	
3994	Cover—Motor switch cover	$0.26
10184	Plate—Automatic brake latch plate—Package of 5	.40
10174	Springs—Automatic brake springs—Package of 4	.50
6896	Switch—Eccentric automatic switch complete	2.50
3322	Switch—Motor switch (S15)	.75
	TURNTABLE ASSEMBLIES	
7084	Cover—Turntable cover	.40
7838	Turntable complete	2.15
	MISCELLANEOUS ASSEMBLIES	
3166	Bolt — Reproducer mounting assembly — Comprising 2 bolts, 2 nuts, 2 lockwashers and 1 plate	.50
7837	Bezel—Station selector (escutcheon) bezel	.82
3430	Box—Needle box with lid—Package of 2	.90
4696	Cable—2-conductor motor cable with section of connector plug—From receiver chassis to motor cord connector	.95
4695	Cable—3-conductor shielded cable with grid and female section of connector—From receiver chassis to volume control cable connector	1.05
7843	Cable—5-conductor shielded with male section of connector plug—From phonograph volume control to input transformer	.98
4153	Connector—Female section (4-contact) of connector for cable Stock No. 4695	.48
4573	Connector—Female section (2-contact) of connector plug for cable Stock No. 4696	.30
6614	Glass—Station selector dial glass	.30
3829	Knob—Phonograph volume control knob—Package of 5	1.10
4449	Knob—Station selector volume control, range switch or operating switch knob—Package of 5	.60
6123	Plug—Male section (4-prong) of phonograph volume control and input transformer cable plug	.30
3396	Receptacle—Needle receptacle	.52
4678	Ring—Dial retaining ring—Package of 5	.34
4393	Screw—8-32-5/16" headless set screw for knob No. 3829—Package of 10	.25
4698	Screw—Chassis mounting screw assembly—Comprising 1 screw, 1 lockwasher, 1 washer, 2 cushions and 1 spacer	.45
3391	Suspension spring and washer assembly—For motor board—Comprising 1 bolt, 1 top spring, 1 bottom spring, 2 cup washers, 1 "C" washer and 1 nut	.50
7844	Transformer—Phonograph input transformer pack comprising one transformer, one reactor, one 15,000 ohm and one 13,000 ohm resistor, one .01 mfd. and one .05 mfd. capacitor (T5, L31, R31, R32, C60, C61)	5.38
6766	Volume control—Phonograph volume control (R30, S16)	2.28

RCA Victor Model 342

Eight-Tube, Four-Band, A. C. Radio-Phonograph

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage Rating............................105–125 Volts and 105–130/200–250 Volts (Double Range)
Frequency Rating..25, 30, 40, 50 and 60 Cycles
Power Consumption...170 Watts, 60 Cycles
Type and Number of Radiotrons
2 RCA-6D6, 1 RCA-6A7, 1 RCA-75, 1 RCA-76, 2 RCA-42, 1 RCA-5Z3—Total, 8

Tuning Frequency Range.......................................
- Band X— 140 KC.– 410 KC.
- Band A— 540 KC.– 1720 KC.
- Band B—1720 KC.– 5400 KC.
- Band C—5400 KC.–18,000 KC.

Line-up Frequencies......175 K. C., 410 K. C., 460 K. C., 600 K. C., 1720 K. C., 5160 KC., 18,000 KC.
Maximum Undistorted Output...4.0 Watts
Maximum Output...5.0 Watts
Type of Magnetic Pickup...High Impedance, Viscoloid
Turntable Speed..78 R. P. M.

PHYSICAL SPECIFICATIONS

Height...43 5/16 Inches
Width..26 Inches
Depth...16 7/8 Inches

The eight-tube, four-band all-wave combination radio-phonograph instrument provides entertainment either from the perfected all-wave radio receiver or from records of the standard (78 r.p.m.) variety. Record or radio reproduction is characterized by unusual tone quality.

This receiver is of the "all-wave" Superheterodyne type, having a continuous tuning range extending from 140 K. C. to 18,000 K. C., except for one break between 410 K. C. and 540 K. C. Such a tuning range permits the listener to receive all of the important broadcasting, police, aircraft and amateur call bands throughout the world.

Excellent sensitivity, selectivity and tone quality, together with a high output (4 watts undistorted), Class A amplifier gives the receiver outstanding performance. Operating features include an "airplane" type dial, a double-ratio vernier drive, a visual band indicator, and a special "second hand" on the dial for logging short-wave stations. Other important features include automatic volume control, sensitivity control and a large loudspeaker unit.

DESCRIPTION OF ELECTRICAL CIRCUIT

RADIO

The general circuit arrangement consists of an R. F. stage, a combined oscillator and first detector, an I. F. stage, a combined second detector, A. F. amplifier and automatic volume control, a driver audio stage and a push-pull Pentode output stage. An RCA-5Z3 rectifier, together with a suitable filtering system, provides plate and grid voltages for all tubes and field excitation for the loudspeaker. Figure 1 shows the schematic diagram, Figures 2 and 3 the chassis wiring, Figure 4 the loudspeaker wiring and Figure 7 the assembly wiring.

The signal enters the receiver through a shielded antenna lead and is applied to the grid of the R. F. tube through the antenna coupling transformer. The secondary of this transformer is tuned to the signal frequency by means of one unit of the gang capacitor. The output of this stage is transformer coupled to the grid circuit of the first detector, which is also tuned to the signal frequency by a unit of the gang capacitor.

Combined with the signal in the first detector is the local oscillation, which is 460 K. C. higher than the signal frequency. A separate coil system and the third unit of the gang capacitor are used in this circuit.

In conjunction with these circuits, it is well to point out that four groups of tuned circuits are used, one for each tuning band. A four-position selector switch is

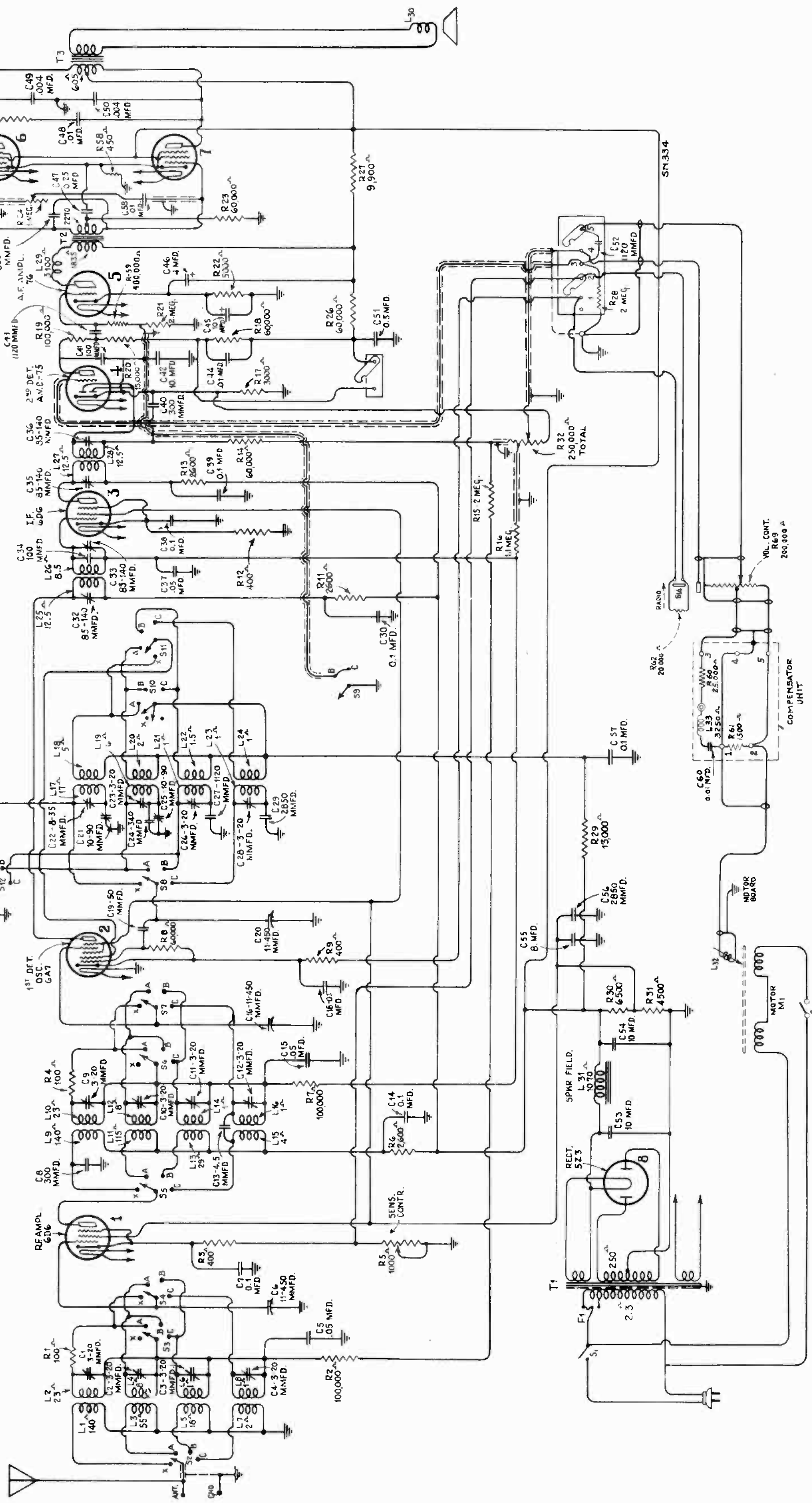


Figure 1—Schematic Circuit Diagram

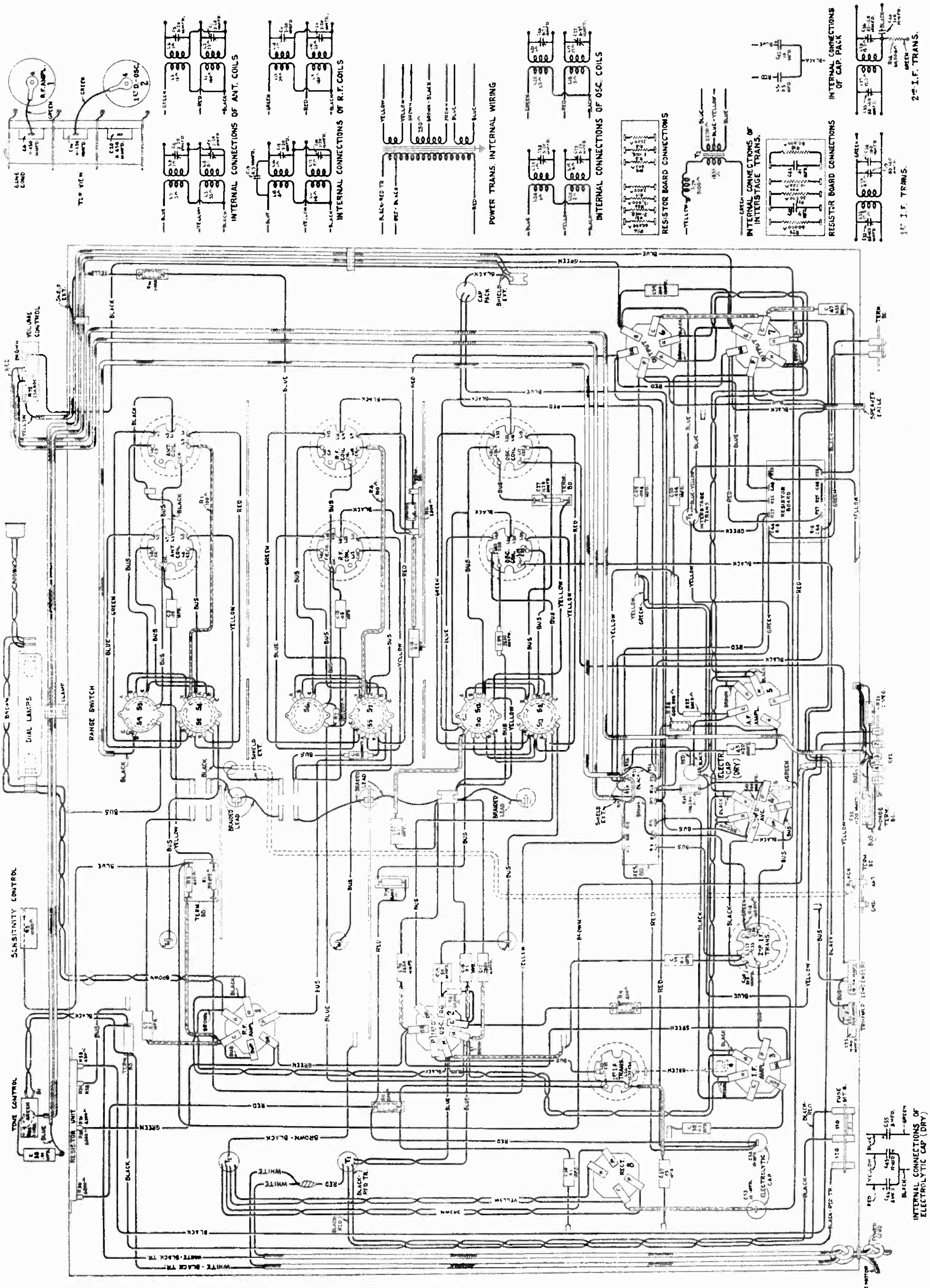


Figure 2 —Wiring Diagram—(Early Production)

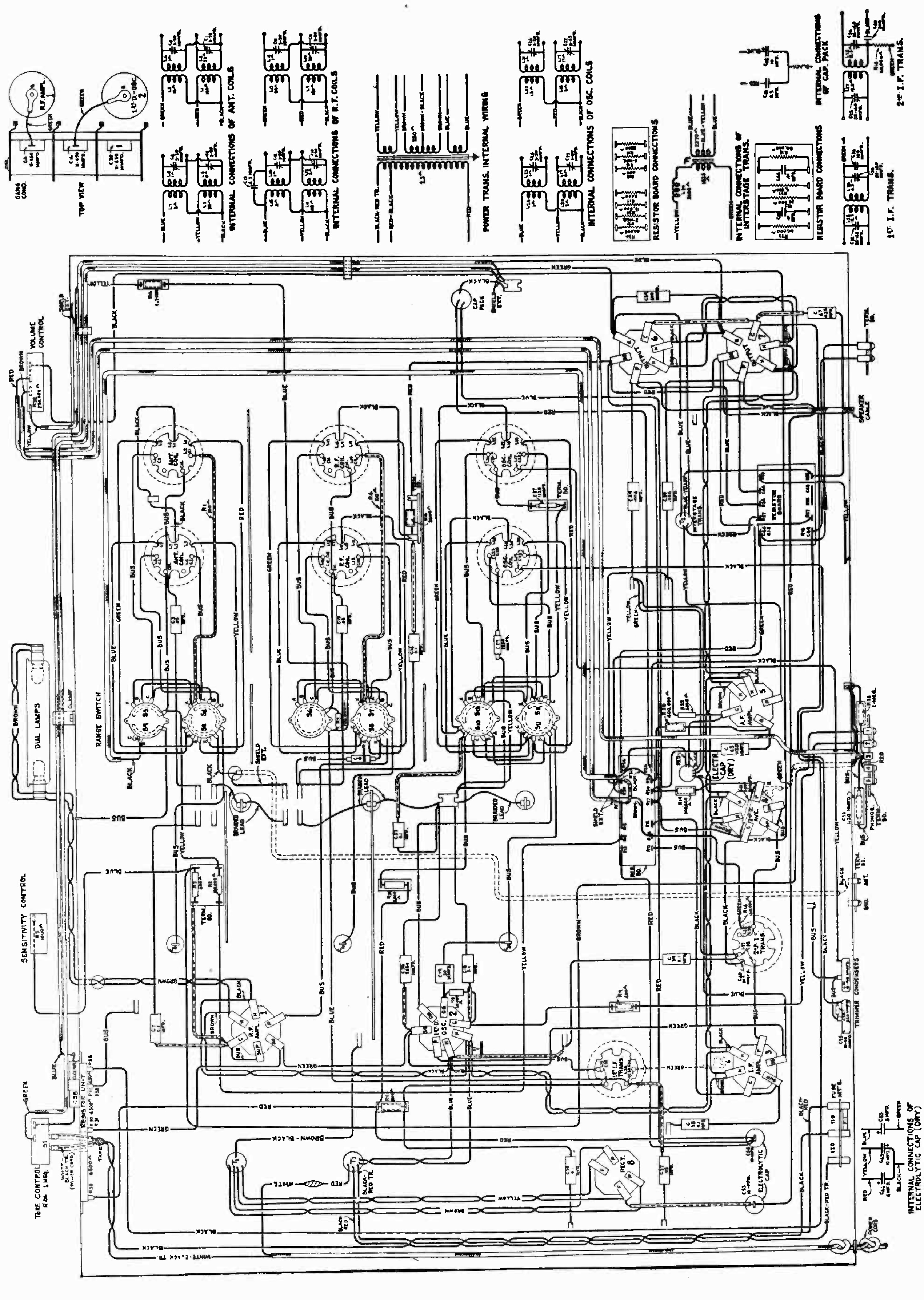


Figure 3—Chassis Wiring Diagram—(Late Production)

NOTE: MOTOR POWER CABLE CONNECTS TO POWER TRANSFORMER INPUT

provided for selecting the desired signal range. In addition to selecting the desired coil system, additional groups of contacts are provided for short-circuiting the preceding lower frequency R. F. and detector coils and the two preceding oscillator coils. This is to prevent "dead" spots due to the absorption effects caused by the coils, the natural period of which, with the tuning capacitor disconnected, falls in the next higher frequency band.

The output of the first detector, which an I. F. signal (460 K. C.), is fed directly through two tuned circuits to the grid of the I. F. amplifier stage. The I. F. stage, which utilizes an RCA-6D6 Radiotron, uses two transformers, which consist of four tuned circuits, all of which are resonated at 460 K. C.

The output of the I. F. amplifier is then applied to the input electrodes of the RCA-75, which is a combined second detector, audio amplifier and AVC. The direct current component of the rectified signal produces a voltage drop across resistor R-32. The full voltage drop constitutes the automatic bias voltage for the R. F. while a tap is provided for the first detector and I. F. voltage. These automatic bias voltages for the R. F., first detector and I. F. give the automatic volume-control action of the receiver. The volume control selects the amount of audio voltage that is applied to the grid of the RCA-75 and thereby regulates the audio output of the entire receiver.

The output of the A. F. section of the RCA-75 is resistance-coupled to the grid of the RCA-76, first audio stage, which is transformer-coupled to the push-pull output stage.

The output stage uses two RCA-42's, which give a low distortion, high audio output to the loudspeaker. A high-frequency tone control, consisting of a variable resistor and capacitor, is connected across the grids of the output stage. At the minimum resistance position of the variable resistor, maximum attenuation of the high audio frequencies is obtained.

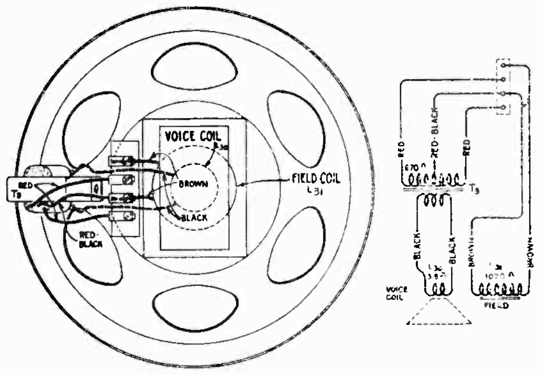


Figure 4—Loudspeaker Wiring

Plate and grid voltages for all tubes are supplied from the output of the rectifier-filter system. An RCA-5Z3 is used as a rectifier and a suitable network of capacitors and resistors gives the necessary filtering and voltages. The loudspeaker field is used as a filter reactor.

PHONOGRAPH

The record reproducing device consists of a high impedance magnetic pickup with an inertia type tone arm, a compensated volume control, the audio amplifier of the receiver and the loudspeaker. The radio receiver is made inoperative by the switch used for changing from radio to record reproduction. The turntable assembly consists of a perfected manual record player, which is simple and fool-proof in operation.

SERVICE DATA

(1) LINE-UP PROCEDURE

The line-up procedure of this receiver is somewhat involved and it is important that these instructions be carefully followed when making adjustments.

Equipment

To properly align this receiver, proper test equipment must be used. This consists of a modulated R. F. oscillator having proper frequency range, an output indicator, an alignment tool and a tuning wand.

Checking with Tuning Wand

Before making any R. F., oscillator or first detector adjustments, the accuracy of the present adjustments may be checked by means of the tuning wand (Stock No. 6679). The tuning wand consists of a bakelite rod having a brass cylinder at one end and a special, finely divided iron insert at the other end. Inserting the cylinder into the center of a coil lowers its inductance, while inserting the iron end increases its inductance. From this, it is seen that unless the trimmer adjustment for a particular coil is correct at alignment frequencies, inserting one end of the wand may increase the output of a particular signal. A perfect adjustment is evidenced by a lowering of output when either end of the wand is inserted into a coil.

The shield over each R. F. coil assembly has a hole at its top for entrance of the tuning wand. The locations of the various coils inside these shields are shown in Figure 5. An example of the proper manner of using the tuning wand would be to assume the external oscillator were set at 1720 K. C. and the signal tuned in, and the output indicator connected across the voice coil of the loudspeaker. Then the tuning wand should be inserted, first one end and then the other end, into the top of the three transformers at the left of the R. F. assembly, facing the front of the chassis. A perfect adjustment of the trimmer would be evidenced by a reduction in output when each end of the wand is inserted in each of the three transformers. If one end—for example, the iron end—when inserted in one coil caused an increase in output, then that circuit is low. An increase in the trimmer capacitance would be the proper remedy.

(2) I. F. TUNING CAPACITOR ADJUSTMENTS

This receiver has one I. F. stage. Two transformers, having four adjustments, are used. The transformers are all peaked at 460 K. C.

A detailed procedure for making this adjustment follows:

(a) Connect the output of an external oscillator tuned at 460 K. C. between the first detector grid and ground. Connect the output indicator across the voice coil of the loudspeaker.

(b) Place the oscillator in operation at 460 K. C. Place the receiver in operation and adjust the tuning control until a point is reached (Band A) where no signals are heard and turn the volume control to its maximum position. Reduce the test oscillator output until the output indicator glows faintly.

(c) Refer to Figure 6. Adjust each trimmer of the I. F. transformers until maximum output is obtained. Go over the adjustments a second time.

This completes the I. F. adjustments. However, it is good practice to follow the I. F. adjustments with the R. F. and oscillator adjustments due to interlocking which always occurs.

(3) R. F., OSCILLATOR AND FIRST DETECTOR ADJUSTMENTS

Four R. F., oscillator and first detector adjustments are required in Bands "A" and "X." Three are required in Bands "B" and "C."

To properly align the various bands, each must be aligned individually. The preliminary set-up requires that the external oscillator be connected between the antenna and ground terminals of the receiver and the output indicator across the voice coil of the loudspeaker. The volume and sensitivity controls must be at their maximum positions and the output of the oscillator at the minimum output which will afford an indication under the conditions stated. In the high frequency bands, it may be necessary to disconnect the oscillator from the receiver and place it at a distance in order to get a sufficiently low input to the receiver.

The dial pointer must be properly set before starting any actual adjustments. This is done by turning the variable capacitor until it is at its maximum capacity position. One end of the pointer should be exactly at the horizontal line at the lowest frequency end of Band "A," while the other end should point to within 1/64 inch of the horizontal line at the highest frequency end of that band.

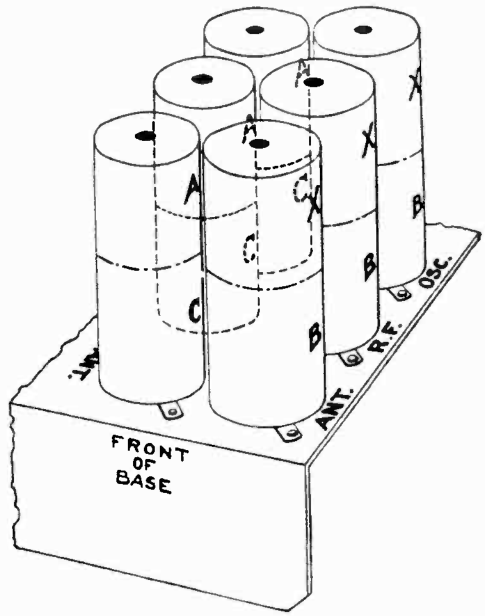


Figure 5—Location of Coils in Shields

Figure 6 shows the location of the trimmers for each band. Care must be exercised to only adjust the trimmers in the band under test.

Band "X"

(a) Set the band switch at "X."

(b) Tune the external oscillator to 410 K. C., set the dial pointer at 410 K. C. and adjust the oscillator, detector and R. F. trimmers for maximum output.

(c) Shift the external oscillator frequency to 175 K. C. Tune in the 175 K. C. signal irrespective of scale calibration and adjust the series trimmer, marked 175 K. C. on Figure 6, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 410 K. C. as described in (b).

Band "A"

(a) Set the band switch at "A."

(b) Tune the external oscillator to 1,720 K. C., set the pointer at 1,720 K. C. and adjust the oscillator, detector and R. F. trimmers for maximum output.

(c) Shift the external oscillator frequency to 600 K. C. Tune in the 600 K. C. signal, irrespective of scale calibration, and adjust the series trimmer, marked 600 K. C., on Figure 6, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 1,720 K. C. as described in (b).

Band "B"

(a) Set the band switch at "B."

(b) Tune the external oscillator to 5,160 K. C. and set the pointer at 5,160 K. C. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacitor from minimum to maximum.

(c) Check for the image signal, which will be received at approximately 4,240 K. C. on the dial if (b) has been correctly done. It will be necessary to increase the external oscillator output for this check.

(d) The antenna and detector trimmers should now be peaked for maximum output.

Band "C"

(a) Set the band switch at "C."

(b) Tune the external oscillator to 18,000 K. C. and set the pointer at 18 M. C. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacitor from minimum to maximum.

(c) Check for the image signal, which will be received at approximately 17,080 on the dial if (b) has been properly done.

(d) Reduce the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal disappears. The first detector circuit is then at the oscillator frequency and the RCA-6A7 tube is blocked. Then increase the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal is peaked for maximum output.

(e) The antenna trimmer should now be peaked for maximum output. It is not necessary to rock the main tuning capacitor while making this adjustment.

(4) POWER TRANSFORMER CONNECTIONS

The 220-volt, 50 or 60 cycle, power transformer furnished with some instruments includes taps for operating on 110-volt lines. Figure 12 shows the schematic circuit of the transformer and the proper voltage to be applied to the various taps. The taps are located on the power transformer assembly and are accessible without removing the chassis from the cabinet.

(5) FIDELITY LINK

It will be noted that a small link, normally, open, is mounted on the rear apron of the chassis. Closing the link reduces the low frequency output of the receiver.

(6) VOLTAGE READINGS

The voltages given are those at the various tube sockets while the receiver is in operating condition. No allowance has been made for currents drawn by the meter, and if low-resistance meters are used, such allowances must be made. Figure 11 shows the voltages at each individual socket contact.

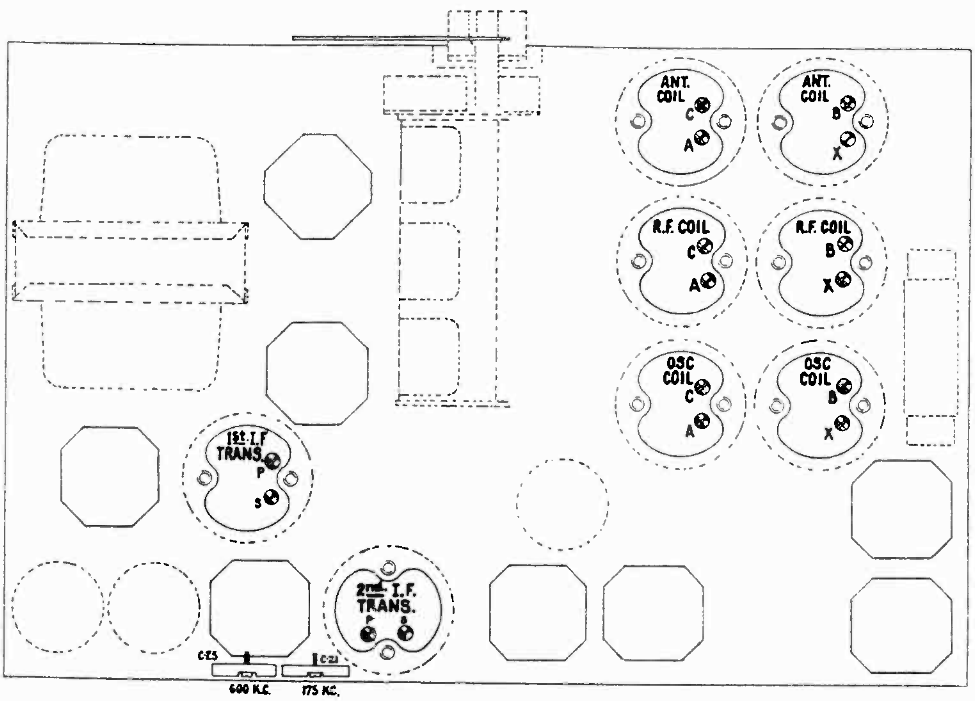


Figure 6—Location of Trimmer Capacitors

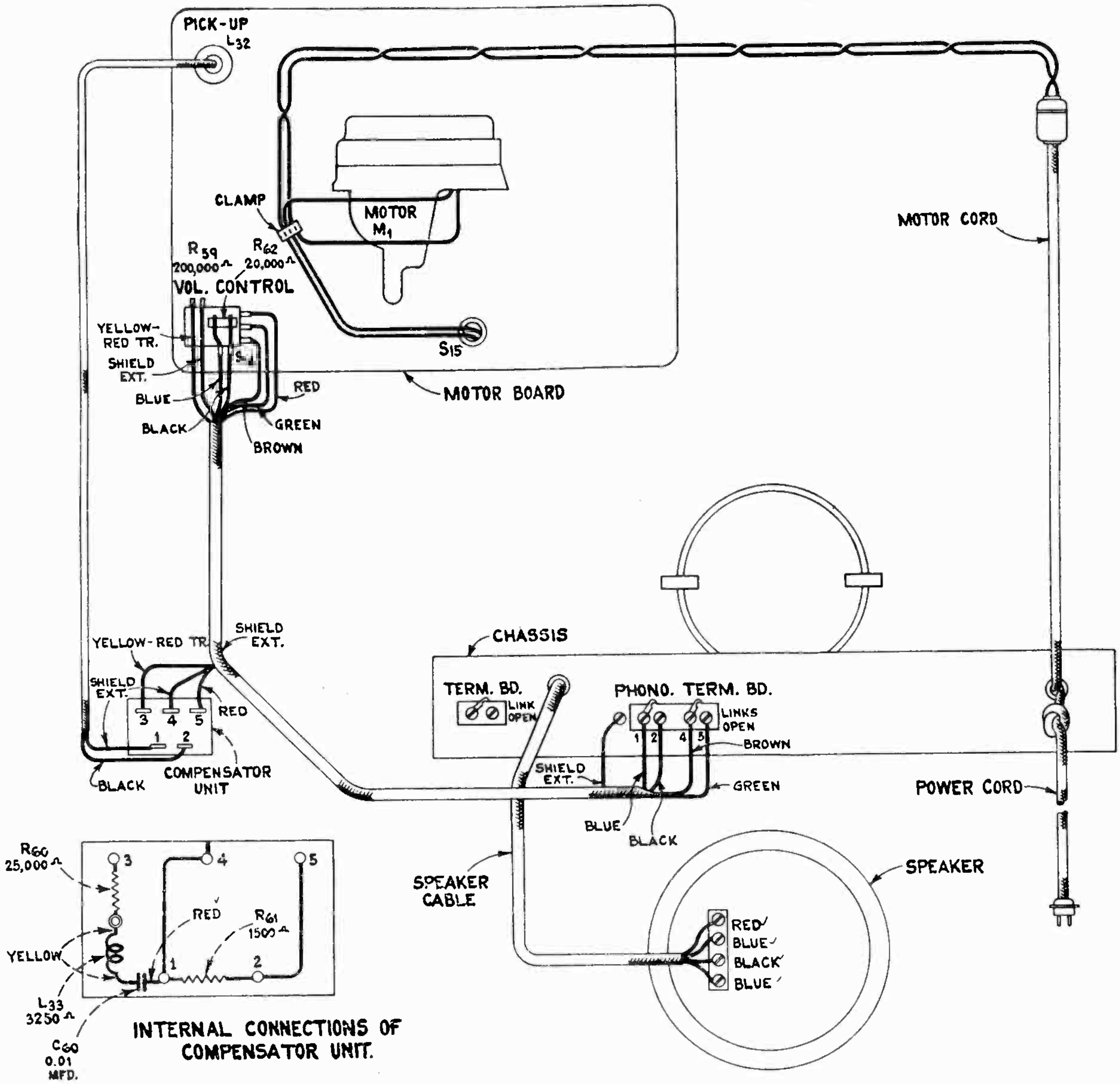


Figure 7—Phonograph Wiring Diagram

(7) SERVICE DATA ON MAGNETIC PICKUP

The magnetic pickup used in this combination instrument is of a new design with an improved frequency range. Although in physical appearance it is similar to that of the older type, details of construction are considerably different. It consists essentially of a chromium steel magnet, two thin pole pieces, a mechanism support and bracket, a coil, and an armature that is damped by means of an anchored damping block.

The use of the anchored damping block eliminates any bad peaks in the frequency range. The response characteristic is substantially flat from 50 to 5,000 cycles.

(8) REPLACING MAGNET COIL, PIVOT RUBBERS, ARMATURE OR DAMPING BLOCK

In order to replace a defective coil or the hardened pivot rubbers (see Figure 9), it is necessary to proceed as follows:

(a) Remove the pickup cover by removing the center holding screw and needle screw.

(b) Remove the pickup magnet and the magnet clamp by pulling them forward.

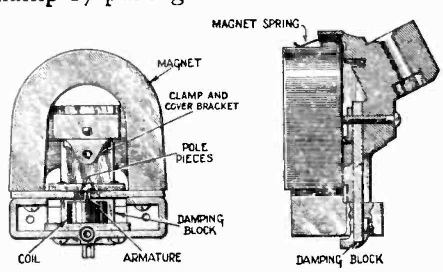


Figure 8—Details of Pickup

(c) Unsolder the coil leads and remove the mechanism assembly from the back plate by releasing the two mounting screws and the damping block clamping screw.

(d) Remove screws A and B, Figure 9, and then remove the mechanism assembly from the pole pieces.

(e) The coil or the front pivot rubber may now be removed and replaced. If it is desired to replace the rear pivot rubber, then the end of the armature soldered to the mechanism support must be unsoldered and the damping block removed. The rear pivot rubber may now be replaced. After putting the pivot rubbers in place a new damping block should be fastened to the armature as outlined in instructions on replacing the damping block.

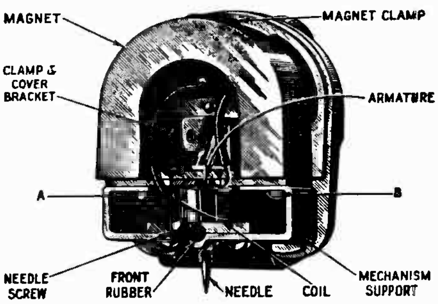


Figure 9—Pickup Nomenclature

(f) The mechanism should now be reassembled, except for the magnet, which must be magnetized. After being magnetized, the mechanism—with the pole pieces upward—should be placed so that the magnet may be slid from the magnetizer onto the pole pieces without breaking physical contact. After placing the pole pieces on the magnet, the entire assembly should be remagnetized thoroughly, being careful not to change the polarity obtained by the initial magnetization. The magnetizer shown on page 2 is useful for magnetizing pickups.

(g) After assembling the mechanism, the entire assembly should be fastened to the back plate by means of the screws provided, making sure the damping block is securely clamped. At the same time, the metal dust cover must be placed in position.

(h) After remagnetizing, it is necessary to correctly center the armature. This may be done quite accurately by feeling its play after the needle is inserted. A little practice will quickly show which way an adjustment is necessary to have the armature centered properly. The adjustment is made by loosening screws A and B (Figure 9), and sliding the mechanism into proper relation with the pole pieces.

(i) The cover may be now replaced over the entire assembly, and the pickup returned to the tone arm.

In assembling, it may be desirable to check the armature air gap by means of a small feeler gauge. This air gap should be .009″ on each side of the armature. However, a little practice with the needle in place will quickly disclose whether or not the armature is centered.

(9) REPLACING THE DAMPING BLOCK

If it is desired to replace the damping block, it may be done in the following manner:

(a) Disassemble the pickup as described under the preceding section.

(b) Remove the armature entirely by unsoldering it at its joint with the mechanism support.

(c) Remove the damping block from the armature and clean the bushing for holding the damping block with emery paper.

(d) Insert the armature through the new block so that it occupies the same position as that of the old. Also ascertain that the block is in correct vertical alignment with the armature. It will be noted that the hole in the damping block is somewhat smaller than the diameter of the armature. This is done so that a snug fit will be obtained.

(e) After properly locating the damping block, a soldering iron should be applied to the armature so that the block will melt slightly at its point of contact with the armature. A special tip, constructed as shown in Figure 10, will prove desirable for fusing the block in place. The iron should be applied long enough to slightly melt the block and cause a small bulge on both sides, but should not be applied long enough to cause any bubbling. The pickup should then be reassembled as described in the preceding section.

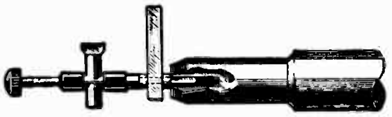


Figure 10—Special Soldering Iron Tip

Only rosin core solder should be used for soldering the coil leads in the pickup. Also rosin core solder should be satisfactory for resoldering the end of the spring in the hole in the mechanism, since both these parts have been previously tinned. In case the parts are not well tinned, it will be necessary to scrape the end of the spring and the hole in the mechanism until bright. These parts may now be tinned by using as a flux a water solution of zinc chloride (commonly called acid flux). After tinning, dip the parts in water to wash off the acid flux and thereby prevent serious subsequent corrosion. After making sure that the pivot rubbers and damping block are properly in place, as described under (e) above, the armature may now be soldered in place in the mechanism by using rosin core solder, since the parts are now tinned. Care must be exercised to get the needle hole perfectly square with respect to the mechanism, or otherwise it will be difficult if not impossible to center the armature in the air gap as explained under (h), section (8).

(10) ADJUSTMENT OF DIAL VERNIER MECHANISM

A small vernier indicator is provided for giving a simple means of band spread. Under normal conditions, adjustment of this mechanism will not be required. However, in event the initial adjustment is not satisfactory or adjustment is required because of replacement, the following procedure should be used:

(a) Remove the chassis from the cabinet to a place convenient for work.

(b) Check the tension on the vernier hand by pushing it in a counter-clockwise direction. There should be considerable tension against such a push. If this tension does not exist, the action of the hand may be erratic and possibly fail to return to the same position for a particular station.

(c) Pull off the long hand with a pair of long-nose pliers.

(d) Straighten the lugs that hold the dial in place. Then remove the dial "vernier" hand and stem gear together.

(e) Then remove the "vernier" hand from the stem gear.

(f) Turn the dial to each extreme and to its center position and check the backlash of the back gear (closest to reflector). There should be definite backlash in each direction at each of these three positions.

(g) If this backlash is not obtained it will be necessary to readjust the gears. Loosen the lockscrew located above the central set of gears and move the adjoining gear in or out of mesh as required.

(h) After making sure there is backlash at the three check points mentioned, turn the outside gear in a clockwise direction 1½ turns. Hold it at this position and replace the stem gear.

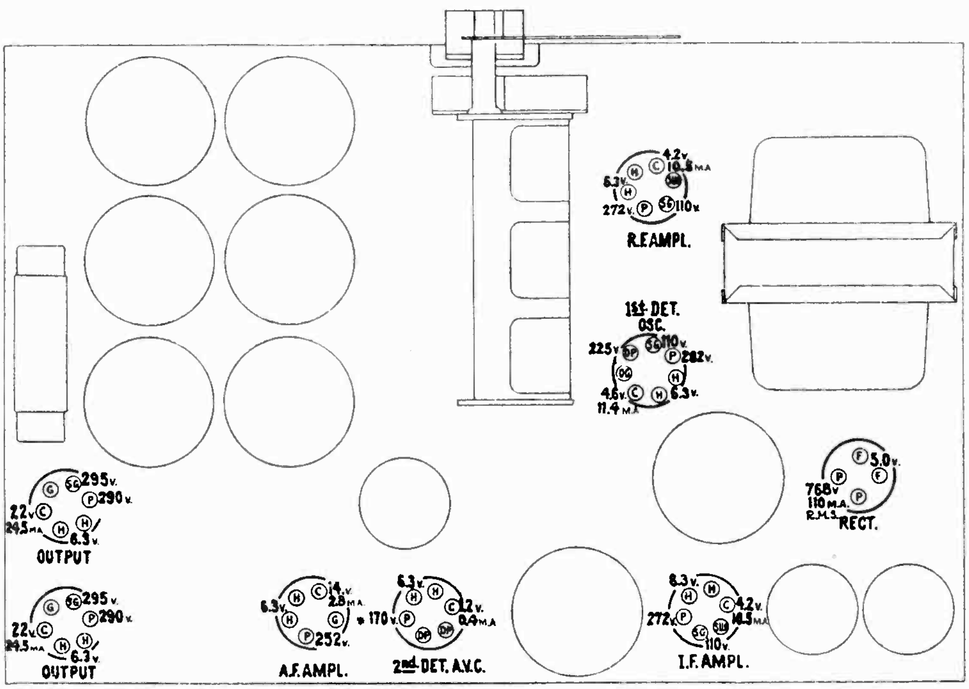
(i) Turn the dial throughout its range. If the gears become noisy, move the gear further toward the reflector edges described in (g).

(j) Replace the dial scale, making sure the hole clears the spindle.

(k) Replace the vernier hand. It should point at zero when the tuning capacitor is fully meshed.

(l) Replace the large hand. One end of the pointer should point exactly at the horizontal line at the lowest frequency end of Band "A" when the tuning capacitor is fully meshed.

The above covers the proper manner of making adjustments, assuming all parts are in normal condition. Of course, if any part is defective, it must be replaced. The spring gear may be checked by turning it until the spring is tight and unwinding it slowly. It should unwind 4¼ turns.



* CANNOT BE MEASURED WITH ORDINARY VOLTMETER

ALL D. C. VOLTAGES ARE TO GROUND

Figure 11—Radiotron Socket Voltages

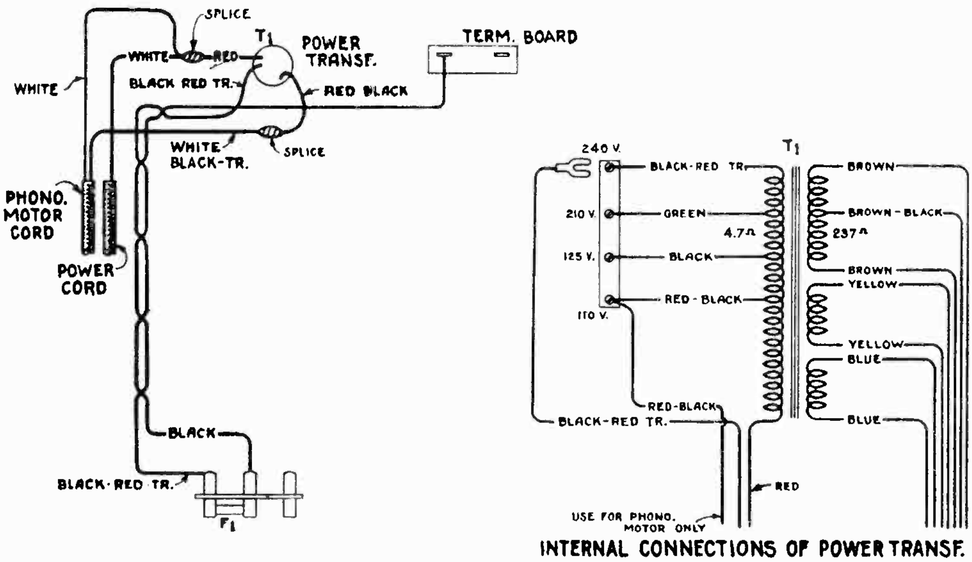


Figure 12—Universal Power Transformer Connections

RADIOTRON SOCKET VOLTAGES

120-Volt A. C. Line—Maximum Volume and Sensitivity—No Signal

Radiotron No.		Cathode to Ground Volts, D. C.	Screen Grid to Ground Volts, D. C.	Plate to Ground Volts, D. C.	Cathode Current M. A.	Heater Volts, A. C.
RCA-6D6 R. F.		4.2	110	272	10.5	6.3
RCA-6A7	Oscillator	—	—	225	11.4	6.3
	1st Detector	4.6	110	282		
RCA-6D6 I. F.		4.2	110	272	10.5	6.3
RCA-75 2nd Detector		1.2	—	170*	0.4	6.3
RCA-76 A. F.		14.0	—	252	2.8	6.3
RCA-42 Power		22.0	295	290	24.5	6.3
RCA-42 Power		22.0	295	290	24.5	6.3
RCA-5Z3 Rectifier		—	—	768/384 R. M. S.	110.0	5.0

*Cannot be measured with ordinary voltmeter.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4632	Board—Terminal board—Two terminals and link—For changing fidelity	$0.25
4379	Board—Antenna terminal board	.20
4427	Bracket—Volume control, tone control or noise suppressor mounting bracket	.18
4244	Cap—Contact cap—Package of 5	.20
3861	Capacitor — Oscillator trimmer capacitor (C21, C25)	.78
4633	Capacitor—50 mmfd. (C19)	.25
4635	Capacitor—100 mmfd. (C41)	.25
4248	Capacitor—300 mmfd. (C8)	.22
4811	Capacitor—340 mmfd. (C24)	.25
4183	Capacitor—400 mmfd. (C59)	.26
4412	Capacitor—1120 mmfd. (C27)	.25
4409	Capacitor—1120 mmfd. (C43)	.35
4634	Capacitor—1120 mmfd. (C52)	.35
4524	Capacitor—2850 mmfd. (C29)	.35
4615	Capacitor—2850 mmfd. (C56)	.34
4628	Capacitor—0.004 mfd. (C49, C50)	.28
3787	Capacitor—0.01 mfd. (C48)	.30
4212	Capacitor—0.01 mfd. (C44)	.30
4624	Capacitor—0.01 mfd. (C58)	.54
4836	Capacitor—0.05 mfd. (C5, C15, C37)	.30
4791	Capacitor—0.1 mfd. (C7, C18, C38)	.24
4885	Capacitor—0.1 mfd. (C14, C30, C39, C57)	.28
4840	Capacitor—0.25 mfd. (C47)	.30
7790	Capacitor—10 mfd. (C53, C54)	1.05
4619	Capacitor pack—Comprising one 0.5 mfd., one 10 mfd. capacitor (C42, C51)	1.44
4626	Capacitor pack—Comprising one 4 mfd., one 10 mfd. and one 8 mfd. capacitor (C45, C46, C55)	2.82
4358	Clamp—Electrolytic capacitor clamp—For capacitor Stock No. 7790	.15
4693	Clamp—Electrolytic capacitor clamp—For capacitor Stock No. 4626	.15
7810	Coil—Antenna coil "Band B-X" (L1, L2, L5, L6, C1, C3)	2.10
7803	Coil—Antenna coil "Band A-C" (L3, L4, L7, L8, C2, C4)	1.82
7808	Coil—Detector coil "Band X-B" (L9, L10, L13, L14, C9, C11)	2.05
7805	Coil—Detector coil "Band A-C" (L11, L12, L15, L16, C10, C12, C13)	2.15
7807	Coil—Oscillator coil "Band A-C" (L19, L20, L23, L24, C23, C28)	1.62
7809	Coil—Oscillator coil "Band X-B" (L17, L18, L21, L22, C22, C26)	1.70
4806	Condenser—3-gang variable tuning condenser (C6, C16, C20)	5.64
4371	Cover—Fuse mount cover	.15
4631	Cover—Terminal strip cover	.15
10907	Fuse—3-ampere—Package of 5	.40
3376	Mount — Fuse mount — 105-125-volt instrument	.40
4604	Mount—Fuse mount for 200-250-volt instrument	.35
4625	Resistor—Wire wound resistor—Comprising one 6500-ohm—4500-ohm and 450 section (R30, R31, R58)	1.00
3704	Resistor—400 ohms—Carbon type—¼ watt (R3, R9, R12)—Package of 5	1.00
4812	Resistor — 2600 ohms — Carbon type — ¼ watt (R6, R11, R13)—Package of 5	1.00
4242	Resistor — 3000 ohms — Carbon type — ¼ watt (R17)—Package of 5	1.00
2871	Resistor — 5000 ohms — Carbon type — ¼ watt (R22)—Paskage of 5	1.00
3998	Resistor—15,000 ohms—Carbon type—¼ watt (R20)—Package of 5	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R8, R18, R23, R26)—Package of 5	$1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R2, R7, R19)—Package of 5	1.00
3619	Resistor—400,000 ohms—Carbon type—¼ watt (R59)—Package of 5	1.00
4783	Resistor—1,100,000 ohms—Carbon type—¼ watt (R16)—Package of 5	1.00
6242	Resistor — 2 megohms — Carbon type — ¼ watt (R15, R21, R28)—Package of 5	1.00
3078	Resistor—10,000 ohms—Carbon type—½ watt (R27)—Package of 5	1.00
4623	Resistor—13,000 ohms—Carbon type—½ watt (R29)—Package of 10	2.00
2240	Resistor—30,000 ohms—Carbon type—1 watt (R25)	.22
4418	Resistor—100 ohms—Flexible type (R1, R4) —Package of 10	1.50
4618	Rheostat—Sensitivity control (R5)	1.25
4742	Shield—Antenna, detector or oscillator coil shield	.40
4627	Shield—First detector—Oscillator Radiotron shield	.36
6956	Shield—First detector—Oscillator Radiotron shield top	.15
4452	Shield—Second detector—"A.V.C." Radiotron shield	.35
4629	Shield—Second detector—"A.V.C." Radiotron shield top	.15
3950	Shield—I. F. amplifier Radiotron shield	.26
4521	Shield—I. F. amplifier shield	.42
4663	Shield—Oscillator coil wiring shield—Shields oscillator coil wiring from R. F. coil—Complete with terminal board, clamp and resistor	.32
4664	Shield—Oscillator wiring shield—Shields oscillator coil wiring from R. F. coil—Complete with terminal strip and resistor	.36
4630	Shield—R. F. amplifier—Radiotron shield	.36
4665	Shield—R. F. coil wiring shield with two resistors and terminal board	.50
3529	Socket—Dial lamp socket	.32
4784	Socket—4-contact Radiotron socket	.15
4814	Socket—5-contact Radiotron socket	.15
4786	Socket—6-contact Radiotron socket	.15
4787	Socket—7-contact Radiotron socket	.15
4617	Switch—Range switch (S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12)	3.32
4813	Tone control (R24, S1)	1.42
4431	Transformer—First intermediate frequency transformer (L25, L26, C32, C33, C34)	2.28
9505	Transformer—Power transformer—105-125 volts—50-60 cycles (T1)	6.35
9506	Transformer—Power transformer—105-125 volts—25-40 cycles	8.90
9507	Transformer—Power transformer—105-250 volts—40-60 cycles	6.40
4433	Transformer—Second intermediate frequency transformer (L27, L28, C35, C36, C40, R14)	2.15
4620	Transformer and reactor—Interstage transformer and reactor (T2, L29)	2.98
4809	Volume control (R32)	1.45
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball for variable condenser drive assembly—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—Comprising drive shaft, balls, ring, spring and washers assembled	.88

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
7799	Drive—Variable tuning condenser drive complete	$2.45
4827	Gear—Spring gear assembly complete with hub, pinion, gear, cover and spring	1.25
4704	Indicator—Band indicator—Celluloid	.12
4367	Indicator—Station selector vernier pointer—Small	.15
4520	Indicator—Station selector main pointer—Large	.18
3943	Screen—Translucent screen for dial light—Package of 2	.18
3993	Screw—No. 6–32–5/32″ square head set screw for band indicator operating arm or condenser drive—Package of 10	.25
4377	Spring — Band indicator and arm tension spring—Package of 5	.25
4722	Pinion — Vernier pointer pinion — Station selector pointer stem	.18
4378	Stud—Band indicator operating arm stud—Package of 5	.25
	REPRODUCER ASSEMBLY	
5038	Cable—4-conductor—Reproducer cable with female connector plug	.60
9591	Coil—Field coil magnet and cone support (L31)	4.00
8969	Cone—Reproducer cone (L30)—Package of 5	6.35
5039	Connector—4-prong male connector for reproducer cable	.25
5040	Connector—4-contact female connector for reproducer cable	.25
9592	Reproducer complete	8.00
5041	Transformer—Output transformer (T3)	1.40
	MOTOR ASSEMBLIES	
4577	Connector—Male section two-prong motor connector plug	.30
8989	Motor—105–125 volts—60 cycle motor complete	18.52
8990	Motor—105–125 volts—50 cycle motor complete	18.52
8992	Motor—105–125 volts—25 cycle motor complete	23.36
8993	Rotor and shaft—For 105–125 volt—60 cycle motor	7.00
8995	Rotor and shaft—For 105–125 volt—50 cycle motor	7.00
8999	Rotor and shaft—For 105–125 volt—25 cycle motor	8.00
8994	Spindle—Turntable spindle with fibre gear for 60 cycle motor	4.75
8996	Spindle—Turntable spindle with fibre gear for 50 cycle motor	4.75
9001	Spindle—Turntable spindle with fibre gear for 25 cycle motor	5.50
3817	Stud—Motor mounting stud—Package of 3	.18
3398	Motor mounting—Spring and washer assembly—Comprising 2 cup washers, 4 springs and 1 "C" washer	.48
	SWITCH ASSEMBLIES	
3994	Cover—Motor switch cover	.26
10184	Plate—Automatic brake latch plate—Package of 5	.40
10174	Springs—Automatic brake springs—Package of 4	.50
6896	Switch—Eccentric automatic switch complete	2.50
3322	Switch—Motor switch (S15)	.75

Stock No.	Description	List Price
	TURNTABLE ASSEMBLIES	
7084	Cover—Turntable cover	$0.40
7838	Turntable complete	2.15
	PICKUP AND ARM ASSEMBLIES	
4942	Arm—Pickup arm complete, less escutcheon and pickup	4.00
4940	Armature—Pickup armature	.80
6346	Back—Pickup housing back	.45
4941	Coil—Pickup coil (L32)	.60
5091	Cushion—Pickup armature spacer cushion—Package of 10	.50
3386	Cover—Pickup cover	.56
3521	Cover—Magnetic pickup back cover	.18
3737	Damper—Pickup damper—Package of 5	.65
3516	Damper assembly—Comprising one upper and one lower damper, one upper bushing and one lower bearing—Located in bottom of pickup base	.14
3390	Escutcheon—Pickup arm escutcheon complete with mounting rivets	.46
4939	Pickup—Pickup unit complete	4.00
3389	Rod—Automatic brake trip rod with lock nut—Package of 5	.40
3387	Screw assembly—Pickup mounting screw assembly comprising one screw, one nut and one washer—10 sets	.40
3388	Screw—Pickup needle holding screw—Package of 10	.60
3419	Screw—Pickup cover mounting screw—Package of 10	.40
	MISCELLANEOUS ASSEMBLIES	
7837	Bezel—Station selector (escutcheon) bezel	.82
3430	Box—Needle box with lid—Package of 2	.90
5092	Cable—2-conductor motor cable with section of connector plug—From receiver chassis to motor cord connector	.95
4673	Cable—6-conductor shielded—From phonograph volume control to compensator unit and chassis	1.90
4938	Compensator unit—Comprising one reactor, one 1500 ohm resistor, one 25,000 ohm resistor and one .01 mfd. capacitor (L33, R60, R61, C60)	1.92
4573	Connector—Female section (2-contact) of connector plug for cable Stock No. 5092	.30
6614	Glass—Station selector dial glass	.30
4449	Knob—Station selector volume control, range switch, sensitivity control, tone control or phonograph volume control knob—Package of 5	.60
4340	Lamp—Dial lamp—Package of 5	.60
3396	Receptacle—Needle receptacle	.52
6306	Resistor—20,000 ohms—Carbon type—¼ watt (R62)—Package of 5	1.10
4678	Ring—Dial retaining ring—Package of 5	.34
5093	Screw—8–32–7/16″ set screw for knob No. 4449—Package of 10	.52
4698	Screw—Chassis mounting screw assembly—Comprising 1 screw, 1 lockwasher, 1 washer, 2 cushions and 1 spacer	.45
3391	Suspension spring and washer assembly—For motor board—Comprising 1 bolt, 1 top spring, 1 bottom spring, 2 cup washers, 1 "C" washer and 1 nut	.50
6766	Volume control—Phonograph volume control (R59, S14)	2.28

RCA VICTOR MODELS BT 6-3, BC 6-4 AND BT 6-10

Six-Tube, Two-Band, Superheterodyne, Battery Receivers

SERVICE NOTES

Electrical Specifications

FREQUENCY RANGES
Broadcast .... 540-1850 kc.
Shortwave .... 1850-6900 kc.

ALIGNMENT FREQUENCIES
Broadcast ...... 600 kc. (osc.), 1720 kc. (osc., ant.)
Shortwave .... None required

Intermediate Frequency .... 460 kc.

RADIOTRON COMPLEMENT
(1) RCA 1C6 .... First Detector and Oscillator
(2) RCA 34 .... Intermediate Amplifier
(3) RCA 1B5 .... Detector, A.F. and A.V.C.
(4) RCA 30 .... Audio Driver Amplifier
(5) RCA 49 .... Power Output Amplifier
(6) RCA 49 .... Power Output Amplifier

BATTERIES REQUIRED
"A" Supply .... Eveready Aircell or 2 volt storage cell
"B" Supply .... 3—45 volt, heavy or medium duty, plug-in type
"C" Supply .... 3—4½ volt (with 3 volt tap), plug-in type

CURRENT DRAIN
"A" .... 0.52 Amperes
"B" .... 16 Milliamperes
Screen .... 3 Milliamperes

FUSE RATING .... ½ Ampere

POWER OUTPUT
Undistorted .... 1.2 Watts
Maximum .... 2.2 Watts

LOUDSPEAKER
Table Models .... 8 inch, Permanent Magnet
Console Model .... 10 inch, Permanent Magnet

Mechanical Specifications

	BT 6-3	BC 6-4	BT 6-10
Height	17½ inches	37¼ inches	21⅝ inches
Width	14½ inches	23⅛ inches	15¾ inches
Depth	10 inches	12 inches	13¼ inches

Chassis Base .... 12" W x 7" D x 2½" H

General Description

These receivers are related in that they have identical chassis assemblies. An 8 inch loudspeaker is used in each table model and a 10 inch is used in the console (BC 6-4). Model BT 6-10 differs from the others by having a cabinet which is adapted to house the battery equipment.

The range of tuning afforded by these instruments includes the standard 540-1600 kc. broadcast band which extends to cover the 1700 kc. police channels, and a shortwave band, covering reception on frequencies from 1850-6900 kc.

Vernier tuning of 6 to 1 ratio is provided. Automatic volume control is incorporated in the Superheterodyne circuit. Two-point, high-frequency tone control is another feature. Batteries required are the "plug-in" type, which permit ready installation and prevent improper connection. Space and mounting holes are provided on the chassis base for installation of a 460 kc. wave trap when needed in locations where code interference is encountered.

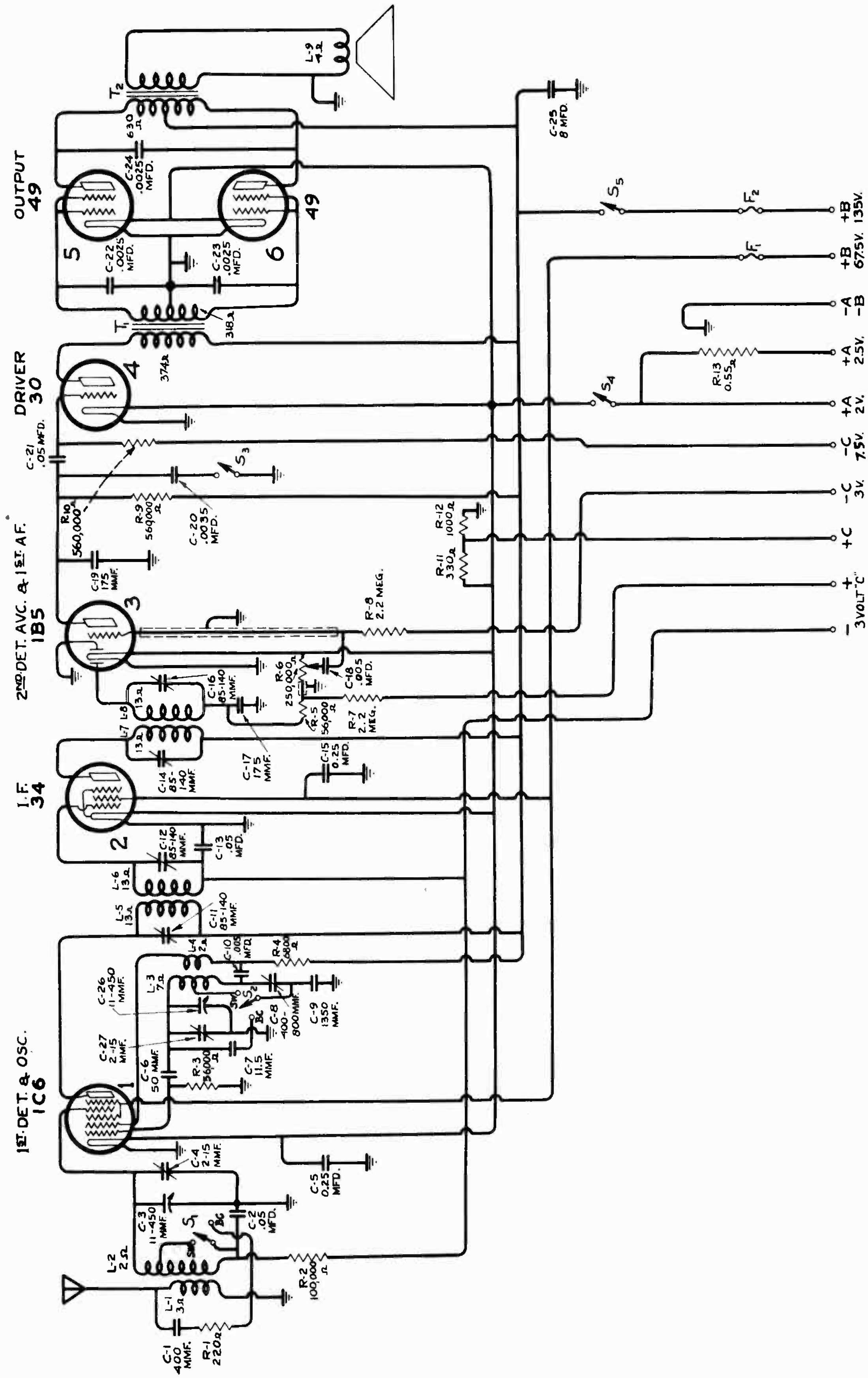


Figure 1—Schematic Circuit Diagram

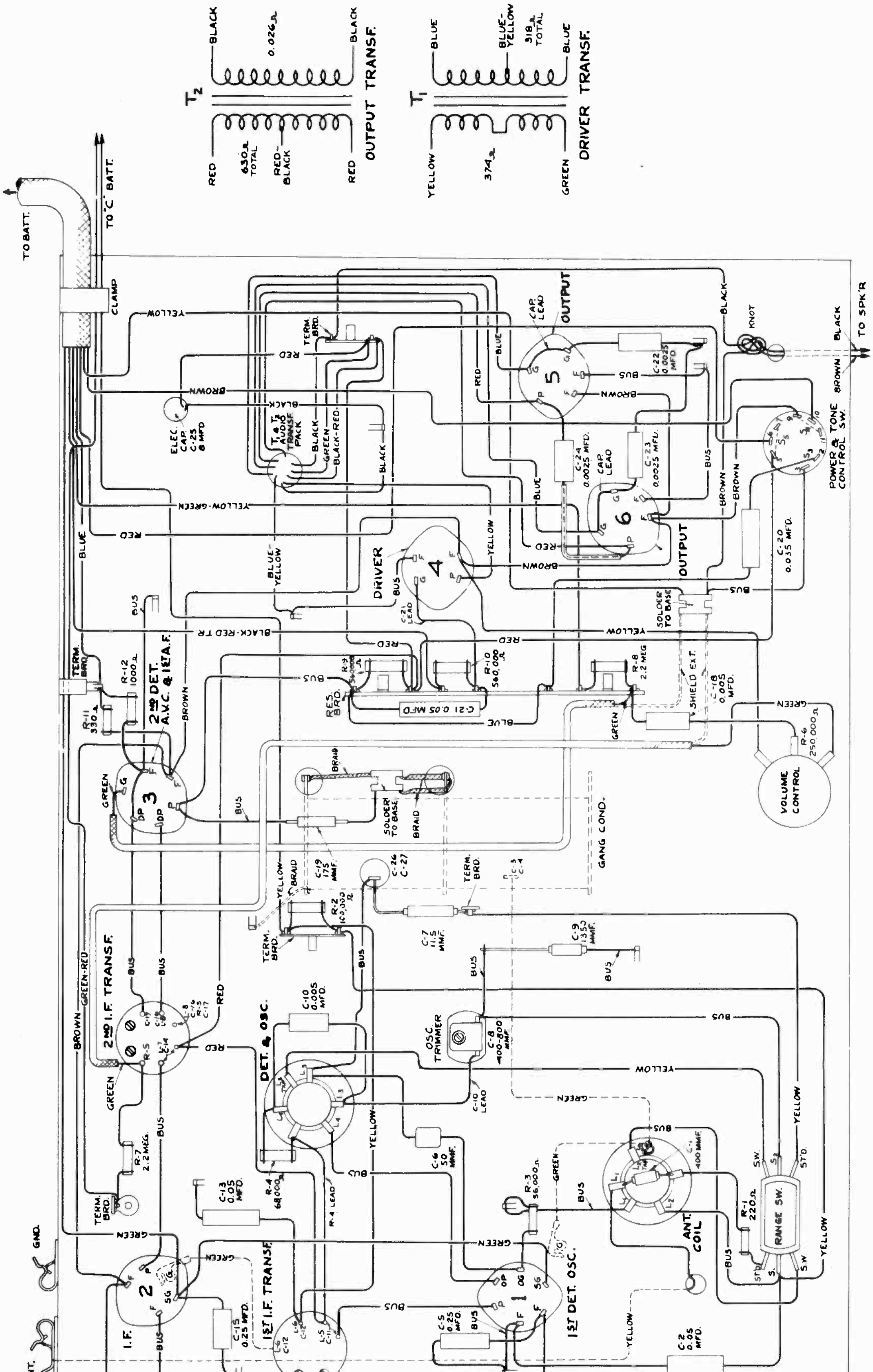


Figure 2—Chassis Wiring Diagram

Circuit Arrangement

The conventional Superheterodyne circuit is used. The first stage combines the local oscillator and first detector functions in one tube, an RCA-1C6. Coils of the detector input and oscillator are tuned by a two-section variable condenser and are aligned by a total of three adjustable trimmers. Each coil is tapped so that a portion of it may be shorted by the band switch in order to extend the tuning range to the higher frequencies. The oscillator operates at a fundamental frequency which is at all times above the incoming signal by 460 kc.

An RCA-34 is employed as i-f amplifier. Its input and output are coupled by transformers to the first detector and second detector, respectively. Each transformer has both its secondary and primary windings tuned to 460 kc. by adjustable trimmer capacitors.

The modulated signal as obtained from the output of the i-f system is detected by a diode of the RCA-1B5. Audio developed by such detection in the diode load resistor, R-6, is selected by the variable arm of the volume control (R-6) and passed on to the a-f system for amplification and final reproduction. The d.c. which occurs in resistor R-6, due to signal detection, is used for automatic volume control by varying the control grid bias on the first detector and i-f tubes.

Resistance-capacitance coupling is used between the RCA-1B5 and the RCA-30 driver tube. A high-frequency tone control, consisting of a switch in series with a condenser, is shunted across the plate circuit of the RCA-1B5. In the closed position of the switch, the high a-f frequencies are reduced.

The power output stage is arranged for Class "B" operation. The high level of power afforded, is fed to the permanent magnet, dynamic speaker through a step-down transformer.

Battery "On-off" control is by means of a double pole switch, one side of which is in the +A lead; the other side being in the 135 volt, +B lead. Two +A leads are provided in order to permit operation from either a standard 2 volt storage cell or an "Eveready 2.5 volt Aircell". A resistor (R-13) is in series with the +A, 2.5 volt lead to drop the voltage to the proper value. Fuse protection is incorporated in the screen and plate supply leads from the "B" batteries.

SERVICE DATA

Alignment Procedure

There are a total of seven trimmer adjustments provided. Four of these are located in the i-f system and the remainder are associated with the antenna and oscillator coils. They are precisely adjusted at the factory to give the correct performance. Their settings should remain intact indefinitely when the receiver is used under ordinary conditions, however, necessity for readjustment may occasionally occur from continued extremes of climate, tampering, purported alteration for service purposes, or after repairs have been made to the r-f or i-f tuned circuits. Improper alignment usually causes the receiver to be insensitive, non-selective, and sub-normal in respect to tone quality. Such indications will usually exist simultaneously.

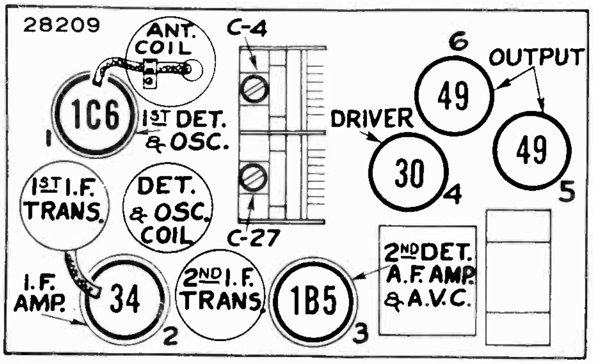


Figure 3—Radiotron and Coil Locations

In re-adjusting the trimmers to their normal settings, it is quite important to apply a definite procedure and to use adequate and reliable test equipment. A standard test oscillator such as the RCA Stock No. 9595, will be required as a source of signal at the specified alignment frequencies. Means for indication of the receiver output during alignment is also necessary to accurately show when the correct point. of adjustment is reached. This indication should be by means of an instrument such as the RCA Stock No. 4317 Neon Glow Indicator. Proceed with the alignment as follows:

Place the receiver in operation where it will be easily accessible. Attach the Output Indicator across the loudspeaker voice coil circuit, or across the output transformer primary. Advance the receiver volume control to its maximum position, letting it remain in such position for *all* adjustments. For each trimming operation, regulate the test oscillator output control so that the signal level is as low as possible and still observable at the receiver output. Use of such a small signal will obviate broadness of tuning which would otherwise result from A. V. C. action on a stronger one.

I-F Adjustments

(a) Connect the output of the test oscillator between the control grid cap of the i-f tube (RCA-34) and chassis-ground. Adjust the frequency of the oscillator to **460 kc.** Tune the receiver to a point where no interference is received from the heterodyne oscillator or local station.

(b) Adjust the trimmers, C-16 and C-14, of the second i-f transformer so that each produces maximum (peak) receiver output as shown by the indicating device.

(c) Remove the oscillator from the i-f tube input and connect it between the control grid cap of the first detector tube (RCA-1C6) and chassis-ground. Allow its tuning to remain at **460 kc.** Tune the receiver to avoid interference as in (a).

(d) Adjust the trimmers, C-12 and C-11, of the first i-f transformer for maximum (peak) receiver output. This completes the i-f transformer adjustments.

R-F Adjustments

(a) Check the calibration of the dial scale by rotating the tuning control until the variable condenser plates are in full mesh. (Maximum capacity). This will carry the dial pointer to its minimum frequency position. Then adjust the dial pointer until it points to the horizontal line at the low frequency end of the broadcast band scale.

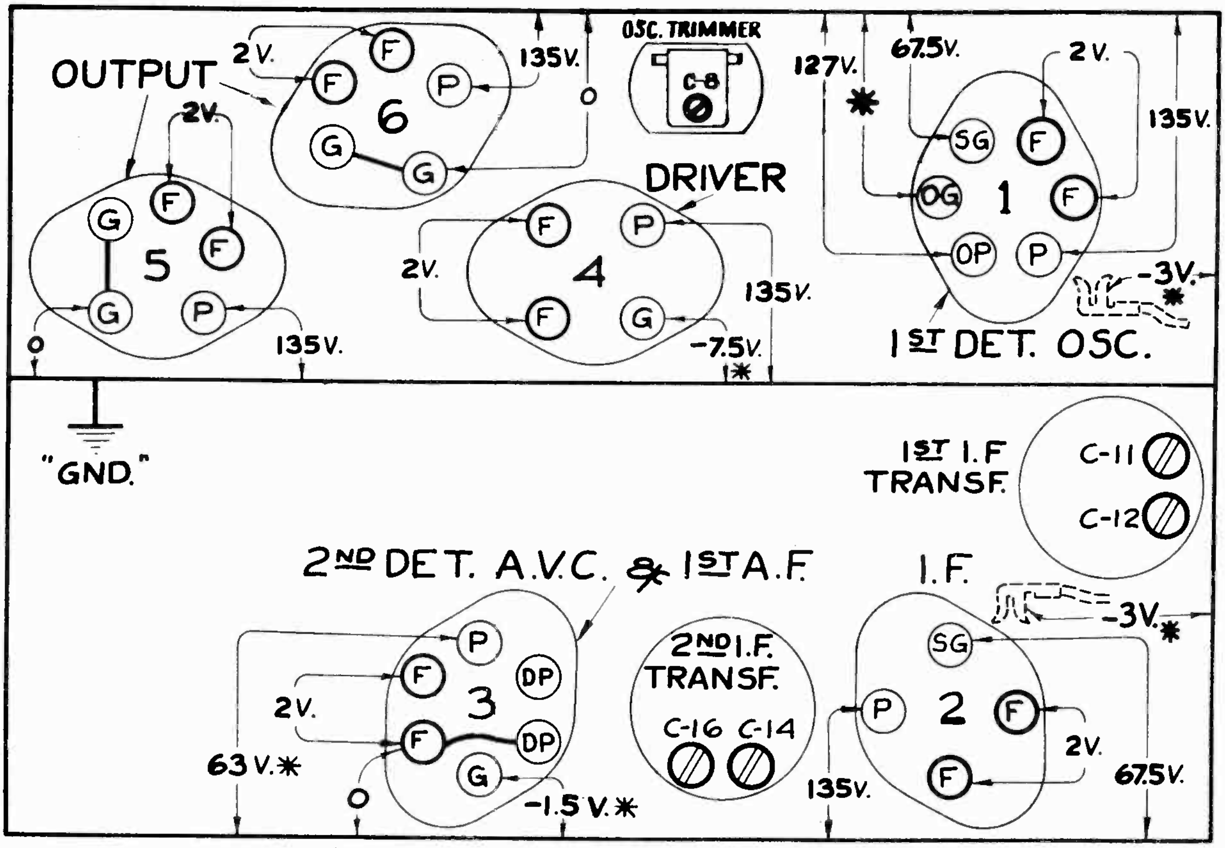
(b) Connect the output of test oscillator to the antenna-ground terminals of the receiver. Adjust the receiver range switch to its "Broadcast" position. Tune the oscillator to **1720 kc.** Allow the output indicator to remain attached to the receiver output.

(c) Tune the receiver so that the dial reading is **1720 kc.** Then adjust the oscillator and antenna coil trimmers, C-27 and C-4 respectively, tuning each to the point producing maximum indicated receiver output.

(d) Shift the oscillator frequency to **600 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. The oscillator series trimmer, C-8, should then be adjusted, simultaneously rocking the receiver tuning backward and forward through the signal until maximum receiver output results from the combined operations. The adjustment of C-27 should be repeated as in (c) to correct for any change in its alignment due to the adjustment of C-8.

Radiotron Socket Voltages

Voltage values indicated at the Radiotron socket contacts on Figure 4 form a reference basis for test of the receiver. It is to be noted that all voltages are given in respect to chassis-ground excepting those appearing across the heaters (H-H). The values shown are obtainable when the receiver is in normal operating condition. They do not take into account inaccuracies caused by current consumed in the voltmeter used for the tests. The lower the meter resistance, the lower will be the degree of accuracy. Allowances must therefore be made, dependent upon the type of test instrument used, for the loading effect of the voltmeter on the circuit.



(✱) CANNOT BE MEASURED WITH ORDINARY VOLTMETER

Figure 4—Radiotron Socket Voltages and Trimmer Locations
Measured at Normal Battery Voltages—No Signal Being Received

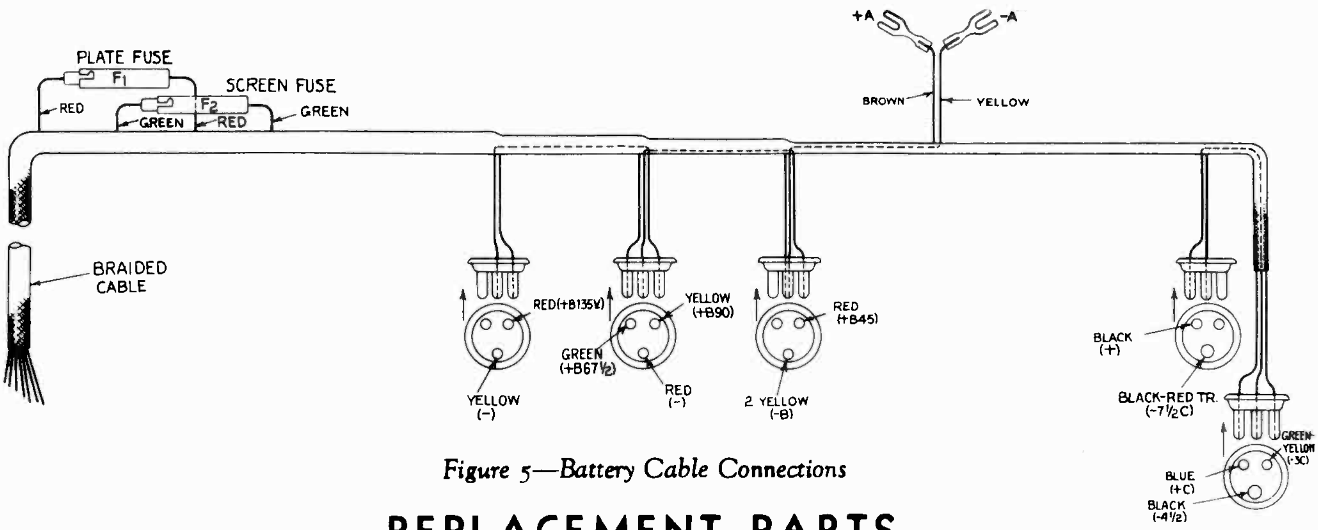


Figure 5—Battery Cable Connections

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
11465	Capacitor—Adjustable capacitor—(C8)	$0.48
11450	Capacitor—11.5 MMfd.—(C7)	.14
11289	Capacitor—50 MMfd.—(C6)	.26
5116	Capacitor—175 MMfd.—(C19)	.18
11171	Capacitor—400 MMfd.—(C1)	.22
11597	Capacitor—1350 MMfd.—(C9)	.22
5107	Capacitor—.0025 Mfd.—(C22, C23, C24)	.16
5005	Capacitor—.0035 Mfd.—(C20)	.16
4868	Capacitor—.005 Mfd.—(C10, C18)	.20
4836	Capacitor—.05 Mfd.—(C2, C13, C21)	.30
4840	Capacitor—0.25 Mfd.—(C5, C15)	.30
11595	Capacitor—8 Mfd.—(C25)	1.04
11590	Coil—Antenna coil—(L1, L2)	1.70
11463	Coil—Oscillator coil—(L3, L4)	1.65
11457	Condenser—Two gang variable tuning condenser—(C3, C4, C26, C27)	3.46
11467	Indicator—Station selector indicator pointer	.10
11174	Resistor—220 Ohms—Carbon type—¼ watt—(R1)—Package of 5	1.00
11296	Resistor—330 Ohms—Carbon type—¼ watt—(R11)—Package of 5	1.00
5112	Resistor—1000 Ohms—Carbon type—¼ watt—(R12)—Package of 5	1.00
11454	Resistor—6800 Ohms—Carbon type—¼ watt—(R4)—Package of 5	1.00
5029	Resistor—56,000 Ohms—Carbon type—¼ watt—(R3)—Package of 5	1.00
3118	Resistor—100,000 Ohms—Carbon type—¼ watt—(R2)—Package of 5	1.00
5035	Resistor—560,000 Ohms—Carbon type—¼ watt—(R9, R10)—Package of 5	1.00
11626	Resistor—2.2 Megohms—Carbon type—¼ watt—(R7, R8)—Package of 5	1.00
11464	Shield—Antenna or oscillator coil shield	.25
3682	Shield—First or Second detector Radiotron shield	.22
3056	Shield—Intermediate frequency Radiotron shield—Package of 2	.40
11390	Shield—Intermediate frequency transformer shield	.25
11461	Switch—Range switch—(S1, S2)	.56
11588	Switch—Tone control and power switch—(S3, S4, S5)	.90
5238	Terminal—Antenna terminal board with clip, insulation strip and rivets	.14
11594	Transformer—Audio driver and output transformer pack—(T1, T2)	4.10
11592	Transformer—First intermediate frequency transformer—(L5, L6, C11, C12)	2.55

Stock No.	Description	List Price
11593	Transformer—Second intermediate frequency transformer—(L7, L8, C14, C16, C17, R5)	2.75
11589	Volume Control—(R6)	.85
	MISCELLANEOUS ASSEMBLIES	
4289	Body—Fuse connector body—Package of 10	.35
4288	Cap—Fuse connector cap—Package of 10	.36
6516	Connector—Fuse connector—complete	.16
11340	Connector—Three contact male connector with three small prongs—for "B" battery connections	.24
11341	Connector—Three contact male connector with two small and one large prong—for "C" battery connection	.24
11627	Dial—Station selector dial	.32
4286	Ferrule—Fuse connector—ferrule and bushing—Package of 10	.38
3748	Fuse—½ Ampere fuse—(F1, F2)—Package of 5	.40
4290	Insulator—Fuse connector insulator—Package of 10	.35
11587	Resistor—0.55 Ohms—Flexible type, complete with terminal (R13)	.24
4284	Spring—Fuse connector spring—Package of 10	.30
4285	Washer—Fuse connector insulating washer—Package of 10	.22
	REPRODUCER ASSEMBLIES (Table Models BT 6-3, BT 6-10)	
9539	Cone—Reproducer cone—(L9)—Package of 5	4.30
9540	Magnet Assembly—Comprising cone bracket, core, and magnet	5.72
9538	Reproducer—Complete	7.65
	REPRODUCER ASSEMBLIES (Console Model BC 6-4)	
9432	Cone—Reproducer cone—complete with voice coil—(L9)	1.88
7820	Magnet—Cone housing and magnet assembly	8.98
7819	Reproducer—Complete	12.18

RCA VICTOR MODELS BT 6-5 AND BC 6-6

Six-Tube, Two-Band, Superheterodyne, Battery-Vibrator Receivers

SERVICE NOTES

Electrical Specifications

FREQUENCY RANGES		ALIGNMENT FREQUENCIES	
Band A	540- 1,720 kc.	Band A	600 kc. (osc.); 1,720 kc. (osc., ant.)
Band C	5,600-18,000 kc.	Band C	18,000 kc. (osc., ant.)

Intermediate Frequency .... **460 kc.**

RADIOTRON COMPLEMENT

(1) RCA-1C6	First Detector and Oscillator	(4) RCA-30	Audio Driver Amplifier
(2) RCA-34	Intermediate Amplifier	(5) RCA-49	Power Output Amplifier
(3) RCA-75	Second Det., A.F., and A.V.C.	(6) RCA-49	Power Output Amplifier

BATTERIES REQUIRED

"A" Supply .... Storage Battery (6-volt)
"B" Supply .... None
"C" Supply .... None

CURRENT DRAIN

"A" Battery .... 1.5 Amperes

FUSE RATING .... 15 Amperes

POWER OUTPUT			
Undistorted	0.8 Watt	Maximum	1.2 Watts
LOUDSPEAKER			
Table Model	8 inch Permanent Magnet	Console Model	10 inch Permanent Magnet

Mechanical Specifications

	BT 6-5	BC 6-6
Height	$20\frac{3}{16}$ inches	38 inches
Width	$14\frac{7}{16}$ inches	24 inches
Depth	$9\frac{3}{4}$ inches	12 inches
Chassis Base	13 inches x $7\frac{1}{2}$ inches x $2\frac{1}{2}$ inches	
Weight (Net)	$33\frac{1}{2}$ pounds	40 pounds
Weight (Shipping)	59 pounds	74 pounds

General Description

These instruments each employ a synchronous type vibrator and require only one 6-volt storage battery for power supply.

The receiver chassis of both models are identical. An 8-inch loudspeaker is used in the table model (BT 6-5) and a 10-inch loudspeaker is used in the console model (BC 6-6).

The tuning range afforded by these instruments includes (1) the standard 540-1,600 kc. broadcast band which extends to cover the 1,700 kc. police channels, and (2) a shortwave band from 5,600-18,000 kc. which covers the principal shortwave broadcast stations on the 49, 31, 25, 19, and 16 meter bands.

Outstanding features include automatic volume control, two-point tone control, antenna wave trap, airplane type dial, dual ratio tuning drive, class "B" output stage, and vibrator power unit (V.P.U.)

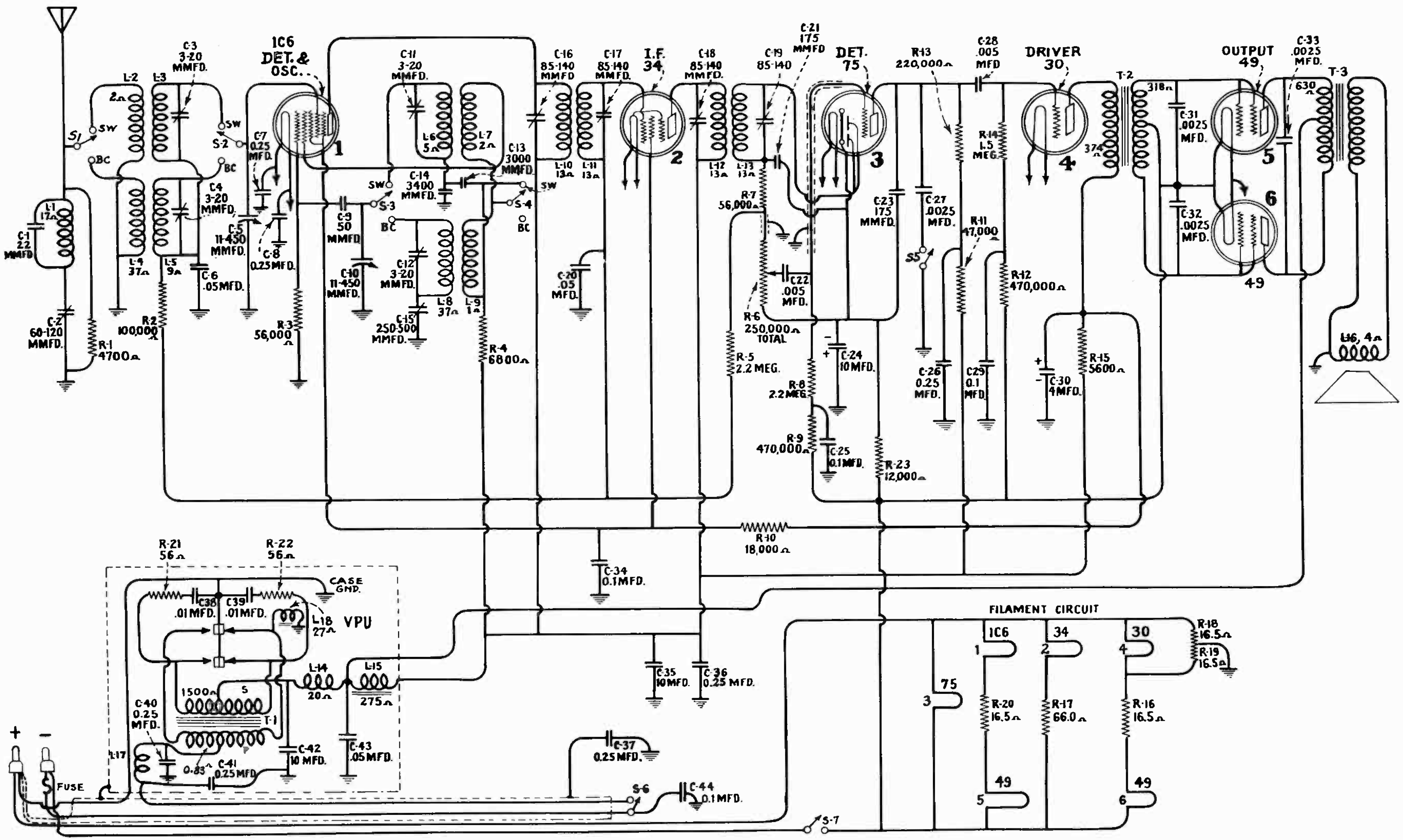


Figure 1—Schematic Circuit Diagram

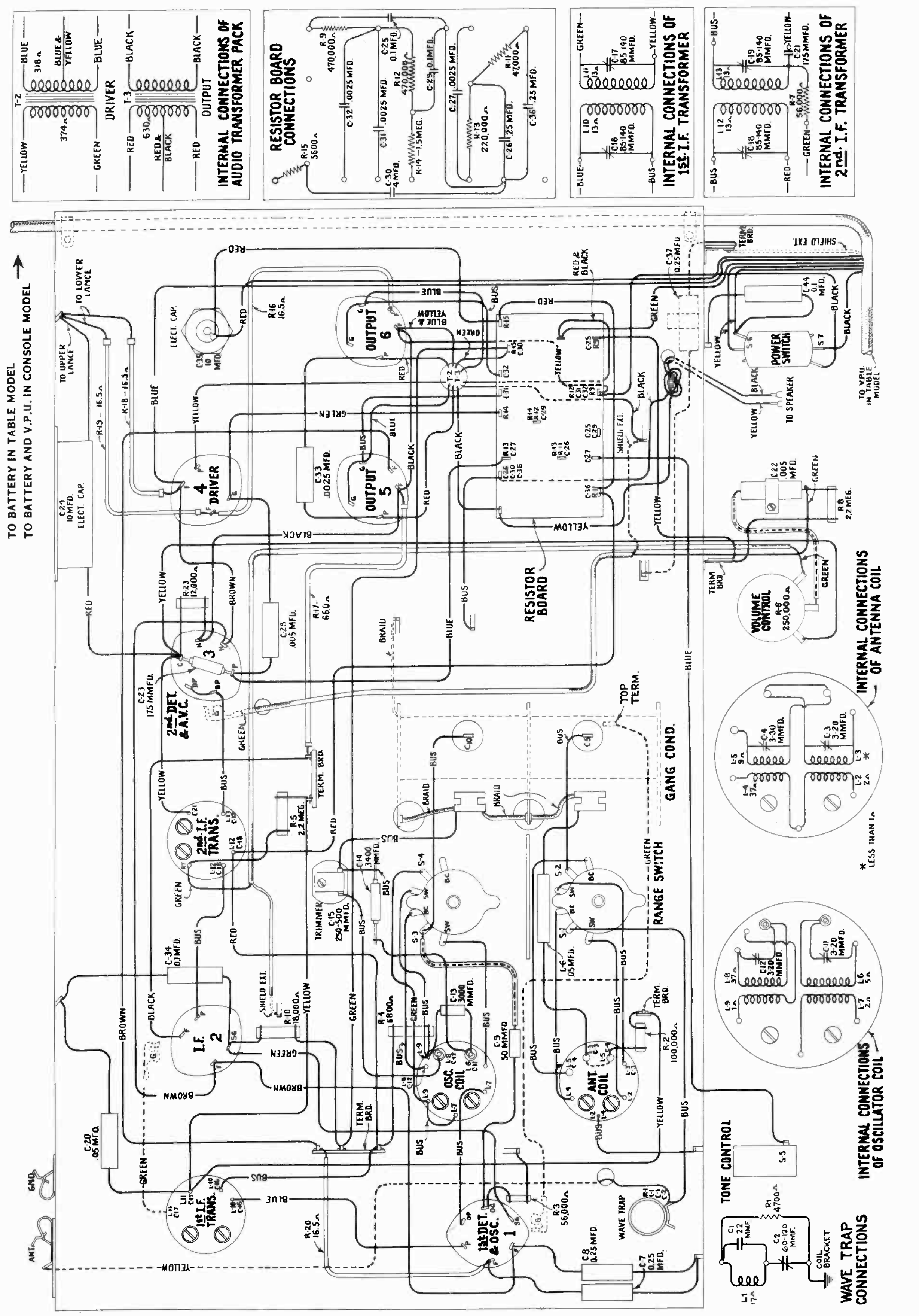


Figure 2—Chassis Wiring Diagram

Circuit Arrangement

The conventional Superheterodyne circuit is used. The first stage combines the local oscillator and first detector functions in one tube, an RCA-1C6. Coils of the detector input and oscillator are tuned by a two-section variable condenser and are aligned by a total of five adjustable trimmers. Selection of the individually wound coil systems is made by the range selector. The oscillator operates at a fundamental frequency which is at all times above the incoming signal by **460 kc.**

An RCA-34 is employed as an i-f amplifier. Its input and output are coupled by transformers to the first detector and second detector, respectively. Each transformer has both its secondary and primary windings tuned to **460 kc.** by adjustable trimmer capacitors.

The modulated signal, as obtained from the output of the i-f system, is detected by the diode section of the RCA-75. The a-f voltage appearing across the diode load resistor, R-6, is selected by the variable arm of the volume control (R-6) and passed on to the a-f system for amplification and final reproduction. The d.c. which occurs in resistor R-6 due to signal detection, is used for automatic volume control by varying the control-grid bias on the first detector and i-f tubes.

Resistance-capacitance coupling is used between the RCA-75 and the RCA-30 driver tube. A high-frequency tone control, consisting of a switch in series with a condenser, is shunted across the plate circuit of the RCA-75. When this switch is closed, the high a-f frequencies are reduced.

The power output stage is arranged for Class "B" operation. The high level of power afforded is fed to the permanent magnet dynamic speaker through an output transformer.

Battery "On-Off" control is by means of a double pole switch, one side of which controls the filament and bias circuits, while the other side controls the vibrator power unit circuit. A fuse is provided in the V. P. U. circuit.

SERVICE DATA

Alignment Procedure

Four adjusting trimmers are provided for the i-f coils and five for the antenna and oscillator coils. They are precisely adjusted during manufacture to give correct performance. Their settings should remain intact indefinitely when the receiver is used under ordinary conditions. Necessity for readjustment may occasionally occur from continued extremes of climate, tampering, purported alteration for service purposes, or after repairs have been made to the r-f or i-f tuned circuits.

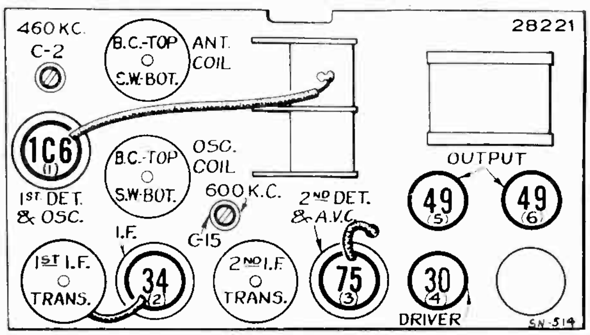


Figure 3—Radiotron and Coil Locations

In readjusting the trimmers to their normal settings, it is quite important to apply a definite procedure and to use adequate and reliable test equipment. A standard source of the specified alignment frequencies is required. It is recommended that such a source consist of an **RCA Stock No. 9595 Full-Range Test Oscillator.** Means for indication of the receiver output during alignment is also necessary to accurately show when the correct point of adjustment is reached. This indication should be obtained by means of such an instrument as the **RCA Stock No. 4317 Neon Glow Indicator.** Proceed with the alignment as follows:

Place the receiver in operation where it will be easily accessible. Attach the output indicator across the loudspeaker voice coil circuit, or across the output transformer primary. Advance the receiver volume control to its maximum position, letting it remain in such position for ***all*** adjustments. For each trimming operation, regulate the test oscillator output control so that the signal level is as low as possible and still observable at the receiver output. Use of such a small signal will avoid broadness of tuning which would otherwise result from A.V.C. action on a stronger one.

I-F Adjustments

(a) Connect the output of the test oscillator between the control-grid cap of the first detector tube (RCA-1C6) and chassis-ground. Adjust the frequency of the oscillator to **460 kc.** Tune the receiver to a point where no interference is received from the heterodyne oscillator or local station.

(b) Adjust the trimmers, **C-19** and **C-18**, of the second i-f transformer, and **C-17** and **C-16** of the first i-f transformer, so that each produces maximum (peak) receiver output as shown by the indicating device. This completes the i-f trimmer adjustments.

R-F Adjustments

(a) Check the calibration of the dial scale by rotating the tuning control until the variable condenser plates are in full mesh. (Maximum capacity.) Then adjust the dial pointer until it points to the ***horizontal*** line at the low frequency end of the broadcast band scale.

(b) Connect the output of test oscillator to the antenna-ground terminals of the receiver. Adjust the receiver range switch to its Band A (broadcast) position. Tune the oscillator to **1,720 kc.** Allow the output indicator to remain attached to the receiver output.

(c) Tune the receiver so that the dial reading is **1,720 kc.** Then adjust the oscillator and antenna coil trimmers, **C-12** and **C-4** respectively, tuning each to the point producing maximum indicated receiver output.

(d) Shift the oscillator frequency to **600 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. The oscillator series trimmer, **C-15,** should then be adjusted, simultaneously rocking the receiver tuning control backward and forward through the signal until maximum receiver output results from the combined operations. The adjustment of **C-12** should be repeated as in **(c)** to correct for any changes in its alignment due to the adjustment of **C-15.**

(e) Shift the oscillator frequency to **18,000 kc.** Adjust the receiver range switch to its Band C **(shortwave)** position, and set the receiver dial to a reading of **18,000 kc.** The oscillator and antenna trimmers, **C-11** and **C-3,** should then be adjusted for maximum indicated receiver output.

Retune receiver to **17,080 kc.** and check for image signal. If **C-11** has been correctly aligned, the **18,000 kc.** signal will be received. It may be necessary to increase the oscillator output for this indication of the "image." ***No adjustments should be made during this check.***

Vibrator Power Unit

The Vibrator Power Unit supplies the necessary plate, screen, and cathode voltage for proper operation of the receiver. It contains a plug-in type vibrator, step-up transformer, and an efficient filter system. Rectification of the high voltage is by means of the synchronous vibrator. The complete unit is acoustically shielded to prevent noise. ***The radio chassis is 1 volt negative with respect to the vibrator chassis and, therefore, it is necessary to insulate the vibrator power unit from the chassis when they are removed for service purposes.*** The vibrator unit has been carefully adjusted by means of special equipment to insure quiet operation over an extensive period of life. No adjustments should be attempted on a vibrator suspected of being in a defective condition, but a renewal installed. A convenient plug-in base is provided for effecting a quick replacement.

Radiotron Socket Voltages

Voltage values indicated at the Radiotron socket contacts on Figure 4 form a reference basis for test of the receiver. All voltages are given in respect to

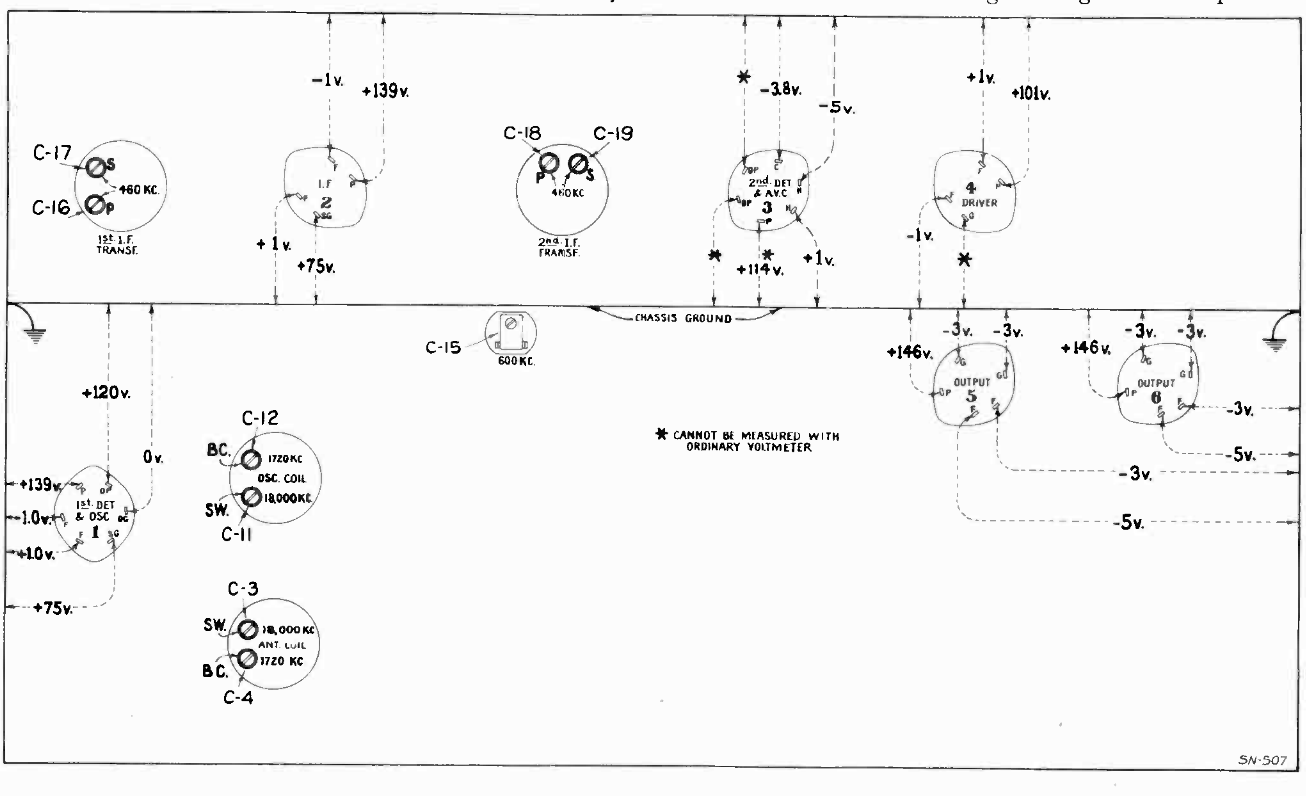


Figure 4—Radiotron Socket Voltages and Trimmer Locations

Measured at Normal Battery Voltage —No Signal Being Received chassis-ground. The values shown are obtainable when the receiver is in normal operating condition. They do not take into account inaccuracies caused by current consumed in the voltmeter used for the tests. The lower the meter resistance, the lower will be the degree of accuracy. Allowances must therefore be made, dependent upon the type of test instrument used, for the loading effect of the voltmeter on the circuit.

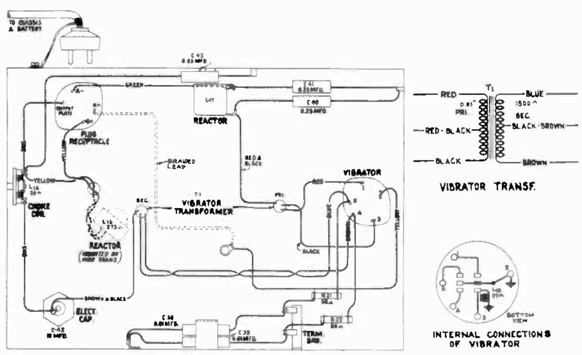


Figure 5—Vibrator Power Unit Wiring

Operation on 32-Volt Farm Plants

The recommended method for operating these receivers from a 32-volt Farm Lighting System is to connect the 6-volt battery leads across a medium-duty 6-volt storage battery which is connected in series with a 100-watt 32-volt lamp and switch across the 32-volt system. This method will permit the battery to be charged at a rate of about 3 amperes. The 6-volt battery should be charged from the 32-volt system about two-thirds the number of hours the receiver is in operation to prevent the battery from becoming overcharged. It is recommended that a frequent check be made with a hydrometer as to the state of charge of the battery. The wiring should be made permanent so that no mistake could be made as to the proper battery polarity.

In some cases, these receivers may be operated from a 6-volt tap (ground side) on the 32-volt battery system provided the interference radiated from the battery leads does not seriously affect reception. It will be necessary to extend the 4-conductor battery leads of the receiver to the 32-volt battery system and properly shield them to reduce radiation of interference into the antenna. The extension of only a single pair of leads will cause excessive vibrator interference in the filament circuits of the receiver. If the receiver is located some distance from the 32-volt battery system, the radiation of interference and the resistance in the battery leads will result in unsatisfactory operation of the receiver. This method of operation places an uneven load on the 32-volt battery system with a greater discharge occurring in three of the battery cells which may affect their life.

If these receivers are operated directly from the 32-volt system by means of a series dropping resistance without the floating battery, excessive hum and interference will result. It is also impossible to recommend a value for the dropping resistance which will insure that the receiver will not be damaged under certain operating conditions of the lighting plant.

A small capacitor (.05 mfd.) should be placed in series with the ground lead of the receiver to prevent shorting the 32-volt system.

Wave-Trap Adjustment

With the receiver in operation using its normal antenna, tune station selector to the point at which the intermediate frequency interference is most intense. Then adjust the wave trap trimmer to the point which causes maximum suppression of the interference.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers.

Stock No.	Description	List Price	Stock No.	Description	List Price
	RECEIVER ASSEMBLIES		4836	Capacitor—.05 Mfd.—(C6, C20)	.30
5237	Bushing—Variable tuning condenser mounting bushing assembly—Package of 3	$0.43	4841	Capacitor—0.1 Mfd.—(C25, C29, C34, C44)	.22
11223	Capacitor—Adjustable capacitor—(C15)	.46	4840	Capacitor—0.25 Mfd.—(C7, C8, C26, C36, C37)	.30
11292	Capacitor—22 MMfd.—(C1)	.24	6832	Capacitor—4 Mfd.—(C30)	.85
11289	Capacitor—50 MMfd.—(C9)	.26	11387	Capacitor—10 Mfd.—(C35)	.86
5116	Capacitor—175 MMfd.—(C23)	.18	11645	Capacitor—10 Mfd.—(C24)	1.08
11622	Capacitor—3000 MMfd.—(C13)	.36	11639	Coil—Antenna coil—(L2, L3, L4, L5, C3, C4)	2.40
4439	Capacitor—3400 MMfd.—(C14)	.35	11640	Coil—Oscillator coil—(L6, L7, L8, L9, C11, C12)	2.46
5107	Capacitor—.0025 Mfd.—(C27, C31, C32, C33)	.16	11638	Condenser—Two-gang variable tuning condenser (C5, C10)	3.05
4868	Capacitor—.005 Mfd.—(C28)	.20			
5242	Capacitor—.005 Mfd.—(C22)	.52			

REPLACEMENT PARTS (Continued)

Stock No.	Description	List Price
11648	Foot—Chassis foot and bracket assembly—Package of 2	.64
11134	Resistor—16.5 ohms—Flexible type—(R16, R20)—Package of 5	.68
11611	Resistor—16.5 ohms—Flexible type—(R18, R19)—Package of 5	.68
11473	Resistor—66 ohms—Flexible type—(R17)—Package of 5	.68
11650	Resistor—4700 ohms—Carbon type—1/10 watt—(R1)—Package of 5	.75
11647	Resistor—5600 ohms—Carbon type—¼ watt—(R15)—Package of 5	1.00
11726	Resistor—6800 ohms—Carbon type—¼ watt—(R4)—Package of 5	1.00
5109	Resistor—12,000 ohms—Carbon type—¼ watt—(R23)—Package of 5	1.00
11175	Resistor—18,000 ohms—Carbon type—¼ watt—(R10)—Package of 5	1.00
11646	Resistor—47,000 ohms—Carbon type—¼ watt—(R11)—Package of 5	1.00
5029	Resistor—56,000 ohms—Carbon type—¼ watt—(R3)—Package of 5	1.00
11281	Resistor—100,000 ohms—Carbon type—1/10 watt—(R2)—Package of 5	.75
5158	Resistor—220,000 ohms—Carbon type—¼ watt—(R13)—Package of 5	1.00
11172	Resistor—470,000 ohms—Carbon type—¼ watt—(R9, R12)—Package of 5	1.00
4241	Resistor—1.5 megohms—Carbon type—¼ watt—(R14)—Package of 5	1.00
11626	Resistor—2.2 megohms—Carbon type—¼ watt—(R5, R8)—Package of 5	1.00
11641	Shield—Antenna or oscillator coil shield	.34
11390	Shield—Intermediate frequency transformer shield	.25
3682	Shield—Radiotron (1C6 or 75) shield	.22
3056	Shield—Radiotron (34) shield—Package of 2	.40
4794	Socket—4-contact Radiotron (30 or 34) socket	.15
4814	Socket—5-contact Radiotron (49) socket	.15
4786	Socket—6-contact Radiotron (1C6 or 75) socket	.15
11643	Switch—Power switch—(S6, S7)	.60
11642	Switch—Range switch—(S1, S2, S3, S4)	1.52
11644	Switch—Tone control switch—(S5)	.30
5238	Terminal—Antenna terminal board with clip, insulating strip and rivets	.14
11594	Transformer—Audio driver and output transformer pack—(T2, T3)	4.10
11592	Transformer—First intermediate frequency transformer—(L10, L11, C16, C17)	2.55
11593	Transformer—Second intermediate frequency transformer—(L12, L13, C18, C19, C21, R7)	2.75
11649	Trap—Wave trap—(L1, C1, C2, R1)	1.15
11589	Volume control—(R6)	.85
	DRIVE ASSEMBLIES	
10194	Ball—Steel ball for drive assembly—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—comprising drive shaft, balls, ring, spring and washers assembled	1.00
11674	Dial—Station selector dial	.30
11651	Drive—Variable tuning condenser drive assembly	1.84
4520	Indicator—Station selector indicator pointer	.18
4669	Screw—No. 8-32x5/32-in. set screw for condenser assembly—Package of 10	.25
	POWER UNIT ASSEMBLIES	
11654	Capacitor—.01 Mfd.—(C38, C39)	.16
4836	Capacitor—.05 Mfd.—(C43)	.30
4840	Capacitor—.25 Mfd.—(C40, C41)	.30
11387	Capacitor—10 Mfd.—(C42)	.86
11655	Coil—Choke coil—(L14)	.38
11657	Reactor—Filter reactor—(L15)	.96
11652	Reactor—(L17)	1.28
5034	Resistor—56 ohms—Carbon type—½ watt—(R21, R22)—Package of 5	1.00
4794	Socket—4-contact socket for cable plug connector	.15
4814	Socket—5-contact vibrator socket	.15
11653	Transformer—Vibrator transformer—(T1)	6.50
11656	Vibrator	5.92
	MISCELLANEOUS ASSEMBLIES	
4289	Body—Fuse connector body—Package of 10	.35
11635	Cable—Battery cable complete with four-contact male connector, fuse connector and two-contact pins—for table model	2.30
11636	Cable—Battery cable complete with four-contact male connector, fuse connector, and two-contact pins—for console model	2.60
4288	Cap—Fuse connector cap—Package of 10	.36
11634	Connector—Clip and strap connector assembly for storage battery—Package of 2	.26
6516	Connector—Fuse connector—complete	.16
11570	Connector—Four-contact male connector for battery cable	.32
11337	Escutcheon—Station selector escutcheon	.70
4286	Ferrule—Fuse connector ferrule and bushing—Package of 10	.38
5023	Fuse—15 Ampere fuse—Package of 5	.40
6614	Glass—Station selector dial glass	.30
4290	Insulator—Fuse connector insulator—Package of 10	.35
11346	Knob—Station selector knob—Package of 5	.75
11455	Knob—Volume control, tone control, range switch or power switch knob—Package of 5	.48
11637	Pin—Contact pin—for battery cable—colored black—Package of 5	.10
11658	Pin—Contact pin—for battery cable—colored red—Package of 5	.10
4678	Ring—Station selector dial glass retaining ring—Package of 5	.34
5210	Screw—Chassis mounting screw assembly—Package of 4	.16
11348	Screw—No. 8-32x7/16-in. headless cupped point set screw—for knob, stock No. 11346—Package of 10	.32
4284	Spring—Fuse connector spring—Package of 10	.30
11349	Spring—Retaining spring for knob, stock No. 11455—Package of 5	.15
4285	Washer—Fuse connector insulating washer—Package of 10	.22
	REPRODUCER ASSEMBLIES Table Model	
9539	Cone—Reproducer cone (L9)—Package of 5	4.30
9540	Magnet Assembly—Comprising cone bracket, core and magnet	5.72
9538	Reproducer—Complete	7.65
	REPRODUCER ASSEMBLIES Console Model	
9432	Cone—Reproducer cone—complete with voice coil—(L9)	1.88
7820	Magnet—Cone housing and magnet assembly	8.98
7819	Reproducer—Complete	12.18

RCA VICTOR MODELS BT 7-8 AND BC 7-9

Seven-Tube, Two-Band, Superheterodyne, Battery Receivers

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Type and Number of Radiotrons	1 RCA-1C6, 2 RCA-34, 2 RCA-30, 1 RCA-32, 1 RCA-19—Total, 7
Total "A" Battery Current	0.68 Ampere
Maximum "B" Battery Current	21 M. A.
Tuning Ranges	540-1720 kc. and 5400-18000 kc.
Maximum Undistorted Output	1.2 Watts
Maximum Output	2.2 Watts
Line-up Frequencies	460 kc., 600 kc., 1720 kc., and 18000 kc.

PHYSICAL SPECIFICATIONS

	Model BT 7-8	Model BC 7-9
Height	18½ Inches	39 Inches
Width	14½ Inches	25½ Inches
Depth	11 Inches	14½ Inches

These seven-tube, battery-operated, Superheterodyne receivers provide excellent reception of standard-wave and short-wave broadcasting stations. High sensitivity, excellent selectivity and good fidelity characterize their performance. Outstanding features include a permanent magnet dynamic type loudspeaker, two-point tone control, Class "B" output stage, vernier drive and excellent mechanical construction. The chassis is unusually accessible for repair or replacement of parts. Fuses in the "B" battery leads provide protection for the Radiotrons in event of short circuits. Battery connections are by means of plugs. Figure 1 shows the schematic diagram, while Figure 2 shows the chassis wiring.

DESCRIPTION OF ELECTRICAL CIRCUIT

The circuit is of the superheterodyne type and consists of a combined oscillator-detector stage, two i-f amplifying stages, a combined, second detector and automatic volume control, a two-stage audio amplifier and a Class "B" output stage. A two-pole operating switch opens the "+A" and "+B" battery leads when the switch is turned to the "off" position.

The signal enters the receiver through a shielded antenna lead and is applied through the antenna transformer to the grid circuit of the first detector which also serves as the local oscillator for producing a signal, 460 kc. higher in frequency than the incoming signal. The combined signals after passing through the first detector produce the i-f signal.

The i-f amplifier uses two RCA-34 Radiotrons in conjunction with three transformers. Two of the transformers are tuned very accurately to the i-f frequency (460 kc.) by means of suitable trimmer capacitors. The third transformer is untuned and couples the output of the second stage to the input of the second detector, an RCA-30, the plate of which is grounded.

Automatic volume control action is obtained from the voltage drop of a portion of the rectified signal across resistor R-9. The voltage drop constitutes the automatic bias voltage for the first detector and i-f stages and thereby gives the automatic volume control action of the receiver.

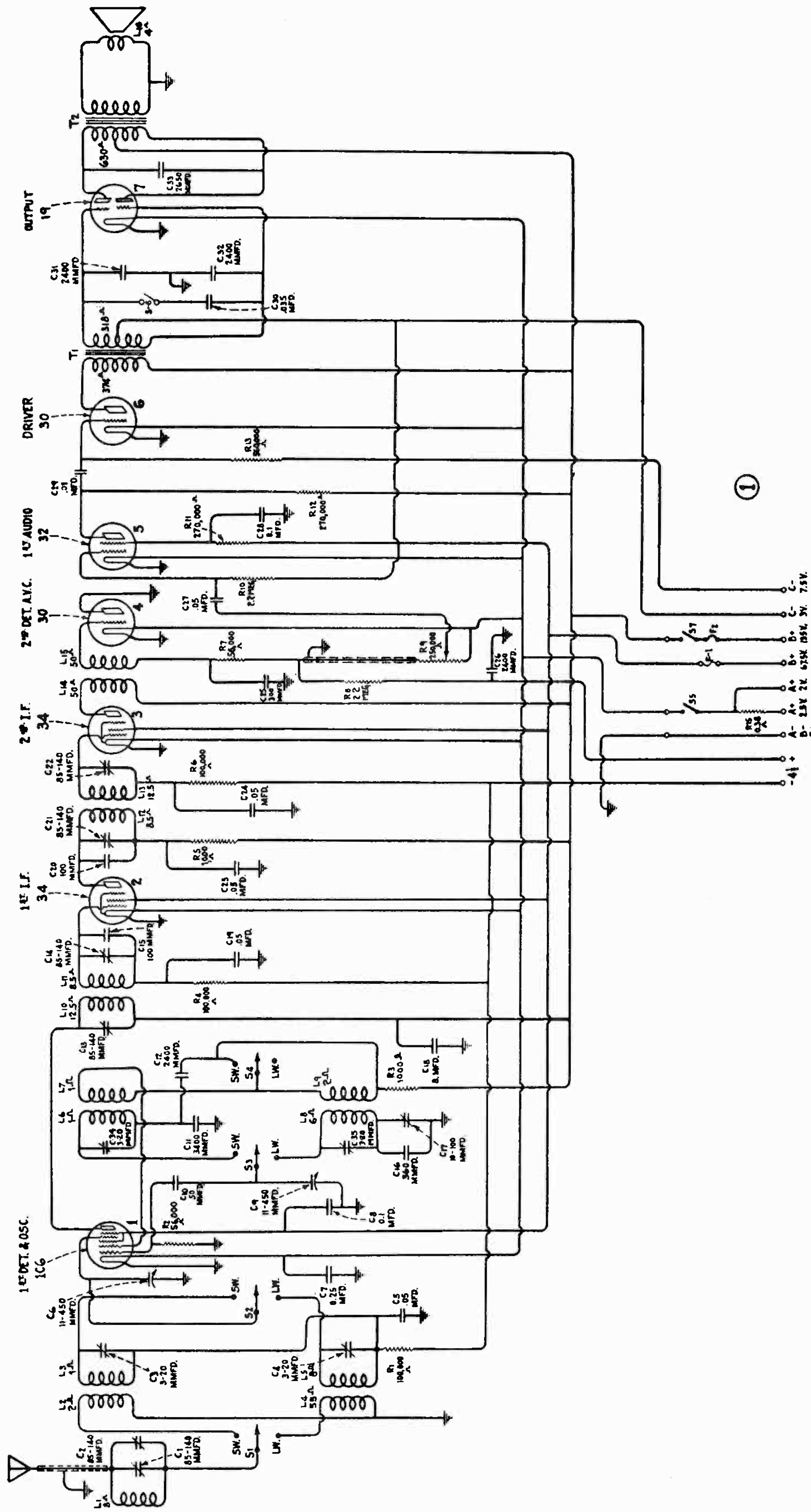


Figure 1—Schematic Circuit Diagram

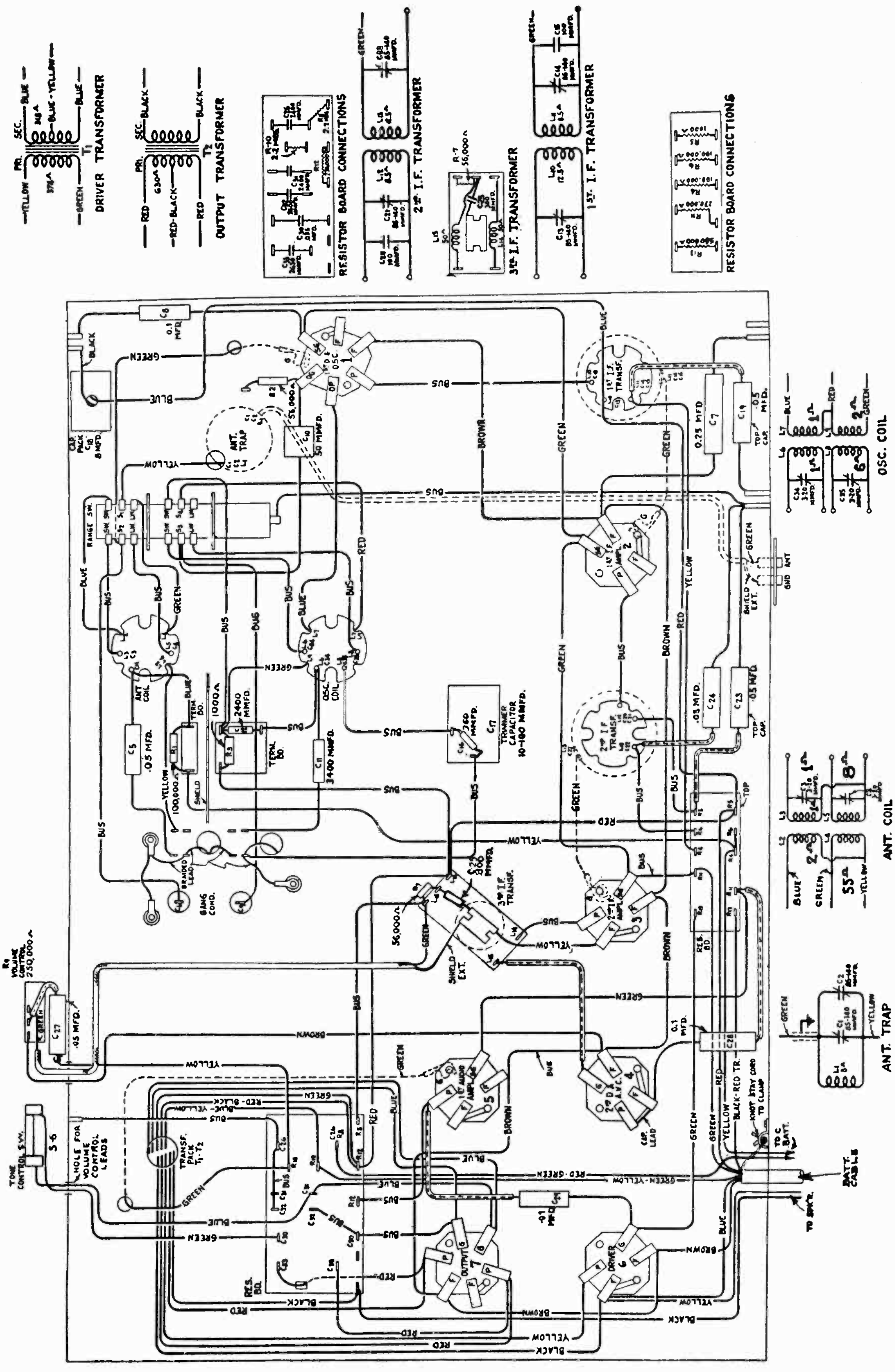


Figure 2—Chassis Wiring Diagram

The volume control selects the desired amount of audio signal from the drop across R-9 and applies it to the grid circuit of the first audio stage, RCA-32.

The output of the first audio stage is resistance coupled to the grid circuit of the RCA-30 driver stage, which is transformer coupled to the Class "B" output stage. The output stage utilizes the twin amplifier Radiotron RCA-19, which has two separate sets of elements and eliminates the necessity of having two separate tubes for a Class "B" output stage. The plate circuit of this tube is transformer coupled to the cone coil of the permanent magnet, dynamic loudspeaker.

Plate, grid and filament voltages are supplied by individual batteries. Two +A leads are provided, one permitting operation on a 2-volt storage cell and the other used for operation on a 2.5-volt "Eveready Air Cell."

SERVICE DATA

ALIGNMENT PROCEDURE

To properly align this receiver, it is essential that a modulated R. F. oscillator of suitable frequency range such as Stock No. 9595, an output indicator, Stock No. 4317, and an alignment tool, Stock No. 4160, be available. Figure 4 shows the location of the various line-up capacitors.

I-F Tuning Adjustments

The i-f amplifier comprises two stages including three transformers. The third transformer is untuned so that only a total of four circuits are to be adjusted. Refer to Figure 4 and proceed as follows:

(a) Short-circuit the antenna and ground terminals and tune the receiver so that no signal is heard. Set the volume control at maximum and connect a ground to the ground terminal.

(b) Connect the test oscillator output between the first detector control grid and chassis ground. Connect the output indicator across the voice coil of the loudspeaker and adjust the oscillator output so that, with the receiver volume control at maximum, a slight glow is obtained in the output indicator.

(c) Adjust the secondary and primary of the second and then the first i-f transformers until a maximum deflection is obtained. The third transformer is untuned and does not require adjusting. Keep the oscillator output at a low value so that only a slight glow is obtained in the output indicator at all times. Go over these adjustments a second time, as there is a slight interlocking of adjustments. This completes the i-f alignment.

(d) Connect Test Oscillator to antenna-ground terminals. Adjust wave trap trimmer, C-1, to give minimum receiver output.

R-F and Oscillator Adjustments

The important points to remember are the need for using the minimum oscillator output to obtain an indication in the output device with the volume control at its maximum position and the manner of obtaining the proper high-frequency oscillator and detector adjustments.

The r-f line-up capacitors are located at the bottom of the coil assemblies instead of their usual position on the gang capacitor. They are all accessible from the bottom of the chassis except the 600 kc. series capacitor, which is accessible from the top of the chassis. Proceed as follows:

(a) Connect the output of the oscillator to the antenna and ground terminals of the receiver. Check the position of the dial pointer when the tuning capacitor plates are fully meshed. It should be coincident with the radial line adjacent to the dial reading of 540.

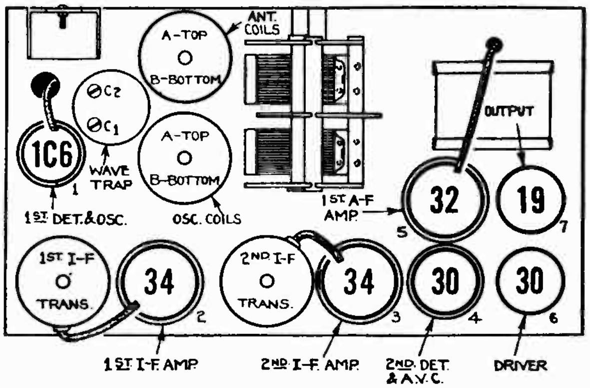


Figure 3—Radiotron and Coil Locations

(b) Then set the receiver band switch to its broadcast position, the Test Oscillator at 1720 kc., and the dial pointer at 1720. Adjust the oscillator output so that a slight glow will be obtained in the output indicator when the volume control is at its maximum position. Adjust the two trimmers, C-35 and C-4, under the two r-f coils, see Figure 4, until a maximum output is obtained. Then shift the Test Oscillator frequency to 600 kc. The trimmer capacitor, C-17, accessible from the top of the chassis, should now be adjusted for maximum output while rocking the main tuning capacitor back and forth through the signal. Then repeat the 1720 kc. adjustment.

(c) Change the receiver range switch to its high frequency (short wave) position and tune the Station Selector to a dial reading of 18,000 kc. Adjust the Test Oscillator to this same frequency and regulate its output to give a slight indication on the output meter. Then adjust trimmer C-34 to the point giving maximum receiver output. Two points may be found on the trimmer, C-34, which give this maximum. The one of least capacitance is correct and should be used. To assure that this point has been used, tune the receiver to a dial setting of 17,080 kc. and increase the output of the Test

Oscillator. The "image" of the 18,000 kc. signal will be received, if the adjustment of C-34 has been properly made. *No adjustments are to be made during the "image" check.*

Return the receiver tuning to 18,000 kc., re-adjust C-34 if necessary, and then tune the antenna trimmer, C-3, simultaneously rocking the tuning control backward and forward through the signal, until maximum output is obtained. Two positions of the trimmer may be found which give this condition—the one of maximum capacitance is correct.

Radiotron Socket Voltages

Voltage and current values indicated at the Radiotron socket contacts on Figure 4 form a reference basis for test of the receiver. It is to be noted that all voltages are given with respect to chassis-ground, excepting those appearing across the filaments (F-F). The values shown are obtainable when the receiver is in normal operating condition. They do not take into account inaccuracies caused by current consumed in the voltmeter used for the tests; the lower the voltmeter resistance, the lower the degree of accuracy. Allowances must therefore be made, dependent upon the type of test instrument used, for the loading effect of the voltmeter on the circuit.

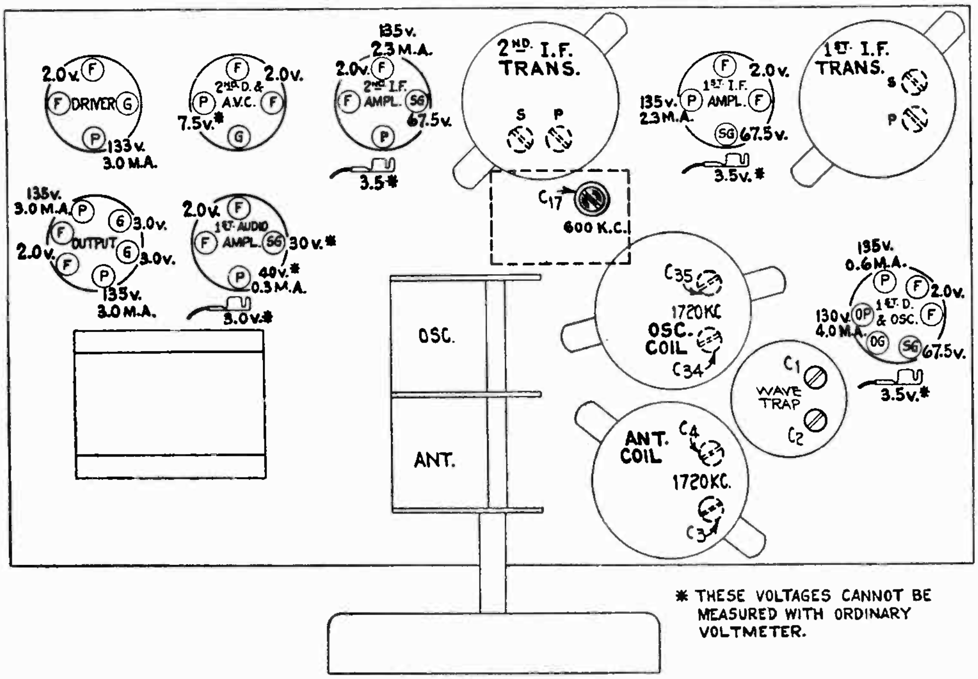


Figure 4—Line-Up Capacitor Locations and Voltage Values at Socket Contacts

Volume Control at Maximum—No Signal—135 Volt "B" Battery—
4.5 and 7.5-Volt Bias Batteries

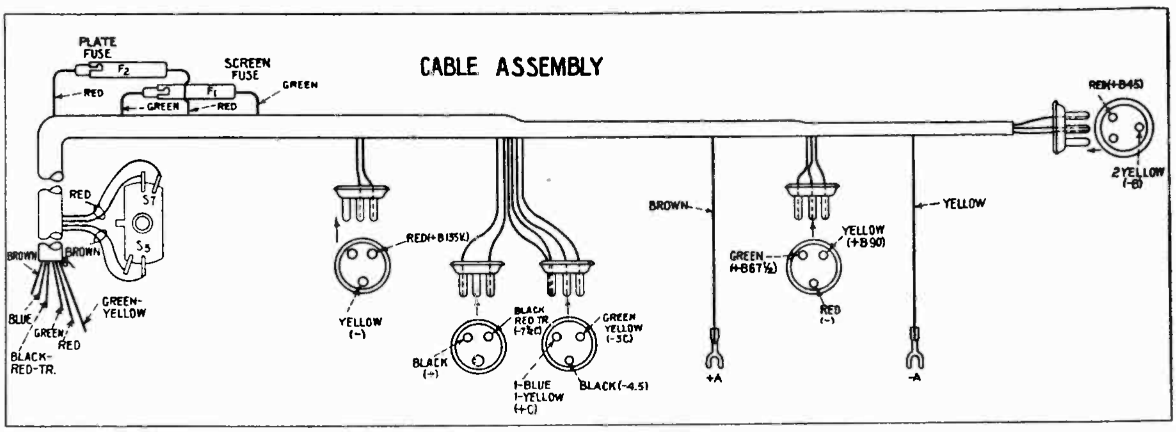


Figure 5—Battery Cable Connections

BT 7-8 and BC 7-9
REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4427	Bracket—Volume control or tone control mounting bracket	$0.18
4244	Cap—Grid contact cap—Package of 5	.20
3861	Capacitor—Adjustable capacitor (C17)	.78
11289	Capacitor—50 MMfd. (C10)	.26
3794	Capacitor—100 MMfd. (C15, C20)	.30
3981	Capacitor—300 MMfd. (C25)	.30
11413	Capacitor—360 MMfd. (C16)	.22
4801	Capacitor—2400 MMfd. (C12, C31, C32)	.50
2749	Capacitor—2400 MMfd. (C26)	.35
4529	Capacitor—2650 MMfd. (C33)	.32
4439	Capacitor—3400 MMfd. (C11)	.35
5196	Capacitor—0.035 Mfd. (C30)	.18
4883	Capacitor—0.01 Mfd. (C29)	.20
4518	Capacitor—0.05 Mfd. (C27)	.52
4836	Capacitor—0.05 Mfd. (C5, C19, C23, C24)	.30
4841	Capacitor—0.1 Mfd. (C8, C28)	.22
4840	Capacitor—0.25 Mfd. (C7)	.30
11344	Capacitor—8 Mfd. (C18)	0.00
4430	Coil—Antenna coil (L2, L3, L4, L5, C3, C4)	1.92
4432	Coil—Oscillator coil (L6, L7, L8, L9, C34, C35)	1.65
4539	Coil and shield assembly—Antenna trap circuit	2.05
4504	Condenser—Two-gang variable tuning condenser (C6, C9)	2.78
11338	Volume control—(R9)	1.00
5112	Resistor—1000 Ohms—Carbon type—¼ Watt—(R5)—Package of 5	1.00
5029	Resistor—56,000 Ohms—Carbon type—¼ Watt—(R2, R7)—Package of 5	1.00
3118	Resistor—100,000 Ohms—Carbon type—¼ Watt—(R1, R4, R6)—Package of 5	1.00
11323	Resistor—270,000 Ohms—Carbon type—¼ Watt—(R11, R12)—Package of 5	1.00
5035	Resistor—560,000 Ohms—Carbon type—¼ Watt—(R13)—Package of 5	1.00
11151	Resistor—2.2 Megohms—Carbon type—¼ Watt—(R8, R10)—Package of 5	1.00
4521	Shield—Antenna, oscillator, or intermediate frequency coil shield	.42
3942	Shield—First detector, oscillator Radiotron shield	.18
7487	Shield—Second detector Radiotron shield	.25
3056	Shield—First or second intermediate frequency, or first audio Radiotron shield—Package of 2	.40
4532	Socket—4-contact first audio Radiotron socket	.28
6980	Socket—4-contact intermediate frequency, second detector or driver Radiotron socket	.20
4232	Socket—6-contact first detector, oscillator Radiotron socket	.35
4531	Socket—6-contact output Radiotron socket	.30
5053	Switch—Tone control switch (S6)	.50
11339	Switch—Operating switch—less knob (stock #3088) and escutcheon (stock #6176)—(S5, S7)	.80
4437	Switch—Range switch (S1, S2, S3, S4)	2.35
4533	Transformer—Audio transformer pack comprising driver and output transformer (T1, T2)	3.98
4431	Transformer—First intermediate frequency transformer—(L10, L11, C13, C14, C15)	2.28
7840	Transformer—Second intermediate frequency transformer (L12, L13, C20, C21, C22)	$2.35
4538	Transformer—Third intermediate frequency transformer (L14, L15, R7, C45)	2.15
	DRIVE ASSEMBLIES	
10194	Ball—Steel ball—Package of 20	.50
4422	Clutch—Tuning condenser drive clutch assembly—comprising shaft, balls, ring, spring and washers—assembled	1.00
11342	Dial—Station selector dial	.72
4586	Drive—Variable tuning condenser drive assembly—complete	2.42
4520	Indicator—Station selector indicator pointer	.18
4669	Screw—No. 8-32 5/32" set screw for variable condenser drive assembly—Package of 10	.25
	REPRODUCER ASSEMBLIES (TABLE MODEL—BT 7-8)	
9539	Cone—Reproducer cone—Package of 5—(L16)	4.30
9540	Magnet assembly—Comprising cone bracket, core, and magnet	5.72
9538	Reproducer—Complete—(L16)	7.65
	REPRODUCER ASSEMBLIES (CONSOLE MODEL—BC 7-9)	
9432	Cone—Reproducer cone—complete with voice coil (L16)	1.88
7820	Magnet—Cone housing and magnet assembly	8.98
7819	Reproducer—Complete—(L16)	12.18
	MISCELLANEOUS ASSEMBLIES	
11343	Cable—Main battery cable complete with three stock #11340 connectors, two stock #11341, connectors, two stock #6516 fuse connectors, two stock #3748 fuses—except, less one stock #11339 switch	3.55
6516	Connector—Fuse connector	.16
11340	Connector—3-contact male connector with three small prongs—for "B" battery connections	.24
11341	Connector—3-contact male connector with two small and one large prong for "C" battery connections	.24
11337	Escutcheon—Station selector escutcheon	.70
6176	Escutcheon—Off-on operating switch escutcheon—Package of 5	.50
3748	Fuse—½ ampere F1—Package of 5	.40
6614	Glass—Station selector dial glass	.30
3088	Knob—Operating switch knob and screw—Package of 5	.50
4449	Knob—Station selector, volume control, tone or range switch knob—Package of 5	.60
4644	Resistor—.38 Ohms—Flexible type—Filament series resistor—(R15)—Package of 5	.80
4678	Ring—Dial glass retaining ring—Package of 5	.34
3238	Screw—No. 6-40 17/32" Knurled head screw for knob, stock 3088—Package of 10	.25
4945	Screw—Chassis mounting screw assembly—Console Model	.50
4446	Screw—Chassis mounting screw assembly—Table Model	.28
4613	Screw—No. 8-32 7/16" headless set screw for station selector volume control, tone control switch, or range switch knob—Package of 10	.25

Printed in U. S. A.

RCA VICTOR MODEL C 9-4

Nine-Tube, Three-Band, A-C, Superheterodyne, Console Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Frequency Ranges	
Band A	540— 1800 kc.
Band B	1800— 6000 kc.
Band C	6000—18000 kc.
Radiotron Complement	
(1) RCA-6K7	Radio-Frequency Amplifier
(2) RCA-6L7	First Detector
(3) RCA-6J7	Heterodyne Oscillator
(4) RCA-6K7	Intermediate Amplifier
(5) RCA-6H6	Second Detector and A.V.C.
(6) RCA-6F5	Audio Amplifier
(7) RCA-6F6	Power Output Amplifier
(8) RCA-5Z3	Full Wave Rectifier
(9) RCA-6E5	Tuning Indicator
Voltage and Frequency	
Rating A	105—125 volts, 50—60 cycles
Rating B	105—125 volts, 25—60 cycles
Rating C	100—130/140—160/195—250 volts, 40—60 cycles
Power Consumption	105 watts
Undistorted Output	2 watts
Maximum Output	4½ watts
Loudspeaker	12 inch, Electrodynamic
Voice Coil Impedance	2¼ ohms at 400 cycles
Intermediate Frequency	460 kc.
Alignment Frequencies	
Band A	600 kc. (osc), 1720 kc. (osc, ant, det)
Band B	6132 kc. (osc, ant, det)
Band C	18000 kc. (osc, ant, det)

MECHANICAL SPECIFICATIONS

Height	40 inches
Width	26 inches
Depth	12½ inches
Weight (Net)	52 pounds

GENERAL FEATURES

This instrument comprises a nine-tube chassis mounted in a console type cabinet. Its tuning ranges cover frequencies from 540 kc. to 18,000 kc. The following features are of outstanding interest:—

Metal Tubes

This receiver uses the new metal tubes which are much smaller in size than the corresponding glass types. The high frequency efficiency of these metal tubes is greater, because of the shorter lengths of leads, lesser interelectrode capacitance and the more complete shielding of the metallic envelopes. Their rugged construction prevents breakage and reduces microphonic tendencies. The bases and sockets of all types have a standardized arrangement of connecting prongs.

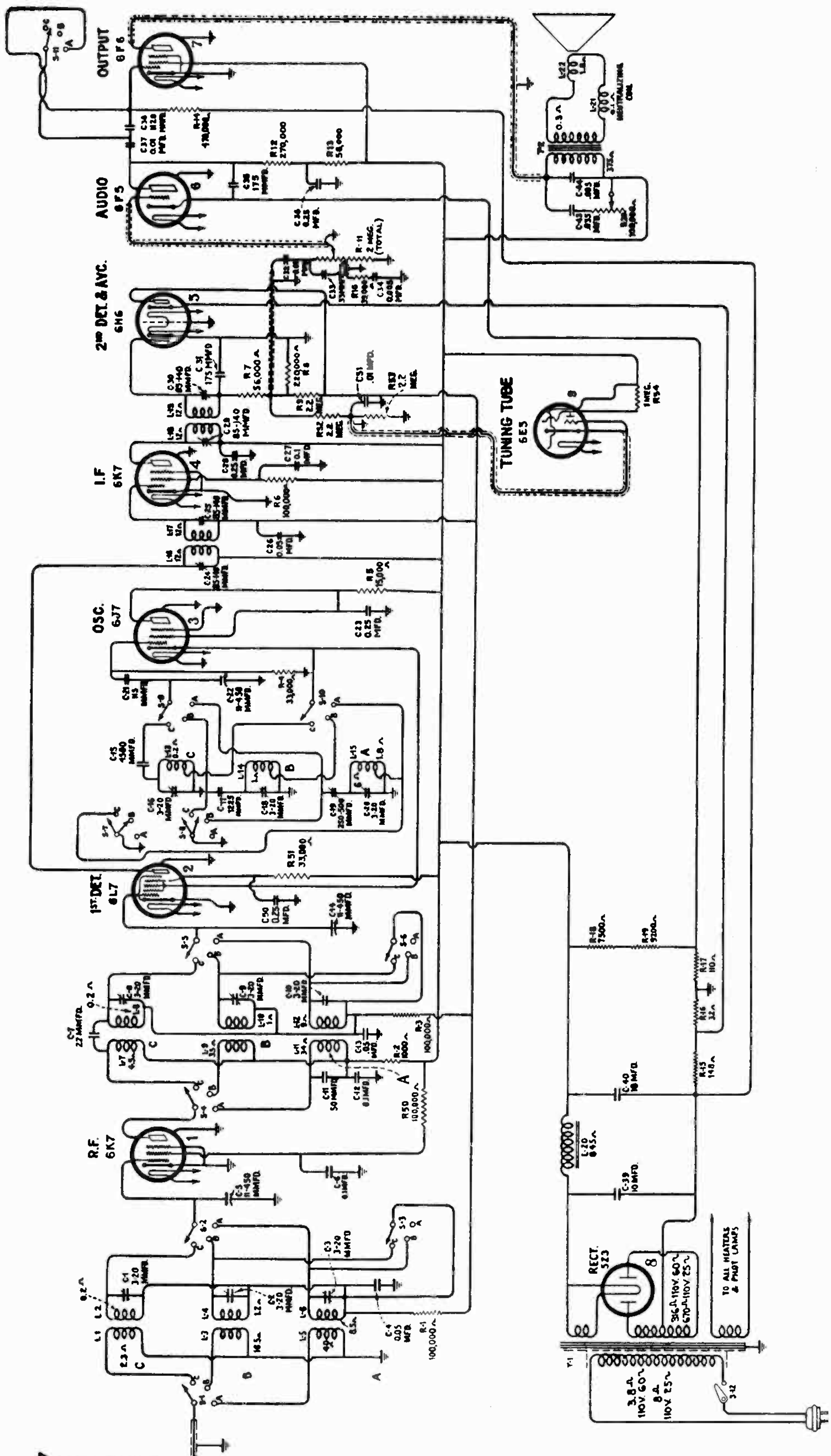


Figure 1—Schematic Circuit Diagram

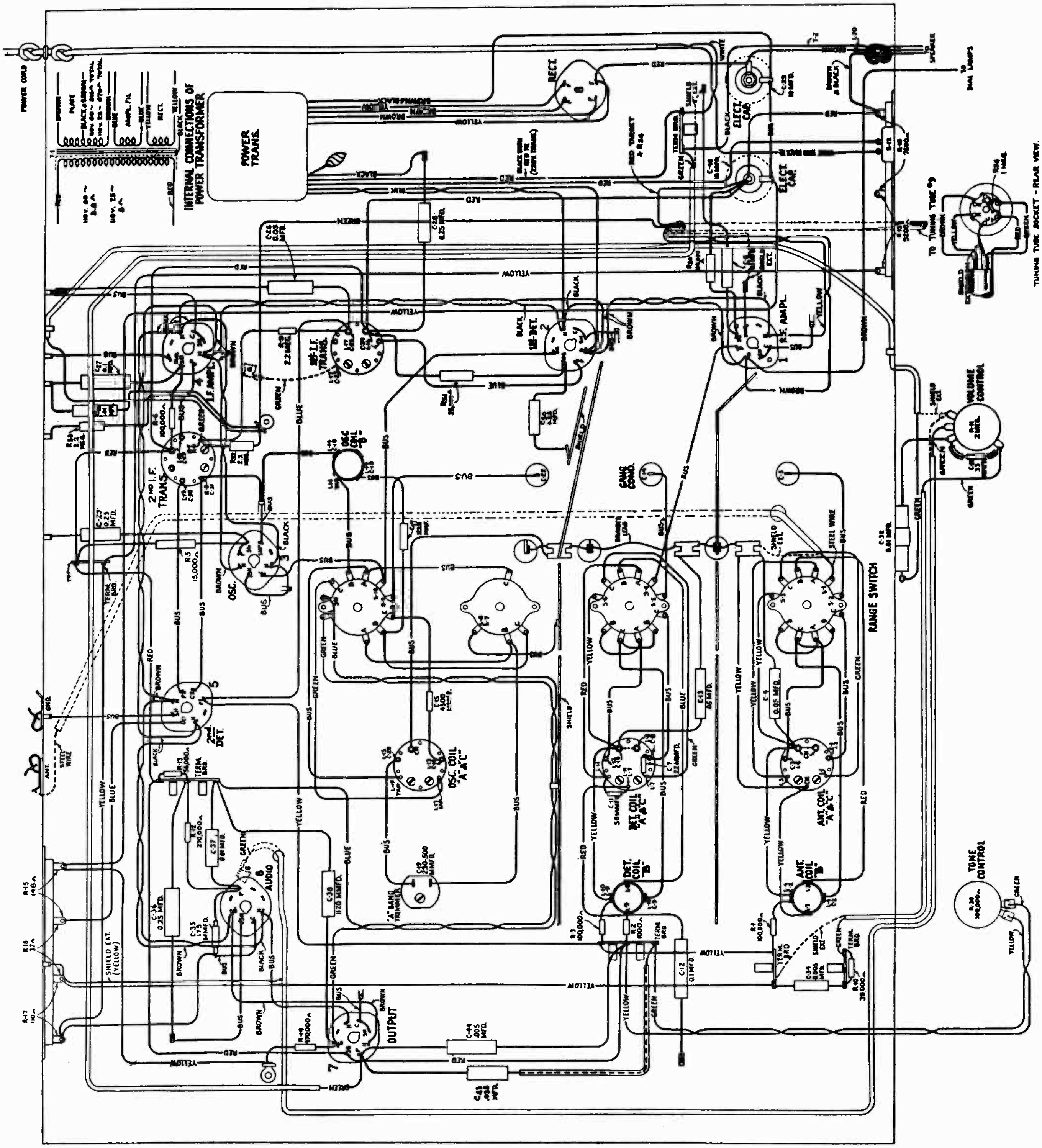


Figure 2—Chassis Wiring Diagram

Dial Drive

An open face airplane type of dial is used. Each scale has a band of color adjacent to its graduations and three short strips of corresponding colors at the lower part of the dial for index purposes. An index pointer, which moves as the band switch is rotated, points to one of these colors to identify the band in use. The drive mechanism is variable, there being either a 50 to 1 or 10 to 1 ratio available between the tuning knob and condenser drive shaft.

Tuning Indicator

A cathode-ray tube is used as a means of visually indicating when the receiver is accurately tuned to the incoming signal. This tube is of new design and comprises an amplifier section and a cathode-ray section built in the same glass envelope. The cathode-ray section consists of a conically shaped luminescent screen, upon which a pattern is formed by an effect of the detected signal after said effect has been amplified by the amplifier section which is fed from the detector diode circuit. The size of the pattern is determined by the strength of the signal voltage, so that any change of tuning may be readily observed in order to facilitate tuning to exact resonance.

CIRCUIT FEATURES

The circuit is based upon the Superheterodyne principle. The three ranges of tuning are covered by three sets of coils. A single r-f stage provides the desired selectivity and gain ahead of the hexode first detector tube. The oscillator stage operates separately from the first detector. A single stage i-f system is employed. Its basic frequency is 460 kc. Diode detection is performed by a double diode RCA-6H6 Radiotron. Automatic volume control is provided by this same tube. The audio system consists of two stages, one an RCA-6F5, and the output, an RCA-6F6. High voltages for plate and bias supplies are obtained from an RCA-5Z3 full wave rectifier through an efficient filter. The field of the loudspeaker acts as a reactor in the filter circuit. Further details of the circuit are as follows:—

Oscillator

The oscillator circuit has extreme stability of frequency and good uniformity of output over the tuning ranges. These qualities assure that the tuning of the receiver will not drift as the line voltage varies. The action of the circuit is such that when the cathode emission tends to change with line voltage or because of other reasons, the variation of voltage drop in the plate and screen resistor restores the operating characteristics of the tube to normal and thus maintains constancy of the generated signal.

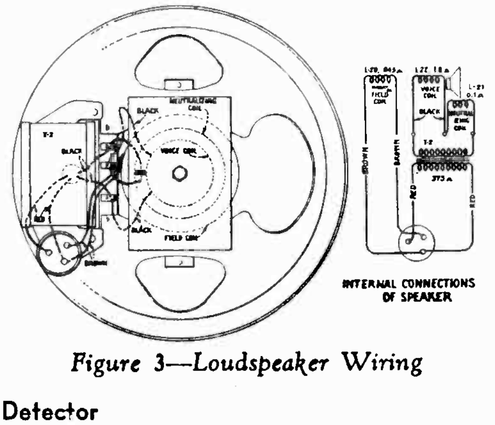


Figure 3—Loudspeaker Wiring

First Detector

This stage has unusually good high frequency mixing efficiency. The tube used, an RCA-6L7, is a new hexode type. The signal is supplied to the first control grid and the oscillator voltage is fed in on a second control grid, a screen grid separating the two. The arrangement of the grids prevents degenerative difficulties, particularly at the higher frequencies. The second grid is direct-connected to the cathode of the oscillator and has no d-c bias.

Compensated Volume Control

The variation in response of the human ear with different degrees of volume is compensated for by a resistor and condenser network in the manual volume control circuit. The volume control itself is an acoustically tapered potentiometer which provides equal changes of sound intensity for the listener per degree of rotation.

Range Switch

The band change switch has several functions. It exchanges the antenna, detector and oscillator coils in order to select the range desired. At the same time, it shorts out the unused coils so as to eliminate their absorptive effects. It also varies the fidelity by shorting a coupling condenser in the audio system to provide the desired reproduction for short as well as long wave reception.

Tone Control

Provision is included for variable reduction of high frequencies. This consists of a resistor and condenser combination across the primary winding of the output transformer, the resistor being the variable element. As it is decreased, the high frequency response limit is lowered.

Power System

The power transformer has its primary winding capacitively shielded from its secondary windings to eliminate transfer of line disturbances into the receiver and to stop any tendency for the circuit to radiate into the line. Rectification is performed in the usual manner by a full wave tube.

Detection and A.V.C.

The modulated signal as obtained from the output of the i-f system is detected by an RCA-6H6 double diode tube. The audio frequency secured by this process is passed on to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal is used for automatic volume control. This voltage, which develops across resistor R-8, is applied as automatic control grid bias to the r-f, first detector and i-f tubes through suitable resistance-capacitance filter circuits. The second diode of the RCA-6H6 is used to supply residual bias for

these controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current, which flows through R-9 and R-8, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed for servicing the receiver. The ratings of all resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. The coils, reactors and transformer windings are rated in terms of their d-c resistances only and where the value is less than one ohm, no rating is given. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and replacement parts list.

Alignment Procedure

There are a total of fourteen adjustments necessary for obtaining proper alignment when such a process becomes necessary. Four of these are involved with the i-f system and the remainder are associated with the antenna, first detector and oscillator coils.

Correct performance of the receiver can only be obtained when the trimmer adjustments have been made by a skilled service man with the use of adequate and reliable test equipment. Such apparatus as may be required for this particular instrument is illustrated and described on a separate page of this booklet.

Two methods of alignment are applicable. One utilizes a Cathode-Ray Oscillograph as a means of output indication and the other follows former procedure where a glow type indicator or meter is used. The oscillographic method is much to be preferred, since greater accuracy is possible from the type of indication afforded. There are no approximations necessary as with the meter or aural method, but each adjustment can be made with excellent precision. Both methods are hereinafter outlined so that alignment operations may be made according to the equipment available.

It is wise to determine the necessity for alignment as well as the direction of misalignment before making adjustments. The RCA Tuning Wand is an instrument designed particularly for such a purpose.

The Tuning Wand consists of a bakelite rod having a small brass cylinder at one end and a core of finely divided iron at the other. It may be inserted into a tuned coil while a signal of the normal resonant frequency is being supplied to such coil to obtain an indication of the tuning. Holes are provided at the top of the r-f shield cans for entrance of the Wand. The presence of either end of the Wand will cause a change in tuning which will be indicated at the receiver output as an increase or decrease in signal level. If there is a decrease of output when either end is inserted, the tuning is correct and will require no adjustment. However, should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output while the iron end causes a decrease, reduction of inductance will be necessary to place the circuit in alignment. This is equivalent to decreasing the trimmer concerned. The following tabulation gives the various changes and the adjustments required:—

WAND	SIGNAL	TRIMMER
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

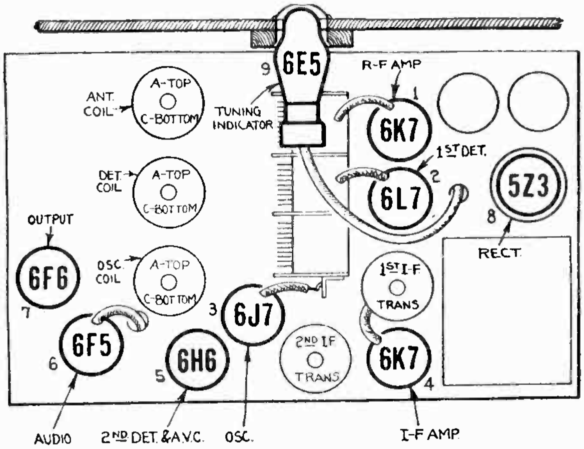


Figure 4—Coil and Radiotron Locations

(I) CATHODE-RAY ALIGNMENT

Equipment

A standard source of the specified alignment frequencies is required. Such a source should consist of an RCA Full Range Oscillator, Stock No. 9595. Output indication should be by means of an RCA Stock No. 9545 Cathode-Ray Oscillograph. An RCA Stock No. 9558 Frequency Modulator will be needed to sweep the generated signal and synchronize it with the Oscillograph in order to make possible the visual representation of the resonant characteristic of the circuit being tuned on the cathode-ray fluorescent screen.

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 6. Each must be aligned to a basic frequency of 460 kc. The last transformer must be aligned firstly and the first transformer aligned secondly. For such a process, it is necessary to feed the output of the Full Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each transformer and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The proper point of connection of the Oscillograph is with its vertical "high" input terminal attached to the juncture of R-7, R-8 and R-9 as illustrated in Figure 6, and with the "0" or ground terminal to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as shown by

Figure 5. A .001 mfd. capacitor installed in series with the Oscillator "Ant." lead will prevent the voltages of the stage under alignment from becoming upset. The vertical "A" amplifier should be "On" for the ensuing adjustments and the gain control kept at its maximum position. For each adjustment, the Oscillator output need be regulated so that the image obtained

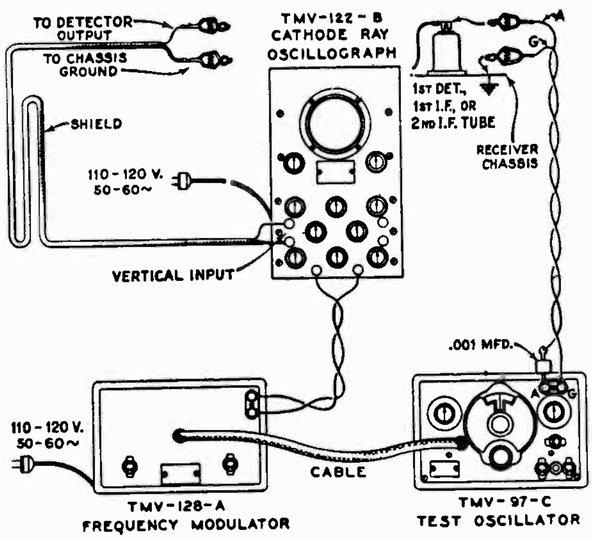


Figure 5—Alignment Apparatus Connections

on the Oscillograph screen will be of sufficient size as to be accurately observable. Proceed further as follows:—

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver range switch to Band "A" and tune the station selector to a point where no interference will be picked up, shorting the antenna and ground terminals if necessary. Set the Oscillograph horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a straight line trace completely across the screen. Place the timing control to "Int." Adjust the intensity and focusing controls of the Oscillograph to produce the correct size and strength of the spot.

(b) Attach the output of the test Oscillator between the control grid cap of the RCA-6K7 i-f tube and chassis ground as shown typically by Figure 5. Tune the Oscillator to **460 kc.** and set its modulation switch to "On". Regulate its output until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph controls to give the desired number of cycles. Cause the image to stand still on the screen by manipulation of the frequency and synchronizing controls. Then carefully tune the two trimmers C-29 and C-30 of the second i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full Range Oscillator by means of the special shielded patch cord. Figure 5 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off". Change the timing control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then carefully shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become exactly coincident at their highest points. These curves will be found to occur at an Oscillator setting of *approximately 540 kc.* They will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with the above requirements and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-29 and C-30 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as in (c), change the Oscillator output to the control grid cap of the RCA-6L7 first detector tube. Then adjust the first i-f transformer trimmers C-24 and C-25 so that the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the overall tuning characteristic of the i-f system. Each trimmer of the entire group should then be checked to assure that it is in correct alignment as indicated by the degree of coincidence and relative amplitude of the image on the Oscillograph screen.

R-F Trimmer Adjustments

Locations of the various antenna, detector and oscillator coil trimmers are shown by Figure 6. The test Oscillator should be removed from connection with the i-f system and its output connected to the antenna-ground terminals of the receiver. No changes are to be made in the connections of the Oscillograph at the second detector. During the following adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Adherence to such a procedure will obviate the broadness of tuning that would result from a.v.c. action on a stronger signal. Proceed with the adjustments as follows:—

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning condenser plates are in full mesh (maximum capacitance). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the Band A scale.

Band A

(a) With the receiver range switch in its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the test Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector and antenna trimmers C-20, C-10 and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. After each trimmer has been peaked, the Oscillograph timing control should be set to "Ext." and the Frequency Modulator placed into operation with its connections to the Oscillator and Oscillograph made in accordance with Figure 5. Turn the modulation switch of the Oscillator to "Off" and retune the Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-20, C-10 and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the wave images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Place the modulation switch to "On". Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator (modulation "Off") until the two similar forward and reverse waves appear on the screen. For this adjustment, it is advisable to shift the Oscillator to its 200—400 kc. range and use the third harmonic of the generated signal in order to obtain the desired range of sweep. The oscillator series trimmer C-19 should then be adjusted to produce maximum amplitude of the images. No rocking will be necessary on the station selector inasmuch as the signal frequency is being "wobbled" by the Frequency Modulator to produce the same effect.

After completing this adjustment the trimmer C-20 should be re-aligned as in (a) to correct for any change brought about by the adjustment of C-19.

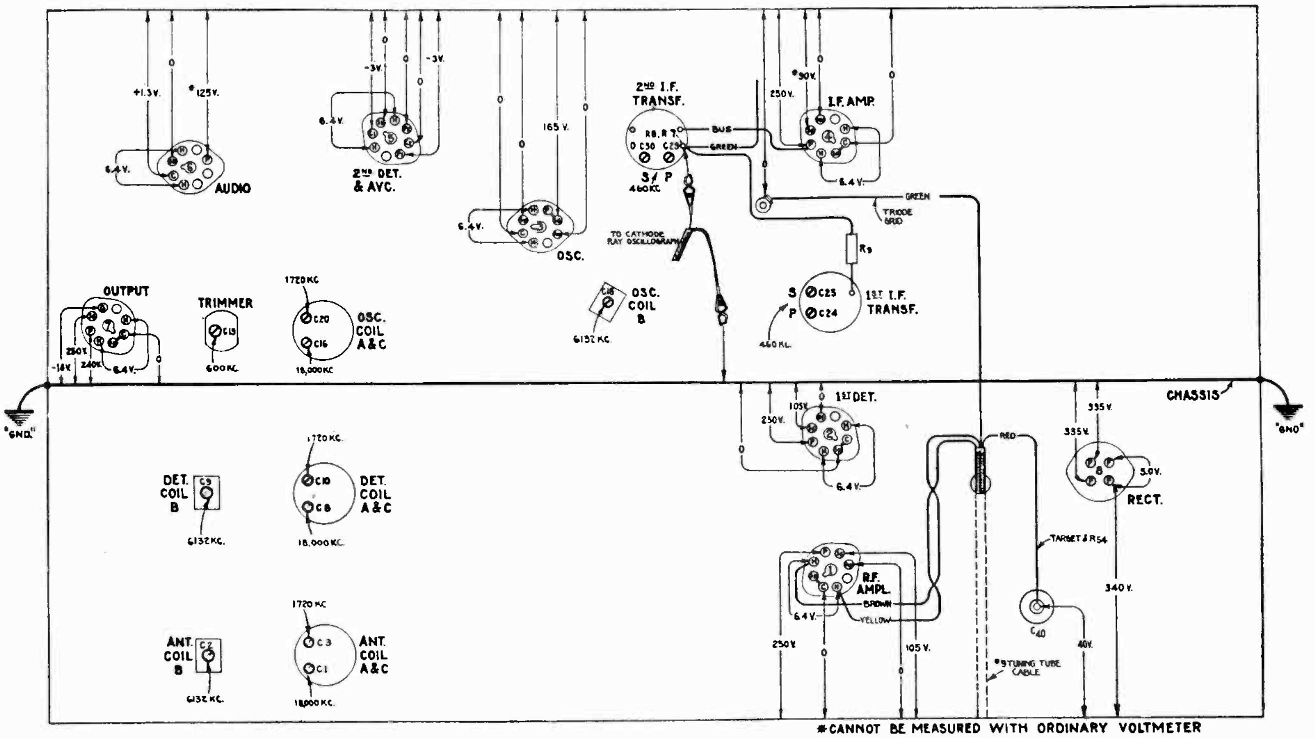


Figure 6—Trimmer Locations and Radiotron Socket Voltages

Measured at 115 volts A.C.—No Signal—Volume Control Maximum

Band B

(a) Advance the receiver range switch to its Band B position and tune the station selector to a dial reading of **6132 kc.** Set the test Oscillator to this same frequency (modulation "On" and Frequency Modulator disconnected) and increase its output until a suitable indication is apparent on the Oscillograph. The Oscillograph should be adjusted for "Int." timing. Then adjust the oscillator trimmer C-18 to the point at which maximum amplitude of the image is obtained. Two points will be found for this trimmer which give such a maximum. The one of least capacitance is correct and should be used. This can be checked by tuning the "image" signal, which will be received at **5212 kc.** on the dial if the adjustment of C-18 has been properly made. An increase in test Oscillator output may be necessary for this test, however, *its frequency should not be changed from* **6132 kc.** *nor any trimmer adjustments made on the receiver.*

(b) Return the station selector to the **6132 kc.** reading and align the detector, and antenna coil trimmers, C-9 and C-2 respectively, for maximum (peak) output as shown by the Oscillograph. No further adjustments are to be made on this band.

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to the same frequency (modulation "On" and Frequency Modulator disconnected) and regulate its output to the level required for convenient observation. Adjust the trimmer C-16 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of the proper "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of C-16 has been properly made using the position of least capacitance which gives maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, re-align C-16 if necessary, and then adjust the detector and antenna trimmers, C-8 and C-1, for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on this band.

(2) ALIGNMENT WITH OUTPUT METER

To align the receiver by means of an output indicator other than a Cathode-Ray Oscillograph will require the use of a standard test Oscillator such as that recommended above for the source of signals and means of indication for the output. The RCA Neon Output Indicator, Stock No. 4317 will be found very satisfactory for such use. It should be connected across the voice coil circuit of the loudspeaker or across the output transformer primary.

I-F Alignment

Connect the test Oscillator to the control grid cap of the i-f tube. Advance the volume control of the receiver to its full-on position. Tune the test Oscillator accurately to **460 kc,** and align the trimmers C-29 and C-30 to give maximum receiver output. Regulate the Oscillator output during this adjustment so that the output indi-

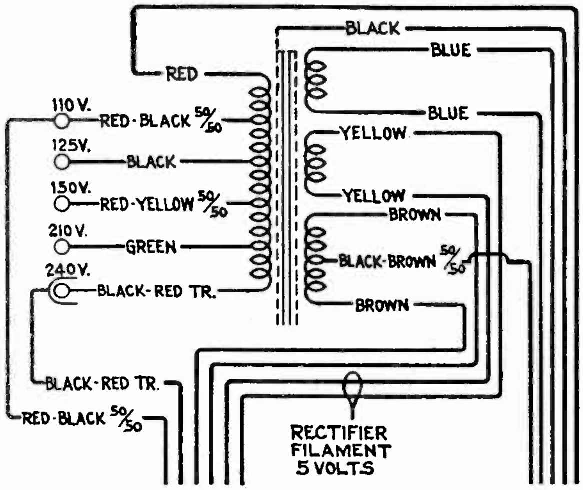


Figure 7—Universal Power Transformer Connections

Pri. Res.—10.3 Ohms, Total
Sec. Res.—383 Ohms, Total

cation is as small as can be conveniently observed. After completing the adjustments of these trimmers, re-connect the Oscillator so that it will feed into the control grid circuit of the RCA-6L7 first detector. Then tune the first i-f transformer trimmers C-24 and C-25 for maximum receiver output.

R-F Alignment

After completing the i-f adjustments, it is advisable to correct the line-up of the circuits ahead of the first detector. The test Oscillator should be connected to the antenna-ground terminals of the receiver and the manual volume control kept at its maximum position. For each adjustment the Oscillator output should be maintained as low as possible in order to avoid broadness of tuning which would result from a.v.c. action on a stronger signal. **Band A** should be aligned by supplying a **1720 kc.** signal to the receiver, tuning the station selector to a dial reading of **1720** and adjusting the trimmers C-20, C-10 and C-3 to produce maximum receiver output. The Oscillator should then be shifted to **600 kc.** and the receiver tuned to resonate this signal, disregarding the reading at which it is best received. Trimmer C-19 must then be adjusted, simultaneously while rocking the station selector backward and forward through the signal until the maximum output results from the combined operations. C-20 should be rechecked to assure that its adjustment has not changed because of the trimming of C-19. **Band B** must be aligned at **6132 kc.** by tuning the test Oscillator to such a frequency and turning the station selector to the same dial reading. Tune the trimmer C-18 to produce maximum receiver output, using the setting of least capacitance which causes same. The presence of the proper "image" may be checked by tuning the receiver to **5212 kc.** at which point the **6132 kc.** signal will be heard if the trimmer C-18 has been properly set to the position of least capacitance for maximum (peak) output. It may be necessary to increase the Oscillator output for this check. *No adjustments are to be made.* Return the station selector to the **6132 kc.** dial marking and trim capacitors C-9 and C-2 for maximum receiver output. No other adjustments are necessary on Band B. Change the receiver so that it is operative and the dial reads **18,000 kc.** on the **"C" Band.** Tune the test Oscillator to this same frequency. Then adjust the oscillator trimmer C-16 to produce maximum (peak) output. Two positions of this trimmer will be found which conform with this requirement. The one of least capacitance is correct. Check for the presence of "image" response at **17,080 kc.** by shifting the receiver tuning. If it is received at such a point, the trimmer C-16 has been correctly adjusted to the right peak. *No adjustments are to be made during this check.* Tune the receiver back to the **18,000 kc.** dial marking, re-adjust C-16 if necessary, and then tune the detector and antenna capacitors C-1 and C-8 for maximum receiver output. No further adjustments are necessary.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 6 will serve to assist in the location of causes for faulty operation. Each value as specified should hold within ± 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Universal Transformer

The transformer used on some models of these receivers is adaptable to several ranges of voltage as given under rating C of Electrical Specifications. Its schematic and wiring are shown by Figure 7. Terminals are provided at the top of the transformer case for changing the primary connections to suit the voltage being used.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers.

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4427	Bracket—Volume control or high frequency tone control mounting bracket	$0.18
5237	Bushing—Variable tuning condenser mounting bushing assembly—Package of 3	.43
11350	Cap—Contact cap—Package of 5	.20
11223	Capacitor—Adjustable capacitor (C19)	.46
11292	Capacitor—22 MMfd. (C7)	.24
11321	Capacitor—33 MMfd. (C33)	.26
11289	Capacitor—50 MMfd. (C11)	.26
11291	Capacitor—115 MMfd. (C21)	.24
5116	Capacitor—175 MMfd. (C35)	.18
4409	Capacitor—1120 MMfd. (C38)	.35
11288	Capacitor—1225 MMfd. (C17)	.30
11287	Capacitor—4500 MMfd. (C15)	.30
4868	Capacitor—0.005 Mfd. (C34, C44)	.20
4624	Capacitor—0.01 Mfd. (C32)	.54
4858	Capacitor—0.01 Mfd. (C37)	.25
5196	Capacitor—0.035 Mfd. (C43)	.18
4836	Capacitor—0.05 Mfd. (C4, C13, C26)	.30
4886	Capacitor—.05 Mfd. (C51)	.20
4885	Capacitor—0.1 Mfd. (C6, C12, C27)	.28
5170	Capacitor—0.25 Mfd. (C23, C28, C36, C50)	.25
11240	Capacitor—10 Mfd. (C39)	1.08
5212	Capacitor—18 Mfd. (C40)	1.16
11272	Clamp—Antenna cable clamp — Located near antenna terminal	.10

Stock No.	Description	List Price
5215	Coil—Antenna coil (A and C Bands)—(L1, L2, L5, L6, C1, C3)	$2.32
5245	Coil—Antenna coil (B Band)—(L3, L4, C2)	1.58
5216	Coil—Detector coil (A and C Bands)—(L7, L8, L11, L12, C8, C10)	2.34
5246	Coil—Detector coil (B Band)—(L9, L10, C9)	1.62
5217	Coil—Oscillator coil (A and C Bands)—(L13, L15, C16, C20)	2.20
5247	Coil—Oscillator coil (B Band)—(L14, C18)	1.44
11214	Condenser—3-gang variable tuning condenser (C5, C14, C22)	4.20
11238	Tone Control—High frequency tone control (R20)	.96
11237	Volume Control—(R11)	1.20
4340	Lamp—Dial lamp—Package of 5	.60
11710	Lead—Shield lead for antenna	.40
8041	Plate—R.F. or I.F. coil shield locking plate—Package of 2	.12
11244	Resistor—Voltage divider resistor, comprising one 7500 ohm and one 9200 ohm section—(R18, R19)	1.08
11329	Resistor—Voltage divider resistor, comprising one 148 ohm, one 32 ohm and one 85 ohm section—(R15, R16, R17)	.52
5112	Resistor—1000 ohm—Carbon Type — 1/4 Watt—(R2)—Package of 5	1.00

REPLACEMENT PARTS—CONT'D

Stock No.	Description	List Price
5114	Resistor—15,000 Ohm—Carbon Type—1 Watt—(R5)	$0.22
11300	Resistor—33,000 Ohm—Carbon Type—1/10 Watt—(R4)—Package of 5	.75
5033	Resistor—33,000 Ohm—Carbon Type—1 Watt—(R51)—Package of 5	1.10
11322	Resistor—39,000 Ohm—Carbon Type—1/4 Watt—(R10)—Package of 5	1.00
5029	Resistor—56,000 Ohm—Carbon Type—1/4 Watt—(R13)—Package of 5	1.00
3118	Resistor—100,000 Ohm—Carbon Type—1/4 Watt—(R1, R3, R6, R50)—Package of 5.	1.00
11323	Resistor—270,000 Ohm—Carbon Type—1/4 Watt—(R12)—Package of 5	1.00
11172	Resistor—470,000 Ohm—Carbon Type—1/4 Watt—(R14)—Package of 5	1.00
11151	Resistor—2.2 Megohms—Carbon Type—1/4 Watt—(R9, R52, R53)—Package of 5	1.00
5249	Shield—Antenna, detector or oscillator coil shield	.20
5250	Shield—Intermediate frequency transformer shield	.22
11273	Shield—Rectifier Radiotron shield	.25
11222	Socket—Dial lamp socket	.18
4794	Socket—4-contact rectifier Radiotron socket.	.15
11313	Socket—5-contact Radiotron socket	.18
11198	Socket—7-contact Radiotron socket	.15
11236	Switch—Band switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11)	2.44
11133	Switch—Power switch—(S12)	.62
5238	Terminal—Antenna terminal clip assembly.	.14
11216	Transformer—First intermediate frequency transformer (L16, L17, C24, C25)	2.15
11239	Transformer—Second intermediate frequency transformer—(L18, L19, C29, C30, C31, R7, R8)	2.72
11330	Transformer—Power transformer—105-125 volts—50-60 cycles (T1)	5.52
11242	Transformer—Power transformer—105-125 volts—25-60 cycles	6.52
11243	Transformer—Power transformer—100-130, 140-160, 195-250 volts—40-60 cycles	4.64
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—comprising drive shaft, balls, ring, spring and washers—assembled	1.00
11328	Dial—Dial scale	.68
11252	Drive—Variable tuning condenser drive assembly	1.88
4520	Indicator—Station selector indicator pointer.	.18
11226	Indicator—Band indicator pointer assembly comprising indicator pointer, arm, link and stud	.20
3993	Screw—No. 6-32-5/32" square head set screw for band indicator operating arm—Package of 10	.25

Stock No.	Description	List Price
4669	Screw—No. 8-32-5/32" set screw for variable condenser drive assembly—Package of 10	$0.25
4377	Spring—Band indicator operating arm spring—Package of 5	.25
4378	Stud—Band indicator operating arm stud and nut assembly—Package of 5	.25
	MISCELLANEOUS ASSEMBLIES	
11191	Bracket—Tuning Lamp mounting bracket—Less Clamp 11192	.12
11331	Cable—Tuning Lamp Cable—Complete with socket	1.28
11192	Clamp—Tuning Lamp Mounting Clamp—Less Bracket 11191	.12
11276	Escutcheon—Tuning Lamp Escutcheon	.40
11337	Escutcheon—Station selector escutcheon	.70
6614	Glass—Station selector dial glass	.30
11346	Knob—Station selector knob—Package of 5.	.75
11347	Knob—Volume control, tone control, range switch or power switch knob—Package of 5	.75
11246	Foot—Chassis mounting foot and bracket assembly—Package of 2	.76
11382	Resistor—1 Megohm—Carbon Type—1/10 Watt—(R54)—Package of 5	.75
4678	Ring—Spring retaining ring for dial glass—Package of 5	.34
5210	Screw—Chassis mounting screw assembly—Package of 4	.16
11348	Screw—No. 8-32-7/16" headless cupped point set screw for knob, stock #11346—Package of 10	.32
11381	Socket—Tuning Lamp Socket and Cover	.45
11349	Spring—Retaining spring for knob, stock #11347—Package of 5	.15
	REPRODUCER ASSEMBLIES	
11232	Board—Terminal board assembly with two lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut.	.16
8060	Bracket—Output transformer mounting bracket	.14
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
11254	Coil—Field coil—L20	2.00
11233	Coil—Hum neutralizing coil—L21	.30
11258	Cone—Reproducer cone—L22—Package of 5	3.85
5118	Connector—3-contact male connector for reproducer	.25
5119	Connector—3-contact female connector plug for reproducer cable	.25
9619	Reproducer—Complete	6.05
11253	Transformer—Output transformer—T2	1.56
11230	Washer—"Binders board" "C" washer used to hold field coil assembly	.18

RCA VICTOR MODELS C 9-6 and T 9-9

Nine-Tube, Three-Band, A-C, Superheterodyne Receivers

SERVICE NOTES

Electrical Specifications

Frequency Ranges

Band X	140 kc.— 410 kc.
Band A	540 kc.— 1,800 kc.
Band C	5,700 kc.—18,000 kc.

Alignment Frequencies

Band X	150 kc. (osc.), 400 kc. (osc., ant., det.)
Band A	600 kc. (osc.), 1,720 kc. (osc., ant., det.)
Band C	18,000 kc. (osc., ant., det.)

Intermediate Frequency .... **460 kc.**

Radiotron Complement

(1) RCA-6K7..........Radio-Frequency Amplifier
(2) RCA-6L7..........First Detector
(3) RCA-6J7..........Heterodyne Oscillator
(4) RCA-6K7..........Intermediate Amplifier
(5) RCA-6H6..........Second Detector and A.V.C.
(6) RCA-6F5..........Audio Amplifier
(7) RCA-6F6..........Power Output Amplifier
(8) RCA-5Z3..........Full Wave Rectifier
(9) RCA-6E5..........Tuning Indicator

Power Supply Ratings

Rating A	105—125 volts, 50—60 cycles, 105 watts
Rating B	105—125 volts, 25—60 cycles, 105 watts
Rating C	100—130/140—160/195—250 volts, 40—60 cycles, 105 watts

Loudspeaker

Type	Electrodynamic
Voice Coil Impedance	2¼ Ohms at 400 Cycles

Power Output Ratings

Undistorted	2 Watts
Maximum	4½ Watts

Mechanical Specifications

	Model C 9-6	Model T 9-9
Height	40 inches	22$\frac{13}{16}$ inches
Width	26 inches	16½ inches
Depth	12½ inches	11⅞ inches
Weight (Net)	55 pounds	39 pounds
Weight (Shipping)	72 pounds	50 pounds

Chassis Base Dimensions .... 14½ inches x 9 inches x 3½ inches

General Features

These two models each employ the same nine-tube chassis. The table model (T 9-9) uses an 8-inch dynamic speaker and the console model (C 9-6) uses an improved 12-inch dynamic speaker.

Metal Tubes

The new metal tubes are used in the radio receiver for amplifying and detecting purposes. These tubes make possible a greater range of stable amplification not previously attainable with corresponding glass types. Their metal envelopes form a perfect electrostatic and electromagnetic shield, precluding the former necessity for elaborate shielding by means of cans. The metal tubes are especially adaptable to the modern, extended-range receivers because of their efficient shielding and their favorable internal characteristics.

Dial Drive

An open face airplane-type of dial is used. Each scale has a band of color adjacent to its graduations and three short strips of corresponding colors at the lower part of the dial for index purposes. An index pointer, which moves as the band switch is rotated, points to one of these colors to identify the band in use. The drive mechanism is variable, there being either a 50-to-1 or 10-to-1 ratio available between the tuning knob and condenser drive shaft.

Tuning Indicator

A cathode-ray tube is used as a means of visually indicating when the receiver is accurately tuned to the incoming signal. This tube is of new design and comprises an amplifier section and a cathode-ray section built in the same glass envelope. The cathode-ray section consists of a conically shaped luminescent screen, upon which a pattern is formed by an effect of the detected signal after said effect has been amplified by the amplifier section which is fed from the detector diode circuit. The size of the patterns is determined by the strength of the signal voltage, so that any change of tuning may be readily observed in order to facilitate tuning to exact resonance.

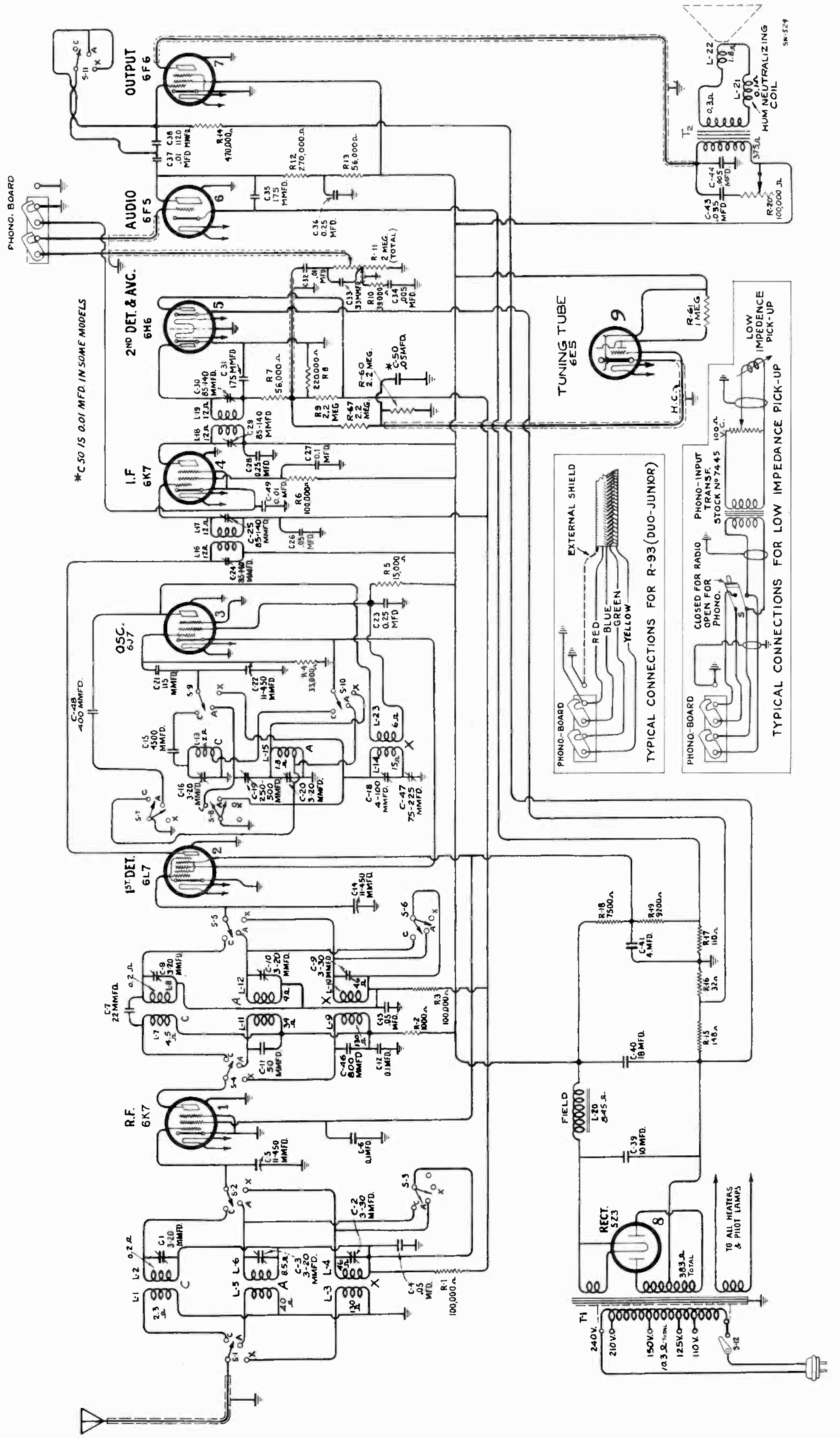


Figure 1—Schematic Circuit Diagram

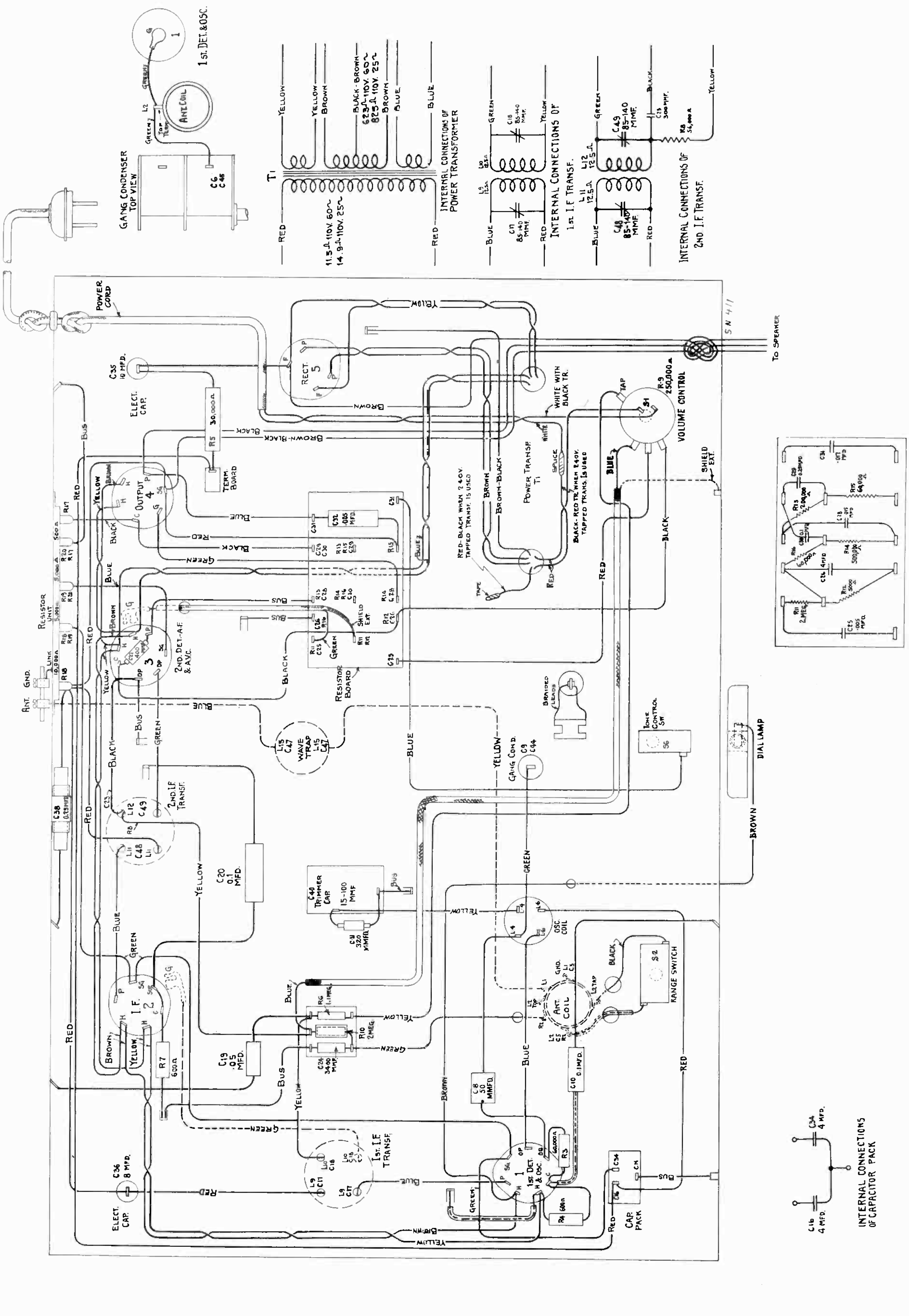


Figure 2—Chassis Wiring Diagram

CIRCUIT FEATURES

The circuit is based upon the Superheterodyne principle. The three ranges of tuning are covered by three sets of coils. A single r-f stage provides the desired selectivity and gain ahead of the hexode first-detector tube. The oscillator stage operates separately from the first detector. A single stage i-f system is employed. Its basic frequency is 460 kc. Diode detection is performed by a double diode RCA-6H6 Radiotron. Automatic volume control is provided by

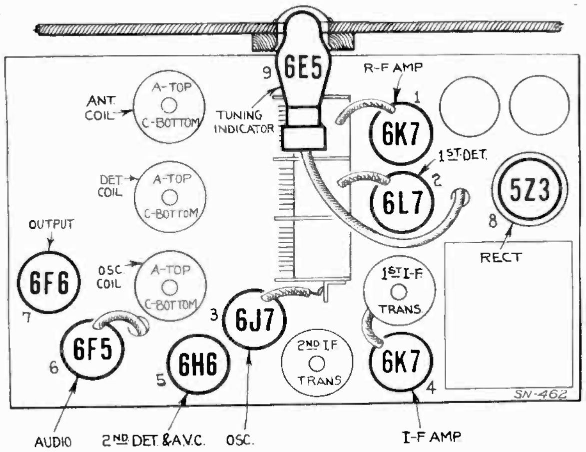


Figure 3—Radiotron and Coil Locations

this same tube. The audio system consists of two stages, the driver, an RCA-6F5, and the output, an RCA-6F6. High voltages for plate, screen, and bias supplies are obtained from an RCA-5Z3 full-wave rectifier through an efficient filter. The field of the loudspeaker acts as a reactor in the filter circuit. Further details of the circuit are as follows:

Oscillator

The oscillator circuit has extreme stability of frequency and good uniformity of output over the tuning ranges. These qualities assure that the tuning of the receiver will not drift as the line voltage varies. The action of the circuit is such that when the cathode emission tends to change with line voltage or because of other reasons, the variation of voltage drop in the plate and screen resistor restores the operating characteristics of the tube to normal and thus maintains constancy of the generated signal.

First Detector

This stage has unusually good high frequency mixing efficiency. The tube used, an RCA-6L7, is a new hexode type. The signal is supplied to the first control-grid and the oscillator voltage is fed in on a second control-grid, a screen-grid separating the two. The arrangement of the grids prevents degenerative difficulties, particularly at the higher frequencies. The second grid is direct-connected to the cathode of the oscillator and has no d-c bias.

Compensated Volume Control

The variation in response of the human ear with different degrees of volume is compensated for by a resistor and condenser network in the manual volume control circuit. The volume control itself is an acoustically tapered potentiometer which provides equal changes of sound intensity for the listener per degree of rotation.

Range Switch

The band-change switch has several functions. It exchanges the antenna, detector, and oscillator coils in order to select the range desired. At the same time, it shorts out the unused coils so as to eliminate their absorptive effects. It also varies the fidelity by shorting a coupling condenser in the audio system to provide the desired reproduction for short-wave as well as long-wave reception.

Tone Control

Provision is included for variable reduction of high frequencies. This consists of a resistor and condenser combination across the primary winding of the output transformer, the resistor being the variable element. As it is decreased, the high-frequency response limit is lowered.

Power System

The power transformer has its primary winding capacitively shielded from its secondary windings to eliminate transfer of line disturbances into the receiver and to stop any tendency for the circuit to radiate into the line. Rectification is performed in the usual manner by a full-wave tube.

Detection and A.V.C.

The modulated signal as obtained from the output of the i-f system is detected by an RCA-6H6 twin diode tube. The audio frequency secured by this process is passed on to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal is used for automatic volume control. This voltage, which develops across resistor R-8, is applied as automatic control-grid bias to the r-f, first-detector, and i-f tubes through suitable resistance-capacitance filter circuits. The second diode of the RCA-6H6 is used to supply residual bias for these controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current, which flows through R-9 and R-8, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed for servicing the receiver. The ratings of all resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. The coils, reactors, and transformer windings are rated in terms of their d-c resistances only. Ratings of less than one ohm are generally omitted. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and replacement parts.

Alignment Procedure

The extensive frequency range of this receiver necessitates a more or less involved method of alignment. However, if the following directions are carefully applied, the normal performance of the instrument will be obtained.

Correct performance of the receiver can only be obtained when the trimmer adjustments have been made by a skilled service man with the use of adequate and reliable test equipment. Such apparatus as may be required for this particular instrument is illustrated and described on a separate page of this booklet.

Two methods of alignment are applicable. One utilizes a Cathode-Ray Oscillograph as a means of output indication and the other follows former procedure where a glow type indicator or meter is used. The oscillographic method is much to be preferred, since greater accuracy is possible from the type of indication afforded. There are no approximations necessary as with the meter or aural method, but each adjustment can be made with excellent precision. Both methods are hereinafter outlined so that alignment operations may be made according to the equipment available.

It is wise to determine the necessity for alignment as well as the direction of misalignment before making adjustments. The RCA Tuning Wand is an instrument designed particularly for such a purpose.

The Tuning Wand consists of a bakelite rod having a small brass cylinder at one end and a core of finely divided iron at the other. It may be inserted into a tuned coil while a signal of the normal resonant frequency is being supplied to such coil to obtain an indication of the tuning. Holes are provided at the top of the r-f shield cans for entrance of the Wand. The presence of either end of the Wand will cause a change in tuning which will be indicated at the receiver output as an increase or decrease in signal level. If there is a decrease of output when either end is inserted, the tuning is correct and will require no adjustment. However, should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output while the iron end causes a decrease, reduction of inductance will be necessary to place the circuit in alignment. This is equivalent to decreasing the trimmer concerned. The following tabulation gives the various changes and the adjustments required:

WAND	SIGNAL	TRIMMER
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

CATHODE-RAY ALIGNMENT

Equipment

A standard source of the specified alignment frequencies is required. Such a source should consist of an **RCA Full Range Oscillator, Stock No. 9595.** Output indication should be by means of an **RCA Stock No. 9545 Cathode-Ray Oscillograph.** An **RCA Stock No. 9558 Frequency Modulator** will be needed to sweep the generated signal and synchronize it with the Oscillograph in order to make possible the visual representation of the resonant characteristic of the circuit being tuned on the cathode-ray fluorescent screen.

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 6. Each must be aligned to a basic frequency of **460 kc.** The last transformer must be aligned firstly and the first transformer aligned secondly. For such a process, it is necessary to feed the output of the Full-Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each transformer and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The proper point of connection of the Oscillograph is with its vertical "high" input terminal attached to the junction of R-7, R8 and R9 as illustrated in Figure 6, and with the "0" or ground terminal to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as shown by Figure 4. A .001 mfd. capacitor installed in series with the Oscillator "Ant." lead will prevent the voltages of the stage under alignment from becoming upset. The vertical "A" amplifier should be "On" for the ensuing adjustments and the gain control kept at its maximum position. For each adiustment, the Oscillator output need be regulated so that the image obtained on the

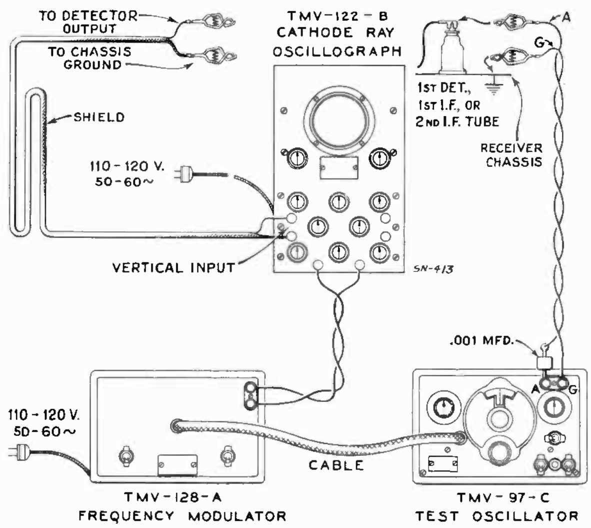


Figure 4—Alignment Apparatus Connections

Oscillograph screen will be of sufficient size as to be accurately observable. Proceed further as follows:

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver range switch to Band "A" and tune the station selector to a point where no interference will be picked up, shorting the antenna and ground terminals if necessary. Set the Oscillograph horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a straight line trace completely across the screen. Place the timing control to "Int." Adjust the intensity and focusing controls of the Oscillograph to produce the correct size and strength of the spot.

(b) Attach the output of the test Oscillator between the control grid cap of the RCA-6K7 i-f tube and chassis ground as shown typically by Figure 4. Tune the Oscillator to **460 kc.** and set its modulation switch to "On". Regulate its output until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph controls to give the desired number of cycles. Cause the image to stand still on the screen by manipulation of the frequency and synchronizing controls. Then carefully tune the two trimmers **C-29** and **C-30** of the second i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition the transformer will be sharply resonated to **460 kc.**

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full-Range Oscillator by means of the special shielded patch cord. Figure 4 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off". Change the timing control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then carefully shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become exactly coincident at their highest points. These curves will be found to occur at an Oscillator setting of ***approximately*** **540 kc.** They will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with the above requirements and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers **C-29** and **C-30** should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as in (c), change the Oscillator output to the control-grid cap of the RCA-6L7 first-detector tube. Then adjust the first i-f transformer trimmers **C-24** and **C-25** so that the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the overall tuning characteristic of the i-f system. Each trimmer of the entire group should then be checked to assure that it is in correct alignment as indicated by the degree of coincidence and relative amplitude of the image on the Oscillograph screen.

R-F Trimmer Adjustments

Locations of the various antenna, detector and oscillator coil trimmers are shown by Figure 6. The test Oscillator should be removed from connection with the i-f system and its output connected to the antenna-ground terminals of the receiver. No changes are to be made in the connections of the Oscillograph at the second detector. During the following

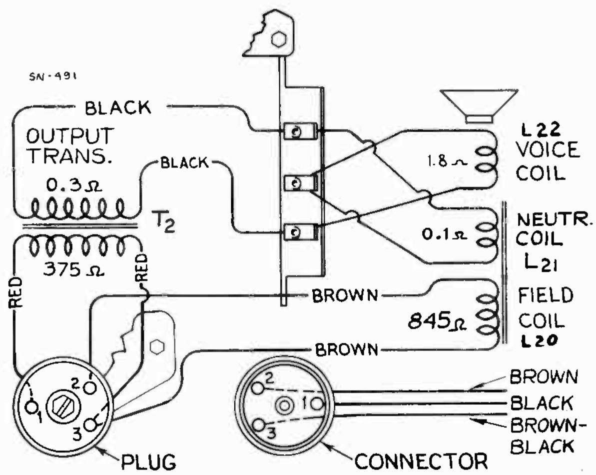


Figure 5—Loudspeaker Wiring

adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Adherence to such a procedure will obviate the broadness of tuning that would result from a.v.c. action on a stronger signal. Proceed with the adjustments as follows:

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning condenser plates are in ***full mesh*** (maximum capacitance). Then move the main dial pointer until it points exactly to the ***horizontal*** line at the low frequency end of the Band A scale.

Band A

(a) With the receiver range switch in its Band A position, tune the station selector until the dial pointer is at a reading of **1,720 kc.** Adjust the test Oscillator to **1,720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector, and antenna trimmers **C-20, C-10** and **C-3** respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the

Oscillograph on "Int." for this operation. After each trimmer has been peaked, the Oscillograph timing control should be set to "Ext." and the Frequency Modulator placed into operation with its connections to the Oscillator and Oscillograph made in accordance with Figure 4. Turn the modulation switch of the Oscillator to "Off" and retune the Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers **C-20, C-10** and **C-3** again, setting each to the point which produces the best coincidence and maximum amplitude of the wave images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Place the modulation switch to "On". Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator (modulation "Off") until the two similar forward and reverse waves appear on the screen. For this adjustment, it is advisable to shift the Oscillator to its 200—400 kc. range and use the third harmonic of the generated signal in order to obtain the desired range of sweep. The oscillator series trimmer **C-19** should then be adjusted to produce maximum amplitude of the images. No rocking will be necessary on the station selector inasmuch as the signal frequency is being "wobbled" by the Frequency Modulator to produce the same effect.

After completing this adjustment, the trimmer **C-20** should be realigned as in (a) to correct for any change brought about by the adjustment of **C-19.**

Band X

(a) Disconnect the Frequency Modulator and tune the test Oscillator to a frequency of **400 kc.** (Modulation "On"). Place the receiver range switch to its Band X position and tune the station selector until the dial pointer reads exactly **400 kc.** Adjust the Oscillograph timing control to "Int." Then align each of the trimmers **C-18, C-9** and **C-2** to the point producing maximum output at the Oscillograph. Place the Frequency Modulator in operation and attach it to the test Oscillator by means of the shielded cable. Change the Oscillograph timing to "Ext." Increase the frequency of the Oscillator (Modulation "Off") until the two forward and reverse waves appear and become coincident at their highest point, ***approximately at* 462 *kc.*** These waves may be made to remain stationary on the screen by manipulation of the Oscillograph range switch (No. 2 position) and frequency control (mid-position). Readjust the three trimmers **C-18, C-9** and **C-2** to give maximum amplitude and complete coincidence of the waves.

(b) Change the test Oscillator so that it delivers a signal of **150 kc.** with the Frequency Modu-

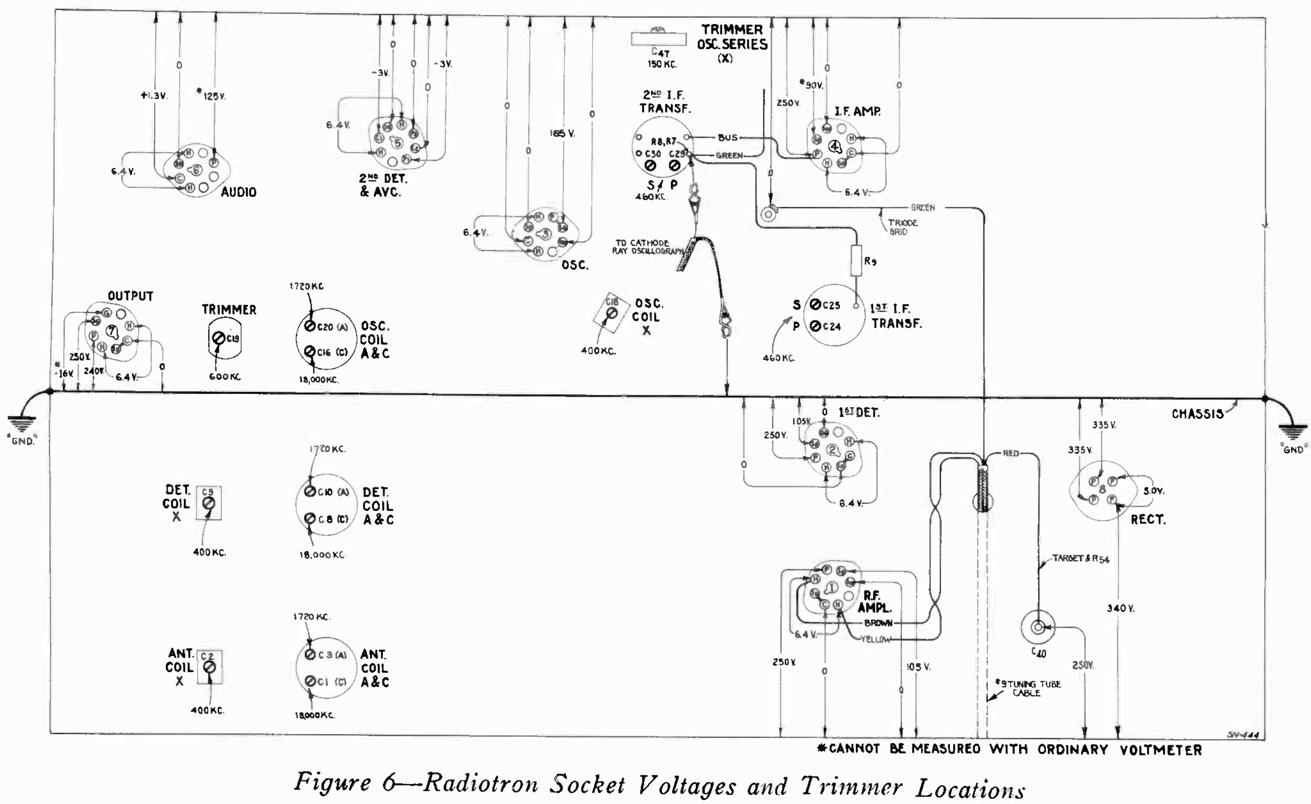


Figure 6—Radiotron Socket Voltages and Trimmer Locations

Measured at 115 volts, 60 cycle supply—No signal being received

lator disconnected. Tune this signal on the receiver, which should be set to the Band X setting, disregarding the dial reading at which the signal is best received. Then interconnect the Frequency Modulator with the Oscillator and retune the latter to the point at which the two similar waves appear on the screen. Adjust the trimmer **C-47** for maximum amplitude of the wave images. Rocking of the tuning condenser will not be necessary for this operation as such is duplicated by the Frequency Modulator. Repeat the alignment of **C-18** as in (a) to correct for any error brought about by the adjustment of **C-47.**

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to **18,000 kc.** (modulation "On" and Frequency Modulator disconnected) and regulate its ouput to the level required for convenient observation. Adjust the trimmer **C-16** to the point producing maximum output as indicated on the Oscillograph. Check for the presence of the proper "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of **C-16** has been properly made using the position of least capacitance which gives maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". ***No adjustments should be made during this check.***

(b) Return the receiver tuning to **18,000 kc.**, realign **C-16** if necessary, and then adjust the detector and antenna trimmers, **C-8** and **C-1**, for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on this band.

OUTPUT INDICATOR ALIGNMENT

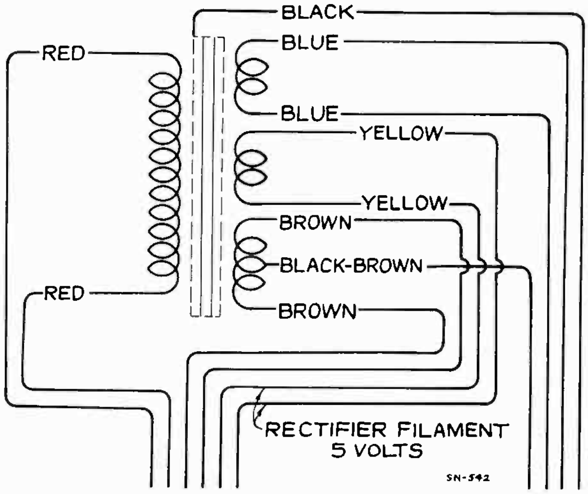
To align the receiver by means of an output indicator other than a Cathode-Ray Oscillograph will require the use of a standard test Oscillator such as that recommended above for the source of signals and means of indication for the output. The **RCA Neon Output Indicator, Stock No.** 4317 will be found very satisfactory for such use. It should be connected across the voice coil circuit of the loudspeaker or across the output transformer primary.

I-F Alignment

Connect the test Oscillator to the control-grid cap of the i-f tube. Advance the volume control of the receiver to its full-on position. Tune the test Oscillator to **460 kc.** and align the trimmers **C-29** and **C-30** to give maximum receiver output. Regulate the Oscillator output during this adjustment so that the output indication is as small as can be conveniently observed. After completing the adjustments of these trimmers, reconnect the Oscillator so that it will feed into the control-grid circuit of the RCA-6L7 first detector. Then tune the first i-f transformer trimmers **C-24** and **C-25** for maximum receiver output.

R-F Alignment

After completing the i-f adjustments, it is advisable to correct the line-up of the circuits ahead of the first detector. The test Oscillator should be connected to the antenna-ground terminals of the receiver and the manual volume control kept at its maximum position. For each adjustment the Oscillator output should be maintained as low as possible in order to avoid broadness of tuning which would



Pri. Res.—8.0 ohms, total
Sec. Res.—670 ohms, total

Figure 7—Standard Power Transformer Connections

result from a.v.c. action on a stronger signal. **Band A** should be aligned by supplying a **1,720 kc.** signal to the receiver, tuning the station selector to a dial reading of **1,720** and adjusting the trimmers **C-20, C-10** and **C-3** to produce maximum receiver output. The Oscillator should then be shifted to **600 kc.** and the receiver tuned to resonate this signal, disregarding the reading at which it is best received. Trimmer **C-19** must then be adjusted, simultaneously while rocking the station selector backward and forward through the signal until the maximum output results from the combined operations. **C-20** should be rechecked to assure that its adjustment has not changed because of the trimming of **C-19. Band X** must be aligned at **400 kc.** and **150 kc.** Tune the test Oscillator to **400 kc.** and turn the receiver dial to the same reading. Adjust trimmers **C-18, C-9** and **C-2** for maximum (peak) receiver output. Then shift the Oscillator to **150 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Adjust trimmer **C-47,** simultaneously rocking the tuning condenser backward and forward through the signal, until maximum receiver output results from the combined operations. Repeat the alignment of **C-18** as above to correct for any change which may have been caused by the adjustment of **C-47.** Change the receiver so that it is operative and the dial reads **18,000 kc.** on the **"C" Band.** Tune the test Oscillator to **18,000 kc.** Then adjust the oscillator trimmer **C-16** to produce maximum (peak) output. Two positions of this trimmer will be found which conform with this requirement. The one of least capacitance is correct. Check for the presence of "image" response at **17,080 kc.** by shifting the receiver tuning. If it is received at such a point, the trimmer **C-16** has been correctly adjusted to the right peak. ***No adjustments are to be made during this check.*** Tune the receiver back to the **18,000 kc.** dial marking, readjust **C-16** if necessary, and then tune the detector and antenna capacitors **C-1** and **C-8** for maximum receiver output. No further adjustments are necessary.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 6 will serve to assist in the location of causes for faulty operation. Each value as specified should hold within ± 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1,000-ohms-per-volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Standard Transformer

The transformer used on some models of this instrument is adaptable for voltages and frequencies as given under Ratings A and B of Electrical Specifications. Its schematic and wiring are shown by Figure 7.

Phonograph Attachment

A terminal board is provided for connecting a phonograph attachment into the audio amplifying circuit. Two typical methods of connection are shown on the schematic diagram, Figure 1. The radio volume control must be set to minimum when using phonograph.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	DESCRIPTION	List Price
	RECEIVER ASSEMBLIES	
11698	Board—Three-terminal phonograph terminal board	$0.22
4427	Bracket—Volume control or high-frequency tone control mounting bracket	.18
5237	Bushing—Variable tuning condenser mounting bushing assembly—Package of 3	.43
11350	Cap—Contact cap—Package of 5	.20
11223	Capacitor—Adjustable capacitor (C19)	.46
11256	Capacitor—Adjustable capacitor (C-47)	.48
11292	Capacitor—22 MMfd. (C7)	.24
11321	Capacitor—33 MMfd. (C33)	.26
11289	Capacitor—50 MMfd. (C11)	.26
11291	Capacitor—115 MMfd. (C21)	.24
5116	Capacitor—175 MMfd. (C35)	.18
11290	Capacitor—400 MMfd. (C48)	.25
11269	Capacitor—800 MMfd. (C46)	.30
4409	Capacitor—1120 MMfd. (C38)	.35
11287	Capacitor—4500 MMfd. (C15)	.30
4868	Capacitor—.005 Mfd. (C34)	.20
4838	Capacitor—.005 Mfd. (C44)	.20
4624	Capacitor—.01 Mfd. (C32)	.54
4858	Capacitor—.01 Mfd. (C37, C49)	.25
5196	Capacitor—.035 Mfd. (C43)	.18
4886	Capacitor—.05 Mfd. (C50)	.20
4836	Capacitor—.05 Mfd. (C4, C13, C26)	.30
4885	Capacitor—0.1 Mfd. (C6, C12, C27)	.28
5170	Capacitor—0.25 Mfd. (C23, C28, C36)	.25
11248	Capacitor—4 Mfd. (C41)	1.06
11240	Capacitor—10 Mfd. (C39)	1.08
5212	Capacitor—18 Mfd. (C40)	1.16
11272	Clamp—Antenna cable clamp—Located near antenna terminal	.10
4748	Clamp—Capacitor mounting clamp assembly—for Stock No. 11248	$0.15
5215	Coil—Antenna coil (A and C Bands)—(L1, L2, L5, L6, C1, C3)	2.32
11325	Coil—Antenna coil (X Band)—(L3, L4, C2)	1.56
5216	Coil—Detector coil (A and C Bands)—(L7, L8, L11, L12, C8, C10)	2.34
11326	Coil—Detector coil (X Band)—(L9, L10, C9)	1.60
5217	Coil—Oscillator coil (A and C Bands)—(L13, L15, C16, C20)	2.20
11327	Coil—Oscillator coil (X Band)—(L14, L23, C18)	1.44
11214	Condenser—Three-gang variable tuning condenser (C5, C14, C22)	4.20
11697	Cover—Phonograph terminal board cover	.12
4340	Lamp—Dial lamp—Package of 5	.60
8041	Plate—R.F. or I.F. coil shield locking plate—Package of 2	.12
11244	Resistor—Voltage divider resistor, comprising one 7500-ohm and one 9200-ohm sections (R18, R19)	1.08
11245	Resistor—Voltage divider resistor, comprising one 148-ohm, one 32-ohm, and one 110-ohm section (R15, R16, R17)	.62
5112	Resistor—1000 Ohm—Carbon type—¼ Watt—(R2)—Package of 5	1.00
5114	Resistor—15,000 Ohm—Carbon type—1 Watt—(R5)	.22
11300	Resistor—33,000 Ohm—Carbon type—1/10 Watt—(R4)—Package of 5	.75

The prices quoted above are subject to change without notice.

REPLACEMENT PARTS—Continued

Stock No.	DESCRIPTION	List Price
11322	Resistor—39,000 Ohm—Carbon type—¼ Watt—(R10)—Package of 5	$1.00
5029	Resistor—56,000 Ohm—Carbon type—¼ Watt—(R13)—Package of 5	1.00
3118	Resistor—100,000 Ohm—Carbon type—¼ Watt—(R1, R3, R6)—Package of 5	1.00
11323	Resistor—270,000 Ohm—Carbon type—¼ Watt—(R12)—Package of 5	1.00
11172	Resistor—470,000 Ohm—Carbon type—¼ Watt—(R14)—Package of 5	1.00
11151	Resistor—2.2 Megohms—Carbon type—¼ Watt—(R9, R60, R67)—Package of 5	1.00
5249	Shield—Antenna, detector, or oscillator coil shield	.20
5250	Shield—I.F. transformer shield	.22
11273	Shield—Rectifier Radiotron shield	.25
11222	Socket—Dial lamp socket	.18
4794	Socket—Four-contact rectifier Radiotron socket	.15
11313	Socket—Five-contact Radiotron socket	.18
11198	Socket—Seven-contact Radiotron socket	.15
11236	Switch—Band switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11)	2.44
11133	Switch—Power switch (S12)	.62
5238	Terminal—Antenna terminal clip assembly	.14
11238	Tone Control—High-frequency tone control (R20)	.96
11216	Transformer—First intermediate frequency transformer (L16, L17, C24, C25)	2.15
11239	Transformer—Second intermediate frequency transformer (L18, L19, C29, C30, C31, R7, R8)	2.72
11242	Transformer—Power transformer—105-125 Volts—25-60 Cycles	6.52
11243	Transformer—Power transformer—100-130, 140-160, 195-250 Volts—40-60 Cycles—(T1)	4.64
11237	Volume control (R11)	1.20
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—comprising drive shaft, balls, ring, spring and washers—assembled	1.00
11262	Dial—Dial scale	.60
11252	Drive—Variable tuning condenser drive assembly	1.88
4520	Indicator—Station selector indicator pointer	.18
11226	Indicator—Band indicator pointer assembly—comprising indicator pointer, arm, link and stud	.20
3993	Screw—No. 6-32-5/32″ square head set-screw for band indicator operating arm—Package of 10	.25
4669	Screw—No. 8-32-5/32″ set-screw for variable condenser drive assembly—Package of 10	.25
4377	Spring—Band indicator operating arm spring—Package of 5	.25
4378	Stud—Band indicator operating arm stud and nut assembly—Package of 5	.25

Stock No.	DESCRIPTION	List Price
	REPRODUCER ASSEMBLIES	
11232	Board—Terminal board assembly with two lead wire clips	$0.18
11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Output transformer mounting bracket	.14
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
11254	Coil—Field coil (L20)	2.00
11233	Coil—Neutralizing coil (L21)	.30
11235	Cone—Reproducer cone (L22)—Package of 5 (table model)	3.50
11258	Cone—Reproducer cone (L22)—Package of 5 (console model)	3.85
5119	Connector—Three-contact female connector plug for reproducer cable	.25
5118	Connector—Three-contact male connector for reproducer	.25
9618	Reproducer—Complete (table model)	6.40
9619	Reproducer—Complete (console model)	6.05
11253	Transformer—Output transformer (T2)	1.56
11230	Washer—"Binder's board" "C" washer—Used to hold field coil securely—Package of 5	.18
	MISCELLANEOUS ASSEMBLIES	
11729	Bolt—Reproducer mounting bolt assembly—Comprising one bolt, one washer, one lockwasher and one nut—Package of 2 (table model)	.20
11191	Bracket—Tuning tube mounting bracket—less clamp	.12
11319	Cable—Tuning tube cable complete with socket (table model)	1.38
11331	Cable—Tuning tube cable complete with socket (console model)	1.28
11192	Clamp—Tuning tube mounting clamp—less bracket	.12
11276	Escutcheon—Radiotron tuning tube escutcheon	.40
11337	Escutcheon—Station selector escutcheon	.70
11246	Foot—Chassis mounting foot and bracket assembly—Package of 2	.76
6614	Glass—Station selector dial glass	.30
11347	Knob—Volume control, tone control, range switch or power switch knob—Package of 5	.75
11346	Knob—Station selector knob—Package of 5	.75
11382	Resistor—1 Megohm—Carbon type—1/10 Watt—(R61)—Package of 5	.75
4678	Ring—Retaining ring for station selector dial glass—Package of 5	.34
5210	Screw—Chassis mounting screw assembly—Package of 4 (console model)	.16
11377	Screw—Chassis mounting screw assembly—Comprising one screw, one washer and one lockwasher—Package of 4 (table model)	.12
11348	Screw—No. 8-32-7/16″ Headless cupped point set screw for knob, Stock No. 11346—Package of 10	.32
11381	Socket—Tuning tube socket and cover	.45
11349	Spring—Retaining spring for knob—Stock No. 11347—Package of 5	.15

The prices quoted above are subject to change without notice.

RCA VICTOR MODEL C 11-1

Eleven-Tube, Three-Band, A-C, Superheterodyne, Console Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Frequency Ranges

Band A .... 540 kc.— 1800 kc.
Band B .... 1800 kc.— 6000 kc.
Band C .... 6000 kc.—18000 kc.

Alignment Frequencies

Band A.....600 kc. (osc.), 1720 kc. (osc., ant., det.)
Band B..................6132 kc. (osc., ant., det.)
Band C..................18000 kc. (osc., ant., det.)

Radiotron Complement

(1) RCA-6K7...........Radio-Frequency Amplifier
(2) RCA-6L7.....................First Detector
(3) RCA-6J7...............Heterodyne Oscillator
(4) RCA-6K7..............Intermediate Amplifier
(5) RCA-6H6........Second Detector and A.V.C.
(6) RCA-6C5..............First Audio Amplifier
(7) RCA-6C5.............Audio Driver Amplifier
(8) RCA-6F6............Power Output Amplifier
(9) RCA-6F6............Power Output Amplifier
(10) RCA-5Z3................Full Wave Rectifier
(11) RCA-6E5 ....Tuning Indicator

Power Ratings

Rating A.......................105—125 volts, 50—60 cycles
Rating B.......................105—125 volts, 25—60 cycles
Rating C.......................100—130/140—160/195—250 volts, 40—60 cycles
Power Consumption.......................135 watts

Miscellaneous

Undistorted Output................... 8.5 watts
Maximum Output .... 11.5 watts
Loudspeaker ....Electrodynamic—12 inch
Voice Coil Impedance.........7.5 ohms at 400 cycles

Intermediate Frequency.......................460 kc.

MECHANICAL SPECIFICATIONS

Height ....41 inches
Width ....26 inches
Depth ....14 inches
Weight (Net).......................79 pounds
Weight (Shipping).......................124 pounds
Chassis Base ....15½ inches × 10½ inches × 3½ inches

GENERAL FEATURES

This instrument comprises an eleven-tube chassis mounted in a console type of cabinet. Its tuning ranges cover frequencies between 540 kc. and 18,000 kc. including the standard broadcast, short wave broadcast, police, amateur and aviation bands. The following points of design are of particular importance:—

Metal Radiotrons

The new metallic tubes are used in the amplifying and detecting stages of this receiver. They provide distinct advantages over corresponding glass types in a number of respects. Their size makes for compact chassis design; the metal envelope eliminates need for shielding; they are not subject to breakage; microphonic tendencies are reduced; bases and sockets are standardized for all types; short wave efficiencies are higher; and general improvements in operation are gained from their use.

Tuning Condenser

The variable tuning condenser is supported by a new design of shock-proof mount which has been developed by our engineers to prevent chassis vibration from producing audio frequency howl.

Chassis

Servicing convenience has been a governing factor in the layout of the chassis parts and the associated wiring. Each part has been situated so that a minimum of wiring is necessary. Adjustments provided by means of substantial trimmers are mounted where they may be easily reached. Holes are included in the shield cans of the r-f coil system for testing the tuning with a Tuning Wand.

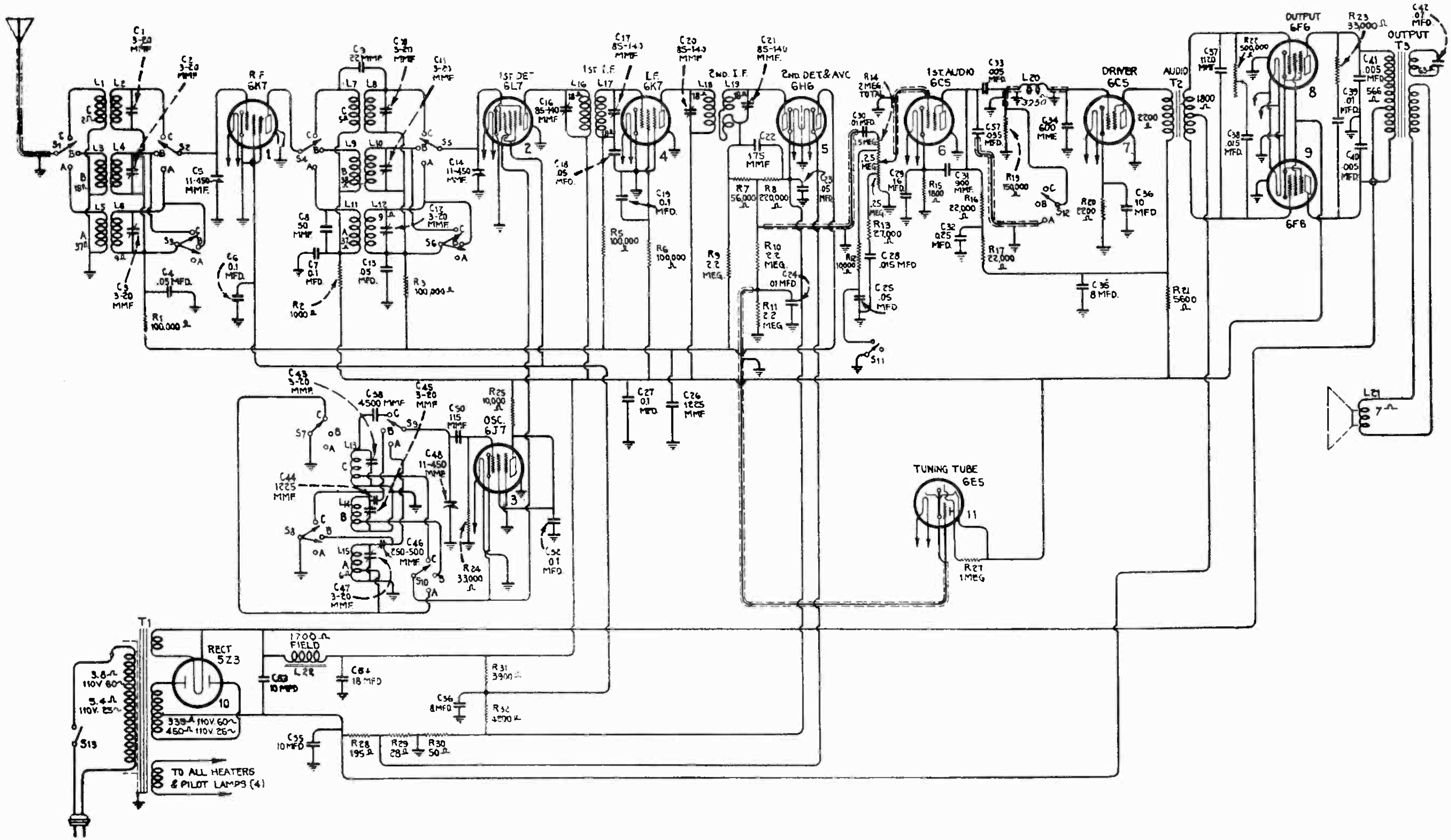


Figure 1—Schematic Circuit Diagram

(On some instruments—C-33 is .035 mfd. and C-57 is removed.)

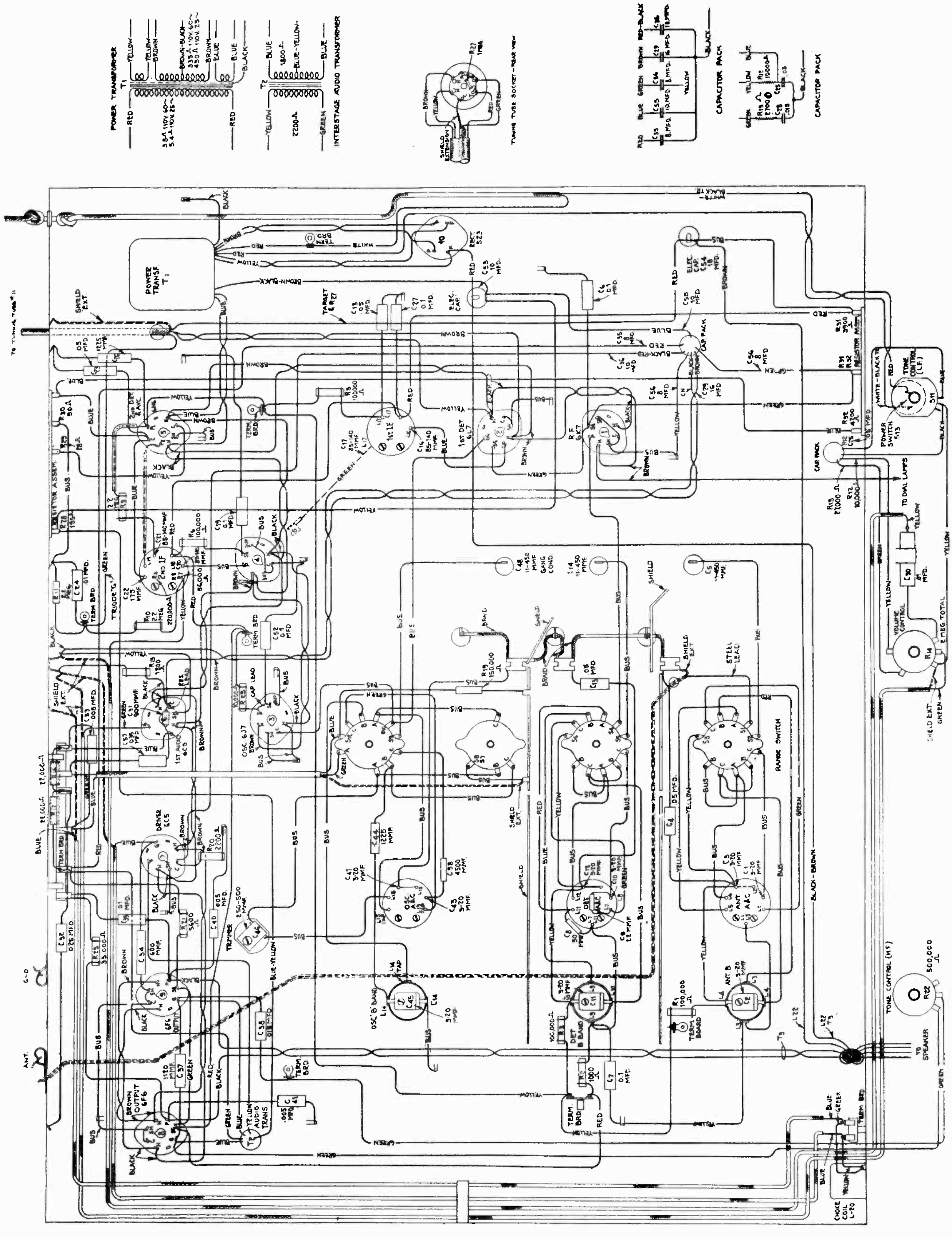


Figure 2—Chassis Wiring Diagram

Loudspeaker

A super-sensitive 12 inch electrodynamic speaker is employed. It is correctly adapted to the cabinet design to assure the best possible acoustic performance. Electrical connection is made from the speaker to the chassis through a plug and connector attachment, permitting easy removal for servicing.

Dial Drive

The dial drive and station indicator system are of new and unique design. Three individual dial scales, each with full 180 degree band spread, are provided, one for use on each band. The scales are eccentrically arranged on a rotary disc and adapted to operate in connection with the band change switch so that as the switch is shifted to a certain band, the corresponding dial scale rotates into position. For other positions of the band switch, a similar scale selection takes place, there being only one scale visible at a time. The driving mechanism for the dial and condenser has tuning ratios of 10 to 1 and 50 to 1. Control may be interchanged between these two ratios by push-in operation of a positive action clutch which is actuated by the tuning knob. From the clutch and ratio controlling mechanism, the drive system interlinks with the tuning condenser, main dial pointer and vernier dial pointer through means of fibre and brass gears. The ratio of vernier rotation to the main pointer is 20 to 1. An intermediate gear is used in the system to reduce gear back-lash. This gear is suspended in position with two tension springs which maintain the proper mesh at all times. A flexible coupling disc is used between the drive and the condenser shaft.

CIRCUIT ARRANGEMENT

The Superheterodyne principle of operation forms the basis of the circuit design. A single, tuned r-f stage is used ahead of the first detector. The functions of oscillator and detector are performed by two separate tubes. One i-f stage is employed and designed to operate at 460 kc. The combined second detector and a.v.c. stage uses an RCA-6H6 double diode. The audio system consists of two single amplifier stages working in cascade with a push-pull power output stage. The loudspeaker is an electrodynamic type, receiving its field supply from the rectifier and filter system and simultaneously acting as a filter reactor. Full wave rectification is performed in the RCA-5Z3 tube. The outstanding features of electrical design are concerned with the following:—

Tuned Circuits

A total of seven circuits are tuned to provide gain and selectivity to the incoming signal. The variable gang condenser resonates the antenna transformer secondary, the detector transformer secondary and the oscillator coil. Alignment trimmers are included for each of these same circuits. Additional trimmers are used on the i-f transformers, tuning both the secondaries and primaries to 460 kc. There are separate groups of antenna, detector and oscillator coils for each of the tuning ranges. They are placed into operation by means of a rugged rotary switch.

First Detector

This stage has unusually good high frequency mixing efficiency. The tube used, an RCA-6L7, is a new hexode type. The signal is supplied to the first control grid and the oscillator is fed in on a second control grid, a screen grid separating the two. The arrangement of the grids prevents degenerative difficulties, particularly at the higher frequencies. The second grid is direct-connected to the cathode of the oscillator tube and has no d-c bias.

Oscillator

The oscillator circuit is worthy of careful study inasmuch as it is different from the type ordinarily employed. It has self-stabilizing properties which are very advantageous for short wave operation. The generated frequency remains substantially constant, the circuit being unaffected by variation of line voltage and other similar influences. Output also remains uniform over the individual tuning ranges. The switching of the tuning coils is arranged so as to short those not in use in order to prevent absorption or any reactive effects in the particular band being tuned.

Detector and A.V.C.

The modulated signal as obtained from the output of the i-f system is detected by an RCA-6H6 double diode tube. The audio frequency secured by this process is passed on to the a-f system for amplification

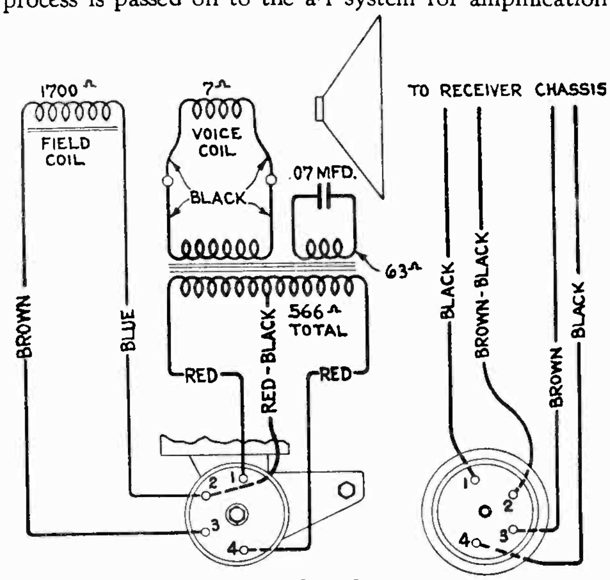


Figure 3—Loudspeaker Wiring

and final reproduction. The d-c voltage which results from detection of the signal, is used for automatic volume control. This voltage, which develops across resistors R-7 and R-8, is applied as automatic control grid bias to the r-f, first detector and i-f tubes through suitable resistance-capacitance filter circuits. The second diode of the RCA-6H6 is used to supply residual bias for these controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current, which flows through resistors R-7, R-8 and R-9, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function. The cathode and anode of the signal-a.v.c diode have positive potential in respect to chassis-ground and cathodes of the a.v.c. controlled tubes when no signal is being received.

Audio System

Manual volume control of the detected signal is effected bŷ an acoustically tapered potentiometer in the grid circuit of the first a-f stage. This control has tone compensating filters connected to two points thereon. These filters effect the correct aural balance at different volume settings. A music-speech switch (low frequency tone control) is associated with one of the compensation filters. The purpose of this control is to make speech reproduction more intelligible and to reduce hum obtained from stray modulation on a carrier. The driver stage of the audio system uses an RCA-6C5 which is resistance coupled to the first a-f tube and transformer coupled into the push-pull power output stage.

Tuning Indicator

A cathode-ray tube is used as a means of visually indicating when the receiver is accurately tuned to the incoming signal. This tube is of new design and comprises an amplifier section and a cathode-ray section built in the same glass envelope. The cathode-ray section consists of a conically shaped luminescent screen, upon which a pattern is formed by an effect of the detected signal after said effect has been amplified by the amplifier section which is fed from the detector diode circuit. The size of the pattern is determined by the strength of the signal voltage, so that any change of tuning may be readily observed in order to facilitate tuning to exact resonance.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed to isolate causes for defective operation when such develops. The ratings of the resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and the Replacement Parts List. The coils, reactors, and transformer windings are rated in terms of their d-c resistances only and where the resistance is less than one ohm, no rating is given.

Alignment Procedure

Ten alignment trimmers are provided in the r-f, first detector and oscillator tuning system and four are used in the i-f system. All of these are accurately adjusted during manufacture and should remain in proper alignment unless affected by abnormal conditions of climate or have been altered by other means. Loss of sensitivity, improper tone quality and poor selectivity are the usual indications of improper alignment.

Correct performance of the receiver can only be obtained when the trimmer adjustments have been made by a skilled service man with the use of adequate and reliable test equipment. Such apparatus as may be required for alignment of this particular instrument is illustrated and described on a separate page of this booklet.

Two methods of alignment are applicable. One utilizes a Cathode-Ray Oscillograph as a means of output indication and the other follows former procedure where a glow type indicator or meter is used. The oscillographic method is much to be preferred, since greater accuracy is possible from the type of indication afforded. There are no approximations necessary as with the meter or aural method, but each adjustment can be made with definite precision. Both methods are hereinafter outlined so that alignment operations may be made according to the equipment available.

It is wise to determine the necessity for alignment as well as the direction of misalignment before making adjustments. The RCA Tuning Wand is an instrument designed particularly for such a purpose.

The Tuning Wand consists of a bakelite rod having a small brass cylinder at one end and a core of finely divided iron at the other It may be inserted into a tuned coil while a signal of the normal resonant frequency is being supplied to such coil to obtain an indication of the tuning. Holes are provided at the top of the r-f shield cans for entrance of the Wand. The presence of either end of the Wand will cause a change in tuning which will be indicated at the receiver output as an increase or decrease in signal level. If there is a decrease of output when either end is inserted, the tuning is correct and will require no adjustment. However should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output while the iron end causes a decrease, reduction of inductance will be necessary to place the circuit in alignment. This is equivalent to decreasing the trimmer concerned. The following tabulation gives the various changes and the adjustments required:—

WAND	SIGNAL	TRIMMER
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

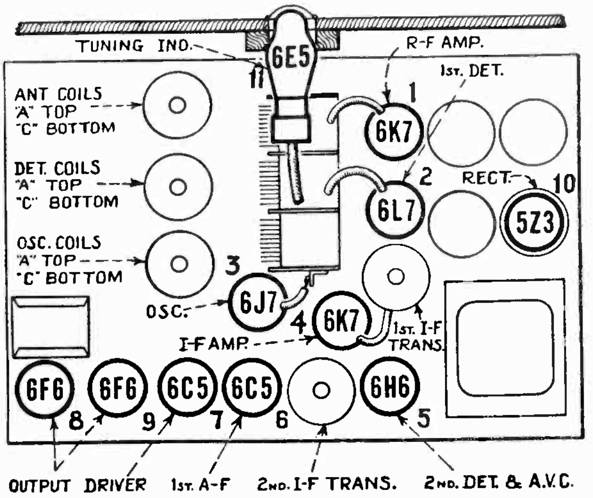


Figure 4—Coil and Radiotron Locations

CATHODE-RAY ALIGNMENT

Equipment

A standard source of alignment frequencies is required. Such a source should consist of an RCA Full Range Oscillator, Stock No. 9595 Output indication should be by means of an RCA Stock No 9545

Cathode-Ray Oscillograph. An RCA Stock No. 9558 Frequency Modulator will be needed to sweep the generated signal and synchronize it with the Oscillograph in order to obtain visual representation of the resonant characteristic of the circuit being tuned on the cathode-ray fluorescent screen.

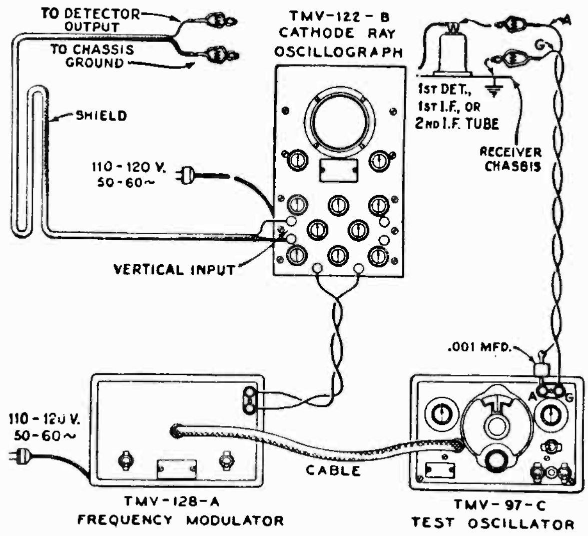


Figure 5—Alignment Apparatus Connections

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 6. Each must be aligned to a basic frequency of **460 kc.** The last transformer must be aligned firstly and the first transformer aligned secondly. For such a process, it is necessary to feed the output of the Full Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each transformer and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The proper point of connection of the Oscillograph is with its vertical "high" input terminal attached to the juncture of R-7 and R-8, as illustrated in Figure 6, and with the "0" or ground terminal to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as shown by Figure 5. A .001 mfd. capacitor installed in series with the Oscillator "Ant." lead will prevent the voltages of the stage under alignment from becoming upset. The vertical "A" amplifier should be "On" for the ensuing adjustments and its gain control kept at maximum. For each adjustment, the Oscillator output must be regulated so that the image obtained on the Oscillograph screen will be of the minimum size convenient for accurate observation. Proceed further as follows:—

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver range switch to Band "A" and tune the station selector to a point where no interference will be encountered from signal pickup or from the RCA-6J7 oscillator, removing the tube if necessary. Set the Oscillograph horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a straight line trace completely across the screen. Place the timing control to "Int." Adjust the intensity and focusing controls of the Oscillograph to produce the correct size and strength of spot.

(b) Attach the output of the test Oscillator between the control grid cap of the RCA-6K7 i-f tube and chassis ground as shown typically by Figure 5. Tune the Oscillator to **460 kc.** and set its modulation switch to "On." Regulate its output until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph controls to give a shape which is convenient for peak indications. Cause the image to stand still on the screen by manipulation of the frequency and synchronizing controls. Then carefully tune the two trimmers C-20 and C-21 of the second i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full Range Oscillator by means of the special shielded patch cord. Figure 5 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off." Change the timing control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then carefully shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become exactly coincident at their highest points. This condition will be found to occur at an Oscillator setting of *approximately 540 kc.* The curves will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with the above requirement and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-20 and C-21 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as in (c), change the Oscillator output to the control grid cap of the RCA-6L7 first detector tube. Then adjust the first i-f transformer trimmers C-16 and C-17 so that the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the overall tuning characteristic of the i-f system.

R-F Trimmer Adjustments

Locations of the various antenna, detector and oscillator coil trimmers are shown by Figure 6. The test Oscillator should be removed from connection with

the i-f system and its output connected to the antenna-ground terminals of the receiver. No changes are to be made in the connections of the Oscillograph at the second detector. During the following adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Adherence to this procedure will obviate the broadness of tuning that would result from a.v.c. action on a stronger signal. Proceed with the adjustments as follows:—

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning condenser plates are in full mesh (maximum capacitance). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the Band A scale. Correct the setting of the vernier second hand pointer to read zero.

Band A

(a) With the receiver range switch in its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the test Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector and antenna trimmers, C-47, C-12 and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. After each trimmer has been peaked, the Oscillograph timing control should be set to "Ext." and the Frequency Modulator placed into operation with its connections to the Oscillator and Oscillograph made in accordance with Figure 5. Turn the modulation switch of the Oscillator to "Off" and retune the Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-47, C-12 and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the wave images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Place the modulation switch to "On". Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator (modulation "Off") until the two similar forward and reverse waves appear on the screen. For this adjustment, it is advisable to shift the Oscillator to its 200-400 kc. range using the third harmonic of the generated signal in order to obtain the desired range of sweep. The oscillator series trimmer, C-46, should then be adjusted to produce maximum amplitude of the images. No rocking will be necessary on the station selector inasmuch as the signal frequency

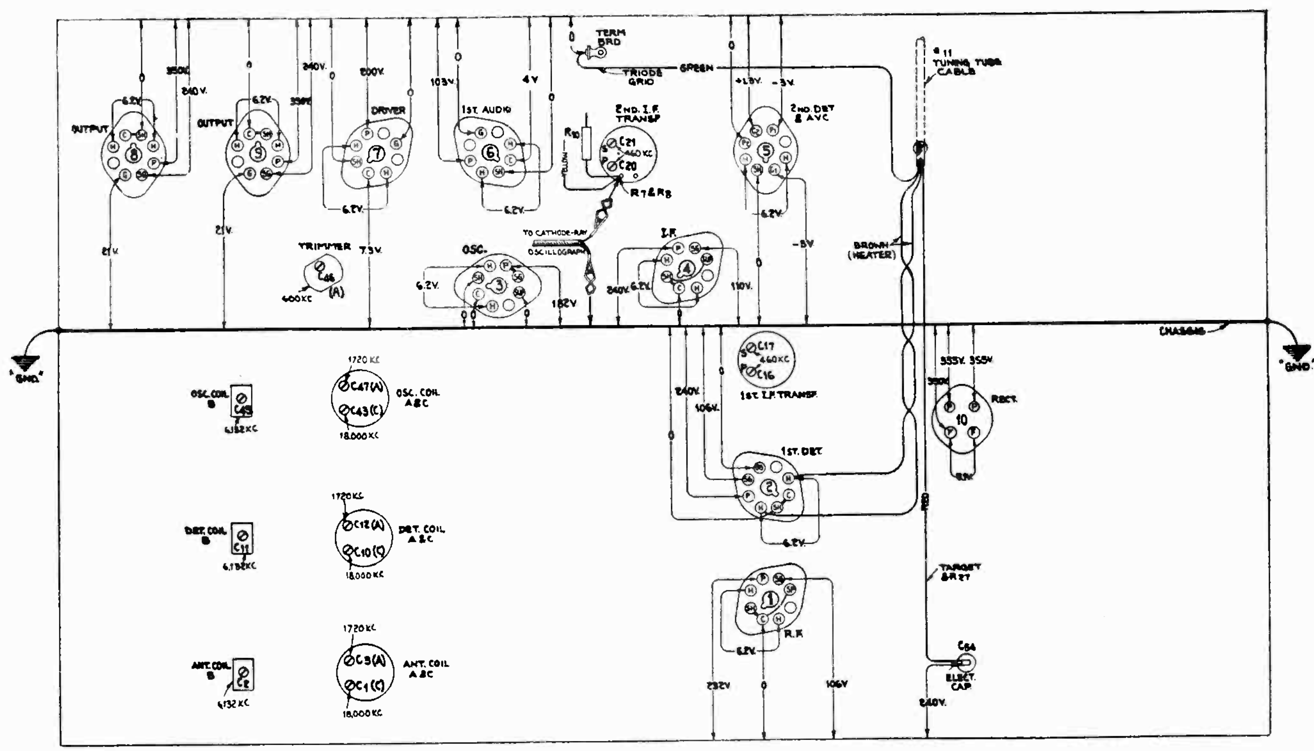


Figure 6—Trimmer Locations and Radiotron Socket Voltages
Measured at 115 Volts A.C.—No Signal—Volume Control Maximum

is being "wobbled" by the Frequency Modulator to produce the same effect. After completing this adjustment, the trimmer C-47 should be re-aligned as in (a) to correct for any change brought about by the adjustment of C-46.

Band B

(a) Advance the receiver range switch to its Band B position and tune the station selector to a dial reading of **6132 kc.** Set the test Oscillator to this same frequency (modulation "On" and Frequency Modulator disconnected) and increase its output until a suitable indication is apparent on the Oscillograph. The Oscillograph should be adjusted for "Int." timing. Then adjust the oscillator trimmer, C-45, to the point at which maximum amplitude of the image is obtained. Two positions will be found for this trimmer which gives such a maximum. The one of least capacitance is correct and should be used. This can be checked by tuning the "image" signal, which will be received at **5212 kc.** on the dial if the adjustment of C-45 has been properly made. An increase in test Oscillator output may be necessary for this test. *Its frequency should not be changed from* **6132 kc.** *nor any trimmer adjustments made on the receiver.*

(b) Return the station selector to the **6132 kc.** reading and align the detector, and antenna coil trimmers, C-11 and C-2 respectively, for maximum (peak) output as shown by the Oscillograph. No further adjustments are to be made on this band.

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to the same frequency (modulation "On" and Frequency Modulator disconnected) and regulate its output to the level required for convenient observation. Adjust the trimmer C-43 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of the proper "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of C-43 has been properly made by using the position of least capacitance which gives maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, re-align C-43 if necessary, and then adjust the detector and antenna trimmers, C-10 and C-1, for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on this band.

ALIGNMENT WITH OUTPUT METER

To align the receiver by means of an output indicator other than a Cathode-Ray Oscillograph will require the use of a standard test Oscillator, such as that recommended above, for the source of signals and

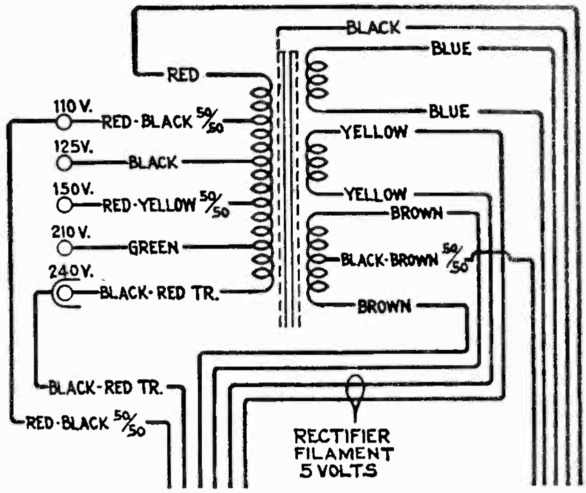


Figure 7—Universal Power Transformer Connections

Pri. Res.—7.42 ohms, total
Sec. Res.—274 ohms, total

means of indication for the output. The RCA Neon Output Indicator, Stock No. 4317, will be found very satisfactory for such use. It should be connected across the voice coil circuit of the loudspeaker or across the output transformer primary.

I-F Alignment

Connect the test Oscillator to the control grid cap of the i-f tube. Advance the volume control of the receiver to its full-on position. Tune the test Oscillator accurately to **460 kc.** and align the trimmers C-20 and C-21 to give maximum receiver output. Regulate the Oscillator output during this adjustment so that the output indication is as small as can be conveniently observed. After completing the adjustments of these trimmers, re-connect the Oscillator so that it will feed into the control grid circuit of the RCA-6L7 first detector. Then tune the first i-f transformer trimmers C-16 and C-17 for maximum receiver output.

R-F Alignment

After completing the i-f adjustments, it is advisable to correct the line-up of the circuits ahead of the first detector. The test Oscillator should be connected to the antenna-ground terminals of the receiver and the manual volume control turned to its maximum position. For each adjustment, the Oscillator output should be maintained as low as possible in order to avoid broadness of tuning which would result from a.v.c. action on a stronger signal.

Band A—This band should be aligned by supplying a **1720 kc.** signal to the receiver, tuning the station selector to a dial reading of **1720** and adjusting the trimmers C-47, C-12 and C-3 to produce maximum receiver output. The Oscillator should then be shifted to **600 kc.** and the receiver tuned to resonate this signal, disregarding the reading at which it is best received. Trimmer C-46 must then be adjusted, simultaneously while rocking the station selector backward and forward through the signal until the maximum output results from the combined operations. C-47 should be rechecked to assure that its adjustment has not changed because of the trimming of C-46.

Band B—This band must be aligned at **6132 kc.** by tuning the test Oscillator to such a frequency and turning the station selector to the **6132 kc.** dial reading. Then tune the trimmer C-45 to produce maximum receiver output, using the setting of least capacitance which causes same. The presence of the proper "image" may be checked by tuning the receiver to **5212 kc.** at which point the **6132 kc.** signal will be heard if the trimmer C-45 has been properly set to the position of least capacitance for maximum (peak) output. It may be necessary to increase the Oscillator output for this check. *No adjustments are to be made.* Return the station selector to the **6132 kc.** dial marking and trim capacitors C-11 and C-2 for maximum receiver output. No other adjustments are necessary on Band B.

Band C—Change the receiver so that it is operative and the dial reads **18,000 kc.** on the "C" Band. Tune the test Oscillator to this same frequency. Then adjust the oscillator trimmer C-43 to produce maximum (peak) output. Two positions of this trimmer will be found which conform with this requirement. The one of least capacitance is correct. Check for the presence of "image" response at **17,080 kc.** by shifting the receiver tuning. If it is received at such a point, the trimmer C-43 has been correctly adjusted to the right peak. *No adjustments are to be made during this check.* Tune the receiver back to the **18,000 kc.** dial marking, readjust C-43 if necessary, and then tune the detector and antenna capacitors C-10 and C-1 for maximum receiver output. No further adjustments are necessary.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 6 will serve to assist in the location of causes for faulty operation. Each value as specified should hold within + 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Universal Transformer

The transformer used on some models of this receiver is adaptable to several ranges of voltage as given under Rating C of Electrical Specifications. Its schematic and wiring are shown by Figure 7. Terminals are provided at the top of the transformer case for changing the primary connections to suit the voltage being used. Note that a 110 volt tap is brought out separately for supplying a phonograph motor.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price	Stock No.	Description	List Price
	RECEIVER ASSEMBLIES		5170	Capacitor—0.25 Mfd. (C32)	$0.25
4427	Bracket—High or low frequency tone control or volume control mounting bracket	$0.18	11203	Capacitor—10 Mfd. (C53)	1.18
5237	Bushing—Variable condenser mounting bushing assembly—Package of 3	.43	5212	Capacitor—18 Mfd. (C54)	1.16
11223	Capacitor—Adjustable capacitor (C46)	.46	11215	Capacitor pack—Comprising one 16 Mfd., two 10 Mfd., and two 8 Mfd. capacitors (C29, C35, C36, C55, C56)	3.85
11292	Capacitor—22 MMfd. (C9)	.24	11318	Capacitor pack—Comprising one .015 Mfd., one .05 Mfd., one 10,000 Ohm resistor and one 27,000 Ohm resistor (C25, C28, R12, R13)	1.30
11289	Capacitor—50 MMfd. (C8)	.26	11201	Clamp—Cable clamp—located near variable tuning condenser—Package of 5	.20
11291	Capacitor—115 MMfd. (C50)	.24	11272	Clamp—Cable clamp—located above antenna terminal	.10
11317	Capacitor—600 MMfd. (C34)	.30	4693	Clamp—Electrolytic capacitor clamp—for stock #11215	.15
3784	Capacitor—900 MMfd. (C31)	.30	5215	Coil—Antenna coil—A and C bands (L1, L2, L5, L6, C1, C3)	2.32
4409	Capacitor—1120 MMfd. (C37)	.35	5245	Coil—Antenna coil—B band (L3, L4, C2)	1.58
11288	Capacitor—1225 MMfd. (C44)	.30	11320	Coil—Choke coil (L20)	1.00
11316	Capacitor—1225 MMfd. (C26)	.40	5216	Coil—Detector coil—A and C bands (L7, L8, L11, L12, C10, C12)	2.34
11287	Capacitor—4500 MMfd. (C58)	.30	5246	Coil—Detector coil—B band (L9, L10, C11)	1.62
4907	Capacitor—0.005 Mfd. (C40, C41)	.38	5217	Coil—Oscillator coil—A and C bands (L13, L15, C43, C47)	2.20
4868	Capacitor—0.005 Mfd. (C33)	.20			
4624	Capacitor—0.01 Mfd. (C30)	.54			
4937	Capacitor—0.01 Mfd. (C39)	.25			
11315	Capacitor—0.015 Mfd. (C38)	.20			
5196	Capacitor—0.035 Mfd. (C57)	.18			
4836	Capacitor—0.05 Mfd. (C4, C13, C18, C23)	.30			
4886	Capacitor—.05 Mfd. (C24)	.20			
4885	Capacitor—0.1 Mfd. (C7, C19, C27, C52)	.28			
4841	Capacitor—0.1 Mfd. (C6)	.22			

REPLACEMENT PARTS (Continued)

Stock No.	Description	List Price
5247	Coil—Oscillator coil—B band (L14, C45)	$1.44
5214	Condenser—Three gang variable tuning condenser—(C5, C14, C48)	4.42
11205	Volume control (R14)	1.30
11219	Tone Control—High frequency tone control (R22)	.90
5226	Lamp—Pilot lamp—Package of 5	.70
11710	Lead—Shielded lead for antenna	.40
8041	Plate—I.F. or R.F. coil shield locking plate with screw—Package of 2	.12
11220	Resistor—Voltage divider resistor—comprising one 3900 Ohm and one 4200 Ohm section (R31, R32)	.84
11221	Resistor—Voltage divider resistor—comprising one 50 Ohm, one 28 Ohm and one 195 Ohm section (R28, R29, R30)	.48
5112	Resistor—1000 Ohm—Carbon type—¼ watt—(R2)—Package of 5	1.00
3706	Resistor—1800 Ohm—Carbon type—¼ watt—(R15)—Package of 5	1.00
5159	Resistor—2200 Ohm—Carbon type—¼ watt—(R20)—Package of 5	1.00
5175	Resistor—5600 Ohm—Carbon type—½ watt—(R21)—Package of 5	1.00
2731	Resistor—10,000 Ohm—Carbon type—1 watt—(R25)—Package of 5	1.10
11305	Resistor—22,000 Ohm—Carbon type—¼ watt—(R16, R17)—Package of 5	1.00
11300	Resistor—33,000 Ohm—Carbon type—¹⁄₁₀ watt—(R24)—Package of 5	.75
5033	Resistor—33,000 Ohm—Carbon type—1 watt—(R23)—Package of 5	1.10
3118	Resistor—100,000 Ohm—Carbon type—¼ watt—(R1, R3, R5, R6)—Package of 5	1.00
5027	Resistor—150,000 Ohm—Carbon type—¼ watt—(R19)—Package of 5	1.00
11151	Resistor—2.2 Megohm—Carbon type—¼ watt—R9, R10, R11)—Package of 5	1.00
11250	Shield—Choke coil shield	.20
5249	Shield—R.F. coil shield	.20
11273	Shield—Radiotron shield	.25
5250	Shield—I.F. Transformer shield	.22
11222	Socket—Dial lamp socket	.18
4794	Socket—4-contact Radiotron socket	.15
11197	Socket—6-contact Radiotron socket	.14
11198	Socket—7-contact Radiotron socket	.15
5224	Switch—Low frequency tone control with power switch—(S11, S13)	1.00
11236	Switch—Range switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S12)	2.44
5238	Terminal—Antenna terminal assembly	.14
11218	Transformer—Audio driver transformer (T2)	2.58
11216	Transformer—First intermediate frequency transformer (L16, L17, C16, C17)	2.15
11217	Transformer—Second intermediate frequency transformer (L18, L19, C20, C21, C22, R7, R8)	3.10
11213	Transformer—Power Transformer—105/125/150/210/250 volts—40-60 cycles	5.10
11212	Transformer—Power transformer—105-125 volts—25-50 cycles	7.18
11211	Transformer—Power transformer (T1)—105-125 volts—50-60 cycles	4.88
	DRIVE ASSEMBLIES	
5243	Arm—Band indicator operating arm	.42
10194	Ball—Steel ball for drive assembly—Package of 20	.25
8054	Cam—Five position cam for station selector drive assembly	.28
4422	Clutch—Tuning condenser drive clutch assembly—comprising shaft, balls, ring, spring and washers assembled	1.00

Stock No.	Description	List Price
8048	Coupling—Flexible coupling for variable capacitor—(includes indicator shaft)	$0.70
11334	Dial—Dial scale with mounting rivets	.75
8045	Disc—Drive disc and gear assembly	.46
11631	Drive—Tuning condenser drive assembly complete	6.35
8044	Escutcheon—Dial escutcheon with vernier scale	1.08
8046	Gear—Indicator shaft drive gear and vernier idler with one spring	.72
8050	Gear—Gear sector and band indicator operating link—(link connects to arm on band switch)	.15
8053	Indicator—Station selector vernier indicator pointer	.12
11793	Indicator—Station selector indicator pointer	.15
8051	Link—Complete with roller and spring	.30
8049	Pinion—Vernier pointer drive pinion and shaft	.55
4669	Screw—No. 8-32 ⁵⁄₃₂″ square head set screw—for variable condenser drive assembly—Package of 10	.25
8047	Spring—Coil spring for indicator shaft drive gear and vernier idler (Stock #8046)	.12
8052	Spring—Coil spring for link—Package of 5	.32
8042	Stud—Band indicator operating arm stud—Package of 5	.25
	REPRODUCER ASSEMBLIES	
8059	Board—Reproducer terminal board—(2 terminals)	.14
8060	Bracket—Output transformer mounting bracket	.14
11304	Cable—Reproducer cable—complete with connector	.80
8058	Clamp—Cone rim clamp—Package of 4	.44
11189	Coil—Field coil, magnet and cone housing (L22)	10.60
8056	Cone—Reproducer cone (L21)	1.58
5039	Connector—4-prong male connector plug for reproducer	.25
5040	Connector—4-contact female connector socket for reproducer cable	.25
9620	Reproducer—Complete	16.32
8057	Transformer—Output transformer—(T3, C42)	3.22
	MISCELLANEOUS ASSEMBLIES	
5211	Bolt—Speaker mounting bolt assembly—Package of 2	.24
11191	Bracket—Radiotron tuning lamp mounting bracket—less clamp (Stock #11192)	.12
11319	Cable—Radiotron tuning lamp cable and plug—approximately 25″ long	1.38
11192	Clamp—Radiotron tuning lamp mounting clamp—less bracket (Stock #11191)	.12
11276	Escutcheon—Radiotron tuning lamp escutcheon	.40
11379	Escutcheon—Station selector escutcheon and crystal	1.08
11346	Knob—Station selector knob—Package of 5	.75
11347	Knob—Volume control, tone control, power switch or range switch knob—Package of 5	.75
11382	Resistor—1 Megohm—Carbon type—¹⁄₁₀ watt (R27)—Package of 5	.75
5210	Screw—Chassis mounting screw assembly—Package of 4	.16
11348	Screw—No. 8-32 ⁷⁄₁₆″ Headless cupped point set screw for knob (Stock #11346)—Package of 10	.32
11193	Shield—Reproducer cover (shield)	.82
11381	Socket—Tuning lamp socket and cover	.45
11349	Spring—Retaining spring for knob (Stock #11347)—Package of 5	.15

RCA VICTOR MODEL C 13-2

Thirteen-Tube, Five-Band, A-C, Superheterodyne, Console Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Frequency Ranges

Band X	140— 410 kc.
Band A	540— 1,800 kc.
Band B	1,800— 6,000 kc.
Band C	6,000—18,000 kc.
Band D	18,000—60,000 kc.

Alignment Frequencies

Band X	150 kc. (osc.), 400 kc. (osc., det., ant.)
Band A	600 kc. (osc.), 1,720 kc. (osc., det., ant.)
Band B	6,132 kc. (osc., det., ant.)
Band C	18,000 kc. (osc., det., ant.)
Band D	No adjustments required

Voltage and Frequency

Rating A	105—125 volts, 50—60 cycles
Rating B	105—125 volts, 25—60 cycles
Rating C	100—130/140—160/195—250 volts, 40—60 cycles

Radiotron Complement

(1)	RCA-6K7	Radio-Frequency Amplifier
(2)	RCA-6L7	First Detector
(3)	RCA-6J7	Heterodyne Oscillator
(4)	RCA-6K7	First Intermediate Amplifier
(5)	RCA-6K7	Second Intermediate Amplifier
(6)	RCA-6H6	Second Detector and A.V.C.
(7)	RCA-6C5	First Audio Amplifier
(8)	RCA-6C5	Audio Driver Amplifier
(9)	RCA-6C5	Audio Driver Amplifier
(10)	RCA-6F6	Power Output Amplifier
(11)	RCA-6F6	Power Output Amplifier
(12)	RCA-5Z3	Full Wave Rectifier
(13)	RCA-6E5	Tuning Indicator

Miscellaneous

Power Consumption	140 watts
Undistorted Output	10 watts
Maximum Output	15 watts
Loudspeaker	12 inch, Electrodynamic
Voice Coil Impedance	7.5 ohms at 400 cycles
Intermediate Frequency	460 kc.

MECHANICAL SPECIFICATIONS

Height	41 inches
Width	26¼ inches
Depth	15¾ inches
Weight (Net)	100 pounds
Weight (Shipping)	153 pounds
Chassis Base Dimensions	20¾ inches x 10½ inches x 3½ inches.

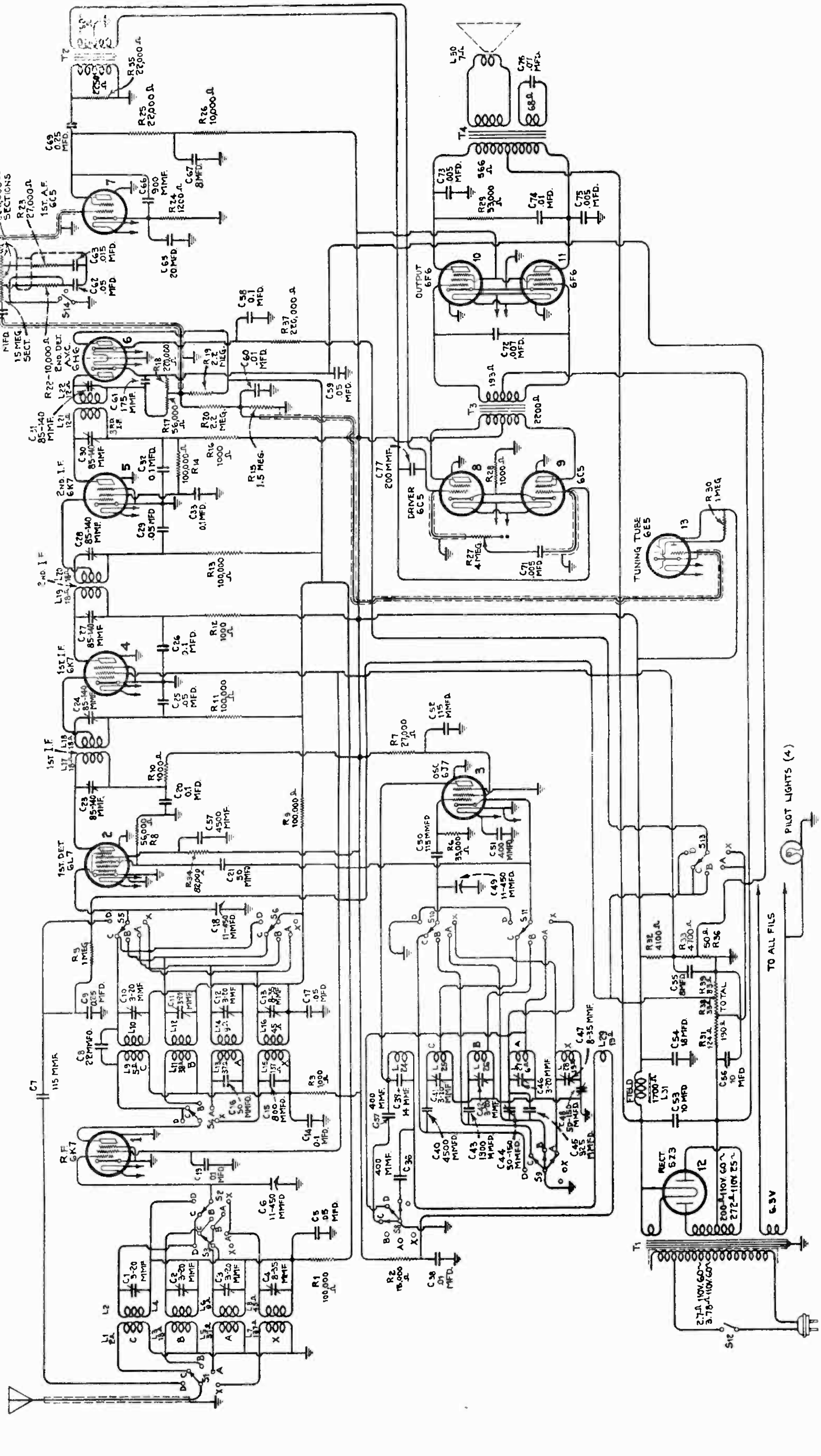


Figure 1—Schematic Circuit Diagram

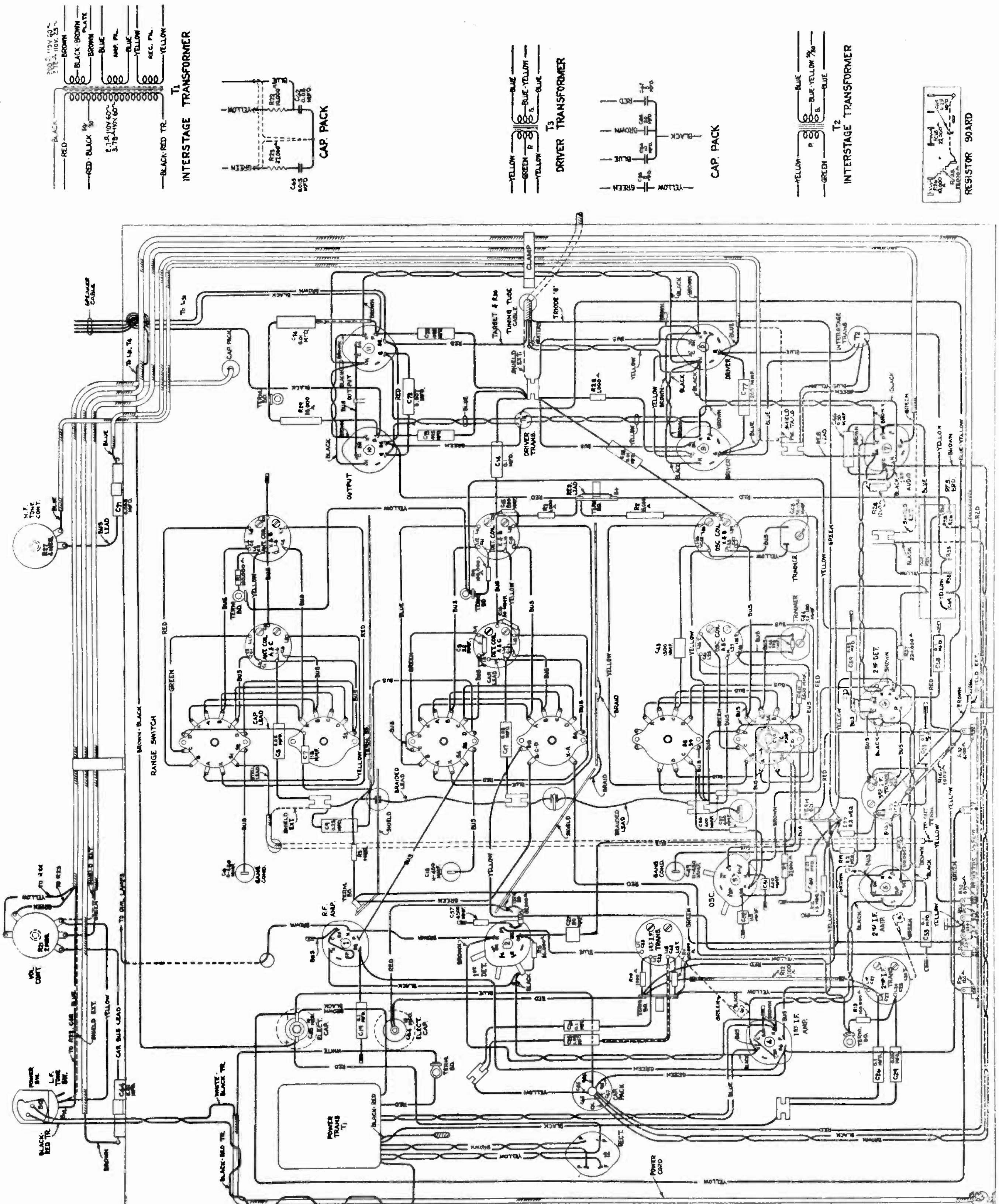


Figure 2—Chassis Wiring Diagram

GENERAL FEATURES

Metal Tubes

This receiver uses the new metal tubes which are much smaller in size than the corresponding glass types. The high frequency efficiency of these metal tubes is greater because of the shorter lengths of leads, lesser interelectrode capacitance and the more complete shielding of the metallic envelopes. Their rugged construction prevents breakage and reduces microphonic tendencies. The bases and sockets of all types have a standardized arrangement of connecting prongs.

Receiver Chassis

Service convenience has been a controlling factor in the layout of the chassis parts and wiring. The assembly of these various elements is such that the number of conductors is minimized with all important connections being readily accessible. Further accessibility to all parts of the chassis is due to the open construction of the base and mounting supports. Trimmer adjustments are easily reached from the underside of the chassis. The r-f, detector and oscillator coils are identified by markings on their bases, which for example read "AAO" to indicate the Band A, "antenna" and "oscillator" coils.

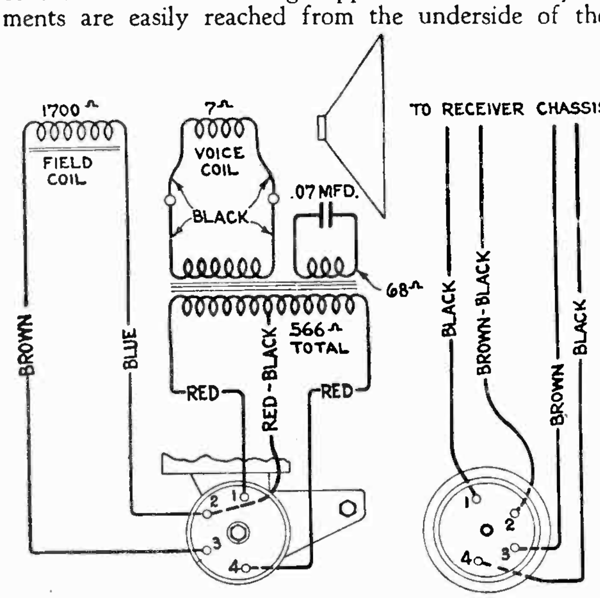


Figure 3—Loudspeaker Schematic and Wiring

Dial Drive

The dial drive and station indicator system are of new and unique design. Five individual dial scales, each with full 180 degree band spread, are provided, one for use on each band. The scales are eccentrically arranged on a rotary disc and adapted to operate in connection with the band change switch so that as the switch is shifted to a certain band, the corresponding dial scale rotates into position. For other positions of the band switch, a similar scale selection takes place, there being only one scale visible at a time. The driving mechanism for the dial and condenser has tuning ratios of 10 to 1 and 50 to 1. Control may be interchanged between these two ratios by push-in operation of a positive action clutch which is actuated by the tuning knob. From the clutch and ratio controlling mechanism, the drive system interlinks with the tuning condenser, main dial pointer and vernier dial pointer through means of fibre and brass gears. The ratio of vernier rotation to the main pointer is 20 to 1. An intermediate gear is used in the system to reduce gear back-lash. This gear is suspended in position with two tension springs which maintain the proper mesh at all times. A flexible coupling disc is used between the drive and the condenser shaft permitting the dial drive mechanism to be rigidly mounted to the chassis base.

Tuning Condenser

The variable tuning condenser is supported by a new design of shock-proof mount which has been developed by our engineers to minimize audio-frequency "howl" produced by chassis vibration.

Power Transformer

The transformer is assembled flat against the chassis base which acts as a radiating fin to disseminate the heat developed in the windings. An improved electrostatic shield is used between the primary and secondary windings to reduce a-c line disturbances and to prevent the receiver from radiating into the line.

Loudspeaker

A super-sensitive 12 inch electrodynamic speaker is employed. It is correctly adapted to the cabinet design to assure the best possible acoustic performance. Electrical connection is made from the speaker to the chassis through a plug and connector attachment, permitting easy removal for servicing.

ELECTRICAL CIRCUIT

The circuit is based upon the Superheterodyne principle. The radio frequency and audio frequency amplification are balanced in such manner that the maximum of performance is obtained. The following general items cover the circuit arrangement and notable features involved:—

Tuned Circuits

Six adjustable tuned circuits are used in the i-f system, each resonating at 460 kc. A three section variable condenser tunes the secondary of the antenna transformer, the secondary of the detector input transformer and the oscillator coil on all bands with the exception of D, which has only its detector and oscillator tuned. Each tuning range has its own group of r-f and oscillator coils, they being selected as desired by operation of the band-change switch. Trimmer condensers are provided on all of the tuned circuits for use in obtaining precise alignment.

Band D Tuning

Special notice should be taken of the manner of tuning this band. The r-f stage is unused when the range switch is turned to its Band D position and the signal is fed from the antenna directly to the first detector input circuit. The inductance of this circuit consists of a short length of bus wire to which the antenna lead is tapped at a definite predetermined point. The total length of this inductive wire from the stator of the tuning capacitor to ground represents the secondary of a high frequency autotransformer, while the inductive section included between the antenna lead tap and ground forms the primary. Alteration of the dimensions and position of this wiring will change the tuning and alignment of the circuit, resulting in total

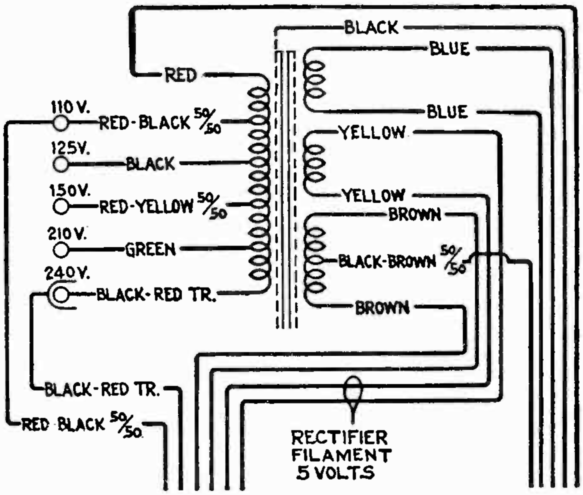


Figure 4—Universal Transformer Schematic and Wiring

Pri. Res.—4.89 Ohms, Total
Sec. Res.—165 Ohms, Total

lack of operation or seriously poor operation. *It is therefore necessary when servicing to avoid changes in the wiring which includes Band D detector and oscillator r-f circuits unless the arrangement is restored to its exact original condition.* Similar caution should be observed when exchanging by-pass condensers in these same circuits, since their values, physical positions, length of leads, quality of dielectric etc. are critical and variations will definitely affect operation of the receiver. The small heater by-pass condensers and ground terminals installed at the tube sockets are very important in this respect.

Oscillator Stage

The heterodyne oscillator circuit used in this receiver is an improved type, having exceptional frequency stability and uniformity of output over its various tuning ranges. It operates on fundamental frequencies which are fed to the first detector hexode tube (RCA-6L7) on an auxiliary mixing grid. The oscillator generates a signal which is at all times above the frequency of the incoming signal by 460 kc. As shown by the schematic diagram, the cathode of the oscillator tube is above ground potential for r.f., while the plate is effectively at ground potential. This particular arrangement, together with the plate and screen series resistors, makes the circuit independent of supply voltage variations in regard to stability and uniformity of output. Separate coils are used for each of the tuning ranges. The switching of the different bands is such as to short circuit certain unused coils which would absorb energy from the circuits used.

Intermediate Amplifier

Two stages of i-f amplification comprising three tuned transformers and two RCA-6K7 tubes are arranged in cascade to operate at 460 kc. The transformers have their primaries as well as secondaries tuned by adjustable trimmer capacitors. These trimmers are designed to resist moisture, temperature and other detrimental factors which may affect their adjustments. Litz wire is used for the windings of the third transformer in order to provide the proper efficiency in driving the diode second detector.

Detection and A. V. C.

The modulated signal as obtained from the output of the i-f system is detected by an RCA-6H6 double diode tube. The audio frequency secured by this process is passed on to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal is used for automatic volume control. This voltage, which develops across resistor R-18, is applied as automatic control grid bias to the r-f, first detector and i-f tubes through suitable resistance-capacitance filter circuits. The second diode of the RCA-6H6 is used to supply residual bias for these controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current, which flows through R-18, R-19, and R-37, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function. The cathode and the anode of the signal-a.v.c. diode have positive potential in respect to chassis-ground and cathodes of the a.v.c. controlled tubes when no signal is being received.

Audio System

Several stages of audio amplification provide excellent fidelity and wide range of volume both for short wave as well as on the standard and long wave bands. The high gain of the system has necessitated thorough shielding and careful manufacture. All wiring, transformers, etc., should always be placed as originally installed if it has been necessary to remove such for service purposes. Hum difficulties are likely to occur if this caution is not observed. Manual volume control is by means of an acoustically tapered potentiometer which conveys the audio output of the second detector to the first a-f amplifier stage. This control has tone compensation produced by filters connected to two points thereon. This gives the correct aural balance at different volume settings. A music-speech switch is provided in one of the volume control filter circuits for use in obtaining good speech intelligibility. On the speech position, the low frequency tones are reduced. A push-pull driver stage is used between the first a.f. and the Class AB output amplifier. A continuously variable high frequency tone control is shunted across the grids of the driver tubes. A sharp, high audio frequency cut-off is obtained by a tertiary winding on the audio output transformer and by the correct design of the driver and interstage transformers. This cut-off feature results in quieter operation by the reduction of high frequency noise, especially on weaker stations.

Rectifier and Filter

An RCA-5Z3 full-wave rectifier tube is employed in the high voltage supply system. The loudspeaker field coil serves as a filter reactor in conjunction with high capacity, electrolytic condensers. Fixed bias voltages are made available at the filter output on a divider system, which is likewise well filtered with large capacitors.

Tuning Indicator

A cathode-ray tube is used as a means of visually indicating when the receiver is accurately tuned to the incoming signal. This tube is of new design and comprises an amplifier section and a cathode-ray section built in the same glass envelope. The cathode-ray section consists of a conically shaped luminescent screen, upon which a pattern is formed by an effect of the detected signal after said effect has been amplified by the amplifier section which is fed from the detector diode circuit. The size of the pattern is determined by the strength of the signal voltage, so that any change of tuning may be readily observed in order to facilitate tuning to exact resonance.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed to isolate causes for defective operation. In general, the ratings of the resistors, capacitors, coils, etc. are indicated adjacent to the symbols signifying these parts. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and Replacement Parts List. The coils, reactors and transformer windings are rated in terms of their d-c resistances. Where the value is not given, the resistance is less than one ohm.

Alignment Procedure

The extensive frequency range of this receiver necessitates a more or less involved method of alignment. However, if the following directions are carefully applied, the normal performance of the instrument will be obtained.

Circuits aligned by use of Cathode-Ray equipment will be as near to perfection as possible, hence this method is to be preferred in all cases. Alignment by other methods is oftentimes an approximation unless extreme care is taken and a good deal of time expended. The oscillographic method is particularly advantageous for trimming the i-f tuned circuits to obtain

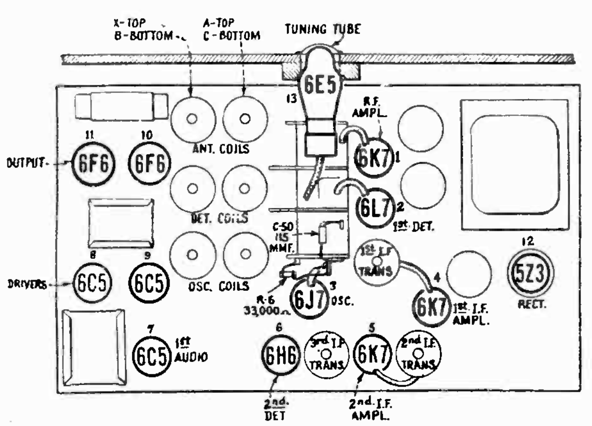


Figure 5—Radiotron and Coil Locations

the utmost in tone quality and at the same time the maximum of selectivity. Procedure to be followed when using a Cathode-Ray Oscillograph is therefore given in detail. Should this type of equipment be unavailable, a substitute indicator may be used.

Equipment

The instruments required for placing this receiver in proper alignment should consist of an RCA Cathode-Ray Oscillograph, an RCA Full Range Oscillator, an RCA Frequency Modulator, a Tuning Wand and a non-metallic screw driver. These devices are illustrated and described on a separate page of this book. The Cathode-Ray Oscillograph is to be used as an output indicator to show precisely when the circuits are correctly aligned. The Full Range Oscillator is required as the source of standard alignment signals at the various frequencies. Visual alignment is made possible through use of the Frequency Modulator, which in conjunction with the Oscillograph and Oscillator, causes the characteristic wave shape of the circuit under test to be formed on the Oscillograph screen. The necessity for alignment and direction of required change may be tested with a Tuning Wand. It's use is as follows:—

The Tuning Wand, which consists of a bakelite rod having a small brass cylinder installed at one end and a core of finely divided iron at the other. may be inserted into a tuned coil to obtain an indication of the tuning. With a signal being supplied to the receiver at the alignment frequency of the circuit concerned, each end of the Wand should be placed through the center of the coil. Holes are provided in the r-f coil shields for this test. A change in tuning will be produced by the presence of the brass cylinder or iron core and consequent change of receiver output occurs. If there is a decrease of output when either of the two ends are inserted, the tuning is correct and will require no adjustment. However, should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output, while the iron end causes a decrease, reduction of inductance will be necessary to bring the circuit into alignment. This will be equivalent to decreasing the trimmer concerned.

End of Wand Used	Change of Signal Output	Change Req'd in Trimmer Capacity
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

I-F TRIMMER ADJUSTMENT

Six trimmers are associated with the three i-f transformers. Their locations on the chassis are shown by Figure 7. Each must be aligned to a basic frequency of **460 kc.** The last i-f transformer should be adjusted first, the one preceding it second and the operation carried through successive stages until the first transformer has been aligned. For such a process, it is necessary to feed the output of the Full Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The most convenient point for connection of the Oscillograph is at the detector diode load circuit, with the vertical "Hi" terminal attached to the juncture of R-17, R-18 and R-19, and the "Gnd" to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as illustrated in Figure 6. A .001 mfd. capacitor installed in series with the Oscillator "Ant." output lead will prevent the voltage constants of the stage being aligned from becoming upset. Proceed further as follows:—

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver volume control to maximum and the range switch to Band "A". Tune the station selector to a point where no interference is caused by local stations or the local oscillator, removing the 6J7 tube if necessary. Turn the Oscillograph vertical "A" amplifier to "On" and advance the vertical gain control to its maximum position. Set the horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a trace completely across the screen. Have the timing control adjusted to "Int."

(b) Attach the output of the test Oscillator to the control grid cap of the second i-f tube (RCA-6K7) and chassis ground. Tune the Oscillator

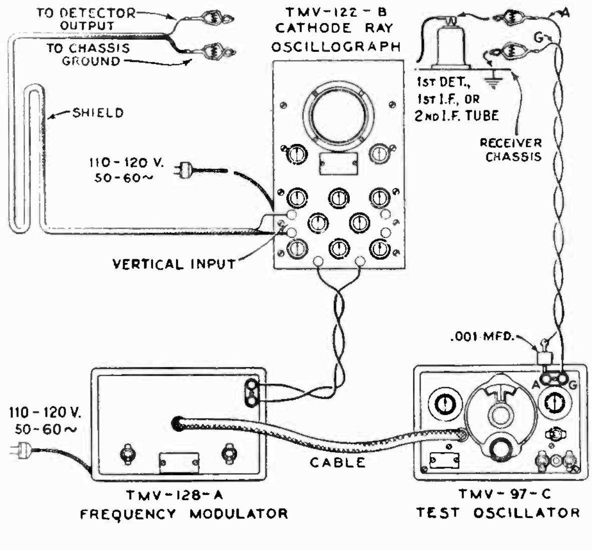


Figure 6—Alignment Apparatus Connections

to **460 kc.** having its modulation switch turned to "On". Regulate the output control until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph frequency and range controls to give several complete cycles, the amplitude of which will afford an accurate peak indication. Cause the image formed to stand still on the screen by manipulation of the "Sync." control. Use as low a signal output from the Oscillator as can be accurately observed at the Oscillograph. Then tune the two trimmers. C-30 and C-31 of the third i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition, the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full Range Oscillator by means of the shielded patch cord provided. Figure 6 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off". Change the timing (Sync.) control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become coincident at their highest points. These curves will be found to occur at an Oscillator setting of *approximately* 540 kc. They will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with these requirements and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-30 and C-31 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as above, change the Oscillator output to the control grid cap of the first i-f tube (RCA-6K7). Adjust the two trimmers C-27 and C-28 of the second i-f transformer until the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude.

(e) Change the test Oscillator output to the control grid of the first detector tube (RCA-6L7) without disturbing the connections and adjustments of the other apparatus. Then align the trimmers C-23 and C-24 of the first i-f transformer to produce waves of maximum coincidence and maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the over-all tuning characteristic of the i-f system.

ANTENNA, DETECTOR AND OSCILLATOR

For Bands A and X, adjustments must be made at the high and low frequency ends of the range. On Bands B and C, alignment is required only at the high frequency end. Band D is permanently adjusted during manufacture, hence no alignment will be necessary in this range. Locations of the various antenna, detector and oscillator trimmers are shown on Figure 7. The test Oscillator should be removed from connection with the i-f system and its output attached to the antenna-ground terminals of the receiver. No changes are to be made in the attachment of the Oscillograph at the second detector. During the adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Such procedure will obviate apparent broadness of tuning which would result from a.v.c. action on a stronger signal. The sequence of alignment should be Band A, Band X, Band B and Band C. Proceed with the adjustments as follows:—

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning capacitor plates are in full mesh (maximum capacity). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the Band A scale. Correct the setting of the vernier second hand pointer to read zero.

Band A

(a) With the receiver range switch on its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector and antenna trimmers, C-46, C-12 and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. Then shift the timing control to "Ext." and place the Frequency Modulator into operation with its connections to the Oscillator and Oscillograph as shown on Figure 6. Retune the test Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-46, C-12 and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator until the similar forward and reverse waves appear on the screen. It is advisable to shift the Oscillator to its 200—400 kc. range and use the third harmonic of the generated signal in order to obtain the desired range of sweep for this adjustment. The trimmer C-44 should then be adjusted until a point is reached where the waves have the greatest amplitude. It will be unnecessary to rock the tuning condenser for this operation inasmuch as the Frequency Modulator is automatically producing the same effect. After completing this adjustment, the trimmer C-46 should be realigned as in (a) to correct for any change in the oscillator high frequency tuning which has been caused by the adjustment of C-44.

Band X

(a) Disconnect the Frequency Modulator and tune the test Oscillator to a frequency of **400 kc.** (Modulation "On"). Place the receiver range switch in its Band X position and turn the station selector until the dial pointer reads **400 kc.** Adjust the Oscillograph timing control to "Int." Then align each of the trimmers C-47, C-13 and C-4 to the point producing maximum output at the Oscillograph. Place the Frequency Modulator in operation and attach it to the Oscillator in the normal manner. Change the Oscillograph timing to "Ext." Increase the frequency of the Oscillator (modulation "Off") until the two waves appear and become coincident at their highest points, *approximately at 462 kc.*. They may be made to remain stationary on the screen by manipulation of the Oscillograph range switch and frequency control. Readjust the three trimmers C-47, C-13 and C-4 to give maximum amplitude and complete coincidence of the waves.

(b) Change the test Oscillator so that it delivers a signal of **150 kc.** with the Frequency Modulator disconnected. Tune this signal on the receiver which has previously been set to Band X, disregarding the dial reading at which the signal is best received. Then interconnect the Frequency Modulator with the Oscillator and retune the latter to the point at which the two similar waves appear on the screen. Adjust the trimmer C-48, for maximum amplitude of the wave images. Rocking of the tuning condenser will not be necessary as the Frequency Modulator duplicates such an operation. Repeat the alignment of C-47 as outlined in (a) to correct for any reflective error brought about by the adjustment of C-48.

Band B

(a) Advance the receiver range switch to its Band B position and tune the station selector to a dial reading of **6132 kc.** Set the test Oscillator to this same frequency (Modulation "On" and Frequency Modulator disconnected) and increase its output until a suitable indication is apparent on the Oscillograph. Then adjust the trimmer C-42 to the point producing the maximum amplitude of the image. Two positions will be found on this trimmer which causes maximum amplitude. The one of least capacitance is correct and should be used. Check for the "image" signal, which will be received at **5212 kc.** on the dial if the adjustment of C-42 has been properly made. An increase in Oscillator output may be necessary for this test, however *its frequency should not be changed nor any trimmer adjustments made on the receiver.*

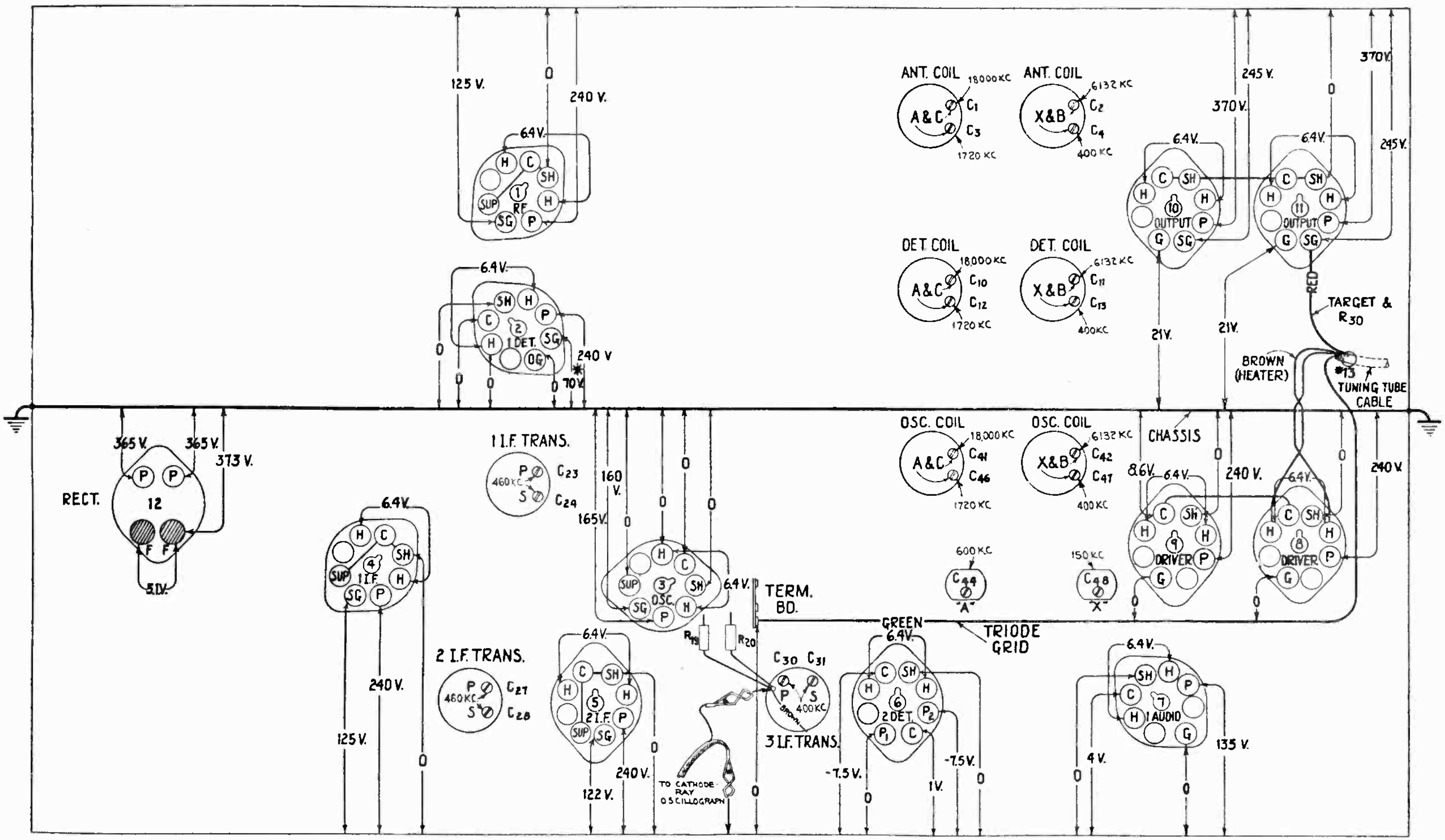


Figure 7—Trimmer Locations and Radiotron Socket Voltages

Measured at 120 volts A.C.—No Signal—All Tubes Intact—Volume Control Maximum—Band Switch on "A"

* Measured on 250 Volt Range of 1000 Ohm Per Volt Meter

(b) Return the station selector to the **6132 kc.** reading and align the detector and antenna trimmers C-11 and C-2 respectively, for maximum (peak) output as shown by the Oscillograph. No further adjustments are to be made on Band B.

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to this same frequency (Modulation "On" and Frequency Modulator disconnected), regulating its output to the level required for convenient observation. Adjust the trimmer C-41 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of C-41 has been properly made, using the position of minimum capacitance giving maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, realign C-41 if necessary, and then adjust the detector and antenna trimmers C-10 and C-1 for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on Band C.

Band D

No adjustments are required on this band.

Output Meter Alignment

To align the receiver by other methods than that explained above will require the use of a standard test oscillator, such as the Stock No. 9595, and a suitable output indicator, such as the Stock No. 4317. The indicator should be connected either to the voice coil circuit or across the output transformer primary. For each adjustment, the volume control should be maintained at maximum and the Oscillator output regulated until the indication is barely perceptible. The smaller the amount of glow, the more accurate will be the indication. The signal level will also be below the range of the receiver a.v.c., preventing broadness of tuning.

I-F Adjustments—Connect the output of the test Oscillator from the RCA-6L7 first detector control grid to chassis-ground and adjust its frequency to **460 kc.** Tune the receiver to Band "A", setting the station selector at a point where no interference is received from local stations or the local oscillator. Then tune the i-f trimmers C-31, C-30, C-28, C-27, C-24 and C-23 in order, each for maximum indicated receiver output.

R-F Adjustments—Connect the Oscillator output to the antenna-ground terminals of the receiver. Keep the output indicator attached to the receiver output as above. For each adjustment, use the minimum signal which will give a perceptible indication on glow indicator.

BAND A

(a) Set the range switch of the receiver to its Band A position and tune the selector to a dial reading of **1720 kc.** Tune the Oscillator to this same frequency and adjust trimmers C-46, C-12 and C-3 to produce maximum indicated receiver output.

(b) Shift the Oscillator to **600 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then adjust trimmer C-44, simultaneously rocking the tuning control backward and forward through the signal, until maximum output is obtained from the combined operations. Repeat the alignment of C-46 as in (a) to correct for any change caused by adjustment of C-44.

BAND X

(a) Change the range switch to its Band "X" position. Tune the receiver to read **400 kc.** and set the Oscillator to produce this same frequency. Adjust trimmers C-47, C-13 and C-4 to produce maximum receiver output.

(b) Shift the Oscillator frequency to **150 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then tune the oscillator series trimmer C-48, simultaneously rocking the tuning control (receiver) backward and forward through the signal, until maximum output results from the combined operations. Repeat the alignment of C-47 as in (a) to correct for any change caused by the adjustment of C-48.

BAND B

Place the receiver range switch in its Band "B" position and tune the station selector to a dial reading of **6132 kc.** Set the frequency of the Oscillator to **6132 kc.**

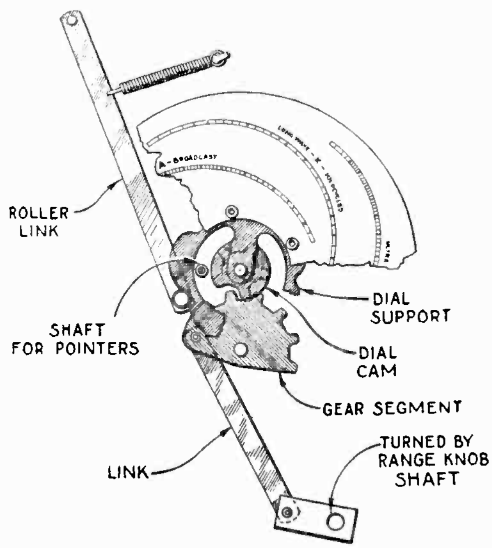


Figure 8—Selector Dial Change Mechanism

Then adjust trimmer C-42 to give maximum receiver output. Two positions may be found which fulfill this condition. The one of least capacitance is correct. To assure that the right peak has been used; tune the *receiver* to **5212 kc.** and increase the Oscillator output. The "image" of **6132 kc.** will be received at this point if C-42 has been adjusted to the proper point of maximum output. *No trimmer adjustments are to be made* *during this check.* Return the receiver tuning to **6132 kc.**, readjust C-26 if necessary, and then tune the detector and antenna coil trimmers, C-11 and C-2 to produce maximum (peak) receiver output as indicated on the glow meter.

BAND C

Turn the receiver range switch to its Band "C" position and set the tuning control to a dial reading of **18,000 kc.** Tune the Oscillator to this same frequency. Adjust the oscillator parallel trimmer C-41 to produce maximum receiver output. Two positions of the trimmer will be found which fulfill such a condition. The one of least capacitance is correct. To assure that the right position has been used, check for the "image" of the **18,000 kc.** signal which will be received at **17,080 kc.** on the dial if C-41 is correctly adjusted. An increase in Oscillator output may be necessary. *No trimmer adjustments should be made during this check.* Return the receiver tuning to **18,000 kc.**, readjust C-41 if necessary, and then tune the detector and antenna trimmers C-10 and C-1 to give maximum receiver output.

Dial Adjustment

Figure 8 illustrates the relations of the various parts of the dial mechanism when it is in its A–Broadcast position and the range switch is likewise turned to its Band A setting. In re-assembling the dial after repair, see that the gears are meshed in accordance with the diagram, at the same time noting that the lever which is attached to the range switch shaft is in the position as shown.

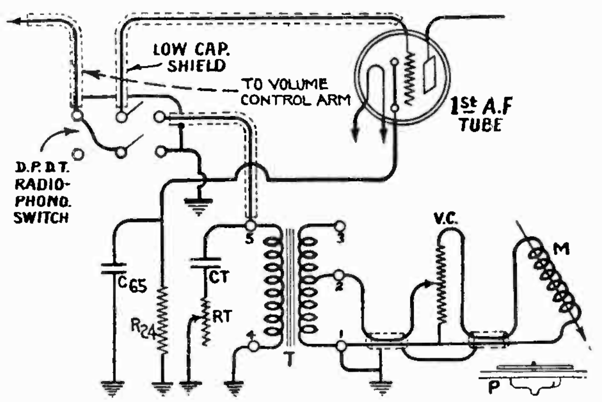


Figure 9—General Phonograph Connections

INSTALLATION

Change the receiver circuits and add phonograph connections to conform with the above schematic. Thoroughly shield leads where indicated, keeping them clear of a-c circuits and transformers. Place transformer T so as to obtain minimum lengths of secondary leads and mount it in the position which does not cause hum.

PARTS REQUIRED

M—Magnetic Pickup —Low Impedance
VC—Volume Control —100 ohms
T—Phono Input Transformer—Stock No. 7445
P—Phono Turntable Mechanism
CT—Condenser—.05 mfd.
RT—Variable Resistor —0 to 10,000 ohms

Phonograph Attachment

The audio system of this receiver may be adapted for use in the reproduction of phonograph records by proper connection and arrangement of an external turntable and its associated accessories. The relatively high amplification due to the number of a-f stages employed, necessitates that great care be taken when the circuits are changed for phonograph input. It is recommended that the pickup used be fed directly to the grid circuit of the first audio stage, with suitable switching installed for changing between radio and phonograph operation. Diagrams covering suggested methods of phonograph attachment are given in Figures 9 and 10 with installation details. Hum may possibly be encountered from lack of shielding and improper placement and shielding of the input transformer if these items are not taken care of during rearrangement of the circuits. All wiring should be installed in a substantial and permanent manner.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to ground on Figure 7 will serve to assist in locating causes for faulty operation when existent. Each value as specified should hold within ± 20% when the receiver is normally operative at the rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given on the diagram are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance is comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each check is chosen as high as possible consistent with good readability.

Universal Transformer

The wiring of the special transformer used in some models of this receiver is given by Figure 4. This transformer is adaptable to several ranges of voltage, hence, in cases of receiver inoperation, the connections should be checked to assure that they are correct for the voltage being used.

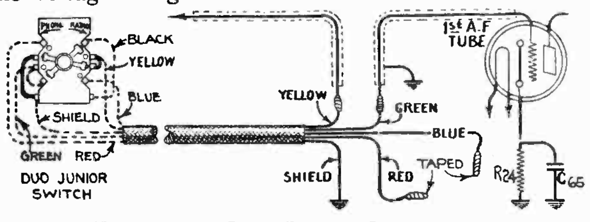


Figure 10—Duo Junior Connections

INSTALLATION

Arrange connections from Duo Junior output cable to receiver so that completed wiring is in accordance with schematic above. Add two jumpers shown by heavy full lines to Duo Junior Radio-Phono switch. Keep all leads as short as possible and well shielded where indicated.

PARTS REQUIRED

Model R-93—Duo Junior Phonograph

MODEL C13-2
REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4427	Bracket—Low frequency tone control switch, volume control or high frequency tone control mounting bracket	$0.18
5237	Bushing—Variable capacitor mounting assembly—Package of 3	.43
11255	Cable—Radiotron tuning lamp cable complete with socket	1.20
5241	Capacitor—Adjustable capacitor—(C44, C48)	.40
11286	Capacitor—14 Mmfd. (C39)	.24
11292	Capacitor—22 Mmfd. (C8)	.24
11289	Capacitor—50 Mmfd. (C16,C21)	.26
11291	Capacitor—115 Mmfd. (C7, C50, C52)	.24
11295	Capacitor—200 Mmfd. (C77)	.30
11294	Capacitor—325 Mmfd. (C45)	.32
11290	Capacitor—400 Mmfd. (C36, C37, C51)	.25
11269	Capacitor—800 Mmfd. (C15)	.30
11293	Capacitor—900 Mmfd. (C66)	.40
11335	Capacitor—1300 Mmfd. (C43)	.30
11287	Capacitor—4500 Mmfd. (C40, C57)	.30
4838	Capacitor—.005 Mfd. (C73, C75)	.20
5242	Capacitor—.005 Mfd. High frequency tone control capacitor (C71)	.52
5148	Capacitor—.007 Mfd. (C72)	.20
4624	Capacitor—.01 Mfd. (C64)	.54
4883	Capacitor—.01 Mfd. (C38,	.20
4937	Capacitor—.01 Mfd. (C74)	.25
4836	Capacitor—.05 Mfd. (C5, C17, C25, C29, C59)	.30
4886	Capacitor—.05 Mfd. (C60)	.20
4841	Capacitor—.1 Mfd. (C19, C58)	.22
4885	Capacitor—.1 Mfd. (C14, C20, C26, C32, C33)	.28
4840	Capacitor—.25 Mfd. (C9)	.30
3597	Capacitor—.25 Mfd. (C69)	.40
11203	Capacitor—10 Mfd. (C53)	1.18
5212	Capacitor—18 Mfd. (C54)	1.16
11204	Capacitor Pack—Comprising one 10 Mfd., one 20 Mfd., and two 8 Mfd. capacitors C55, C56, C65, C67)	3.44
11208	Capacitor Pack—Comprising one .015 Mfd. and one .05 Mfd. capacitor and one 27,000 ohm and one 10,000 ohm resistors C62, C63, R22, R23)	1.32
11272	Clamp—Cable clamp—Located on top surface of chassis near variable tuning condenser	.10
4693	Clamp—Electrolytic capacitor mounting clamp—for Stock No. 11204	.15
5215	Coil—Antenna coil—A and C Bands—(L1, L2, L5, L6, C1, C3)	2.32
5218	Coil—Antenna coil—X and B Bands—(L3, L4, L7, L8, C2, C4)	2.58
5216	Coil—Detector coil—A and C Bands—L9, L10, L13, L14, C10, C12)	2.34
5219	Coil—Detector coil—X and B Bands—(L11, L12, L15, L16, C11, C13)	2.58
5217	Coil—Oscillator coil—A and C Bands—(L25, L27, C41, C46)	2.20
5220	Coil—Oscillator coil—X and B Bands—(L26, L28, L29, C42, C47)	2.24
5221	Coil—Oscillator coil—D Band—(L24)	.64
5214	Condenser—3 gang variable tuning condenser—(C6, C18, C49)	4.42
5226	Lamp—Pilot lamp—Package of 5	.70
11710	Lead—Shielded lead for antenna	.40
8041	Plate—I.F. or R.F. coil shield locking plate—Package of 2	.12
5112	Resistor—1000 ohms—Carbon type—¼ watt (R3, R10, R28)—Package of 5	1.00
11285	Resistor—1000 ohms—Flexible type—(R12, R16)—Package of 5	1.00
11283	Resistor—1200 ohms—Carbon type—¼ watt—(R24)—Package of 5	$1.00
3381	Resistor—10,000 ohms—Carbon type—¼ watt (R26)—Package of 5	1.00
5114	Resistor—15,000 ohms—Carbon type—1 watt (R2)	.22
8070	Resistor—22,000 ohms—Carbon type—½ watt (R25)—Package of 5	1.00
11305	Resistor—22,000 ohms—Carbon type—¼ watt (R35)—Package of 5	1.00
8065	Resistor—27,000 ohms—Carbon type—½ watt (R7)—Package of 5	1.00
5033	Resistor—33,000 ohms—Carbon type—1 watt (R29)—Package of 5	1.10
11300	Resistor—33,000 ohms—Carbon type—1/10 watt (R6)—Package of 5	.75
11282	Resistor—56,000 ohms—Carbon type—1/10 watt (R8)—Package of 5	.75
8064	Resistor—82,000 ohms—Carbon type—½ watt (R34)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R11, R13, R14)—Package of 5	1.00
11281	Resistor—100,000 ohms—Carbon type—1/10 watt (R1, R9)—Package of 5	.75
5158	Resistor—220,000 ohms—Carbon type—¼ watt (R37)—Package of 5	1.00
3033	Resistor—1 megohm—Carbon type—¼ watt (R5)—Package of 5	1.00
4241	Resistor—1.5 Megohms—Carbon type—¼ watt (R15)—Package of 5	
11151	Resistor—2.2 megohm—Carbon type—¼ watt (R19, R20)—Package of 5	1.00
11209	Resistor—Voltage divider resistor—Comprising one 4100 ohm, one 4700 ohm, one 50 ohm, two 33 ohm and one 124 ohm sections—(R31, R32, R33, R36, R38, R39)	1.16
5249	Shield—Antenna, Dectector or Oscillator coil shield	.20
5250	Shield—Intermediate frequency transformer shield	.22
11273	Shield—Rectifier Radiotron shield	.25
4794	Socket—4 contact rectifier Radiotron socket	.15
11197	Socket—6 contact Radiotron socket—For first audio or driver radiotrons—(6C5)	.14
11198	Socket—7 contact Radiotron socket—For 6K7, 6H6, or 6F6 radiotrons	.15
11278	Socket—7 contact oscillator Radiotron (6J7) socket	.20
11279	Socket—7 contact First Detector Radiotron (6L7) socket	.20
11199	Socket—Dial lamp socket	.14
5224	Switch—Low frequency tone control switch and power switch (S12, S14)	1.00
5225	Switch—Range switch—(S1, S2, S3, S4, S5, S6, S8, S9, S10, S11, S13)	3.75
5238	Terminal—Antenna terminal board and clip with insulating strip and rivets	.14
5222	Tone Control—High frequency tone control—(R27)	1.04
5232	Transformer—Audio driver transformer—(T3)	2.50
5228	Transformer—First Intermediate frequency transformer—(L17, L18, C23, C24)	1.80
5234	Transformer—Interstage Audio transformer—(T2)	3.40
8061	Transformer—Power transformer—105-125 volts 50/60 cycles—(T1)	6.75
8062	Transformer—Power transformer—105/125 volts 25/50 cycles	9.84
11194	Transformer—Power transformer—105/125/150/210/250 volts 40/60 cycles	7.08

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
11206	Transformer—Second Intermediate frequency transformer—(L19, L20, C27, C28)....	1.82
5230	Transformer—Third Intermediate frequency transformer—(L21, L22, C30, C31, C61, R17, R18)........................	2.76
11205	Volume Control—Complete (R21).......	1.30
	DRIVE ASSEMBLIES	
5243	Arm—Band indicator operating arm......	.42
10194	Ball—Steel ball for drive assembly—Package of 20.........................	.25
8054	Cam—Five position cam—For station selector drive assembly....................	.28
4422	Clutch—Tuning condenser drive clutch assembly—Comprising drive shaft, balls, ring, spring and washers assembled......	1.00
8048	Coupling—Flexible coupling for variable capacitors—Includes indicator shaft.....	.70
11336	Dial—Dial scale with mounting rivets....	.60
8045	Disc—Drive disc and gear assembly.......	.46
11380	Drive—Tuning condenser drive assembly complete..........................	6.35
8044	Escutcheon—Dial escutcheon and vernier label	1.08
8050	Gear—Gear sector and band indicator operating link—(Link connects to arm on band switch).......................	.15
8046	Gear—Indicator shaft drive gear and vernier idler with one spring............	.72
8053	Indicator—Station selector vernier pointer	.12
11793	Indicator—Station selector indicator pointer	.15
8051	Link—Complete with roller and spring....	.30
8049	Pinion—Vernier pointer drive pinion and shaft	.55
4669	Screw—8-32x5/32" Square head set screw for drive assembly—Package of 10......	.25
8047	Spring—Coil spring for indicator shaft drive gear and vernier idler (Stock No. 8046)	.12
8052	Spring—Coil spring for link—Package of 5	.32
8042	Stud—Band indicator operating arm stud—Package of 5..	.25
	MISCELLANEOUS ASSEMBLIES	
5211	Bolt—Reproducer mounting bolt assembly—Package of 2......................	.24

Stock No.	Description	List Price
11191	Bracket—Radiotron tuning lamp mounting bracket—Less clamp.................	.12
11192	Clamp—Radotron tuning lamp mounting clamp—Less bracket.................	.12
11193	Cover—Reproducer cover...............	.82
11276	Escutcheon—Radiotron tuning lamp escutcheon	.40
11379	Escutcheon—Station selector escutcheon and crystal	1.08
11346	Knob—Station selector knob—Package of 5	.75
11347	Knob—Volume control, tone control range switch or power switch knob—Package of 5	.75
11382	Resistor—1 megohm—Carbon type—1/10 watt—Used in tuning tube socket—Package of 5 (R30).....................	.75
5210	Screw—Chassis mounting screw assembly—Package of 4......................	.16
11348	Screw—8-32x7/16" Headless cupped point set screw for knob No. 11346—Package of 10............................	.32
11381	Socket—Radiotron tuning tube socket and cover.............................	.45
11349	Spring—Retaining spring for knob (Stock No. 11347)—Package of 5............	.15
	REPRODUCER ASSEMBLIES	
8059	Board—Terminal board (2 terminals)....	.14
8060	Bracket—Output transformer mounting bracket	.14
11200	Cable—Reproducer cable................	.50
8058	Clamp—Cone rim clamp—Package of 4....	.44
11189	Coil—Field coil—magnet and cone housing (L31)	10.60
8056	Cone—Reproducer cone (L30)..........	1.58
5039	Connector—4 contact male connector for reproducer	.25
5040	Connector—4 contact female connector for reproducer cable.....................	.25
9620	Reproducer—Complete	16.32
8057	Transformer—Output transformer (T4, C76)	3.22

RCA VICTOR MODEL C 15-3

Fifteen-Tube, Five-Band, A-C, Superheterodyne Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Frequency Ranges

Band X	140— 410 kc.
Band A	540— 1,800 kc.
Band B	1,800— 6,000 kc.
Band C	6,000—18,000 kc.
Band D	18,000—60,000 kc.

Alignment Frequencies

Band X	150 kc. and 400 kc.
Band A	600 kc. and 1720 kc.
Band B	6132 kc.
Band C	18000 kc.
Band D	*none required*

Voltage and Frequency

Rating A	105—125 volts, 50—60 cycles
Rating B	105—125 volts, 25—60 cycles
Rating C	100—130/140—160/195—250 volts, 40—60 cycles

Radiotron Complement

(1)	RCA-6K7	Radio-Frequency Amplifier
(2)	RCA-6L7	First Detector
(3)	RCA-6J7	Heterodyne Oscillator
(4)	RCA-6K7	First Intermediate Amplifier
(5)	RCA-6K7	Second Intermediate Amplifier
(6)	RCA-6K7	Automatic Volume Control Amplifier
(7)	RCA-6H6	Automatic Volume Control
(8)	RCA-6H6	Second Detector
(9)	RCA-6C5	First Audio Amplifier
(10)	RCA-6C5	Audio Driver Amplifier
(11)	RCA-6C5	Audio Driver Amplifier
(12)	RCA-6F6	Power Output Amplifier
(13)	RCA-6F6	Power Output Amplifier
(14)	RCA-5Z3	Full Wave Rectifier
(15)	RCA-6E5	Tuning Indicator

Miscellaneous

Power Consumption	145 watts
Undistorted Output	10 watts
Maximum Output	15 watts

Loudspeaker	12 inch, Electrodynamic
Voice Coil Impedance	7.5 ohms at 400 cycles
Intermediate Frequency	460 kc.

MECHANICAL SPECIFICATIONS

Cabinet Dimensions

Height	42 inches
Width	29⅜ inches
Depth	15⅝ inches

Weight (Net)	113 pounds
Weight (Shipping)	165 pounds
Chassis Base Size	20¾ inches x 10½ inches x 3½ inches

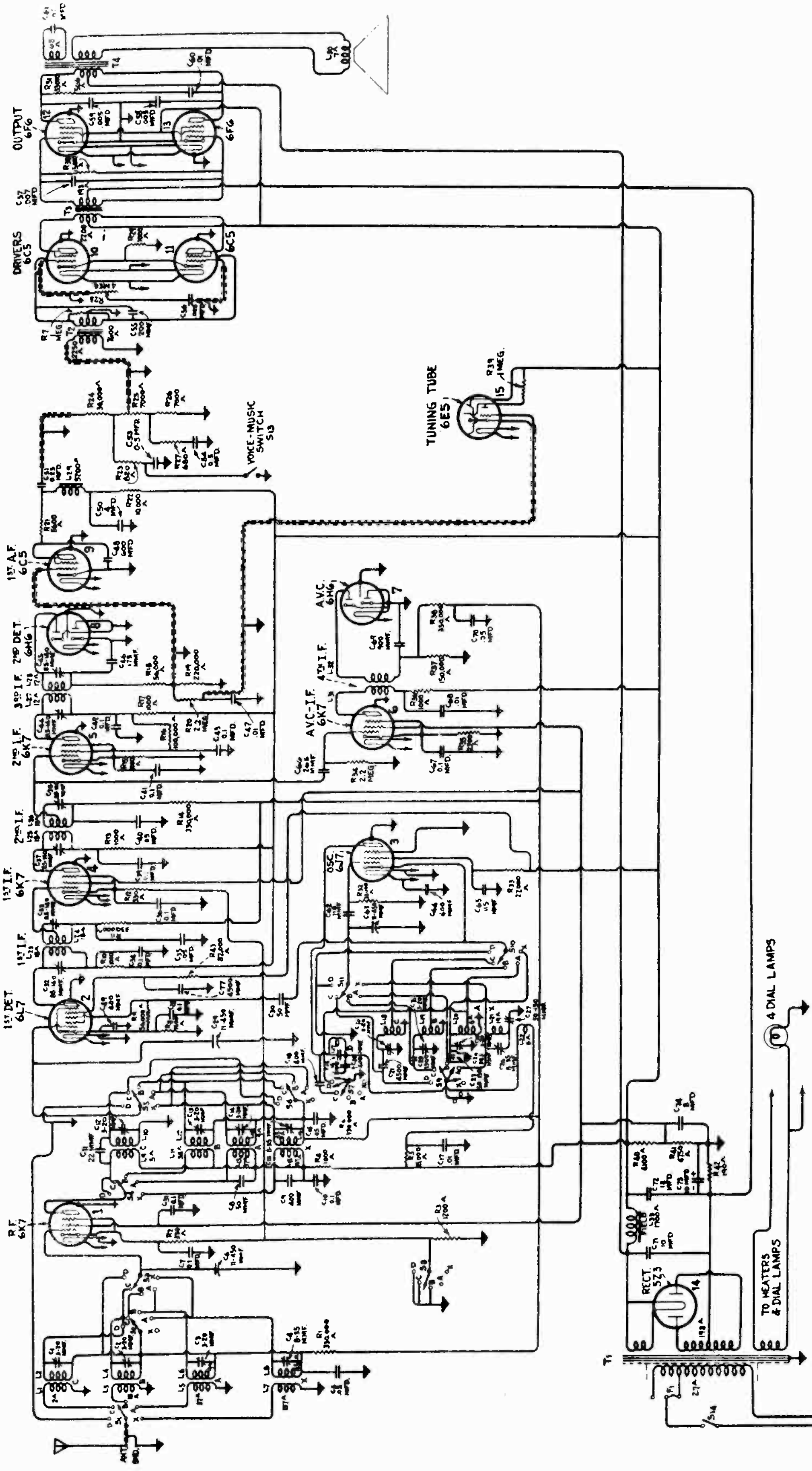


Figure 1—Schematic Circuit Diagram

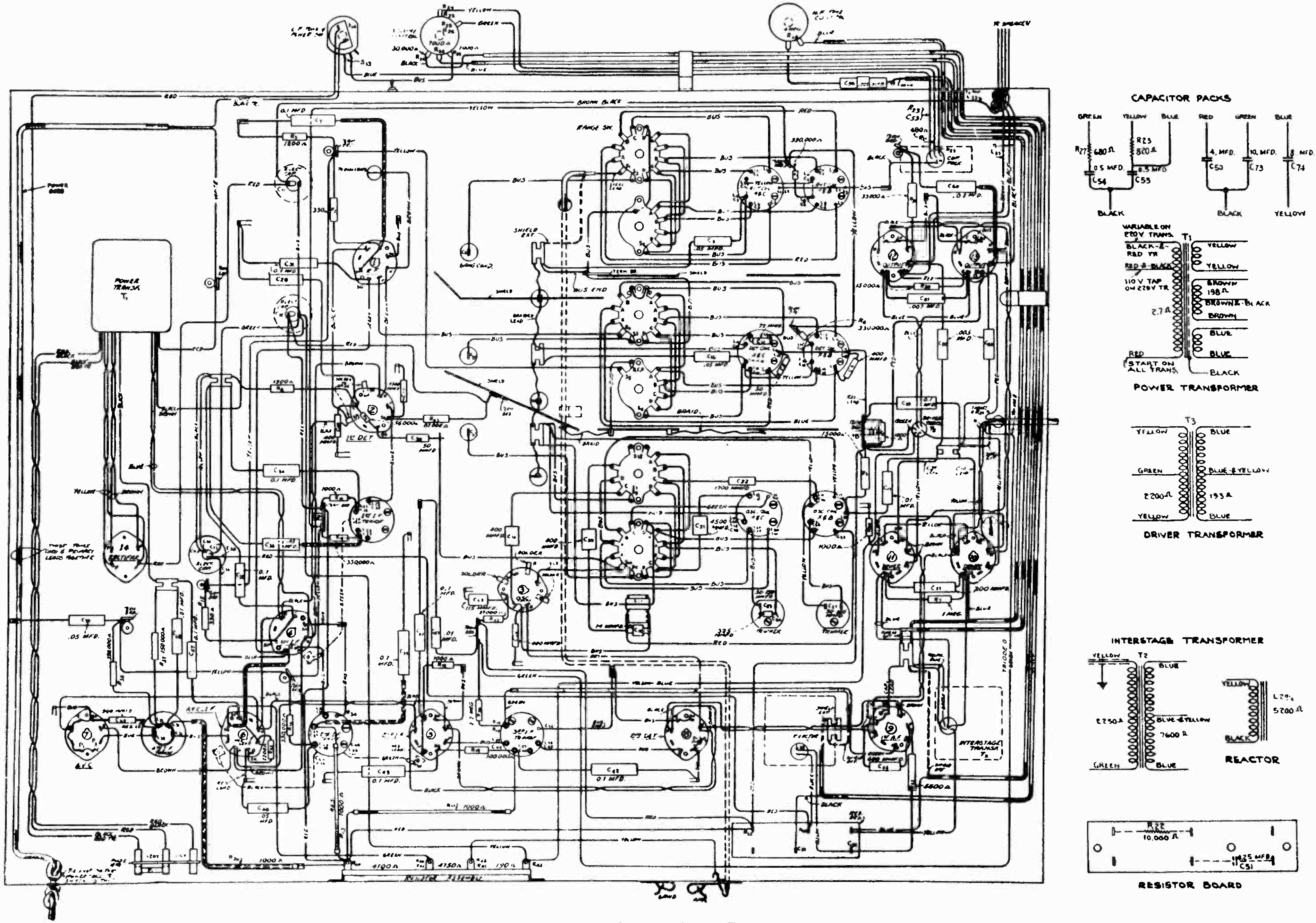


Figure 2—Chassis Wiring Diagram

GENERAL FEATURES

Metal Tubes

This receiver uses the new metal tubes which are much smaller in size than the corresponding glass types. The high frequency efficiency of these metal tubes is greater because of the shorter lengths of leads, lesser interelectrode capacitance and the more complete shielding of the metallic envelopes. Their rugged construction prevents breakage and reduces microphonic tendencies. The bases and sockets of all types have a standardized arrangement of connecting prongs.

Receiver Chassis

Service convenience has been a controlling factor in the layout of the chassis parts and wiring. The assembly of these various elements is such that the number of conductors is minimized with all important connections being readily accessible. Further accessibility to all parts of the chassis is due to the open construction of the base and mounting supports. Trimmer adjustments are easily reached from the underside of the chassis. The r-f, detector and oscillator coils are identified by markings on their bases, which for example read "AAO" to indicate the Band A, "antenna" and "oscillator" coils.

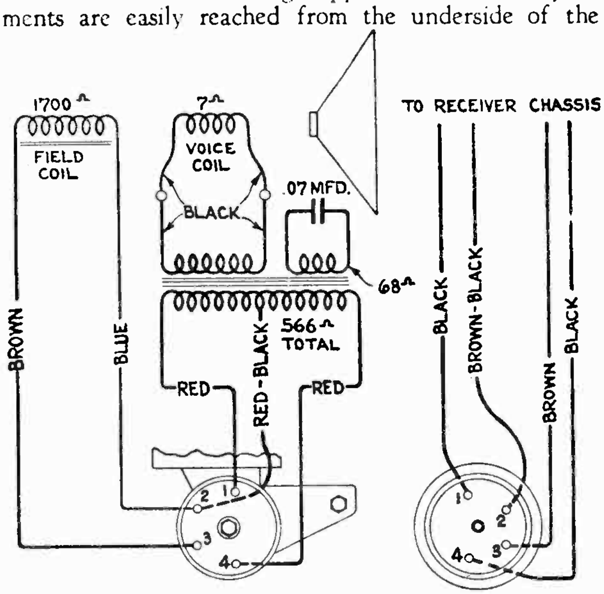


Figure 3—Loudspeaker Schematic and Wiring

Dial Drive

The dial drive and station indicator system are of new and unique design. Five individual dial scales, each with full 180 degree band spread, are provided, one for use on each band. The scales are eccentrically arranged on a rotary disc and adapted to operate in connection with the band change switch so that as the switch is shifted to a certain band, the corresponding dial scale rotates into position. For other positions of the band switch, a similar scale selection takes place, there being only one scale visible at a time. The driving mechanism for the dial and condenser has tuning ratios of 10 to 1 and 50 to 1. Control may be interchanged between these two ratios by push-in operation of a positive action clutch which is actuated by the tuning knob. From the clutch and ratio controlling mechanism, the drive system interlinks with the tuning condenser, main dial pointer and vernier dial pointer through means of fibre and brass gears. The ratio of vernier rotation to the main pointer is 20 to 1. An intermediate gear is used in the system to reduce gear back-lash. This gear is suspended in position with two tension springs which maintain the proper mesh at all times. A flexible coupling disc is used between the drive and the condenser shaft.

Tuning Condenser

The variable tuning condenser is supported by a new design of shock-proof mount which has been developed by our engineers to prevent chassis vibration from producing audio frequency "howl."

Power Transformer

The heat incident to the operation of the transformer is efficiently radiated by the fin effect of the chassis base to which it is mounted. Life of the transformer and its efficiency of performance are thereby appreciably increased. An improved static shield is used between the windings to eliminate line disturbances.

Loudspeaker

A super-sensitive 12 inch electrodynamic speaker is employed. It is correctly adapted to the cabinet design to assure the best possible acoustic performance. Electrical connection is made from the speaker to the chassis through a plug and connector attachment, permitting easy removal for servicing.

ELECTRICAL CIRCUIT

The Superheterodyne method of operation is the basis of the design. The amount of radio frequency as well as audio frequency amplification is balanced in such manner that the maximum of performance is obtained. The following general items cover the circuit arrangement and notable features involved:—

Tuned Circuits

Six adjustable tuned circuits are used in the i-f system, each resonating at 460 kc. A three section variable condenser tunes the secondary of the antenna transformer, the secondary of the detector input transformer and the oscillator coil on all bands with the exception of D, which has only its detector and oscillator tuned. Each tuning range has its own group of r-f and oscillator coils, they being selected as desired by operation of the band-change switch. Trimmer condensers are provided on all of the tuned circuits for use in obtaining precise alignment.

Band D Tuning

Special notice should be taken of the manner of tuning this band. The r-f stage is unused when the range switch is turned to its Band D position and the signal is fed from the antenna directly to the first detector input circuit. The inductance of this circuit consists of a short length of bus wire to which the antenna lead is tapped at a definite predetermined point. The total length of this inductive wire from the stator of the tuning capacitor to ground represents the secondary of a high frequency autotransformer, while the inductive section included between the antenna lead tap and ground forms the primary. Alteration of the dimensions and position of this wiring will change the tuning and alignment of the circuit, resulting in total

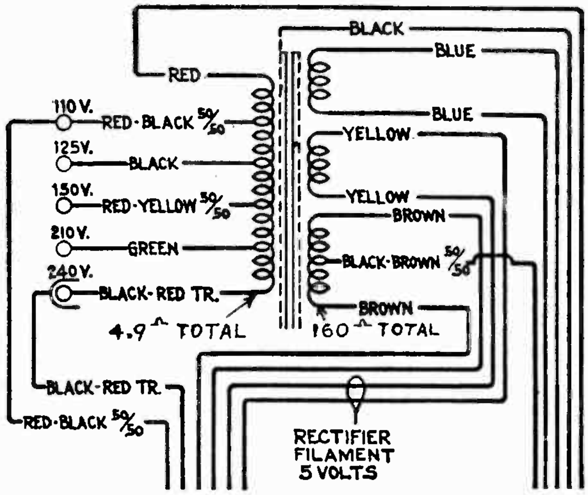


Figure 4—Universal Transformer Schematic and Wiring

lack of operation or seriously poor operation. *It is therefore necessary when servicing to avoid changes in the wiring which includes Band D detector and oscillator r-f circuits unless the arrangement is restored to its exact original condition.* Similar caution should be observed when exchanging by-pass condensers in these same circuits, since their values, physical positions, length of leads, quality of dielectric etc. are critical and variations will definitely affect operation of the receiver. The small heater by-pass condensers and ground terminals installed at the tube sockets are very important in this respect.

Oscillator Stage

The heterodyne oscillator circuit used in this receiver is an improved type, having exceptional frequency stability and uniformity of output over its various tuning ranges. It operates on fundamental frequencies which are fed to the first detector hexode tube (RCA-6L7) on an auxiliary mixing grid. The oscillator generates a signal which is at all times above the frequency of the incoming signal by 460 kc. As shown by the schematic diagram, the cathode of the oscillator tube is above ground potential for r.f., while the plate is effectively at ground potential. This particular arrangement, together with the plate and screen series resistors, makes the circuit independent of supply voltage variations in regard to stability and uniformity of output. Separate coils are used for each of the tuning ranges. The switching of the different bands is such as to short circuit certain unused coils which would absorb energy from the circuits used.

Intermediate Amplifier

Two stages of i-f amplification comprising three tuned transformers and two RCA-6K7 tubes are arranged in cascade to operate at 460 kc. The transformers have their primaries as well as secondaries tuned by adjustable trimmer capacitors. These trimmers are designed to resist moisture, temperature and other detrimental factors which may affect their adjustments. Litz wire is used for the windings of the third transformer in order to provide the proper efficiency in driving the diode second detector.

Second Detector

Signal detection is brought about by the rectifying action of the RCA-6H6 double diode tube. Audio signal obtained from the voltage drop across resistor R-19 in the diode circuit, is transmitted to the first audio stage by direct coupling. The direct signal component across resistor R-19 is used for bias for the RCA-6C5 first audio tube.

Automatic Volume Control

The a.v.c. operates as a parallel system, being fed from the first i-f output through an auxiliary amplifier tube, an RCA-6K7. This stage has an untuned input and broadly resonated output, as accomplished in the natural period fourth i-f transformer. A double diode RCA-6H6 receives the signal at i-f frequency from the No. 6 stage and rectifies it in order to obtain the d-c component required for a.v.c. This component, which develops across resistor R-37, is applied to the control grids of the r-f, first detector and i-f tubes through resistor-condenser filter systems. The value of the bias obtained by this process varies with the intensity of the received signal and in turn governs the amplification of the receiver, thereby automatically regulating the output to the same level when there are fading tendencies and similarly when tuning from station to station.

Audio System

Several stages of audio amplification provide excellent fidelity and wide range of volume both for short wave as well as on the standard and long wave bands. The high gain of the system has necessitated thorough shielding and careful manufacture. All wiring, transformers, etc., should always be placed as originally installed if it has been necessary to remove such for service purposes. Hum difficulties are likely to occur if this caution is not observed. Manual volume control is by means of an acoustically tapered potentiometer which conveys the audio output of the first a-f stage to the interstage coupling transformer. This control has tone compensation produced by filters connected to two points thereon. This gives the correct aural balance at different volume settings. A music-speech switch is provided in one of the volume control filter circuits for use in obtaining good speech intelligibility. On the speech position, the low frequency tones are reduced. A push-pull driver stage is used between the first a.f. and the Class AB output amplifier. A continuously variable high frequency tone control is shunted across the grids of the driver tubes. A sharp, high audio frequency cut-off is obtained by a tertiary winding on the audio output transformer and by the correct design of the driver and interstage transformers. This cut-off feature results in quieter operation by the reduction of high frequency noise, especially on weaker stations.

Rectifier and Filter

An RCA-5Z3 full-wave rectifier tube is employed in the high voltage supply system. The loudspeaker field coil serves as a filter reactor in conjunction with high capacity, electrolytic condensers. Fixed bias voltages are made available at the filter output on a divider system, which is likewise well filtered with large capacitors.

Tuning Indicator

A cathode-ray tube is used as a means of visually indicating when the receiver is accurately tuned to the incoming signal. This tube is of new design and comprises an amplifier section and a cathode-ray section built in the same glass envelope. The cathode-ray section consists of a conically shaped luminescent screen, upon which a pattern is formed by an effect of the detected signal after said effect has been amplified by the amplifier section which is fed from the detector diode circuit. The size of the pattern is determined by the strength of the signal voltage, so that any change of tuning may be readily observed in order to facilitate tuning to exact resonance.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed to isolate causes for defective operation. In general, the ratings of the resistors, capacitors, coils, etc. are indicated adjacent to the symbols signifying these parts. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and Replacement Parts List. The coils, reactors and transformer windings are rated in terms of their d-c resistances. Where the value is not given, the resistance is less than one ohm.

Alignment Procedure

The extensive frequency range of this receiver necessitates a more or less involved method of alignment. However, if the following directions are carefully applied, the normal performance of the instrument will be obtained.

Circuits aligned by use of Cathode-Ray equipment will be as near to perfection as possible, hence this method is to be preferred in all cases. Alignment by other methods is oftentimes an approximation unless extreme care is taken and a good deal of time expended. The oscillographic method is particularly advantageous for trimming the i-f tuned circuits to obtain

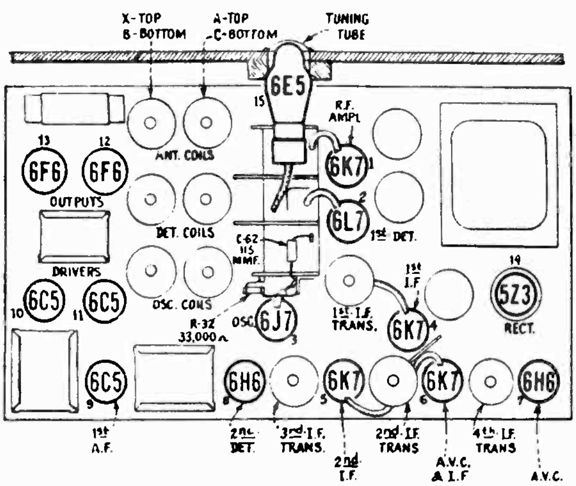


Figure 5—Radiotron and Coil Locations

the utmost in tone quality and at the same time the maximum of selectivity. Procedure to be followed when using a Cathode-Ray Oscillograph is therefore given in detail. Should this type of equipment be unavailable, a substitute indicator may be used, the procedure being the same but without the sweeping operations.

Equipment

The instruments required for placing this receiver in proper alignment should consist of an RCA Cathode-Ray Oscillograph, an RCA Full Range Oscillator, an RCA Frequency Modulator, a Tuning Wand and an Alignment Tool. All of these devices are illustrated and described on a separate page of this booklet. The Cathode-Ray Oscillograph is to be used as an output indicator to precisely show when the circuits are correctly aligned. The Full Range Oscillator is required as the source of standard alignment signals at the various frequencies. Visual alignment is made possible through use of the Frequency Modulator, which in conjunction with the Oscillograph and Oscillator, causes the characteristic wave shape of the circuit under test to be formed on the Oscillograph screen. Adjustments must be made with an insulated screw driver, the Alignment Tool fitting such a requirement. The necessity for alignment and direction of required change may be tested with the Tuning Wand. Its use is as follows:—

The Tuning Wand, which consists of a bakelite rod having a small brass cylinder installed at one end and a core of finely divided iron at the other, may be inserted into a tuned coil to obtain an indication of the tuning. With a signal being supplied to the receiver at the particular frequency of the circuit concerned, each end of the Wand should be placed through the center of the coil. Holes are provided in the coil shields for this test. A change in tuning will be produced by the presence of the brass cylinder or iron core and consequent change of receiver output occurs. If there is a decrease of output when either of the two ends are inserted, the tuning is correct and will require no adjustment. However, should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output, while the iron end causes a decrease, reduction of inductance will be necessary to bring the circuit into alignment. This will be equivalent to decreasing the trimmer concerned.

Changes Indicated by Tuning Wand

Wand	Signal	Trimmer
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

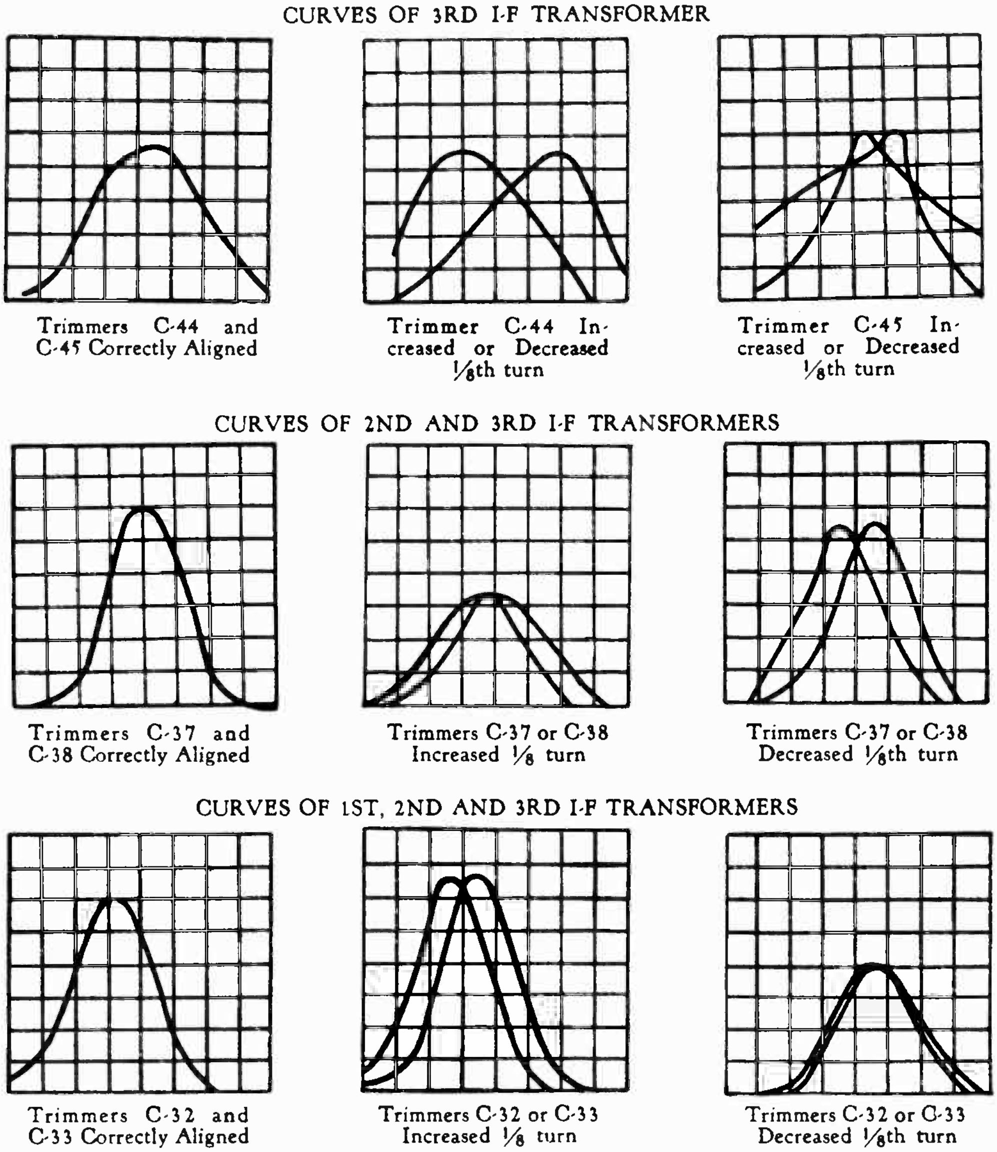


Figure 6—Cathode-Ray Images for I-F System

I-F TRIMMER ADJUSTMENT

Six trimmers are associated with the three i-f transformers. Their locations on the chassis are shown by Figure 8. Each must be aligned to a basic frequency of **460 kc.** The last i-f transformer should be adjusted first, the one preceding it second and the operation carried through successive stages until the first transformer has been aligned. For such a process, it is necessary to feed the output of the Full Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The most convenient point for connection of the Oscillograph is at the control grid of the RCA-6C5 first audio tube, with the vertical "Hi" input terminal attached to the grid connection and the "Gnd" to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as illustrated in Figure 7. A .001 mfd. capacitor installed in series with the Oscillator "Ant." output lead will prevent the voltage constants of the stage being aligned from becoming upset. Proceed further as follows:—

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver volume control to maximum and the range switch to Band "A". Tune the station selector to a point where no interference is caused by local stations or the local oscillator, removing the 6J7 tube if necessary. Turn the Oscillograph vertical "A" amplifier to "On" and advance the vertical gain control to its maximum position. Set the horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a trace completely across the screen. Have the timing control adjusted to "Int."

(b) Attach the output of the test Oscillator to the control grid cap of the second i-f tube (RCA-6K7) and chassis ground. Tune the Oscillator

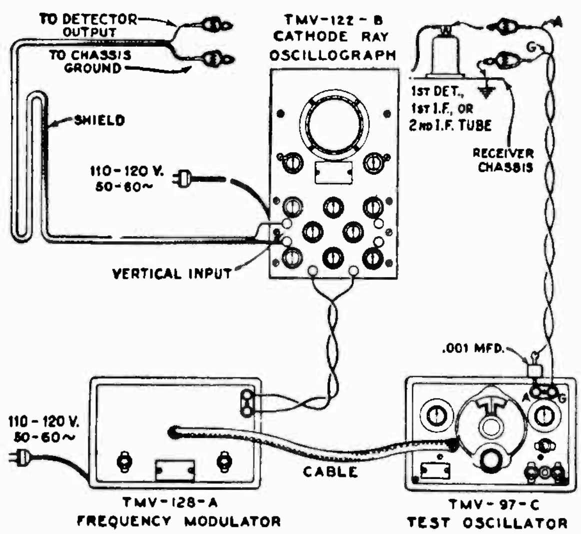


Figure 7—Alignment Apparatus Connections

to **460 kc.** having its modulation switch turned to "On". Regulate the output control until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph frequency and range controls to give the desired number of cycles. Cause the image formed to stand still on the screen by manipulation of the "Sync." control. Use as low a signal output from the Oscillator as can be accurately observed at the Oscillograph. Then tune the two trimmers C-44 and C-45 of the third i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition, the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full Range Oscillator by means of the shielded patch cord provided. Figure 7 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off". Change the timing (Sync.) control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become coincident at their highest points. These curves will be found to occur at an Oscillator setting of *approximately* 540 kc. They will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with these requirements and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-44 and C-45 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as above, change the Oscillator output to the control grid cap of the first i-f tube (RCA-6K7). Adjust the two trimmers C-37 and C-38 of the second i-f transformer until the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude.

(e) Change the test Oscillator output to the control grid of the first detector tube (RCA-6L7) without disturbing the connections and adjustments of the other apparatus. Then align the trimmers C-32 and C33 of the first i-f transformer to produce waves of maximum coincidence and maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the over-all tuning characteristic of the i-f system.

ANTENNA, DETECTOR AND OSCILLATOR

For Bands A and X, adjustments must be made at the high and low frequency ends of the range. On Bands B and C, alignment is required only at the high frequency end. Band D is permanently adjusted during manufacture, hence no alignment will be necessary in this range. Locations of the various antenna, detector and oscillator trimmers are shown on Figure 8. The test Oscillator should be removed from connection with the i-f system and its output attached to the antenna-ground terminals of the receiver. No changes are to be made in the attachment of the Oscillograph at the second detector. During the adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Such procedure will obviate apparent broadness of tuning which would result from a.v.c. action on a stronger signal. The sequence of alignment should be Band A, Band X, Band B and Band C. Proceed with the adjustments as follows:—

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning capacitor plates are in full mesh (maximum capacity). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the and A scale. Correct the setting of the vernier second hand pointer to read zero.

Band A

(a) With the receiver range switch on its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector and antenna trimmers, C-25, C-14 and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. Then shift the timing control to "Ext." and place the Frequency Modulator into operation with its connections to the Oscillator and Oscillograph as shown on Figure 7. Retune the test Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-25, C-14 and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator until the two similar forward and reverse waves appear on the screen. It is advisable to shift the Oscillator to its 200—400 kc. range and use the third harmonic of the generated signal in order to obtain the desired range of sweep for this adjustment. The trimmer C-23 should then be adjusted until a point is reached where the waves have the greatest amplitude. It will be unnecessary to rock the tuning condenser for this operation inasmuch as the Frequency Modulator is automatically producing the same effect. After completing this adjustment, the trimmer C-25 should be realigned as in (a) to correct for any change in the oscillator high frequency tuning which has been caused by the adjustment of C-23.

Band X

(a) Disconnect the Frequency Modulator and tune the test Oscillator to a frequency of **400 kc.** (Modulation "On"). Place the receiver range switch in its Band X position and turn the station selector until the dial pointer reads **400 kc.** Adjust the Oscillograph timing control to "Int." Then align each of the trimmers C-26, C-15 and C-4 to the point producing maximum output at the Oscillograph. Place the Frequency Modulator in operation and attach it to the Oscillator in the normal manner. Change the Oscillograph timing to "Ext." Increase the frequency of the Oscillator (modulation "Off") until the two waves appear and become coincident at their highest points, *ap-*

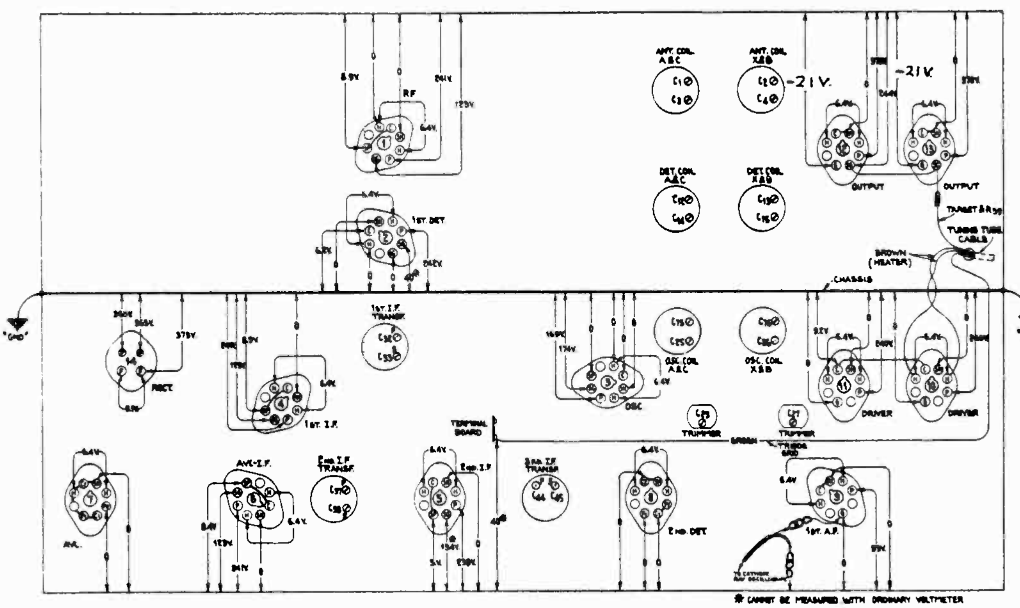


Figure 8—Trimmer Locations and Radiotron Socket Voltages

Measured at 120 volts A.C.—No Signal—All Tubes Intact—Band Switch on "A" *proximately at 462 kc..* They may be made to remain stationary on the screen by manipulation of the Oscillograph range switch and frequency control. Readjust the three trimmers C-26, C-15 and C-4 to give maximum amplitude and complete coincidence of the waves.

(b) Change the test Oscillator so that it delivers a signal of **150 kc.** with the Frequency Modulator disconnected. Tune this signal on the receiver which has previously been set to Band X, disregarding the dial reading at which the signal is best received. Then interconnect the Frequency Modulator with the Oscillator and retune the latter to the point at which the two similar waves appear on the screen. Adjust the trimmer C-27, for maximum amplitude of the wave images. Rocking of the tuning condenser will not be necessary as the Frequency Modulator duplicates such an operation. Repeat the alignment of C-26 as outlined in (a) to correct for any reflective error brought about by the adjustment of C-27.

Band B

(a) Advance the receiver range switch to its Band B position and tune the station selector to a dial reading of **6132 kc.** Set the test Oscillator to this same frequency (Modulation "ON" and Frequency Modulator disconnected) and increase its output until a suitable indication is apparent on the Oscillograph. Then adjust the trimmer C-76 to the point producing the maximum amplitude of the image. Two positions will be found on this trimmer which causes maximum amplitude. The one of least capacitance is correct and should be used. Check for the "image" signal, which will be received at **5212 kc.** on the dial if the adjustment of C-76 has been properly made. An increase in Oscillator output may be necessary for this test, however its frequency should not be changed nor any trimmer adjustments made on the receiver.

(b) Return the station selector to the **6132 kc.** reading and align the detector and antenna trimmers C-13 and C-2 respectively, for maximum (peak) output as shown by the Oscillograph. No further adjustments are to be made on Band B.

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to this same frequency (Modulation "On" and Frequency Modulator disconnected), regulating its output to the level required for convenient observation. Adjust the trimmer C-75 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of C-75 has been properly made, using the position of minimum capacitance giving maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, realign C-75 if necessary, and then adjust the detector and antenna trimmers C-12 and C-1 for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on Band C.

Band D

No adjustments are required on this band.

To align the receiver by other means than those explained in the above procedure will require the use of an output indicator and a suitable test oscillator. The output device should be connected at the receiver output, either to the voice coil circuit or to the output transformer primary. Successive points of connection of the test Oscillator will be identical to those specified for Cathode-Ray alignment, the same test frequencies being used in each case. The process of sweeping the frequency of the test Oscillator with the Frequency Modulator will of course be omitted, instead, the trimmers throughout the system should be adjusted to produce maximum indication at the output. It will be essential to rock the tuning condenser for the low frequency adjustments of Bands X and A, but to cause maximum output rather than the type of indication afforded by the Oscillograph. The receiver volume control must be kept at its maximum setting and for each test, the Oscillator output regulated to maintain an indication which will be as small as possible. Under this condition, the receiver will be operating at maximum gain, but receiving only a weak signal of insufficient strength to cause appreciable a.v.c. action. This requirement is of importance in either method of procedure, since the a.v.c. will have a definite effect on the indication if a more intense input is used.

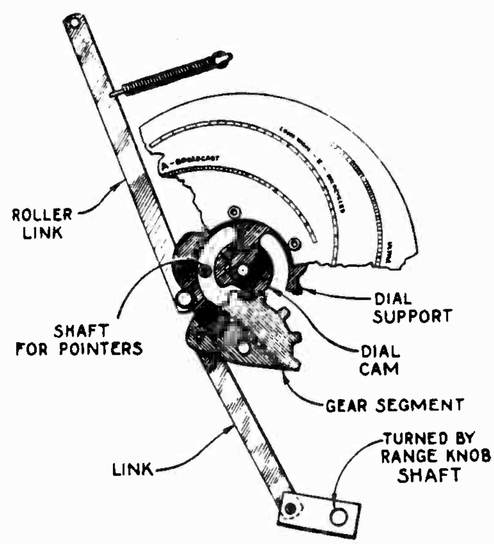


Figure 9—Selector Dial Change Mechanism

Dial Adjustment

Figure 9 illustrates the relations of the various parts of the dial mechanism when it is in its A—Broadcast position and the range switch is likewise turned to its

Band A setting. In re-assembling the dial after repair, see that the gears are meshed in accordance with the diagram, at the same time noting that the lever which is attached to the range switch shaft is in the position as shown.

Phonograph Attachment

The audio system of this receiver may be adapted for use in the reproduction of phonograph records by proper connection and arrangement of an external turntable and its associated accessories. The relatively

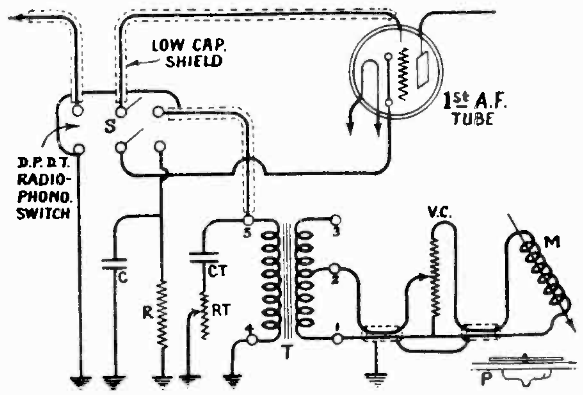


Figure 10—General Phonograph Connections

INSTALLATION

Change the receiver circuits and add phonograph connections to conform with the above schematic. Resistor R and capacitor C must be used to provide the proper bias. Thoroughly shield leads where indicated, keeping them clear of a-c circuits and transformers. Place transformer T so as to obtain minimum lengths of secondary leads and mount it in the position which does not cause hum.

PARTS REQUIRED

- M—Magnetic Pickup —Low Impedance
- VC—Volume Control —100 ohms
- R—Biasing Resistor— 2500 ohms
- C—By-pass Condenser —10 mfd.
- T—Phono Input Transformer—Stock No. 7445
- P—Phono Turntable Mechanism
- C_t—Condenser—.05 mfd.
- R_t—Variable Resistor —0 to 10,000 ohms

high amplification due to the number of a-f stages employed, necessitates that great care be taken when the circuits are changed for phonograph input. It is recommended that the pickup used be fed directly to the grid circuit of the first audio stage, with suitable switching installed for changing between radio and phonograph operation. Bias of the stage must be maintained by addition of a resistor, to be shorted out for the radio position of the switch. This resistor should be by-passed by a condenser of appropriate rating. Diagrams covering suggested methods of phonograph attachment are given in Figures 10 and 11 with installation details. Hum may possibly be encountered from lack of shielding and improper placement and shielding of the input transformer if these items are not taken care of during re-arrangement of the circuits. All wiring should be installed in a substantial and permanent manner.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to ground on Figure 8 will serve to assist in locating causes for faulty operation when existent. Each value as specified should hold within ± 20% when the receiver is normally operative at the rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given on the diagram are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance is comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each check is chosen as high as possible consistent with good readability.

Universal Transformer

The wiring of the special transformer used in some models of this receiver is given by Figure 4. This transformer is adaptable to several ranges of voltage, hence, in cases of receiver inoperation, the connections should be checked to assure that they are correct for the voltage being used.

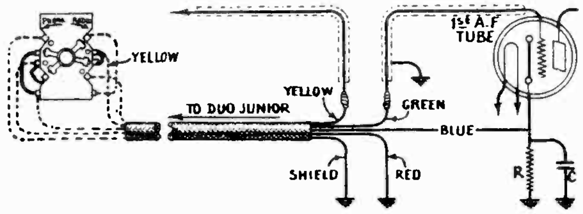


Figure 11—Duo Junior Connections

INSTALLATION

Arrange connections from Duo Junior output cable to receiver so that completed wiring is in accordance with schematic above. Add two jumpers shown by heavy full lines to Duo Junior Radio-Phono switch. Resistor R and capacitor C must be added to receiver circuit to maintain bias. Keep all leads as short as possible and well shielded where indicated.

PARTS REQUIRED

- Model R-93—Duo Junior Phonograph
- R—Biasing Resistor— 2500 ohms
- C—By-pass Condenser —10 mfd.

MODEL C15-3
REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4427	Bracket—Low frequency tone control switch, volume control or high frequency tone control mounting bracket	$0.18
5237	Bushing—Variable capacitor mounting bushing assembly—Package of 3	.43
11255	Cable—Radiotron tuning lamp cable complete with socket	1.20
5241	Capacitor—Adjustable capacitor—C23, C27	.40
11286	Capacitor—14 Mmfd. capacitor—C19	.24
11292	Capacitor—22 Mmfd. capacitor—C11	.24
11289	Capacitor—50 Mmfd. capacitor—C8, C30	.26
11291	Capacitor—115 Mmfd. capacitor—C62, C65	.24
11295	Capacitor—200 Mmfd. capacitor—C55	.30
11294	Capacitor—325 Mmfd. capacitor—C24	.32
11290	Capacitor—400 Mmfd. capacitor—C9, C18, C20, C49, C64	.25
11299	Capacitor—600 Mmfd. capacitor—C48	.26
3784	Capacitor—900 Mmfd. capacitor—C69	.30
11335	Capacitor—1300 Mmfd. capacitor—C22	.30
11287	Capacitor—4500 Mmfd. capacitor—C21, C77	.30
4838	Capacitor—.005 Mfd. capacitor—C58, C59	.20
5242	Capacitor—.005 Mfd. High frequency tone control capacitor—C56	.52
5148	Capacitor—.007 Mfd. capacitor—C57	.20
4937	Capacitor—.01 Mfd. capacitor—C60	.25
4858	Capacitor—.01 Mfd. capacitor—C17, C68.	.25
4870	Capacitor—.025 Mfd.—C47	.20
4836	Capacitor—.05 Mfd. capacitor—C5, C16, C35, C40, C70	.30
4835	Capacitor—.1 Mfd. capacitor—C31	.28
4841	Capacitor—.1 Mfd. capacitor—C7, C28, C36, C41, C67	.22
4885	Capacitor—.1 Mfd. capacitor—C10, C34, C39, C42, C43	.28
3597	Capacitor—.25 Mfd. capacitor—C51	.40
11203	Capacitor—10 Mfd. capacitor—C71	1.18
5212	Capacitor—18 Mfd. capacitor—C72	1.16
5213	Capacitor Pack—Comprising one 4. Mfd., one 10 Mfd. and one 8. Mfd. capacitors—C50, C73, C74	2.94
5236	Capacitor Pack—Comprising two .5 Mfd., capacitors, one 680 ohm resistor and one 820 ohm resistor—C53, C54, R23, R27.	1.36
4693	Clamp—Electrolytic capacitor mounting clamp (For stock No. 5213)	.15
5215	Coil—Antenna coil—A and C Bands—L1, L2, L5, L6 ,C1, C3	2.32
5218	Coil—Antenna coil—X and B Bands—L3, L4, L7, L8, C2, C4	2.58
5216	Coil—Detector coil—A and C Bands—L9, L10, L13, L14, C12, C14	2.34
5219	Coil—Detector coil—X and B Bands—L11, L12, L15, L16, C13, C15	2.58
5217	Coil—Oscillator coil—A and C Bands—L18, L20, C25, C75	2.20

Stock No.	Description	List Price
5220	Coil—Oscillator coil—X and B Bands—L19, L22, C26, C76	$2.24
5221	Coil—Oscillator coil—D Band—L17	.64
5214	Condenser—3 gang variable tuning condenser—C6, C29, C63	4.42
5240	Cover—Fuse cover plate	.24
11202	Foot—Chassis mounting foot and bracket assembly—Package of 2	.78
10907	Fuse—3 ampere fuse—F1—Package of 5	.40
5226	Lamp—Dial lamp—Package of 5	.70
11710	Lead—Shielded lead for antenna	.40
5239	Mounting—Fuse mounting for 110 volt instrument	.36
5244	Mounting—Fuse mounting for 220 volt instrument	.32
8041	Plate—I.F. or R.F. coil shield locking plate—Package of 2	.12
5233	Reactor—Coupling reactor—L29	2.32
11296	Resistor—330 ohms—Carbon type—¼ watt (R2, R12)—Package of 5	1.00
11285	Resistor—1000 ohms—Flexible type resistor (R13, R17, R36)—Package of 5	1.00
5112	Resistor—1000 ohms—Carbon type—¼ watt (R4, R10, R15, R29)—Package of 5	1.00
11283	Resistor—1200 ohms—Carbon type—¼ watt (R3)—Package of 5	1.00
4408	Resistor—1500 ohms—Carbon type—¼ watt (R8)—Package of 10	2.00
5159	Resistor—2200 ohms—Carbon type—¼ watt (R35)—Package of 5	1.00
11298	Resistor—5600 ohms—Carbon type—1 watt (R21)	.22
8043	Resistor—10,000 ohms—Carbon type—2 watts (R22)	.25
3998	Resistor—15,000 ohms—Carbon type—¼ watt (R30)—Package of 5	1.00
5114	Resistor—15,000 ohms—Carbon type—1 watt (R5)	.22
8065	Resistor—27,000 ohms—Carbon type—½ watt (R33)—Package of 5	1.00
11300	Resistor—33,000 ohms—Carbon type—1/10 watt (R32)—Package of 5	.75
5033	Resistor—33,000 ohms—Carbon type—1 watt (R31)—Package of 5	1.10
11282	Resistor—56,000 ohms—Carbon type—1/10 watt (R9)—Package of 5	.75
8064	Resistor—82,000 ohms—Carbon type—½ watt (R43)—Package of 5	1.00
5145	Resistor—100,000 ohms—Carbon type—¼ watt (R16)—Package of 5	1.00
5027	Resistor—150,000 ohms—Carbon type—¼ watt (R37)—Package of 5	1.00
11297	Resistor—330,000 ohms—Carbon type—1/10 watt (R1, R6)—Package of 5	.75
5108	Resistor—330,000 ohms—Carbon type—¼ watt (R11, R14, R38)—Package of 5	1.00
3033	Resistor—1 Megohm—Carbon type—¼ watt (R7)—Package of 5	1.00
11151	Resistor—2.2 Megohm—Carbon type—¼ watt (R20)—Package of 5	1.00

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
5235	Resistor—Voltage divider resistor—3 sections—4100 ohms, 4750 ohms and 190 ohms (R40, R41, R42)	$1.15
5249	Shield—Antenna, detector or oscillator coil shield	.20
5250	Shield—Intermediate frequency transformer shield	.22
11273	Shield—Radiotron shield	.25
4794	Socket—4 contact Radiotron socket—For Radiotron 5Z3	.15
11197	Socket—6 contact Radiotron socket—For Radiotron 6C5	.14
11198	Socket—7 contact Radiotron socket—For Radiotron 6K7, 6H6 or 6F6	.15
11278	Socket—7 contact Radiotron socket—For Radiotron 6J7 (oscillator)	.20
11280	Socket—7 contact Radiotron socket—For Radiotron 6L7 (First detector)	.14
11199	Socket—Dial lamp socket	.14
5224	Switch—Low frequency tone control and power switch—S13, S14	1.00
5225	Switch—Range switch—S1, S2, S3, S4, S5, S6, S7, S8 ,S9, S10, S11	3.75
5238	Terminal—Antenna terminal board with clip, insulating strip and rivets	.14
5222	Tone Control—High frequency tone control (R28)	1.04
5232	Transformer—Audio driver transformer—(T3)	2.50
5228	Transformer—First intermediate frequency transformer (L23, L24, C32, C33)	1.80
5231	Transformer—Fourth intermediate frequency transformer (L31, L32)	1.50
5234	Transformer—Interstage transformer (T2)	3.40
8061	Transformer—Power transformer 105-125 volts 50/60 cycles (T1)	6.75
8062	Transformer—Power transformer 105-125 volts 25-50 cycles	9.84
11194	Transformer—Power transformer 105/125/150/210/250 volts—40-60 cycles	7.08
5229	Transformer—Second intermediate frequency transformer (L25, L26, C37, C38, C66, R34)	2.42
5230	Transformer—Third intermediate frequency transformer (L27, L28, C44, C45, C46, R18, R19)	2.76
5223	Volume Control—(R24, R25, R26)	1.22
	DRIVE ASSEMBLIES	
5243	Arm—Band indicator operating arm	.42
10194	Ball—Steel ball for drive assembly—Package of 20	.25
8054	Cam—Five position cam for station selector drive assembly	.28
4422	Clutch—Tuning condenser drive clutch assembly comprising shaft, balls, ring, spring and washers assembled	1.00
8048	Coupling—Flexible coupling for variable capacitor (includes indicator shaft)	.70
11336	Dial—Dial scale with mounting rivets	.60
8045	Disc—Drive disc and micarta gear assembly	.46
11380	Drive—Tuning condenser drive assembly complete	$6.35
8044	Escutcheon—Dial escutcheon with vernier scale	1.08
8046	Gear—Indicator shaft micarta drive gear and vernier idler brass gear with one spring	.72
8050	Gear—Gear sector and band indicator operating link (link connects to arm on band switch)	.15
8053	Indicator—Station selector vernier indicator pointer	.12
11793	Indicator—Station selector indicator pointer	.15
8051	Link—Complete with roller and spring	.30
8049	Pinion—Vernier pointer drive pinion and shaft	.55
4669	Screw—Square head No. 8-32x5/32 set screw—Package of 10	.25
8047	Spring—Coil spring for indicator shaft drive gear and vernier idler (Stock No. 8046)	.12
8052	Spring—Coil spring for link—Package of 5	.32
8042	Stud—Band indicator operating arm stud—Package of 5	.25
	LOUDSPEAKER ASSEMBLY	
8059	Board—Reproducer terminal board (2 terminals)	.14
8060	Bracket—Output transformer mounting bracket	.14
11200	Cable—Reproducer cable—Complete with connector	.50
8058	Clamp—Cone rim clamp—Package of 4	.44
11189	Coil—Field coil, magnet and cone housing (L33)	10.60
8056	Cone—Reproducer cone (L30)	1.58
5039	Connector—4 prong male connector plug for reproducer	.25
5040	Connector—4 contact female connector socket for reproducer cable	.25
9620	Reproducer—Complete	16.32
8057	Transformer—Output transformer (T4, C61)	3.22
	MISCELLANEOUS ASSEMBLY	
5211	Bolt—Speaker mounting bolt assembly—Package of 2	.24
11191	Bracket—Radiotron tuning lamp mounting bracket—less clamp (Stock No. 11192)	.12
11192	Clamp—Radiotron tuning lamp mounting clamp—less bracket (Stock No. 11191)	.12
11193	Cover—Reproducer cover	.82
11276	Escutcheon—Tuning lamp escutcheon	.40
11379	Escutcheon—Station selector escutcheon and crystal	1.08
11346	Knob—Station selector knob—Package of 5	.75
11347	Knob—Volume control, tone control, power switch or range switch knob—Package of 5	.75
11382	Resistor—1 Megohm—Carbon type—1/10 watt (R39)—Package of 5	.75
11348	Screw—8-32-7/16" headless set screw for knob (Stock No. 11346)—Package of 10	.32
5210	Screw—Chassis mounting screw assembly—Package of 4	.16
11381	Socket—Tuning tube socket and cover	.45
11349	Spring—Retaining spring for knob (Stock No. 11347)—Package of 5	.15

RCA VICTOR MODEL D7-7

Seven-Tube, Three-Band, A-C, Radio-Phonograph

SERVICE NOTES

Electrical Specifications

Frequency Ranges		Alignment Frequencies	
Band A	540- 1,625 kc.	Band A	600 kc. (osc.), 1,400 kc. (osc., det., ant.)
Band B	1,625- 5,700 kc.	Band B	None required
Band C	5,700-18,000 kc.	Band C	18,000 kc. (osc., det., ant.)

Intermediate Frequency .... **460 kc**

Radiotron Complement			
(1) RCA-6K7	Radio-Frequency Amplifier	(4) RCA-6H6	Second Detector-A.V.C.
(2) RCA-6A8	First Detector-Oscillator	(5) RCA-6F5	Audio Voltage Amplifier
(3) RCA-6K7	Intermediate Amplifier	(6) RCA-6F6	Audio Power Amplifier
		(7) RCA-80	Full-Wave Rectifier

Power Supply Ratings

Rating A-6	105-125 Volts, 60 Cycles, 105 Watts
Rating A-5	105-125 Volts, 50 Cycles, 105 Watts
Rating B-2	105-125 Volts, 25 Cycles, 110 Watts
Rating C-6	105-130/140-160/200-250 Volts, 60 Cycles, 105 Watts
Rating C-5	105-130/140-160/200-250 Volts, 50 Cycles, 105 Watts

Loudspeaker		Power Output Ratings	
Type	12-inch Electrodynamic	Undistorted	2¼ Watts
Voice Coil Impedance	2¼ Ohms at 400 Cycles	Maximum	5 Watts

Phonograph			
Type	Manual	Type of Pickup	High-Impedance Magnetic
Turntable Speed	78 R.P.M.	Pickup Impedance	1,400 Ohms at 1,000 Cycles

Mechanical Specifications

Height	39¼ inches
Width	23 9/16 inches
Depth	14⅛ inches
Weight (Net)	65 pounds
Weight (Shipping)	85 pounds
Chassis Base Dimensions	13⅞ inches x 7⅝ inches x 2½ inches

General Description

The RCA Victor Model D7-7 combination instrument consists of a seven tube radio receiver and a manually operated phonograph combined in the one cabinet. An improved 12-inch dynamic loudspeaker provides excellent reproduction and readily handles the high level of sound energy obtainable from the output of this instrument.

Magic Brain

The radio receiver incorporates the Junior "Magic Brain" which is a scientifically correct co-ordination of all the parts of the r-f, oscillator, and first detector functions of a Superheterodyne Receiver. This arrangement provides greater efficiency, especially in the short-wave ranges, as all lead lengths are kept as short as possible and all sockets and other parts are located for best possible operation.

RCA All-Metal Tubes

The new metal tubes are used in the radio receiver for amplifying and detecting purposes. These tubes make possible a greater range of stable amplification not previously attainable with corresponding glass types. Their metal envelopes form a perfect electrostatic and electromagnetic shield, precluding the former necessity for elaborate shielding by means of cans. The metal tubes are especially adaptable to the modern, extended-range receivers because of their efficient shielding and their favorable internal characteristics.

Phonograph Mechanism

The phonograph mechanism is of the manually operated type, having a synchronous motor which rotates the turntable at a speed of 78 R.P.M. The 10-inch turntable will accommodate either the 10-inch or 12-inch phonograph records. The pickup mechanism and tone arm are combined as one unit. The instrument may be purchased with any one of five ratings as specified under Electrical Specifications. *It is important that a machine of any particular rating be operated at the frequency and voltage for which it is rated.* Attempts to operate at ratings other than specified for the particular instrument will result in improper reproduction from the phonograph and may result in damage to both the phonograph motor and radio receiver. An automatic switch is provided to turn "off" the phonograph motor at the completion of record play.

Tuning Dial

The tuning dial is an illuminated semi-airplane type. Each band is distinctively marked with a separate color for each band. Positions of the range selector knob are plainly marked on the control panel with letters indicating each band position placed over color strips corresponding to the band colors on the dial. The tuning control is of the dual-ratio type which permits fast tuning through a 10-to-1 drive ratio and vernier tuning through a 50-to-1 drive ratio. The latter is especially advantageous for accurate tuning of the short-wave stations. The new shock-proof condenser mounting reduces microphonic tendencies to a minimum.

Circuit Arrangement

The conventional Superheterodyne type of circuit, consisting of an r-f stage, a combined first-detector–oscillator stage, a single i-f stage, a diode-detector automatic-volume-control stage, an audio voltage amplifier stage, an audio power output stage and a high-voltage rectifier power-supply stage, is used.

Tuned Circuits

The antenna coil system and the detector coil system each consist of a single primary and three series-connected secondary windings to provide the three ranges of tuning. The oscillator coil system is similarly wound on a single form. A range selector switch (S-1) is used for connecting the various sections of these three coil systems into the circuit to provide operation on the band desired. The coils are tuned by a variable three-section gang condenser having trimmer capacitors in shunt with each section. There are additional trimmer capacitors across the section of each coil used for Band "A." A series trimmer is also associated with the Band "A" oscillator coil.

The intermediate frequency amplifier system consists of an RCA-6K7 in a transformer-coupled circuit. This stage operates at a basic frequency of 460 kc. Each winding of both i-f transformers (input and output) is tuned by an adjustable trimmer.

Detector and A.V.C.

The modulated signal as obtained from the output of the i-f stage is detected by an RCA-6H6 twin-diode tube. The audio frequency secured by this process is transferred to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal is used for automatic volume control. This voltage, which develops across resistor R-8, is applied as automatic control-grid bias to the r-f, first-detector, and i-f tubes through a suitable resistance filter circuit. The second (auxiliary) diode of the RCA-6H6 is used to supply residual bias for the controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current which flows through resistors R-8 and R-9, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias-diode ceases to draw current and the a.v.c. diode takes over the biasing function.

Audio System

The manual volume control consists of an acoustically tapered potentiometer in the audio circuit between the output of the detector diode and the input grid of the audio-voltage-amplifier tube. This control has a tone compensating filter connected to it so that the correct aural balance will be obtained at different volume settings.

Resistance-capacitance coupling is used between the first audio stage and the power output stage. The output of the power amplifier is transformer-coupled into the dynamic loudspeaker. High-frequency tone control is effected by a capacitor across the plate circuit of the output tube. Speech-music control is effected by a resistor connected to the compensated volume control circuit. Control of tone is obtained by means of the switch (S-2).

Rectifier

The power required for operation of this receiver is supplied through transformer T-1. This transformer has an efficient electrostatic shield between its primary and secondary windings. This shield prevents interference which is on the power-supply circuit from entering the receiver and conversely reduces the tendency of the receiver to re-radiate into the power circuit. An RCA-80 furnishes the d-c voltages necessary for plate, screen, cathode, and grid potentials.

The field winding of the loudspeaker is used as a reactor in the filter circuit from which it simultaneously receives its magnetizing current. The heaters of all Radiotrons are supplied from a low voltage (6.3 volt) winding on the power transformer. One side of this winding is at ground potential.

SERVICE DATA

The various diagrams of this bulletin contain such information as will be needed to isolate causes for defective operation when such a condition develops. Values of the resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles, such as R-3, L-2, C-1, etc., are provided for reference between the diagrams and the replacement parts list. Locating of the parts in the schematic circuit is facilitated by the fact that the numerical titles increase from left to right on the diagram. The coils, reactors, and transformer windings are rated in terms of their d-c resistances only. Resistances of less than one ohm are generally omitted.

Alignment Procedure

Precise alignment is vital to the proper functioning of this receiver. There are four trimming adjustments provided in the i-f system, three in the oscillator coil system, two in the detector coil system, and two in the antenna coil system. Each of these trimmers has been accurately adjusted during manufacture and should remain properly aligned unless affected by abnormal conditions of climate or have been altered for service purposes. Incorrect alignment is usually evidenced by loss of sensitivity, improper tone quality, and poor selectivity. These indications will generally be present together.

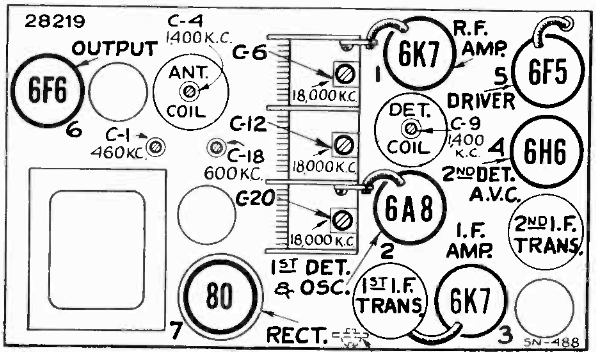
The correct performance of the receiver can only be obtained when the alignment is performed with adequate and reliable test apparatus. The manufacturer of this instrument has a complete assortment of such service equipment available. This equipment, illustrated and described on a separate page of this booklet, may be purchased from authorized distributors and dealers.

An oscillator (signal generator) is required as a source of the specified alignment frequencies. Visual indication of the receiver output during the adjustments is necessary to enable the serviceman to obtain an accuracy of alignment which is not possible by listening to the signal. **The RCA Victor Stock No. 9595 Full-Range Oscillator and the RCA Victor Stock No. 4317 Neon Output Indicator are especially suitable and fulfill the above requirements.**

The following procedure should be followed in adjusting the various trimmer capacitors:

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 6. Each must be aligned to a basic frequency of **460 kc.** To do this, attach the Output Indicator across the voice coil circuit or across the output transformer primary. Connect the output of the test oscillator between the control-grid of the RCA-6A8 first detector tube and chassis-ground. Tune the oscillator to **460 kc.** Advance the receiver volume control to its full-on position and adjust the receiver tuning control to a point within its range where no interference is encountered either from local broadcast stations or the heterodyne oscillator. Increase the output of the test oscillator until a slight indication is apparent on the output indicator. Then adjust the two trimmers, **C-25** and **C-26**, of the second i-f transformer to produce maximum (peak)



1400K.C. OSC. (C-15) ADJ. CENTER REAR OF CHASSIS

Figure 1—Radiotron and Coil Locations

indicated receiver output. Then, adjust the two trimmers, **C-23** and **C-24**, of the first i-f transformer for maximum (peak) receiver output as shown by the indicating device. During these adjustments, regulate the test oscillator output so that the indication is always as low as possible. By doing so, broadness of tuning due to a.v.c. action will be avoided. It is advisable to repeat the adjustment of all i-f trimmers a second time to assure that the inter-action between them has not disturbed the original adjustment.

R-F Trimmer Adjustments

The seven trimmers associated with the r-f, first detector, and oscillator tuned circuits have their locations shown by Figure 1. The three trimmers which are at all times directly in shunt with the variable tuning condenser necessitate that the high-frequency range (Band C) be aligned first. The range selector switch should, therefore, be turned to its Band C position for the first adjustment. The Output Indicator should be left connected to the output system. Attach the output terminals of the test oscillator to the antenna and ground terminals of the receiver.

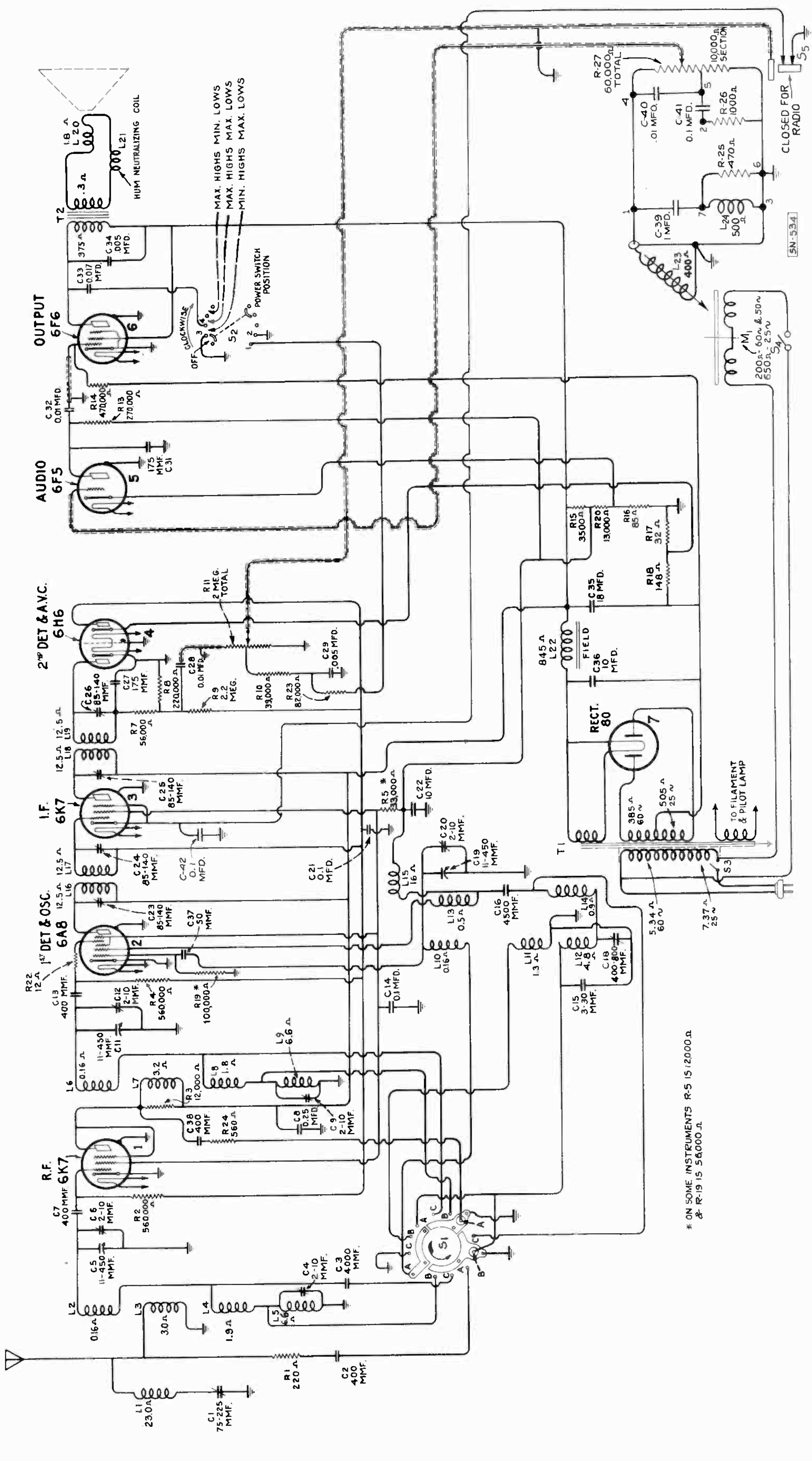


Figure 2—Schematic Circuit Diagram

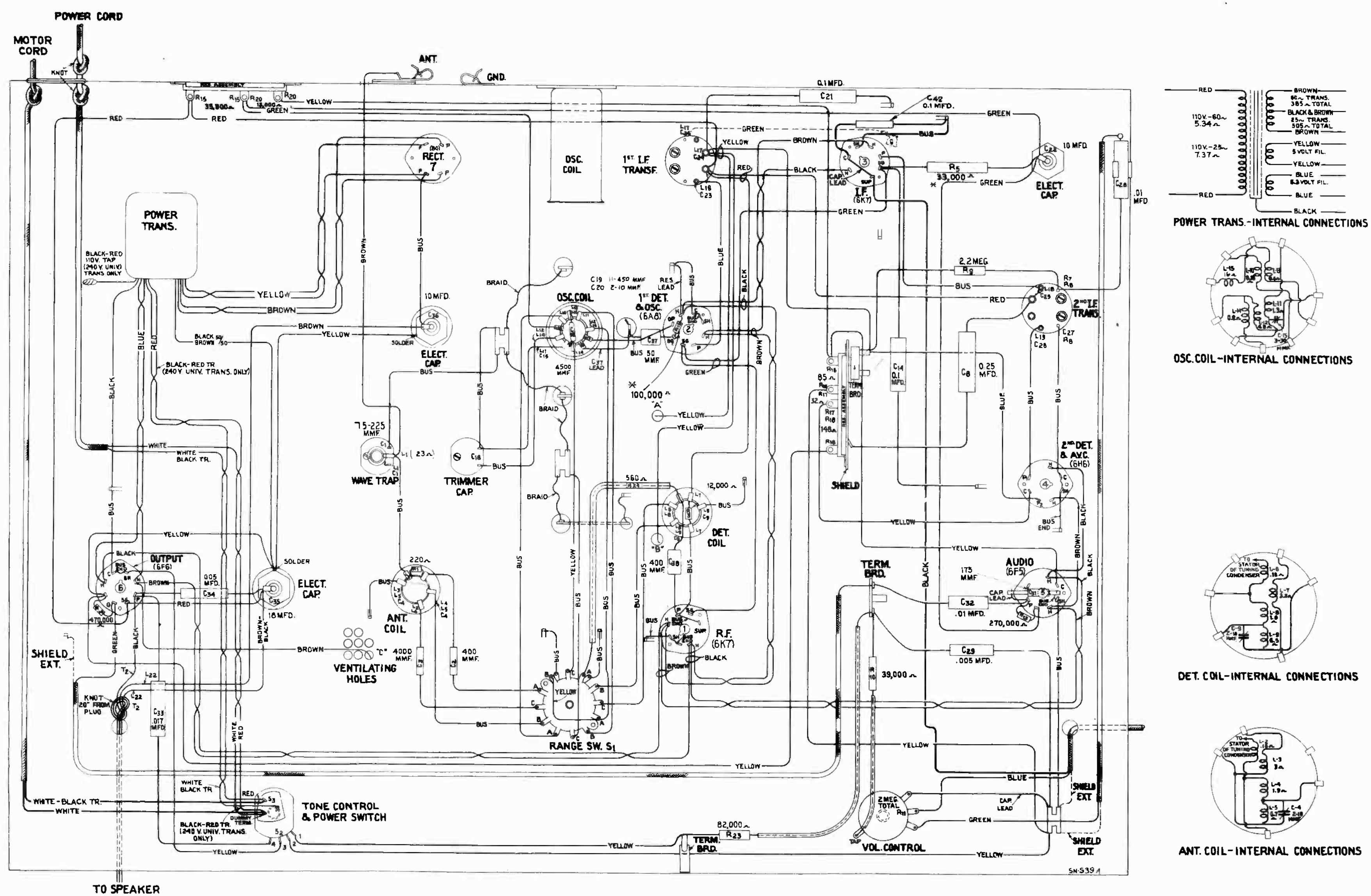


Figure 3—Chassis Wiring Diagram

Calibrate the dial by rotating the tuning control until the variable condenser plates are in their full mesh (maximum capacity) position and adjusting the dial pointer so that its end points to the ***horizontal*** graduation (530 kc.) at the low frequency end of the Band A scale.

Proceed further as follows:

(a) Adjust the test oscillator to **18,000 kc.** and set the receiver tuning control to a dial reading of **18,000 kc.**

(b) Regulate the output of the test oscillator until a slight indication is perceptible at the receiver output. Then adjust the trimmer, **C-20,** on the oscillator section of the variable condenser to the point at which it produces maximum indicated receiver output. Two points may be found, each of which produces such a maximum. The one of ***maximum trimmer capacitance*** is correct and should be used. (The oscillator will be 460 kc. below the signal frequency at this adjustment point.)

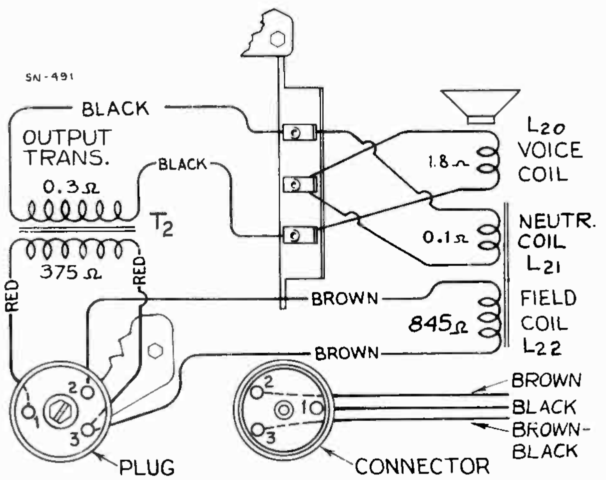


Figure 4—Loudspeaker Wiring

(c) Adjust the trimmer, **C-12,** of the detector section of the variable condenser, simultaneously rocking the receiver tuning control backward and forward through the **18,000 kc.** input signal, until maximum receiver output results from these combined operations. Rocking of the variable condenser will prevent inaccurate adjustment which would otherwise be caused by the inter-action between the heterodyne oscillator circuit and the detector tuned circuit.

(d) With the receiver tuning control set to **18,000 kc.** adjust the trimmer, **C-6,** on the antenna section of the variable condenser to the point which produces maximum (peak) indicated receiver output.

(e) Change the receiver range selector to its Band A position and set the receiver tuning control to a dial reading of **1,400 kc.** Tune the test oscillator to **1,400 kc.** and regulate its output to produce a slight indication on the receiver output indicating device.

(f) Adjust the high frequency trimmers of the Band A oscillator, detector, and antenna coils, **C-15, C-9,** and **C-4** respectively, to the points at which each produces maximum indicated receiver output.

(g) Shift the test oscillator frequency to **600 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received.

(h) Tune the low frequency trimmer, **C-18,** of the oscillator Band A coil, simultaneously rocking the tuning control of the receiver backward and forward through the signal, until maximum indicated receiver output results from these combined operations. The adjustment of **C-20, C-12,** and **C-6** should be corrected at **18,000 kc.** as in (b), (c), and (d); also **C-15, C-9,** and **C-4** should be corrected at **1,400 kc.** as in (f) to compensate for any changes caused by the adjustment of the low frequency oscillator coil trimmer.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 6 will assist in the location of causes for faulty operation. Each value as specified should hold within $\pm$ 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Universal Transformer

The special transformer used on some receivers of this type is adaptable to several ranges of voltage as given under Rating C of Electrical Specifications. Its schematic and wiring are shown by Figure 5. Terminals are provided at the top of the transformer case for changing the primary connections to suit the voltage available. Note that a 110-volt tap is brought out separately for supplying a phonograph motor.

Wave-Trap Adjustment

With the receiver in operation using its normal antenna, tune station selector to the point at which the intermediate frequency interference is most intense. Then adjust the wave trap trimmer to the point which causes maximum suppression of the interference. This trimmer is adjusted to 460 kc. during manufacture, however, local conditions may require a readjustment, depending upon the interfering frequency.

Phonograph Mechanism

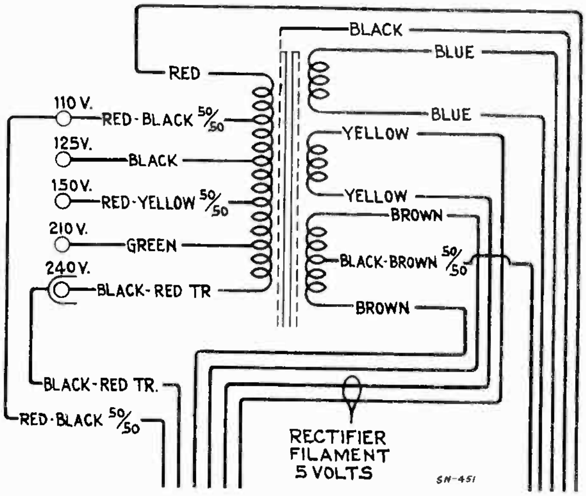
The phonograph motor is of the synchronous type and designed to be simple and foolproof. Under normal operating conditions, service difficulties should be negligible. Occasionally, however, certain adjustments may be required. These adjustments are illustrated and explained in Figure 8.

Magnetic Pickup

The pickup used in the phonograph unit is of an improved design. The horseshoe magnet is rigidly welded to the pole pieces and is irremovable. There is a centering spring attached to the armature to maintain proper adjustment and to provide a limiting effect on the movement of the armature. The frequency response is substantially uniform over a wide range. Service operations which may be necessary on the pickup are as follows:

Centering Armature

Refer to Figure 9 showing the pickup inner structure. The armature is shown in its proper relation to the magnet pole pieces, i. e., exactly centered. Whenever this centering adjustment has been disturbed it will be necessary to remove the pickup mechanism from the tone arm by removing the needle holding



Primary Resistance—10.5 ohms, Total
Secondary Resistance—330 ohms, Total

Figure 5—Universal Transformer

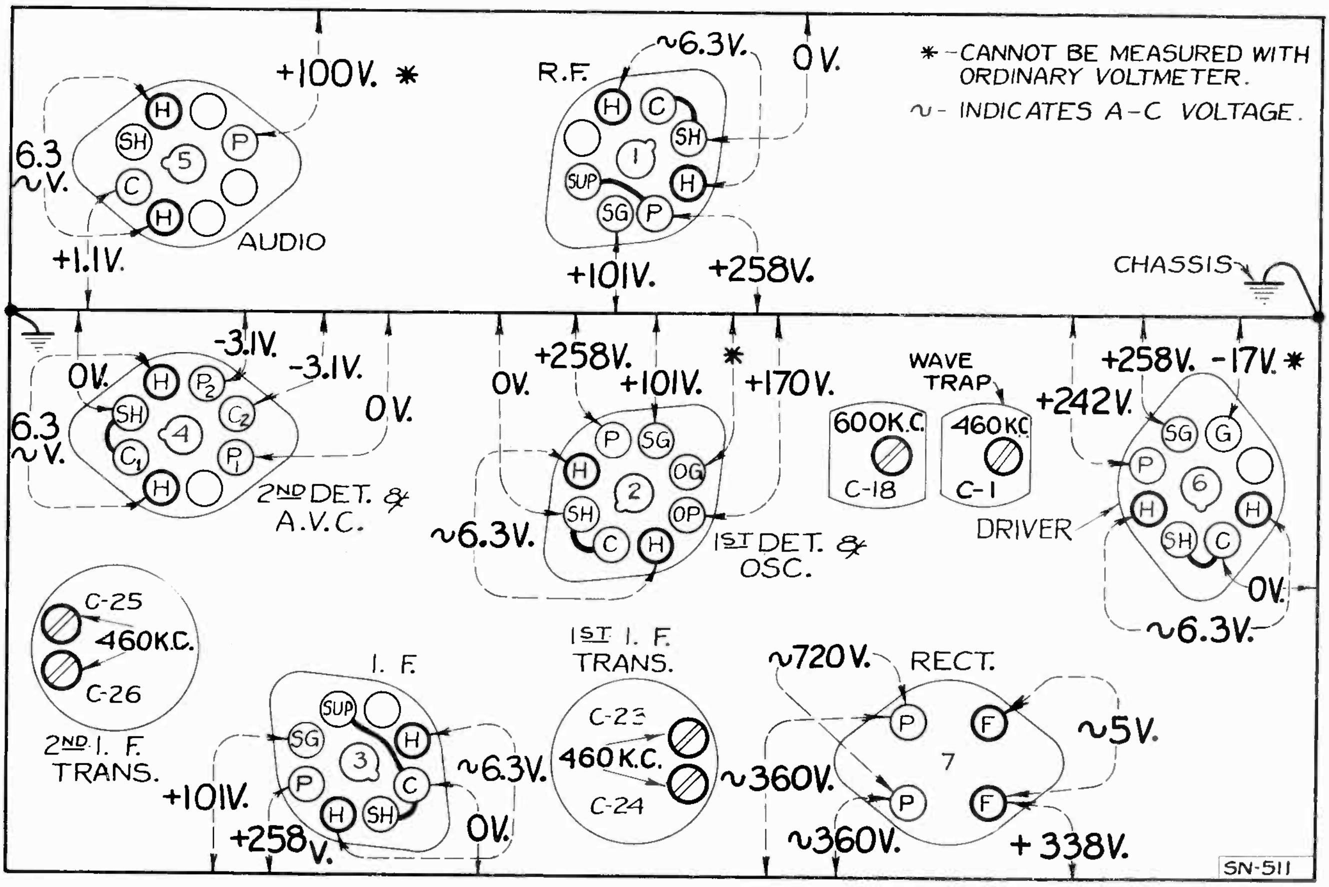


Figure 6—Radiotron Socket Voltages

Measured at 115 volts, 60 cycles—No signal input

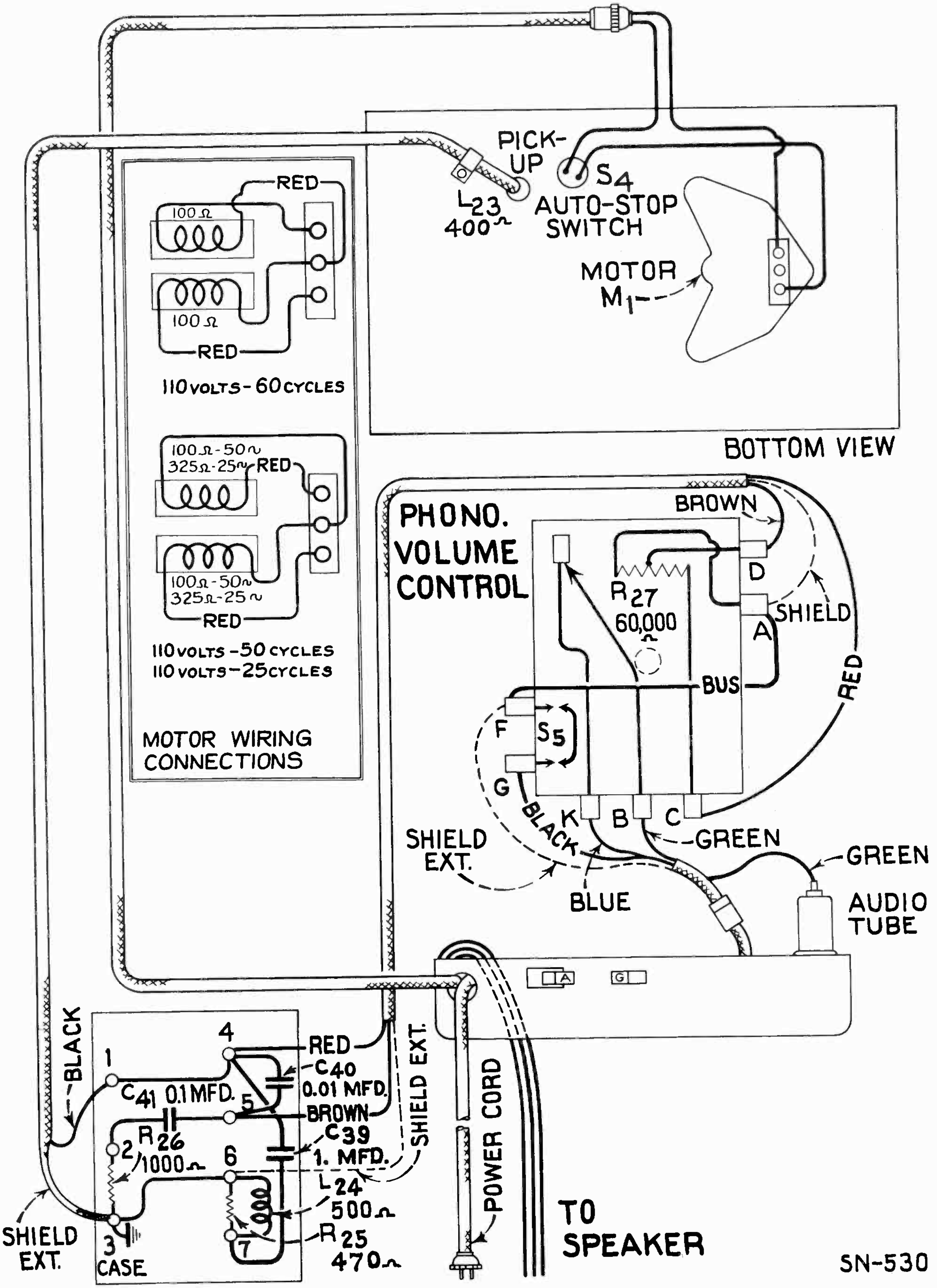


Figure 7—Assembly Wiring

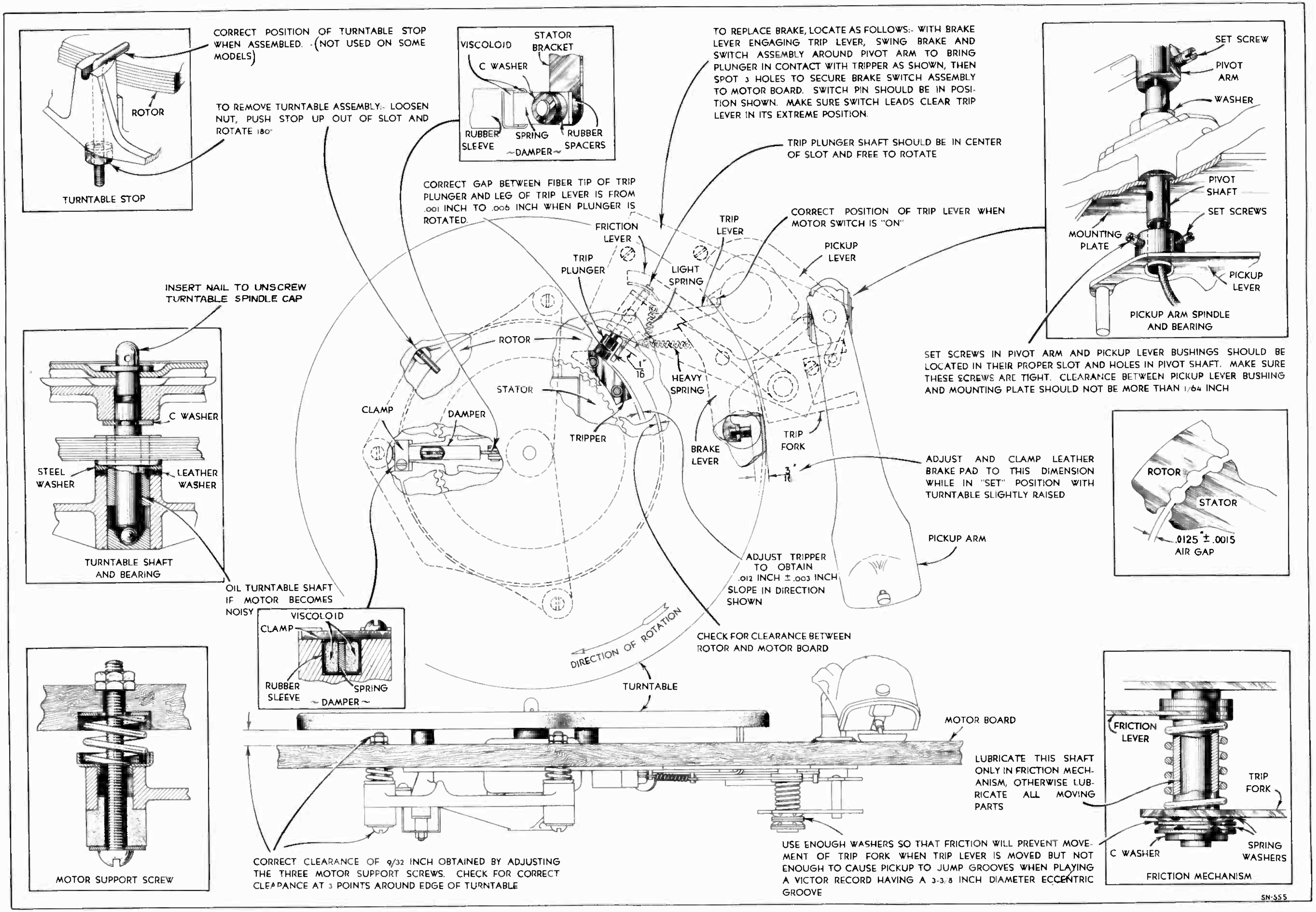


Figure 8—Motor Board Adjustments

screw and the two mounting screws from the front of the tone arm, holding the pickup assembly to keep it from dropping. Unsolder the two leads from the lugs on the terminal board at the rear of the pickup. Insert a small rod or nail into the armature needle hole and replace the needle holding screw, tightening it to hold the rod securely. If the armature clamping screws A and B have not been disturbed, screw C should be loosened which will permit the armature

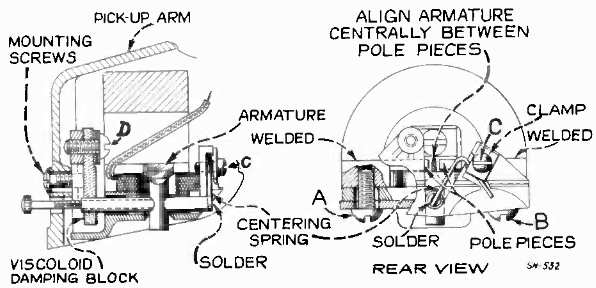


Figure 9—Details of Pickup

to be moved from side to side, the rod acting as a lever to perform this operation. The proper adjustment is obtained when the armature is moved to the extreme position on each side (the movement being limited by the armature striking the pole pieces) and then brought to the mid position between these two extremes. Screw C should then be tightened. The armature position should then be central between the pole pieces and at right angles to them. With a little practice, the correct adjustment of the armature will be obtained. The air gap between the pole pieces and the armature should be kept free from dust, filings, and other foreign material which would obstruct the movement of the pickup armature.

Damping Block

The viscoloid damping block which is attached to the front end of the armature shank serves as a mechanical filter to eliminate undesirable resonances and to cause the frequency response to be uniform. Should it be necessary to replace this damping block, the pickup mechanism should be removed from the tone arm as explained above. Then unsolder the pickup coil leads from the two lugs on the pickup terminal board and remove the terminal board mounting screw and the terminal board. Then remove screw D and the damping block from the pickup assembly. Make sure that the shaft of the armature which contacts the viscoloid is clean. Then insert the new damping block so that it occupies the same position as that of the original block, and is in correct vertical alignment with the armature. The hole in the block is somewhat smaller than the diameter of the armature in order to permit a snug fit. With the damping block properly aligned on the armature, screw D with its washer should then be replaced. Heat should be applied to the armature (viscoloid side) so that the damping block will fuse at the point of contact and become rigidly attached to the armature. A special-tip soldering iron, constructed as shown in Figure 10, will be found very useful in performing this operation. The iron should be applied only long enough to slightly melt the block, causing a small bulge on both sides.

Replacing Coil

Whenever there is defective operation due to an open or shorted pickup coil, this coil should be replaced. Remove the pickup mechanism and terminal board as described above. Remove screws A and B and the magnet assembly. Remove the bakelite coil support (with coil attached) and insert the new coil support assembly in its place, after which replace the magnet assembly and center the armature as described above, then reassemble the remainder of the unit. Only rosin core solder should be used for soldering the coil leads and pickup leads to the pickup terminal board. This same type of solder should be used when necessary for soldering the centering spring to the armature.

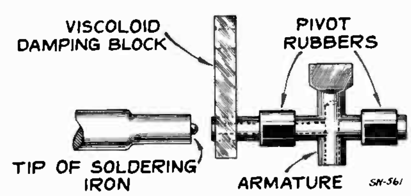


Figure 10—Special Soldering-Iron Tip

Magnetizing

Loss of magnetization will not usually occur when the pickup has received normal care due to the fact that the magnet and pole pieces are one unit and the magnetic circuit remains closed at all times. When the pickup has been mishandled, subjected to a strong a-c field, jolted, or dropped, there may be an appreciable loss of magnetic strength, in which case it will be necessary to remagnetize the entire structure. To do this, it will be necessary to first remove the pickup mechanism from the tone arm, and then remove the magnet assembly. Place the magnet assembly on the poles of a standard pickup magnetizer such as the ***RCA Stock No. 9549 Pickup Magnetizer*** and charging the magnet in accordance with the instructions accompanying the magnetizer. It is preferable to check the polarity of the pickup magnet and to remagnetize it so that the same polarity is maintained.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price	Stock No.	Description	List Price
	RECEIVER ASSEMBLIES		11282	Resistor—56,000 ohms—Carbon type—1/10 watt—(R19*)—Package of 5...	.75
5237	Bushing—Variable tuning condenser mounting bushing assembly—Package of 3	$0.43	11365	Resistor—82,000 ohms—Carbon type—¼ watt—(R23)—Package of 5......	1.00
11759	Cable—Two-conductor shielded cable—complete with four-contact female connector	.92	3118	Resistor—100,000 ohms—Carbon type—¼ watt—(R19*)—Package of 5.....	1.00
11758	Cable—Three-conductor shielded cable—complete with four-contact male connector and grid contact cap—connects phonograph volume control to chassis cable	1.04	11323	Resistor—270,000 ohms—Carbon type—¼ watt—(R13)—Package of 5......	1.00
11350	Cap—Contact cap—Package of 5......	.20	11172	Resistor—470,000 ohms—Carbon type—¼ watt—(R14)—Package of 5......	1.00
11465	Capacitor—Adjustable capacitor—(C18).	.48	11397	Resistor—560,000 ohms—Carbon type—1/10 watt—(R2, R4)—Package of 5..	.75
11289	Capacitor—50 MMfd.—(C37)..........	.26	11626	Resistor—2.2 megohms—Carbon type—¼ watt—(R9)—Package of 5........	1.00
5116	Capacitor—175 MMfd.—(C31).........	.18	11603	Shield—Antenna or detector coil shield..	.26
11290	Capacitor—400 MMfd.—(C2, C7, C13, C38)	.25	11604	Shield—Oscillator coil shield...........	.24
11401	Capacitor—4000 MMfd.—(C3).........	.38	11383	Shield—Rectifier Radiotron shield......	.20
4868	Capacitor—.005 Mfd.—(C29, C34).....	.20	11390	Shield—Intermediate frequency transformer shield	.25
4906	Capacitor—.017 Mfd.—(C33).........	.25	11199	Socket—Dial lamp socket..............	.14
11395	Capacitor—.01 Mfd.—(C28)...........	.18	4794	Socket—4-contact rectifier Radiotron socket	.15
4858	Capacitor—.01 Mfd.—(C32)...........	.25	11198	Socket—7-contact 6K7—6F5—or 6H6 Radiotron socket	.15
11414	Capacitor—0.1 Mfd.—(C42)...........	.20	11196	Socket—8-contact 6A8 or 6F6 Radiotron socket	.15
4839	Capacitor—0.1 Mfd.—(C14)...........	.28	11386	Switch—Range switch—(S1)..........	1.16
4841	Capacitor—0.1 Mfd.—(C21)...........	.22	11392	Switch—Tone control and power switch assembly—(S2, S3)................	1.14
5170	Capacitor—0.25 Mfd.—(C8)...........	.25	11388	Transformer—First intermediate frequency transformer—(L16, L17, C23, C24)...	1.90
11240	Capacitor—10 Mfd.—(C36)...........	1.08	11389	Transformer—Second intermediate frequency transformer—(L18, L19, C25, C26, C27, R7, R8).................	3.02
11387	Capacitor—10 Mfd.—(C22)...........	.86	11384	Transformer—Power transformer—105-125 volts—50-60 cycles—(T1)......	4.65
5212	Capacitor—18 Mfd.—(C35)...........	1.16	11725	Transformer—Power transformer—105-125 volts—25-50 cycles............	6.60
5238	Clip—Antenna terminal board with clip, insulating strip and rivets...........	.14	11727	Transformer—Power transformer—105-130, 140-160, 195-250 volts—40-60 cycles	6.60
11600	Coil—Antenna coil—(L2, L3, L4, L5, C4, R1)	1.78	11391	Trap—Wave trap—(L1, C1)..........	1.22
11601	Coil—Detector coil—(L6, L7, L8, L9, C9, R3)	1.78	11237	Volume Control—(R11)..............	1.20
11602	Coil—Oscillator coil—(L10, L11, L12, L13, L14, L15, C15, C16)...........	2.15		PICKUP AND ARM ASSEMBLY	
6123	Connector—Four-contact male connector for cable, Stock No. 11758..........	.30	11731	Armature—Pickup armature............	.64
4153	Connector—Four-contact female connector for cable, Stock No. 11759..........	.48	11730	Cable—Pickup cable..................	.14
11385	Condenser—Three gang variable tuning condenser—(C5, C6, C11, C12, C19, C20)	5.02	11732	Coil—Pickup coil (L23)...............	.60
11673	Dial—Station selector dial............	.78	4543	Damper—Pickup damper block complete with damper plate.................	.10
11394	Foot—Chassis foot assembly—Package of 2	.70	11728	Pickup and Arm Assembly—Complete...	8.15
11396	Indicator—Station selector indicator pointer	.25	3811	Screw—Needle holding screw—Package of 10............................	.46
5226	Lamp—Dial lamp—Package of 5.......	.70		MOTOR ASSEMBLY	
11393	Resistor—Voltage divider resistor—comprising one 3,500 ohm and one 13,000 ohm sections—(R15, R20)..........	.74	10194	Ball—Steel ball bearing—Package of 20..	.25
11329	Resistor—Voltage divider resistor—comprising one 85 ohm, one 148 ohm, one 32 ohm sections—(R16, R17, R18)..	.52	11740	Base—Motor base and bearing assembly..	1.45
11369	Resistor—12 ohms—flexible type complete with contact cap—(R22).......	.22	11745	Cap—Turntable spindle cap—Package of 5	.30
11324	Resistor—560 ohms—Carbon type—¼ watt—(R24)—Package of 5.........	1.00	11733	Coil—Stator assembly—comprising coil and laminations—105-125 volt, 60 cycle operation	2.96
3066	Resistor—12,000 ohms—Carbon type—1 watt—(R5*)—Package of 5.........	1.10	11734	Coil—Stator assembly—comprising coil and laminations—105-125 volt, 50 cycle operation	3.08
8072	Resistor—33,000 ohms—Carbon type—½ watt—(R5*)—Package of 5.........	1.00			
11322	Resistor—39,000 ohms—Carbon type—¼ watt—(R10)—Package of 5......	1.00			

The prices quoted above are subject to change without notice.

*** Refer to Schematic Diagram.**

REPLACEMENT PARTS—Continued

Stock No.	Description	List Price
11735	Coil—Stator assembly—comprising coil and laminations—105-125 volt, 25 cycle operation	3.08
11748	Damper—Motor damper assembly— comprising one damper, one damper plate, one screw, two rubber washers and one "C" washer	.20
11741	Motor—105-125 volts—60 cycle motor complete (MI)	11.10
11742	Motor—105-125 volts—50 cycle motor complete	11.10
11743	Motor—105-125 volts—25 cycle motor complete	11.60
11746	Tripper — Automatic brake tripper — located on rotor laminations	.16
11737	Turntable—Turntable assembly—complete with rotor laminations — 60 cycle operation	4.80
11738	Turntable—Turntable assembly—complete with rotor laminations — 50 cycle operation	4.80
11739	Turntable—Turntable assembly—complete with rotor laminations — 25 cycle operation	5.05
4083	Washer—Leather washer—Package of 10	.20
4084	Washer—Metal washer—Package of 10	.26
	MOTOR BOARD ASSEMBLY	
11752	Brake—Automatic brake and switch—complete	2.50
11751	Bushing—Motor mounting bushing and spring assembly—comprising one bushing, one large washer, one cup washer, one spring, one small washer and two nuts	.74
4577	Connector—Two-contact male connector for power supply cable	.30
2947	Leather—Automatic brake friction leather —Package of 20	.50
11749	Lever—Brake mechanism actuating lever —fastens to pivot shaft under base of pickup arm	.28
11754	Lever—Friction lever assembly—complete	.38
11753	Plunger—Automatic brake trip plunger	.18
3261	Rest—Pickup rubber rest—Package of 5	.40
11750	Screw—No. 4-40x9/32-in. cone pointed headless set screw for brake mechanism actuating lever, Stock No. 11749—Package of 10	.22
11756	Spring—Automatic stop mechanism trip lever spring—Package of 10	.22
11757	Spring—Automatic stop mechanism brake lever spring—Package of 10	.20
11755	Switch—Automatic brake switch (S4)	.75
	REPRODUCER ASSEMBLIES	
11232	Board—Terminal board assembly with two lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Output transformer mounting bracket	.14
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
11254	Coil—Field coil—(L22)	2.00
11233	Coil—Hum neutralizing coil—(L21)	.30
11258	Cone—Reproducer cone— (L20) —Package of 5	3.85
5118	Connector—3-contact male connector for reproducer	.25
5119	Connector—3-contact female connector plug for reproducer cable	.25
9619	Reproducer—Complete	6.05
11253	Transformer—Output transformer—(T2)	1.56
11886	Washer—spring washer used to hold speaker field coil securely—Package of 5	.20
	MISCELLANEOUS ASSEMBLIES	
11762	Box—Used needle box	.25
11764	Cable—Two-conductor shielded cable approximately 28-in. long, connects phonograph volume control to compensator pack	.56
11760	Compensator — Phonograph compensator pack—Comprising one 470 ohm and one 1,000 ohm resistors, one .01 Mfd., one 0.1 Mfd. and one 1.0 Mfd. capacitors, and one 0.25H reactor—(R25, R26, C39, C40, C41, L24)	3.85
11376	Escutcheon—Station selector escutcheon and crystal	.70
11582	Knob—Range switch knob—Package of 5	.50
11347	Knob—Volume control, power switch or phonograph volume control knob—Package of 5	.75
11610	Knob—Station selector knob assembly—comprising one large and one small knob—Package of 5	1.00
11763	Receptacle—Needle receptacle	.38
11210	Screw—Chassis mounting screw assembly —Package of 4	.28
11761	Screw—Motor board screw and finishing washer assembly—Package of 10	.28
11349	Spring—Retaining spring for knobs, Stock No. 11347, No. 11582 and small knob in Stock No. 11610—Package of 5	.15
4982	Spring—Retaining spring for large knob in Stock No. 11610—Package of 10	.26
11695	Volume Control — Phonograph volume control (R27, S5)	1.60

The prices quoted above are subject to change without notice.

—NOTES—

(1) Beat notes or heterodyning (whistles) may be encountered in some instances on these receivers due to excessive antenna capacitance. This condition may be corrected by reducing the size of the antenna or by inserting a 150 mmfd. capacitor in series with the antenna lead. This may be accomplished in the receiver by removing the brown lead which connects from the antenna terminal to the wave trap inductance L-1 and inserting the condenser between these points. Interference in the form of "beats" from a local station may frequently be remedied by tuning the antenna wave trap to that station. The wave trap will tune up to 700 kc.

RCA VICTOR MODEL D9-19

Nine-Tube, Three-Band, A-C, Radio-Phonograph

SERVICE NOTES

Electrical Specifications

Frequency Ranges

Band X	140 kc.— 410 kc.
Band A	540 kc.— 1,800 kc.
Band C	5,700 kc.—18,000 kc.

Alignment Frequencies

Band X	150 kc. (osc.), 400 kc. (osc., ant., det.)
Band A	600 kc. (osc.), 1,720 kc. (osc., ant., det.)
Band C	18,000 kc. (osc., ant., det.)

Intermediate Frequency .... **460 kc.**

Radiotron Complement

(1) RCA-6K7..........Radio-Frequency Amplifier
(2) RCA-6L7..........First Detector
(3) RCA-6J7..........Heterodyne Oscillator
(4) RCA-6K7..........Intermediate Amplifier
(5) RCA-6H6..........Second Detector and A.V.C.
(6) RCA-6F5..........Audio Amplifier
(7) RCA-6F6..........Power Output Amplifier
(8) RCA-5Z3..........Full Wave Rectifier
(9) RCA-6E5..........Tuning Indicator

Power Supply Ratings

Rating A	105—125 volts, 50—60 cycles, 140 watts
Rating B	105—125 volts, 25 cycles, 140 watts
Rating C	100—130/140—160/195—250 volts, 50—60 cycles, 140 watts

Loudspeaker

Type	12-inch Electrodynamic
Voice Coil Impedance	$2\frac{1}{4}$ Ohms at 400 Cycles

Power Output Ratings

Undistorted	2 Watts
Maximum	$4\frac{1}{2}$ Watts

Phonograph

Type	Manual
Turntable Speed	(Adjustable) 78 R.P.M.
Type of Pickup	Improved High-Impedance Magnetic
Pickup Impedance	2,800 Ohms at 1,000 Cycles

Mechanical Specifications

Height	42 inches
Width	$26\frac{1}{8}$ inches
Depth	$16\frac{1}{4}$ inches
Weight (Net)	93 pounds
Weight (Shipping)	152 pounds
Chassis Base Dimensions	$14\frac{1}{2}$ inches x 9 inches x $3\frac{1}{2}$ inches

General Description

The RCA Victor Model D 9-19 combination radio receiver and manual phonograph provides excellent entertainment from either broadcast reception or record reproduction. It consists of a nine-tube, three-band radio receiver, and a manual phonograph, combined in the one cabinet. The high level of sound energy obtainable from the output of this instrument is capably handled by a new sensitive, twelve-inch, electrodynamic loudspeaker. Outstanding features of this instrument are as follows:

Magic Brain

The radio receiver includes the "Magic Brain" unit for maximum all-around efficiency. This unit is a scientifically correct co-ordination of all the parts for the r-f, oscillator, and first detector functions of a Superheterodyne Receiver. Such design of the important head end, or "Magic Brain" unit, gives greater efficiency in the short-wave ranges as all lead lengths are kept as short as possible, and all sockets and other parts are located for best possible operation.

Magic Eye

A cathode-ray tube whose fluorescent screen has the appearance of a human eye is used for visually indicating when the receiver is accurately tuned to the incoming signal. This tube is of new design. It contains two groups of elements; one group operates as an amplifier and the other group operates as a cathode-ray tube.

The cathode-ray section consists of a conically shaped luminescent screen, a cathode, and a control electrode. The detected signal from the receiver is applied through the amplifier section of the tuning tube to the control electrode of the cathode-ray section. This control electrode, in turn, affects the electron stream emitted by the cathode in such a manner as to cause a triangular shadow on the luminescent screen. The size of the shadow caused by the control electrode is determined by the strength of the incoming signal, so that a change-of-tuning is readily exhibited on the cathode-ray screen, and therefore tuning to exact resonance can be definitely obtained.

RCA All-Metal Tubes

The new metal tubes are used in the radio receiver for amplifying and detecting purposes. These tubes make possible a greater range of stable amplification not previously attainable with corresponding glass types. Their metal envelopes form a perfect electrostatic and electromagnetic shield, precluding the former necessity for elaborate shielding by means of cans. The metal tubes are especially adaptable to the modern, extended-range receivers because of their efficient shielding and their favorable internal characteristics.

Phonograph Mechanism

An improved manually operated phonograph mechanism is used in this model. The 12-inch turntable will accommodate either the 10-inch or the 12-inch phonograph records. The turntable rotates at a speed of 78 r.p.m. A speed regulator is provided for accurate adjustment of this speed. The instrument may be purchased with any one of three ratings as specified under Electrical Specifications. *It is important that a machine of any particular rating be operated at the frequency and voltage for which it is rated.* Attempts to operate at ratings other than specified for the particular instrument may result in damage to both the phonograph motor and the radio receiver. An automatic switch is provided to turn "off" the phonograph motor at the completion of record play when the eccentric-type inside groove record is used.

Colorband Dial

An open face airplane-type of dial is used. Each scale has a band of color adjacent to its graduations and three short strips of corresponding colors at the lower part of the dial for index purposes. An index pointer, which moves as the band switch is rotated, points to one of these colors to identify the band in use. The drive mechanism is variable, there being either a 50-to-1 or 10-to-1 ratio available between the tuning knob and condenser drive shaft. The new shock-proof condenser mounting reduces microphonic tendencies to a minimum.

CIRCUIT FEATURES

The circuit is based upon the Superheterodyne principle. The three ranges of tuning are covered by three sets of coils. A single r-f stage provides the desired selectivity and gain ahead of the hexode first-detector tube. The oscillator stage operates separately from the first detector. A single stage i-f system is employed. Its basic frequency is 460 kc. Diode detection is performed by a double diode RCA-6H6 Radiotron. Automatic volume control is provided by this same tube. The audio system consists of two stages, the driver, an RCA-6F5, and the output, an RCA-6F6. High voltages for plate, screen, and bias supplies are obtained from an RCA-5Z3 full-wave rectifier through an efficient filter. The field of the loudspeaker acts as a reactor in the filter circuit. Further details of the circuit are as follows:

Oscillator

The oscillator circuit has extreme stability of frequency and good uniformity of output over the tuning ranges. These qualities assure that the tuning of the receiver will not drift as the line voltage varies. The action of the circuit is such that when the cathode emission tends to change with line voltage or because of other reasons, the variation of voltage drop in the plate and screen resistor restores the operating characteristics of the tube to normal and thus maintains constancy of the generated signal.

First Detector

This stage has unusually good high frequency mixing efficiency. The tube used, an RCA-6L7, is a new hexode type. The signal is supplied to the first control-grid and the oscillator voltage is fed in on a second control-grid, a screen-grid separating the two. The arrangement of the grids prevents degenerative difficulties, particularly at the higher frequencies. The second grid is direct-connected to the cathode of the oscillator and has no d-c bias.

Compensated Volume Control

The variation in response of the human ear with different degrees of volume is compensated for by a resistor and condenser network in the manual volume control circuit. The volume control itself is an acoustically tapered potentiometer which provides equal changes of sound intensity for the listener per degree of rotation.

Range Switch

The band-change switch has several functions. It exchanges the antenna, detector, and oscillator coils in order to select the range desired. At the same time, it shorts out the unused coils so as to eliminate their absorptive effects. It also varies the fidelity by shorting a coupling condenser in the audio system to provide the desired reproduction for short-wave as well as long-wave reception.

Tone Control

Provision is included for variable reduction of high frequencies. This consists of a resistor and condenser combination across the primary winding of the output transformer, the resistor being the variable element. As it is decreased, the high-frequency response limit is lowered.

Power System

The power transformer has its primary winding capacitively shielded from its secondary windings to eliminate transfer of line disturbances into the receiver and to stop any tendency for the circuit to radiate into the line. Rectification is performed in the usual manner by a full-wave tube.

Detection and A.V.C.

The modulated signal as obtained from the output of the i-f system is detected by an RCA-6H6 twin diode tube. The audio frequency secured by this process is passed on to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal is used for automatic volume control. This voltage, which develops across resistor R-8, is applied as automatic control-grid bias to the r-f, first-detector, and i-f tubes through suitable resistance-capacitance filter circuits. The second diode of the **RCA-6H6** is used to supply

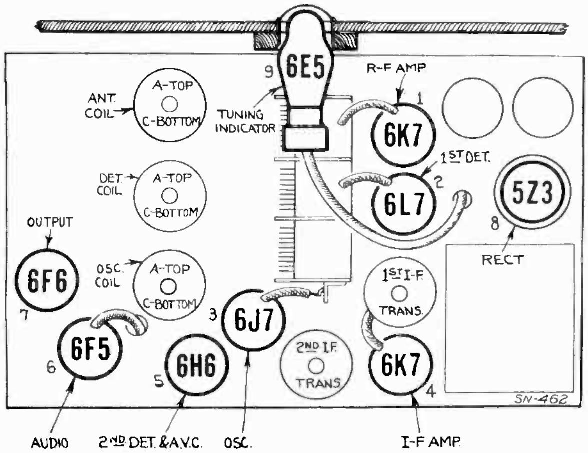


Figure 1—Radiotron and Coil Locations

residual bias for these controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current, which flows through R-9 and R-8, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed for servicing the receiver. The ratings of all resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. The coils, reactors, and transformer windings are rated in terms of their d-c resistances only. Ratings of less than one ohm are generally omitted. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and replacement parts.

Alignment Procedure

The extensive frequency range of this receiver necessitates a more or less involved method of alignment. However, if the following directions are carefully applied, the normal performance of the instrument will be obtained.

Correct performance of the receiver can only be obtained when the trimmer adjustments have been made by a skilled service man with the use of adequate and reliable test equipment. Such apparatus as may be required for this particular instrument is illustrated and described on a separate page of this booklet.

Two methods of alignment are applicable. One utilizes a Cathode-Ray Oscillograph as a means of output indication and the other follows former procedure where a glow type indicator or meter is used. The oscillographic method is much to be preferred, since greater accuracy is possible from the type of indication afforded. There are no approximations necessary as with the meter or aural method, but each adjustment can be made with excellent precision. Both methods are hereinafter outlined so that alignment operations may be made according to the equipment available.

It is wise to determine the necessity for alignment as well as the direction of misalignment before making adjustments. The RCA Tuning Wand is an instrument designed particularly for such a purpose.

The Tuning Wand consists of a bakelite rod having a small brass cylinder at one end and a core of finely divided iron at the other. It may be inserted into a tuned coil while a signal of the normal resonant frequency is being supplied to such coil to obtain an indication of the tuning. Holes are provided at the top of the r-f shield cans for entrance of the Wand. The presence of either end of the Wand will cause a change in tuning which will be indicated at the receiver output as an increase or de-

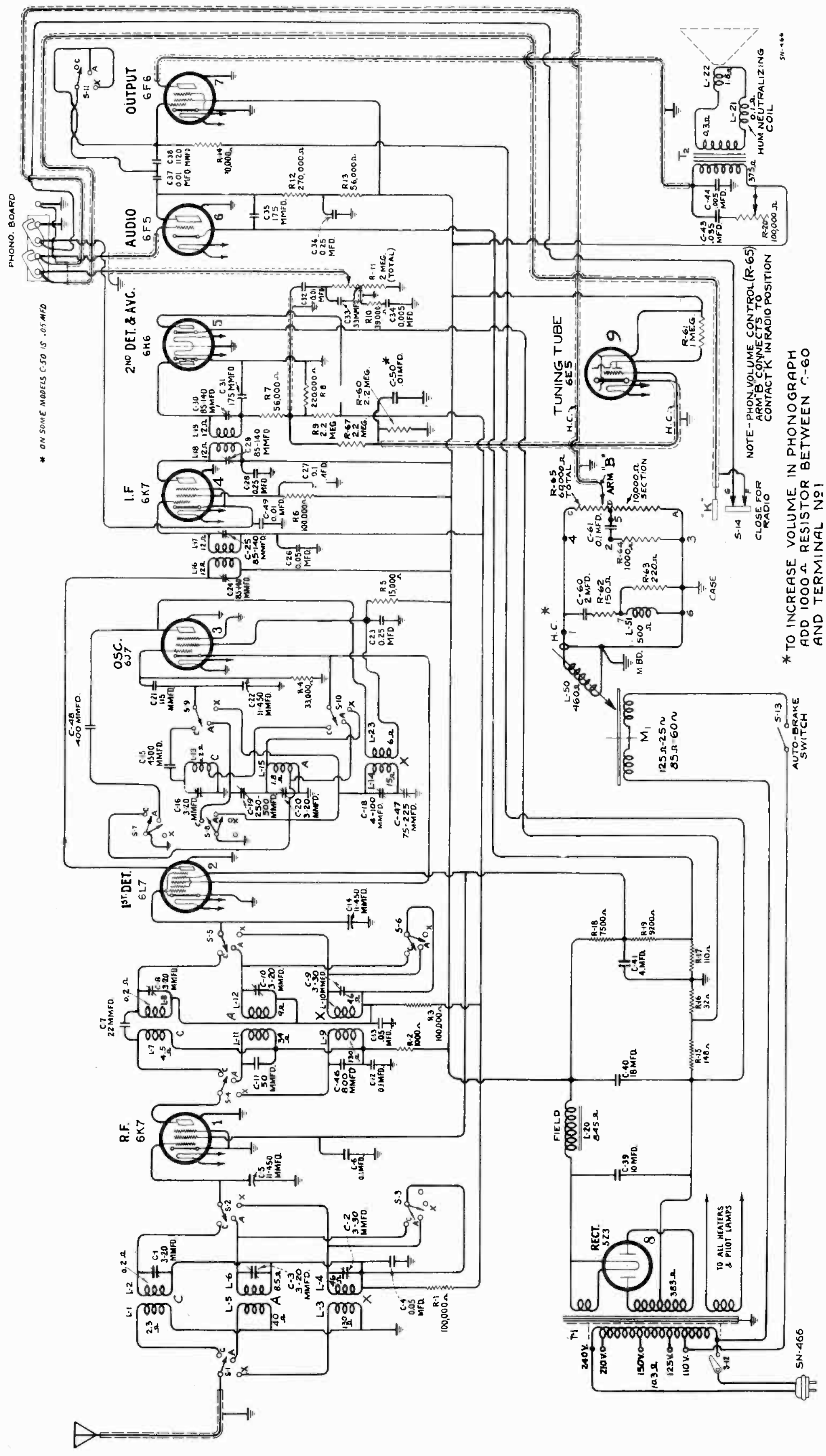


Figure 2—Schematic Circuit Diagram

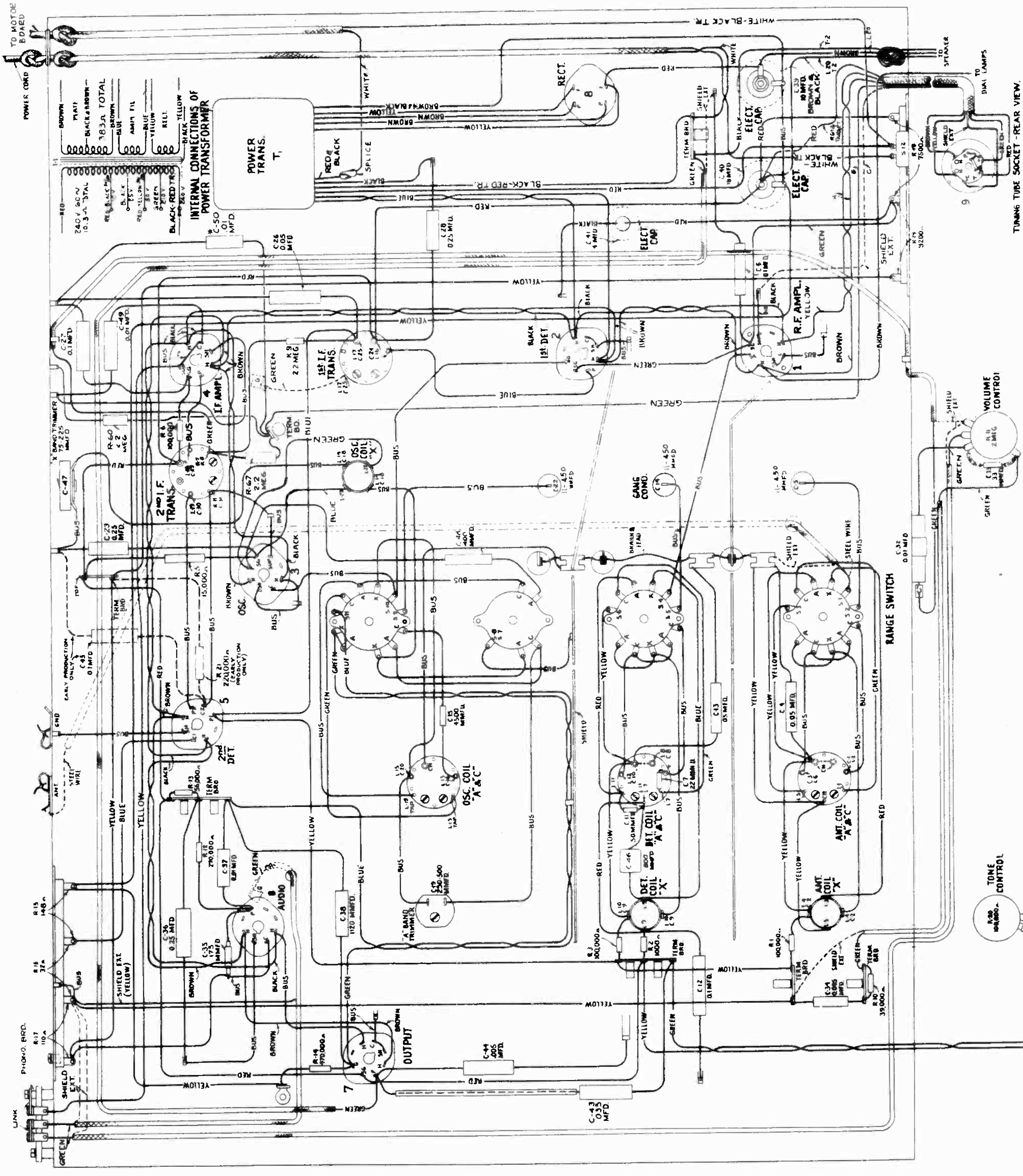


Figure 3—Chassis Wiring Diagram

crease in signal level. If there is a decrease of output when either end is inserted, the tuning is correct and will require no adjustment. However, should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output while the iron end causes a decrease, reduction of inductance will be necesarry to place the circuit in alignment. This is equivalent to decreasing the trimmer concerned. The following tabulation gives the various changes and the adjustments required:

WAND	SIGNAL	TRIMMER
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

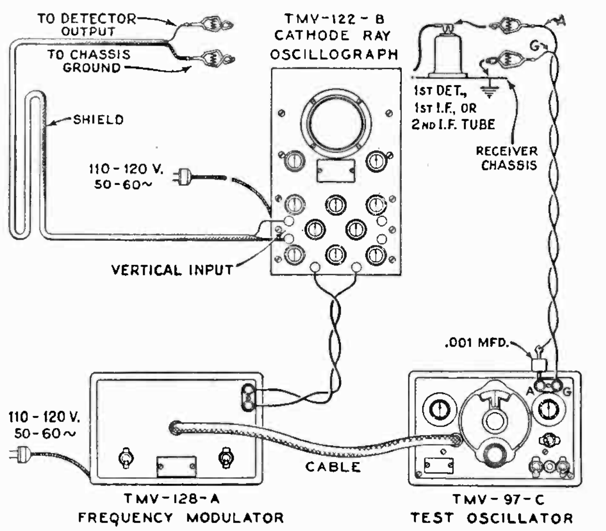


Figure 4—Alignment Apparatus Connections

CATHODE-RAY ALIGNMENT

Equipment

A standard source of the specified alignment frequencies is required. Such a source should consist of an **RCA Full Range Oscillator, Stock No. 9595.** Output indication should be by means of an **RCA Stock No. 9545 Cathode-Ray Oscillograph.** An **RCA Stock No. 9558 Frequency Modulator** will be needed to sweep the generated signal and synchronize it with the Oscillograph in order to make possible the visual representation of the resonant characteristic of the circuit being tuned on the cathode-ray fluorescent screen.

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 5. Each must be aligned to a basic frequency of **460 kc.** The last transformer must be aligned firstly and the first transformer aligned secondly. For such a process, it is necessary to feed the output of the Full-Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each transformer and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The proper point of connection of the Oscillograph is with its vertical "high" input terminal attached to the junction of R-7, R8 and R9 as illustrated in Figure 5, and with the "0" or ground terminal to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as shown by Figure 4. A .001 mfd. capacitor installed in series with the Oscillator "Ant." lead will prevent the voltages of the stage under alignment from becoming upset. The vertical "A" amplifier should be "On" for the ensuing adjustments and the gain control kept at its maximum position. For each adjustment, the Oscillator output need be regulated so that the image obtained on the Oscillograph screen will be of sufficient size as to be accurately observable. Proceed further as follows:

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver range switch to Band "A" and tune the station selector to a point where no interference will be picked up, shorting the antenna and ground terminals if necessary. Set the Oscillograph horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a straight line trace completely across the screen. Place the timing control to "Int." Adjust the intensity and focusing controls of the Oscillograph to produce the correct size and strength of the spot.

(b) Attach the output of the test Oscillator between the control grid cap of the RCA-6K7 i-f tube and chassis ground as shown typically by Figure 4. Tune the Oscillator to **460 kc.** and set its modulation switch to "On". Regulate its output until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph controls to give the desired number of cycles. Cause the image to stand still on the screen by manipulation of the frequency and synchronizing controls. Then carefully tune the two trimmers **C-29** and **C-30** of the second i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition the transformer will be sharply resonated to **460 kc.**

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full-Range Oscillator by means of the special shielded patch cord. Figure 4 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off". Change the timing control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then carefully shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become exactly coincident at their highest points. These curves will be found to occur at an Oscillator setting of ***approximately*** **540 kc.** They will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with the above requirements and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers **C-29** and **C-30** should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as in (c), change the Oscillator output to the control-grid cap of the RCA-6L7 first-detector tube. Then adjust the first i-f transformer trimmers **C-24** and **C-25** so that the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the overall tuning characteristic of the i-f system. Each trimmer of the entire group should then be checked to assure that it is in correct alignment as indicated by the degree of coincidence and relative amplitude of the image on the Oscillograph screen.

R-F Trimmer Adjustments

Locations of the various antenna, detector and oscillator coil trimmers are shown by Figure 5. The test Oscillator should be removed from connection with the i-f system and its output connected to the antenna-ground terminals of the receiver. No changes are to be made in the connections of the Oscillograph at the second detector. During the following adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Adherence to such a procedure will obviate the broadness of tuning that would result from a.v.c. action on a stronger signal. Proceed with the adjustments as follows:

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning condenser plates are in ***full mesh*** (maximum capacitance). Then move the main dial pointer until it points exactly to the ***horizontal*** line at the low frequency end of the Band A scale.

Band A

(a) With the receiver range switch in its Band A position, tune the station selector until the dial pointer is at a reading of **1,720 kc.** Adjust the test Oscillator to **1,720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector, and antenna trimmers **C-20, C-10** and **C-3** respectively, so that each brings

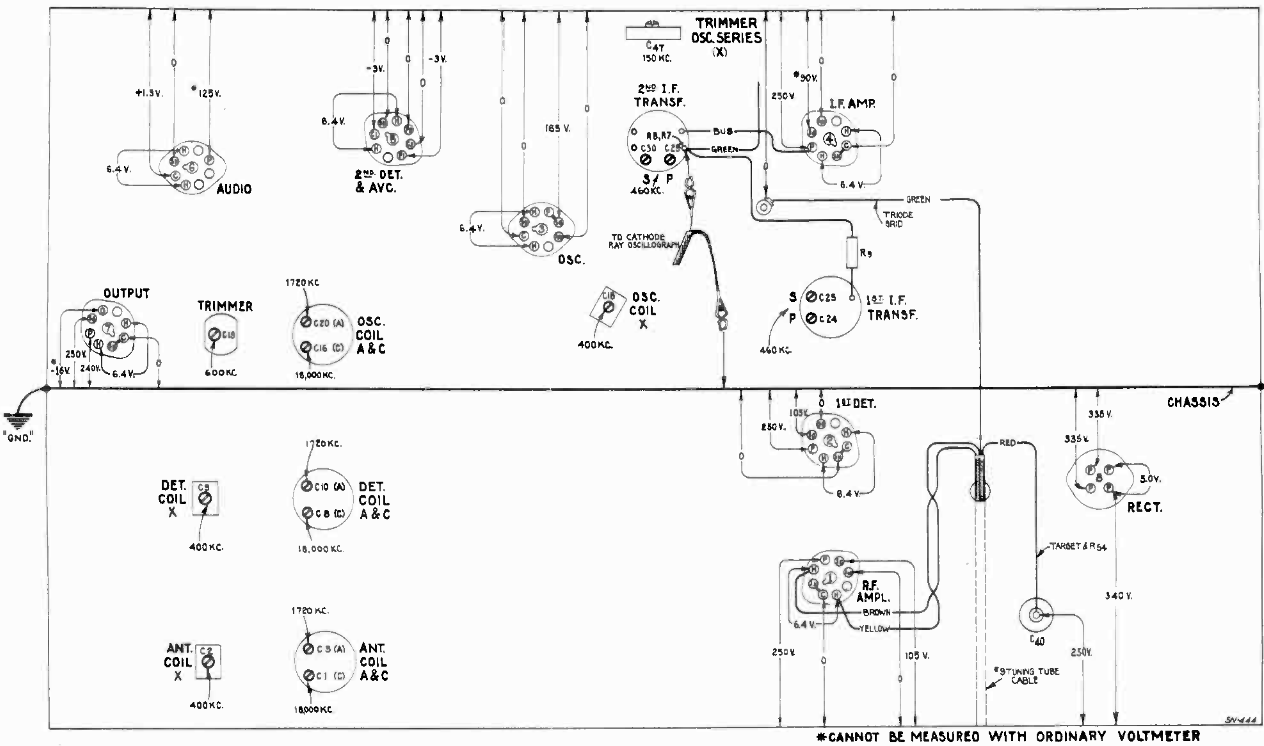


Figure 5—Radiotron Socket Voltages

Measured at 115 volts, 60 cycle supply—No signal being received

about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. After each trimmer has been peaked, the Oscillograph timing control should be set to "Ext." and the Frequency Modulator placed into operation with its connections to the Oscillator and Oscillograph made in accordance with Figure 4. Turn the modulation switch of the Oscillator to "Off" and retune the Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers **C-20, C-10** and **C-3** again, setting each to the point which produces the best coincidence and maximum amplitude of the wave images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Place the modulation switch to "On". Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator (modulation "Off") until the two similar forward and reverse waves appear on the screen. For this adjustment, it is advisable to shift the Oscillator to its 200—400 kc. range and use the third harmonic of the generated signal in order to obtain the desired range of sweep. The oscillator series trimmer **C-19** should then be adjusted to produce maximum amplitude of the images. No rocking will be necessary on the station selector inasmuch as the signal frequency is being "wobbled" by the Frequency Modulator to produce the same effect.

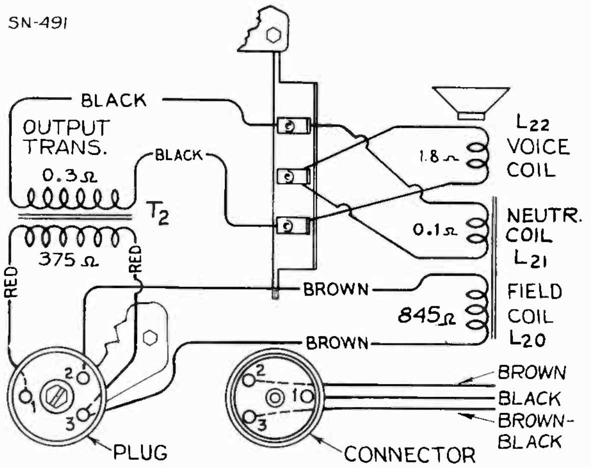


Figure 6—Loudspeaker Wiring

After completing this adjustment, the trimmer **C-20** should be realigned as in (a) to correct for any change brought about by the adjustment of **C-19.**

Band X

(a) Disconnect the Frequency Modulator and tune the test Oscillator to a frequency of **400 kc.** (Modulation "On"). Place the receiver range switch to its Band X position and tune the station selector until the dial pointer reads exactly **400 kc.** Adjust the Oscillograph timing control to "Int." Then align each of the trimmers **C-18, C-9** and **C-2** to the point producing maximum output at the Oscillograph. Place the Frequency Modulator in operation and attach it to the test Oscillator by means of the shielded cable. Change the Oscillograph timing to "Ext." Increase the frequency of the Oscillator (Modulation "Off") until the two forward and reverse waves appear and become coincident at their highest point, ***approximately at*** 462 ***kc.*** These waves may be made to remain stationary on the screen by manipulation of the Oscillograph range switch (No. 2 position) and frequency control (mid-position). Readjust the three trimmers **C-18, C-9** and **C-2** to give maximum amplitude and complete coincidence of the waves.

(b) Change the test Oscillator so that it delivers a signal of **150 kc.** with the Frequency Modulator disconnected. Tune this signal on the receiver, which should be set to the Band X setting, disregarding the dial reading at which the signal is best received. Then interconnect the Frequency Modulator with the Oscillator and retune the latter to the point at which the two similar waves appear on the screen. Adjust the trimmer **C-47** for maximum amplitude of the wave images. Rocking of the tuning condenser will not be necessary for this operation as such is duplicated by the Frequency Modulator. Repeat the alignment of **C-18** as in (a) to correct for any error brought about by the adjustment of **C-47.**

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to **18,000 kc.** (modulation "On" and Frequency Modulator disconnected) and regulate its ouput to the level required for convenient observation. Adjust the trimmer **C-16** to the point producing maximum output as indicated on the Oscillograph. Check for the presence of the proper "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of **C-16** has been properly made using the position of least capacitance which gives maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". ***No adjustments should be made during this check.***

(b) Return the receiver tuning to **18,000 kc.**, re-align **C-16** if necessary, and then adjust the detector and antenna trimmers, **C-8** and **C-1**, for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on this band.

OUTPUT INDICATOR ALIGNMENT

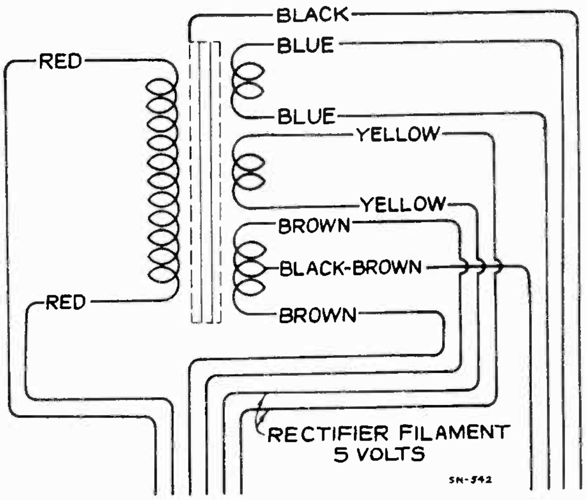
To align the receiver by means of an output indicator other than a Cathode-Ray Oscillograph will require the use of a standard test Oscillator such as that recommended above for the source of signals and means of indication for the output. The **RCA Neon Output Indicator, Stock No. 4317** will be found very satisfactory for such use. It should be connected across the voice coil circuit of the loudspeaker or across the output transformer primary.

I-F Alignment

Connect the test Oscillator to the control-grid cap of the i-f tube. Advance the volume control of the receiver to its full-on position. Tune the test Oscillator to **460 kc.** and align the trimmers **C-29** and **C-30** to give maximum receiver output. Regulate the Oscillator output during this adjustment so that the output indication is as small as can be conveniently observed. After completing the adjustments of these trimmers, reconnect the Oscillator so that it will feed into the control-grid circuit of the RCA-6L7 first detector. Then tune the first i-f transformer trimmers **C-24** and **C-25** for maximum receiver output.

R-F Alignment

After completing the i-f adjustments, it is advisable to correct the line-up of the circuits ahead of the first detector. The test Oscillator should be connected to the antenna-ground terminals of the receiver and the manual volume control kept at its maximum position. For each adjustment the Oscillator output should be maintained as low as possible in order to avoid broadness of tuning which would result from a.v.c. action on a stronger signal. **Band A** should be aligned by supplying a **1,720 kc.** signal to the receiver, tuning the station selector to a dial reading of **1,720** and adjusting the trimmers **C-20, C-10** and **C-3** to produce maximum receiver output. The Oscillator should then be shifted to **600 kc.** and the receiver tuned to resonate this signal, disregarding the reading at which it is best received. Trimmer **C-19** must then be adjusted, simultaneously while rocking the station selector backward and forward through the signal until the maximum output results from the combined operations. **C-20** should be rechecked to assure that its adjustment has not changed because of the trimming of **C-19**. **Band X** must be aligned at **400 kc.** and **150 kc.** Tune the test Oscillator to **400 kc.** and turn the receiver dial to the same reading. Adjust trimmers **C-18, C-9** and **C-2** for maximum (peak) receiver output. Then shift the Oscillator to **150 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Adjust trimmer **C-47,** simultaneously rocking the tuning condenser backward and forward through the signal, until maximum receiver output results from the combined operations. Repeat the alignment of **C-18** as above to correct for any change which may have been caused by the adjustment of **C-47.** Change the receiver so that it is operative and the dial reads **18,000 kc.** on the **"C" Band.** Tune the test Oscillator to **18,000 kc.** Then adjust the oscillator trimmer **C-16** to produce maximum (peak) output. Two positions of this trimmer will be found which conform with this requirement. The one of least capacitance is correct. Check for the presence of "image" response at **17,080 kc.** by shifting the receiver tuning. If it is received at such a point, the trimmer **C-16** has been correctly adjusted to the right peak. ***No adjustments are to be made during this check.*** Tune the receiver back to the **18,000 kc.** dial marking, readjust **C-16** if necessary, and then tune the detector and antenna capacitors **C-1** and **C-8** for maximum receiver output. No further adjustments are necessary.



Pri. Res.—8.0 ohms, total
Sec. Res.—670 ohms, total

Figure 7—Standard Power Transformer Connections

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 5 will serve to assist in the location of causes for faulty operation. Each value as specified should hold within 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1,000-ohms-

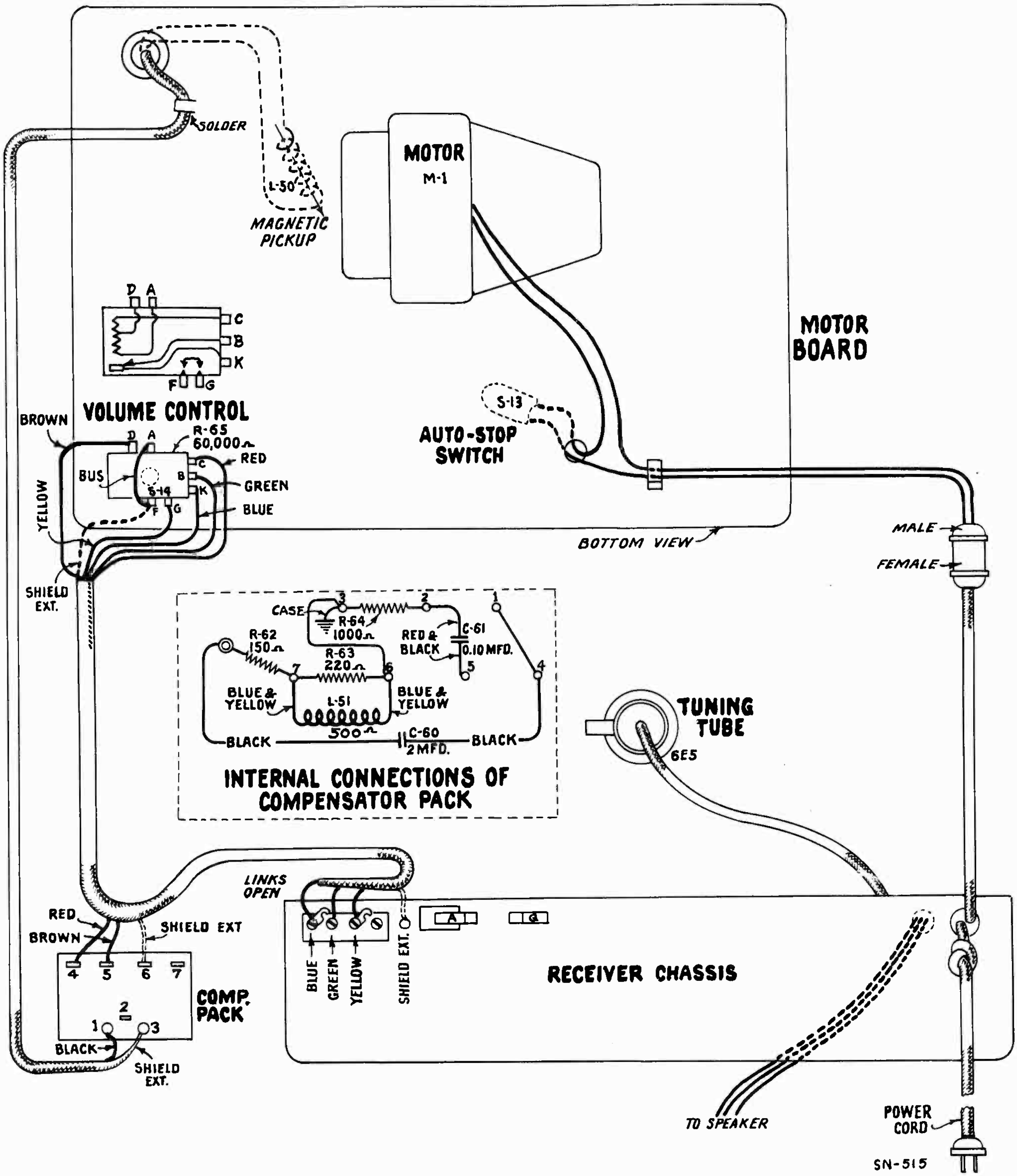


Figure 8—Assembly Wiring

per-volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Standard Transformer

The transformer used on some models of this instrument is adaptable for voltages and frequencies as given under Ratings A and B of Electrical Specifications. Its schematic and wiring are shown by Figure 7.

Phonograph Mechanism

The phonograph motor is of the governor induction type and designed to be simple and foolproof. Under normal operating conditions, service difficulties should be negligible. Occasionally, however, certain adjustments may be required. These adjustments are illustrated and explained in Figure 9. Application of oil to the felt pad which rubs against the governor disc will insure smooth operation.

Magnetic Pickup

The pickup used in the phonograph unit is of an improved design, having several variations from the usual type of pickup. The magnetic assembly is one rigid piece. The horseshoe magnet is solidly welded to the pole pieces and is irremovable. There is a centering spring attached to the armature to maintain proper adjustment and provide a limiting effect on the movement of the armature. The frequency response is uniform over a wide range.

Service operations which may be necessary on the pickup are as follows:

Centering Armature

Refer to Figure 10 showing the pickup inner structure. The armature is shown in its proper relation to the magnet pole pieces, i. e., exactly centered. Whenever this centering adjustment has been disturbed, the screws **A**, **B**, and **C** should be loosened and the armature clamp adjusted to the point where the vertical axis of the armature is at right angles to the horizontal axis of the pole pieces, and centered between them. This centering operation may be facilitated by inserting a small rod or nail into the armature needle hole, using it as a lever to test the angular movement of the armature. The limitation of the movement in each direction will be caused by the armature striking the pole pieces. The proper adjustment is obtained when there is equal angular displacement of the armature and adjustment rod or nail to each side of the vertical axis of the magnet and coil assembly. The screws **A** and **B** should then be secured, observing care not to disturb the adjustment of the armature clamp. Then place the pickup in a vise and secure the centering spring-clamp by means of the screw **C**, allowing the centering spring to remain in the position at which the armature is exactly centered between the pole pieces. With a little practice, the correct adjustment of the armature may be readily obtained. The air gap between the pole pieces and the armature should be kept free from dust, filings, and other such foreign materials which would obstruct the movement of the pickup armature.

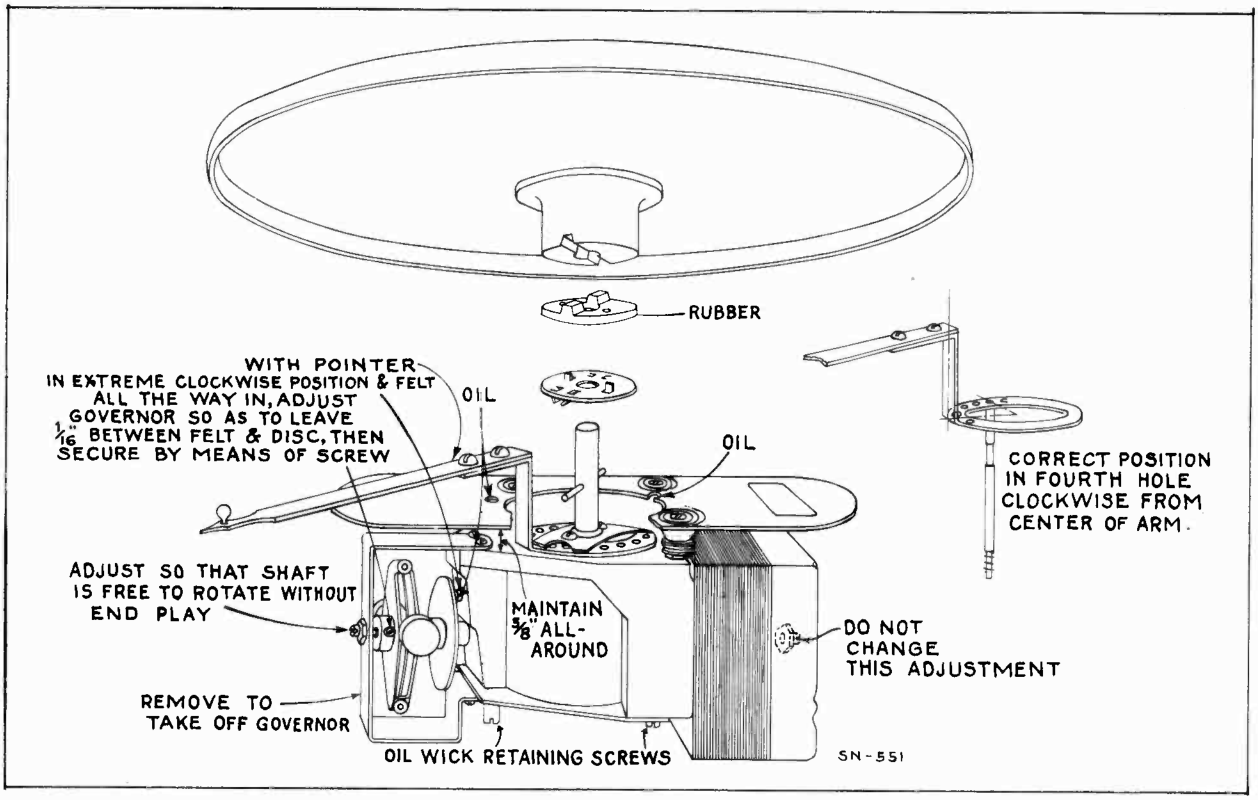


Figure 9—Motor Details

Damping Block

The viscoloid block which is attached to the back end of the armature shank serves as a mechanical filter to eliminate undesirable resonances and to cause the frequency response to be uniform. Should it be necessary to replace this damping block, it may be done by removing screw **D** and the cover support bracket from the mechanism and taking off the old viscoloid block. The surface of the armature which is in contact with the viscoloid should be thoroughly

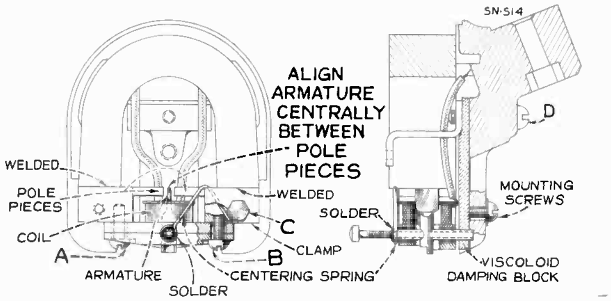


Figure 10—Details of Pickup

cleaned with fine emery cloth. Then insert the new block so that it occupies the same position as it did originally. Make certain that the block is in correct vertical alignment with the armature. The hole in the new viscoloid block is somewhat smaller than the diameter of the armature in order to permit a snug fit. With the viscoloid aligned on the armature, screw **D** and the cover support bracket should then be replaced. Heat should be applied to the armature (viscoloid side) so that the viscoloid block will fuse at the point of contact and become rigidly attached to the armature. A special-tip soldering iron constructed as shown in Figure 11 will be found very useful in performing this operation. The iron should be applied only long enough to slightly melt the block and cause a small bulge on both sides.

Replacing Coil

Whenever there is defective operation due to an open or shorted pickup coil, this coil should be replaced. The method of replacement will be obvious upon inspection of the pickup assembly and by study of the cut-a-way illustrations. Make sure that the new coil is properly centered with the hole in the support strip and glued securely in that position. It is important to readjust the armature as previously explained after reassembly of the mechanism. Only rosin core solder should be used for soldering the coil leads in the pickup. This same type of solder should be used when necessary for soldering the centering spring to the armature.

Magnetizing

Loss of magnetization will not usually occur when the pickup has received normal care due to the fact that the magnet and pole pieces are one unit and the magnetic circuit remains closed at all times. When the pickup has been mishandled, subjected to a strong a-c field, jolted, or dropped, there may be an appreciable loss of magnetic strength, in which case it will be necessary to remagnetize the entire structure. This should be done by first removing the cover and then placing the pickup assembly on the poles of a standard pickup magnetizer such as the **RCA Stock No. 9549 Pickup Magnetizer** and charging the pickup in accordance with the instructions accompanying the

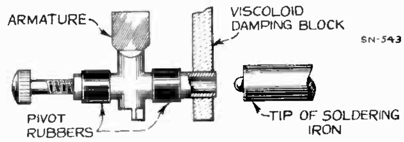


Figure 11—Special Soldering-Iron Tip

magnetizer. It is recommended that the pickup be magnetized while the armature assembly is in place. This will necessitate that one of the poles of the magnetizer be rotated 180 degrees. This will provide proper clearance for the armature clamp assembly. It is preferable to check the polarity of the pickup magnet and to remagnetize it so that the same polarity is maintained.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	DESCRIPTION	List Price	Stock No.	DESCRIPTION	List Price
	RECEIVER ASSEMBLIES		11292	Capacitor—22 MMfd. (C7)	.24
11698	Board—Three-terminal phonograph terminal board	$0.22	11321	Capacitor—33 MMfd. (C33)	.26
4427	Bracket—Volume control or high-frequency tone control mounting bracket	.18	11289	Capacitor—50 MMfd. (C11)	.26
5237	Bushing—Variable tuning condenser mounting bushing assembly—Package of 3	.43	11291	Capacitor—115 MMfd. (C21)	.24
11350	Cap—Contact cap—Package of 5	.20	5116	Capacitor—175 MMfd. (C35)	.18
11223	Capacitor—Adjustable capacitor (C19)	.46	11290	Capacitor—400 MMfd. (C48)	.25
11256	Capacitor—Adjustable capacitor (C-47)	.48	11269	Capacitor—800 MMfd. (C46)	.30
			4409	Capacitor—1120 MMfd. (C38)	.35
			11287	Capacitor—4500 MMfd. (C15)	.30
			4868	Capacitor—.005 Mfd. (C34)	.20
			4838	Capacitor—.005 Mfd. (C44)	.20

The prices quoted above are subject to change without notice.

REPLACEMENT PARTS—Continued

Stock No.	DESCRIPTION	List Price
4624	Capacitor—.01 Mfd. (C32)	.54
4858	Capacitor—.01 Mfd. (C37, C49, C50*)	.25
5196	Capacitor—.035 Mfd. (C43)	.18
4886	Capacitor—.05 Mfd. (C50*)	.20
4836	Capacitor—.05 Mfd. (C4, C13, C26)	.30
4885	Capacitor—0.1 Mfd. (C6, C12, C27)	.28
5170	Capacitor—0.25 Mfd. (C23, C28, C36)	.25
11248	Capacitor—4 Mfd. (C41)	1.06
11240	Capacitor—10 Mfd. (C39)	1.08
5212	Capacitor—18 Mfd. (C40)	1.16
11272	Clamp—Antenna cable clamp—Located near antenna terminal	.10
4748	Clamp—Capacitor mounting clamp assembly—for Stock No. 11248	.15
5215	Coil—Antenna coil (A and C Bands)—(L1, L2, L5, L6, C1, C3)	2.32
11325	Coil—Antenna coil (X Band)—(L3, L4, C2)	1.56
5216	Coil—Detector coil (A and C Bands)—(L7, L8, L11, L12, C8, C10)	2.34
11326	Coil—Detector coil (X Band)—(L9, L10, C9)	1.60
5217	Coil—Oscillator coil (A and C Bands)—(L13, L15, C16, C20)	2.20
11327	Coil—Oscillator coil (X Band)—(L14, L23, C18)	1.44
11214	Condenser—Three-gang variable tuning condenser (C5, C14, C22)	4.20
11697	Cover—Phonograph terminal board cover	.12
4340	Lamp—Dial lamp—Package of 5	.60
8041	Plate—R.F. or I.F. coil shield locking plate—Package of 2	.12
11244	Resistor—Voltage divider resistor, comprising one 7500-ohm and one 9200-ohm sections (R18, R19)	1.08
11245	Resistor—Voltage divider resistor, comprising one 148-ohm, one 32-ohm, and one 110-ohm section (R15, R16, R17)	.62
5112	Resistor—1000 Ohm—Carbon type—¼ Watt—(R2)—Package of 5	1.00
5114	Resistor—15,000 Ohm—Carbon type—1 Watt—(R5)	.22
11300	Resistor—33,000 Ohm—Carbon type—1/10 Watt—(R4)—Package of 5	.75
11322	Resistor—39,000 Ohm—Carbon type—¼ Watt—(R10)—Package of 5	1.00
5029	Resistor—56,000 Ohm—Carbon type—¼ Watt—(R13)—Package of 5	1.00
3118	Resistor—100,000 Ohm—Carbon type—¼ Watt—(R1, R3, R6)—Package of 5	1.00
11323	Resistor—270,000 Ohm—Carbon type—¼ Watt—(R12)—Package of 5	1.00
11172	Resistor—470,000 Ohm—Carbon type—¼ Watt—(R14)—Package of 5	1.00
11151	Resistor—2.2 Megohms—Carbon type—¼ Watt—(R9, R60, R67)—Package of 5	1.00
5249	Shield—Antenna, detector, or oscillator coil shield	.20
5250	Shield—I.F. transformer shield	.22
11273	Shield—Rectifier Radiotron shield	.25
11222	Socket—Dial lamp socket	.18
4794	Socket—Four-contact rectifier Radiotron socket	.15
11313	Socket—Five-contact Radiotron socket	.18
11198	Socket—Seven-contact Radiotron socket	.15
11236	Switch—Band switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11)	2.44
11133	Switch—Power switch (S12)	.62
5238	Terminal—Antenna terminal clip assembly	.14
11238	Tone Control—High-frequency tone control (R20)	.96

Stock No.	DESCRIPTION	List Price
11216	Transformer—First intermediate frequency transformer (L16, L17, C24, C25)	2.15
11239	Transformer—Second intermediate frequency transformer (L18, L19, C29, C30, C31, R7, R8)	2.72
11242	Transformer—Power transformer—105-125 Volts—25-60 Cycles	6.52
11243	Transformer—Power transformer—100-130, 140-160, 195-250 Volts—40-60 Cycles—(T1)	4.64
11237	Volume control (R11)	1.20
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—comprising drive shaft, balls, ring, spring and washers—assembled	1.00
11262	Dial—Dial scale	.60
11252	Drive—Variable tuning condenser drive assembly	1.88
4520	Indicator—Station selector indicator pointer	.18
11226	Indicator—Band indicator pointer assembly—comprising indicator pointer, arm, link and stud	.20
3993	Screw—No. 6-32-5/32" square set-screw for band indicator operating arm—Package of 10	.25
4669	Screw—No. 8-32-5/32" set-screw for variable condenser drive assembly—Package of 10	.25
4377	Spring—Band indicator operating arm spring—Package of 5	.25
4378	Stud—Band indicator operating arm stud and nut assembly—Package of 5	.25
	MOTOR ASSEMBLIES	
11703	Governor—Governor complete for phonograph motor—Stock No. 11701 or No. 11702	3.05
11701	Motor—Phonograph turntable motor—110 Volts—50 to 60 Cycles—(M1)	21.20
11702	Motor—Phonograph turntable motor—110 Volts—25 Cycles	33.35
	MOTOR BOARD ASSEMBLIES	
4594	Box—Used needle box (cup)	.30
7084	Cover—Turntable cover	.40
11704	Damper—Turntable rubber damper and damper plate	
4596	Escutcheon—Speed regulator escutcheon plate	.36
4597	Screw—Motor mounting screw assembly—comprising four screws, four lock-washers, four spacers, and four nuts	.22
11696	Turntable—Complete	2.48
11695	Volume Control—Phonograph volume control (R65, S14)	1.60
	ECCENTRIC AUTOMATIC BRAKE SWITCH ASSEMBLIES	
3994	Cover—Eccentric automatic switch cover and screw	.26
10174	Springs—Automatic brake springs—comprising one each of four springs—Package of 2	.50

The prices quoted above are subject to change without notice.

* Refer to Schematic Diagram.

REPLACEMENT PARTS—Continued

Stock No.	DESCRIPTION	List Price
6896	Switch—Eccentric automatic brake and switch assembly—less switch cover	2.50
3322	Switch—Eccentric automatic switch only —less cover (S13)	.75
	PICKUP AND ARM ASSEMBLIES	
11705	Arm—Pickup arm complete—less escutcheon and pickup unit	4.50
11707	Armature—Pickup armature	.28
6346	Back—Pickup housing back	.45
11709	Coil—Pickup coil (L50)	.58
3521	Cover—Pickup back cover	.18
11708	Cover—Pickup front cover	.15
3737	Damper—Pickup damper—Package of 5	.65
3390	Escutcheon—Pickup arm escutcheon	.46
11706	Pickup Unit—Complete (L50)	4.80
3389	Rod—Eccentric automatic brake trip rod —Package of 5	.40
3387	Screw Assembly—Pickup mounting screw assembly—comprising one screw, one lockwasher and one nut—Package of 10	.40
11549	Screw—Pickup front cover screw—Package of 10	.42
11547	Screw—Pickup needle holding screw—Package of 10	.42
	CABLE ASSEMBLIES	
11700	Cable—Five-conductor shielded cable—approximately 24" long—Connects phonograph volume control to compensator pack and chassis terminal strip	.88
11699	Cable—Radiotron tuning tube cable complete with socket and cover—approximately 25" long	1.32
4573	Plug—Female section of two-contact plug —Used on power cable to motor	.30
4577	Plug—Male section of two-contact plug —Used on motor leads	.30
11382	Resistor—1 Megohm—Carbon type—1/10 Watt—Located in tuning tube socket—(R61)—Package of 5	.75
11381	Socket—Radiotron tuning tube socket and cover	.45
	REPRODUCER ASSEMBLIES	
11232	Board—Terminal board assembly with two lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Output transformer mounting bracket	.14
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
11254	Coil—Field coil (L20)	2.00
11233	Coil—Hum neutralizing coil (L21)	.30
11258	Cone—Reproducer cone (L22)—Package of 5	3.85
5118	Connector—Three-contact male connector for reproducer	.25
5119	Connector—Three-contact female connector plug for reproducer cable	.25
9619	Reproducer—Complete	6.05
11253	Transformr—Output transformer (T2)	1.56
11230	Washer—"Binder's board" "C" washers —Used to hold field coil assembly	.18
	MISCELLANEOUS ASSEMBLIES	
11191	Bracket—Tuning tube mounting bracket —less clamp	.12
11192	Clamp—Tuning tube mounting clamp—less bracket	.12
11694	Compensator—Phonograph input compensator pack—comprising one 150-ohm, one 220-ohm, and one 1000-ohm resistor, one 0.1 Mfd. and one 2 Mfd. capacitor, and one 0.25 H reactor—(R62, R63, R64, C60, C61, L51)	3.80
11337	Escutcheon—Station selector escutcheon	.70
11276	Escutcheon—Radiotron tuning tube escutcheon	.40
11246	Foot—Chassis mounting foot and bracket assembly—Package of 2	.76
6614	Glass—Station selector dial glass	.30
11346	Knob—Station selector knob—Package of 5	.75
11347	Knob—Phonograph volume control, radio volume control, tone control, power switch or range switch knob—Package of 5	.75
4678	Ring—Retaining ring for station selector dial glass—Package of 5	.34
11210	Screw—Chassis mounting screw assembly—Package of 4	.28
11348	Screw—No. 8-32-7/16" set-screw for knob—Stock No. 11346—Package of 10	.32
3391	Spring—Motor board mounting spring assembly—comprising one bolt, one "C" washer, two cup washers, one bottom spring, one lockwasher, and one cap nut	.50
11349	Spring—Retaining spring for knob—Stock No. 11347—Package of 5	.15

The prices quoted above are subject to change without notice.

RCA VICTOR MODEL D 11-2

Eleven-Tube, Three-Band, A-C, Automatic Radio-Phonograph

SERVICE NOTES

Electrical Specifications

FREQUENCY RANGES

Band X	140 kc.— 410 kc.
Band A	540 kc.— 1,800 kc.
Band C	5,700 kc.—18,000 kc.

ALIGNMENT FREQUENCIES

Band X	150 kc. (osc.), 400 kc. (osc., ant., det.)
Band A	600 kc. (osc.), 1,720 kc. (osc., ant., det.)
Band C	18,000 kc. (osc., ant., det.)

Intermediate Frequency .... **460 kc.**

RADIOTRON COMPLEMENT

(1)	RCA-6K7	Radio-Frequency Amplifier
(2)	RCA-6L7	First Detector
(3)	RCA-6J7	Heterodyne Oscillator
(4)	RCA-6K7	Intermediate Amplifier
(5)	RCA-6H6	Second Detector and A.V.C.
(6)	RCA-6C5	First Audio Amplifier
(7)	RCA-6C5	Audio Driver Amplifier
(8)	RCA-6F6	Power Output Amplifier
(9)	RCA-6F6	Power Output Amplifier
(10)	RCA-5Z3	Full-Wave Rectifier
(11)	RCA-6E5	Tuning Indicator

POWER SUPPLY RATINGS

Rating A-6	105-125 Volts, 60 Cycles, 170 Watts
Rating A-5	105-125 Volts, 50 Cycles, 165 Watts
Rating B-4	105-125 Volts, 40 Cycles, 170 Watts
Rating B-3	105-125 Volts, 30 Cycles, 160 Watts
Rating B-2	105-125 Volts, 25 Cycles, 165 Watts
Rating C-6	105-130/140-160/200-250 Volts, 60 Cycles, 175 Watts
Rating C-5	105-130/140-160/200-250 Volts, 50 Cycles, 170 Watts

PHONOGRAPH

Type	Automatic Record Ejector
Record Capacity	Seven 10-inch or Six 12-inch
Turntable Speed	78 R.P.M.
Type of Pickup	Improved Low-Impedance Magnetic
Pickup Impedance	12 Ohms at 1,000 Cycles

POWER OUTPUT RATINGS

Undistorted	8.5 Watts
Maximum	11.5 Watts

LOUDSPEAKER

Type	12-inch Electrodynamic
Voice Coil Impedance	7.5 Ohms at 400 Cycles
Field Coil Rating	1,700 Ohms—72 M.A.

Mechanical Specifications

Height	43 inches
Width	30⅝ inches
Depth	18½ inches
Weight (Net)	155 pounds
Weight (Shipping)	229 pounds
Chassis Base Dimensions	15½ inches x 10½ inches x 3½ inches

General Description

The RCA Victor Model D 11-2 combination radio receiver and automatic phonograph provides excellent entertainment from either broadcast reception or record reproduction. It consists of an eleven-tube, three-band radio receiver, and an automatic phonograph, combined in the one cabinet. The high level of sound energy obtainable from the output of this instrument is capably handled by a new Super-Sensitive, twelve-inch, electrodynamic loudspeaker. Outstanding features of this instrument are as follows:

Magic Brain

The radio receiver includes the "Magic Brain" unit for maximum all-around efficiency. This unit is a scientifically correct co-ordination of all the parts for the r-f, oscillator, and first detector functions of a Superheterodyne Receiver. Such design of the important head end, or "Magic Brain" unit, gives greater efficiency in the short-wave ranges as all lead lengths are kept as short as possible, and all sockets and other parts are located for best possible operation.

Magic Eye

A cathode-ray tube whose fluorescent screen has the appearance of a human eye, is used for visually indicating when the receiver is accurately tuned to the incoming signal. This tube is of new design. It contains two groups of elements; one group operates as an amplifier and the other group operates as a cathode-ray tube.

The cathode-ray section consists of a conically shaped luminescent screen, a cathode, and a control electrode. The detected signal from the receiver is applied through the amplifier section of the tuning tube to the control electrode of the cathode-ray section. This control electrode, in turn, affects the electron stream emitted by the cathode in such a manner as to cause a triangular shadow on the luminescent screen. The size of the shadow caused by the control electrode is determined by the strength of the incoming signal, so that a change-of-tuning is readily exhibited on the cathode-ray screen, and therefore, tuning to exact resonance can be definitely obtained.

RCA All-Metal Tubes

The new metal tubes are used in the radio receiver for amplifying and detecting purposes. These tubes make possible a greater range of stable amplification not previously attainable with corresponding glass types. Their metal envelopes form a perfect electrostatic and electromagnetic shield, precluding the former necessity for elaborate shielding by means of cans. The metal tubes are especially adaptable to the modern, extended-range receivers because of their efficient shielding and their favorable internal characteristics.

Automatic Record Changer

An improved automatic mechanism is used in this model. It is of the record ejector type, having a record capacity of seven for the ten-inch type, and a capacity of six for the twelve-inch type. The turntable speed is fixed at 78 r.p.m. by the design of the drive motor and the intermediate gear mechanism. *This speed is invariable and does not vary as long as the supply line frequency remains constant.* The instrument may be purchased with any one of seven ratings as specified under Electrical Specifications. *It is very important that a machine of any particular rating be operated at the frequency for which it is designed and rated.* Attempts to operate at other frequencies will result in improper reproduction from the phonograph system. The ejecting mechanism is arranged so that it will trip on various types of records. This is obtained by having a trip mechanism which is actuated by the rate of needle acceleration toward the center of the record.

Selector Dial

The dial drive and station indicator system are of unique design. There are three individual dial scales, each with full 180 degree band spread, one for use on each of the three tuning bands. These scales are eccentrically arranged on a rotary disc which operates in conjunction with the range selector switch, so that as the switch is shifted to a particular band, the corresponding dial scale rotates into position, leaving the remaining scales concealed. The driving mechanism for the dial pointer and the variable gang condenser has tuning ratios of 10-to-1 and 50-to-1. Control may be interchanged between these two ratios by a push-pull operation of a positive-action clutch which is actuated by the tuning control knob. A vernier dial with an auxiliary pointer (band-spreader) is provided for the accurate tuning required for short-wave reception. The vernier pointer is geared to the main dial-shaft through a mechanism which causes it to rotate ten times to a 180 degree rotation of the main dial-pointer. The dial-drive mechanism connects to the variable gang condenser by means of a flexible coupling. This coupling arrangement together with the new shock-proof condenser mounting makes possible the rigid attachment of the drive mechanism to the receiver-chassis base without causing serious microphonic coupling between the base and the tuning condenser.

CIRCUIT ARRANGEMENT

The Superheterodyne principle of operation forms the basis of the circuit design. A single, tuned r-f stage is used ahead of the first detector. The functions of oscillator and detector are performed by two separate tubes. One i-f stage is employed and designed to operate at 460 kc. The combined second detector and a.v.c. stage uses an RCA-6H6 double diode. The audio system consists of two single amplifier stages working in cascade with a push-pull power output stage. The loudspeaker is an electrodynamic type, receiving its field supply from the rectifier and filter system and simultaneously acting as a filter reactor.

Full wave rectification is performed in the RCA-5Z3 tube. The outstanding features of electrical design are concerned with the following:

Tuned Circuits

A total of seven circuits are tuned to provide gain and selectivity to the incoming signal. The variable gang condenser resonates the antenna transformer secondary, the detector transformer secondary and the oscillator coil. Alignment trimmers are included for each of these same circuits. Additional trimmers are used on the i-f transformers, tuning both the secondaries and primaries to 460 kc. There are separate groups of antenna, detector and oscillator coils for each of the tuning ranges. They are placed into operation by means of a rugged rotary switch.

First Detector

This stage has unusually good high frequency mixing efficiency. The tube used, an RCA-6L7, is a new hexode type. The signal is supplied to the first control grid and the oscillator is fed in on a second control grid, a screen grid separating the two. The arrangement of the grids prevents degenerative difficulties, particularly at the higher frequencies. The second grid is direct-connected to the cathode of the oscillator tube and has no d-c bias.

Oscillator

The oscillator circuit is worthy of careful study inasmuch as it is different from the type ordinarily employed. It has self-stabilizing properties which are very advantageous for short wave operation. The generated frequency remains substantially constant, the circuit being unaffected by variation of line voltage and other similar influences. Output also remains uniform over the individual tuning ranges. The switching of the tuning coils is arranged so as to short those not in use in order to prevent absorption or any reactive effects in the particular band being tuned.

Detector and A.V.C.

The modulated signal as obtained from the output of the i-f system is detected by an RCA-6H6 double diode tube. The audio frequency secured by this process is passed on to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal, is used for automatic volume control. This voltage, which develops across resistors R-7 and R-8, is applied as automatic control grid bias to the r-f, first detector and i-f tubes through suitable resistance-capacitance filter circuits. The second diode of the RCA-6H6 is used to supply residual bias for these controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current, which flows through resistors R-7, R-8 and R-9, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function. The cathode and anode of the signal-a.v.c. diode have positive potential in respect to chassis-ground and cathodes of the a.v.c. controlled tubes when no signal is being received.

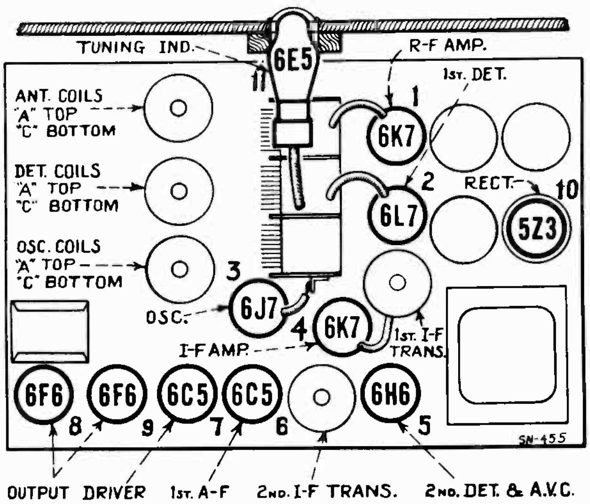


Figure 1—Radiotron and Coil Locations

Audio System

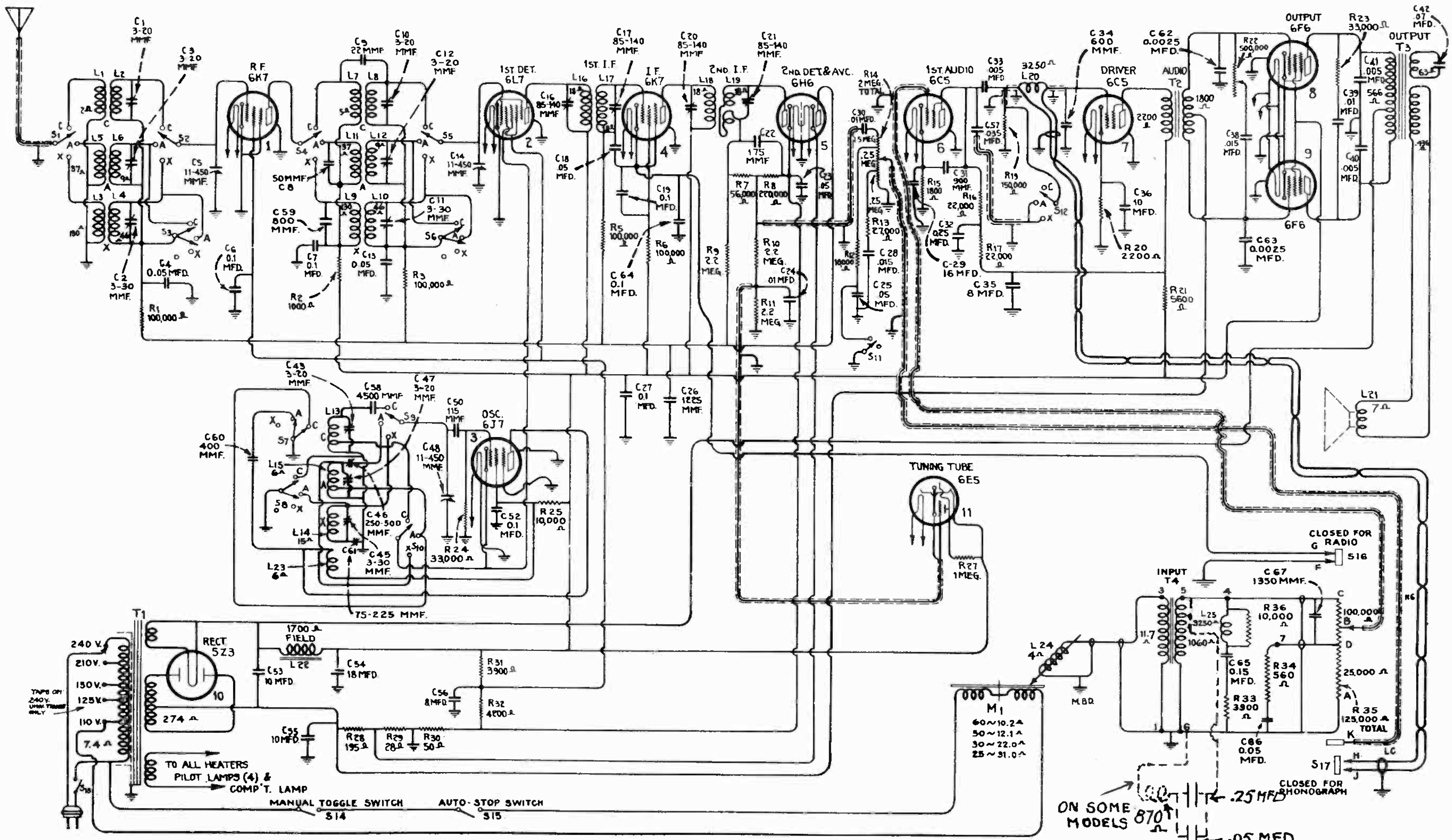
Manual volume control of the detected signal is effected by an acoustically tapered potentiometer in the grid circuit of the first a-f stage. This control has tone compensating filters connected to two points thereon. These filters effect the correct aural balance at different volume settings. A music-speech switch (low frequency tone control) is associated with one of the compensation filters. The purpose of this control is to make speech reproduction more intelligible and to reduce hum obtained from stray modulation on a carrier. The driver stage of the audio system uses an RCA-6C5 which is resistance coupled to the first a-f tube and transformer coupled into the push-pull power output stage.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed to isolate causes for defective operation when such develops. The ratings of the resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and the Replacement Parts List. The coils, reactors, and transformer windings are rated in terms of their d-c resistances only. Ratings of less than one ohm are generally omitted.

Alignment Procedure

Eleven alignment trimmers are provided in the r-f, first detector and oscillator tuning system and four are used in the i-f system. All of these are accurately adjusted during manufacture and should remain in proper alignment unless affected by abnormal condi-



On some models C 24 is .05 M.F.D.

Figure 2—Schematic Circuit Diagram

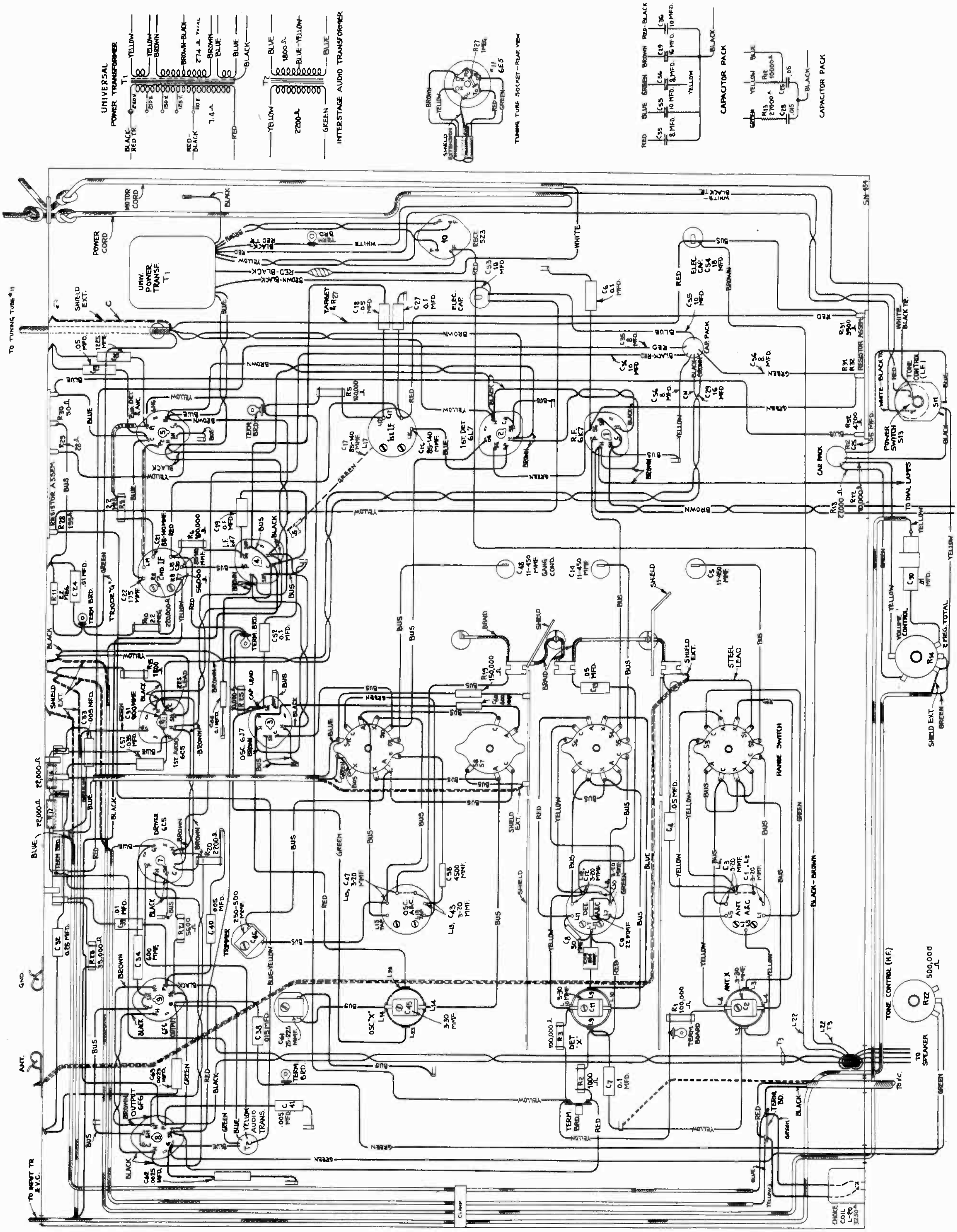


Figure 3—Chassis Wiring Diagram

tions of climate or have been altered by other means. Loss of sensitivity, improper tone quality and poor selectivity are the usual indications of improper alignment.

Correct performance of the receiver can only be obtained when the trimmer adjustments have been made by a skilled service man with the use of ade-

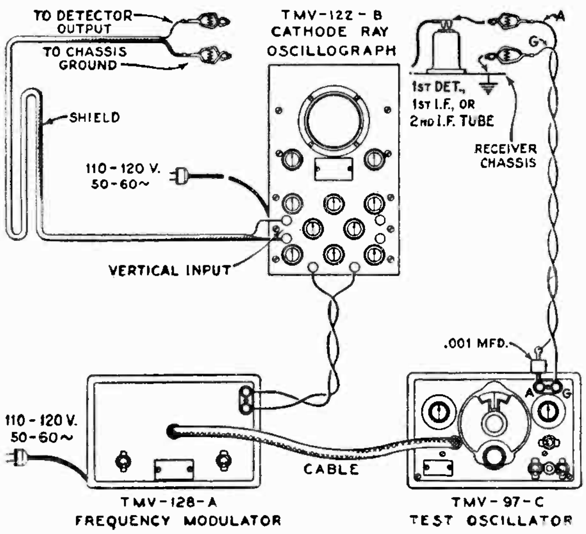


Figure 4—Alignment Apparatus Connections

quate and reliable test equipment. Such apparatus as may be required for alignment of this particular instrument is illustrated and described on a separate page of this booklet.

Two methods of alignment are applicable. One utilizes a Cathode-Ray Oscillograph as a means of output indication and the other follows former procedure where a glow type indicator or meter is used. The oscillographic method is much to be preferred, since greater accuracy is possible from the type of indication afforded. There are no approximations necessary as with the meter or aural method, but each adjustment can be made with definite precision. Both methods are hereinafter outlined so that alignment operations may be made according to the equipment available.

It is wise to determine the necessity for alignment as well as the direction of misalignment before making adjustments. The RCA Tuning Wand is an instrument designed particularly for such a purpose.

The Tuning Wand consists of a bakelite rod having a small brass cylinder at one end and a core of finely divided iron at the other. It may be inserted into a tuned coil while a signal of the normal resonant frequency is being supplied to such coil to obtain an indication of the tuning. Holes are provided at the top of the r-f shield cans for entrance of the Wand. The presence of either end of the Wand will cause a change in tuning which will be indicated at the receiver output as an increase or decrease in signal level. If there is a decrease of output when either end is inserted, the tuning is correct and will require no adjustment. However should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output while the iron end causes a decrease, reduction of inductance will be necessary to place the circuit in alignment. This is equivalent to decreasing the trimmer concerned. The following tabulation gives the various changes and the adjustments required:

WAND	SIGNAL	TRIMMER
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

CATHODE-RAY ALIGNMENT

Equipment

A standard source of alignment frequencies is required. Such a source should consist of an RCA Full Range Oscillator, Stock No. 9595. Output indication should be by means of an RCA Stock No. 9545 Cathode-Ray Oscillograph. An RCA Stock No. 9558 Frequency Modulator will be needed to sweep the generated signal and synchronize it with the Oscillograph in order to obtain visual representation of the resonant characteristic of the circuit being tuned on the cathode-ray fluorescent screen.

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 5. Each must be aligned to a basic frequency of 460 kc. The last transformer must be aligned firstly and the first transformer aligned secondly. For such a process, it is necessary to feed the output of the Full Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each transformer and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The proper point of connection of the Oscillograph is with its vertical "high" input terminal attached to the juncture of R-7 and R-8, as illustrated in Figure 5, and with the "0" or ground terminal to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as shown by Figure 4. A .001 mfd. capacitor installed in series with the Oscillator "Ant." lead will prevent the voltages of the stage under alignment from becoming upset. The vertical "A" amplifier should be "On" for the ensuing adjustments and its gain control kept at maximum. For each adjustment, the Oscillator output must be regulated so that the image obtained on the Oscillograph screen will be of the minimum size convenient for accurate observation. Proceed further as follows:

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver range switch to Band "A" and tune the station selector to a point where no interference will be encountered from signal pickup or from the RCA-6J7 oscillator, removing the tube if necessary. Set the Oscillograph horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a straight line trace completely across the screen. Place the timing control to "Int." Adjust the intensity and focusing controls of the Oscillograph to produce the correct size and strength of spot.

(b) Attach the output of the test Oscillator between the control grid cap of the RCA-6K7 i-f tube and chassis ground as shown typically by Figure 4. Tune the Oscillator to **460 kc.** and set its modulation switch to "On." Regulate its output until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph controls to give a shape which is convenient for peak indications. Cause the image to stand still on the screen by manipulation of the frequency and synchronizing controls. Then carefully tune the two trimmers C-20 and C-21 of the second i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full Range Oscillator by means of the special shielded patch cord. Figure 4 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off." Change the timing control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then carefully shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become exactly co-incident at their highest points. This condition will be found to occur at an Oscillator setting of ***approximately* 540 *kc.*** The curves will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with the above requirement and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-20 and C-21 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as in (c), change the Oscillator output to the control grid cap of the RCA-6L7 first detector tube. Then adjust the first i-f transformer trimmers C-16 and C-17 so that the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the overall tuning characteristic of the i-f system.

R-F Trimmer Adjustments

For Bands A and X, adjustments must be made at the high and low frequency ends of the range. On Band C, alignment is required only at the high frequency end.

Locations of the various antenna, detector and

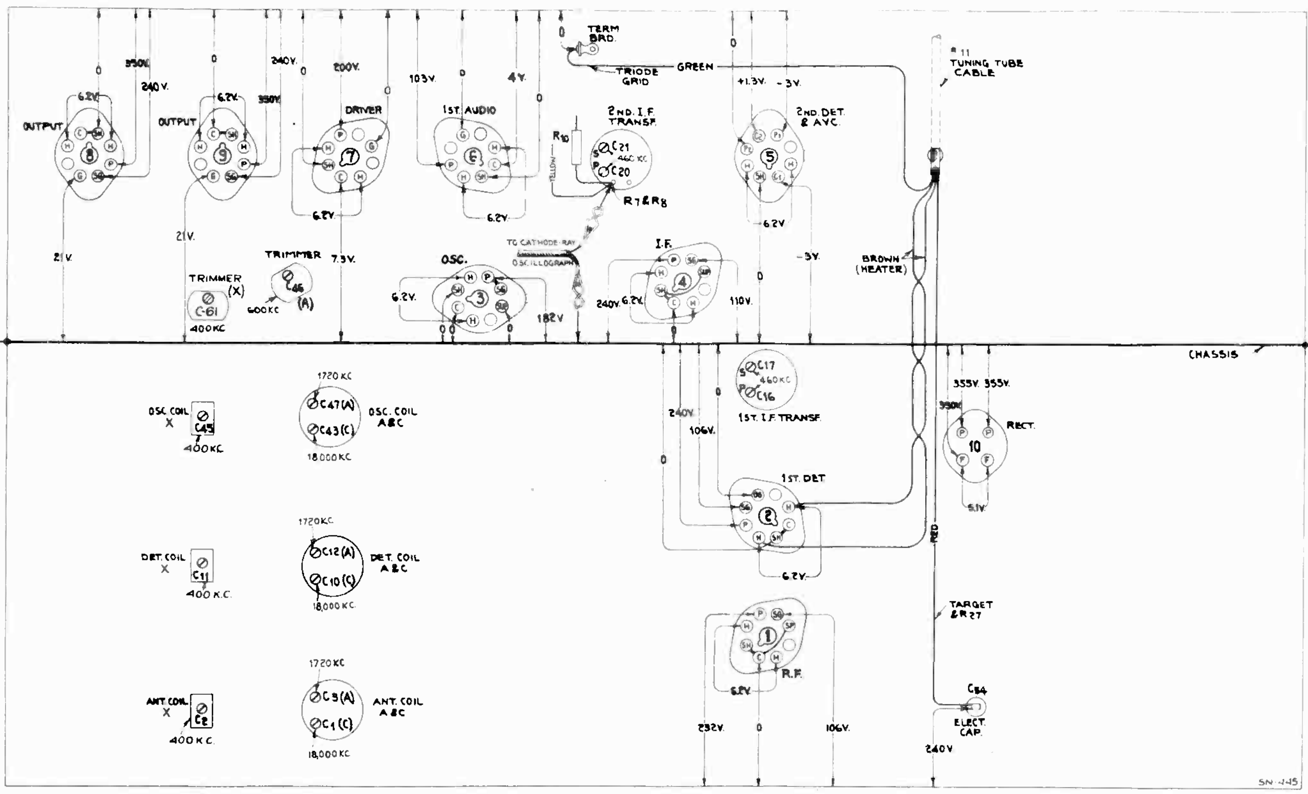


Figure 5—Radiotron Socket Voltages

Measured at 115 volts, 60 cycle supply—No signal being received

oscillator coil trimmers are shown by Figure 5. The test Oscillator should be removed from connection with the i-f system and its output connected to the antenna-ground terminals of the receiver. No changes are to be made in the connections of the Oscillograph at the second detector. During the following adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Adherence to this procedure will obviate the broadness of tuning that would result from a.v.c. action on a stronger signal. Proceed with the adjustments as follows:

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning condenser plates are in full mesh (maximum capacitance). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the Band A scale. Correct the setting of the vernier second hand pointer to read zero.

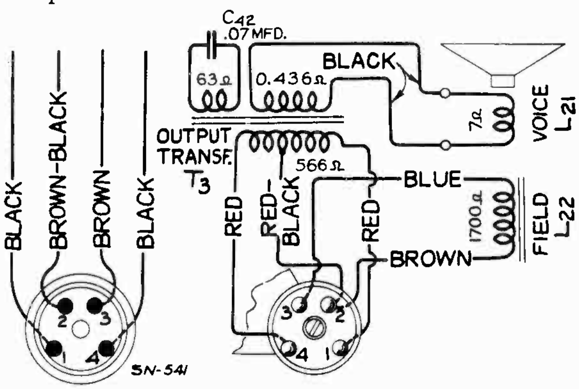


Figure 6—Loudspeaker Wiring

Band A

(a) With the receiver range switch in its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the test Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector and antenna trimmers, C-47, C-12 and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. After each trimmer has been peaked, the Oscillograph timing control should be set to "Ext." and the Frequency Modulator placed into operation with its connections to the Oscillator and Oscillograph made in accordance with Figure 4. Turn the modulation switch of the Oscillator to "Off" and retune the Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-47, C-12 and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the wave images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Place the modulation switch to "On". Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator (modulation "Off") until the two similar forward and reverse waves appear on the screen. For this adjustment, it is advisable to shift the Oscillator to its 200-400 kc. range using the third harmonic of the generated signal in order to obtain the desired range of sweep. The oscillator series trimmer, C-46, should then be adjusted to produce maximum amplitude of the images. No rocking will be necessary on the station selector inasmuch as the signal frequency is being "wobbled" by the Frequency Modulator to produce the same effect. After completing this adjustment, the trimmer C-47 should be re-aligned as in (a) to correct for any change brought about by the adjustment of C-46.

Band X

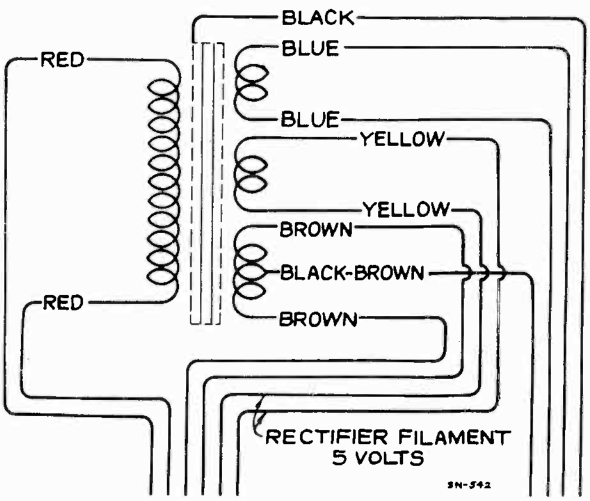
(a) Disconnect the Frequency Modulator and tune the test Oscillator to a frequency of **400 kc.** (Modulation "On"). Place the receiver range switch in its Band X position and turn the station selector until the dial pointer reads **400 kc.** Adjust the Oscillograph timing control to "Int." Then align each of the trimmers C-45, C-11 and C-2 to the point producing maximum output at the Oscillograph. Place the Frequency Modulator in operation and attach it to the Oscillator in the normal manner. Change the Oscillograph timing to "Ext." Increase the frequency of the Oscillator (modulation "Off") until the two waves appear and become coincident at their highest points, *approximately at 462 kc.* They may be made to remain stationary on the screen by manipulation of the Oscillograph range switch and frequency control. Readjust the three trimmers C-45, C-11 and C-2 to give maximum amplitude and complete coincidence of the waves.

(b) Change the test Oscillator so that it delivers a signal of **150 kc.** with the Frequency Modulator disconnected. Tune this signal on the receiver which has previously been set to Band X, disregarding the dial reading at which the signal is best received. Then interconnect the Frequency Modulator with the Oscillator and retune the latter to the point at which the two similar waves appear on the screen Adjust trimmer C-61, for maximum amplitude of the wave images. Rocking of the tuning condenser will not be necessary as the Frequency Modulator duplicates such an operation. Repeat the alignment of C-45 as outlined in (a) to correct for any reflective error brought about by the adjustment of C-61.

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to the same frequency (modulation "On" and Frequency Modulator disconnected) and regulate its output to the level required for convenient observation. Adjust the trimmer C-43 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of the proper "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of C-43 has been properly made by using the position of least capacitance which gives maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, realign C-43 if necessary, and then adjust the detector and antenna trimmers, C-10 and C-1, for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on this band.



Pri. Res.—5.42 ohms, total
Sec. Res.—470 ohms, total

Figure 7—Standard Power Transformer Connections

OUTPUT INDICATOR ALIGNMENT

To align the receiver by means of an output indicator other than a Cathode-Ray Oscillograph will require the use of a standard test Oscillator, such as that recommended above, for the source of signals and means of indication for the output. The RCA Neon Output Indicator, Stock No. 4317, will be found very satisfactory for such use. It should be connected across the voice coil circuit of the loudspeaker or across the output transformer primary.

I-F Alignment

Connect the test Oscillator to the control grid cap of the i-f tube. Advance the volume control of the receiver to its full-on position. Tune the test Oscillator accurately to **460 kc.** and align the trimmers C-20 and C-21 to give maximum receiver output. Regulate the Oscillator output during this adjustment so that the output indication is as small as can be conveniently observed. After completing the adjustments of these trimmers, re-connect the Oscillator so that it will feed into the control-grid circuit of the RCA-6L7 first detector. Then tune the first i-f transformer trimmers C-16 and C-17 for maximum receiver output.

R-F Alignment

After completing the i-f adjustments, it is advisable to correct the line-up of the circuits ahead of the first detector. The test Oscillator should be connected to the antenna-ground terminals of the receiver and the manual volume control turned to its maximum position. For each adjustment, the Oscillator output should be maintained as low as possible in order to avoid broadness of tuning which would result from a.v.c. action on a stronger signal.

Band A—This band should be aligned by supplying a **1720 kc.** signal to the receiver, tuning the station selector to a dial reading of **1720** and adjusting the trimmers C-47, C-12 and C-3 to produce maximum receiver output. The Oscillator should then be shifted to **600 kc.** and the receiver tuned to resonate this signal, disregarding the reading at which it is best received. Trimmer C-46 must then be adjusted, simultaneously while rocking the station selector backward and forward through the signal until the maximum output results from the combined operations. C-47 should be rechecked to assure that its adjustment has not changed because of the trimming of C-46.

Band X—Change the range switch to its Band "X" position. Tune the receiver to read **400 kc.** and set the Oscillator to **400 kc.** Adjust trimmers C-45, C-11 and C-2 to produce maximum receiver output. Then shift the Oscillator frequency to **150 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then tune the oscillator series trimmer, C-61, simultaneously rocking the tuning control (receiver) backward and forward through the signal, until maximum output results from the combined operations. Repeat the alignment of C-45 as in (a) to correct for any change caused by the adjustment of C-61.

Band C—Change the receiver so that it is operative and the dial reads **18,000 kc.** on the "C" Band. Tune the test Oscillator to this same frequency. Then adjust the oscillator trimmer C-43 to produce maximum (peak) output. Two positions of this trimmer will be found which conform with this requirement. The one of least capacitance is correct. Check for the presence of "image" response at **17,080 kc.** by shifting the receiver tuning. If it is received at such a point, the trimmer C-43 has been correctly adjusted to the right peak. *No adjustments are to be made during this check.* Tune the receiver back to the **18,000 kc.** dial marking, readjust C-43 if necessary,

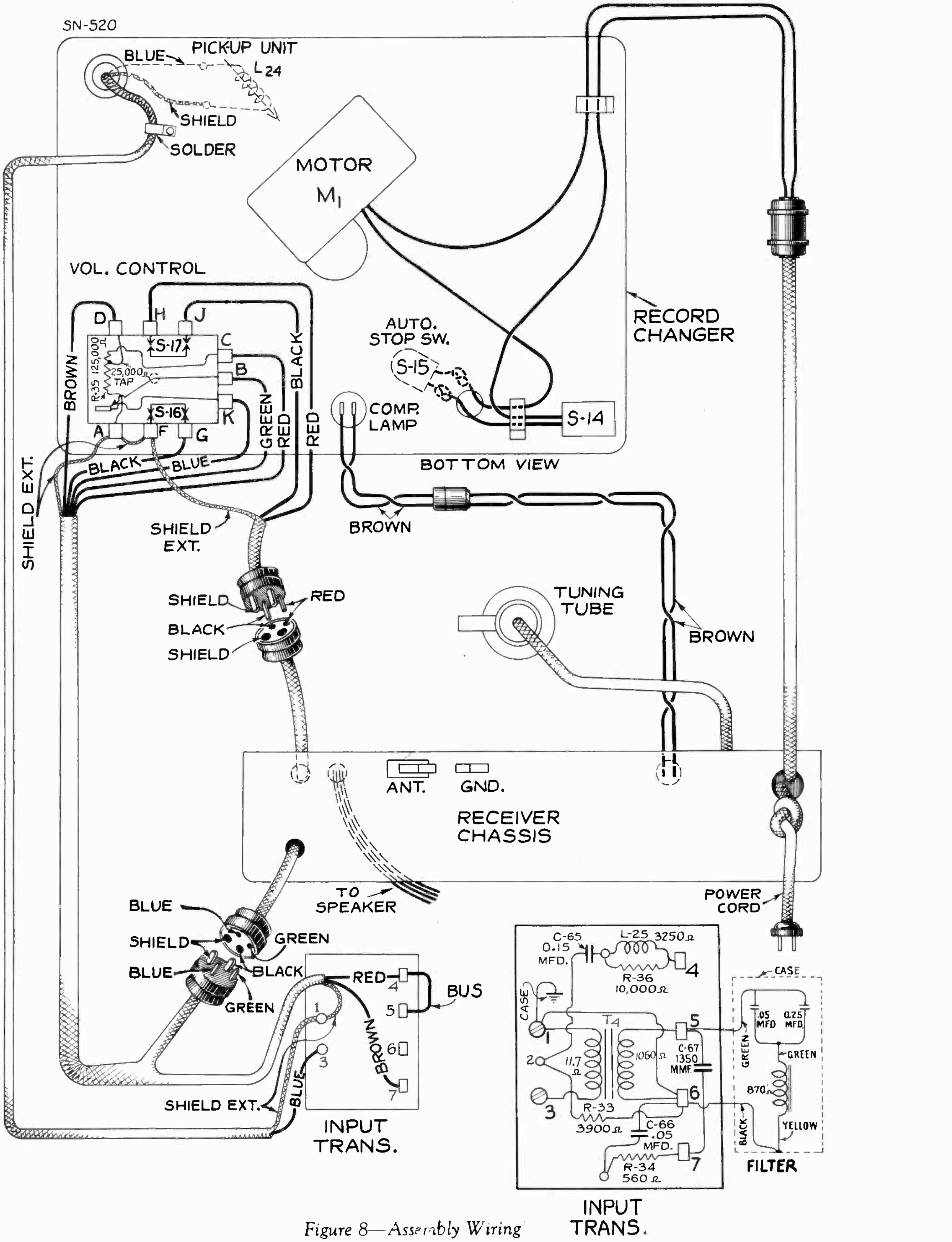


Figure 8—Assembly Wiring

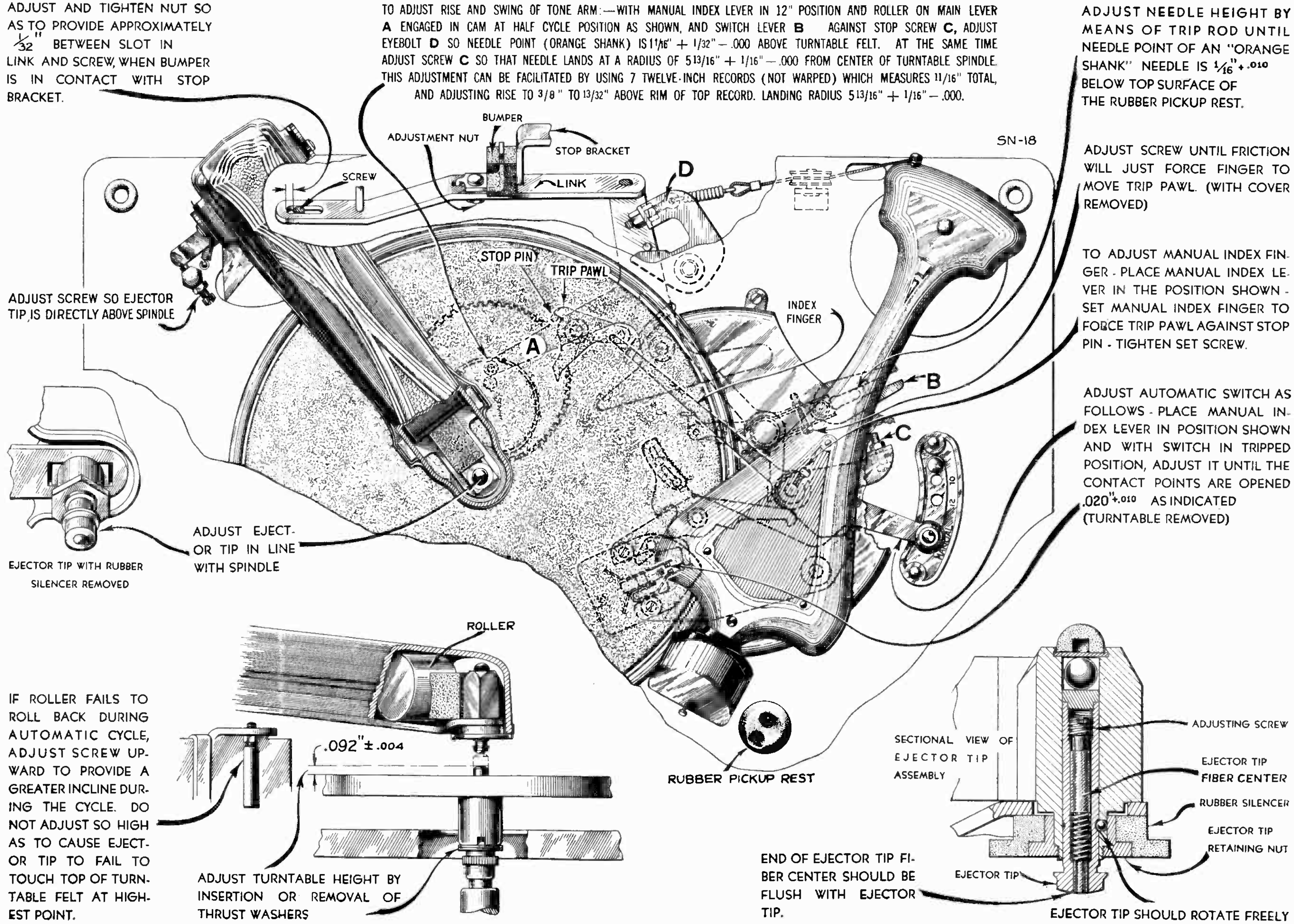


Figure 9—Automatic Record Changer Adjustments.

and then tune the detector and antenna capacitors C-10 and C-1 for maximum receiver output. No further adjustments are necessary.

Dial Adjustment

Figure 10 illustrates the relations of the various parts of the dial mechanism when it is in its A—Broadcast position and the range switch is likewise turned to its Band A setting. In re-assembling the dial after repairs, see that the gears are meshed in accordance with the diagram, at the same time noting that the lever which is attached to the range-switch shaft is in the position as shown.

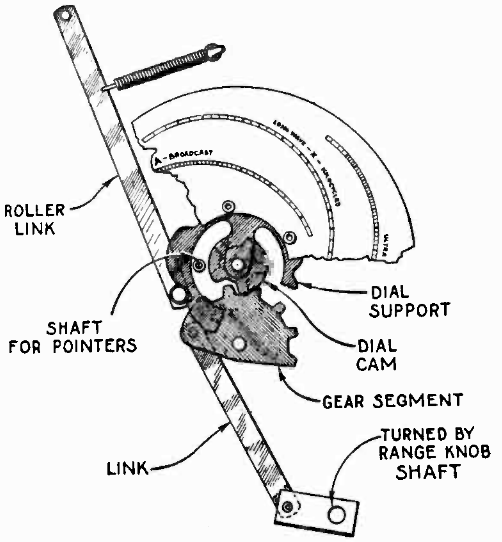


Figure 10—Selector Dial Change Mechanism

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 5 will serve to assist in the location of causes for faulty operation. Each value as specified should hold within ± 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Standard Transformer

The transformer used on some models of this instrument is adaptable for voltages and frequencies as given under Ratings A and B of Electrical Specifications. Its schematic and wiring are shown by Figure 7.

Automatic Record Ejector

The record changing mechanism is designed to be simple and fool-proof. Under normal operating conditions, service difficulties should be negligible. Occasionally, however, certain adjustments may be required. These adjustments are illustrated and explained in Figure 9.

It is important when servicing the automatic mechanism, to have it placed on a level support. It is also important to refrain from forcing the mechanism if there is a tendency to bind or jam, since bent levers and possibly broken parts may result.

The tip of the record ejector is adjustable in relation to the turntable spindle, the two being exactly coaxial when properly adjusted. To align the tip, remove the rubber silencer of the ejector assembly, loosen ejector tip retaining nut and slide the tip assembly to the position where it is in true-line with the axis of the turntable spindle. This adjustment may be simplified by placing several records on the turntable, depressing the spindle through the top record hole and lining up the ejector tip in the spindle hole of the record.

To insure that the ejector tip rotates freely, apply a slight amount of oil to the shank of the tip at the point where it is in contact with the ball bearing.

Magnetic Pickup

The pickup used in the phonograph unit is of an improved design, having several variations from the usual type of pickup. The magnetic assembly is one rigid piece. The horseshoe magnet is solidly welded to the pole pieces and is irremovable. There is a centering spring attached to the armature to maintain proper adjustment and provides a damping effect on the movement of the armature. The frequency response is uniform over a wide range.

Service operations which may be necessary on the pickup are as follows:

Centering Armature

Refer to Figure 11 showing the pickup inner structure. The armature is shown in its proper relation to the magnet pole pieces, i. e., exactly centered. Whenever this centering adjustment has been disturbed, the screws A, B, and C should be loosened and the armature clamp adjusted to the point where the vertical axis of the armature is at right angles to the horizontal axis of the pole pieces, and centered between them. This centering operation may be facilitated by inserting a small rod or nail into the armature needle hole, using it as a lever to test the angular movement of the armature. The limitations of the movement in each direction will be caused by the armature striking the pole pieces. The proper adjustment is obtained when there is equal angular displacement of the armature and adjustment rod or nail to each side of the vertical axis of the magnet and coil assembly. The screws A and B should then be secured, observing care not to disturb the adjustment of the armature clamp. Then place the pickup in a vise and secure the centering spring-clamp by

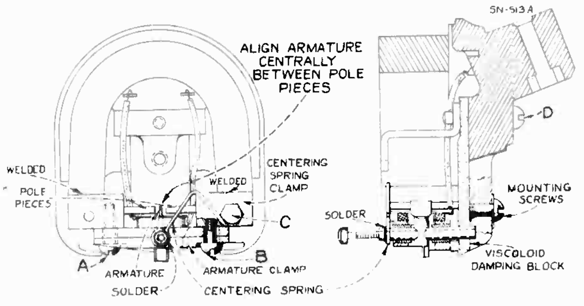


Figure 11—Details of Pickup

means of the screw C, allowing the centering spring to remain in the position at which the armature is exactly centered between the pole pieces. With a little practice, the correct adjustment of the armature may be readily obtained. The air gap between the pole pieces and the armature should be kept free from dust, filings, and other such foreign materials which would obstruct the movement of the pickup armature.

Damping Block

The viscoloid block which is attached to the back end of the armature shank serves as a mechanical filter to eliminate undesirable resonances and to cause the frequency response to be uniform. Should it be necessary to replace this damping block, it may be done by removing screw D and the cover support bracket from the mechanism and taking off the old viscoloid block. The surface of the armature which is in contact with the viscoloid should be thoroughly cleaned with fine emery cloth. Then insert the new block so that it occupies the same position as it did originally. Make certain that the block is in correct vertical alignment with the armature. The hole in the new viscoloid block is somewhat smaller than the diameter of the armature in order to permit a snug fit. With the viscoloid aligned on the armature, screw D and the cover support bracket should then be replaced. Heat should be applied to the armature (viscoloid side) so that the viscoloid block will fuse at the point of contact and become rigidly attached to the armature. A special-tip soldering iron constructed as shown in Figure 12 will be found very useful in performing this operation. The iron should be applied only long enough to slightly melt the block and cause a small bulge on both sides.

Replacing Coil

Whenever there is defective operation due to an open or shorted pickup coil, this coil should be replaced. The method of replacement will be obvious upon inspection of the pickup assembly and by study of the cut-a-way illustrations. Make sure that the new coil is properly centered with the hole in the support strip and glued securely in that position. It is important to readjust the armature as previously explained after re-assembly of the mechanism. Only rosin core solder should be used for soldering the coil leads in the pickup. This same type of solder should be used when necessary for soldering the centering spring to the armature.

Magnetizing

Loss of magnetization will not usually occur when the pickup has received normal care, due to the fact that the magnet and pole pieces are one unit and the magnetic circuit remains closed at all times. When the pickup has been mishandled, subjected to a strong a-c field, jolted, or dropped, there may be an appreciable loss of magnetic strength, in which case it will be necessary to re-magnetize the entire structure. This should be done by first removing the pickup cover and then placing the pickup assembly on the poles of

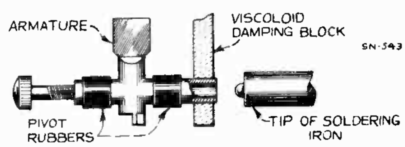


Figure 12—Special Soldering-Iron Tip

a standard pickup magnetizer such as the RCA Pickup Magnetizer, Stock No. 9549, and charging the pickup in accordance with the instructions accompanying the magnetizer. It is recommended that the pickup be magnetized with the armature in place. This will require that one pole piece on the pickup magnetizer be rotated 180 degrees. This gives the desired clearance for the armature clamp assembly. It is preferable to check the polarity of the pickup magnet and to remagnetize it so that the same polarity is maintained.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price	Stock No.	Description	List Price
	RECEIVER ASSEMBLIES		11524	Cable—Two conductor cable with two prong male sections of connector plug.	.36
4427	Bracket—High or low frequency tone control or volume control mounting bracket	$0.18	11712	Cable—Shielded three conductor cable from volume control (R14) to "C" of No. 4 socket, "G" of No. 6 socket and input transformer..................	1.24
5237	Bushing—Variable condenser mounting bushing assembly—Package of 3......	.43			

REPLACEMENT PARTS—Continued

Stock No.	Description	List Price
11713	Cable—Shielded two conductor volume control cable	.80
11223	Capacitor—Adjustable capacitor (C46)	.46
5241	Capacitor—Adjustable capacitor (C61)	.40
11292	Capacitor—22 MMfd. (C9)	.24
11289	Capacitor—50 MMfd. (C8)	.26
11291	Capacitor—115 MMfd. (C50)	.24
11290	Capacitor—400 MMfd. (C60)	.25
11317	Capacitor—600 MMfd. (C34)	.30
11269	Capacitor—800 MMfd. (C59)	.30
3784	Capacitor—900 MMfd. (C31)	.30
11316	Capacitor—1225 MMfd. (C26)	.40
11287	Capacitor—4500 MMfd. (C58)	.30
5107	Capacitor—.0025 Mfd. (C62, C63)	.16
4838	Capacitor—0.005 Mfd. (C40, C41)	.20
4868	Capacitor—0.005 Mfd. (C33)	.20
4624	Capacitor—0.01 Mfd. (C30)	.54
4937	Capacitor—0.01 Mfd. (C39)	.25
4858	Capacitor—.01 Mfd. (C24*)	.25
11315	Capacitor—0.015 Mfd. (C38)	.20
5196	Capacitor—.035 Mfd. (C57)	.18
4886	Capacitor—0.05 Mfd. (C24*)	.20
4836	Capacitor—0.05 Mfd. (C4, C13, C18, C23)	.30
4835	Capacitor—0.1 Mfd. (C64)	.28
4885	Capacitor—0.1 Mfd. (C7, C19, C27, C52)	.28
4841	Capacitor—0.1 Mfd. (C6)	.22
5170	Capacitor—0.25 Mfd. (C32)	.25
11203	Capacitor—10 Mfd. (C53)	1.18
5212	Capacitor—18 Mfd. (C54)	1.16
11215	Capacitor pack—Comprising one 16 Mfd., two 10 Mfd., and two 8 Mfd. capacitors (C29, C35, C36, C55, C56)	3.85
11201	Clamp—Cable clamp—located near variable tuning condenser—Package of 5	.20
11272	Clamp—Cable clamp—located above antenna terminal	.10
4693	Clamp—Electrolytic capacitor clamp—for stock No. 11215	.15
5215	Coil—Antenna coil—A and C bands (L1, L2, L5, L6, C1, C3)	2.32
11325	Coil—Antenna coil—X band (L3, L4, C2)	1.56
5216	Coil—Detector coil—A and C bands (L7, L8, L11, L12, C10, C12)	2.34
11326	Coil—Detector coil—X band (L9, L10, C11)	1.60
5217	Coil—Oscillator coil—A and C bands (L13, L15, C43, C47)	2.20
11327	Coil—Oscillator coil—X band (L14, L23, C45)	1.44
11320	Coil—Choke coil (L20)	1.00
11318	Capacitor Pack—Comprising one 0.015 Mfd., one .05 Mfd. capacitor, one 27,000 ohm and one 10,000 ohm resistor—(C25, C28, R12, R13)	1.30
5214	Condenser—Three gang variable tuning condenser (C5, C14, C48)	4.42
11205	Volume Control (R14)	1.30
11219	Tone Control—High frequency tone control (R22)	.90
4153	Connector—Four contact female connector for cables, stock Nos. 11712 and 11713	.48
11710	Lead—Shielded antenna lead	.40
8041	Plate—I. F. or R. F. coil shield locking plate with screw—Package of 2	.12
11220	Resistor—Voltage divider resistor—Comprising one 3900 ohm and one 4200 ohm section (R31, R32)	.84
11221	Resistor—Voltage divider resistor—Comprising one 50 ohm, one 28 ohm and one 195 ohm section (R28, R29, R30)	.48
5112	Resistor—1000 ohm—Carbon type—¼ watt (R2)—Package of 5	1.00
3706	Resistor—1800 ohm—Carbon type—¼ watt (R15)—Package of 5	1.00
5159	Resistor—2200 ohm—Carbon type—¼ watt (R20)—Package of 5	1.00
5175	Resistor—5600 ohm—Carbon type—½ watt (R21)—Package of 5	1.00
2731	Resistor—10,000 ohm—Carbon type—1 watt (R25)—Package of 5	1.10
11305	Resistor—22,000 ohm—Carbon type—¼ watt (R16, R17)—Package of 5	1.00
11300	Resistor—33,000 ohm—Carbon type—1/10 watt (R24)—Package of 5	.75
5033	Resistor—33,000 ohm—Carbon type—1 watt (R23)—Package of 5	1.10
3118	Resistor—100,000 ohm—Carbon type—¼ watt (R1, R3, R5, R6)—Package of 5.	1.00
5027	Resistor—150,000 ohm—Carbon type—¼ watt (R19)—Package of 5	1.00
11151	Resistor—2.2 megohms—Carbon type—¼ watt (R9, R10, R11)—Package of 5	1.00
5249	Shield—R. F. coil shield	.20
11273	Shield—Radiotron shield	.25
5250	Shield—I. F. transformer shield	.22
11199	Socket—Dial lamp socket	.14
4794	Socket—4-contact Radiotron socket	.15
11197	Socket—6-contact Radiotron socket	.14
11198	Socket—7-contact Radiotron socket	.15
5224	Switch—Low frequency tone control switch and power switch (S11, S13)	1.00
11236	Switch—Range switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S12)	2.44
5238	Terminal—Antenna terminal assembly	.14
11218	Transformer—Audio driver transformer (T2)	2.58
11216	Transformer—First intermediate frequency transformer (L16, L17, C16, C17)	2.15
11217	Transformer—Second intermediate frequency transformer (L18, L19, C20, C21, C22, R7, R8)	3.10
11213	Transformer—Power transformer—105-125-150-210-250 volts—40-60 cycles (T1)	5.10
11212	Transformer—Power transformer—105-125 volts—25-60 cycles	7.18
	DRIVE ASSEMBLIES	
5243	Arm—Band indicator operating arm	.42
10194	Ball—Steel ball for drive assembly—Package of 20	.25
8054	Cam—Five position cam for station selector drive assembly	.28
4422	Clutch—Tuning condenser drive clutch assembly—Comprising shaft, balls, ring, spring and washers, assembled	1.00
8048	Coupling—Flexible coupling for variable capacitor (includes indicator shaft)	.70
11693	Dial—Station selector dial and cam assembly	1.00
8045	Disc—Drive disc and gear assembly	.46
11692	Drive—Tuning condenser drive assembly, complete	6.45
8044	Escutcheon—Dial escutcheon with vernier scale	1.08
8046	Gear—Indicator shaft drive gear and vernier idler with one spring	.72
8050	Gear—Gear sector and band indicator operating link (link connects to arm on band switch)	.15
8053	Indicator—Station selector vernier indicator pointer	.12
11793	Indicator—Station selector indicator pointer	.15
8051	Link—Complete with roller and spring	.30
8049	Pinion—Vernier pointer drive pinion and shaft	.55
4669	Screw—Square head No. 8-32x5/32 set screw—Package of 10	.25

* Refer to Schematic Diagram.

REPLACEMENT PARTS—Continued

Stock No.	Description	List Price
8047	Spring—Coil spring for indicator shaft drive gear and vernier idler (stock No. 8046)	.12
8052	Spring—Coil spring for link—Package of 5	.32
8042	Stud—Band indicator operating arm stud—Package of 5	.25

EJECT ARM ASSEMBLIES

Stock No.	Description	List Price
11541	Arm—Eject arm, complete	8.15
11533	Ball—1/16-inch diameter steel ball—Package of 10	.20
10129	Ball—3/16-inch diameter steel ball—Package of 20	.25
11529	Bearing—Ejector tip bearing and nut	.32
11538	Bracket—Eject arm bracket	1.72
11537	Collar—Eject arm shaft collar and set screw	.24
11540	Cover—Eject arm cover	1.52
11536	Cushion—Counter balance roller cushion—Located inside of eject arm	.14
4055	Post—Vertical adjustment post—Located on eject arm bracket	.30
3729	Roller—Eject arm counter balance roller—Located inside of eject arm	.45
4580	Screw—No. 6—32—3/16-inch square head set screw for eject arm collar—Package of 10	.25
11534	Screw—No. 8—36—7/32-inch special screw for eject arm tip center adjustment—Package of 10	.14
11535	Shaft and Collar—Eject arm vertical action shaft and collar assembly	.15
11528	Silencer—Ejector tip silencer	.14
4067	Spring—Eject arm bracket spring—Package of 10	.30
11531	Spring—Ejector tip spring—Package of 10	.42
11530	Tip—Ejector tip with tip center, adjusting screw and cap	.32
11539	Yoke—Eject arm yoke assembly	.94

PICKUP AND ARM ASSEMBLIES

Stock No.	Description	List Price
11720	Arm—Pickup arm, complete—less escutcheon and pickup unit	4.65
11724	Armature—Pickup armature	.38
11548	Back—Pickup back	.52
11722	Coil—Pickup coil (L24)	.52
11545	Cover—Pickup front cover	.22
11546	Cover—Pickup back cover with mounting screws	.14
3737	Damper—Pickup damper—Package of 5.	.65
3516	Damper—Damper assembly for pickup arm base—Comprising one upper and one lower damper—one upper bushing and one lower bearing	.14
11723	Escutcheon—Pickup arm escutcheon	.62
11721	Pickup—Pickup unit, complete	4.75
11549	Screw—Pickup front cover screw—Package of 10	.42
3387	Screw, nut and washer for mounting pickup to arm—Package of 10	.40
11547	Screw—Pickup needle screw—Package of 10	.42

OPERATING MECHANISM

Stock No.	Description	List Price
6502	Cam—Cam and gear assembly	1.18
6808	Clutch—Trip lever friction clutch	.30
11558	Cover—Metal cover for trip lever and friction finger assembly	.36
6809	Finger—Manual index lever finger assembly	.25
3670	Finger—Friction finger assembly	.32
11554	Lever—Manual index lever—less pin	.62
11556	Lever—Main lever and link assembly	2.10
11557	Lever—Main spring lever	.42
3677	Lever—Pickup arm cable lever assembly—Comprising lever with cable screw, spring and nut	.40
11555	Lever—Trip lever and friction clutch assembly	.94
6503	Pawl—Trip pawl assembly	.40
4124	Plate—Eject arm actuating plate assembly.	.50
4563	Screw—Cable lever screw and nut—Package of 10	.60
4564	Screw—Manual index lever finger set screw—Package of 10	.20
4059	Screw—Trip lever clutch tension adjustment screw—Package of 10	.22
4566	Screw—Special screw used to fasten main lever and link assembly bushing—Package of 10	.30
11559	Spacer—Pickup arm mounting spacer	.28
4127	Spring—Actuating spring—Package of 10	.24
3666	Spring—Cable lever tension spring—Package of 10	.44
4565	Spring—Manual index lever finger tension spring—Package of 10	.30
4061	Spring—Main spring lever tension spring—Package of 10	.38
2893	Spring—Trip lever latch plate tension spring—Package of 10	.30
2917	Washer—Spring washer, "U" type—Package of 10	.25

MOTOR ASSEMBLIES

Stock No.	Description	List Price
9012	Motor—105-125 volts—25 cycles (M1)	24.16
9014	Motor—105-125 volts—50 cycles (M1)	19.72
9011	Motor—105-125 volts—60 cycles (M1)	19.72
4562	Suspension Spring—Motor mounting spring, washer, and stud assembly—Comprising six springs, six cup washers, three spring washers and three studs	.58

AUTOMATIC SWITCH ASSEMBLIES

Stock No.	Description	List Price
3994	Cover—Motor switch cover	.26
10184	Plate—Automatic brake latch plate—Package of 5	.40
10174	Springs—Automatic brake springs—Package of 2	.50
6805	Switch Assembly—Automatic switch, complete	1.90
3322	Switch—Motor switch (S15)	.75

MOTOR BOARD ASSEMBLIES

Stock No.	Description	List Price
11553	Escutcheon—Index escutcheon engraved Manual—12-10	.44
3764	Nut—Cap nut for motor board suspension assembly—Package of 4	.40
3672	Pin—Manual index pin	.42
11551	Rest—Pickup rest	.14
3654	Roller—Pickup arm cable guide roller—Comprising bracket roller and guide pin	.34
3763	Suspension Spring—Suspension spring, washer and bolt assembly for motor board—Comprising one bolt, two cup washers, two springs, two "C" washers and one cap nut	.42
4671	Switch—Operating switch—toggle type (S14)	.72
11542	Cover—Turntable cover	.88
11599	Turntable, complete	2.90

REPLACEMENT PARTS—Continued

Stock No.	Description	List Price	Stock No.	Description	List Price
	MISCELLANEOUS ASSEMBLIES		11348	Screw—No. 8-32—7/16-in. headless cupped point set screw for knob (Stock No. 11346)—Package of 10	.32
11881	Base—Phonograph compartment lamp base	.55	11381	Socket—Tuning lamp socket and cover	.45
4391	Box—Needle box	.70	11349	Spring—Retaining spring for knob (Stock No. 11347)—Package of 5	.15
11191	Bracket—Radiotron tuning lamp mounting bracket—less clamp (Stock No. 11192)	.12	11714	Transformer—Phonograph input transformer—Comprising 1 transformer, 1 choke coil, 3 resistors and 3 capacitors (T4, L25, C65, C66, C67, R33, R34, R36)	3.96
11319	Cable—Radiotron tuning lamp cable and plug—approximately 25-in. long	1.38	11715	Volume Control—Phonograph volume control (S16, S17, R35)	1.55
11716	Cable—Two conductor shielded cable—Volume control "H-J and F" to chassis cable (Stock No. 11712)	.64		REPRODUCER ASSEMBLIES	
11717	Cable—Five conductor shielded cable from volume control "A-B-C-D-G-K" to input transformer terminals No. 4 and No. 7.	1.14	8059	Board—Reproducer terminal board (2 terminals)	.14
11192	Clamp—Radiotron tuning lamp mounting clamp—less bracket (Stock No. 11191)	.12	8060	Bracket—Output transformer mounting bracket	.14
6123	Connector—Four contact male connector plug for cable (Stock No. 11717)	.30	11304	Cable—Reproducer cable—Complete with female connector	.80
11570	Connector—Four contact male connector for cable (Stock No. 11716)	.32	8058	Clamp—Cone rim clamp—Package of 4	.44
11276	Escutcheon — Radiotron tuning lamp escutcheon	.40	11189	Coil—Field coil, magnet and cone housing (L22)	10.60
11379	Escutcheon — Station selector escutcheon and crystal	1.08	8056	Cone—Reproducer cone (L21)	1.58
12037	Filter Pack—Phonograph filter	1.72	5039	Connector—4 prong male connector plug for reproducer	.25
11346	Knob — Station selector knob — Package of 5	.75	5040	Connector—4 contact female connector socket for reproducer cable	.25
11347	Knob — Volume control, tone control, power switch or range switch knob—Package of 5	.75	9620	Reproducer, complete	16.32
11382	Resistor—1 megohm—Carbon type — 1/10 watt (R27)—Package of 5	.75	8057	Transformer—Output transformer (T3, C42)	3.22
11711	Shade—Phonograph compartment lamp shade	.16			

— NOTES —

RCA VICTOR MODEL D 22-1

Twenty-Two Tube, Five-Band, A-C, Automatic Radio-Phonograph

SERVICE NOTES

Electrical Specifications

Frequency Ranges

Band X	140 kc.— 410 kc.
Band A	540 kc.— 1,800 kc.
Band B	1,800 kc.— 6,000 kc.
Band C	6,000 kc.—18,000 kc.
Band D	18,000 kc.—60,000 kc.

Alignment Frequencies

Band X	150 kc. (osc.), 400 kc. (osc., det., ant.)
Band A	600 kc. (osc.), 1,720 kc. (osc., det., ant.)
Band B	6,132 kc. (osc., det., ant.)
Band C	18,000 kc. (osc., det., ant.)
Band D	No adjustments necessary

Intermediate Frequency . . . . **460 kc.**

Radiotron Complement

(1)	RCA-6K7	Radio-Frequency Amplifier
(2)	RCA-6L7	Hexode First Detector
(3)	RCA-6J7	Heterodyne Oscillator
(4)	RCA-6K7	First Intermediate Amplifier
(5)	RCA-6K7	Second Intermediate Amplifier
(6)	RCA-6K7	AVC Intermediate Amplifier
(7)	RCA-6H6	Automatic Volume Control
(8)	RCA-6H6	Diode Second Detector
(9)	RCA-6C5	Audio Voltage Amplifier
(10)	RCA-6C5	Audio Driver Amplifier
(11)	RCA-6C5	Audio Driver Amplifier
(12)	RCA-6C5	Audio Driver Amplifier (Phono)
(13)	RCA-5Z3	Rectifier (Amplifier)
(14)	RCA-5Z3	Rectifier (Radio)
(15)	RCA-6E5	"Magic Eye" Tuning Indicator
(16)	RCA-2A3	Power Output Amplifier
(17)	RCA-2A3	Power Output Amplifier
(18)	RCA-2A3	Power Output Amplifier
(19)	RCA-2A3	Power Output Amplifier
(20)	RCA-6C5	Audio Amplifier (Phono)
(21)	RCA-6C5	Audio Rectifier (Phono)
(22)	RCA-6L7	Audio Volume Expander

Power Supply Ratings

Rating A-6	105-125 Volts, 60 Cycles, 400 Watts
Rating A-5	105-125 Volts, 50 Cycles, 405 Watts
Rating B-4	105-125 Volts, 40 Cycles, 410 Watts
Rating B-3	105-125 Volts, 30 Cycles, 405 Watts
Rating B-2	105-125 Volts, 25 Cycles, 410 Watts

Phonograph

Type	Automatic Record Ejector
Record Capacity	Eight 10-inch or Seven 12-inch
Turntable Speed	78 R.P.M.
Type of Pickup	Improved Low-Impedance Magnetic
Pickup Impedance	18 Ohms at 1,000 Cycles

Power Output Ratings

Undistorted	20 Watts
Maximum	25 Watts

Loudspeakers (2)

Type	12-inch Electrodynamic
Voice Coil Impedance	7.5 Ohms at 400 Cycles
Field Coil Rating	1,700 Ohms—90 M.A.

Mechanical Specifications

Height	$43\frac{5}{16}$ inches
Width	$38\frac{1}{8}$ inches
Depth	$20\frac{5}{16}$ inches
Weight (Net)	269 pounds
Weight (Shipping)	353 pounds

General Description

The RCA Victor Model D 22-1 is an instrument of de luxe quality and performance. It consists of a thirteen-tube, five-band radio receiver; a six-tube, high-level power output amplifier; and a three-tube dynamic amplifier. An automatic phonograph is part of the assembly. Home recording facilities are provided so that recordings may be made direct of a radio program, or, by means of a microphone included with the equipment, of any desired speech or music. The high level of sound energy obtainable from the output of the instrument is capably handled by two of the new Super-Sensitive, twelve-inch, dynamic loudspeakers. The important features which make this instrument outstanding are as follows:—

Dynamic Amplifier

Limitations imposed by present methods of disc recording necessitate a constricted range of sound intensity which may be recorded. The *minimum* intensity of sound which may be recorded is determined by unavoidable record surface-noise which masks the recorded sound when such sound approaches down towards the intensity of the noise. The *maximum* sound intensity which may be recorded is determined by the thickness of the record groove-wall into which the record cutting stylus makes an impression of the original sound. The depth of cutting is, therefore, regulated so that the stylus will not break over into the adjacent groove. It is because of these upper and lower limits that the sound reproduction cannot be identical to the original sound which is produced in the recording studio. To keep the recorded sound within the limiting intensities, the recording control engineer regulates the recording amplifiers accordingly.

The dynamic amplifier of this reproducing instrument is designed to compensate for the recording limitations of intensity range. It serves to restore the original intensity relations of the recorded sound by varying the amplification of the reproducing amplifier in direct accordance with the average intensity value of the sound. Thus, when there is a prevailing rise in the intensity of the recorded sound, the dynamic amplifier increases in gain accordingly, and conversely when there is a prevailing tendency toward a decrease of the recorded sound, the dynamic amplifier decreases in gain. The functions of the dynamic amplifier are particularly advantageous in the reproduction of symphonic and certain other types of music where very great ranges of sound intensity are encountered. The dynamic amplifier causes the very loud or fortissimo and the very soft or pianissimo passages to be reproduced in their natural relations, although they may have been somewhat modified in the actual recording.

Power Amplifier

In order that the dynamic amplifier may bring about its designed purpose, the amplifier and reproducing system into which it works must have an undistorted range of amplification consistent with the degree of volume expansion provided in the dynamic amplifier. The power amplifier is, therefore, designed to have a maximum output of 25 watts. This unusually high level is obtainable from four RCA-2A3 Radiotrons which are arranged in a parallel push-pull Class "A" system. The two twelve-inch loudspeakers faithfully reproduce the amplified sound at all intensities from the minimum to the maximum.

Automatic Record Changer

An improved automatic mechanism is used in this model. It is of the record ejector type, having a record capacity of seven for the ten-inch type, and a capacity of eight for the twelve-inch type. The turntable speed is fixed at 78 r.p.m. by the design of the drive motor and the intermediate gear mechanism. *This speed is invariable and does not vary as long as the supply line frequency remains constant.* The instrument may be purchased with any one of five ratings as specified under Electrical Specifications. *It is very important that a machine of any particular rating be operated at the frequency for which it is designed and rated.* Attempts to operate at other frequencies will result in improper reproduction from the phonograph system. The ejecting mechanism is arranged so that it will trip on various types of records. This is obtained by having a trip mechanism which is actuated by the rate of needle acceleration toward the center of the record.

Magic Brain

The radio receiver includes the "Magic Brain" unit for maximum all-around efficiency. This unit is a scientifically correct co-ordination of all the parts for the r-f, oscillator, and first detector functions of a Superheterodyne Receiver. Such design of the important head end, or "Magic Brain" unit, gives greater efficiency in the short-wave ranges as all lead lengths are kept as short as possible, and all sockets and other parts are located for best possible operation.

Magic Eye

A cathode-ray tube whose fluorescent screen has the appearance of a human eye, is used for visually indicating when the receiver is accurately tuned to the incoming signal. This tube is of new design. It contains two groups of elements; one group operates as an amplifier and the other group operates as a cathode-ray tube.

The cathode-ray section consists of a conically shaped luminescent screen, a cathode, and a control electrode. The detected signal from the receiver is applied through the amplifier section of the tuning tube to the control electrode of the cathode-ray section. This control electrode, in turn, affects the electron stream emitted by the cathode in such a manner as to cause a triangular shadow on the luminescent screen. The size of the shadow caused by the control electrode is determined by the strength of the incoming signal, so that a change-of-tuning is readily exhibited on the cathode-ray screen, and therefore tuning to exact resonance can be definitely obtained.

RCA All-Metal Tubes

The new metal tubes are used in the radio receiver unit, in the dynamic amplifier unit, and in one stage of the power amplifier unit. These tubes make possible a greater range of stable amplification not previously attainable with corresponding glass types. Their metal envelopes form a perfect electrostatic and electromagnetic shield, precluding the former necessity for elaborate shielding by means of cans. The metal tubes are especially adaptable to the modern, extended-range receivers because of their efficient shielding and their favorable internal characteristics.

Selector Dial

The dial drive and station indicator system are of unique design. There are five individual dial scales, each with full 180 degree band spread, one for use on each of the five tuning bands. These scales are eccentrically arranged on a rotary disc which operates in conjunction with the range-selector switch, so that as the switch is shifted to a particular band, the corresponding dial scale rotates into position, leaving the remaining four scales concealed. The driving mechanism for the dial pointer and the variable gang-condenser has tuning ratios of 10 to 1 and 50 to 1. Control may be interchanged between these two ratios by a push-pull operation of a positive-action clutch which is actuated by the tuning control knob. A vernier dial with an auxiliary pointer (band-spreader) is provided for the accurate tuning required for short-wave reception. The vernier pointer is geared to the main dial-shaft through a mechanism which causes it to rotate twenty times to a single rotation of the main dial-pointer. The dial-drive mechanism connects to the variable gang-condenser by means of a flexible coupling. This coupling arrangement together with the new shock-proof condenser mounting makes possible the rigid attachment of the drive mechanism to the receiver-chassis base without causing serious microphonic coupling between the base and the tuning condenser.

Electrical Circuits

The circuits of this instrument are arranged so that for the radio function, the incoming signal is amplified and detected in the normal process and is then transmitted to the power output amplifier through a driver stage which is part of the radio chassis. The phonograph function is accomplished through a system which includes the dynamic amplifier, a separate driver stage, and the same power amplifier as used for radio. These circuits are controlled by means of a ganged rotary-switch which is attached to the motor board in the record-playing compartment. An indicating system of pilot lamps behind engraved windows, readily displays to the operator the position of the change-over switch. It is to be noted that the dynamic amplifier works only in conjunction with the phonograph function. A control is included so that "dynamic amplification" may be eliminated if desired by the listener. The following features of electrical design are of particular importance:

Dynamic Amplifier

The purpose of this unit has been previously described. Electrically, it consists of an RCA-6L7 operating as an audio expander, an RCA-6C5 operating as an audio amplifier which, in turn, feeds another RCA-6C5 operating as an audio rectifier. The audio signal obtained from the magnetic pick-up is boosted by the input transformer and then fed to the paralleled inputs of the RCA-6L7 expander and the RCA-6C5 audio amplifier. Compensation filters are associated with the input-transformer circuit to correct the frequency response of the reproducing system so as to compensate for the recording characteristic. The signal from the input transformer is supplied to the first control-grid of the RCA-6L7 through the manual volume-control potentiometer (R-218), and is simultaneously applied through the expander control (R-204) to the control-grid of the first RCA-6C5. The signal applied to this latter tube is first amplified and then fed to the RCA-6C5 audio-rectifier stage. This latter stage rectifies the audio signal by operating as a diode. Its output is of the nature of a pulsating direct current, the amount varying in direct relation with the average value of intensity of the audio signal. The pulsating voltage due to rectification in the RCA-6C5 appears across resistor (R-207) and is applied through a delay filter (R-202 and C-203), to an auxiliary control-grid of the RCA-6L7. The value of the bias on this auxiliary control-grid determines the amplification of the RCA-6L7 expander stage. The gain of the dynamic amplifier is, therefore, automatically regulated by the average intensity of the audio signal.

Power Amplifier

The power amplifier unit contains four RCA-2A3 Radiotrons and a single RCA-5Z3 rectifier Radiotron. The amplifier tubes are arranged in parallel push-pull and are operated with fixed bias. Their grids are coupled to the radio chassis directly through a coupling transformer (T-3). The same grids are coupled to the phonograph driver-stage (RCA-6C5) through another transformer (T-102). There are two power transformers in the power-supply system; one supplying the high voltage necessary for the plate circuits, and the other supplying the heater voltages for the tubes of the power amplifier and dynamic amplifier. The home-recording level-indicator lamps are supplied from the plate circuit of the power-amplifier stage. The high level of audio energy from the output stage is delivered to the two heavy-duty, super-sensitive, electrodynamic loudspeakers through a step-down matching transformer. Suitable switching is incorporated in the voice-coil circuit for connecting in the pickup as a cutting-head for home recording.

Automatic Signal Stabilizer

The heterodyne oscillator circuit used in the radio receiver is an improved type having exceptional frequency stability and uniformity of output over its various tuning ranges. It operates on fundamental frequencies and the output is fed to the first-detector hexode tube (RCA-6L7) on an auxiliary mixing grid. The oscillator signal is at all times above the frequency of the incoming signal by 460 kc. As shown by the schematic diagram, the cathode of the oscillator tube is above ground potential for r.f. while the plate is effectively at ground potential. This particular arrangement, together with the plate and screen series resistors, makes the circuit independent of supply voltage variations in regard to stability and uniformity of output. Separate oscillator coils are used for each of the tuning ranges. The switching between the ranges is such as to short-circuit certain unused coils which would absorb energy from the operative coils because of their natural tuning in the band being used.

Automatic Sensitivity Booster

The sensitivity on the short-wave bands, B, C, and D is higher than that of bands A and X. This difference is necessary because of the weaker signal strength normally encountered in the short-wave bands as compared to those of the longer-wave bands. Change in sensitivity from band to band is accomplished by variations of the fixed d-c bias on the r-f and i-f tubes. This change is automatically made by the range switch when it is rotated.

Automatic Volume Control

The a.v.c. operates as a parallel system, being fed from the i-f output through an auxiliary amplifier tube, an RCA-6K7. This stage has an untuned input and broadly resonated output, accomplished by the natural-period fourth i-f transformer. A double-diode RCA-6H6 operates as the a.v.c.-detector. It receives the incoming signal at 460 kc. from the a.v.c. i-f stage and rectifies it. This causes a signal d-c component to appear across the diode load resistor (R-37). This d-c component is applied to the control-grid of the r-f, first detector, and i-f tubes through resistor-condenser filters. The value of the bias obtained by this process is in accordance with the intensity of the received signal and governs the amplification of the r-f, first detector, and i-f stages, thereby maintaining the same level of input to the second-detector stage whenever there are fading tendencies, and similarly when tuning from station to station. For a given percentage of modulation, therefore, and within the range of the automatic-volume-control system, a constant output level will be obtained at the output of the receiver.

Band D Tuning

Special notice should be taken of the manner of tuning the ultra-high-frequency band of this receiver. The r-f stage is unused when the range switch is turned to its Band D position and the signal is fed directly from the antenna to the first-detector grid circuit. The inductance of the circuit consists of a short length of bus wire to which the antenna lead is attached at a definite predetermined point. The total length of this inductive wire, from the stator of the tuning capacitor to ground, represents the secondary of a high-frequency autotransformer, while the inductive section included between the antenna lead-tap and ground forms the primary. Alteration of the dimensions and position of this wiring will change the tuning and alignment of the circuit, resulting in poor operation or complete failure of operation. *It is therefore necessary when servicing to avoid any changes in the wiring which includes Band D detector and oscillator r-f circuits. If unavoidable, the arrangement must be restored to its exact original condition.* Similar caution should be observed when exchanging by-pass condensers in these same circuits, since their values, physical position, length of leads, quality of dielectric, etc., are critical, and variation will definitely affect operation of the receiver. The small heater by-pass condensers and ground terminals at the tube socket are very important in this respect.

Power Supply

The voltages for the radio receiver and plate voltage for the dynamic amplifier are supplied separately from

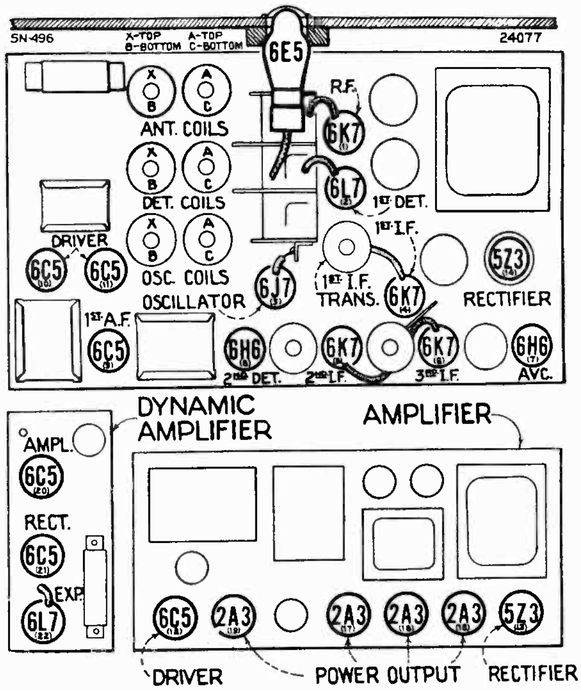


Figure 1—Radiotron and Coil Locations

a power transformer and an RCA-5Z3 rectifier stage. The voltages for the power amplifier and the filament voltages for the dynamic amplifier are supplied from two power transformers and a single RCA-5Z3 rectifier tube.

An efficient electro-static shield is placed in each of the power-supply transformers to isolate the primary and secondary for radio frequency. This isolation prevents r-f disturbances which are on the supply line from entering the receiver circuit and causing interference, and at the same time eliminates the tendency of the receiver to re-radiate into the line.

Compensated Volume Controls

Manual volume control of the radio is by means of an acoustically tapered potentiometer which conveys the audio output of the first a-f stage to the interstage coupling transformer. This control has tone compensation produced by filters connected to two points thereon. These filters give the correct aural balance at different volume settings. A music-speech control is provided in one of the volume control filter circuits for use in obtaining good speech intelligibility. On the speech position, the low-frequency tones are reduced. The phonograph volume control is likewise compensated at two points. A high-frequency tone control is connected from grid to grid of the RCA-6C5 driver tubes of the radio chassis to enable reduction of static and incidental noises which interfere with reception. Two tone controls are used in the phonograph system, one of which (left-hand in record compartment when facing cabinet) reduces low-frequency response (*maximum lows — counter-clockwise,*) and the other (right-hand) reduces high-frequency response (*maximum highs — clockwise*). Each is continuously variable and may be adjusted by the listener to produce the balance of tone which is most pleasing.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed to isolate causes for defective operation when such develops. The values of the various resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and the Replacement Parts List. These identifications are in a sequence which begins at the left of the diagram (antenna) and they increase numerically from left to right as a signal would proceed through the circuit, thus facilitating location of such parts on the schematic diagram. The coils, reactors, and transformer windings are rated in terms of their d-c resistance only. Resistances of less than 1 ohm are generally omitted.

Alignment Procedure

Fourteen alignment trimmers are provided in the r-f, first detector, and oscillator tuning system and six are used in the i-f system. All of these are accurately adjusted during manufacture and should remain in proper alignment unless affected by abnormal conditions of climate or have been altered by other means. Loss of sensitivity, improper tone quality and poor selectivity are the usual indications of improper alignment.

Correct performance of the receiver can only be obtained when the trimmer adjustments have been made by a skilled service man with the use of adequate and reliable test equipment. Such apparatus as may be required for alignment of this particular instrument is illustrated and described on a separate page of this booklet.

The extensive frequency range of this receiver necessitates a more or less involved method of alignment. However, if the following directions are carefully applied, normal performance of the instrument will be obtained.

Two methods of alignment are applicable. One utilizes a cathode-ray oscillograph as a means of output indication and the other follows former procedure where a glow-type indicator, or meter, is used. The oscillographic method is much to be preferred, since greater accuracy is possible from the type of indication afforded. There are no approximations necessary as with the meter or aural methods, but each adjustment can be made with definite precision. Both methods are hereinafter outlined so that the alignment operations may be made in accordance with the equipment available.

It is wise to determine the necessity for alignment, as well as the direction of mis-alignment before making adjustments. The RCA Tuning Wand is an instrument designed particularly for such a purpose.

Its use is outlined as follows:—

The Tuning Wand consists of a bakelite rod having a small brass cylinder at one end and a core of finely divided iron at the other. It may be inserted into a tuned coil while a signal of the normal resonant frequency is being supplied to such a coil in order to obtain an indication of the accuracy of the tuning. Holes are provided at the top of r-f shield-cans for entrance of the Wand. The presence of either end of the Wand will cause a change in tuning which will be indicated at the receiver output as an increase or decrease in signal level. If there is a decrease of output when either end is inserted, the tuning is correct and will require no adjustment. However, should there be an increase of output due to the iron core and a decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into alignment. The trimmer involved should, therefore, be increased in capacitance. If the brass-cylinder end causes an increase in output while the iron end causes a decrease, reduction of inductance or capacity will be necessary to place the circuit in alignment. Therefore, the associated trimmer should be decreased in capacitance. The following tabulation gives the various changes and the adjustments required:

Wand	*Signal*	*Trimmer*
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

CATHODE-RAY ALIGNMENT

Equipment

A standard source of alignment frequencies is required. Such a source should consist of an RCA Full-Range Oscillator, Stock No. 9595. Output indication should be by means of an RCA Cathode-Ray Oscillograph, Stock No. 9545. An RCA Frequency Modulator, Stock No. 9558, will be needed to sweep the generated signal and synchronize it with the Oscillograph in order to obtain visual representation of the resonant characteristic of the circuit being tuned on the cathode-ray fluorescent screen.

I-F Trimmer Adjustments

Six trimmers are associated with the three i-f transformers. Their locations on the chassis are shown by Figure 4. Each must be aligned to a basic frequency of **460 kc.** The last i-f transformer should be adjusted first, the one preceding it second and the operation carried through successive stages until the first transformer has been aligned. For such a process, it is necessary to feed the output of the Full-Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each and observing the effect at the second-detector output on the Cathode-Ray Oscillograph. The most convenient point for connection of the Oscillograph is at the control-grid of the RCA-6C5 first audio tube, with the vertical "Hi" input terminal attached to the grid connection and the "Gnd" to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as illustrated in Figure 2. A .001 mfd. capacitor installed in series with the Oscillator "Ant." output lead will prevent the voltage constants of the stage being aligned, from becoming upset.

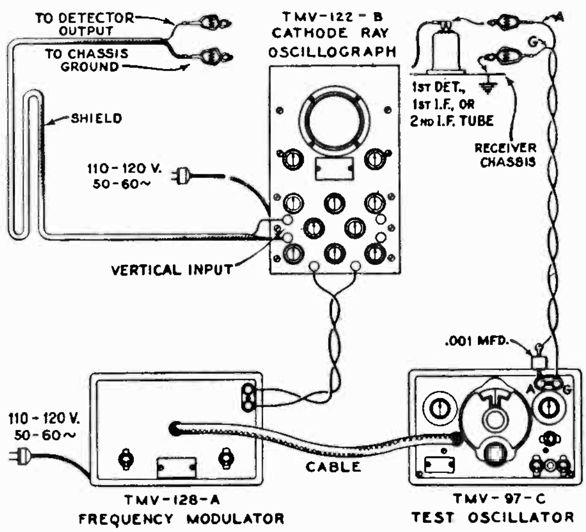


Figure 2—Alignment Apparatus Connections

The vertical "A" amplifier should be "On" for the ensuing adjustments and its gain control kept at maximum. For each adjustment, the Oscillator output must be regulated so that the image obtained on the Oscillograph screen will be of the minimum size convenient for accurate observation. Proceed further as follows:—

(a) Place the Receiver, Oscillograph, and Test Oscillator in operation. Set the receiver range switch to Band "A" and tune the station selector to a point where no interference will be encountered from signal pickup or from the RCA-6J7 oscillator, removing the tube if necessary. Set the Oscillograph horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a straight line trace completely across the screen. Place the timing control to "Int." Adjust the intensity and focusing controls of the Oscillograph to produce the correct size and strength of spot.

(b) Attach the output of the test Oscillator between the control-grid cap of the second i-f tube (RCA-6K7) and chassis ground as shown typically by Figure 2. Tune the Oscillator to **460 kc.** and set its modulation switch to "On." Regulate its output until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph controls to give a shape which is convenient for peak indications. Cause the image to stand still on the screen by manipulation of the frequency and synchronizing controls. Then carefully tune the two trimmers C-44 and C-45 of the third i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full-Range Oscillator by means of the special shielded patch cord. Figure 2 shows the proper arrangement. Set the Frequency Modulator sweep-range switch to its "Lo" position and turn the Oscillator modulation switch to "Off." Change the timing control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then carefully shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become exactly coincident at their highest points. This condition will be found to occur at an Oscillator setting of *approximately 540 kc.* The curves will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with the above requirement and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-44 and C-45 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as above, change the Oscillator output to the control-grid cap of the first i-f tube (RCA-6K7). Adjust the two trimmers C-37 and C-38 of the second i-f transformer until the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude.

(e) Change the test Oscillator output to the control-grid of the first detector tube (RCA-6L7) without disturbing the connections and adjustments of the other apparatus. Then align the trimmers C-32 and C-33 of the first i-f transformer to produce waves of maximum coincidence and maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the over-all tuning characteristic of the i-f system.

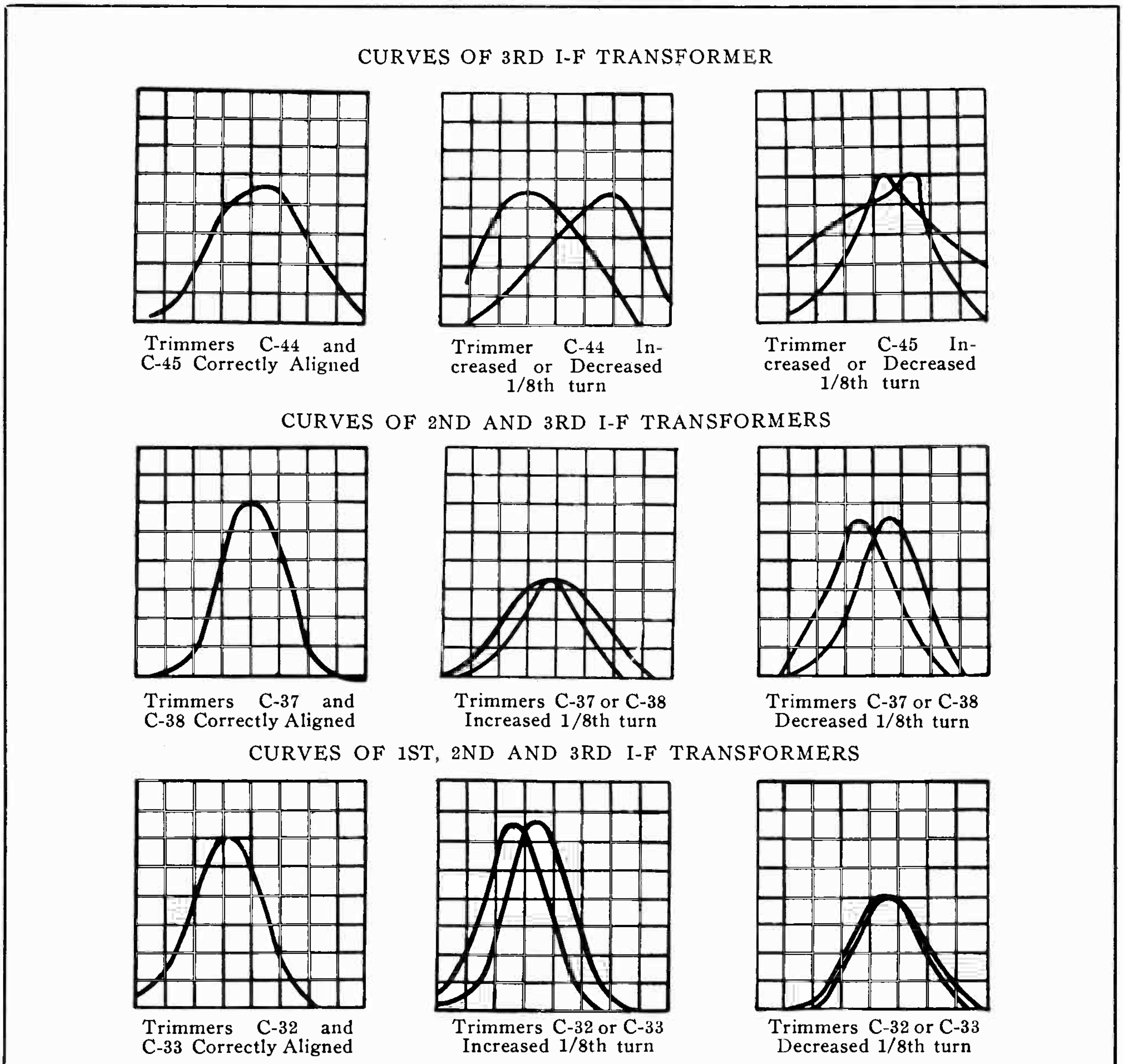


Figure 3—Cathode-Ray Images for I-F System

R-F Trimmer Adjustments

For Bands A and X, adjustments must be made at the high and low frequency ends of the range. On Bands B and C, alignment is required only at the high frequency end. Band D is permanently adjusted during manufacture, hence no alignment will be necessary in this range. Locations of the various antenna, detector, and oscillator trimmers are shown on Figure 4. The test Oscillator should be removed from connection with the i-f system and its output attached to the antenna-ground terminals of the receiver. No changes are to be made in the attachment of the Oscillograph at the second detector. During the adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Adherence to this procedure will obviate apparent broadness of tuning which would result from a.v.c. action on a stronger signal. The sequence of alignment should be Band A, Band X, Band B, and Band C. Proceed with the adjustments as follows:—

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning condenser plates are in full mesh (maximum capacitance). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the Band A scale. Correct the setting of the vernier second hand pointer to read zero.

Band A

(a) With the receiver range switch in its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the test Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector, and antenna trimmers, C-25, C-14, and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. After each trimmer has been peaked, the Oscillograph timing control should be set to "Ext." and the Frequency Modulator placed into operation with its connections to the Oscillator and Oscillograph made in accordance with Figure 2. Turn the modulation switch of the Oscillator to "Off" and retune the Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-25, C-14, and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the wave images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Place the modulation switch to "On". Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator (modulation "Off") until the two similar forward and reverse waves appear on the screen. For this adjustment, it is advisable to shift the Oscillator to its 200-400 kc. range using the third harmonic of the generated signal in order to obtain the desired range of sweep. The oscillator series trimmer, C-23, should then be adjusted to produce maximum amplitude of the images. No rocking will be necessary on the station selector inasmuch as the signal frequency is being "wobbled" by the Frequency Modulator to produce the same effect. After completing this adjustment, the trimmer C-25 should be re-aligned as in (a) to correct for any change brought about by the adjustment of C-23.

Band X

(a) Disconnect the Frequency Modulator and tune the test Oscillator to a frequency of **400 kc.** (Modulation "On"). Place the receiver range switch in its Band X position and turn the station selector until the dial pointer reads **400 kc.** Adjust the Oscillograph timing control to "Int." Then align each of the trimmers C-26, C-15, and C-4 to the point producing maximum output at the Oscillograph. Place the Frequency Modulator in operation and attach it to the Oscillator in the normal manner. Change the Oscillograph timing to "Ext." Increase the frequency of the Oscillator (modulation "Off") until the two waves appear and become coincident at their highest points, *approximately at 462 kc.* They may be made to remain stationary on the screen by manipulation of the Oscillograph range switch and frequency control. Readjust the three trimmers C-26, C-15, and C-4 to give maximum amplitude and complete coincidence of the waves.

(b) Change the test Oscillator so that it delivers a signal of **150 kc.** with the Frequency Modulator disconnected. Tune this signal on the receiver which has previously been set to Band X, disregarding the dial reading at which the signal is best received. Then interconnect the Frequency Modulator with the Oscillator and retune the latter to the point at which the two similar waves appear on the screen. Adjust trimmer C-27, for maximum amplitude of the wave images. Rocking of the tuning condenser will not be necessary as the Frequency Modulator duplicates such an operation. Repeat the alignment of C-26 as outlined in (a) to correct for any reflective error brought about by the adjustment of C-27.

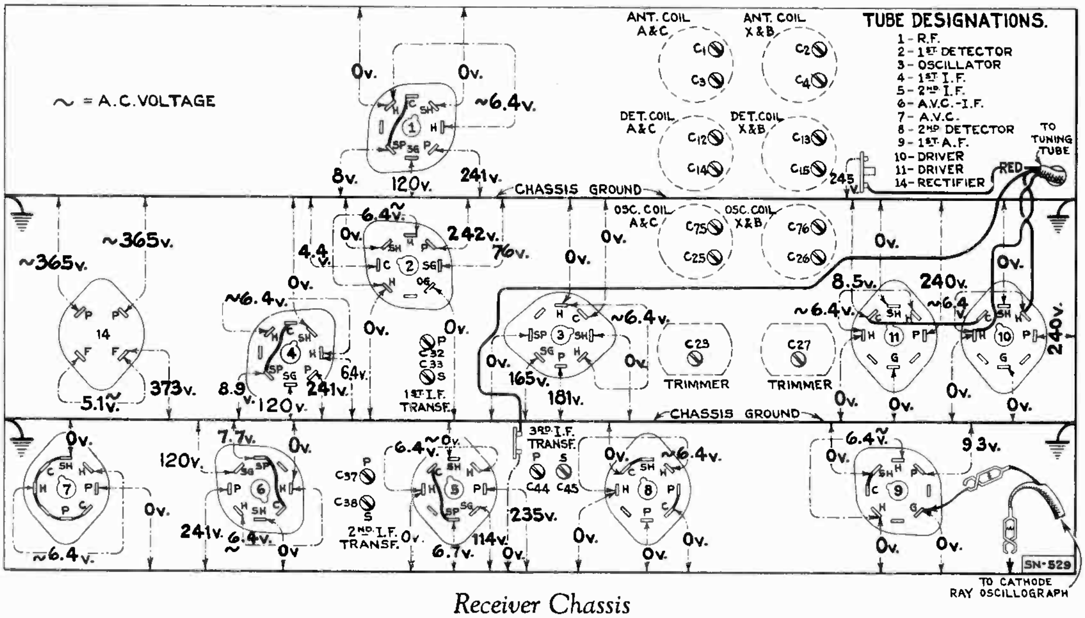
Band B

(a) Advance the receiver range switch to its Band B position and tune the station selector to a dial reading of **6132 kc.** Set the test Oscillator to **6132 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output until a suitable indication is apparent on the Oscillograph. The Oscillograph should be adjusted for "Int." timing. Then adjust the oscillator trimmer, C-76, to the point at which maximum amplitude of the image is obtained. Two positions will be found for this trimmer which gives such a maximum. The one of least capacitance is correct and should be used. This can be checked by tuning the "image" signal, which will be received at **5212 kc.** on the dial if the adjustment of C-76 has been properly made. An increase in the test Oscillator output may be necessary for this test. *Its frequency should not be changed from* **6132 kc.** *nor any trimmer adjustments made on the receiver.*

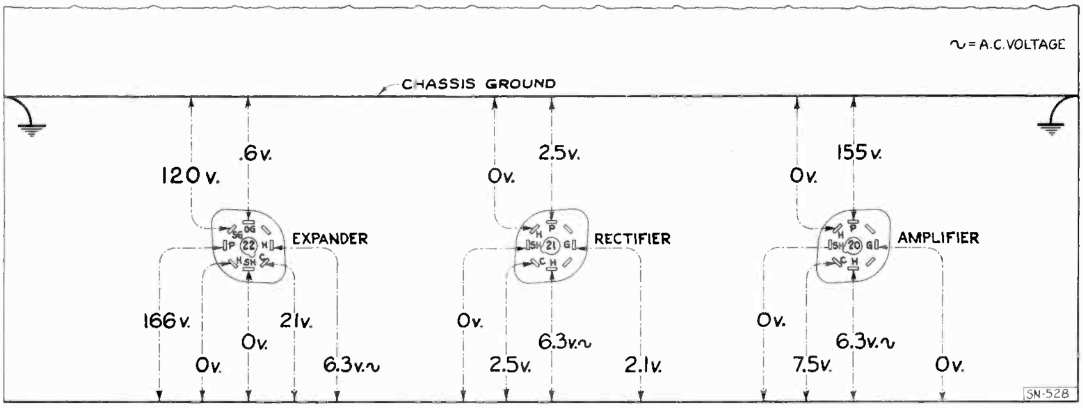
(b) Return the station selector to the **6132 kc.** reading and align the detector, and antenna coil trimmers, C-13 and C-2 respectively, for maximum (peak) output as shown by the Oscillograph. No further adjustments are to be made on this band.

Band C

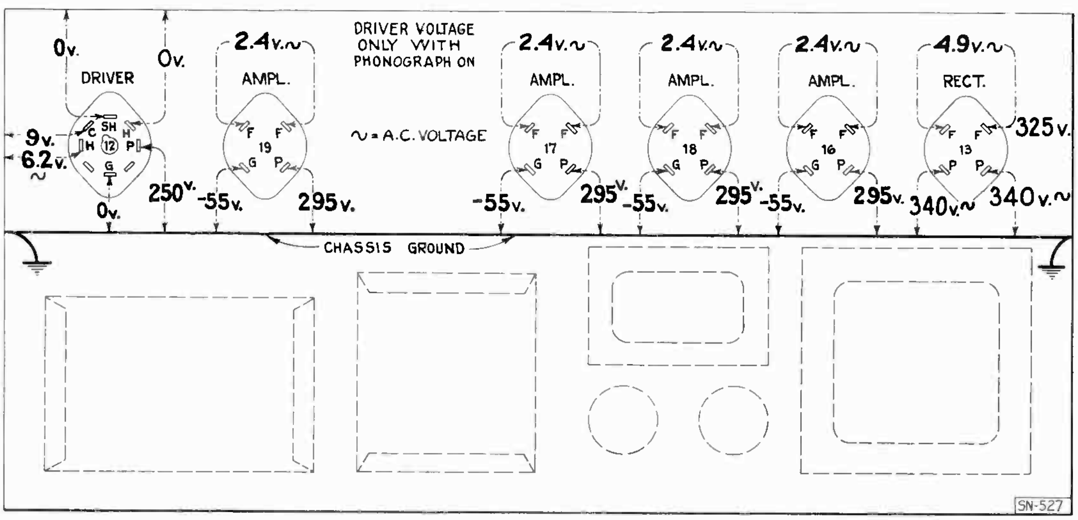
(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to **18,000 kc.** (Modulation "On" and Frequency Modulator disconnected), regulating its output to the level required for convenient observation. Adjust trimmer C-75 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of "image" signals by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the



Receiver Chassis



Dynamic Amplifier



Power Amplifier

Figure 4—Radiotron Socket Voltages
Measured at 115 volts, 60 cycle supply—No signal being received

Oscillator will be received at this point if the adjustment of C-75 has been properly made, using the position of minimum capacitance giving maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, realign C-75 if necessary, and then adjust the detector and antenna trimmers C-12, and C-1 for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on Band C.

BAND D

No adjustments are required on this band.

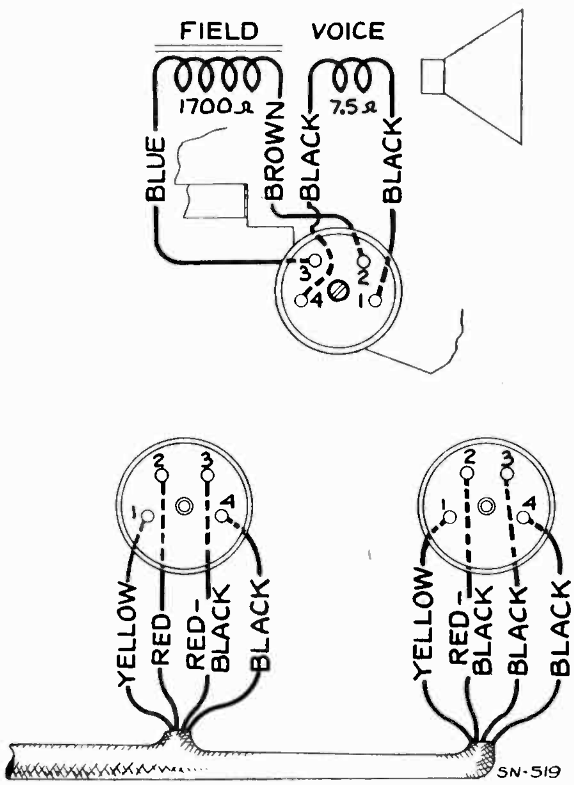


Figure 5—Loudspeaker Wiring

OUTPUT METER ALIGNMENT

To align the receiver by other methods than that explained above will require the use of a standard test oscillator, such as the Stock No. 9595, and a suitable output indicator, such as the Stock No. 4317. The indicator should be connected either to the voice coil circuit or across the output transformer primary. For each adjustment, the volume control should be maintained at maximum and the Oscillator output regulated until the indication is barely perceptible. The smaller the amount of glow, the more accurate will be the indication. The signal level will also be below the range of the receiver a.v.c., preventing broadness of tuning.

I-F Adjustments—Connect the output of the test Oscillator from the RCA-6L7 first detector control-grid to chassis-ground and adjust its frequency to **460 kc.** Tune the receiver to Band "A", setting the station selector at a point where no interference is received from local stations or the local oscillator. Then tune the i-f trimmers C-45, C-44, C-38, C-37, C-33, and C-32 in order, each for maximum indicated receiver output.

R-F Adjustments—Connect the Oscillator output to the antenna-ground terminals of the receiver. Keep the output indicator attached to the receiver output as above. For each adjustment, use the minimum signal which will give a perceptible indication on the glow indicator.

BAND A

(a) Set the range switch of the receiver to its Band A position and tune the selector to a dial reading of **1720 kc.** Tune the Oscillator to this same frequency and adjust trimmers C-25, C-14, and C-3 to produce maximum indicated receiver output.

(b) Shift the Oscillator to **600 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then adjust trimmer C-23, simultaneously rocking the tuning control backward and forward through the signal, until maximum output is obtained from the combined operations. Repeat the alignment of C-25 as in (a) to correct for any change caused by adjustment of C-23.

BAND X

(a) Change the range switch to its Band "X" position. Tune the receiver to read **400 kc.** and set the Oscillator to produce this same frequency. Adjust trimmers C-26, C-15, and C-4 to produce maximum receiver output.

(b) Shift the Oscillator frequency to **150 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then tune the oscillator series trimmer, C-27, simultaneously rocking the tuning control (receiver) backward and forward through the signal, until maximum output results from the combined operations. Repeat the alignment of C-26 as in (a) to correct for any change caused by the adjustment of C-27.

BAND B

Place the receiver range switch in its Band "B" position and tune the station selector to a dial reading of **6132 kc.** Set the frequency of the Oscillator to **6132 kc.** Then adjust trimmer C-76 to give maximum receiver output. Two positions may be found which fulfill this condition. The one of least capacitance is correct. To assure that the right peak has been used, tune the *receiver* to **5212 kc.** and increase the Oscillator output. The "image" of **6132 kc.** will be received at this point if C-76 has been adjusted to the proper point of maximum output. *No trimmer adjustments are to be made during this check.* Return the receiver tuning to **6132 kc.**, readjust C-76 if necessary, and then tune the detector and antenna coil trimmers, C-13 and C-2 to produce maximum (peak) receiver output as indicated on the glow meter.

Band C

Turn the receiver range switch to its Band "C" position and set the tuning control to a dial reading of **18,000 kc.** Tune the Oscillator to this same frequency. Adjust the oscillator parallel trimmer C-75 to produce maximum receiver output. Two positions of the trimmer will be found which fulfill such a condition. The one of least capacitance is correct. To assure that the right position has been used, check for the "image" of the **18,000 kc.** signal which will be received at **17,080 kc.** on the dial if C-75 is correctly adjusted. An increase in Oscillator output may be necessary. *No trimmer adjustments should be made during this check.* Return the receiver tuning to **18,000 kc.**, readjust C-75 if necessary, and then tune the detector and antenna trimmers, C-12 and C-1 to give maximum receiver output.

Dial Adjustment

Figure 6 illustrates the relations of the various parts of the dial mechanism when it is in its A—Broadcast position and the range switch is likewise turned to its Band A setting. In re-assembling the dial after repairs, see that the gears are meshed in accordance with the diagram, at the same time noting that the lever which is attached to the range-switch shaft is in the position as shown.

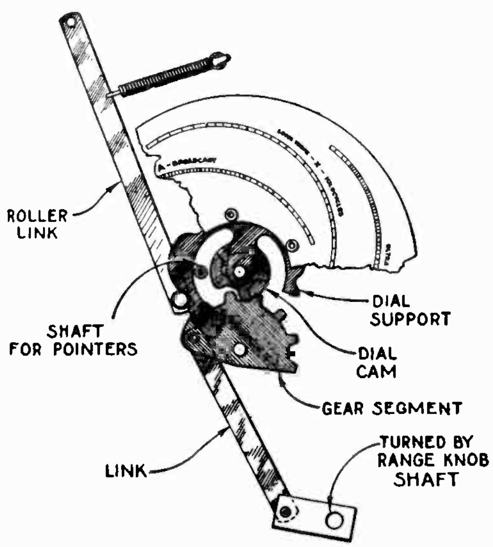


Figure 6—Selector Dial Change Mechanism

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to ground and appearing across the heaters (H-H) on Figure 4 will serve to assist in locating causes for faulty operation when existent. Each value as specified should hold within $\pm$ 20% when the receiver is normally operative at the rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits.

The voltages given on this diagram are actual measured voltages, and are the results obtained after the loading of the circuit, by the voltmeter, has taken place.

To fulfill the conditions under which these d-c voltages were measured it requires a 1,000-ohm-per-volt voltmeter having ranges of 30, 300, and 600 volts.

For all d-c voltages under 30, measure on the 30-volt scale; all d-c voltages between 30 and 300, measure on the 300-volt scale; and all d-c voltages between 300 and 600, measure on the 600-volt scale.

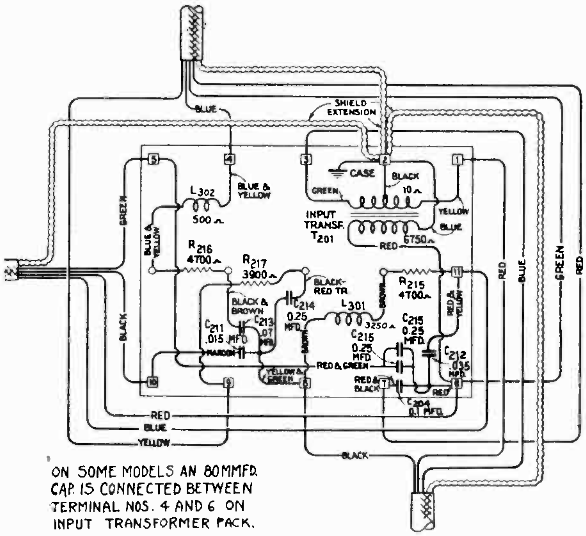


Figure 7—Input Transformer Wiring

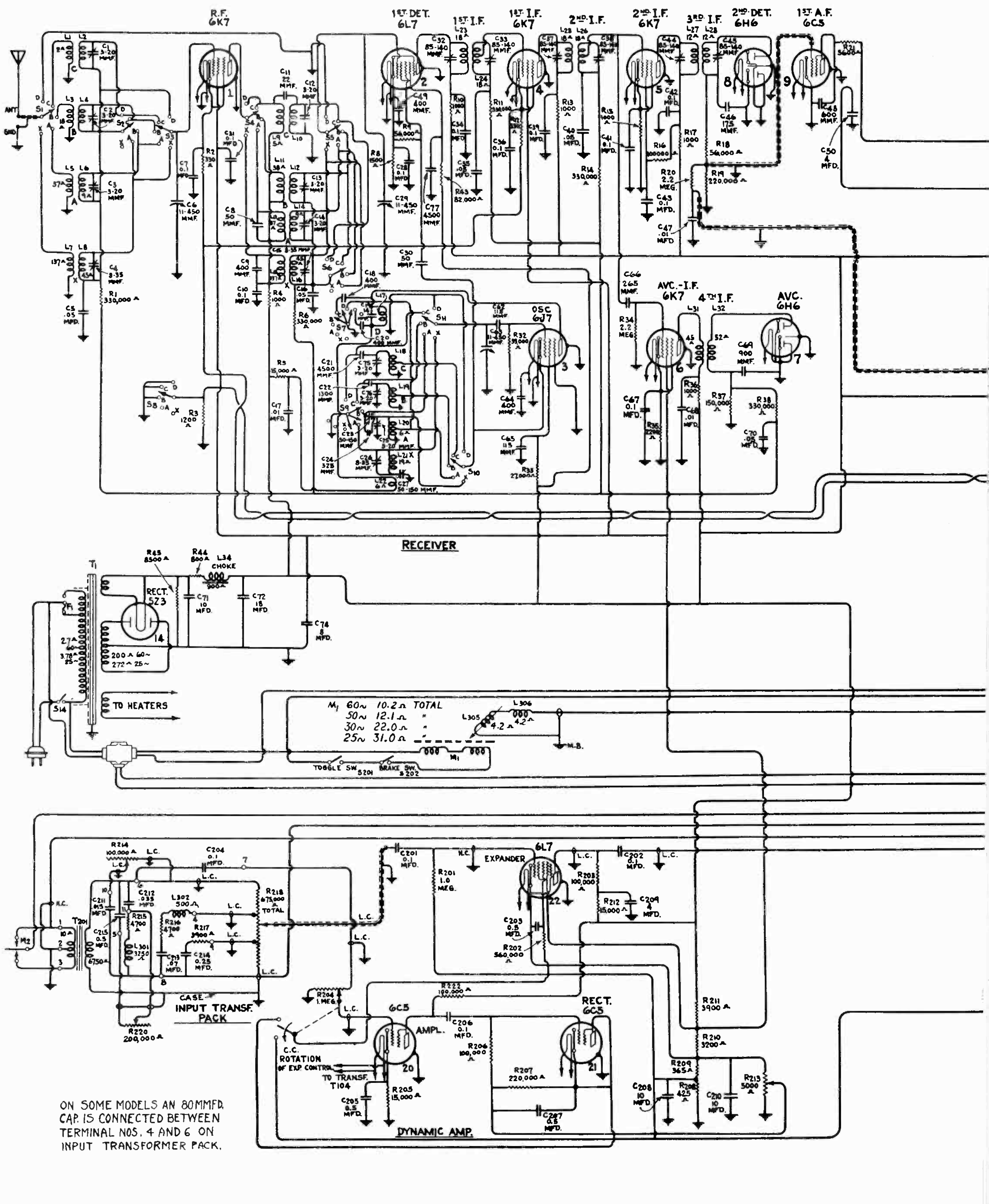
For meters of the 1,000-ohm-per-volt type, but ranges other than above, use the nearest ranges to those specified. If the range is higher the voltage *may be* higher, and if the range is lower the voltage *may be* lower; either condition depending on the percentage of circuit current drawn by the meter.

Dynamic Amplifier

It is essential that the correct voltages and currents exist at the RCA-6L7 audio expander stage in order that the expanding function may take place in the proper manner. A screw-driver adjustment (see Figure 14) is accordingly provided for regulating the fixed bias of the RCA-6L7 auxiliary grid so that the plate current may be adjusted to the correct value under a no-signal condition. This current should be adjusted to a value of 0.10—0.13 ma. with no signal input to the dynamic amplifier and with a normal voltage of 275 volts appearing across the resistance-divider system (R-211, R-210, R-209, and R-208).

A substitute method for adjusting the RCA-6L7 no-signal characteristic is by means of a voltmeter having an internal resistance of 600,000 ohms (600 volt range, 1,000-ohms-per-volt). This voltmeter should be used to set the plate (of the RCA-6L7) to chassis voltage. The plate voltage as indicated by the specified meter should be adjusted to exactly 195 volts, with a power line supply-voltage of 115 volts.

An indication of the operation of the dynamic amplifier may be obtained by playing a record which has predominating loudness. Such a record is Victor Red Seal Record No. 8651, "Die Fledermaus"—Over-



ON SOME MODELS AN 80 MMFD. CAP. IS CONNECTED BETWEEN TERMINAL NOS. 4 AND 6 ON INPUT TRANSFORMER PACK.

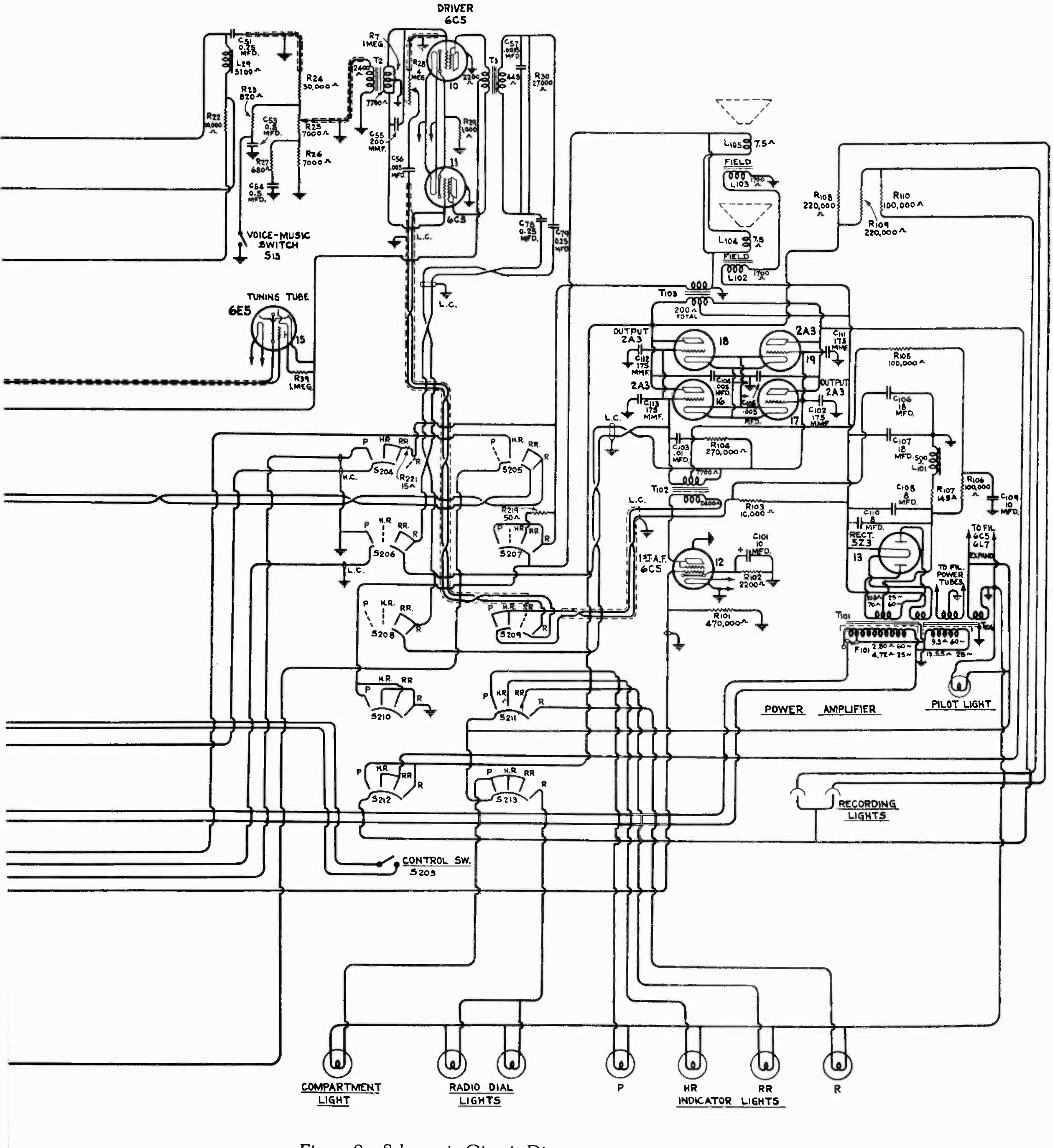


Figure 8—Schematic Circuit Diagram

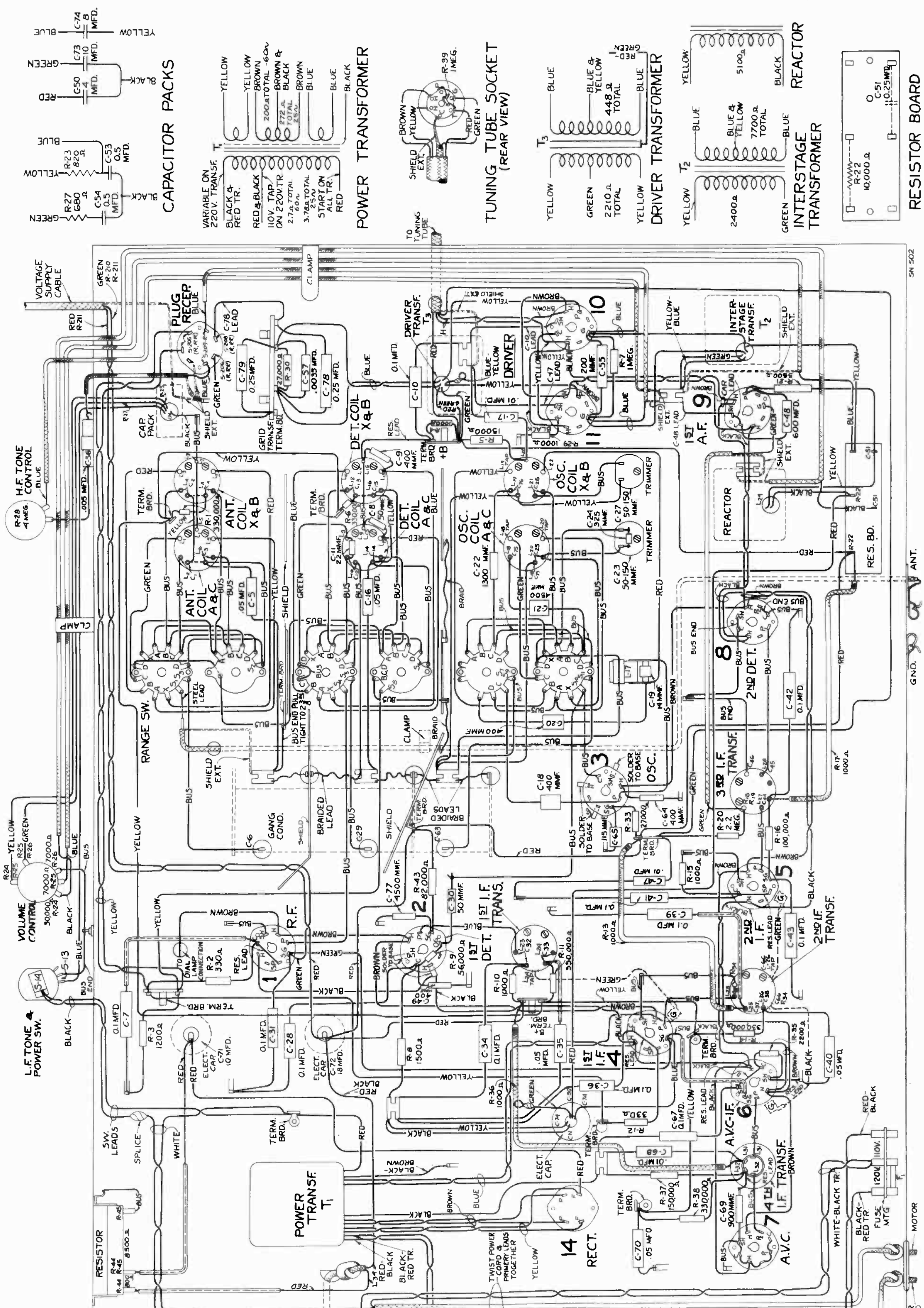


Figure 9—Chassis Wiring Diagram

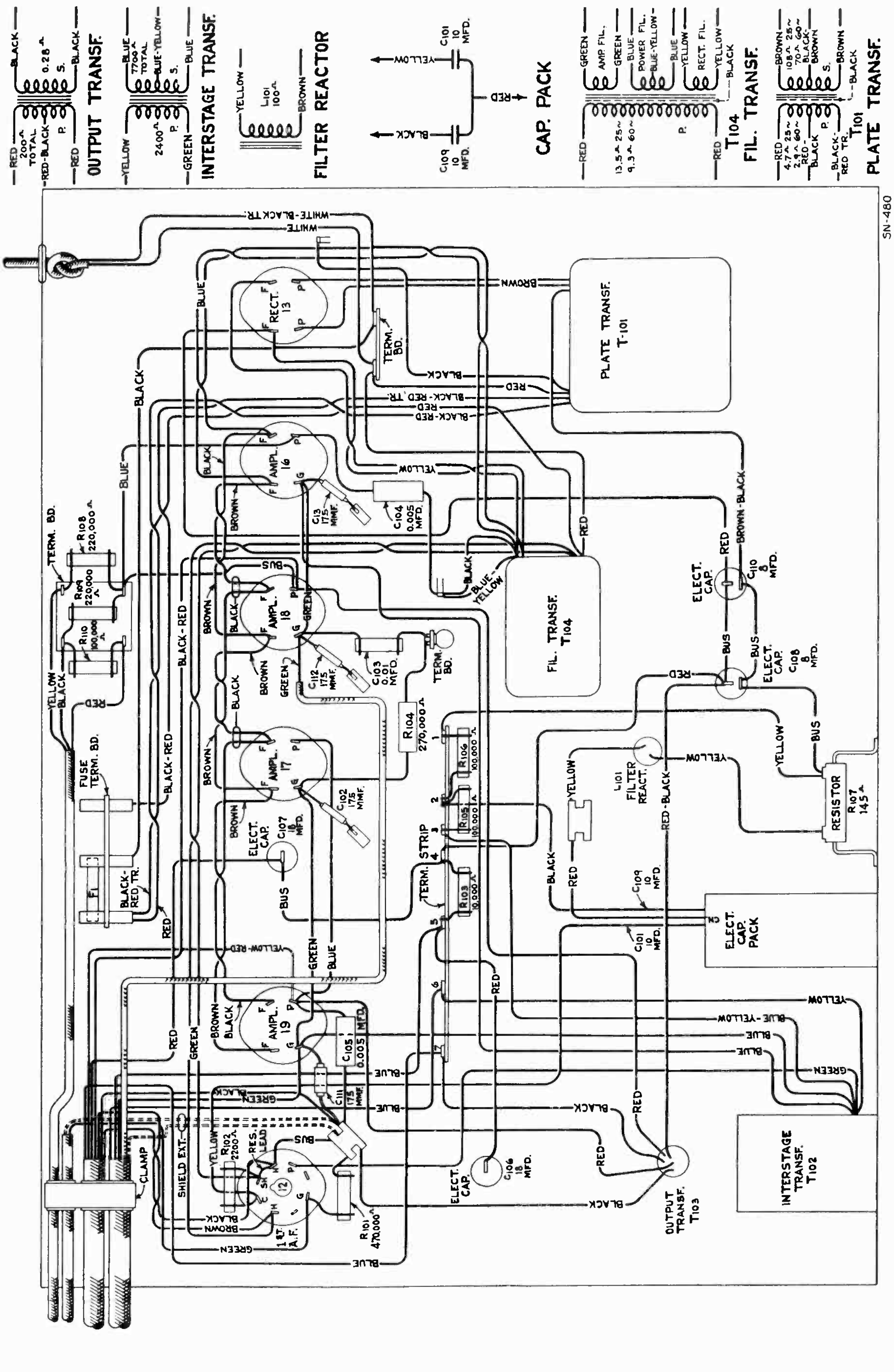


Figure 10—Power Amplifier Wiring

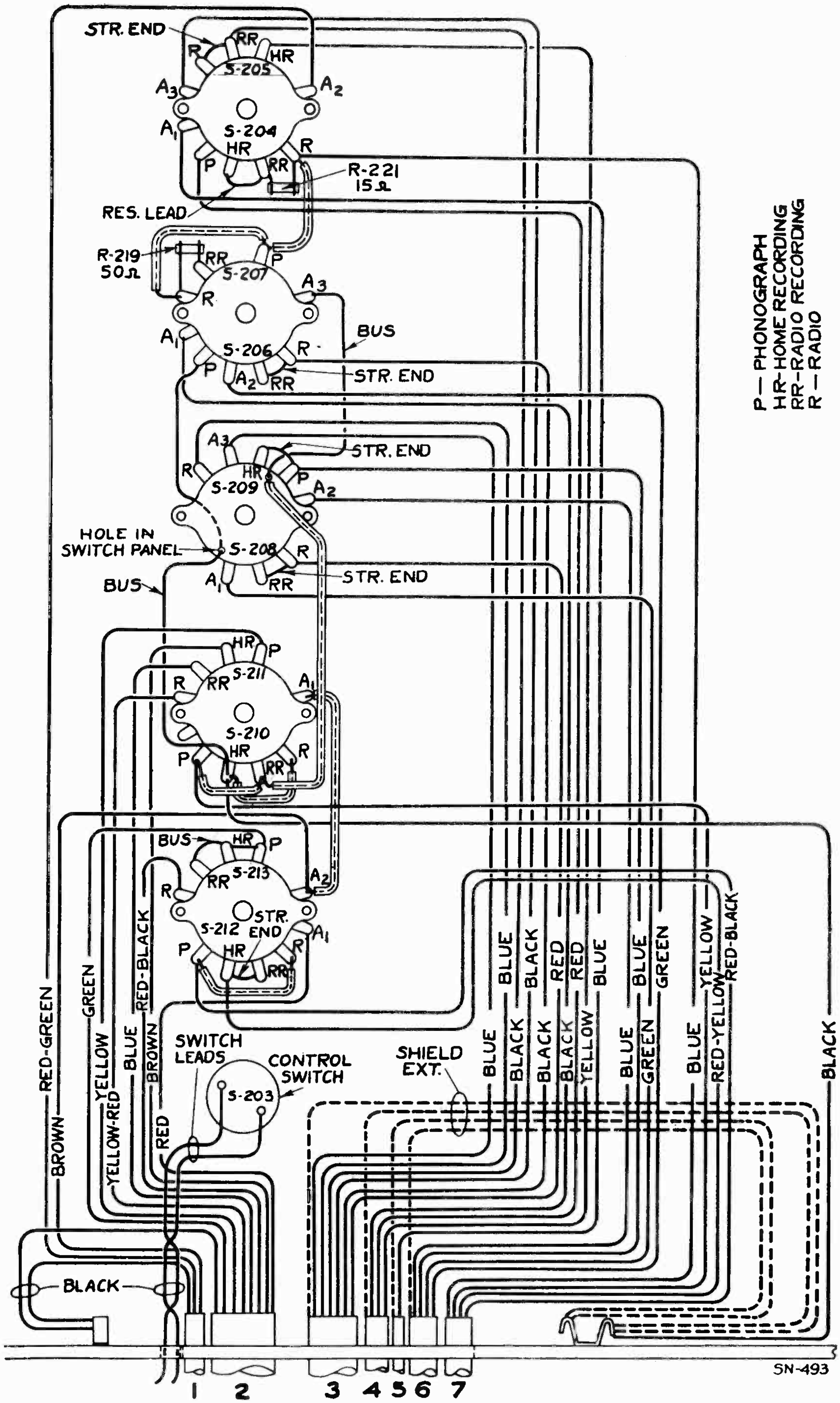


Figure 11—Change-Over Switch Wiring

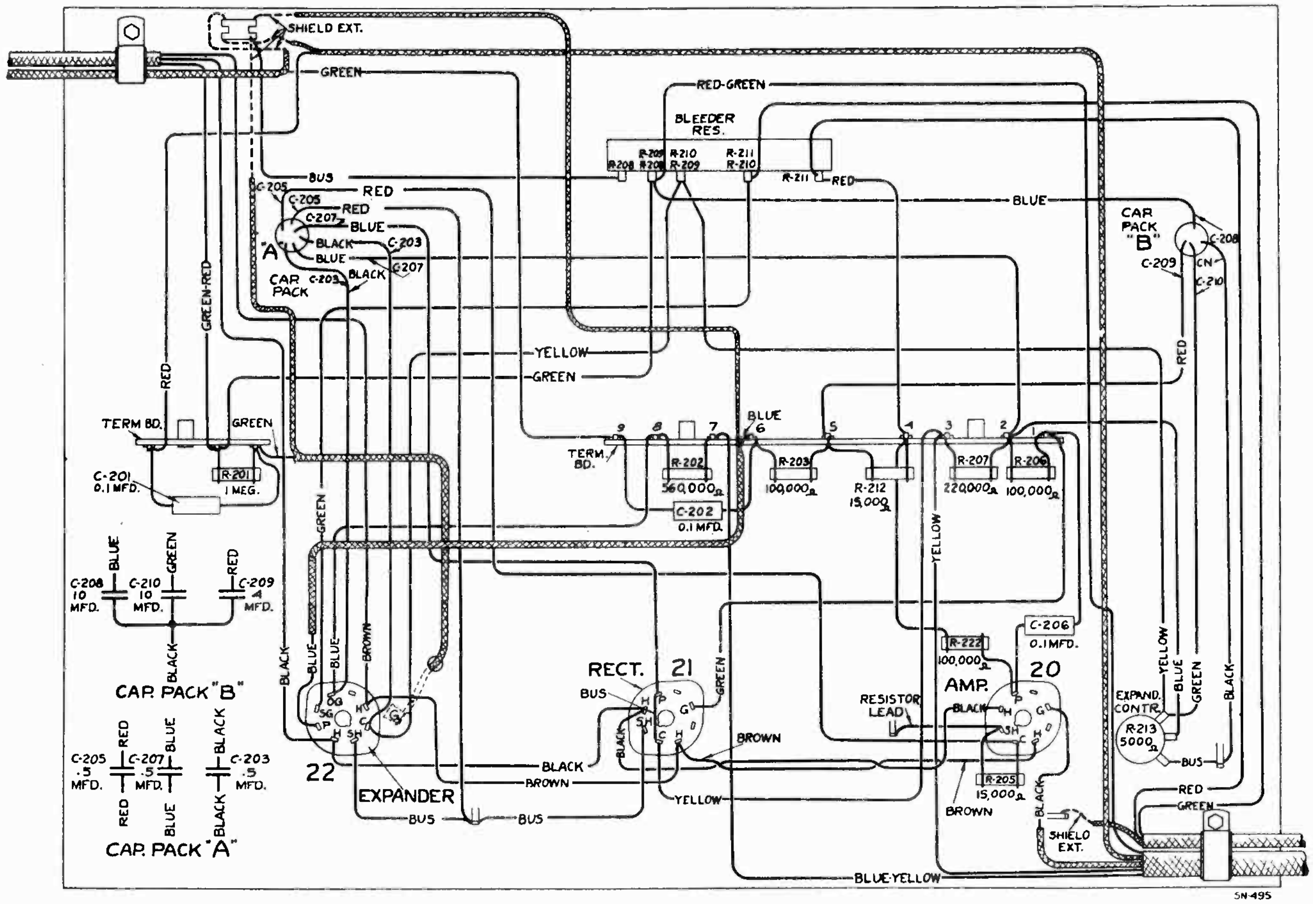


Figure 12—Dynamic Amplifier Wiring

ture. The plate current during the playing of such a record should increase from the static value of 0.10-0.13 ma. to a minimum of 0.55 ma.

Variations of the Radiotron (RCA-6L7) in the audio expander stage may affect operation of the circuit. Several tubes of such type should therefore be tried when correct performance is not obtainable from a single tube. The various voltages of the dynamic amplifier under a no-signal condition are indicated in Figure 4. It is very important that these voltages be as near to the specified values as possible.

If excessive hum is encountered, it is recommended that a different RCA-6L7 be tried in the expander unit. If this does not reduce the hum to a low enough value try reversing the power-line supply cord plug and/or the power amplifier supply plug to obtain a condition of minimum hum. The continuity of ground connections between chassis, expander unit, and power amplifier should be of very low resistance to maintain minimum hum.

Automatic Record Ejector

The record changing mechanism is designed to be simple and fool-proof. Under normal operating conditions, service difficulties should be negligible. Occasionally, however, certain adjustments may be required. These adjustments are illustrated and explained in Figure 15.

It is important when servicing the automatic mechanism, to have it placed on a level support. It is also important to refrain from forcing the mechanism if there is a tendency to bind or jam, since bent levers and possibly broken parts may result.

The tip of the record ejector is adjustable in relation to the turntable spindle, the two being exactly coaxial when properly adjusted. To align the tip, remove the rubber silencer of the ejector assembly, loosen ejector tip retaining nut and slide the tip assembly to the position where it is in true-line with the axis of the turntable spindle. This adjustment may be simplified by placing several records on the turntable, depressing the spindle through the top record hole and lining up the ejector tip in the spindle hole of the record.

To insure that the ejector tip rotates freely, apply a slight amount of oil to the shank of the tip at the point where it is in contact with the ball bearing.

Magnetic Pickup

The pickup used in the phonograph unit is of an improved design, having several variations from the usual type of pickup. The magnetic assembly is one rigid piece. The horseshoe magnet is solidly welded to the pole pieces and is irremovable. There is a centering spring attached to the armature to maintain proper adjustment and provides a damping effect on the movement of the armature. A neutralizing coil is mounted in the magnet assembly in such manner that it balances out hum induced by stray magnetic fields but does not affect the audio signal. The frequency response is uniform over a wide range.

Service operations which may be necessary on the pickup are as follows:—

Centering Armature

Refer to Figure 16 showing the pickup inner structure. The armature is shown in its proper relation to the magnet pole pieces, i. e., exactly centered. Whenever this centering adjustment has been disturbed, the screws A, B, and C should be loosened and the armature clamp adjusted to the point where the vertical axis of the armature is at right angles to the horizontal axis of the pole pieces, and centered between them. This centering operation may be facilitated by inserting a small rod or nail into the armature needle hole, using it as a lever to test the angular movement of the armature. The limitations of the movement in each direction will be caused by the armature striking the pole pieces. The proper adjustment is obtained when there is equal angular displacement of the armature and adjustment rod or nail to each side of the vertical axis of the magnet and coil assembly. The screws A and B should then be secured, observing care not to disturb the adjustment of the armature clamp. Then place the pickup in a vise and secure the centering spring-clamp by means of the screw C, allowing the centering spring to remain in the position at which the armature is exactly centered between the pole pieces. With a little practice, the correct adjustment of the armature may be readily obtained. The air gap between the pole pieces and the armature should be kept free from dust, filings, and other such foreign materials which would obstruct the movement of the pickup armature.

Damping Block

The viscoloid block which is attached to the back end of the armature shank serves as a mechanical filter to eliminate undesirable resonances and to cause the frequency response to be uniform. Should it be necessary to replace this damping block, it may be done by removing the armature and viscoloid assembly from the mechanism and taking off the old viscoloid block. The

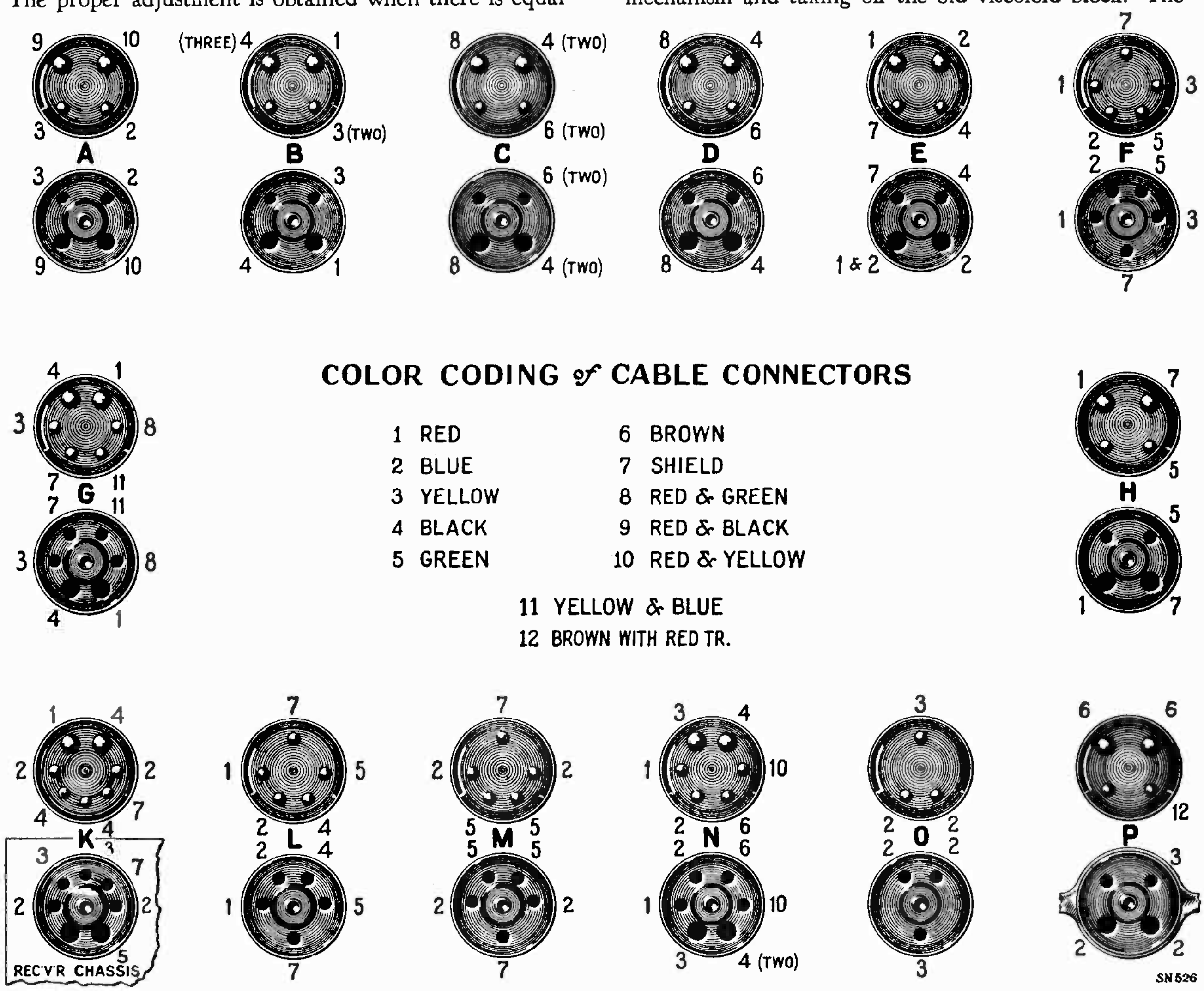
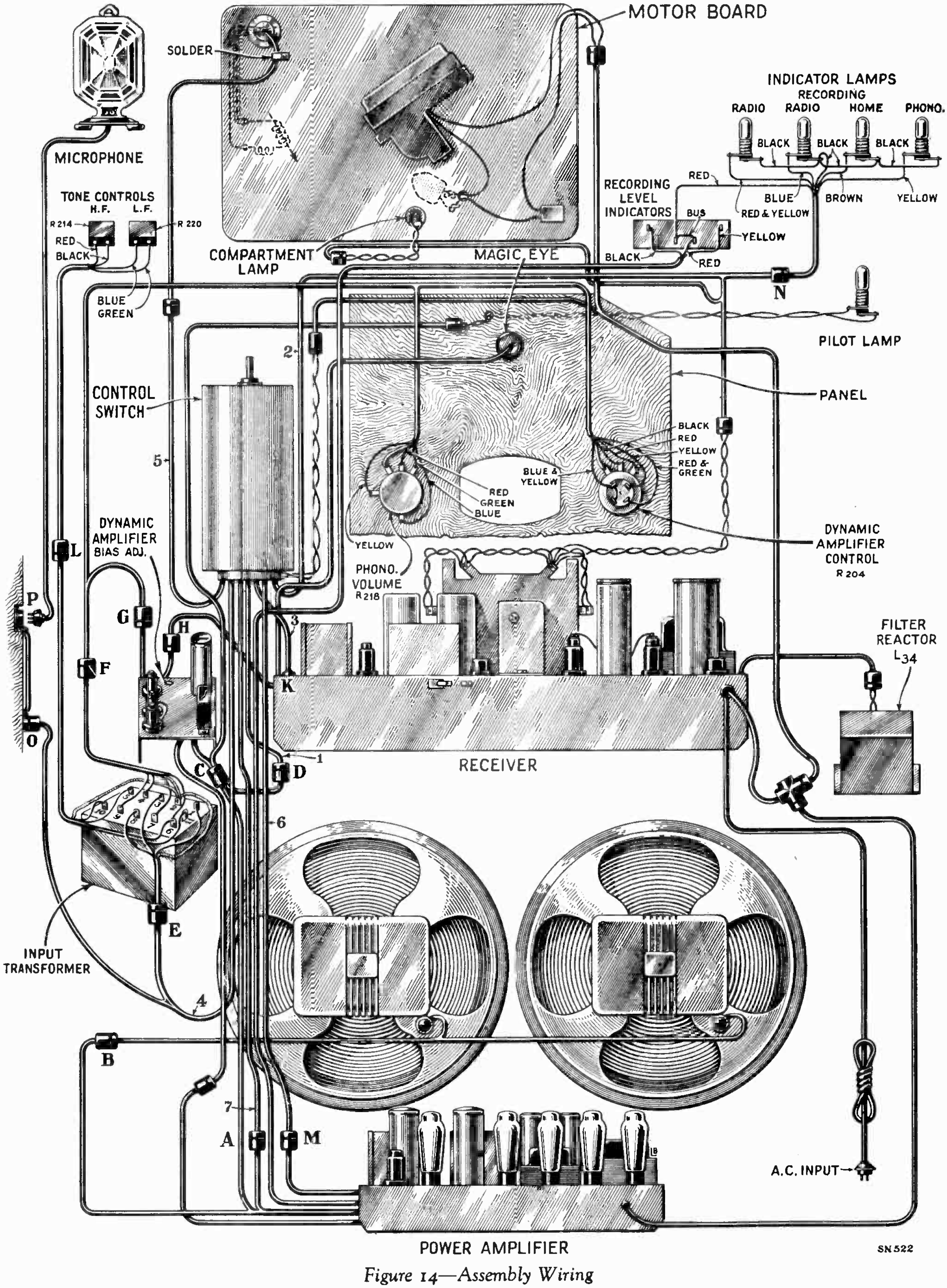


Figure 13—Socket and Plug Details of Assembly Wiring
(Refer to Figure 14)



POWER AMPLIFIER

Figure 14—Assembly Wiring

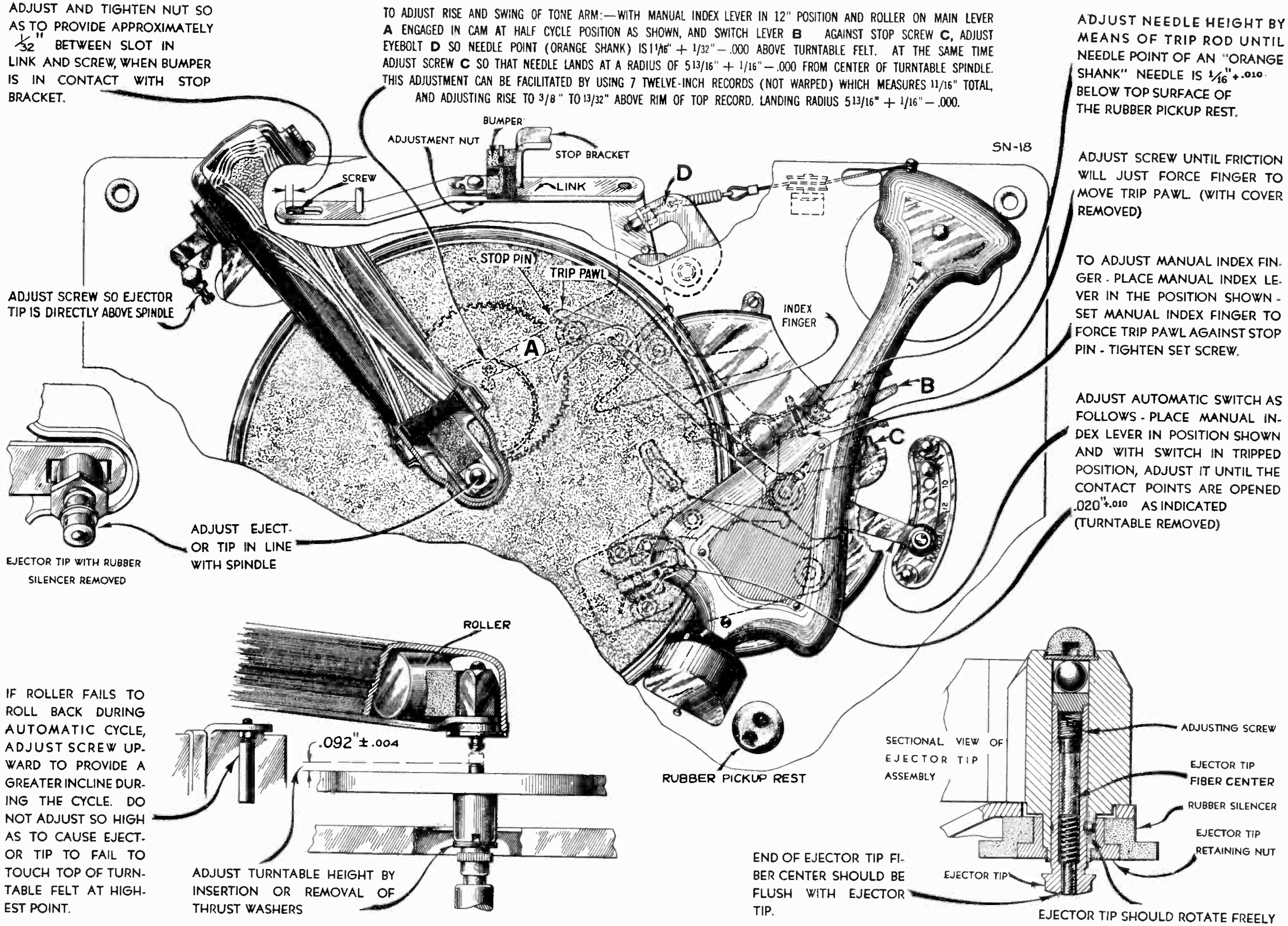


Figure 15—Automatic Record Changer Adjustments

surface of the armature which is in contact with the viscoloid should be thoroughly cleaned with fine emery cloth and then inserted into the new block so that it occupies the same position as it did originally. Make certain that the block is in correct vertical alignment with the armature. The hole in the new viscoloid block

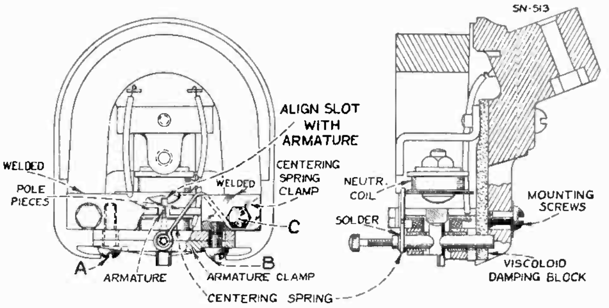


Figure 16—Details of Pickup

is somewhat smaller than the diameter of the armature in order to permit a snug fit. With the viscoloid aligned on the armature, heat should be applied to the armature (viscoloid side) so that the viscoloid block will fuse at the point of contact and become rigidly attached to the armature. A special-tip soldering iron constructed as shown in Figure 17 will be found very useful in performing this operation. The iron should be applied only long enough to slightly melt the block and cause a small bulge on both sides. The pickup should then be carefully re-assembled and the armature centered as previously explained.

Replacing Coils

Whenever there is defective operation due to open or shorted pickup coils, these coils should both be replaced. The method of replacement will be obvious upon inspection of the pickup assembly and by study of the cut-a-way illustrations. It is important to readjust the armature as previously explained after reassembly of the mechanism. It is also necessary to have the hum and signal coils mounted in proper relation to each other in order that there may be the intended neutralization between them. Make certain that the slot in the center screw of the neutralizing coil is aligned directly over the armature tip, as illustrated. Only rosin core solder should be used for soldering the coil leads in the pickup. This same type of solder should be used when necessary for soldering the centering spring to the armature.

Magnetizing

Loss of magnetization will not usually occur when the pickup has received normal care, due to the fact that the magnet and pole pieces are one unit and the magnetic circuit remains closed at all times. When the pickup has been mishandled, subjected to a strong a-c field, jolted, or dropped, there may be an appreciable loss of magnetic strength, in which case it will be necessary to re-magnetize the entire structure. This should

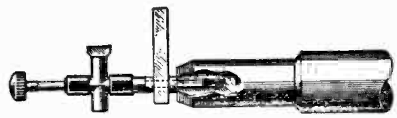


Figure 17—Special Soldering-Iron Tip

be done by placing the pickup assembly on the poles of a standard pickup magnetizer and charging the pickup in accordance with the instructions accompanying the magnetizer. It is preferable to check the polarity of the pickup magnet and to re-magnetize it so that the same polarity is maintained.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
5243	Arm—Band indicator operating arm with stud, set screws, nut, and washer	$0.42
4427	Bracket—High frequency tone control, low frequency tone or power switch or volume control mounting bracket	.18
11591	Button—Plug button	.10
11489	Cable—Two conductor cable with three way connector plug—Stock No. 11490	.66
11487	Cable—Two conductor shielded cable with female section of two contact connector plug—Stock No. 11488—To choke—(L34)	.42
11486	Cable—Two conductor shielded voltage supply cable with female section of four contact connector plug—Stock No. 4153—To (1) Terminal board and R19, (1) Terminal board, R3 and S8 shield to S205—Expander unit	1.08
11255	Cable—Four conductor tuning tube cable with connector socket—Stock No. 11381	1.20
5241	Capacitor—Adjustable capacitor—(C23, C27)	.40
5242	Capacitor—High frequency tone capacitor—.005 Mfd.—(C56)	.52
11286	Capacitor—14 MMfd.—(C19)	.24
11292	Capacitor—22 MMfd.—(C11)	.24
11289	Capacitor—50 MMfd.—(C8, C30)	.26
11291	Capacitor—115 MMfd.—(C62, C65)	.24
11295	Capacitor—200 MMfd.—(C55)	.30
11294	Capacitor—325 MMfd.—(C24)	.32
11290	Capacitor—400 MMfd.—(C9, C18, C20, C49, C64)	.25
11299	Capacitor—600 MMfd.—(C48)	.26
3784	Capacitor—900 MMfd.—(C69)	.30
11335	Capacitor—1300 MMfd.—(C22)	.30
11287	Capacitor—4500 MMfd.—(C21, C77)	.30
5005	Capacitor—0.0035 Mfd.—(C57)	.16
4858	Capacitor—0.01 Mfd.—(C17, C68)	.25
4870	Capacitor—.025 Mfd. (C47)	.20
4836	Capacitor—0.05 Mfd.—(C5, C16, C35, C40, C70)	.30
11414	Capacitor—0.1 Mfd.—(C31)	.20
4885	Capacitor—0.1 Mfd.—(C10, C34, C39, C42, C43)	.28
4841	Capacitor—0.1 Mfd.—(C7, C28, C36, C41, C67)	.22
5170	Capacitor—0.25 Mfd.—(C78, C79)	.25
3597	Capacitor—0.25 Mfd.—(C51)	.40
11203	Capacitor—10 Mfd.—(C71)	1.18
5212	Capacitor—18 Mfd.—(C72)	1.16
5213	Capacitor Pack—Comprising one 4. Mfd., one 8. Mfd., and one 10. Mfd. capacitors—(C50, C73, C74)	2.94

REPLACEMENT PARTS—Continued

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES—Continued	
5236	Capacitor Pack—Comprising two 0.5 Mfd. capacitors, one 680 ohm resistor and one 820 ohm resistor—(C53, C54, R23, R27)	1.36
5215	Coil—Antenna coil for "A" and "C" band—(L1, L2, L5, L6, C1, C3)	2.32
5218	Coil—Antenna coil for "X" and "B" band—(L3, L4, L7, L8, C2, C4)	2.58
5216	Coil—Dectector coil for "A" and "C" band—(L9, L10, L13, L14, C12, C14)	2.34
5219	Coil—Detector coil for "X" and "B" band—(L11, L12, L15, L16, C13, C15)	2.58
5217	Coil—Oscillator coil for "A" and "C" band—(L18, L20, C25, C75)	2.20
5221	Coil—Oscillator coil—"D" band—Located on Range Switch	.64
5220	Coil—Oscillator coil for "X" and "B" band—(L19, L21, L22, C26, C76)	2.24
5214	Condenser—Three gang variable tuning condenser —(C6, C29, C63)	4.42
5222	Control—Tone control—High frequency tone control—(R28)	1.04
5223	Control—Volume control—(R24, R25, R26)	1.22
5240	Cover—Fuse cover	.24
11202	Foot—Chassis mounting (bracket) foot—Package of 2	.78
10907	Fuse—Three ampere fuse—(F1)—Package of 5	.40
5226	Lamp—Dial lamp—Package of 5	.70
5239	Mounting—Fuse mounting	.36
4153	Plug—Female section four-contact connector plug—used on cables—Stock Nos. 11486, 11503, 11569	.48
11490	Plug—Three-way plug for cable—Stock No. 11489	.26
5233	Reactor—Coupling reactor—(L29)	2.32
11488	Receptacle—Two-contact female section of connector—used with cables—Stock Nos. 11487, 11502, 11513, 11567, 11571	.14
11718	Resistor—Wire wound resistor—800-8500 Ohms—(R44, R45)	1.08
11296	Resistor—330 Ohms—Carbon type—¼ watt—(R2, R12)—Package of 5	1.00
11285	Resistor—1000 ohms—Flexible type resistor—(R13, R17, R36)—Package of 5	1.00
5112	Resistor—1000 ohms—Carbon type—¼ watt—(R4, R10, R15, R29)—Package of 5	1.00
11283	Resistor—1200 Ohms—Carbon type—¼ watt—(R3, R31)—Package of 5	1.00
4408	Resistor—1500 Ohms—Carbon type—¼ watt—(R8)—Package of 10	2.00
5159	Resistor—2200 Ohms—Carbon type—¼ watt—(R35)—Package of 5	1.00
11298	Resistor—5600 Ohms—Carbon type—1 watt—(R21)	.22
8043	Resistor—10,000 Ohms—Carbon type—2 watts—(R22)	.25
5114	Resistor—15,000 Ohms—Carbon type—1 watt—(R5)	.22
11400	Resistor—27,000 Ohms—Carbon type—¼ watt—(R30)—Package of 5	1.00
8065	Resistor—27,000 Ohms—Carbon type—½ watt—(R33)—Package of 5	1.00
11300	Resistor—33,000 Ohms—Carbon type—1/10 watt—(R32)—Package of 5	.75
11282	Resistor—56,000 Ohms—Carbon type—1/10 watt—(R9)—Package of 5	.75
8064	Resistor—82,000 Ohms—Carbon type—½ watt—(R43)—Package of 5	1.00
3118	Resistor—100,000 Ohms—Carbon type—¼ watt—(R16)—Package of 5	1.00
5027	Resistor—150,000 Ohms—Carbon type—¼ watt—(R37)—Package of 5	1.00
5108	Resistor—330,000 Ohms—Carbon type—¼ watt—(R11, R14, R38)—Package of 5	1.00
11297	Resistor—330,000 Ohms—Carbon type—1/10 watt—(R1, R6)—Package of 5	.75
3033	Resistor—1 Megohm—Carbon type—¼ watt—(R7)—Package of 5	1.00
11382	Resistor—1 Megohm—Carbon type—1/10 watt—(R39)—Located in tuning tube cable—Package of 5	.75
11626	Resistor—2.2 Megohm—Carbon type—¼ watt—(R20)—Package of 5	1.00
4669	Screw—No. 8—32—5/32" Set screw for indicator operating arm—Package of 10	.25
5249	Shield—Metal shield case for antenna, detector, or oscillator coils	.20
11273	Shield—Radiotron shield	.25
11381	Socket—Tuning tube cable connector socket	.45
11598	Socket—Dial lamp socket	.14
4794	Socket—Four-contact socket for 5Z3 Radiotron—(No. 14)	.15
11197	Socket—Six-contact socket for 6C5 Radiotrons—(Nos. 9, 10, 11)	.14
11278	Socket—Seven-contact socket for 6J7 Radiotron—(No. 3)	.20
4787	Socket—Seven-contact socket for Cable Stock—(No. 11568)	.15
11198	Socket—Seven-contact socket for 6K7, 6H6, Radiotrons—(Nos. 2, 4, 5, 6 and 8)	.15
11280	Socket—Seven-contact socket for 6L7 Radiotron—(No. 2)	.14
5225	Switch—Range switch—(S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11)	3.75
11507	Switch—Low frequency tone or power switch—(S13, S14)	.92
11508	Transformer—Driver transformer—T3	2.75
5234	Transformer—Interstage transformer—T2	3.40
5228	Transformer—First intermediate frequency transformer—(L23, L24, C32, C33)	1.80
5229	Transformer—Second intermediate frequency transformer—(L25, L26, C37, C38, C66, R34)	2.42
5230	Transformer—Third intermediate frequency transformer—(L27, L28, C44, C45, C46, R18, R19)	2.76
5231	Transformer—Fourth intermediate frequency transformer—(L31, L32)	1.50
8062	Transformer—Power transformer—105-125 volts—25-50 cycles	9.84
8061	Transformer—Power transformer—105-125 volts—50-60 cycles—(T1)	6.75
	CONDENSER DRIVE ASSEMBLIES	
5243	Arm—Band indicator operating arm	.42
10194	Ball—Steel ball for drive assembly—Package of 20	.25
8054	Cam—Five-position cam for station selector drive assembly	.28
4422	Clutch—Tuning condenser drive clutch assembly—comprising shaft, balls, ring, spring and washers assembled	1.00
8048	Coupling—Flexible coupling for variable capacitor—includes indicator shaft	.70
11336	Dial—Dial scale with mounting rivets	.60
8045	Disc—Drive disc and Micarta gear assembly	.46
11380	Drive—Tuning condenser drive assembly—complete	6.35
8044	Escutcheon—Dial escutcheon with vernier scale	1.08
8046	Gear—Indicator shaft, Micarta drive gear and Brass vernier idler with one spring	.72
8050	Gear—Gear sector and band indicator operating link—(link connects to arm on band switch)	.15
8053	Indicator—Station selector vernier indicator pointer	.12
11793	Indicator—Station selector indicator pointer.	.15
8051	Link—Complete—with roller and spring	.30
8049	Pinion—Vernier pointer drive pinion and shaft	.55
4669	Screw—No. 8—32—5/32" Square head set screw—Package of 10	.25
8047	Spring—Coil spring for indicator shaft drive gear and vernier idler—(Stock No. 8046)	.12
8052	Spring—Coil spring for link—Package of 5	.32
8042	Stud—Band indicator operating arm stud—Package of 5	.25

REPLACEMENT PARTS—Continued

Stock No.	Description	List Price
	AMPLIFIER ASSEMBLIES	
11502	Cable—Single conductor shielded cable with female section of connector—Stock No. 11488)—Connects to Grid of first audio socket in amplifier—to expander unit—(C202)	.74
11501	Cable—Three conductor cable—Connects from R108, R109 and R110 in amplifier—to Neon indicator lamp	.64
11504	Cable—Four conductor shielded cable with five contact female connector plug—Stock No. 11506—connects to Amplifier "G," sockets No. 18 and No. 19—(T102, C106)—Terminals	.20
11503	Cable—Eight conductor cable with four female sections of connectors—(Stock No. 4153) — From (C107)—Amplifier Plate—(C111)—and "H" of first "AF" in Amplifier—to expander, control switch and reproducers	3.70
11500	Capacitor—175 MMfd.—(C102, C111, C112, C113)	.18
4838	Capacitor—0.005 Mfd.—(C104, C105)	.20
4858	Capacitor—0.01 Mfd.—(C103)	.25
11497	Capacitor—8 Mfd.—(C108, C110)	1.04
11496	Capacitor—18 Mfd.—(C106, C107)	1.15
11498	Capacitor Pack—Comprising two 10 Mfd. capacitors—(C101, C109)	1.00
4358	Clamp—Capacitor clamp for capacitor—(Stock No. 11498)	.15
11488	Connector—Female section—two contact connector—used on cables—(Stock Nos. 11502, 11513, 11487, 11567 and 11571)	.14
4153	Connector—Female section—four contact connector—used on cables—Stock Nos. 11503, 11486, 11569	.48
5240	Cover—Fuse cover	.24
10907	Fuse—Three ampere fuse—Package of 5—(F1)	.40
5239	Mounting—Fuse mounting	.36
11493	Reactor—Power filter reactor—(L101)	3.70
11506	Receptacle—Female section—five prong plug—used on cable—Stock Nos. 11504, 11517, 11518	.65
11499	Resistor—Wire wound—145 ohms—(R107)	.74
5159	Resistor—2200 Ohms—Carbon type—¼ watt—Package of 5—(R102)	1.00
3078	Resistor—10,000 Ohms—Carbon type—½ watt—(R103)—Package of 5	1.00
3118	Resistor—100,000 Ohms—Carbon type—¼ watt—(R106, R105, R110)—Package of 5	1.00
5158	Resistor—220,000 Ohms—Carbon type—¼ watt—(R108, R109)—Package of 5	1.00
11323	Resistor—270,000 Ohms—Carbon type—¼ watt—(R104)—Package of 5	1.00
11172	Resistor—470,000 Ohms—Carbon type—¼ watt—(R101)—Package of 5	1.00
4794	Socket—Four contact socket—for 2A3 and 5Z3 Radiotrons	.15
11198	Socket—Seven contact socket—for 6C5 Radiotron	.15
11492	Transformer—Filament transformer—105-125 volts—50-60 cycle—(T104)	6.10
11879	Transformer—Filament transformer—105-125 volts—25-50 cycle—(T104)	3.50
11878	Transformer—Plate transformer — 105-125 volts—25-50 cycle—(T101)	5.55
11495	Transformer—Interstage transformer—(T102)	3.16
11494	Transformer—Output transformer—(T103)	5.65
11491	Transformer—Plate transformer — 105-125 volts—50-60 cycle—(T101)	6.00
	DYNAMIC (EXPANDER) AMPLIFIER ASSEMBLIES	
11514	Cable—Single conductor shielded cable—with male section of two-prong plug—Stock No. 4674—From (C202) and ground terminal	1.00
11516	Cable—Two conductor shielded cable—with male section of four-prong plug—Stock No. 6123—To (R211) and capacitor pack—(C208, C209 and C210)	.68

Stock No.	Description	List Price
11513	Cable—Three conductor cable—with one male section of connector and one female section of connector—Stock Nos. 6123, 11488—To (R208) and "H-H"—Socket No. 22	1.06
11515	Cable—Five conductor shielded cable—with male section six-prong connector—Stock No. 4574—To (R202), (R207), "G Amplifier 20," (C201), (R206) and ground terminal	1.50
11350	Cap—Grid control contact cap—Package of 5	.20
11414	Capacitor—0.1 Mfd.—(C202, C206)	.20
4841	Capacitor—0.1 Mfd.—(C201)	.22
11509	Capacitor Pack—Comprising three 0.5 Mfd. capacitors—(C203, C205, C207)	1.75
11608	Capacitor Pack—Comprising two 10 Mfd. and one 4 Mfd. capacitors—(C208, C209, C210)	1.98
4358	Clamp—Capacitor clamp	.15
11488	Connector—Two contact female section of connectors—used with cables—Stock Nos. 11513, 11502, 11567, 11487, 11571	.14
11512	Control—Expander bias control—(R213)	.78
11511	Foot—Chassis mounting (bracket) foot	.50
4674	Plug—Male section two prong connector—used with cables—Stock Nos. 11514, 11524	.25
6123	Plug—Male section four prong plug—used with cables—Stock Nos. 11513, 11516, 11526, 11525, 11572	.30
4574	Plug—Six prong male section of connector plug—used with cables—Stock Nos. 11515, 11522	.48
5158	Resistor—220,000 Ohms—Carbon type—¼ watt—(R207)—Package of 5	1.00
3998	Resistor—15,000 Ohms—Carbon type—¼ watt—(R205, R212)—Package of 5	1.00
3118	Resistor—100,000 Ohms—¼ watt—Carbon type—(R203, R206)—Package of 5	1.00
3252	Resistor—100,000 Ohms—Carbon type—½ watt—(R213)—Package of 5	1.00
5035	Resistor—560,000 Ohms—Carbon type—¼ watt—(R202)—Package of 5	1.00
3033	Resistor—1 Megohm—Carbon type—¼ watt—(R201)—Package of 5	1.00
11510	Resistor—Wire wound—425, 365, 3200 and 3900 Ohms—(R208, R209, R210, R211)	.74
11197	Socket—Six-contact socket for 6C5 Radiotron	.14
11198	Socket—Seven-contact socket for 6L7 Radiotron	.15
	MISCELLANEOUS CABLE AND PLUGS	
11524	Cable—Two-conductor cable with two-prong male section of connector plug—Stock No. 4674—From pilot lamp to cable—Stock 11567	.36
11526	Cable—Three-conductor shielded cable with four-prong male section of connector plug Stock No. 6123 and three terminals—connects from input transformer terminals Nos. 1, 3 and 8 to cable—Stock No. 11527	1.02
11527	Cable—Three-conductor cable with one four-contact microphone socket and one three-prong male section of connector plugs—Stock Nos. 4592, 5118	.50
11523	Cable—Three-conductor cable with two female two-contact and one male section of connector plugs—Stock Nos. 2308, 4573—From power cable, Stock No. 11489 to motor leads, and leads from control switch S203	2.22
11517	Cable—Four-conductor shielded cable with female section of connector plug—Stock No. 11506—Connects from tone controls, R214 and R220, to input transformer cable—Stock No. 11521	2.15
11518	Cable—Four-conductor shielded cable with female section of connector plug—Stock No. 11506—From input transformer terminals, Nos. 2, 5, 6 and 10, to cable—Stock No. 11519	1.92
11521	Cable—Four-conductor shielded cable with five-prong male section of connector—Stock No. 11520—From input transformer terminals Nos. 4, 5, 7 and 9 to cable—Stock No. 11517	1.12

REPLACEMENT PARTS—Continued

Stock No.	Description	List Price
	MISCELLANEOUS CABLE AND PLUGS—Continued	
11522	Cable—Six-conductor cable, with Connector Stock No. 4574, from Radio-Phonograph, Home and Radio Recording indicator lamps, to cable—Stock No. 11567 from control switch	1.18
11525	Cable—Seven-conductor cable with one four-contact male and two four-contact female sections of connectors—Stock Nos. 5040, 6123—connects from Reproducers to cable—Stock No. 11503 amplifier	1.98
11519	Cable—Nine-conductor shielded cable with one six-contact female and one five-prong male section of connector plugs—Stock Nos. 4151, 11520—From expander control (R204) and phonograph volume control (R218) to expander and input transformer cable—Stock No. 11518	4.50
4577	Plug—Two-prong male section of motor connection plug—Connects to cable—Stock No. 11523	.30
4674	Plug—Two-contact male section of connector plug for cable—Stock Nos. 11524, 11514	.25
2308	Plug—Two-contact male section of connector plug for cable—Stock No. 11523	.55
5118	Plug—Three-prong male section of connector plug for cable—Stock No. 11527	.25
6123	Plug—Four-prong male section of connector for cable—Stock No. 11525 and Stock Nos. 11526, 11516, 11513, 11572	.30
11520	Plug—Five-prong male section of connector plug for cable—Stock No. 11519 and Stock Nos. 11521, 11630	.34
4574	Plug—Six-contact male section of connector for cable—Stock Nos. 11522, 11515	.48
4573	Receptacle—Two-contact female section of connector plug for cable—Stock No. 11523	.30
5040	Receptacle—Four-contact female section of connector for cable—Stock No. 11525	.25
11506	Receptacle—Five-contact female section of connector for cable—Stock No. 11517 and Stock Nos. 11518, 11504	.65
4151	Receptacle—Six-contact female section of connector for cable—Stock Nos. 11519, 11567	.60
4593	Socket—Four-contact microphone socket for cable—Stock No. 11527	.42
	EJECT ARM ASSEMBLIES	
11541	Arm—Eject arm—complete	8.15
11533	Ball—$\frac{1}{16}$" diameter steel ball—Package of 10	.20
10129	Ball—$\frac{3}{16}$" diameter steel ball—Package of 20	.25
11529	Bearing—Ejector tip bearing and nut	.32
11538	Bracket—Eject arm bracket	1.72
11537	Collar—Eject arm shaft collar and set screw	.24
11540	Cover—Eject arm cover	1.52
11536	Cushion—Counter balance roller cushion—Located inside of eject arm	.14
4055	Post—Vertical adjustment post—Located on eject arm bracket	.30
3729	Roller—Eject arm counter balance roller—Located inside of eject arm	.45
4580	Screw—No. 6—32—$\frac{3}{16}$" Square head set screw for eject arm collar—Package of 10	.25
11534	Screw—No. 8—36—$\frac{7}{32}$" Special screw for eject arm tip center adjustment—Package of 10	.14
11535	Shaft and Collar—Eject arm vertical action shaft and collar assembly	.15
11528	Silencer—Ejector tip silencer	.14
4067	Spring—Eject arm bracket spring—Package of 10	.30
11531	Spring—Ejector tip spring—Package of 10	.42
11530	Tip—Ejector tip with tip center, adjusting screw and cap	.32
11539	Yoke—Eject arm yoke assembly	.94

Stock No.	Description	List Price
	PICKUP AND ARM ASSEMBLIES	
11482	Arm—Pickup arm complete—less pickup mounting screw, escutcheon and pickup unit	4.80
11543	Armature—Pickup armature	.72
11548	Back—Pickup back	.52
4064	Cable—Pickup arm operating cable—Package of 5	1.00
11544	Coil—Pickup coil—(L305)	.80
11532	Coil—Pickup hum bucking coil—(L306)	.60
4674	Connector—Two-prong male section of pickup cable connector plug—Stock Nos. 11514, 11524	.25
11545	Cover—Pickup front cover	.22
11546	Cover—Pickup back cover with mounting screws	.14
3737	Damper—Pickup damper—Package of 5	.65
11723	Escutcheon—Pickup arm escutcheon	.62
11481	Pickup—Pickup unit complete	4.80
11549	Screw—Pickup front cover screw—Package of 10	.42
3387	Screw, nut and washer for mounting pickup to arm—Package of 10	.40
11547	Screw—Pickup needle screw—Package of 10	.42
11550	Weight—Home recording weight	1.50
	MOTOR BOARD ASSEMBLIES	
11553	Escutcheon—Index escutcheon engraved Manual—12–10	.44
3764	Nut—Cap nut for motor board suspension assembly—Package of 4	.40
3672	Pin—Manual index pin	.42
11551	Rest—Pickup rest	.14
3654	Roller—Pickup arm cable guide roller—comprising bracket roller and guide pin	.34
3763	Suspension Spring—Suspension spring, washer and bolt assembly for motor board—comprising one bolt, two cup washers, two springs, two "C" washers and one cap nut	.42
4671	Switch—Operating switch—toggle type—(S201)	.72
11542	Cover—Turntable cover	.88
11599	Turntable—complete	2.90
	MOTOR ASSEMBLIES	
8055	Gear—Pinion gear for motor spindle	.30
9479	Motor—105–125 volts—25 cycles—(M1)	36.48
9478	Motor—105–125 volts—50 cycles—(M1)	25.88
9477	Motor—105–125 volts—60 cycles—(M1)	25.88
4562	Suspension Spring—Motor mounting spring, washer, and stud assembly—comprising six springs, six cup washers, three spring washers and three studs	.58
11995	Washer—Turntable spindle shim washer assembly—comprising one thin and one thick washer—Package of 3	.15
	AUTOMATIC SWITCH ASSEMBLIES	
3994	Cover—Motor switch cover	.26
10184	Plate—Automatic brake latch plate—Package of 5	.40
10174	Springs—Automatic brake springs—Package of 2	.50
6805	Switch Assembly—Automatic switch complete	1.90
3322	Switch—Motor switch—(S202)	.75
	OPERATING MECHANISM	
6502	Cam—Cam and gear assembly	1.18
6808	Clutch—Trip lever friction clutch	.30
11558	Cover—Metal cover for trip lever and friction finger assembly	.36
6809	Finger—Manual index lever finger assembly	.25
3670	Finger—Friction finger assembly	.32
11554	Lever—Manual index lever—less pin	.62
11556	Lever—Main lever and link assembly	2.10
11557	Lever—Main spring lever	.42
3677	Lever—Pickup arm cable lever assembly—comprising lever with cable screw, spring and nut	.40
11555	Lever—Trip lever and friction clutch assembly	.94
6503	Pawl—Trip pawl assembly	.40
4124	Plate—Eject arm actuating plate assembly	.50
4563	Screw—Cable lever screw and nut—Package of 10	.60

OPERATING MECHANISM—Continued

Stock No.	Description	List Price
4564	Screw—Manual index lever finger set screw—Package of 10	.20
4059	Screw—Trip lever clutch tension adjustment screw—Package of 10	.22
4566	Screw—Special screw used to fasten main lever and link assembly bushing—Package of 10	.30
11559	Spacer—Pickup arm mounting spacer	.28
4127	Spring—Actuating spring—Package of 10	.24
3666	Spring—Cable lever tension spring—Package of 10	.44
4565	Spring—Manual index lever finger tension spring—Package of 10	.30
4061	Spring—Main spring lever, tension spring—Package of 10	.38
2893	Spring—Trip lever latch plate tension spring—Package of 10	.30
2917	Washer—Spring washer "U" type—Package of 10	.25

MICROPHONE ASSEMBLIES

Stock No.	Description	List Price
7534	Cable—Microphone cable	.70
11561	Cover—Microphone cover—Package of 2	.32
11560	Frame—Microphone frame	1.00
7533	Mechanism—Microphone mechanism	6.80
11480	Microphone—Complete—(M2)	7.50
11562	Plug—Microphone plug	.25
4158	Socket—Microphone socket	.40

RECORDING SWITCH ASSEMBLIES

Stock No.	Description	List Price
11571	Cable—Single conductor shielded cable with one female section of connector—Stock No. 11488—To S204, shield grounded to terminal lug—To cable from pickup arm assembly—Stock No. 11482	.64
11566	Cable—Three-conductor cable with male section of four-prong plug—Stock No. 11570—To S213, S205 and terminal lug—and cable—Stock No. 11503	.72
11572	Cable—Four-conductor cable with male section of four-prong plug—Stock No. 6123—To (1) S204, (1) S210, (2) S212 and cable—Stock No. 11503	.88
11569	Cable—Four-conductor shielded cable with one female section of four-contact plug—Stock No. 4153—and one female section of three-contact plug—Stock No. 5119—To (1) S204, (1) S205, (1) S206, (2) three-contact receptacle, shield grounded to terminal lug—and cable—Stock Nos. 11526 and 11527	2.45
11630	Cable—Four-conductor shielded cable with one five-prong male section of plug—Stock No. 11520—To (1) S206, (1) S208, (2) S209—shield grounded to terminal and cable—Stock No. 11504	1.18
11568	Cable—Six-conductor shielded cable—with male section of seven-prong connector plug—Stock No. 4602—To (2) S205, (1) S206, (1) S208, (2) S209 and shield grounded to terminal—Receptacle—Stock No. 4787 on receiver chassis	1.40
11567	Cable—Ten-conductor cable with two-contact female section of plug—Stock No. 11488—and one female section of six-contact plug—Stock No. 4151—To (1) S212, (2) S213, (4) S211 and (1) to terminal lug and cable—Stock No. 11522	.26
11347	Knob—Control switch knob—Package of 5	.75
4577	Plug—Two-prong male section of connector plug—Part of connector cord from S203	.30
6123	Plug—Four-contact male section of connector plug—used with cables—Stock Nos. 11572, 11516, 11513, 11526, 11525	.30
11570	Plug—Male section of four-prong connector plug for cable—Stock No. 11566	.32
11520	Plug—Five-prong male section of connector plug for cable—Stock Nos. 11519, 11521, 11630	.34
4602	Plug—Seven-prong male section of connector plug—used with cable—Stock No. 11568	.56
11488	Receptacle—Two-contact female section of connector plug—used with cables—Stock Nos. 11567, 11571, 11487, 11502, 11513	.14
5119	Receptacle—Female section—three-contact plug receptacle for cable—Stock No. 11569	.25
4153	Receptacle—Female section—four-contact plug receptacle for cable—Stock No. 11569	.48
4151	Receptacle—Six-contact female section of connector plug used with cables—Stock Nos. 11519, 11567	.60
11564	Resistor—47 Ohms—Carbon type—1/10 watt—Package of 5—(R219)	.75
11565	Resistor—15 Ohms—Carbon type—1/4 watt—(R221)—Package of 5	1.00
11563	Switch—Phonograph, Radio, Home Recording and Phonograph recording switch—complete—(S203, S204, S205, S206, S207, S208, S209, S210, S211, S212, S213)	4.80

INDICATOR ASSEMBLIES

Stock No.	Description	List Price
11522	Cable—Six-conductor indicator assembly cable with male section of six-prong connector plug—Stock No. 4574	1.18
4340	Lamp—Indicator lamp—Package of 5	.60
4574	Plug—Six-prong male section of connector plug—for use with cables—Stock Nos. 11515, 11522	.48
11719	Screen—Indicator lamp screen—Package of 5	.34
11573	Socket—Indicator lamp socket	.28

RECORDING INDICATOR ASSEMBLIES

Stock No.	Description	List Price
11574	Escutcheon—Recording indicator escutcheon	.32
4161	Lamp—Neon lamp	.56
4164	Screen—Indicator lamp screen	.18
11575	Screw—Screen escutcheon and terminal board mounting screw assembly—comprising two screws, two spacers, two nuts and two lockwashers	.12

REPRODUCER ASSEMBLIES

Stock No.	Description	List Price
11577	Coil—Field coil magnet and cone support—(L102, L103)	12.00
8056	Cone—Reproducer cone—(L104, L105)	1.58 6.85
5039	Plug—Male section of four-prong plug	.25
9629	Reproducer—Complete	14.55

MISCELLANEOUS ASSEMBLIES

Stock No.	Description	List Price
11881	Base—Phonograph compartment lamp base	.55
4391	Box—Needle box	.70
11606	Cap—Pilot lamp cap—Package of 5	.22
11997	Capacitor—75 MMfd.—(C216)	.14
11884	Control—Expander control—(R204)	1.16
11580	Cover—Pilot lamp cover	.12
11379	Escutcheon—Station selector escutcheon and crystal	1.08
11347	Knob—Phonograph or Radio high or low frequency tone control, Radio volume control, Range switch, Selector switch knob—Package of 5	.75
11582	Knob—Expander control or Phonograph volume control knob—Package of 5	.50
11346	Knob—Station selector knob—Package of 5	.75
11605	Pad—Home recording pad	.45
11578	Reactor—Filter reactor—(L34)	3.70
11607	Receptacle—Receptacle for new needles	.38
11711	Shade—Phonograph compartment lamp shade	.16
11579	Tone Control—Phonograph low frequency tone control	.98
11581	Tone Control—Phonograph high frequency tone control	.98
11883	Transformer—Microphone and pickup input transformer pack—(R215, R216, R217, C204, C211, C212, C213, C214, C215, L301, L302, T201)	10.45
11877	Volume Control—Phonograph volume control—(R28)	1.42

RCA VICTOR MODELS T 4-8 and T 4-9

Four-Tube, Single Band, A-C, Superheterodyne Receivers

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Type of Circuit	Superheterodyne
Radiotron Complement	(1) RCA-6A7, First Detector and Oscillator (2) RCA-6F7, I-F Amplifier and Second Detector (3) RCA-41, Power Output Amplifier (4) RCA-1v, Half-wave Rectifier
Tuning Range	540-1720 kc.
Intermediate Frequency	460 kc.
Alignment Frequencies	460 kc. (i.f.), 600 kc. (det., osc.), 1720 kc. (det., osc.)
Voltage and Frequency Ratings	105-125 volts, 50-60 cycles 105-125 volts, 25-60 cycles 200-250 volts, 50-60 cycles
Power Consumption	40 watts at 115 volts
Undistorted Audio Output	1.75 watts
Maximum Audio Output	2.50 watts
Loudspeaker	6 inch, Electrodynamic

PHYSICAL SPECIFICATIONS

	Model T 4-8	Model T 4-9
Height	$14\frac{1}{8}$ inches	$7\frac{7}{8}$ inches
Width	$11\frac{1}{4}$ inches	$10\frac{1}{8}$ inches
Depth	$6\frac{1}{4}$ inches	$4\frac{3}{8}$ inches
Weight (Net)	12 pounds	$13\frac{1}{2}$ pounds
Weight (Shipping)	15 pounds	$16\frac{1}{2}$ pounds
Number of Operating Controls	Two	

GENERAL DESCRIPTIVE DATA

These two receivers have identical chassis assemblies. The T 4-8 is mounted in a cathedral type, table cabinet, while the T 4-9 is housed in a wooden chest type of cabinet. The chassis is constructed and wired in such a manner as to facilitate servicing when necessary. An open face dial is used with a direct coupled station selector. The dial is calibrated in kilocycles. On-off control of power is combined with the volume control by means of a switch. The frequency range extends from 540 to 1720 kc. which includes one of the regular police bands. An adjustable wave trap is incorporated for suppression of code interference.

DESCRIPTION OF CIRCUIT

The first two stages of the electrical circuit are arranged to have two functions each. One operates as first detector and local oscillator, using an RCA-6A7 pentagrid-converter tube, and the second, an RCA-6F7 triode-pentode is employed for i-f amplification and final detection. Power amplification at the output stage is handled by an RCA-41 power-amplifier pentode. Rectification of high voltage a.c. is accomplished through an RCA-1v half-wave tube. Direct current from the rectifier stage is supplied to the various stages of the receiver through a filter system which includes the speaker field as a reactor.

Radio-frequency and intermediate-frequency stages are intercoupled by means of transformers. The antenna transformer couples directly into the first detector having its secondary tuned by one section (front) of the two-gang tuning condenser. The oscillator system is tuned by the second (rear) section of the condenser. Trimmer condensers are connected to the first i-f transformer for resonating it to 460 K.C. The second i-f transformer has a natural tuning inherent to the design of its windings. Trimmer condensers for alignment purposes are also employed on the antenna and oscillator coils.

Volume control of the received signal is accomplished in the cathode circuits of the first two tubes of the receiver by variation of a biasing resistance which is common to both stages.

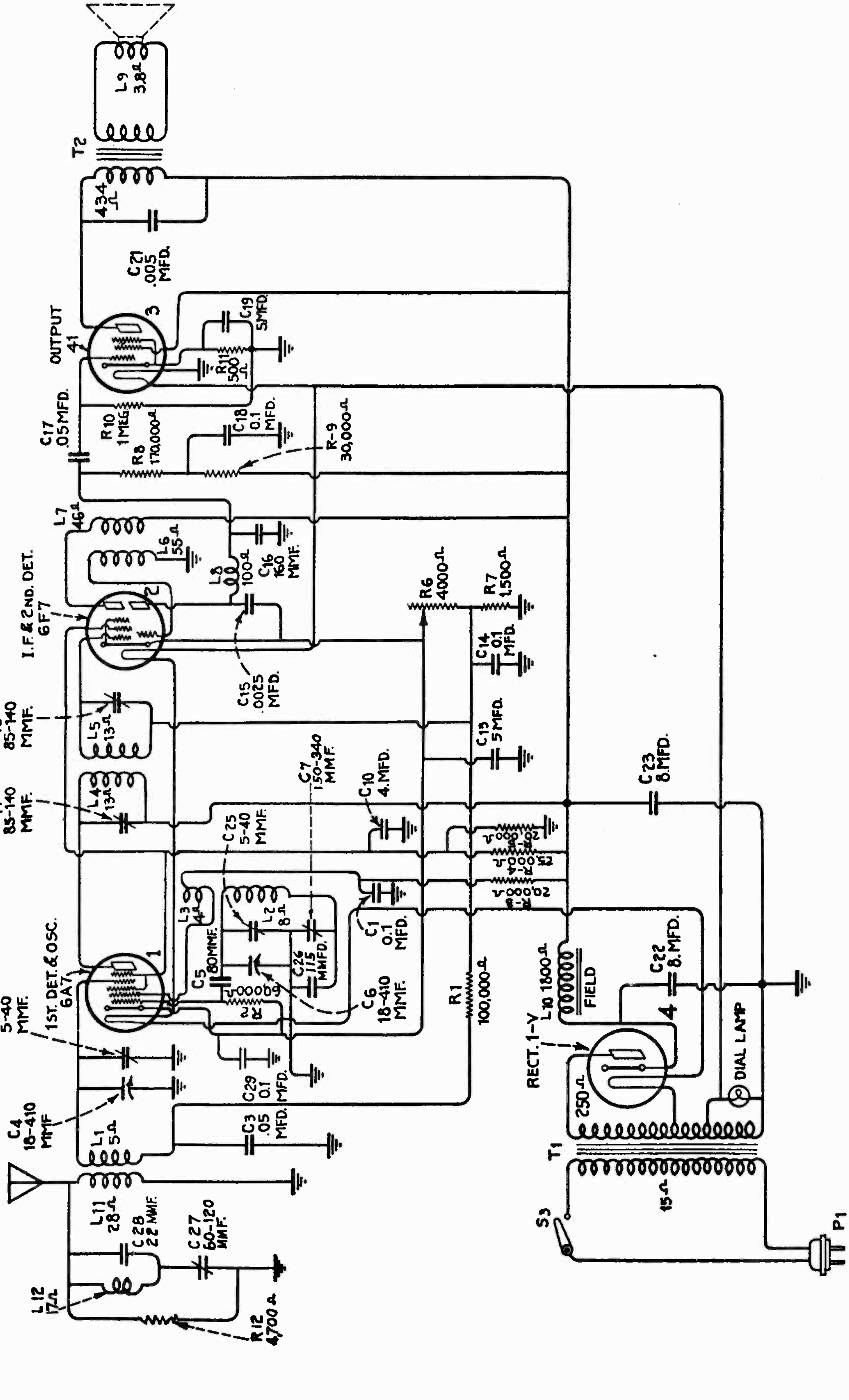


Figure 1—Schematic Circuit Diagram

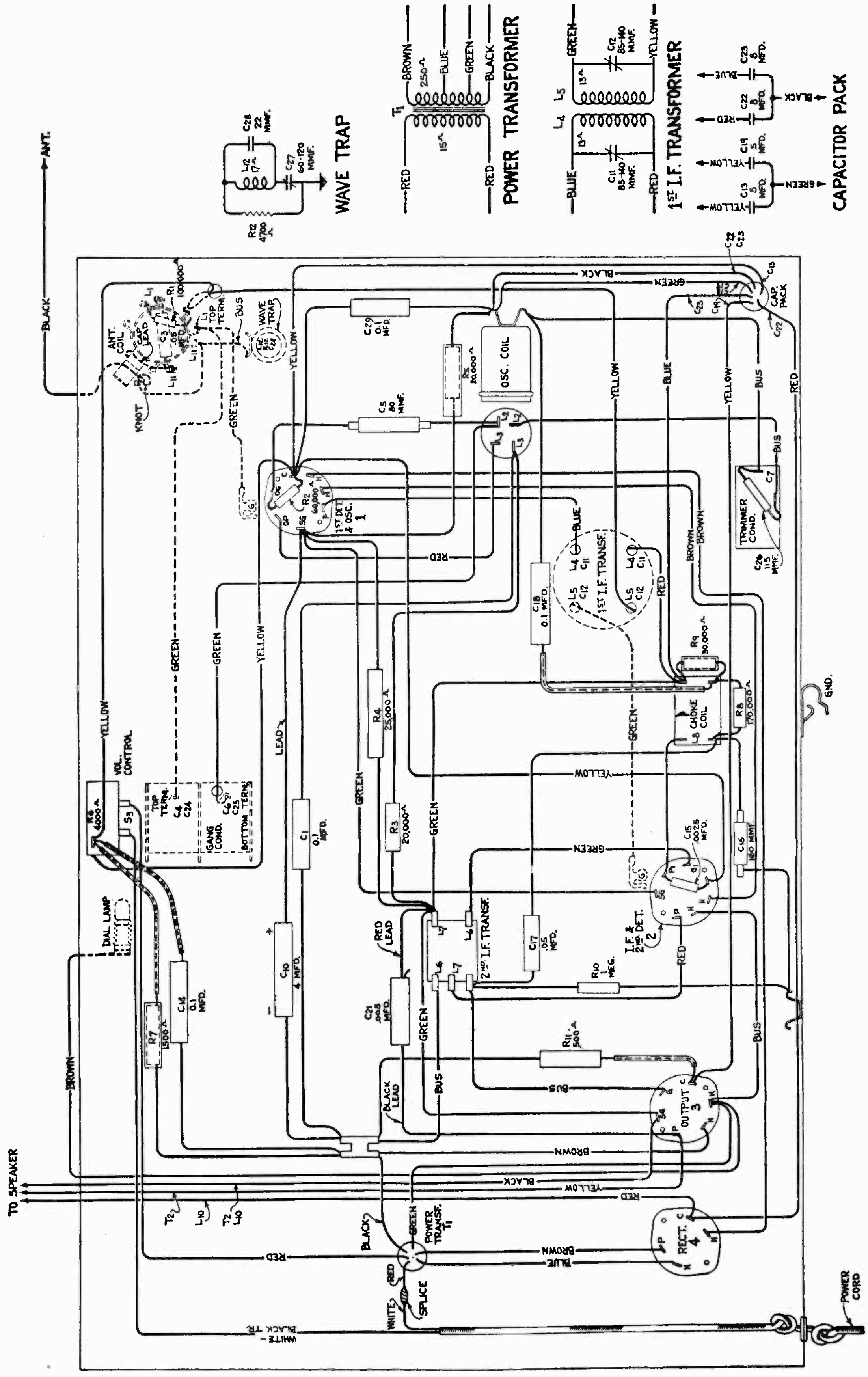


Figure 2—Chassis Wiring Diagram

SERVICE DATA

Alignment Procedure

Five aligning trimmers are provided, the physical locations of which are indicated on Figure 3. These trimmers are accurately adjusted during manufacturing tests and should remain in proper alignment indefinitely unless affected by abnormal conditions of temperature or humidity, or unless they have been altered for service purposes. Loss of sensitivity, improper tone quality and poor selectivity usually indicate necessity for re-alignment.

The correct performance of the receiver can only be obtained when the aligning has been done with adequate and reliable apparatus. Such test apparatus as may be required for this operation should be in the hands of a skilled service engineer. The manufacturer of this receiver has available for sale through its distributors and dealers, a complete assortment of service test equipment. The instruments needed for alignment operations are illustrated and described on a separate page of this booklet.

An oscillator or signal generator is required as a source of the standard alignment frequencies recommended under Electrical Specifications. Visual indication of receiver output during the adjustments is very advantageous and may be accomplished by use of a Cathode Ray Oscillograph such as the RCA Victor Stock No. 9545. The method of alignment is explained in the instruction booklet for this instrument. Where an oscillograph is not available, an RCA Victor Neon Type Output Indicator may be used with good results. It should be connected to the voice coil circuit of the loudspeaker so as to be actuated by the audio signal voltage.

The following method of procedure should be followed in adjusting the various trimmer capacitors:—

(1) **Intermediate Frequency Amplifier**—The first i-f transformer has two trimmers identified as C-11 and C-12 on the diagram, Figure 3. Each must be tuned to *460 kc.* by feeding a signal of this frequency from the Full Range Oscillator into the RCA-6A7 control grid and chassis-ground and adjusting both trimmers to the point giving maximum output. The oscillator output and the receiver volume control should be regulated so as to produce a sensitive indication on the receiver output indicator. If interference is noticed from strong local stations during these adjustments, the station selector should be tuned to a point at which they will be subdued.

(2) **Detector and Oscillator**—A total of three adjustments are necessary on the detector and oscillator coil systems. Two of these are to be made at *1720 kc.* and the other at *600 kc.* The *1720 kc.* trimmers are mounted on the variable tuning condenser and are accessible from the top of the chassis. The *600 kc.* trimmer, which is associated with the oscillator system, is located on the rear apron of the chassis as shown by Figure 3. To align these

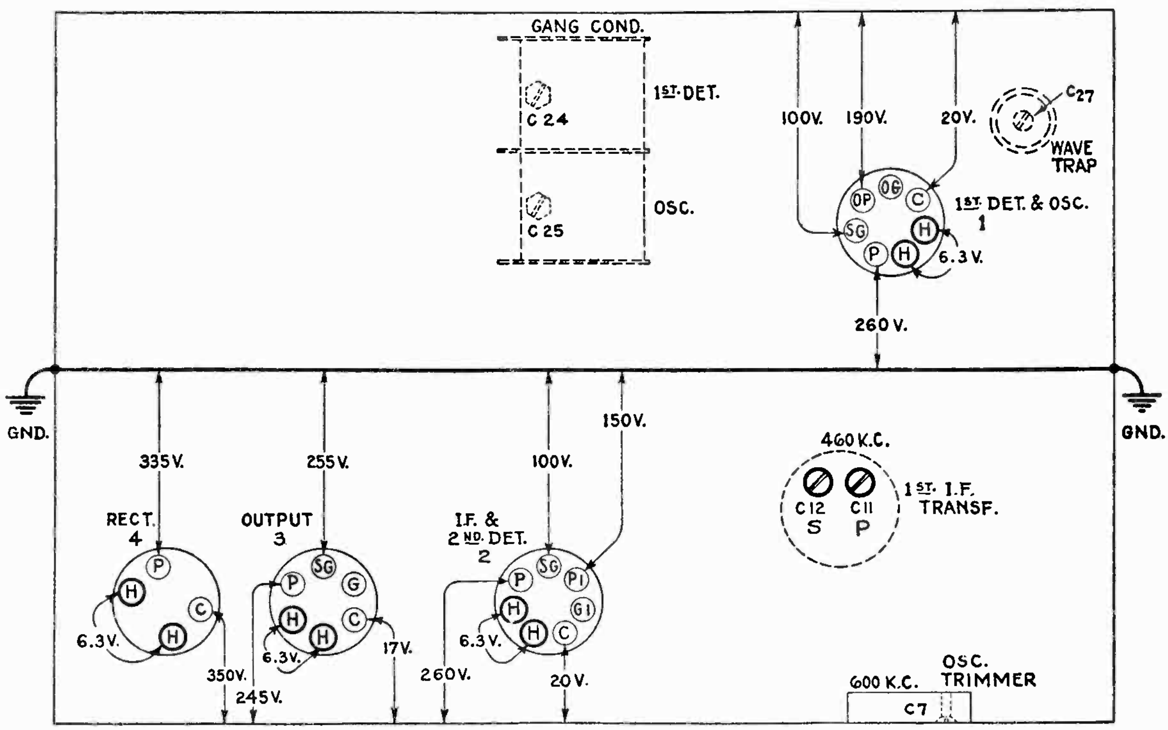


Figure 3—Trimmer Locations and Radiotron Socket Voltages to Chassis
Measured at 120 volts A-C Supply—No Signal — Volume Control Maximum

various trimmers, after correcting the i-f alignment, proceed in the following manner. Supply a *1720 kc.* signal from the standard oscillator to the receiver imput (ant-gnd) terminals and accurately set the station selector to the *1720 kc.* dial marking. (If for any reason, the dial pointer has slipped or been misplaced on the tuning shaft, it should be checked for proper calibration at full mesh of the variable condenser. With the station selector set to *1720 kc.* adjust the trimmers C-25 and C-24 so that each produces maximum (peak) receiver output. Then shift the test oscillator frequency to *600 kc.* and tune this standard signal on the receiver, disregarding the dial reading at which it is received. Adjust the *600 kc.* oscillator trimmer C-7, simultaneously rocking the variable gang condenser backward and forward through the signal so

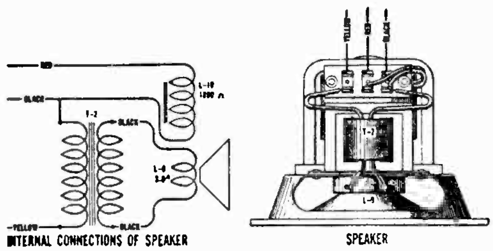


Figure 4—Loudspeaker Wiring

that maximum receiver output results from the combined operations. The point at which maximum output is obtained will not always be exactly at *600 kc.* on the dial. The error should be disregarded. It is advisable to repeat the adjustments of C-24 and C-25 as explained above to correct for any reflective changes brought about by the adjustment of C-7.

Radiotron Socket Voltages

The voltage values indicated from socket contacts to chassis-ground on Figure 3 will serve to assist in locating causes for faulty operation when such a condition develops. Each value as specified may be expected to hold within ± 20% when the supply voltage is normal. Variations in excess of this limit will usually be indicative of trouble in the receiver circuits. Voltages given are actual operating values and do not allow for inaccuracies which may be caused by loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance is comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each check is chosen as high as possible consistent with good readability.

Circuit Constants

Ratings of resistors and capacitors are indicated adjacent to their respective parts on the schematic and wiring diagrams and in the Replacement Parts List. Note that each is numbered for identification purposes when referring between the diagrams and parts section. The numbering begins at the left of the schematic and increases to the right as the signal would progress through the circuit. Transformer windings, reactors and miscellaneous coils are rated in terms of d-c resistance only. Where the resistance is less than one ohm, no rating is given.

Code Interference

In some localities near to high-powered, radio-telegraph communication stations, slight interference may be encountered. This trouble may be remedied by adjustment of the 460 kc. wave trap provided in the antenna circuit. Adjust the wave trap trimmer C-27 to produce a minimum of interference.

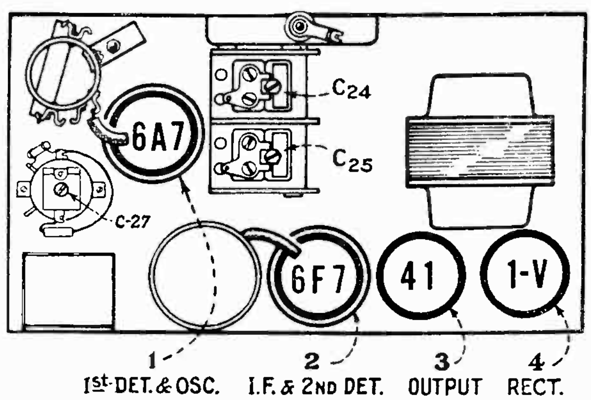


Figure 5—Radiotron Locations

REPLACEMENT PARTS

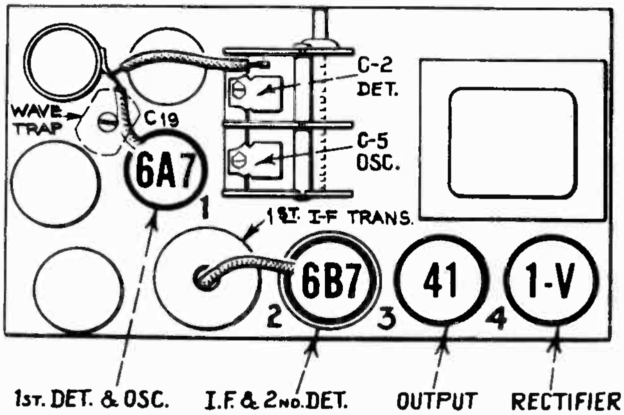
Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

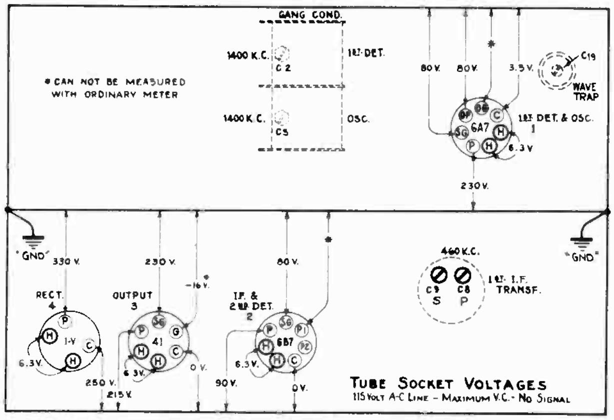
Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4244	Cap—Grid contact cap—Package of 5	$0.20
4000	Capacitor—Adjustable capacitor (C7)	.78
3459	Capacitor—80 mmfd. (C5)	.44
11302	Capacitor—115 mmfd. (C26)	.15
3865	Capacitor—160 mmfd. (C16)	.30
5107	Capacitor—0.0025 mfd. (C15)	.16
6787	Capacitor—0.005 mfd. (C21)	.30
4836	Capacitor—0.05 mfd. (C3)	.30
4886	Capacitor—0.05 mfd. (C17)	.20
4835	Capacitor—0.1 mfd. (C1)	.28
4885	Capacitor—0.1 mfd. (C14, C18)	.28
4841	Capacitor—0.1 mfd. (C29)	.22
6832	Capacitor—4.0 mfd. (C10)	.85
6661	Capacitor pack—Comprising two 5.0 mfd. and two 8.0 mfd. capacitors (C13, C19, C22, C23)	2.70
5051	Coil—Antenna coil (L1, L11, C3, R1)	1.28
3857	Coil—Choke coil (L8)	.90
5050	Coil—Oscillator coil (L2, L3)	.56
6660	Condenser—Two-gang variable tuning condenser (C4, C6, C24, C25)	2.78
6667	Volume control (R6, S3)	1.58
11301	Dial—Station selector dial	.40
4340	Lamp—Dial lamp—Package of 5	.60
3632	Resistor—500 ohms—Carbon type—1 watt (R11)—Package of 5	1.10
3047	Resistor—1500 ohms—Carbon type—½ watt (R7)—Package of 5	1.00
6114	Resistor—20,000 ohms—Carbon type—1 watt (R3, R5)—Package of 5	1.10
3889	Resistor—25,000 ohms—Carbon type—3 watt (R4)	.25
3077	Resistor—30,000 ohms—Carbon type—½ watt (R9)—Package of 5	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R2)—Package of 5	$1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R1)—Package of 5	1.00
3869	Resistor—170,000 ohms—Carbon type—½ watt (R8)—Package of 5	1.00
3076	Resistor—1 megohm—Carbon type—½ watt (R10)—Package of 5	1.00
3584	Ring—Oscillator coil shield ring—Package of 5	.40
6665	Shield—Oscillator coil shield and bracket assembly	.34
3942	Shield—I. F. and second detector Radiotron shield	.18
8098	Socket—Dial lamp socket	.10
11187	Transformer—First intermediate frequency transformer (L4, L5, C11, C12)	1.72
6663	Transformer—Second intermediate frequency transformer (L6, L7)	1.06
9465	Transformer—Power transformer—105-125 volts—25-50 cycles	4.38
9464	Transformer—Power transformer—105-125 volts—50-60 cycles (T1)	3.20
9466	Transformer—Power transformer—200-250 volts—50-60 cycles	3.28
11224	Trap—Wave trap (R12, L12, C27, C28)	.90
	REPRODUCER ASSEMBLIES	
9548	Coil assembly—Comprising field coil, magnet and cone support (L10)	$3.08
9588	Cone—Reproducer cone—(L9)—Package of 5	3.55
9547	Reproducer—Complete	5.45
4447	Shield—Terminal board shield for reproducer	.18
4803	Transformer—Output transformer (T2)	1.45

RCA VICTOR MODELS T 4-8A and T 4-9A

SERVICE NOTES

These instruments are similar to Models T 4-8 and T 4-9 except for several circuit modifications. The major differences include:—rearrangement of wave-trap circuit, removal of oscillator low frequency trimmer, replacement of the RCA-6F7 with an RCA-6B7, and reflexing of the i-f stage for additional audio amplification. The intermediate frequency remains at **460 kc.** The antenna and oscillator coils are to be aligned only at **1400 kc.** Refer to T 4-8 and T 4-9 Service Notes for loudspeaker data, power ratings and specifications.

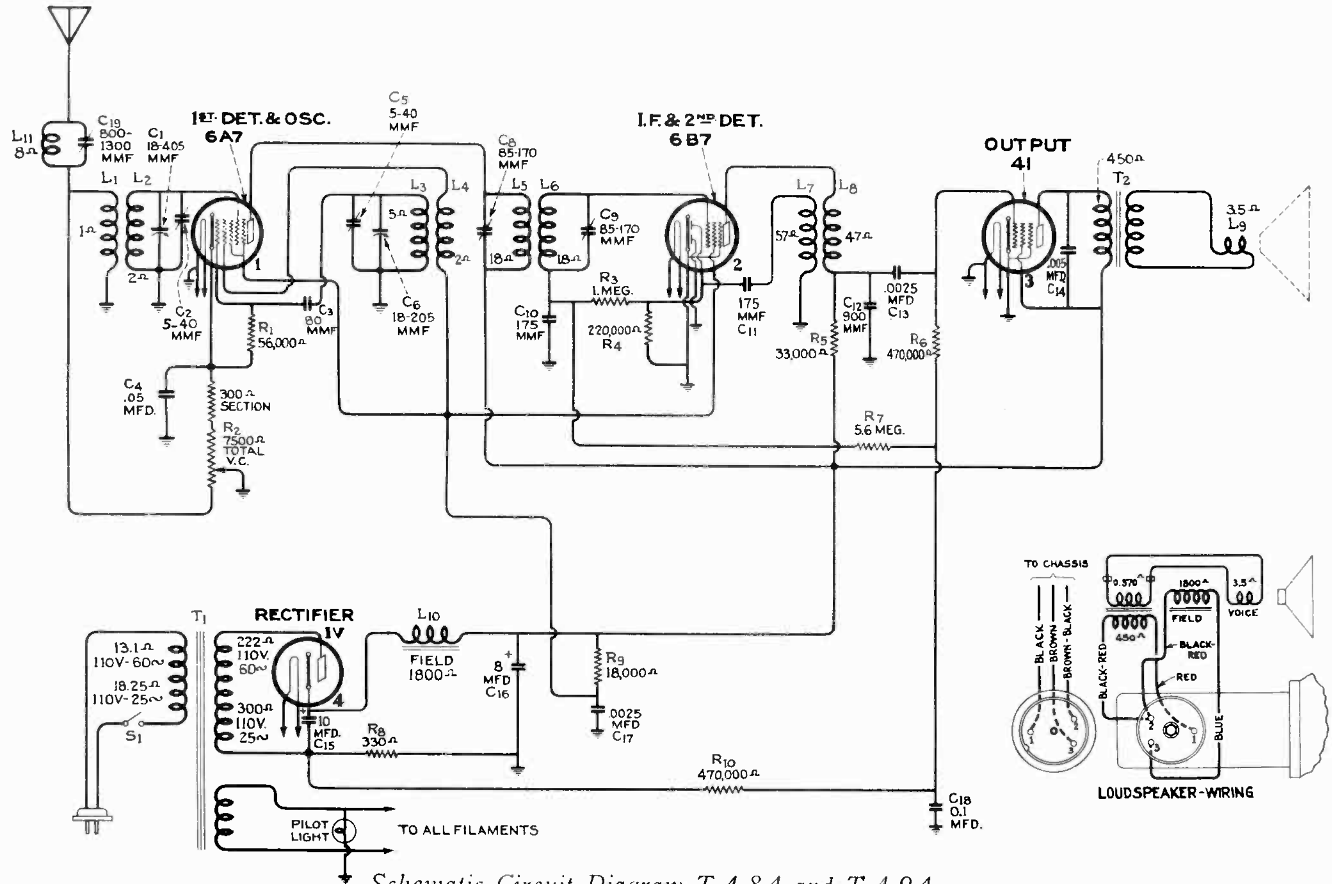




REPLACEMENT PARTS

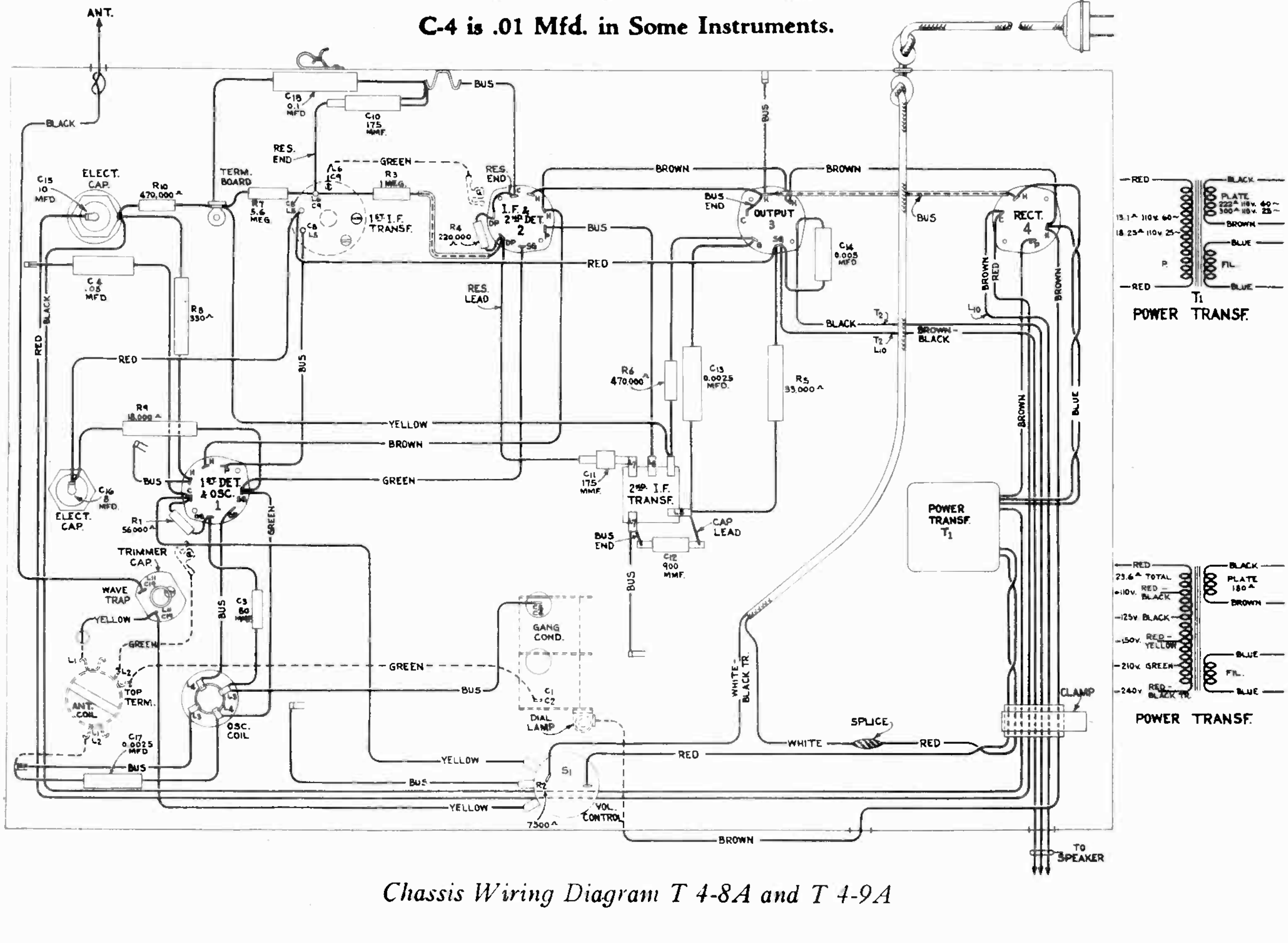
Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	Receiver Assemblies	
4244	Cap—Grid contact cap—Package of 5	$ 0.20
6956	Cap—Second detector Radiotron shield cap	.15
4246	Capacitor—80 mmfd. (C3)	.24
5116	Capacitor—175 mmfd. (C10)	.18
11500	Capacitor—175 mmfd. (C11)	.18
3784	Capacitor—900 mmfd. (C12)	.30
5107	Capacitor—.0025 mfd. (C13, C17)	.16
4868	Capacitor—.005 mfd. (C14)	.20
4836	Capacitor—.05 mfd. (C4)	.30
4841	Capacitor—0.1 mfd. (C18)	.22
11497	Capacitor—8 mfd. (C16)	1.04
11240	Capacitor—10 mfd. (C15)	1.08
11661	Coil—Antenna coil (L1, L2)	.52
11662	Coil—Oscillator coil (L3, L4)	.56
11660	Condenser—Two gang variable tuning condenser (C1, C2, C5, C6)	2.50
11659	Dial—Station selector dial	.35
11670	Resistor—330 ohms—carbon type—1 watt (R8)—Package of 5	1.10
11671	Resistor—18,000 ohms—carbon type—2 watts (R9)	.22
11669	Resistor—33,000 ohms—carbon type—1 watt (R5)—Package of 5	1.10
5029	Resistor—56,000 ohms—carbon type—¼ watt (R1)—Package of 5	1.00
5158	Resistor—220,000 ohms—carbon type—¼ watt (R4)—Package of 5	1.00
11172	Resistor—470,000 ohms—carbon type—¼ watt (R6, R10)—Package of 5	1.00
3033	Resistor—1 Megohm—carbon type—¼ watt (R3)—Package of 5	1.00
11668	Resistor—5.6 Megohms—carbon type—¼ watt (R7)—Package of 5	1.00
11126	Shield—Oscillator coil shield	.12
3942	Shield—Second detector Radiotron shield	.18
11390	Shield—First intermediate frequency transformer shield	.25
4340	Lamp—Dial lamp—Package of 5	.60
5152	Transformer—First intermediate frequency transformer (L5, L6, C8, C9)	1.68
7955	Transformer—Second intermediate frequency transformer (L7, L8)	.85
11665	Transformer—Power transformer—105-125 volts 25-50 cycles	5.06
11666	Transformer—Power transformer—100-130/140-160/195-250 volts 40-60 cycles	3.80
11664	Transformer—Power transformer—105-125 volts 50-60 cycles—(T1)	3.60
11667	Trap—Wave trap (L11, C19)	1.22
11663	Volume control (R2, S1)	1.20
	Reproducer Assemblies	
11672	Coil—Field coil, magnet and cone support assembly (L10)	3.45
9588	Cone—Reproducer cone (L9)—Package of 5	3.55
5119	Connector—Three-contact female connector for reproducer cable	.25
5118	Connector—Three-contact male connector for reproducer	.25
9630	Reproducer—Complete	5.50
4893	Transformer—Output transformer (T2)	1.48



Schematic Circuit Diagram T 4-8A and T 4-9A

C-4 is .01 Mfd. in Some Instruments.



Chassis Wiring Diagram T 4-8A and T 4-9A

RCA VICTOR MODEL T 4-10

Four-Tube, Single Band, Tuned R.F., A-C, D-C Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Type of Circuit	Two Circuit, Tuned R.F.
Radiotron Complement	(1) RCA-6D6, R-F Amplifier (2) RCA-6C6, Detector (3) RCA-38, Power Amplifier (4) RCA-76, Rectifier
Tuning Range	540 kc. to 1712 kc.
Alignment Frequency	1720 kc.
Voltage Rating	100-125 volts
Frequency Rating (a.c.)	25-133 cycles
Maximum Power Output	0.40 watts
Loudspeaker	Magnetic (5 inch)

PHYSICAL SPECIFICATIONS

Cabinet	Table Type
Height	7⅞ inches
Width	10 inches
Depth	4½ inches
Tuning Controls	(1) Station Selector (2) Volume Control-Power Switch
Weight of Complete Instrument	5½ pounds
Weight Packed for Shipment	7 pounds

GENERAL DESCRIPTIVE DATA

This small, table type receiver embodies a compact, four-tube chassis housed in a box-type, closed-in, wood cabinet. The two operating controls appearing on the front panel, consist of a station selector at the right and a combined power switch-volume control at the left.

The range of tuning includes the standard broadcast band and extends to cover the 1712 kc. Police band at its upper limit. Scale graduations for the station selector are arbitrary, reading "0" at the left and increasing to "100" at right or high frequency end.

The power cord is of special design. It contains three conductors, one of which is a distributed resistance element used for reducing the line voltage to the value required for filament supply. This arrangement is used to provide better heat radiation from the "dropping" resistor.

The loudspeaker is a rugged, magnetic type. It is connected directly to the output tube without use of transformers or other coupling elements.

An antenna of small dimensions will usually be found sufficient for this receiver. A ground connection is not provided since it will not be required. The ground path of the signal will normally be over the power supply circuit.

DESCRIPTION OF ELECTRICAL CIRCUIT

The specifications pertaining to compactness require that the electrical circuit be as simple and elementary as possible, consistent with attainment of good performance. Fundamentally, therefore, the circuit is designed to include a tuned r-f stage, a tuned detector stage, a resistance coupled audio system and a half-wave rectifier stage.

Following the signal from the antenna into the receiver, it may be seen that it is applied to the first stage through a blocking condenser (C-1) and a tuned secondary antenna transformer. The condenser isolates the antenna for d.c. and thus prevents presence of voltage on the antenna connection which would otherwise be caused by the internal circuit arrangement.

Volume control is accomplished with a variable cathode biasing resistor (R-1). Its setting determines the gain of the RCA-6D6 stage and thereby controls the signal output to the desired level. A stop on this control at 300 ohms limits the minimum bias which will be applied to the control grid of this tube.

Filaments of the four tubes are wired in series as shown in the schematic diagram. They are supplied from the power line through the power cord "dropping resistor" indicated as R-8.

An RCA-76 heater type triode functions as a half-wave rectifier in the power supply system. The plate and grid elements of this tube are strapped together to act as the anode. A suitable filter, comprised of a single reactor and two capacitors is provided for smoothing the rectified current.

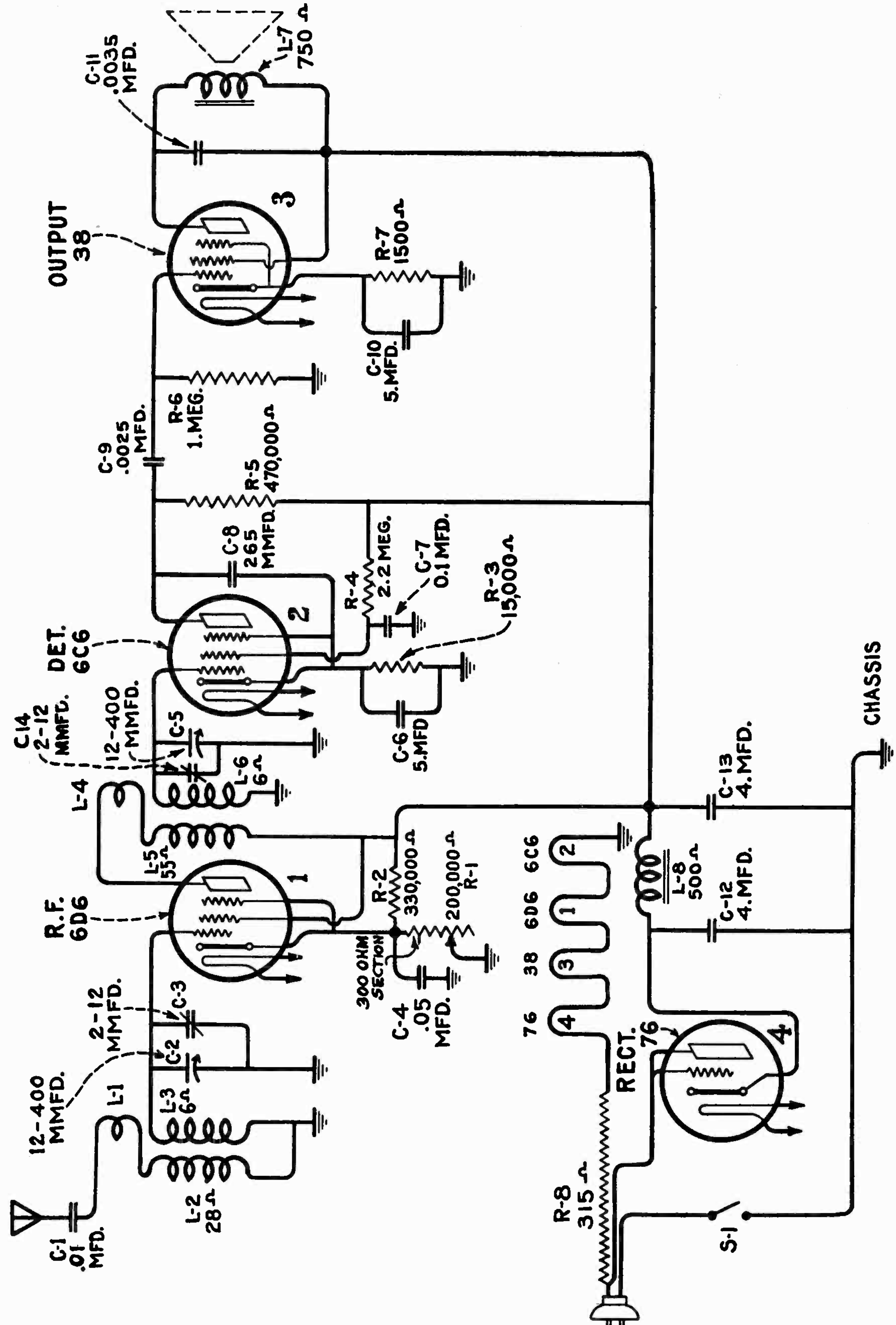


Figure 1—Schematic Circuit Diagram

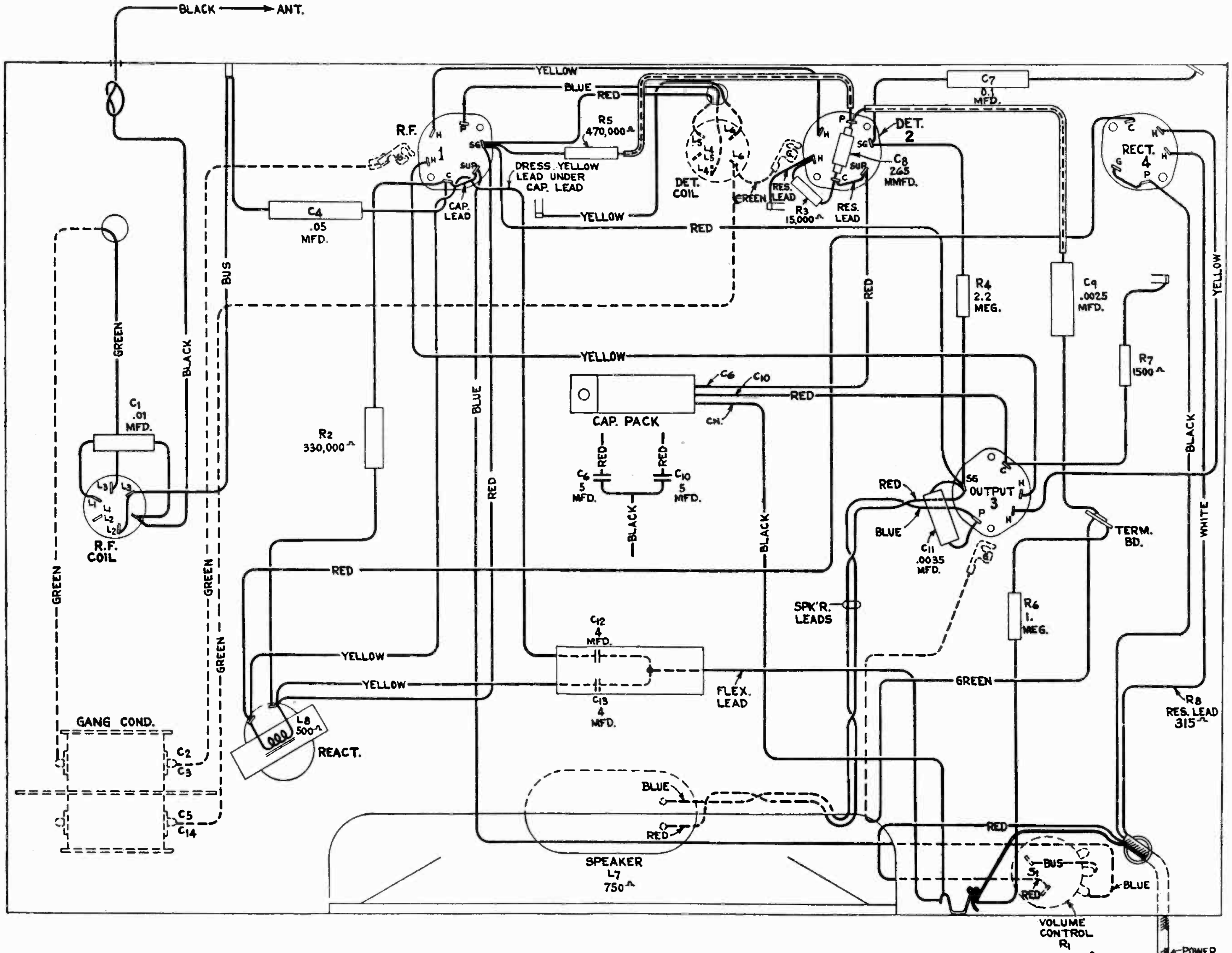


Figure 2—Chassis and Speaker Wiring

SERVICE DATA

Two trimmer capacitors are mounted on the variable tuning condenser for alignment purposes. Their exact locations and identifications are given by Figure 3. It will be necessary to re-adjust these capacitors only when they have become altered from their original alignment by reason of change of parts for service purposes, effects of extreme climate, or possibly because of tampering. Poor all-round performance is the general indication of improper alignment.

To re-align the receiver, proceed as follows:—

(1) Place the receiver in operation with a standard signal generator (RCA Victor Stock No. 9595) connected to its antenna terminal. Correct the "zero" setting of the tuning knob so that it reads "0" when turned to its extreme left or full mesh of the variable condenser.

(2) Set the trimmer screws so that they are approximately equal at their medium capacity. This may be done by turning each the same number of turns from their maximum positions.

(3) Tune the external test oscillator to 1700 kc. and rotate the station selector until it is received. Adjust the output of the oscillator and volume control of the receiver to give the desired output level. It is advisable to use an output indicator attached to the speaker circuit. An RCA Stock No. 4317 Output Indicator is especially suitable.

(4) Adjust the two trimmers C-3 and C-14, at the same time observing the output indicator, until the maximum (peak) receiver output is obtained.

Radiotron Socket Voltages

The voltages indicated from the socket contacts to the chassis on Figure 3 will serve to assist in analyzing defective circuit conditions when existent. Each value specified should hold within ± 20% when the receiver is normally operative at the rated voltage. Variations in excess of this limit will usually be indicative of a faulty part. If all readings are incorrect, trouble should be investigated in the rectifier system. Defects occurring at other points in the circuits will affect a single or group of measurements related to that section.

Readings given are actual operating values and do not take into account measurement inaccurracies due to internal voltmeter resistance. A meter having a resistance of at least 1000 ohms per volt should be used. The amount of circuit resistance which shunts the meter will determine the accuracy obtained, the error increasing as the former becomes comparable to or less than the latter.

Antenna-Ground

The circuit of the receiver is arranged in such manner that the chassis is at negative high voltage. The usual ground connection is therefore omitted and the chassis mounted so that it is insulated. The r-f circuit to ground is by way of the negative d-c lead or neutral a-c lead.

Interference present on the power supply line may occasionally attain a bothersome level in the receiver. When being operated on a.c., some reduction of this

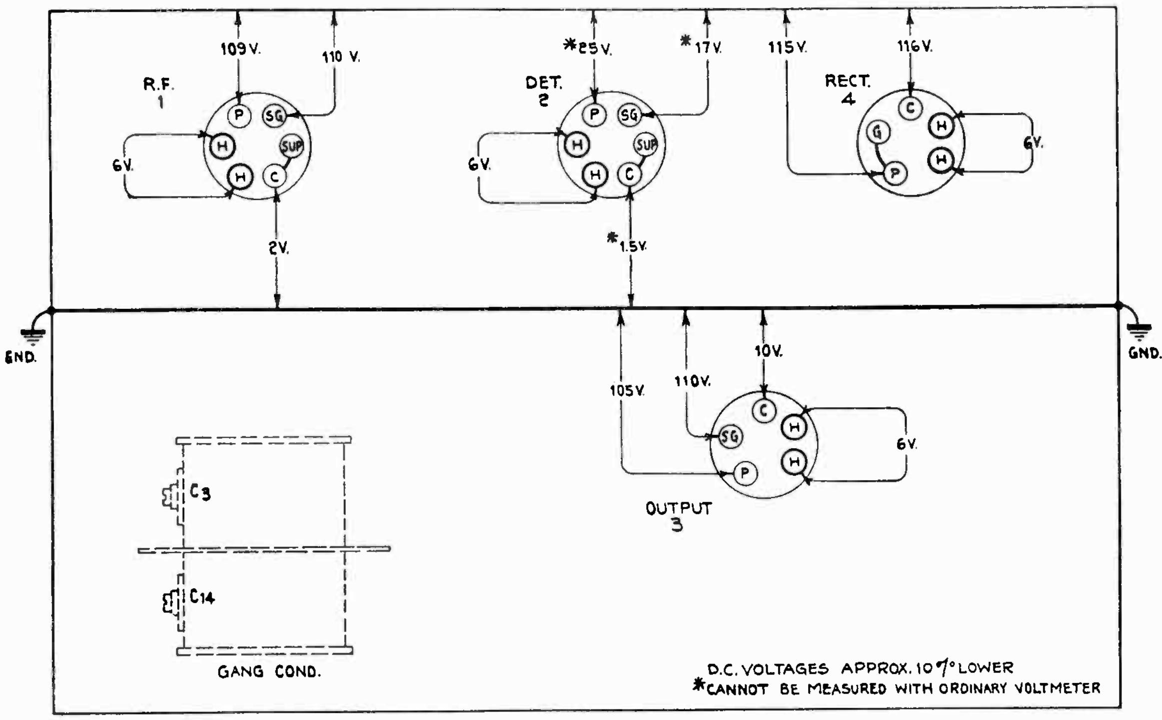


Figure 3—Trimmer Locations and Radiotron Socket Voltages
Measured at 115 volts a.c.—No Signal—Volume Control Maximum

noise may be brought about by reversal of the power plug. For more serious interference, either from an a-c or d-c line, an external ground should be made to the receiver chassis through a small series condenser (.006 mfd, 200 volts). The length of the grounding lead should be kept to an absolute minimum.

Power Cord

The resistance element of the power lead will produce a noticeable amount of heat while the receiver is in operation. This heating should not be regarded as abnormal. No changes should be made in the length of the cord. In case of failure, it should be replaced in its entirety by a standard part.

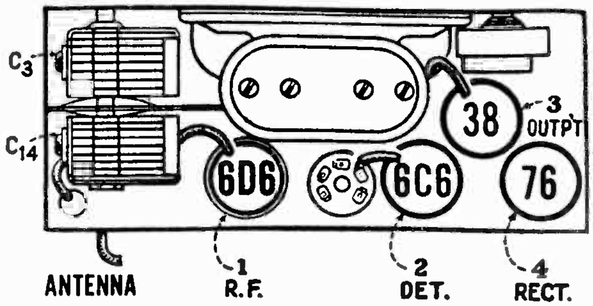


Figure 4—Tube Location Layout

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4244	Cap—Grid contact cap—Package of 5....	$0.20
11135	Capacitor—265 mmfd. (C8)...........	.15
5107	Capacitor—.0025 mfd. (C9)...........	.16
5005	Capacitor—.0035 mfd. (C11)..........	.16
4858	Capacitor—.01 mfd. (C1).............	.25
4836	Capacitor—.05 mfd. (C4).............	.30
4841	Capacitor—.1 mfd. (C7)..............	.22
11268	Capacitor pack—Comprising two 4.0 mfd. capacitors (C12, C13)..............	.80
7956	Capacitor pack—Comprising two 5.0 mfd. capacitors (C6, C10)................	.80
6821	Coil—Detector coil (L4, L5, L6)........	.96
11261	Coil—RF coil (L1, L2, L3)............	1.00
11260	Condenser—Two-gang variable tuning condenser (C2, C3, C5, C14)...........	1.75
11263	Volume control (R1, S1)...............	.88
11267	Cord—Power cord—315 ohms (R8).....	1.00
3537	Reactor—Filter reactor (L8)...........	1.10
4408	Resistor—1500 ohm—Carbon type—¼ watt (R7)—Package of 10................	2.00
3998	Resistor—15,000 ohm—Carbon type—¼ watt (R3)—Package of 5.............	$1.00
5108	Resistor—330,000 ohm—Carbon type—¼ watt (R2)—Package of 5.............	1.00
11172	Resistor—470,000 ohm—Carbon type—¼ watt (R5)—Package of 5.............	1.00
3033	Resistor—1 megohm—Carbon type—¼ watt (R6)—Package of 5.............	1.00
11151	Resistor—2.2 megohm—Carbon type—¼ watt (R4)—Package of 5............	1.00
5129	Ring—Radiotron shield ring—Package of 5	.10
11265	Shield—Radiotron shield...............	.15
	REPRODUCER ASSEMBLIES	
9471	Cone—Reproducer cone—Package of 5...	3.50
7713	Mechanism—Reproducer mechanism—Complete	3.72
9470	Reproducer—Complete (L7)............	4.62
7712	Support—Cone support................	.50

RCA VICTOR MODEL T 5-2

Five-Tube, Two-Band, A-C, Superheterodyne Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage and Frequency Ratings	105-125 Volts, 50-60 Cycles 105-125 Volts, 25-60 Cycles 100-130/140-160/195-250 Volts, 50-60 Cycles
Power Consumption	80 Watts
Radiotrons and Functions	(1) RCA-6A7, First Detector and Oscillator (2) RCA-6D6, I.F. Amplifier (3) RCA-6B7, Second Detector—Audio Amplifier—A.V.C. (4) RCA-41, Power Output (5) RCA-80, Rectifier
Tuning Frequency Ranges	540 kc. to 1720 kc. and 1600 kc. to 3500 kc.
Alignment Frequencies	460 kc. (I.F.), 1720 kc. (R.F. and Oscillator) 600 kc. (Oscillator)
Undistorted Output	1.75 Watts
Maximum Output	3.50 Watts
Loudspeaker	6-Inch, Electro-Dynamic

PHYSICAL SPECIFICATIONS

Height	15 Inches
Width	13⅝ Inches
Depth	8⅜ Inches

This model contains a five-tube chassis, mounted in a table-type cabinet. The superheterodyne type of circuit is used, with such features of design as: Automatic volume control, diode detection, two-point tone control, illuminated full-vision dial scale, resistance-coupled audio system, electrodynamic loudspeaker, six to one tuning ratio, antenna wave trap and other important points of improvement.

Service convenience has been an especial requirement in the layout and construction of this receiver. A plug-connector attachment is used in the chassis to speaker cable which will allow ready removal of either unit without disturbing the other. Trimmer adjustments are located at accessible points. Their number is reduced to the least that is consistent with efficient operation.

ELECTRICAL CIRCUIT

Five Radiotrons are associated in combination with a superheterodyne circuit. Two of the Radiotrons are applied so as to obtain plural functions. In the first stage of the circuit, an RCA-6A7 pentagrid converter tube is employed as an r-f amplifier and local oscillator, the related external high-frequency circuits consisting of a tuned antenna transformer with a short-wave tap. The oscillator second harmonic is used for the short-wave position. Within the first detector tube, mixing of signal and oscillator voltages is accomplished through electron coupling, the i-f appearing in the plate circuit.

The combined second detector—audio amplifier—a.v.c. stage, utilizes an RCA-6B7, a duplex-diode pentode Radiotron. One diode connects directly to ground, the other is used for detection. Part of the detected signal is filtered to remove the audible fluctuations and is applied to the first and second stages as a means of providing automatic volume control. The audio component of the detected signal is amplified by the RCA-6B7 and conveyed to a resistance-capacitance coupling network.

A power-amplifier pentode, RCA-41, is used in the output stage and is coupled by a transformer to the low impedance voice-coil of the speaker.

Full-wave rectification is employed in the power-supply stage. The speaker field winding serves in the filter circuit as a reactor.

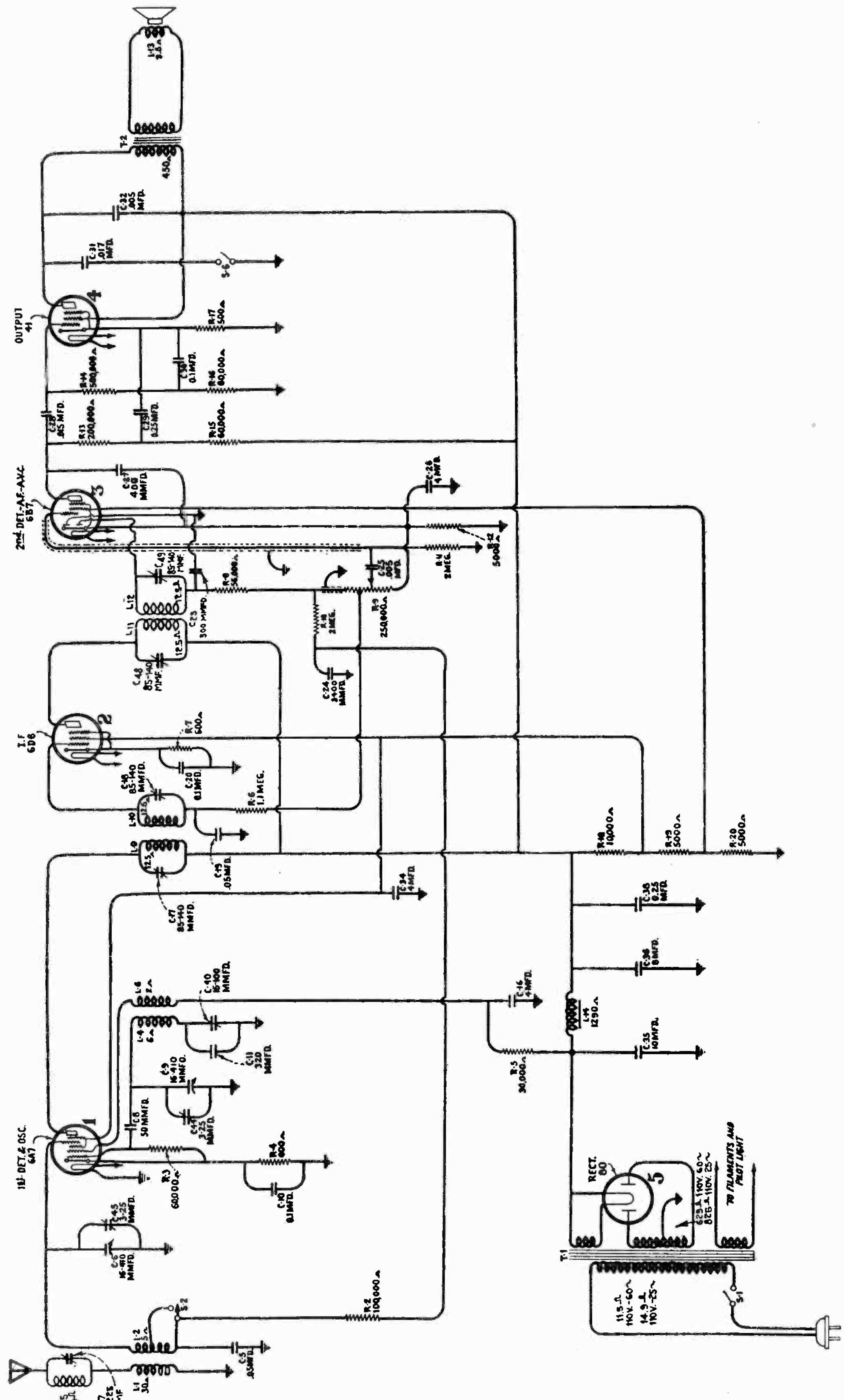


Figure 1—Schematic Circuit Diagram

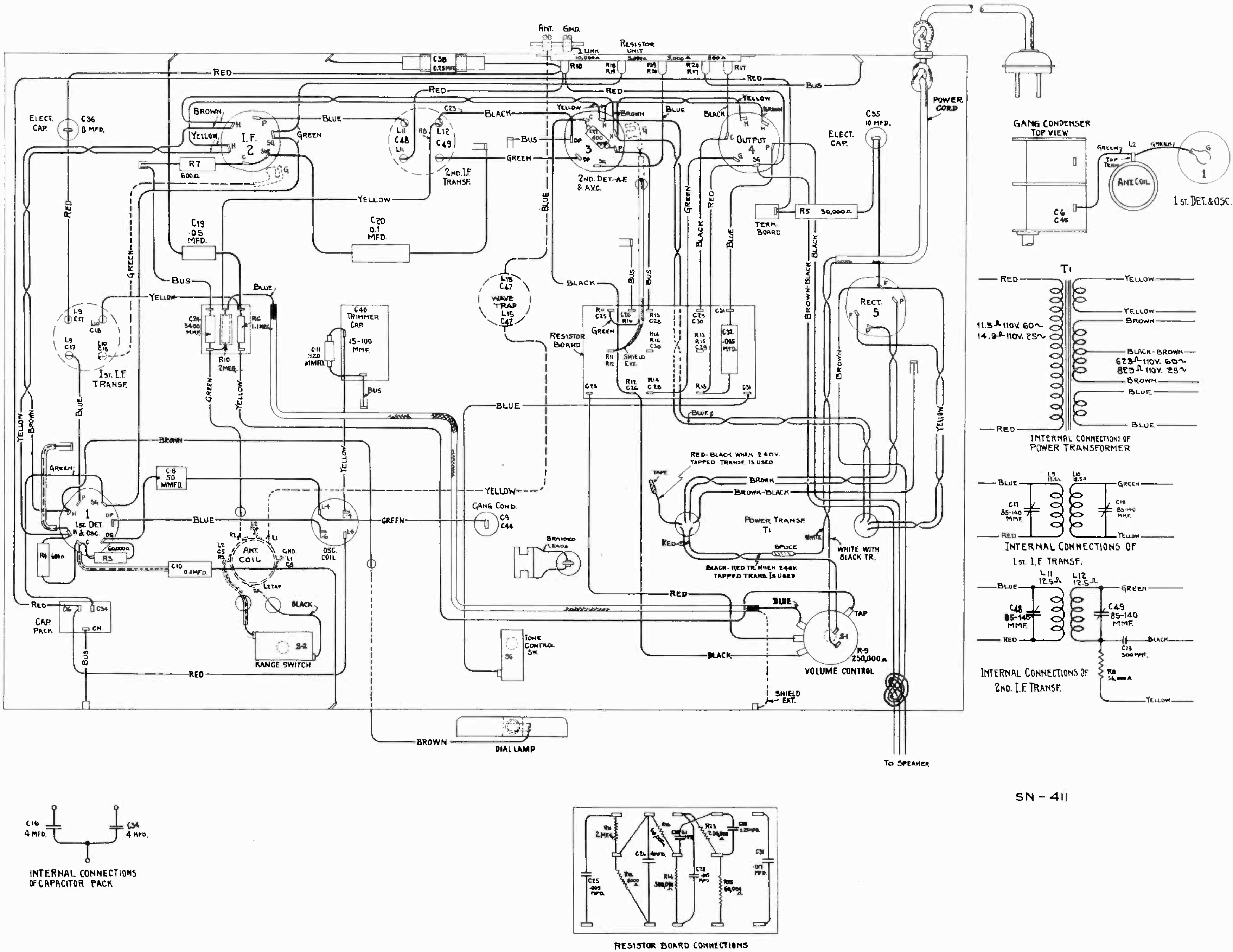


Figure 2—Chassis Wiring Diagram

SERVICE DATA

ALIGNMENT PROCEDURE

This receiver must be in correct electrical alignment in order to obtain maximum efficiency and best quality of performance. The circuits should be realigned after each major service or repair operation, and whenever there are positive indications that the adjustments have deviated from normal by ordinary usage. These indications will be present together and will have the nature of: low sensitivity, poor tone quality and irregular double-peaked tuning.

A definite procedure must be applied in readjusting the line-up trimmers. The proper oscillator and indication equipment must also be used. A number of standard service instruments, which are useful for receiver adjustments, have been designed and made available by the manufacturer of this receiver. These are illustrated and described on a separate page.

I-F Tuning Adjustments

There are two i-f transformers associated in the intermediate amplifier system. They are both tuned by accessible trimmers. To obtain the correct alignment proceed as follows:

(a) Short circuit the antenna and ground terminals and tune the receiver so that no signal is received. Set the volume control to its maximum position. Ground the receiver.

(b) Connect the output of the test oscillator between the first detector control grid and chassis ground. Attach an indicating meter, such as is illustrated, to the speaker circuit.

(c) Place the external oscillator into operation at 460 kc. Adjust the output so that a slight registration occurs on the output indicator. The output should be set at as low a value as will give a convenient indication during adjustment; this requirement is important in that the a.v.c. action is voided by such a method. Adjust the trimmers, C-49, C-48, C-18 and C-17 in order, for maximum receiver output.

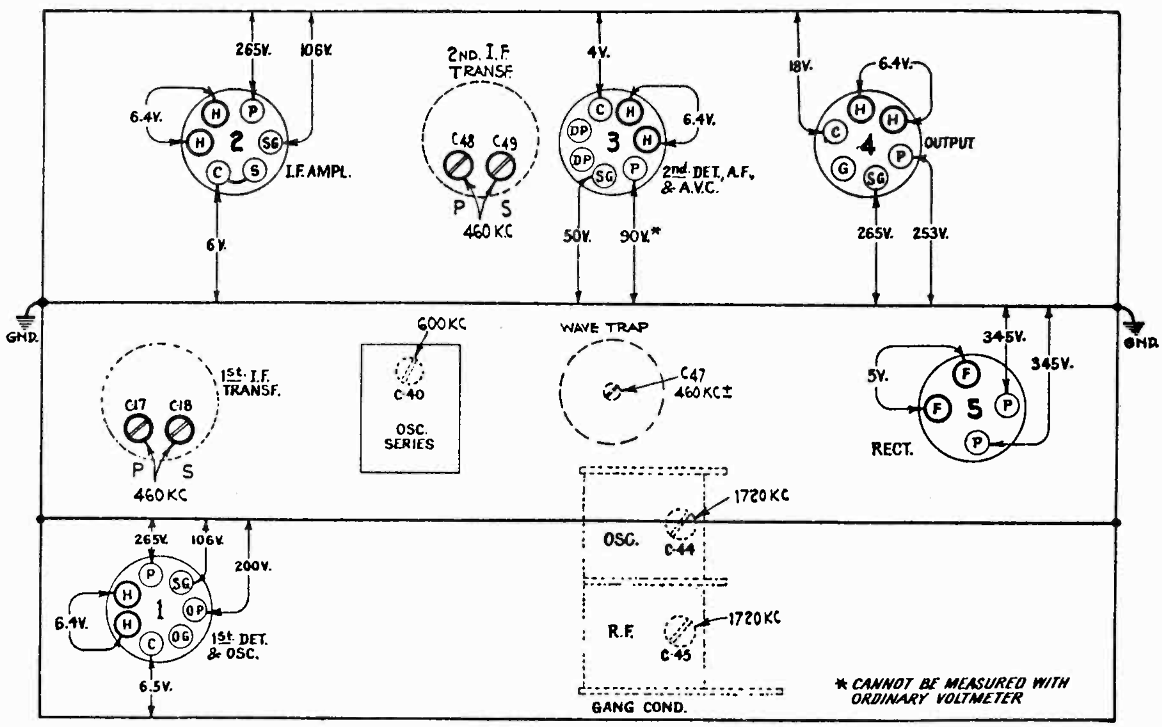


Figure 3—Trimmer Locations and Radiotron Socket Voltages (Measured at 115 volts A. C. Supply—Maximum Volume Control—No Signal)

R-F and Oscillator Adjustments

Three trimmers are provided, two for adjustment at 1720 kc. and one for oscillator line-up at 600 kc. No adjustments are required on the medium wave band. Locations of the trimmers are shown on Figure 3. They should be adjusted in the following manner:

(a) Connect the output of the modulated Full Range Oscillator to the antenna and ground terminals of the receiver. Check the position of the dial pointer. It should set exactly on the radial line, adjacent to the dial reading of 540 when the tuning capacitor plates are at full mesh. After correcting the dial pointer, place the receiver in operation and set the selector at 1720 kc., advance the volume control to maximum and turn the range switch to its broadcast position.

(b) Adjust the frequency of the external oscillator to 1720 kc. and regulate its output until a perceptible indication appears on the output indicator. This indication should be held at a minimum during the adjustments. The trimmers C44 and C45 should then be tuned to the point giving peak receiver output.

(c) Re-tune the test oscillator, setting its frequency to 600 kc. Turn the receiver selector control to the point where the incoming oscillator signal is received best. *This point will not always be exactly at 600 on the dial.* Then adjust the low-frequency trimmer, C40, simultaneously rocking the tuning capacitor slowly through the signal until maximum receiver output results from these combined operations. This adjustment must be made irrespective of dial calibration. It is advisable to repeat the 1720 kc. adjustment of the oscillator trimmer C44, in order to correct for any change caused by the tuning of C40.

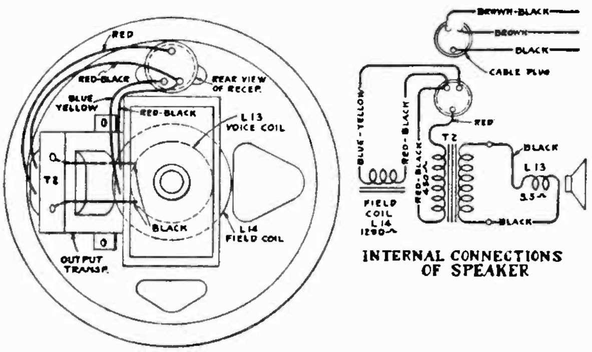


Figure 4—Loudspeaker Wiring

Wave Trap Adjustment

With receiver in operation using its normal antenna, tune the station selector to the point at which the intermediate-wave interference is most intense. Then adjust the wave-trap trimmer to the point which cause maximum suppression of the interference.

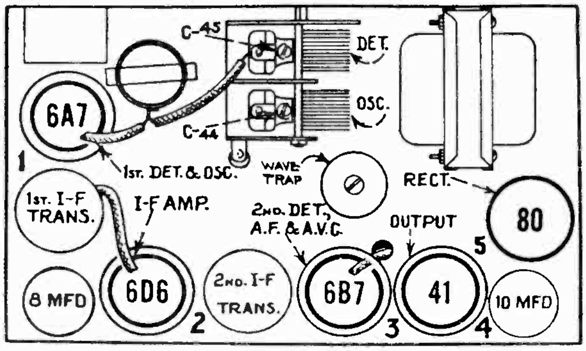


Figure 5—Radiotron Locations

RADIOTRON SOCKET VOLTAGES

The various normal operating voltages are given on Figure 3. As specified, they are referred to the chassis ground. Accuracy of measurements will be a function of the internal resistance of the voltmeter used. It is advisable to employ a meter having at least 1000 ohms per volt, and for each reading use the highest range which will give an acceptably accurate reading. General deviations from the values given, due to line voltage difference, should not be taken as indicating a defective condition. The erratic departure from normal of a single value or group of values should form the basis of circuit diagnosis.

T 5-2 REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4244	Cap—Contact cap—Package of 5	$0.20
3861	Capacitor—Adjustable capacitor (C40)	.78
5094	Capacitor—50 MMfd. (C8)	.20
5151	Capacitor—320 MMfd. (C11)	.20
4297	Capacitor—400 MMfd. (C27)	.30
4881	Capacitor—3400 MMfd. (C24)	.20
4868	Capacitor—0.005 Mfd. (C25, C32)	.20
11315	Capacitor—0.015 Mfd. (C28)	.20
4906	Capacitor—0.017 Mfd. (C31)	.25
4836	Capacitor—0.05 Mfd. (C5, C19)	.30
4841	Capacitor—0.1 Mfd. (C10, C20, C30)	.22
3597	Capacitor—0.25 Mfd. (C29, C38)	.40
3796	Capacitor—4.0 Mfd. (C26)	.60
4428	Capacitor—8.0 Mfd. (C36)	1.05
7790	Capacitor—10.0 Mfd. (C35)	1.05
7589	Capacitor Pack—Comprising two 4.0 Mfd. capacitors (C16, C34)	1.64
4358	Clamp—Capacitor mounting clamp for Stock No. 4428 and No. 7790	.15
5051	Coil—Antenna coil (L1, L2, C5, R2)	1.28
5050	Coil—Oscillator coil (L4, L6)	.56
11475	Condenser—2-gang variable tuning condenser (C6, C9, C44, C45)	3.25
11476	Drive—Variable condenser drive	.65
3708	Resistor—600 Ohm—Carbon type—¼ watt (R4, R7)—Package of 5	1.00
4436	Resistor—5000 Ohm—Carbon type—¼ watt (R12)—Package of 10	2.00
2240	Resistor—30,000 Ohm—Carbon type—1 watt (R5)	.22
3602	Resistor—60,000 Ohm—Carbon type—¼ watt (R3, R15, R16)—Package of 5	1.00
3118	Resistor—100,000 Ohm—Carbon type—¼ watt (R2)—Package of 5	1.00
3116	Resistor—200,000 Ohm—Carbon type—¼ watt (R13)—Package of 5	1.00
6186	Resistor—500,000 Ohm—Carbon type—¼ watt (R14)—Package of 5	1.00
4783	Resistor—1,100,000 Ohm—Carbon type—¼ watt (R6)—Package of 5	1.00
6242	Resistor—2 Megohm—Carbon type—¼ watt (R10, R11)—Package of 5	1.00
4721	Resistor—Tapped resistor—One 500 Ohm, two 5,000 Ohm, and one 10,000 Ohm sections (R17, R18, R19, R20)	.88
3584	Ring—Oscillator coil retaining ring—Package of 5	$0.40
3623	Shield—Oscillator coil shield	.30
3942	Shield—First detector and output Radiotron shield	.18
3782	Shield—Second detector Radiotron shield	.26
7487	Shield—I.F. Radiotron shield	.25
5186	Shield—I.F. Transformer shield	.28
3858	Socket—Dial lamp socket	.26
4784	Socket—4-contact Radiotron socket	.15
4785	Socket—6-contact output Radiotron socket	.15
4786	Socket—6-contact Radiotron socket	.15
4787	Socket—7-contact Radiotron socket	.15
5053	Switch—Range switch (S2)	.50
4905	Switch—Tone control switch (S6)	.30
4900	Transformer—First intermediate frequency transformer—(L9, L10, C17, C18)	2.25
11477	Transformer—Second intermediate frequency transformer (L11, L12, C23, C48, C49, R8)	2.02
4898	Transformer—Power transformer—105-125 volts—25-60 cycles	5.55
4897	Transformer—Power transformer—105-125 volts—50-60 cycles (T1)	3.98
4899	Transformer—Power transformer—105-125/200-240 volts—40-60 cycles	4.05
11479	Trap—Wave trap (L15, C47)	1.02
4429	Volume Control—(R9, S1)	1.40
	REPRODUCER ASSEMBLIES	
9587	Coil—Field coil, magnet and cone support (L14)	2.18
9588	Cone—Reproducer cone (L13)—Package of 5	3.55
5118	Connector—3-contact male connector for reproducer cable	.25
5119	Connector—3-contact female connector for reproducer cable	.25
9586	Reproducer—Complete	5.95
4893	Transformer—Output transformer (T2)	1.48
	MISCELLANEOUS ASSEMBLIES	
11835	Dial—Station selector dial scale	.32
11478	Indicator—Station selector indicator pointer	.12
4340	Lamp—Station selector dial lamp—Package of 5	.60

RCA VICTOR MODELS T 6-1 and C 6-2

Six-Tube, Three-Band, A-C, Superheterodyne Receivers

SERVICE NOTES

Electrical Specifications

RADIOTRON COMPLEMENT

(1) RCA-6A8	First Detector-Oscillator
(2) RCA-6K7	Intermediate Amplifier
(3) RCA-6H6	Second Detector-A.V.C.
(4) RCA-6F5	Audio Voltage Amplifier
(5) RCA-6F6	Audio Power Amplifier
(6) RCA-80	Full Wave Rectifier

FREQUENCY RANGES

Band A	540— 1625 kc.
Band B	1625— 5700 kc.
Band C	5700—18000 kc.

ALIGNMENT FREQUENCIES

Band A	600 kc. (osc.), 1400 kc. (osc., ant.)
Band B	None required
Band C	18000 kc. (osc., ant.)

Intermediate Frequency .... **460 kc.**

POWER SUPPLY RATINGS

Rating A	105—125 volts, 50—60 cycles, 85 watts
Rating B	105—125 volts, 25—60 cycles, 90 watts
Rating C	100—130/140—160/195—250 volts, 40—60 cycles, 85 watts

POWER OUTPUT

Undistorted	2.0 watts
Maximum	4.5 watts

LOUDSPEAKER

Type	Electrodynamic
Voice Coil Impedance	2.25 ohms—400 cycles

Mechanical Specifications

Chassis Base Dimensions	12 inches x 7 inches x 2½ inches
Tuning Drive Ratio	10 to 1 and 50 to 1

MODEL T 6-1

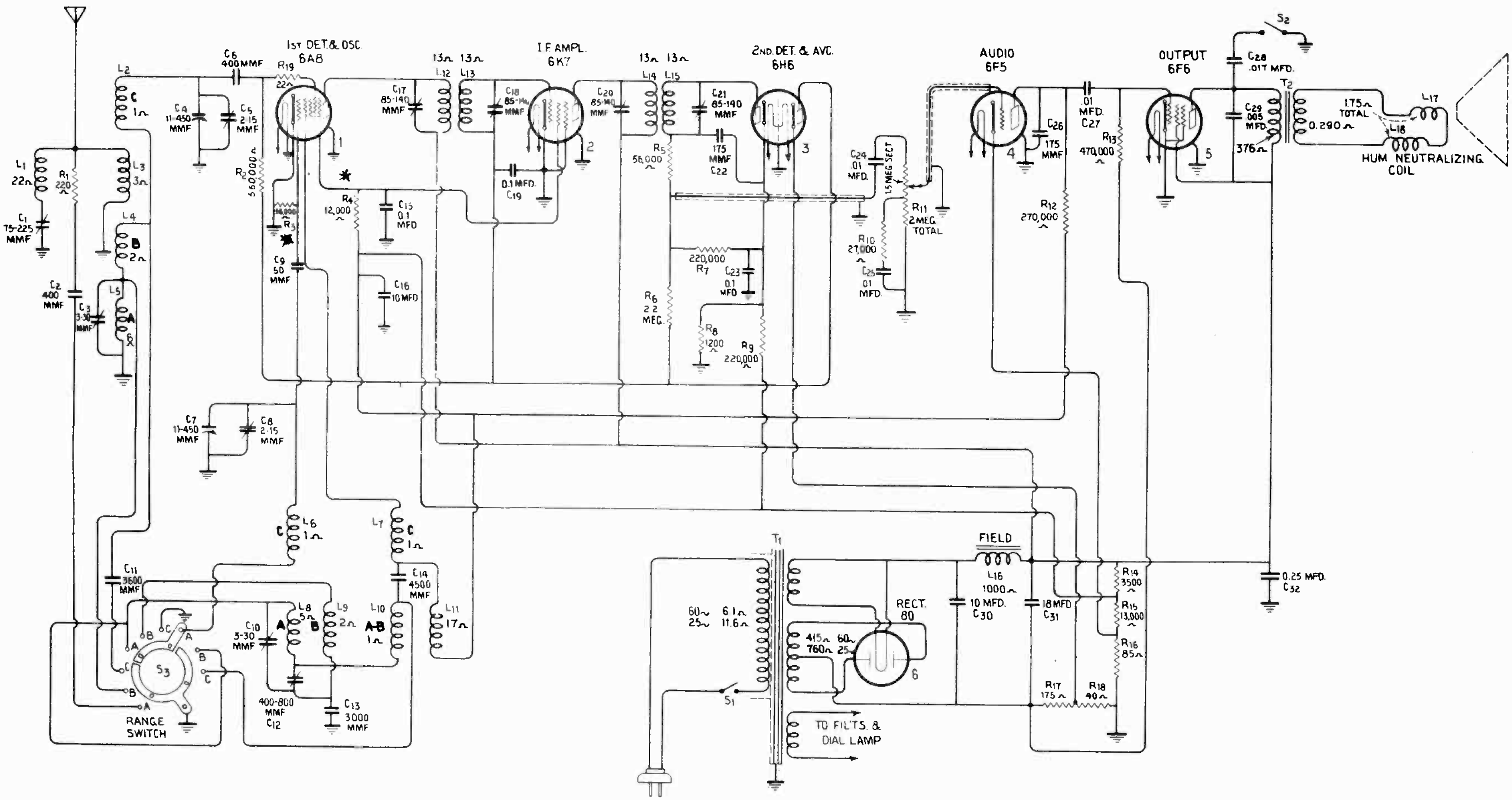
Height	19⅛ inches
Width	13⅝ inches
Depth	8½ inches
Weight (Net)	20½ pounds
Weight (Shipping)	23½ pounds

MODEL C 6-2

Height	37¼ inches
Width	23⅝ inches
Depth	11 inches
Weight (Net)	43 pounds
Weight (Shipping)	56 pounds

General Features

These two models each employ the same six-tube chassis. They have the new metallic tubes. The tuning-range is from 540 to 18,000 kc. The coverage includes domestic broadcast, police, aircraft and amateur services and also the important foreign shortwave broadcast bands at 49, 31, 25, 19 and 16 meters. Chassis features include automatic volume control, high frequency tone control, antenna wave trap and audio tone compensation. A high level of output is available from the receiver for reproduction by the electrodynamic loudspeaker. The table model **(T 6-1)** uses an 8-inch dynamic speaker and the console model (C 6-2) uses an improved 12-inch dynamic speaker. The tuning dial is an illuminated semi-airplane type. Positions of the range selector knob are marked on the control panel to show which tuning band is in use. The tuning control is of the dual-ratio type, which permits rough tuning through a 10-1 drive ratio and vernier tuning through a 50-1 drive ratio. The latter is especially advantageous for accurate tuning of the short-wave stations.



On some instruments R3, is 100,000 ohms and **R4** is 33,000 ohms.

Figure 1—Schematic Circuit Diagram

On some instruments, R-8, R-9 and C-23 are omitted and the RCA-6H6 first Cathode is directly grounded.

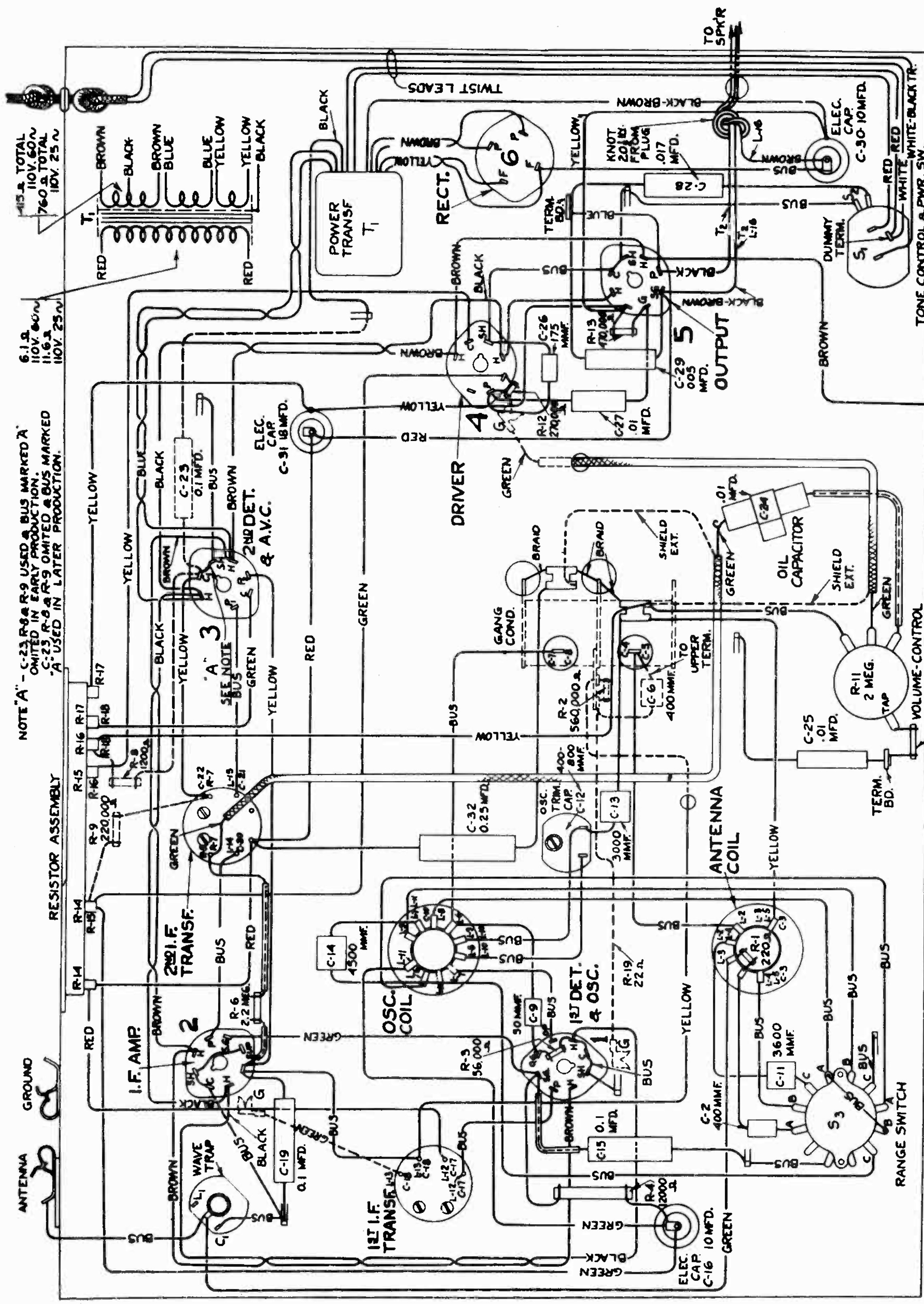


Figure 2—Chassis Wiring Diagram

Circuit Arrangement

The conventional Superheterodyne type of circuit, consisting of a combined first detector-oscillator stage, a single i-f stage, a diode detector-automatic volume control stage, an audio voltage amplifier stage, an audio power output stage and a high voltage rectifier power supply stage is used.

Tuned Circuits

The antenna coil system consists of a single primary and three series connected secondary windings to provide the three ranges of tuning. The oscillator coil system is similarly wound on a single form. A range selector switch (S-3) is used for connecting the various sections of these two coil systems into the circuit to provide operation on the band desired. The coils are tuned by a variable two-section gang condenser having trimmer capacitors in shunt with each section. There are additional trimmer capacitors across the section of each coil used for Band "A." A series trimmer is also associated with the Band "A" oscillator coil.

The intermediate frequency amplifier system consists of an RCA-6K7 in a transformer-coupled circuit. This stage operates at a basic frequency of 460 kc. Each winding of both i-f transformers (input and output) is tuned by an adjustable trimmer.

Detector and A.V.C.

The modulated signal as obtained from the output of the i-f stage is detected by an RCA-6H6 double diode tube. The audio frequency secured by this process is transferred to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal is used for automatic volume control. This voltage, which develops across resistor R-7, is applied as automatic control grid bias to the first detector and i-f tubes through a suitable resistance filter circuit. The second (auxiliary) diode of the RCA-6H6 is used to supply residual bias for the controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current which flows through resistors R-6, R-7 and R-8, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function. The cathode and anode of the signal-a.v.c. diode have positive potential in respect to chassis-ground and cathodes of the a.v.c. controlled tubes when no signal is being received. (The cathode of the second detector diode is being grounded on later production to simplify manufacture and to minimize the number of component parts required. Two resistors, R-9 and R-8, and one condenser, C-23, of the first production models have accordingly been eliminated as is noted on the schematic and chassis wiring diagrams.)

Audio System

The manual volume control consists of an acoustically tapered potentiometer in the audio circuit between the output of the detector diode and the input grid of the audio voltage amplifier tube. This control has a tone compensating filter connected to it so that the correct aural balance will be obtained at different volume settings.

Resistance-capacitance coupling is used between the first audio stage and the power output stage. The output of the power amplifier is transformer-coupled into the dynamic loudspeaker. High frequency tone control is effected by a capacitor across the plate circuit of the output tube. This capacitor may be cut in or out of the circuit as desired by means of a switch (S-2).

Rectifier

The power required for operation of this receiver is supplied through transformer T-1. This transformer has an efficient static shield between its primary and secondary windings. This shield prevents interference which is on the power supply circuit from entering the receiver and conversely reduces the tendency of the receiver to re-radiate into the power circuit. An RCA-80 furnishes the high voltage necessary for plate, screen, cathode and grid potentials through a brute-force filter. The field winding of the loudspeaker is used as a reactor in this filter circuit from which it simultaneously receives its magnetizing current. The heaters of all Radiotrons are supplied from a low voltage (6.3 volt) winding on the power transformer. One side of this winding is at ground potential.

SERVICE DATA

The various diagrams of this bulletin contain such information as will be needed to isolate causes for defective operation when such a condition develops. Ratings of the resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles, such as R-3, L-2, C-1, etc., are provided for reference between the diagrams and the replacement parts list. Locating of the parts in the schematic circuit is facilitated by the fact that the numerical titles increase from left to right on the diagram. The coils, reactors, and transformer windings are rated in terms of their d-c resistances only, and when the resistance is less than one ohm, no rating is given.

Alignment Procedure

Precise alignment is vital to the proper functioning of this receiver. There are four trimming adjustments provided in the i-f system, three in the oscillator coil system and two in the antenna coil system. Each of these trimmers have been accurately adjusted during manufacture and should remain properly aligned unless affected by abnormal conditions of climate or have been altered for service purposes. Incorrect alignment is usually evidenced by loss of sensitivity, improper tone quality and poor selectivity. These indications will generally be present together.

The correct performance of the receiver can only be obtained when the alignment is performed with adequate and reliable test apparatus. The manufacturer of this instrument has a complete assortment of such service equipment available. This equipment may be purchased from authorized distributors and dealers.

An oscillator (signal generator) is required as a source of the specified alignment frequencies. Visual indication of receiver output during the adjustment is necessary to enable the serviceman to obtain an accuracy of alignment which is not possible by listening to the signal. The RCA Victor Stock No. 9595 Full Range Oscillator and the RCA Victor Stock No. 4317 Neon Output Indicator are especially suitable and fulfill the above requirements.

The following procedure should be followed in adjusting the various trimmer capacitors:

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 4. Each must be aligned to a basic frequency of **460 kc.** To do this, attach the Output Indicator across the voice coil circuit or across the output transformer primary. Connect the output of the test oscillator between the control grid of the RCA-6A8 first detector tube and chassis-ground. Tune the oscillator to **460 kc.** Advance the receiver volume control to its full-on position and adjust the receiver tuning control to a point within its range where no interference is encountered either from local broadcast stations or the heterodyne oscillator. Increase the output of the test oscillator until a slight indication is apparent on the output indicator. Then adjust the two trimmers of the second i-f transformer to produce maximum (peak) indicated receiver output. Then, adjust the two trimmers of the first i-f transformer for maximum (peak) receiver output as shown by the indicating device. During these adjustments, regulate the test oscillator output so that the indication is always as low as possible. By doing so, broadness of tuning due to a.v.c. action will be avoided. It is advisable to repeat the adjustment of all i-f trimmers a second time to assure that the interaction between them has not disturbed the original adjustment.

R-F Trimmer Adjustments

The two trimmers which are at all times directly in shunt with the variable tuning condenser necessitate that the high-frequency range (Band C) be aligned first. The range selector switch should, therefore, be turned to its Band C position for the first adjustment. The Output Indicator should be left connected to the output system. Attach the output terminals of the test oscillator to the antenna and ground terminals of the receiver input.

Calibrate the dial by rotating the tuning control until the variable condenser plates are in their full mesh (maximum capacity) position and adjusting the dial pointer so that its end points to the *horizontal* graduation (530 kc.) at the low frequency end of the Band A scale.

Proceed further as follows:

(a) Adjust the test oscillator to **18,000 kc.** and set the receiver tuning control to a dial reading of **18,000 kc.**

(b) Regulate the output of the test oscillator until a slight indication is perceptible at the receiver output. Then adjust the trimmer on the oscillator section of the variable condenser to the point at which it produces maximum indicated receiver output. Two points may be found, each of which produces such a maximum. The one of *maximum trimmer capacitance* is correct and should be used. (The oscillator will be 460 kc. below the signal frequency at this adjustment point.)

(c) Adjust the trimmer of the antenna section of the variable condenser, simultaneously rocking the receiver tuning control backward and forward through the **18,000 kc.** input signal, until maximum receiver output results from these combined operations. Rocking of the variable condenser will prevent inaccurate adjustment which would otherwise be caused by the inter-action between the heterodyne oscillator circuit and the antenna tuned circuit.

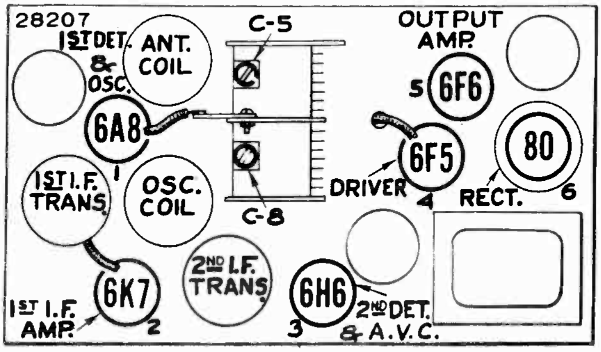


Figure 3—Radiotron and Coil Locations

(d) Change the receiver range selector to its Band A position and set the receiver tuning control to a dial reading of **1400 kc.** Tune the test oscillator to this same frequency and regulate its output to produce a slight indication on the receiver output indicating device.

(e) Adjust the high frequency trimmers of the Band A oscillator and antenna coils, C-10 and C-3 respectively, to the points at which each produces maximum indicated receiver output.

(f) Shift the test oscillator frequency to **600 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received.

(g) Tune the low frequency trimmer, C-12, of the oscillator Band A coil, simultaneously rocking the tuning control of the receiver backward and forward through the signal, until maximum indicated receiver output results from these combined operations. The adjustment of C-10 and C-3 should be corrected at **1400 kc.** to compensate for any changes caused by the adjustment of the low frequency oscillator coil trimmer.

Radiotron Socket Voltages

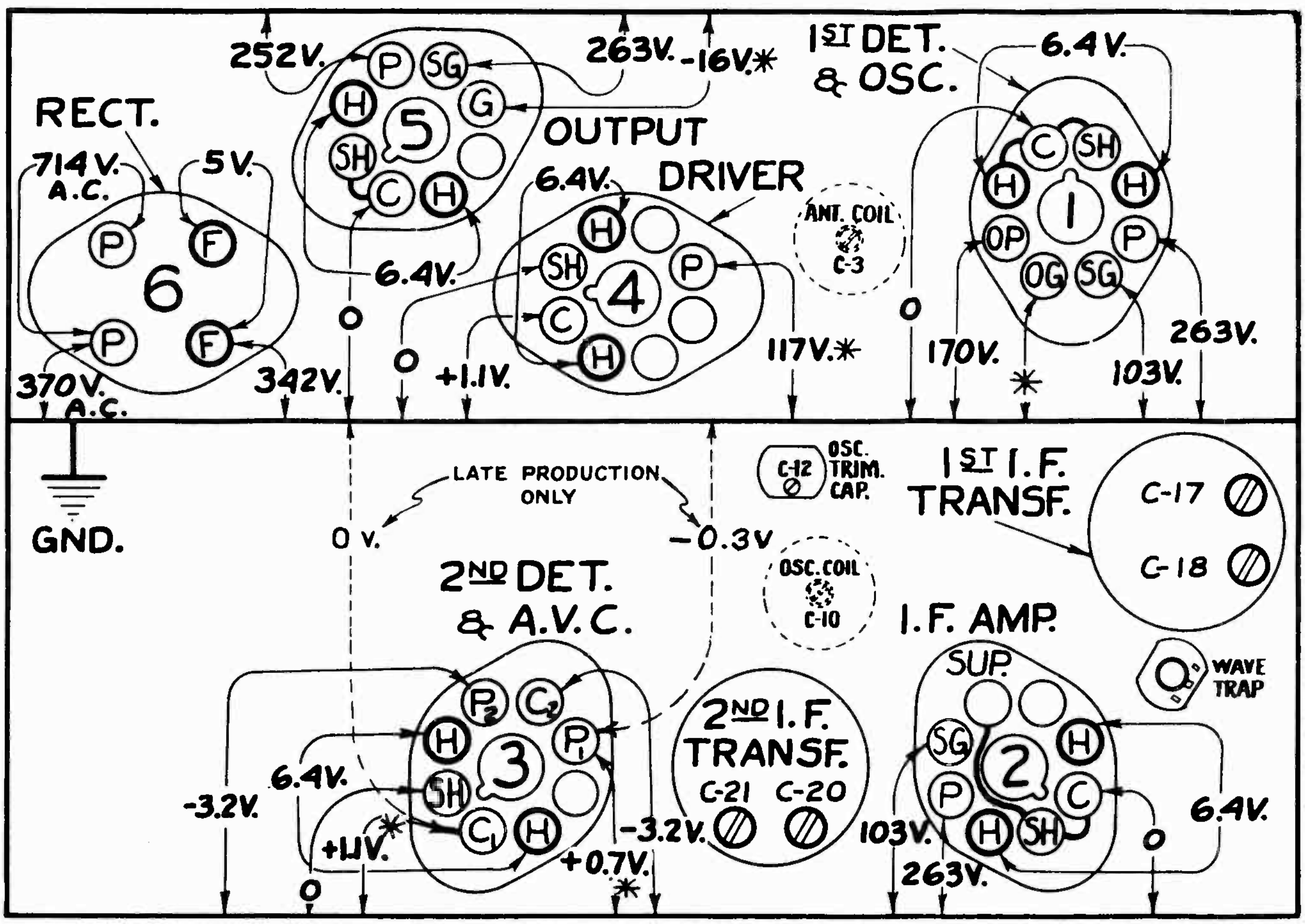
The voltage values indicated from the Radiotron socket contacts to chassis on Figure 4 will assist in the location of causes for faulty operation. Each value as specified should hold within $\pm$ 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Universal Transformer

The special transformer used on some receivers of this type is adaptable to several ranges of voltage as given under Rating C of Electrical Specifications. Its schematic and wiring are shown by Figure 6. Terminals are provided at the top of the transformer case for changing the primary connections to suit the voltage available. Note that a 110-volt tap is brought out separately for supplying a phonograph motor.

Wave-Trap Adjustment

With the receiver in operation using its normal antenna, tune station selector to the point at which the intermediate frequency interference is most intense. Then adjust the wave trap trimmer to the point which causes maximum suppression of the interference.



(*) CANNOT BE MEASURED WITH ORDINARY VOLTMETER

Figure 4—Radiotron Socket Voltages
Measured at 115 volts, 60 cycle supply—No signal being received

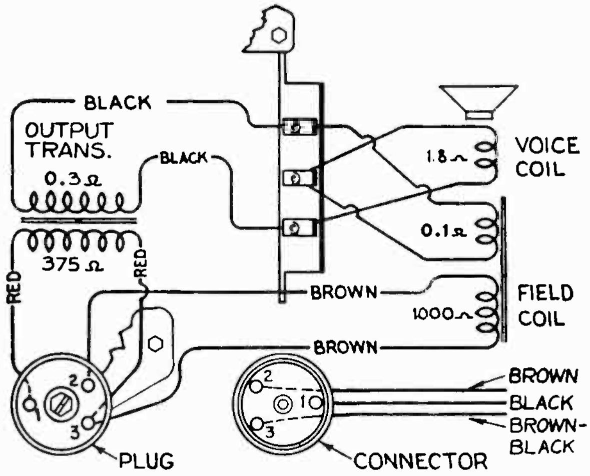
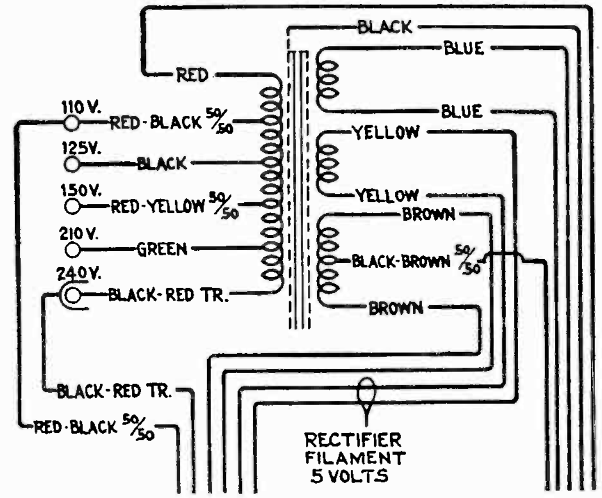


Figure 5—Loudspeaker Wiring



Primary Resistance—17.3 ohms, Total
Secondary Resistance—408 ohms, Total

Figure 6—Universal Transformer

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers.

Stock No.	Description	List Price	Stock No.	Description	List Price
	RECEIVER ASSEMBLIES		** 3066	Resistor—12,000 Ohms—Carbon type—1 watt—(R4)—Package of 5	1.10
5237	Bushing—Variable tuning condenser mounting bushing—Package of 3	$0.43	11400	Resistor—27,000 Ohms—Carbon type—1/4 watt—(R10)—Package of 5	1.00
11465	Capacitor—Adjustable capacitor—(C12)	.48	** 5029	Resistor—56,000 Ohms—Carbon type—1/4 watt—(R3)—Package of 5	1.00
11289	Capacitor—50 MMfd.—(C9)	.26	5158	Resistor—220,000 Ohms—Carbon type—1/4 watt—(R9)*—Package of 5	1.00
11623	Capacitor—175 MMfd.—(C26)	.18	11453	Resistor—270,000 Ohms—Carbon type—1/10 watt—(R12)—Package of 5	.75
11290	Capacitor—400 MMfd.—(C2, C6)	.25	11452	Resistor—470,000 Ohms—Carbon type—1/10 watt—(R13)—Package of 5	.75
11622	Capacitor—3000 MMfd.—(C13)	.36	11397	Resistor—560,000 Ohms—Carbon type—1/10 watt—(R2)—Package of 5	.75
11621	Capacitor—3600 MMfd.—(C11)	.38	11626	Resistor—2.2 Megohms—Carbon type—1/4 watt—(R6)—Package of 5	1.00
11287	Capacitor—4500 MMfd.—(C14)	.30	11603	Shield—Antenna or oscillator coil shield	.26
4868	Capacitor—.005 Mfd.—(C29)	.20	11390	Shield—Intermediate frequency transformer shield	.25
11395	Capacitor—.01 Mfd.—(C24)	.18	11383	Shield—Rectifier Radiotron shield	.20
4858	Capacitor—.01 Mfd.—(C25, C27)	.25	11614	Spring—Coil spring for large gears on variable tuning condenser—Package of 10	.70
4906	Capacitor—.017 Mfd.—(C28)	.25	11616	Switch—Range switch—(S3)	1.00
4841	Capacitor—0.1 Mfd.—(C19, C23)*	.22	11460	Switch—Tone control and power switch—(S1, S2)	.95
11414	Capacitor—0.1 Mfd.—(C15)	.20	5238	Terminal—Antenna terminal board, with clip	.14
5170	Capacitor—0.25 Mfd.—(C32)	.25	11388	Transformer—First intermediate frequency transformer—(L12, L13, C17, C18)	1.90
11387	Capacitor—10 Mfd.—(C16)	.86	11389	Transformer—Second intermediate frequency transformer—(L14, L15, C20, C21, C22, R5, R7)	3.02
11240	Capacitor—10 Mfd.—(C30)	1.08	11458	Transformer—Power transformer—105-125 volts—50-60 cycles—(T1)	4.85
5212	Capacitor—18 Mfd.—(C31)	1.16	11585	Transformer—Power transformer—105-125 volts—25-50 cycles	7.00
11617	Coil—Antenna coil—(L2, L3, L4, L5, C3, R1)	1.68	11584	Transformer—Power transformer—100-130, 140-160, 195-250 volts—40-60 cycles	5.05
11618	Coil—Oscillator coil—(L6, L7, L8, L9, L10, L11, C10)	2.22	11391	Trap—Wave trap—(L1, C1)	1.22
11612	Condenser—Two-gang variable tuning condenser—(C4, C5, C7, C8)	3.80	11237	Volume Control—(R11)	1.20
11615	Dial—Station selector dial	.60		REPRODUCER ASSEMBLIES	
11613	Drive—Variable tuning condenser drive	1.00		Console Model	
11376	Escutcheon—Station selector escutcheon and crystal	.70	11232	Board—Terminal board assembly	.18
11619	Foot—Chassis mounting foot and bracket assembly—Package of 2	.65			
11396	Indicator—Station selector indicator pointer	.25			
5226	Lamp—Dial lamp—Package of 5	.70			
11466	Resistor—Voltage divider resistor—comprising one 3500 ohm, one 13000 ohm, one 85 ohm, one 40 ohm, and one 175 ohm sections—(R14, R15, R16, R17, R18)	.95			
11624	Resistor—22 Ohms—Flexible type—complete with contact cap—(R19)	.22			
11620	Resistor—220 Ohms—Carbon type—1/10 watt—(R1)—Package of 5	.75			
11283	Resistor—1200 Ohms—Carbon type—1/4 watt—(R8)*—Package of 5	1.00			

*** R8, R9, C23 used in some models**

** 8072	Resistor— 33,000 Ohms—Carbon type—½ watt—(R4)—Package of 5	1.00	Used in some models.
3118	Resistor—100,000 Ohms—Carbon type—¼ watt—(R3)—Package of 5	1.00	Used in some models.

REPLACEMENT PARTS (Continued)

Stock No.	Description	List Price	Stock No.	Description	List Price
11231	Bolt—Yoke and core assembly bolt and nut	.16	11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Output transformer mounting bracket	.14	8060	Bracket—Output transformer mounting bracket	.14
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5.	.25	11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5.	.25
11470	Coil—Field coil—(L16)	2.16	11470	Coil—Field coil—(L16)	2.16
11469	Coil—Neutralizing coil—(L18)	.20	11469	Coil—Neutralizing coil—(L18)	.20
11258	Cone—Reproducer cone—(L17)—Package of 5	3.85	11235	Cone—Reproducer cone—(L17)—Package of 5	3.50
5118	Connector—Three contact male connector for reproducer	.25	5118	Connector—Three contact male connector for reproducer	.25
5119	Connector—Three contact female connector for reproducer cable	.25	5119	Connector—Three contact female connector for reproducer cable	.25
9622	Reproducer—Complete	7.16	9621	Reproducer—Complete	6.85
11253	Transformer—Output transformer—(T2).	1.56	11253	Transformer—Output transformer—(T2).	1.56
11230	Washer—Binders board "C" washer—used to hold field coil assembly—Package of 5	.18	11230	Washer—Binders board "C" washer—used to hold field coil assembly—Package of 5	.18
	REPRODUCER ASSEMBLIES Table Model				
11232	Board—Terminal board assembly	.18			

— NOTES —

(1) Beat notes or heterodyning (whistles) may be encountered in some instances on these receivers due to excessive antenna capacitance. This condition may be corrected by reducing the size of the antenna or by inserting a 150 mmfd. capacitor in series with the antenna lead. This may be accomplished in the receiver by removing the bus lead which connects from the antenna terminal to the wave trap inductance L-1 and inserting the condenser between these points.

RCA VICTOR MODEL T 6-9

Six-Tube, Two-Band, A-C, Superheterodyne, Table Receiver

SERVICE NOTES

Electrical Specifications

FREQUENCY RANGES

Broadcast Band (A) ....540-1850 kc.
Shortwave Band (B) ....1850-6900 kc.

ALIGNMENT FREQUENCIES

Broadcast Band (A) ....600 kc. and 1720 kc.
Shortwave Band (B) ......No Adjustments Required

RADIOTRON COMPLEMENT

(1) RCA-6A8 ....First Detector-Oscillator
(2) RCA-6K7 ....Intermediate Amplifier
(3) RCA-6H6 ....Second Detector-A.V.C.
(4) RCA-6F5 ....Audio Voltage Amplifier
(5) RCA-6F6 ....Audio Power Amplifier
(6) RCA-80 ....Full Wave Rectifier

VOLTAGE AND FREQUENCY

Rating A .... 105-125 volts, 50-60 cycles
Rating B .... 105-125 volts, 25-60 cycles
Rating C .... 100-130/140-160/195-250 volts, 40-60 cycles

Power Consumption ....90 watts

Intermediate Frequency....................460 kc.

POWER OUTPUT

Undistorted ....2.0 watts
Maximum ....4.5 watts

LOUDSPEAKER

Type ....8 inch, Electrodynamic
Voice Coil Impedance.......2.25 ohms at 400 cycles

Mechanical Specifications

Height...17¼ inches
Width..13⅜ inches
Depth ....8¼ inches
Weight (Net)...19½ pounds
Weight (Shipping)......................................24 pounds
Chassis Base Size........................12 inches x 7 inches x 2½ inches
Controls........(1) H-F Tone Control-Power Switch, (2) Tuning, (3) Volume Control, (4) Range Selector
Tuning Ratio...6 to 1

General Features

This table-type receiver has many distinctive features. It employs the new RCA All-Metal tubes operating in a Superheterodyne circuit. The tuning ranges cover the standard broadcast band and extend above it to include the 49 meter short wave broadcast band. The short wave portion of this extensive range also includes the channels assigned for police, amateur and aviation communication.

A high-ratio gang condenser drive is provided to facilitate accurate tuning. This feature is especially valuable for short wave reception. The dial is clearly graduated and uniformly illuminated.

Automatic volume control is incorporated in the circuit to compensate for fluctuations of signal strength due to fading.

High-frequency tone control enables the listener to reduce unavoidable noises and static.

An adjustable series wave-trap in parallel with the antenna input serves to suppress code interference which may be encountered in certain localities from intermediate frequency radio telegraph signals.

Circuit Arrangement

The first detector and oscillator functions are accomplished in a single tube, an RCA-6A8. The input of this tube is coupled to the antenna through a tuned transformer. A shunt (series tuned) wave-trap is connected across the primary of this transformer to prevent signals of intermediate frequency (460 kc) from being intro-

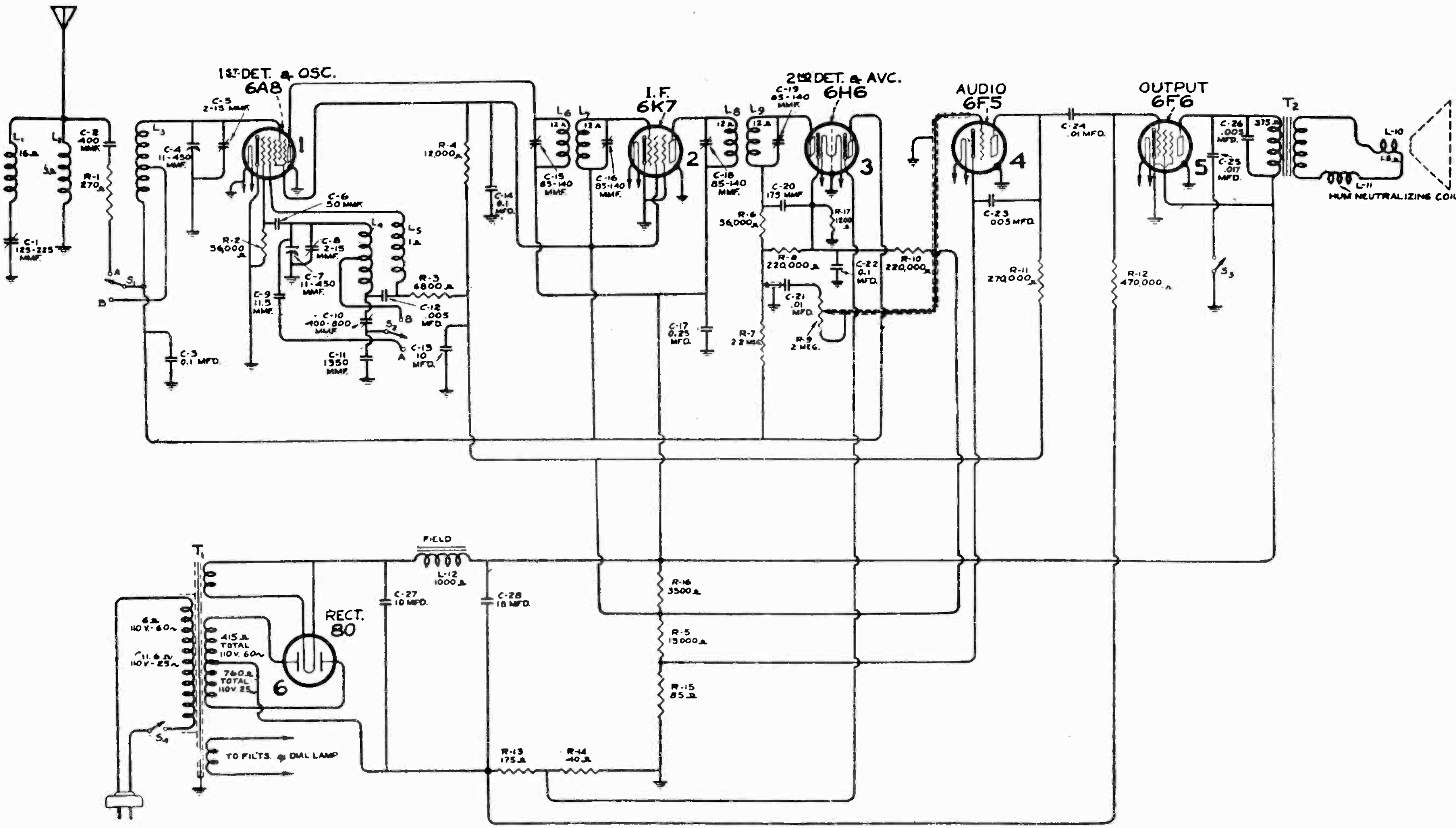


Figure 1—Schematic Circuit Diagram

On some Instruments, R-10, R-17 and C-22 are omitted and the RCA-6H6 first Cathode is directly grounded.

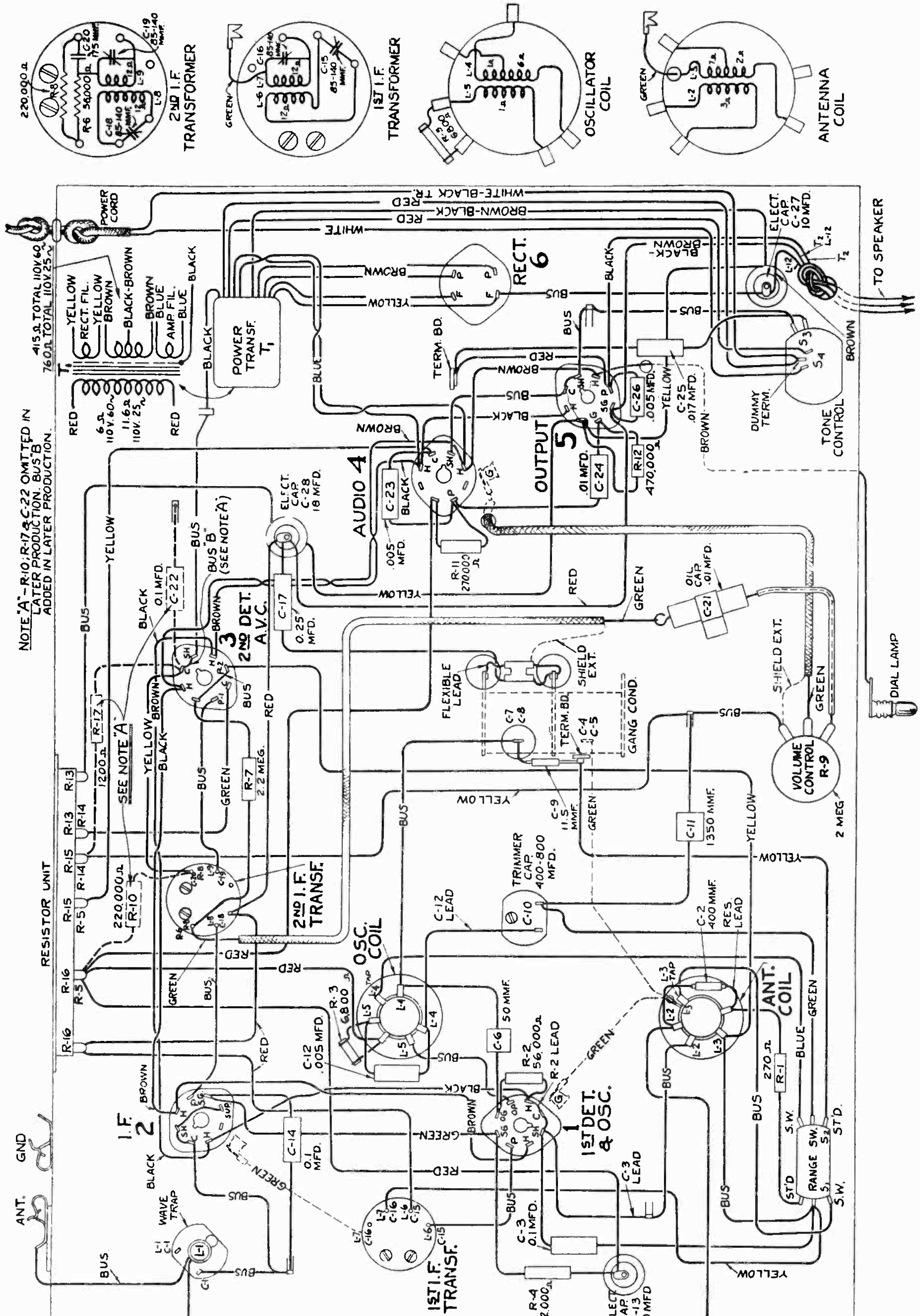


Figure 2—Chassis Wiring Diagram

duced into the first stage as interference. The two-section gang condenser which tunes the antenna transformer secondary and the heterodyne oscillator coil has adjustable trimmers for use in obtaining exact alignment. Each of these coils is tapped so that the range switch increases the range of tuning by decreasing the amount of inductance.

The intermediate frequency stage is coupled to the RCA-6A8 and to the RCA-6H6 second detector by means of tuned transformers. These transformers are adjusted to resonance at 460 kc. by means of trimmers.

The modulated signal as obtained from the output of the i-f system is detected by the RCA-6H6 double diode tube. Audio frequency secured by this process is passed on to the a-f system for amplification and final reproduction. The d-c voltage, which results from detection of the signal, is used for automatic volume control. This voltage, which develops across resistor R-8, is applied as automatic control grid bias to the first detector and i-f tubes through a suitable resistance filter. The second diode of the RCA-6H6 is used to supply residual bias for the controlled tubes under conditions of little or no signal. This auxiliary diode, under such conditions, draws current which flows through resistors R-7, R-8 and R-10, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function. The cathode and anode of the signal-a.v.c. diode have positive potential in respect to chassis-ground and cathodes of the a.v.c.-controlled tubes when no signal is being received.

Manual volume control is by means of an acoustically tapered potentiometer connected as a variable coupling element between the output of the second detector and the first audio control grid. After amplification by the RCA-6F5, the audio signal is transmitted by resistance-capacitance coupling to the input of the RCA-6F6 power output stage which in turn is transformer-coupled to the dynamic speaker. High-frequency tone control is provided by means of a shunt capacitor across the plate circuit of the output tube, which may be cut in or out of the circuit with a control switch (S3).

The power supply system consists of a RCA-80 rectifier tube which is supplied from an efficiently designed power transformer and which works into a suitable filter. The various potentials required for the plate, screen, control grid, and cathode circuits are obtained from the output of the filter on a resistance-divider system. The electrodynamic loudspeaker field coil is used as a filter reactor.

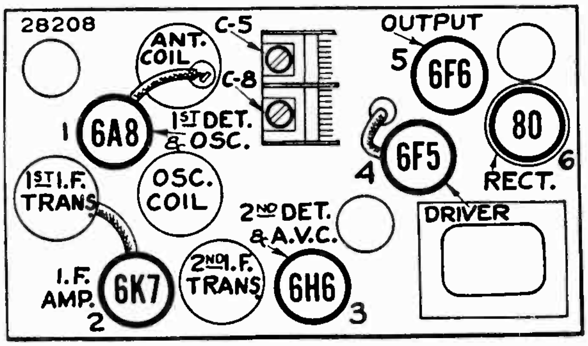


Figure 3—Radiotron and Coil Locations

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed to isolate causes for defective operation when such develops. The ratings of the resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and the Replacement Parts List. The coils, reactors, and transformer windings are rated in terms of their d-c resistances only, and when the resistance is less than one ohm, no rating is given.

Alignment Procedure

There are three alignment trimmers provided in the antenna transformer and oscillator coil tuned circuits and four are used in the i-f system. All of these have been accurately adjusted during manufacture and should remain properly aligned unless affected by abnormal conditions of climate or have been altered for service purposes. Loss of sensitivity, improper tone quality and poor selectivity are the usual indications of improper alignment.

The correct performance of this receiver can only be obtained when the aligning has been done with adequate and reliable apparatus. The manufacturer of this receiver has available for sale through its distributors and dealers, a complete assortment of such service equipment as may be needed for the alignment operation. These instruments are illustrated and described on a separate page of this book.

An oscillator (signal generator), such as the RCA Stock No. 9595, is required as a source of the specified alignment frequencies. Visual indication of receiver output during the adjustment is necessary and should be accomplished by the use of an indicator such as the RCA Victor Stock No. 4317 Neon Output Indicator.

The following method of procedure should be followed in adjusting the various trimmer capacitors:

I-F Trimmer Adjustment

The four trimmers of the two i-f transformers are located as shown by Figure 4. Each trimmer must be aligned to a basic frequency of **460 kc.** To do this, attach the output indicator across the voice coil or across the output transformer primary. Connect the output of the test oscillator between the control grid of the RCA-6A8 and chassis-ground. Tune the oscillator to **460 kc.** Advance the receiver volume control to its full-on position and adjust the receiver tuning control to a point within its range where no interference is encountered either from local broadcast stations or from the heterodyne oscillator. Increase the output of the test oscillator until a slight indication is present on the output indicator. Then, adjust the two trimmers of the second i-f transformer to produce maximum (peak) indicated receiver output. Then, adjust the two trimmers of the first i-f transformer for maximum (peak) receiver output as shown by the indicating device. During these adjustments, regulate the test oscillator output so that the indication is always as low as possible. By doing so, broadness of tuning due to a.v.c. will be avoided. It is advisable to repeat the adjustment of all i-f trimmers to assure that the interaction between them has not disturbed the original adjustment.

R-F Trimmer Adjustment

Calibrate the tuning dial by setting pointer to horizontal line at low frequency end of broadcast band scale while variable condenser is at maximum capacity.

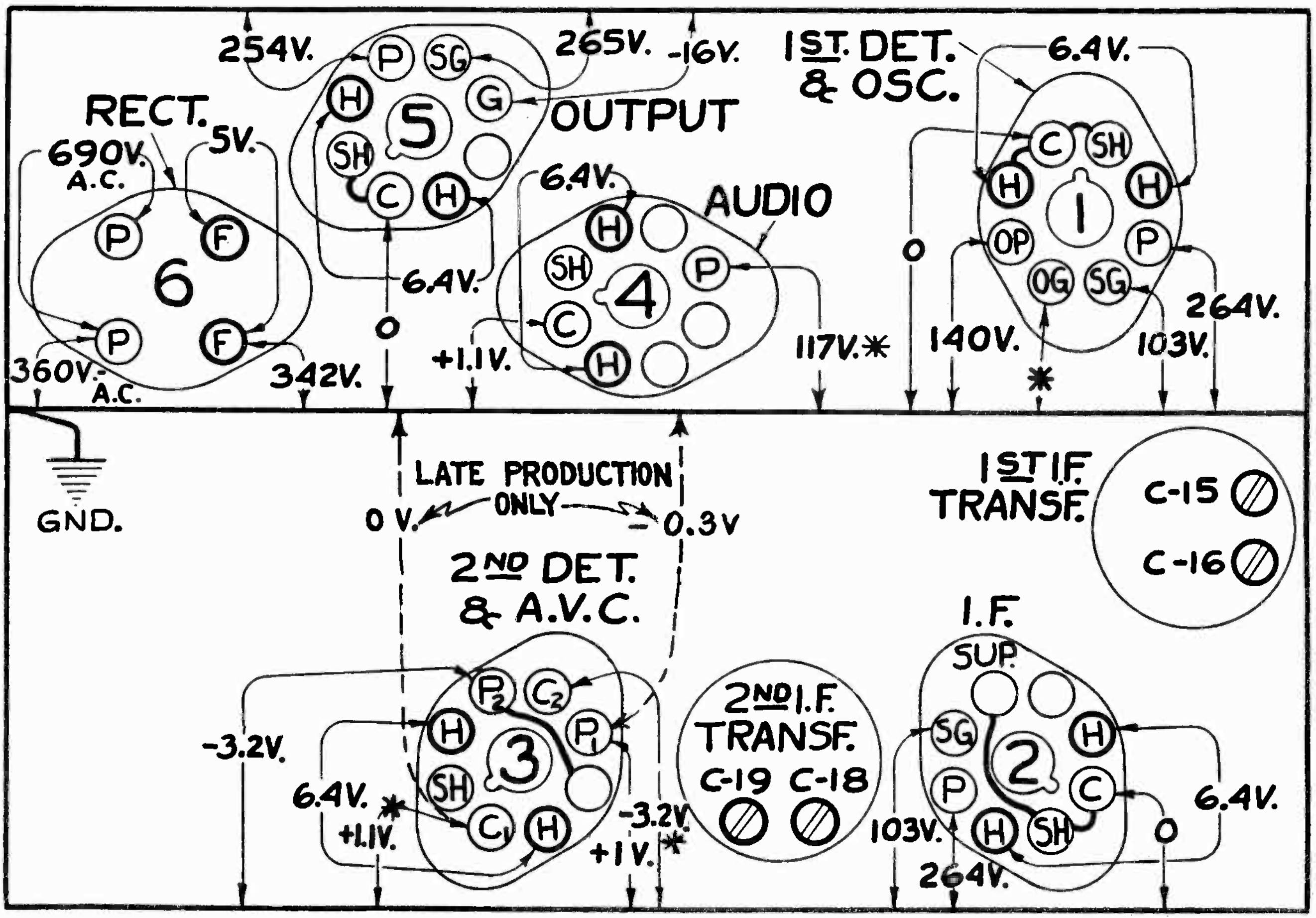
The output indicator should be left connected to the output system. Attach the output of the test oscillator between the antenna and ground terminals of the receiver input. Adjust the oscillator to **1720 kc.** and set the receiver tuning control to a dial reading of **1720 kc.** Leave the volume control of the receiver at its maximum position. Make sure that the range selector is at its broadcast position. Regulate the output of the test oscillator until a slight indication is perceptible at the receiver output. Then adjust the two trimmers of the oscillator and antenna transformer coils (mounted on the variable condenser) so that each produces maximum (peak) receiver output. After this maximum has been accurately obtained, shift the test oscillator to **600 kc.** Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then adjust the receiver oscillator series trimmer, simultaneously rocking the tuning control backward and forward through the signal until maximum receiver output results from these combined operations. The adjustment at **1720 kc.** should then be repeated to correct for any change which may have been caused by the oscillator series trimmer adjustment.

Radiotron Socket Voltages

Voltage values indicated at the Radiotron socket contacts on Figure 4 form a reference basis for test of the receiver. It is to be noted that all voltages are given with respect to chassis-ground, excepting those appearing across the heaters (H-H). The values shown are obtainable when the receiver is in normal operating condition with all tubes intact. They do not take into account inaccuracy caused by the resistance of the voltmeter used for the tests, the lower the voltmeter resistance, the lower the degree of accuracy. Allowance must, therefore, be made, dependent upon the type of test instrument used, for the loading effect of the voltmeter on the circuit.

Wave-Trap Adjustment

With the receiver in operation using its normal antenna, tune station selector to the point at which the intermediate frequency interference is most intense. Then adjust the wave trap trimmer to the point which causes maximum suppression of the interference.



(*) CANNOT BE MEASURED WITH ORDINARY VOLTMETER

Figure 4—Radiotron Socket Voltages

Measured at 115 volts, 60 cycle supply—No signal being received

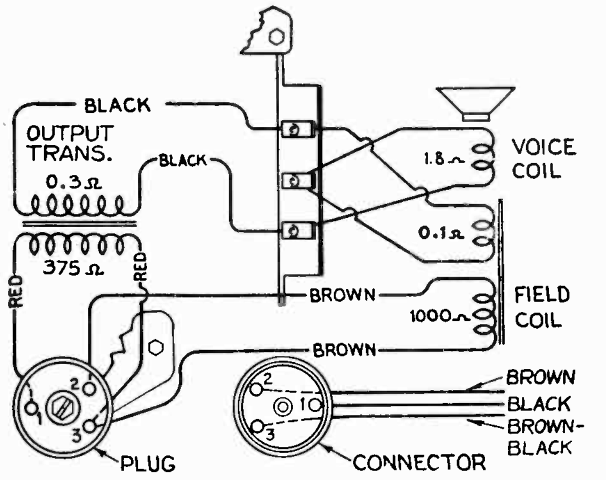
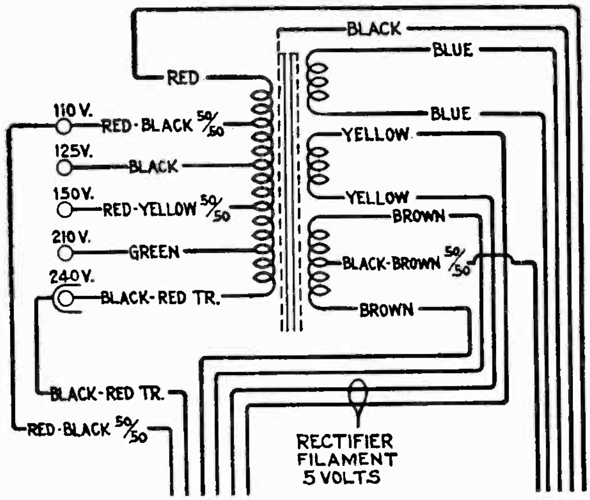


Figure 5—Loudspeaker Wiring



Primary Resistance—17.3 ohms, Total
Secondary Resistance—408 ohms, Total

Figure 6—Universal Transformer

T6-9 REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers.

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
11468	Bracket—Dial mounting bracket	$0.14
11465	Capacitor—Adjustable capacitor—(C10)	.48
11450	Capacitor—11.5 Mmfd. (C9)	.14
11289	Capacitor—50 Mmfd. (C6)	.26
4297	Capacitor—400 Mmfd. (C2)	.30
11449	Capacitor—1350 Mmfd. (C11)	.26
4868	Capacitor—0.005 Mfd. (C12, C23, C26)	.20
4858	Capacitor—0.01 Mfd. (C24)	.25
4624	Capacitor—0.01 Mfd. (C21)	.54
11451	Capacitor—0.017 Mfd. (C25)	.18
11414	Capacitor—0.1 Mfd. (C14)	.20
4841	Capacitor—0.1 Mfd. (C3, C22*)	.22
5170	Capacitor—0.25 Mfd. (C17)	.25
11387	Capacitor—10 Mfd. (C13)	.86
11240	Capacitor—10 Mfd. (C27)	1.08
5212	Capacitor—18 Mfd. (C28)	1.16
11462	Coil—Antenna coil (L2, L3)	1.85
11463	Coil—Oscillator coil (L4, L5)	1.65
11457	Condenser—Two-gang variable tuning condenser—complete with mounting bushing assembly (C4, C5, C7, C8)	3.46
11583	Dial—Dial scale	.40
12042	Drive—Vernier drive for tuning condenser	.35
11467	Indicator—Station selector indicator pointer	.10
5226	Lamp—Dial lamp—Package of 5	.70
11466	Resistor—Voltage divider resistor—comprising one 3,500 ohm, one 13,000 ohm, one 85 ohm, one 40 ohm and one 175 ohm sections (R5, R13, R14, R15, R16)	.95
6135	Resistor—270 Ohms—Carbon type—¼ watt (R1)—Package of 5	1.00
11283	Resistor—1200 Ohms—Carbon type—¼ watt (R17*)—Package of 5	1.00
11454	Resistor—6800 Ohms—Carbon type—¼ watt (R3)—Package of 5	1.00
3066	Resistor—12,000 Ohms—Carbon type—1 watt (R4)—Package of 5	1.10
5029	Resistor—56,000 Ohms—Carbon type—¼ watt (R2)—Package of 5	1.00
11453	Resistor—270,000 Ohms—Carbon type—1/10 watt (R11)—Package of 5	.75
11452	Resistor—470,000 Ohms—Carbon type—1/10 watt (R12)—Package of 5	.75
5158	Resistor—220,000 Ohms—Carbon type—¼ watt (R10*)—Package of 5	1.00
11626	Resistor—2.2 Megohms—Carbon type—¼ watt (R7)—Package of 5	1.00
11464	Shield—Antenna or oscillator coil shield	.25
11390	Shield—Intermediate frequency transformer shield	.25
11383	Shield—Radiotron shield	.20
11461	Switch—Range switch (S1, S2)	.56
5238	Terminal—Antenna terminal board assembly—with clip, insulation strip and rivets	.14
11460	Tone Control—Tone control and power switch (S3, S4)	.95
11388	Transformer—First intermediate frequency transformer (L6, L7, C15, C16)	1.90
11389	Transformer—Second intermediate frequency transformer (L8, L9, C18, C19, C20, R6, R8)	3.02
11458	Transformer—Power transformer—105-125 volts—50-60 cycles (T1)	4.85
11585	Transformer—Power transformer—105-125 volts—25-50 cycles	7.00
11584	Transformer—Power transformer—100-130/140-160/195-250 volts—40-60 cycles	5.05
11391	Trap—Wave trap (L1, C1)	1.22
11459	Volume Control (R9)	.85
	REPRODUCER ASSEMBLIES	
11232	Board—Terminal board assembly with two lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Output transformer mounting bracket	.14
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
11470	Coil—Field coil (L12)	2.16
11469	Coil—Neutralizing coil (L11)	.20
11235	Cone—Reproducer cone (L10)—Package of 5	3.50
5118	Connector—Three-contact male connector for reproducer	.25
5119	Connector—Three-contact female connector for reproducer cable	.25
9621	Reproducer—Complete	6.85
11253	Transformer—Output transformer (T2)	1.56
11230	Washer—Binders board "C" washer—Used to hold field coil assembly—Package of 5	.18

** C-22, R-10 and R-17 used in some models*

RCA VICTOR MODELS T 7-5 and C 7-6

Seven-Tube, Three-Band, A-C, Superheterodyne Receivers

SERVICE NOTES

Electrical Specifications

FREQUENCY RANGES		ALIGNMENT FREQUENCIES	
Band A	540- 1,625 kc.	Band A	600 kc. (osc.), 1,400 kc. (osc., det., ant.)
Band B	1,625- 5,700 kc.	Band B	None required
Band C	5,700-18,000 kc.	Band C	18,000 kc. (osc., det., ant.)

Intermediate Frequency .... **460 kc.**

RADIOTRON COMPLEMENT

(1) RCA-6K7 .... Radio-Frequency Amplifier	(5) RCA-6F5 .... Audio Voltage Amplifier
(2) RCA-6A8 .... First Detector-Oscillator	(6) RCA-6F6 .... Audio Power Amplifier
(3) RCA-6K7 .... Intermediate Amplifier	(7) RCA-80 .... Full-Wave Rectifier
(4) RCA-6H6 .... Second Detector-A.V.C.	

POWER SUPPLY RATINGS

Rating A	105-125 Volts, 50-60 Cycles, 100 Watts
Rating B	105-125 Volts, 25-60 Cycles, 105 Watts
Rating C	100-130/140-160/195-250 Volts, 40-60 Cycles, 105 Watts

POWER OUTPUT		LOUDSPEAKER	
Undistorted	2.25 Watts	Type	Electrodynamic
Maximum	5.0 Watts	Voice Coil Impedance	2.25 ohms at 400 cycles

Mechanical Specifications

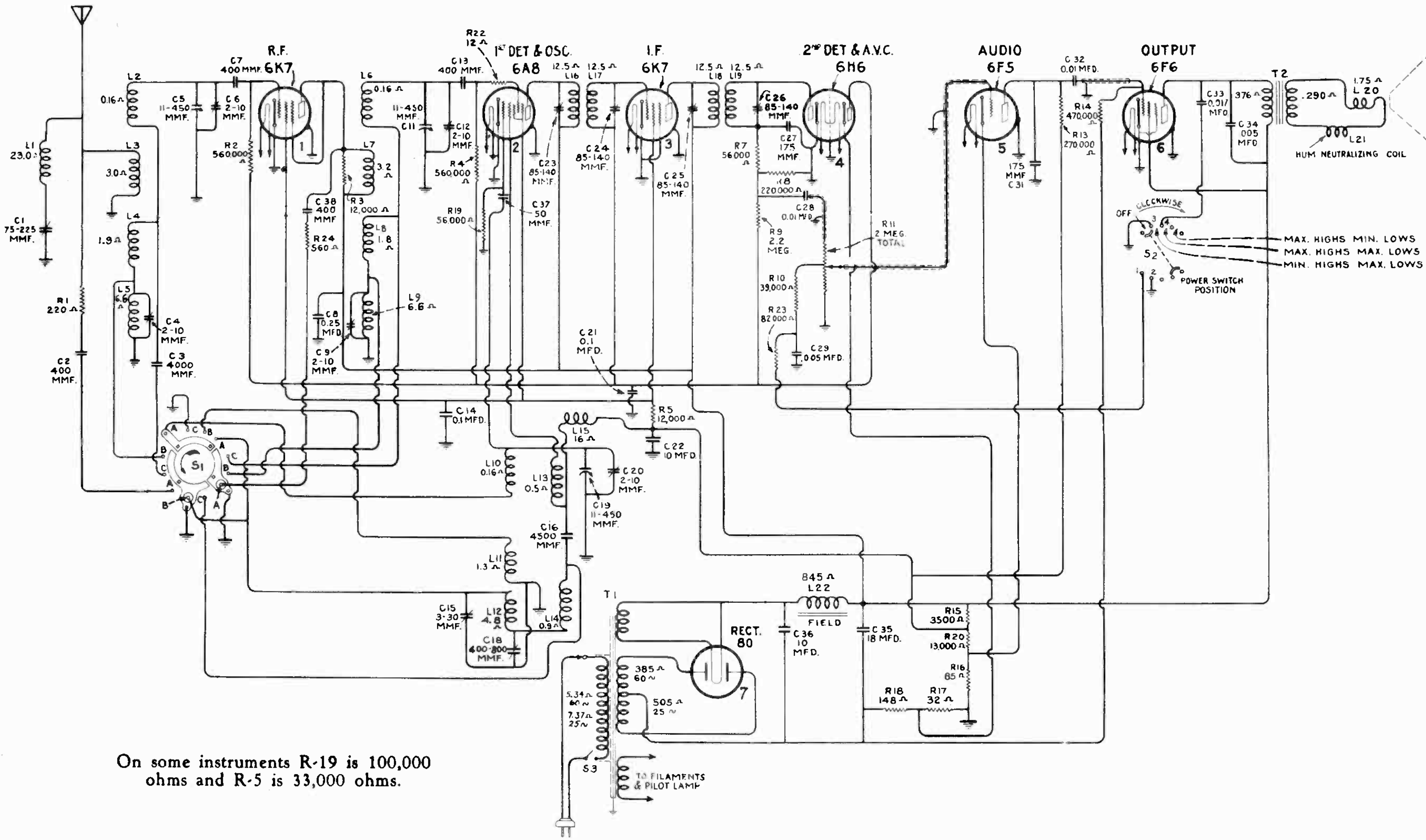
Tuning Drive Ratios	10-to-1 and 50-to-1
Chassis Base Dimensions	13⅞ inches x 7⅝ inches x 2½ inches

	MODEL T 7-5	MODEL C 7-6
Height	19⅜ inches	38 inches
Width	15⅜ inches	24 inches
Depth	9⅜ inches	11 inches
Weight (Net)	30½ pounds	49½ pounds
Weight (Shipping)	36 pounds	64 pounds

Operating Controls .... (1) Volume, (2) Tuning, (3) Range Selector, (4) Power Switch-Tone

General Features

These two models each employ the same seven-tube chassis. They have the new metal tubes. The tuning range is from 540 to 18,000 kc. The coverage includes domestic broadcast, police, aircraft and amateur services and also the important foreign short-wave broadcast bands at 49, 31, 25, 19, and 16 meters. Chassis features include automatic volume control, 3-point tone control, antenna wave trap, and audio tone compensation. A high level of output is available from the receiver for reproduction by the electrodynamic loudspeaker. The table model (T 7-5) uses an 8-inch dynamic speaker and the console model (C 7-6) uses an improved 12-inch dynamic speaker. The tuning dial is an illuminated semi-airplane type. Each band is distinctively marked with a separate color for each band. Positions of the range selector knob are plainly marked on the control panel with letters indicating each band position placed over color strips corresponding to the band colors on the dial. The tuning control is of the dual-ratio type, which permits fast tuning through a 10-to-1 drive ratio and vernier tuning through a 50-to-1 drive ratio. The latter is especially advantageous for accurate tuning of the short-wave stations.



On some instruments R-19 is 100,000 ohms and R-5 is 33,000 ohms.

Figure 1—Schematic Circuit Diagram

On some instruments R-19 is 100,000 ohms and R-5 is 33,000 ohms.

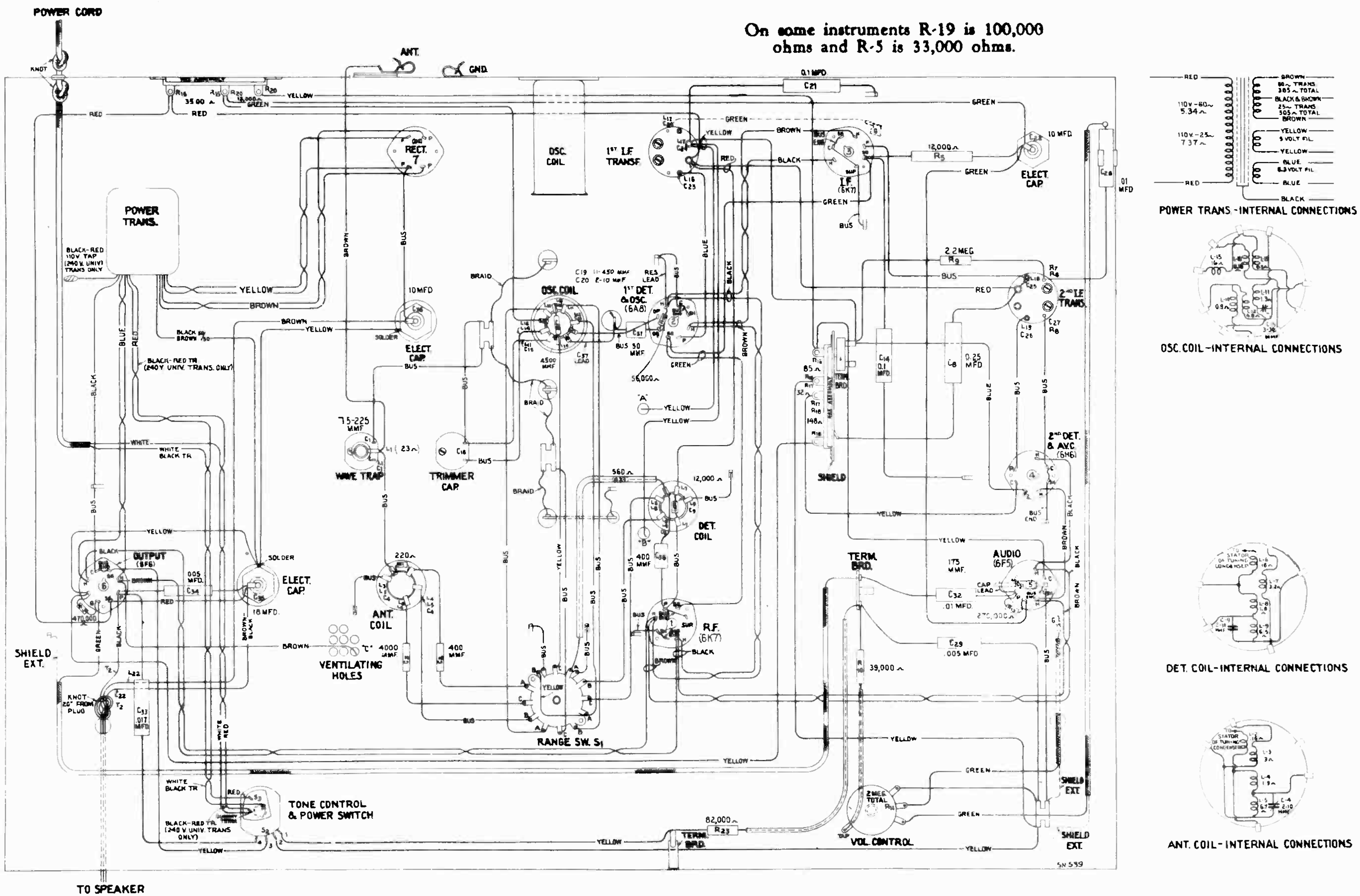


Figure 2—Chassis Wiring Diagram

Circuit Arrangement

The conventional Superheterodyne type of circuit, consisting of an r-f stage, a combined first-detector–oscillator stage, a single i-f stage, a diode-detector–automatic-volume-control stage, an audio voltage amplifier stage, an audio power output stage and a high-voltage rectifier power-supply stage, is used.

Tuned Circuits

The antenna coil system and the detector coil system each consist of a single primary and three series-connected secondary windings to provide the three ranges of tuning. The oscillator coil system is similarly wound on a single form. A range selector switch (S-1) is used for connecting the various sections of these three coil systems into the circuit to provide operation on the band desired. The coils are tuned by a variable three-section gang condenser having trimmer capacitors in shunt with each section. There are additional trimmer capacitors across the section of each coil used for Band "A." A series trimmer is also associated with the Band "A" oscillator coil.

The intermediate frequency amplifier system consists of an RCA-6K7 in a transformer-coupled circuit. This stage operates at a basic frequency of 460 kc. Each winding of both i-f transformers (input and output) is tuned by an adjustable trimmer.

Detector and A.V.C.

The modulated signal as obtained from the output of the i-f stage is detected by an RCA-6H6 twin-diode tube. The audio frequency secured by this process is transferred to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal is used for automatic volume control. This voltage, which develops across resistor R-8, is applied as automatic control-grid bias to the r-f, first-detector, and i-f tubes through a suitable resistance filter circuit. The second (auxiliary) diode of the RCA-6H6 is used to supply residual bias for the controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current which flows through resistors R-8 and R-9, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias-diode ceases to draw current and the a.v.c. diode takes over the biasing function.

Audio System

The manual volume control consists of an acoustically tapered potentiometer in the audio circuit between the output of the detector diode and the input grid of the audio-voltage-amplifier tube. This control has a tone compensating filter connected to it so that the correct aural balance will be obtained at different volume settings.

Resistance-capacitance coupling is used between the first audio stage and the power output stage. The output of the power amplifier is transformer-coupled into the dynamic loudspeaker. High-frequency tone control is effected by a capacitor across the plate circuit of the output tube. Speech-music control is effected by a resistor connected to the compensated volume control circuit. Control of tone is obtained by means of the switch (S-2).

Rectifier

The power required for operation of this receiver is supplied through transformer T-1. This transformer has an efficient electrostatic shield between its primary and secondary windings. This shield prevents interference which is on the power-supply circuit from entering the receiver and conversely reduces the tendency of the receiver to re-radiate into the power circuit. An RCA-80 furnishes the d-c voltages necessary for plate, screen, cathode, and grid potentials. The field winding of the loudspeaker is used as a reactor in the filter circuit from which it simultaneously receives its magnetizing current. The heaters of all Radiotrons are supplied from a low voltage (6.3 volt) winding on the power transformer. One side of this winding is at ground potential.

SERVICE DATA

The various diagrams of this bulletin contain such information as will be needed to isolate causes for defective operation when such a condition develops. Values of the resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles, such as R-3, L-2, C-1, etc., are provided for reference between the diagrams and the replacement parts list. Locating of the parts in the schematic circuit is facilitated by the fact that the numerical titles increase from left to right on the diagram. The coils, reactors, and transformer windings are rated in terms of their d-c resistances only. Resistances of less than one ohm are generallv omitted.

Alignment Procedure

Precise alignment is vital to the proper functioning of this receiver. There are four trimming adjustments provided in the i-f system, three in the oscillator coil system, two in the detector coil system, and two in the antenna coil system. Each of these trimmers has been accurately adjusted during manufacture and should remain properly aligned unless affected by abnormal conditions of climate or have been altered for service purposes. Incorrect alignment is usually evidenced by loss of sensitivity, improper tone quality, and poor selectivity. These indications will generally be present together.

The correct performance of the receiver can only be obtained when the alignment is performed with adequate and reliable test apparatus. The manufacturer of this instrument has a complete assortment of such service equipment available. This equipment, illustrated and described on a separate page of this booklet, may be purchased from authorized distributors and dealers.

An oscillator (signal generator) is required as a source of the specified alignment frequencies. Visual indication of the receiver output during the adjustments is necessary to enable the serviceman to obtain an accuracy of alignment which is not possible by listening to the signal. **The RCA Victor Stock No. 9595 Full-Range Oscillator and the RCA Victor Stock No. 4317 Neon Output Indicator are especially suitable and fulfill the above requirements.**

The following procedure should be followed in adjusting the various trimmer capacitors:

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 4. Each must be aligned to a basic frequency of **460 kc.** To do this, attach the Output Indicator across the voice coil circuit or across the output transformer primary. Connect the output of the test oscillator between the control-grid of the RCA-6A8 first detector tube and chassis-ground. Tune the oscillator to **460 kc.** Advance the receiver volume control to its full-on position and adjust the receiver tuning control to a point within its range where no interference is encountered either from local broadcast stations or the heterodyne oscillator. Increase the output of the test oscillator until a slight indication is apparent on the output indicator. Then adjust the two trimmers, **C-25** and **C-26,** of the second i-f transformer to produce maximum (peak) indicated receiver output. Then, adjust the two trimmers, **C-23** and **C-24,** of the first i-f transformer for maximum (peak) receiver output as shown by the indicating device. During these adjustments, regulate the test oscillator output so that the indication is always as low as possible. By doing so, broadness of tuning due to a.v.c. action will be avoided. It is advisable to repeat the adjustment of all i-f trimmers a second time to assure that the inter-action between them has not disturbed the original adjustment.

R-F Trimmer Adjustments

The seven trimmers associated with the r-f, first detector, and oscillator tuned circuits have their locations shown by Figure 3. The three trimmers which are at all times directly in shunt with the variable tuning condenser necessitate that the high-frequency range (Band C) be aligned first. The range selector switch should, therefore, be turned to its Band C position for the first adjustment. The Output Indicator should be left connected to the output system. Attach the output terminals of the test oscillator to the antenna and ground terminals of the receiver.

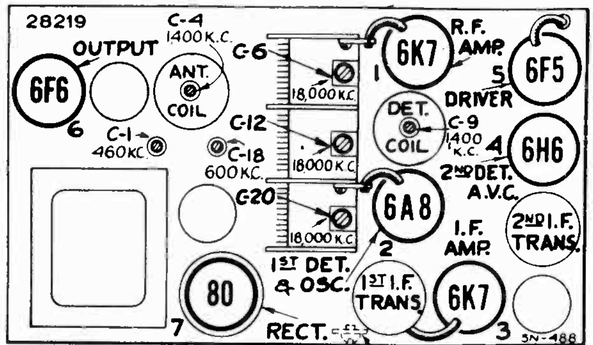
Calibrate the dial by rotating the tuning control until the variable condenser plates are in their full mesh (maximum capacity) position and adjusting the dial pointer so that its end points to the ***horizontal*** graduation (530 kc.) at the low frequency end of the Band A scale.

Proceed further as follows:

(a) Adjust the test oscillator to **18,000 kc.** and set the receiver tuning control to a dial reading of **18,000 kc.**

(b) Regulate the output of the test oscillator until a slight indication is perceptible at the receiver output. Then adjust the trimmer, **C-20,** on the oscillator section of the variable condenser to the point at which it produces maximum indicated receiver output. Two points may be found, each of which produces such a maximum. The one of ***maximum trimmer capacitance*** is correct and should be used (The oscillator will be 460 kc. below the signal frequency at this adjustment point.)

(c) Adjust the trimmer, **C-12,** of the detector section of the variable condenser, simultaneously rocking the receiver tuning control backward and forward through the **18,000 kc.** input signal, until maximum receiver output results from these combined operations. Rocking of the variable condenser will prevent inaccurate adjustment which would otherwise be caused by the inter-action between the heterodyne oscillator circuit and the detector tuned circuit.



1400 K.C. OSC. (C-15) ADJ. CENTER REAR OF CHASSIS

Figure 3—Radiotron and Coil Locations

(d) With the receiver tuning control set to **18,000 kc.** adjust the trimmer, **C-6,** on the antenna section of the variable condenser to the point which produces maximum (peak) indicated receiver output.

(e) Change the receiver range selector to its Band A position and set the receiver tuning control to a dial reading of **1,400 kc.** Tune the test oscillator to **1,400 kc.** and regulate its output to produce a slight indication on the receiver output indicating device.

(f) Adjust the high frequency trimmers of the Band A oscillator, detector, and antenna coils, **C-15, C-9,** and **C-4** respectively, to the points at which each produces maximum indicated receiver output.

(g) Shift the test oscillator frequency to **600 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received.

(h) Tune the low frequency trimmer, **C-18**, of the oscillator Band A coil, simultaneously rocking the tuning control of the receiver backward and forward through the signal, until maximum indicated receiver output results from these combined operations. The adjustment of **C-20, C-12,** and **C-6** should be corrected at **18,000 kc.** as in (b), (c), and (d); also **C-15, C-9,** and **C-4** should be corrected at **1,400 kc.** as in (f) to compensate for any changes caused by the adjustment of the low frequency oscillator coil trimmer.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 4 will assist in the location of causes for faulty operation. Each value as specified should hold within $\pm$ 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Universal Transformer

The special transformer used on some receivers of this type is adaptable to several ranges of voltage as given under Rating C of Electrical Specifications. Its schematic and wiring are shown by Figure 6. Terminals are provided at the top of the transformer case for changing the primary connections to suit the voltage available. Note that a 110-volt tap is brought out separately for supplying a phonograph motor.

Wave-Trap Adjustment

With the receiver in operation using its normal antenna, tune station selector to the point at which the intermediate frequency interference is most intense. Then adjust the wave trap trimmer to the point which causes maximum suppression of the interference. This trimmer is adjusted to 460 kc. during manufacture, however, local conditions may require a readjustment, depending upon the interfering frequency.

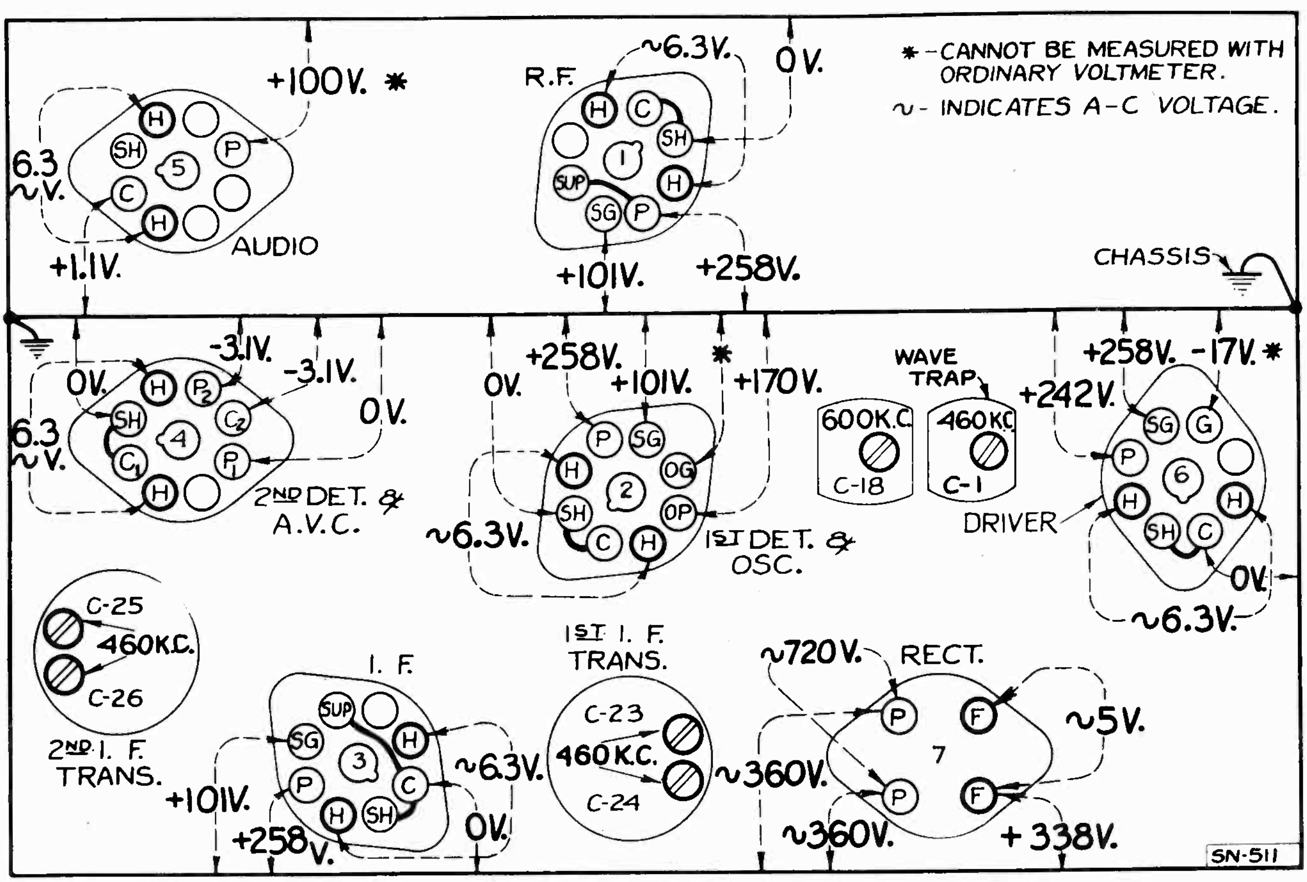


Figure 4—Radiotron Socket Voltages

Measured at 115 volts, 60 cycles—No signal input

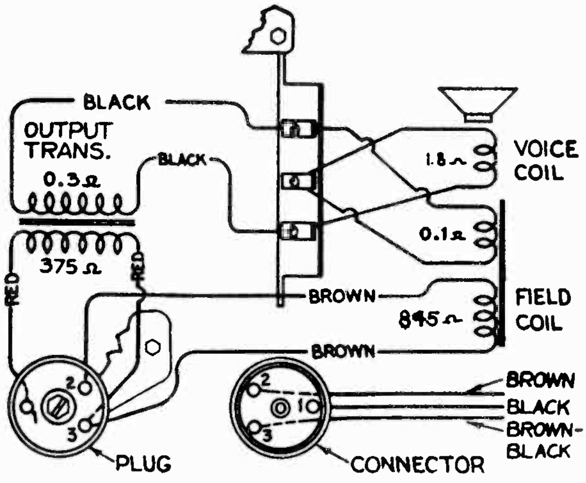
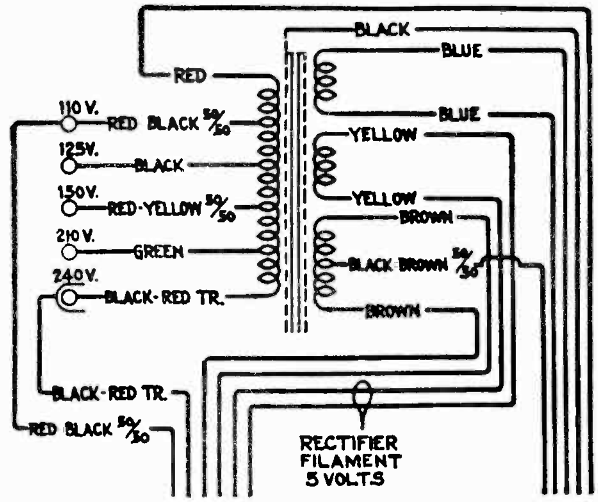


Figure 5—Loudspeaker Wiring



Primary Resistance—10.5 ohms, Total
Secondary Resistance—330 ohms, Total

Figure 6—Universal Transformer

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers.

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
5237	Bushing—Variable tuning condenser mounting bushing assembly—Package of 3	$0.43
11350	Cap—Contact cap—Package of 5	.20
11465	Capacitor—Adjustable capacitor—(C18)	.48
11289	Capacitor—50 MMfd.—(C37)	.26
5116	Capacitor—175 MMfd.—(C31)	.18
11290	Capacitor—400 MMfd.—(C2, C7, C13, C38)	.25
11401	Capacitor—4000 MMfd.—(C3)	.38
4868	Capacitor—.005 Mfd.—(C29, C34)	.20
4906	Capacitor—.017 Mfd.—(C33)	.25
11395	Capacitor—.01 Mfd.—(C28)	.18
4858	Capacitor—.01 Mfd.—(C32)	.25
4839	Capacitor—0.1 Mfd.—(C14)	.28
4841	Capacitor—0.1 Mfd.—(C21)	.22
5170	Capacitor—0.25 Mfd.—(C8)	.25
11240	Capacitor—10 Mfd.—(C36)	1.08
11387	Capacitor—10 Mfd.—(C22)	.86
5212	Capacitor—18 Mfd.—(C35)	1.16
5238	Clip—Antenna terminal board with clip, insulating strip and rivets	.14
11600	Coil—Antenna coil—(L2, L3, L4, L5, C4, R1)	1.78
11601	Coil—Detector coil—(L6, L7, L8, L9, C9, R3)	1.78
11602	Coil—Oscillator coil—(L10, L11, L12, L13, L14, L15, C15, C16)	2.15
11385	Condenser—Three gang variable tuning condenser—(C5, C6, C11, C12, C19, C20)	5.02
11673	Dial—Station selector dial	.78
11394	Foot—Chassis foot assembly—Package of 2	.70
11396	Indicator—Station selector indicator pointer	.25
5226	Lamp—Dial lamp—Package of 5	.70
11393	Resistor—Voltage divider resistor—comprising one 3,500 ohm and one 13,000 ohm sections—(R15, R20)	.74
11329	Resistor—Voltage divider resistor—comprising one 148 ohm, one 32 ohm and one 85 ohm sections—(R16, R17, R18)	.52
11369	Resistor—12 ohms—flexible type complete with contact cap—(R22)	.22
11324	Resistor—560 ohms—Carbon type—¼ watt—(R24)—Package of 5	1.00
3066	Resistor—12,000 ohms—Carbon type—1 watt—(R5*)—Package of 5	1.10
11322	Resistor—39,000 ohms—Carbon type—¼ watt—(R10)—Package of 5	1.00
11282	Resistor—56,000 ohms—Carbon type—1/10 watt—(R19*)—Package of 5	.75
11365	Resistor—82,000 ohms—Carbon type—¼ watt—(R23)—Package of 5	1.00
11323	Resistor—270,000 ohms—Carbon type—¼ watt—(R13)—Package of 5	1.00
11172	Resistor—470,000 ohms—Carbon type—¼ watt—(R14)—Package of 5	1.00
11397	Resistor—560,000 ohms—Carbon type—1/10 watt—(R2, R4)—Package of 5	.75
11626	Resistor—2.2 megohms—Carbon type—¼ watt—(R9)—Package of 5	1.00
11603	Shield—Antenna or detector coil shield	.26
11604	Shield—Oscillator coil shield	.24
11383	Shield—Rectifier Radiotron shield	.20
11390	Shield—Intermediate frequency transformer shield	.25
11199	Socket—Dial lamp socket	.14
4794	Socket—4-contact rectifier Radiotron socket	.15
11198	Socket—7-contact 6K7—6F5—or 6H6 Radiotron socket	.15
11196	Socket—8-contact 6A8 or 6F6 Radiotron socket	.15
11386	Switch—Range switch—(S1)	1.16
11392	Switch—Tone control and power switch assembly—(S2, S3)	1.14
11388	Transformer—First intermediate frequency transformer—(L16, L17, C23, C24)	1.90
11389	Transformer—Second intermediate frequency transformer—(L18, L19, C25, C26, C27, R7, R8)	3.02
11384	Transformer—Power transformer—105-125 volts—50-60 cycles—(T1)	4.65
11725	Transformer—Power transformer—105-125 volts—25-50 cycles	6.60

REPLACEMENT PARTS (Continued)

Stock No.	Description	List Price	Stock No.	Description	List Price
11727	Transformer—Power transformer—105-130, 140-160, 195-250 volts—40-60 cycles	6.60	11233	Coil—Neutralizing coil—(L21)	.30
11391	Trap—Wave trap—(L1, C1)	1.22	11235	Cone—Reproducer cone—(L20)—Package of 5	3.50
11237	Volume Control—(R11)	1.20	5119	Connector—3-contact female connector for reproducer cable	.25
	MISCELLANEOUS ASSEMBLIES		5118	Connector—3-contact male connector for reproducer	.25
11376	Escutcheon—Station selector escutcheon and crystal	.70	9618	Reproducer—Complete	6.40
11582	Knob—Range switch knob—Package of 5	.50	11253	Transformer—Output transformer—(T2)	1.56
11610	Knob—Station selector knob assembly—comprising one small and one large knob—Package of 5	1.00	11230	Washer—"Binders board" "C" washer—used to hold field coil securely—Package of 5	.18
11347	Knob—Volume control or tone control knob—Package of 5	.75		REPRODUCER ASSEMBLIES (Console Model)	
11210	Screw—Chassis mounting screw assembly—Console Model—Package of 4	.28	11232	Board—Terminal board assembly with two lead wire clips	.18
11377	Screw—Chassis mounting screw assembly—Table Model—Package of 4	.12	11231	Bolt—Reproducer yoke and core assembly bolt and nut	.16
11349	Spring—Retaining spring for knobs, Stock No. 11347, No. 11582 and small knob in Stock No. 11610—Package of 5	.15	8060	Bracket—Output transformer mounting bracket	.14
4982	Spring—Retaining spring for large knob in Stock No. 11610—Package of 10	.26	11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
	REPRODUCER ASSEMBLIES (Table Model)		11254	Coil—Field coil—(L22)	2.00
11232	Board—Terminal board with two lead wire clips	.18	11233	Coil—Neutralizing coil—(L21)	.30
11231	Bolt—Yoke and core assembly bolt and nut	.16	11258	Cone—Reproducer cone—(L20)—Package of 5	3.85
8060	Bracket—Output transformer mounting bracket	.14	5118	Connector—3-contact male connector for reproducer	.25
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25	5119	Connector—3-contact female connector for reproducer cable	.25
11254	Coil—Field coil—(L22)	2.00	9619	Reproducer—Complete	6.05
			11253	Transformer—Output transformer—(T2)	1.56
			11230	Washer—"Binders board" "C" washers—used to hold field coil securely—Package of 5	.18

***THE FOLLOWING ARE USED IN SOME MODELS:**

8072	Resistor—33,000 ohms—Carbon type—½ watt—(R5*)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt—(R19*)—Package of 5	1.00

— NOTES —

(1) Beat notes or heterodyning (whistles) may be encountered in some instances on these receivers due to excessive antenna capacitance. This condition may be corrected by reducing the size of the antenna or by inserting a 150 mmfd. capacitor in series with the antenna lead. This may be accomplished in the receiver by removing the lead which connects from the antenna terminal to the wave trap inductance L-1 and inserting the condenser between these points.

RCA VICTOR MODELS T 8-14 and C 8-15

Eight-Tube, Three-Band, A-C, Superheterodyne Receivers

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Frequency Ranges	
Band A	540— 1800 kc.
Band B	1800— 6000 kc.
Band C	6000—18000 kc.
Radiotron Complement	
(1) RCA-6K7	Radio-Frequency Amplifier
(2) RCA-6L7	First Detector
(3) RCA-6J7	Heterodyne Oscillator
(4) RCA-6K7	Intermediate Amplifier
(5) RCA-6H6	Second Detector and A.V.C.
(6) RCA-6F5	Audio Amplifier
(7) RCA-6F6	Power Output Amplifier
(8) RCA-5Z3	Full Wave Rectifier
Voltage and Frequency	
Rating A	105—125 volts, 50—60 cycles
Rating B	105—125 volts, 25—60 cycles
Rating C	100—130/140—160/195—250 volts, 40—60 cycles
Power Consumption	105 watts
Undistorted Output	2 watts
Maximum Output	4½ watts
Loudspeaker	C 8-15—12 inch, Electrodynamic T 8-14— 8 inch, Electrodynamic
Voice Coil Impedance	2¼ ohms at 400 cycles
Intermediate Frequency	460 kc.
Alignment Frequencies	
Band A	600 kc. (osc), 1720 kc. (osc, ant, det)
Band B	6132 kc. (osc, ant, det)
Band C	18000 kc. (osc, ant, det)

MECHANICAL SPECIFICATIONS

	MODEL T 8-14	MODEL C 8-15
Height	19⅞ inches	39 inches
Width	16 inches	25¼ inches
Depth	11¾ inches	12¼ inches
Weight (Net)	35 pounds	52 pounds
Weight (Shipping)	41 pounds	68 pounds

GENERAL FEATURES

These two instruments are alike in chassis construction and design. The table model employs an 8 inch loudspeaker while the console model uses a 12 inch unit. The following features are of outstanding interest:—

Metal Tubes

This receiver uses the new metal tubes which are much smaller in size than the corresponding glass types. The high frequency efficiency of these metal tubes is greater, because of; the shorter lengths of leads, lesser interelectrode capacitance and the more complete shielding of the metallic envelopes. Their rugged construction prevents breakage and reduces microphonic tendencies. The bases and sockets of all types have a standardized arrangement of connecting prongs.

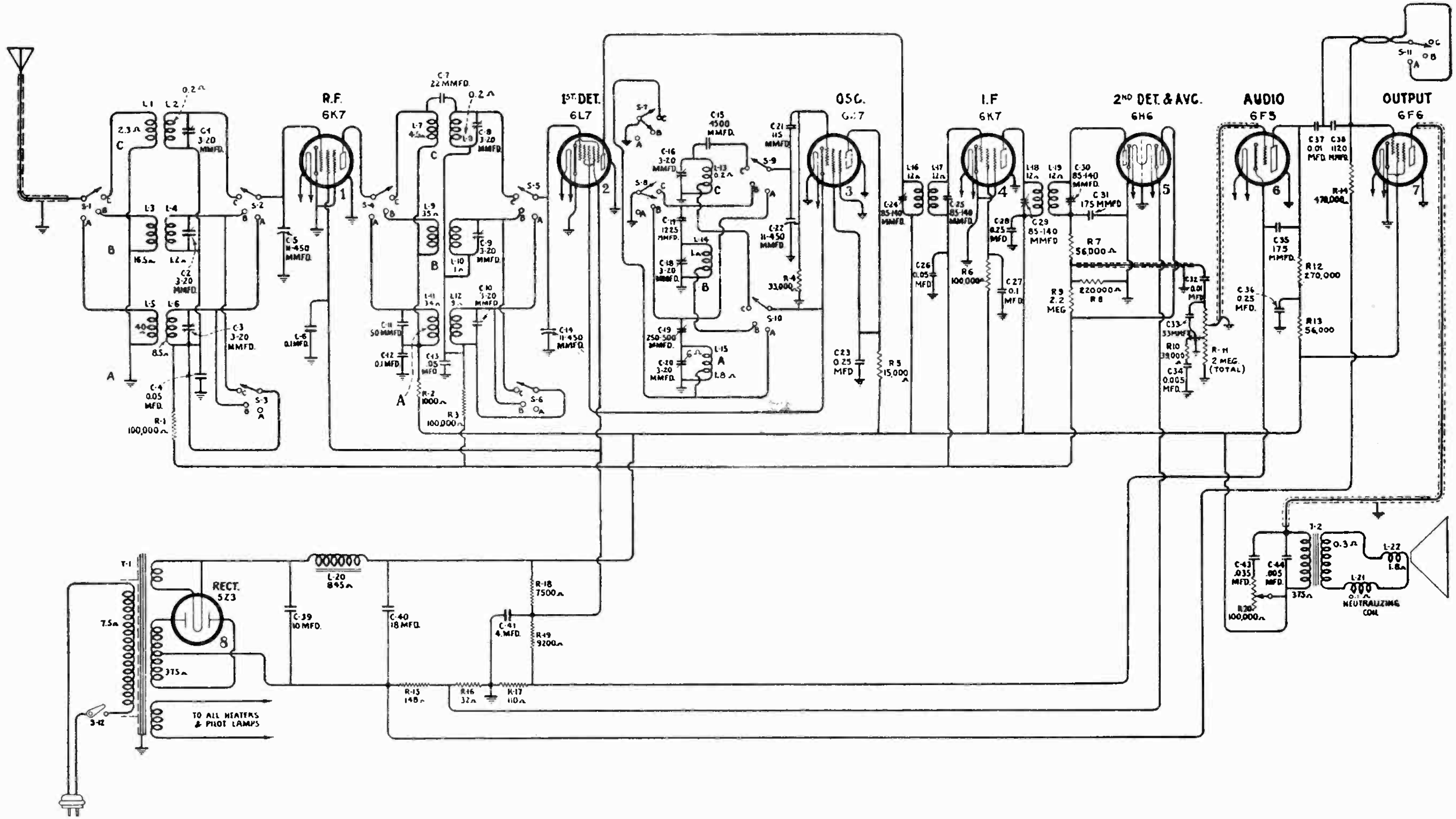


Figure 1—Schematic Circuit Diagram

NOTE: CAPACITOR C-33 IS CONNECTED TO TAP ON VOLUME CONTROL AND NOT TO GROUND AS INDICATED.

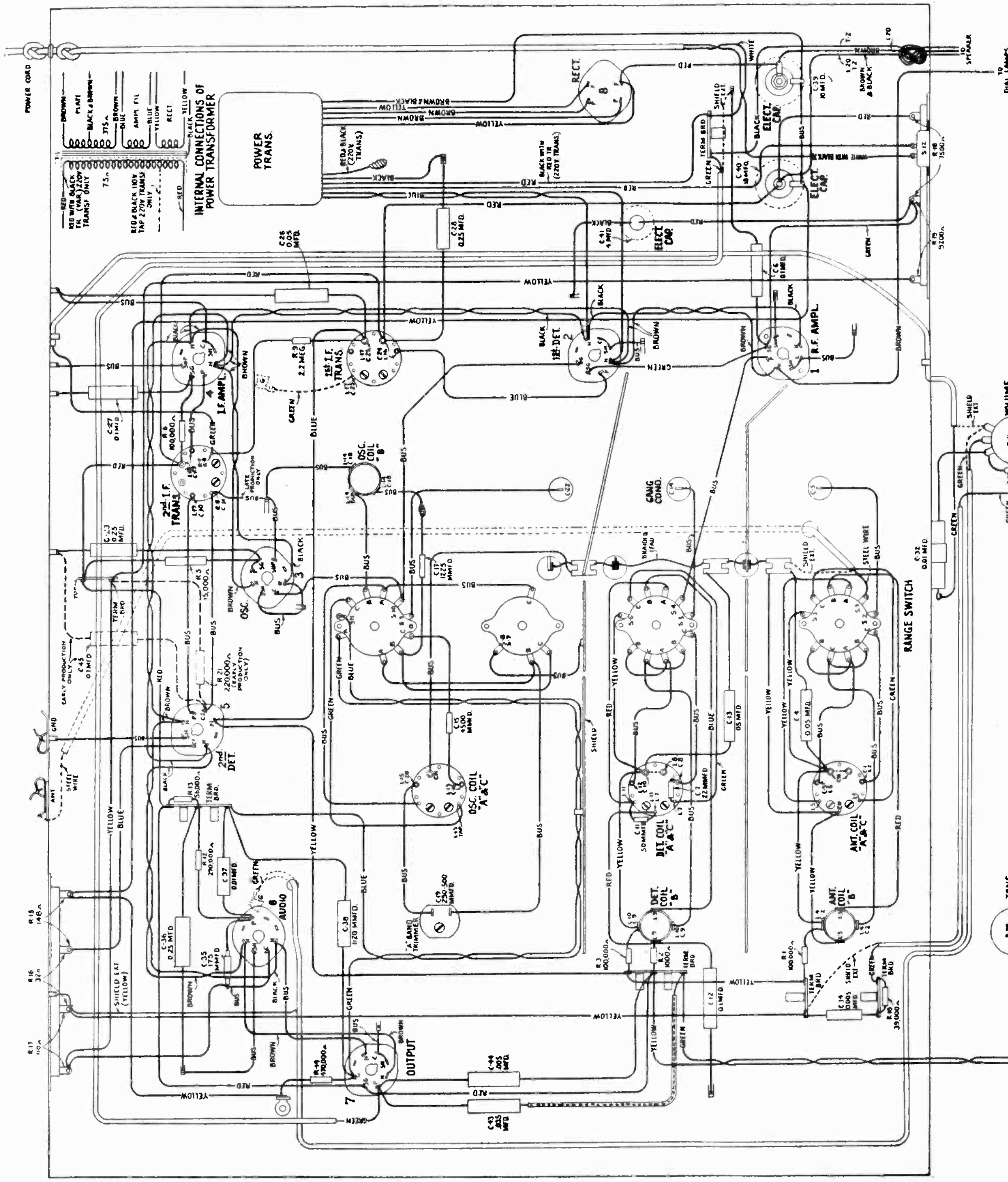


Figure 2—Chassis Wiring Diagram

Dial Drive

An open face airplane type of dial is used. Each scale has a band of color adjacent to its graduations and three short strips of corresponding colors at the lower part of the dial for index purposes. An index pointer, which moves as the band switch is rotated, points to one of these colors to identify the band in use. The drive mechanism is variable, there being either a 50 to 1 or 10 to 1 ratio available between the tuning knob and condenser drive shaft.

Tuning Condenser

The variable tuning condenser is supported by a new design of shock-proof mount which has been developed by our engineers to prevent chassis vibration from producing audio frequency "howl".

Plug-In Loudspeaker

A readily detachable plug type of connection is used in the chassis to loudspeaker cable. This permits ready removal for service.

CIRCUIT FEATURES

The circuit is based upon the Superheterodyne principle. The three ranges of tuning are covered by three sets of coils. A single r-f stage provides the desired selectivity and gain ahead of the hexode first detector tube. The oscillator stage operates separately from the first detector. A single stage i-f system is employed. Its basic frequency is 460 kc. Diode detection is performed by a double diode RCA-6H6 Radiotron. Automatic volume control is provided by this same tube. The audio system consists of two stages, one an RCA-6F5, and the output, an RCA-6F6. High voltages for plate and bias supplies are obtained from an RCA-5Z3 full wave rectifier through an efficient filter. The field of the loudspeaker acts as a reactor in the filter circuit. Further details of the circuit are as follows:—

Oscillator

The oscillator circuit has extreme stability of frequency and good uniformity of output over the tuning ranges. These qualities assure that the tuning of the receiver will not drift as the line voltage varies or the receiver heats. The action of the circuit is such that when the cathode emission tends to change with line voltage or because of other reasons, the variation of voltage drop in the plate and screen resistor restores the operating characteristics of the tube to normal and thus maintains constancy of the generated signal.

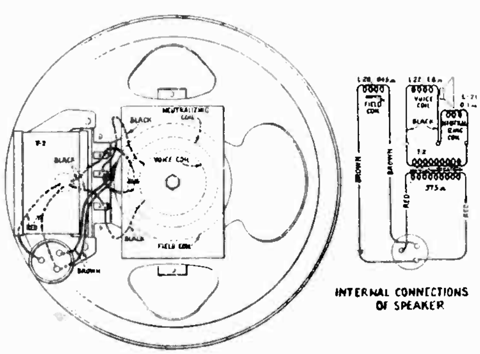


Figure 3—Loudspeaker Wiring

First Detector

This stage has unusually good high frequency mixing efficiency. The tube used, an RCA-6L7, is a new hexode type. The signal is supplied to the first control grid and the oscillator voltage is fed in on a second control grid, a screen grid separating the two. The arrangement of the grids prevents degenerative difficulties, particularly at the higher frequencies. The second grid is direct-connected to the cathode of the oscillator and has no d-c bias.

Compensated Volume Control

The variation in response of the human ear with different degrees of volume is compensated for by a resistor and condenser network in the manual volume control circuit. The volume control itself is an acoustically tapered potentiometer which provides equal changes of sound intensity for the listener per degree of rotation.

Range Switch

The band change switch has several functions. It exchanges the antenna, detector and oscillator coils in order to select the range desired. At the same time, it shorts out the unused coils so as to eliminate their absorptive effects. It also varies the fidelity by shorting a coupling condenser in the audio system to provide the desired reproduction for short as well as long wave reception.

Tone Control

Provision is included for variable reduction of high frequencies. This consists of a resistor and condenser combination across the primary winding of the output transformer, the resistor being the variable element. As it is decreased, the high frequency response limit is lowered.

Power System

The power transformer has its primary winding capacitively shielded from its secondary windings to eliminate transfer of line disturbances into the receiver and to stop any tendency for the circuit to radiate into the line. Rectification is performed in the usual manner by a full wave tube.

Detection and A.V.C.

The modulated signal as obtained from the output of the i-f system is detected by an RCA-6H6 double diode tube. The audio frequency secured by this process is passed on to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal is used for automatic volume control. This voltage, which develops across resistor R-8, is applied as automatic control grid bias to the r-f, first detector and i-f tubes through suitable resistance-capacitance filter circuits. The second diode of the RCA-6H6 is used to supply residual bias for

these controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current, which flows through R-9 and R-8, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain low level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed for servicing the receiver. The ratings of all resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. The coils, reactors and transformer windings are rated in terms of their d-c resistances only and where the value is less than one ohm, no rating is given. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and replacement parts list.

Alignment Procedure

There are a total of fourteen adjustments necessary for obtaining proper alignment when such a process becomes necessary. Four of these are involved with the i-f system and the remainder are associated with the antenna, first detector and oscillator coils.

Correct performance of the receiver can only be obtained when the trimmer adjustments have been made by a skilled service man with the use of adequate and reliable test equipment. Such apparatus as may be required for this particular instrument is illustrated and described on a separate page of this booklet.

Two methods of alignment are applicable. One utilizes a Cathode-Ray Oscillograph as a means of output indication and the other follows former procedure where a glow type indicator or meter is used. The oscillographic method is much to be preferred, since greater accuracy is possible and the time required is lessened. There are no approximations necessary as with the meter or aural method, but each adjustment can be made with excellent precision. Both methods are hereinafter outlined so that alignment operations may be made according to the equipment available.

It is wise to determine the necessity for alignment as well as the direction of misalignment before making adjustments. The RCA Tuning Wand is an instrument designed particularly for such a purpose.

The Tuning Wand consists of a bakelite rod having a small brass cylinder at one end and a core of finely divided iron at the other. It may be inserted into a tuned coil while a signal of the normal resonant frequency is being supplied to such coil to obtain an indication of the tuning. Holes are provided at the top of each shield can for entrance of the Wand. The presence of either end of the Wand will cause a change in tuning which will be indicated at the receiver output as an increase or decrease in signal level. If there is a decrease of output when either end is inserted, the tuning is correct and will require no adjustment. However, should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output while the iron end causes a decrease, reduction of inductance will be necessary to place the circuit in alignment. This is equivalent to decreasing the trimmer concerned. The following tabulation gives the various changes and the adjustments required:—

WAND	SIGNAL	TRIMMER
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

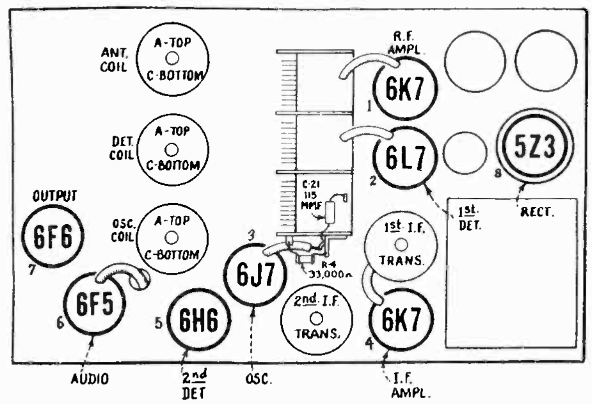


Figure 4—Coil and Radiotron Locations

(1) CATHODE-RAY ALIGNMENT

Equipment

A standard source of the specified alignment frequencies is required. Such a source should consist of an RCA Full Range Oscillator, Stock No. 9595. Output indication should be by means of an RCA Stock No. 9545 Cathode-Ray Oscillograph. An RCA Stock No. 9558 Frequency Modulator will be needed to sweep the generated signal and synchronize it with the Oscillograph in order to make possible the visual representation of the resonant characteristic of the circuit being tuned on the cathode-ray fluorescent screen.

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 6. Each must be aligned to a basic frequency of 460 kc. The last transformer must be aligned firstly and the first transformer aligned secondly. For such a process, it is necessary to feed the output of the Full Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each transformer and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The proper point of connection of the Oscillograph is with its vertical "high" input terminal attached to the juncture of R-7, R-8 and R-9 as illustrated in Figure 6, and with the "0" or ground terminal to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as shown by

Figure 5. A .001 mfd. capacitor installed in series with the Oscillator "Ant." lead will prevent the voltages of the stage under alignment from becoming upset. The vertical "A" amplifier should be "On" for the ensuing adjustments and the gain control kept at its maximum position. For each adjustment, the Oscillator output need be regulated so that the image obtained

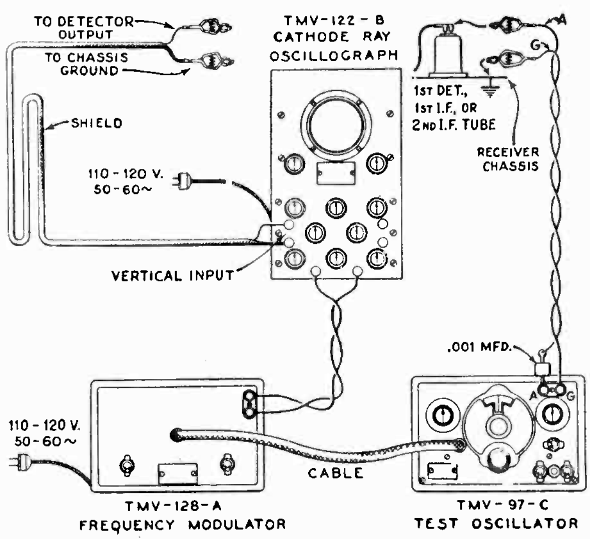


Figure 5—Alignment Apparatus Connections

on the Oscillograph screen will be of sufficient size as to be accurately observable. Proceed further as follows:—

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver range switch to Band "A" and tune the station selector to a point where no interference will be picked up, shorting the antenna and ground terminals if necessary. Set the Oscillograph horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a straight line trace completely across the screen. Place the timing control to "Int." Adjust the intensity and focusing controls of the Oscillograph to produce the correct size and strength of the spot.

(b) Attach the output of the test Oscillator between the control grid cap of the RCA-6K7 i-f tube and chassis ground as shown typically by Figure 5. Tune the Oscillator to **460 kc.** and set its modulation switch to "On". Regulate its output until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph controls to give the desired number of cycles. Cause the image to stand still on the screen by manipulation of the frequency and synchronizing controls. Then carefully tune the two trimmers C-29 and C-30 of the second i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full Range Oscillator by means of the special shielded patch cord. Figure 5 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off". Change the timing control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then carefully shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become exactly coincident at their highest points. These curves will be found to occur at an Oscillator setting of *approximately 540 kc.* They will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with the above requirements and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-29 and C-30 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as in (c), change the Oscillator output to the control grid cap of the RCA-6L7 first detector tube. Then adjust the first i-f transformer trimmers C-24 and C-25 so that the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the overall tuning characteristic of the i-f system. Each trimmer of the entire group should then be checked to assure that it is in correct alignment as indicated by the degree of coincidence and relative amplitude of the image on the Oscillograph screen.

R-F Trimmer Adjustments

Locations of the various antenna, detector and oscillator coil trimmers are shown by Figure 6. The test Oscillator should be removed from connection with the i-f system and its output connected to the antenna-ground terminals of the receiver. No changes are to be made in the connections of the Oscillograph at the second detector. During the following adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Adherence to such a procedure will obviate the broadness of tuning that would result from a.v.c. action on a stronger signal. Proceed with the adjustments as follows:—

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning condenser plates are in full mesh (maximum capacitance). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the Band A scale.

Band A

(a) With the receiver range switch in its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the test Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector and antenna trimmers C-20, C-10 and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. After each trimmer has been peaked, the Oscillograph timing control should be set to "Ext." and the Frequency Modulator placed into operation with its connections to the Oscillator and Oscillograph made in accordance with Figure 5. Turn the modulation switch of the Oscillator to "Off" and retune the Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-20, C-10 and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the wave images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Place the modulation switch to "On". Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator (modulation "Off") until the two similar forward and reverse waves appear on the screen. For this adjustment, it is advisable to shift the Oscillator to its 200—400 kc. range and use the third harmonic of the generated signal in order to obtain the desired range of sweep. The oscillator series trimmer C-19 should then be adjusted to produce maximum amplitude of the images. No rocking will be necessary on the station selector inasmuch as the signal frequency is being "wobbled" by the Frequency Modulator to produce the same effect.

After completing this adjustment the trimmer C-20 should be re-aligned as in (a) to correct for any change brought about by the adjustment of C-19.

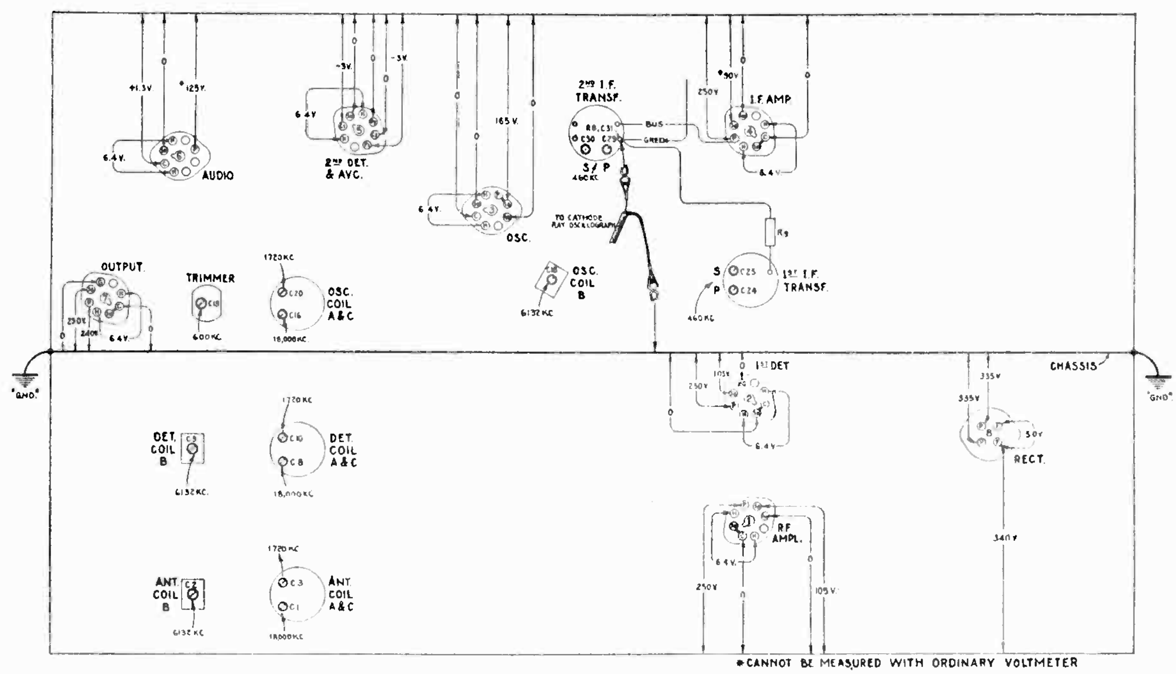


Figure 6—Trimmer Locations and Radiotron Socket Voltages
Measured at 115 volts A.C.—No Signal—Volume Control Maximum

Band B

(a) Advance the receiver range switch to its Band B position and tune the station selector to a dial reading of **6132 kc.** Set the test Oscillator to this same frequency (modulation "On" and Frequency Modulator disconnected) and increase its output until a suitable indication is apparent on the Oscillograph. The Oscillograph should be adjusted for "Int." timing. Then adjust the oscillator trimmer C-18 to the point at which maximum amplitude of the image is obtained. Two positions will be found for this trimmer which gives such a maximum. The one of least capacitance is correct and should be used. This can be checked by tuning the "image" signal, which will be received at **5212 kc.** on the dial if the adjustment of C-18 has been properly made. An increase in test Oscillator output may be necessary for this test, however, *its frequency should not be changed from* **6132 kc.** *nor any trimmer adjustments made on the receiver.*

(b) Return the station selector to the **6132 kc.** reading and align the detector, and antenna coil trimmers, C-9 and C-2 respectively, for maximum (peak) output as shown by the Oscillograph. No further adjustments are to be made on this band.

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to the same frequency (modulation "On" and Frequency Modulator disconnected) and regulate its output to the level required for convenient observation. Adjust the trimmer C-16 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of the proper "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of C-16 has been properly made using the position of least capacitance which gives maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, re-align C-16 if necessary, and then adjust the detector and antenna trimmers, C-8 and C-1, for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on this band.

(2) ALIGNMENT WITH OUTPUT METER

To align the receiver by means of an output indicator other than a Cathode-Ray Oscillograph will require the use of a standard test Oscillator such as that recommended above for the source of signals and means of indication for the output. The RCA Neon Output Indicator, Stock No. 4317 will be found very satisfactory for such use. It should be connected across the voice coil circuit of the loudspeaker or across the output transformer primary.

I-F Alignment

Connect the test Oscillator to the control grid cap of the i-f tube. Advance the volume control of the receiver

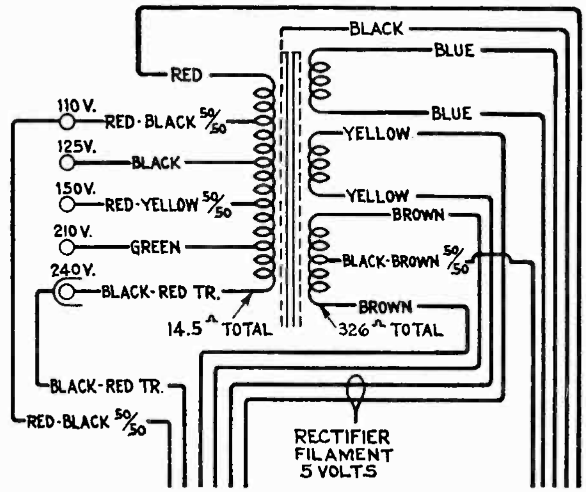


Figure 7—Universal Power Transformer Connections

to its full-on position. Tune the test Oscillator accurately to **460 kc,** and align the trimmers C-29 and C-30 to give maximum receiver output. Regulate the Oscillator output during this adjustment so that the output indication is as small as can be conveniently observed. After completing the adjustments of these trimmers, re-connect the Oscillator so that it will feed into the control grid circuit of the RCA-6L7 first detector. Then tune the first i-f transformer trimmers C-24 and C-25 for maximum receiver output.

R-F Alignment

After completing the i-f adjustments, it is advisable to correct the line-up of the circuits ahead of the first detector. The test Oscillator should be connected to the antenna-ground terminals of the receiver and the manual volume control kept at its maximum position. For each adjustment the Oscillator output should be maintained as low as possible in order to avoid broadness of tuning which would result from a.v.c. action on a stronger signal. **Band A** should be aligned by supplying a **1720 kc.** signal to the receiver, tuning the station selector to a dial reading of **1720** and adjusting the trimmers C-20, C-10 and C-3 to produce maximum receiver output. The Oscillator should then be shifted to **600 kc.** and the receiver tuned to resonate this signal, disregarding the reading at which it is best received. Trimmer C-19 must then be adjusted, simultaneously while rocking the station selector backward and forward through the signal until the maximum output results from the combined operations. C-20 should be rechecked to assure that its adjustment has not changed because of the trimming of C-19. **Band B** must be aligned at **6132 kc.** by tuning the test Oscillator to such a frequency and turning the station selector to the same dial reading. Tune the trimmer C-18 to produce maximum receiver output, using the setting of least capacitance which causes same. The presence of the proper "image" may be checked by tuning the receiver to **5212 kc.** at which point the **6132 kc.** signal will be heard if the trimmer C-18 has been properly set to the position of least capacitance for maximum (peak) output. It may be necessary to increase the Oscillator output for this check. *No adjustments are to be made.* Return the station selector to the **6132 kc.** dial marking and trim capacitors C-9 and C-2 for maximum receiver output. No other adjustments are necessary on Band B. Change the receiver so that it is operative and the dial reads **18,000 kc.** on the **"C" Band.** Tune the test Oscillator to this same frequency. Then adjust the oscillator trimmer C-16 to produce maximum (peak) output. Two positions of this trimmer will be found which conform with this requirement. The one of least capacitance is correct. Check for the presence of "image" response at **17,080 kc.** by shifting the receiver tuning. If it is received at such a point, the trimmer C-16 has been correctly adjusted to the right peak. *No adjustments are to be made during this check.* Tune the receiver back to the **18,000 kc.** dial marking, re-adjust C-16 if necessary, and then tune the detector and antenna capacitors C-1 and C-8 for maximum receiver output. No further adjustments are necessary.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 6 will serve to assist in the location of causes for faulty operation. Each value as specified should hold within ± 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Universal Transformer

The transformer used on some models of these receivers is adaptable to several ranges of voltage as given under rating C of Electrical Specifications. Its schematic and wiring are shown by Figure 7. Terminals are provided at the top of the transformer case for changing the primary connections to suit the voltage being used.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers.

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4427	Bracket—Volume control or high frequency tone control mounting bracket	$0.18
5237	Bushing—Variable tuning condenser mounting bushing assembly—Package of 3	.43
11350	Cap—Contact cap—Package of 5	.20
11223	Capacitor—Adjustable capacitor (C19)	.46
11292	Capacitor—22 MMfd. (C7)	.24
11321	Capacitor—33 MMfd. (C33)	.26
11289	Capacitor—50 MMfd. (C11)	.26
11291	Capacitor—115 MMfd. (C21)	.24
5116	Capacitor—175 MMfd. (C35)	.18
4409	Capacitor—1120 MMfd. (C38)	.35
11288	Capacitor—1225 MMfd. (C17)	.30
11287	Capacitor—4500 MMfd. (C15)	.30
4868	Capacitor—0.005 Mfd. (C34, C44)	.20
4624	Capacitor—0.01 Mfd. (C32)	.54
4858	Capacitor—0.01 Mfd. (C37)	.25
5196	Capacitor—0.035 Mfd. (C43)	.18
4836	Capacitor—0.05 Mfd. (C4, C13, C26)	.30
4885	Capacitor—0.1 Mfd. (C6, C12, C27)	.28
5170	Capacitor—0.25 Mfd. (C23, C28, C36)	$0.25
11248	Capacitor—4 Mfd. (C41)	1.06
11240	Capacitor—10 Mfd. (C39)	1.08
5212	Capacitor—18 Mfd. (C40)	1.16
11272	Clamp—Antenna cable clamp—Located near antenna terminal	.10
4748	Clamp—Capacitor mounting clamp assembly—for stock #11248	.15
5215	Coil—Antenna coil (A and C Bands)—(L1, L2, L5, L6, C1, C3)	2.32
5245	Coil—Antenna coil (B Band)—(L3, L4, C2)	1.58
5216	Coil—Detector coil (A and C Bands)—(L7, L8, L11, L12, C8, C10)	2.34
5246	Coil—Detector coil (B Band)—L9, L10, C9)	1.62
5217	Coil—Oscillator coil (A and C Bands)—(L13, L15, C16, C20)	2.20
5247	Coil—Oscillator coil (B Band)—(L14, C18)	1.44
11214	Condenser—3-Gang variable tuning condenser (C5, C14, C22)	4.20
11238	Tone Control—High frequency tone control (R20)	.96

REPLACEMENT PARTS—CONT'D

Stock No.	Description	List Price
11237	Volume Control—(R11)	$1.20
4340	Lamp—Dial lamp—Package of 5	.60
11710	Lead—Shielded lead for antenna	.40
8041	Plate—R.F. or I.F. coil shield locking plate—Package of 2	.12
11244	Resistor—Voltage divider resistor, comprising one 7500 ohm and one 9200 ohm section—(R18, R19)	1.08
11245	Resistor—Voltage divider resistor, comprising one 148 ohm, one 32 ohm and one 110 ohm section—(R15, R16, R17)	62
5112	Resistor—1000 Ohm—Carbon Type—¼ Watt—(R2)—Package of 5	1.00
5114	Resistor—15,000 Ohm—Carbon Type—1 Watt—(R5)	.22
11300	Resistor—33,000 Ohm—Carbon Type—1⁄10 Watt—(R4)—Package of 5	.75
11322	Resistor—39,000 Ohm—Carbon Type—¼ Watt—(R10)—Package of 5	1.00
5029	Resistor—56,000 Ohm—Carbon Type—¼ Watt—(R13)—Package of 5	1.00
3118	Resistor—100,000 Ohm—Carbon Type—¼ Watt—(R1, R3, R6)—Package of 5	1.00
11323	Resistor—270,000 Ohm—Carbon Type—¼ Watt—(R12)—Package of 5	1.00
11172	Resistor—470,000 Ohm—Carbon Type—¼ Watt—(R14)—Package of 5	1.00
11151	Resistor—2.2 Megohms—Carbon Type—¼ Watt—(R9)—Package of 5	1.00
5249	Shield—Antenna, detector or oscillator coil shield	.20
5250	Shield—Intermediate frequency transformer shield	.22
11273	Shield—Rectifier Radiotron shield	.25
11222	Socket—Dial lamp socket	.18
4794	Socket—4-contact rectifier Radiotron socket	.15
11313	Socket—5-contact Radiotron socket	.18
11198	Socket—7-contact Radiotron socket	.15
11236	Switch—Band switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11)	2.44
11133	Switch—Power switch—(S12)	.62
5238	Terminal—Antenna terminal clip assembly	.14
11216	Transformer—First intermediate frequency transformer (L16, L17, C24, C25)	2.15
11239	Transformer—Second intermediate frequency transformer—(L18, L19, C29, C30, C31, R7, R8)	2.72
11241	Transformer—Power transformer—105-125 volts—50-60 cycles (T1)	4.56
11242	Transformer—Power transformer—105-125 volts—25-60 cycles	6.52
11243	Transformer—Power transformer—100-130, 140-160, 195-250 volts—40-60 cycles	4.64
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball—Used with winding shaft—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—comprising drive shaft, balls, ring, spring and washers—assembled	1.00
11328	Dial—Dial scale	.68
11252	Drive—Variable tuning condenser drive assembly	1.88
11225	Indicator—Band indicator pointer	.18
4520	Indicator—Station selector indicator pointer	.18
11226	Link—Band indicator operating link and arm assembly—less pointer	.20
3993	Screw—No. 6-32-5/32" square set screw for band indicator operating arm—Package of 10	.25
4669	Screw—No. 8-32-5/32" set screw for variable condenser drive assembly—Package of 10	.25
4377	Spring—Band indicator operating arm spring—Package of 5	$0.25
4378	Stud—Band indicator operating arm stud and nut assembly—Package of 5	.25
	MISCELLANEOUS ASSEMBLIES	
11337	Escutcheon—Station selector escutcheon	.70
6614	Glass—Station selector dial glass	.30
11346	Knob—Station selector knob—Package of 5	.75
11347	Knob—Volume control, tone control, range switch or power switch knob—Package of 5	.75
11246	Foot—Chassis mounting foot and bracket assembly—Package of 2	.76
4678	Ring—Spring retaining ring for dial glass—Package of 5	.34
11210	Screw—Chassis mounting screw assembly—Package of 4	.28
11348	Screw—No. 8-32-7/16" headless cupped point set screw for knob, stock #11346—Package of 10	.32
11349	Spring—Retaining spring for knob, stock #11347—Package of 5	.15
	REPRODUCER ASSEMBLIES Table Model	
11232	Board—Terminal board with two lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Output transformer mounting bracket	.14
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
11254	Coil—Field coil—(L20)	2.00
11233	Coil—Neutralizing coil (L21)	.30
11235	Cone—Reproducer cone—(L22)—Package of 5	3.50
5119	Connector—3-contact female connector for reproducer cable	.25
5118	Connector—3-contact male connector for reproducer	.25
9618	Reproducer—Complete	6.40
11253	Transformer—Output transformer—(T2)	1.56
11230	Washer—"Binders board" "C" washer—used to hold field coil securely—Package of 5	.18
	REPRODUCER ASSEMBLIES Console Model	
11232	Board—Terminal board assembly with two lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Output transformer mounting bracket	.14
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
11254	Coil—Field coil—L20	2.00
11233	Coil—Hum neutralizing coil—L21	.30
11258	Cone—Reproducer cone—L22—Package of 5	3.85
5118	Connector—3-contact male connector for reproducer	.25
5119	Connector—3-contact female connector plug for reproducer cable	.25
9619	Reproducer—Complete	6.05
11253	Transformer—Output transformer—T2	1.56
11230	Washer—"Binders board" "C" washer used to hold field coil assembly	.18

RCA VICTOR MODELS T 8-16 and C 8-17

Eight-Tube, Three-Band, A-C, Superheterodyne Receivers

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

FREQUENCY RANGES

Band X	140— 410 kc.
Band A	540— 1800 kc.
Band C	5700—18000 kc.

RADIOTRON COMPLEMENT

(1) RCA-6K7	Radio-Frequency Amplifier
(2) RCA-6L7	First Detector
(3) RCA-6J7	Heterodyne Oscillator
(4) RCA-6K7	Intermediate Amplifier
(5) RCA-6H6	Second Detector and A.V.C.
(6) RCA-6F5	Audio Amplifier
(7) RCA-6F6	Power Output Amplifier
(8) RCA-5Z3	Full Wave Rectifier

VOLTAGE AND FREQUENCY

Rating A	105—125 volts, 50—60 cycles
Rating B	105—125 volts, 25—60 cycles
Rating C	100—130/140—160/195—250 volts, 40—60 cycles

Power Consumption	105 watts
Undistorted Output	2 watts
Maximum Output	4½ watts
Loudspeaker	C 8-17—12 inch, Electrodynamic T 8-16— 8 inch, Electrodynamic
Voice Coil Impedance	2¼ ohms at 400 cycles
Intermediate Frequency	460 kc.

ALIGNMENT FREQUENCIES

Band X	150 kc. (osc), 400 kc. (osc, det, ant)
Band A	600 kc. (osc), 1720 kc. (osc, ant, det)
Band C	18000 kc. (osc, ant, det)

MECHANICAL SPECIFICATIONS

	MODEL T 8-16	MODEL C 8-17
Height	19⅞ inches	39 inches
Width	16 inches	25¼ inches
Depth	11¾ inches	12¼ inches
Weight (Net)	35 pounds	52 pounds

GENERAL FEATURES

These two instruments are alike in chassis construction and design. The table model employs an 8 inch loudspeaker while the console model uses a 12 inch unit. The following features are of outstanding interest:—

Metal Tubes

This receiver uses the new metal tubes which are much smaller in size than the corresponding glass types. The high frequency efficiency of these metal tubes is greater, because of the shorter lengths of leads, lesser interelectrode capacitance and the more complete shielding of the metallic envelopes. Their rugged construction prevents breakage and reduces microphonic tendencies. The bases and sockets of all types have a standardized arrangement of connecting prongs.

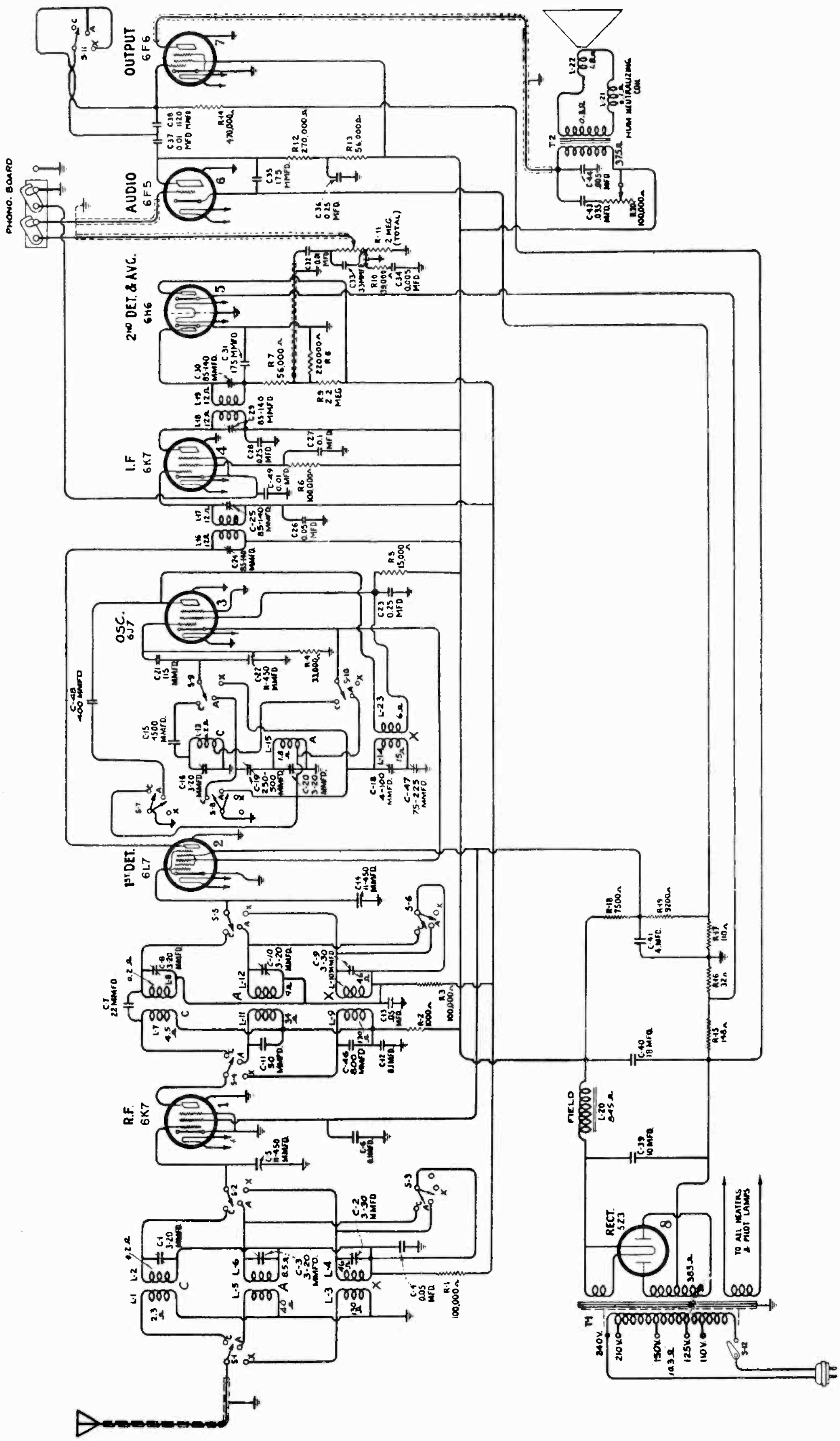


Figure 1—Schematic Circuit Diagram

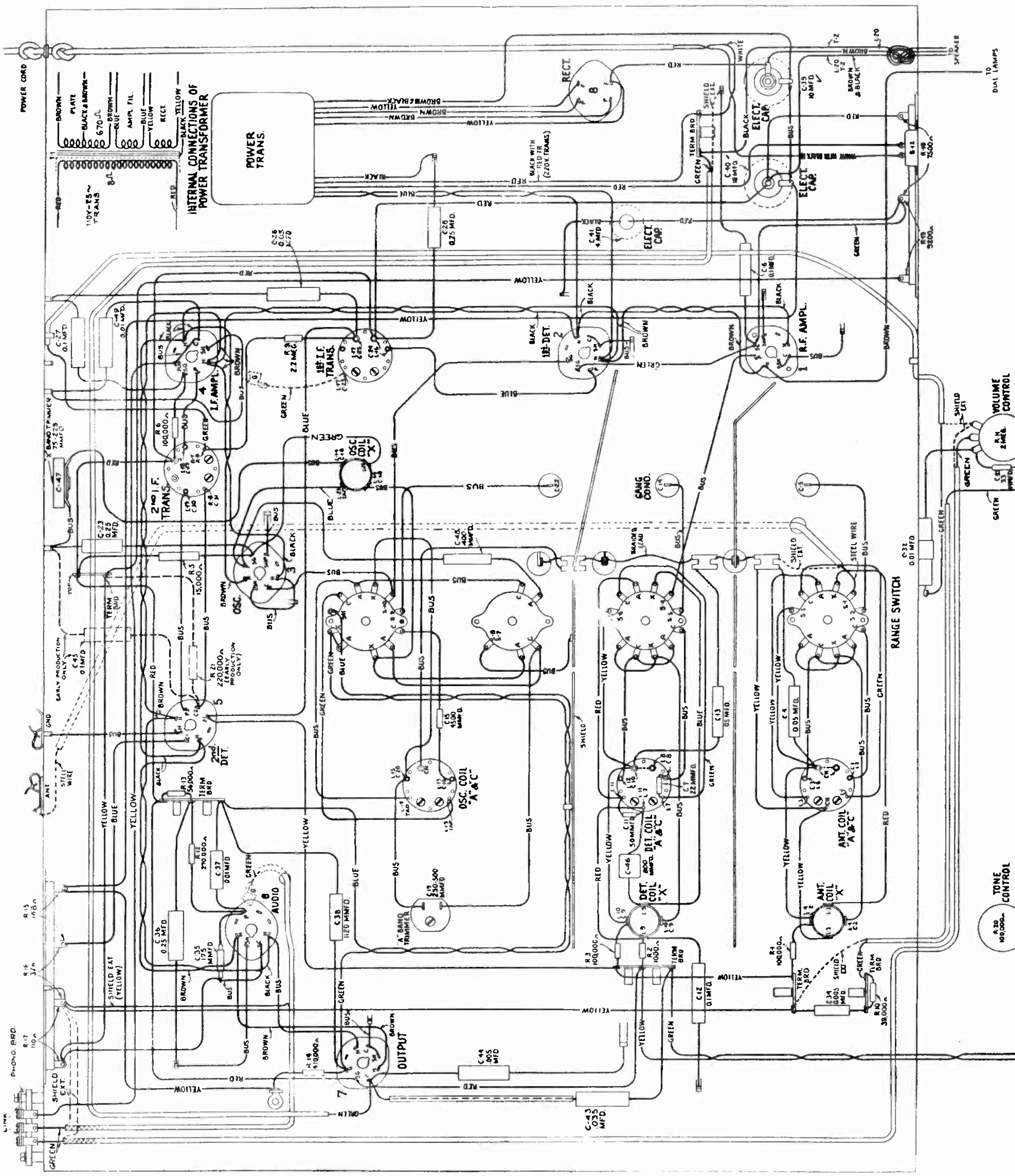


Figure 2—Chassis Wiring Diagram.

Dial Drive

An open face airplane type of dial is used. Each scale has a band of color adjacent to its graduations and three short strips of corresponding colors at the lower part of the dial for index purposes. An index pointer, which moves as the band switch is rotated, points to one of these colors to identify the band in use. The drive mechanism is variable, there being either a 50 to 1 or 10 to 1 ratio available between the tuning knob and condenser drive shaft.

Tuning Condenser

The variable tuning condenser is supported by a new design of shock-proof mount which has been developed by our engineers to prevent chassis vibration from producing audio frequency "howl".

Plug-In Loudspeaker

A readily detachable plug type of connection is used in the chassis to loudspeaker cable. This permits ready removal for service.

CIRCUIT FEATURES

The circuit is based upon the Superheterodyne principle. The three ranges of tuning are covered by three sets of coils. A single r-f stage provides the desired selectivity and gain ahead of the hexode first detector tube. The oscillator stage operates separately from the first detector. A single stage i-f system is employed. Its basic frequency is 460 kc. Diode detection is performed by a double diode RCA-6H6 Radiotron. Automatic volume control is provided by this same tube. The audio system consists of two stages, one an RCA-6F5, and the output, an RCA-6F6. High voltages for plate and bias supplies are obtained from an RCA-5Z3 full wave rectifier through an efficient filter. The field of the loudspeaker acts as a reactor in the filter circuit. Further details of the circuit are as follows:—

Oscillator

The oscillator circuit has extreme stability of frequency and good uniformity of output over the tuning ranges. These qualities assure that the tuning of the receiver will not drift as the supply line voltage fluctuates. The action of the circuit is such that when the cathode emission tends to change with line voltage or because of other reasons, the variation of voltage drop in the plate and screen resistor restores the operating characteristics of the tube to normal and thus maintains constancy of the generated signal.

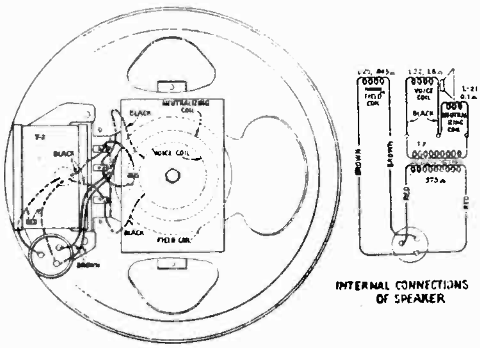


Figure 3—Loudspeaker Wiring

First Detector

This stage has unusually good high frequency mixing efficiency. The tube used, an RCA-6L7, is a new hexode type. The signal is supplied to the first control grid and the oscillator voltage is fed in on a second control grid, a screen grid separating the two. The arrangement of the grids prevents degenerative difficulties, particularly at the higher frequencies. The second grid is direct-connected to the cathode of the oscillator and has no d-c bias.

Compensated Volume Control

The variation in response of the human ear with different degrees of volume is compensated for by a resistor and condenser network in the manual volume control circuit. The volume control itself is an acoustically tapered potentiometer which provides equal changes of sound intensity for the listener per degree of rotation.

Range Switch

The band change switch has several functions. It exchanges the antenna, detector and oscillator coils in order to select the range desired. At the same time, it shorts out the unused coils so as to eliminate their absorptive effects. It also varies the fidelity by shorting a coupling condenser in the audio system to provide the desired reproduction for short as well as long wave reception.

Tone Control

Provision is included for variable reduction of high frequencies. This consists of a resistor and condenser combination across the primary winding of the output transformer, the resistor being the variable element. As it is decreased, the high frequency response limit is lowered.

Power System

The power transformer has its primary winding capacitively shielded from its secondary windings to eliminate transfer of line disturbances into the receiver and to stop any tendency for the circuit to radiate into the line. Rectification is performed in the usual manner by a full wave tube.

Detection and A.V.C.

The modulated signal as obtained from the output of the i-f system is detected by an RCA-6H6 double diode tube. The audio frequency secured by this process is passed on to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal is used for automatic volume control. This voltage, which develops across resistor R-8, is applied as automatic control grid bias to the r-f, first detector and i-f tubes through suitable resistance-capacitance filter circuits. The second diode of the RCA-6H6 is used to supply residual bias for

these controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current, which flows through R-9 and R-8, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed for servicing the receiver. The ratings of all resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. The coils, reactors and transformer windings are rated in terms of their d-c resistances only and where the value is less than one ohm, no rating is given. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and replacement parts list.

Alignment Procedure

There are a total of fourteen adjustments necessary for obtaining proper alignment when such a process becomes necessary. Four of these are involved with the i-f system and the remainder are associated with the antenna, first detector and oscillator coils.

Correct performance of the receiver can only be obtained when the trimmer adjustments have been made by a skilled service man with the use of adequate and reliable test equipment. Such apparatus as may be required for this particular instrument is illustrated and described on a separate page of this booklet.

Two methods of alignment are applicable. One utilizes a Cathode-Ray Oscillograph as a means of output indication and the other follows former procedure where a glow type indicator or meter is used. The oscillographic method is much to be preferred, since greater accuracy is possible from the type of indication afforded. There are no approximations necessary as with the meter or aural method, but each adjustment can be made with excellent precision. Both methods are hereinafter outlined so that alignment operations may be made according to the equipment available.

It is wise to determine the necessity for alignment as well as the direction of misalignment before making adjustments. The RCA Tuning Wand is an instrument designed particularly for such a purpose.

The Tuning Wand consists of a bakelite rod having a small brass cylinder at one end and a core of finely divided iron at the other. It may be inserted into a tuned coil while a signal of the normal resonant frequency is being supplied to such coil to obtain an indication of the tuning. Holes are provided at the top of the r-f shield cans for entrance of the Wand. The presence of either end of the Wand will cause a change in tuning which will be indicated at the receiver output as an increase or decrease in signal level. If there is a decrease of output when either end is inserted, the tuning is correct and will require no adjustment. However, should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output while the iron end causes a decrease, reduction of inductance will be necessary to place the circuit in alignment. This is equivalent to decreasing the trimmer concerned. The following tabulation gives the various changes and the adjustments required:—

WAND	SIGNAL	TRIMMER
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

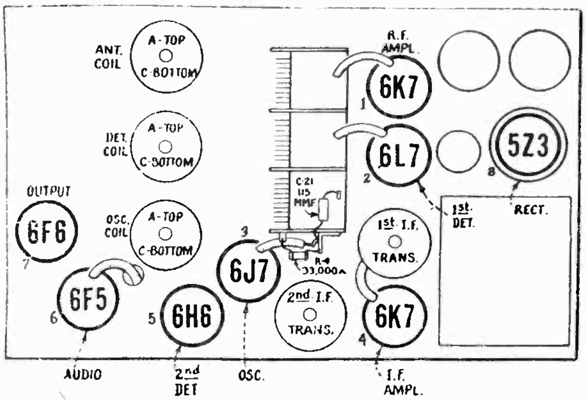


Figure 4—Coil and Radiotron Locations

(1) CATHODE-RAY ALIGNMENT

Equipment

A standard source of the specified alignment frequencies is required. Such a source should consist of an RCA Full Range Oscillator, Stock No. 9595. Output indication should be by means of an RCA Stock No. 9545 Cathode-Ray Oscillograph. An RCA Stock No. 9558 Frequency Modulator will be needed to sweep the generated signal and synchronize it with the Oscillograph in order to make possible the visual representation of the resonant characteristic of the circuit being tuned on the cathode-ray fluorescent screen.

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 6. Each must be aligned to a basic frequency of 460 kc. The last transformer must be aligned firstly and the first transformer aligned secondly. For such a process, it is necessary to feed the output of the Full Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each transformer and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The proper point of connection of the Oscillograph is with its vertical "high" input terminal attached to the juncture of R-7, R-8 and R-9 as illustrated in Figure 6, and with the "0" or ground terminal to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as shown by

Figure 5. A .001 mfd. capacitor installed in series with the Oscillator "Ant." lead will prevent the voltages of the stage under alignment from becoming upset. The vertical "A" amplifier should be "On" for the ensuing adjustments and the gain control kept at its maximum position. For each adjustment, the Oscillator output need be regulated so that the image obtained

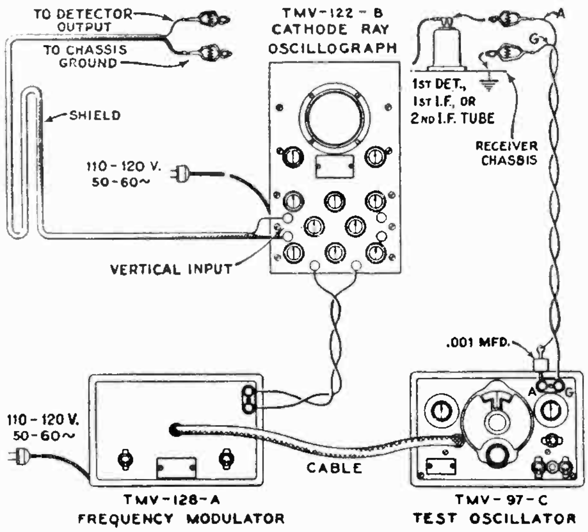


Figure 5—Alignment Apparatus Connections

on the Oscillograph screen will be of sufficient size as to be accurately observable. Proceed further as follows:—

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver range switch to Band "A" and tune the station selector to a point where no interference will be picked up, shorting the antenna and ground terminals if necessary. Set the Oscillograph horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a straight line trace completely across the screen. Place the timing control to "Int." Adjust the intensity and focusing controls of the Oscillograph to produce the correct size and strength of the spot.

(b) Attach the output of the test Oscillator between the control grid cap of the RCA-6K7 i-f tube and chassis ground as shown typically by Figure 5. Tune the Oscillator to **460 kc.** and set its modulation switch to "On". Regulate its output until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph controls to give the desired number of cycles. Cause the image to stand still on the screen by manipulation of the frequency and synchronizing controls. Then carefully tune the two trimmers C-29 and C-30 of the second i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full Range Oscillator by means of the special shielded patch cord. Figure 5 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off". Change the timing control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then carefully shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become exactly coincident at their highest points. These curves will be found to occur at an Oscillator setting of *approximately 540 kc.* They will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with the above requirements and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-29 and C-30 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as in (c), change the Oscillator output to the control grid cap of the RCA-6L7 first detector tube. Then adjust the first i-f transformer trimmers C-24 and C-25 so that the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the overall tuning characteristic of the i-f system. Each trimmer of the entire group should then be checked to assure that it is in correct alignment as indicated by the degree of coincidence and relative amplitude of the image on the Oscillograph screen.

R-F Trimmer Adjustments

Locations of the various antenna, detector and oscillator coil trimmers are shown by Figure 6. The test Oscillator should be removed from connection with the i-f system and its output connected to the antenna-ground terminals of the receiver. No changes are to be made in the connections of the Oscillograph at the second detector. During the following adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Adherence to such a procedure will obviate the broadness of tuning that would result from a.v.c. action on a stronger signal. Proceed with the adjustments as follows:—

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning condenser plates are in full mesh (maximum capacitance). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the Band A scale.

Band A

(a) With the receiver range switch in its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the test Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector and antenna trimmers C-20, C-10 and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. After each trimmer has been peaked, the Oscillograph timing control should be set to "Ext." and the Frequency Modulator placed into operation with its connections to the Oscillator and Oscillograph made in accordance with Figure 5. Turn the modulation switch of the Oscillator to "Off" and retune the Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-20, C-10 and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the wave images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Place the modulation switch to "On". Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator (modulation "Off") until the two similar forward and reverse waves appear on the screen. For this adjustment, it is advisable to shift the Oscillator to its 200—400 kc. range and use the third harmonic of the generated signal in order to obtain the desired range of sweep. The oscillator series trimmer C-19 should then be adjusted to produce maximum amplitude of the images. No rocking will be necessary on the station selector inasmuch as the signal frequency is being "wobbled" by the Frequency Modulator to produce the same effect.

After completing this adjustment the trimmer C-20 should be re-aligned as in (a) to correct for any change brought about by the adjustment of C-19.

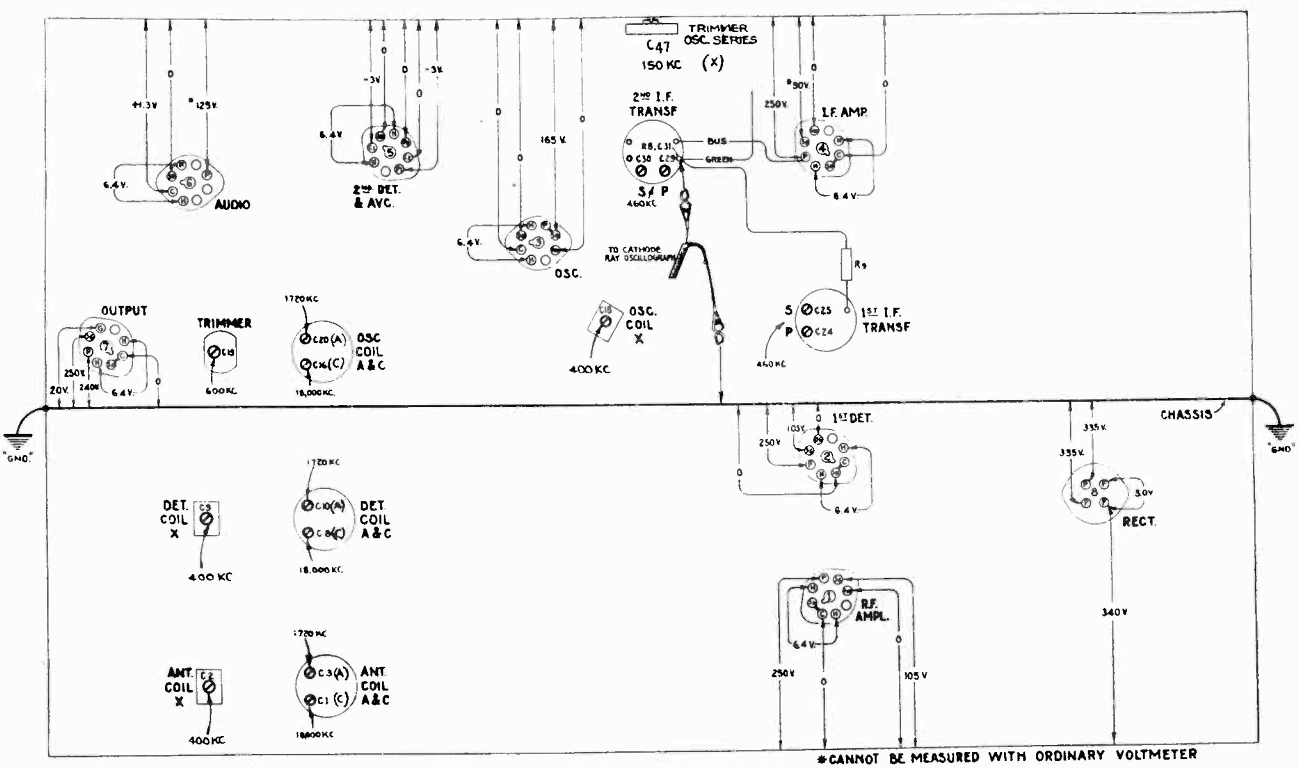


Figure 6—Trimmer Locations and Radiotron Socket Voltages
Measured at 115 volts A.C.—No Signal—Volume Control Maximum

Band X

(a) Disconnect the Frequency Modulator and tune the test Oscillator to a frequency of **400 kc.** (Modulation "On"). Place the receiver range switch to its Band X position and tune the station selector until the dial pointer reads exactly **400 kc.** Adjust the Oscillograph timing control to "Int." Then align each of the trimmers C-18, C-9 and C-2 to the point producing maximum output at the Oscillograph. Place the Frequency Modulator in operation and attach it to the test Oscillator by means of the shielded cable. Change the Oscillograph timing to "Ext." Increase the frequency of the Oscillator (Modulation "Off" until the two forward and reverse waves appear and become coincident at their highest point, *approximately at 462 kc.* These waves may be made to remain stationary on the screen by manipulation of the Oscillograph range switch (No. 2 position) and frequency control (mid-position). Re-adjust the three trimmers C-18, C-9 and C-2 to give maximum amplitude and complete coincidence of the waves.

(b) Change the test Oscillator so that it delivers a signal of **150 kc.** with the Frequency Modulator disconnected. Tune this signal on the receiver, which should be set to the Band X setting, disregarding the dial reading at which the signal is best received. Then interconnect the Frequency Modulator with the Oscillator and retune the latter to the point at which the two similar waves appear on the screen. Adjust the trimmer C-47 for maximum amplitude of the wave images. Rocking of the tuning condenser will not be necessary for this operation as such is duplicated by the Frequency Modulator. Repeat the alignment of C-18 as in (a) to correct for any error brought about by the adjustment of C-47.

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to the same frequency (modulation "On" and Frequency Modulator disconnected) and regulate its output to the level required for convenient observation. Adjust the trimmer C-16 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of the proper "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of C-16 has been properly made using the position of least capacitance which gives maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, re-align C-16 if necessary, and then adjust the detector and antenna trimmers, C-8 and C-1, for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on this band.

(2) ALIGNMENT WITH OUTPUT METER

To align the receiver by means of an output indicator other than a Cathode-Ray Oscillograph will require the use of a standard test Oscillator such as that recommended above for the source of signals and means of indication for the output. The RCA Neon Output Indicator, Stock No. 4317 will be found very satisfactory for such use. It should be connected

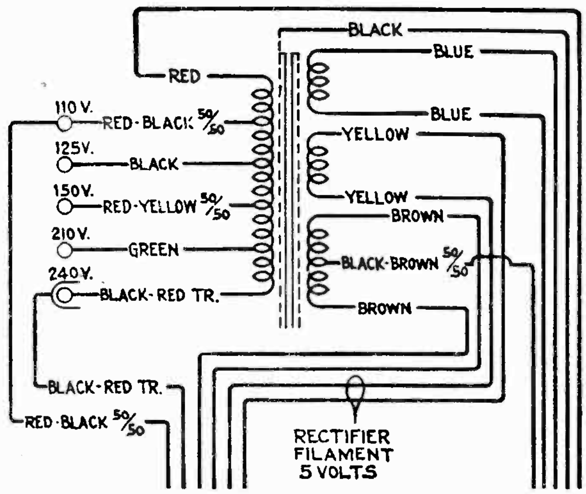


Figure 7—Universal Power Transformer Connections
Pri. Res.—10.3 Ohms, Total
Sec. Res.—383 Ohms, Total

across the voice coil circuit of the loudspeaker or across the output transformer primary.

I-F Alignment

Connect the test Oscillator to the control grid cap of the i-f tube. Advance the volume control of the receiver to its full-on position. Tune the test Oscillator accurately to **460 kc**, and align the trimmers C-29 and C-30 to give maximum receiver output. Regulate the Oscillator output during this adjustment so that the output indication is as small as can be conveniently observed. After completing the adjustments of these trimmers, re-connect the Oscillator so that it will feed into the control grid circuit of the RCA-6L7 first detector. Then tune the first i-f transformer trimmers C-24 and C-25 for maximum receiver output.

R-F Alignment

After completing the i-f adjustments, it is advisable to correct the line-up of the circuits ahead of the first detector. The test Oscillator should be connected to the antenna-ground terminals of the receiver and the manual volume control kept at its maximum position. For each adjustment the Oscillator output should be maintained as low as possible in order to avoid broadness of tuning which would result from a.v.c. action on a stronger signal. **Band A** should be aligned by supplying a **1720 kc.** signal to the receiver, tuning the station selector to a dial reading of **1720** and adjusting the trimmers C-20, C-10 and C-3 to produce maximum receiver output. The Oscillator should then be shifted to **600 kc.** and the receiver tuned to resonate this signal, disregarding the reading at which it is best received. Trimmer C-19 must then be adjusted, simultaneously while rocking the station selector backward and forward through the signal until the maximum output results from the combined operations. C-20 should be rechecked to assure that its adjustment has not changed because of the trimming of C-19. **Band X** must be aligned at **400 kc.** and **150 kc.** Tune the test Oscillator to **400 kc.** and turn the receiver dial to the same reading. Adjust trimmers C-18, C-9 and C-2 for maximum (peak) receiver output. Then shift the Oscillator to **150 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Adjust trimmer C-47, simultaneously rocking the tuning condenser backward and forward through the signal, until maximum receiver output results from the combined operations. Repeat the alignment of C-18 as above to correct for any change which may have been caused by the adjustment of C-47. Change the receiver so that it is operative and the dial reads **18,000 kc.** on the **"C" Band.** Tune the test Oscillator to this same frequency. Then adjust the oscillator trimmer C-16 to produce maximum (peak) output. Two positions of this trimmer will be found which conform with this requirement. The one of least capacitance is correct. Check for the presence of "image" response at **17,080 kc.** by shifting the receiver tuning. If it is received at such a point, the trimmer C-16 has been correctly adjusted to the right peak. *No adjustments are to be made during this check.* Tune the receiver back to the **18,000 kc.** dial marking, re-adjust C-16 if necessary, and then tune the detector and antenna capacitors C-1 and C-8 for maximum receiver output. No further adjustments are necessary.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 6 will serve to assist in the location of causes for faulty operation. Each value as specified should hold within ± 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Universal Transformer

The transformer used on some models of these receivers is adaptable to several ranges of voltage as given under rating C of Electrical Specifications. Its schematic and wiring are shown by Figure 7. Terminals are provided at the top of the transformer case for changing the primary connections to suit the voltage being used.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers.

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4427	Bracket—Volume control or high frequency tone control mounting bracket	$0.18
5237	Bushing—Variable tuning condenser mounting bushing assembly—Package of 3	.43
11350	Cap—Contact cap—Package of 5	.20
11223	Capacitor—Adjustable capacitor (C19)	.46
11256	Capacitor—Adjustable capacitor (C47)	.48
11292	Capacitor—22 MMfd. (C7)	.24
11321	Capacitor—33 MMfd. (C33)	.26
11289	Capacitor—50 MMfd. (C11)	.26
11291	Capacitor—115 MMfd. (C21)	.24
5116	Capacitor—175 MMfd. (C35)	.18
11290	Capacitor—400 MMfd. (C48)	.25
11269	Capacitor—800 MMfd. (C46)	.30
4409	Capacitor—1120 MMfd. (C38)	.35
11287	Capacitor—4500 MMfd. (C15)	.30
4868	Capacitor—0.005 Mfd. (C34)	.20
4838	Capacitor—0.005 Mfd. (C-44)	.20
4624	Capacitor—0.01 Mfd. (C32)	.54
4858	Capacitor—0.01 Mfd. (C37)	.25
5196	Capacitor—0.035 Mfd. (C43)	.18
4836	Capacitor—0.05 Mfd. (C4, C13, C26)	$0.30
4885	Capacitor—0.1 Mfd. (C6, C12, C27)	.28
5170	Capacitor—0.25 Mfd. (C23, C28, C36)	.25
11248	Capacitor—4 Mfd. (C41)	1.06
11240	Capacitor—10 Mfd. (C39)	1.08
5212	Capacitor—18 Mfd. (C40)	1.16
11272	Clamp—Antenna cable clamp—Located near antenna terminal	.10
4748	Clamp—Capacitor mounting clamp assembly—for stock #11248	.15
5215	Coil—Antenna coil (A and C Bands)—(L1, L2, L5, L6, C1, C3)	2.32
11325	Coil—Antenna coil (X Band)—(L3, L4, C2)	1.56
5216	Coil—Detector coil (A and C Bands)—(L7, L8, L11, L12, C8, C10)	2.34
11326	Coil—Detector coil (X Band)—(L9, L10, C9)	1.60
5217	Coil—Oscillator coil (A and C Bands)—(L13, L15, C16, C20)	2.20
11327	Coil—Oscillator coil (X Band)—(L14, C18)	1.44
11214	Condenser—3-Gang variable tuning condenser (C5, C14, C22)	4.20

REPLACEMENT PARTS—CONT'D

Stock No.	Description	List Price
11238	Tone Control—High frequency tone control (R20)	$0.96
11237	Volume Control—(R11)	1.20
4340	Lamp—Dial lamp—Package of 5	.60
11710	Lead—Shielded lead for antenna	.40
8041	Plate—R.F. or I.F. coil shield locking plate—Package of 2	.12
11244	Resistor—Voltage divider resistor, comprising one 7500 ohm and one 9200 ohm section—(R18, R19)	1.08
11245	Resistor—Voltage divider resistor, comprising one 148 ohm, one 32 ohm and one 110 ohm section—(R15, R16, R17)	.62
5112	Resistor—1000 Ohm—Carbon Type—1/4 Watt—(R2)—Package of 5	1.00
5114	Resistor—15,000 Ohm—Carbon Type—1 Watt—(R5)	.22
11300	Resistor—33,000 Ohm—Carbon Type—1/10 Watt—(R4)—Package of 5	.75
11322	Resistor—39.000 Ohm—Carbon Type—1/4 Watt—(R10)—Package of 5	1.00
5029	Resistor—56,000 Ohm—Carbon Type—1/4 Watt—(R13)—Package of 5	1.00
3118	Resistor—100.000 Ohm—Carbon Type—1/4 Watt—(R1, R3, R6)—Package of 5	1.00
11323	Resistor—270,000 Ohm—Carbon Type—1/4 Watt—(R12)—Package of 5	1.00
11172	Resistor—470,000 Ohm—Carbon Type—1/4 Watt—(R14)—Package of 5	1.00
11151	Resistor—2.2 Megohms—Carbon Type—1/4 Watt—(R9)—Package of 5	1.00
5249	Shield—Antenna, detector or oscillator coil shield	.20
5250	Shield—Intermediate frequency transformer shield	.22
11273	Shield—Rectifier Radiotron shield	.25
11222	Socket—Dial lamp socket	.18
4794	Socket—4-contact rectifier Radiotron socket	.15
11313	Socket—5-contact Radiotron socket	.18
11198	Socket—7-contact Radiotron socket	.15
11236	Switch—Band switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11)	2.44
11133	Switch—Power switch—(S12)	.62
5238	Terminal—Antenna terminal clip assembly	.14
11216	Transformer—First intermediate frequency transformer (L16, L17, C24, C25)	2.15
11239	Transformer—Second intermediate frequency transformer—(L18, L19, C29, C30, C31, R7, R8)	2.72
11241	Transformer—Power transformer—105-125 volts—50-60 cycles (T1)	4.56
11242	Transformer—Power transformer—105-125 volts—25-60 cycles	6.52
11243	Transformer—Power transformer—100-130, 140-160, 195-250 volts—40-60 cycles	4.64

DRIVE ASSEMBLIES

Stock No.	Description	List Price
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball—Used with winding shaft—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—comprising drive shaft, balls, ring, spring and washers—assembled	1.00
11262	Dial—Dial scale	.60
11252	Drive—Variable tuning condenser drive assembly	1.88
4520	Indicator—Station selector indicator pointer	.18
11226	Indicator—Band indicator pointer assembly comprising indicator pointer, arm, link and stud	.20
3993	Screw—No. 6-32-5/32" square set screw for band indicator operating arm—Package of 10	.25
4669	Screw—No. 8-32-5/32" set screw for variable condenser drive assembly—Package of 10	.25

Stock No.	Description	List Price
4377	Spring—Band indicator operating arm spring—Package of 5	$0.25
4378	Stud—Band indicator operating arm stud and nut assembly—Package of 5	.25

MISCELLANEOUS ASSEMBLIES

Stock No.	Description	List Price
11337	Escutcheon—Station selector escutcheon	.70
6614	Glass—Station selector dial glass	.30
11346	Knob—Station selector knob—Package of 5	.75
11347	Knob—Volume control, tone control, range switch or power switch knob—Package of 5	.75
11246	Foot—Chassis mounting foot and bracket assembly—Package of 2	.76
4678	Ring—Spring retaining ring for dial glass—Package of 5	.34
11210	Screw—Chassis mounting screw assembly—Package of 4	.28
11348	Screw—No. 8-32-7/16" headless cupped point set screw for knob, stock #11346—Package of 10	.32
11349	Spring—Retaining spring for knob, stock #11347—Package of 5	.15

REPRODUCER ASSEMBLIES
Table Model

Stock No.	Description	List Price
11232	Board—Terminal board with two lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Output transformer mounting bracket	.14
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
11254	Coil—Field coil—(L20)	2.00
11233	Coil—Neutralizing coil (L21)	.30
11235	Cone—Reproducer cone—(L22)—Package of 5	3.50
5119	Connector—3-contact female connector for reproducer cable	.25
5118	Connector—3-contact male connector for reproducer	.25
9618	Reproducer—Complete	6.40
11253	Transformer—Output transformer—(T2)	1.56
11230	Washer—"Binders board" "C" washer—used to hold field coil securely—Package of 5	.18

REPRODUCER ASSEMBLIES
Console Model

Stock No.	Description	List Price
11232	Board—Terminal board assembly with two lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Output transformer mounting bracket	.14
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
11254	Coil—Field coil—L20	2.00
11233	Coil—Hum neutralizing coil—L21	.30
11258	Cone—Reproducer cone—L22—Package of 5	3.85
5118	Connector—3-contact male connector for reproducer	.25
5119	Connector—3-contact female connector plug for reproducer cable	.25
9619	Reproducer—Complete	6.05
11253	Transformer—Output transformer—T2	1.56
11230	Washer—"Binders board" "C" washer used to hold field coil assembly	.18

RCA VICTOR MODEL T 10-1

Ten-Tube, Three Band, A-C, Superheterodyne, Table Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Frequency Ranges

Band A	540 kc.— 1800 kc.
Band B	1800 kc.— 6000 kc.
Band C	6000 kc.—18000 kc.

Alignment Frequencies

Band A	600 kc. (osc.), 1720 kc. (osc., ant., det.)
Band B	6132 kc. (osc., ant., det.)
Band C	18,000 kc. (osc., ant., det.)

Radiotron Complement

(1)	RCA-6K7	Radio-Frequency Amplifier
(2)	RCA-6L7	First Detector
(3)	RCA-6J7	Heterodyne Oscillator
(4)	RCA-6K7	Intermediate Amplifier
(5)	RCA-6H6	Second Detector and A.V.C.
(6)	RCA-6C5	First Audio Amplifier
(7)	RCA-6C5	Audio Driver Amplifier
(8)	RCA-6F6	Power Output Amplifier
(9)	RCA-6F6	Power Output Amplifier
(10)	RCA-5Z3	Full Wave Rectifier

Power Ratings

Rating A	105—125 volts, 50—60 cycles
Rating B	105—125 volts, 25—60 cycles
Rating C	100—130/140—160/195—250 volts, 40—60 cycles
Power Consumption	135 watts

Miscellaneous

Undistorted Output	8.5 watts
Maximum Output	11.5 watts
Loudspeaker	Electrodynamic—8 inch
Voice Coil Impedance	2.25 ohms at 400 cycles

Intermediate Frequency .... 460 kc.

MECHANICAL SPECIFICATIONS

Height	20⅛ inches
Width	17⅝ inches
Depth	13¾ inches
Weight (Net)	41 pounds
Weight (Shipping)	49 pounds
Chassis Base	15½ inches × 10½ inches × 3½ inches

GENERAL FEATURES

This instrument comprises a ten-tube chassis mounted in a table type of cabinet. Its tuning ranges cover frequencies between 540 kc. and 18,000 kc. including the standard broadcast, short wave broadcast, police, amateur and aviation bands. The following points of design are of particular importance:—

Metal Radiotrons

The new metallic tubes are used in the amplifying and detecting stages of this receiver. They provide distinct advantages over corresponding glass types in a number of respects. Their size makes for compact chassis design; the metal envelope eliminates need for shielding; they are not subject to breakage; microphonic tendencies are reduced; bases and sockets are standardized for all types; short wave efficiencies are higher; and general improvements in operation are gained from their use.

Tuning Condenser

The variable tuning condenser is supported by a new design of shock-proof mount which has been developed by our engineers to prevent chassis vibration from producing audio frequency howl.

Chassis

Servicing convenience has been a governing factor in the layout of the chassis parts and the associated wiring. Each part has been situated so that a minimum of wiring is necessary. Adjustments provided by means of substantial trimmers are mounted where they may be easily reached. Holes are included in the shield cans of the r-f coil system for testing the tuning with a Tuning Wand.

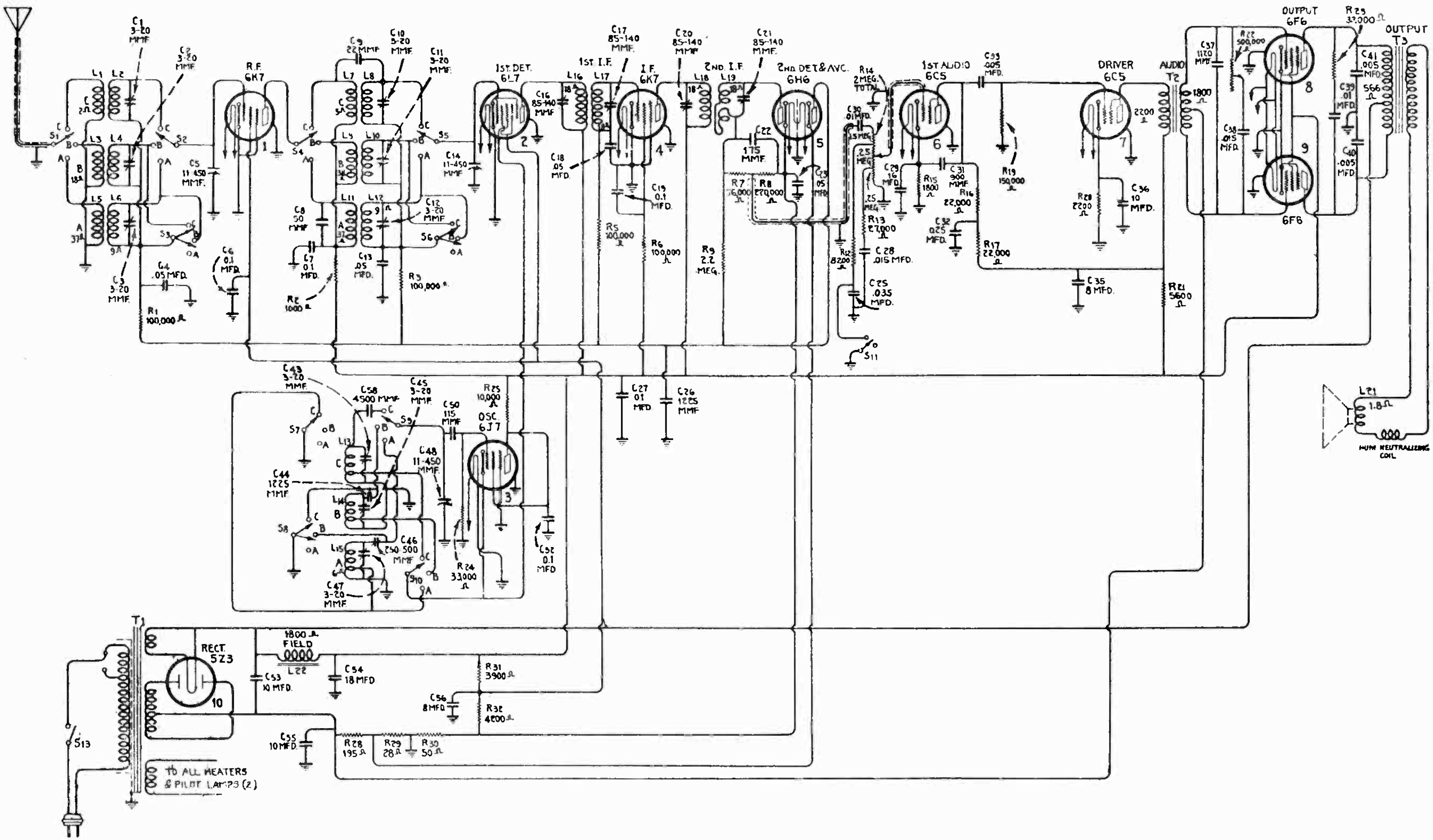


Figure 1—Schematic Circuit Diagram

POWER TRANSFORMER

Pri. Res.	Sec. Res.
3.8 ohms	335 ohms (60 cycle)
5.4 ohms	470 ohms (25 cycle)

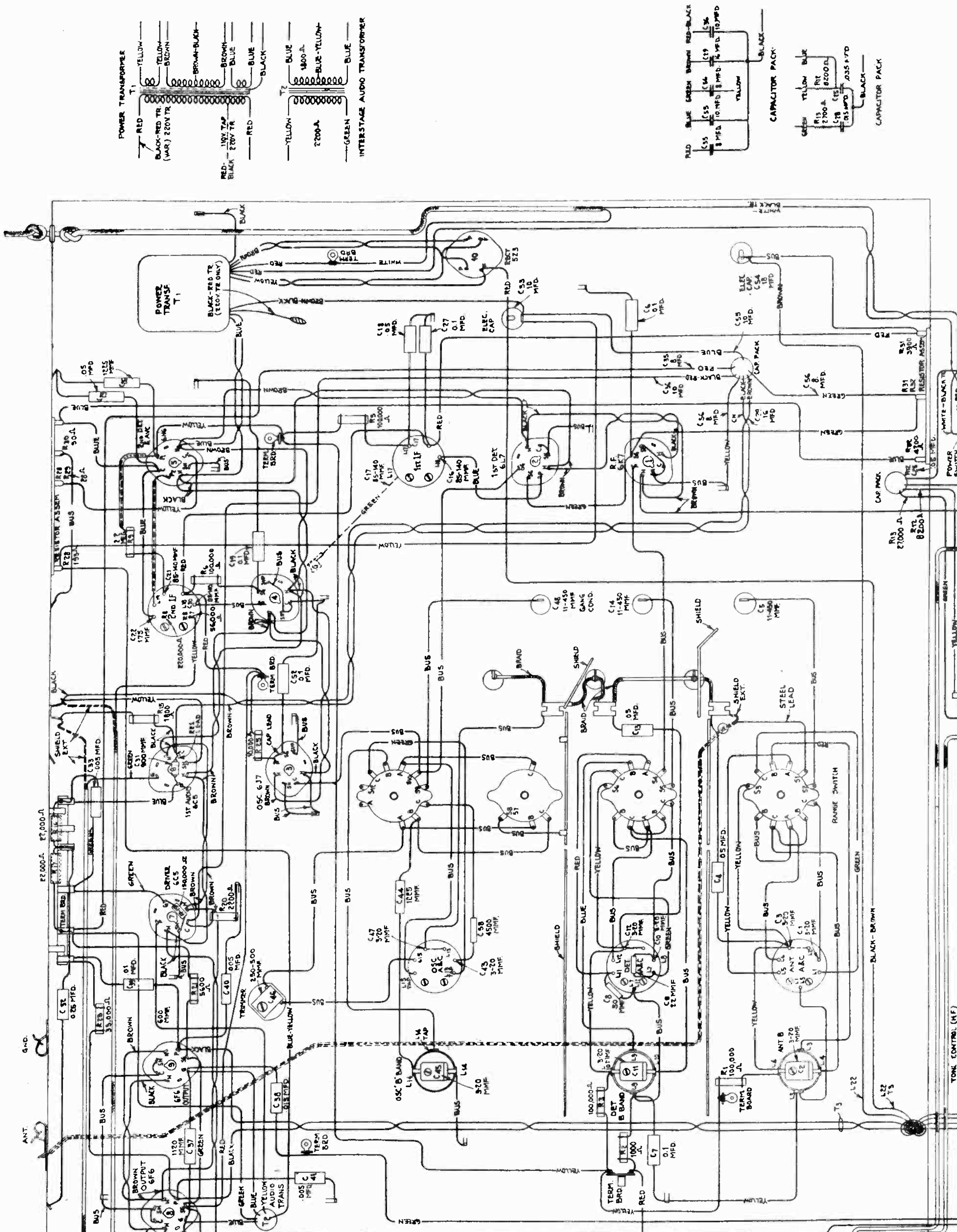


Figure 2—Chassis Wiring Diagram

Loudspeaker

An eight-inch, electrodynamic reproducer unit is used to handle the high level output of the receiver. The speaker is designed to operate in such manner with the acoustics of the cabinet that the best quality of reproduction is obtained. Connections from the chassis to speaker are made through a plug and connector, which permits either unit to be removed quickly for service.

Color Band Dial

The station indicating dial is neatly designed with each scale identified by a different color. As the range switch is changed from one band to another, an index pointer moves so as to point to a short strip of color at the lower part of the dial to indicate the band being used. The tuning drive ratio is variable by means of a push-in clutch arrangement, which gives a 10 to 1 and 50 to 1 movement of the tuning knob in respect to the main dial pointer. A vernier pointer having a ratio of 20 to 1 in respect to the main pointer permits extremely accurate tuning and logging of the high frequency stations.

CIRCUIT ARRANGEMENT

The Superheterodyne principle of operation forms the basis of the circuit design. A single, tuned r-f stage is used ahead of the first detector. The functions of oscillator and detector are performed by two separate tubes. One i-f stage is employed and designed to operate at 460 kc. The combined second detector and a.v.c. stage uses an RCA-6H6 double diode. The audio system consists of two single amplifier stages working in cascade with a push-pull power output stage. The loudspeaker is an electrodynamic type, receiving its field supply from the rectifier and filter system and simultaneously acting as a filter reactor. Full wave rectification is performed in the RCA-5Z3 tube. The outstanding features of electrical design are concerned with the following:—

Tuned Circuits

A total of seven circuits are tuned to provide gain and selectivity to the incoming signal. The variable gang condenser resonates the antenna transformer secondary, the detector transformer secondary and the oscillator coil. Alignment trimmers are included for each of these same circuits. Additional trimmers are used on the i-f transformers, tuning both the secondaries and primaries to 460 kc. There are separate groups of antenna, detector and oscillator coils for each of the tuning ranges. They are placed into operation by means of a rugged rotary switch.

First Detector

This stage has unusually good high frequency mixing efficiency. The tube used, an RCA-6L7, is a new hexode type. The signal is supplied to the first control grid and the oscillator is fed in on a second control grid, a screen grid separating the two. The arrangement of the grids prevents degenerative difficulties, particularly at the higher frequencies. The second grid is direct-connected to the cathode of the oscillator tube and has no d-c bias.

Oscillator

The oscillator circuit is worthy of careful study inasmuch as it is different from the type ordinarily employed. It has self-stabilizing properties which are very advantageous for short wave operation. The generated frequency remains substantially constant when the circuit is affected by variation of line voltage and other similar influences. Output also remains uniform over the individual tuning ranges. The switching of the tuning coils is arranged so as to short those not in use in order to prevent absorption or any reactive effects in the particular band being tuned.

Detector and A.V.C.

The modulated signal as obtained from the output of the i-f system is detected by an RCA-6H6 double diode tube. The audio frequency secured by this process is passed on to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal, is used for automatic volume control. This voltage, which develops across resistors R-7 and R-8, is applied as automatic control grid bias to the r-f, first detector and i-f tubes through suitable resistance-capacitance filter circuits. The second diode of the RCA-6H6 is used to supply residual bias for these controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current, which flows through resistors R-7, R-8 and R-9, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function. The cathode and anode of the signal-a.v.c. diode have positive potential in respect to chassis-ground and cathodes of the a.v.c. controlled tubes when no signal is being received.

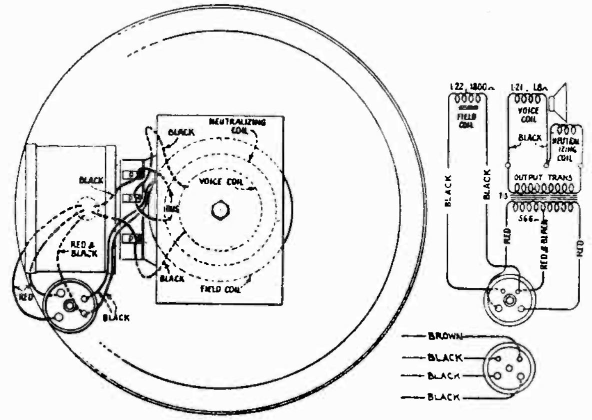


Figure 3—Loudspeaker Wiring

Audio System

Manual volume control of the detected signal is effected by an acoustically tapered potentiometer in the grid circuit of the first a-f stage. This control has tone compensating filters connected to two points thereon. These filters effect the correct aural balance at different volume settings. A music-speech switch (low frequency tone control) is associated with one of the compensation filters. The purpose of this control is to make speech reproduction more intelligible and to reduce hum obtained from stray modulation on a carrier. The driver stage of the audio system uses an RCA-6C5 which is resistance coupled to the first a-f tube and transformer coupled into the push-pull power output stage. High-frequency tone control is obtained by use of a condenser and variable resistor in series across the grids of the output tubes. The field coil serves as a reactor in the high voltage filter circuit.

Rectifier

The a-c voltage supplied by the power line is stepped up by the transformer T-1 and applied to the 5Z3 full wave rectifier for production of high voltage d.c. to be used for plate and bias supply. Simultaneously, a step down takes place in the same transformer to provide the low voltage necessary for heaters. The current obtained from the rectifier is thoroughly filtered by large capacitors and the field coil reactance.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed to isolate causes for defective operation when such develops. The ratings of the resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and the Replacement Parts List. The coils, reactors, and transformer windings are rated in terms of their d-c resistances only and where the resistance is less than one ohm, no rating is given.

Alignment Procedure

Ten alignment trimmers are provided in the r-f, first detector and oscillator tuning system and four are used in the i-f system. All of these are accurately adjusted during manufacture and should remain in proper alignment unless affected by abnormal conditions of climate or have been altered by other means. Loss of sensitivity, improper tone quality and poor selectivity are the usual indications of improper alignment.

Correct performance of the receiver can only be obtained when the trimmer adjustments have been made by a skilled service man with the use of adequate and reliable test equipment. Such apparatus as may be required for alignment of this particular instrument is illustrated and described on a separate page of this booklet.

Two methods of alignment are applicable. One utilizes a Cathode-Ray Oscillograph as a means of output indication and the other follows former procedure where a glow type indicator or meter is used. The oscillographic method is much to be preferred, since greater accuracy is possible from the type of indication afforded. There are no approximations necessary as with the meter or aural method, but each adjustment can be made with definite precision. Both methods are hereinafter outlined so that alignment operations may be made according to the equipment available.

It is wise to determine the necessity for alignment as well as the direction of misalignment before making adjustments. The RCA Tuning Wand is an instrument designed particularly for such a purpose.

The Tuning Wand consists of a bakelite rod having a small brass cylinder at one end and a core of finely divided iron at the other. It may be inserted into a tuned coil while a signal of the normal resonant frequency is being supplied to such coil to obtain an indication of the tuning. Holes are provided at the top of the r-f shield cans for entrance of the Wand. The presence of either end of the Wand will cause a change in tuning which will be indicated at the receiver output as an increase or decrease in signal level. If there is a decrease of output when either end is inserted, the tuning is correct and will require no adjustment. However should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output while the iron end causes a decrease, reduction of inductance will be necessary to place the circuit in alignment. This is equivalent to decreasing the trimmer concerned. The following tabulation gives the various changes and the adjustments required:-

WAND	SIGNAL	TRIMMER
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

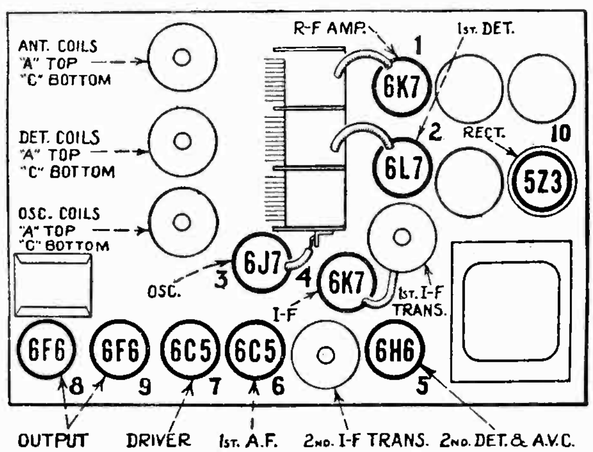


Figure 4—Coil and Radiotron Locations

CATHODE-RAY ALIGNMENT

Equipment

A standard source of alignment frequencies is required. Such a source should consist of an RCA Full Range Oscillator, Stock No. 9595. Output indication should be by means of an RCA Stock No. 9545

Cathode-Ray Oscillograph. An RCA Stock No. 9558 Frequency Modulator will be needed to sweep the generated signal and synchronize it with the Oscillograph in order to obtain visual representation of the resonant characteristic of the circuit being tuned on the cathode-ray fluorescent screen.

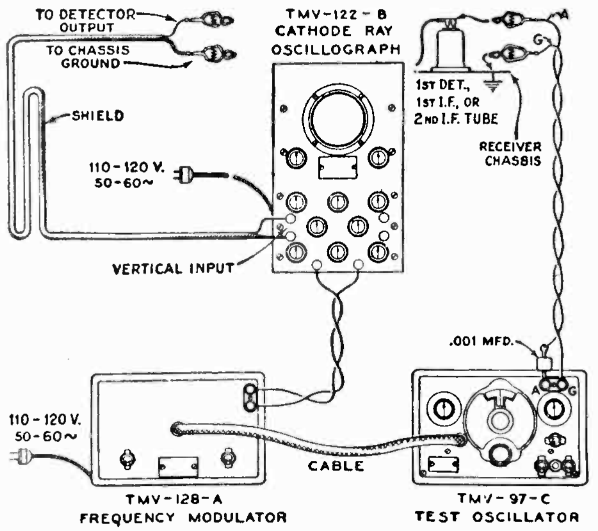


Figure 5—Alignment Apparatus Connections

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 6. Each must be aligned to a basic frequency of **460 kc.** The last transformer must be aligned firstly and the first transformer aligned secondly. For such a process, it is necessary to feed the output of the Full Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each transformer and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The proper point of connection of the Oscillograph is with its vertical "high" input terminal attached to the junc-ture of R-7 and R-8, as illustrated in Figure 6, and with the "0" or ground terminal to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as shown by Figure 5. A .001 mfd. capacitor installed in series with the Oscillator "Ant." lead will prevent the voltages of the stage under alignment from becoming upset. The vertical "A" amplifier should be "On" for the ensuing adjustments and its gain control kept at maximum. For each adjustment, the Oscillator output must be regulated so that the image obtained on the Oscillograph screen will be of the minimum size convenient for accurate observation. Proceed further as follows:—

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver range switch to Band "A" and tune the station selector to a point where no interference will be encountered from signal pickup or from the RCA-6J7 oscillator, removing the tube if necessary. Set the Oscillograph horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a straight line trace completely across the screen. Place the timing control to "Int." Adjust the intensity and focusing controls of the Oscillograph to produce the correct size and strength of spot.

(b) Attach the output of the test Oscillator between the control grid cap of the RCA-6K7 i-f tube and chassis ground as shown typically by Figure 5. Tune the Oscillator to **460 kc.** and set its modulation switch to "On." Regulate its output until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph controls to give a shape which is convenient for peak indications. Cause the image to stand still on the screen by manipulation of the frequency and synchronizing controls. Then carefully tune the two trimmers C-20 and C-21 of the second i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full Range Oscillator by means of the special shielded patch cord. Figure 5 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off." Change the timing control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then carefully shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become exactly coincident at their highest points. This condition will be found to occur at an Oscillator setting of *approximately 540 kc.* The curves will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with the above requirement and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-20 and C-21 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as in (c), change the Oscillator output to the control grid cap of the RCA-6L7 first detector tube. Then adjust the first i-f transformer trimmers C-16 and C-17 so that the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the overall tuning characteristic of the i-f system.

R-F Trimmer Adjustments

Locations of the various antenna, detector and oscillator coil trimmers are shown by Figure 6. The test Oscillator should be removed from connection with

the i-f system and its output connected to the antenna-ground terminals of the receiver. No changes are to be made in the connections of the Oscillograph at the second detector. During the following adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Adherence to this procedure will obviate the broadness of tuning that would result from a.v.c. action on a stronger signal. Proceed with the adjustments as follows:—

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning condenser plates are in full mesh (maximum capacitance). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the Band A scale. Correct the setting of the vernier second hand pointer to read zero.

Band A

(a) With the receiver range switch in its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the test Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector and antenna trimmers, C-47, C-12 and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. After each trimmer has been peaked, the Oscillograph timing control should be set to "Ext." and the Frequency Modulator placed into operation with its connections to the Oscillator and Oscillograph made in accordance with Figure 5. Turn the modulation switch of the Oscillator to "Off" and retune the Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-47, C-12 and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the wave images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Place the modulation switch to "On". Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator (modulation "Off") until the two similar forward and reverse waves appear on the screen. For this adjustment, it is advisable to shift the Oscillator to its 200-400 kc. range using the third harmonic of the generated signal in order to obtain the desired range of sweep. The oscillator series trimmer, C-46, should then be adjusted to produce maximum amplitude of the images. No rocking will be necessary on the station selector inasmuch as the signal frequency

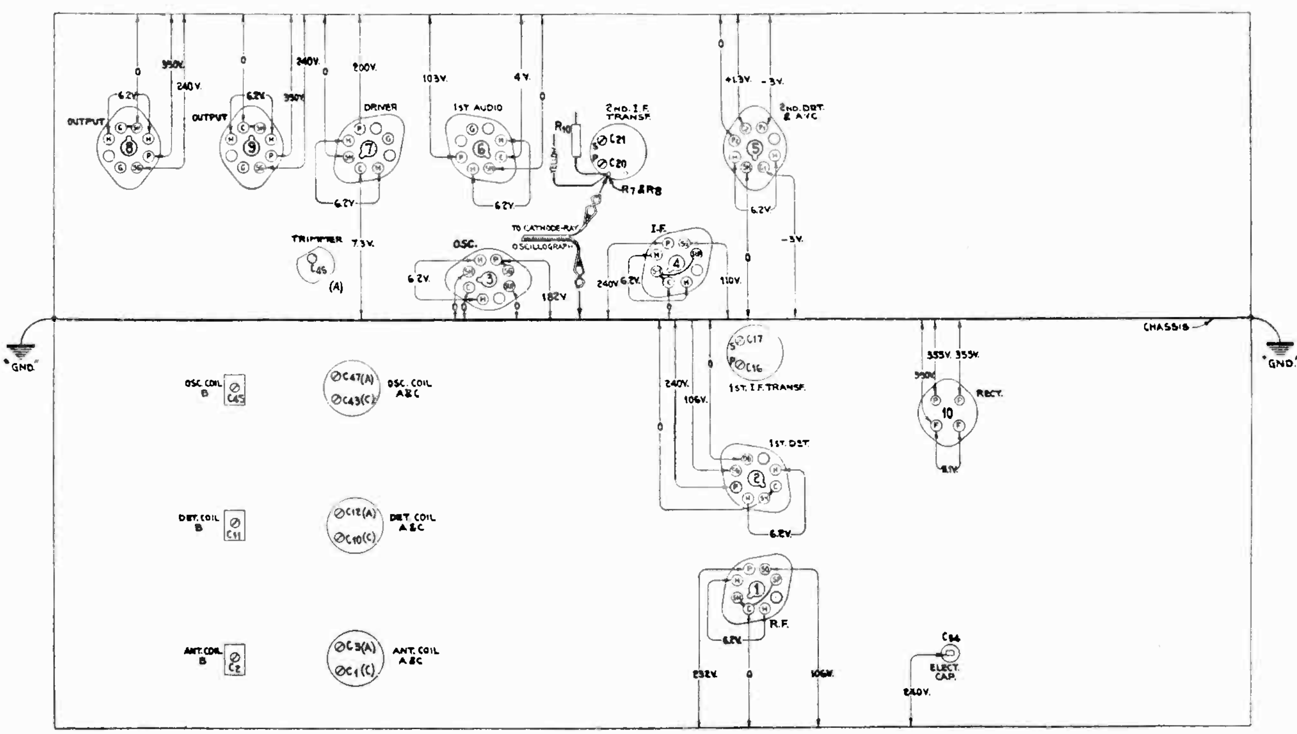


Figure 6—Trimmer Locations and Radiotron Socket Voltages
Measured at 115 Volts A.C.—No Signal—Volume Control Maximum

(Control grid bias on tubes No. 7 and 8 is —20 volts)

is being "wobbled" by the Frequency Modulator to produce the same effect. After completing this adjustment, the trimmer C-47 should be re-aligned as in (a) to correct for any change brought about by the adjustment of C-46.

Band B

(a) Advance the receiver range switch to its Band B position and tune the station selector to a dial reading of **6132 kc.** Set the test Oscillator to this same frequency (modulation "On" and Frequency Modulator disconnected) and increase its output until a suitable indication is apparent on the Oscillograph. The Oscillograph should be adjusted for "Int." timing. Then adjust the oscillator trimmer, C-45, to the point at which maximum amplitude of the image is obtained. Two positions will be found for this trimmer which gives such a maximum. The one of least capacitance is correct and should be used. This can be checked by tuning the "image" signal, which will be received at **5212 kc.** on the dial if the adjustment of C-45 has been properly made. An increase in test Oscillator output may be necessary for this test. *Its frequency should not be changed from* **6132 kc.** *nor any trimmer adjustments made on the receiver.*

(b) Return the station selector to the **6132 kc.** reading and align the detector, and antenna coil trimmers, C-11 and C-2 respectively, for maximum (peak) output as shown by the Oscillograph. No further adjustments are to be made on this band.

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to the same frequency (modulation "On" and Frequency Modulator (disconnected) and regulate its output to the level required for convenient observation. Adjust the trimmer C-43 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of the proper "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of C-43 has been properly made by using the position of least capacitance which gives maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, realign C-43 if necessary, and then adjust the detector and antenna trimmers, C-10 and C-1, for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on this band.

ALIGNMENT WITH OUTPUT METER

To align the receiver by means of an output indicator other than a Cathode-Ray Oscillograph will require the use of a standard test Oscillator, such as that recommended above, for the source of signals and

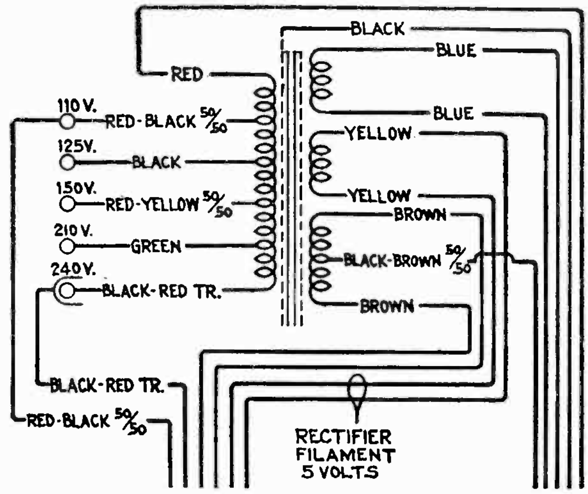


Figure 7—Universal Power Transformer Connections

Pri. Res.—7.42 ohms, total
Sec. Res.—274 ohms, total

means of indication for the output. The RCA Neon Output Indicator, Stock No. 4317, will be found very satisfactory for such use. It should be connected across the voice coil circuit of the loudspeaker or across the output transformer primary.

I-F Alignment

Connect the test Oscillator to the control grid cap of the i-f tube. Advance the volume control of the receiver to its full-on position. Tune the test Oscillator accurately to **460 kc.** and align the trimmers C-20 and C-21 to give maximum receiver output. Regulate the Oscillator output during this adjustment so that the output indication is as small as can be conveniently observed. After completing the adjustments of these trimmers, re-connect the Oscillator so that it will feed into the control grid circuit of the RCA-6L7 first detector. Then tune the first i-f transformer trimmers C-16 and C-17 for maximum receiver output.

R-F Alignment

After completing the i-f adjustments, it is advisable to correct the line-up of the circuits ahead of the first detector. The test Oscillator should be connected to the antenna-ground terminals of the receiver and the manual volume control turned to its maximum position. For each adjustment, the Oscillator output should be maintained as low as possible in order to avoid broadness of tuning which would result from a.v.c. action on a stronger signal.

Band A—This band should be aligned by supplying a **1720 kc.** signal to the receiver, tuning the station selector to a dial reading of **1720** and adjusting the trimmers C-47, C-12 and C-3 to produce maximum receiver output. The Oscillator should then be shifted to **600 kc.** and the receiver tuned to resonate this signal, disregarding the reading at which it is best received. Trimmer C-46 must then be adjusted, simultaneously while rocking the station selector backward and forward through the signal until the maximum output results from the combined operations. C-47 should be rechecked to assure that its adjustment has not changed because of the trimming of C-46.

Band B—This band must be aligned at **6132 kc.** by tuning the test Oscillator to such a frequency and turning the station selector to the **6132 kc.** dial reading. Then tune the trimmer C-45 to produce maximum receiver output, using the setting of least capacitance which causes same. The presence of the proper "image" may be checked by tuning the receiver to **5212 kc.** at which point the **6132 kc.** signal will be heard if the trimmer C-45 has been properly set to the position of least capacitance for maximum (peak) output. It may be necessary to increase the Oscillator output for this check. *No adjustments are to be made.* Return the station selector to the **6132 kc.** dial marking and trim capacitors C-11 and C-2 for maximum receiver output. No other adjustments are necessary on Band B.

Band C—Change the receiver so that it is operative and the dial reads **18,000 kc.** on the "C" Band. Tune the test Oscillator to this same frequency. Then adjust the oscillator trimmer C-43 to produce maximum (peak) output. Two positions of this trimmer will be found which conform with this requirement. The one of least capacitance is correct. Check for the presence of "image" response at **17,080 kc.** by shifting the receiver tuning. If it is received at such a point, the trimmer C-43 has been correctly adjusted to the right peak. *No adjustments are to be made during this check.* Tune the receiver back to the **18,000 kc.** dial marking, readjust C-43 if necessary, and then tune the detector and antenna capacitors C-10 and C-1 for maximum receiver output. No further adjustments are necessary.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 6 will serve to assist in the location of causes for faulty operation. Each value as specified should hold within ± 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Universal Transformer

The transformer used on some models of this receiver is adaptable to several ranges of voltage as given under Rating C of Electrical Specifications. Its schematic and wiring are shown by Figure 7. Terminals are provided at the top of the transformer case for changing the primary connections to suit the voltage being used. Note that a 110 volt tap is brought out separately for supplying a phonograph motor.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price	Stock No.	Description	List Price
	RECEIVER ASSEMBLIES		11315	Capacitor—0.015 Mfd.—(C38)	.20
4427	Bracket—High or low frequency tone control or volume control mounting bracket	$0.18	4836	Capacitor—0.05 Mfd.—(C4, C13, C18, C23)	.30
5237	Bushing—Variable condenser mounting bushing assembly—Package of 3	.43	4885	Capacitor—0.1 Mfd.—(C7, C19, C27, C52)	.28
11223	Capacitor—Adjustable capacitor—(C46)	.46	4841	Capacitor—0.1 Mfd.—(C6)	.22
11292	Capacitor—22 MMfd.—(C9)	.24	5170	Capacitor—0.25 Mfd.—(C32)	.25
11289	Capacitor—50 MMfd.—(C8)	.26	11203	Capacitor—10 Mfd.—(C53)	1.18
11291	Capacitor—115 MMfd.—(C50)	.24	5212	Capacitor—18 Mfd.—(C54)	1.16
3784	Capacitor—900 MMfd.—(C31)	.30	11215	Capacitor Pack—Comprising one 16 Mfd., two 10 Mfd., and two 8 Mfd capacitors—(C29, C35, C36, C55, C56)	3.85
4409	Capacitor—1120 MMfd.—(C37)	.35			
11288	Capacitor—1225 MMfd.—(C44)	.30			
11316	Capacitor—1225 MMfd.—(C26)	.40	11201	Clamp—Cable clamp—located near variable tuning condenser—Package of 5	.20
11287	Capacitor—4500 MMfd.—(C58)	.30			
4907	Capacitor—0.005 Mfd.—(C40, C41)	.38	11272	Clamp—Cable clamp—located above antenna terminal	.10
4868	Capacitor—0.005 Mfd.—(C33)	.20			
4624	Capacitor—0.01 Mfd.—(C30)	.54	4693	Clamp—Electrolytic capacitor clamp—for stock #11215	.15
4937	Capacitor—0.01 Mfd.—(C39)	.25			

REPLACEMENT PARTS (Continued)

Stock No.	Description	List Price
5215	Coil—Antenna coil—A and C Bands—(L1, L2, L5, L6, C1, C3)	2.32
5245	Coil—Antenna coil—B band—(L3, L4, C2)	1.58
5216	Coil—Detector coil—A and C bands—(L7, L8, L11, L12, C10, C12)	2.34
5246	Coil—Detector coil—B band—(L9, L10, (C11)	1.62
5217	Coil—Oscillator coil—A and C bands—(L13, L15, C43, C47)	2.20
5247	Coil—Oscillator coil—B band—(L14, C45)	1.44
11277	Compensating Pack—Comprising one 0.015 Mfd., one 0.035 Mfd. capacitor, one 27,000 ohm and one 8200 ohm resistor—(C25, C28, R12, R13)	.92
11214	Condenser—Three gang variable tuning condenser—(C5, C14, C48)	4.20
11205	Volume Control—(R14)	1.30
11219	Tone Control—High frequency tone control—(R22)	.90
11710	Lead—Shielded lead for antenna	.40
8041	Plate—I. F. or R. F. coil shield locking plate with screw—Package of 2	.12
11220	Resistor—Voltage divider resistor—comprising one 3900 ohm and one 4200 ohm section—(R31, R32)	.84
11221	Resistor—Voltage divider resistor—comprising one 50 ohm, one 28 ohm and one 195 ohm section—(R28, R29, R30)	.48
5112	Resistor—1000 Ohm—Carbon type—¼ Watt—(R2)—Package of 5	1.00
3706	Resistor—1800 Ohm—Carbon type—¼ Watt—(R15)—Package of 5	1.00
5159	Resistor—2200 Ohm—Carbon type—¼ Watt—(R20)—Package of 5	1.00
5175	Resistor—5600 Ohm—Carbon type—½ Watt—(R21)—Package of 5	1.00
2731	Resistor—10,000 Ohm—Carbon type—1 Watt—(R25)—Package of 5	1.10
11305	Resistor—22,000 Ohm—Carbon type—¼ Watt—(R16, R17)—Package of 5	1.00
11300	Resistor—33,000 Ohm—Carbon type—1/10 Watt—(R24)—Package of 5	.75
5033	Resistor—33,000 Ohm—Carbon type—1 Watt—(R23)—Package of 5	1.10
3118	Resistor—100,000 Ohm—Carbon type—¼ Watt—(R1, R3, R5, R6)—Package of 5.	1.00
5027	Resistor—150,000 Ohm—Carbon type—¼ Watt—(R19)—Package of 5	1.00
11151	Resistor—2.2 Megohms—Carbon type—¼ Watt—(R9)—Package of 5	1.00
5249	Shield—R. F. coil shield	.20
11273	Shield—Radiotron shield	.25
5250	Shield—I. F. Transformer shield	.22
11222	Socket—Dial lamp socket	.18
4794	Socket—4-contact Radiotron socket	.15
11197	Socket—6-contact Radiotron socket	.14
11198	Socket—7-contact Radiotron socket	.15
5224	Switch—Low frequency tone control switch and power switch—(S11, S13)	1.00
11236	Switch—Range switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10)	2.44
5238	Terminal—Antenna terminal assembly	.14
11218	Transformer—Audio driver transformer—(T2)	2.58
11216	Transformer—First intermediate frequency transformer—(L16, L17, C16, C17)	2.15
11217	Transformer—Second intermediate frequency transformer—(L18, L19, C20, C21, C22, R7, R8)	3.10
11213	Transformer—Power transformer—105-125-150-210-250 volts—40-60 cycles	5.10
11212	Transformer—Power transformer—105-125 volts—25-60 cycles	7.18
11211	Transformer—Power transformer—105-125 volts—50-60 cycles	4.88

DRIVE ASSEMBLIES

Stock No.	Description	List Price
4362	Arm—Band indicator operating arm	$0.28
10194	Ball—Steel ball—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—comprising drive shaft, balls, ring, spring and washers assembled	1.00
11375	Dial—Station selector dial scale	.68
11227	Drive—Variable tuning condenser drive complete—less dial scale	2.08
11228	Gear—Vernier pointer drive gear	.42
4827	Gear—Spring gear assembly	1.25
11303	Indicator	.22
11226	Indicator—Band indicator pointer assembly—comprising indicator, arm, link and stud	.20
4475	Indicator—Station selector indicator	.18
4340	Lamp—Dial lamp—Package of 5	.60
3993	Screw—No. 6-32-5/32" set screw—for band indicator operating arm—Package of 10	.25
4669	Screw—No. 8-32-5/32" Square head set screw—for tuning condenser shaft—Package of 10	.25
4377	Spring—Band indicator operating arm spring—Package of 5	.25
4378	Stud—Band indicator operating arm stud assembly—Package of 5	.25

MISCELLANEOUS ASSEMBLIES

Stock No.	Description	List Price
11337	Escutcheon—Station selector escutcheon	.70
6614	Glass—Station selector dial glass	.30
11346	Knob—Station selector knob—Package of 5	.75
11347	Knob—Volume control, range switch, tone control or power switch knob—Package of 5	.75
4678	Ring—Spring retaining ring for station selector dial glass—Package of 5	.34
11210	Screw—Chassis mounting screw assembly—Package of 4	.28
11348	Screw—No. 8-32-7/16" Headless, cupped point, set screw for knob, Stock #11346—Package of 10	.32
11349	Spring—Retaining spring for knob, stock #11347—Package of 5	15

REPRODUCER ASSEMBLIES

Stock No.	Description	List Price
11232	Board—Terminal board with two lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Mounting bracket for output transformer and connector	.14
11304	Cable—Reproducer cable—complete with female connector	.80
11234	Coil—Field Coil—(L22)	2.15
11233	Coil—Neutralizing coil	.30
11235	Cone—Reproducer cone (L21)—Package of 5	3.50
5040	Connector — 4-prong female connector socket for reproducer cable	.25
5039	Connector—4-prong male connector plug for reproducer	.25
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
9617	Reproducer—Complete	6.60
11229	Transformer—Output transformer—(T3)	1.66
11230	Washer—Binders board "C" washer—used to hold field coil securely—Package of 5	.18

RCA VICTOR MODEL T 10-3

Ten-Tube, Three-Band, A-C, Superheterodyne, Table Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Frequency Ranges

Band X	140 kc.— 410 kc.
Band A	540 kc.— 1800 kc.
Band C	5700 kc.—18000 kc.

Alignment Frequencies

Band X	150 kc. (osc.), 400 kc. (osc., ant., det.)
Band A	600 kc. (osc.), 1720 kc. (osc., ant., det.)
Band C	18000 kc. (osc., ant., det.)

Radiotron Complement

(1) RCA-6K7	Radio-Frequency Amplifier
(2) RCA-6L7	First Detector
(3) RCA-6J7	Heterodyne Oscillator
(4) RCA-6K7	Intermediate Amplifier
(5) RCA-6H6	Second Detector and A.V.C.
(6) RCA-6C5	First Audio Amplifier
(7) RCA-6C5	Audio Driver Amplifier
(8) RCA-6F6	Power Output Amplifier
(9) RCA-6F6	Power Output Amplifier
(10) RCA-5Z3	Full Wave Rectifier

Power Ratings

Rating A	105—125 volts, 50—60 cycles
Rating B	105—125 volts, 25—60 cycles
Rating C	100—130/140—160/195—250 volts, 40—60 cycles
Power Consumption	135 watts

Miscellaneous

Undistorted Output	8.5 watts
Maximum Output	11.5 watts
Loudspeaker	Electrodynamic—8 inch
Voice Coil Impedance	2.25 ohms at 400 cycles

Intermediate Frequency .... **460 kc.**

MECHANICAL SPECIFICATIONS

Height	20⅛ inches
Width	17⅝ inches
Depth	13¾ inches
Weight (Net)	41 pounds
Chassis Base	15½ inches × 10½ inches × 3½ inches

GENERAL FEATURES

This instrument comprises a ten-tube chassis mounted in a table type of cabinet. Its tuning ranges cover the long wave, standard broadcast, short wave broadcast, amateur and aviation bands. The following points of design are of particular importance:—

Metal Radiotrons

The new metallic tubes are used in the amplifying and detecting stages of this receiver. They provide distinct advantages over corresponding glass types in a number of respects. Their size makes for compact chassis design; the metal envelope eliminates need for shielding; they are not subject to breakage; microphonic tendencies are reduced; bases and sockets are standardized for all types; short wave efficiencies are higher; and general improvements in operation are gained from their use.

Tuning Condenser

The variable tuning condenser is supported by a new design of shock-proof mount which has been developed by our engineers to prevent chassis vibration from producing audio frequency howl.

Chassis

Servicing convenience has been a governing factor in the layout of the chassis parts and the associated wiring. Each part has been situated so that a minimum of wiring is necessary. Adjustments provided by means of substantial trimmers are mounted where they may be easily reached. Holes are included in the shield cans of the r-f coil system for testing the tuning with a Tuning Wand.

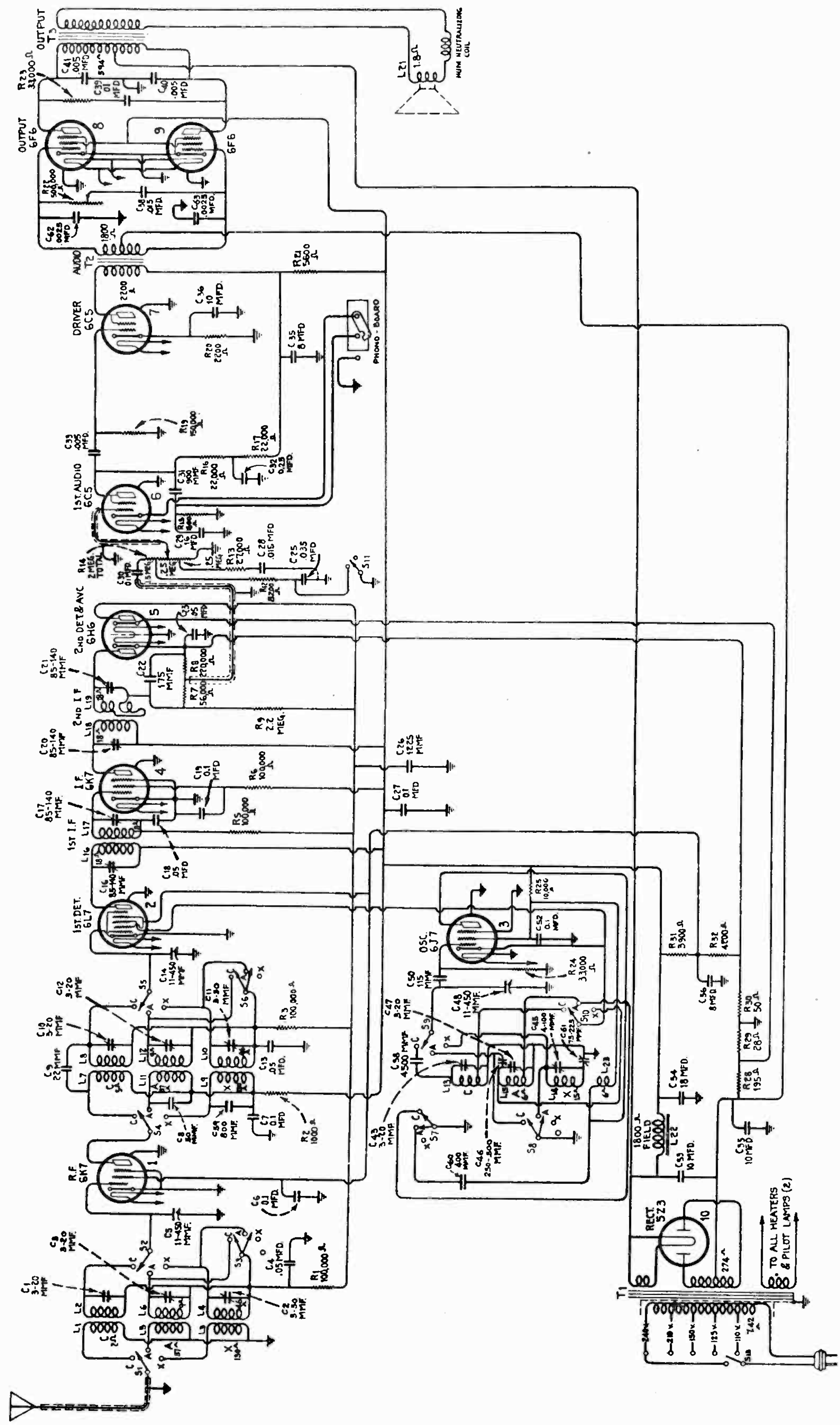


Figure 1—Schematic Circuit Diagram

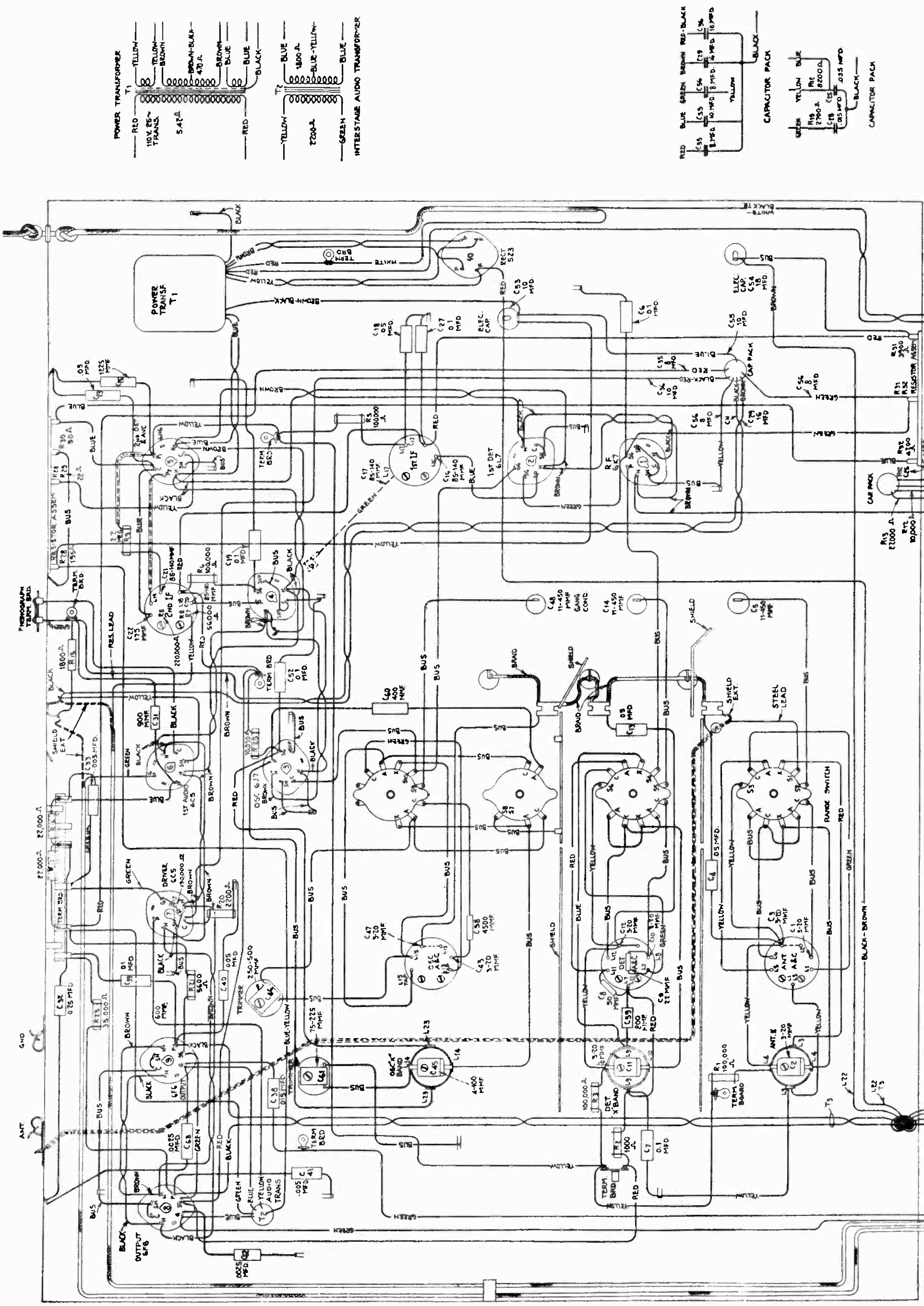


Figure 2—Chassis Wiring Diagram

Loudspeaker

An eight-inch, electrodynamic reproducer unit is used to handle the high level output of the receiver. The speaker is designed to operate in such manner with the acoustics of the cabinet that the best quality of reproduction is obtained. Connections from the chassis to speaker are made through a plug and connector, which permits either unit to be removed quickly for service.

Color Band Dial

The station indicating dial is neatly designed with each scale identified by a different color. As the range switch is changed from one band to another, an index pointer moves so as to point to a short strip of color at the lower part of the dial to indicate the band being used. The tuning drive ratio is variable by means of a push-in clutch arrangement, which gives a 10 to 1 and 50 to 1 movement of the tuning knob in respect to the main dial pointer. A vernier pointer having a ratio of 20 to 1 in respect to the main pointer permits extremely accurate tuning and logging of the high frequency stations.

CIRCUIT ARRANGEMENT

The Superheterodyne principle of operation forms the basis of the circuit design. A single, tuned r-f stage is used ahead of the first detector. The functions of oscillator and detector are performed by two separate tubes. One i-f stage is employed and designed to operate at 460 kc. The combined second detector and a.v.c. stage uses an RCA-6H6 double diode. The audio system consists of two single amplifier stages working in cascade with a push-pull power output stage. The loudspeaker is an electrodynamic type, receiving its field supply from the rectifier and filter system and simultaneously acting as a filter reactor. Full wave rectification is performed in the RCA-5Z3 tube. The outstanding features of electrical design are concerned with the following:—

Tuned Circuits

A total of seven circuits are tuned to provide gain and selectivity to the incoming signal. The variable gang condenser resonates the antenna transformer secondary, the detector transformer secondary and the oscillator coil. Alignment trimmers are included for each of these same circuits. Additional trimmers are used on the i-f transformers, tuning both the secondaries and primaries to 460 kc. There are separate groups of antenna, detector and oscillator coils for each of the tuning ranges. They are placed into operation by means of a rugged rotary switch.

First Detector

This stage has unusually good high frequency mixing efficiency. The tube used, an RCA-6L7, is a new hexode type. The signal is supplied to the first control grid and the oscillator is fed in on a second control grid, a screen grid separating the two. The arrangement of the grids prevents degenerative difficulties, particularly at the higher frequencies. The second grid is direct-connected to the cathode of the oscillator tube and has no d-c bias.

Oscillator

The oscillator circuit is worthy of careful study inasmuch as it is different from the type ordinarily employed. It has self-stabilizing properties which are very advantageous for short wave operation. The generated frequency remains substantially constant when the circuit is affected by variation of line voltage and other similar influences. Output also remains uniform over the individual tuning ranges. The switching of the tuning coils is arranged so as to short those not in use in order to prevent absorption or any reactive effects in the particular band being tuned.

Detector and A.V.C.

The modulated signal as obtained from the output of the i-f system is detected by an RCA-6H6 double diode tube. The audio frequency secured by this process is passed on to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal, is used for automatic volume control. This voltage, which develops across resistors R-7 and R-8, is applied as automatic control grid bias to the r-f, first detector and i-f tubes through suitable resistance-capacitance filter circuits. The second diode of the RCA-6H6 is used to supply residual bias for these controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current, which flows through resistors R-7, R-8 and R-9, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function. The cathode and anode of the signal-a.v.c. diode have positive potential in respect to chassis-ground and cathodes of the a.v.c. controlled tubes when no signal is being received.

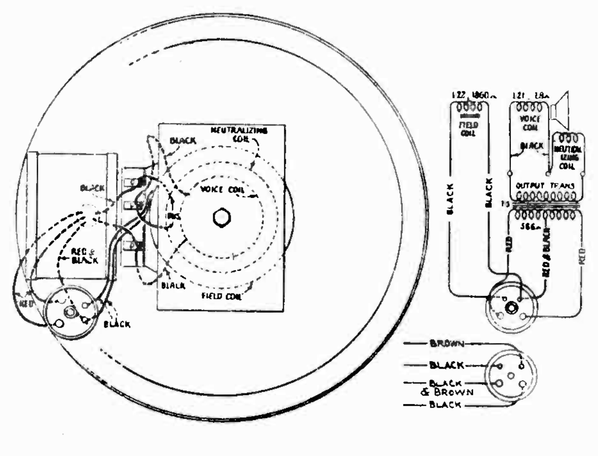


Figure 3—Loudspeaker Wiring

Audio System

Manual volume control of the detected signal is effected by an acoustically tapered potentiometer in the grid circuit of the first a-f stage. This control has tone compensating filters connected to two points thereon. These filters effect the correct aural balance at different volume settings. A music-speech switch (low frequency tone control) is associated with one of the compensation filters. The purpose of this control is to make speech reproduction more intelligible and to reduce hum obtained from stray modulation on a carrier. The driver stage of the audio system uses an RCA-6C5 which is resistance coupled to the first a-f tube and transformer coupled into the push-pull power output stage. High-frequency tone control is obtained by use of a condenser and variable resistor in series across the grids of the output tubes. The field coil serves as a reactor in the high voltage filter circuit.

Rectifier

The a-c voltage supplied by the power line is stepped up by the transformer T-1 and applied to the 5Z3 full wave rectifier for production of high voltage d.c. to be used for plate and bias supply. Simultaneously, a step down takes place in the same transformer to provide the low voltage necessary for heaters. The current obtained from the rectifier is thoroughly filtered by large capacitors and the field coil reactance.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed to isolate causes for defective operation when such develops. The ratings of the resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and the Replacement Parts List. The coils, reactors, and transformer windings are rated in terms of their d-c resistances only and where the resistance is less than one ohm, no rating is given.

Alignment Procedure

Ten alignment trimmers are provided in the r-f, first detector and oscillator tuning system and four are used in the i-f system. All of these are accurately adjusted during manufacture and should remain in proper alignment unless affected by abnormal conditions of climate or have been altered by other means. Loss of sensitivity, improper tone quality and poor selectivity are the usual indications of improper alignment.

Correct performance of the receiver can only be obtained when the trimmer adjustments have been made by a skilled service man with the use of adequate and reliable test equipment. Such apparatus as may be required for alignment of this particular instrument is illustrated and described on a separate page of this booklet.

Two methods of alignment are applicable. One utilizes a Cathode-Ray Oscillograph as a means of output indication and the other follows former procedure where a glow type indicator or meter is used. The oscillographic method is much to be preferred, since greater accuracy is possible from the type of indication afforded. There are no approximations necessary as with the meter or aural method, but each adjustment can be made with definite precision. Both methods are hereinafter outlined so that alignment operations may be made according to the equipment available.

It is wise to determine the necessity for alignment as well as the direction of misalignment before making adjustments. The RCA Tuning Wand is an instrument designed particularly for such a purpose.

The Tuning Wand consists of a bakelite rod having a small brass cylinder at one end and a core of finely divided iron at the other. It may be inserted into a tuned coil while a signal of the normal resonant frequency is being supplied to such coil to obtain an indication of the tuning. Holes are provided at the top of the r-f shield cans for entrance of the Wand. The presence of either end of the Wand will cause a change in tuning which will be indicated at the receiver output as an increase or decrease in signal level. If there is a decrease of output when either end is inserted, the tuning is correct and will require no adjustment. However should there be an increase of output due to the iron-core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output while the iron end causes a decrease, reduction of inductance will be necessary to place the circuit in alignment. This is equivalent to decreasing the trimmer concerned. The following tabulation gives the various changes and the adjustments required:—

WAND	SIGNAL	TRIMMER
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

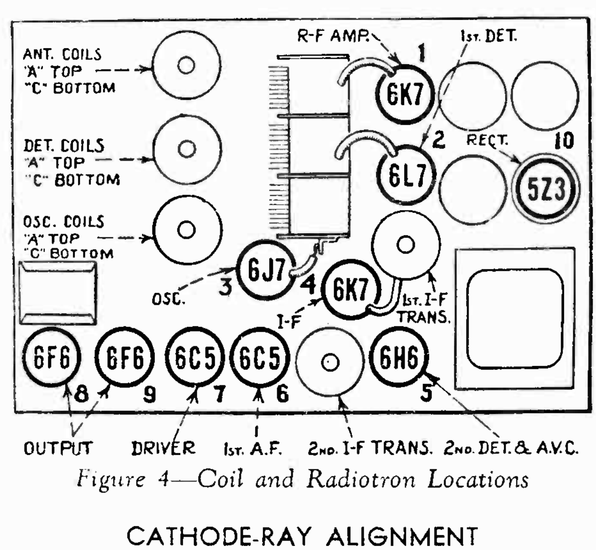


Figure 4—Coil and Radiotron Locations

CATHODE-RAY ALIGNMENT

Equipment

A standard source of alignment frequencies is required. Such a source should consist of an RCA Full Range Oscillator, Stock No. 9595. Output indication should be by means of an RCA Stock No. 9545

Cathode-Ray Oscillograph. An RCA Stock No. 9558 Frequency Modulator will be needed to sweep the generated signal and synchronize it with the Oscillograph in order to obtain visual representation of the resonant characteristic of the circuit being tuned on the cathode-ray fluorescent screen.

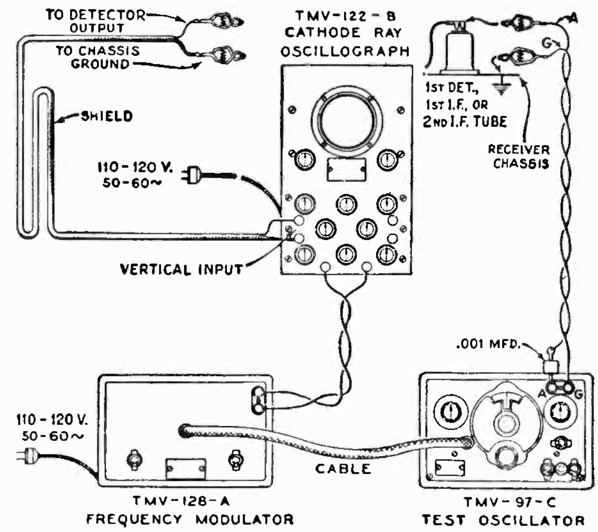


Figure 5—Alignment Apparatus Connections

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 6. Each must be aligned to a basic frequency of **460 kc.** The last transformer must be aligned firstly and the first transformer aligned secondly. For such a process, it is necessary to feed the output of the Full Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each transformer and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The proper point of connection of the Oscillograph is with its vertical "high" input terminal attached to the juncture of R-7 and R-8, as illustrated in Figure 6, and with the "0" or ground terminal to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as shown by Figure 5. A .001 mfd. capacitor installed in series with the Oscillator "Ant." lead will prevent the voltages of the stage under alignment from becoming upset. The vertical "A" amplifier should be "On" for the ensuing adjustments and its gain control kept at maximum. For each adjustment, the Oscillator output must be regulated so that the image obtained on the Oscillograph screen will be of the minimum size convenient for accurate observation. Proceed further as follows:—

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver range switch to Band "A" and tune the station selector to a point where no interference will be encountered from signal pickup or from the RCA-6J7 oscillator, removing the tube if necessary. Set the Oscillograph horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a straight line trace completely across the screen. Place the timing control to "Int." Adjust the intensity and focusing controls of the Oscillograph to produce the correct size and strength of spot.

(b) Attach the output of the test Oscillator between the control grid cap of the RCA-6K7 i-f tube and chassis ground as shown typically by Figure 5. Tune the Oscillator to **460 kc.** and set its modulation switch to "On." Regulate its output until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph controls to give a shape which is convenient for peak indications. Cause the image to stand still on the screen by manipulation of the frequency and synchronizing controls. Then carefully tune the two trimmers C-20 and C-21 of the second i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full Range Oscillator by means of the special shielded patch cord. Figure 5 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off." Change the timing control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then carefully shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become exactly coincident at their highest points. This condition will be found to occur at an Oscillator setting of *approximately 540 kc.* The curves will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with the above requirement and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-20 and C-21 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as in (c), change the Oscillator output to the control grid cap of the RCA-6L7 first detector tube. Then adjust the first i-f transformer trimmers C-16 and C-17 so that the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the overall tuning characteristic of the i-f system.

R-F Trimmer Adjustments

Locations of the various antenna, detector and oscillator coil trimmers are shown by Figure 6. The test Oscillator should be removed from connection with

the i-f system and its output connected to the antenna-ground terminals of the receiver. No changes are to be made in the connections of the Oscillograph at the second detector. During the following adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Adherence to this procedure will obviate the broadness of tuning that would result from a.v.c. action on a stronger signal. Proceed with the adjustments as follows:—

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning condenser plates are in full mesh (maximum capacitance). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the Band A scale. Correct the setting of the vernier second hand pointer to read zero.

Band A

(a) With the receiver range switch in its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the test Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector and antenna trimmers, C-47, C-12 and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. After each trimmer has been peaked, the Oscillograph timing control should be set to "Ext." and the Frequency Modulator placed into operation with its connections to the Oscillator and Oscillograph made in accordance with Figure 5. Turn the modulation switch of the Oscillator to "Off" and retune the Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-47, C-12 and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the wave images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Place the modulation switch to "On". Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator (modulation "Off") until the two similar forward and reverse waves appear on the screen. For this adjustment, it is advisable to shift the Oscillator to its 200-400 kc. range using the third harmonic of the generated signal in order to obtain the desired range of sweep. The oscillator series trimmer, C-46, should then be adjusted to produce maximum amplitude of the images. No rocking will be necessary on the station selector inasmuch as the signal frequency

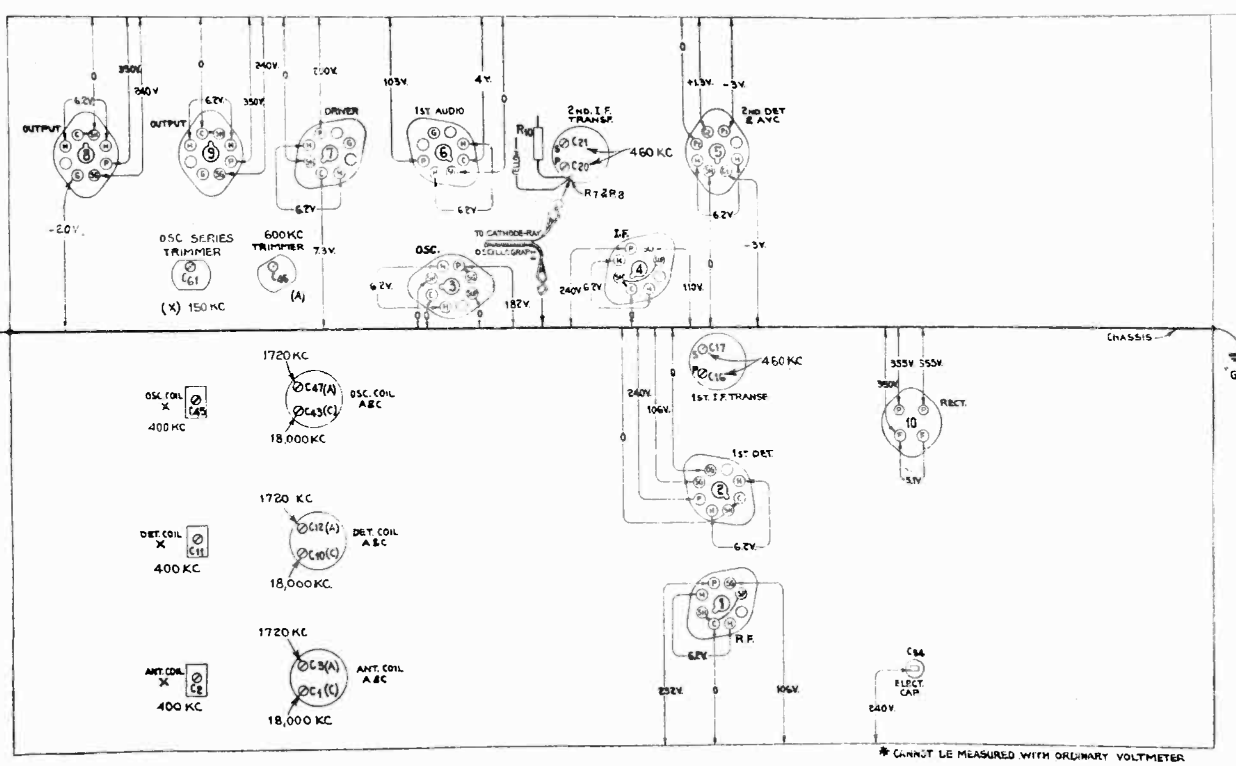


Figure 6—Trimmer Locations and Radiotron Socket Voltages
Measured at 115 Volts A.C.—No Signal—Volume Control Maximum

is being "wobbled" by the Frequency Modulator to produce the same effect. After completing this adjustment, the trimmer C-47 should be re-aligned as in (a) to correct for any change brought about by the adjustment of C-46.

Band X

(a) Disconnect the Frequency Modulator and tune the test Oscillator (Modulation "On") to **400 kc.** Place the receiver range switch to its Band X position and tune the station selector to 400 kc. Turn Oscillograph timing control to "Int." Then align trimmers C-45, C-11 and C-2 for maximum indication at the Oscillograph. Place the Frequency Modulator in operation and attach it to the test Oscillator. Change the Oscillograph timing to "Ext." Increase Oscillator frequency (Modulation "Off") until the forward and reverse waves appear and become coincident at their highest point, approximately at 462 kc. These images may be made to remain stationary by manipulation of the Oscillograph range switch (No. 2 position) and frequency control (mid-position). Readjust trimmers C-45, C-11 and C-2 to give maximum amplitude and complete coincidence of the waves.

(b) Change the test Oscillator to **150 kc.** (Frequency Modulator disconnected). Tune this signal on the receiver, disregarding the dial reading at which it is best received. Then interconnect the Frequency Modulator and Oscillator. Retune the latter to the point at which the two similar waves appear on the screen. Adjust trimmer C-61 for maximum amplitude of the waves. Rocking of the tuning condenser will not be necessary for this operation as such is duplicated by the Frequency Modulator. Re-align C-45 as in (a) to correct for any error caused by the adjustment of C-61.

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to the same frequency (modulation "On" and Frequency Modulator disconnected) and regulate its output to the level required for convenient observation. Adjust the trimmer C-43 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of the proper "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of C-43 has been properly made by using the position of least capacitance which gives maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, re-align C-43 if necessary, and then adjust the detector and antenna trimmers, C-10 and C-1, for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on this band.

ALIGNMENT WITH OUTPUT METER

To align the receiver by means of an output indicator other than a Cathode-Ray Oscillograph will require the use of a standard test Oscillator, such as that recommended above, for the source of signals and

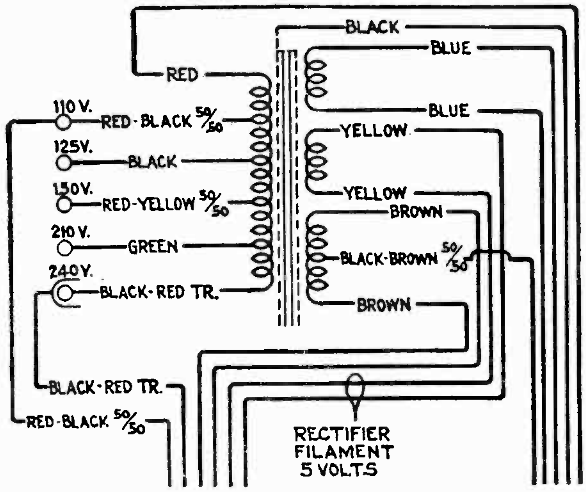


Figure 7—Universal Power Transformer Connections

Pri. Res.—7.42 ohms, total
Sec. Res.—274 ohms, total

means of indication for the output. The RCA Neon Output Indicator, Stock No. 4317, will be found very satisfactory for such use. It should be connected across the voice coil circuit of the loudspeaker or across the output transformer primary.

I-F Alignment

Connect the test Oscillator to the control grid cap of the i-f tube. Advance the volume control of the receiver to its full-on position. Tune the test Oscillator accurately to **460 kc.** and align the trimmers C-20 and C-21 to give maximum receiver output. Regulate the Oscillator output during this adjustment so that the output indication is as small as can be conveniently observed. After completing the adjustments of these trimmers, re-connect the Oscillator so that it will feed into the control grid circuit of the RCA-6L7 first detector. Then tune the first i-f transformer trimmers C-16 and C-17 for maximum receiver output.

R-F Alignment

After completing the i-f adjustments, it is advisable to correct the line-up of the circuits ahead of the first detector. The test Oscillator should be connected to the antenna-ground terminals of the receiver and the manual volume control turned to its maximum position. For each adjustment, the Oscillator output should be maintained as low as possible in order to avoid broadness of tuning which would result from a.v.c. action on a stronger signal.

Band A—This band should be aligned by supplying a **1720 kc.** signal to the receiver, tuning the station selector to a dial reading of **1720** and adjusting the trimmers C-47, C-12 and C-3 to produce maximum receiver output. The Oscillator should then be shifted to **600 kc.** and the receiver tuned to resonate this signal, disregarding the reading at which it is best received. Trimmer C-46 must then be adjusted, simultaneously while rocking the station selector backward and forward through the signal until the maximum output results from the combined operations. C-47 should be rechecked to assure that its adjustment has not changed because of the trimming of C-46.

Band X—This band must be aligned at **400 kc.** and **150 kc.** Tune the test Oscillator to **400 kc.** and turn the receiver dial to the same reading. Adjust trimmers C-45, C-11 and C-2 for maximum (peak) receiver output. Then shift the Oscillator to **150 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Adjust trimmer C-61, simultaneously rocking the tuning condenser backward and forward through the signal, until maximum receiver output results from the combined operations. Repeat the alignment of C-45 as above to correct for any change which may have been caused by the adjustment of C-61.

Band C—Change the receiver so that it is operative and the dial reads **18,000 kc.** on the "C" Band. Tune the test Oscillator to this same frequency. Then adjust the oscillator trimmer C-43 to produce maximum (peak) output. Two positions of this trimmer will be found which conform with this requirement. The one of least capacitance is correct. Check for the presence of "image" response at **17,080 kc.** by shifting the receiver tuning. If it is received at such a point, the trimmer C-43 has been correctly adjusted to the right peak. *No adjustments are to be made during this check.* Tune the receiver back to the **18,000 kc.** dial marking, readjust C-43 if necessary, and then tune the detector and antenna capacitors C-10 and C-1 for maximum receiver output. No further adjustments are necessary.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 6 will serve to assist in the location of causes for faulty operation. Each value as specified should hold within ± 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance becomes comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each reading is chosen as high as possible consistent with good readability.

Universal Transformer

The transformer used on some models of this receiver is adaptable to several ranges of voltage as given under Rating C of Electrical Specifications. Its schematic and wiring are shown by Figure 7. Terminals are provided at the top of the transformer case for changing the primary connections to suit the voltage being used. Note that a 110 volt tap is brought out separately for supplying a phonograph motor.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4427	Bracket—High or low frequency tone control or volume control mounting bracket.	$0.18
5237	Bushing—Variable condenser mounting bushing assembly—Package of 3........	.43
11223	Capacitor—Adjustable capacitor (C46)....	.46
5241	Capacitor—Adjustable capacitor (C61)....	.40
11292	Capacitor—22 MMfd. (C9).............	.24
11289	Capacitor—50 MMfd. (C8).............	.26
11291	Capacitor—115 MMfd. (C50)...........	.24
11290	Capacitor—400 MMfd. (C60)...........	.25
11269	Capacitor—800 MMfd. (C59)...........	.30
3784	Capacitor—900 MMfd. (C31)...........	.30
11316	Capacitor—1225 MMfd. (C26)..........	.40
11287	Capacitor—4500 MMfd. (C58)..........	.30
5107	Capacitor—.0025 Mfd. (C62, C63)......	.16
4907	Capacitor—0.005 Mfd. (C40, C41)......	.38
4868	Capacitor—0.005 Mfd. (C33)..........	.20
4624	Capacitor—0.01 Mfd. (C30)...........	.54
4937	Capacitor—0.01 Mfd. (C39)...........	.25
11315	Capacitor—0.015 Mfd. (C38)..........	.20
4836	Capacitor—0.05 Mfd. (C4, C13, C18, C23)	.30
4885	Capacitor—0.1 Mfd. (C7, C19, C27, C52).	$0.28
4841	Capacitor—0.1 Mfd. (C6)..............	.22
5170	Capacitor—0.25 Mfd. (C32)............	.25
11203	Capacitor—10 Mfd. (C53).............	1.18
5212	Capacitor—18 Mfd. (C54).............	1.16
11215	Capacitor pack—Comprising one 16 Mfd., two 10 Mfd., and two 8 Mfd. capacitors (C29, C35, C36, C55, C56)..........	3.85
11201	Clamp—Cable clamp—located near variable tuning condenser—Package of 5.......	.20
11272	Clamp—Cable clamp—located above antenna terminal.....................	.10
4693	Clamp—Electrolytic capacitor clamp—for stock #11215.....................	.15
5215	Coil—Antenna coil—A and C bands (L1, L2, L5, L6, C1, C3)................	2.32
11325	Coil—Antenna coil—X band (L3, L4, C2)	1.56
5216	Coil—Detector coil—A and C bands (L7, L8, L11, L12, C10, C12)............	2.34
11326	Coil—Detector coil—X band (L9, L10, C11)	1.60
5217	Coil—Oscillator coil—A and C bands (L13, L15, C43, C47)....................	2.20

REPLACEMENT PARTS (Continued)

Stock No.	Description	List Price
11327	Coil—Oscillator coil—X band—(L14, L23, C45)	$1.44
11277	Compensating Pack—Comprising one 0.015 Mfd., one 0.035 Mfd. capacitor, one 27,000 ohm and one 8200 ohm resistor—(C25, C28, R12, R13)	.92
11214	Condenser—Three gang variable tuning condenser—(C5, C14, C48)	4.20
11205	Volume Control—(R14)	1.30
11219	Tone Control—High frequency tone control—(R22)	.90
11710	Lead—Shielded lead for antenna	.40
8041	Plate—I. F. or R. F. coil shield locking plate with screw—Package of 2	.12
11220	Resistor—Voltage divider resistor—comprising one 3900 ohm and one 4200 ohm section—(R31, R32)	.84
11221	Resistor—Voltage divider resistor—comprising one 50 ohm, one 28 ohm and one 195 ohm section—(R28, R29, R30)	.48
5112	Resistor—1000 Ohm—Carbon type—¼ Watt—(R2)—Package of 5	1.00
3706	Resistor—1800 Ohm—Carbon type—¼ Watt—(R15)—Package of 5	1.00
5159	Resistor—2200 Ohm—Carbon type—¼ Watt—(R20)—Package of 5	1.00
5175	Resistor—5600 Ohm—Carbon type—½ Watt—(R21)—Package of 5	1.00
2731	Resistor—10,000 Ohm—Carbon type—1 Watt—(R25)—Package of 5	1.10
11305	Resistor—22,000 Ohm—Carbon type—¼ Watt—(R16, R17)—Package of 5	1.00
11300	Resistor—33,000 Ohm—Carbon type—1/10 Watt—(R24)—Package of 5	.75
5033	Resistor—33,000 Ohm—Carbon type—1 Watt—(R23)—Package of 5	1.10
3118	Resistor—100,000 Ohm—Carbon type—¼ Watt—(R1, R3, R5, R6)—Package of 5	1.00
5027	Resistor—150,000 Ohm—Carbon type—¼ Watt—(R19)—Package of 5	1.00
11151	Resistor—2.2 Megohms—Carbon type—¼ Watt—(R9)—Package of 5	1.00
5249	Shield—R. F. coil shield	.20
11273	Shield—Radiotron shield	.25
5250	Shield—I. F. Transformer shield	.22
11222	Socket—Dial lamp socket	.18
4794	Socket—4-contact Radiotron socket	.15
11197	Socket—6-contact Radiotron socket	.14
11198	Socket—7-contact Radiotron socket	.15
5224	Switch—Low frequency tone control switch and power switch—(S11, S13)	1.00
11236	Switch—Range switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10)	2.44
5238	Terminal—Antenna terminal assembly	.14
11218	Transformer—Audio driver transformer—(T2)	2.58
11216	Transformer—First intermediate frequency transformer—(L16, L17, C16, C17)	2.15
11217	Transformer—Second intermediate frequency transformer—(L18, L19, C20, C21, C22, R7, R8)	3.10
11213	Transformer—Power transformer—105-125-150-210-250 volts—40-60 cycles	5.10
11212	Transformer—Power transformer—105-125 volts—25-60 cycles	7.18
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball—Package of 20	$0.25
4422	Clutch—Tuning condenser drive clutch assembly—comprising drive shaft, balls, ring, spring and washers assembled	1.00
11333	Dial—Station selector dial scale	.60
11227	Drive—Variable tuning condenser drive complete—less dial scale	2.08
11228	Gear—Vernier pointer drive gear	.42
4827	Gear—Spring gear assembly	1.25
11303	Indicator	.22
11226	Indicator—Band indicator pointer assembly—comprising indicator, arm, link and stud	.20
4475	Indicator—Station selector indicator	.18
4340	Lamp—Dial lamp—Package of 5	.60
3993	Screw—No. 6-32-5/32″ set screw—for band indicator operating arm—Package of 10	.25
4669	Screw—No. 8-32-5/32″ Square head set screw—for tuning condenser shaft—Package of 10	.25
4377	Spring—Band indicator operating arm spring—Package of 5	.25
4378	Stud—Band indicator operating arm stud assembly—Package of 5	.25
	MISCELLANEOUS ASSEMBLIES	
11337	Escutcheon—Station selector escutcheon	.70
6614	Glass—Station selector dial glass	.30
11346	Knob—Station selector knob—Package of 5	.75
11347	Knob—Volume control, range switch, tone control or power switch knob—Package of 5	.75
4678	Ring—Spring retaining ring for station selector dial glass—Package of 5	.34
11210	Screw—Chassis mounting screw assembly—Package of 4	.28
11348	Screw—No. 8-32-7/16″ Headless, cupped point, set screw for knob, Stock #11346—Package of 10	.32
11349	Spring—Retaining spring for knob, stock #11347—Package of 5	15
	REPRODUCER ASSEMBLIES	
11232	Board—Terminal board with two lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Mounting bracket for output transformer and connector	.14
11304	Cable—Reproducer cable—complete with female connector	.80
11234	Coil—Field Coil—(L22)	2.15
11233	Coil—Neutralizing coil	.30
11235	Cone—Reproducer cone (L21)—Package of 5	3.50
5040	Connector — 4-prong female connector socket for reproducer cable	.25
5039	Connector—4-prong male connector plug for reproducer	.25
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
9617	Reproducer—Complete	6.60
11229	Transformer—Output transformer—(T3)	1.66
11230	Washer—Binders board "C" washer—used to hold field coil securely—Package of 5	.18

RCA VICTOR MODEL T 11-8

Eleven-Tube, Three-Band, A-C, Superheterodyne Table Receiver

SERVICE NOTES

Electrical Specifications

FREQUENCY RANGES

Band X	140 kc.— 410 kc.
Band A	540 kc.— 1,800 kc.
Band C	5,700 kc.—18,000 kc.

ALIGNMENT FREQUENCIES

Band X	150 kc. (osc.), 400 kc. (osc., ant., det.)
Band A	600 kc. (osc.), 1,720 kc. (osc., ant., det.)
Band C	18,000 kc. (osc., ant., det.)

Intermediate Frequency .... **460 kc.**

RADIOTRON COMPLEMENT

(1)	RCA-6K7	Radio-Frequency Amplifier
(2)	RCA-6L7	First Detector
(3)	RCA-6J7	Heterodyne Oscillator
(4)	RCA-6K7	Intermediate Amplifier
(5)	RCA-6H6	Second Detector and A.V.C.
(6)	RCA-6C5	First Audio Amplifier
(7)	RCA-6C5	Audio Driver Amplifier
(8)	RCA-6F6	Power Output Amplifier
(9)	RCA-6F6	Power Output Amplifier
(10)	RCA-5Z3	Full-Wave Rectifier
(11)	RCA-6E5	Tuning Indicator

POWER SUPPLY RATINGS

Rating A	105-125 volts, 50-60 cycles, 130 watts
Rating B	105-125 volts, 25-60 cycles, 135 watts
Rating C	100-130/140-160/195-250 volts, 40-60 cycles, 135 watts

POWER OUTPUT RATINGS

Undistorted Output	8.5 watts
Maximum Output	11.5 watts

LOUDSPEAKER

Type	8-inch Electrodynamic
Voice Coil Impedance	2¼ ohms at 400 cycles

Mechanical Specifications

Height	23 3/16 inches
Width	17 inches
Depth	13½ inches
Weight (Net)	48 pounds
Weight (Shipping)	60½ pounds
Chassis Base Dimensions	15½ inches x 10½ inches x 3½ inches

GENERAL FEATURES

This instrument comprises an eleven-tube chassis mounted in a table type of cabinet. Its tuning ranges cover the long wave, standard broadcast, short wave broadcast, amateur and aviation bands. The following points of design are of particular importance:

Metal Radiotrons

The new metal tubes are used in the radio receiver for amplifying and detecting purposes. These tubes make possible a greater range of stable amplification not previously attainable with corresponding glass types. Their metal envelopes form a perfect electrostatic and electromagnetic shield, precluding the former necessity for elaborate shielding by means of cans. The metal tubes are especially adaptable to the modern, extended-range receivers because of their efficient shielding and their favorable internal characteristics.

Tuning Condenser

The variable tuning condenser is supported by a new design of shock-proof mount which has been developed by our engineers to prevent chassis vibration from producing audio frequency howl.

Chassis

Servicing convenience has been a governing factor in the layout of the chassis parts and the associated wiring. Each part has been situated so that a minimum of wiring is necessary. Adjustments provided by means of substantial trimmers are mounted where they may be easily reached. Holes are included in the shield cans of the r-f coil system for testing the tuning with a Tuning Wand.

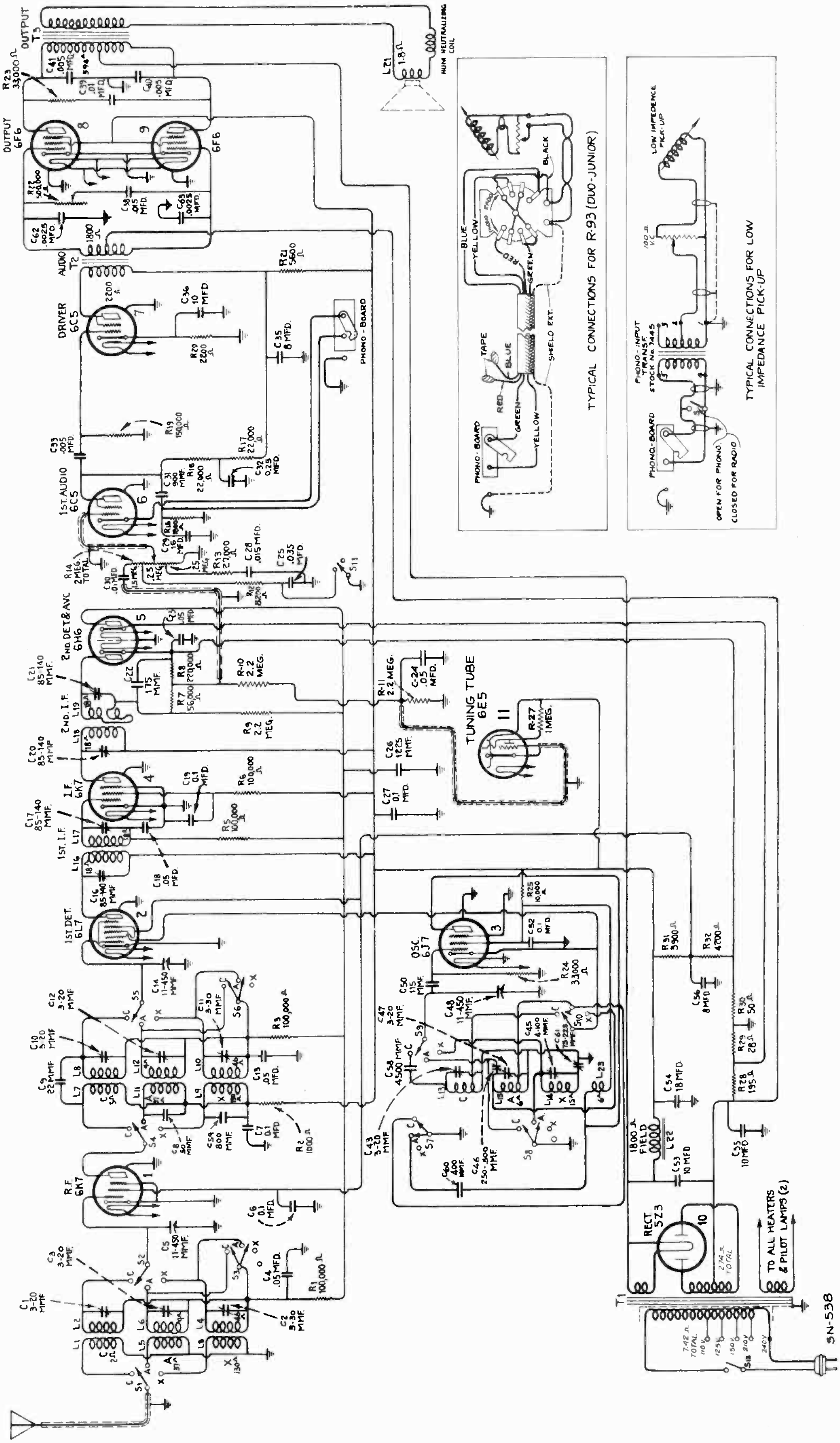


Figure 1—Schematic Circuit Diagram

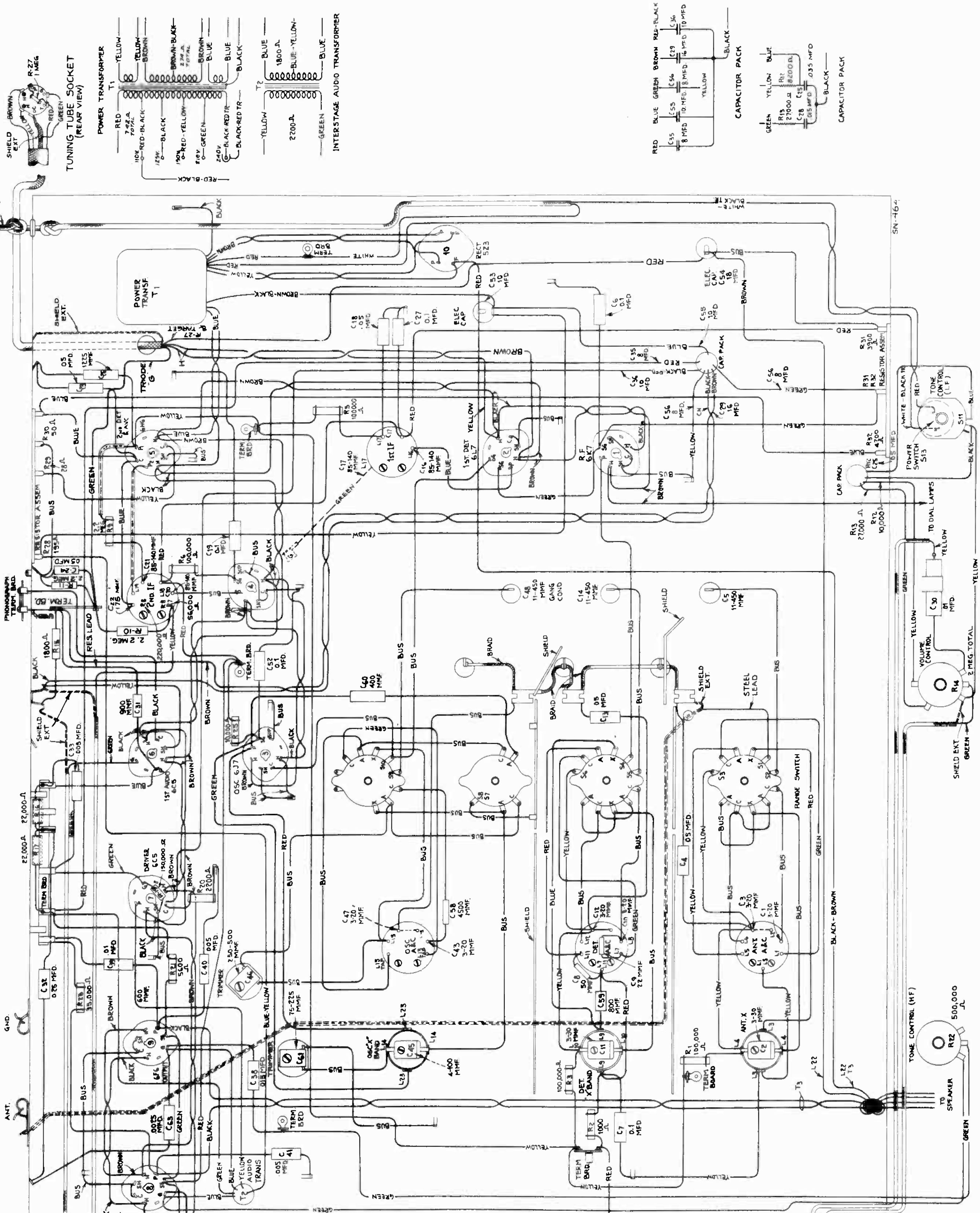


Figure 2—Chassis Wiring Diagram

Loudspeaker

An eight-inch, electrodynamic reproducer unit is used to handle the high level output of the receiver. The speaker is designed to operate in such manner with the acoustics of the cabinet that the best quality of reproduction is obtained. Connections from the chassis to speaker are made through a plug and connector, which permits either unit to be removed quickly for service.

Color Band Dial

The station indicating dial is neatly designed with each scale identified by a different color. As the range switch is changed from one band to another, an index pointer moves so as to point to a short strip of color at the lower part of the dial to indicate the band being used. A push-in clutch arrangement gives a 10-to-1 or 50-to-1 drive ratio. The vernier pointer has a ratio of 20-to-1 with respect to the main pointer.

CIRCUIT ARRANGEMENT

The Superheterodyne principle of operation forms the basis of the circuit design. A single, tuned r-f stage is used ahead of the first detector. The functions of oscillator and detector are performed by two separate tubes. One i-f stage is employed and designed to operate at 460 kc. The combined second detector and a.v.c. stage uses an RCA-6H6 double diode. The audio system consists of two single amplifier stages working in cascade with a push-pull power output stage. The loudspeaker is an electrodynamic type, receiving its field supply from the rectifier and filter system and simultaneously acting as a filter reactor. Full wave rectification is performed in the RCA-5Z3 tube. The outstanding features of electrical design are concerned with the following:

Tuned Circuits

A total of seven circuits are tuned to provide gain and selectivity to the incoming signal. The variable gang condenser resonates the antenna transformer secondary, the detector transformer secondary and the oscillator coil. Alignment trimmers are included for each of these same circuits. Additional trimmers are used on the i-f transformers, tuning both the secondaries and primaries to 460 kc. There are separate groups of antenna, detector and oscillator coils for each of the tuning ranges. They are placed into operation by means of a rugged rotary switch.

First Detector

This stage has unusually good high frequency mixing efficiency. The tube used, an RCA-6L7, is a new hexode type. The signal is supplied to the first control grid and the oscillator is fed in on a second control grid, a screen grid separating the two. The arrangement of the grids prevents degenerative difficulties, particularly at the higher frequencies. The second grid is direct-connected to the cathode of the oscillator tube and has no d-c bias.

Oscillator

The oscillator circuit is worthy of careful study inasmuch as it is different from the type ordinarily employed. It has self-stabilizing properties which are very advantageous for short wave operation. The generated frequency remains substantially constant, the circuit being unaffected by variation of line voltage and other similar influences. Output also remains uniform over the individual tuning ranges. The switching of the tuning coils is arranged so as to short those not in use in order to prevent absorption or any reactive effects in the particular band being tuned.

Detector and A.V.C.

The modulated signal as obtained from the output of the i-f system is detected by an RCA-6H6 double diode tube. The audio frequency secured by this process is passed on to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal, is used for automatic volume control. This voltage, which develops across resistors R-7 and R-8, is applied as automatic control grid bias to the r-f, first detector and i-f tubes through suitable resistance-capacitance filter circuits. The second diode of the RCA-6H6 is used to supply residual bias for these controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current, which flows through resistors R-7, R-8 and R-9, thereby maintaining the desired minimum operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias diode ceases to draw current and the a.v.c. diode takes over the biasing function. The cathode and anode of the signal-a.v.c. diode have positive potential in respect to chassis-ground and cathodes of the a.v.c. controlled tubes when no signal is being received.

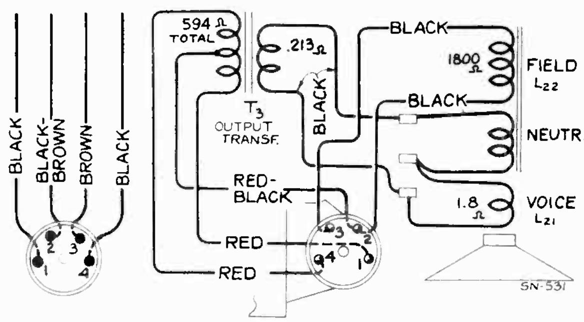


Figure 3—Loudspeaker Wiring

Audio System

Manual volume control of the detected signal is effected by an acoustically tapered potentiometer in the grid circuit of the first a-f stage. This control has tone compensating filters connected to two points thereon. These filters effect the correct aural balance at different volume settings. A music-speech switch (low frequency tone control) is associated with one of the compensation filters. The purpose of this control is to make speech reproduction more intelligible and to reduce hum obtained from stray modulation on a carrier. The driver stage of the audio system uses an

RCA-6C5 which is resistance coupled to the first a-f tube and transformer coupled into the push-pull power output stage.

Tuning Indicator

A cathode-ray tube is used as a means of visually indicating when the receiver is accurately tuned to the incoming signal. This tube is of new design and comprises an amplifier section and a cathode-ray section built in the same glass envelope. The cathode-ray section consists of a conically shaped luminescent screen, upon which a pattern is formed by an effect of the detected signal after said effect has been amplified by the amplifier section which is fed from the detector diode circuit. The size of the pattern is determined by the strength of the signal voltage, so that any change of tuning may be readily observed in order to facilitate tuning to exact resonance.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed to isolate causes for defective operation when such develops. The ratings of the resistors, capacitors, coils, etc., are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and the Replacement Parts List. The coils, reactors, and transformer windings are rated in terms of their d-c resistances only. Ratings of less than one ohm are generally omitted.

Alignment Procedure

Eleven alignment trimmers are provided in the r-f, first detector and oscillator tuning system and four are used in the i-f system. All of these are accurately adjusted during manufacture and should remain in proper alignment unless affected by abnormal conditions of climate or have been altered by other means. Loss of sensitivity, improper tone quality and poor selectivity are the usual indications of improper alignment.

Correct performance of the receiver can only be obtained when the trimmer adjustments have been made by a skilled service man with the use of adequate and reliable test equipment. Such apparatus as may be required for alignment of this particular instrument is illustrated and described on a separate page of this booklet.

Two methods of alignment are applicable. One utilizes a Cathode-Ray Oscillograph as a means of output indication and the other follows former procedure where a glow type indicator or meter is used. The oscillographic method is much to be preferred, since greater accuracy is possible from the type of indication afforded. There are no approximations necessary as with the meter or aural method, but each adjustment can be made with definite precision. Both methods are hereinafter outlined so that alignment operations may be made according to the equipment available.

It is wise to determine the necessity for alignment as well as the direction of misalignment before making adjustments. The RCA Tuning Wand is an instrument designed particularly for such a purpose.

The Tuning Wand consists of a bakelite rod having a small brass cylinder at one end and a core of finely divided iron at the other. It may be inserted into a tuned coil while a signal of the normal resonant frequency is being supplied to such coil to obtain an indication of the tuning. Holes are provided at the top of the r-f shield cans for entrance of the Wand. The presence of either end of the Wand will cause a change in tuning which will be indicated at the receiver output as an increase or decrease in signal level. If there is a decrease of output when either end is inserted, the tuning is correct and will require no adjustment. However should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output while the iron end causes a decrease, reduction of inductance will be necessary to place the circuit in alignment. This is equivalent to decreasing the trimmer concerned. The following tabulation gives the various changes and the adjustments required:

WAND	SIGNAL	TRIMMER
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

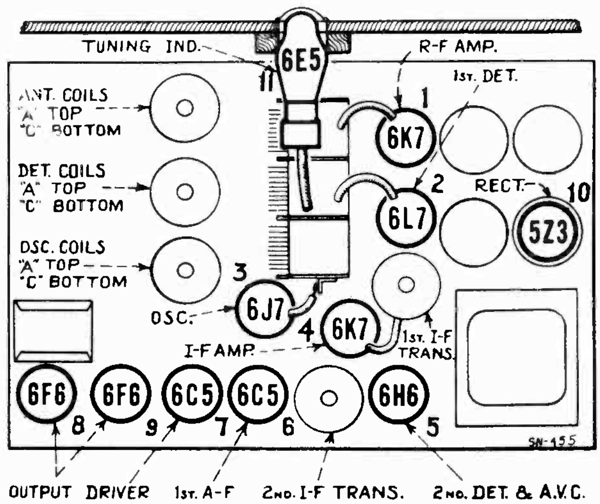


Figure 4—Radiotron and Coil Locations

CATHODE-RAY ALIGNMENT

Equipment

A standard source of alignment frequencies is required. Such a source should consist of an RCA Full Range Oscillator, Stock No. 9595. Output indication should be by means of an RCA Stock No. 9545 Cathode-Ray Oscillograph. An RCA Stock No. 9558 Frequency Modulator will be needed to sweep the generated signal and synchronize it with the Oscillograph in order to obtain visual representation of the resonant characteristic of the circuit being tuned on the cathode-ray fluorescent screen.

I-F Trimmer Adjustments

The four trimmers of the two i-f transformers are located as shown by Figure 6. Each must be aligned to a basic frequency of **460 kc.** The last transformer must be aligned firstly and the first transformer aligned secondly. For such a process, it is necessary to feed the output of the Full Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each transformer and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The proper point of connection of the Oscillograph is with its vertical "high" input terminal attached to the juncture of R-7 and R-8, as illustrated in Figure 6, and with the "0" or ground terminal to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as shown by Figure 5. A .001 mfd. capacitor installed in series with the Oscillator "Ant." lead will prevent the voltages of the stage under alignment from becoming upset. The vertical "A" amplifier should be "On" for the ensuing adjustments

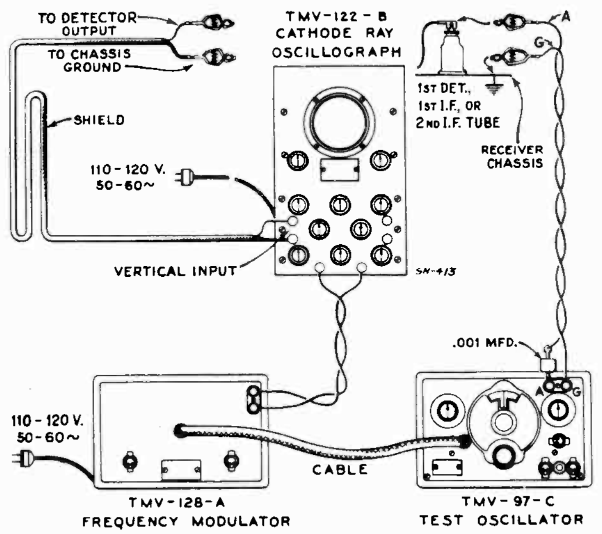


Figure 5—Alignment Apparatus Connections

and its gain control kept at maximum. For each adjustment, the Oscillator output must be regulated so that the image obtained on the Oscillograph screen will be of the minimum size convenient for accurate observation. Proceed further as follows:

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver range switch to Band "A" and tune the station selector to a point where no interference will be encountered from signal pickup or from the RCA-6J7 oscillator, removing the tube if necessary. Set the Oscillograph horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a straight line trace completely across the screen. Place the timing control to "Int." Adjust the intensity and focusing controls of the Oscillograph to produce the correct size and strength of spot.

(b) Attach the output of the test Oscillator between the control grid cap of the RCA-6K7 i-f tube and chassis ground as shown typically by Figure 5. Tune the Oscillator to **460 kc.** and set its modulation switch to "On." Regulate its output until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph controls to give a shape which is convenient for peak indications. Cause the image to stand still on the screen by manipulation of the frequency and synchronizing controls. Then carefully tune the two trimmers C-20 and C-21 of the second i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full Range Oscillator by means of the special shielded patch cord. Figure 5 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off." Change the timing control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then carefully shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become exactly co-incident at their highest points. This condition will be found to occur at an Oscillator setting of *approximately* **540** *kc.* The curves will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with the above requirement and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-20 and C-21 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as in (c), change the Oscillator output to the control grid cap of the RCA-6L7 first detector tube. Then adjust the first i-f transformer trimmers C-16 and C-17 so that the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the overall tuning characteristic of the i-f system.

R-F Trimmer Adjustments

For Bands A and X, adjustments must be made at the high and low frequency ends of the range. On Band C, alignment is required only at the high frequency end.

Locations of the various antenna, detector and oscillator coil trimmers are shown by Figure 6. The test Oscillator should be removed from connection with the i-f system and its output connected to the antenna-ground terminals of the receiver. No changes are to be made in the connections of the Oscillograph at the second detector. During the following adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Adherence to this procedure will obviate the broadness of tuning that would result from a.v.c. action on a stronger signal. Proceed with the adjustments as follows:

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning condenser plates are in full mesh (maximum capacitance). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the Band A scale. Correct the setting of the vernier second hand pointer to read zero.

Band A

(a) With the receiver range switch in its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the test Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscillator, detector and antenna trimmers, C-47, C-12 and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. After each trimmer has been peaked, the Oscillograph timing control should be set to "Ext." and the Frequency Modulator placed into operation with its connections to the Oscillator and Oscillograph made in accordance with Figure 5. Turn the modulation switch of the Oscillator to "Off" and retune the Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-47, C-12 and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the wave images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Place the modulation switch to "On". Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator (modulation "Off") until the two similar forward and reverse waves appear on the screen. For this adjustment, it is advisable to shift the Oscillator to its 200-400 kc. range using the third harmonic of the generated signal in order to obtain the desired range of sweep. The oscillator series trimmer, C-46, should then be adjusted to produce maximum amplitude of the images. No rocking will be necessary on the station selector inasmuch as the signal frequency is being "wobbled" by the Frequency Modulator to produce the same effect. After completing this adjustment, the trimmer C-47 should be re-aligned as in (a) to correct for any change brought about by the adjustment of C-46.

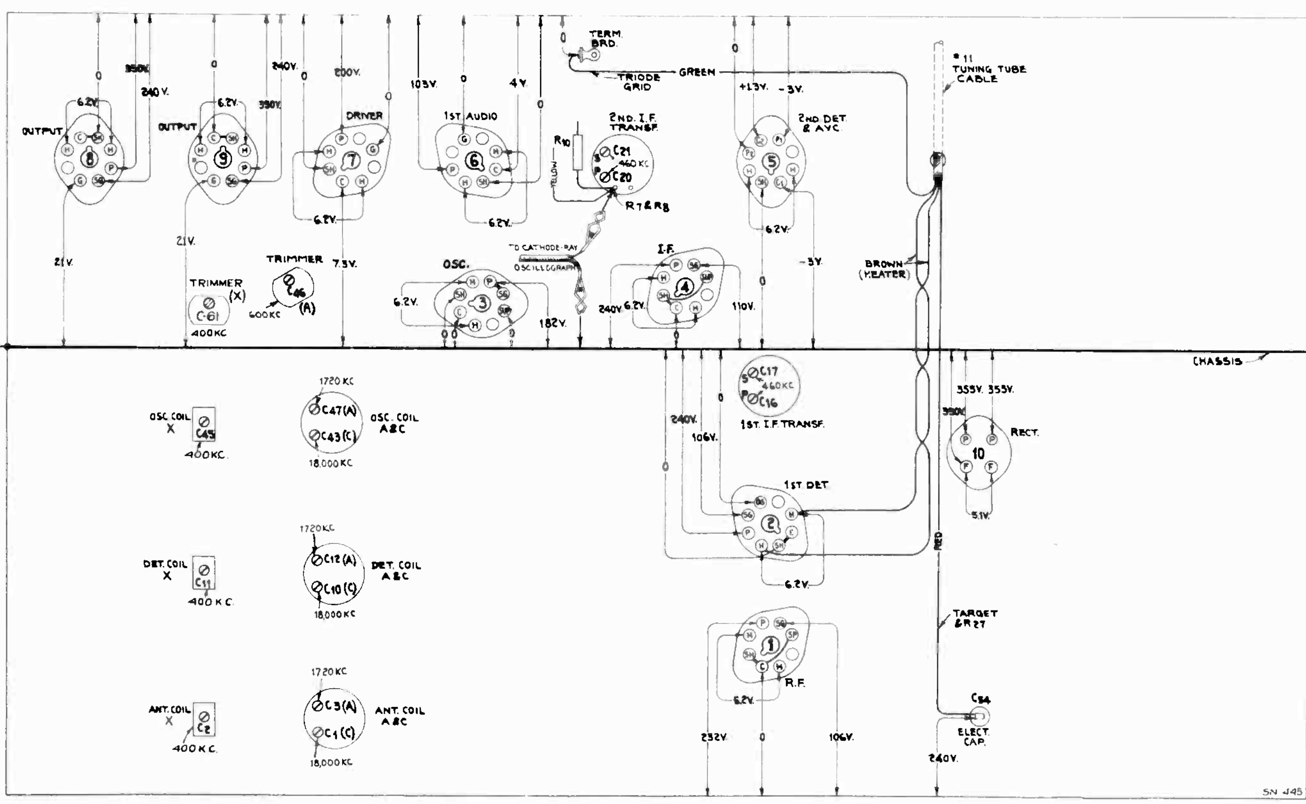


Figure 6—Trimmer Locations and Radiotron Socket Voltages
Measured at 115 volts, 60 cycles—No signal input

Band X

(a) Disconnect the Frequency Modulator and tune the test Oscillator to a frequency of **400 kc.** (Modulation "On"). Place the receiver range switch in its Band X position and turn the station selector until the dial pointer reads **400 kc.** Adjust the Oscillograph timing control to "Int." Then align each of the trimmers C-45, C-11 and C-2 to the point producing maximum output at the Oscillograph. Place the Frequency Modulator in operation and attach it to the Oscillator in the normal manner. Change the Oscillograph timing to "Ext." Increase the frequency of the Oscillator (modulation "Off") until the two waves appear and become coincident at their highest points, *approximately at* **462** *kc.* They may be made to remain stationary on the screen by manipulation of the Oscillograph range switch and frequency control. Readjust the three trimmers C-45, C-11 and C-2 to give maximum amplitude and complete coincidence of the waves.

(b) Change the test Oscillator so that it delivers a signal of **150 kc.** with the Frequency Modulator disconnected. Tune this signal on the receiver which has previously been set to Band X, disregarding the dial reading at which the signal is best received. Then interconnect the Frequency Modulator with the Oscillator and retune the latter to the point at which the two similar waves appear on the screen. Adjust trimmer C-61, for maximum amplitude of the wave images. Rocking of the tuning condenser will not be necessary as the Frequency Modulator duplicates such an operation. Repeat the alignment of C-45 as outlined in (a) to correct for any reflective error brought about by the adjustment of C-61.

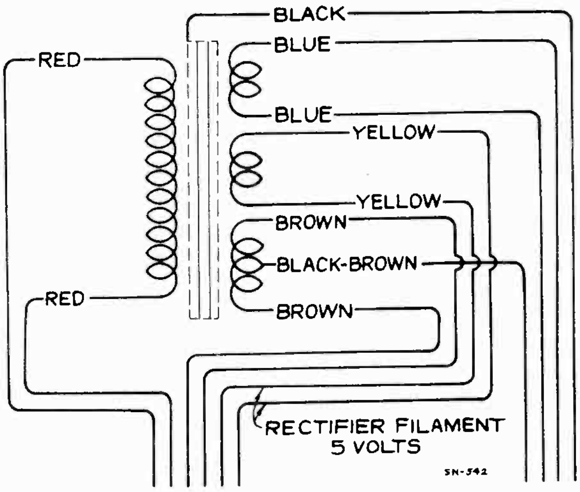
Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to the same frequency (modulation "On" and Frequency Modulator disconnected) and regulate its output to the level required for convenient observation. Adjust the trimmer C-43 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of the proper "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of C-43 has been properly made by using the position of least capacitance which gives maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, realign C-43 if necessary, and then adjust the detector and antenna trimmers, C-10 and C-1, for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on this band.

OUTPUT INDICATOR ALIGNMENT

To align the receiver by means of an output indicator other than a Cathode-Ray Oscillograph will require the use of a standard test Oscillator, such as that recommended above, for the source of signals and means of indication for the output. The RCA Neon Output Indicator, Stock No. 4317, will be found very satisfactory for such use. It should be connected across the voice coil circuit of the loudspeaker or across the output transformer primary.



Pri. Res.—5.42 ohms, total
Sec. Res.—470 ohms, total

Figure 7—Standard Power Transformer Connections

I-F Alignment

Connect the test Oscillator to the control grid cap of the i-f tube. Advance the volume control of the receiver to its full-on position. Tune the test Oscillator accurately to **460 kc.** and align the trimmers C-20 and C-21 to give maximum receiver output. Regulate the Oscillator output during this adjustment so that the output indication is as small as can be conveniently observed. After completing the adjustments of these trimmers, re-connect the Oscillator so that it will feed into the control-grid circuit of the RCA-6L7 first detector. Then tune the first i-f transformer trimmers C-16 and C-17 for maximum receiver output.

R-F Alignment

After completing the i-f adjustments, it is advisable to correct the line-up of the circuits ahead of the first detector. The test Oscillator should be connected to the antenna-ground terminals of the receiver and the manual volume control turned to its maximum position. For each adjustment, the Oscillator output should be maintained as low as possible in order to avoid broadness of tuning which would result from a.v.c. action on a stronger signal.

Band A—This band should be aligned by supplying a **1720 kc.** signal to the receiver, tuning the station selector to a dial reading of **1720** and adjusting the trimmers C-47, C-12 and C-3 to produce maximum receiver output. The Oscillator should then be shifted to **600 kc.** and the receiver tuned to resonate this signal, disregarding the reading at which it is best received. Trimmer C-46 must then be adjusted, simultaneously while rocking the station selector backward and forward through the signal until the maximum output results from the combined operations. C-47 should be rechecked to assure that its adjustment has not changed because of the trimming of C-46.

Band X—Change the range switch to its Band "X" position. Tune the receiver to read **400 kc.** and set the Oscillator to **400 kc.** Adjust trimmers C-45, C-11 and C-2 to produce maximum receiver output. Then shift the Oscillator frequency to **150 kc.** and tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then tune the oscillator series trimmer, C-61, simultaneously rocking the tuning control (receiver) backward and forward through the signal, until maximum output results from the combined operations. Repeat the alignment of C-45 as in (a) to correct for any change caused by the adjustment of C-61.

Band C—Change the receiver so that it is operative and the dial reads **18,000 kc.** on the "C" Band. Tune the test Oscillator to this same frequency. Then adjust the oscillator trimmer C-43 to produce maximum (peak) output. Two positions of this trimmer will be found which conform with this requirement. The one of least capacitance is correct. Check for the presence of "image" response at **17,080 kc.** by shifting the receiver tuning. If it is received at such a point, the trimmer C-43 has been correctly adjusted to the right peak. *No adjustments are to be made during this check.* Tune the receiver back to the **18,000 kc.** dial marking, readjust C-43 if necessary, and then tune the detector and antenna capacitors C-10 and C-1 for maximum receiver output. No further adjustments are necessary.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to chassis on Figure 6 will serve to assist in the location of causes for faulty operation. Each value as specified should hold within $\pm$ 20% when the receiver is normally operative at its rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance.

Standard Transformer

The transformer used on some models of this instrument is adaptable for voltages and frequencies as given under Ratings A and B of Electrical Specifications. Its schematic and wiring are shown by Figure 7.

Phonograph Attachment

A terminal board is provided for connecting a phonograph attachment into the audio amplifying circuit. Two typical methods of connection are shown on the schematic diagram Figure 1. The radio volume control must be set to minimum when using phonograph.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price	Stock No.	Description	List Price
	RECEIVER ASSEMBLIES		11203	Capacitor—10 Mfd. (C53)	1.18
4632	Board—Terminal board assembly—two terminals	$0.25	5212	Capacitor—18 Mfd. (C54)	1.16
4427	Bracket—Volume control mounting bracket	.18	11215	Capacitor pack—Comprising one 16 Mfd., two 10 Mfd., and two 8 Mfd. capacitors (C29, C35, C36, C55, C56)	3.85
5237	Bushing—Variable tuning condenser mounting bushing assembly—comprising one bushing, one washer, one lockwasher and one nut—Package of 3	.43	4693	Clamp—Electrolytic condenser mounting clamp—for stock No. 11215	.15
11223	Capacitor—Adjustable capacitor (C46)	.46	11325	Coil—Antenna coil—X band (L3, L4, C2)	1.56
5241	Capacitor—Adjustable capacitor (C61)	.40	11326	Coil—Detector coil—X band (L9, L10, C11)	1.60
11292	Capacitor—22 MMfd. (C9)	.24	11327	Coil—Oscillator coil—X band (L14, L23, C45)	1.44
11289	Capacitor—50 MMfd. (C8)	.26	5215	Coil—Antenna coil—A and C bands (L1, L2, L5, L6, C1, C3)	2.32
11291	Capacitor—115 MMfd. (C50)	.24	5216	Coil—Detector coil—A and C bands (L7, L8, L11, L12, C10, C12)	2.34
11290	Capacitor—400 MMfd. (C60)	.25	5217	Coil—Oscillator coil—A and C bands (L13, L15, C43, C47)	2.20
11269	Capacitor—800 MMfd. (C59)	.30	11277	Compensating Pack—Comprising one 8200 ohm and one 27,000 ohm resistors, one .015 Mfd., one .035 Mfd. capacitors (C25, C28, R12, R13)	.92
3784	Capacitor—900 MMfd. (C31)	.30	11214	Condenser—Three-gang variable tuning condenser (C5, C14, C48)	4.20
11316	Capacitor—1225 MMfd. (C26)	.40	11697	Cover—Terminal board cover	.12
11287	Capacitor—4500 MMfd. (C58)	.30	11202	Foot—Chassis foot and bracket assembly—Package of 2	.78
5107	Capacitor—.0025 Mfd. (C62, C63)	.16	11710	Lead—Shielded lead—connects antenna terminal to range switch	.40
4838	Capacitor—.005 Mfd. (C40, C41)	.20			
4868	Capacitor—.005 Mfd. (C33)	.20			
4624	Capacitor—.01 Mfd. (C30)	.54			
4937	Capacitor—.01 Mfd. (C39)	.25			
11315	Capacitor—.015 Mfd. (C38)	.20			
4836	Capacitor—.05 Mfd. (C4, C13, C18, C23)	.30			
4886	Capacitor—.05 Mfd. (C24)	.20			
4839	Capacitor—0.1 Mfd. (C7, C19, C27, C52)	.28			
4841	Capacitor—0.1 Mfd. (C6)	.22			
5170	Capacitor—0.25 Mfd. (C32)	.25			

The prices quoted above are subject to change without notice.

REPLACEMENT PARTS—Continued

Stock No.	Description	List Price
8041	Plate—I. F. or R. F. coil shield locking plate—Package of 2	.12
11220	Resistor—Voltage divider resistor—Comprising one 3900 ohm and one 4200 ohm sections (R31, R32)	.84
11221	Resistor—Voltage divider resistor—Comprising one 50 ohm, one 28 ohm and one 195 ohm sections (R28, R29, R30)	.48
5112	Resistor—1000 ohm—Carbon type—1/4 watt (R2)—Package of 5	1.00
3706	Resistor—1800 ohm—Carbon type—1/4 watt (R15)—Package of 5	1.00
5159	Resistor—2200 ohm—Carbon type—1/4 watt (R20)—Package of 5	1.00
5175	Resistor—5600 ohm—Carbon type—1/2 watt (R21)—Package of 5	1.00
2731	Resistor—10,000 ohm—Carbon type—1 watt (R25)—Package of 5	1.10
11305	Resistor—22,000 ohm—Carbon type—1/4 watt (R16, R17)—Package of 5	1.00
5033	Resistor—33,000 ohm—Carbon type—1 watt (R23)—Package of 5	1.10
11300	Resistor—33,000 ohm—Carbon type—1/10 watt (R24)—Package of 5	.75
3118	Resistor—100,000 ohm—Carbon type—1/4 watt (R1, R3, R5, R6)—Package of 5	1.00
5027	Resistor—150,000 ohm—Carbon type—1/4 watt (R19)—Package of 5	1.00
11626	Resistor—2.2 megohms—Carbon type—1/4 watt (R9, R10, R11)—Package of 5	1.00
5249	Shield—Antenna, detector, or oscillator coil shield	.20
5250	Shield—Intermediate frequency transformer shield	.22
11222	Socket—Dial lamp socket	.18
4794	Socket—4-contact rectifier Radiotron socket	.15
11197	Socket—6-contact Radiotron socket	.14
11198	Socket—7-contact Radiotron socket	.15
11236	Switch—Range switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10)	2.44
5224	Switch—Low frequency tone control and power switch (S11, S13)	1.00
5238	Terminal—Antenna terminal board with clip, insulating strip and rivets	.14
11219	Tone Control—High frequency tone control (R22)	.90
11218	Transformer—Audio driver transformer (T2)	2.58
11216	Transformer—First intermediate frequency transformer (L16, L17, C16, C17)	2.15
11217	Transformer—Second intermediate frequency transformer (L18, L19, C20, C21, C22, R7, R8)	3.10
11212	Transformer—Power transformer—105-125 volts—25-50 cycles	7.18
11213	Transformer—Power transformer—250-210-150-125-105 volts—40-60 cycles (T1)	5.10
11205	Volume Control—(R14)	1.30
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—Comprising drive shaft, balls, ring, spring and washers, assembled	1.00
11333	Dial—Station selector dial scale	.60
11227	Drive—Variable tuning condenser drive complete—less dial scale	2.08
11228	Gear—Vernier pointer drive gear	.42
4827	Gear—Spring gear assembly—complete—comprising stud, spring, cover, gears, mounting arm with screws and washers	1.25
11303	Indicator—Station selector vernier indicator pointer	.22
11226	Indicator—Band indicator pointer assembly—comprising indicator, arm, link and stud	.20
4475	Indicator—Station selector indicator	.18
4340	Lamp—Dial lamp—Package of 5	.60
3993	Screw—No. 6-32-5/32-in. set screw for band indicator operating arm—Package of 10	.25
4669	Screw—No. 8-32-5/32-in. square head set screw—for tuning condenser shaft—Package of 10	.25
4377	Spring—Band indicator operating arm spring—Package of 5	.25
4378	Stud—Band indicator operating arm stud assembly—Package of 5	.25
	REPRODUCER ASSEMBLIES	
11232	Board—Terminal board with two lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut	.16
8060	Bracket—Mounting bracket for output transformer and connector	.14
11304	Cable—Reproducer cable—Complete with female connector	.80
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
11234	Coil—Field coil (L-22)	2.15
11233	Coil—Neutralizing coil	.30
11235	Cone—Reproducer cone (L21)—Package of 5	3.50
5040	Connector—4 contact female connector socket for reproducer cable	.25
5039	Connector—4 prong male connector plug for reproducer	.25
9617	Reproducer—Complete	6.60
11229	Transformer—Output transformer (T3)	1.66
11230	Washer—Binders board "C" washer—used to hold field coil securely—Package of 5	.18
	MISCELLANEOUS ASSEMBLIES	
11729	Bolt—Reproducer mounting bolt assembly—Comprising one bolt, one washer, one lockwasher and one nut—Package of 2	.20
11191	Bracket—Tuning lamp mounting bracket—less clamp	.12
11319	Cable—Tuning tube cable—complete with socket	1.38
11192	Clamp—Tuning lamp mounting clamp—less bracket	.12
11276	Escutcheon—Tuning lamp escutcheon	.40
11337	Escutcheon—Station selector escutcheon	.70
6614	Glass—Station selector dial glass	.30
11347	Knob—Volume control, tone control, range switch or power switch knob—Package of 5	.75
11346	Knob—Station selector knob—Package of 5	.75
11382	Resistor—1 megohm—Carbon type—1/10 watt (R27)—Package of 5	.75
4678	Ring—Spring retaining ring for station selector dial glass—Package of 5	.34
11377	Screw—Chassis mounting screw assembly—Comprising one screw, one washer and one lockwasher—Package of 4	.12
11348	Screw—No. 8-32—7/16-in. headless cupped point set screw for knob (Stock No. 11346)—Package of 10	.32
11381	Socket—Tuning tube socket and cover	.45
11349	Spring—Retaining spring for knob (Stock No. 11347)—Package of 5	.15

The prices quoted above are subject to change without notice.

SUPPLEMENT TO

RCA VICTOR MODELS

T 7-5, T 8-14, T 8-16, T 10-1, and T 10-3

SERVICE NOTES

On receiver Models T 7-5 and T 8-14, three different type speakers are used. They can be readily identified by the following numbers stamped on them: (1) RL 63-4, (2) 76365-1, and (3) 76365-3.

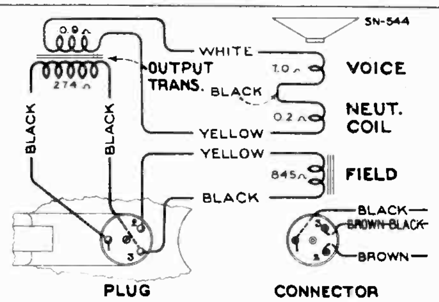
On receiver Models T 10-1 and T 10-3, two different type speakers are used: (1) RL 63-5 and (2) 76365-2.

On receiver Model T 8-16, two different type speakers are used: (1) RL 63-4 and (2) 76365-3.

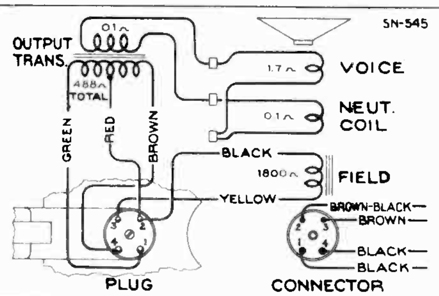
The internal connections and replacement parts for speakers RL 63-4 and RL 63-5 are given in the Service Notes, while the schematic diagrams given below indicate the color code and wiring to the plug and connector for speakers: (1) 76365-1, (2) 76365-2, and (3) 76365-3. The replacement parts appear opposite the respective speakers.

REPLACEMENT PARTS

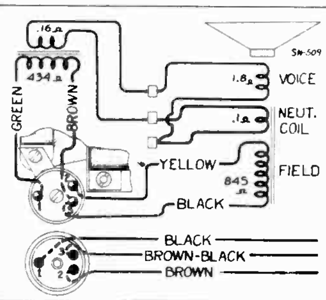
76365-1



76365-2



76365-3



Stock No.	Description	List Price
	76365-1	
11836	CONE—Reproducer cone	$1.75
5118	CONNECTOR—3-contact male connector for reproducer	.25
9634	REPRODUCER—Complete	6.40
11837	TRANSFORMER—Output transformer (Field and hum coils not removable.)	1.56
	76365-2	
11841	COIL—Field coil	2.15
11842	COIL—Hum neutralizing coil	.30
11838	CONE—Reproducer cone	2.00
5039	CONNECTOR—4-contact male connector for reproducer	.25
9636	REPRODUCER—Complete	6.60
11839	SPRING—Reproducer center support casting clamping spring—Package of 2.	.30
11840	TRANSFORMER—Output transformer	1.66
	76365-3	
11844	COIL—Field coil	2.00
11842	COIL—Hum neutralizing coil	.30
11838	CONE—Reproducer cone	2.00
5118	CONNECTOR—3-contact male connector for reproducer	.25
9635	REPRODUCER—Complete	6.40
11839	SPRING—Reproducer center support casting clamping spring—Package of 2.	.30
11843	TRANSFORMER—Output transformer	1.56

The prices quoted above are subject to change without notice.

RCA Victor Portable Victrola Model 2-19

(1935 Production)

SERVICE DATA

MOTOR

The drive motor is of simple design and substantial construction. It should require little or no service if properly maintained. Attention to lubrication of the moving parts and occasional cleaning of the mechanism will go far to prevent faulty operation. Should it become necessary to repair the motor, the following procedure should be applied:

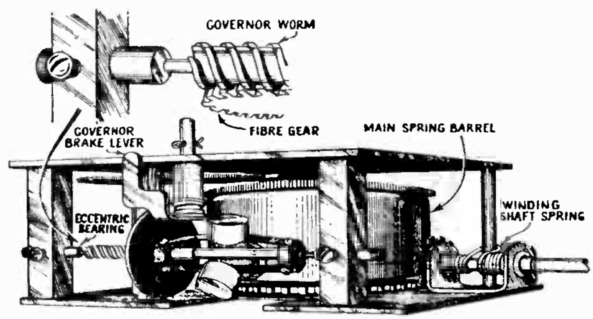
CAUTION.—ALLOW THE MOTOR MECHANISM TO RUN DOWN COMPLETELY BEFORE ATTEMPTING ADJUSTMENT, REPAIRS OR REPLACEMENTS.

Removing Motor from Cabinet. Remove the winding key. To dismount the motor, unscrew the spindle cap with a small rod or nail and remove the turntable. Remove the five screws holding the motor board and lid support to the cabinet and lift the motor board assembly clear. Loosen the set screw holding the speed-regulator lever and remove the latter. The four nuts supporting the motor to the board should be loosened to permit removal of the motor mechanism.

Motor Main Spring. In case of main spring failure, it is recommended that the entire spring barrel and gear be replaced, since the procedure of spring installation requires a good deal of care and involves slight danger. The additional cost of the spring barrel is offset by the saving in labor. To the service man who is properly qualified for handling springs of this type, and who will find it unnecessary to observe the above recommendation, the following method of replacement is suggested:

(*a*) Allow the motor mechanism to run down completely. Loosen the four pillar nuts which secure the motor to the top plate. Raise the plate slightly and remove the spring barrel. The barrel cover should be removed by gently tapping around its edges, firmly grasping the barrel in one hand, holding it open side downward over a large can or similar container to give protection against the sudden expansion of the spring when released. After removing the cover, pull the center turns of the spring from the barrel and as soon as the spring begins to emerge, withdraw the hand and allow the spring to escape into the protective can.

(*b*) The new spring is furnished coiled and clamped in shape with a heavy ring. It should be inserted by holding the barrel in one hand and forcing the spring into place with the other. The end of the spring should be placed over the barrel hook and in such position that the spring spirals in a clockwise direction toward the center. The spring should be



pushed into the case, allowing the shipping clamp to become disengaged. Apply a moderate amount of spring lubricant to the spring coils and replace the barrel cover.

(*c*) Return the barrel mechanism to the motor assembly in a manner reverse to the method of removal.

Winding Shaft Spring. This spring functions as a friction ratchet on the winding shaft. It can be removed by taking the main spring barrel from its mounting, clamping the lower motor plate in a vise, and turning the winding crank in the "wind" direction, at the same time forcing it inward until the spring slides off the shaft. To install a new spring, place it in position hooked around the pillar post; insert the crank through the spring and screw it into the winding shaft. Continue turning the crank in the "wind" direction, simultaneously pulling it outward until the shaft is properly fitted into the spring. Reassemble the motor.

GOVERNOR ADJUSTMENT

The mesh of the worm and fibre gears is adjustable by rotation of the two governor spindle bearings. This operation shifts the spindle bearing holes, due to their eccentric locations in the bearing parts as shown in the illustration. To obtain the proper mesh between the gears, turn the bearings so that the worm moves in toward the fibre gear and binding occurs. Then gradually "back off" on the bearings until smooth operation is obtained. The action of the mechanism can be tested by spinning the governor during the adjustment and noting how freely it operates. It is important to have the two spindle bearing holes accurately aligned with each other. This condition is maintained by always adjusting the bearings to the same relative positions. The minimum of spindle end play which will permit smooth operation should be used. This is preferably adjustable by moving the *left* spindle bearing in or out as required.

SPEED REGULATOR LEVER

It is desirous to have the turntable operate at its normal speed (78 r.p.m.) when the regulator lever sets at its mid-position. To accomplish this adjustment, place the motor in operation, adjust the lever until the turntable revolves steadily at 78 r.p.m.; loosen the set screw which clamps the lever to the brake shaft and shift the lever to the center of the speed indicator scale; tighten the set screw and re-check the turntable speed.

LUBRICATION

Premature wear and failure of parts are direct results of failure to clean and lubricate the motor at necessary intervals. The various bearings and gears of the motor should be cleaned and lubricated at least once every six months. A drop of oil should be applied at the following locations: Regulator friction pad, governor spindle bearings, governor spindle slide mechanism, top and bottom bearings of the turntable spindle, and at the upper and lower bearings of the spring barrel. A small amount of grease should be applied to the worm gear of the governor, to the gear of the winding shaft, and on the small pinion gear. Spring lubricant should be used on the spring of the winding key coupling, and when necessary on the main spring. In addition to the regular lubrication, all motor parts should be covered with a light film of oil to prevent rusting. The oils and greases required are listed under replacement parts.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
7720	Arm—Tone arm assembly	$3.26
7943	Barrel—Spring barrel—Complete with winding gear and drive gear	2.20
7946	Board—Motor board with horn—Less hardware and motor—Green	2.85
7947	Board—Motor board and horn—Less hardware and motor—Blue	2.85
4113	Bracket—Sound box rest bracket	.50
7930	Brake—Turntable brake	.36
7950	Cabinet—Complete with handle and catches—Black	10.85
7951	Cabinet—Complete with handles and catches—Blue	10.85
7932	Cap—Turntable spindle cap	.16
4116	Catch — Cabinet catch — Complete with mounting rivets—Package of 2	.40
7949	Clamp—Record clamp with rivets	.40
4109	Cup—Needle cup	.22
7948	Escutcheon	.15
7945	Gear—Intermediate gear, pinion and shaft	.40
7938	Gear—Winding gear, sleeve and shaft	.28
7940	Governor assembly—Comprising governor spindle, disc, collar, governor weights and springs	2.20
7937	Governor weight and spring assembly	.20
6838	Handle—Carrying handle	.82
7927	Holder—Needle holder	.35
7926	Key—Winding key	.42
7935	Leather—Friction leather for turntable brake—Package of 10	$0.20
7933	Lever—Speed regulator lever and plate	.22
7228	Lubricant—RCA Victor spring lubricant—1 pint can	.65
7931	Motor—Motor complete with spindle cap	5.60
7226	Motor grease—RCA Victor motor grease—1 pint can	.40
7227	Motor oil—RCA Victor motor oil—1 pint can	.50
7936	Nut—Motor mounting nut assembly—Comprising 2 nuts, 1 washer, 1 lockwasher and 1 rubber cushion	.10
7941	Plate—Top plate assembly	.50
7944	Regulator shaft—Complete with friction lever and pad with cotter pin	.24
4115	Screw and washer—Motor board mounting screw and washer—Package of 3	.25
6933	Sound box—Complete with needle screw	1.80
4118	Screw—Needle holding screw—Package of 10	.65
7939	Spindle—Turntable spindle—Complete with two gears	.72
7957	Spring—Main spring for motor	1.00
7934	Spring—Coil spring for turntable brake—Package of 10	.30
7942	Spring—Winding lock spring (ratchet)	.15
4114	Support—Lid support	.25
7928	Turntable—Green	1.12
7929	Turntable—Blue	1.12

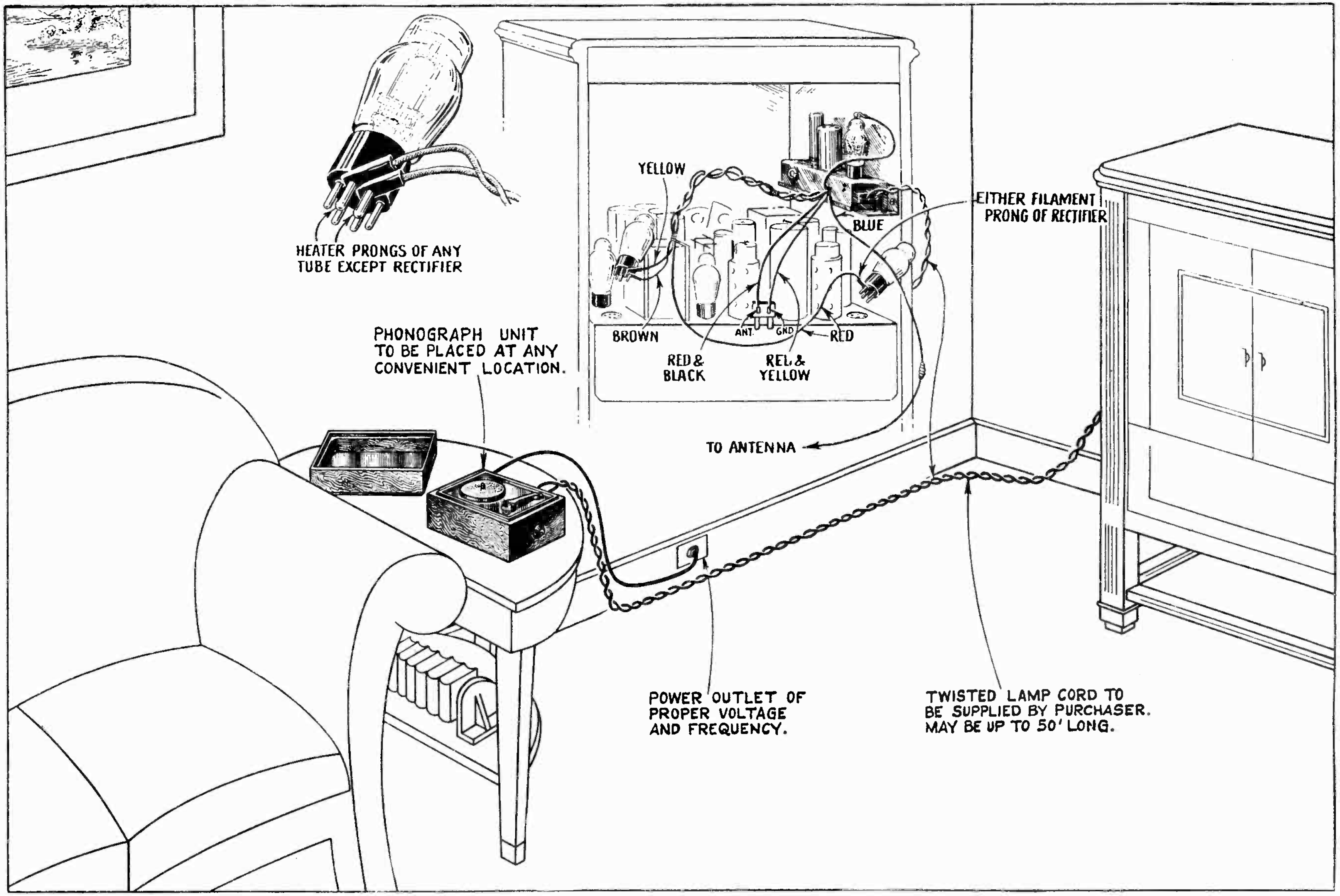


Figure 1—Typical Connections of RK-24 Phonograph Oscillator to Model R-93 Record Player

RCA VICTOR

MODEL RK-24 PHONOGRAPH OSCILLATOR

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Type of Oscillator Circuit	Modified Hartley
Type of Modulation	Pentode Control Grid
Type of Radiotrons	RCA-2A7 or RCA-6A7
Heater Current	0.3 or 1.0 (Depending on Tube Used)
Heater Voltage	2.5 or 6.3 Volts (Depending on Tube Used)
Plate Voltage	150 Volts to 400 Volts
Plate Current	2.0 M. A. at 250 Volts
Input Pickup Impedance	2450 Ohms at 1000 Cycles
Output Impedance	30 Ohms
Tuning Frequency Range	1400 K. C. to 1700 K. C.

PHYSICAL SPECIFICATIONS

Height	5½ Inches
Width	7 Inches
Depth	2½ Inches
Weight	1 Pound
Weight Packed for Shipment	2 Pounds

The RCA Victor RK-24 Phonograph Oscillator is a modulated R. F. oscillator designed for use in conjunction with the RCA Victor Record Player Model R-93. The purpose of the RK-24 Oscillator is to facilitate and ensure the proper connection and operation of the R-93 when connected to a radio receiver of any type and manufacture.

The Oscillator uses Radiotron RCA-2A7 or RCA-6A7, depending on the heater voltage of the receiver with which it is to be used. This Radiotron is of the dual purpose variety and functions both as an oscillator and a modulator. The modulation is of the pentode control grid type and results in excellent quality throughout the audio range of the pickup.

A typical connection of the RK-24 in conjunction with the R-93 Record Player is shown in Figure 1.

Figure 2 shows the schematic circuit diagram, while Figure 3 shows the chassis wiring diagram.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price	Stock No.	Description	List Price
4749	Board—Terminal board assembly	$0.48	3400	Resistor—30 ohms—Carbon type—¼ watt (R6)—Package of 5	$1.00
4013	Capacitor—200 mmfd. (C3)	.30	6143	Resistor—40,000 ohms—Carbon type—½ watt (R2, R3)—Package of 5	1.00
4027	Capacitor—800 mmfd. (C1)	.44	3464	Resistor—70,000 ohms—Carbon type—½ watt (R4)—Package of 5	1.00
4745	Capacitor pack—Comprising two 4.0 mfd. capacitors (C4, C5)	1.28	3058	Resistor—100,000 ohms—Carbon type (R5)—Package of 5	1.10
4748	Clamp—Electrolytic capacitor clamp	.15	6300	Socket—4-contact Radiotron socket	.35
4747	Coil—Oscillator coil and shield assembly (L1, L2, C2)	2.18	4750	Switch—Operating switch	.94
9554	Oscillator—Complete	7.75	4746	Transformer—Output transformer (L3, L4)	.48

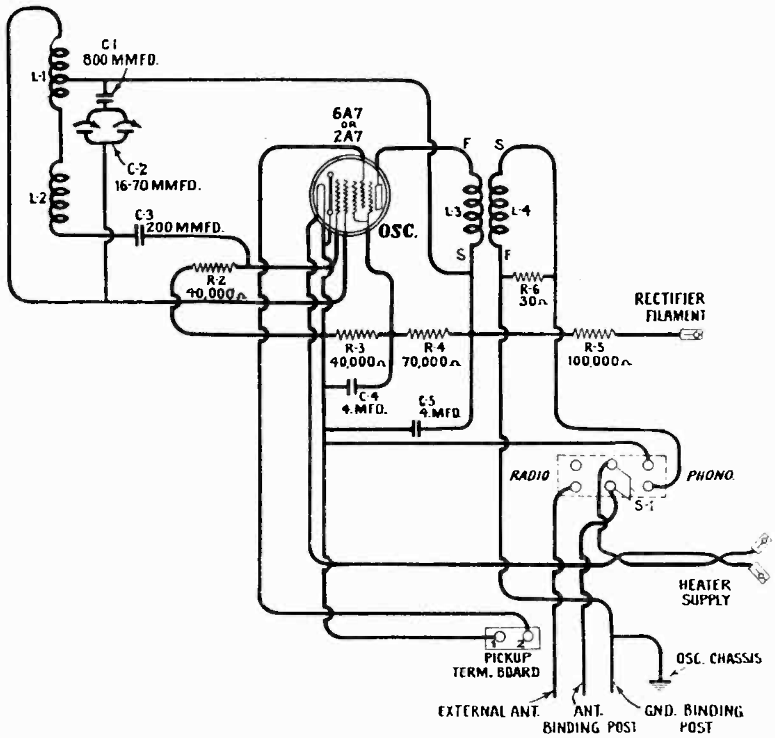


Figure 2—Schematic Circuit Diagram

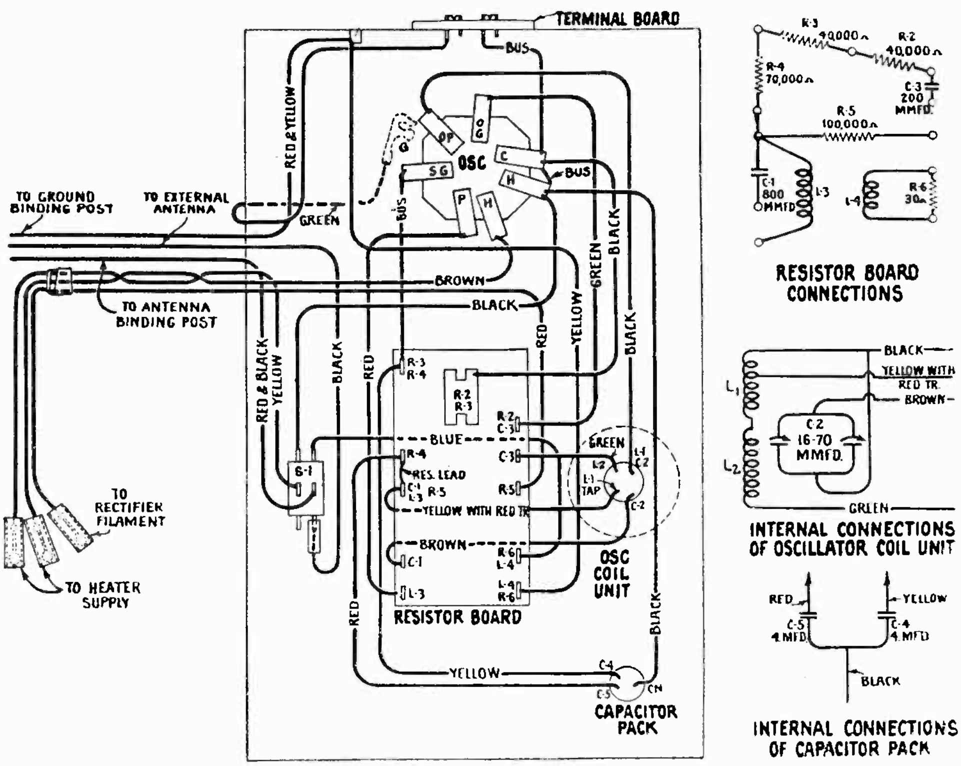


Figure 3—Chassis Wiring

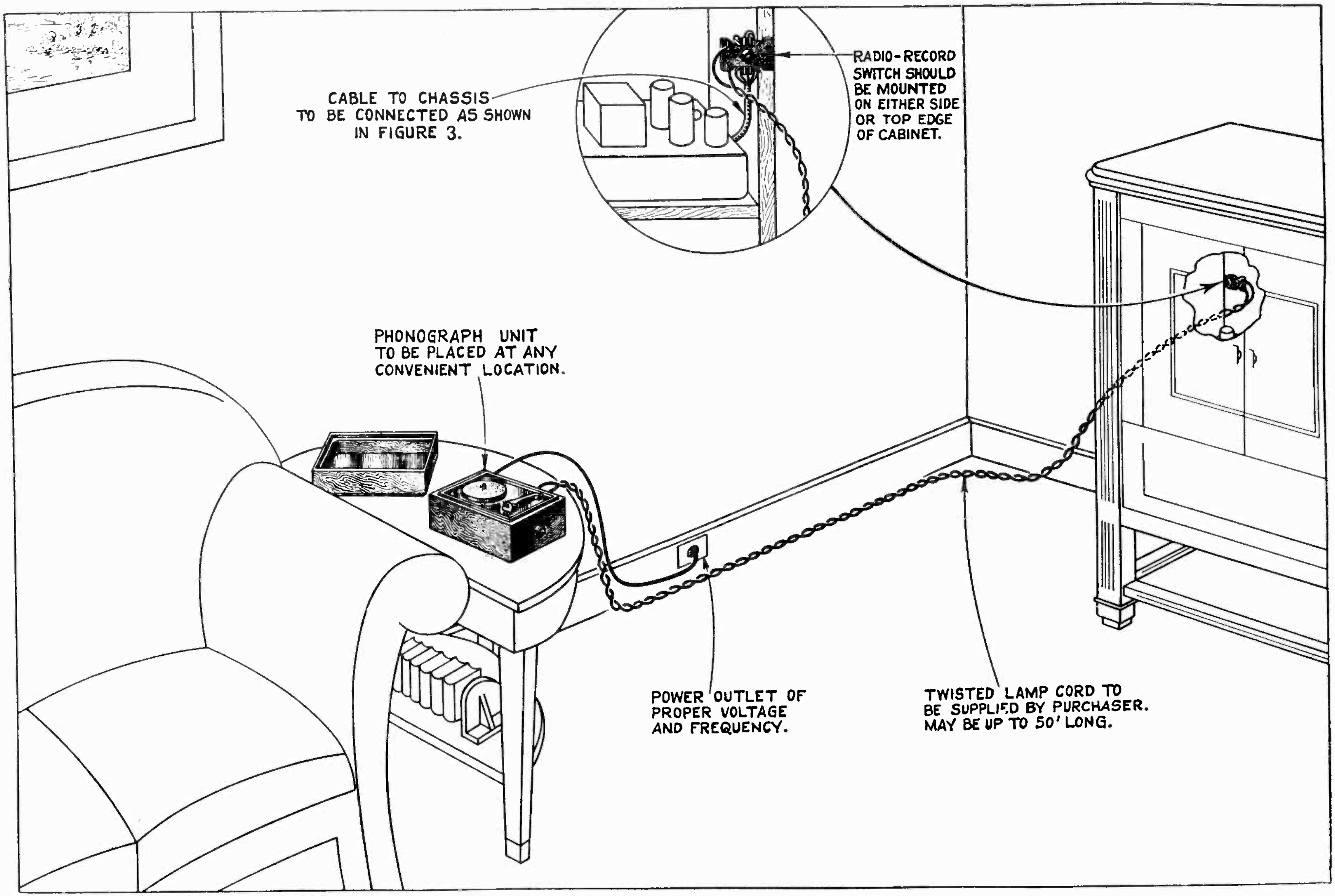


Figure 1—Typical Layout and Connections for Model R-93

RCA VICTOR DUO JUNIOR MODEL R-93

SERVICE NOTES

Electrical Specifications

Voltage Rating . . . . 105-125 Volts A.C.	Type of Motor . . . . Synchronous (Manual Starting)
Frequency Rating (three types) . 25, 50, and 60 Cycles	Turntable Speed . . . . 78 R. P. M.
Power Consumption . . . . 5 Watts	Pickup Impedance . . . . 1,400 Ohms at 1,000 Cycles

Volume Control Resistance . . . . 20,000 Ohms

Mechanical Specifications

Height . . . . 5 inches	Turntable Diameter . . . . 7 inches
Width . . . . 11 inches	Weight (Net) . . . . $8\frac{1}{2}$ pounds
Depth . . . . 8 inches	Weight (Shipping) . . . . 10 pounds

General Description

This phonograph turntable and pickup assembly is designed to provide record reproduction to the owner of a modern radio receiver by utilizing the audio amplifier system and loudspeaker of the radio receiver in such a way as to provide quality of reproduction equal to or better than that obtained from radio stations. A switch is provided for changing from radio to record reproduction, or vice versa. Simplicity, compact size, and ease of connections are outstanding features of this instrument.

Electrically, the instrument consists of a magnetic pickup for transforming the mechanical variations of the record grooves to voltage variations, a combined power switch and volume control for turning power on and off and adjusting the output voltage to any desired level, and a radio-record switch for shifting the connections to the receiver so that either radio or record reproduction may be obtained as desired by the user.

Figure 1 shows a typical layout of an ideal installation. Figure 3 shows the schematic and wiring diagrams. The wiring diagram indicates the proper connections to be made between the pickup unit, the switch assembly, and the end of the cable connecting to the switch.

Connecting Phonograph to the Radio Receiver

When connecting a phonograph unit to a radio receiver, a few fundamental facts should be considered. First, the output of the pickup must be connected to the receiver at a point where sufficient audio gain between it and the speaker is available to give normal sound output. Second, when doing this, some attention should be given to the possibilities of introducing hum and undesired noise, both in the audio and in the radio circuits.

In general, it will be found that the grid or cathode circuits of the second detector of a superheterodyne receiver are suitable for phonograph input. However, on receivers using the type 6H6 as a second detector, the grid of the first audio amplifier should be used. On tuned r-f receivers, either the detector cathode or the first audio transformer primary circuit may be employed, depending upon the amount of audio gain and the type of detector used.

On receivers employing a volume control in the audio circuit between the first and second audio stages, it is advisable to set the phonograph volume control to maximum and use the radio receiver volume control for adjusting the phonograph output. In circuits of this type which are aurally compensated, advantage is taken of the compensation feature when the radio receiver volume control is used.

On receivers employing a volume control between the second detector and first audio, or in the antenna, r-f, or i-f circuits, and with the phonograph input connected to the first a-f stage, it will be necessary to control the phonograph output by using the phonograph volume control. The receiver volume control may then be set to minimum to "kill" radio reception.

Investigation of a large number of receivers has shown that six general types of connections (five of which may be made without removing the chassis from the cabinet) cover practically every type of receiver. These connections are as follows:

(1) Receivers having phonograph input jacks and Radio-Record Switches. With these receivers, the cable and switch supplied with the R-93 are not used. The phonograph output is connected direct to the phonograph input jack and the Radio-Record Switch on the receiver is used for changing from Record to Radio reproduction.

(2) Receivers having phonograph terminal board connections. Such connections should be made in accordance with the instructions pertaining to that particular instrument.

(3) Receivers using the type 2B7 or 6B7 second detectors. With receivers of this type, the

yellow and green leads are connected in series with the grid cap connection of this tube, the green lead connected to the grid cap itself.

(4) Receivers using the type 6F5 as a first audio tube. On receivers of this type, the yellow and green leads are connected in series with the grid cap connection of this tube, the green lead connected to the grid cap itself.

(5) Receivers not having any of the foregoing features. On receivers of this type, a split cathode connection is necessary. Stock No. 4611 five-prong adapter, or Stock No. 4612 six-prong adapter, may be used which is placed under the tube used in the second detector socket of the receiver. Stock No. 11957 eight-prong "octal" adapter may be placed under the first audio tube, such as the type 6C5. In the above cases, the yellow and green leads are connected in series with the cathode, the green lead connected to the tube cathode and yellow lead to the cathode socket contact.

(6) Under Chassis Connections. The above connections (3), (4), and (5), are recommended when it is desired to connect the R-93 without removing the chassis and making changes in its wiring. Better results may often be obtained by making permanent connections underneath the chassis. Additional parts (such as a cathode bias resistor and its by-pass capacitor) may be added to supply the necessary bias for phonograph operation when the stage is signal biased. A typical example of such an arrangement as recommended for Model C 15-3 is shown by Figure 2. (Note the additional jumpers added to the switch for killing radio.) All leads should be kept as short as

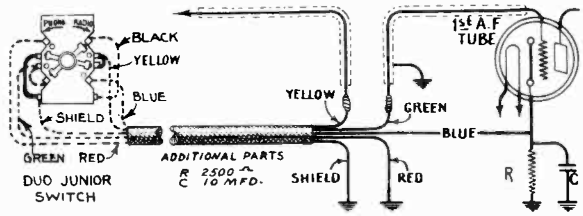


Figure 2—Typical Connections for Model C 15-3

possible and properly shielded. Also, care should be taken in the placement of leads in regard to a-c heater wiring, power transformer, etc., to prevent hum pickup. Receivers using a multi-purpose tube for i-f and second detector (such as Model T 4-8), the yellow and green leads should be connected in series with the detector grid; the connection being made in series with the ground side of the i-f transformer secondary to avoid detuning due to capacity effects.

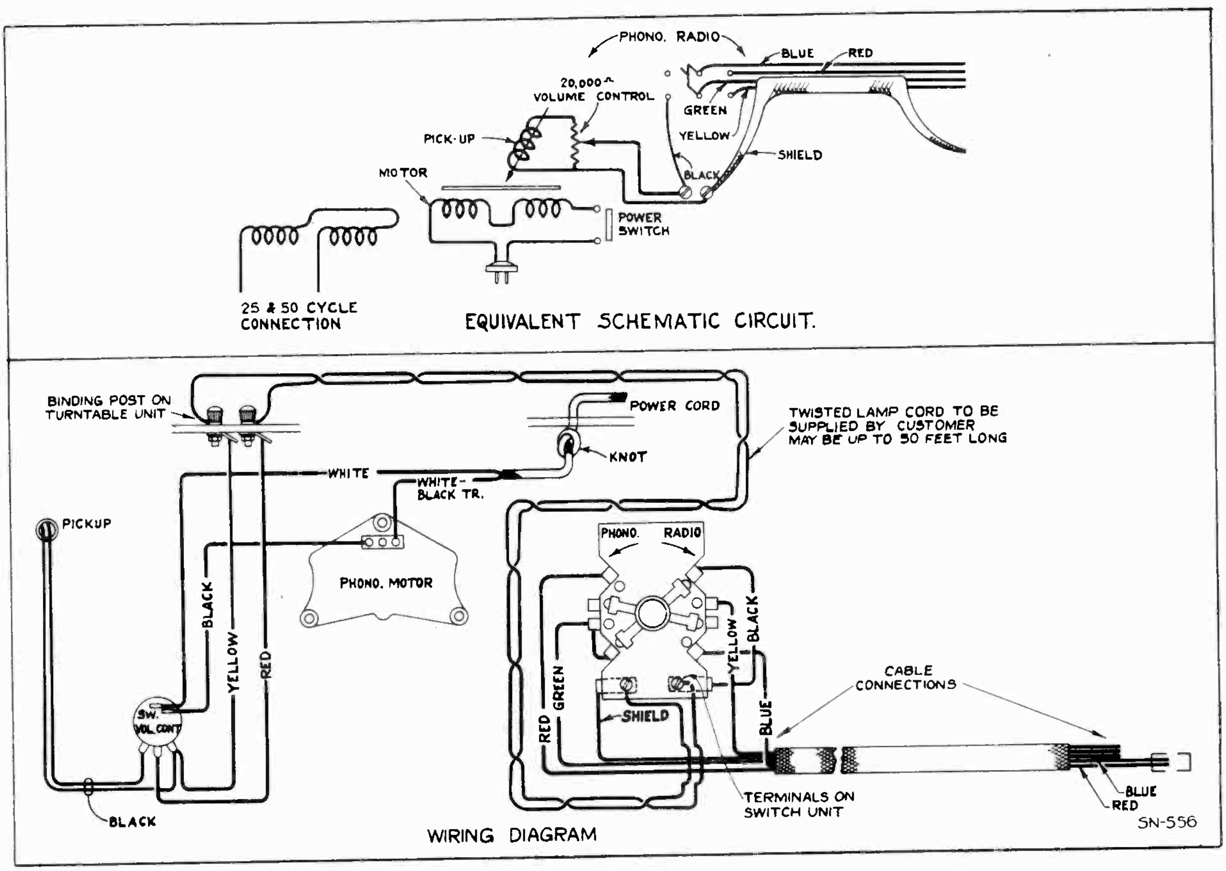


Figure 3—Wiring Diagram and Equivalent Schematic Circuit

RCA VICTOR RECEIVERS—DETAILS OF LEAD CONNECTIONS

Model	Method of Connection	Green	Yellow	Red	Blue	Shield
R-4, 6, 8, 10, 12, 70, 71, 72, 74, 76, 77	5. Adapter	Det. Cathode	Cathode Socket Contact	Ant.	Ant. Lead	Chassis
R-5, 17M, 27	5. Adapter	Det. Cathode	Cathode Socket Contact	Ant.	Ant. Lead	Det. Cathode (Yellow)
R-7, 7A	2. Term. Board	Term. 2 (Open Link)	Term. 1	Ant.	Ant. Lead	Term. 4
R-11,21	2. Term. Board	Term. 2 (Open Link)	Term. 3	Term. 4 (Open Link)	Term. 5	Term. 6
R-18W, 22	5. Adapter	Det. Cathode	Cathode Socket Contact	Ant.	Ant. Lead	Det. Cathode (Yellow)
RO-23	5. Adapter	Det. Cathode	Cathode Socket Contact	Ant.	Ant. Lead	Chassis
R-28	5. Adapter	Det. Cathode	Cathode Socket Contact	Ant.	Ant. Lead	Chassis
R-37, 38, 73, 73A, 75, 75A	3. Grid Clip	Grid Cap of Tube	Grid Clip	Ant.	Ant. Lead or Bind. Post	Chassis
Rad. 48	2. Term. Board	Term. 4 (Open Link)	Term. 5	Term. 2 (Open Link)	Term. 3	Term. 5
R-50, 55	2. Term. Board	Term. 3 (Open Link)	Term. 4	Term. 1 (Open Link)	Term. 2	Term. 6
R-78	2. Term. Board	Term. 7 (Open Link)	Term. 8	Term. 1 (Open Link)	Term. 2	Chassis
Rad. 80	5. Adapter	Det. Cathode	Cathode Socket Contact	Ant.	Ant. Bind. Post	Chassis
Rad. 82	2. Term. Board	Term. 2 (Open Link)	Term. 3 (Tie-in Term. 1 to Term. 3)	Term. 2	Term. 3	Term. 3
R-90, 260, 261	5. Adapter	Det. Cathode	Cathode Socket Contact	I-F Amp.* Cathode	I-F Cathode Socket Contact	Chassis
103	6. Under Chassis	Det. Grid Term.	Grid Lead	Ant.	Ant. Lead	Chassis
110, 111, 115, 210	5. Adapter	Det. Cathode	Cathode Socket Contact	Ant.	Ant. Lead or Bind. Post	Cathode Socket Contact
114	5. Adapter	Det. Cathode	Cathode Socket Contact	Ant.	Ant. Lead	Det. Cathode (Yellow)
117, 118, 119, 120, 121, 122, 124, 125, 128, 211, 214, 220, 221, 222, 224, 225, 226	3. Grid Clip	Grid Cap of Tube	Grid Clip	Ant.	Ant. Lead or Bind. Post	Chassis
140, 141, 240	2. Term. Board	Term. 3	Tape	Term. 1	Term. 2	Term. 1
143, 242	2. Term. Board	Term. 5 (Open Link)	Term. 4	Term. 1 (Open Link)	Term. 2	Chassis
262	2. Term. Board	Term. 2 (Open Link)	Term. 1	I-F Cathode (Adapter)	I-F Cathode Socket Contact	Chassis
280	5. Adapter	Det. Cathode	Cathode Socket Contact	I-F Cathode*	I-F Cathode Socket Contact	Chassis
T 4-8, 4-9	6. Under Chassis	Det. Grid Term.	Grid Lead	Ant.	Ant. Lead	Chassis
T 4-8A, 4-9A, 4-10, 5-2	3. Grid Clip	Grid Cap of Tube	Grid Clip	Ant.	Ant. Lead	Chassis
T 6-1, 6-9, 7-5, 8-14	4. Grid Clip	Grid Cap of Tube	Grid Clip	I-F Cathode (Adapter)	I-F Cathode Socket Contact	Chassis
C 6-2, 7-6, 8-15, 9-4	4. Grid Clip	Grid Cap of Tube	Grid Clip	I-F Cathode (Adapter)	I-F Cathode Socket Contact	Chassis
T 8-16, 9-9 C 8-17, 9-6	2. Term. Board	Term. 2 (Open Link)	Term. 1 (Left Term.)	Term. 3 (OpenLink)	Term. 4	Chassis
T 10-1 C 11-1, 13-2, 15-3	5. Adapter	1st Audio Cathode	Cathode Socket Contact	I-F Cathode*	I-F Cathode Socket Contact	Chassis
T 10-3, 11-8	2. Term. Board	Term. 2 (Open Link)	Term. 1	I-F Cathode (Adapter)	I-F Cathode Socket Contact	Chassis

* Use a second adapter.

It will be noted that red and blue leads are brought out from the switch for "killing" the radio circuit during record reproduction. On early receivers, these may be connected in series with the antenna lead to open the antenna circuit during phonograph operation. In the event of unsatisfactory radio suppression with this connection, better results may be obtained by re-connecting the red and blue leads to the adjacent respective lugs on the Radio-Phono Switch and attaching the outer ends to the Ant.-Gnd. terminals of the receiver so as to short-circuit these terminals during phonograph operation. CAUTION: This scheme of connection should be avoided on AC-DC receivers unless a small capacitor (.05 mfd.) is used in series with either switch lead.

For most positive radio suppression, a split cathode adapter should be used in an i-f socket and the red and blue leads connected (standard connection at Radio-Phono Switch) in series with the cathode so that this circuit will be open for phonograph operation.

If the receiver is of the "All-Wave" type, it is recommended that a split cathode adapter always be used in an i-f socket. CAUTION: If a "Doublet" antenna is used, do not place the switch in series with either side of the transmission line as the operation of the antenna system may be affected.

On the preceding page, a list of numerous receivers and their proper connections are given.

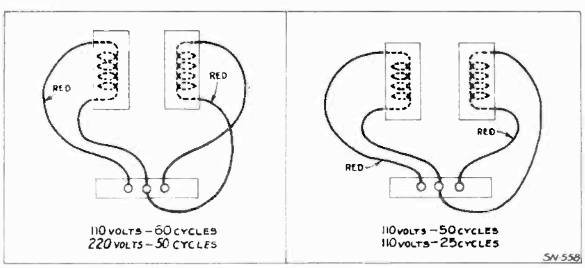
RK-24 Phonograph Oscillator

In addition to the above recommended connections of the R-93 to radio receivers, the RCA Stock No. 9554 RK-24 Phonograph Oscillator provides a convenient and reliable means for connection and operation of the R-93 with a radio receiver of any type of manufacture. Its proper connections are shown in the RCA Victor RK-24 Service Notes.

Phonograph Motor Service Data

NOTE: The motor used in the Second Production R-93 turntables is somewhat different from that used in the First Production. They are hereinafter designated as (1) First Production and (2) Second Production. Changes denoting the difference between the two types are indicated in Figure 5 (First Production) and Figure 6 (Second Production). Replacement Parts are likewise tabulated separately for each type.

The synchronous motor used in this instrument is designed to be simple and foolproof. Among its many features are constancy of speed, low power consumption, single moving part, ease of starting, viscoloid damper, and long life. The main parts of the motor and the points that may require attention are shown by Figure 5 (First Production) and Figure 6 (Second Production). The motor is started by turning "On" the power switch and giving the turntable a clockwise spin with the hand. If the motor is difficult to start it may be due to the stator failing to rotate on the outer bearing. This may be corrected by applying a slight amount of oil to the bearing surfaces. It is very important that the ball bearing be at the bottom of the main bearing assembly.



COIL RESISTANCE

First Production

110 V. 50 or 60 Cycles	218 ohms total
110 V. 25 Cycles	900 ohms total
220 V. 50 Cycles	1270 ohms total

Second Production

110 V. 50 or 60 Cycles	200 ohms total
110 V. 25 Cycles	660 ohms total

Figure 4—Motor Wiring Connections

Excessive Hum and Vibration

A small amount of hum when starting, decreasing to a negligible amount while running, is normal. If excessive vibration occurs either at starting or running, it may be due to one of the following:

(1) Insufficient lubrication in outer bearing or any other failure that will cause the stator to bind.
(2) Metal washer not above the leather washer at the bottom of the main bearing.
(3) Leather washer not oiled. When replacing the leather washer, make sure that it is thoroughly soaked in oil.
(4) Motor not properly supported from motor board. Unless the motor is properly supported from the motor board, normal vibration will be excessive.
(5) Burrs on salient poles of rotor or stator. They should be removed with fine emery cloth.

Removing Rotor from Stator

The rotor which includes the turntable may be removed as follows:

(1) First Production. Loosen the screw shown in Figure 5 until it clears the rotor. Then lift the turntable, being careful not to lose the steel ball of the end-bearing. After replacing the rotor, tighten the retaining screw securely.
(2) Second Production. Loosen the nut shown in (5) of Figure 6, pushing the stop out of the slot and rotating 180 degrees. Then lift the turntable, being careful not to lose the ball end-bearing. After replacing the rotor, return the stop to its normal position and tighten the nut securely.

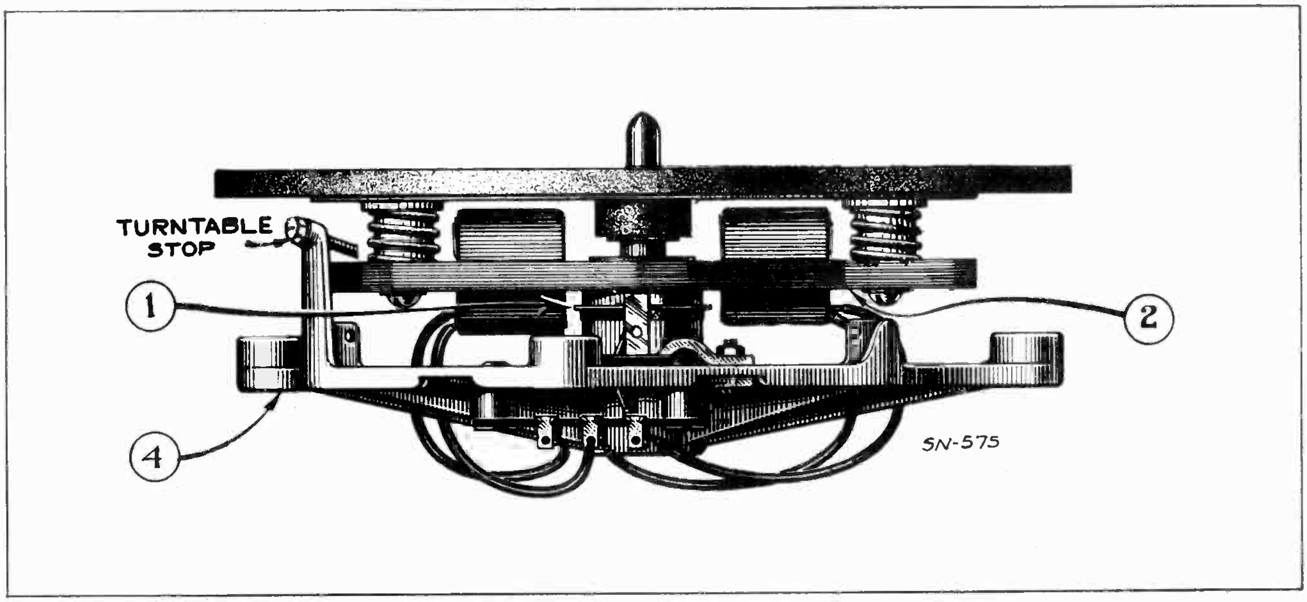


Figure 5—Details of Motor (First Production)

(For details of sections (1), (2), and (4), refer to corresponding sections below)

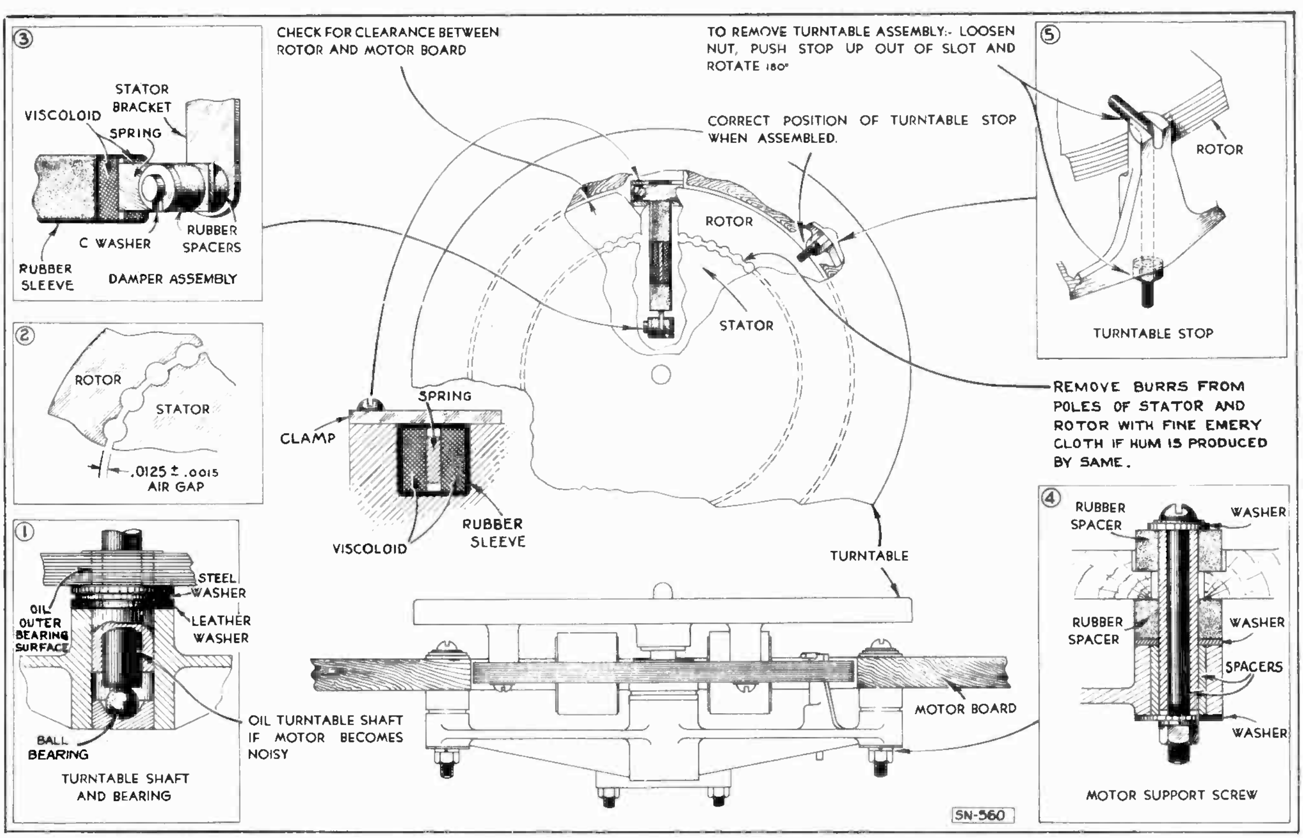


Figure 6—Details of Motor (Second Production)

PICKUP UNIT SERVICE DATA

The magnetic pickup and tone arm assembly of this instrument is of new design and unique construction. Service work will consist of centering the armature and replacing the spacer cushions, damping block, and replacing the magnet coil.

Disassembling the Pickup

The pickup may be disassembled in the following manner.

(a) Unsolder the two cable connections to the terminal strip.

(b) Remove the needle screw and screws "A" and "B."

(c) Remove the pickup assembly from the arm and housing.

(d) Unsolder the two magnet coil leads attached to the terminals and then remove screw E. This will allow the removal of the terminal board.

(e) If centering the pickup armature is the only adjustment required, such centering can be done without removing the terminal board indicated in (d). The armature is centered by loosening screw F, accessible through the hole shown, and holding the armature with the finger in proper position while screw F is tightened. "Feeling" the armature while deflecting it between its two extremes is the best manner of ascertaining proper centering. When centering, after work has been done or the magnet removed, it is important that the magnet be remagnetized while in place.

(f) If the coil or spacer cushions are to be replaced, the pickup must be further disassembled. This is done by removing the magnet and then removing screws C and D. The pole piece may now be removed and the old coil and sleeve disassembled. Acetone will be found helpful for dissolving the old cement that holds the coil in place. The new coil, with its sleeve, may now be replaced and cemented in a similar position to that occupied by the old coil. Duco household or Ambroid cement may be used to hold the coil in place. Be careful to center the coil with its paper sleeve before cementing. Only rosin core solder should be used for soldering the coil leads in the pickup.

(g) The spacer cushions are replaced by loosening the armature adjusting screw F and removing screw G, clamp H and washer I and removing the armature from its bracket. Damping block J must be removed from the armature. After putting the new spacer cushions in place, a new damping block should be fastened to the armature as outlined in instructions on replacing the damping block. The cushions can then be removed by slipping them from each end of the pivot shaft.

Replacing the Damping Block

If it is desired to replace the damping block, it may be done in the following manner:

(a) Disassemble the pickup as described under the preceding section.

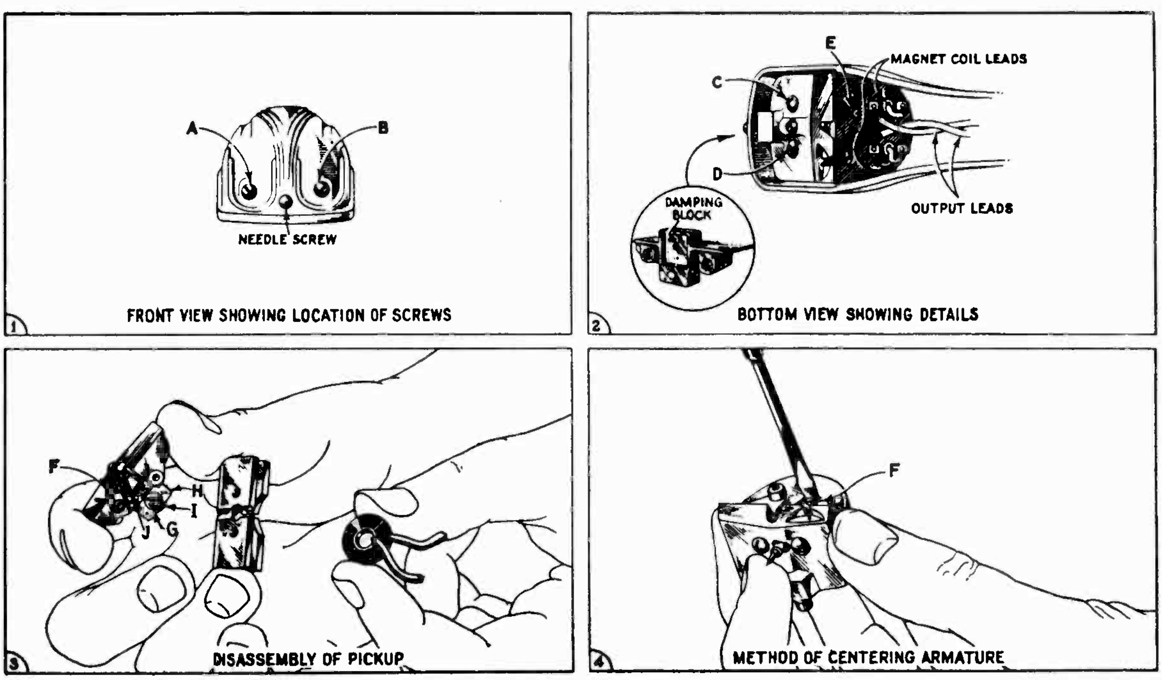


Figure 7—Details of Pickup Assembly

(b) Remove the damping block from the armature and clean the armature shaft with emery paper.

(c) Insert the armature through the new block so that it occupies the same position as that of the old. Also ascertain that the block is in correct vertical alignment with the armature. It will be noted that the hole in the damping block is somewhat smaller than the shaft diameter. This is done so that a snug fit will be obtained.

(d) After properly locating the damping block, a soldering iron should be applied to the armature so that the block will melt slightly at its point of contact with the armature. A special tip, constructed as shown in Figure 8, will prove desirable for fusing the block in place. The iron should be applied only long enough to melt the block sufficiently to cause a small bulge on each side, and must be removed before any bubbling occurs. The pickup should then be reassembled.

It is important to remember that in all operations after reassembling but before placing in the tone arm, the pickup should be magnetized and the armature

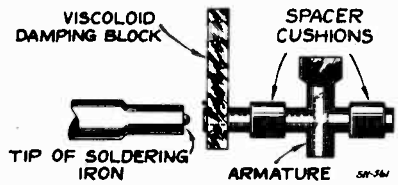


Figure 8—Special Soldering Iron Tip

centered after remagnetizing. Magnetizing should be done by placing the pickup magnet on the magnetizer and sliding it onto the pole pieces, after magnetizing being careful not to break the magnetic circuit.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	MOTOR ASSEMBLIES FIRST PRODUCTION	
10194	Ball—Steel ball bearing—Package of 20	$0.25
7657	Base—Motor base and bearing assembly—50-60 cycle—105-125/200-250 volt operation	1.20
9523	Base—Motor base and bearing assembly—25 cycle operation	1.20
9519	Coil—Stator assembly—Comprising coil and laminations—105-125 volt, 60 cycle operation	2.50
9521	Coil—Stator assembly—Comprising coil and laminations—105-125 volt, 50 cycle operation	2.35
9524	Coil—Stator assembly—Comprising coil and laminations—105-125 volt, 25 cycle operation	2.25
9529	Coil—Stator coil assembly—Comprising coil and laminations—50 cycle, 200-250 volt operation	2.50
9515	Motor—105-125 volts—60 cycle motor	8.80
9516	Motor—105-125 volts—50 cycle motor	8.42
9517	Motor—105-125 volts—25 cycle motor	9.00
9528	Motor—200-250 volts—50 cycle motor	9.60
4456	Motor accessories—Comprising 3 nuts, 1 shield and 1 screw	.10
3813	Motor suspension assembly—Comprising one screw, one metal bushing, two rubber bushings, one flat washer, one lockwasher and one nut—Package of 3	.56
4457	Spring, screw and washer assembly—Used to mount rotor laminations to turntable—Comprising 3 springs, 3 screws and 9 washers	.15
9520	Turntable—Turntable assembly complete with rotor laminations—60 cycle operation	4.45
9525	Turntable—Turntable assembly complete with rotor laminations—25 cycle operation	4.85

Stock No.	Description	List Price
9522	Turntable—Turntable assembly complete with rotor laminations—105-125/200-250 volt—50 cycle operation	4.25
4083	Washer—Leather washer—Package of 10	.20
4084	Washer—Metal washer—Package of 10	.26
	MOTOR ASSEMBLIES SECOND PRODUCTION	
10194	Ball—Steel ball bearing—Package of 20	.25
11740	Base—Motor base and bearing assembly	1.45
11733	Coil—Stator assembly—Comprising coil and laminations—105-125 volt, 60 cycle operation	2.96
11734	Coil—Stator assembly—Comprising coil and laminations—105-125 volt, 50 cycle operation	3.08
11748	Damper—Motor damper assembly—Comprising one damper, one damper plate, one screw, two rubber washers, and one "C" washer	.20
11873	Motor—105-125 volts—60 cycle motor	9.95
11874	Motor—105-125 volts—50 cycle motor	9.95
4456	Motor accessories—Comprising 3 nuts, 1 shield and 1 screw	.10
11876	Turntable—Turntable assembly complete with rotor laminations—60 cycle operation	4.35
11875	Turntable—Turntable assembly complete with rotor laminations—50 cycle operation	4.35
4083	Washer—Leather washer—Package of 10	.20
4084	Washer—Metal washer—Package of 10	.26
	PICKUP AND ARM ASSEMBLIES	
3812	Armature—Pickup armature	.32
4462	Cable—Pickup cable	.20
3810	Coil—Pickup coil	.32
5091	Cushion—Pickup armature spacer cushion—Package of 10	.50

The prices quoted above are subject to change without notice.

REPLACEMENT PARTS—Continued

Stock No.	Description	List Price	Stock No.	Description	List Price
4543	Damper—Damper block complete with damper clamp, washer..............	.10	4461	Cable—5-conductor—Radio-Record switch cable	.28
4503	Pickup and arm assembly complete.....	4.95	4459	Bracket—Volume control mounting bracket	.10
3811	Screw—Needle holding screw—Package of 10............................	.46	4463	Foot—Felt foot for bottom cover—Package of 10.........................	.20
	CABINET ASSEMBLIES		3829	Knob—Radio-Record switch knob—Package of 5..........................	1.10
X-249	Bottom—Lower section of wood cabinet	2.95	3961	Knob—Volume control knob—Package of 5..............................	.60
X-248	Cover—Top half of wood cabinet......	3.00	4458	Post—Binding post—Package of 10.....	2.50
	MISCELLANEOUS ASSEMBLIES		4507	Rest—Pickup rest—Package of 5.......	.60
4611	Adaptor—Five-prong split cathode adaptor	1.00	4119	Screw—No. 8-32-¼-inch headless set screw for knob—Package of 20......	.38
4612	Adaptor—Six-prong split cathode adaptor	1.00	4460	Switch—Radio-Record switch..........	.40
11957	Adaptor—Eight-prong "octal" split cathode adaptor with ground lug........	1.00	4502	Volume control (R1)................	1.16

The prices quoted above are subject to change without notice.

NOTES

RCA VICTOR MODEL R-95

Portable Table Electrola

SERVICE NOTES

Electrical Specifications

Voltage Rating	105-125 Volts A.C.
Frequency Rating (two types)	50 and 60 Cycles
Power Consumption	75 Watts
Number and Type of Radiotrons	1 RCA-77, 1 RCA-43, 1 RCA-25Z5
Type of Loudspeaker	8-inch Electrodynamic
Voice Coil Impedance	2¼ Ohms at 400 Cycles
Type of Pickup	High Impedance Magnetic
Pickup Impedance	1,400 Ohms at 1,000 Cycles
Type of Motor	Synchronous (Manual Starting)
Turntable Speed	78 R.P.M.
Power Output	Maximum 2 Watts

Mechanical Specifications

Height	13¼ inches
Width	15⅝ inches
Depth	13⅛ inches
Weight (net)	24½ pounds
Weight (Shipping)	30 pounds

General Features

The RCA Victor Model R-95 Portable Table Electrola consists of a synchronous motor, pickup, amplifier, and loudspeaker contained in a portable cabinet. This instrument provides a convenient and reliable means for reproducing records of the 78 r.p.m. type up to 12 inches in diameter. A combination power switch and volume control is located on the motor board. A receptacle is provided in the right side of the cabinet for plugging in the power cord. The pickup and tone arm are combined as one unit. The audio output is reproduced by an 8-inch electrodynamic loudspeaker.

Electrical Circuits

The magnetic pickup is coupled to the control grid of the RCA-77 Radiotron through the volume control. A scratch filter is provided to reduce record surface noise. The output of the RCA-77 is resistance coupled to the RCA-43 power output Pentode. The output of the RCA-43 is fed to the loudspeaker through a stepdown transformer.

The rectifier, an RCA-25Z5 Radiotron, is employed in a voltage doubler circuit. This arrangement provides approximately twice the d-c output voltage compared to the a-c voltage input. The loudspeaker field is connected across the output of the rectifier circuit. Figure 2 shows the schematic diagram and Figure 1 shows the wiring diagram.

Radiotron Socket Voltages

The operating conditions of the basic circuits of the amplifier may be determined by measuring the voltages applied to the tube elements. Figure 9 shows the voltage values from the socket contacts to one of the plates of the RCA-25Z5 rectifier, as indicated, and across heater contacts (H-to-H). These voltages are actual measured values and should hold within $\pm$ 20% when the instrument is normally operative.

To duplicate the conditions under which the voltages were measured requires a 1,000-ohm-per-volt a-c—d-c meter having ranges of 50 and 250 volts. Voltages below 50 measure on the 50 volt range; above 50 on the 250 volt range.

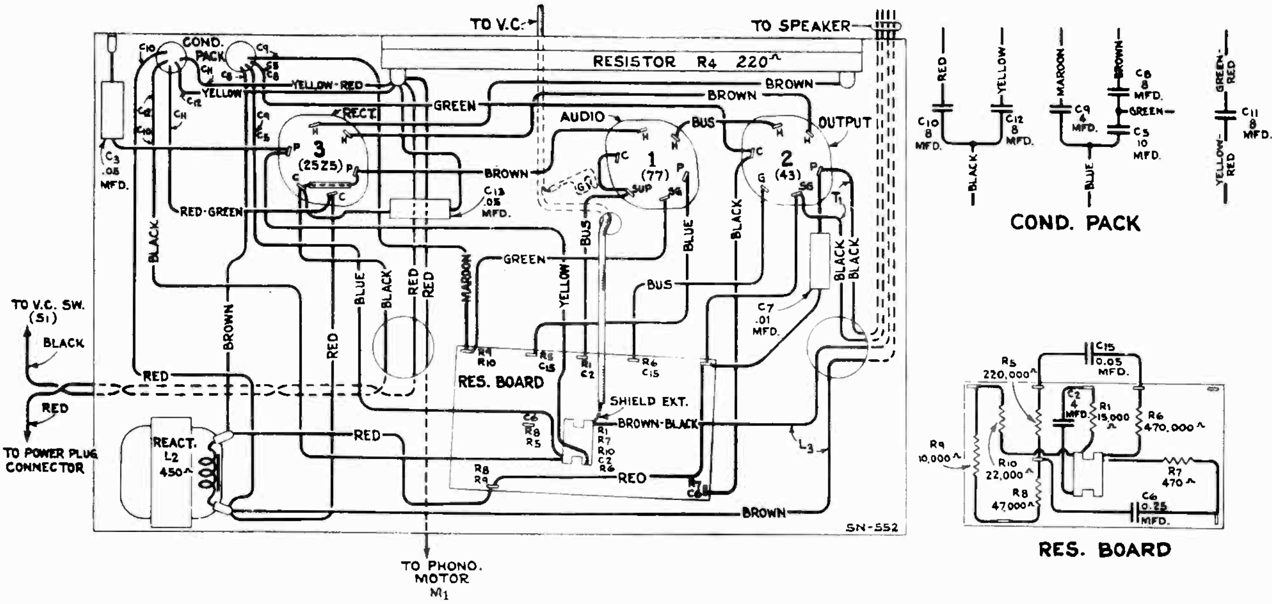


Figure 1—Amplifier Wiring Diagram

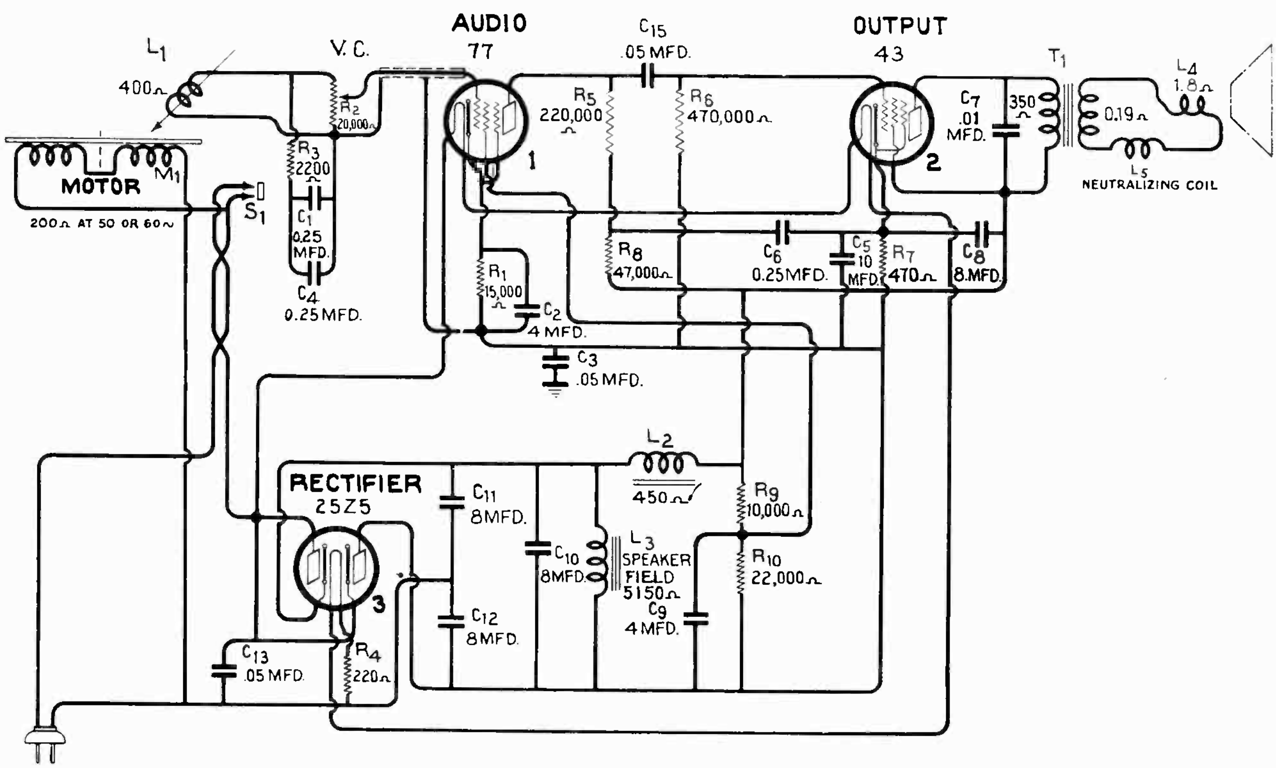


Figure 2—Schematic Circuit Diagram

Phonograph Motor

The synchronous motor used in this instrument is designed to be simple and foolproof. Among its many features are low power consumption, single moving part, ease of starting, viscoloid damper, and long life. The main parts of the motor and the points that may require attention are shown in Figure 4. The motor is started by giving it a clockwise spin with the hand. If the motor is difficult to start,

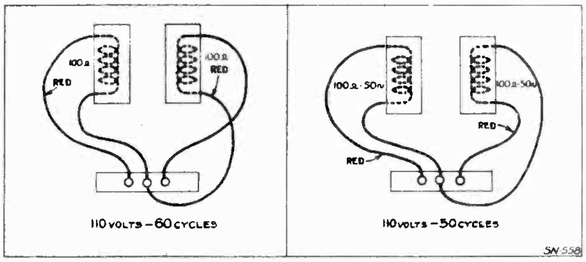


Figure 3—Motor Wiring

it may be due to the stator failing to rotate on the outer bearing. This may be corrected by applying a slight amount of oil to the bearing surfaces. It is very important that the ball bearing be at the bottom of the main bearing assembly.

Excessive Vibration and Hum

A small amount of hum when starting, decreasing to a negligible amount while running, is normal. If excessive vibration occurs either at starting or running, it may be due to one of the following:

(1) Insufficient lubrication in outer bearing or any other failure that will cause the stator to bind.

(2) Metal washer not above the leather washer at the bottom of the main bearing.

(3) Leather washer not oiled. When replacing the leather washer, make sure that it is thoroughly soaked in oil.

(4) Motor not properly supported from motor board. Unless the motor is properly supported from the motor board, normal vibration will be excessive.

Removing Rotor from Stator

The rotor, which includes the turntable, may be removed by loosening the nut shown in Figure 4, pushing the stop out of the slot and rotating it 180 degrees. Then lift the turntable, being careful not to lose the ball end-bearing when this is done. After replacing the rotor, return the stop to its normal position and tighten the nut securely.

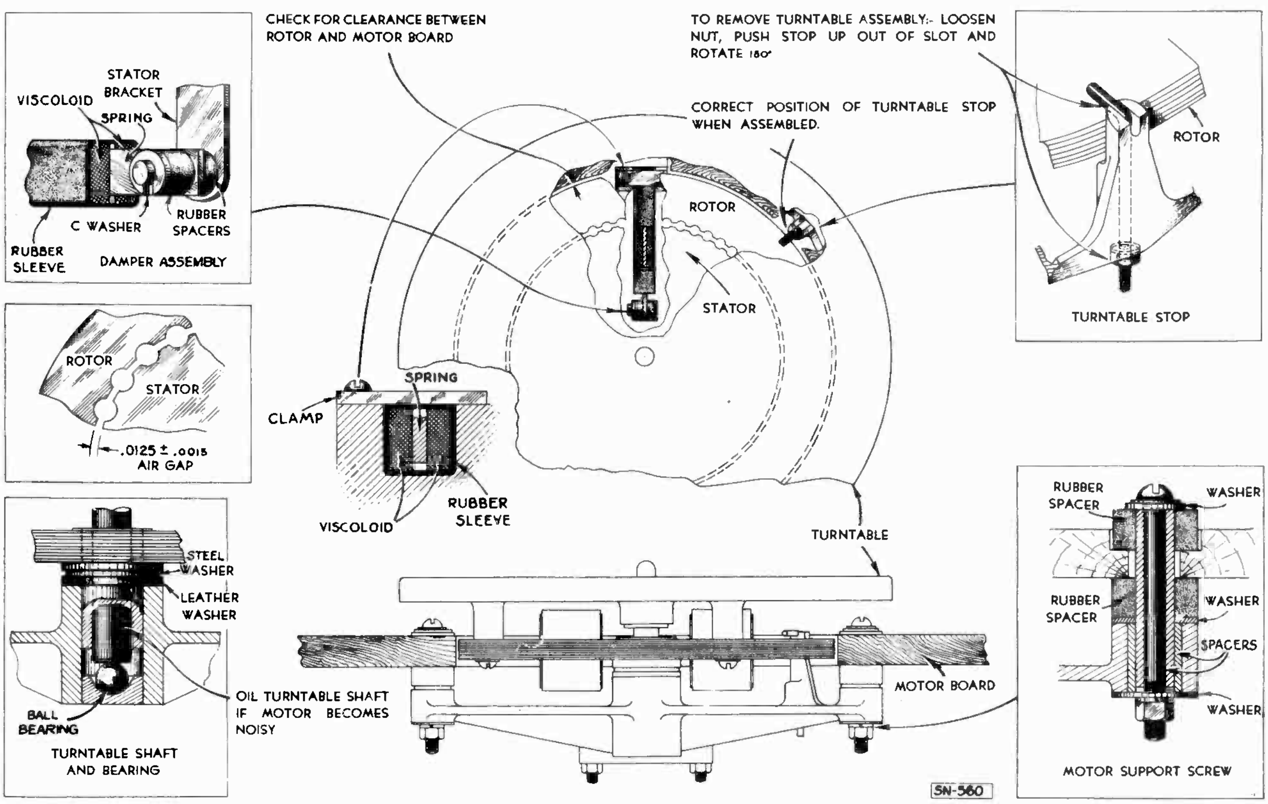


Figure 4—Motor Board Adjustments

Pickup Unit

The magnetic pickup and tone arm assembly is of an improved design. The horseshoe magnet is rigidly welded to the pole pieces and is irremovable. There is a centering spring attached to the armature to maintain proper adjustment and to provide a limiting effect on the movement of the armature. An adjusting screw with lock nut is provided near the rear of the tone arm to adjust for needle clearance above the motor board. Service operations which may be necessary on the pickup are as follows:

Centering Armature

(a) Remove the needle holding screw and screws **A** and **B**, holding the pickup assembly to keep it from dropping. Unsolder the two output leads from the terminal board and remove the pickup assembly.

(b) Insert a small rod or nail into the armature needle hole and replace the needle holding screw, tightening it to hold the rod securely. If the armature clamping screws **C** and **D** have not been disturbed, screw **F** should be loosened which will permit the armature to be moved from side to side, the rod acting as a lever to perform this operation. The proper adjustment is obtained when the armature is moved to the extreme position on each side (the movement being limited by the armature striking the pole pieces) and then brought to the mid position between these two extremes. Screw **F** should then be tightened. The armature position should then be central between the pole pieces and at right angles to them. With a little practice, the correct adjustment of the armature will be obtained. The air gap between the pole pieces and the armature should be kept free from dust, filings, and other foreign material which would obstruct the movement of the pickup armature.

Damping Block

The viscoloid damping block which is attached to the front end of the armature shank serves as a mechanical filter to eliminate undesirable resonances and to cause the frequency response to be uniform.

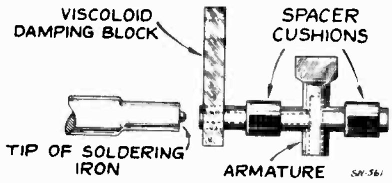


Figure 5—Special Soldering-Iron Tip

Should it be necessary to replace this damping block, the pickup mechanism should be removed from the tone arm as explained in (a).

(c) Unsolder the pickup coil leads from the two lugs on the terminal board and remove screw **E** and the terminal board.

(d) Remove screw **G**, clamp **H**, washer **I**, and the damping block from the pickup assembly. Make sure that the shaft of the armature which contacts the viscoloid is clean. Then insert the new damping block so that it occupies the same position as that of the original block, and is in

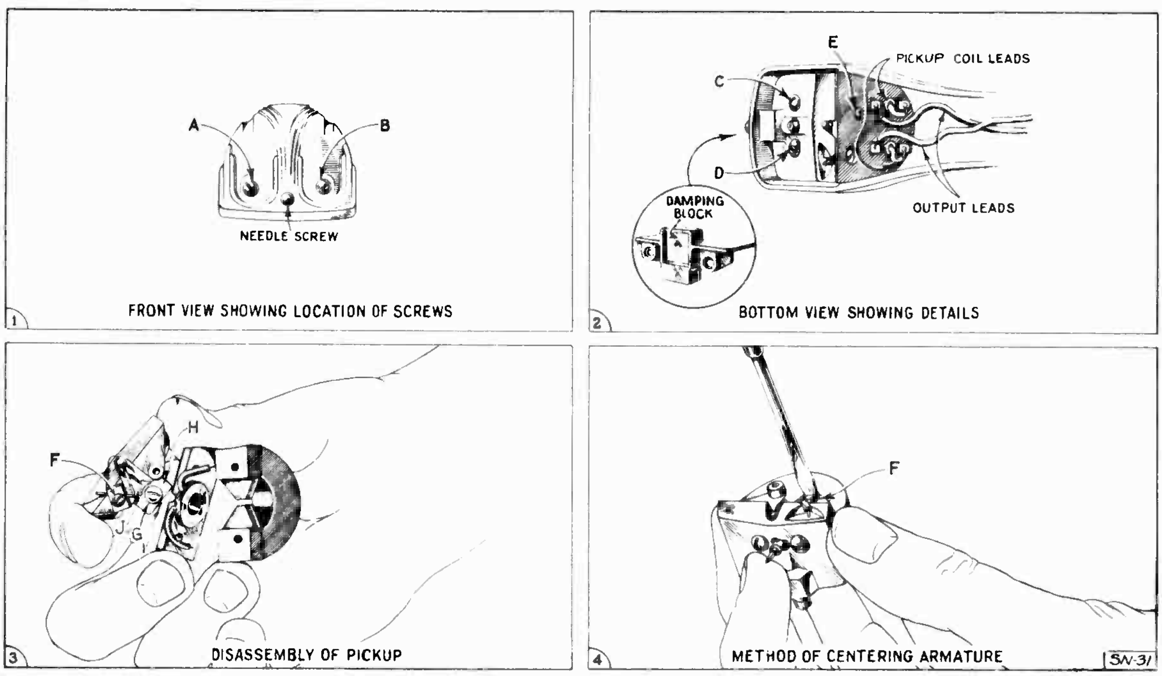


Figure 6—Details of Pickup

correct vertical alignment with the armature. The hole in the block is somewhat smaller than the diameter of the armature in order to permit a snug fit. With the damping block properly aligned on the armature, screw **G,** clamp **H,** and washer **I** should then be replaced. Heat should be applied to the armature (viscoloid side) so that the damping block will fuse at the point of contact and become rigidly attached to the armature. A special-tip soldering iron, constructed as shown in Figure 5, will be found very useful in performing this operation. The iron should be applied only long enough to slightly melt the block, causing a small bulge on both sides. The armature centering should then be checked.

Replacing Coil

Whenever there is defective operation due to an open or shorted pickup coil, this coil should be replaced. Remove the pickup mechanism and terminal board as described in (a) and (c).

(e) Remove screws **C** and **D** and the magnet assembly.

(f) Remove the bakelite coil support (with coil attached) and insert the new coil support assem-

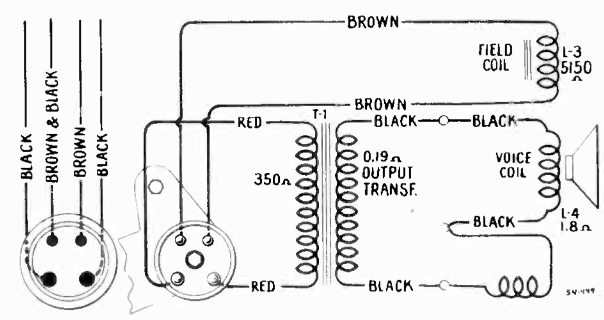


Figure 7—Loudspeaker Wiring

bly in its place, after which, replace the magnet assembly and center the armature as described above. Then reassemble the remainder of the unit. Only rosin core solder should be used for soldering the pickup coil leads and output leads to the terminal board. This same type of solder should be used when necessary for soldering the centering spring to the armature.

Replacing Spacer Cushions

After a long period of time, the spacer cushions may become hard, in which case they should be replaced.

(g) Disassemble the pickup as described in (a), (c), (d), and (e), and remove screw **F** and the armature. Remove the spacer cushions by slipping them from each end of the shaft. After putting the new spacer cushions in place, a new damping block should be installed as in (d).

Magnetizing

Loss of magnetism will not usually occur when the pickup has received normal care, due to the fact that

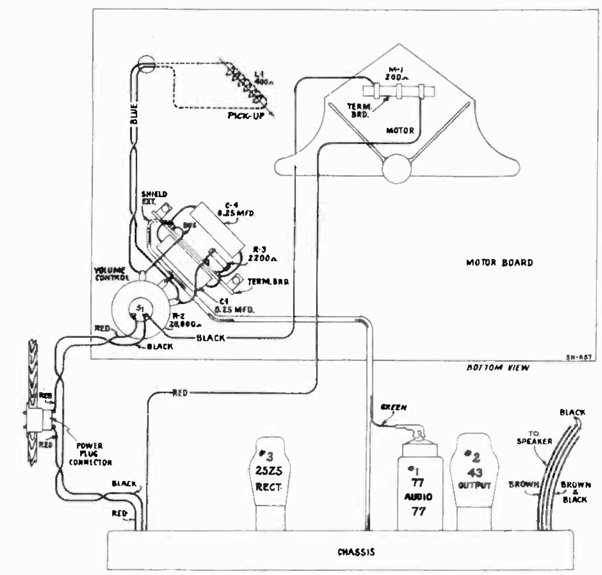


Figure 8—Assembly Wiring

the magnet and pole pieces are one unit and the magnetic circuit remains practically closed at all times. When the pickup has been mishandled, subjected to a strong a-c field, jolted, or dropped, there may be an appreciable loss of magnetic strength, in which case it will be necessary to remagnetize the entire structure. To do this, it will be necessary to first remove the pickup mechanism from the tone arm, and then remove the magnet assembly as described in (a), (c) and (e).

(h) Place the magnet assembly on the poles of a standard pickup magnetizer, such as the **RCA Stock No. 9549 Pickup Magnetizer,** and charge the magnet in accordance with the instructions

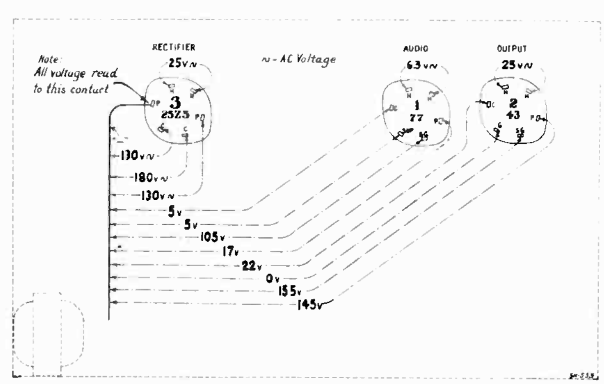


Figure 9—Radiotron Socket Voltages

accompanying the magnetizer. It is preferable to check the polarity of the pickup magnet and to remagnetize it so that the same polarity is maintained.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers.

Stock No.	DESCRIPTION	List Price
	MOTOR BOARD ASSEMBLIES	
4840	Capacitor—0.25 Mfd. (C1, C4)	$0.30
11865	Holder—Needle holder	.22
3961	Knob—Volume control knob—Package of 5	.60
11863	Resistor—2200 ohms—carbon type—1/10 watt—(R3)—Package of 5	.75
11866	Rest—Pickup rubber rest	.28
11869	Screw—Motor mounting screw assembly—comprising one screw, three metal washers, two rubber washers, one lock-washer, one nut, and two spacers—Package of 3	.32
11864	Screw—Motor board mounting screw and finishing washer—Package of 10	.36
11862	Socket—Power cord socket	.18
11861	Volume control—R2, S1	1.32
	AMPLIFIER ASSEMBLIES	
4244	Cap—Grid contact cap—Package of 5	.20
4858	Capacitor—.01 Mfd. (C7)	.25
4836	Capacitor—.05 Mfd. (C3, C13, C15)	.30
5170	Capacitor—0.25 Mfd. (C6)	.25
3796	Capacitor—4 Mfd. (C2)	.60
11867	Capacitor pack—Comprising four sections of 8 Mfd., one section of 4 Mfd., and one section of 10 Mfd. (C5, C8, C9, C10, C11, C12)	4.50
11871	Lead—Shielded lead—less grid contact cap—connects volume control to chassis	.26
6505	Reactor—Filter reactor (L2)	1.06
11870	Resistor—220 ohms—line resistor (R4)	.90
11868	Resistor—470 ohms—carbon type—1 watt (R7)	.22
2731	Resistor—10,000 ohms—carbon type—1 watt—(R9)—Package of 5	1.10
11332	Resistor—22,000 ohms—carbon type—1 watt—(R10)—Package of 5	1.10
3998	Resistor—15,000 ohms—carbon type—¼ watt—(R1)—Package of 5	1.00
11646	Resistor—47,000 ohms—carbon type—¼ watt—(R8)—Package of 5	1.00
5158	Resistor—220,000 ohms—carbon type—¼ watt—(R5)—Package of 5	1.00
11172	Resistor—470,000 ohms—carbon type—¼ watt—(R6)—Package of 5	1.00
3682	Shield—First audio Radiotron shield	.22
4785	Socket—6-contact Radiotron socket	.15
	SPEAKER ASSEMBLIES	
11232	Board—Terminal board assembly—complete with lead wire clips	.18
11231	Bolt—Yoke and core assembly bolt and nut	$0.16
8060	Bracket—Output transformer mounting bracket	.14
11257	Clamp—Cone center suspension clamping nut and screw assembly—Package of 5	.25
11983	Coil—Field coil (L3)	3.15
11233	Coil—Neutralizing coil (L5)	.30
11235	Cone—Reproducer cone—(L4)—Package of 5	3.50
5040	Connector—4-contact female connector for reproducer cable	.25
5039	Connector—4-contact male connector for reproducer	.25
9637	Reproducer—Complete	7.45
11828	Transformer—Output transformer (T1)	1.46
11886	Washer—Spring washer—used to hold field coil securely—Package of 5	.20
	PICKUP ASSEMBLIES	
11731	Armature—Pickup armature—complete with spacer cushions	.64
11732	Coil—Pickup coil (L1)	.60
4543	Damper—Pickup damper block complete with damper plate and screw	.10
11872	Pickup and arm assembly—Complete	8.15
5091	Spacer cushions—Pickup armature spacer cushions—Package of 10	.50
3811	Screw—Needle holding screw—Package of 10	.46
	MOTOR ASSEMBLIES	
10194	Ball—Steel ball bearing—Package of 20	.25
11740	Base—Motor base and bearing assembly	1.45
11734	Coil—Stator assembly—comprising coil and laminations—105-125 volts—50-cycle operation	3.08
11733	Coil—Stator assembly—comprising coil and laminations—105-125 volts—60-cycle operation	2.96
11748	Damper—Motor damper assembly—comprising one damper, one damper plate, one screw, two rubber washers and one "C" washer	.20
12083	Motor—Complete—110 volts—50 cycles	11.10
12082	Motor—Complete—110 volts—60 cycles, M1	11.10
12048	Turntable—Turntable assembly complete with rotor laminations—60-cycle operation	4.80
12049	Turntable—Turntable assembly complete with rotor laminations—50-cycle operation	4.80
4083	Washer—Leather washer—Package of 10	.20
4084	Washer—Metal washer—Package of 10	.26

The prices quoted above are subject to change without notice.

Instructions 23334-1

for

Full Range Test Oscillator

Type TMV-97-C

INTRODUCTION

The Type TMV-97-C Test Oscillator is a compact, self-contained portable instrument designed especially for service and test purposes. It is essentially an r-f oscillator modulated with 400 cycles and covers a frequency range from 90 kc. to 25,000 kc. in eight steps. Power for its two RCA-30 Radiotrons is obtained from two batteries housed in the instrument. The coils are contained in a drawn copper can, thus effectively shielding them separately from the remainder of the oscillatory circuit. The whole is entirely shielded in an aluminum case.

In conjunction with other apparatus it is adaptable for the following test and service functions:

1. R.F. and I.F. tests and alignments on receivers either with the Cathode Ray Oscillograph (TMV-122-B) and Frequency Modulator (TMV-128-A), sweeping the oscillator output frequency over a definite range, or with an output indicating meter such as the TMV-121-A.

2. Overall response characteristics of receivers (r-f input to a-f output) with oscillograph or output meter and a Beat Frequency Oscillator such as the TMV-52-E, or similar, furnishing a variable frequency modulation.

3. Heterodyne detection of an external frequency with headphones, the test oscillator functioning as a frequency or wave meter.

4. Calibration with headphones and a source of known frequencies, by heterodyne detection.

All controls, regulation and connections are made from the front panel, on which are mounted the following devices:

1. "On-Off" or Power Switch (S-2).

2. "Mod-Off" or Modulation Switch for Modulator tube (S-3).

3. "Hi-Lo" or Attenuation Range Switch (S-4).

4. Vernier Tuning Dial—calibrated directly in kilocycles.

5. Range Switch with eight-position plate.

6. Output Control with graduated plate, 0–100.

7. Sweep Capacitor Jack for Frequency Modulator (J-1).

8. Jack for External Modulator or Heterodyne Detector (J-2).

9. Antenna and Ground Binding Posts for connection to the circuit under test.

The overall dimensions of the instrument are approximately 9¾" wide, 4½" deep and 8½" high (including handle). Its weight is 5¾ pounds, including batteries.

A calibration correction card is provided, installed in a frame on the back of the instrument.

The following frequency ranges are covered by the eight-position range switch:

Position	*Approximate Frequency Range (K.C.)*
1	90– 200
2	200– 400
3	400– 800
4	800– 1500
5	1500– 3100
6	3100– 6800
7	6800–14000
8	14000–25000

The oscillator is shipped complete with Radiotrons, but less batteries. Figure 2 shows the schematic circuit and Figure 5 the wiring diagram.

CONNECTIONS

Installation of Batteries

Two batteries are required, one 4½-volt filament battery (Burgess No. 2370, or equivalent) and one 22½-volt "B" battery (Burgess No. 4156, or equivalent).

Remove the four screws at the top and side edges of the front panel and withdraw the panel and chassis from the cabinet. Make certain that the Radiotrons are firmly in their sockets and the "On-Off" switch is off. Then turn the chassis upside down. Sufficient space is allowed beneath the chassis for insertion of the batteries, which should be located and connected as shown in Figure 3. Turn the case upside down and replace the chassis, bottom uppermost. This assures proper location of the chassis and batteries within the case. Turn the oscillator over and replace the front panel mounting screws. The unit is then ready for operation.

R.F. and I.F. Test Connections

Connect the output of the oscillator to the receiver under test from the two binding posts "Ant" and "Gnd" on the front panel. Reference to the service instructions for the receiver will disclose

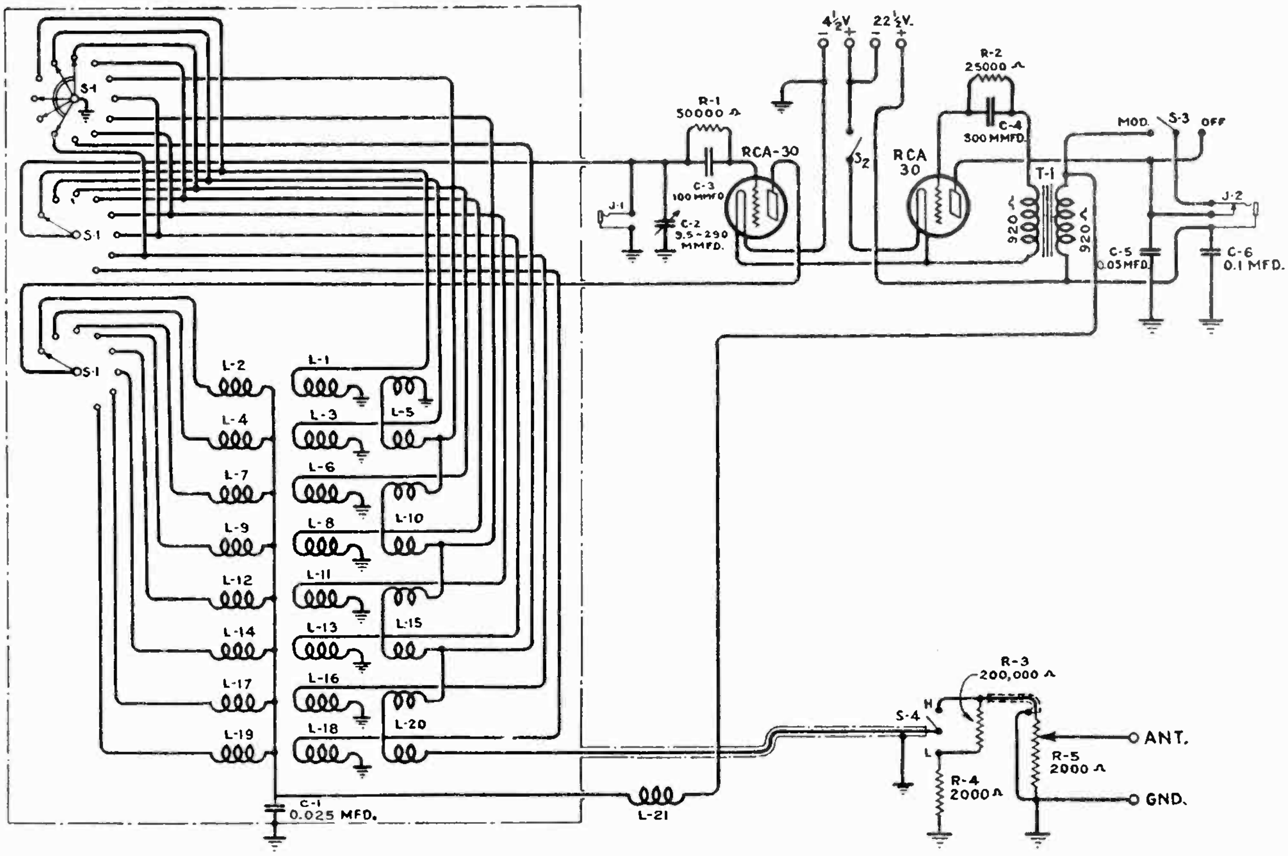


Figure 2—Schematic Circuit

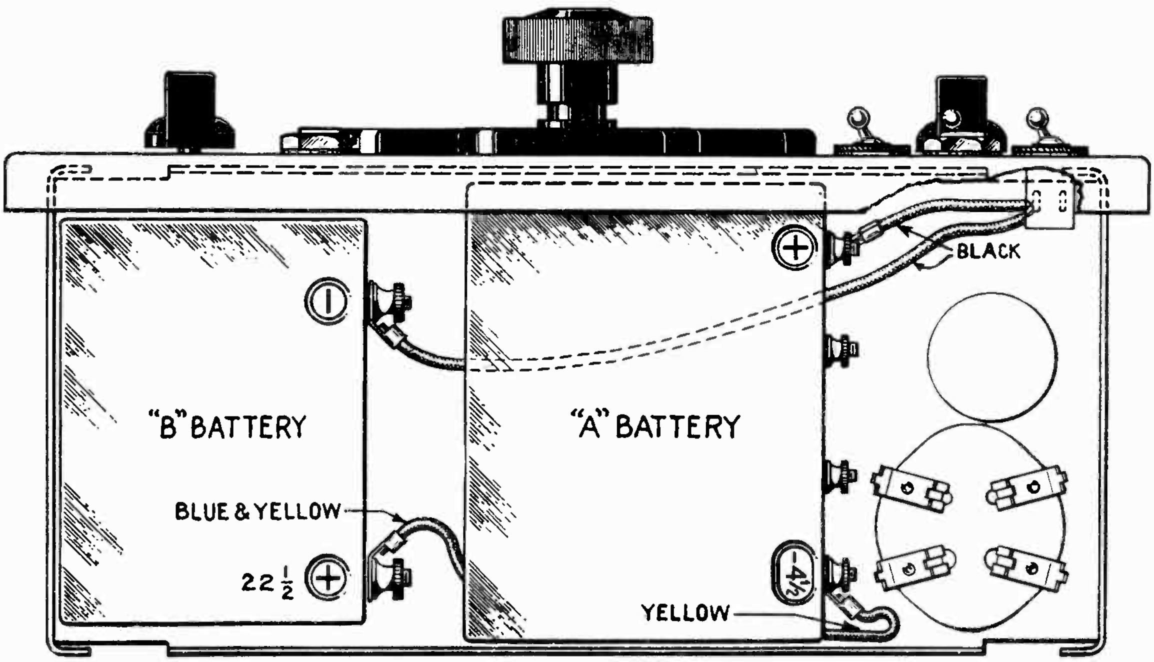


Figure 3—Location of Batteries

the proper points for making the connections on the set. Connect the output of the receiver either to an indicating meter or to a cathode ray oscillograph. In the latter case when it is desired to observe the selectivity curve of the receiver, connections will be made in accordance with Figure 1, the frequency modulator being plugged in at the sweep capacitor jack (No. 7) and connected to the oscillograph.

Overall Response Test Connections

Connect the test oscillator output to the receiver under test and the receiver output to meter or oscillograph, all as for r-f connections. Plug in a beat frequency oscillator at the external modulator jack (No. 8). The output from the instrument should be delivered through a low resistance transformer and both output leads must be insulated from both ground and instrument case. The beat oscillator should be capable of providing approximately 9 volts (r.m.s.) when connected to a 2,000-ohm load, and give a constant audio output voltage.

Heterodyne Connections

Connect the signal source to the "Ant" and "Gnd" binding posts, and plug headphones in detector jack (No. 8).

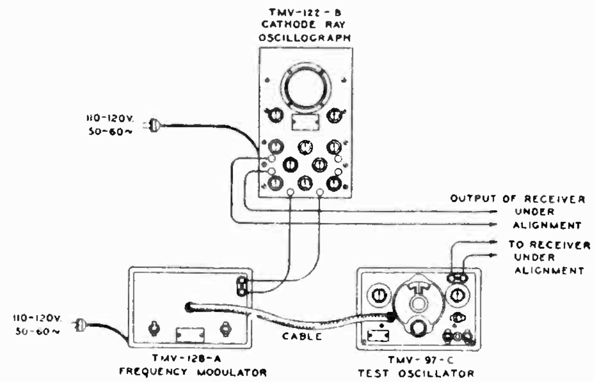


Figure 1—Connections for Oscillograph Test

OPERATION

Check connections for the particular test being made and turn the power switch (On-Off) to "On." Turn modulation switch to "Mod" for all tests except those using the frequency modulator and for heterodyne detection. Adjust the eight-point range switch and tuning dial for desired frequency signal. The tuning dial is calibrated directly in kilocycles with eight scales, one corresponding to each position of the range switch. The vernier tuning ratio may be varied from 6:1 to 20:1 by adjustment of the position of the small arm at the tuning knob. The extreme clockwise position of the arm gives a 20:1 ratio which is particularly advantageous for critical tuning.

Adjust the output of the oscillator to the particular test requirements by means of the output control knob and scale and the attenuation (Hi-Lo) switch. This switch provides a stage of attenuation of 100:1 in addition to the variable output control attenuation. The minimum signal with the switch on "Lo" and the control knob on zero will be less than 20 microvolts at any frequency setting within the range of the instrument. By recording the position of the output dial setting throughout the receiver range (for same signal output) a good indication of the relative receiver sensitivity may be obtained.

R.F. and I.F. Alignment with Indicating Meter

With modulation switch on "Mod" adjust the attenuation switch and output control to give the desired reading on the output meter and then adjust the receiver trimmers, in accordance with the instructions in the Service Notes for the set, to give maximum output. It will be found advisable to make tests with the attenuation switch on "Lo" except when extremely high signal intensities are necessary.

R.F. and I.F. Alignment with Cathode Ray Oscillograph

R.F. and I.F. alignment with cathode ray oscillograph is effected in a manner similar to the above, the frequency modulator being plugged in at the sweep capacitor jack and the modulator switch turned to "Off." Readings are taken on the cathode ray oscillograph which replaces the indicating meter and provides more extensive and detailed performance data. Information with regard to the operation of the oscillograph and frequency modulator is contained in their respective instruction books.

Overall Response Tests

Set the receiver at a definite point, as, for example, 1,000 kc. Plug in the beat frequency oscillator. Turn the power switch to "On," the modulation switch to "Mod" and adjust the instrument controls as required. Take output readings, on an indicating meter or cathode ray oscillograph, corresponding to the various modulation frequencies of the beat frequency oscillator. A check may be made at any other setting of the receiver.

Any discrepancies in the audio frequency characteristics of the receiver may thus be definitely detected.

***Note**—The beat frequency oscillator output voltage should be set at the required value to give the desired percentage modulation. A voltage of approximately 9 volts (r.m.s.) will modulate the TMV-97-C oscillator 50 per cent.*

Heterodyne Detection

Plug headphones in the detector jack, turn modulation switch to "Off" and adjust frequency controls to give beat note. The frequency being checked may now be read on the dial or the dial readings may be checked against known frequencies for rough calibration of the instrument. The output control should always be used at the lowest possible value at which it will provide an audible beat note.

CALIBRATION

The individual oscillators will be found to be within plus or minus 3% of the dial scale reading. However, if it is desirable to have a more accurate calibration than this, a separate correction card is included for each owner to calibrate his own instrument. This is done by tuning in stations in the various ranges on a receiving set and then beating them with the test oscillator for zero beat. The frequency of the test oscillator will then be identical with that of the station. By noting the oscillator dial reading and the station frequency, a very accurate correction curve may be plotted on this card.

For the lower frequencies, 90 kc. to 550 kc., a calibration is readily made by using harmonics of the oscillator for checking against frequencies in the broadcasting band. For example, 175 kc. can be checked by beating its fourth harmonic with Station WLW, the frequency of which is 700 kc.

The instrument will be factory calibrated and a curve plotted on the card at customer's expense, on request, before shipment is made.

MAINTENANCE

The battery voltages should be checked if at any time the output of the oscillator becomes weak.

The drain on the batteries is small, so that their expected life is approximately 15 hours' operation. However, the batteries should be replaced when the filament battery voltage is less than 3 volts and the "B" battery voltage is less than 17 volts.

The combined series battery voltage may easily be metered between the external modulator jack (No. 8) and ground. If this reading is less than 25 volts each battery should be checked separately.

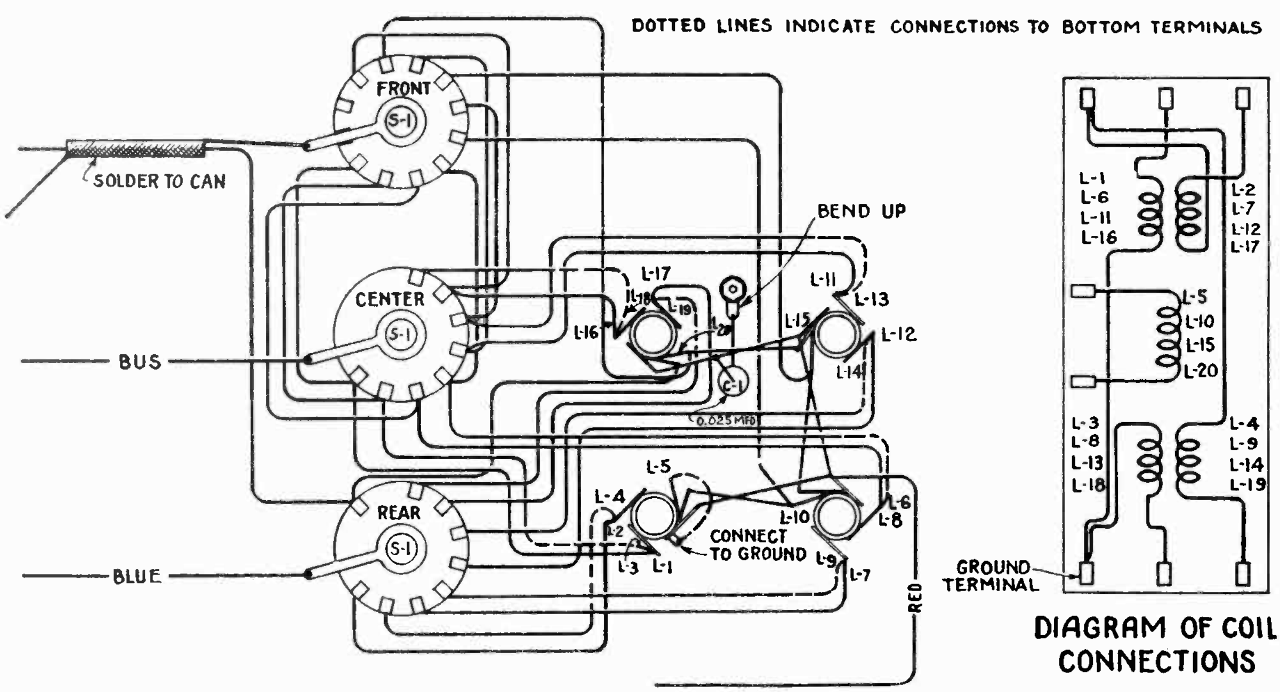


Figure 4—Coil Assembly

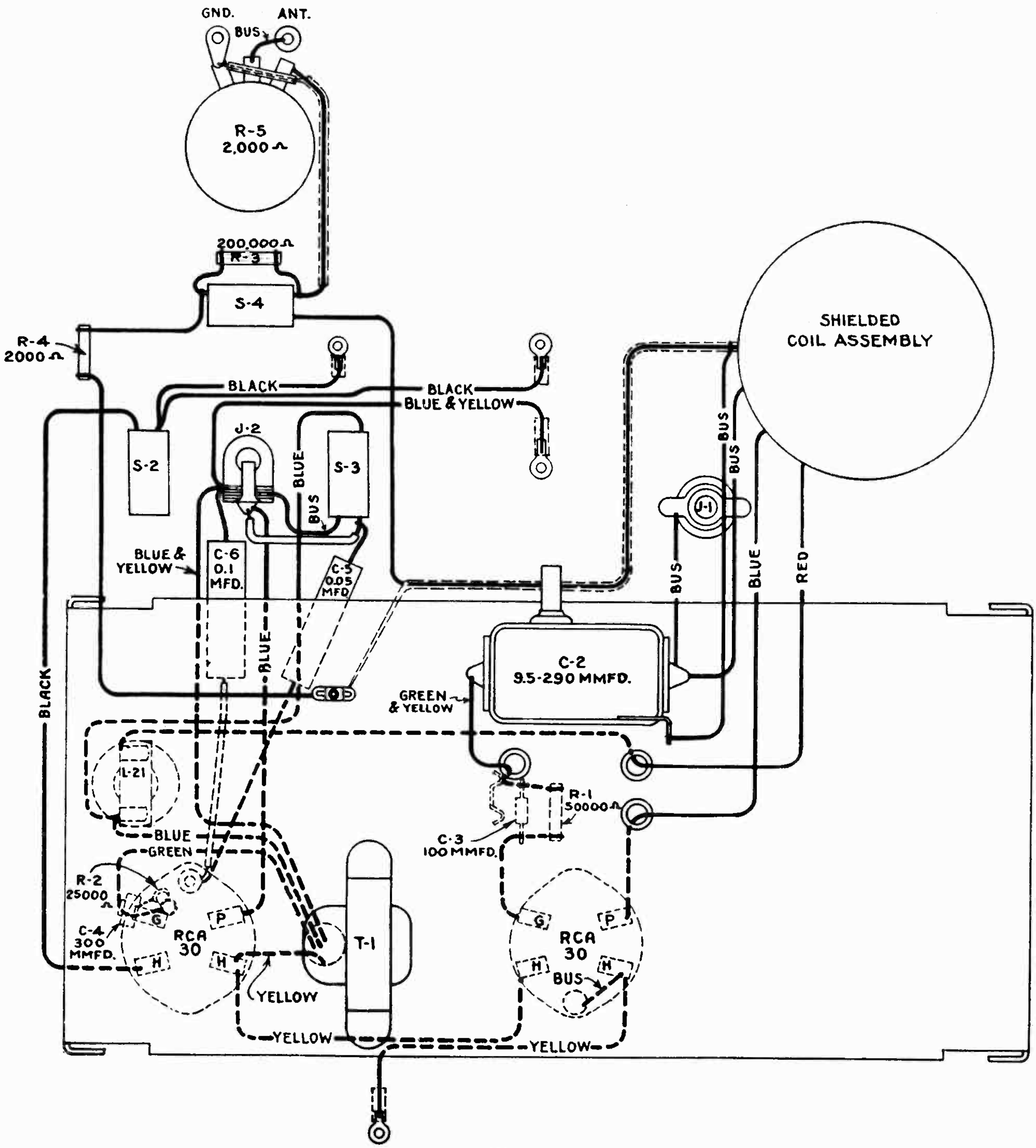


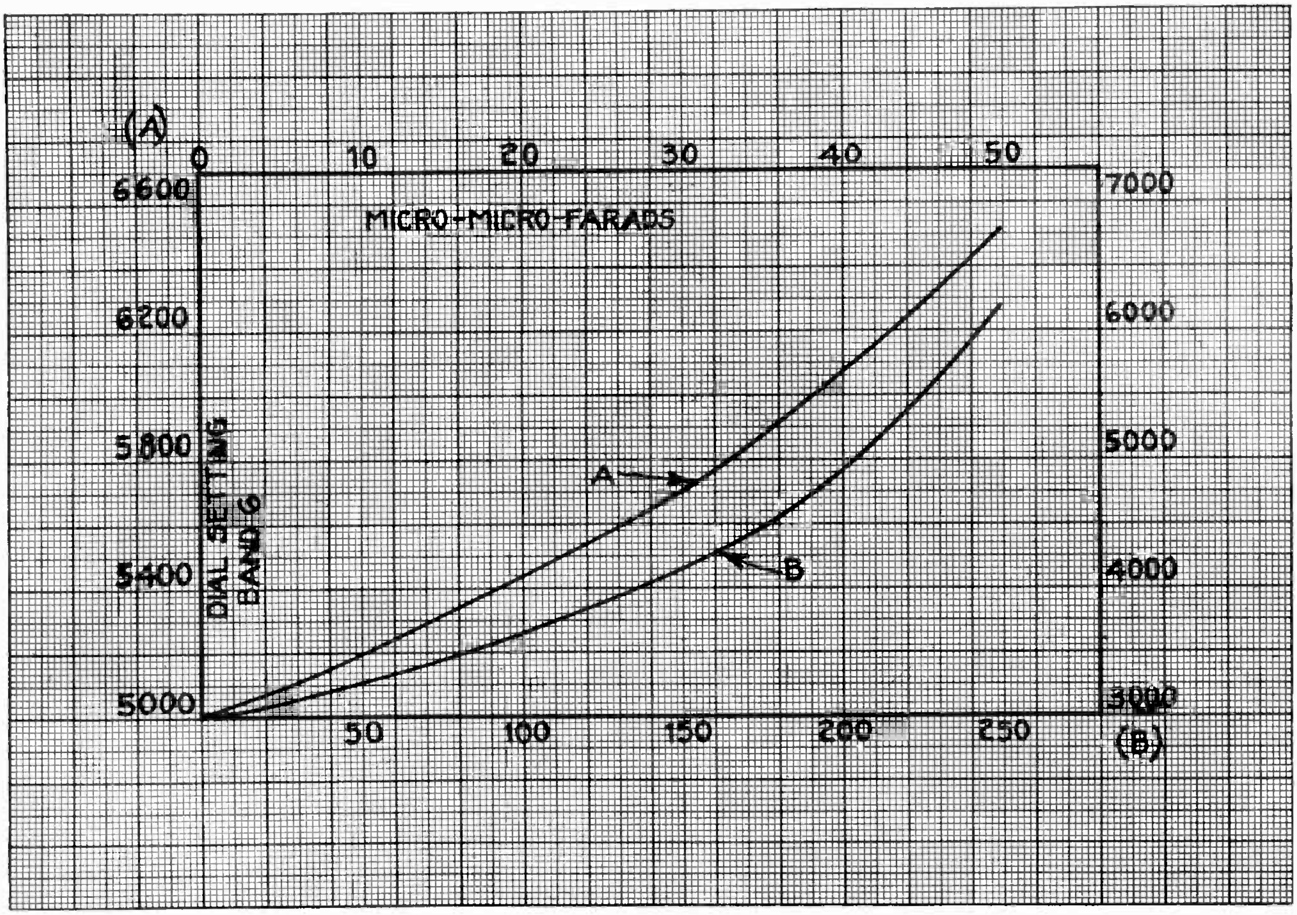
Figure 5—Wiring Diagram

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	DESCRIPTION	List Price
7918	Base—Coil mounting base complete with bushings and terminal	$0.22
7914	Coil—Oscillator coil—Range 90-200 and 200-400 kc. (L1, L2, L3, L4, L5)	1.06
7915	Coil—Oscillator coil—Range 400-800 and 800-1500 kc. (L6, L7, L8, L9, L10)	.80
7916	Coil—Oscillator coil—Range 1500-3100 and 3100-6800 kc. (L11, L12, L13, L14, L15)	.65
7917	Coil—Oscillator coil—Range 6800-14,000 and 14,000-25,000 kc. (L16, L17, L18, L19, L20)	.65
7268	Coil—R.F. plate choke coil (L21)	.40
3794	Capacitor—100 mmfd. (C3)	.30
3981	Capacitor—300 mmfd. (C4)	.30
4870	Capacitor—0.025 mfd. (C1)	.20
4836	Capacitor—0.05 mfd. (C5)	.30
4841	Capacitor—0.1 mfd. (C6)	.22
3980	Capacitor—Tuning capacitor (C2)	1.40
7958	Dial—Tuning condenser dial—Complete	4.00
7923	Escutcheon—Modulation switch escutcheon —Engraved "MOD" and "OFF"	.16
7922	Escutcheon—Output control switch escutcheon—Engraved "HI" "LO"	.16
7901	Escutcheon — Power switch escutcheon — Engraved "ON" "OFF"	.28
3982	Handle—Carrying handle	.60
7961	Jack—Modulation input jack (J2)	.72
7903	Jack—R.F. jack—For use with frequency modulator (J1)	$0.45
7960	Knob—Range switch or output potentiometer knob	.20
7959	Potentiometer—Output control potentiometer (R5)	1.00
5195	Resistor—2,000 ohms—Carbon type—¼ watt (R4)—Package of 5	1.00
3110	Resistor—25,000 ohms—Carbon type—¼ watt (R2)—Package of 5	1.00
5194	Resistor—50,000 ohms—Carbon type—¼ watt (R1)—Package of 5	1.00
3116	Resistor—200,000 ohms—Carbon type—¼ watt (R3)—Package of 5	1.00
3986	Scale—Output potentiometer dial plate scale	.66
7921	Scale—Range switch dial plate scale	.20
7924	Scale—Tuning condenser dial scale	.16
7912	Shield—Coil assembly shield (top)	.20
7913	Shield—Coil assembly shield (bottom)	.30
4794	Socket—4-contact Radiotron socket	.15
7925	Switch—Modulation control or output control switch (S3, S4)	.52
7900	Switch—Power switch (S2)	.75
7919	Switch—Range switch—Less coil mounting base (S1)	1.85
3979	Transformer—Audio oscillator transformer (T1)	1.94

USE OF TMV-97-C, CONVERTED TMV-97-A OR CONVERTED TMV-97-B TEST OSCILLATOR FOR CHECKING SMALL CAPACITORS OF VALUES FROM 2 TO 250-MMFD



Proceed as follows:

Connect a two wire cable to a standard telephone plug. If two separate wires are used, lace them together so that their capacity remains constant. Leave three inches free at the end. Insert the plug in the sweep jack and place the oscillator in operation with the range switch in the 800 to 1500 kc. position.

CAPACITORS 2—50-MMFD

Set oscillator dial to 5000 kc. on scale for band 6. Tune in signal on broadcast range of a receiver. Place unknown capacitor across free ends of wires from test cable. Reset oscillator dial until signal is again tuned in at receiver. Compare reading of new oscillator dial setting from scale for band 6 with the capacity chart and follow across to curve A. At intersection, follow line up to Scale A and read the corresponding value of capacity. EXAMPLE: Oscillator dial at 5000. Connect capacitor. Retune oscillator for signal in receiver. New reading 5800. Consult chart. Read value of capacitor as 33-MMFD.

CAPACITORS UP TO 250-MMFD

Set oscillator dial to 3000 kc. on scale for band 6. Tune in signal as before and connect the unknown capacitor. Retune the oscillator as above until the signal is tuned in at the receiver. Compare the new setting of the oscillator dial for scale 6 with the capacity chart and follow across to curve B. At intersection follow the line down to scale B and read the corresponding value of capacity. EXAMPLE: Oscillator dial at 3000. Connect the unknown capacitor. Retune the oscillator for signal in receiver. New reading 5000. Consult chart. Read value of capacitor as 204-MMFD.

Figure 1—External view of Type TMV-118-B Regulated Power Unit

RCA REGULATED POWER UNIT

TYPE TMV-118-B

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

A. C. Input Voltage Rating	90–130 Volts
Frequency Rating	50–60 Cycles
Power Consumption	70 Watts
Maximum Output Voltage	See Curves
Maximum Output Current	See Curves
Type and Number of Radiotrons	1 RCA-80, 1 RCA-2A3, 2 RCA-874, 1 RCA-57—Total, 5

PHYSICAL SPECIFICATIONS

Height	7¼ Inches
Width	12 Inches
Depth	7 Inches
Weight	25 Pounds
Weight Packed for Shipment	28 Pounds

The RCA Regulated Power Unit, Type TMV-118-B, is a device for converting the usual alternating current line power into direct current suitable for use with devices normally requiring "B" batteries. The voltage regulation is better than that obtained from a set of heavy-duty batteries while the hum is negligible. A special regulating circuit maintains constant output voltages independently of line or load variations over a wide range. A general view of the external appearance of the TMV-118-B Power Unit is shown in Figure 1.

DESCRIPTION OF ELECTRICAL CIRCUIT

Figure 2 shows the schematic circuit diagram of the complete unit, while Figure 3 shows a sketch of the current-carrying section of the circuit. All by-pass capacitors and filter circuits are omitted.

Before examining the circuit, it is well to understand the action of the voltage regulating tube, RCA-874. The RCA-874 is a gaseous tube of two elements The tube functions to maintain a fairly constant voltage (90 volts) across a circuit, independently of load due to the fact that its resistance varies with the voltage across its terminals. The tube requires 125 volts for starting and maintains an approximately constant D. C. voltage across its terminal for any current from 10 to 50 milliamperes. A link circuit is provided by having two of the tube prongs tied together so that the power circuit may be wired through this link. This prevents power from being applied to the unit without the RCA-874 in place. Excessive voltage might otherwise occur if such a condition existed due to absence of the load of the regulator tube.

The rectifier and filter circuit of the TMV-118-B functions in the usual manner, a full-wave rectifier and a tapped choke being used. The voltage regulating feature consists of four tubes which function as follows:

Referring to Figure 3, the general purpose of each tube is as follows:

RCA-874 is a voltage regulator, maintaining a fairly constant voltage across resistors R-5 and R-6. This voltage is known as the reference voltage and a portion of it comprises the grid voltage of the RCA-57.

RCA-57 is a control tube for changing the grid voltage of Radiotron RCA-2A3 in accordance with voltage variations.

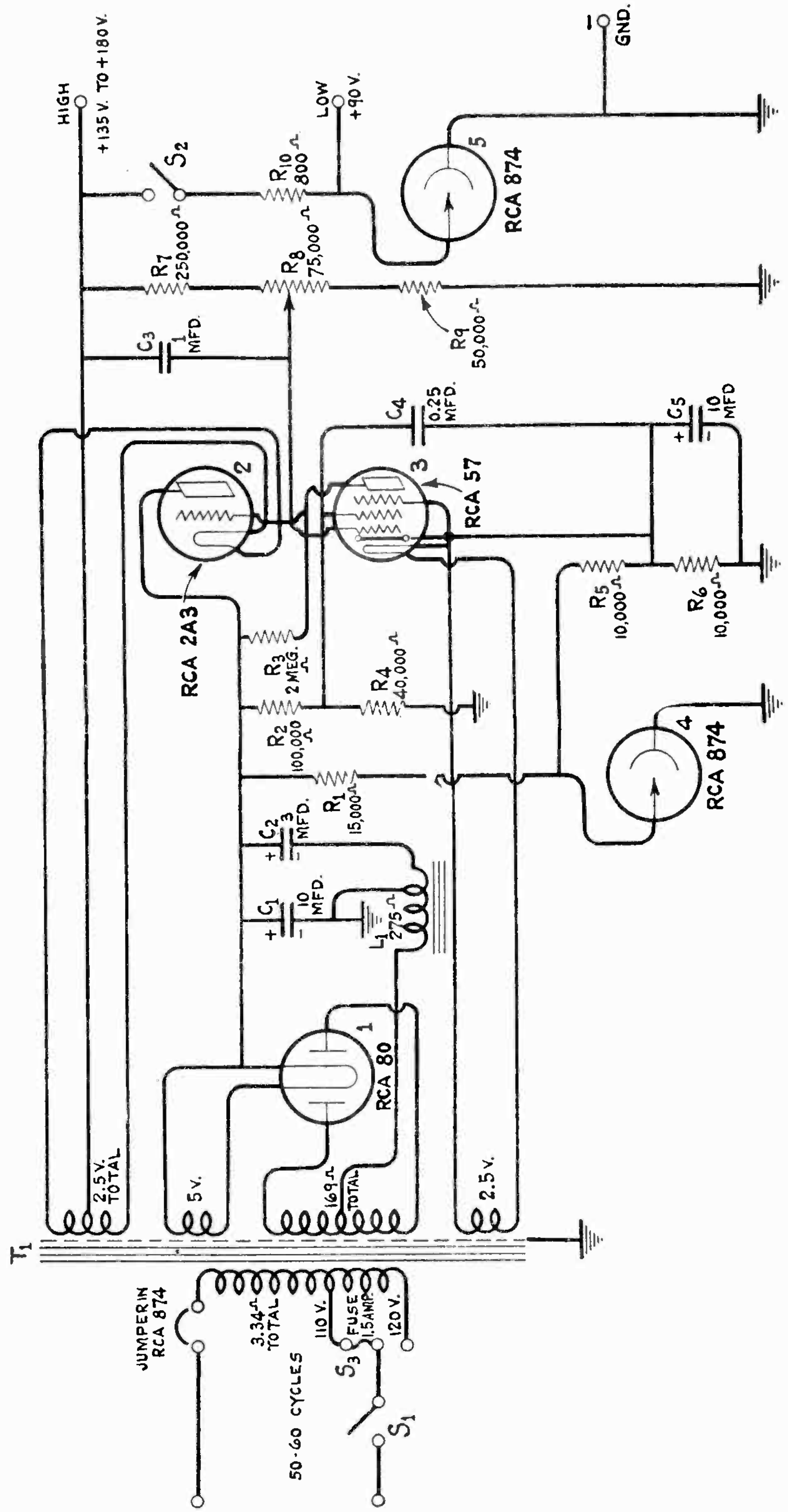


Figure 2—Schematic Circuit Diagram

RCA-2A3 is a voltage regulating tube which functions as a series resistor in the output line. Its resistance is governed by the value of its grid voltage.

RCA-874 (2) is a voltage regulating tube that is used only when the 90-volt tap is used.

The functioning of the circuit may best be explained by considering its action when a variation in line voltage or load occurs.

Assume that the voltage at a particular instant is reduced across the — and +B taps, either by reason of high load current or low A. C. line voltage. This would cause a reduced voltage from ground to the arm of the voltage adjusting potentiometer, which is connected to the grid of RCA-57. Inasmuch as the voltage across resistors R-5 and R-6 is normally higher between cathode and ground than that from the potentiometer arm to ground, reducing this voltage will cause an increased negative voltage to be applied between the cathode and grid of the RCA-57.

Increasing the negative potential on the grid of the RCA-57 reduces its plate current and consequently the voltage drop across resistor R-3. This causes the grid of the RCA-2A3 to become less negative and its resistance less. This reduces the voltage drop across the RCA-2A3, which gives an increased voltage at the output, thereby compensating for the reduction caused by load or low-line voltage.

As this action occurs very rapidly, the effect is a constant voltage output at all times. While only a portion of the D. C. output is applied to the grid of the RCA-57, the full ripple voltage is applied through capacitor C-3. The regulating action of the circuit also functions on this ripple voltage which causes a further hum reduction. The final result is D. C. almost entirely free from ripple voltage.

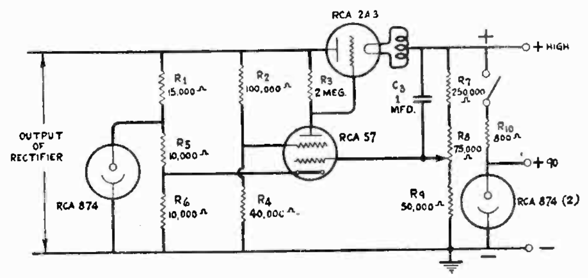
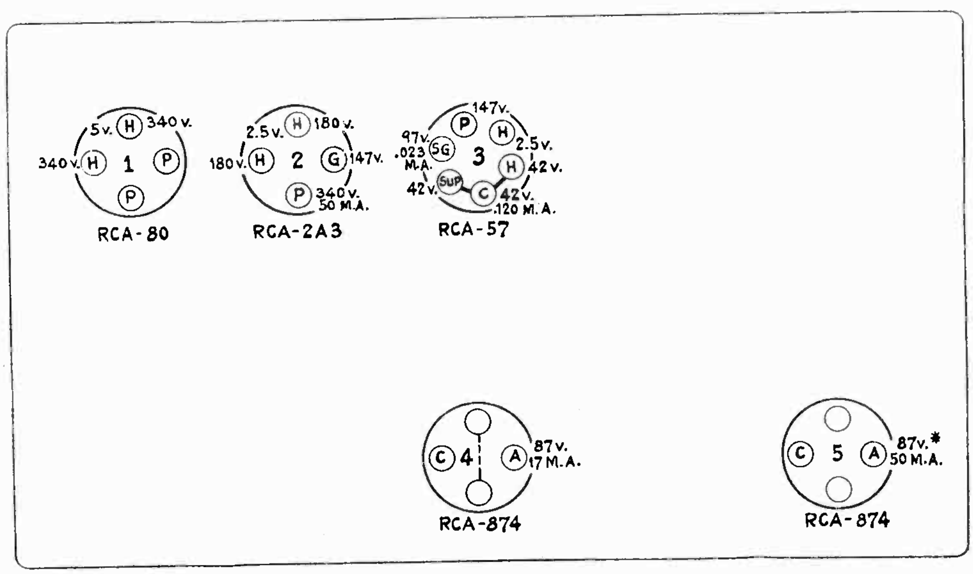


Figure 3—Voltage Regulating Circuits

A switch is provided for the 90-volt output which has the additional regulation of the UX-874 (2) when it is connected.



* Set output volts to 135—no load with 90-volt switch "on"

All D. C. voltages are to ground except heaters—Voltages are with 180-volt, 50 M. A. load, 90-volt switch "off"—Input voltage 115 volts, 60 cycles—transformer on 110-volt tap.

Figure 4—Voltages at Radiotron Sockets

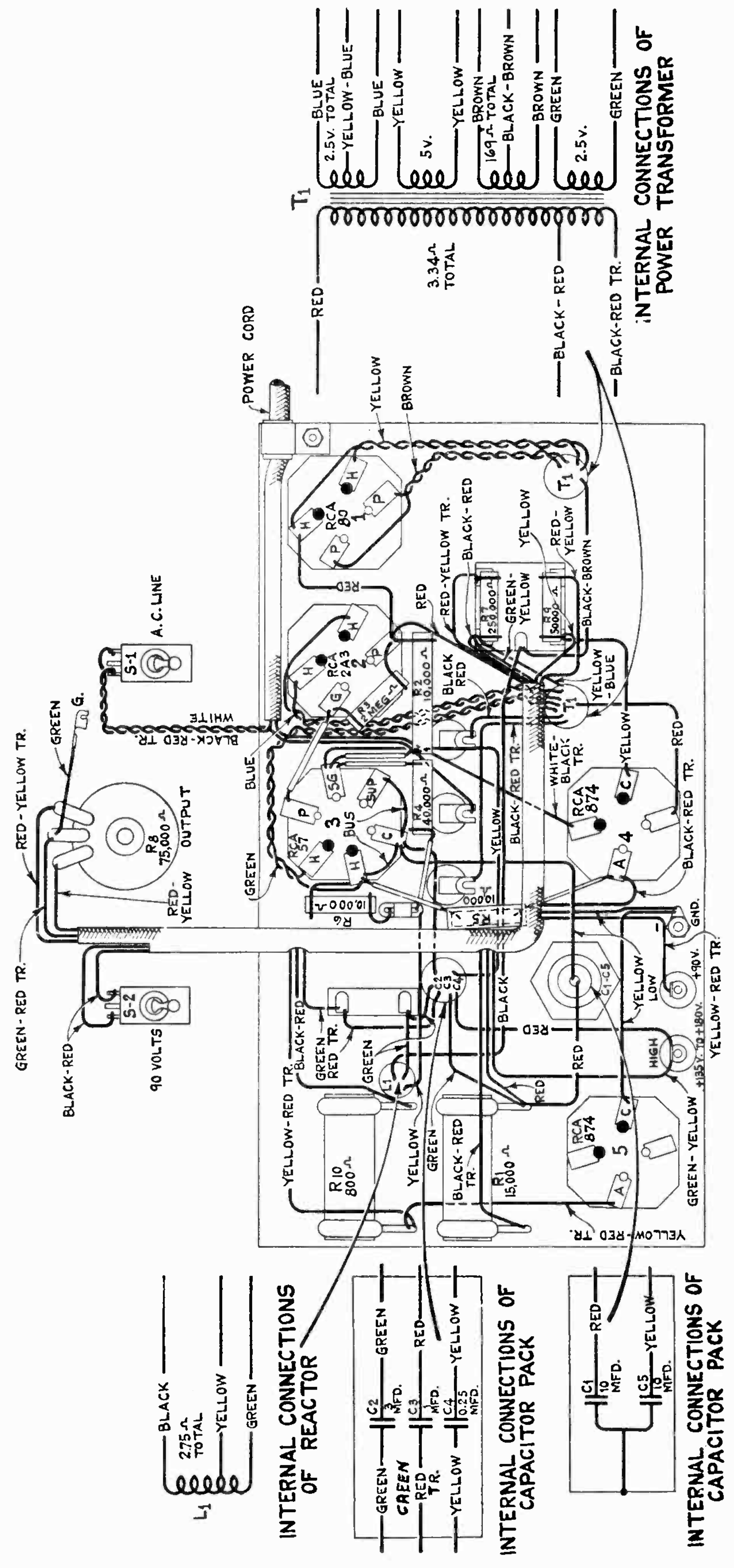


Figure 5—Wiring Diagram

SERVICE DATA

CAUTION

When using the TMV-118-B power unit with devices having filter capacitors, it is desirable to have a switch between the power unit and the device to open the circuit during a 30-second warming-up period. During this warming-up period, the output voltages may be high and unless the filter or by-pass capacitors are conservatively rated, premature failure may result.

(1) EXCESSIVE HUM

Excessive hum may be caused by operating the TMV-118-B beyond the limits of its capacity. A reference to the curves shown in Figure 4 shows the safe limits and regulation to be expected for such operation. A good test for maximum load is maximum permissible hum. Excessive hum with the equipment in normal condition is an indication of excessive load.

Excessive hum accompanied by high voltage is caused by a defective Radiotron RCA-57.

Excessive hum accompanied by normal voltage is an indication of a defective capacitor C-3.

(2) LOW VOLTAGE

Low voltage may be caused by a low emission Radiotron RCA-80 or RCA-2A3.

(3) HIGH VOLTAGE

High voltage may be caused by a defective Radiotron UX-874 or, if accompanied by hum, a defective RCA-57.

(4) VOLTAGE READINGS

The voltages shown on Figure 4 are those at which the various tubes operate. When taking readings, suitable allowance must be made for the load of the meter.

(5) VOLTAGE REGULATION

Figures 6 to 11, inclusive, show the voltage regulation of the TMV-118-B over a wide range of line voltages, load current and output voltage conditions. A reference to the charts should be made to ascertain the regulation for any given condition, prior to placing the unit in operation.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
4782	Cable—Wiring cable—6-conductor—Tapped	$0.85
2747	Cap—Grid contact cap—Package of 5	.50
4770	Capacitor pack—Comprising one 3.0 mfd., one 0.25 mfd. and one 1.0 mfd. capacitors (C2, C3, C4)	1.35
4776	Capacitor pack—Comprising two 10.0 mfd. capacitors (C1, C5)	1.80
3883	Fuse—2 amperes—Package of 5	.40
4336	Knob—Potentiometer knob—Package of 5	.40
4774	Mount—Fuse mount	.42
4777	Post—Binding post assembly—3 posts	.85
4779	Potentiometer (R8)	1.48
4773	Reactor—Filter reactor (L1)	4.75
4771	Resistor—800 ohms (R10)	.85
4772	Resistor—15,000 ohms (R-1)	.85
4781	Resistor—10,000 ohms—Carbon type—½ watt—Package of 5 (R5, R6)	1.00
3594	Resistor—50,000 ohms—Carbon type—½ watt—Package of 5 (R9)	$1.00
3058	Resistor—100,000 ohms—Carbon type—1 watt—Package of 5 (R2)	1.10
3514	Resistor—250,000 ohms—Carbon type—½ watt—Package of 5 (R7)	1.00
3079	Resistor—40,000 ohms—Carbon type—½ watt—Package of 5 (R4)	1.00
4046	Resistor — 2 megohms — Carbon type — ½ watt—Package of 5 (R3)	1.00
3986	Scale—Dial scale—0 to 100	.66
4780	Screw—Thumb screw—Package of 2	.34
6300	Socket—4-contact Radiotron socket	.35
7485	Socket—6-contact Radiotron socket	.40
21131	Switch—Toggle switch	1.75
4775	Transformer—Power transformer (T1)	11.82

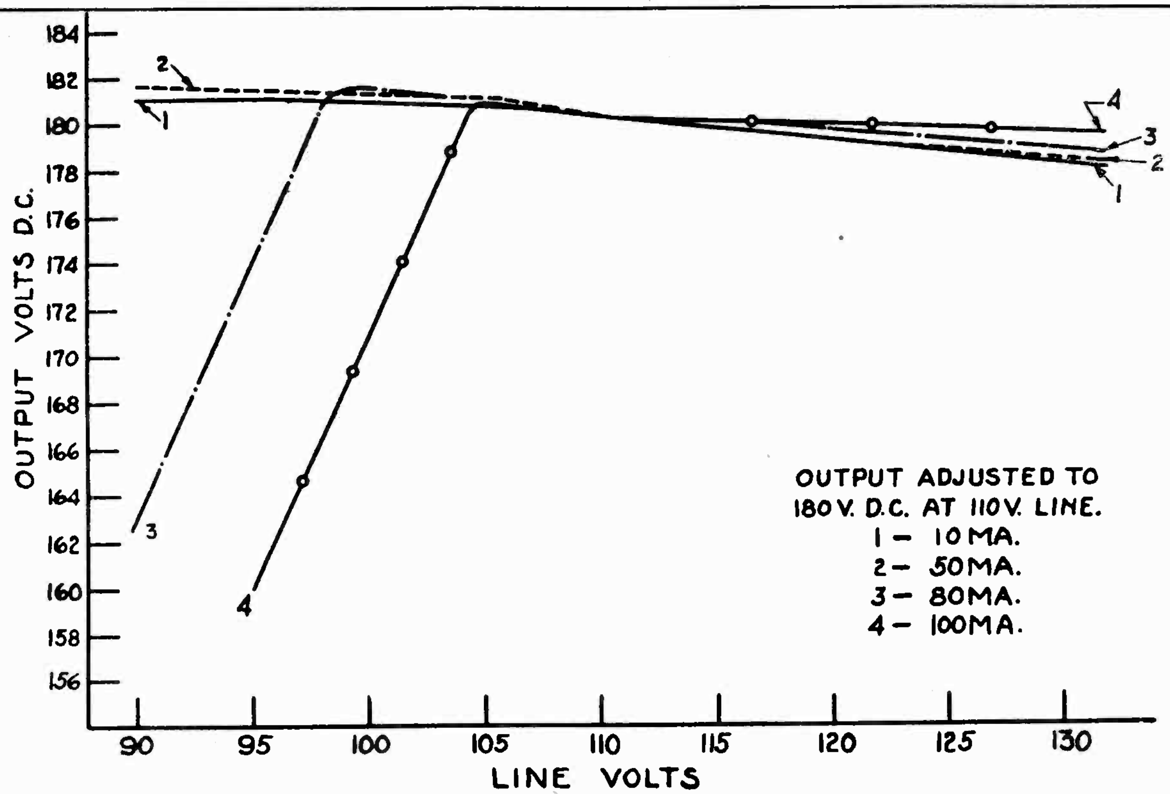


Figure 6—Voltage Regulation vs. Line Volts

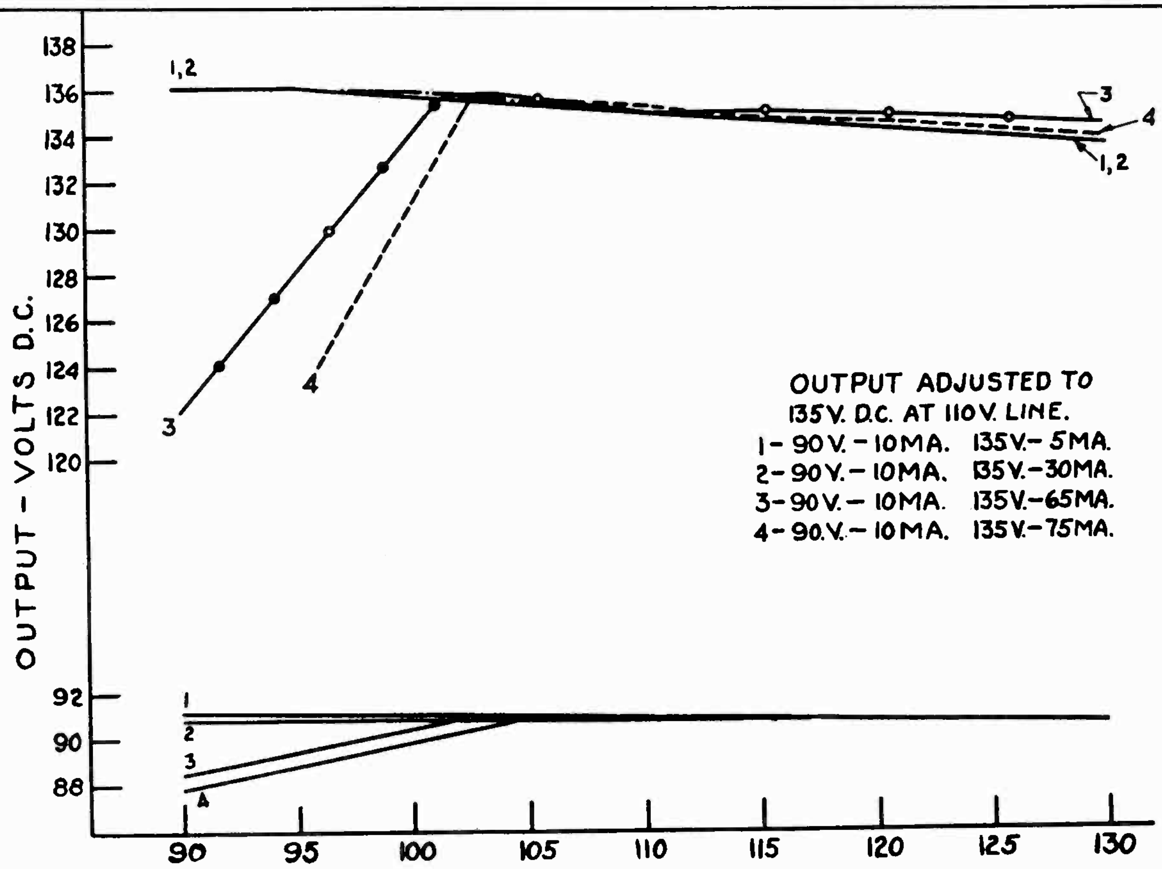


Figure 7—Voltage Regulation vs. Line Volts

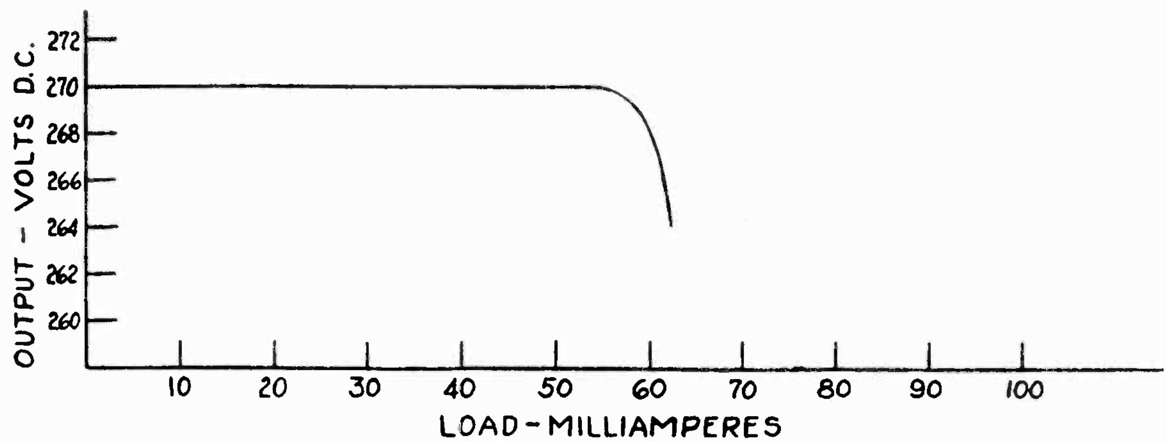


Figure 8—Voltage Regulation vs. Load with Constant Line Voltage (110 Volt-60 Cycle)

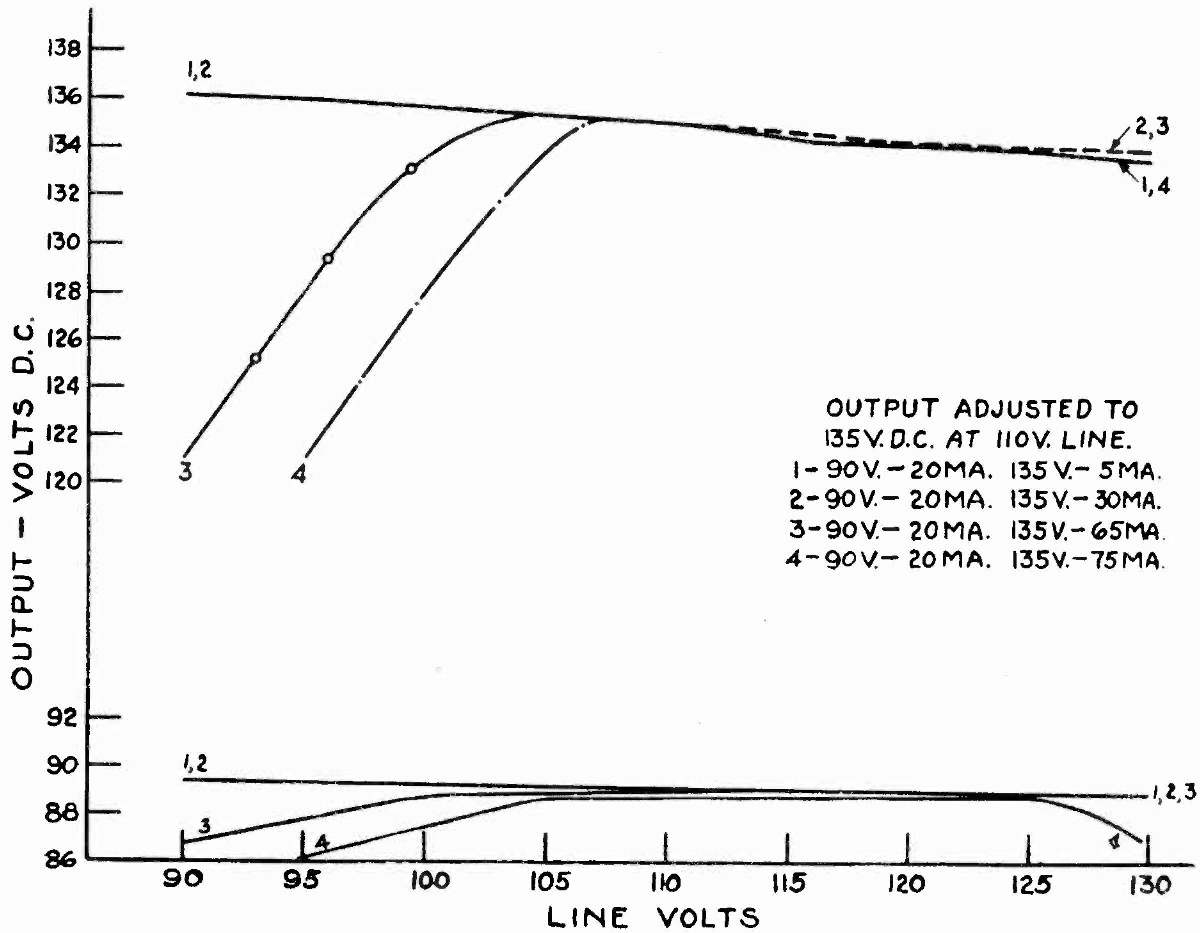


Figure 9—Voltage Regulation vs. Line Volts

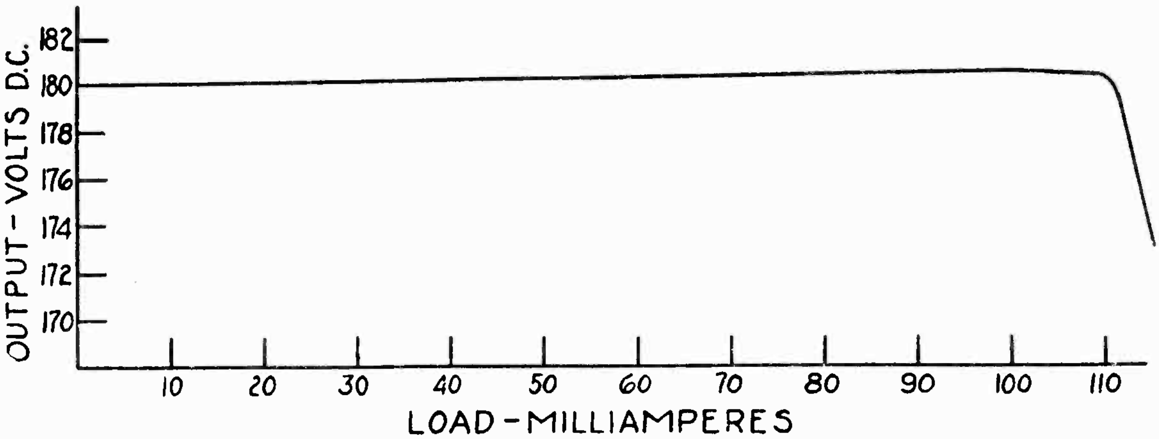


Figure 10—Voltage Regulation vs. Load with Constant Line Voltage (110 Volt-60 Cycle)

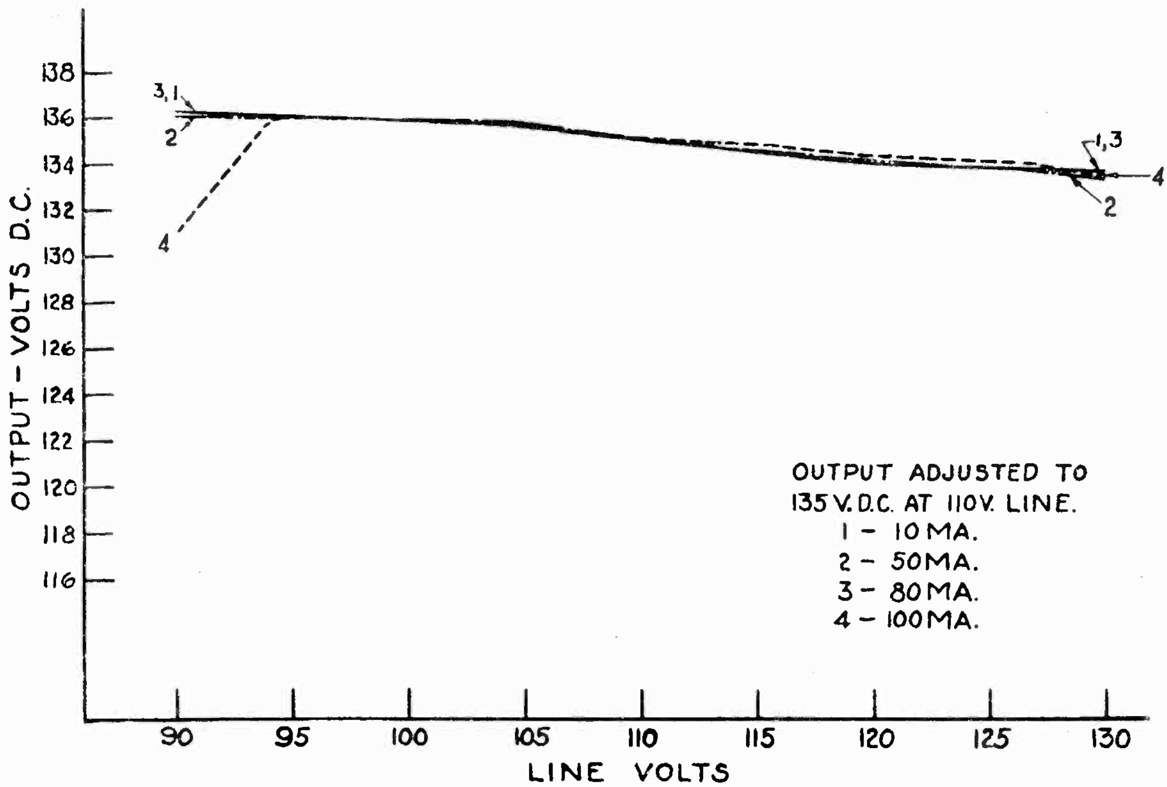


Figure 11—Voltage Regulation vs. Line Volts

Cathode-Ray Oscillograph

Type TMV-122-B

Part I

OPERATING INSTRUCTIONS

WARNING—WHEN SAFETY SWITCH IS CLOSED, 1300 VOLTS IS PRESENT AT CATHODE-RAY TUBE SOCKET AND OTHER POINTS ON THE CHASSIS. ALWAYS DISCONNECT POWER CORD BEFORE REMOVING CHASSIS FROM CABINET.

Introduction

These instructions cover the installation, operation, maintenance and servicing of the Type TMV-122-B Cathode-Ray Oscillograph, designed especially for high-quality servicing of radio receiving sets and other communication devices. This Oscillograph provides a reliable instrument for the study of wave shapes and transients, measurement of modulation, adjustment of radio receivers and transmitters, determination of peak voltages, tracing of vacuum-tube characteristics and other similar applications. Its chief (although not the only) advantage over older types of measuring instruments is its freedom from inertia, allowing the observation of very rapid changes of current or voltage without appreciable distortion. The unit is entirely portable, the dimensions are approximately 14 inches high by 7¼ inches wide by 17¾ inches deep, and the weight is approximately 39½ pounds. The illustration on the opposite page shows the general appearance of the instrument and the operating controls. It operates entirely from an a-c source of 110 volts, 60-cycle current, an integral power unit supplying all operating voltages required for operation of the equipment.

The purpose of these instructions is to give the fundamentals of operation. As the use of cathode-ray apparatus becomes more widespread many new applications will be found for this equipment so that a thorough understanding of these fundamentals will enable the operator to readily adapt the equipment to his particular use. Since the equipment is built around the cathode-ray tube, a discussion of cathode-ray tubes and images obtained follows, which serves to explain the operation of the equipment and aids in analyzing figures which appear on the screen. The operator is urged to read this section thoroughly so that the numerous applications of the equipment may be readily understood and also that optimum performance may be obtained at all times.

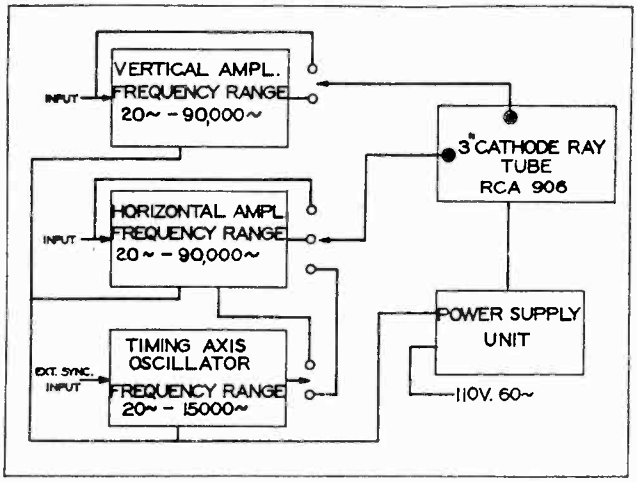


Figure 1—Block Diagram

Figure 1 shows the essential units of the instrument, which include an RCA-906 cathode-ray tube, a vertical amplifier, a horizontal amplifier, a timing axis oscillator (saw-tooth generator) and a power unit for supplying all operating voltages required.

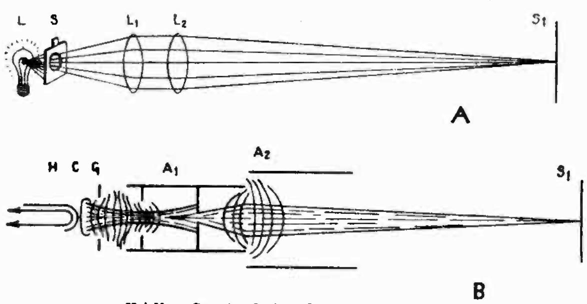
General Discussion of Cathode-Ray Tube

Fundamentally, a cathode-ray tube consists of (1) an electron-beam source, (2) provision for deflecting the beam, (3) provision for focusing the beam on a screen, and (4) a fluorescent screen for visibly indicating the position of the beam.

In the RCA-906 tube the electron source is a substantial cathode, indirectly heated. The cathode, control electrode (grid), and focusing electrodes constitute an electron gun, used to project a beam of electrons (Function 1). Two sets of electrostatic plates at right-angles to each other are located within the neck of the bulb to provide for deflection of the electron beam (Function 2). Focusing (Function 3) is accomplished by adjusting the ratio between the voltages on anodes No. 2 and No. 1. This ratio is in the neighborhood of 5:1. In practice, the anode No. 2 voltage is generally held constant and the anode No. 1 voltage is varied, since it is the smaller potential to control. The screen (Function 4) forms one end of the tube. It is three inches in diameter, and the inside is coated with material which emits light when struck by the electron beam. The control electrode (grid) constitutes a means of controlling the quantity of electrons admitted into the stream, and thus allows control of spot intensity (also called "brilliancy")—the more negatively the grid is biased, the fewer electrons in the beam, the smaller the spot, and the less the intensity.

The RCA-906 requires a high potential between cathode and anode No. 2 (in the order of 1000 volts). The voltage on anode No. 1 is usually around one-fifth of the high voltage, and is made variable to provide a means of focusing. The bias supply to the control electrode (grid) is also made variable to provide a means of controlling intensity. Since the anode current is usually less than 0.1 milliamperes, it is entirely satisfactory to use a rectifier tube in the power supply rated at only a few milliamperes, and to employ only capacity in the filter circuit. With such a small current drain imposed on this power supply, a condenser of 0.4 mfd. or more will filter very effectively.

The following few paragraphs constitute a very elementary development of cathode-ray tube deflection, and should be omitted by anyone familiar with the basic theory of operation of cathode-ray tubes. Those desiring to make this omission may start at "Study of Lissajou's Figures."



"A"—Optical Analogy
"B"—Three Element Cathode Rays

Figure 2—Focusing Cathode Rays

The "Electron Gun" in the cathode-ray tube may be compared to a simple optical system as shown in Figure 2-A. In this diagram the light emitted from the lamp, "L," is focused on the screen, "S_1," by means of a double lens system, "L_1," "L_2," and the amount of light is controlled by the shutter, "S," which, when closed, shuts off the light completely. The brilliancy of the image on the screen depends on the size of opening in the shutter, "S," and the candle power or wattage of the lamp, "L." If the candle power of the lamp is fixed (that is if we select a lamp of a given wattage) then the brilliancy is solely controlled by the shutter, "S." The size or definition of the image on the screen, "S," is controlled by adjusting the position of the lenses, "L_1" and "L_2," to the correct distance, which is called focusing. If the position of the lens, "L_2," is fixed, then the focus will depend solely on the adjustment of the position of lens, "L_1." Furthermore, with both lenses, "L_1 and L_2," adjusted correctly, it would be possible to change the focus by actually substituting for the lens, "L_1," various lenses until the one having the correct index of refraction is obtained. This is essentially the method of controlling the focus in the cathode-ray tube.

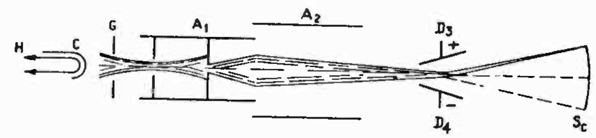


Figure 3—Deflection in One Direction

Figure 2B shows the elements constituting the "electron gun" previously mentioned. "C" is the cathode which radiates electrons when warmed by the heater, "H." The bias voltage of the grid "G" controls the number of electrons allowed to pass through it. The distance from the "gun" at which the electrons converge to a point, or "focus," is determined by the ratio of the voltages on the two anodes, A_1 and A_2. Obviously then, there is a particular ratio of these two voltages which will cause the beam to focus at the screen distance. In practice, the A_2 voltage is usually fixed and the A_1 voltage is made variable through sufficient range to assure that the beam can be focused on the screen.

Figure 3 shows the addition of one pair of deflecting plates, D_3 and D_4, to the previous figure. If these two plates are at the same potential, that is if no voltage difference exists between them, the electron stream is unaffected by their presence. However, if a difference of potential does exist between D_3 and D_4 the electron stream will be deflected toward the plate which is more positive (D_3 in the figure). (A positive charge attracts electrons, which are negative, while a negative charge repels. Both plates therefore bend the electron beam up as shown.)

Assume that a cathode-ray tube has both pairs of deflecting plates connected to a d-c source through potentiometers, as shown in Figure 4A. The center position of the "electron spot" on the luminescent screen, with zero voltage on both axes, is shown at B. At C, E_1 has been raised from zero, and it can be seen that the electron beam has been deflected upward and the spot now appears near the top of the screen. At D, E_1 has been returned to zero, and E_2 raised. A horizontal deflection is obtained. The directions of deflection, BC and BD are essentially at right-angles, due to the physical position of the electrostatic deflecting plates in the cathode-ray tube. At E, both E_1 and E_2 are impressed simultaneously, and with deflections on both axes, the spot has assumed the position resulting from the displacement in the two directions.

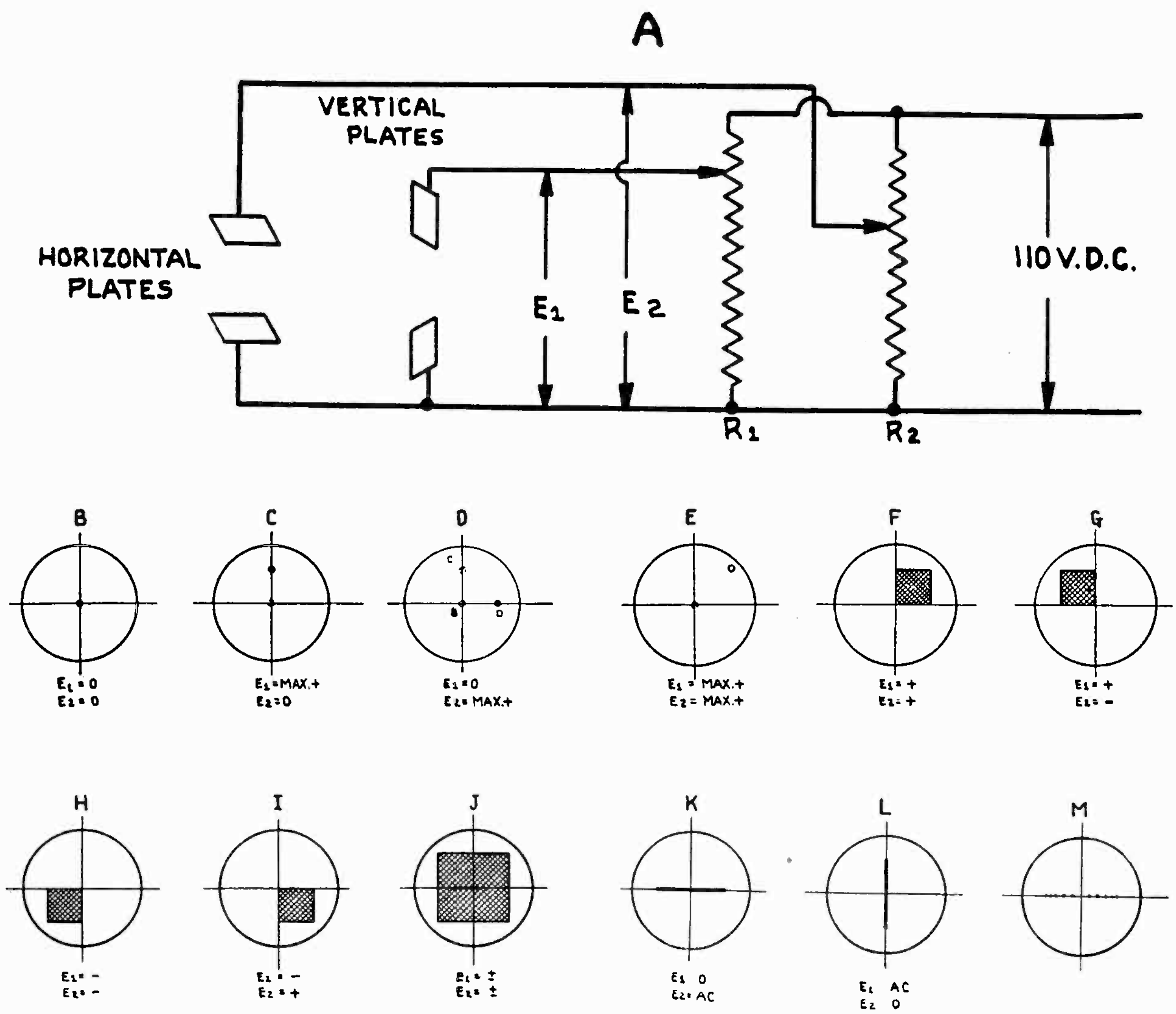


Figure 4—Application of Voltage to Deflecting Plates

It is readily apparent that by proper choice of E_1 and E_2 the spot may be made to assume any position within the shaded area of F. If the supply to R_2 is reversed, the beam will move to the left of center position as the E_2 voltage is increased from zero, and the shaded area of G applies. H and I need no explanation. J shows in shade the area the spot can be made to cover by changing polarity and value of the impressed voltages, E_1 and E_2. Now assume that a 2-cycle a-c voltage is impressed at E_2 ($E_1 = 0$). The spot will be seen to traverse the screen (see M) four times a second, and if the voltage is sinusoidal, the spot will move rapidly in the center of its travel and slowly at each end. If the 2-cycle source is replaced by a higher frequency (20 cycles or more) the spot will no longer be seen, but instead will cause a horizontal line to appear as shown at K. A similar voltage impressed on E_1, with $E_2 = 0$, gives a vertical line as in L. It should be borne in mind that the electron stream is always causing only a small spot to become luminous (assuming correct focus, etc.), but due solely to the illusion of persistence of vision (neglecting screen retentivity) the course of the spot appears as a line or image. A familiar analogy is the motion picture, in which a rapid series of still pictures gives apparent motion.

Study of Lissajou's Figures

When varying voltages are applied to the deflecting plates of a cathode-ray tube, a pattern is obtained on the fluorescent screen. The shape of this pattern depends upon the wave forms of the applied voltages, their frequencies and phase relationships. The following study of these patterns, or Lissajou's figures, is made with particular attention to their development, their use in identifying frequency ratios, and the effect of phase shift.

Figure 5 represents a sine-wave voltage (A) applied to the vertical pair of deflecting plates of a cathode-ray tube and an identical voltage (B) applied to the horizontal deflecting plates. The resulting pattern, shown by (C), is a straight line having a 45-degree slope. The direction of the slope of this line is determined by the phase relation of the two voltages as illustrated in Figures 10A and 10E.* Figure 6 illustrates the case of two identical voltages having the same amplitude but 90 degrees, or 270 degrees, out of phase. In this case, the resulting figure is a circle. If one of the figures is of greater amplitude

*Figures 10 to 16 inclusive, and Figures 26 and 27 adapted from "Frequency Measurements with the Cathode Ray Oscillograph," Frederick J. Rasmussen, A. I. E. E. Transactions, November, 1926, Vol. XLV, Pages 1256–65.

than the other, the resulting figure will be an ellipse as shown by Figure 10C. If the phase relation is such that one voltage leads by 45 degrees, or 315 degrees, the resulting pattern will be that of Figure 10D; if leading by 135 degrees, or 225 degrees, the resulting pattern will be that of 10B. Figures 5 to 9 inclusive, show a graphical method for determining the resulting pattern, where the wave shapes, the relative amplitudes, the phase relation, and the frequencies of the two deflecting voltages are known. By means of the cathode-ray tube, the resultant pattern is traced on the fluorescent screen. Conversely, from this pattern, the frequency, and the phase relations of the two deflecting voltages can be determined. Where, in addition, the wave form is known for one of the deflecting voltages, the wave form of the other can readily be obtained by graphical analysis.

Figures 5, 6, and 10A to 10E are for a 1:1 frequency ratio. When a 2:1 frequency ratio of the voltages applied to the deflecting plates is the case, the wave shapes of Figures 10A to 10E become those shown by Figures 10F and 10J.

As the ratio of the frequencies increases, the pattern becomes more complex. In Figure 7, A and B,

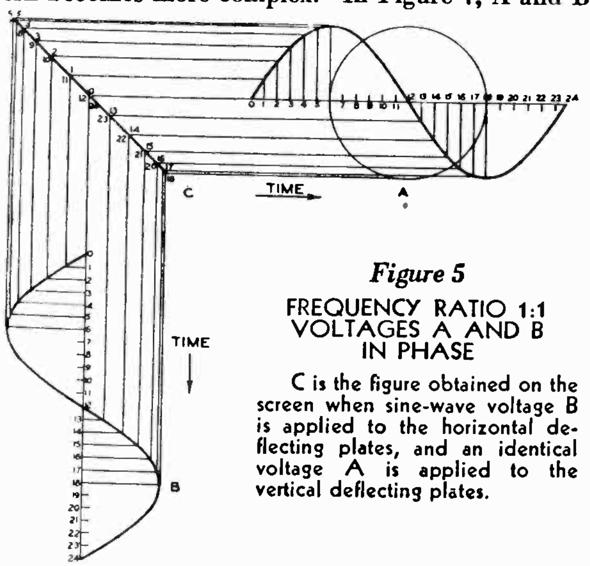


Figure 5

FREQUENCY RATIO 1:1
VOLTAGES A AND B
IN PHASE

C is the figure obtained on the screen when sine-wave voltage B is applied to the horizontal deflecting plates, and an identical voltage A is applied to the vertical deflecting plates.

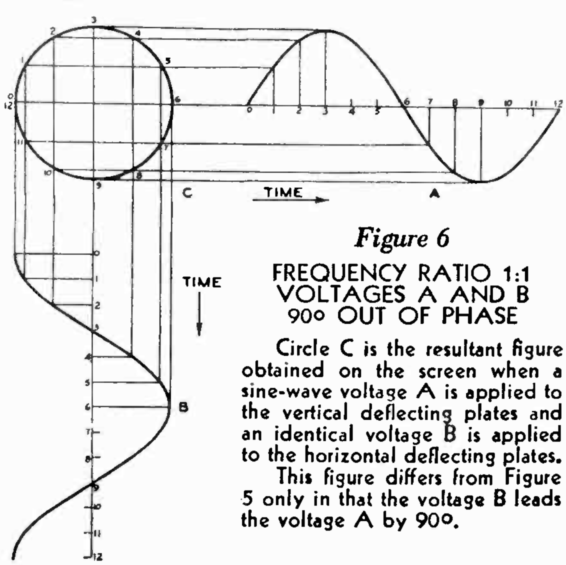


Figure 6

FREQUENCY RATIO 1:1
VOLTAGES A AND B
90° OUT OF PHASE

Circle C is the resultant figure obtained on the screen when a sine-wave voltage A is applied to the vertical deflecting plates and an identical voltage B is applied to the horizontal deflecting plates.

This figure differs from Figure 5 only in that the voltage B leads the voltage A by 90°.

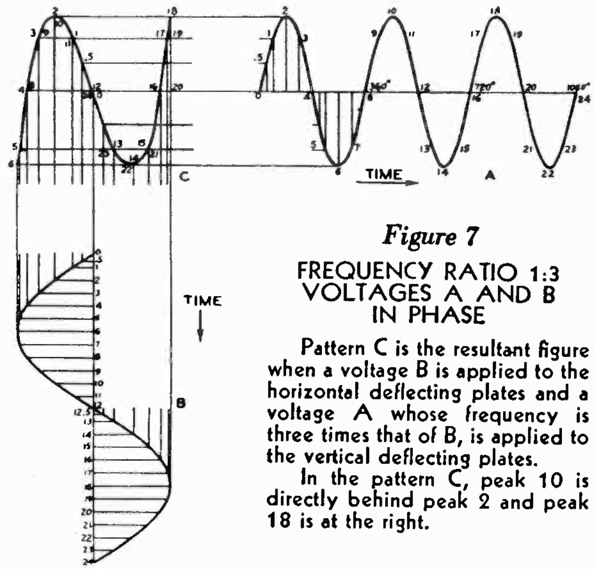


Figure 7

FREQUENCY RATIO 1:3
VOLTAGES A AND B
IN PHASE

Pattern C is the resultant figure when a voltage B is applied to the horizontal deflecting plates and a voltage A whose frequency is three times that of B, is applied to the vertical deflecting plates.

In the pattern C, peak 10 is directly behind peak 2 and peak 18 is at the right.

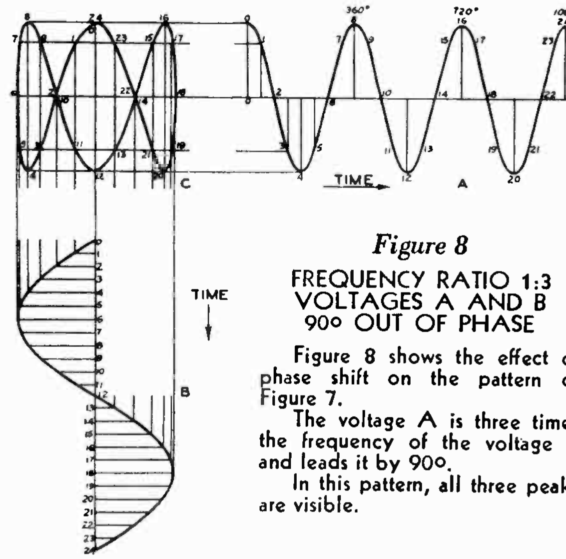


Figure 8

FREQUENCY RATIO 1:3
VOLTAGES A AND B
90° OUT OF PHASE

Figure 8 shows the effect of phase shift on the pattern of Figure 7.

The voltage A is three times the frequency of the voltage B and leads it by 90°.

In this pattern, all three peaks are visible.

are the voltages applied to the deflecting plates. In this case, the frequency of A is three times that of B. The resultant figure (C) shows a 1:3 pattern in which both voltages start in phase. Figure 8 is the same as Figure 7 except that voltage A is started 90 degrees out of phase with respect to voltage B. Figure 9C shows the resultant pattern obtained where B is a saw-tooth wave and A a sine wave. This is of interest because this type of wave form results when a linear timing axis is used. Figures 11, 12, and 13 show patterns of increasing complexity, Figure 13 being an 8:6 pattern.

When the cathode-ray oscillograph is used for calibration purposes, frequency ratios of less than 10:1 can be readily determined by visual inspection of the image. For frequency ratios greater than 10:1, the complexity of the pattern makes visual determination difficult and requires determination by means of photography. In general, the standard frequency selected should be one whose multiples and submultiples will cover the desired range and provide the simplest patterns.

In examining Lissajou's figures, one should consider them as the side view or elevation of a picture traced on a glass cylinder on which the observer may view the wave as it travels around the cylinder. The illusion is clearest when the whole figure rotates slowly. Figure 14 is a simple single-line pattern having a frequency ratio of 6:1. With a base frequency of 60 cycles, this pattern would be the picture for 360 cycles, or with a base frequency of 100 cycles, would be the picture of 600 cycles. The frequency ratio is determined by counting the peaks (six in number) of the waves in the horizontal plane and the

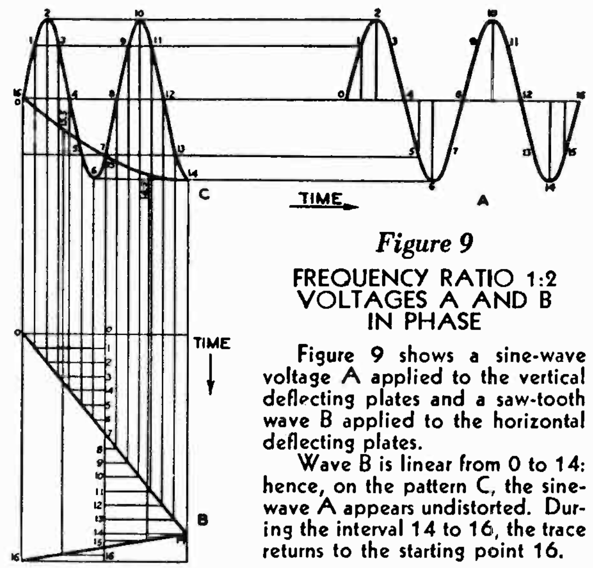


Figure 9

FREQUENCY RATIO 1:2
VOLTAGES A AND B
IN PHASE

Figure 9 shows a sine-wave voltage A applied to the vertical deflecting plates and a saw-tooth wave B applied to the horizontal deflecting plates.

Wave B is linear from 0 to 14: hence, on the pattern C, the sine-wave A appears undistorted. During the interval 14 to 16, the trace returns to the starting point 16.

number of end loops which for this case is one; hence, a frequency ratio of 6:1. In Figure 14, the front tracing has been made heavy and the back tracing light so that the two can be readily distinguished. If the figure were to be shifted slightly, the front and back waves might appear to be one. This condition might mislead the observer to believe that the frequency ratio was less than 6:1. Adjustment of the unknown frequency so that the pattern rotates very slowly, or stands still with the rear peaks uncovered by the front peaks, will make determination simplest.

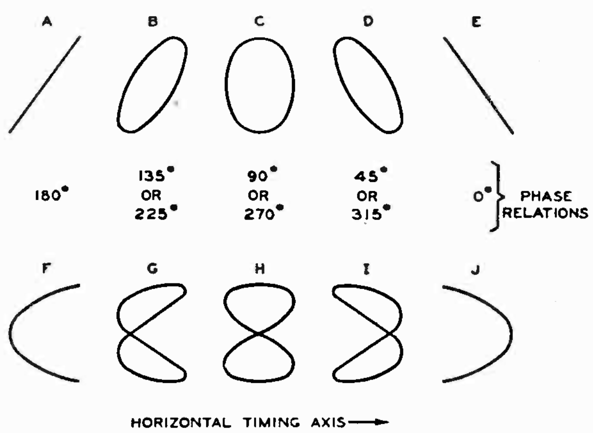
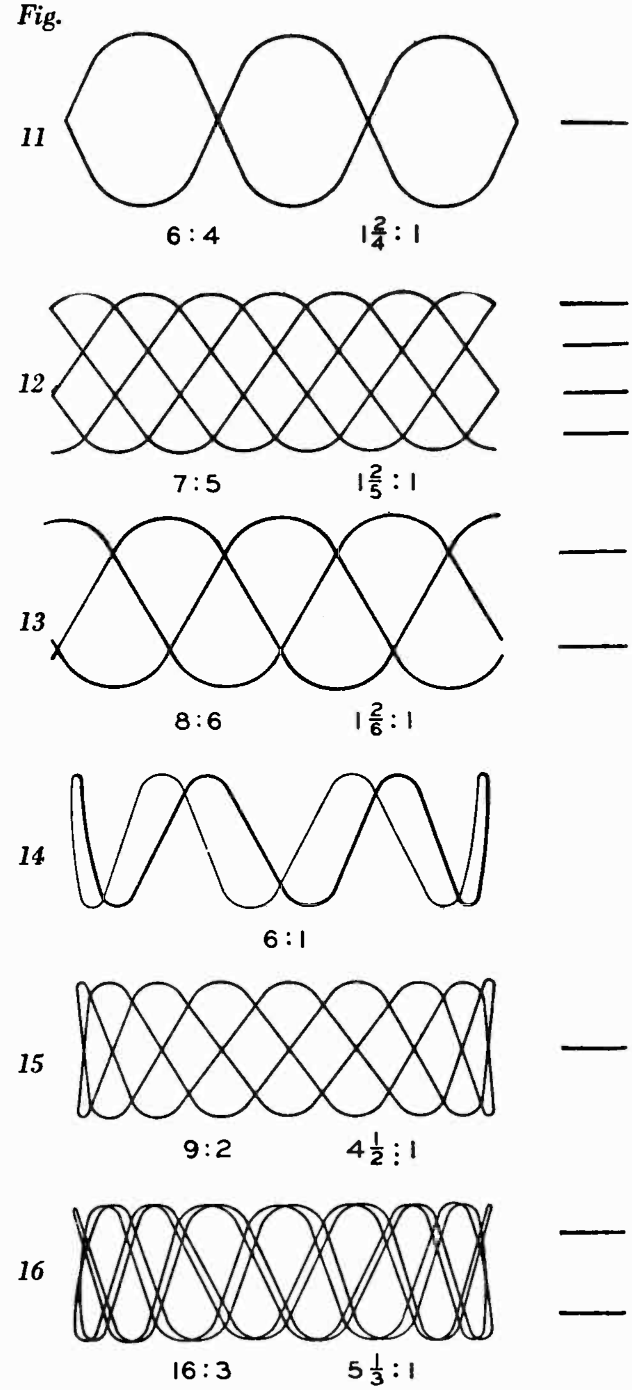


Figure 10

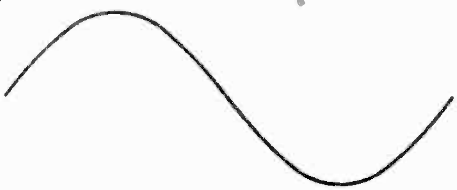
It will be observed that the wave form of Figure 14 corresponds to that of Figure 17,* a single-line pattern whose back trace is not visible. Figure 23 shows the simplest 2:1 wave or two-line figure. Figure 15 is a complete two-line figure illustrating a ratio of 9:2, which again, is readily determined by counting the number of peaks along the top of the figure and the number of loops at the end. Figure 16 has 16 peaks and is a three-line pattern, indicating a frequency ratio of 16:3.

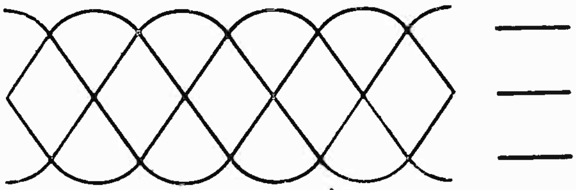
Fig.

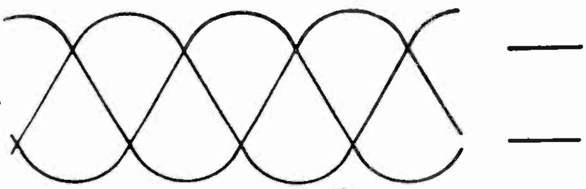


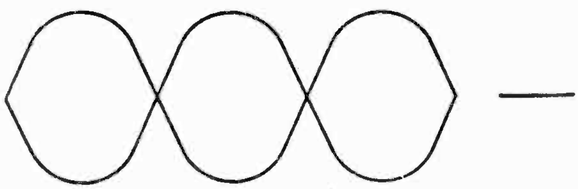
*Figures 17 to 25, inclusive, adapted from "The Cathode Ray Oscillograph in Radio Research," R. A. Watson Watt. Published by His Majesty's Stationery Office, London, England.

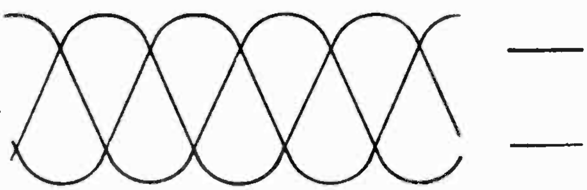
Fig.

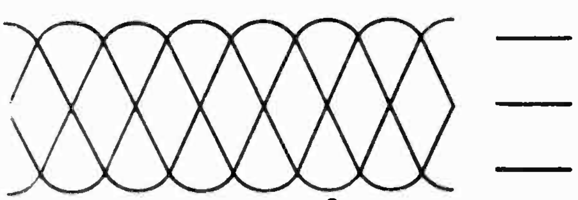
17 

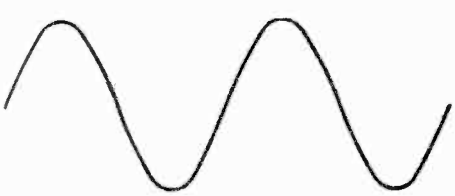
18 

19 

20 

21 

22 

23 

Figures 14, 15, and 16 illustrate patterns as they generally appear on the fluorescent screen. Figures 11 to 13, and 17 to 23 are shown as pictures whose appearance suggests that the pattern has been developed on a plane. They have been shown in this fashion to facilitate study.

An optional method for determination of the frequency ratio is that of comparing the number of peaks on a given figure with the horizontal lines of intersections on the figure instead of with the number of loops at the end of the figure. A study of some of the patterns will make this clear. In Figure 20, there is a single line of intersections along the axes of the figures. It can easily be seen that this is a two-line figure by comparing it with the single line Figures 17 and 23. Figures 16, 19, and 21 having two horizontal lines of intersections, each spaced approximately one-third from the top and bottom, are three-line patterns. In the same manner, the four-line patterns of Figures 11, 18, and 22 are distinguished by three lines of intersection, the five-line pattern of Figure 12 by four lines of intersection, and the six-line pattern of Figure 13 by five lines of intersection with characteristic positions for these lines in each case. Thus, the frequency ratio is also equal to the number of peaks on circumference divided by the term, one + number of horizontal lines of intersection.

Of the patterns from 5 to 23, those of Figures 17, 23 and 7 show simple ratios of 1:1, 2:1, and 3:1. Both these direct multiples and fractional multiples of the base frequency are available to the user of the cathode-ray oscillograph. For example, with a base frequency of 60 cycles, the following tabulation will serve to illustrate the sequence of relatively simple patterns obtained as the frequency of the variable unit is decreased from a 1:1 ratio of frequencies to a 3:1 ratio.

Frequency In Cycles-Sec.	Frequency Ratio* Whole Number	Fractional	Illustrated By Figure
60	1 : 1	1 : 1	17
75	5 : 4	1¼ : 1	18
80	4 : 3	1⅓ : 1	19
90	3 : 2	1½ : 1	20
100	5 : 3	1⅔ : 1	21
105	7 : 4	1¾ : 1	22
120	2 : 1	2 : 1	23
135	9 : 4	2¼ : 1	—
140	7 : 3	2⅓ : 1	—
150	5 : 2	2½ : 1	—
160	8 : 3	2⅔ : 1	—
165	11 : 4	2¾ : 1	—
180	3 : 1	3 : 1	7

*The frequency ratio is expressed either as a ratio of two integers, the first of which represents the number of peaks and the second the number of lines in the patterns, or as a ratio of a whole number and a fraction to unity. The denominator of the fraction is equal to the number of lines in the figure.

If the base frequency is 1000 cycles instead of 60, the same ratios hold. Thus, instead of 60 to 180 cycles, the frequencies for these patterns would be those for 1000 to 3000 cycles with intermediate values of 1250, 1333⅓, 1500, 1666⅔, 1750 cycles, 2000 cycles, 2250 cycles, 2333⅓ cycles, 2666⅔ cycles, and 2750 cycles.

When waves having frequency ratios greater than 10:1 are compared, accurate determinations may be difficult with the front and back portions of the figures in the same horizontal plane. To separate the back and front portions, the figures can be displaced to show either on an ellipse or a circle.

For an ellipse, a phase-splitting device as shown in Figure 28 is employed. Resistance (R_1) is connected across one set of deflecting plates and capacitance (C) is connected across the other pair. With R_2 at maximum resistance the phase shift is almost 90 degrees. As R_2 is decreased, the phase shift decreases. Figures 24 and 25 show the same single-line pattern and were obtained by adjusting the circuit of Figure 28 for different vertical amplitudes. Figure 26 is a two-line pattern having a frequency ratio of 31:2. The frequency ratio of this figure would be much more difficult to determine without displacement.

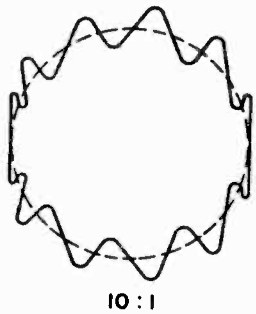


Figure 24

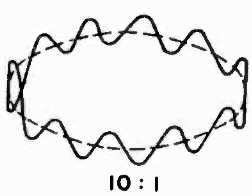


Figure 25

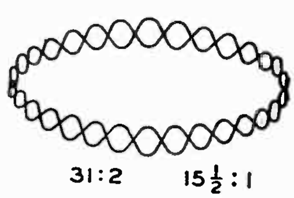


Figure 26

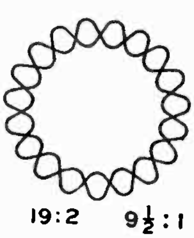


Figure 27

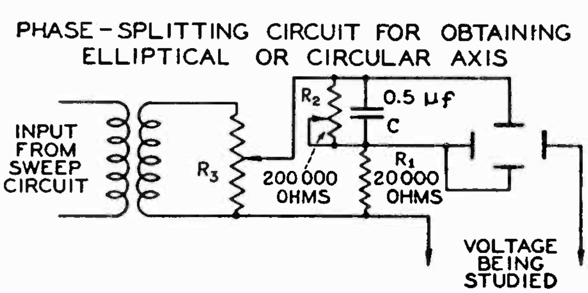


Figure 28

To produce the type of pattern shown in Figure 27, a circular axis is developed using the circuit of Figure 28, with the exception that the voltage under study is introduced in series with anode No. 2. It will be found that the peaks on this type of pattern will be somewhat blurred due to the defocusing effect caused by introduction of the voltage under study into the anode No. 2 circuit. Defocusing can be minimized by keeping this voltage at a low amplitude.

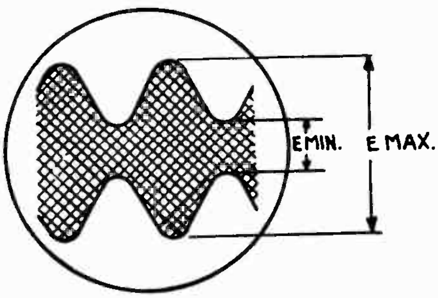
It was pointed out that the patterns of Figures 11 to 13, and 17 to 23 are developed on a plane. The resulting patterns are much simpler than they would be with their normal appearance because the back wave has been removed by spreading it out in the same plane with the front wave. The advantages of this simplified appearance can be obtained in practice by total elimination of the back wave. Where there is some doubt as to the number of lines in a pattern because of the presence of the additional lines of intersections observed in the back wave, this method will be of considerable assistance. Figure 15, for instance, is a two-line pattern, as is shown by the two loops at the end of the figure. However, because of the shift of the figure, the intersection made by the lines of the back wave with the lines of the front wave give it the same appearance as the five-line pattern of Figure 12. To eliminate the back wave, voltage of the same frequency as that used for the spreader, but 90 degrees out of phase, is applied to the control grid of the cathode-ray tube. Adjustment of this voltage will permit weakening the back wave and brightening the front wave, or the total elimination of the back wave.

General Applications

The most universal method of employing a cathode-ray tube is to impress the voltage to be observed on the vertical deflecting plates and to impress a voltage varying linearly with time on the horizontal axis. The latter voltage is usually obtained from an oscillator having a "saw-tooth" characteristic, as in Figure 32B. The true wave form of the signal on the vertical axis can then be observed without distortion, since none is introduced by the horizontal signal source. The conventional procedure when observing recurrent phenomena is to operate the timing axis supply at a sub-multiple of the observed frequency, so that several complete cycles will appear on the screen. Since the image will drift across the screen unless the ratio of the two frequencies remains constant and of a certain value, it is usually desirable to synchronize the timing axis oscillator. For the observation of transient phenomena the timing axis supply frequency is, of course, not critical and synchronizing is often useless. In some cases, however, it is desirable to synchronize the start of the phenomenon with a timing axis impulse.

Although use of a linear timing axis is fairly general, there are quite a few applications of the tube which do not employ one. From the table on page 8 it can be seen that if a sine-wave source of known frequency is impressed on one axis, a variable-frequency source can be impressed on the other axis and calibrated at a number of points other than the known frequency. The phase shift in an electrical device can be observed by impressing the input on one axis and the output on the other axis. If there is 0 or 180-degree phase displacement in the unit, a sloping straight-line image will appear. Refer to Figure 10 (A to E). If the above electrical device happened to be a frequency doubler, Figures 10F to 10J would apply.

Either set of deflecting plates can be used as a peak voltmeter. The impedance can be made very high, and the input capacitance very low, so that the voltmeter will show no discrimination between d-c



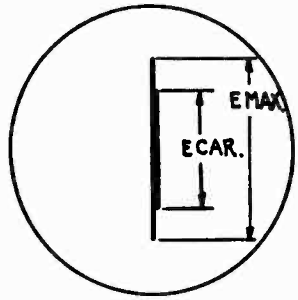
R. F. Modulated at 1000 Cycles
Timing Axis Supply: 500-Cycle Saw-Tooth

$$\text{Percent Modulation} = \frac{\text{EMax.} - \text{EMin.}}{\text{EMax.} + \text{EMin.}} \times 100$$

Figure 29

and reasonably high radio frequencies. Transients can be observed almost as effectively with a sine-wave timing axis supply as with a linear one, as in this case the supply functions purely as a "spreader."

In order to illustrate the flexibility of such apparatus, a desired measurement will be assumed and several methods of obtaining the unknown quantity outlined. An r-f oscillator is being modulated an unknown amount with a 1000-cycle tone, and it is desired to determine the percentage modulation. One method is to observe the modulated r-f envelope by impressing either a sine-wave or linear supply on the horizontal axis and impressing the modulated r-f signal on the vertical axis. Figure 29 shows this method graphically. Incidentally, if a linear timing axis is used, as shown, the true wave-shape of the envelope will appear, and an appreciable lack of symmetry or other irregularities will be immediately apparent, indicating distortion. If no timing axis voltage is used, the percentage can be determined as shown at Figure 30. This obviously necessitates removal of modulation. A third method is shown at Figure 31. The 1000-cycle audio voltage which is modulating the r-f signal is impressed on the horizontal axis (modulated r-f remains on vertical). A trapezoid results which allows ready measurement of the peak deflections. Symmetry of modulation can be checked with methods of Figures 29 or 31 by removing modulation from the r-f oscillator and noting whether the carrier height is mid-way between the positive and negative audio heights.

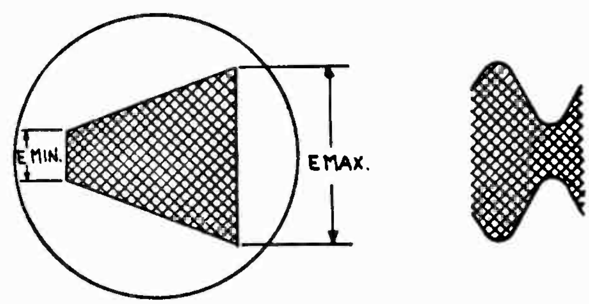


Timing Axis Supply—None

$$\text{Percent Modulation} = \frac{\text{EMax.} - \text{ECar.}}{\text{ECar.}} \times 100$$

Figure 30

Another application of the cathode-ray tube is as a "visual" or curve-tracing device. This consists of an r-f oscillator being varied at an audio rate between two extremes of frequency, a means of displacing the indicating device horizontally in synchronism with the change of radio frequency, and a means of obtaining vertical deflection of the indicating device proportional to the output of the unit whose performance is to be observed. Usually, a condenser is arranged so that it "sweeps" the frequency of the r-f (test) oscillator continually, and at the same time an impulse generator, driven in synchronism with the "sweep" condenser varies an oscillator providing horizontal displacement of the indicating device in synchronism with the "sweep" condenser. Perhaps the greatest use of such a device is for the alignment of the intermediate frequency stages of superheterodyne receivers. A frequency-response curve of the circuit under test is continually before the aligner,

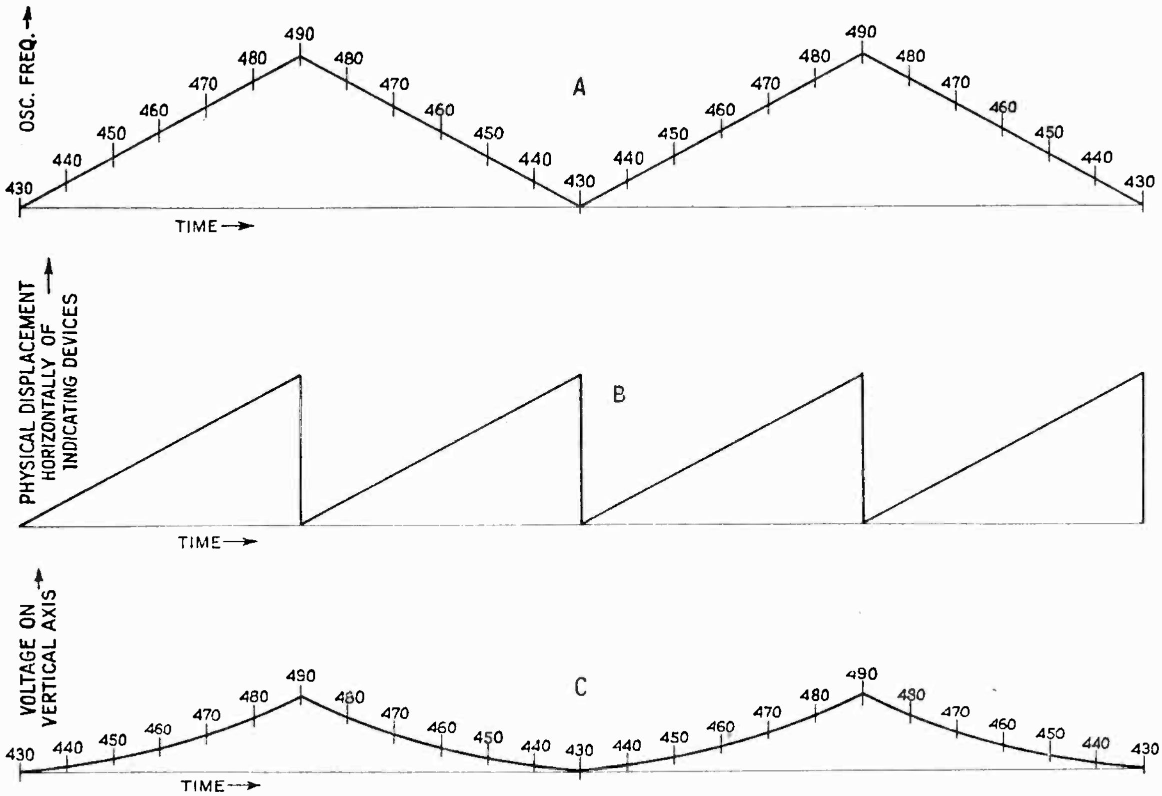


Timing Axis Supply—The Modulating Signal

$$\text{Percent Modulation} = \frac{\text{EMax.} - \text{EMin.}}{\text{EMax.} + \text{EMin.}} \times 100$$

Figure 31

which allows rapid and very accurate adjustment of the stage in question. The greatest advantage from such a system is realized when the circuit to be aligned has sufficiently greater than critical coupling



NOTE: C is the resultant curve when the signal of A is fed into a circuit with characteristics of D. With signal B on the horizontal plates and C on the vertical plates, E is the resultant image on the screen.

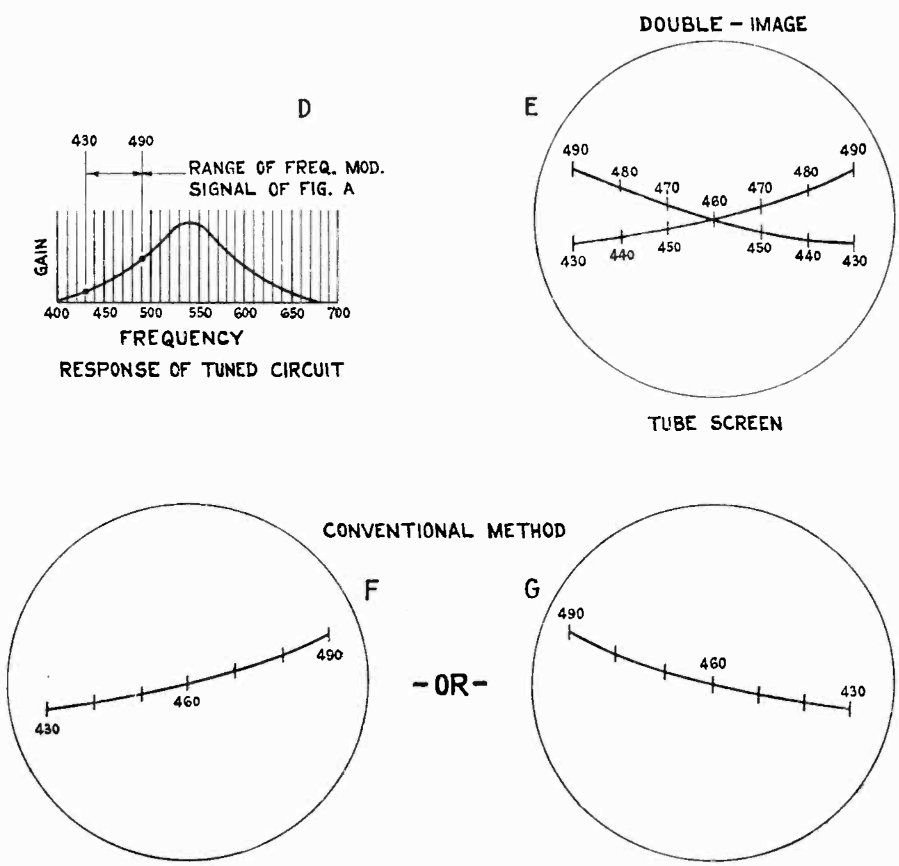


Figure 32

to give a flat-topped or double-peaked response. The same result can eventually be obtained by manually plotting a curve each time an adjustment on the unknown is made. However, this latter method is very laborious and requires considerable time.

A rather new development in such "visual" equipment has been made. The system dispenses with the conventional electrical or mechanical shutter and instead of employing one series of curves corresponding to a sweep through the r-f range in one direction, it employs two series of curves, one corresponding to an r-f sweep in one direction, and the other to an r-f sweep in the reverse direction. In other words, two curves (except in one case to be described later), appear on the screen, and the side of the screen which represents high frequency on one curve represents low frequency on the other. If on the first, third, fifth, ..."saw-tooth" pulses the left side of the

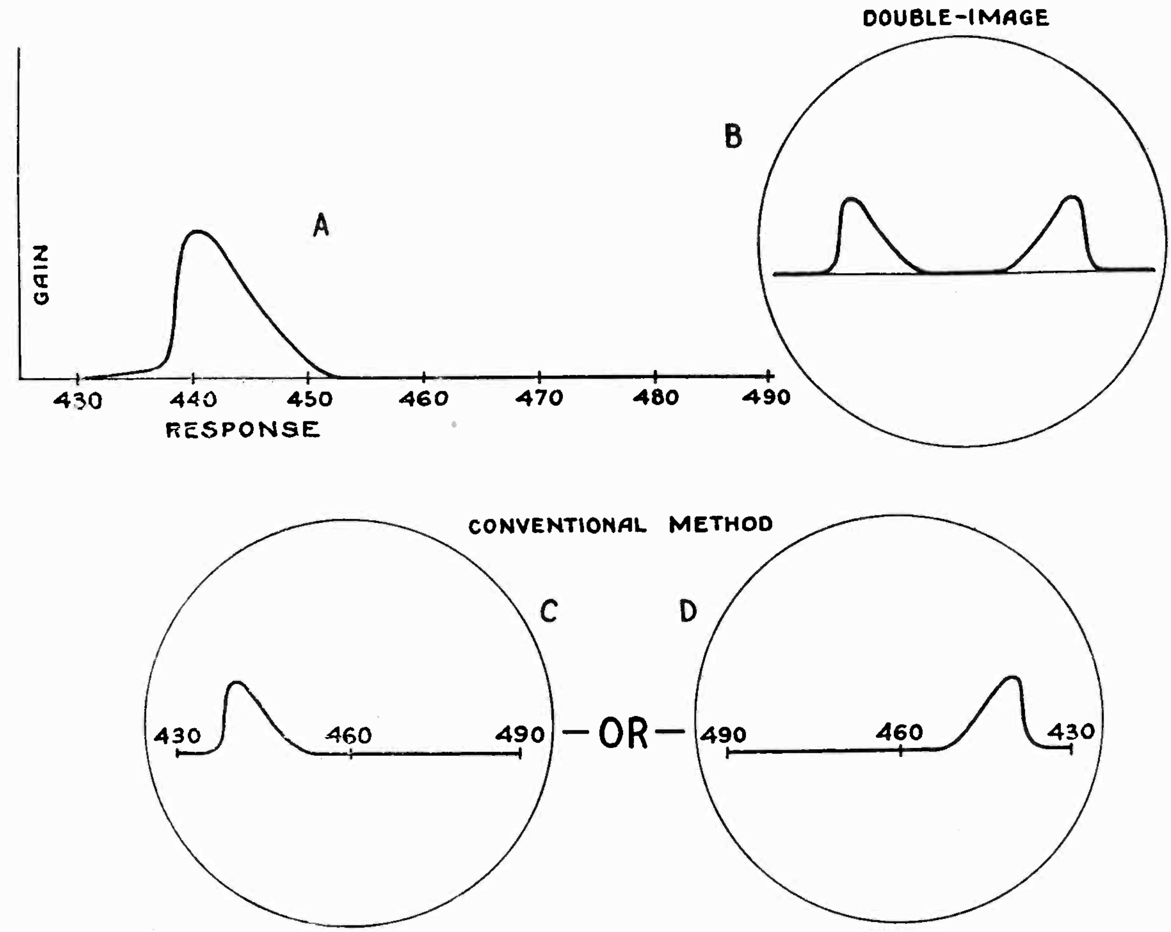


Figure 33

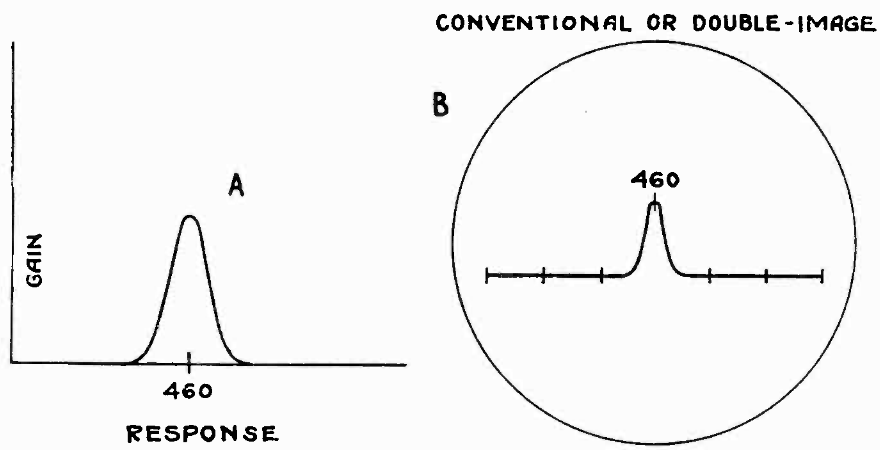


Figure 34

screen represents low frequency, then on the second, fourth, sixth .... pulses the left side represents high frequency. There is only one point on the screen which represents the same frequency on alternate "saw-tooth" pulses. This point is the calibration point; it is also the point at which equal capacity is obtained on the sweep condenser at two points 180 degrees apart. All other points on the screen represent two frequencies, one above and one below the "periodic" frequency. The term "periodic frequency" is used to designate the frequency of the oscillator when the sweep condenser is set at the point at which equal capacity would be obtained if the condenser were rotated 180 degrees. Since the condenser rotates at constant speed, this value of capacity is the only one which occurs at equal time intervals (other than the two extreme values, which repeat themselves half as frequently) and hence is termed the "periodic" capacity. The corresponding frequency is the periodic frequency, and, of course, is dependent upon the value of the periodic capacity and upon the remainder of the oscillator circuit. The value of periodic capacity is determined by the physical construction of the sweep condenser, and in a straight-line-capacity condenser with low minimum is close to half maximum capacity. It is a fixed value for a given condenser and will be affected only by physical change of the condenser.

Figure 32A shows a curve of oscillator frequency against time, demonstrating how the oscillator is periodically increasing and decreasing in frequency. Figure 32B shows the horizontal displacement of the indicating device. In the string galvanometer oscillograph this is accomplished by the rotation of the mirror; in the cathode-ray tube oscillograph by the action of the "saw-tooth" oscillator output on the pair of horizontal deflecting plates. Figure 32D shows the frequency response of a tuned circuit (very broad, for illustration). Figures 32F and 32G show how it may look with conventional method, Figure 32E with "double-image" method. (For explanation of Figure 32C, see note under diagram.)

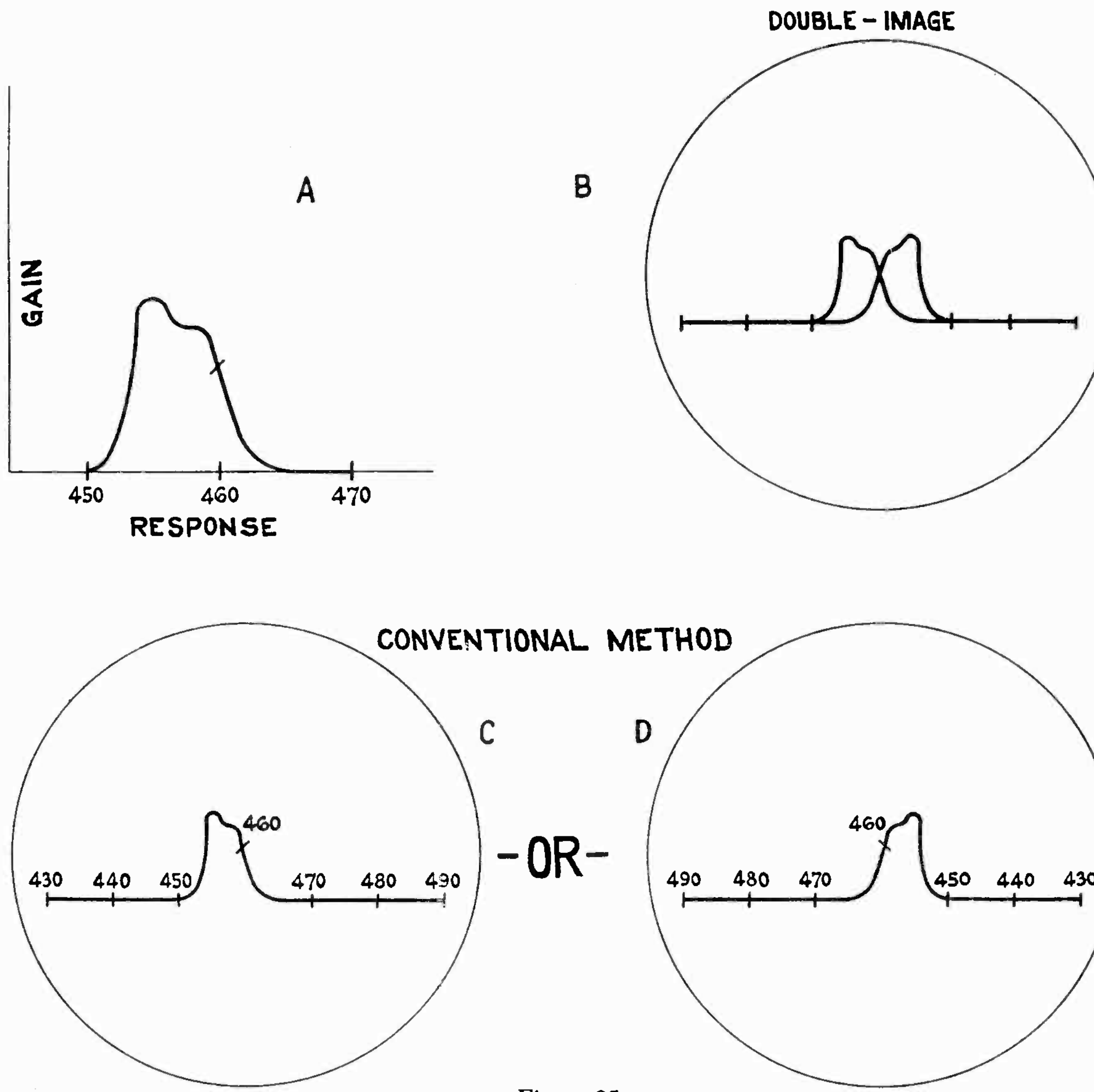
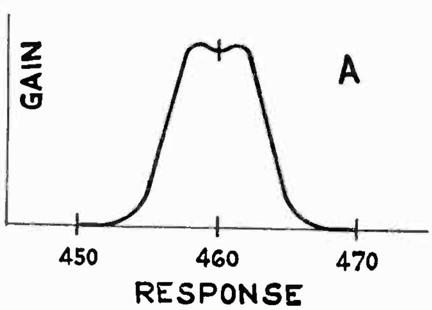


Figure 35

In Figure 33A is shown the response of an asymmetrical circuit resonant about 20 KC below the "periodic" frequency. Figures 33B, C and D show screen images obtained. Figure 34A shows response of a symmetrical circuit resonant at exactly the "periodic" frequency. In this case, Figure 34B, the image seen with the two systems is identical, for with the "double-image" method the two curves coincide and resolve into a single curve. Figure 35A gives response of a closely coupled transformer, slightly asymmetrical, and about 4 KC below the periodic frequency. Figure 36A shows response of a closely coupled transformer, symmetrically aligned at the periodic frequency. Here again the two curves of the "double-image" method resolve into a single image. The only difference between 34A and 36A is in selectivity, 34A representing a sharp and 36A a relatively broad circuit.

The chief advantages of the "double-image" over the conventional method are:

1. The superposition or "folding back" of the high and low-frequency sides makes symmetrical adjustments easy and very accurate.
2. The probability of frequency error in aligning is reduced to less than half. For a given frequency error the separation between the two curves of the "double-image" method is twice the displacement of the one curve of the conventional method. Also any small error is much more obvious with two images on the screen.



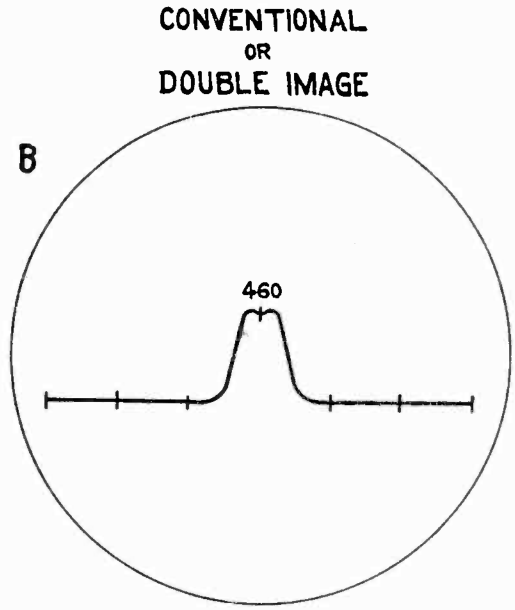


Figure 36

3. The necessity of employing an electrical or mechanical shutter is eliminated.
4. Distortion in the detector or audio amplifier does not cause error in aligning. If appreciable audio distortion is present, the images on the screen will not be true response curves of the tuned circuit. Nevertheless, the actual response is still truly symmetrical when the two curves are made to completely coincide.
5. The necessity of marking a vertical reference line on the screen for use in frequency calibration and alignment is avoided.
6. The advantage (4) above further allows frequency calibration of the variable frequency oscillator by zero-beating with a standard-frequency oscillator, *without* regard to displacement of the curve by any audio distortion.

Alignment of the radio frequency stages of receivers can be made using the same method discussed above for i-f alignment. The single-frequency source and output meter method may be used, if desired, but from the standpoint of demonstrating the performance of the r-f stages or explaining their operation, the oscillographic method is preferable.

Another type of visual, commonly known as a "universal" type, has as its primary function the measurement of capacity and inductance. Fundamentally it is the same as the visual described above for aligning i-f stages, but the i-f stage, instead of being the part under test, is permanently incorporated in the equipment. In other words, the output of the r-f oscillator, instead of feeding the grid of an i-f tube, is coupled to a tuned tank circuit which is across the grid circuit of a detector tube. Parts are tested by comparing the resonant frequency of this tank circuit with a part of known characteristics to the resonant frequency with a part of unknown values. (In either case the part forms a portion of the tank circuit.) The universal visual is chiefly applicable for quantity testing of coils and condensers. Very rapid testing can be done, as there is only the necessity of connecting the part to be tested and observing the position of the curve on the screen. Small fixed condensers have been tested manually as rapidly as 2,000 per hour on equipment of this type, though this is somewhat above average. The visual also has the advantage of affording a test at any radio frequency, so that difficulties from skin effect, distributed capacity and inductance can be greatly lessened by employing a frequency at or near the one the part will be subjected to in use.

The "double-image" method has a minor disadvantage when applied to the universal visual whenever it is desired to segregate the high and low rejects. No distinction can be made between them by merely observing the screen. However, by adding a small increment of inductance or capacity and

CATHODE-RAY OSCILLOGRAPH

TYPE TMV-122-B

POSITION OF CONTROLS FOR VARIOUS APPLICATIONS

No.	APPLICATION OR DEMONSTRATION	SWITCH POSITIONS				CONTROLS						APPLIED VOLTAGES			REMARKS	
		Ampl. A	Ampl. B	Synchronizing	Range	Intensity	Focus	Freq.	Ampl. A Gain	Ampl. B Gain	Sync.	"A" Bdg. Posts (Vertical)	"B" Bdg. Posts (Horizontal)	"Ext. Sync." Bdg. Posts		
1	FIRST OBTAINING SPOT	Off	Off	*	*	First clockwise rotation closes power switch	Adjust for maximum concentration of electron beam (smallest line or spot) after setting for desired intensity	*	*	*	*	None	None	None	Do not burn screen; adjust the two beam shift controls to center spot on screen.	Preliminary Adjustments
2	LOCATING TUBE POSITION	Off	Timing	Ext.	**	Adjust for desired brilliancy of image		**	*	Set for line about 2" long	*	None	None	None	Rotate cathode-ray tube so line is exactly horizontal.	
3	APPLYING VERTICAL DEFLECTING VOLTAGE	On	Off	*	*	Remember tube screen can be burned		*	Vary	*	*	60 cycle supply between 2 and 150 volts	None	None	Elementary Demonstration	
4	APPLYING HORIZONTAL DEFLECTING VOLTAGE	Off	On	*	*			*	*	Vary	*	None	60 cycle supply between 2 and 150 volts	None	Elementary Demonstration	
5	APPLYING DEFLECTING VOLTAGE ON BOTH AXES	On	On	*	*			*	Vary	Vary	*	60 cycle as above	60 cycle supply as above	None	Guard against shorting 60 cycle supply; all "O" binding posts are common.	
6	AC VOLTMETER WITHOUT AMPLIFIER	Off	Off	*	*			*	*	*	*	Voltage to be measured	None	None	Set up is same for calibrating; use substitution method.	
7	AC VOLTMETER WITH AMPLIFIER	On	Off	*	*			*	Max. or other calibrated point	*	*	Voltage to be measured	None	None	Set up is same for calibrating; use substitution method.	
8	OBSERVING WAVE-SHAPE OF AUDIO VOLTAGE	On	Timing	Int.	Depends on freq. of observed audio			Depends on freq. of observed audio	For desired amplitude	For desired spread	Just enough to lock image	Voltage to be observed	None	None	Probably greatest application.	
9	OBSERVING WAVE-SHAPE OF RADIO-FREQUENCY VOLTAGE	Off	Timing	Ext.	Depends on freq. of modulating audio			Depends on freq. of modulating audio	*	For desired spread	Just enough to lock image	Voltage to be observed (50 volts or more)	None	1 volt or more of audio from modulator	If frequency is less than 100 KC, Ampl. A can be used.	
10	MEASURING PERCENTAGE OF MODULATION	Off	Timing	Ext.	Depends on freq. of modulating audio			Depends on freq. of modulating audio	*	For desired spread	Just enough to lock image	Voltage to be observed	None	1 volt or more of audio from modulator	Wave-shape method.	
11	MEASURING PERCENTAGE OF MODULATION	Off	On	*	Depends on freq. of modulating audio			*	*	For desired spread at 100% mod.	*	Voltage to be observed	2 volts or more of audio from the modulator	None	Trapezoid method.	
12	"VISUAL," I. E., RF CURVE TRACING	On	Timing	Ext.	Tap "2"			For about 51 cycles	For desired amplitude	For desired spread	Just enough to lock image	Audio output of chassis 2nd detector	None	Bdg. posts on TMV-128-A Freq. Mod.	Output of TMV-97 impressed in grid circuit of tube preceding stage to be aligned. Cable connects TMV-97 and TMV-128-A	
13	CHECKING PHASE SHIFT OF AMPLIFIER	On	On	*	*			*	For desired vertical defl.	For desired horiz. defl.	*	2 volts or more of audio output of amp.	2 volts or more of audio input to amp.	None	Watch out for phase shift in internal amplifiers; if sufficient voltage is available do not use Ampl. A and B.	
14	FREQUENCY MEASUREMENT UP TO 100,000 CYCLES	On	Timing	Ext.	Depends on freq. desired			Depends on freq. desired	For desired vertical defl.	For desired horiz. defl.	Just enough to lock image	2 volts or more of signal freq. to be measured	None	1 volt or more of standard frequency	Saw-tooth oscillator in step at 1, ½, ⅓, etc. times standard frequency. For frequencies above 100,000 cycles use Lissajou figures; set up as 13 with standard voltage on "Ampl. B" binding posts, unknown on "A" posts.	

*Denotes position immaterial.
**Denotes frequency immaterial.

noting whether the two curves move closer together or farther apart, the direction from nominal of the part under test can be readily determined. Since this extra operation is necessary only in the case of a rejected part, normally it is not of much consequence.

In using cathode-ray tubes, quite often the voltage to be observed is not of sufficient value to give the desired amount of deflection. In this case a voltage amplifier is employed. The amplifier should have an essentially flat output over a sufficient frequency range to avoid appreciable distortion of the observed signal. For ordinary use it is not objectionable if the amplifier is non-linear above the sixth harmonic of the frequency of the observed voltage.

Installation

Unpack the instrument from the shipping container and remove the screws securing the front panel to the case. Withdraw the chassis from the case, supporting the panel at the bottom, and feeding the power cable through the hole in the back. Make certain that all tubes are firmly in their sockets and all grid cap connections are in place, then replace the chassis in the case and replace the securing screws. With "Intensity" control in extreme counter-clockwise position ("Off"), plug the power supply cable into an electrical outlet supplying 110–120 volt, 50–60 cycle alternating current. The instrument is then ready for operation.

NOTE: A safety switch is incorporated in the instrument, located at the rear of the chassis. This breaks the power supply connection when the chassis is withdrawn from the case. DO NOT ATTEMPT TO OPERATE THE EQUIPMENT WHEN WITHDRAWN FROM THE CASE AS THE HIGH POTENTIALS USED ARE DANGEROUS.

Operation

Controls

(Refer to the Schematic and Wiring Diagrams, Figures 37 and 38, for location of circuit units designated by symbols.)

1. "Intensity" control, R-17, is a potentiometer in low side of 1200-volt bleeder. Its position controls the bias on the grid of the cathode-ray tube, which in turn determines the quantity of electrons emanating from the "gun," thus controlling spot size. The power switch S_5 is located on this potentiometer. Initial clockwise rotation of this control turns on switch, additional rotation increases spot size.

2. "Focus" control, R-19, is a potentiometer in the 1200-volt bleeder. Its position controls the anode No. 1 voltage, which (with constant A_2 voltage) determines the distance at which the electron beam focuses. In general, for a given "Intensity" setting, the "Focus" control should be set for maximum distinctness of spot or image.

3. "Ampl. A" switch, S_1, connects the "Vertical" binding posts either straight through to the vertical deflecting plates on the cathode-ray tube or through an amplifier to these deflecting plates. In either case there is a condenser in the input circuit.

4. "Ampl. B" switch, S_2, has 3 positions: "Timing," "On," and "Off." On "Timing" the "saw-tooth" or timing axis oscillator feeds through an amplifier to the horizontal deflecting plates on the cathode-ray tube. When "On" the "Horizontal" binding posts are connected through an amplifier to these deflecting plates. When "Off" the binding posts are connected straight through to the deflecting plates. In either of the latter two cases there is a condenser in the input circuit.

5. "Ampl. A Gain" control (vertical), R_1, is a potentiometer on the input circuit of the vertical amplifier. With "Amplifier A" switch "On," this potentiometer controls the vertical deflection.

6. "Ampl. B Gain" control (horizontal), R_4, is a potentiometer on the input circuit of the horizontal amplifier. With "Amplifier B" switch on "Timing" or "On" this potentiometer controls the horizontal deflection.

7. "Range" switch, S_4, selects one of four timing capacitors and on alternate positions it places a resistor, R_{11}, in and out of the circuit. It thus changes the timing axis oscillator frequency in steps, giving 8 ranges as follows: No. 1, 20–37; No. 2, 37–120; No. 3, 120–205; No. 4, 205–700; No. 5, 700–1100; No. 6, 1100–3700; No. 7, 3700–5700, and No. 8, 5700–15000 cycles.

8. "Freq." control, R_{12}, is a rheostat in series with the timing condenser. It changes the timing axis oscillator frequency gradually as it is rotated, and in conjunction with "Range" switch above gives continuous range between the extremes of frequency (20–15,000 cycles).

9. "Sync." control, R_9, is a potentiometer controlling the amount of synchronizing voltage fed to the grid of the RCA-885 tube. In general it should be set as far counter-clockwise as is consistent with a locked image, as over-synchronization causes poor wave-form from the timing axis oscillator.

10. "Synchronizing" switch, S_3, has three positions, "Int.," "60 Cycle," and "Ext." On "Int." the voltage drop across resistor R_9 in the plate circuit of the vertical amplifier is fed through the "Sync." control and input transformer to the grid of the RCA-885 tube. Thus the timing axis oscillator can be synchronized with the signal on the vertical axis at fundamental frequency or any small sub-multiple, such as ½, ⅓ . . . . Synchronization is not effective if it is attempted to operate the timing axis oscillator at a higher frequency than that of the synchronizing voltage. On "60 Cycle," a 2.5 V. 60 cycle source is impressed across the "Sync." control, and can be used for locking the timing axis oscillator at 60, 30, or 20 cycles. On "Ext." the "Ext. Sync." binding

posts are connected across the "Sync." control. This allows the use of an external source for synchronizing.

11. On the right-hand side of the cabinet, toward the rear, there are two potentiometers slotted for screw-driver control. These potentiometers control the amount of d-c potential between the two deflecting plates of each pair, and thereby allow adjustment of the position of the spot or image. The rear potentiometer controls the horizontal deflection and the front one controls the vertical deflection.

12. There are three pairs of binding posts on the unit. Voltage impressed on the "Vertical" posts will give deflection vertically. Voltage impressed on the "Horizontal" posts will give deflection horizontally. The "Ext. Sync." posts are used when it is desired to synchronize the timing axis oscillator with some external source. (See [10] above.) The binding posts marked "O" are all common ground and the ones marked "HIGH" are insulated from ground, which is the chassis.

Applications

General. The following procedures are included in order to familiarize the operator with the operations and connections involved in the particular applications. All applications of the equipment are not described, but analysis of the particular problem involved will show wherein it is similar to or differs from those given, enabling the operator to work out his own sequence of operation.

As has been previously pointed out, most applications of this instrument are carried out with the output of the unit under test connected to the vertical plates of the cathode ray tube, and the wave shape studied by application of known constants on the horizontal plates of the tube. Before any measurements are attempted, the operator is urged to go through the following procedure in order to familiarize himself with the controls and their location and to get the "feel" of their operation:

1. Connect the power plug to an a-c source of 110 volts, 60 cycles. Turn "Intensity" control clockwise, causing a spot to appear on the screen, increasing in size as the "Intensity" control is advanced further clockwise. The "Focus" control should then be adjusted until maximum distinctness of spot or image occurs.

CAUTION. DO NOT ALLOW A SMALL SPOT OF HIGH BRILLIANCY TO REMAIN STATIONARY ON THE SCREEN FOR ANY LENGTH OF TIME, AS DISCOLORATION OR BURNING OF THE SCREEN WILL RESULT.

With the spot on the screen and with the "Intensity" control retarded so that the spot is not too brilliant, adjust the position of the spot to the center of the screen by rotation of the two screw-driver controls near the rear of the cabinet on the right-hand side. The control at the rear adjusts the spot horizontally and the one nearer the front adjusts the spot vertically. After initial adjustment, these controls will rarely require re-adjustment, except when the RCA-906 tube is replaced.

To turn the equipment off, turn "Intensity" control to its extreme counter-clockwise position, until a distinct "snap" is heard.

2. Apply a source of 60-cycle current to the "Vertical" binding posts. To adjust the length of the resultant line appearing on the screen turn "Ampl. A" switch "On" and adjust "Ampl. A Gain" control until the length is as desired. The line will be as shown in Figure 4L. Application of the same 60-cycle source to the "Horizontal" binding posts with "Ampl. B" switch "On" or "Off" will similarly show a horizontal line on the screen, the length of which may be varied (with "Ampl. B" switch "On") by manipulation of "Ampl. B Gain" control. See Figure 4K.

3. To expand (2) further, have 60 cycles available at both "Horizontal" and "Vertical" terminals.

CAUTION. Since all "Ground" or "O" binding posts on the Oscillograph are common, it is advisable to use an isolating transformer for one supply, so that there is no common connection between the two.

Apply the horizontal 60-cycle supply on the screen, preferably through "Ampl. B" and its gain control, then apply the 60-cycle vertical supply through "Ampl. A" and its gain control. The result will be a straight line. (See Figure 5 and explanation.)

AC Voltmeter without Amplifier—For this application, the characteristics of the unit are as follows: Input resistance—400,000 ohms, input capacity—approximately 10 mmf.; voltage range—150 volts (higher with external attenuator); calibration—approximately 75 peak volts per inch or 27 r-m-s volts per inch.

Procedure—Make connections to the Oscillograph and turn controls to the positions specified in Application No. 6 on the enclosed operating chart. Measure or estimate the length of line appearing on the screen in inches (depending on accuracy desired) and multiply by 75. This gives the approximate peak-to-peak value of the unknown voltage. For approximate effective value, if voltage being measured is sinusoidal, divide peak value by 2.8.

AC Voltmeter with Amplifier—For this application, the characteristics of the unit are as follows: Input resistance—500,000 ohms; input capacity—approximately 20 mmf.; frequency range—20–90,000 cycles; maximum voltage—700 volts (higher with external attenuator); calibration—(roughly) 2 peak volts per inch, or 0.7 r-m-s volts per inch.

Procedure—Make connections and adjust controls according to Application No. 7 on the chart. With "Ampl. A Gain" control in the extreme clockwise position a line one inch long is obtained on the screen for about 2 volts peak input. Intermediate positions of the gain control give different calibrations, of course, and if considerable use is made of this feature it may be advisable to plot a curve of the inputs required to give a one-inch deflection at various intermediate positions of the gain control. If working at a frequency above 10,000 cycles, it must be remembered that retarding the gain control from maximum destroys the linearity of the amplifier.

A particular application of operation as an a-c voltmeter is in making hum measurements in a power supply unit. In this case the "O" binding post ("Vertical") is connected to the common lead of the filter circuit of the unit under test and a clip lead, connected to the "High" binding post, is used to check the a-c ripple present at the various circuit component terminals.

AC Ammeter with Amplifier—For this application, the unit is used as an a-c voltmeter with an external shunt. The range with a one-megohm shunt is, roughly, 1–2100 microamperes, and the audio frequency impedance is about 330,000 ohms; with a 1000-ohm shunt the range is, roughly, 0.3–700 milliamperes.

Procedure—The Oscillograph should be connected as for the a-c voltmeter with amplifier, except the circuit with the unknown current should be connected to the "Vertical" binding posts across an external shunt of 1000 ohms or one megohm, depending on the amplitude of the current. Variation of the "Ampl. A Gain" control will adjust the length of line appearing on the screen. As when used as an a-c voltmeter, it may be advantageous to plot a curve of inputs vs. gain control settings for one-inch deflection on the screen in order to obtain the values of unknown currents more quickly.

Audio Quality Measurements — Use of the "saw-tooth oscillator" feature of the Oscillograph provides a check which cannot be made with an ordinary voltmeter. This is extremely helpful in discovering the audio quality of a receiver or similar instrument and also in locating causes of audio distortion.

Procedure—Apply the output from a constant frequency record or audio oscillator to the "Vertical" binding posts, with controls set as in Application No. 8. Turn "Range" switch to that tap giving a range including the frequency of the input signal and adjust "Freq." control until the saw-tooth oscillator frequency is near that of the input signal. If the two frequencies are identical, one cycle of the input signal will be observed on the screen; if the saw-tooth oscillator frequency is one-half that of the input signal, two cycles of the latter will appear; if one-third, three cycles; etc. Next, connect this constant frequency record or audio oscillator output to the audio input of the unit under test and connect the output of the unit under test to the "Vertical" binding posts of the Oscillograph, all adjustments of which are as previously set. If the resultant wave does not correspond to that obtained when the input was direct to the Oscillograph, audio distortion is present.

If it is desired to measure the overall audio fidelity of a receiver, for instance, the procedure is similar to that above except that the voltage modulating an r-f oscillator is fed into the Oscillograph, adjusted as above. Then the modulated oscillator is connected to the r-f input terminals of the receiver and the loudspeaker voice coil connected to the Oscillograph. Comparison of the two resultant waves will indicate how much distortion occurs in the receiver under test. Observing the quality of the input to the receiver from the test oscillator will also show how much distortion is being fed into the receiver from the test oscillator. This is desirable, since it may show that all the distortion present in the receiver output may not be due to the receiver characteristics, but to those of the test oscillator (assuming no distortion from modulation).

Modulation Indicator — (1) One method of measuring the modulation of a transmitter is to place the modulated r-f output of the transmitter into the vertical plates of the cathode ray tube and the audio input signal to the transmitter on the horizontal plates of the tube through the synchronous circuit.

Procedure—Connect a constant frequency input to the transmitter and connect a small pickup coil, located near the transmitter tank coil, to the "Vertical" binding posts. The pickup on this coil should be from 50–75 volts. Connect the "Ext. Synch." binding posts of the Oscillograph to transmitter audio amplifier at a point providing a 2–4-volt signal. Turn controls to positions given in Application No. 10 on the chart. Turn "Range" switch to tap including the frequency of the input signal and adjust "Freq." control until the saw-tooth oscillator interlocks with the signal on the vertical plates. Adjustment of the "Sync." control provides control of the voltage from the pick-up coil to the grid of the RCA-885 tube. Adjustment of "Ampl. B Gain" control varies the horizontal deflection.

(2) Another, somewhat similar, method of modulation measurement is to connect the pickup coil to the "Vertical" binding posts as before, but connect the audio signal (from the transmitter audio amplifier) to the "Horizontal" binding posts. Turn controls to positions given in the chart for Application No. 11. Adjust "Ampl. B Gain" control until desired horizontal deflection is obtained. The percentage modulation can then be readily determined. See Figure 31.

Alignment of Intermediate Frequency Stages—For alignment of the intermediate frequency stages of a receiver it is essential that an auxiliary apparatus be available to sweep the intermediate frequency for which the receiver is designed. The Type TMV-128-A Frequency Modulator is designed for this use. It consists of sweep condenser and a synchronizing generator rotated in synchronism by a driving motor. The condenser is arranged to "sweep" the frequency of the r-f input to the receiver (or i-f stages) and the synchronizing generator connects to the "Sync." binding posts of the Oscillograph so as to synchronize the saw-tooth oscillator with the frequency variation of the test oscillator (such as the TMV-97-C) input to the receiver. A switch on the panel of the Modulator provides two ranges of capacity for "sweeping" the test oscillator output frequency; on "Hi" the range is 20–65 mmf., and on "Lo" the range is 15–35 mmf.

The test oscillator output should be coupled to the grid of the tube preceding the i-f stage under alignment. It is essential that this connection be made without altering any of the operating characteristics of this stage. If the grid of the tube to which connection is to be made is at zero d-c potential with respect to ground, connect the oscillator to the grid of the tube and disconnect the lead normally on the grid, the low side of the test oscillator output returning to chassis ground. If the grid is not at zero d-c potential with respect to ground, connect the high side of the oscillator to the grid (disconnecting the lead on the grid) and the other side to the "—C" lead for this grid.

The "Vertical" binding posts of the Oscillograph should be connected to the audio output of the second detector. For a diode detector this connection may be across the volume control alone or across both the volume control and automatic volume control resistor, if this connection is convenient. When the second detector is a triode, tetrode or pentode, resistance-coupled to the first audio stage, the connection to the "High" binding post may be to the plate of the tube, the "O" post being connected to ground. In the case of a triode, tetrode or pentode, transformer or impedance-coupled to the first audio stage, connect a resistor of approximately 20,000 ohms in series with the plate of the tube and by-pass the inductance in the plate circuit by a 1.0 mfd. or larger capacitor. This changes the impedance of the plate circuit to resistance rather than inductive reactance; the "High" binding post should be connected to the plate of the tube and the "O" post to ground in order to take the audio voltage off this resistor.

Procedure—Connect the test oscillator output to the grid of the tube preceding the i-f transformer being aligned, and connect the "Vertical" binding posts in the second detector as previously explained. The test oscillator should be set at the i-f alignment frequency with modulation "On." Turn Intensity-control "On," adjust "Focus" properly, turn "Ampl. A" switch "On" and adjust the gain control. Turn "Ampl. B" switch on "Timing," turn "Synchronizing" switch to "Int.," adjust "Range" switch to include the frequency of the modulating audio signal. Adjust "Ampl. B Gain" control and set "Freq." control to interlock the signal. Adjust the i-f transformer trimmers for maximum output, *i. e.*, peak them as much as possible. Remove the modulation on the test oscillator, connect the sweep condenser to the r-f oscillator and connect the synchronizing generator to the "Ext. Sync." binding post. Turn motor "On." Turn "Synchronizing" switch to "Ext." and readjust the frequency of the test oscillator until the forward and reverse waves show on the screen of the tube. Raise the frequency of the test oscillator until the highest points of the two waves coincide. See Figure 10. (This readjustment is necessary to compensate for the added capacity of the cable and one-half of the sweep condenser capacity.) Record the dial setting of the oscillator for future reference. Adjust the trimmer condensers of the primary and secondary of the i-f transformer until the two curves coincide throughout their entire length. When this occurs, the stage is symmetrical with respect to the i-f frequency. During i-f alignment, the receiver tuning dial should be set at a point where variation of its position has no effect on the resultant curve. If this point cannot be found, short-circuit the grid or plate coil of the receiver r-f oscillator. The i-f stages should be aligned in order, starting at the last stage and working toward the first detector.

Alignment of Radio Frequency Stages—The equipment used for r-f alignment is identical to that for i-f alignment, except that the test oscillator output is connected to the antenna lead of the receiver.

Procedure—Set the test oscillator at the r-f alignment frequency of the receiver and set the receiving tuning dial at this same frequency. Connect the second detector to the "Vertical" binding posts and turn the test oscillator "On" with modulation "On." Turn "Intensity" control "On" and adjust the "Focus" control; turn "Ampl. B" switch to "Timing," "Synchronizing" switch to "Int.," "Range" switch to cover the r-f signal, "Ampl. A" switch "On," adjust "Ampl. A and B Gain" controls properly, with the test oscillator disconnected from the sweeping capacitor. Adjust the oscillator and r-f trimmers of the receiver until maximum possible output is obtained. Turn modulation of test oscillator "Off," connect sweep condenser to test oscillator and synchronous generator to "Sync." binding posts of the Oscillograph, turn "Synchronizing" switch to "Ext." Adjust the test oscillator tuning until two curves show on the screen and readjust the oscillator tuning until the two curves coincide at their highest points. Record the dial setting of the test oscillator for future reference. Adjust the receiver oscillator trimmer until the forward and reverse curves coincide as well as possible and then adjust the r-f trimmers until the curves coincide throughout.

Frequency Measurements—In using the Oscillograph for frequency measurement, either Lissajou figures (sine waves on both axes) may be used, or the linear timing axis may be employed on the horizontal axis. The most flexible method for frequencies up to 100,000 cycles is the linear timing axis method. The frequency stability of the saw-tooth oscillator running free is not good enough to depend on for accurate measurements, but when this oscillator is synchronized with a standard-frequency voltage its frequency stability is the same as that of the standard, and it can be synchronized at any sub-multiple of the standard frequency down to about one tenth. This allows convenient calibration of a device at many points between one-hundredth of—and ten times a single standard-frequency source, and every point is as accurate as the standard. If a 1000-cycle standard source is used, calibration points between 10 and 10,000 cycles are easily obtained. Using Lissajou figures, calibration points between 100 and 10,000 cycles can be obtained. A frequency standard which is almost universally available is the 60-cycle a-c supply. Since the advent and rapid spread of electric clocks the frequency of nearly all commercial power is held to a very close tolerance. With the "Synchronizing" switch on "60 cycle," the saw-tooth oscillator can be locked at 20, 30, or 60 cycles, as desired. This allows accurate calibration at frequencies up to about 600 cycles. Refer to the table on page 8 and Application No. 14 on the chart.

Checking Phase Shift—To check phase shift of a device with the Oscillograph, set controls as shown on Application No. 13 on enclosed chart, observing the screen pattern with input to device on "Horizontal" binding posts and output from device on "Vertical." If no phase shift exists, a sloping straight-line image will appear. The internal amplifiers in the Oscillograph introduce some phase displacement which must be considered. If sufficient voltage is available, the internal amplifiers should not be employed.

Part II
SERVICE DATA

Electrical Specifications

Power Supply Rating	Voltage	110–120 Volts AC
	Frequency	50–60 Cycles
	Wattage Consumption	50 Watts
	Fuse Protection	1.5 Amps.

Operating Limits

- Deflection sensitivity at amplifier inputs 2 peak volts per inch (max. "gain.")
- Deflection sensitivity at cathode-ray tube inputs...75 peak volts per inch
- Input Characteristics:
  - (1) Through either amplifier..500,000 ohms, approximately 20 mmfd.
  - (2) Without either amplifier..400,000 ohms, approximately 10 mmfd.
- Frequency response range of amplifiers .... 20–90,000 Cycles
- Maximum signal input (with amplifier) .... 700 Volts (RMS)
- Frequency range of timing axis or "Saw-tooth" oscillator 20–15,000 Cycles
- Maximum d-c voltage across input binding posts .... 300 Volts

Radiotrons Used and Functions	1 RCA-57	Signal amplifier for vertical deflection
	1 RCA-57	Signal amplifier for horizontal deflection
	1 RCA-885	"Saw-tooth" oscillator
	1 RCA-906	Cathode-ray tube (3-inch)
	1 RCA-879	High-voltage rectifier
	1 RCA-80	Low-voltage rectifier

Physical Specifications

Overall Dimensions	Height (including carrying-handle)	14 inches
	Width	7¼ inches
	Depth	17¾ inches

Weight packed for shipment	68 pounds
Weight	39½ pounds

Circuit Description

The schematic arrangement of the entire circuit is shown in Figure 37.

An amplifier consisting of a single RCA-57 constitutes the means of obtaining "gain" for the signal applied to the vertical deflecting system. The input to this stage is a high-resistance potentiometer connected to provide "gain" control. An isolation capacitor is made a part of the input circuit to exclude any DC which may be associated with the circuit being observed. The plate, or output circuit of the RCA-57 is composed of two elements in series, a resistor and an inductance whose values are so designed as to effect a broad and uniform frequency response in the amplifier stage. Coupling from the amplifier plate to the cathode-ray tube is made through a capacitor.

The amplifier for the signal applied to the horizontal deflecting plates is identical to that described above. Switches are provided to disconnect either or both amplifiers, thereby applying the voltage to be studied directly to the deflecting plates. Extra contacts are used on the input switch to the horizontal amplifier for feeding in the timing or "Saw-tooth" oscillator signal.

A synchronization system is included, as shown in the input circuit of the RCA-885. This is the "Synchronizing" switch described under "Operation." The timing axis oscillator stage, using the RCA-885, is designed to have a frequency range of 20 to 15,000 cycles, controlled through the "Range" switch and "Frequency" control. The signal from this oscillator has a "saw-tooth" wave shape, obtained as follows: A d-c potential is applied across a capacitor and resistor in series in the plate circuit of the RCA-885 tube. This voltage charges the capacitor until the ionization potential (plate voltage at which the gas in the RCA-885 ionizes) is reached. When the RCA-885 ionizes the capacitor is short-circuited and the voltage across it drops nearly to zero. The RCA-885 immediately de-ionizes and allows the capacitor to start charging again. In this manner, the voltage across the capacitor has a "saw-tooth" characteristic. The capa-

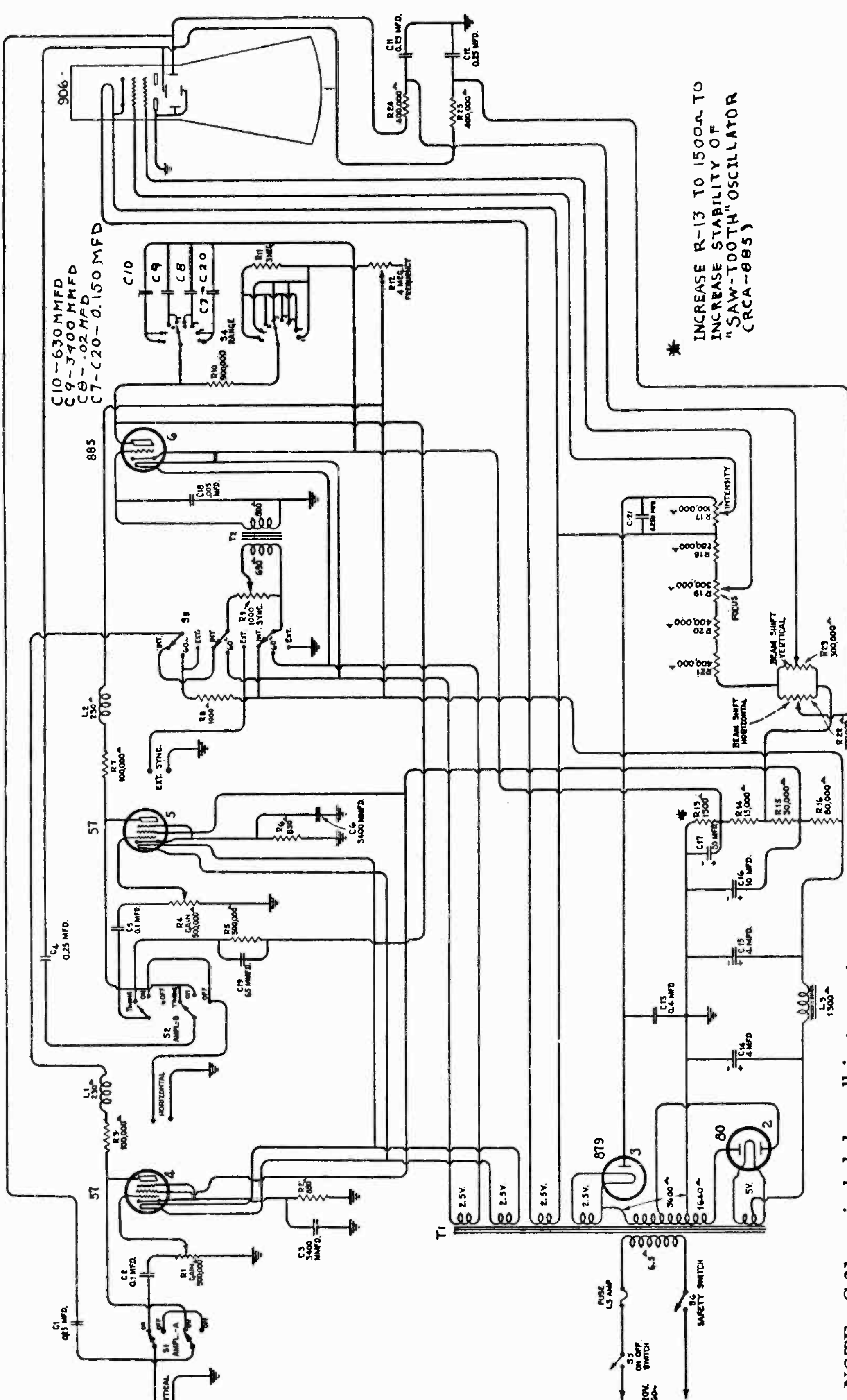


Figure 37—Schematic Diagram

NOTE: C-21 not included on all instruments.

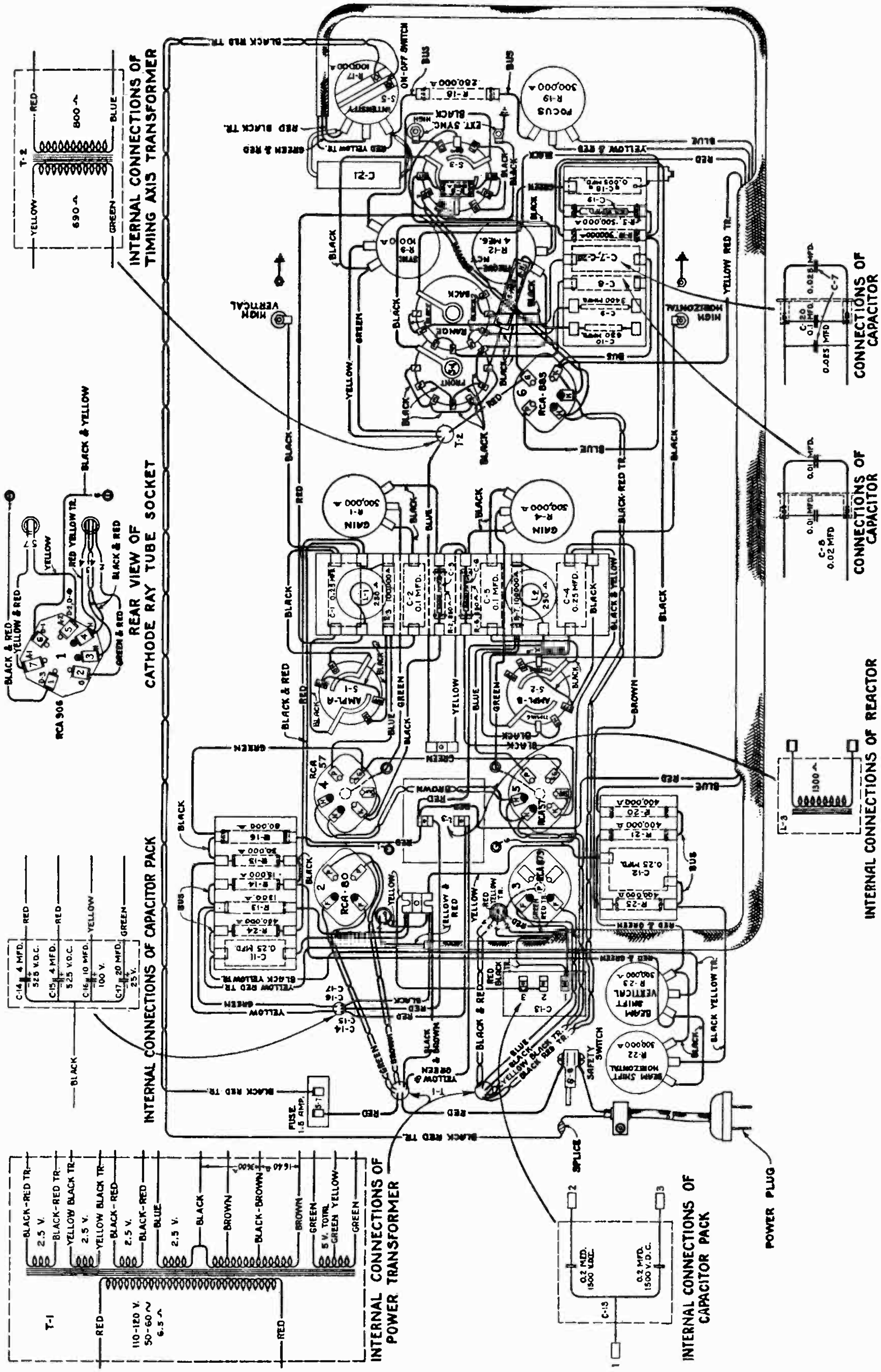


Figure 38—Wiring Diagram

citor referred to above is selected by the position of the "Range" switch as described in "Operation." With "Ampl. B" switch on "Timing," the voltage across this capacitor passes through the horizontal amplifier to the plates of the RCA-906. The operation of the "Synchronizing" control, in the grid circuit of the RCA-885 is described under "Operation."

The RCA-906 cathode-ray tube has previously been described, under "Discussion of Cathode-Ray Tubes." Controls used to control the intensity, focus and zero adjustments are described under "Operation."

Power required for operation of the instrument is obtained through the power unit from a 110–120-volt, 60-cycle supply. Voltage rectification is accomplished by an RCA-80 and an RCA-879 connected in the secondary windings of the power transformer. The RCA-80 supplies plate voltages for the amplifier stages and sweep oscillator, filtered through a reactor-capacitor combination. The RCA-879 supplies the high voltage to the cathode-ray tube for polarization purposes.

Maintenance

(1) Radiotrons

Under ordinary usage within the ratings specified for voltage supply, tube life will be consistent with that obtained in other applications. The rectifier, oscillator, and rectifier tubes will wear in accordance with loss of emission; whereas the determining factor in the life of the RCA-906 cathode-ray tube is the deterioration of the fluorescent screen. It is therefore advisable to avoid leaving a bright, concentrated "spot" on the screen. Also, the image of the phenomena under observation should be removed from the screen when not actually being studied or measured; this item of care will enable a long and useful life to be obtained from the tube.

It is not ordinarily possible to test the Radiotrons in their respective sockets, due to the likelihood of circuit effects causing error. Their removal and check with standard tube-testing apparatus is therefore desirable. Replacement of the questionable tube with one known to be in good condition, is another acceptable and definite means of tracing tube troubles.

On the RCA-906, excessive wear and approach to its limit of life, is indicated by inability to obtain a satisfactory focus, and also by the screen becoming streaked and spotted. When it becomes necessary to install a new RCA-906, some rotational adjustment may be required to bring the axes of deflection into their proper horizontal and vertical planes. This is accomplished by pushing against the screen end of the tube with the hand, and turning the tube until the correct alignment is secured.

To remove the RCA-906, it is necessary to loosen the wing nut securing the tube socket to the chassis, slide the socket toward the back of the chassis, then tilting the tube up until it can be withdrawn from its socket. Replacement is the reverse operation, sliding the tube into the panel opening, *carefully spreading the metal guides*, until a slight tension is placed on the mounting spring. Tighten the wing nut securely and replace the chassis in the cabinet.

(2) Fuse Replacements

A small 1½-ampere cartridge fuse is used in the primary circuit of the power transformer. This fuse is intended for protection of the entire power system of the oscillograph, and should, therefore, not be replaced by one having a higher rating, nor be shorted out. A fuse failure should be carefully investigated before making a replacement, as usually in the use of fuses of accepted quality, there must be a definite cause for the fuse breakdown. The cause may originate from a surge in the power-supply line, but the greater percentage of causes may be centered in the apparatus protected, such as shorted rectifier elements, and so forth. Occasionally a fuse may open from heat generated at one of its clip contacts. These points should therefore be kept clean and in secure contact with the fuse.

(3) Resistance and Continuity Tests

The schematic circuit is shown in Figure 37, and the actual wiring layout giving color code and physical relation of the parts is shown in the chassis wiring diagram, Figure 38. All resistor and capacitor values are given to facilitate a rapid and sure test for continuity of circuit and the condition of same. Coils and transformer windings have their d-c resistances shown.

In working on the chassis of the Oscillograph, care must be observed in having the safety switch open, or better, to have the power supply completely disconnected. The high voltages associated with the circuits of the cathode-ray tube make it especially dangerous to attempt to handle or work on the chassis while the power is "On."

Care should be exercised in replacing any part that may be found faulty. All wiring associated with the part involved must be taken off, and especial attention given to possibility of damage to other wiring or parts. The relation of wiring and parts should be the same as in the original assembly. The insulation and spacing of the high-voltage leads is very necessary and an important item to be adhered to in servicing of the instrument.

The **BRILLIANCY** and **FOCUSING** controls are connected with the adjustment knobs through insulating couplings. In replacing either of these parts, the coupling has to be fitted with 5-0 taper pins.

(4) Voltage Measurements

One means of learning the condition of operation and tracing the circuit faults of the oscillograph is by checking the correctness of the voltages and currents at the Radiotron sockets. The normal values, which can be expected to be found when the instrument is working properly under the specified power ratings, are indicated adjacent to the socket positions in Figure 39, and also given by the Radiotron Socket Voltage Table. In general, the values shown are measured from the socket contacts to ground; however, the heater or filament voltages are a-c and appear between the F-F or H-H clips. All readings given are actual operating values, and do not allow for any errors likely to be caused by current drain of the measuring instrument. Some of the voltages are not measurable with ordinary test equipment; these have been asterisked in the table. Notice should also be given to the fact that in the diagram of Figure 39 the bottom view of the sockets is shown.

REPLACEMENT PARTS

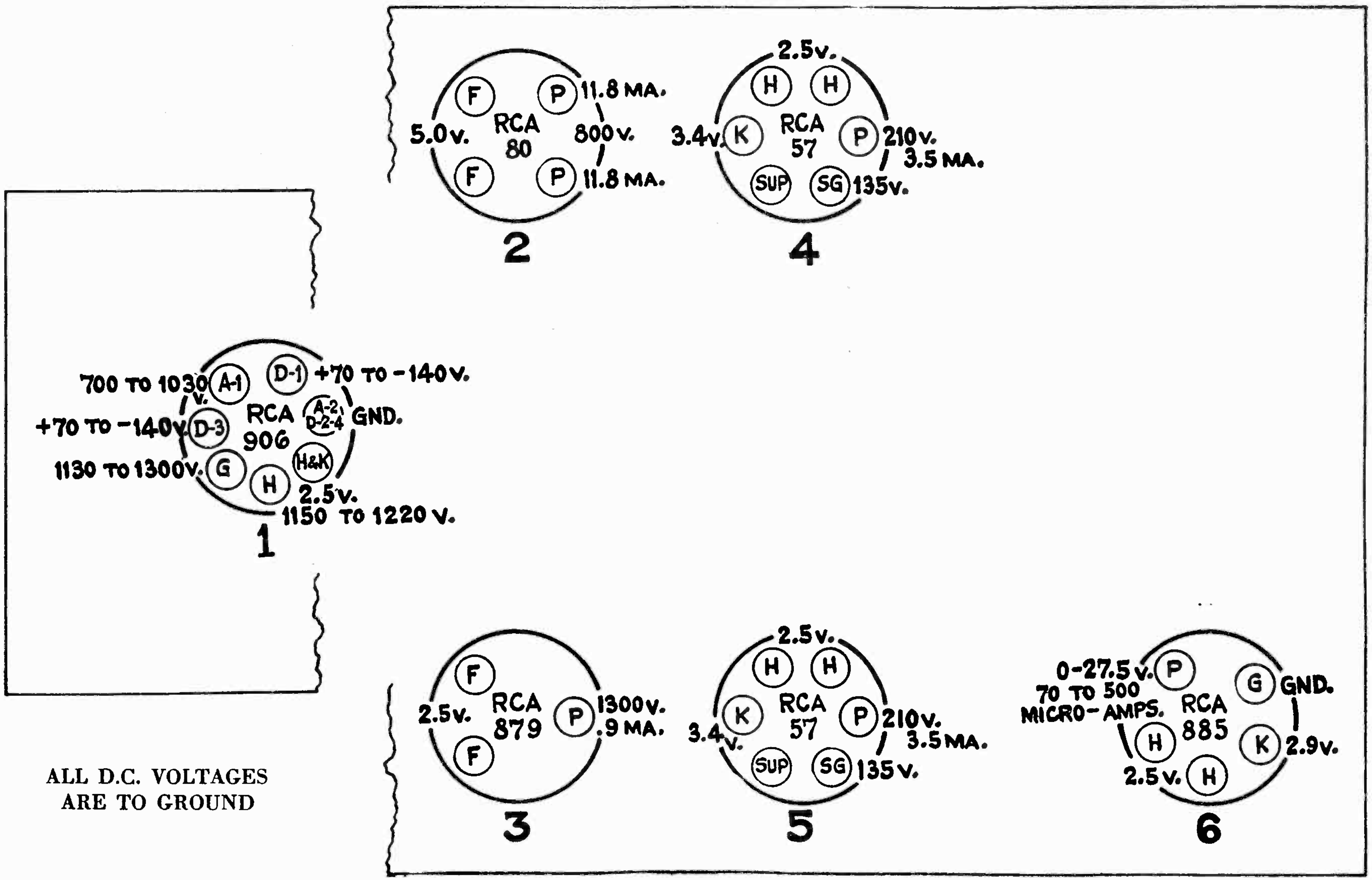
Stock No.	DESCRIPTION	List Price	Stock No.	DESCRIPTION	List Price
4146	Block—Fuse block	$0.35	4876	Potentiometer—Synchronization control potentiometer (R9)	$0.90
4855	Bushing—Socket support bushing—Package of 2	.15	4846	Reactor—Filter reactor (L3)	1.65
4873	Cable—7-conductor—Braid-covered cable	.85	3441	Resistor—850 ohms—Carbon type—½ watt—Package of 5 (R2, R6)	1.00
4868	Capacitor—.005 mfd. (C18)	.20	2816	Resistor — 1,000 ohms — Carbon type — ½ watt (R8)—Package of 5	1.00
4858	Capacitor—.01 mfd. (C8)	.25	4850	Resistor — 1300 ohms — Carbon type — ½ watt (R13)—Package of 5	1.00
4870	Capacitor—.025 mfd. (C7)	.20	6279	Resistor—15,000 ohms—Carbon type—½ watt (R14)—Package of 5	1.00
4871	Capacitor—65 mmfd. (C19)	.20	3077	Resistor—30,000 ohms—Carbon type—½ watt (R15)—Package of 5	1.00
4841	Capacitor—0.1 mfd. (C2, C5, C20)	.22	4849	Resistor — 80,000 ohms — Carbon type — 3 watt (R16)	.25
3597	Capacitor—0.25 mfd. (C1, C4)	.40	3058	Resistor—100,000 ohms—Carbon type—1 watt (R3, R7)—Package of 5	1.10
3702	Capacitor—0.25 mfd. (C11, C12)	.42	2971	Resistor—280,000 ohms—Carbon type—1 watt (R18)—Package of 5	1.10
4840	Capacitor—0.25 mfd. (C21)	.30	4851	Resistor—400,000 ohms—Carbon type—1 watt (R20, R21, R24, R25)	.25
4844	Capacitor—0.4 mfd. (C13)	7.25	2970	Resistor—500,000 ohms—Carbon type—1 watt (R5)—Package of 5	1.10
3933	Capacitor—630 mmfd. (C10)	.32	4869	Resistor—900,000 ohms—Carbon type—1 watt (R10)	.22
4439	Capacitor—3400 mmfd. (C3, C6, C9)	.35	4863	Resistor—3 megohms—Carbon type—1 watt (R11)	.22
4845	Capacitor pack—Comprising two 4.0 mfd. and one 10.0 mfd. and one 20.0 mfd. capacitors (C14, C15, C16, C17)	4.00	4268	Screw—Wing screw—Package of 10	.68
4867	Coil—Plate Choke Coil (L1, L2)	.70	7487	Shield—Radiotron shield	.25
4877	Coupling — Potentiometer insulator and coupling—Package of 2	.32	4794	Socket—4-contact Radiotron socket	.15
4862	Escutcheon—Cathode-ray tube escutcheon	.50	4814	Socket—5-contact Radiotron socket	.15
2725	Fuse—Cartridge type fuse—Package of 5	.40	4786	Socket—6-contact Radiotron socket	.15
4336	Knob—Intensity, focus, amplifier A-B, tuning or gain control knob—Package of 5	.40	4852	Socket—Socket, socket support and springs and studs	1.20
4857	Post—Binding post—Engraved "HIGH"—Package of 2	.52	4853	Spring—Socket support spring—Package of 2	.10
4860	Post—Binding post—Engraved "0"—Package of 2	.52	4854	Stud—Socket support stud—Package of 2	.18
4879	Potentiometer—Beam shift potentiometer (R22, R23)	.90	4875	Switch—2-gang—8-position (S4)	1.60
4856	Potentiometer — Brilliancy control potentiometer—Complete with "Off" and "On" switch (R17, S5)	1.25	4864	Switch—2-pole—2-position (S1)	1.25
4859	Potentiometer—Focus control potentiometer (R19)	.90	4865	Switch—2-pole—3-position (S2)	1.25
4878	Potentiometer — Frequency control potentiometer (R12)	.90	4866	Switch—3-pole—3-position (S3)	1.25
4874	Potentiometer—Gain control potentiometer (R1, R4)	1.00	4872	Switch—Safety switch (S6)	1.30
			4848	Transformer—Power transformer (T1)	8.25
			4847	Transformer—Timing axis transformer (T2)	2.50

RADIOTRON SOCKET VOLTAGE TABLE

120-Volt, 60-Cycle Supply Line

RADIOTRON			Cathode Volts to Ground DC.	Screen Grid Volts To Ground DC.	Plate Volts to Ground DC.	Cathode Current MA-DC.	Anode Volts to Ground DC.		Deflecting Plates to Ground DC.		Filament or Heater Volts AC.
Socket Number	Type	Function					No. 1	No. 2	D_1	D_2	
1	RCA-906	Cathode Ray	−1150 to −1220*	—	—	—	−700 to −1030*	0	+70 to −140*	+70 to −140*	2.5
2	RCA-80	Low Voltage Rectifier	—	—	400 (RMS)	23.6	—	—	—	—	5.0
3	RCA-879	High Voltage Rectifier	—	—	+1300*	—	—	—	—	—	2.5
4	RCA-57	20–90,000 Cycle Amp.	+3.4	+135	+210	3.5	—	—	—	—	2.5
5	RCA-57	20–90,000 Cycle Amp.	+3.4	+135	+210	3.5	—	—	—	—	2.5
6	RCA-885	20–15,000 Cycle Osc.	+2.9	—	0 to +27*	70 to 500 Micro-Amps	—	—	—	—	2.5

* Cannot be correctly measured with ordinary voltmeter.



ALL D.C. VOLTAGES
ARE TO GROUND

Figure 39—Radiotron Socket Voltages (Bottom View)

IB-23339-1

(Supplement to IB-23339)

Cathode-Ray Oscillograph

Type TMV-122-B

The following sheets contain revised servicing information for the Cathode Ray Oscillograph, Type TMV-122-B, Serial Numbers 1500 and above. These sheets are to be used with Instruction Book IB-23339, replacing the servicing information included in that book.

The theory of operation, installation and operation are thoroughly covered in the instruction book. However, due to a slight circuit change, the operation of the "Range" switch is better described as follows (page 15):—

7. "Range" switch, S4, selects one of eight timing capacitors. It thus changes the timing axis oscillator frequency in steps giving 8 ranges as follows: No. 1, 10-35; No. 2, 20-65; No. 3, 55-180; No. 4, 130-450; No. 5, 375-1400; No. 6, 900-3500; No. 7, 2000-7500, and No. 8, 5500-18,000 cycles.

Also under "6. Ampl. 'B' Gain Control (horizontal)" note the following:

Due to the capacity load on this input potentiometer, when operating on "Timing" at the higher audio frequencies, linear sweep will not be obtained at all settings of this control. For best results, the control should be set for maximum linearity, which will occur at about 2/3 full screen deflection.

Under "Replacement Parts," note the addition or changes in the items shown on page 5.

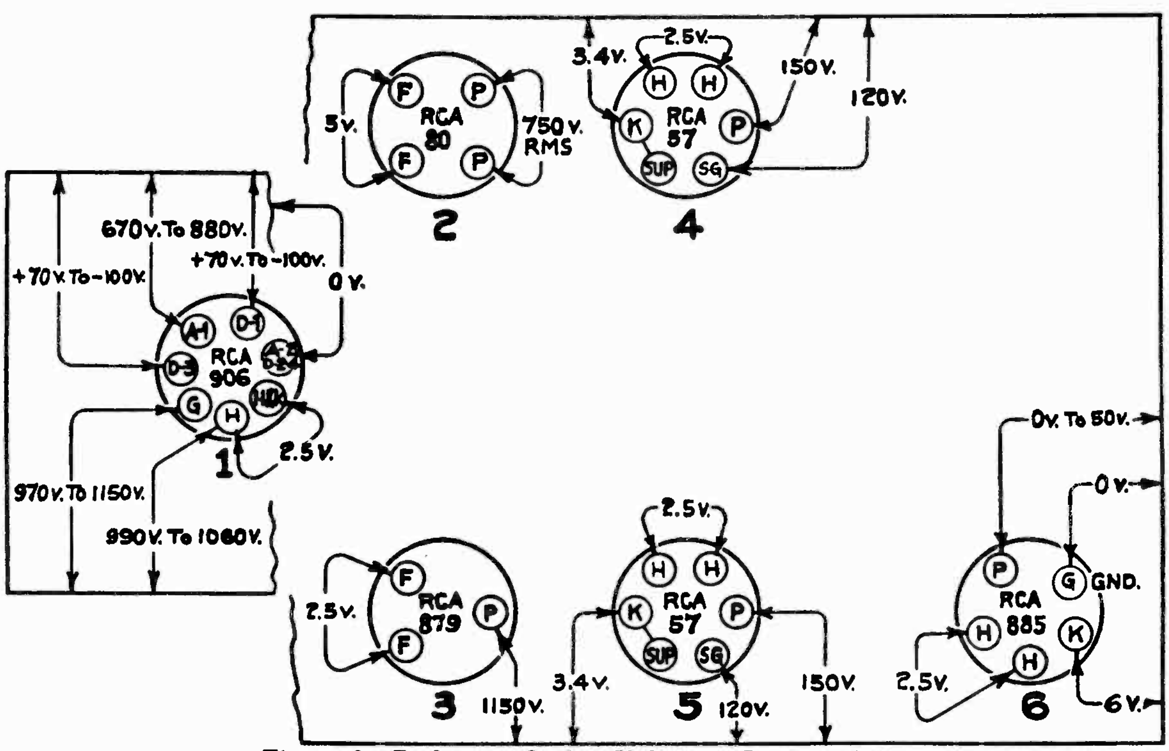


Figure 1—Radiotron Socket Voltages (Bottom View)

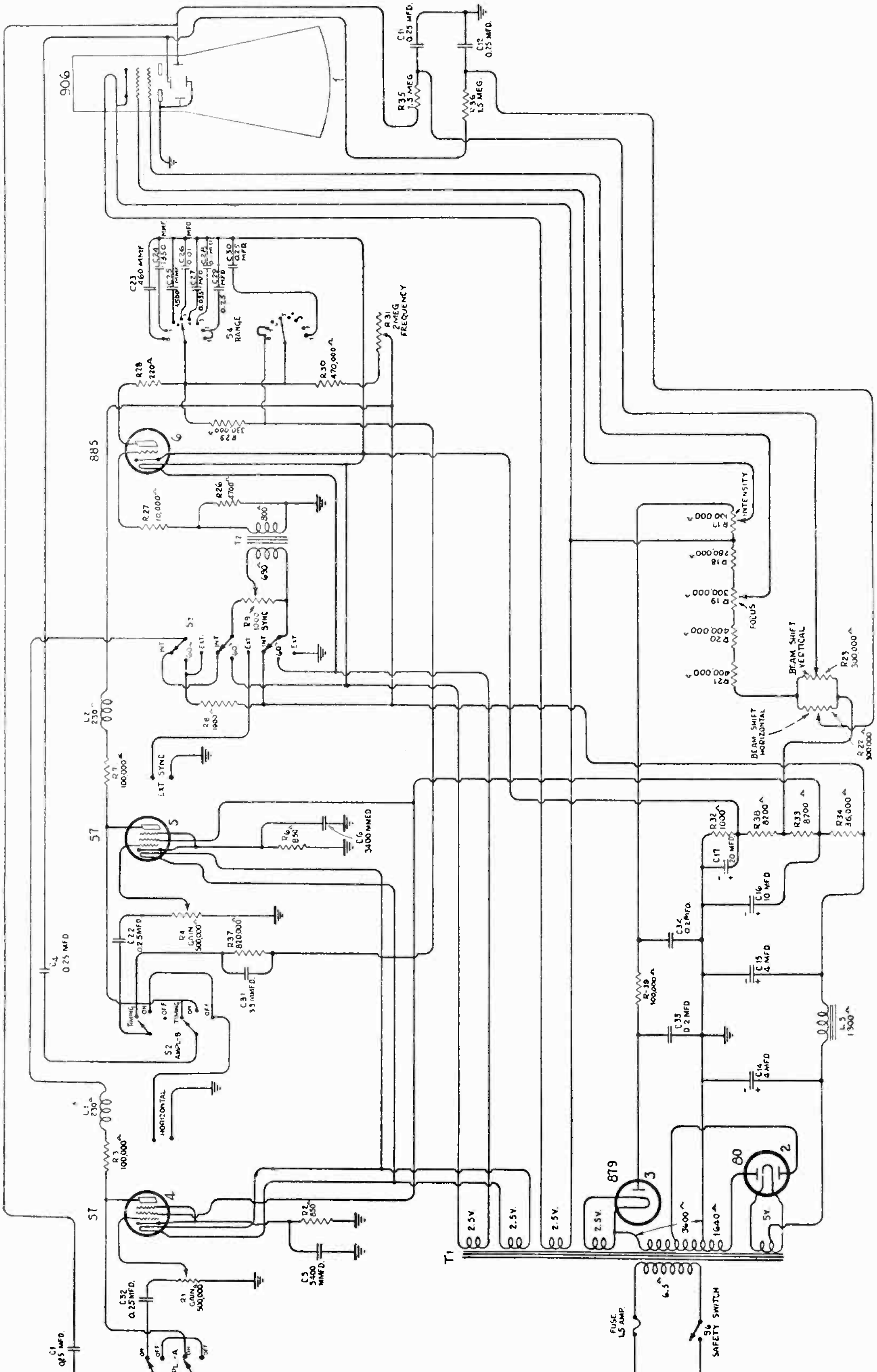


Figure 2—Schematic Diagram

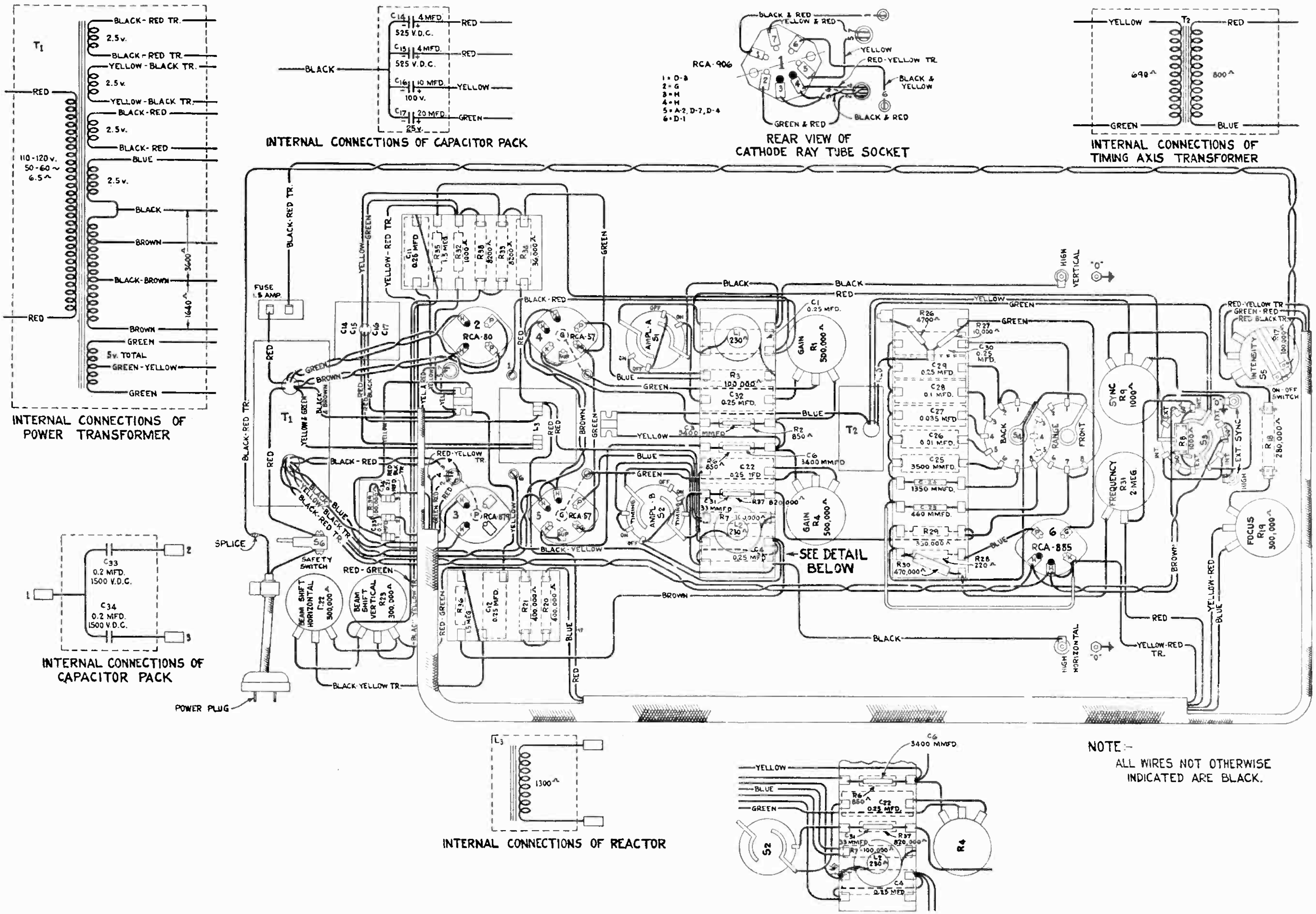


Figure 3—Wiring Diagram

RADIOTRON SOCKET VOLTAGE TABLE

120-Volt, 60-Cycle Supply Line

RADIOTRON			Cathode Volts to Ground DC.	Screen Grid Volts To Ground DC.	Plate Volts to Ground DC.	Cathode Current MA-DC.	Anode Volts to Ground DC.		Deflecting Plates to Ground DC.		Filament or Heater Volts AC.
Socket Number	Type	Function					No. 1	No. 2	D_1	D_2	
1	RCA-906	Cathode Ray	−990 to −1060*	—	—	—	−670 to −880*	0	+70 to −100*	+70 to −100*	2.5
2	RCA-80	Low Voltage Rectifier	—	—	575 (RMS)	24	—	—	—	—	5.0
3	RCA-879	High Voltage Rectifier	—	—	+1150*	—	—	—	—	—	2.5
4	RCA-57	20–90,000 Cycle Amp.	+3.4	+120	+150	2.5	—	—	—	—	2.5
5	RCA-57	20–90,000 Cycle Amp.	+3.4	+120	+150	2.5	—	—	—	—	2.5
6	RCA-885	20–15,000 Cycle Osc.	+6.0	—	0 to +50*	180 to 900 Micro-Amps	—	—	—	—	2.5

* Cannot be correctly measured with ordinary voltmeter.

Stock No.	DESCRIPTION	List Price	Stock No.	DESCRIPTION	List Price
4244	Cap—Contact cap....Package of 5..	$0.20	5199	Resistor—4700 ohms—Carbon type —¼ watt (R26)—Package of 5...	$1.00
5198	Capacitor—33 mmfd. (C31)........	.16	5205	Resistor—8200 ohms—Carbon type —1 watt (R33, R38)..............	.22
5197	Capacitor—460 mmfd. (C23).......	.18	3381	Resistor—10,000 ohms—Carbon type ¼ watt (R27)—Package of 5.....	1.00
5115	Capacitor—1350 mmfd. (C24)......	.25	5206	Resistor—36,000 ohms—wire wound (R34)	.35
4439	Capacitor—3400 mmfd. (C3, C6)....	.35	3252	Resistor—100,000 ohms — Carbon type—½ watt (R39)—Package of 5	1.00
5005	Capacitor—3500 mmfd. (C25)......	.16	5200	Resistor—330,000 ohms — Carbon type—½ watt (R29)—Package of 5	1.00
4858	Capacitor—0.01 mfd. (C26).........	.25	4851	Resistor—400,000 ohms — Carbon type—1 watt (R20, R21).........	.25
5196	Capacitor—0.035 mfd. (C27).......	.18	5202	Resistor—470,000 ohms — Carbon type—½ watt (R30)—Package of 5	1.00
4841	Capacitor—0.1 mfd. (C28).........	.22	5203	Resistor—820,000 ohms — Carbon type—½ watt (R37)—Package of 5	1.00
4840	Capacitor—0.25 mfd. (C11, C12, C29, C30)......................	.30	5204	Resistor—1.5 megohm—Carbon type —½ watt (R35, R36)—Package of 5	1.00
5170	Capacitor—0.25 mfd. (C1, C4, C22, C32)	.25			
4844	Capacitor Pack—Two sections of 0.2 mfd. each (C33, C34).........	7.25			
7960	Knob—Range or Ext. Sync. switch knob	.20			
5207	Potentiometer—Frequency control potentiometer (R31).............	1.35			
5201	Resistor—220 ohms—Carbon type—½ watt (R28)—Package of 5.....	1.00			
2816	Resistor—1000 ohms—Carbon type —½ watt (R8, R32)—Package of 5	1.00			

SERVICE APPLICATIONS

OF

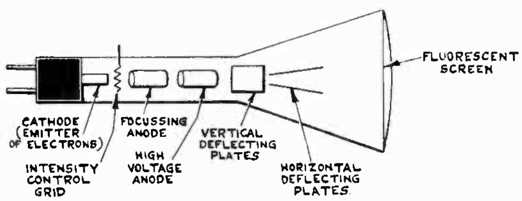
CATHODE RAY OSCILLOGRAPH

TYPE TMV 122-B

OPERATION OF THE CATHODE-RAY OSCILLOGRAPH

THE RCA CATHODE-RAY TUBE

The heart of the Cathode-Ray Oscillograph is the Cathode-Ray Tube, a development of RCA Engineers to its present practical form. The Cathode-Ray tube has often been called the "Electron Gun," as this describes its functions. The illustration shows an elementary diagram of the tube.

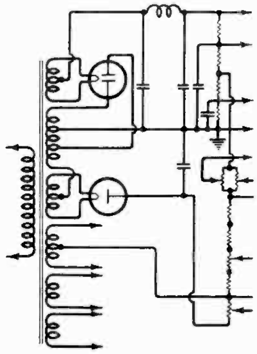


For the purpose of understanding the action of the "electron gun," one may consider the cathode as emitting electrons, which are accelerated by the high voltage anodes and which strike the fluorescent screen at the end of the tube, thereby creating light. The course of the electrons is controlled by the two sets of deflecting plates, one for horizontal deflection and one for vertical deflection. The amount of deflection, which controls the location of the light-spot on the screen, is a direct function of the voltage at any particular instant on the deflecting plates.

From the foregoing it is seen that a pattern of light may be traced on the screen by the simultaneous application of voltages to the horizontal and vertical deflecting plates. If this action is repeated twenty or more times per second, the retentive power of the eye is such that the tracing will not be discernible and the entire pattern will be seen.

Focusing of the light beam on the fluorescent screen is accomplished by adjusting the voltage on the anode nearest the cathode. The intensity of light is controlled by the negative voltage applied to the grid.

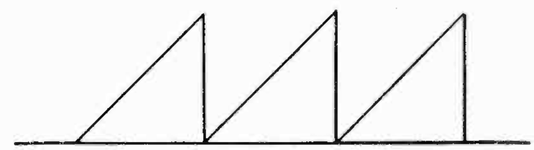
POWER SUPPLY



The high voltage anode of the Cathode-Ray Tube requires 1000 volts DC for proper operation. Also, DC voltages are required for the amplifier. The RCA-879 rectifier is used in a half-wave rectifying circuit for providing the necessary anode voltage for the RCA-906. The RCA-80, connected in a full-wave rectifying circuit, provides plate and grid voltages for the two RCA-57 amplifiers. While a single transformer is used for both rectifiers, individual filter circuits are provided. The transformer is oversize to prevent stray magnetic leakage that would otherwise affect the operation of the Cathode-Ray Tube.

THE SAW-TOOTH OSCILLATOR

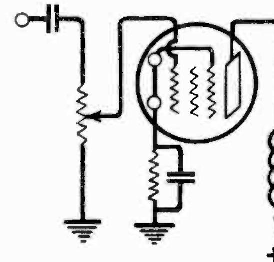
The external voltage under test is always connected to the vertical deflecting plates. However, unless some means is provided for moving the beam simultaneously in a horizontal direction, a beam rising and falling vertically will be obtained. As this would merely give an indication of the



maximum voltage available, a means must be provided for simultaneously deflecting the beam horizontally. For this, the so-called variable frequency "saw-tooth" oscillator is necessary. The "saw-tooth" refers to the wave shape of the oscillator and is required because of the necessity for having the horizontal deflection increase in a linear manner and then abruptly return to zero and again shift across the screen. The frequency of the oscillator must have a definite relationship to the frequency of the voltage under test. For example, to examine one cycle, the saw-tooth oscillator must be the exact frequency of the voltage under test. If the saw-tooth oscillator is one-half of the frequency of the voltage under test, then two cycles will be shown on the screen at one time.

With the saw-tooth oscillator provided in the TMV-122-B, the minimum number of cycles for the highest frequency is six, being obtained when a 90,000-cycle voltage is observed with the saw-tooth oscillator at 15,000 cycles. Higher frequencies may be examined by connecting directly to the vertical plates and using an external timing oscillator.

AMPLIFIERS



The sensitivity of the Cathode-Ray Tube is such that a voltage of 75 is required for either a vertical or horizontal deflection of one inch. Because many voltages used in radio circuits are very small, an amplifier has been provided for each set of deflecting plates. Both amplifiers use an RCA-57 tube and have a high gain and wide frequency range. The gain is approximately 40 and the frequency range is 20 to 90,000 cycles $\pm 10\%$.

Designing an amplifier circuit of such wide frequency range is a difficult engineering problem. Its solution greatly increases the flexibility of the equipment.

APPLICATIONS OF THE CATHODE-RAY OSCILLOGRAPH

VOLTMETER AND AMMETER

In all of its applications, the oscillograph receives the voltage to be studied from an external source on its vertical deflecting plates and a voltage which may be either external or internal on its horizontal plates. The deflection in either direction is proportional to the voltage impressed on the plates. If voltage is impressed on the vertical plates only, the instrument can be considered as an a-c meter. It may be used as a voltmeter without the amplifier; it may be used as a voltmeter with the amplifier; or it may be used

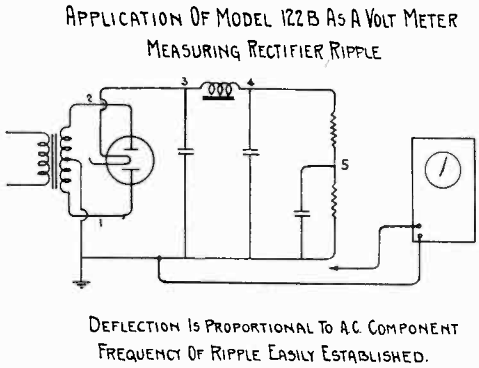


Figure 1—Oscillograph as a Voltmeter

as an a-c ammeter. The specifications for voltmeter and ammeter use may be briefly summarized as follows:

A—A-C voltmeter without amplifier
- (1)—Impedance: 400,000 ohms below 100 KC (80,000 ohms at 1,000 KC)
- (2)—Frequency range: at 20-100,000 cycles (higher at low impedances)
- (3)—Voltage range: 150 volts (higher with external attenuator)
- (4)—No needle to bend
- (5)—No delicate coils to burn out
- (6)—Calibration: 75 peak volts per inch (approx.)

B—A-C voltmeter with amplifier
- (1)—Impedance: 500,000 ohms below 100 KC (160,000 ohms at 1,000 KC)
- (2)—Frequency range: 20 to 90,000 cycles
- (3)—Voltage range: 700 volts (higher with external attenuator)
- (4)—No needle to bend
- (5)—No delicate coils to burn out
- (6)—Calibration: 2 peak volts per inch (maximum)

C—A-C ammeter with the amplifier
- (1)—Use as voltmeter across external shunt
- (2)—Range, with 1 megohm shunt: 0.6-2100 micro-amperes
- (3)—Range, with 1000 ohm shunt: 0.2-700 milli-amperes

The diagram, Figure 1, shows an application of the oscillograph for checking power supply units. The oscillograph shown on the right has one terminal connected to the common lead of the filter circuit and the other lead is placed in turn at "1" and "2" to measure the magnitude of the a-c supply; at "3" to measure the a-c ripple across the first condenser; at "4" to measure the ripple on the low side of the choke coil; and at "5" to measure the ripple across that section of the voltage divider circuit. Putting the leads across terminals "3" and "4" very readily checks for shorted turns in the filter choke. The particular value of this instrument over a voltmeter in this application is the fact that, unlike a voltmeter, it has no delicate coils to burn out, no delicate mechanical moving element, no pointer to slap up against the stop pins and, for small voltages, an extraordinary high impedance.

In Figure 2 the application of the cathode-ray instrument as an audio frequency voltmeter is illustrated. One side of the "vertical" input is shown connected to ground and the other side is placed alternately across "1", "2", "3", "4", "5", "6", "7" and "8", in order to find the cause for loss of sound. By applying the sweep circuit on the horizontal plate, one can observe the character of the wave. This helps greatly in locating intermittent troubles.

OBSERVATION OF AUDIO WAVE SHAPES

In the diagram of Figure 3 is shown a general scheme of measurement using cathode-ray equipment which cannot be accomplished by the means of a voltmeter. The problem here is in discovering the audio quality of a receiver, and perhaps in locating the cause for audio distortion. In the upper part of the diagram is shown an audio oscillator or frequency record, which feeds into the second detector of the receiver. The character of the output is observed on the oscillograph. The saw-tooth sweep circuit is interlocked with the signal on the vertical plate. In this way the audio wave stands still and distortion is readily discernible. Normally one should observe the quality of the input as well

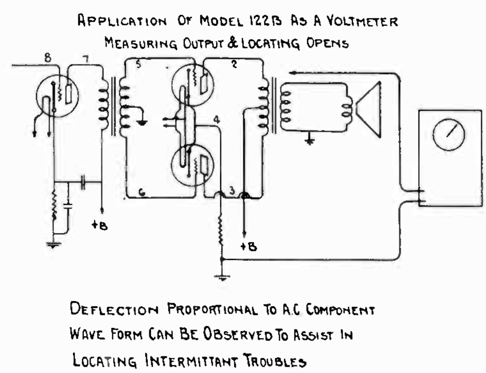


Figure 2—Audio Frequency Voltmeter

as that of the output to make certain that the distortion is not being fed into the receiver.

In order to check the overall audio performance of the receiver, a modulated r-f oscillator can be used. The output of the oscillator should be observed and this compared with the output of the receiver.

MEASUREMENT OF MODULATION

The application of the cathode-ray tube as a modulation indicator or the modulation meter is of interest, especially to "hams". It should not be inferred that only "hams" have troubles maintaining the proper percentage of modulation. Sometimes commercial stations are lax in this respect and a knowledge of modulation is often very helpful in servicing receivers. In Figure 4 is shown method "A", in which the modulated r-f output of a transmitter is fed into the vertical plates of the oscillograph and the audio signal is fed into the synchronous circuit. The saw-tooth oscillator should be adjusted so that for normal audio frequencies, several modulation envelopes appear on the screen and the wave can be observed quite readily, although it is

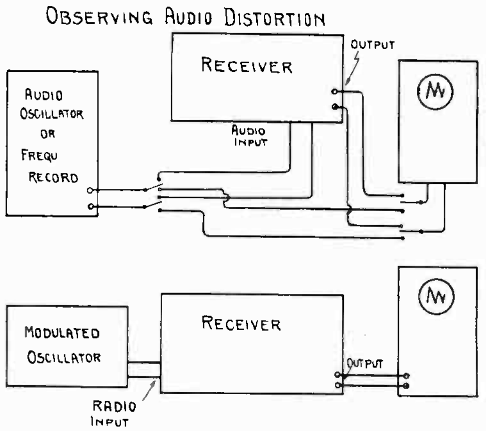


Figure 3—Audio Quality Measurement

not stationary. There is no way of synchronizing this signal with the speech or music which would ordinarily be used for transmission because of the great variation in frequency, but one can nevertheless get an excellent idea of the amount of modulation. In checking the transmitter, a constant frequency input can be used and the horizontal timing-axis interlocked with this frequency so that the wave stands still and the amount of modulation is very clearly defined.

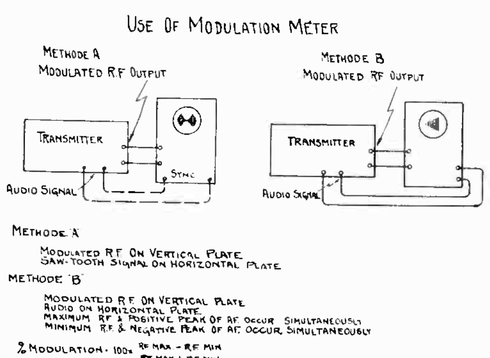


Figure 4—Measurement of Modulation

Method "B" on the right of Figure 4 shows the instrument used in a somewhat different manner as a modulation meter. The modulated output is put on the vertical plates and the audio signal on the horizontal plates of the oscillograph. Since the r-f amplitude is maximum when the audio voltage is maximum in the positive direction; since the r-f voltage is minimum when the audio is maximum in the negative direction; and since the audio and the envelope of the r-f both are sinusoidal voltages, the resultant figure is a trapezoid if the modulation lies between zero and 100%. The figure becomes a triangle if the modulation is 100%, and a vertical line if the modulation is zero. The percent modulation equals 100 times the difference between the maximum and minimum vertical sides of the trapezoid, divided by the sum of these two sides. This is shown somewhat clearer by Figure 5.

On the left of figure 5 appears the oscillogram for 100% modulated wave; immediately below it the corresponding audio voltage which causes the horizontal swing, and below that, the 100% modulated r-f voltage which causes the vertical swing. If it is remembered that, when the vertical amplitude increases in direct proportion to the horizontal deflections, the result is a straight line, it will be understood why this triangle results.

Below the trapezoid which represents 50% modulation, is shown the decreased audio frequency voltage which does not bring the r-f amplitude down to zero on the negative voltage wave and does not cause such a high value of r-f when the audio voltage is at a positive maximum. This diagram serves well to develop the formula for percent modulation. Under normal operating conditions, the unmodulated r-f will have an amplitude which is the average between the maximum r.f. and minimum r.f. shown in the diagram. This follows because the wave increases as far on the positive audio loop as it decreases on the negative audio loop. This average will equal maximum r.f. plus the minimum r.f. divided by two. The difference between the maximum r.f. and minimum r.f. represents twice the audio voltage. Therefore, the percent modulation which is equal to the audio voltage divided by the unmodulated carrier voltage, will equal r-f maximum minus r-f minimum divided by the quantity r-f maximum plus r-f minimum.

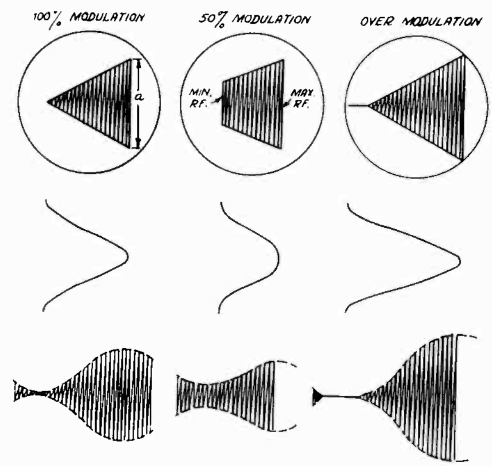


Figure 5—Indication of Percent Modulation

On the right of the diagram is the figure which results when the modulation is over 100%. Below it is the cause for such a figure. The audio voltage is much larger than it was before and on the right-hand side the positive loop causes the r-f energy to increase to a very large amplitude. When the audio voltage swings negative, however, it reduces the carrier to zero and the carrier stays zero until the audio voltage swings through its negative peak and back to a sufficiently low negative voltage to again permit r-f output.

I-F ALIGNMENT

Alignment of i-f stages with the oscillograph is a subject in which there is much interest. Figure 6 shows the necessary apparatus and general connections. On the lower left is a sweep condenser which causes the frequency generated in the r-f oscillator to sweep up and down about the frequency for which the oscillator is set. For example, if the

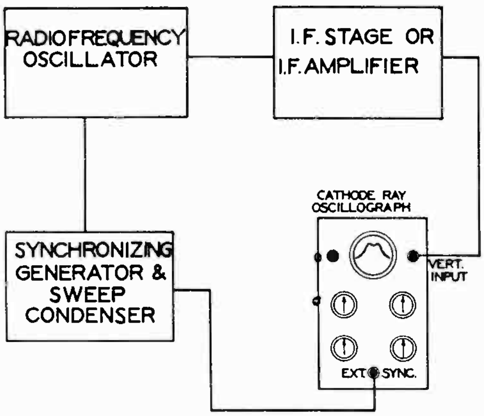


Figure 6—Scheme for I-F Alignment

oscillator is set at 460 kc, then the sweep condenser will cause this frequency to vary from, say, 445 to 475 kc. This varying frequency of constant amplitude is fed into the i-f amplifier, the output of which is impressed on the vertical plates of the oscillograph. A synchronizing (or impulse) generator which rotates in synchronism with the sweep condenser, is connected to the synchronizing terminals of the oscillograph so as to synchronize the saw-tooth generator with the frequency variation of the input into the i-f amplifier. The oscillator should not be modulated by audio frequency for this adjustment.

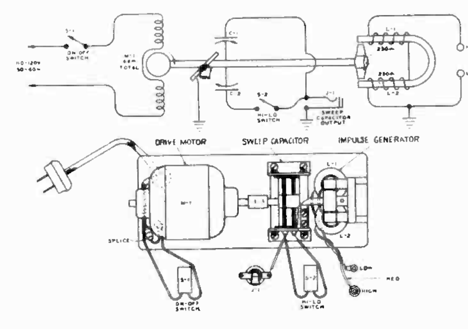


Figure 7—Frequency Modulator

An illustration of the sweep condensers, the synchronizing generator and the motor which drives them is reproduced in Figure 7. The sweep condenser is connected across the condenser of the r-f oscillator and in rotating causes the capacity of that circuit to vary above and below the normal fixed frequency. Provision is made so that the capacity of the sweep condenser can be varied, thus controlling the frequency range of the sweep.

The synchronizing generator consists of a permanent magnet with an air gap in which is rotated an armature with two poles. Twice each revolution these poles are across the air gap and produce an increase in magnetic flux so that the field coils which are mounted on the magnet have two pulses of voltage induced in them for each revolution of the condenser. The relative position of the armature of the synchronizing generator with respect to the plates of the sweep condenser can be varied so that these pulses occur at the point of maximum and of minimum capacity, to the end that the horizontal movement of the ray of the oscillograph starts when the frequency is just beginning to increase and starts again when the frequency is just beginning to decrease.

At the top of Figure 8 is depicted the frequency-modulated signal which is fed into the i-f amplifier. Because the i-f amplifier is tuned to a particular frequency the output of the amplifier will look somewhat as shown on the second line. If this i-f amplifier output is passed into a rectifier, and the high frequency component by-passed, a rectified current as shown on the third line will be produced. It is possible to feed either the output of the i-f amplifier or the rectified current onto the vertical plates of the oscillograph in order to make the alignment; the latter, however, is preferred because of the difficulty of connecting into the i-f amplifier without changing the tuning of its circuit and the

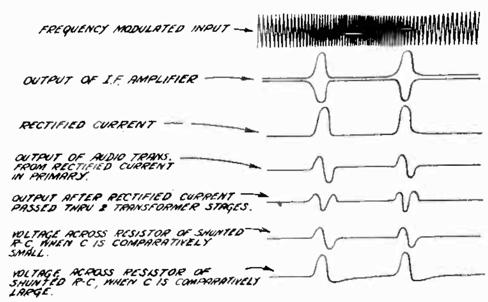


Figure 8—Frequency Modulation and Rectification Waves

fact that the intermediate frequency of most present day receivers is far above the range of the amplifier in the oscillograph, so that the i-f output would have to be large enough to be fed directly to the plates of the cathode-ray tube without amplification.

In utilizing the rectified current, the fact that it is not an audio frequency current but instead a pulsating direct current, requires certain considerations as to its use. If the pulsating direct current passes through the primary of an audio transformer, the voltage produced on the secondary will appear as shown in the fourth line, having a positive maximum when the current is increasing at the maximum rate, a negative maximum when the current is decreasing at a maximum rate and being zero whenever the current is not changing.

If such a current is fed through a second transformer stage, the curve shown on line 5 is produced. In Calculas terminology, curve 4 is the derivative of curve 3 and curve 5 is the derivative of curve 4. Obviously, it is better to establish the standard shape of curve desired, as that of rectified current rather than that which has passed through one or two audio transformers.

If the oscillograph is coupled to the rectifier circuit, by putting a resistor in series with a condenser across a resistor which is in the rectifier circuit, it is necessary to be careful of the relative size of the resistor and condenser. If the ohmage of the resistor is comparatively large with respect to the capacity reactance of the condenser, a curve as shown in the seventh line will appear, which is almost identical with that of the rectified current and which can be made near enough for all practical purposes by making the condenser sufficiently large.

If a small condenser, having a high capacity reactance and a low ohmage resistor is used, the resultant curve of voltage across the resistor will be as shown in line 6, which, of course, is not desirable as a standard.

In Figure 9 there are three diagrams indicating the preferred method of connecting the oscillograph into the detector circuit. On the left is shown a modern set using a diode for detector. It is possible to connect the vertical plates across the volume control, or across the volume control and AVC resistor both, if it is convenient to make this connection. The capacitor and gain control of the vertical amplifier in the oscillograph are properly proportioned so as to cause no distortion of the curve.

In the center diagram a second detector is shown, which may be either a triode, a tetrode or a pentode, and which is resistance coupled to the first audio stage. Here the vertical amplifier of the oscillograph is connected to the plate of the detector and the other side connected to ground. The voltage used is that across the coupling resistor. The condenser in the amplifier input circuit serves to block out the d-c plate potential.

In the figure on the right, there is a triode, tetrode or pentode, which is coupled to the first audio amplifier by a transformer, or by an inductor. Here, a resistor is connected between the plate and the coil to by-pass the signal around the coil by a one mfd. or larger capacitor. The impedance in the plate circuit is changed to a resistance rather

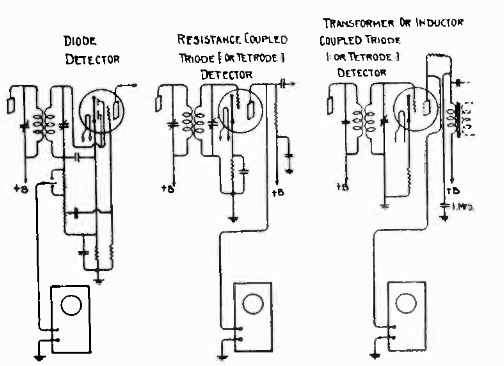


Figure 9—Connections of Oscillograph to Receiver

than an inductance. The vertical amplifier is connected between the plate and ground so as to take the voltage off this resistor.

In the factory, when using the resistor in series with the plate, the alignment operators are provided with a detector tube which is normal in every respect except that a hole has been drilled through the base. The lead from the plate to the prong is brought out and the connections are made to these leads. This special tube can be substituted for the regular second detector tube and the connections can be made rapidly, and without undue loss of time.

Use of an adapter between the socket and the tube might be considered in order to get at the plate lead but the use of such an adapter will increase the length of the grid lead and change the tuning of the i-f transformer. Of course, the i-f transformer can be retuned if the adapter is to be left in permanently, but an adapter cannot be properly used to align the i-f coils and then remove the adapter and the coil expected to remain aligned.

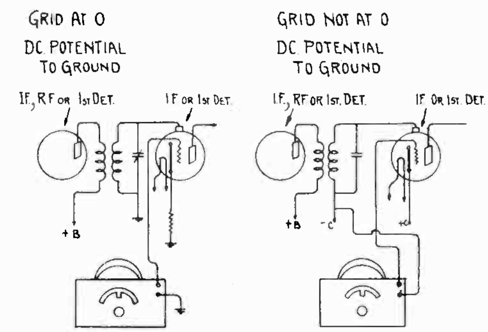


Figure 10—Oscillator Connections

Figure 10 is for the purpose of showing how the r-f oscillator can be connected so as to feed the signal into the i-f amplifier.

The connection from the r-f oscillator should be made to the grid of the tube preceding the coil to be adjusted. For example, if adjusting the last i-f transformer (between the last i-f tube and the second detector), feed the signal into the grid of the last i-f tube. If adjusting the first i-f transformer, feed the signal into the grid circuit of the first detector.

If the grid of the tube into which the connection is made is at zero d-c potential with respect to ground, the oscillator should be connected to the grid of the tube and the lead ordinarily connected to the grid should be removed.

If the grid is not at d-c potential with respect to ground, it is necessary that the bias be maintained unchanged and the proper connection, as shown on the right of this diagram, is to connect one terminal of the oscillator to the grid (removing the wires that were previously connected to it) and connecting the other wire to "—C".

It will be noted that in both of these cases, the tuned circuit which was connected to the grid has been disconnected so that it cannot interfere with the operation of the r-f oscillator. In making the connection into the grid circuit there will be no difficulty, of course, if the grid is brought out through a cap in the top of the tube. By drilling a hole in the base of a tube and bringing out the connections from the grid and the grid prong, considerable time can be saved in making these connections when the tube has no grid cap.

One might consider using a "socket selector" or analyzer which permits access to the elements of the tube by a plug and cable arrangement. In doing so, be very careful that oscillation is not set up by virtue of the change in capacity which has taken place between the plate and grid lead, The general process which is followed in aligning intermediate frequency amplifiers with the cathode-ray equipment follows:

(1)—Feed the sweeping input of proper frequency into the grid of the last i-f tube shown at point 1 on the Figure 11 and align the last i-f transformer. The detailed method of alignment follows in connection with another diagram.

(2)—Shift the receiver tuning condenser to see that the curve is not affected by signals generated or picked

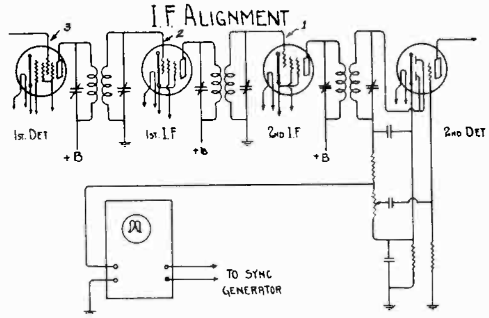


Figure 11—Connections of Oscillograph

up in the r-f or oscillator part of the receiver. (This is sometimes caused by strong local signals or harmonics of the signal generator, which get to the grid of the first detector tube and beat with the oscillator, or with harmonics of the oscillator frequency.) An alternative method is to stop the oscillator of the receiver from oscillating by short-circuiting its grid coil or plate coil, or other obvious means.

(3)—Change the external input to the grid of the next previous tube and align the second from the last i-f transformer.

(4)—Change the input to the grid of the next previous tube (if there are three i-f transformers) and align the first i-f transformer.

(5)—AVC circuits may be made ineffective if desired, but in general, the sweeping of the input frequency takes place so fast (26 revolutions per second) that AVC action does not affect alignment.

Refer to Figure 12, the uppermost diagram. The capacity of the sweep condenser changes from minimum to maximum and back to minimum again in one revolution of the condenser shaft, and of course the impressed frequency would likewise change from minimum to maximum and back to minimum. (When the capacity is minimum, the frequency is maximum so that the variation of the frequency is in the reverse order to the variation in capacity of the sweep condenser. This is immaterial in the following discussion.)

On the next line is seen the voltage which will be impressed on the vertical plates of the cathode-ray tube, which is recognized as the rectified current output of the i-f amplifier, discussed in a previous diagram. If the i-f coils are to be aligned in the center of the sweep, then they are in alignment at the center of the increasing sweep and again in the center of the decreasing sweep which operation gives two waves for each revolution of the sweep condenser.

Of course, it is possible to show these two waves on the oscillograph screen, but as a rule, better results are obtained by using but one loop and enlarging the other so as to better study its configuration.

On the third line of the diagram there is shown the saw-tooth voltage which causes the horizontal swing of the beam. The frequency of the saw-tooth is twice that of the frequency of revolution of the sweep condenser. In most methods of i-f alignment, the ray of the cathode-ray tube is cut off every other cycle by biasing the control grid of the cathode-ray tube during this period (or by other means) so that for the first half-revolution, a wave is generated as shown on the left of the fourth line of the diagram; for the second half-revolution the screen is blank; for the third half-revolution the curve is again identical with the first and so on. The curve re-appearing every half-revolution will, of course, appear on the screen as a stationary curve and by its shape one can tell whether or not the alignment is correct.

The vertical line seen on the screen can be drawn by the operator in preparation for alignment to make sure that when the coils are finally adjusted they are aligned to the proper frequency. This should be done by disconnecting the sweep condenser, adjusting the oscillator to the proper i-f frequency and peaking the i-f coils for maximum output. Then the sweep condenser should be reconnected and the setting of the input frequency adjusted so that the highest peak lies on a vertical line drawn approximately in the center of the sweep. The receiver should then be trimmed so the curve is centered on this line and is exactly alike on the two sides.

The method just described, which is "usual method", is not the method recommended for use with this equipment and no provision has been made for using same.

The method used in the RCA Victor factory and for which this equipment is designed, may properly be called the reverse sweep method.

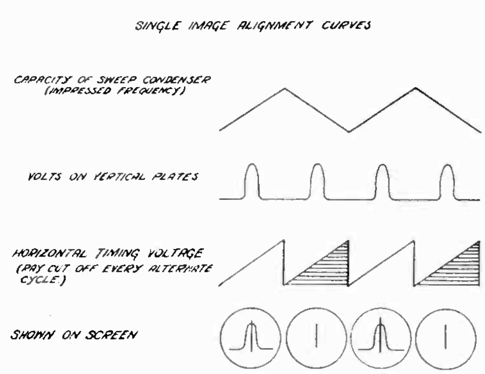


Figure 12—Alignment Curves (Single Image)

At the top of the Figure 13 is shown the curve which represents the capacity of the sweep condenser and at the same time the frequency of the input signal.

On the next line, is represented the output of the detector which is impressed on the vertical plates of the cathode-ray oscillograph as an asymmetrical wave. That is, a wave in which the leading side differs from the trailing side. Wave "A" will be produced when the frequency is increasing; wave "B" will be formed when the input frequency is decreasing and the next revolution of the sweep condensers these two waves are repeated, etc. Wave "B" is dotted so that it can be more clearly distinguished from wave "A" in the lower diagrams. On the third line is illustrated the saw-tooth voltage which produces a horizontal swing for each half-revolution of the sweep.

In the reverse sweep method the ray is not extinguished, as in the "usual method", but the increasing and decreasing curves are thrown on the screen one on top of the other.

In aligning a receiver by the reverse image method, the r f unmodulated oscillator must be adjusted so that the frequency is correct at the middle of the sweep. The trimmers

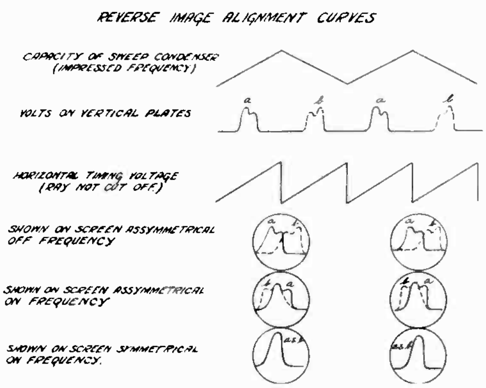


Figure 13—Alignment Curves (Reversed Image)

are then to be turned until the two curves exactly coincide throughout. The fact that the two curves have their centers coincident indicates that the transformer is tuned to the middle of the sweep (and are therefore on frequency) and the fact that the sides coincide shows that the transformer curve is the same on both sides of this point.

The fourth line of Figure 13 shows typical curves when the coil is neither properly tuned nor adjusted to the right frequency. The fifth line shows the curves when they are peaked at the right frequency but are not properly adjusted to accept both side-bands equally, i.e., they are asymmetrical.

The lowest line shows the curves "A" and "B" exactly coinciding and therefore symmetrical and on frequency.

In preparing for alignment using the reverse sweep method, the same procedure is to be followed as in preparing for the single sweep or "usual method".

(1)—Pull the plug extending from the sweep condenser to the r-f oscillator. Set the oscillator on the proper i-f frequency and arrange it for audio modulation.

(2)—Adjust the i-f amplifier for maximum output; i.e., peak it as much as possible.

(3)—Readjust the r-f oscillator to remove the audio modulation. Impress the sweep frequency. Adjust the frequency of the r-f oscillator until the forward and reverse waves show on the screen of the oscillograph. The highest point of wave "A" will be at the frequency for which alignment is to be made and will occur on the point of the increasing sweep at which the sweep frequency is exactly that for which the i-f is to be aligned. The highest point on wave "B" will be at the i-f frequency for which the coil is to be aligned and occurs when the downward sweeping frequency comes at the right point.

(4)—Adjust the frequency of the external r-f oscillator (raise the frequency) until the highest point of these two waves coincide. The highest point of wave "A" will then lie exactly in the middle of the upward sweep and the highest point of wave "B" will lie exactly in the middle of the downward sweep. (Perhaps the best way of showing this is to consider that the position of minimum capacity is the zero degree position; the position of average capacity, the ninety degree position; the position of maximum capacity, the 180 degree position; the position of average capacity in the decreasing side as the 270 position and the return to minimum capacity as the 360 or zero degree position. If the sweeping frequency passes through the alignment frequency at the 80 degree position, it will of necessity pass through the same point in the 280 degree position, hence peak "A" will lie a little to the left of the center of the horizontal beam movement and point "B" will lie a little to the right of the center of the horizontal beam movement. Only when the peaks come at the 90 and 270 degree positions can each peak lie on the center of the horizontal movement and only then can they coincide.) The adjustment of the r-f oscillator, to make the highest point of wave "A" and wave "B" coincide, corrects the oscillator setting to compensate for the added capacity of the cable and half of the sweep condenser capacity. This new position of the r-f oscillator dial can be read and recorded for future use so as to make unnecessary this calibration when future alignment is to be made using this same higher frequency. After the highest point of the two waves has been made to coincide, adjust the primary and secondary trimmers on the i-f coils until the two curves coincide

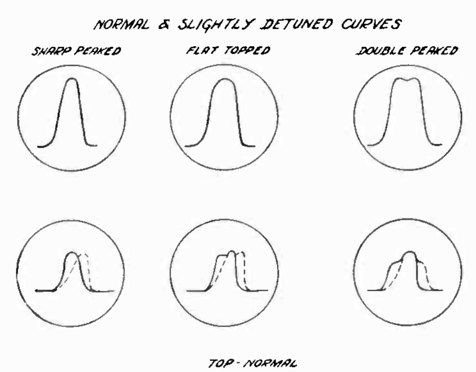


Figure 14—Typical I-F Curves

throughout their entire length. When this occurs, the coil is symmetrical with respect to the i.f. so that it does not favor one side band nor part of one side band more than it does the corresponding part of the other, and it is adjusted to the proper frequency.

The advantages of the reverse sweep method over the "usual method" are:

(1)—Avoids the necessity for extinguishing the ray on alternate half cycles.

(2)—Avoids the necessity of marking a line on the screen for vertical reference.

(3)—The possibility of error in aligning on frequency is reduced by more than one-half, since the separation between the two waves will be twice the displacement of one of the waves.

(4)—Distortion following detection (because of passing the signal through a transformer or condenser) does not cause error, since this distortion will occur on the right, or on the left, of both waves and proper alignment will be had, following the normal procedure of making the two curves coincide throughout.

(5)—The superposition of the right and left sides makes symmetrical adjustments easy and accurate.

In Figure 14 is shown three curves used in i-f transformers when properly aligned. The shape of these curves is very closely interconnected with the audio frequency characteristic of the audio end of the receiver and any change in the shape of the curve will change the audio frequency response. For example, in the sharply peaked curve at the left, a considerable cutting of side bands occurs with corresponding reduction in high frequency response, which would be compensated by a corresponding rise in the audio response of the amplifier.

Correspondingly, the flat-top wave shown in the center requires a different audio frequency characteristic and the double peak curve which results from overcoupling has a still different audio frequency response curve.

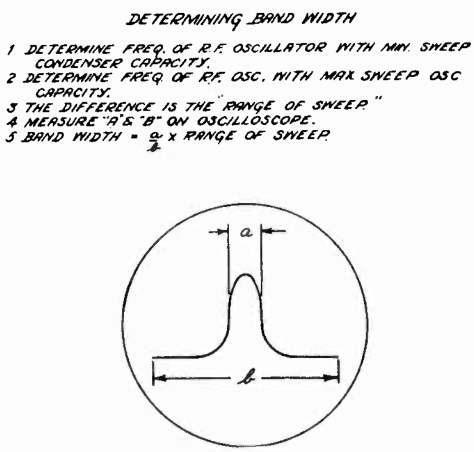


Figure 15—Typical Wave Shape

Below these three normal curves, there is a curve which obtains if one of the trimmers on the transformer was turned slightly. These indicate the necessity for great care, not only in getting the i-f transformer onto the proper frequency, but also in getting it to have the proper wave shape.

The determining of the width of the band which will be passed by an intermediate frequency amplifier is somewhat complicated until the constants of the apparatus are determined for the particular frequency in question, after which the determination of band width is comparatively easy. In outlining the procedure to be followed it is assumed that the particular intermediate frequency amplifier in question is aligned at 460 kc. and that the r-f oscillator is adjusted so that this frequency is in the middle of the sweep.

First determine the frequency of the r-f oscillator when the sweep condenser is in the minimum capacity position. This is done by setting the capacity of the sweep condenser at its minimum and adjusting the r-f oscillator so as to have it audio-modulated and feeding this signal into a receiver which is in reasonably good calibration. Tune the receiver to the fundamental, or to a harmonic of the modulated r-f signal and from the dial setting, record the frequency of

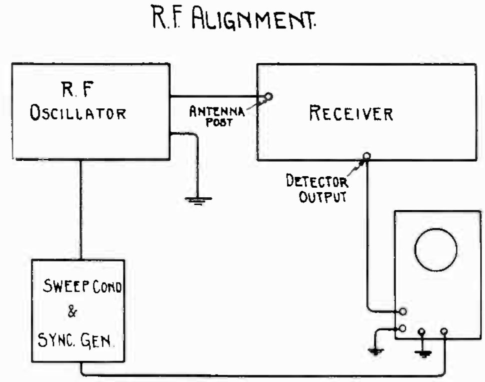


Figure 16—Connection for R-F Alignment

the input signal and calculate the fundamental frequency. Next, determine the frequency with the sweep condenser in the maximum capacity position. To do this tune the receiver harmonics of the r-f signal and calculate the fundamental frequency. Then subtract the minimum from the maximum capacity to obtain the total "range of sweep" in kilocycles.

This "range of sweep" is a constant for the particular r-f oscillator and sweep condenser at the r-f oscillator dial setting used. When this is known, the calculation of band width is very simple.

Figure 15 illustrates the wave as it will appear when symmetrical and on frequency, the length of line "B" is proportional to the range of sweep and if this range of sweep is 60 kc, band "A" will be 10 kc wide if the distance "A" were 1/6 as long as distance "B". The formula as shown on the diagram is: "band width" equals "A" divided by "B" times the "range of sweep".

R-F ALIGNMENT

The equipment and connections for making an r-f alignment using cathode-ray equipment is almost identical with that for making an i-f alignment, except, of course, in this case the r-f oscillator is fed into the antenna rather than onto the grid of the i-f amplifier tube. The output is again taken off the second detector. Figure 16 shows the necessary connections.

The procedure to be followed is:

(1)—Adjust the r-f oscillator so that the frequency in the middle of the sweep is exactly that to which the r-f is to be aligned and calibrated.

(2)—Set the dial at the proper point.

(3)—Feed the sweeping signal into the antenna.

(4)—Adjust the receiver oscillator trimmer until the forward and reverse curves coincide as well as possible.

(5)—Adjust the r-f trimmers until the curves coincide throughout. (It may be necessary to slightly re-adjust the receiver oscillator and again adjust the r-f trimmers to get maximum coincidence.)

In order to determine the proper setting of the dial of the r-f oscillator to give the proper frequency when the sweep capacity is exactly in the middle of its range proceed as follows:

(1)—Set the dial on the receiver to the point at which it is to be aligned.

(2)—Feed an audio-modulated signal of the single proper frequency (not sweeping) into the receiver and adjust the oscillator and the r-f coils to maximum possible output.

(3)—Then feed an unmodulated r-f frequency into the receiver and adjust the external oscillator until two curves show on the screen and until they coincide at their highest points. Record the setting of the r-f oscillator so that this (the above) procedure will not have to be repeated the next time an r-f amplifier is to be aligned at this frequency.

CONCLUSION

No mention is made in this discussion of the application of model TMV-122B oscillograph, which is perhaps the most valuable use it can have. By the use of cathode-ray equipment, knowledge of electrical apparatus and electrical circuits can be made much more real and conclusive. Whenever there is something which is not understood thoroughly, one will find that the oscillograph, by giving the picture of the otherwise invisible electric current, is an invaluable aid. There is no place where one can invest his money with a greater security or a greater percentage of profit than in increasing his own knowledge and ability. From this angle, a flexible cathode-ray equipment opens advantages which previously have been denied to any but the greatest of our laboratories.

Instructions 23341

for

Type TMV-128-A Frequency Modulator

INTRODUCTION

The Type TMV-128-A Frequency Modulator is a device for use with a test oscillator (such as the TMV-97-C or similar) to "sweep" the oscillator frequency and at the same time provide a voltage for synchronizing the timing axis of a cathode-ray oscillograph (such as the TMV-122-B) with the position of the sweep condenser. It consists of a driving motor coupled to a sweep condenser and an impulse generator. Two ranges of sweep capacity are provided, as listed below, and a cable fitted with plugs at each end is furnished for connection to the test oscillator. The unit operates entirely from a 110/120 volt, 50/60 cycle a-c supply.

INSTALLATION

Figure 1 shows the interconnections of the Frequency Modulator with the TMV-97-C Test Oscillator and Cathode-Ray Oscillograph, Type TMV-122-B. This arrangement is commonly used for making r-f and i-f alignment of a radio receiver. For other applications, this set up may be modified according to the requirements of the particular case.

OPERATION

When the units are properly interconnected, select the "Hi" or "Lo" position of the range switch according to the percentage sweep desired (see the curve on the back of this sheet), and turn the motor "On." When through operating, turn the motor switch to the "Off" position.

MAINTENANCE AND SERVICE

Specifications

Power Supply Voltage and Freq.	110/120 Volts, 50/60 Cycles
Power Consumption	25 Watts
Drive Motor	Shaded Pole-Induction; 1/200 HP.
Drive Motor Speed	1550 R.P.M.
Sweep Condenser Capacitance	High Range—25 to 70 Mmfd. Low Range—15 to 37 Mmfd.
Connection Cable Capacitance	40 Mmfd.
Impulse Generator Output	1.5 Volts
Over All Dimensions	Height, 8½ Inches Width, 9¾ Inches Depth, 4½ Inches
Weight	5¼ Pounds

Bearing Lubrication

The small induction drive motor has oil holes at each of its waste-packed bearings. Light engine oil should be used at these points. A ball-bearing support is used at the impulse generator. It is packed with "vaseline," which should be replenished after every 100 hours of operation.

Sweep Condenser

This element of the assembly consists of two conventional type rotary condensers, each having a single rotor plate attached to a revolving shaft. The stators are wired so that one remains connected at all times and a switch is used to parallel the two in order to increase the range of sweep.

The rotor plates should be exactly centered between the stator plates when the mechanism is operating at its normal speed (1550 r.p.m.). If the plates change their relation, they should be re-centered by adjusting the drive shaft in the coupling, or shifting the rotor plates on the shaft. The line-up of the rotor plates in respect to the armature of the impulse generator is important in that it governs the synchronization of the system. The proper adjustment is obtained when the two rotor plates are either at maximum or minimum capacitance, and the armature sets horizontal (air gap minimum). A slight shift may be necessary to center the resonance curve on the screen of the TMV-122-B.

Impulse Generator

A small induction generator is used to furnish means of controlling the frequency of the "Saw Tooth Oscillator" of the Oscillograph. It is necessary to maintain a definite polarity on the output connec-

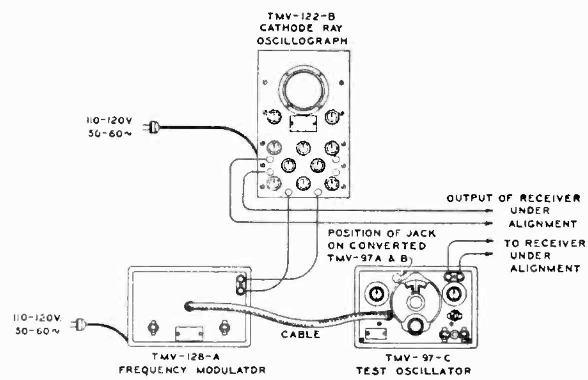


Figure 1

tions of this generator. The horse-shoe magnet should therefore be replaced as originally installed, if it has been removed for repair or service. It is also important to retain the original relation of the coils. Correct polarity exists when a positive swing is obtained on a 200 microampere d-c meter with its plus terminal connected to "high," and the mechanism rotated by hand in such a direction as to cause a decrease in air gap.

Mechanical Alignment

The drive motor, sweep condenser and impulse generator must be in correct physical relations to each other, inasmuch as they all rotate on the same shaft. The motor mounting screws are arranged to permit small lateral adjustments of the motor position. Both the stator and rotor plates of the sweep condenser may be adjusted to obtain the correct centering alignment. End-play of the shaft should be kept at a minimum without affecting the freedom of rotation.

Brush Connection

The point of contact between the revolving shaft and the brush of the sweep condenser circuit should be kept clean at all times. No oil or dirt should be allowed to accumulate. Poor contact is evidenced by ragged wave form on the oscillographic image.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	DESCRIPTION	List Price
	FREQUENCY MODULATOR (TMV-128-A)	
7905	Brush—Grounding brush—Package of 5	$0.85
7907	Cable—Connector cable with two plugs	1.50
7909	Case—Case complete—Less binding posts, jack, switches and chassis	6.70
7904	Coil—Impulse coil (L1, L2)	1.25
7899	Coupling—Motor coupling	$0.25
7901	Escutcheon—Off-On switch escutcheon	.28
7902	Escutcheon—High-Low switch escutcheon	.28
7903	Jack (J1)	.45
7898	Motor—Motor complete (M1)	12.00
7908	Plug—Cable plug	.68
7906	Post—Binding post engraved "High"-"Low"	.45
7900	Switch—Toggle switch (S1, S2)—Off-On, High-Low—Less escutcheon	.75

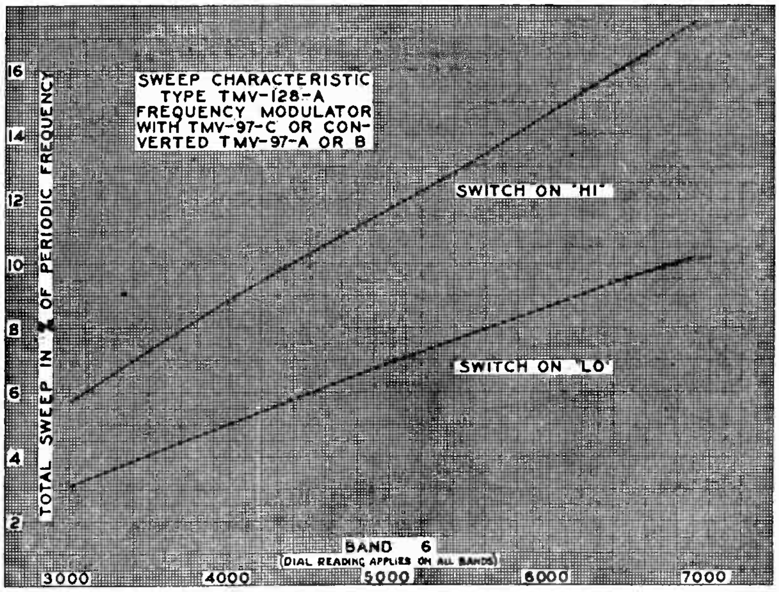


Figure 2—Sweep Characteristics of TMV-128-A with TMV-97-C

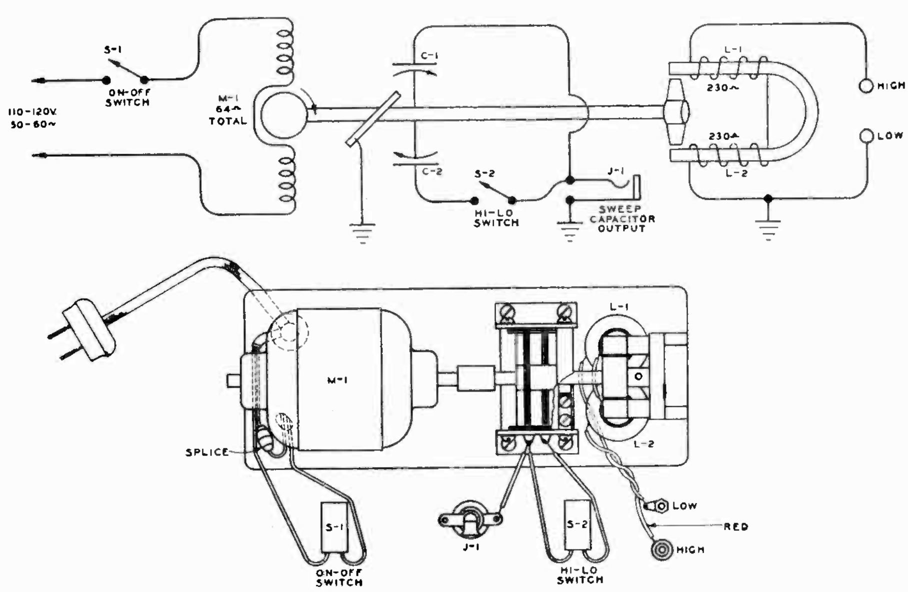


Figure 3—Schematic and Wiring Diagrams, Type TMV-128-A Frequency Modulator

Instructions 23340

Test Oscillator Conversion Kit

Type TMV-131-A

For Use on Oscillator, Type TMV-97-A or B

(Read Carefully before making changes)

—INTRODUCTION—

This kit is for the purpose of extending the use of the Full Range Oscillator, TMV-97-A or B, to permit the alignment of radio and intermediate frequency stages of a receiver by means of the Cathode Ray Oscillograph, TMV-122-B. This is accomplished through the use of the Frequency Modulator, TMV-128-A, which sweeps the oscillator output frequency over a definite range when plugged into the jack on the front panel of the modified oscillator.

The kit includes:

- Shielded Coil Assembly with Mounting Unit.
- Attenuator High-Low Output Switch and Escutcheon.
- Modulation Switch and Escutcheon.
- Range Switch Escutcheon.
- Sweep Capacitor Jack.
- Dial Scale.
- Two Resistors, one 220,000 ohms and one 2200 ohms.
- Nut ⅜″–32.

The controls on the front panel will now comprise the "On-Off" switch for the oscillator, the "Mod-Off" switch for the modulator tube and the "Hi-Lo" switch for attenuation of oscillator signal, all of which are toggle type. There is also a new range switch plate, a jack for plugging in the frequency modulator, and a new dial scale.

In addition to the greater field of utility for the oscillator the performance is considerably improved by the complete shielding of the coils. The converted unit operates with a maximum output increased to 0.1 volts (r.m.s.). The attenuator switch provides a stage of attenuation of 100 to 1 in addition to the variable attenuation provided by the output control. The minimum signal with the attenuation switch on "Lo" and the output control on zero will be less than 20 microvolts at any frequency setting within the range of the instrument.

—REMODELLING—

Note — *Keep the variable capacitor (C-3, Figure 2) closed while making changes, to prevent bending or damaging the plates.*

Dismantling

1. Take out the front panel, complete with the chassis and batteries, from the case and remove the tubes and batteries from the chassis.

2. Disconnect the chassis and remove it and all other parts and connections from the back and front of the panel leaving the panel stripped.

3. Remove the coils and their connectors and wires and also the antenna capacitors, C-1 and C-2 (see TMV-97-A or B diagram), from the chassis.

4. Take dial apart by removing the knob and extracting the pin in the shaft, thus releasing the spiral spring and freeing the plate. The center hub cap will have been taken off and the set screw loosened in dismantling the front panel. Remove the old paper scale from the dial plate.

Re-Assembly

1. Clean the back of the front panel with coarse sandpaper at the points where contact is made with the coil assembly, output control, phone jack, dial contact spring and ground binding post, thus assuring good electrical connections to the panel at these points.

2. Tear off the template, attached to this booklet, and cut out along the boundary lines. Place on the back of the front panel and mark for drilling. Drill holes in accordance with instructions on template. The holes for the new and old output controls and range switches run together, making it advisable to file rather than drill the new holes.

3. Mount in sequence the following parts on the front panel, in accordance with the wiring diagram, Figure 2.

(a) Modulation Switch and Plate (Mod-Off)—S-5.
(b) Attenuation Switch and Plate (Hi-Lo)—S-6.
(c) Output Control, Plate and Knob.
(d) Antenna and Ground Binding Posts.
(e) Coil Unit, Range Switch Plate and Knob.
(f) Sweep Capacitor Jack.

4. Cut out the new dial scale accurately around the outer and inner circles and carefully attach in

place centrally on the dial plate using gasket cement, shellac or an equivalent binder. Reassemble the dial.

5. Attach the chassis to the front panel and mount the Power Switch and Plate (On-Off), S-4, in position.

6. Solder the resistors R-4 and R-5 (Figures 2 and 3) in place at the Attenuator Switch and make the necessary connections and grounds in accordance with the diagrams (Figures 1, 2 and 3). New wiring is shown in heavy lines on the General Wiring Diagram (Figure 2). The shielded lead from the coil assembly should pass below the shaft of the tuning capacitor (C-3). The lead to the jack should be spaghetti covered bus wire. The lead from S-6 to R-1 if shielded will give improved performance. The shielding should be soldered to case of R-1 and to ground binding post. All other additional wiring should be done with flexible hook-up wire.

7. Mount the dial assembly in place on the front panel, leaving the hub screw untightened. Set the dial scale by turning the knob until the indicator line at the outer circle coincides with the hairline on the transparent window. Set the variable capacitor (C-3) by hand to its closed position of maximum capacity. Check alignment, tighten up dial hub set screw, making sure that the movable part of the tuning capacitor revolves freely. Replace hub cover.

8. Replace the tubes and batteries and assemble the unit in the outer case.

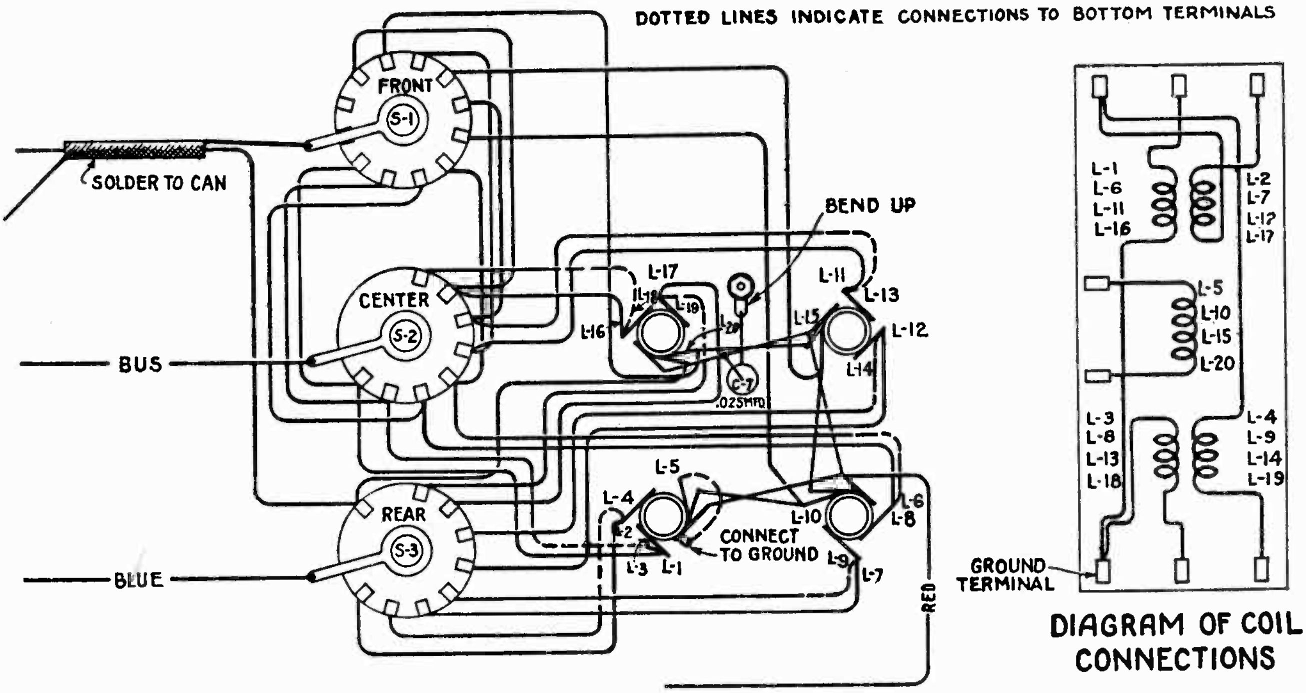


Figure 1—Coil and Switch Assembly

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	DESCRIPTION	List Price	Stock No.	DESCRIPTION	List Price
7918	Base — Coil mounting base — Complete — With bushings and terminal	$0.22	5159	Resistor — 2,200 ohms — Carbon type — ¼ watt (R4)—Package of 5	$1.00
4870	Capacitor—.025 mfd. capacitor (C7)	.20	5158	Resistor—220,000 ohms—Carbon type—¼ watt (R5)—Package of 5	1.00
7914*	Coil—Oscillator coil (L1, L2, L3, L4, L5)	1.06	7922	Scale—Attenuator switch dial scale	.16
7915*	Coil—Oscillator coil (L6, L7, L8, L9, L10)	.80	7923	Scale—Modulator switch dial scale	.16
7916*	Coil—Oscillator coil (L11, L12, L13, L14, L15)	.65	7921	Scale—Range switch dial scale	.20
7917*	Coil—Oscillator coil (L16, L17, L18, L19, L20)	.65	7912	Shield—Coil assembly shield (top)	.20
7911*	Shielded coil assembly—Complete with mounting unit	9.00	7913	Shield—Coil assembly shield (bottom)	.30
7924	Dial—Tuning condenser drive dial scale	.16	7919	Switch—Range switch—Less coil, mounting base (S1, S2, S3)	1.85
7903	Jack (J1)	.45	7925	Switch—Single pole, double throw, toggle switch (S5, S6)	.52
7920	Lead—Shielded lead	.18			

*FOR REPLACEMENT PURPOSES ONLY—ITEM TO BE REPLACED MUST BE RETURNED WITH ORDER.

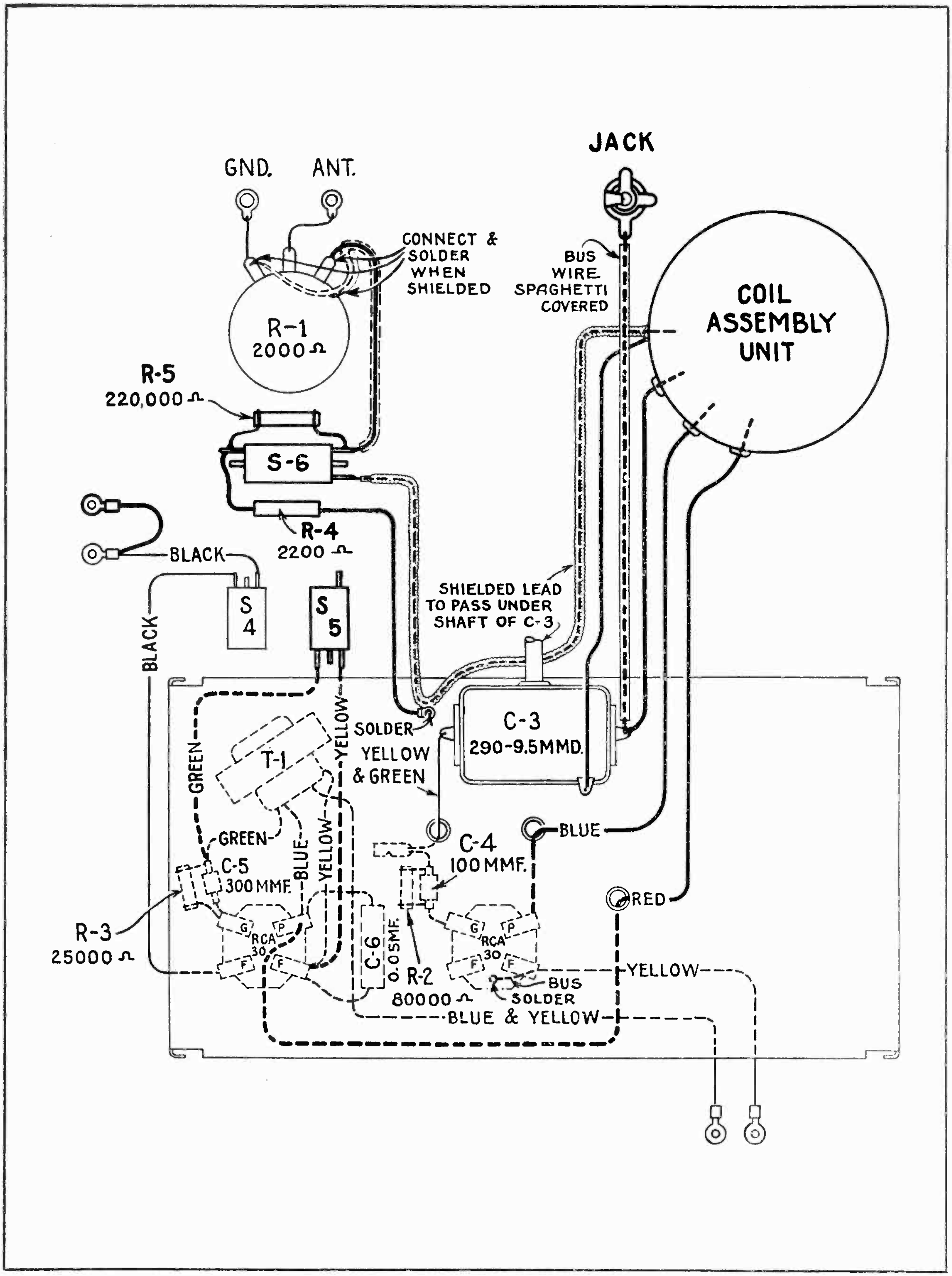
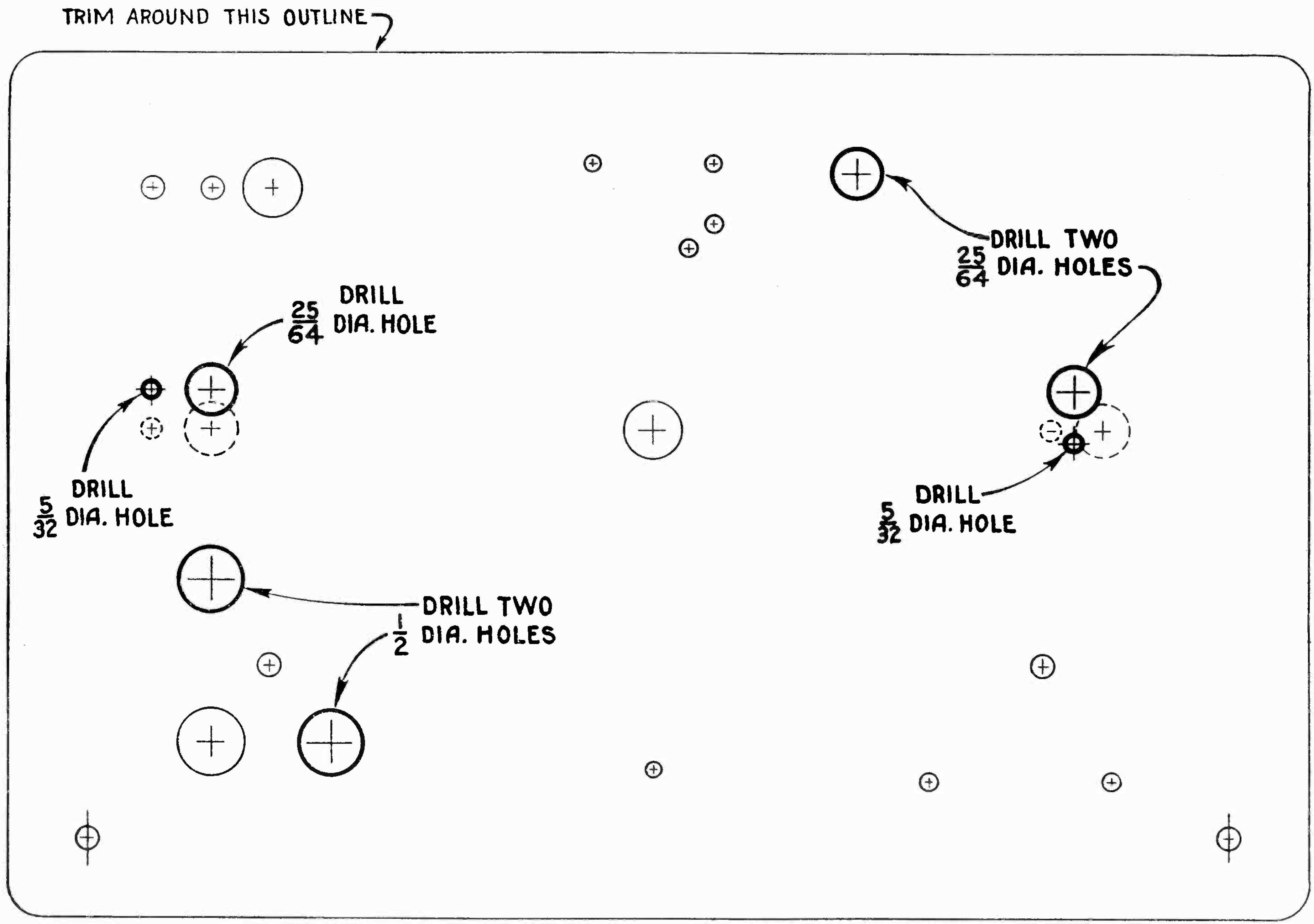


Figure 2—General Wiring Diagram



BACK OF PANEL

Cut out along boundary lines and attach to back of panel for drilling Template

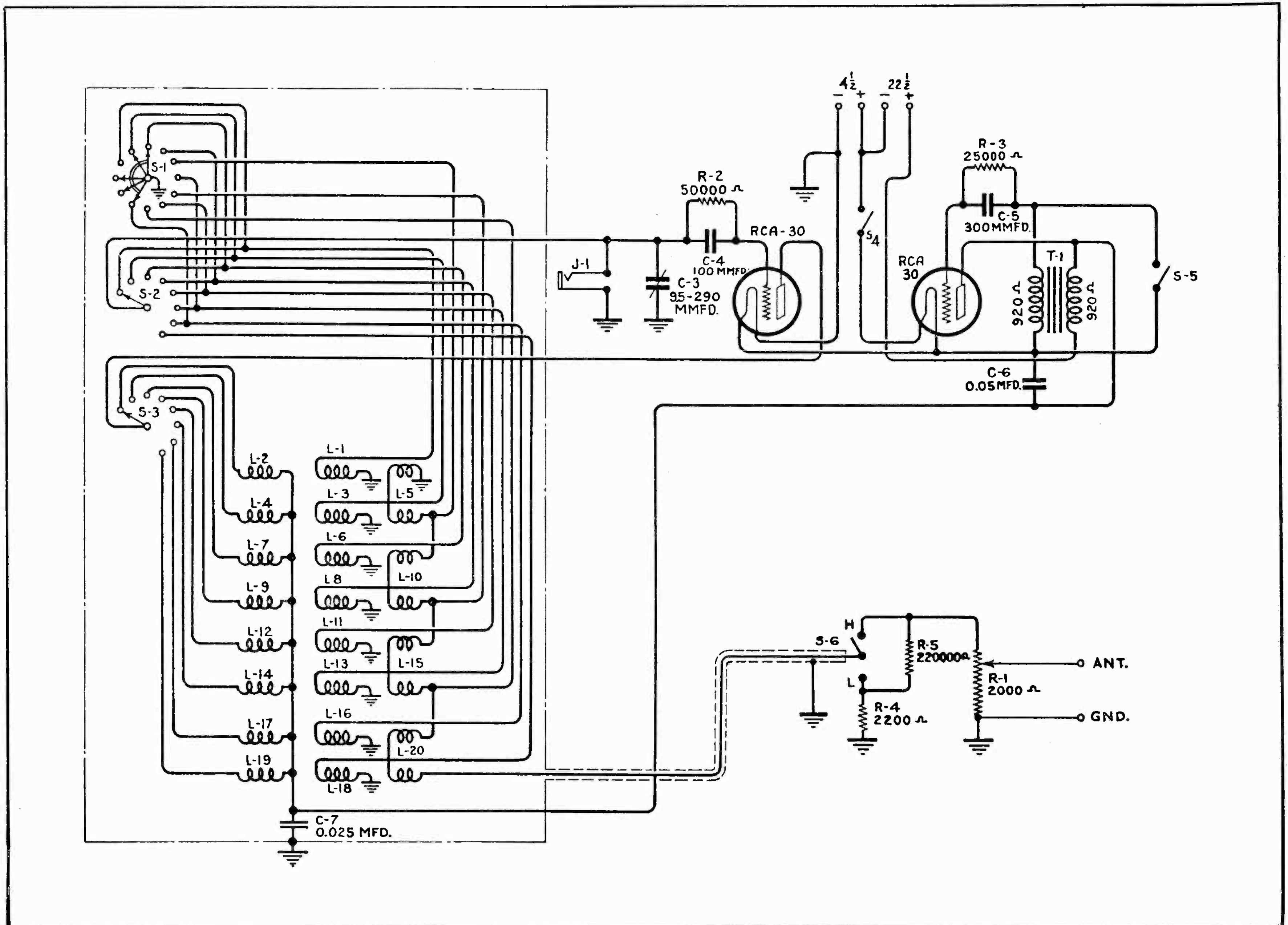


Figure 3—Schematic Diagram

UNIVERSAL A. C. BRIDGE

TYPE TMV-132A

INTRODUCTION

These instructions cover the operation, maintenance, and servicing of the Type TMV-132A Universal A.C. Bridge, a self-contained, portable, a-c operated instrument. This Universal Bridge consists of a variable-ratio-arm Wheatstone Bridge having three standards each of inductance, capacity and resistance. A vacuum tube 1,000-cycle oscillator and a two-stage amplifier, together with their power supply, make up the major part of the equipment. The only additional equipment required is a "null" indicator for which the usual high impedance headphones suffice. Power is obtained from a 110- to 120-volt, 25- to 60-cycle supply.

Referring to Figure 1, two terminal posts in the upper left-hand corner, marked "X," are the points to which the component to be measured is connected. Beneath are the two phasing controls, used for balancing out the resistance component always present in inductors or capacitors. The upper control graduated from 1 to 100 is for coarse adjustment. The lower control, graduated from 1 to 10, is used when fine adjustment is required. The control, "Capacity Balance for Resistance, 100M-1 Meg.," in the lower right-hand corner is a phasing control necessary for obtaining balance in this range. Above this phasing control is the "Range" selector switch, which determines the type and range of measurement, i. e., whether it is resistance, capacity or inductance, and in conjunction with the "Low-High" switch, the bracket of measurement is indicated. The main dial, (calibrated from 1 to 10) located in the center of the panel, is used for obtaining balance on all measurements. The switch marked "R in X Arm" and "R in Std. Arm" shifts the "phase" controls from the "X" arm to the "Std.". arm of the bridge.

OPERATION

With the phones plugged in and with no external connections to the "X" terminals, make the 110-volt connection to the line and turn the "110-Volt A.C." switch "ON." After a short interval, during which the tubes are warming up, a 1,000-cycle tone will be heard in the phones. The bridge is now ready for operation.

Caution: Do not connect the case or any part of this instrument to ground. The unknown unit being measured must not be grounded. This is necessary for the protection, operation and accuracy of this bridge.

The unit to be measured may now be connected to the binding posts marked "X" with its low terminal connected to the "X" terminal to the left. By low terminal it is meant that terminal nearest ground potential. The bridge may now be balanced (see specific instruction under Resistance, Capacity and Inductance measurements). Remember that the balance is indicated by minimum ***1,000-cycle*** tone in the headphones. When this condition exists, the second harmonic, 2,000 cycles, often becomes quite loud in the phones. This, however, does not indicate an unbalance. The ***1,000-cycle*** tone is always the tone to adjust to a minimum.

If it is found impossible to obtain a null point on the bridge, the unit under test is either defective or outside the range of the bridge. Note, however, that it is impossible to measure with the bridge the resistance of an inductor. This does not indicate a faulty inductor or bridge, but is simply a characteristic of this type bridge circuit.

RESISTANCE MEASUREMENTS

Connect the resistance to be measured to the binding posts marked "X." The low side of the resistor should be connected to the terminal to the left. The two phasing controls should be set so that each is at its counterclockwise position, since they are not used in resistance measurements. More conveniently, they may be cut out of the circuit by throwing the phasing toggle switch to the down, "R in Std. Arm" position. Now select the lowest resistance scale. This is done by throwing the range toggle switch to "Low" and by turning the Range Switch to the first resistance position (1-10 ohm). Now turn the large centrally located knob so that the pointer moves over the main scale from 1 to 10. If the resistance we have selected to measure lies anywhere between 1 and 10 ohms, a null point (balance) will occur and moving the pointer in either direction will ***increase*** the signal in the phones. If the null point is exactly at 5 on the scale, the resistance of the unknown is 5 ohms. If it occurs between 5 and 6 and exactly on the first small division to the right of 5, the resistance is 5.1 ohms. If no null point is found on this scale, throw the toggle switch to "High." The main scale now reads from 10 to 100 ohms. If still no null point is found, set the toggle switch on "Low" again and move the Range Switch one position to the right, so that just under ohms we read 100-1M. Since M represents 1,000, the scale now reads 100 to 1,000 ohms. In a

Figure 1. Universal A. C. Bridge

like manner, by throwing the toggle switch to "High" the main scale becomes 1M to 10M; that is 1,000 to 10,000 ohms. On this latter scale, a null point at 5 means that the unknown resistance is 5,000 ohms. If it is known before-hand that the resistance is somewhere between 1,000 and 10,000 ohms, then the range switch and "Low-High" switch are set to select this range and the resistance reading obtained from the main scale after locating the null point. With this control set at approximately mid scale obtain an initial resistance balance. Then vary the capacitor for a null point. A slight readjustment of the resistance balance may be necessary for the minimum null point.

CAPACITY MEASUREMENTS

Set the bar pointer knob so that it is pointing to MMFarads, which is an abbreviation for the familiar micro-micro-farads. Set the toggle switch to "Low" so that the range we are using is "below 100." Now move the pointer over the main scale and at somewhere near 30 (scale division 3) a null point will be found. This is the balance point with no capacity across the "X" terminals. For convenience, we will refer to this reading as the capacity constant "K." Now if a small capacity is connected across the "X" terminals, say 20 MMFarads, a new null point will be found at the capacity constant reading plus 20. Therefore when making measurements with the range switch in the lowest capacity position, the null point is found, the scale is read and then "K" is subtracted from this reading. For illustration, if "K" is 28 MMFarads, and with the unknown connected, the reading is 90, then the value of this unknown is 90-28 or 62 MMFarads.

At this point the two variable resistor phasing controls should be considered. For the very small capacitors treated above, their setting does not affect the null point appreciably. The reason for the inclusion of these controls in this bridge is that all capacitors and inductances have some resistance. The amount of this resistance is an indication of power loss. Ordinarily we are not interested in exact power loss, but in order to secure a null point the effect of this resistance must be balanced out.

To continue with capacity measurements, leaving the range switch (pointer) at MMFarad, throw the toggle switch to "High." The scale is now from 100 to 1,000 MMFarad. In this range, the phasing controls have more effect on the null point. Set the phasing controls at their minimum positions and with the main control secure a tentative null reading. Then increase the upper (coarse) control to see if the signal increases or decreases. If the signal decreases, adjust the phasing control for a minimum signal. Then readjust the main control for minimum. The true null point is obtained by successive adjustments as outlined above.

If increasing the phasing control causes an increase in signal instead of a decrease, then the toggle switch to the right of the lower control should be thrown to the opposite position and successive adjustments made until the null point is obtained. In this capacity range (100 to 1,000 MMFds.) the lower (fine) phasing control will have little effect. In this range also the capacity constant "K" is subtracted from the null point reading. If the null is at 500 MMFd. and "K" is 30, then the true capacity is 500 minus 30 equals 470 MMFd. For all higher capacity ranges, this correction need not be made as it will be a negligible portion of the capacity.

INDUCTANCE MEASUREMENTS

Connect the inductance to be measured to the "X" terminals and with its low side connected to the left terminal, a preliminary null point is obtained on the main scale. Then the phasing controls should be adjusted to reduce the signal in the phones to a new low point. Successive adjustments of the main control and phasing controls should be made until the lowest signal can be obtained. The inductance is read directly from the main scale. For illustration, suppose the Range Switch is set to "millihenry," the range toggle switch is on "Low" and the main scale reads 6, then the inductance is 6 millihenries. The setting of the phasing controls is not taken into consideration at all. The two phasing controls are in series and in measuring inductance it will usually be necessary to find the resistance component balance roughly on the "coarse" control and then adjust the "fine" control for the final balance. Facility in successively manipulating the phase control and ratio comes readily with practice. On the lowest inductance scales, the resistance balance is quite critical and some care will be required to secure the correct null point. This same care is necessary with a laboratory bridge as well.

RANGE AND APPLICATIONS

Capacity

The capacity range of this instrument is from 10 MMFarads to 10 MFarads, a range of 1,000,000 to 1. Capacity between leads, capacity from wiring to ground, the minimum and maximum of tuning condensers can be found readily, as well as the higher values of capacity of by-pass capacitors, etc. Electrolytic condensers may be measured up to values of 10 microfarads. For accurate measurements, the electrolytic condenser should be formed from three to five minutes by the application of rated voltage of the proper polarity.

Inductance

The inductance range is from 100 Microhenries to 10 Henries, a range of 100,000 to 1. In general, the inductance of the windings of the audio transformer cannot be measured, due to their high values. However, this type of measurement is not generally made by bridge measurements. Due to the iron cores, the inductance is not constant and a satisfactory balance cannot usually be obtained.

Resistance

The resistance range is from 1 ohm to 1 megohm. Above 100,000 ohms, the capacity to ground of the bridge arms must be balanced out to obtain a sharp null point. The control directly below the range switch is for this purpose and functions in that range only.

The greater part of the values of resistance, inductance and capacity used in communication engineering can be measured very satisfactorily. Testing, servicing and development is practically impossible unless the quantities used are known.

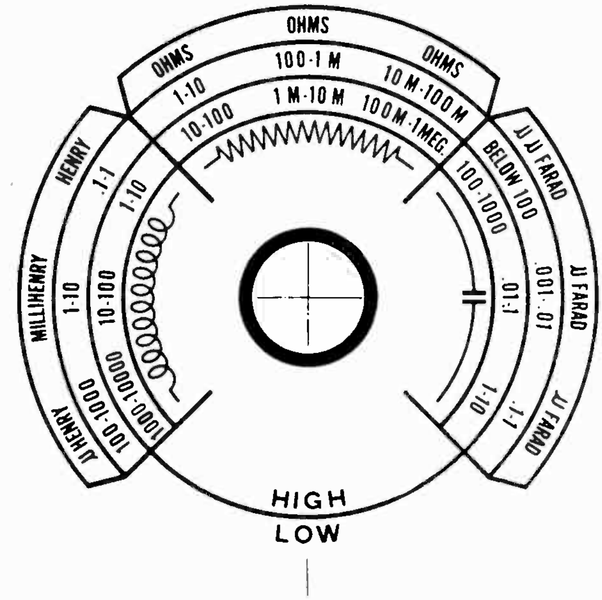


Figure 2. Range Scale

Circuit Description

Bridge Elements

A simplified a-c Wheatstone Bridge is shown in Figure 3 to illustrate the principles of measurement involved, whereby, the value of an unknown resistance, capacitance, or inductance may be measured by comparison with a known standard resistance, capacitance, or inductance. This diagram shows an impedance network into which an unknown "X" may be connected in series with a known "Standard," a variable ratio arm "A," and a fixed arm "B." An a-c voltage of 1,000 cycles is connected across the bridge elements between points C and D. An indicating device (headphones) is connected between points E and F to detect balance. Such a balance is indicated when a minimum signal is heard in the headphones, thus indicating that the ratio of arm "A" to arm "B" is identical to the ratio of the unknown "X" to the "Standard." By calibrating arm "A," the value of the unknown may be read direct. By properly choosing the values of the standards, the various ranges may be made multiples of the basic range of 1 to 10.

In the schematic circuit of the TMV-132-A Bridge shown by Figure 4, the 1,000-cycle energy is delivered to the bridge elements through the transformer (T-1) which is balanced capacitively to ground. This transformer isolates the bridge elements from the auxiliary equipment; that is, the power supply and oscillator, and insures the desired capacity-to-ground of the "known" and "standard" arms of the bridge.

The differential voltage, which indicates unbalance, is fed from the bridge elements through condenser (C-4) to the pentode-grid of the RCA-6F7 Radiotron. This unbalance-voltage is amplified in both sections of the tube and then made audible by headphones connected to the secondary of the output transformer (T-3), the primary of which is connected in the plate circuit of the triode section.

Three standards each of inductance, capacitance, and resistance contained in the bridge elements are so arranged as to be selected by the Range switch (S-1). Two ranges for each standard are obtained by means of the High-Low switch (S-4).

Arm "A" is the Main Linear Control (R-6) calibrated over a range of from 1,000 to 10,000 ohms. Arm "B" is 10,000 ohms (R-8) for the "low" position of the High-Low switch, and 1,000 ohms (R-7) for the "high" position of the High-Low switch. This arrangement, for a given standard, gives ratios of 0.1-to-1 for the "low" position and 1-to-10 for the "high" position. An overall range for one standard is, therefore, 1-to-100. By this arrangement, the ratio of the bridge arm is never greater than 10, thus preserving sensitivity.

For inductance and resistance measurements, the "X" arm is the unknown element being measured, and "standard" is the internal standard selectable by the Range switch (S-1). Then, the ratio of the unknown resistance or inductance is to the standard resistance or inductance as arm "A" is to arm "B." The two phasing controls, (R-5) and (R-4) can be placed in either the "X" arm or "standard" arm by means of the "R in X Arm—R in Std. Arm" switch (S-3). The two rear sections of the Range switch act as a double pole-double throw switch to reverse arms "X" and "standard" ***for capacity measurements,*** since the reactance of a condenser decreases as its value increases. This permits use of the same linear scale for all measurements.

Oscillator

The oscillator which supplies the 1,000-cycle energy to the bridge elements consists of an RCA-76 and transformer (T-2). The grid winding of the transformer is tuned to 1,000 cycles by condensers (C-7) and (C-16). Self bias is obtained by the grid leak-condenser combination (R-13) and (C-5). A separate winding is provided to feed the energy to the bridge elements through transformer (T-1).

Amplifier

An RCA-6F7 Triode-Pentode Radiotron is used as a two-stage amplifier to provide adequate 1,000-cycle energy to the headphones for detecting balance. The signal from the bridge elements is amplified in the pentode section and then fed to the triode section through condenser (C-12) The plate impedance of the pentode section is tuned to 1,000 cycles by (L-4) and (C-13), which permits maximum signal voltage to appear on the triode grid. This arrangement provides high sensitivity, giving a sharp balance. The energy is then transferred to the headphones through transformer (T-3).

Power Supply

The rectifier, an RCA-25Z5 Radiotron, comprises two separate diodes of the heater-cathode type. It is employed in a voltage-doubler circuit and acts as a full-wave rectifier with one-half of the tube passing current to the load on each half of the a-c input

Electrical Specifications

Power Supply Rating	Voltage	110-120 Volts A.C.
	Frequency	25-60 Cycles
	Wattage Consumption	40 Watts
	Fuse Protection	2 Amps.
Applications and Ranges	Capacity	10 Mmfd. to 10 Mfd.
	Resistance	1 Ohm to 1 Megohm
	Inductance	100 Microhenries to 10 Henries
Radiotrons Used and Functions	1 RCA-76	Oscillator
	1 RCA-6F7	Triode-Pentode Amplifier
	1 RCA-25Z5	Rectifier-Doubler

Mechanical Specifications

Overall Dimensions	Height	6½ inches
	Width	9¾ inches
	Depth	4½ inches
Weight (Net)		6 pounds
Weight (Shipping)		9½ pounds

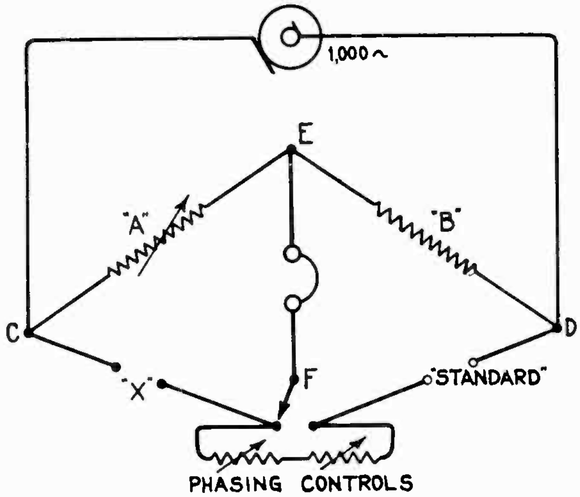


Figure 3. Simplified Wheatstone Bridge

cycle. During the period that one half of the Radiotron is rectifying, the condenser across the other half is discharging through the conducting diode and the load. The voltage across the load is the sum of the d-c output voltage of the conducting diode and the discharge voltage of the condenser. C-8 and C-9 are the condensers which are alternately charging and discharging. C-10 and R-11 constitute a resistance-capacity filter. R-11 and R-12 form a bleeder circuit. The filaments of the three tubes and the dropping resistor (R-9) are in series across the line.

MAINTENANCE

The various diagrams given in this booklet contain such information as will be needed to isolate causes for defective operation when such develops. The values of the various resistors, capacitors, and inductances are indicated adjacent to the symbols signifying these parts on the diagrams. Identification titles such as R-3, L-2, and C-1, etc., are provided for reference between the illustrations and the Replacement Parts List. These identifications are in a sequence which begins at the left of the diagram and increases numerically from left to right, thus facilitating the location of such parts on the schematic diagram.

The coils, reactors, and transformer windings are rated in terms of their d-c resistance. This method of rating provides ready means for checking continuity of circuits. Suspected faulty circuits or parts may be checked and their resistances compared with the value given on the schematic diagram.

Failure of operation may result from:

(1) Power supply being "off."
(2) Open fuses within the instrument.
(3) Defective tubes.
(4) Open or disconnected headphones.
(5) Defects within the instrument itself.

CAUTION—Disconnect power supply before removing case.

Care in removing the case will prevent damage to the internal parts. After the four screws around the edge of the front panel are removed, the panel should be tilted forward and the case slipped off, simultaneously pushing in the power cord.

Radiotrons

Under ordinary usage within the ratings specified for voltage supply, tube life should be consistent with that obtained in other applications. Inability to obtain balance, loss of sensitivity, or total failure of operation, may be indicative of tube trouble.

If tube trouble is suspected, the tubes should be removed from the instrument and tested in a reliable tube-testing device. Replacing a questionable tube with one known to be good is another sure and definite means of tracing tube trouble.

Fuse Replacements

Both sides of the a-c line are protected by small 2-ampere cartridge fuses. These fuses are located on a fuse board mounted beneath the chassis on the left apron, when viewed from the bottom-rear. These fuses are intended for protection of the entire power system of this instrument and, therefore, should not be replaced with ones having a higher rating, nor be shorted out. Fuse failures should be carefully investigated before making replacements, since fuses of good quality fail only under conditions of overload. The cause may originate from a surge in the power-supply line, but more likely the cause may be centered in the apparatus protected, such as shorted rectifier elements, etc. Poor contact of the fuse clips may result in an open fuse due to the heat developed. These contacts should, therefore, be kept clean and in secure contact with the fuses.

Radiotron Socket Voltages

Operating conditions of the basic circuits of this instrument may be determined by measuring the voltages applied to the tube elements. Figure 6 shows the voltage values from the socket contacts to ground and appearing across the heater contacts (H-H). Each value as specified should hold within ± 20% when this instrument is normally operative with all tubes intact and rated voltage applied. Variations in excess of this limit will usually be indicative of trouble.

The voltages given on this diagram are actual measured voltages, and are the results obtained after the loading of the circuit, by the voltmeter, has taken place.

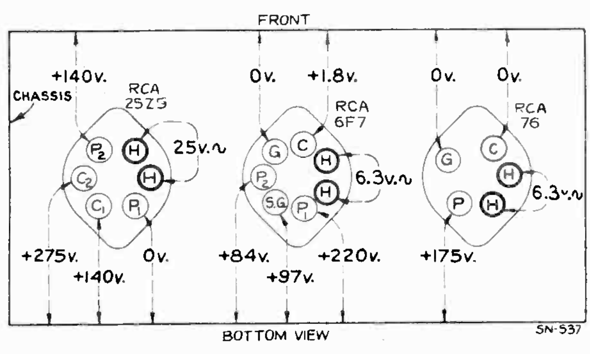


Figure 6. Socket Voltages

To fulfill the conditions under which the d-c voltages were measured requires a 1,000-ohm-per-volt d-c voltmeter having ranges of 10, 250, and 750 volts. Voltages below 10 volts should be measured on the 10-volt scale; between 10 and 250, on the 250-volt scale; and above 250 on the 750-volt scale. To accu-

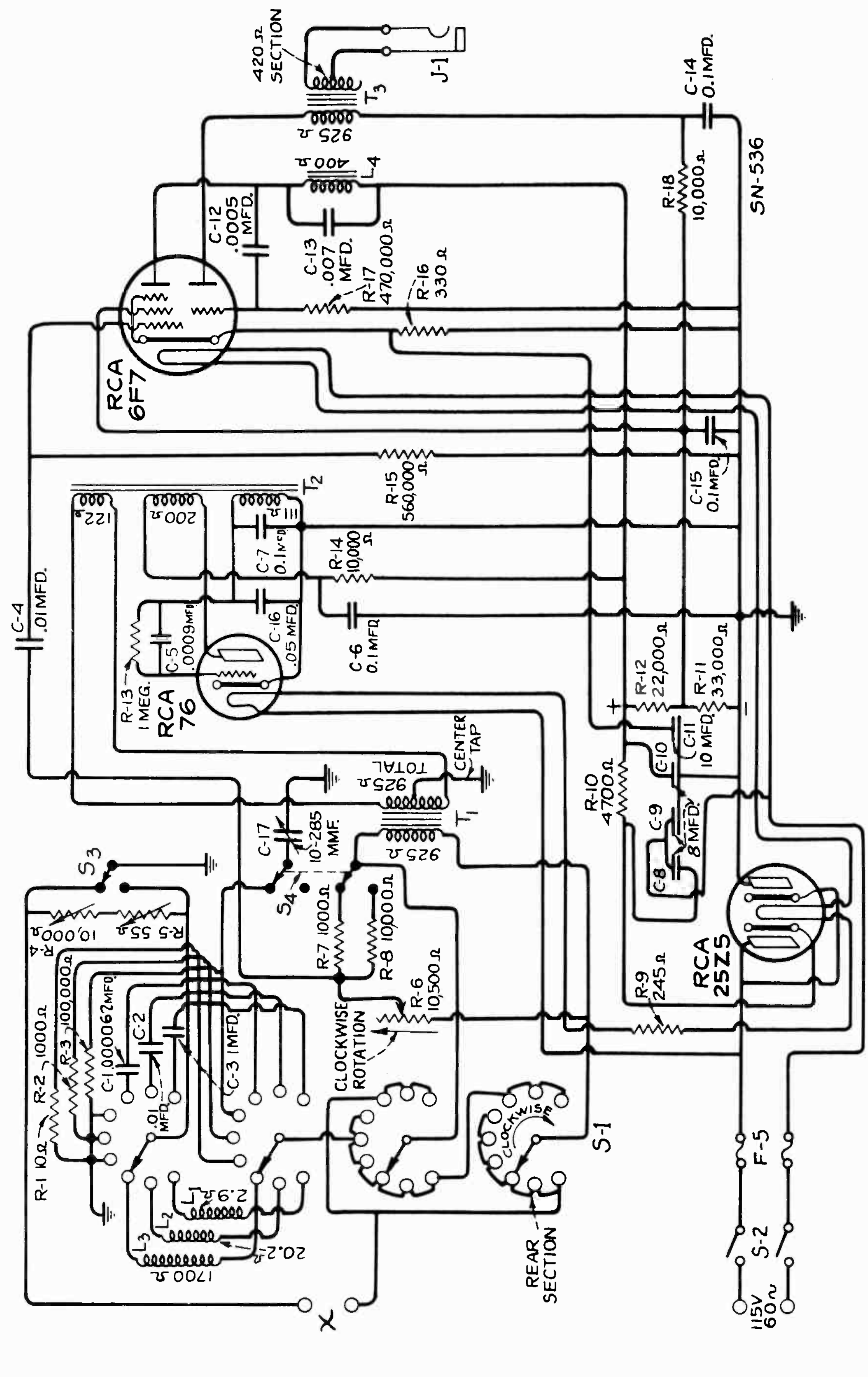


Figure 4. Schematic Circuit Diagram

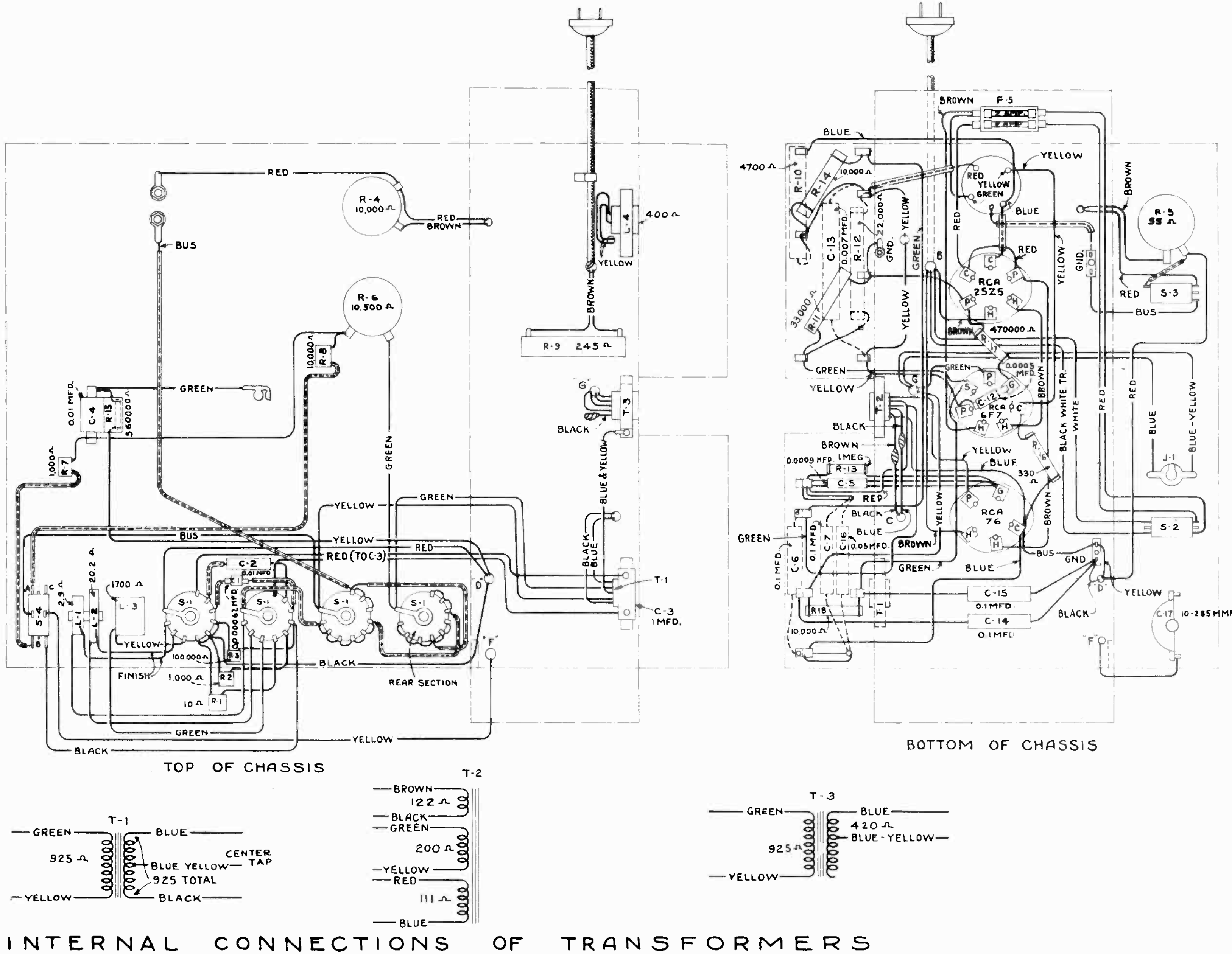


Figure 5. Connection Wiring Diagram

rately measure the heater voltage requires a 1,000-ohm-per-volt a-c voltmeter having ranges of 10 and 50 volts. Voltages below 10 volts should be measured on the 10-volt scale; and from 10 to 50, on the 50-volt scale.

For meters of the 1,000-ohm-per-volt type, but ranges other than above, use the nearest ranges to those specified. If the range is higher the voltage may be higher, if the range is lower the voltage may be lower; either condition depending on the percentage of circuit current drawn by the meter.

Noisy Operation of Controls

The Main control (R-6), and both Phasing controls (R-4) and (R-5) are sliding arm type variable resistors. Noisy operation, evidenced by a grating noise in the headphones when either of these three controls are manipulated will occur when dust or corrosion, collects or forms on the sliding contact arm, or on that portion of the resistance wire over which the sliding arm rides. These controls are properly lubricated during manufacture to guard against noise and insure correct operation; however, after lengthy use all types of contacts require some attention. This condition may be corrected by turning the controls a few times. The application of a small amount of lubricant (petroleum jelly) to the resistance wire and contact arm will aid in obtaining quiet operation by preventing corrosion. The lower Phasing control contact arm makes contact by a pressure spring. To correct noisy operation caused by a dirty contact at this point, pry off the back cover and slip a visiting card between the spring and center shaft contact. Moving the visiting card back and forth a few times will restore the contacts to their correct operating condition.

Resetting Main Control Pointer

If for any reason the Main control dial is removed or its position altered from its initial setting on the shaft of R-6, accurate adjustment will be required. An accurate 1,000-ohm resistor, such as RCA Victor Stock No. 11795, should be placed across the "X" binding post. Place the instrument in operation with the Range selector set to "1M-10M" position and High-Low switch to "high" position. Rotate the Main control shaft until balance is obtained. Place the knob on the shaft with its pointer set to 1. Tighten the set screw. The balance point will be at 1 indicating 1,000 ohms.

A substitute method may be used if an accurate means of measuring 1,000 ohms is available. With the instrument removed from the case, disconnect the green lead connecting from the Main control to the Range switch. Connect the resistance measuring device across the two terminals of the Main control and accurately set the sliding arm until a value of 1,000 ohms is obtained. Set the pointer of the Main control to 1. Tighten the set screw and restore the green lead to its original condition.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from any authorized dealers

Stock No.	DESCRIPTION	List Price
11792	Capacitor—Variable capacity—for capacity balance—(C17)	$0.98
11782	Capacitor Pack—Comprising three sections of 8 Mfd., and one section of 10 Mfd.—(C8, C9, C10, C11)	3.25
11798	Capacitor—.000062 Mfd.—(C1)	.28
11800	Capacitor—.0005 Mfd.—(C12)	.20
4245	Capacitor—.0009 Mfd.—(C5)	.26
5148	Capacitor—.007 Mfd.—(C13)	.20
15779	Capacitor—.01 Mfd.—Faradon model "T"—(C4)	1.30
11799	Capacitor—.01 Mfd.—(C2)	.20
4836	Capacitor—.05 Mfd.—(C16)	.30
4841	Capacitor—0.1 Mfd.—(C6, C7, C14, C15)	.22
11790	Capacitor—1.0 Mfd.—(C3)	2.40
4693	Clamp—Electrolytic capacitor mounting clamp—for Stock No. 11782	.15
11788	Coil—(L2)	.38
11789	Coil—(L1)	.38
11773	Choke—Choke coil—located in plate circuit of 6F7 Radiotron—(L4)	1.16
11776	Escutcheon—Front panel escutcheon	2.25
3883	Fuse—2.0 ampere fuse—Package of 5	.40
11780	Jack—Phone jack—(J1)	.80
3984	Knob—Phase adjusting or capacitor balance knob	.30
7960	Knob—Range switch knob	.20
11784	Knob—for Stock No. 11783	.46
11787	Reactor—(L3)	2.00
11772	Rheostat—Phase adjusting rheostat—for coarse adjustment—(R4)	4.55
11777	Rheostat—Phase adjusting rheostat—for fine adjustment—(R5)	1.12
11783	Rheostat—(R6)	4.50
11794	Resistor—10 ohms—wire wound—(R1)	1.68
11785	Resistor—245 ohms—wire wound—(R9)	2.10
8063	Resistor—330 ohms—carbon type—½ watt—(R16)—Package of 5	1.00
11795	Resistor—1000 ohms—wire wound—(R2, R7)	1.78
11768	Resistor—4700 ohms—carbon type—2 watts—(R10)	.25
3078	Resistor—10,000 ohms—carbon type—½ watt—(R14, R18)—Package of 5	1.00
11796	Resistor—10,000 ohms—wire wound—(R8)	2.52
11332	Resistor—22,000 ohms—carbon type—1 watt—(R12)—Package of 5	1.10
8072	Resistor—33,000 ohms—carbon type—½ watt—(R11)—Package of 5	1.00
11797	Resistor—100,000 ohms—wire wound—(R3)	3.52
5202	Resistor—470,000 ohms—carbon type—½ watt—(R17)—Package of 5	1.00
5035	Resistor—560,000 ohms—carbon type—¼ watt—(R15)—Package of 5	1.00
3033	Resistor—1 megohm—carbon type—¼ watt—(R13)—Package of 5	1.00
4814	Socket—5-contact Radiotron 76 socket	.15
4786	Socket—6-contact Radiotron 25Z5 socket	.15
4787	Socket—7-contact Radiotron 6F7 socket	.15
11778	Switch—Standard resistance change over toggle switch—(S3)	.88
11779	Switch—Double pole single throw toggle power switch—(S2)	1.25
11781	Switch—Range switch—(S1)	2.45
11786	Switch—Double pole—double throw toggle switch—(S4)	1.05
11774	Transformer—Input transformer—(T1)	5.15
11775	Transformer—Oscillator transformer—(T2)	1.05
11791	Transformer—Output Transformer—(T3)	5.15

RADIO DEFINITIONS*

"A" Power Supply. A power supply device providing heating current for the cathode of a vacuum tube.

Alternating Current. A current, the direction of which reverses at regularly recurring intervals, the algebraic average value being zero.

Amplification Factor. A measure of the effectiveness of the grid voltage relative to that of the plate voltage in affecting the plate current.

Amplifier. A device for increasing the amplitude of electric current, voltage or power, through the control by the input power of a larger amount of power supplied by a local source to the output circuit.

Anode. An electrode to which an electron stream flows.

Antenna. A conductor or a system of conductors for radiating or receiving radio waves.

Atmospherics. Strays produced by atmospheric conditions.

Attenuation. The reduction in power of a wave or a current with increasing distance from the source of transmission.

Audio Frequency. A frequency corresponding to a normally audible sound wave. The upper limit ordinarily lies between 10,000 and 20,000 cycles.

Audio-Frequency Transformer. A transformer for use with audio-frequency currents.

Autodyne Reception. A system of heterodyne reception through the use of a device which is both an oscillator and a detector.

Automatic Volume Control. A self-acting device which maintains the output constant within relatively narrow limits while the input voltage varies over a wide range.

"B" Power Supply. A power supply device connected in the plate circuit of a vacuum tube.

Baffle. A partition which may be used with an acoustic radiator to impede circulation between front and back.

Band-Pass Filter. A filter designed to pass currents of frequencies within a continuous band limited by an upper and a lower critical or cut-off frequency and substantially reduce the amplitude of currents of all frequencies outside of that band.

Beat. A complete cycle of pulsations in the phenomenon of beating.

Beat Frequency. The number of beats per second. This frequency is equal to the difference between the frequencies of the combining waves.

Beating. A phenomenon in which two or more periodic quantities of different frequencies react to produce a resultant having pulsations of amplitude.

Broadcasting. Radio transmission intended for general reception.

By-Pass Condenser. A condenser used to provide an alternating-current path of comparatively low impedance around some circuit element.

"C" Power Supply. A power supply device connected in the circuit between the cathode and grid of a vacuum tube so as to apply a grid bias.

Capacitive Coupling. The association of one circuit with another by means of capacity common or mutual to both.

Carbon Microphone. A microphone which depends for its operation upon the variation in resistance of carbon contacts.

Carrier. A term broadly used to designate carrier wave, carrier current, or carrier voltage.

Carrier Frequency. The frequency of a carrier wave.

Carrier Suppression. That method of operation in which the carrier wave is not transmitted.

Carrier Wave. A wave which is modulated by a signal and which enables the signal to be transmitted through a specific physical system.

Cathode. The electrode from which the electron stream flows. (See **Filament.**)

Choke Coil. An inductor inserted in a circuit to offer relatively large impedance to alternating current.

Class A Amplifier is an amplifier in which the bias and exciting grid voltages are such that the plate current through the tube flows at all times. The ideal Class A Amplifier is one in which the alternating component of the plate current is an exact reproduction of the form of the input signal, and the plate current flows during the 360 electrical degrees of the cycle. The characteristics of a Class A Amplifier are low efficiency and output.

Class B Amplifier is an amplifier in which the grid bias is approximately equal to that required to cut off the plate current to approximately zero when no exciting grid voltage is applied, so that the plate current in a tube flows during approximately one-half of each cycle when an exciting grid voltage is applied. The ideal Class B Amplifier is one in which the alternating component of plate current is an exact replica of the input signal for the half-cycle when the grid is positive with respect to the bias voltage, and the plate current flows 180 electrical degrees. The characteristics of a Class B Amplifier are medium efficiency and output.

Class C Amplifier is an amplifier in which the grid bias is appreciably more than necessary to cut off the plate current to zero when no exciting grid voltage is present, so that the plate current flows in the tube for appreciably less than one-half of each cycle when an exciting grid voltage is present. At the present time Class C Amplifier application is confined to radio transmission where high plate-circuit efficiency is a paramount requirement and where departures from linearity between input and output are permissible. The characteristics of a Class C Amplifier are high-plate-circuit efficiency and high power output.

(1) **A Class AB Amplifier** is one in which the bias and exciting grid voltages are such that the plate current flows during appreciably more than 180 electrical degrees yet less than 360 electrical degrees of the cycle. This has also been called Class "A prime." The characteristics of a Class AB Amplifier are efficiency and output intermediate between a Class A and a Class B Amplifier. The idle plate current and attendant dissipation may be made substantially less than is possible with Class A Amplifiers.

(2) **A Class BC Amplifier** is an amplifier in which the bias and exciting grid voltages are such that the plate current flows during less than 180 electrical degrees and yet for a considerable part of the cycle. The characteristics of a Class BC Amplifier are efficiency and output intermediate between a Class B and a Class C Amplifier. Class BC Amplifiers are not in general use.

(3) To denote that grid current does not flow during any part of the input cycle, add the suffix 1 to the letter or letters of the class identification. The suffix 2 is used to denote that grid current flows during some part of the cycle.

Condenser Loud Speaker. A loud speaker in which the mechanical forces result from electrostatic reactions.

Condenser Microphone. A microphone which depends for its operation upon variations in capacitance.

Continuous Waves. Continuous waves are waves in which successive cycles are identical under steady state conditions.

Conversion Transconductance is the ratio of the magnitude of a single beat-frequency component $(f_1 + f_2)$ or $(f_1 - f_2)$ of the output current to the magnitude of the input voltage of frequency f_1 under the conditions that all direct voltages and the magnitude of the second input alternating voltage f_2 must remain constant. As most precisely used, it refers to an infinitesimal magnitude of the voltage of frequency f_1.

* Most of these definitions are based on I.R.E. Standards.

Converter (generally, in superheterodyne receivers). A converter is a vacuum-tube which performs simultaneously the functions of oscillation and mixing (first detection) in a radio receiver.

Coupling. The association of two circuits in such a way that energy may be transferred from one to the other.

Cross Modulation. A type of intermodulation due to modulation of the carrier of the desired signal in a radio apparatus by an undesired signal.

Current Amplification. The ratio of the alternating current produced in the output circuit of an amplifier to the alternating current supplied to the input circuit for specific circuit conditions.

Cycle. One complete set of the recurrent values of periodic phenomenon.

Damped Waves. Waves of which the amplitude of successive cycles, at the source, progressively diminishes.

Decibel. The common transmission unit of the decimal system, equal to 1/10 bel.

$$1 \text{ bel} = 2 \log_{10} \frac{E_1}{E_2} = 2 \log_{10} \frac{I_1}{I_2}$$

(See Transmission Unit.)

Detection is any process of operation on a modulated signal wave to obtain the signal imparted to it in the modulation process.

Detector. A detector is a device which is used for operation on a signal wave to obtain the signal imparted to it in the modulation process.

Diaphragm. A diaphragm is a vibrating surface which produces sound vibrations.

Diode. A type of thermionic tube containing two electrodes which passes current wholly or predominantly in one direction.

Direct Capacitance (C) between two conductors—The ratio of the charge produced on one conductor by the voltage between it and the other conductor, divided by this voltage, all other conductors in the neighborhood being at the potential of the first conductor.

Direct Coupling. The association of two circuits by having an inductor, a condenser, or a resistor common to both circuits.

Direct Current. An unidirectional current. As ordinarily used, the term designates a practically non-pulsating current.

Distortion. A change in wave form occurring in a transducer or transmission medium when the output wave form is not a faithful reproduction of the input wave form.

Double Modulation. The process of modulation in which a carrier wave of one frequency is first modulated by the signal wave and is then made to modulate a second carrier wave of another frequency.

Dynamic Amplifier. The RCA Dynamic Amplifier is a variable gain audio amplifier, the gain of which is proportional to the average intensity of the audio signal. Such an amplifier compensates for the contraction of volume range required because of recording or transmission line limitations.

Dynamic Sensitivity of a Phototube. The alternating-current response of a phototube to a pulsating light flux at specified values of mean light flux, frequency of pulsation, degree of pulsation, and steady tube voltage.

Electro-Acoustic Transducer. A transducer which is actuated by power from an electrical system and supplies power to an acoustic system or vice versa.

Electron Emission. The liberation of electrons from an electrode into the surrounding space. In a vacuum tube it is the rate at which the electrons are emitted from a cathode. This is ordinarily measured as the current carried by the electrons under the influence of a voltage sufficient to draw away all the electrons.

Electron Tube. A vacuum tube evacuated to such a degree that its electrical characteristics are due essentially to electron emission.

Emission Characteristic. A graph plotted between a factor controlling the emission (such as the temperature, voltage, or current of the cathode) as abscissas, and the emission from the cathode as ordinates.

Facsimile Transmission. The electrical transmission of a copy or reproduction of a picture, drawing or document. (This is also called picture transmission.)

Fading. The variation of the signal intensity received at a given location from a radio transmitting station as a result of changes occurring in the transmission path. (See Distortion.)

Fidelity. The degree to which a system, or a portion of a system, accurately reproduces at its output the signal which is impressed upon it.

Filament. A cathode in which the heat is supplied by current passing through the cathode.

Filter. A selective circuit network, designed to pass currents within a continuous band or bands of frequencies or direct current, and substantially reduce the amplitude of currents of undesired frequencies.

Frequency. The number of cycles per second.

Full-Wave Rectifier. A double element rectifier arranged so that current is allowed to pass in the same direction to the load circuit during each half cycle of the alternating-current supply, one element functioning during one-half cycle and the other during the next half cycle, and so on.

Fundamental Frequency. The lowest component frequency of a periodic wave or quantity.

Fundamental or Natural Frequency (of an antenna). The lowest resonant frequency of an antenna, without added inductance or capacity.

Gas Phototube. A type of phototube in which a quantity of gas has been introduced, usually for the purpose of increasing its sensitivity.

Grid. An electrode having openings through which electrons or ions may pass.

Grid Bias. The direct component of the grid voltage.

Grid Condenser. A series condenser in the grid or control circuit of a vacuum tube.

Grid Leak. A resistor in a grid circuit, through which the grid current flows, to affect or determine a grid bias.

Grid-Plate Transconductance. The name for the plate current to grid voltage transconductance. (This has also been called mutual conductance.)

Ground System (of an antenna). That portion of the antenna system below the antenna loading devices or generating apparatus most closely associated with the ground and including the ground itself.

Ground Wire. A conductive connection to the earth.

Half-Wave Rectifier. A rectifier which changes alternating current into pulsating current, utilizing only one-half of each cycle.

Harmonic. A component of a periodic quantity having a frequency which is an integral multiple of the fundamental frequency. For example, a component the frequency of which is twice the fundamental frequency is called the second harmonic.

Heater. An electrical heating element for supplying heat to an indirectly heated cathode.

Heterodyne Reception. The process of receiving radio waves by combining in a detector a received voltage with a locally generated alternating voltage. The frequency of the locally generated voltage is commonly different from that of the received voltage. (Heterodyne reception is sometimes called beat reception.)

Homodyne Reception. A system of reception by the aid of a locally generated voltage of carrier frequency. (Homodyne reception is sometimes called zero-beat reception.)

Hot-Wire Ammeter, Expansion Type. An ammeter dependent for its indications on a change in dimensions of an element which is heated by the current to be measured.

Indirectly Heated Cathode. A cathode of a thermionic tube, in which heat is supplied from a source other than the cathode itself.

Induction Loud Speaker is a moving coil loud speaker in which the current which reacts with the polarizing field is induced in the moving member.

Inductive Coupling. The association of one circuit with another by means of inductance common or mutual to both.

Interelectrode Capacitance. The direct capacitance between two electrodes.

Interference. Disturbance of reception due to strays, undesired signals, or other causes; also, that which produces the disturbance.

Intermediate Frequency, in Superheterodyne Reception. A frequency between that of the carrier and the signal, which results from the combination of the carrier frequency and the locally generated frequency.

Intermodulation. The production, in a non-linear circuit element, of frequencies corresponding to the sums and differences of the fundamentals and harmonics of two or more frequencies which are transmitted to that element.

Interrupted Continuous Waves. Interrupted continuous waves are waves obtained by interruption at audio frequency in a substantially periodic manner of otherwise continuous waves.

Kilocycle. When used as a unit of frequency, is a thousand cycles per second.

Lead-In. That portion of an antenna system which completes the electrical connection between the elevated outdoor portion and the instruments or disconnecting switches inside the building.

Linear Detection. That form of detection in which the audio output voltage under consideration is substantially proportional to the modulation envelope throughout the useful range of the detecting device.

Loading Coil. An inductor inserted in a circuit to increase its inductance but not to provide coupling with any other circuit.

Loud Speaker. A telephone receiver designed to radiate acoustic power into a room or open air.

Magnetic Loud Speaker. One in which the mechanical forces result from magnetic reactions.

Magnetic Microphone. A microphone whose electrical output results from the motion of a coil or conductor in a magnetic field.

Master Oscillator. An oscillator of comparatively low power so arranged as to establish the carrier frequency of the output of an amplifier.

Megacycle. When used as a unit of frequency, is a million cycles per second.

Mercury-Vapor Rectifier. A mercury-vapor rectifier is a two electrode, vacuum-tube rectifier which contains a small amount of mercury. During operation, the mercury is vaporized. A characteristic of mercury-vapor rectifiers is the low-voltage drop in the tube.

Microphone. A microphone is an electro-acoustic transducer actuated by power in an acoustic system and delivering power to an electric system, the wave form in the electric system corresponding to the wave form in the acoustic system. This is also called a telephone transmitter.

Mixer Tube (generally, in superheterodyne receivers). A mixer tube is one in which a locally generated frequency is combined with the carrier-signal frequency to obtain a desired beat frequency.

Modulated Wave. A modulated wave is a wave of which either the amplitude, frequency, or phase is varied in accordance with a signal.

Modulation is the process in which the amplitude, frequency, or phase of a wave is varied in accordance with a signal, or the result of that process.

Modulator. A device which performs the process of modulation.

Monochromatic Sensitivity. The response of a phototube to light of a given color, or narrow frequency range.

Moving-Armature Speaker. A magnetic speaker whose operation involves the vibration of a portion of the ferromagnetic circuit. (This is sometimes called an electromagnetic or a magnetic speaker.)

Moving Coil Loud Speaker. A moving coil loud speaker is a magnetic loud speaker in which the mechanical forces are developed by the interaction of currents in a conductor and the polarizing field in which it is located. (This is sometimes called an Electro-Dynamic or a Dynamic Loud Speaker.)

Mu-Factor. A measure of the relative effect of the voltages on two electrodes upon the current in the circuit of any specified electrode. It is the ratio of the change in one electrode voltage to a change in the other electrode voltage, under the condition that a specified current remains unchanged.

Mutual Conductance. (See Grid-Plate Transconductance.)

Oscillator. A non-rotating device for producing alternating current, the output frequency of which is determined by the characteristics of the device.

Oscillatory Circuit. A circuit containing inductance and capacitance, such that a voltage impulse will produce a current which periodically reverses.

Pentode. A type of thermionic tube containing a plate, a cathode, and three additional electrodes. (Ordinarily the three additional electrodes are of the nature of grids.)

Percentage Modulation. The ratio of half the difference between the maximum and minimum amplitudes of a modulated wave to the average amplitude, expressed in per cent.

Phonograph Pickup. An electromechanical transducer actuated by a phonograph record and delivering power to an electrical system, the wave form in the electrical system corresponding to the wave form in the phonograph record.

Phototube. A vacuum tube in which electron emission is produced by the illumination of an electrode. (This has also been called photo-electric tube.)

Plate. A common name for the principal anode in a vacuum tube.

Power Amplification (of an amplifier)—The ratio of the alternating-current power produced in the output circuit to the alternating-current power supplied to the input circuit.

Power Detection. That form of detection in which the power output of the detecting device is used to supply a substantial amount of power directly to a device such as a loud speaker or recorder.

Pulsating Current. A periodic current, that is, current passing through successive cycles, the algebraic average value of which is not zero. A pulsating current is equivalent to the sum of an alternating and a direct current.

Push-Pull Microphone. One which makes use of two functioning elements 180 degrees out of phase.

Radio Channel. A band of frequencies or wavelengths of a width sufficient to permit of its use for radio communication. The width of a channel depends upon the type of transmission. (See Band of Frequencies.)

Radio Compass. A direction finder used for navigational purposes.

Radio Frequency. A frequency higher than those corresponding to normally audible sound waves. (See Audio Frequency.)

Radio-Frequency Transformer. A transformer for use with radio-frequency currents.

Radio Receiver. A device for converting radio waves into perceptible signals.

Radio Transmission. The transmission of signals by means of radiated electromagnetic waves originating in a constructed circuit.

Radio Transmitter. A device for producing radio-frequency power, with means for producing a signal.

Rectifier. A device having an asymmetrical conduction characteristic which is used for the conversion of an alternating current into a pulsating current. Such devices include vacuum-tube rectifiers, gas rectifiers, oxide rectifiers, electrolytic rectifiers, etc.

Reflex Circuit Arrangement. A circuit arrangement in which the signal is amplified, both before and after detection, in the same amplifier tube or tubes.

Regeneration. The process by which a part of the output power of an amplifying device reacts upon the input circuit in such a manner as to reinforce the initial power, thereby increasing the amplification. (Sometimes called "feedback" or "reaction.")

Resistance Coupling. The association of one circuit with another by means of resistance common to both.

Resonance Frequency (of a reactive circuit)—The frequency at which the supply current and supply voltage of the circuit are in phase.

Rheostat. A resistor which is provided with means for readily adjusting its resistance.

Screen Grid. A screen grid is a grid placed between a control grid and an anode, and maintained at a fixed positive potential, for the purpose of reducing the electrostatic influence of the anode in the space between the screen grid and the cathode.

Secondary Emission. Electron emission under the influence of electron or ion bombardment.

Selectivity. The degree to which a radio receiver is capable of differentiating between signals of different carrier frequencies.

Sensitivity. The degree to which a radio receiver responds to signals of the frequency to which it is tuned.

Sensitivity of a Phototube. The electrical current response of a phototube, with no impedance in its external circuit, to a specified amount and kind of light. It is usually expressed in terms of the current for a given radiant flux, or for a given luminous flux. In general the sensitivity depends upon the tube voltage, flux intensity, and spectral distribution of the flux.

Service Band. A band of frequencies allocated to a given class of radio communication service.

Side Bands. The bands of frequencies, one on either side of the carrier frequency, produced by the process of modulation.

Signal. The intelligence, message or effect conveyed in communication.

Single-Side-Band Transmission. That method of operation in which one side band is transmitted, and the other side band is suppressed. The carrier wave may be either transmitted or suppressed.

Static. Strays produced by atmospheric conditions.

Static Sensitivity of a Phototube. The direct current response of a phototube to a light flux of specified value.

Stopping Condenser. A condenser used to introduce a comparatively high impedance in some branch of a circuit for the purpose of limiting the flow of low-frequency alternating current or direct current without materially affecting the flow of high frequency alternating current.

Strays. Electromagnetic disturbances in radio reception other than those produced by radio transmitting systems.

Superheterodyne Reception. Superheterodyne reception is a method of reception in which the received voltage is combined with the voltage from a local oscillator and converted into voltage of an intermediate frequency which is usually amplified and then detected to reproduce the original signal wave. (This is sometimes called double detection or supersonic reception.)

Swinging. The momentary variation in frequency of a received wave.

Telephone Receiver. An electro-acoustic transducer actuated by power from an electrical system and supplying power to an acoustic system, the wave form in the acoustic system corresponding to the wave form in the electrical system.

Television. The electrical transmission of a succession of images and their reception in such a way as to give a substantially continuous reproduction of the object or scene before the eye of a distant observer.

Tetrode. A type of thermionic tube containing a plate, a cathode, and two additional electrodes. (Ordinarily the two additional electrodes are of the nature of grids.)

Thermionic. Relating to electron emission under the influence of heat.

Thermionic Emission. Electron or ion emission under the influence of heat.

Thermionic Tube. An electron tube in which the electron emission is produced by the heating of an electrode.

Thermocouple Ammeter. An ammeter dependent for its indications on the change in thermo-electro-motive force set up in a thermo-electric couple which is heated by the current to be measured.

Total Emission. The value of the current carried by electrons emitted from a cathode under the influence of a voltage such as will draw away all the electrons emitted.

Transconductance. The ratio of the change in the current in the circuit of an electrode to the change in the voltage on another electrode, under the condition that all other voltages remain unchanged.

Transducer. A device actuated by power from one system and supplying power to another system. These systems may be electrical, mechanical, or acoustic.

Transmission Unit. A unit expressing the logarithmic ratios of powers, voltages, or currents in a transmission system. (See Decibel.)

Triode. A type of thermionic tube containing an anode, a cathode, and a third electrode, in which the current flowing between the anode and the cathode may be controlled by the voltage between the third electrode and the cathode.

Tuned Transformer. A transformer whose associated circuit elements are adjusted as a whole to be resonant at the frequency of the alternating current supplied to the primary, thereby causing the secondary voltage to build up to higher values than would otherwise be obtained.

Tuning. The adjustment of a circuit or system to secure optimum performance in relation to a frequency; commonly, the adjustment of a circuit or circuits to resonance.

Vacuum Phototube. A type of phototube which is evacuated to such a degree that the residual gas plays a negligible part in its operation.

Vacuum Tube. A device consisting of a number of electrodes contained within an evacuated enclosure.

Vacuum-Tube Transmitter. A radio transmitter in which vacuum tubes are utilized to convert the applied electric power into radio-frequency power.

Vacuum-Tube Volt-Meter. A device utilizing the characteristics of a vacuum tube for measuring alternating voltages.

Voltage Amplification. The ratio of the alternating voltage produced at the output terminals of an amplifier to the alternating voltage impressed at the input terminals.

Voltage Divider. A resistor provided with fixed or movable contacts and with two fixed terminal contacts; current is passed between the terminal contacts, and a desired voltage is obtained across a portion of the resistor. (The term potentiometer is often erroneously used for this device.)

Wave. a. A propagated disturbance, usually periodic, as an electric wave or sound wave.
b. A single cycle of such a disturbance, or.
c. A periodic variation as represented by a graph.

Wavelength. The distance traveled in one period or cycle by a periodic disturbance.

Receiver Circuit Analysis

All receivers are built around the vacuum tube used as amplifier, detector, rectifier or oscillator. Whenever an open or short occurs in the filament, plate, grid or screen-grid circuit of a vacuum tube, it will have a definite effect upon the voltage and current readings obtained at these different tube elements with an analyzer.

The analyzer is designed to indicate the variations caused by such opens or shorts, and thus enables the service man to determine in which tube circuit the abnormal condition exists. Having done this the analyzer has done all that it is possible for an instrument to do. It now remains for the service man to decide (by analytic reasoning based on previous experience and thought on trouble shooting problems) in which portion of that particular tube's circuits the trouble is.

On the following pages will be found 4 fundamental, schematic diagrams of the complete filament, grid and screen-grid circuits for:

1. Filament type triodes and screen-grid tubes.
2. Heater-cathode type triodes and screen-grid tubes.
3. Filament type pentodes (voltage or power amplifiers).
4. Heater-cathode type pentodes (voltage or power amplifiers).

The various circuits are numbered as:

Example:

1 = grid return from grid of tubes to negative C in grid circuit.

2 = plate circuit from positive B on voltage divider to plate of tube.

On a following page will be found a chart listing the effects noted (as compared to the normal readings) when the various circuits or parts are open or shorted. By the use of this chart, knowing what normal conditions are, and how the abnormal conditions compare with them, it is possible for a service man to narrow his tracing of the suspected tube circuit, down to the testing of one or two of the parts of that circuit.

Diagrams No. 1 and No. 2 apply equally as well to triodes of the filament and cathode-heater types by omitting circuit No. 13 and condenser No. 7 which apply to screen-grid types only.

It will be noted that circuit No. 14 in diagrams No. 3 and No. 4 applies only to a pentode. It represents the connection between the suppressor grid (located between the space charge or screen-grid and plate) and the cathode, or to a point in the circuit whose potential is more negative than the cathode. Since the suppressor grid serves the same purpose (i. e., to practically eliminate the effects of secondary emission) whether the tube be a radio-frequency pentode, such as the 57, or whether it be a power-output pentode, such as the 47, diagrams No. 3 and No. 4 apply equally as well to both types of tubes. The effects upon normal voltage readings when this circuit opens are listed under circuit No. 14 on the following chart. In certain tube types, such as the 47, circuit No. 14 is made within the tube, as indicated by the dotted lines in Fig. 3. An open in this internal connection will cause the same analyzer readings as those noted under circuit No. 14 in the accompanying chart.

Diagram No. 4 applies to triple-grid amplifiers, such as the 89, when used as a pentode power amplifier. When this tube is used as a class A or B amplifier, it would then be classified as a triode, and in this case diagram No. 2 would apply. For information on the operation and connections of the grids of a triple-grid amplifier when used in class A or B amplifier circuits, refer to the set manufacturer's service notes.

Example:

If it is found that the readings at one tube socket show E_{c1} = above normal, I_b = o, E_b = o, E_{kf} = above normal; referring to the chart we see that when this condition exists it indicates a short in No. 6—(the plate bypass condenser)—when its return is connected to positive side of grid-bias resistor No. 4, or it indicates an open in the cathode circuit through conductor No. 3 or grid-bias resistor No. 4.

The meaning of the symbols used in the reference chart are as follows:—

E_{c1} = Grid voltage or control grid on S. G. tubes.	S = Shorted.
E_{kf} = Cathode voltage on cathode heater tube.	L = Leaking.
	Op = Open.
	O = Zero voltage or current.
E_b = Plate voltage.	Lo = Below normal.
E_{c2} = Screen grid voltage.	Hi = Above normal.
E_{c3} = Suppressor grid voltage.	Nor = Normal.
I_b = Plate current.	F = Fluctuating.

Note: In servicing modern receivers it is extremely desirable that the service man use the set manufacturer's service notes. These will be found to be of great assistance in locating troubles and applying the correct remedy. Most radio set manufacturers will gladly furnish responsible service men with service notes on any model of their receivers upon a written request to the manufacturer's service department.

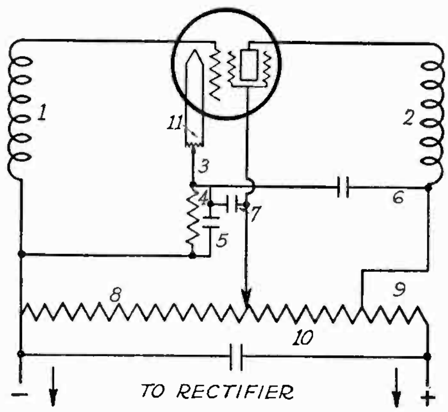


Fig. 1

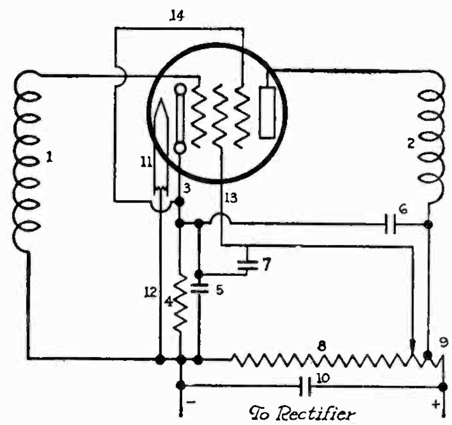


Fig. 4

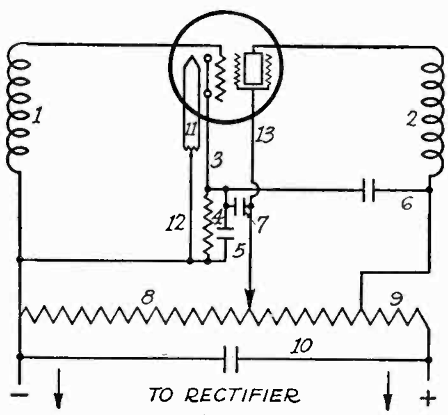


Fig. 2

Cir-cuit No.	Con-di-tion	Ec_1	Ec_2	Ic_2	Ib	Eb	Ekf	Ec_3
1	Op	O	Lo	Hi	Hi	Lo	Hi	
* 2	Op	O	Nor	Hi	O	O	O	
† 3	Op	Hi	O	O	O	O	Hi	
4	Op	Hi	O	O	O	O	Hi	
5	S	O	Lo	Hi	Hi	Lo	O	
5	L	F or Lo	Nor	Nor	F or Hi	F or Lo	F or Lo	
5	Op	Nor	Nor	Nor	Nor	Nor	Nor	
‡ 6	S	Hi	O	O	O	O	Hi	
6	L	F or Hi	F or Lo	F or Lo	F or Lo	F or Lo	F or Hi	
6	Op	Nor	Nor	Nor	Nor	Nor	Nor	
‡ 7	S	Hi	O	O	O	Lo	Hi	
7	L	F or Hi	F or Lo	F or Lo	F or Lo	F or Lo	F or Hi	
7	Op	Nor	Nor	Nor	Nor	Nor	Nor	
8	Op	Hi	Hi	Hi	Hi	Hi	Hi	
9	Op	O	O	O	O	O	O	
10	S	O	O	O	O	O	O	
11	Op	Nor	Nor	Nor	Nor	Nor	Nor	Hum
12	Op	Nor	Nor	Nor	Nor	Nor	O	Hum
13	Op	O	O	O	O	Hi	O	
14	Op	Nor	Nor	Hi	Lo	Nor	Nor	Hi

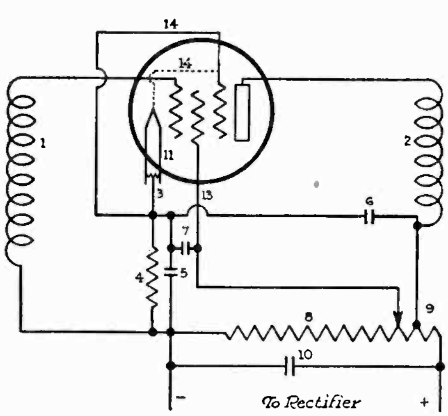


Fig. 3

Exceptions:

*Ec_1 = O when Individual Bias Resistor.

Ec_1 = Lo when Common Bias Resistor, or S. G. Tube.

†Ec_1 & E_{kf} = Hi when Individual Bias Resistor.

Ec_1 & E_{kf} = Lo when Common Bias Resistor.

‡Ec_1 & E_{kf} = O when condenser return is to neg. end No. 4 or Neg. Rectifier.

RCA VICTOR

BULL'S-EYE SOCKET - VOLTAGE CHARTS FOR NEW "OCTAL" METAL TUBE SOCKETS

AS USED IN

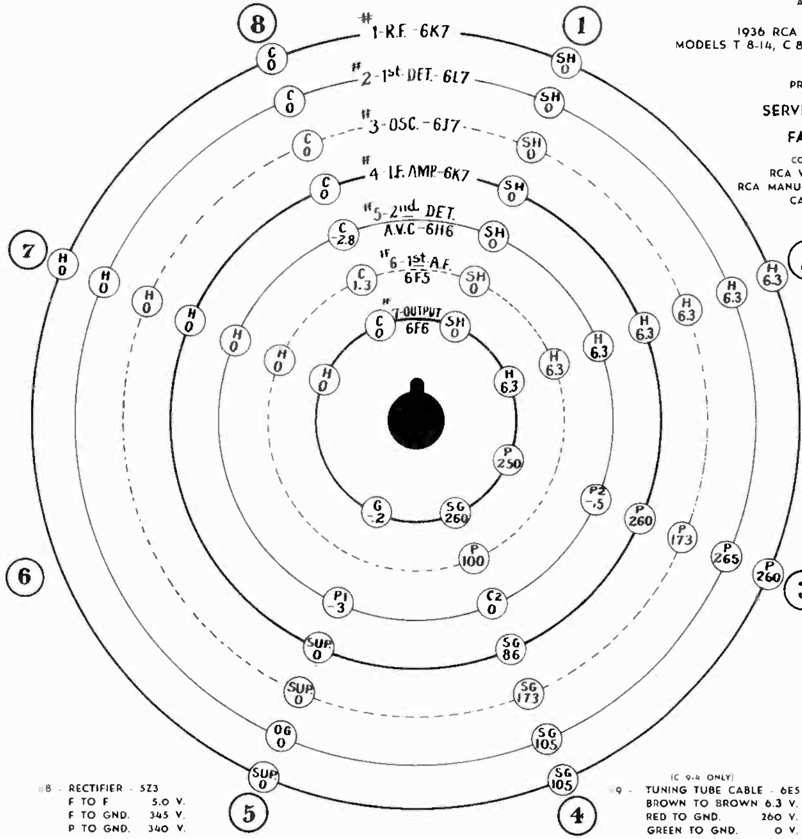
1936 RCA VICTOR RECEIVERS
MODELS T 8-14, C 8-15, C 9-4, T 10-1 AND C 11-1

PRESENTED AT

SERVICE MEETING

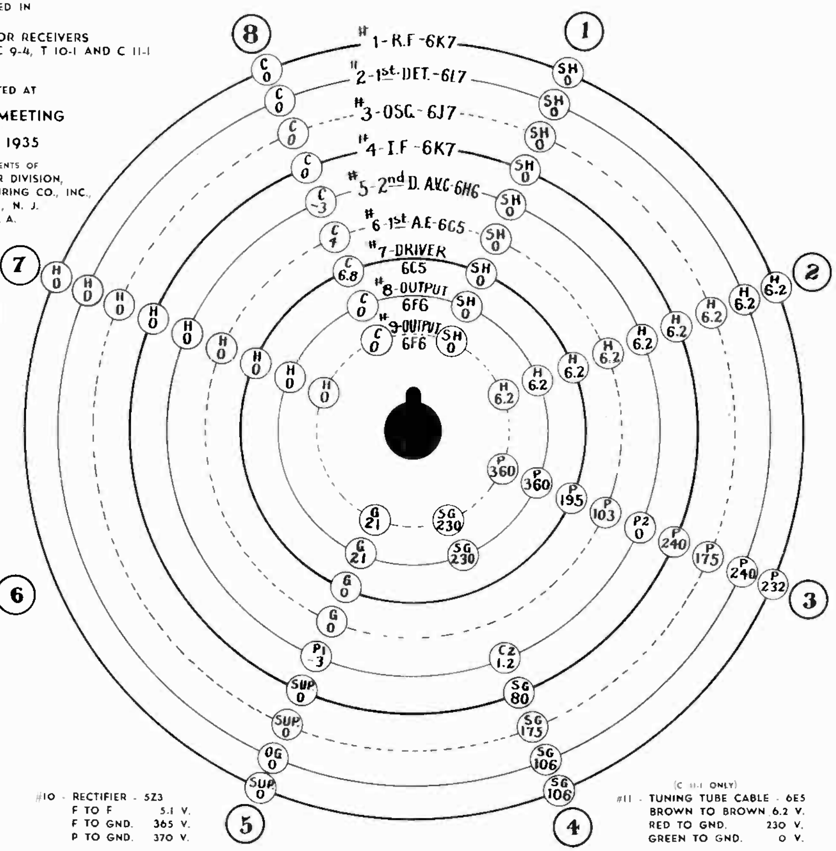
FALL - 1935

COMPLIMENTS OF
RCA VICTOR DIVISION,
RCA MANUFACTURING CO., INC.
CAMDEN, N. J.
U. S. A.



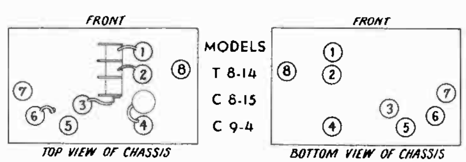
#8 - RECTIFIER - 5Z3
F TO F 5.0 V.
F TO GND. 345 V.
P TO GND. 340 V.

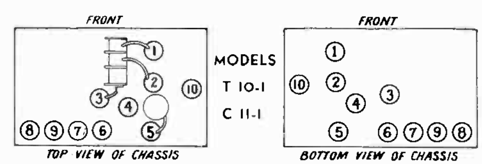
#9 - (C 9-4 ONLY) TUNING TUBE CABLE - 6E5
BROWN TO BROWN 6.3 V.
RED TO GND. 260 V.
GREEN TO GND. 0 V.



#10 - RECTIFIER - 5Z3
F TO F 5.1 V.
F TO GND. 365 V.
P TO GND. 370 V.

#11 - (C 11-1 ONLY) TUNING TUBE CABLE - 6E5
BROWN TO BROWN 6.2 V.
RED TO GND. 230 V.
GREEN TO GND. 0 V.





PROCEDURE: Place chassis with bottom up, speaker connected, all tubes in place, range switch on Band "A", dial setting at low-frequency end of Band "A", NO station tuned in, volume control setting optional. Select socket by referring to "under chassis view". Locate Pin #1, which is the first pin clockwise from the aligning lug; then continue in a clockwise direction for the remaining pins, comparing voltage readings obtained with those on the chart. All readings are positive with respect to chassis (ground) unless indicated by a negative (-) sign. All d-c readings taken with a 1000 ohms-per-volt voltmeter. Screen voltages measured on 250 volt range. Power supply - 115 volts, 60 cycles.

INSTRUCTIONS: Each bull's-eye represents the under-chassis socket terminals for the receiver models indicated. Each large circle represents the particular socket-pin layout for which it is labeled. The small outer circles indicate the pin numbers. The upper and lower designations in each small circle, on the large circles, indicate respectively; PIN CONNECTION and PIN VOLTAGE TO GROUND. All heater voltages and plate-to-ground rectifier voltages are a-c; all other voltages are d-c. At the lower left are voltages for the rectifier tube; at the lower right, voltages for the tuning-tube cable.

RCA VICTOR

BULL'S - EYE SOCKET - VOLTAGE CHARTS FOR NEW "OCTAL" METAL TUBE SOCKETS

AS USED IN

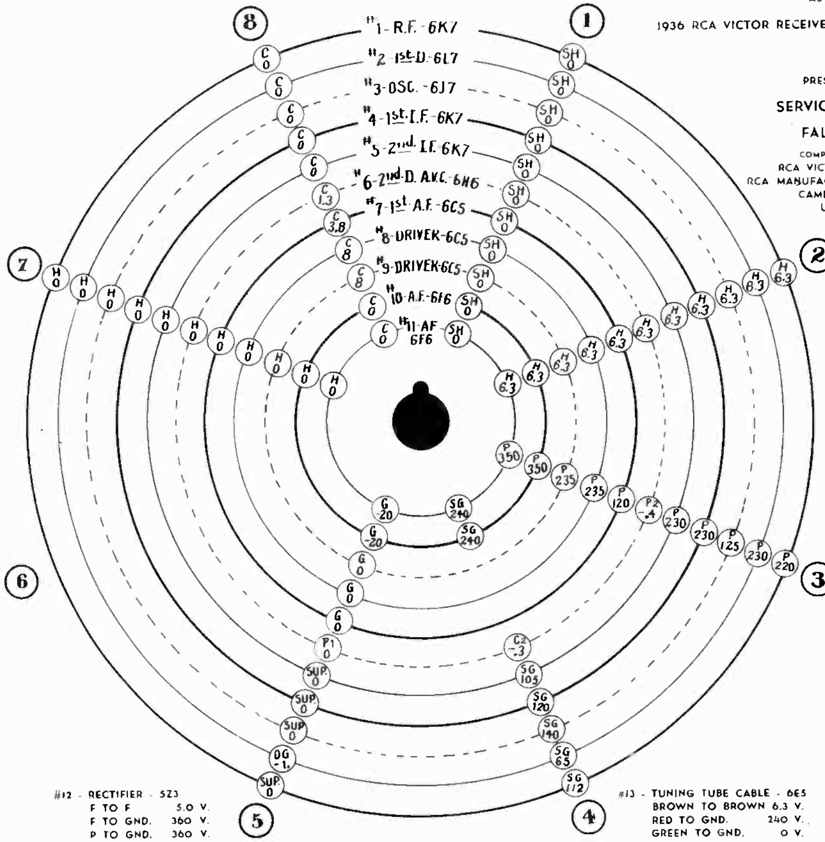
1936 RCA VICTOR RECEIVERS; MODELS C 13-2 AND C 15-3.

PRESENTED AT

SERVICE MEETING

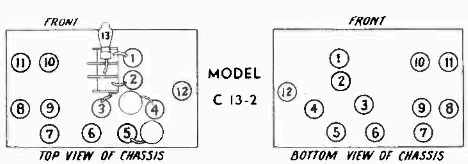
FALL - 1935

COMPLIMENTS OF
RCA VICTOR DIVISION,
RCA MANUFACTURING CO., INC.,
CAMDEN, N. J.
U. S. A.

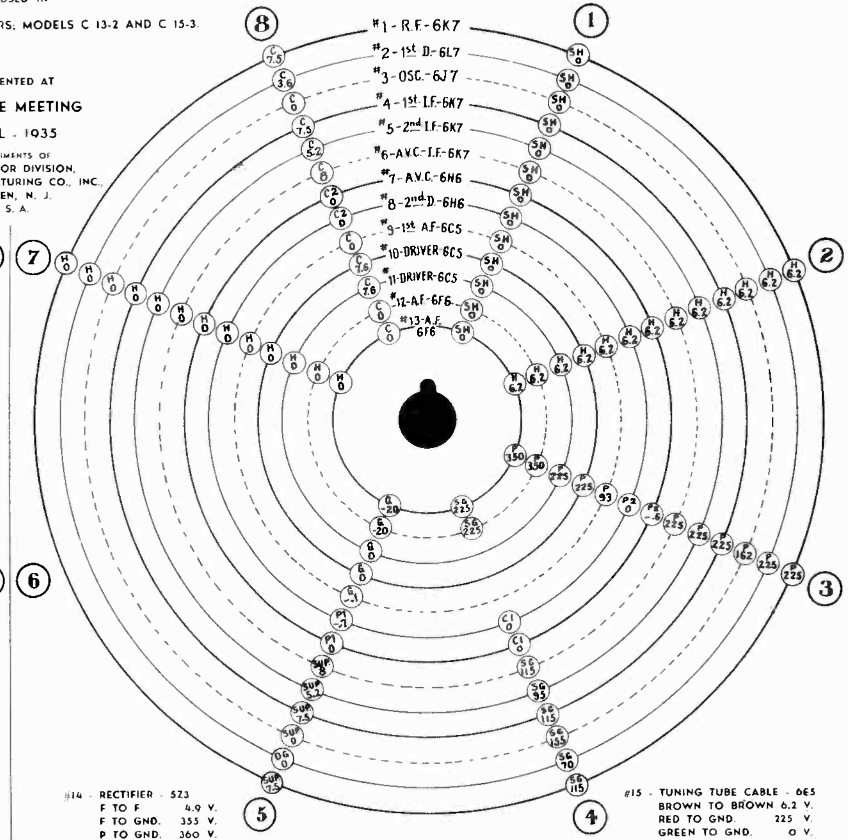


#12 - RECTIFIER - 5Z3
F TO F 5.0 V.
F TO GND. 360 V.
P TO GND. 360 V.

#13 - TUNING TUBE CABLE - 6E5
BROWN TO BROWN 6.3 V.
RED TO GND. 240 V.
GREEN TO GND. 0 V.

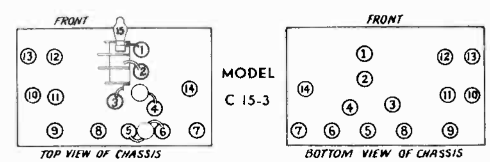


MODEL C 13-2



#14 - RECTIFIER - 5Z3
F TO F 4.9 V.
F TO GND. 355 V.
P TO GND. 360 V.

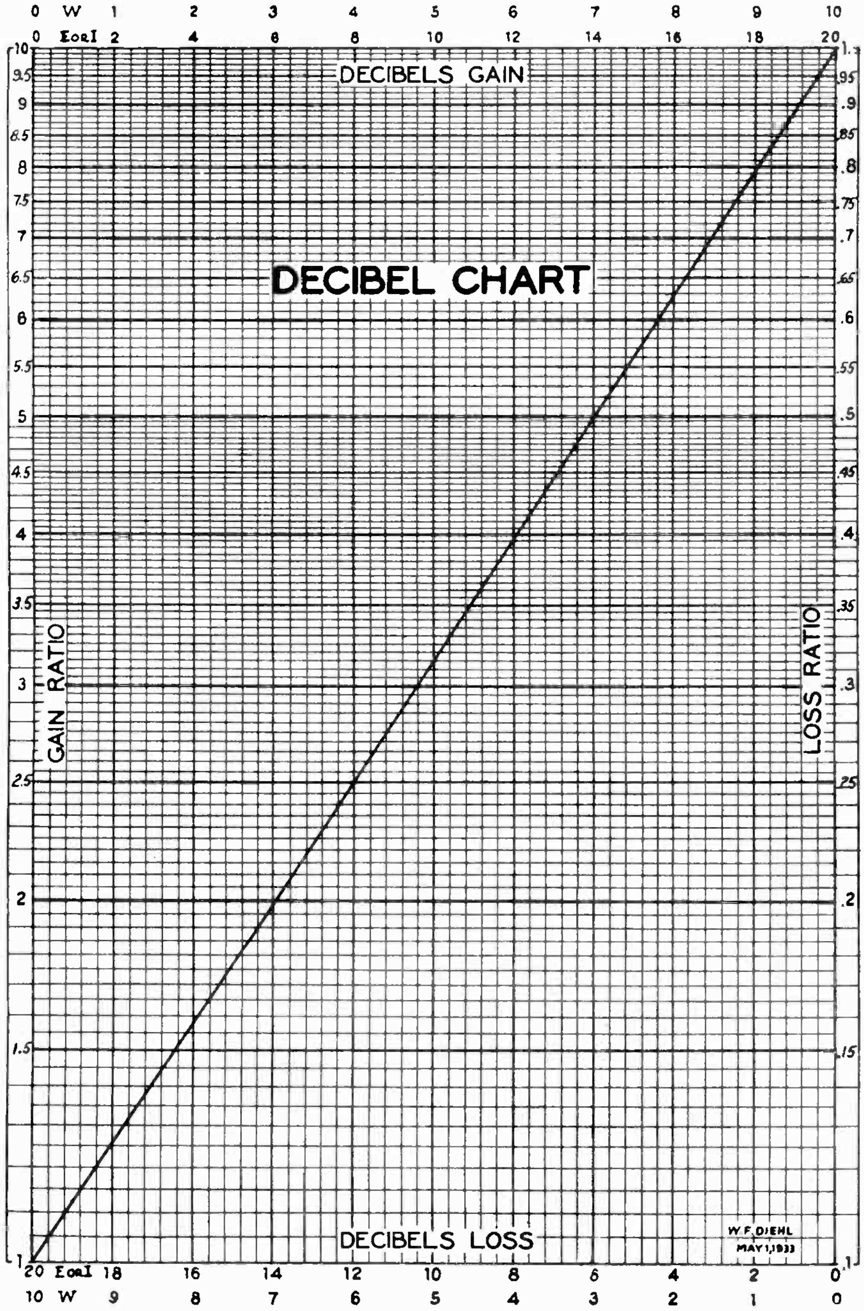
#15 - TUNING TUBE CABLE - 6E5
BROWN TO BROWN 6.2 V.
RED TO GND. 225 V.
GREEN TO GND. 0 V.



MODEL C 15-3

INSTRUCTIONS: Each bull's-eye represents the under-chassis socket terminals for the receiver models indicated. Each large circle represents the particular socket-pin layout for which it is labeled. The small outer circles indicate the pin numbers. The upper and lower designations in each small circle, on the large circles, indicate respectively; **PIN CONNECTION** and **PIN VOLTAGE TO GROUND**. All heater voltages and plate-to-ground rectifier voltages are a-c; all other voltages are d-c. At the lower left are voltages for the rectifier tube; at the lower right, voltages for the tuning-tube cable.

PROCEDURE: Place chassis with bottom up, speaker connected, all tubes in place, range switch on Band "A", dial setting at low-frequency end of Band "A", **NO** station tuned in, volume control setting optional. Select socket by referring to "under chassis view". Locate Pin #1, which is the first pin clockwise from the aligning lug; then continue in a clockwise direction for the remaining pins, comparing voltage readings obtained with those on the chart. All readings are positive with respect to chassis (ground) unless indicated by a negative ( ) sign. All d-c readings taken with a 1000 ohms-per-volt voltmeter. Screen voltages measured on 250 volt range. Power supply - 115 volts, 60 cycles.



The Decibel

The decibel (db) 1/10 of the "bel" is a logarithmic unit which may be properly used to express power ratios and power levels only. It is the exact equivalent of the term "Transmission Unit" (TU) which is now obsolete, and is most useful for expressing the relation of the power output to the power input of devices in a communication system, since the overall power gain of the system may be readily obtained by adding algebraically the db gain of the individual devices comprising the entire network or system. When the power output is greater than the power input, the device acts as a repeater or amplifier and there results a transmission gain. When the power output is less than the power input, the device acts as an attenuator and there results a transmission loss.

The number of decibels (N db) by which two amounts of power differ may be expressed as follows:

$$N\,db = 10\,Log_{10}\frac{P_0}{P_i}$$ where P_0 = power output and P_i = power input. If voltage instead of power is used, then

$$N\,db = 20\,Log_{10}\frac{E_0}{E_i} + 10\,Log_{10}\frac{Z_i}{Z_0} + 10\,Log_{10}\frac{Cos_0\,\Theta}{Cos_i\,\Theta}$$

For current instead of voltage

$$N\,db = 20\,Log_{10}\frac{I_0}{I_i} + 10\,Log_{10}\frac{Z_0}{Z_i} + 10\,Log_{10}\frac{Cos_0\,\Theta}{Cos_i\,\Theta}$$

Where I_0, E_0, $\angle_0$, $Cos_0\,\Theta$ = the output, current, voltage, impedance and power factor respectively and I_i, E_i, Z_i, $Cos_i\,\Theta$ = the input current, voltage, impedance, and power factor respectively.

In order to save considerable time in solving the equations the chart shown herewith has been prepared.

Instructions for Using the Decibel Chart

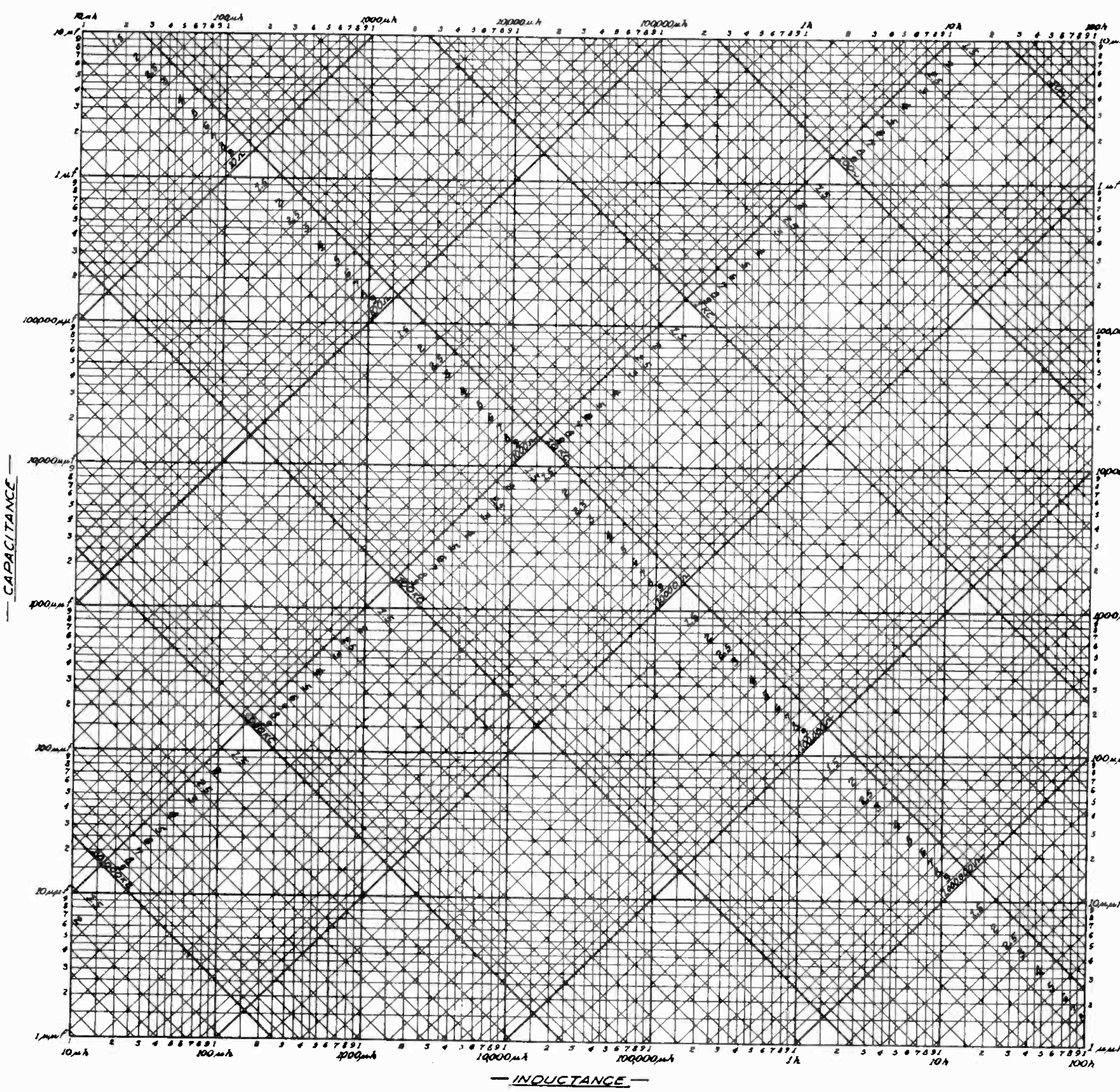
Assume the power output of a device is twice the power input. The power output being greater than the power input, the quantity 2 is located on the left of the chart, on the "Gain Ratio" Scale. Where the horizontal 2 line joins the diagonal line, the gain in dbs is located at the top of the chart opposite the column marked "W." In this example the gain is found to be 3 db. If the ratio were 20 instead of 2, then 10 db would be added, making a total of 13 db. If the power output were less than the input, the ratio would be found on the scale marked "Loss Ratio" and the number of dbs (negative) would be located at the bottom of the chart as indicated on the "DECIBELS LOSS" scale opposite the column marked "W." For example, a loss ratio of 0.50 corresponds to a loss of 3 dbs. A loss ratio of .050 would correspond to a loss of 13 dbs.

When voltage or current is used instead of power, the chart is used in a similar manner with the exception that the scales marked "E or I" are used instead of the scale "W." In this case, when the gain or loss ratio is outside the range of the chart, it is necessary to add 20 db for each power of 10 for power gains, and add minus 20 db for each negative power of 10 for power loss. In using the final complete formula, the number of decibels should first be determined for the voltage or current ratio, then the correction for the impedance mismatch determined from the chart by assuming the impedance ratio to be a power ratio. If a correction is still required for power factor, this can also be obtained from the chart by assuming the power factor ratio to be a power ratio.

NOTE: As the ear is a non-linear device the minimum change in intensity perceptible by the average human ear is not a constant, three (3) db as is generally stated, but varies from one-half (.50) db to eight (8) db depending on the intensity, the frequency and the waveform of the sound. I lthe sound is very loud, eighty (80) db above threshold, then the ear is approximately uniformly sensitive to a change in intensity as small as one-half (.50) db over the entire frequency range of 30 cycles to 10,000 cycles. However, if the sound is of very low intensity, five (5) db above threshold, then the ear is only sensitive to a minimum change of eight (8) db at low frequencies, three (3) db at medium frequencies and eight (8) db at high frequencies.

CHART OF FREQUENCY OR IMPEDANCE
VS.
INDUCTANCE AND CAPACITY

The Chart shown below provides a quick method of determining several unknown factors when one or more are known. The Chart covers a very wide range, namely, from 10 micro-henries to 100 henries inductance, 10 cycles to 50.000 kilocycles, 1 ohm to 10 megohms and 1 micro-microfarad to 10 microfarads. If, for example, one wishes to know the capacitance to use with a 10 henry inductor to have it resonate at 50 cycles, it can be readily seen that it would be a 1 mfd. capacitor. This is determined by finding the intersection of the vertical line representing 10 henries and the oblique line representing 50 cycles. The intersection occurs at the horizontal line representing 1 mfd. The other oblique line at this intersection represents the impedance at this frequency. This is approximately 3000 ohms.



RCA RADIO TUBE CHART

RADIO TUBES

TYPE	NAME	BASE	SOCKET CONNEC-TIONS	DIMENSIONS MAXIMUM OVERALL LENGTH x DIAMETER	CATHODE TYPE ■	RATING: FILAMENT OR HEATER VOLTS	FILAMENT OR HEATER AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	USE Values to right give operating conditions and characteristics for indicated typical use	PLATE SUP-PLY VOLTS	GRID VOLTS ■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESIS-TANCE OHMS	MUTUAL CON-DUC-TANCE MICRO-MHOS	VOLT-AGE AMPLI-FICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUT-PUT WATTS	TYPE
1A6	PENTAGRID CONVERTER ◊	SMALL 6-PIN	FIG. 20	4 11/32" x 1 9/16"	D-C FILAMENT	2.0	0.06	180	67.5	CONVERTER	180	−3.0 min.	67.5	2.4	1.3	500000	Anode-Grid (#2) 135 max. volts, 2.3 ma. Oscillator Grid (#1) Resistor, 50000 ohms. Conversion conductance, 300 micromhos.				1A6
1B5-25S	DUPLEX-DIODE TRIODE	SMALL 6-PIN	FIG. 28	4 1/4" x 1 9/16"	D-C FILAMENT	2.0	0.06	135	—	TRIODE UNIT AS CLASS A AMPLIFIER	135	−3.0	—	—	0.8	35000	575	20	—	—	1B5-25S
1C6	PENTAGRID CONVERTER ◊	SMALL 6-PIN	FIG. 20	4 11/32" x 1 9/16"	D-C FILAMENT	2.0	0.12	180	67.5	CONVERTER	180	−3.0 min.	67.5	2.0	1.5	750000	Anode Grid (#2) 135 max. volts, 3.3 ma. Oscillator Grid (#1) Resistor, 50000 ohms. Conversion conductance, 325 micromhos.				1C6
2A3	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	5 5/8" x 2 1/16"	FILAMENT	2.5	2.5	250	—	CLASS A AMPLIFIER	250	−45	—	—	60.0	800	5250	4.2	2500	3.5	2A3
								300	—	PUSH-PULL AMPLIFIER	300 300	−62 −62	Self-bias Fixed-bias		40.0 40.0	Power Output is for 2 tubes at stated load, plate-to-plate			5000 3000	10.0 15.0	
2A5	POWER AMPLIFIER PENTODE	MEDIUM 6-PIN	FIG. 15A	4 11/16" x 1 13/16"	HEATER	2.5	1.75	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.5	34.0	100000	2200	220	7000	3.0	2A5
2A6	DUPLEX-DIODE HIGH-MU TRIODE	SMALL 6-PIN	FIG. 13	4 11/32" x 1 9/16"	HEATER	2.5	0.8	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	250 ⌘	−1.35	—	—	0.4	—	—	Gain per stage = 50-60			2A6
2A7	PENTAGRID CONVERTER ◊	SMALL 7-PIN	FIG. 20	4 11/32" x 1 9/16"	HEATER	2.5	0.8	250	100	CONVERTER	250	−3.0 min.	100	2.2	3.5	360000	Anode Grid (#2) 200 max. volts, 4.0 ma. Oscillator Grid (#1) Resistor, 50000 ohms. Conversion conductance, 520 micromhos.				2A7
2B7	DUPLEX-DIODE PENTODE	SMALL 7-PIN	FIG. 21	4 11/32" x 1 9/16"	HEATER	2.5	0.8	250	125	PENTODE UNIT AS R-F AMPLIFIER	100 250	−3.0 −3.0	100 125	1.7 2.3	5.8 9.0	300000 650000	950 1125	285 730	—	—	2B7
										PENTODE UNIT AS A-F AMPLIFIER	250 ✠	−4.5	50	—	0.65	—	—	—	—	—	
6A4 also LA	POWER AMPLIFIER PENTODE	MEDIUM 6-PIN	FIG. 6	4 11/16" x 1 13/16"	FILAMENT	6.3	0.3	180	180	CLASS A AMPLIFIER	100 180	−6.5 −12.0	100 180	1.6 3.9	9.0 22.0	83250 45500	1200 2200	100 100	11000 8000	0.31 1.40	6A4 also LA
6A7	PENTAGRID CONVERTER ◊	SMALL 7-PIN	FIG. 20	4 11/32" x 1 9/16"	HEATER	6.3	0.3	250	100	CONVERTER	250	−3.0 min.	100	2.2	3.5	360000	Anode Grid (#2) 200 max. volts, 4.0 ma. Oscillator Grid (#1) Resistor, 50000 ohms. Conversion conductance, 520 micromhos.				6A7
6B7	DUPLEX-DIODE PENTODE	SMALL 7-PIN	FIG. 21	4 11/32" x 1 9/16"	HEATER	6.3	0.3	250	125	PENTODE UNIT AS R-F AMPLIFIER	100 250	−3.0 −3.0	100 125	1.7 2.3	5.8 9.0	300000 650000	950 1125	285 730	—	—	6B7
										PENTODE UNIT AS A-F AMPLIFIER	250 ✠	−4.5	50	—	0.65	—	—	—	—	—	
6C6	TRIPLE-GRID DETECTOR AMPLIFIER	SMALL 6-PIN	FIG. 11	4 13/16" x 1 9/16"	HEATER	6.3	0.3	250	100	SCREEN GRID R-F AMPLIFIER	250	−3.0	100	0.5	2.0	exceeds 1.5 meg.	1225	exceeds 1500	—	—	6C6
										BIAS DETECTOR	250	−1.95	50	Cathode current 0.65 ma.		—	Plate coupling resistor 250000 ohms. Grid coupling resistor 250000 ohms.**				

6D6	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL 6-PIN	FIG. 11	4 13/16" x 1 9/16"	HEATER	6.3	0.3	250	100	SCREEN GRID R-F AMPLIFIER	250	−3.0 min.	100	2.0	8.2	800000	1600	1280	—	—	6D6
										MIXER IN SUPERHETERODYNE	250	−10.0	100	—	—		Oscillator peak volts = 7.0.				
6E5	ELECTRON-RAY TUBE	SMALL 6-PIN	FIG. 29	4 1/4" x 1 9/16"	HEATER	6.3	0.3	250	—	TUNING INDICATOR	250	Grid Volts 0 approx. at 90° shadow angle; −0.8 approx. at 0° angle. Plate Resistor, 1 megohm. Current plate at 0 grid volts, 0.25 ma.; target, 4.5 ma. approx.									6E5

◊ Grids #3 and #5 are screen. Grid #4 is signal-input control grid.

✠ Applied through plate coupling resistor of 200000 ohms. **For grid of following tube.

⌘ Applied through plate coupling resistor of 250000 ohms.

6F7	TRIODE-PENTODE	SMALL 7-PIN	FIG. 27	4 11/32" x 1 9/16"	HEATER	6.3	0.3	100	—	TRIODE UNIT AS AMPLIFIER	100	−3.0	—	—	3.5	17800	450	8	—	—	6F7
								250	100	PENTODE UNIT AS AMPLIFIER	250	−3.0 min.	100	1.5	6.5	850000	1100	900	—	—	
								250	100	PENTODE UNIT AS MIXER	250	−10.0	100	0.6	2.8	Oscillator peak volts = 7.0. Conversion conductance = 300 micromhos.					
'00-A	DETECTOR TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	D-C FILAMENT	5.0	0.25	45	—	GRID LEAK DETECTOR	45	Grid Return to (−) Filament			1.5	30000	666	20	—	—	'00-A
01-A	DETECTOR★ AMPLIFIER	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	D-C FILAMENT	5.0	0.25	135	—	CLASS A AMPLIFIER	90 135	−4.5 −9.0	—	—	2.5 3.0	11000 10000	725 800	8.0 8.0	—	—	01-A
10	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	5 5/8" x 2 3/16"	FILAMENT	7.5	1.25	425	—	CLASS A AMPLIFIER	350 425	−31.0 −39.0	—	—	16.0 18.0	5150 5000	1550 1600	8.0 8.0	11000 10200	0.9 1.6	10
11 12	DETECTOR★ AMPLIFIER TRIODE	WD 4-PIN MEDIUM 4-PIN	FIG. 12 FIG. 1	4 1/4" x 1 3/16" 4 11/16" x 1 13/16"	D-C FILAMENT	1.1	0.25	135	—	CLASS A AMPLIFIER	90 135	−4.5 −10.5	—	—	2.5 3.0	15500 15000	425 440	6.6 6.6	—	—	11 12
19	TWIN-TRIODE AMPLIFIER	SMALL 6-PIN	FIG. 25	4 1/4" x 1 9/16"	D-C FILAMENT	2.0	0.26	135	—	CLASS B AMPLIFIER	135 135	0 −3.0	—	—	Power output value is for one tube at stated load, plate-to-plate.				10000 10000	2.1 1.9	19
20	POWER AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/8" x 1 3/16"	D-C FILAMENT	3.3	0.132	135	—	CLASS A AMPLIFIER	90 135	−16.5 −22.5	—	—	3.0 6.5	8000 6300	415 525	3.3 3.3	9600 6500	0.045 0.110	'20
22	R-F AMPLIFIER TETRODE	MEDIUM 4-PIN	FIG. 4	5 17/32" x 1 13/16"	D-C FILAMENT	3.3	0.132	135	67.5	SCREEN GRID R-F AMPLIFIER	135 135	−1.5 −1.5	45 67.5	0.6* 1.3*	1.7 3.7	725000 325000	375 500	270 160	—	—	22
24-A	R-F AMPLIFIER TETRODE	MEDIUM 5-PIN	FIG. 8	5 17/32" x 1 13/16"	HEATER	2.5	1.75	275	90	SCREEN GRID R-F AMPLIFIER	180 250	−3.0 −3.0	90 90	1.7* 1.7*	4.0 4.0	400000 600000	1000 1050	400 630	—	—	24-A
										BIAS DETECTOR	250●	−5.0 approx.	20 to 45	—	Plate current to be adjusted to 0.1 milliampere with no signal.						
26	AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	FILAMENT	1.5	1.05	180	—	CLASS A AMPLIFIER	90 180	−7.0 −14.5	—	—	2.9 6.2	8900 7300	935 1150	8.3 8.3	—	—	26
27	DETECTOR★ AMPLIFIER TRIODE	MEDIUM 5-PIN	FIG. 8	4 1/4" x 1 9/16"	HEATER	2.5	1.75	275	—	CLASS A AMPLIFIER	135 250	−9.0 −21.0	—	—	4.5 5.2	9000 9250	1000 975	9.0 9.0	—	—	27
										BIAS DETECTOR	250	−30.0 approx.	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
30	DETECTOR★ AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/4" x 1 9/16"	D-C FILAMENT	2.0	0.06	180	—	CLASS A AMPLIFIER	90 135 180	−4.5 −9.0 −13.5	—	—	2.5 3.0 3.1	11000 10300 10300	850 900 900	9.3 9.3 9.3	—	—	30

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.

● Applied through plate coupling resistor of 250000 ohms or 500 henry choke shunted by 0.25 megohm resistor. *Maximum.

31	POWER AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/4" x 1 9/16"	D-C FILAMENT	2.0	0.13	180	—	CLASS A AMPLIFIER	135 180	−22.5 −30.0	—	—	8.0 12.3	4100 3600	925 1050	3.8 3.8	7000 5700	0.185 0.375	31
32	R-F AMPLIFIER TETRODE	MEDIUM 4-PIN	FIG. 4	5 17/32" x 1 13/16"	D-C FILAMENT	2.0	0.06	180	67.5	SCREEN GRID R-F AMPLIFIER	135 180	−3.0 −3.0	67.5 67.5	0.4* 0.4*	1.7 1.7	950000 1200000	640 650	610 780	—	—	32
										BIAS DETECTOR	180♥	−6.0 approx.	67.5	—	Plate current to be adjusted to 0.2 milliampere with no signal.						

33	POWER AMPLIFIER PENTODE	MEDIUM 5-PIN	FIG. 6	4 11/16" x 1 13/16"	D-C FILAMENT	2.0	0.26	180	180	CLASS A AMPLIFIER	180	−18.0	180	5.0	22.0	55000	1700	90	6000	1.4	33
34	SUPER-CONTROL R-F AMPLIFIER PENTODE	MEDIUM 4-PIN	FIG. 4A	5 17/32" x 1 13/16"	D-C FILAMENT	2.0	0.06	180	67.5	SCREEN GRID R-F AMPLIFIER	135 180	−3.0 min.	67.5 67.5	1.0 1.0	2.8 2.8	600000 1000000	600 620	360 620	—	—	34
35	SUPER-CONTROL R-F AMPLIFIER TETRODE	MEDIUM 5-PIN	FIG. 9	5 17/32" x 1 13/16"	HEATER	2.5	1.75	275	90	SCREEN GRID R-F AMPLIFIER	180 250	−3.0 min.	90 90	2.5* 2.5*	6.3 6.5	300000 400000	1020 1050	305 420	—	—	35
36	R-F AMPLIFIER TETRODE	SMALL 5-PIN	FIG. 9	4 11/32" x 1 9/16"	HEATER	6.3	0.3	250	90	SCREEN GRID R-F AMPLIFIER	100 180 250	−1.5 −3.0 −3.0	55 90 90	— — 1.7*	1.8 3.1 3.2	550000 500000 550000	850 1050 1080	470 525 595	—	—	36
										BIAS DETECTOR	100● 250●	−5.0 −8.0	55 90	—	Plate current to be adjusted to 0.1 milliampere with no signal.						
37	DETECTOR★ AMPLIFIER TRIODE	SMALL 5-PIN	FIG. 8	4 1/4" x 1 9/16"	HEATER	6.3	0.3	250	—	CLASS A AMPLIFIER	90 180 250	−6.0 −13.5 −18.0	—	—	2.5 4.3 7.5	11500 10200 8400	800 900 1100	9.2 9.2 9.2	—	—	37
										BIAS DETECTOR	90 250	−10.0 −28.0	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
38	POWER AMPLIFIER PENTODE	SMALL 5-PIN	FIG. 9A	4 11/32" x 1 9/16"	HEATER	6.3	0.3	250	250	CLASS A AMPLIFIER	100 180 250	−9.0 −18.0 −25.0	100 180 250	1.2 2.4 3.8	7.0 14.0 22.0	140000 115000 100000	875 1050 1200	120 120 120	15000 11600 10000	0.27 1.00 2.50	38
39-44	SUPER-CONTROL R-F AMPLIFIER PENTODE	SMALL 5-PIN	FIG. 9A	4 11/32" x 1 9/16"	HEATER	6.3	0.3	250	90	SCREEN GRID R-F AMPLIFIER	90 180 250	−3.0 min.	90 90 90	1.6 1.4 1.4	5.6 5.8 5.8	375000 750000 1000000	960 1000 1050	360 750 1050	—	—	39-44

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.

■ Either A. C. or D. C. may be used on filament or heater, except as specifically noted. For use of D. C. on A-C filament types, decrease stated grid volts by ½ (approx.) of filament voltage.

● Applied through plate coupling resistor of 250000 ohms or 500-henry choke shunted by 0.25 megohm resistor.

♥ Applied through plate coupling resistor of 100000 ohms.

*Maximum.

40	VOLTAGE AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	D-C FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	135 ⌘ 180 ⌘	−1.5 −3.0	—	—	0.2 0.2	150000 150000	200 200	30 30	—	—	40
41	POWER AMPLIFIER PENTODE	SMALL 6-PIN	FIG. 15A	4 1/4" x 1 9/16"	HEATER	6.3	0.4	250	250	CLASS A AMPLIFIER	100 180 250	−7.0 −13.5 −18.0	100 180 250	1.6 3.0 5.5	9.0 18.5 32.0	103500 81000 68000	1450 1850 2200	150 150 150	12000 9000 7600	0.33 1.50 3.40	41
42	POWER AMPLIFIER PENTODE	MEDIUM 6-PIN	FIG. 15A	4 11/16" x 1 13/16"	HEATER	6.3	0.7	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.5	34.0	100000	2200	220	7000	3.00	42
43	POWER AMPLIFIER PENTODE	MEDIUM 6-PIN	FIG. 15A	4 11/16" x 1 13/16"	HEATER	25.0	0.3	135	135	CLASS A AMPLIFIER	95 135	−15.0 −20.0	95 135	4.0 7.0	20.0 34.0	45000 35000	2000 2300	90 80	4500 4000	0.90 2.00	43
45	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	FILAMENT	2.5	1.5	275	—	CLASS A AMPLIFIER	180 250 275	−31.5 −50.0 −56.0	180 250 275	—	31.0 34.0 36.0	1650 1610 1700	2125 2175 2050	3.5 3.5 3.5	2700 3900 4600	0.82 1.60 2.00	45
46	DUAL-GRID POWER AMPLIFIER	MEDIUM 5-PIN	FIG. 7	5 5/8" x 2 3/16"	FILAMENT	2.5	1.75	250	—	CLASS A AMPLIFIER □	250	−33.0	—	—	22.0	2380	2350	5.6	6400	1.25	46
								400	—	CLASS B AMPLIFIER ◆	300 400	0 0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				5200 5800	16.0 20.0	
47	POWER AMPLIFIER PENTODE	MEDIUM 5-PIN	FIG. 6	5 5/8" x 2 1/16"	FILAMENT	2.5	1.75	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.0	31.0	60000	2500	150	7000	2.7	47
48	POWER AMPLIFIER TETRODE	MEDIUM 6-PIN	FIG. 16	5 5/8" x 2 1/16"	D-C HEATER	30.0	0.4	125	100	CLASS A AMPLIFIER	96 125	−19.0 −20.0	96 100	9.0 9.5	52.0 56.0	—	3800 3900	—	1500 1500	2.0 2.5	48
49	DUAL-GRID POWER AMPLIFIER	MEDIUM 5-PIN	FIG. 7	4 11/16" x 1 13/16"	D-C FILAMENT	2.0	0.12	135	—	CLASS A AMPLIFIER □	135	−20.0	—	—	6.0	4175	1125	4.7	11000	0.17	49
								180	—	CLASS B AMPLIFIER ◆	180	0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				12000	3.5	
50	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	6 1/4" x 2 11/16"	FILAMENT	7.5	1.25	450	—	CLASS A AMPLIFIER	300 400 450	−54.0 −70.0 −84.0	—	—	35.0 55.0 55.0	2000 1800 1800	1900 2100 2100	3.8 3.8 3.8	4600 3670 4350	1.6 3.4 4.6	50
53	TWIN-TRIODE AMPLIFIER	MEDIUM 7-PIN ✱	FIG. 24	4 11/16" x 1 13/16"	HEATER	2.5	2.0	300	—	CLASS B AMPLIFIER	250 300	0 0	—	—	Power output value is for one tube at stated load, plate-to-plate.				8000 10000	8.0 10.0	53
55	DUPLEX-DIODE TRIODE	SMALL 6-PIN	FIG. 13	4 11/32" x 1 9/16"	HEATER	2.5	1.0	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	135 180 250	−10.5 −13.5 −20.0	—	—	3.7 6.0 8.0	11000 8500 7500	750 975 1100	8.3 8.3 8.3	25000 20000 20000	0.075 0.160 0.350	55
56	SUPER-TRIODE AMPLIFIER DETECTOR★	SMALL 5-PIN	FIG. 8	4 1/4" x 1 9/16"	HEATER	2.5	1.0	250	—	CLASS A AMPLIFIER	250	−13.5	—	—	5.0	9500	1450	13.8	—	—	56
										BIAS DETECTOR	250	−20.0 approx.	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
57	TRIPLE-GRID DETECTOR AMPLIFIER	SMALL 6-PIN	FIG. 11	4 13/16" x 1 9/16"	HEATER	2.5	1.0	250	100	SCREEN GRID R-F AMPLIFIER	250	−3.0	100	0.5	2.0	exceeds 1.5 meg.	1225	exceeds 1500	—	—	57
										BIAS DETECTOR	250	−1.95	50	Cathode current 0.65 ma.		—	Plate coupling resistor 250000 ohms. Grid coupling resistor 250000 ohms**				

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.

✱ Requires different socket from small 7-pin.

□ Grid next to plate tied to plate. ◆ Two grids tied together. **For grid of following tube.

⌘ Applied through plate coupling resistor of 250000 ohms.

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS MAXIMUM OVERALL LENGTH x DIAMETER	CATHODE TYPE ■	RATING: FILAMENT OR HEATER VOLTS	RATING: FILAMENT OR HEATER AMPERES	RATING: PLATE MAX. VOLTS	RATING: SCREEN MAX. VOLTS	USE Values to right give operating conditions and characteristics for indicated typical use	PLATE SUPPLY VOLTS	GRID VOLTS ■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICRO-MHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
58	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL 6-PIN	FIG. 11	4 11/16" x 1 9/16"	HEATER	2.5	1.0	250	100	SCREEN GRID R-F AMPLIFIER	250	−3.0 min.	100	2.0	8.2	800000	1600	1280	—	—	58
										MIXER IN SUPERHETERODYNE	250	−10.0	100	—	—	Oscillator peak volts = 7.0.					
59	TRIPLE-GRID POWER AMPLIFIER	MEDIUM 7-PIN#	FIG. 18	5 3/8" x 2 1/16"	HEATER	2.5	2.0	250	—	AS TRIODE ¶ CLASS A AMPLIFIER	250	−28.0	—	—	26.0	2300	2600	6.0	5000	1.25	59
								250	250	AS PENTODE ** CLASS A AMPLIFIER	250	−18.0	250	9.0	35.0	40000	2500	100	6000	3.00	
								400	—	AS TRIODE ● CLASS B AMPLIFIER	300 400	0 0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				4600 6000	15.0 20.0	
71-A	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	90 180	−19.0 −43.0	—	—	10.0 20.0	2170 1750	1400 1700	3.0 3.0	3000 4800	0.125 0.790	71-A
75	DUPLEX-DIODE HIGH-MU TRIODE	SMALL 6-PIN	FIG. 13	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	250 ⌘	−1.35	—	—	0.4	—	—	Gain per stage = 50-60			75
76	SUPER-TRIODE AMPLIFIER DETECTOR★	SMALL 5-PIN	FIG. 8	4 1/4" x 1 5/16"	HEATER	6.3	0.3	250	—	CLASS A AMPLIFIER	250	−13.5	—	—	5.0	9500	1450	13.8	—	—	76
										BIAS DETECTOR	250	−20.0	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
77	TRIPLE-GRID DETECTOR AMPLIFIER	SMALL 6-PIN	FIG. 11	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	100	SCREEN GRID R-F AMPLIFIER	100 250	−1.5 −3.0	60 100	0.4 0.5	1.7 2.3	650000 1500000	1100 1250	715 1500	—	—	77
										BIAS DETECTOR	250	−1.95	50	Cathode current 0.65 ma.		—	Plate coupling resistor 250000 ohms. Grid coupling resistor 250000 ohms**				
78	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL 6-PIN	FIG. 11	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	125	SCREEN GRID R-F AMPLIFIER	90 180 250 250	−3.0 min.	90 75 100 125	1.3 1.0 1.7 2.6	5.4 4.0 7.0 10.5	315000 1000000 800000 600000	1275 1100 1450 1650	400 1100 1160 990	—	—	78
79	TWIN-TRIODE AMPLIFIER	SMALL 6-PIN	FIG. 19	4 17/32" x 1 9/16"	HEATER	6.3	0.6	250	—	CLASS B AMPLIFIER	180 250	0 0	—	—	Power output value is for one tube at stated load, plate-to-plate.				7000 14000	5.5 8.0	79
85	DUPLEX-DIODE TRIODE	SMALL 6-PIN	FIG. 13	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	135 180 250	−10.5 −13.5 −20.0	—	—	3.7 6.0 8.0	11000 8500 7500	750 975 1100	8.3 8.3 8.3	25000 20000 20000	0.075 0.160 0.350	85
89	TRIPLE-GRID POWER AMPLIFIER	SMALL 6-PIN	FIG. 14	4 17/32" x 1 9/16"	HEATER	6.3	0.4	250	250	AS TRIODE ¶ CLASS A AMPLIFIER	160 180 250	−20.0 −22.5 −31.0	—	—	17.0 20.0 32.0	3300 3000 2600	1425 1550 1800	4.7 4.7 4.7	7000 6500 5500	0.300 0.400 0.900	89
										AS PENTODE ** CLASS A AMPLIFIER	100 180 250	−10.0 −18.0 −25.0	100 180 250	1.6 3.0 5.5	9.5 20.0 32.0	104000 80000 70000	1200 1550 1800	125 125 125	10700 8000 6750	0.33 1.50 3.40	
										AS TRIODE ● CLASS B AMPLIFIER	180	0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				13600 9400	2.50 3.50	
V-'99 X-'99	DETECTOR★ AMPLIFIER TRIODE	SMALL 4-NUB SMALL 4-PIN	FIG. 10 FIG. 1	3 1/2" x 1 3/16" 4 1/8" x 1 3/16"	D-C FILAMENT	3.3	0.063	90	—	CLASS A AMPLIFIER	90	−4.5	—	—	2.5	15500	425	6.6	—	—	V-'99 X-'99
112-A	DETECTOR★ AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	D-C FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	90 180	−4.5 −13.5	—	—	5.0 7.7	5400 4700	1575 1800	8.5 8.5	—	—	112-A

★For Grid leak Detection—plate volts 45, grid return to + filament or to cathode.
■ Either A. C. or D. C. may be used on filament or heater, except as specifically noted. For use of D. C. on A-C filament types, decrease stated grid volts by ½ (approx.) of filament voltage.
Requires different socket from small 7-pin.

** Grid #1 is control grid. Grid #2 is screen. Grid #3 tied to cathode.
¶ Grid #1 is control grid. Grids #2 and #3 tied to plate. ⌘ Applied through plate coupling resistor of 250000 ohms.
● Grids #1 and #2 connected together. Grid #3 tied to plate. **For grid of following tube.

RECTIFIERS

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS	CATHODE TYPE	FIL. VOLTS	FIL. AMPERES	PLATE	SCREEN	RATINGS	TYPE
5Z3	FULL-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 2	5 3/8" x 2 1/16"	FILAMENT	5.0	3.0	—	—	Maximum A-C Voltage per Plate........500 Volts, RMS Maximum D-C Output Current........250 Milliamperes	5Z3
12Z3	HALF-WAVE RECTIFIER	SMALL 4-PIN	FIG. 22	4 1/4" x 1 9/16"	HEATER	12.6	0.3	—	—	Maximum A-C Plate Voltage........250 Volts, RMS Maximum D-C Output Current........60 Milliamperes	12Z3
25Z5	RECTIFIER-DOUBLER	SMALL 6-PIN	FIG. 5	4 1/4" x 1 9/16"	HEATER	25.0	0.3	—	—	Maximum A-C Voltage per Plate........125 Volts, RMS Maximum D-C Output Current........100 Milliamperes	25Z5
1-v°	HALF-WAVE RECTIFIER	SMALL 4-PIN	FIG. 22	4 1/4" x 1 9/16"	HEATER	6.3	0.3	—	—	Maximum A-C Plate Voltage........350 Volts, RMS Maximum D-C Output Current........50 Milliamperes	1-v°
80	FULL-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 2	4 11/16" x 1 13/16"	FILAMENT	5.0	2.0	—	—	A-C Voltage per Plate (Volts RMS) 350 400 550 D-C Output Current (Maximum MA) 125 110 135 The 550 volt rating applies to filter circuits having an input choke of at least 20 henries.	80
'81	HALF-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 3	6 1/4" x 2 7/16"	FILAMENT	7.5	1.25	—	—	Maximum A-C Plate Voltage........700 Volts, RMS Maximum D-C Output Current........85 Milliamperes	'81
82	FULL-WAVE ▸ RECTIFIER	MEDIUM 4-PIN	FIG. 2	4 11/16" x 1 13/16"	FILAMENT	2.5	3.0	—	—	Maximum A-C Voltage per Plate....500 Volts, RMS Maximum D-C Output Current........125 Milliamperes Maximum Peak Inverse Voltage....1400 Volts Maximum Peak Plate Current........400 Milliamperes	82
83	FULL-WAVE ▸ RECTIFIER	MEDIUM 4-PIN	FIG. 2	5 3/8" x 2 1/16"	FILAMENT	5.0	3.0	—	—	Maximum A-C Voltage per Plate....500 Volts, RMS Maximum D-C Output Current........250 Milliamperes Maximum Peak Inverse Voltage....1400 Volts Maximum Peak Plate Current........800 Milliamperes	83
84 also 6Z4	FULL-WAVE RECTIFIER	SMALL 5-PIN	FIG. 23	4 1/4" x 1 9/16"	HEATER	6.3	0.5	—	—	Maximum A-C Voltage per Plate........350 Volts, RMS Maximum D-C Output Current........50 Milliamperes	84 also 6Z4

▸ Mercury Vapor Type. ° Interchangeable with Type 1.

RCA ALL-METAL RADIO TUBE CHARACTERISTICS CHART

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS MAXIMUM OVERALL LENGTH x DIAMETER	CATHODE TYPE ■	RATING: FILAMENT OR HEATER VOLTS	RATING: FILAMENT OR HEATER AMPERES	RATING: PLATE MAX. VOLTS	RATING: SCREEN MAX. VOLTS	USE Values to right give operating conditions and characteristics for indicated typical use	PLATE SUPPLY VOLTS	GRID VOLTS ■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICRO-MHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
6A8	PENTAGRID CONVERTER ●	SMALL OCTAL 8-PIN	FIG. 8A	3 1/4" x 1 5/16"	HEATER	6.3	0.3	250	100	CONVERTER	250	−3.0 min.	100	3.2	3.3	Anode Grid (#2): Supply**, 250 max. volts; Current, 4.0 ma. Oscillator-Grid (#1) Resistor, 50000 ohms. Conversion conductance, 500 micromhos.					6A8
6C5	DETECTOR ★ AMPLIFIER TRIODE	SMALL OCTAL 6-PIN	FIG. 6Q	2 5/8" x 1 5/16"	HEATER	6.3	0.3	250	—	CLASS A AMPLIFIER	250	−8.0	—	—	8.0	10000	2000	20	—	—	6C5
										BIAS DETECTOR	250	−17.0 approx.	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
6F5	HIGH-MU TRIODE	SMALL OCTAL 5-PIN	FIG. 5M	3 1/4" x 1 5/16"	HEATER	6.3	0.3	250	—	CLASS A AMPLIFIER	250	−2.0	—	—	0.9	66000	1500	100	—	—	6F5
6F6	POWER AMPLIFIER PENTODE	SMALL OCTAL 7-PIN	FIG. 7S	3 1/4" x 1 5/16"	HEATER	6.3	0.7	315	315	CLASS A AMPLIFIER	250	−16.5	250	6.5	34.0	80000	2500	200	7000	3	6F6
6J7	TRIPLE-GRID DETECTOR AMPLIFIER	SMALL OCTAL 7-PIN	FIG. 7R	3 1/4" x 1 5/16"	HEATER	6.3	0.3	250	125	SCREEN GRID R-F AMPLIFIER	250	−3.0	100	0.5	2.0	exceeds 1.5 meg.	1225	exceeds 1500	—	—	6J7
										BIAS DETECTOR	250	−4.3	100	Cathode current 0.43 ma.		—	Plate coupling resistor 500000 ohms. Grid coupling resistor 250000 ohms.**				
6K7	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL OCTAL 7-PIN	FIG. 7R	3 1/4" x 1 5/16"	HEATER	6.3	0.3	250	125	SCREEN-GRID R-F AMPLIFIER	250	−3.0 min.	125	2.6	10.5	600000	1650	990	—	—	6K7
										MIXER IN SUPERHETERODYNE	250	−10.0	100	—	—	Oscillator peak volts = 7.0					
6L7	PENTAGRID MIXER & AMPLIFIER	SMALL OCTAL 7-PIN	FIG. 7T	3 1/4" x 1 5/16"	HEATER	6.3	0.3	250	150	MIXER IN SUPERHETERODYNE	250	−3.0	100	6.2	2.4	Oscillator Grid (#3) bias, −10 volts. Grid #3 peak swing, 12 volts min. Conversion conductance, 350 micromhos.					6L7
										AMPLIFIER ◖	250	−3.0	100 max.	5.5	5.3	800000	1100	—	—	—	

● Grids #3 and #5 are screen. Grid #4 is signal-input control grid.
★ For Grid-leak Detection—plate volts 45-100.
▲ Grids #2 and #4 are screen. Grid #1 is signal-input control grid.

◖ Grid #3 connected to grid #1.
** Applied through 20000 ohm voltage-dropping resistor.

** For grid of following tube.
■ Either A.C. or D.C. may be used on heater.

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS	CATHODE TYPE	FIL. VOLTS	FIL. AMPERES	PLATE	SCREEN	RATINGS	TYPE
5Z4	FULL-WAVE RECTIFIER	SMALL OCTAL 5-PIN	FIG. 5L	5 1/4" x 1 5/16"	HEATER	5.0	2.0	—	—	Maximum A-C Voltage per Plate........400 Volts, RMS Maximum D-C Output Current........125 Milliamperes	5Z4
6H6	TWIN-DIODE DETECTOR RECTIFIER	SMALL OCTAL 7-PIN	FIG. 7Q	1 3/4" x 1 5/16"	HEATER	6.3	0.3	—	—	Maximum A-C Voltage per Plate........100 Volts, RMS Maximum D-C Output Current........2 Milliamperes	6H6

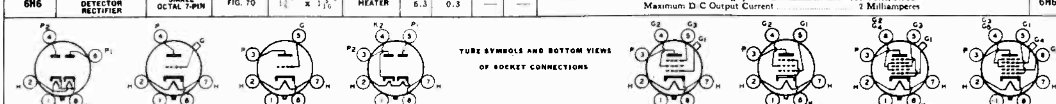


FIG. 5-L FIG. 5-M FIG. 6-Q FIG. 7-Q FIG. 7-R FIG. 7-S FIG. 7-T FIG. 8-A

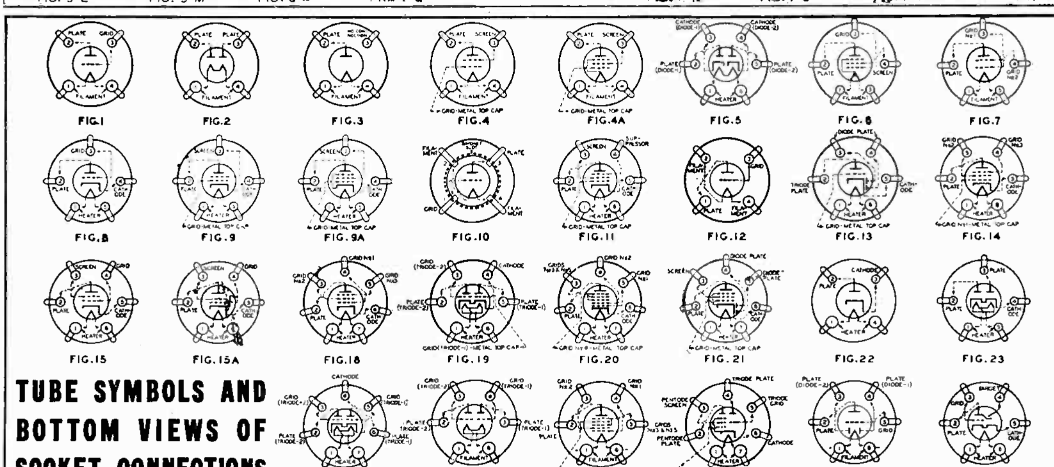
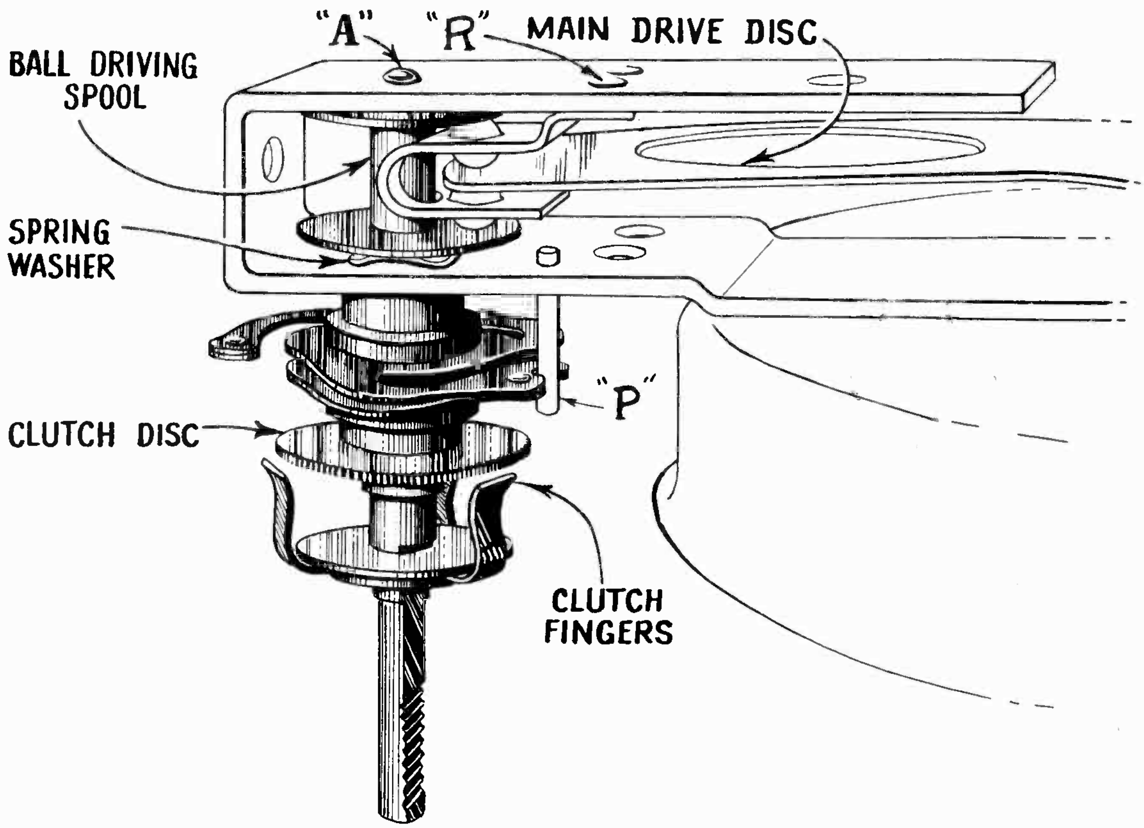


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 4A FIG. 5 FIG. 6 FIG. 7
FIG. 8 FIG. 9 FIG. 9A FIG. 10 FIG. 11 FIG. 12 FIG. 13 FIG. 14
FIG. 15 FIG. 15A FIG. 18 FIG. 19 FIG. 20 FIG. 21 FIG. 22 FIG. 23

TUBE SYMBOLS AND BOTTOM VIEWS OF SOCKET CONNECTIONS

FIG. 24 FIG. 25 FIG. 26 FIG. 27 FIG. 28 FIG. 29

SLIPPING DIAL DRIVE MECHANISMS

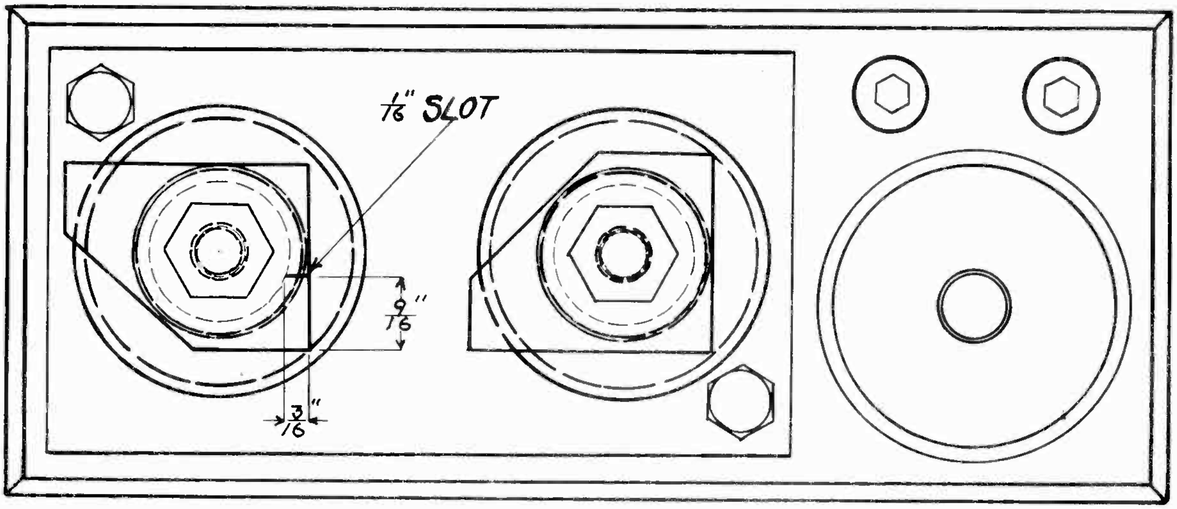


The occasional slippage encountered in the Stock No. 7799 tuning control, resulting from worn clutch fingers, should be repaired by replacement of the clutch assembly and ball drive spool. These two parts, which are shown shaded in the illustration, are supplied as Stock No. 4422. The spool is "press-fitted" to the small end of the tuning shaft; hence it will be necessary to force the two apart in order to remove them from the mechanism. A new spool is required with the new clutch in order to attain the proper and original fit. The old spool is unsatisfactory for use with the new shaft.

Removing Defective Clutch — Remove the dial pointers and dial face. Dismount the drive assembly from the receiver chassis, and clamp it in a vise in a position such as illustrated. Rotate the tuning shaft until the main drive disc is out of mesh with the steel balls. Force the tuning shaft from its engagement with the ball driving spool by carefully driving the end "A" with a flat-nose pin punch of 5/32 inch diameter. To release the spool, remove one of the rivets "R" which support the ball retaining bracket. Then shift the retainer until the spool is free. Do not let the steel balls escape from their positions. Be careful not to lose the spring washer which is adjacent to the spool on the shaft.

Installation of New Clutch—Invert the drive assembly in the vise so that the large end of the tuning shaft is upward. Install the new clutch and new spool by placing the spool in position, and forcing or carefully driving the tuning shaft into the spool from the control knob end. See that the spring washer is in its proper position on the shaft; also that the steel balls fit correctly. Replace the rivet which was removed from the ball retainer, or use a small machine screw as a substitute. Test the operation of the drive by rotating the shaft. If the fingers strike the pin "P," bend it slightly outward so they will clear. Remount the drive on the receiver chassis. In clamping the main drive disc to the condenser shaft, be certain that at neither extreme of motion will it become disengaged from the steel balls.

INSTRUCTIONS FOR RCA VICTOR PICKUP MAGNETIZER
STOCK No. 9549



SN 594

Introduction

The RCA Victor Pickup Magnetizer is a battery energized electro-magnet for magnetizing electric pick-ups, permanent magnet loudspeakers and similar devices. It consists essentially of two pole-piece assemblies, the respective coils of which are connected through a push-button to two binding posts for the external storage battery supply.

In some instances it will be necessary to make a slight change on the magnetizer, as indicated in Figure 1, in order that the pickup centering spring will not interfere with the pole piece of the pickup making firm contact with the electro-magnet.

One pole piece must be rotated 180 degrees, while 9/16 of an inch from the lower edge a slot 1/16 of an inch wide must be cut to a depth of 3/16 of an inch.

Installation

The magnetizer may be mounted in any location convenient to the storage battery connections. The power supply should be capable of delivering at least 6 volts at 4 amperes to the magnetizer. The leads for connecting to the battery should be No. 14 B. & S. or larger.

Operation

To re-magnetize an electric pickup, first make certain that all adjustments involving removal of the magnet have been made. Proceed as follows:

For Obsolete Types— Place the pickup on the magnetizer so that the pole pieces of the pickup are in contact with those of the magnetizer, irrespective of polarity. It is important that adjacent surfaces of the respective pole pieces shall make good contact over as large an area as possible. Press the button and hold it down for a period of from one to two seconds. Remove the pickup gently, being careful not to jar its magnet from the pole pieces. For magnetizing chromium pickup magnets, 6 volts will be sufficient. With cobalt magnets, however, 12 volts will be required for full saturation, although a fairly satisfactory magnetization is possible with only 6 volts. If a 12 volt source is employed, care should be taken to prevent overheating of the magnetizer coils.

For Present Types—Remove the magnet from the electric pickup and place it on the magnetizer. Press the push-button and hold it down for one or two seconds. To remove, hold the pickup so that the surfaces of its pole pieces are level with the pole pieces of the magnetizer and *slide* the magnet from the magnetizer onto the pickup so that the magnetic circuit will not be broken. Practically all modern types of electric pickups embody a chromium magnet for which a 6 volt supply is sufficient.