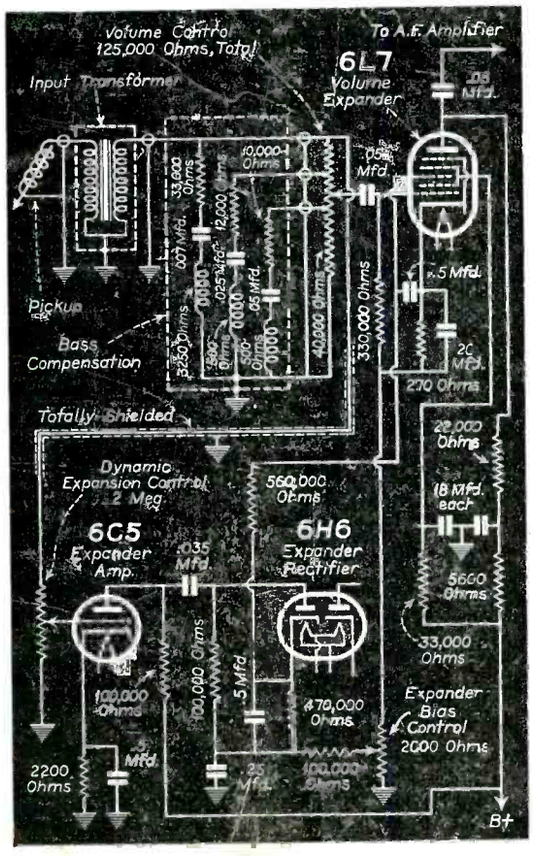
SERVICE

A MONTHLY DIGEST OF

RADIO

AND ALLIED MAINTENANCE



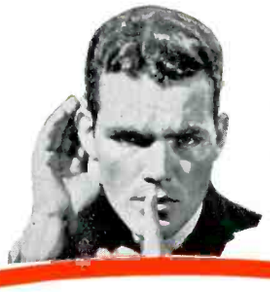
Complete Volume Expander Circuit

(See Page 572)

PER COPY
25 CENTS

NOVEMBER
1936

It's Not Only Quiet



It's SILENT!

Patent applied for

Perfect Smooth Taper.

Pure Silver Shortouts for Switch Action.

New Spring Wedge Prevents Loose Terminals.

You Can't Hear It!

and of course . . . It's a

YAXLEY

Replacement Volume Control

Silent—soundless—you can't hear it—here's the answer to the Serviceman's prayer. Mallory-Yaxley has perfected the universal SILENT Replacement Control — and that's news you have been waiting to hear about volume controls for a long time.

The roller that doesn't roll holds the secret of silent, velvety smooth operation. With it goes a track with an exclusive Mallory-Yaxley compound (with twice the wear) that permits no hard, thin surface as on ordinary track. It means perfect, soundless contact; complete prevention of noise-making dust and dirt; with absolute electrical and mechanical smoothness.

Silver to silver contacts eliminate corrosion. Silver shortouts for switch action. Perfect smooth tapers. Low humidity and low temperature coefficients; no need to fear "damp spots" or "hot spots." Uniform characteristics. Long life. New spring wedge avoids possibility of loose terminals. Equipped with the famous Yaxley attachable switch and other exclusive universal features.

You'll want Yaxley Silent Replacement Volume Controls for every service requirement. If you haven't tried them yet, get after your distributor today. Just say—"I want a Yaxley Silent."

YAXLEY MANUFACTURING DIVISION
of P. R. MALLORY & CO., Inc.
INDIANAPOLIS INDIANA
Cable Address—PELMALLO

P. R. MALLORY & CO. Inc.
MALLORY

YAXLEY

What to do and how to do it . . .

The radio service man who wishes to thrive in his highly competitive business must have adequate service data right at his finger tips, so that he can do his work quickly, accurately . . . economically for the radio set owner . . . and profitably for himself. To this end, General Electric has released a new Bound Volume —

GENERAL ELECTRIC
RADIO SERVICE NOTES
1930-1935

From every page of this practical new volume, the alert service man will secure sound instruction and valuable service information on all radio receivers sold by General Electric during the past six years . . . 1930-31-32-33-34-35. This new book also contains a cross-index to certain comparable models of other manufacturers made during the same years.

PARTIAL LIST OF SUBJECTS COVERED

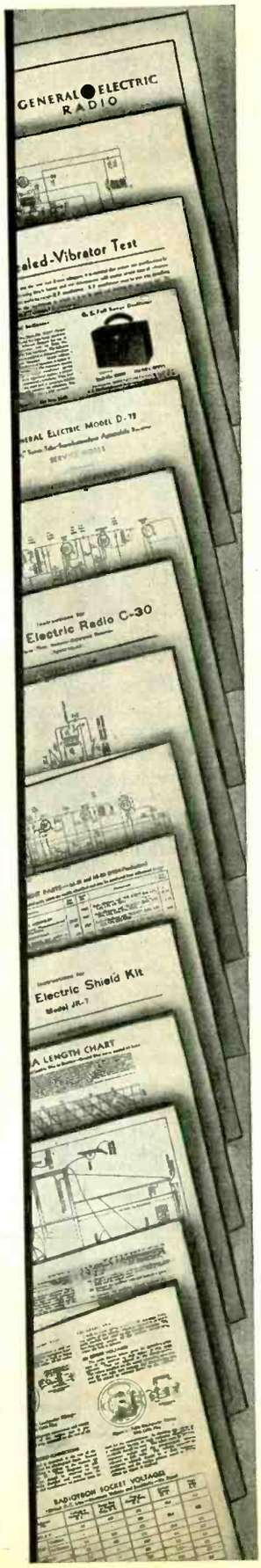
- Electrical & Physical Specifications
- Descriptions of Electrical Circuits
- Schematic Circuit Diagrams
- Chassis Wiring Diagrams
- Radiotron Socket Voltages
- Locations of Line-up Capacitors
- Line-up Procedure
- Continuity Tests
- Condenser Drive Cord Arrangements
- Line Voltage Adjustments
- Loudspeaker Wiring
- Speaker Cone Alignment
- Auto Radio Installation
- Vibrator Service Data
- Checking with Tuning Wand
- Replacement Parts and Prices
- Phonograph Pickup Service Data
- Recording and Microphone Data
- Microphone Service Data
- Automatic Record Changer Service Data
- Phonograph Motor Service Data
- Remote Control Service Data
- Test Oscillator Data
- Short-wave Adapters and Converters
- Interference Suppression
- Frequency vs. Impedance Chart
- Inductance vs. Capacity Chart
- Decibel Chart and Instructions
- Radiotron Data, Symbols and Socket Connections
- Antenna Data
- Wave Trap Data
- Short-wave Reception Notes
- Station Logs

General Electric's Bound Volume of 1930-35 RADIO SERVICE NOTES gives you a practical and helpful "brass-tack" manual on how to correctly service and replace parts in over 350 radio receivers . . . PLUS considerable extra data applicable to all makes of receivers.

You can purchase the bound volume of GENERAL ELECTRIC RADIO SERVICE NOTES for 1930-1935 direct from your local G-E Radio Distributor.

GENERAL ELECTRIC

Appliance and Merchandise Department
Bridgeport, Connecticut



SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U. S. Patent Office. Member, Audit Bureau of Circulations

NOVEMBER, 1936 — EDITOR Robert G. Herzog — VOL. 5, NO. 11

EDITORIAL CONTENTS

BRYAN S. DAVIS, *President*
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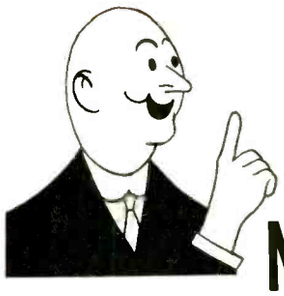


. . . and let me tell you a few things about this "PRECISION" ELECTRONOMETER No. 600

FIRST: The new No. 600 Electronometer is a complete modern tube analyzer combined with adequate volts, current and resistance measurements for point to point set testing. . . . Compact in size (12 x 12 x 6), weighs only 12 pounds, and is ruggedly built to withstand rough usage.

SECOND: Accuracy, simplicity, ease and speed for obtaining tube or set analyses, is the keynote of this instrument. No side gadgets to be considered or remembered when obtaining the various tests.

THIRD: It is entirely automatic in operation. For tube analyzing, simply set controls as indicated on the data chart for the tube to be tested. For set testing, a rotary switch selects the desired measurement and pin jacks are employed to select the various ranges. Instructions, although furnished, are almost unnecessary.

FOURTH: Tube analyzing is accomplished with the most advanced engineering principles. . . . Properly rated loads applied; each section of multi-element tubes such as full wave rectifiers, twin triodes, triode diodes, pentode diodes, duo diodes, pentode triodes and frequency converters can be *individually* checked; neon method hot cathode leakage detection; hot neon point to point interelectrode leakage and short tests between any elements within the tube for detecting noisy and fading conditions; micro line adjustment can be obtained and is shown directly on the meter.

FIFTH: The most important set analyses features have been included in the No. 600 Electronometer: Four D.C. voltage ranges 0-10; 0-100; 0-500; 0-1000 at 1000 ohms per volt. Three D.C. current ranges 0-1; 0-10; 0-100. Three resistance ranges 0-2500; 0-250,000; 0-2½ megs; one scale with large easy reading numerals; center low ohms scale, 35 ohms; readings as low as ½ of an ohm can be obtained; self-contained power supply. Qualitative paper condenser tests available. Provision for measuring leakages of electrolytic condensers in terms of current leakage per microfarad.

SIXTH: Extreme flexibility for future tube releases is provided by means of a group of individual switches giving a complete FREE POINT TUBE ANALYSIS SYSTEM. Each of these switches is connected to the various prong positions of the sockets permitting an arrangement whereby any combination of electrodes desired may be connected to obtain complete tests of various tube elements regardless of electrode pin positions. This method amply affords a means of accommodating future releases without the necessity of wiring. Instructions furnished explain in detail how test limits for future tube releases can very easily be adapted to the tube chart.

Here's an instrument that makes radio men everywhere say, "I'm extremely satisfied in every way with your No. 600 Electronometer" . . . and you'll say so, too! Or, it doesn't cost you a single penny. Go to your nearest distributor—purchase it—and if within two weeks you don't think it's the finest instrument in its class that can be bought for the price, then return it for an unconditional refund.

DISTRIBUTORS: The Precision Apparatus Corporation will stand behind the statement made in the above paragraph.

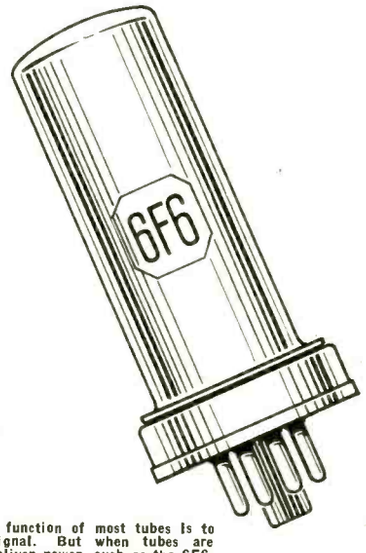
. . . and it's only $45.75

SEE IT AT YOUR LOCAL DISTRIBUTOR OR WRITE TO FACTORY FOR DETAILS

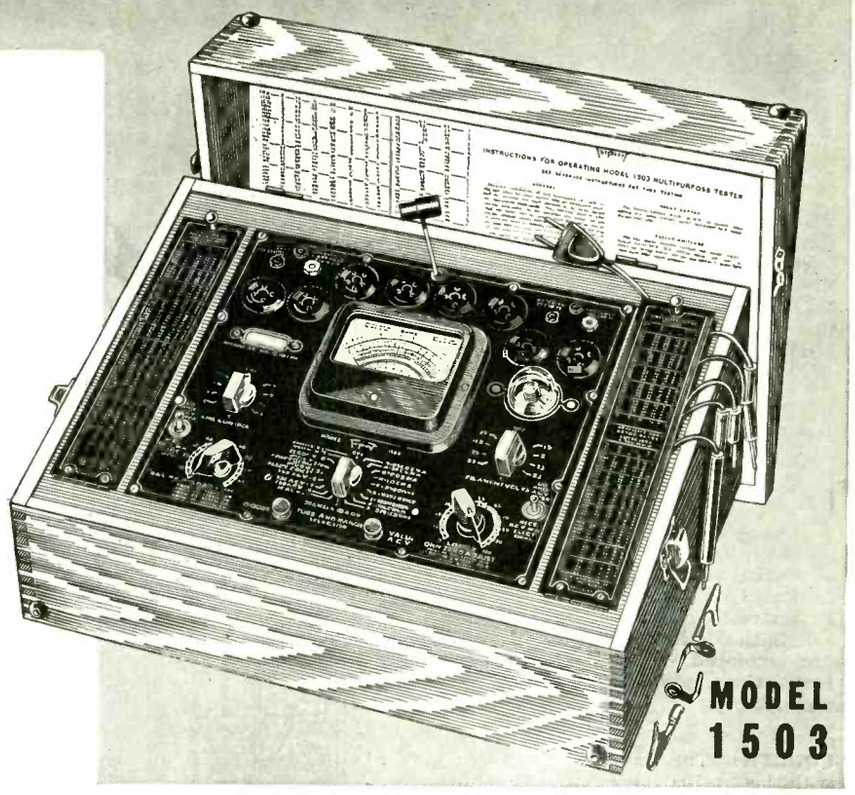
PRECISION
Apparatus Corporation

821 EAST NEW YORK AVENUE, BROOKLYN, N. Y.

Give It A Full Test

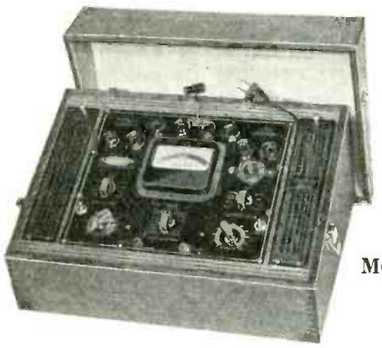


Normally the function of most tubes is to amplify a signal. But when tubes are required to deliver power, such as the 6F6, the amplification may test up and yet the tube may distort badly. Reason . . . weak emission . . . particularly at low frequencies. Such tubes demand both amplification and emission test, now available - -



on The P.O.E. Tester

(Patented Sept. 15, 1936)



MODEL
1502

P.O.E. Tube Tester—tests all types tubes. Tube values are indicated on GOOD - BAD Scale. Has shadow-graph line voltage indicator. Neon interelement short test made while tube is hot. When new tubes are released, up-to-date tube charts are provided. Complete in quartered oak case with all necessary accessories..... Dealer Price...$36.67

● Tubes in radios have three different functions: to amplify, to deliver power, to rectify.

For amplifiers (75% or more of all tubes) the power output test is absolutely the final word in determining the worth of the tube. The Power Output Test in Triplett P.O.E. Tester simulates actual operating conditions in the radio set.

For Power Tubes, the Power Output Test determines the amplification factor. The emission test determines the power handling ability. Both tests are necessary to properly analyze these tubes, available only in the P.O.E. Tester.

The function of the diode tube is to rectify. Here the emission test only is made to determine the condition of the tube. P.O.E. tests these under both voltage and current load. The proper high voltages used in the P.O.E. Tester will detect any flash overs. Model 1503 combines all the required servicing instruments in one

1. P.O.E. Test for All Tubes
2. Neon Short Test
3. Separate Diode Test
4. Condenser Test for Shorts
5. Electrolytic Condenser Leakage Test
6. D.C. Voltmeter and Milliammeter
7. Ohmmeter
8. A.C. Voltmeter
9. Decibel Meter

Complete in quartered oak case with all necessary accessories ..... Dealer Price...$46.67

See Your Jobber . . . . Write for Catalogue

THE
TRIPLETT ELECTRICAL INSTRUMENT CO.
1711 Harmon Drive, Bluffton, Ohio

Without obligation, please send me:

.....More information on Model 1503; .....1502.

.....I am also interested in .....

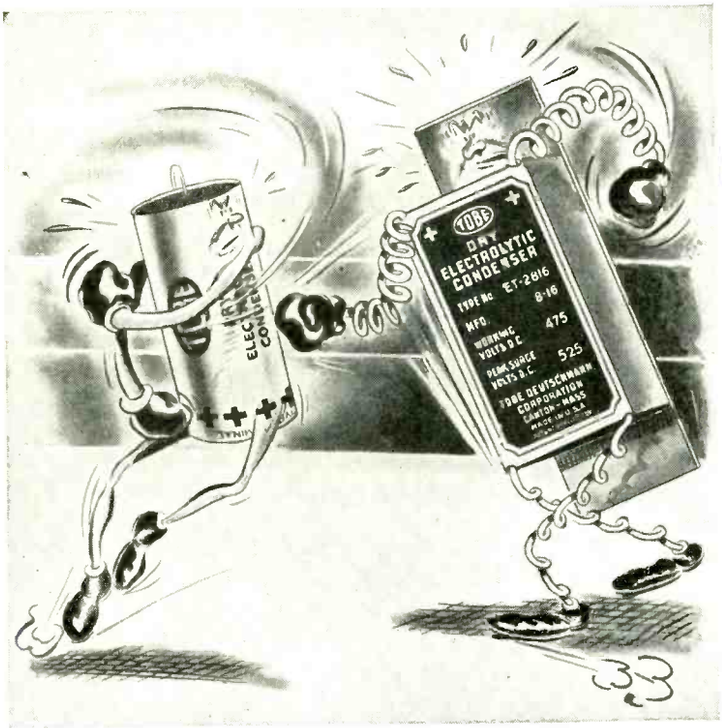
Name .....

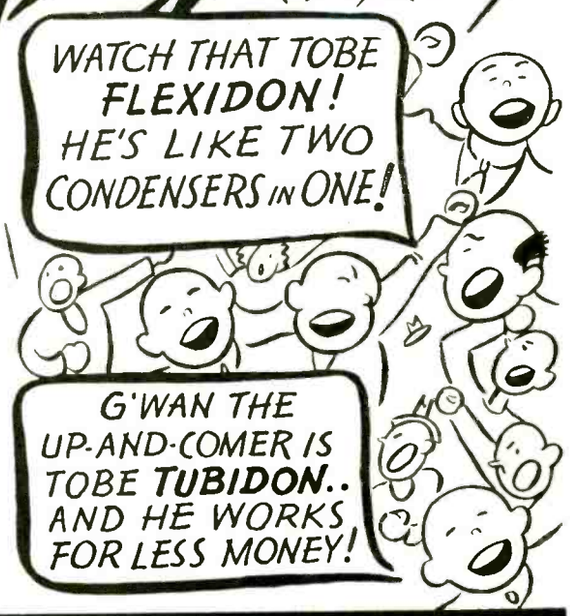
Address .....

City..... State.....

TRIPLETT
Precision
ELECTRICAL INSTRUMENTS

The BIG CONDENSER FIGHT Begins!





"TOBE" TUBIDON vs "TOBE" FLEXIDON

We consider TOBE TUBIDON and TOBE FLEXIDON such ultra-fine condensers that we just can't imagine how either can lose in this big fight for condenser supremacy. But the answer is up to you ... compare their advantages: TOBE TUBIDON is tubular-shaped, up to 525 volts, self-supporting, easier to install, and *lower* in *cost.* TOBE FLEXIDON is rectangular-shaped, up to 525 volts, space-saving design ... with the big feature of *flexibility* (the fact that if one section breaks down, it is necessary to replace *only* the broken section.)

Which do you favor in this big battle? Note how they shape up ... read the exact specifications. *Remember that both are topnotchers* ... thoroughly moisture-proof, double-jacketed, asphalt impregnation and heavy wax seal, added protection against developing open circuit or high resistance contact ... all the features born of skillful manufacture and long experience.

SEE THE CONTESTANTS IN PERSON AT ALL GOOD RADIO JOBBERS

Ask for them by their nicknames, TOBE TUBIDON and TOBE FLEXIDON. And, if you wish to receive our complete illustrated TOBE CATALOG fill in the coupon below, and mail today.

HOW THEY SHAPE UP ...

	TUBIDON	FLEXIDON
VOLTS	35-50-200-525	200-525
MFD.	35v.—5 to 50 50v.—5 to 25 200-525v.-1 to 16	1 to 16 (single) (multiples up to triple eight)
MAXIMUM SIZE	2-¼" x 1"	3-¼"x1⅝"x1-⅝"
MINIMUM SIZE	2-¼" x ½"	2-⅛"x⅞"x⅞"
TYPE LEADS	solid bare tinned copper wire	insulated tinned copper wire
LEAD LENGTHS	2-½"	6"
MOUNTING	self supporting by leads	metal eyeletted tabs
PRICE (typical 8 mfd.-475v.)	$.75	$.95

TOBE

ELECTROLYTIC CONDENSERS

Skillfully Manufactured at Canton, Mass.

TOBE DEUTSCHMANN CORP.
Dept. L-10; Canton, Massachusetts

Please send FREE OF CHARGE full technical description of TOBE TUBIDON and TOBE FLEXIDON, including your complete TOBE catalog.

Name .....

Street .....

Town ..... State .....

THE ANTENNA . . .

SERVICE MEN'S ASSOCIATIONS

MANY OF THE INDEPENDENT Service Men's associations spend considerable time at their meetings quibbling over constitutions, by-laws, president's powers and similar petty political details. It would seem that in such organizations, where most of the active membership is present at any given meeting, any question can be hashed out on the floor *at the time that question arises*. Written constitutions or by-laws will serve only *to limit* the group and greatly detract from the interest at the meetings.

An independent group need not be hampered with either constitution or by-laws—each bridge can be crossed as they come to it—future actions of the governing officers can be based upon previous actions unless voted otherwise by the membership. In this manner much meaningless discussion can be eliminated and more time devoted at the meetings to interesting programs—programs designed to increase the attendance at the meetings.

Such programs are not difficult to arrange. An outside speaker need not always be the order of the day. Nor is the lure of beer and hot dogs required (except as a last resort). A group of active Service Men in the middle west have what they call a technical papers committee. This committee reads all the technical publications of interest to the Service Man. Regularly, at the meetings, timely articles are brought up for discussion. In this manner the busy Service Man has the opportunity to acquaint himself with advancement in this ever growing industry.

In the same organization another committee puts into practice the numerous hints described in SERVICE and other magazines. This committee reports, and in many cases demonstrates, its successes to the assembled members.

Among the members of each organization there are many who could consistently offer suggestions which would draw the membership to the meetings. Ideas along these lines are definitely *not* at a premium. The most capable members of the group (those with the most practical ideas) can be appointed as the program committee and design a specific program for each meeting far enough in advance to give it sufficient publicity. Should any one idea prove more successful than the others it can be used again at intervals.

CHRISTMAS EVE MUSIC

ON THE AFTERNOON BEFORE Christmas many offices and factories stage a Christmas party for their employees. Most school teachers also have a party for their pupils. The local Service Man can earn a suitable fee by supplying the music for these parties.

A small radio receiver with a phonograph connection, the pickup and turntable and a few records would be adequate for any merry group. No more than five or six of the more recent dance selections need be necessary with one of "Stille Nacht" as an encore. Radio programs could be used in between to lend variety.

• • •

NOISELESS RECEPTION

LAST MONTH'S EDITORIAL on noiseless reception brought an enthusiastic response from many of our readers. We refer these and other interested persons to the several manufacturers of noise-reducing equipment. Among those manufacturers who have done work in advancing the banners of noiseless reception we should like to mention: Aerovox Corporation; Cornell-Dubilier Corporation; P. R. Mallory and Company, Inc.; Solar Manufacturing Corporation; Sprague Products Company, and others who are prepared to render assistance to Service Men in this problem of noise interference elimination.

The difficulty of solving any perplexing noise-reducing problem is now no longer left entirely to the Service Man himself—information and materials for successful installations are available from all sides. It remains only for the Service Man to take advantage of the opportunities offered him.

• • •

ON OUR LECTURE TOUR

WE ARE QUITE PROUD of the warm reception given to SERVICE throughout the country. During our lecture tour, upon which we are still engaged, we visited Service Men in their shops and in their homes, and wherever we went they spoke of SERVICE in exceedingly complimentary terms. As proof of their high regard for the publication they were able to show complete files dating back to the very first issue of the magazine.

Equally complimentary is the extent to which hints, published in SERVICE, were found in use exactly as described in the magazine.

We thank our many readers (and listeners) and assure them that we will continue to make SERVICE interesting and instructive.

"EVEREADY LAYERBILT"

Presents two

RECORD-SMASHING VALUES

The Famous 486

"LAYERBILT"

at a new low price **$1.98**

The New

"SUPER LAYERBILT"

The Longest Lasting "B" Battery ever offered at only **$2.25**

Genuine "Eveready Layerbilt" "B" batteries, famous for years for *extra long service,* now cost but a few cents more than ordinary, wasteful, short-lived, old-fashioned round-cell "B" batteries. You can now buy genuine, exclusive "Layerbilt" "B" Batteries for *less* than many makes of round-cell battery. And "Layerbilt" now gives you the new, crack-proof cushion top in addition to the advantages of patented "Layerbilt" construction.

"Layerbilt" gives you longer service because there's no waste space, and because "Layerbilt" construction permits the power-making materials to be more completely used up. For example, the active material in a round-cell battery is contained in 30 zinc cans. The zinc is eaten away to make electricity, and usually tiny holes appear in the zinc long before the battery should be used up. Air gets in, the chemicals dry out, the battery go... dead quickly, before it is use...

In "Layerbilt" batteries, the zi... plates perforate also, but no... admitted and no harm... That's why long aft... cell battery has qu... goes on pouring...

Take adv... extra l... pric... w...

Here's the way we're telling your customers about these two new Eveready— Are you Stocked?

Standard "Eveready" Round Cell "B" Batteries

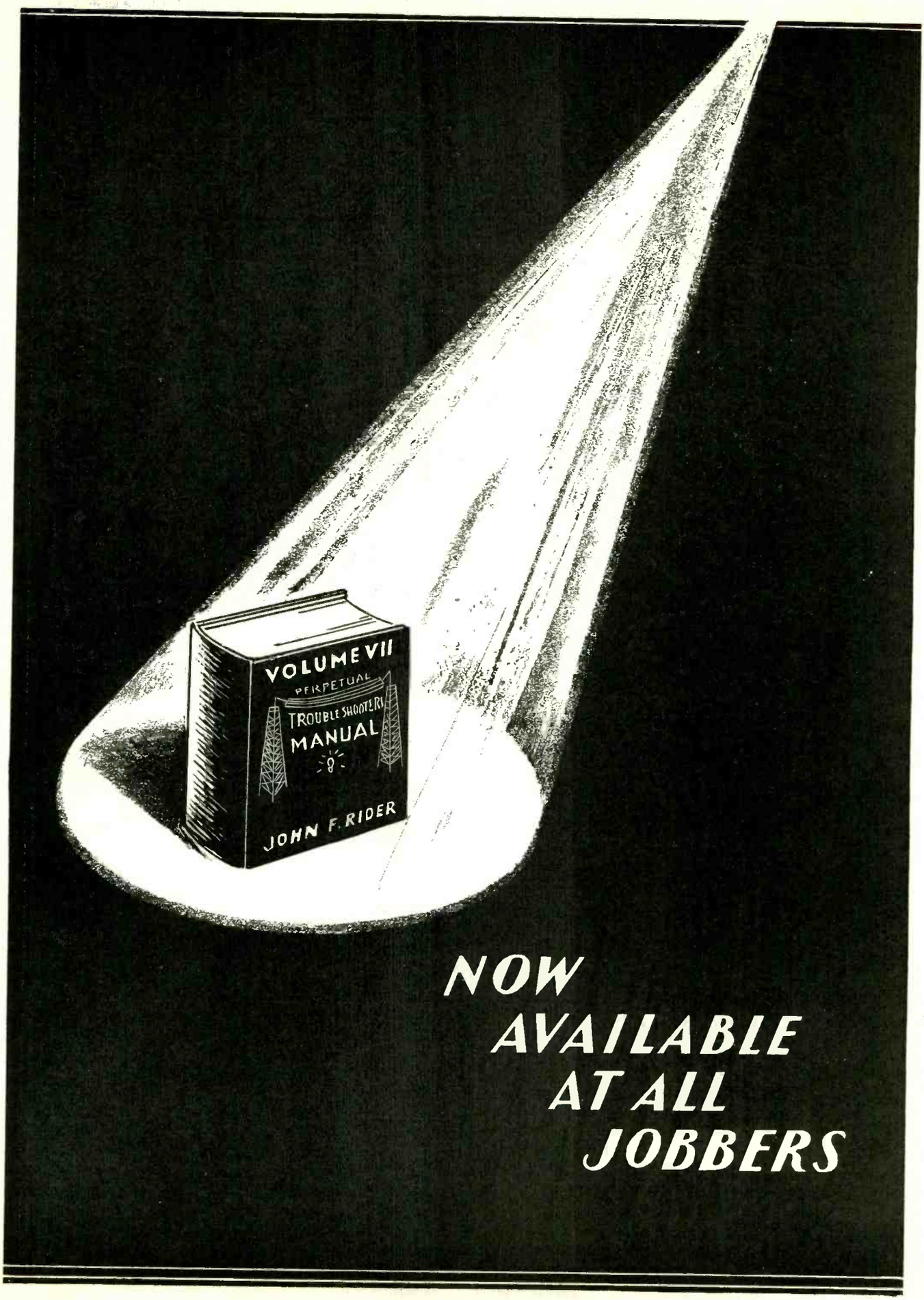
The words "Eveready" and "Layerbilt" are trade-marks of the National Carbon Co., Inc.

NATIONAL CARBON

General Offices: New York, N. Y.

Unit of Union Carbide...

Prices slightly higher in Far Western States



"The Standard by Which Others Are Judged and Valued"

AUDAX *Magneto-Inductive Pick-ups*

Built on the time-tested, unfailing, unvarying Magneto-Induction principle . . . the identical method used in the actual making of the remarkable new high-fidelity records. Preferred by leading Universities, Radio Stations, Theatres and Sound Engineers . . . wherever SOUND must be of the very best!

A sound engineer's pick-up! The more technical and exacting the listener, the better this superfine instrument squares with his ideals. For the first time since the advent of pick-ups in 1926 — here is absolute recording-microphone fidelity — uncompromising in *facsimile* performance and scientific uniformity. Yes —it's MAGNETO INDUCTIVE.

AUDAX Recording Heads

All AUDAX cutters are built on the Magneto-Induction principle as used in the actual making of Hi-Fidelity records by the foremost manufacturers. AUDAX cutters are used in leading radio stations, recording studios; wherever quality transcriptions are demanded.

Listed from **$35.00** *up*

An interesting new brochure—"Pick-up Facts"—is now available to the trade. Write for your copy.

NEW . . . . MAGNETO-CHROMATIC

AUDAX PR-66

For use with records up to 18". High frequency range. Ball-bearing compound movement. Low gravity center. Remarkably fine tracking. Featherweight. Low or high impedance.

Listed at **$35.00**

AUDAX HR-64

MAGNETO-CHROMATIC — Technically identical with PR-66, for use with records up to 12". Featherweight on record. Low or high impedance.

Listed at **$24.50**

AUDAX HR-62

MAGNETO-CHROMATIC—Low priced model for records up to 12". Excellent frequency response. Featherweight on record. Low or high impedance.

Listed at **$15.00**

UPRIGHT TYPE

AUDAX PRO *Listed at* $65.00

High fidelity. Used in leading radio stations on large transcriptions (up to 18"). Frequency range covers full requirements of the finest commercial records. Special heavy gauge arm has ball-bearing compound movement. Very lightweight on the record. Low or high impedance.

AUDAX PRO-2 *Listed at* $35.00

Technically identical with above model, but equipped with lighter gauge arm. For records up to 18".

AUDAX HR-38

Is identical with PRO-2 but for use with 12" records.

Listed at **$17.50**

AUDAX HR-34

A lower priced model similar to HR-38.

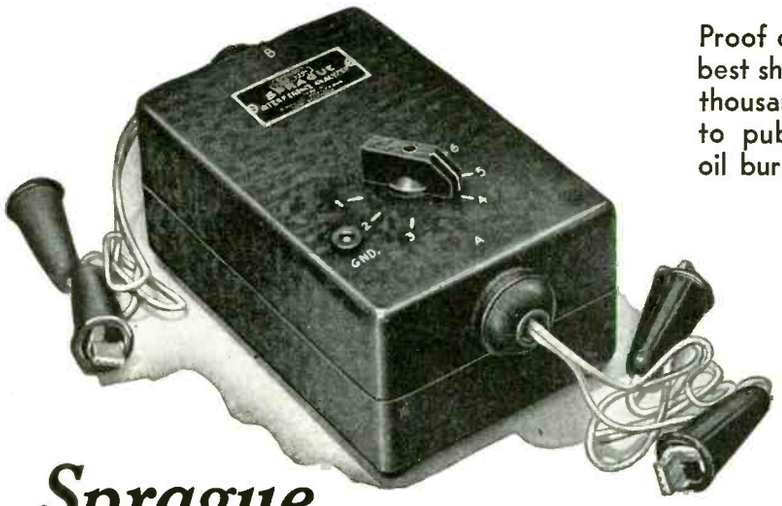
Listed at **$12.50**

AUDAK COMPANY, 500 Fifth Avenue, New York

"Creators of High Grade Electrical and Acoustical Apparatus Since 1915"

SPRAGUE BRINGS YOU

THE FIRST PRACTICAL, INEXPENSIVE METHOD FOR INTERFERENCE ELIMINATION



Proof of the efficiency of the Sprague Method is best shown in the sale, during two years, of several thousand Sprague Interference Analyzers, etc., to public utility trouble-shooting departments, oil burner concerns, and alert radio servicemen.

One prominent utility company writes: "The Sprague Analyzer is most satisfactory. Please send us a lot of your instruction folders for distribution to local servicemen, most of whom are unfamiliar with modern radio interference elimination methods. We believe your plan is the most sensible one offered to date. Hence our willingness to cooperate with you and, at the same time, help our customers enjoy their radios."

In short, here is a wide open field for new profits for alert servicemen. Why not start cashing in on it—today? Send coupon at once for Sprague Catalog giving complete details.

Sprague INTERFERENCE ANALYZER

. . . Makes it easy to eliminate all types of radio interference caused by electrical appliances, motors, etc. Also enables you to demonstrate to radio set owners just where and how radio noises originate. There are dozens of new business opportunities in every city for the man who is equipped with an Analyzer. Investigate!

SPRAGUE NOISE FILTER MATERIALS →

Sprague Interference Elimination Condensers and Chokes combined with the Sprague Interference Analyzer give you the quickest, most practical and inexpensive means of eliminating radio noises. You save time — you make new profits — and you save money *by building your own noise filter combinations as you need them.* Sprague supplies you with ALL of the materials—shows you step by step how to proceed with the work.

NOW! 48 HOUR SERVICE ON EXACT DUPLICATE CONDENSER REPLACEMENTS

. . . A new Sprague service of immense value to every serviceman who is faced with the problem of getting duplicate replacements — *and getting them in a hurry.* Simply send us the defective unit or give us the model number of the radio set and the capacity, voltage, physical dimensions and type of condenser needed. We'll do the rest — and we GUARANTEE 48-HOUR SERVICE on exact duplicate condenser replacements for ANY type of radio.

MAIL COUPON TODAY FOR FREE DETAILS

SPRAGUE PRODUCTS CO. NORTH ADAMS, MASS.

Without cost or obligation on my part, please rush your new catalog detailing the Sprague Interference Elimination Plan and describing all types of the famous Sprague Condensers.

NAME .....

ADDRESS .....

.....

.....

SPRAGUE "600" LINE

SPRAGUE "450" VOLTS

These Trademarks Are Your Guarantee of Quality

NOW.. RADIO SERVICING IS MORE PROFITABLE ...EASIER

MODEL **740**
DEALER PRICE
Only $18.60

WITH

RANGER EXAMINER

VOLT-OHM-MILLIAMMETER

AVAILABLE NOW IN SINGLE TESTERS, COMBINATIONS ALSO TO SUIT YOUR NEEDS

EYE APPEAL... PRECISION ACCURACY...

You and Your Customers Will Appreciate the Utmost in Professional Appearance

Yes, Ranger-Examiner Equipment definitely means that Radio Service work can be done more profitably and easier. More profitably because considerably less money is required for precision equipment, and easier because Ranger-Examiner is a completely new line designed from scratch with all the latest improvements for quick and accurate service. Less weight too to carry around in sturdy all-metal cases.

Ranger-Examiner testers are manufactured by the oldest company in the service equipment field whose contacts make them fully acquainted with the needs of the radio serviceman.

Model 740 Volt-Ohm-Milliammeter has a Triplett 3" square Precision Instrument. Scale readings: 10-50-250-500-1000 A.C. and D.C. Volts at 1000 Ohms per Volt (D.C. Accuracy 2%; A.C. 5%) 1-10-50-250 D.C.M.A.; 0-300 low ohms; high ohms to 250,000 at 1.5 volts. Rheostat adjustment for 13½ volts for ohm readings to 2.5 megohms. Batteries may be added permitting higher resistance readings in 250,000 Ohms steps. Low Ohms to ½ Ohm—with 25 Ohms in center of scale. Backup circuit. Current draw is only 1 M.A.

COMPARE FIRST . . . THEN BUY RANGER-EXAMINER

Be sure to send Coupon for your FREE copy "101 Radio Troubles and Their Cures"

Get this

FREE BOOKLET

LISTING 101 MOST FREQUENT RADIO TROUBLES

★

HOW TO DETECT HOW TO CURE

★

NOTHING LIKE IT BEFORE GREATLY SIMPLIFIES EVERYDAY SERVICE

SEND COUPON NOW . . .

RANGER EXAMINER

READRITE METER WORKS
1117 College St., Bluffton, Ohio

Without obligation please send me your Free Booklet, "101 Radio Troubles and Their Cures," and complete Ranger-Examiner Catalog.

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175 VARICK STREET NEW YORK, N. Y.

SERVICE

A Monthly Digest of Radio and Allied Maintenance

FOR NOVEMBER, 1936

LOOKING FOR TROUBLE

BY R. M. PURINTON

IT might be safely said that service work provides trouble without a search. But, when there is trouble a careful hunt for more can provide opportunities for extra work and extra income. The set that goes dead is just plain dead and the Service Man is no longer a miracle worker because he brings it back to life. If he not only produces lifelike action again, but improves on the old performance, he has some claim to the miraculous and an extra charge as well.

Too much service work today is still done on the trial and error or cut-and-try basis. Too much dependence is placed on the circuit diagram of the receiver being serviced. This applies especially to larger receivers and not so much to the small sets of simple design. Yet no group supplying service of any kind does *more* studying than men engaged in radio service, for the work possesses a fascination that makes study and the extension of one's knowledge natural. However, much of the study is applied to circuit diagrams and to the "case" method of service without enough effort on the part of the Service Man to understand the basic reasons for the difficulty. No well equipped Service Man is without a complete file of "case reports" clipped from the exchange pages of SERVICE and other magazines and they are as helpful in diagnosing trouble as a physician's trouble shooter's manual. But the physician usually obtains a complete understanding of the case at hand and the Service Man who handles each opportunity in this way will do much to extend his knowledge and pleasure in serving the radio owner.

To continue our analogy between physician and Service Man very briefly, we can say that the physician must know and understand many complex functions of the human body. The Service Man *must* understand numerous basic principles back of receiver performance and he has the advantage of being able to take his patient apart and put it together again, replacing vital parts many times. Only the dentist has a similar advantage.

RECEIVER FUNDAMENTALS

An examination of fundamentals of the superheterodyne circuit will cover the points of value in all receiver design. The operating functions of the tuned-radio-frequency amplifier, the heterodyne oscillator and first detector either in combination or as separate functions in separate tubes, the intermediate-frequency amplifier, the second detector, the audio system and the power supply all constitute divisions which must be understood if full service is to be given. Likewise the interrelated functions such as tracking and automatic volume control merit complete study. It is the purpose here to provide no more than an outline, and it is hoped that the outline will be useful in the start or continuance of a study program. Fortunately, the texts available for the service library are well written in the simple terms so helpful in self-education. Highly technical books are "out" so far as practical knowledge is concerned.

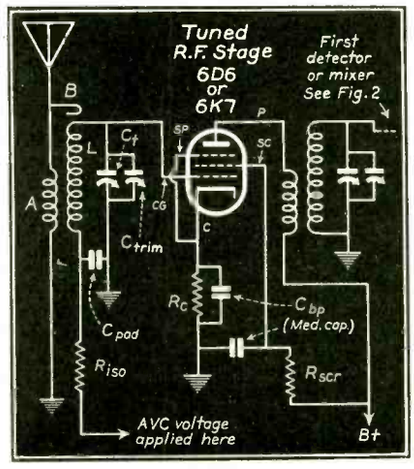

Fig. 1. A typical t-r-f stage.

To follow receiver functions in order, we should start with the radio-frequency amplifier. Most good superheterodynes have one stage of tuned-radio-frequency ahead of the first detector or mixer to provide selectivity which will deliver only one signal at a time to the grid of the first-detector tube. Fig. 1 shows the r-f amplifier circuit in its basic form.

THE R-F AMPLIFIER

The antenna tuning system is made up of coils A and L, the capacity coupling link B and the condensers marked C_t and C_{pad}. Coil A is wound with a sufficient number of turns to provide an appreciable resistance to the flow of signal current at low frequencies, for example, the long-wave end of the broadcast band. Thus the voltage built up across the antenna coil A is substantial at the low-frequency end of the tuning range. The capacity coupling link B provides sufficient capacity coupling between the antenna and the grid end of the secondary to

provide good transfer of signals at high frequencies. Thus the deficiencies in coil A at high frequencies are made up by capacity coupling furnished through the capacity link B. The secondary of the antenna coil L is tuned by the variable condenser C_t which is a part of the gang assembly. The condenser C_{pad} is sufficiently large to have practically no effect on the tuning characteristics of the combination of coil L and condenser C_t. It will be noted that R_{iso} is shown connected between the lower end of coil L and the line supplying automatic voltage control potentials. The purpose of R_{iso} is to isolate the tuned-radio-frequency amplifier circuit from other tuned circuits in the receiver and its use is essential if the receiver is to operate without oscillation. R_c represents the resistance in the cathode circuit which will provide the proper bias voltage for the radio-frequency amplifier tube during those periods of operation when no signal is being received. During such periods or during tuning when no carrier is present in the set, the only bias available for the tuned r-f stage originates in the cathode dropping resistor, R_c in Fig. I. The by-pass condenser across R_c is of medium capacity and generally is not larger than 0.1 mfd and can be much smaller. There is no necessity for the by-pass condenser at this point to be larger than 0.1 microfarad since the only frequencies present are radio frequencies.

The antenna side of the first tuning coil made up of the winding A and the capacity coupling link B does not present any particular degree of selection to incoming signals. However, the secondary tuning system made up of coil L and condenser C_t does provide a considerable degree of selection. When the condenser is adjusted so that the combination of C_t and L resonates at a given frequency, there will be a voltage developed between the ends of the coil. Since the lower end of the coil is by-passed to ground by C_{pad} and the upper end of the coil is connected to the control grid of the radio-frequency amplifier tube, the full voltage developed is impressed on the radio-frequency amplifier tube. Since resonance is necessary for the development of this voltage, a voltage will appear only at the frequency for which the condenser is set. There is not sufficient space to discuss resonance at length, but it is one subject clearly illustrated by a tuned-radio-frequency amplifier and it should be studied carefully. In Fig. 1, the plate of the amplifier tube is shown connected to the primary of a coupling unit which corresponds to coil A and coil L. This radio frequency transformer performs in much the same manner as coils A and L and provides further selection of the signal before it is impressed on the grid of the first detector or mixer tube.

The First Detector or Mixer

In Fig. 2 on the left side of the diagram we show the radio frequency transformer which feeds the signal energy from the tuned radio frequency amplifier tube to the grid of the mixer tube. The elements which provide the selection are the coil L and the variable condenser C_t which is a part of the gang assembly. As in the case of the radio-frequency amplifier the combination of L and C_t will be resonant to some particular frequency at any given setting of condenser C_t and at that frequency r-f voltage will appear between the ends of coil L. This energy is led into the fourth grid of the mixer which is known as the signal control grid.

In the superheterodyne receiver the greatest step up in radio-frequency amplification is obtained in the intermediate-frequency amplifier. Great amplification can be secured because of the fact that a relatively low frequency can be used such as 175 kc or 456 kc where the radio-frequency losses in coils and tuning condensers are much less than at high frequencies. To transfer the incoming radio signal to the frequency of the intermediate-frequency amplifier it is necessary to use a local oscillator, within the receiver, which is tuned to a frequency above or below (usually above) the incoming radio signal by an amount equal to the frequency at which the i-f amplifier performs. In most receivers today the first detector or mixer tube is of a type which combines the functions of mixer and oscillator in one bulb. The 6A7 glass tube or 6A8 metal tube provides characteristics which give good performance of both functions at the same time. It will be noted on the right side of the diagram that the oscillation circuit has two coils designated L_{osc} and L_{tick}. L_{tick} is the tickler coil in the plate of the oscillator section and is fixed in position with respect to the secondary coil, L_{osc}. Coil L_{osc} is tuned to the proper frequency by condenser C_t. It will be noted that in series with coil L_{osc} and condenser C_t is a variable condenser designated C_{pad}. The purpose of condenser C_{pad} is to make the combination of L_{osc} and C_t tune to a higher frequency than the signal circuit on the left side of the diagram, designated by L and C_t. In the usual superheterodyne the tuning condensers in the condenser gang are alike; similarly the coil L in the signal circuit of the mixer stage, the coil L_{osc} and the L in Fig. 1 are alike. Without the use of the series padding condenser shown between coil L_{osc} and C_t all of these tube circuits would be operating at the same resonant frequency. If the oscillator section is made to operate at a fixed higher frequency, 175 kc or 456 kc higher than the signal frequency through the adjustment of C_{pad}, the signal produced by the local oscillator will beat against the signal being received from the antenna and a new signal which is a combination of the two will be fed into the primary of the first intermediate-frequency transformer from the plate of the mixer tube. In this way the intermediate frequency is generated or produced. In magazines and texts oscillograms are used to illustrate the kind of signal which is produced by the mixer. It consists of a carrier having a frequency which will be passed and amplified by the i-f amplifier and it will be found that the audio modulation present on the original signal delivered from the antenna is present on the i-f signal.

One of the best opportunities for service on any superheterodyne receiver is in adjusting the alignment of the tuning system so that the markings on the dial will be accurate. To secure an accurate calibration in any superheterodyne is only a matter of a few minutes' work and it is a service which will be appreciated and readily paid for even though the trouble which required the Service Man's help may have been something in any other part of the set. Receiver manufacturers make a practice of preparing their dial calibration scale with greatest care and at least nine out of ten sets can be adjusted so that the tuning indicator will be accurate over the entire broadcast band at least. Later in this article a particular method of alignment is discussed.

The remaining elements which go to make up the mixer stage are the voltage-dropping resistors for screen grids 3 and 5 which are tied together within the tube, and the oscillator-plate section, and also the by-pass condensers and the elements which go to make up the oscillator grid circuit. The control grid of the oscillator section of the mixing tube is marked 1. It will be noted that this grid is connected with the cathode through a grid leak and to the tuning coil and condensers through a condencer C_{b1}. This blocking condenser has a low value of capacity and is generally never above 0.0001 mfd. The grid leak usually has a resistance of 25,000 or 50,000 ohms. When the circuits are operating satisfactorily there will be a current of 500 microamperes (½ ma) or less flowing in the grid leak. To determine the activity of the oscillator section on the broadcast band or on a short-wave band a 0-1 milliammeter can be inserted between the cathode end of the grid leak and the

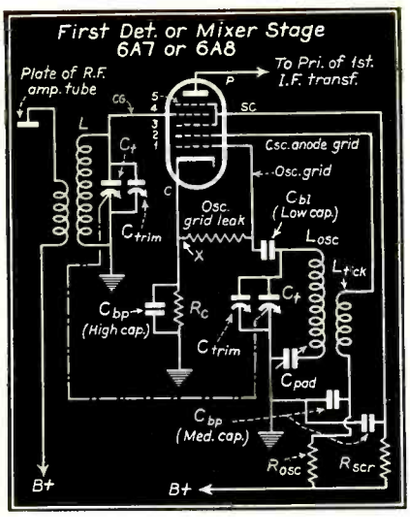

Fig. 2. Superheterodyne mixer stage.

cathode at that point. In general it will be noted that the grid leak current is highest when the rotor plates of the condensers are all the way out and lowest when they are fully meshed. Poor receiver performance can often be traced to poor oscillator performance at this frequency and the insertion of 0-1 milliammeter at the cathode end of the grid leak will provide the complete story of oscillator activity. The grid leak current should never fall below 50 or 70 microamperes if good sensitivity is to be had at the low-frequency end of each band (where the tuning-condenser plates are meshed).

The I-F Amplifier

In Fig. 3 there are shown the elements of a single stage i-f amplifier. The input transformer and output transformer are quite similar and consist of two coils spaced well apart with individual tuning of each coil. The spacing of the primary and secondary is such that the selectivity or selection qualities of these transformers are better than can be obtained with the transformers coupling the radio-frequency amplifier end of the receiver. The fact that the i-f amplifier operates at a low frequency is helpful and makes it easier to secure good selectivity. In fact some of the smaller receivers have dispensed entirely with a tuned-radio-frequency stage ahead of the first detector and depend altogether upon the selectivity of the i-f amplifier to provide the selectivity needed for reception. In other respects the intermediate-frequency amplifier operates exactly like a tuned-radio amplifier. The condensers marked C_p are simply adjusted so that the coils marked L tune or resonate at the i-f frequency. The condensers C_t should then be left alone until it is evident that realignment or retuning is necessary.

While on the subject of i-f amplifier adjustment and operation it is suggested that the i-f amplifier tuning should be checked on any set which is up for service and especially if new tubes have been put into the receiver. The proper adjustment of i-f amplifier tuning will provide maximum sensitivity and best tone quality in the receiver. It is exceedingly important that the i-f transformers be tuned to the frequency specified by the manufacturer. In some automobile receivers and home sets the oscillator padding condenser (refer to Fig. 2) has been eliminated from the circuit and the difference in tuned frequency between the oscillator section and the signal sections is attained by making the oscillator section of the gang condenser with plates which are specially shaped and smaller than the rotor plates in the other sections of the gang condenser. With this type of tuning system, it is essential that the i-f frequency be maintained accurately. Otherwise a set will not have equal sensitivity over the entire band covered and strong local signals will appear at more than one point on the dial.

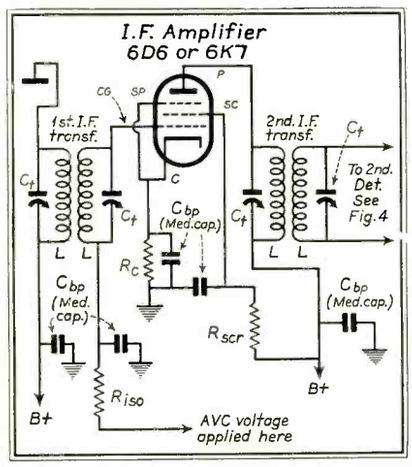

Fig. 3. An i-f amplifier stage.

The Second Detector

The second detector of a modern superheterodyne combines diode detection with another section of the detector tube which performs as an audio amplifier. Diode detection has been surrounded with an air of mystery whereas actually it amounts to nothing more than half-wave rectification of signals passed by the intermediate-frequency amplifier. It will be noted in Figure 4 that the two diodes are shown tied together. There are many variations of circuits employing diode rectifiers, but the one shown is perhaps the most simple and the best for use in studying the fundamental performance of this type of detector. As in the case of our tuned-radio-frequency amplifier circuits we have voltage developed between the ends of the coils designated L and this radio-frequency voltage which appears across the secondary coil L is rectified, or negative half cycles are cut off by the action of the diode rectifier which passes current only in one direction. It may clarify the problem if in considering diode action, the Service Man thinks of the intermediate-frequency current and voltage in the same terms he uses in considering 60-cycle alternating current and voltage. The rectified current must return to the lower end of the intermediate-frequency output transformer secondary coil L. In doing so it flows through the diode load resistor. When this occurs, a voltage drop develops from one end of the diode resistor to the other with the result that the end of the load resistor which is connected to the cathode becomes positive and the end which connects with the i-f transformer secondary becomes negative. Since the positive end is closer to ground than the negative end, the negative voltage can be used to provide bias for the control grids of the r-f and i-f amplifier tubes. When a signal is present and diode load current flows, this automatic volume control voltage is supplied to the r-f and i-f grids and the result is one in which the receiver will always be sensitive to weak signals because the weak signal develops very little diode-load current, and insensitive to strong signals because a strong signal develops considerable diode current and considerable negative voltage when fed back to the grids of the r-f and i-f amplifier tubes reduces their amplifying power. The resister marked R_{iso} prevents any radio frequency energy which may be present at the point B in Fig. 4 from being fed back to the early stages of the receiver where it might cause oscillation. It will be noted that

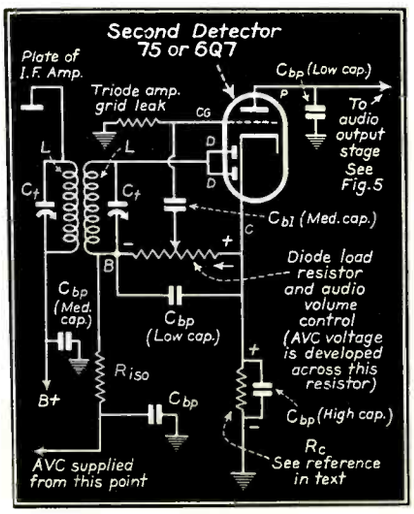

Fig. 4. A simple second detector stage.

the diode load resistor is by-passed with a condenser of low capacity. This is essential to act as a by-pass for any radio-frequency voltage developed at point B—of course the condenser must be small or it will not permit rapid change in voltage across the diode load resistor. The rectified carrier signal produces a pulsating current in the diode load resistor and the envelope of these pulsations (line drawn through the peak of each) has variations up and down corresponding exactly with the voice or music contained in the original signal. These audio variations are fed to the grid of the amplifier section of the second detector through blocking condenser designated C_{b1} of medium capacity. The bias voltage for the audio-amplifier grid of the second detector is obtained by use of the cathode resistor R_c. In Fig. 4 it will be noted that the cathode current flowing to ground makes the upper end of this resistor positive and the lower end negative. It will be noted that the automatic volume control line connects the grid circuits of the r-f and the i-f amplifier tubes through R_{iso} to the point B and then through the diode load resistor to the upper end of the bias resistor R_c and thence to ground. When no signal is present, there will be no avc voltage developed and the positive voltage developed across R_c by the cathode current flowing through it will be impressed on the grids of the r-f and i-f tubes. This positive voltage is usually about 1.5 volts and it must be overcome by a greater cathode bias voltage developed in the cathode of each individual r-f and i-f tube. Otherwise these tubes would operate with a positive bias.

The fundamentals back of automatic volume control are simple and they can be mastered easily if they are regarded just as power supply rectification is considered.

The Output Stage

The audio-output stage is shown as a single tube in Fig. 5. Audio amplifiers are generally well understood although the reasons for the choice of certain values of resistance and capacity in coupling audio stages are not always clear. In Fig. 5 the plate resistance for the triode amplifier which is a part of the second-detector tube is designated R_p. To secure maximum voltage amplification with equal response to all audio frequencies the value of R_p should be several times the plate resistance of the tube. The coupling condenser C and the grid resistor R_g are drawn in a rather unusual arrangement, primarily to show that the coupling condenser and grid resistor in a series form a

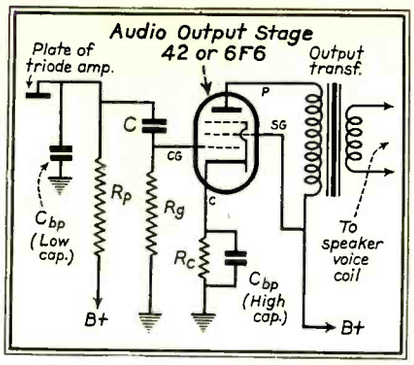

Fig. 5. Typical output stage.

parallel circuit across R_p. The a-c resistance of C and R_g together should be greater than R_p. The control grid of the output tube is connected between condenser C and R_g. These two circuit elements can be compared to a potentiometer with the control grid of the output tube connected to the potentiometer arm. It will be recognized with this type of illustration that if condenser C is of small capacity, having a high impedance to low frequencies, the low-frequency signal fed to the grid of the output tube will be much smaller than the proportion of high-frequency signal which is passed along from the detector. Consequently for good quality R_g should have high resistance (½ megohm) and condenser C should be reasonably large, 0.1 mfd.

Calibration Procedure

Many broadcast receivers do not follow the dial calibration accurately over the entire dial scale. Most of the inaccuracy will be found at the high-frequency end of the tuning range either due to shift in the trimmer-condenser setting on the oscillator section of the gang condenser or to inaccurate adjustment at the time the set was manufactured. While a receiver can be trimmed so that the dial is accurate on all bands covered, it can be treated with respect to the broadcast band in a relatively short time and with good accuracy. The test oscillator is required, of course.

The first step calls for accurate tuning of the i-f transformers to the frequency specified by the manufacturer.

Next the receiver should be tuned to a 600 kc signal from the test oscillator. If the receiver dial pointer does not rest on the 600 kc marker, move the tuning knob until the dial indicates 600 kc and then adjust the oscillator padding condenser for maximum set output of the 600 kc oscillator signal. The usual method of rocking the tuning condenser back and forth between 590 kc and 610 kc while adjusting the padder condenser is helpful.

Now shut off the oscillator and tune in a broadcast station somewhere between 550 kc and 650 kc. If the dial marking does not coincide perfectly with the published frequency of the broadcast station, readjust the padder so that the dial reading is correct.

Next, select a station of known frequency between 600 kc and 700 kc and tune it in on the receiver. Turn on the test oscillator and adjust it so that its signal beats (interferes perfectly) with the broadcast station signal. Next, without touching the oscillator, tune the set to twice the frequency of the broadcast station and test oscillator. Suppose that to be twice 660 kc or 1,320 kc. The first harmonic of the oscillator should be heard with the dial set at this point. If it is not heard, leave the dial adjustment untouched and adjust the trimmer condenser, C_{trim}, across the oscillator section of the gang condenser until the harmonic is loudest.

It is well to go back and recheck the 600 kc setting after this and if some slight readjustment is necessary at 600 kc, the harmonic adjustment can be checked again also.

Using this method, accurate calibration is possible at 1,320 kc using WEAF to set the oscillator accurately at the fundamental frequency, 1,400 kc using WLW and so on.

The customer usually is delighted to find that he can set the dial to a frequency shown by the newspapers or a radio log as the frequency of the station he wants to hear—and find the station there.

It is hoped that this outline will in itself provide some ideas and the inspiration to secure wider understanding through study.

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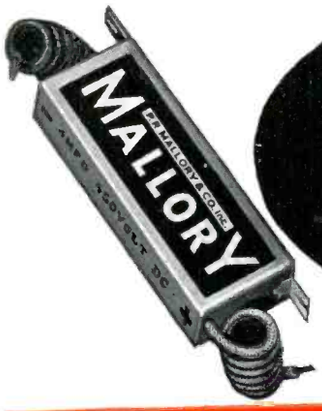
Stromberg Carlson 130 and 140

Sensitivity control: This is a knob on the rear of the chassis, to limit the sensitivity on broadcast reception so that the most powerful nearby broadcast station will not cause rectification in the r-f tube and thus blanket the dial. It is also effective on tweets. Remember to turn this knob clockwise if a newly-installed receiver appears to lack sensitivity.

•

Stromberg Carlson 145, 150, 160 and 180

Fidelity-tone control: Normal setting is *at the middle*—half red, half white. All red (high fidelity) broadens the tuning and should not be used for distant reception. All white (low fidelity or tone control fully operated) causes muffled tone and reduced volume. A definite bump when passing through "normal" shows that the selectivity is maximum and tone control is set for standard fidelity.



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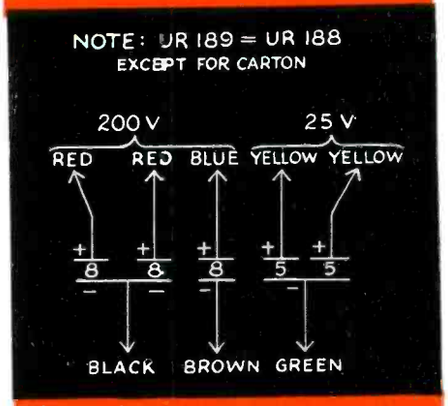

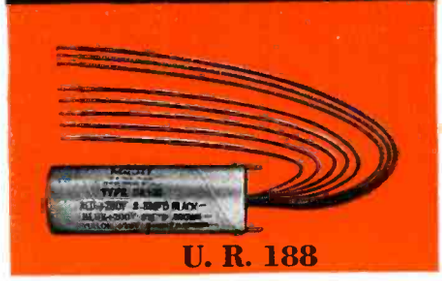

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IMPROVING OLD POWER SUPPLIES*

THE increased sensitivity of present-day receivers necessitates a more efficient hum filter than that contained in old receivers. Moreover, the advent of high-fidelity receivers made the public more critical of audible hum. It follows that the receivers of the 1937 line must have filters which are far superior to the ones employed five or six years ago. Yet, when looking at the diagram of these receivers it is seen that the number of filter sections is not any greater, and often less. Neither is the use of any kind of trick circuit responsible for their efficiency. The only difference is in the electrical constants of the parts themselves.

Exact Replacements

Service Men who found that parts in an old power pack were defective, have been replacing these parts with others of the same electrical and mechanical dimensions as much as possible. It will occur to many that it would be more expedient for the Service Man to know whether a change in capacity of a condenser would be important. In many cases the Service Man may have parts in stock which have a different rating, while the exact replacement part may have to be procured from a distant dealer. Can the other part be used instead? Very often it can be used and will result in better performance if a few simple rules are observed. In fact, the Service Man has the opportunity to reduce the hum level of many old sets by changing the value of the condensers.

The hum level of a filter is inversely proportional to the size of the chokes and of the condensers. Consequently, when replacing condensers by others of a different size, choice of a larger size will reduce the hum. Doubling the capacity will result in half the hum; tripling the capacity results in one-third of the hum. Such results multiply when the condensers have been replaced in more than one section which makes it possible to realize a substantial improvement. The newer type of electrolytic condenser is smaller, better and more economical than its predecessor of several years ago. Therefore it is often possible to obtain larger condensers which will fit the same space as the old ones at a reasonable cost. Of course, the increasing of condenser sizes should not be done indiscriminately. For this reason it is best to trace through a typical power pack and see what will happen when condenser sizes are varied.

*From material prepared by the Aerovox Corporation.

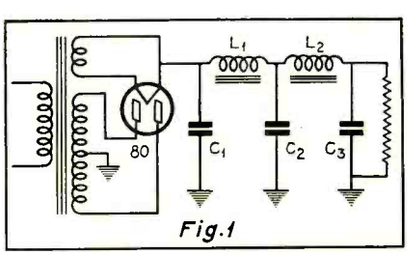


Fig. 1

The First Filter

Fig. 1 shows a typical two-section filter, such as one often finds in sets of a few years ago. The function of the first filter condenser is more to keep up the voltage than to reduce the hum. Why is this so? For easier understanding one might represent the circuit of Fig. 1 as the one in Fig. 2. The two circuits are of course not exactly equivalent, but for purposes of explaining the action of the first condenser, no large error is involved.

The source of pulsating d-c charges the condenser through a resistance (the rectifier) at each half cycle. At the same time the condenser is being discharged at nearly the peak voltage when the drain is very small. In that case the

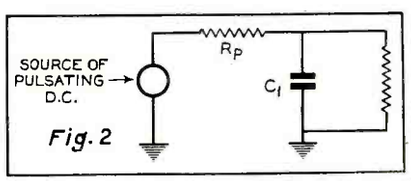


Fig. 2

total current flowing from the given condenser between two charges is only a small fraction of the charge which the condenser is holding. If this total current represented only one twentieth of the charge, for instance, the voltage would have dropped only one twentieth or 5 percent. On the other hand, when the drain is very large or the condenser small, or both, the current between two charges will be so much as to discharge the condenser to a much greater degree with a result in voltage drop. The average voltage will then be much lower and the hum will be greater.

This shows that the condenser need not be as large for a small drain as it is for a large drain. The variation of the condenser capacity results in a change in voltage and that is not always desirable. *A large increase in the size of this condenser is not recommended* unless one wishes to raise the voltage. Even then, there are limits when mercury-vapor rectifiers are used so as not to exceed the allowable peak current. Since these rectifiers are not common in old

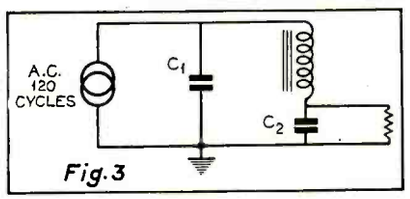


Fig. 3

sets, it is not necessary to go into greater details here.

The voltage rating of the first condensers, that is, "constant working voltage," should be equal to the peak of the applied alternating voltage. Or, in other words, when the constant working voltage is 450 volts, the applied a-c of the transformer should not be more than 315 volts rms. If the a-c supply is higher, the first condenser should be of the paper type. The peak voltage rating of electrolytics refers to surges which may occur when turning the set on or off, but does not refer to continuous peaks.

The Second Filter

Returning now to Fig. 1, the second condenser C_2 has a material effect on the residual hum. In order to understand this, look at Fig. 3. It may be considered that the hum voltage is applied across the choke and condenser in series and the a-c ripple divides in proportion to the impedance of each circuit element. Now, the impedance of a 15-henry choke at 120 cycles is 113,040 ohms and that of an 8-mfd condenser at the same frequency is 166 ohms. The hum across C_2 is then 166/113,040 times the hum across C_1, or it has been cut to about seven-tenths of one percent of its original value. When C_2 is increased to 16 mfd, its impedance is only 83 ohms with the result that the hum across C_2 would then be cut to thirty-five hundredths of one percent of its hum across C_1. Therefore, doubling the condenser size results in half the hum.

Strangely enough, power factors up to 20 percent hardly change these figures. The impedance of an 8-mfd condenser at 120 cycles, having 20 percent power factor is 169 ohms. Replacing 166 in the above paragraph by 169 would not change the total attenuation appreciably. Therefore, replacing a condenser C_2 by another one of better power factor (a paper condenser) and the same capacity will not result in an appreciable improvement of performance. When the electrolytic condenser is replaced by a paper condenser *of lower capacity* the hum will increase. Replacing the condenser C_2 by one of higher capacity either electrolytic or paper will reduce the hum.

(*Continued on page* 574)

AUTOMATIC FREQUENCY CONTROL

By HUBERT R. SHAW*

IN the October issue of SERVICE the automatic frequency control oscillator and control tube were discussed. In that discussion it was stated that unequal voltages are applied to the separate diodes of the afc detector as the incoming i-f signal departs from the resonant frequency to which it is tuned. In the following an explanation is attempted.

The afc i-f transformer feeding the diodes at this point is similar to other i-f transformers in the receiver except that the secondary is center-tapped. Both primary and secondary are tuned to 465 kc, but in addition to the usual inductive coupling we find capacity coupling between the top of the primary and the center tap of the secondary. It is the combination of the induced voltage and the capacity-coupled voltage which is applied to the diode plates. The coupled voltage is really in series with the induced voltage as follows: Whatever a-c voltage may be present across the primary of the i-f coil, that voltage will also exist across the choke. This is true because the top ends are coupled together by a capacitor and the bottom ends are both at ground potential by reason of the capacitors to ground at this point. Therefore, the primary voltage is always present across the choke. Another voltage is also present across each half of the secondary since it is inductively coupled to the primary. Observe that these voltages are in series with each other for either of the diodes, since the choke is part of the return circuit path of the current through either diode.

To make this more clear, let us replace the induced and coupled voltages with generators in this circuit. Now, trace the path of the current through each circuit. Starting from the plate of diode No. 1, the path is through the tube—from the cathode through the load resistor back to the choke, through the choke to the secondary, completing the circuit. The path of the current in circuit No. 2 is from the diode plate, through the tube, through the other load

*Field Technical Section, Radio Division, General Electric Co., Bridgeport, Conn.

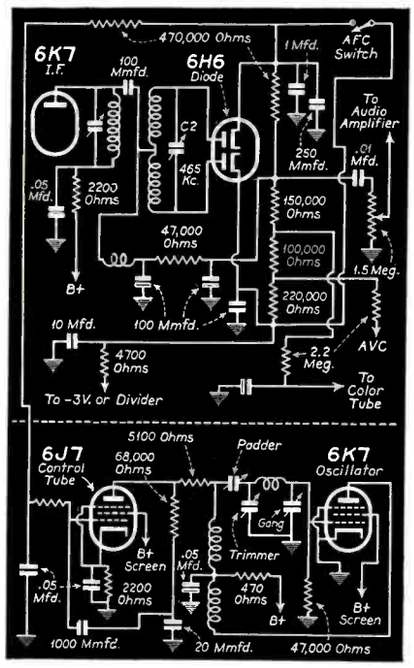


Fig. 1. Complete afc circuit.

resistance, through the choke and back to the secondary. Obviously, for either path, the voltage in each half secondary is in series with the voltage across the choke. These conditions are true regardless of whether or not the incoming frequency is the same as the frequency to which the primary and secondary are tuned. However, it is only at resonance that the two voltages in series add up to the same amount on each individual diode plate.

Off resonance, the phase relations of the various voltages are such that the voltage across one-half secondary added to the choke voltage does not give the same sum as the voltage across the other half secondary added to the choke voltage. This is true even though the voltage across one-half secondary must always be of the same value as the voltage across the other half secondary since the whole secondary is center-tapped. As stated, this is due entirely to the phase relations, which change as the frequency of the i-f signal changes.

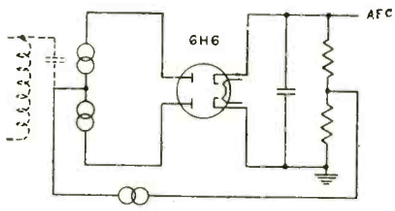


Fig. 2. Placing a-c voltages in series.

PHASE

In order to make this more clear, let us review the result of placing a-c voltages in series with each other as shown in Fig. 2. We will place two a-c generators in series with a voltmeter across each and another voltmeter across both of the generators. If the voltages are out-of-phase with each other the resultant voltage is not the same as when they are in-phase. First of all, what do we mean by phase? If two voltages of the same frequency go through their maximum and their zero values at a different time, they are said to be out-of-phase. If they go through their maximum and their zero values at the same time, they are in-phase.

As shown in the first case, the voltages are in-phase since they start at the same time and reach a maximum at the same time. The resultant voltage in this case is simply the arithmetical sum. If each voltage were 10 volts peak value, the resultant voltage as measured on an a-c peak voltmeter would be 20 volts. This can be done graphically by simply adding the points together to obtain the resultant voltage wave.

In the second case, the voltages are 180° out-of-phase. 180° out-of-phase means that one voltage starts 180° later than the other. Remember that 360° is a complete cycle and 180° is, therefore, one-half cycle. It is evident from the figure that the values of the two waves are equal and opposite at all times. Therefore, the resultant voltage is zero at all times.

As far as these first two cases are concerned, you may easily make the experiment with an ordinary power trans-

former which has two separate windings delivering equal voltages. If connected together in one direction, twice the voltage of a single winding will be obtained. If connected the other way, zero voltage will result.

In the third case, things are a little different. One voltage starts ¼ cycle or 90° after the other. One voltage has reached its maximum when the other is just starting. If we add up the two waves in this figure, we will obtain a third wave which is the resultant wave of voltage. We find now that the maximum is less than twice the value of one. As a matter of fact, for a phase difference of 90° as shown here, the maximum voltage of the resultant wave is 1.414 times either one of the original waves. For any phase difference between 0° and 180°; that is, from an in-phase to a completely out-of-phase condition, the amplitude of the resultant wave will vary from maximum to zero.

Now to return to our afc circuit and referring to Fig. 3, let us replace the voltage developed across the choke with an a-c generator. You will recall that this voltage is really the primary coil voltage. Let us also replace the voltage induced in each secondary with an a-c generator.

Circuit Conditions

A simple explanation of the circuit conditions existing at resonance as well as either side of resonance will now be given.

The voltage induced in the top half-secondary is 180° out-of-phase with the primary voltage which is also the choke voltage. However, the phase of the voltage appearing *across* the top half secondary is something else again because of the inductance of the coils comprising the secondary windings and the phase of the current through them.

At resonance, the top secondary voltage is lagging the choke voltage by 90° as shown in the graph for the top diode. The resultant voltage is shown as the heavy solid line. We know that the voltage across the bottom half-secondary must be 180° out-of-phase with the top; making it lead the choke voltage by 90°. These voltages as well as the resultant are shown in the graph for the bottom diode. Note that the heavy curves in both graphs are of equal amplitude, which means equal voltages applied to the top and bottom diode.

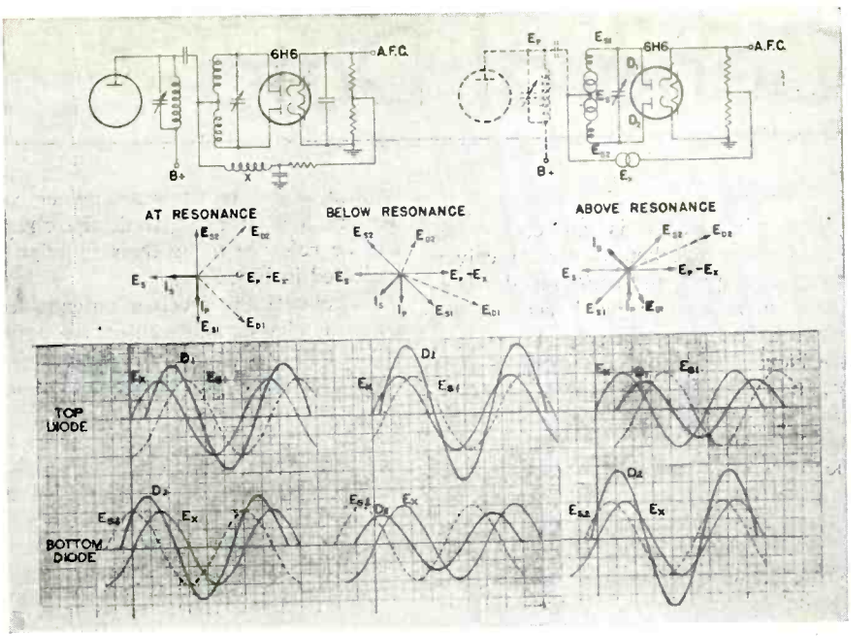


Fig. 4. Circuit conditions.

We already know that if equal a-c voltages are applied to the two diodes, then the d-c voltages developed across the load resistors are equal and the resultant d-c voltage, which is the afc control voltage, is zero. This is as it should be, since no control voltage is required if the correct i-f frequency is being generated.

When the i-f carrier is higher than 465 kc, the voltage across the top half-secondary now lags by more than 90° and the voltage across the bottom half secondary consequently leads by less than 90°. Note that the resultant heavy line curves are no longer equal and indicate that the bottom diode has a greater applied voltage than the top diode.

A greater voltage applied to the bottom diode will result in a greater d-c voltage being developed across the bottom diode load resistor and a negative afc voltage. A negative afc voltage will result in higher grid bias on the control tube across the oscillator circuit and less current will be drawn by the control tube. This is equivalent to making it appear like a larger inductance and the frequency of the oscillator will become lower. If the i-f was above resonance to begin with, that means that the oscillator frequency was too high. Thus it can be seen that the desired action has taken place when the oscillator frequency has been reduced in the manner just described.

When the i-f carrier is less than 465 kc, the conditions are reversed. The voltage across the top half secondary now lags by less than 90° and the voltage across the bottom half secondary now leads by more than 90°. Note that once more the resultant heavy solid resultant curves are unequal. However, this time the top diode has a greater applied voltage than the bottom diode.

A greater voltage applied to the top diode will result in a greater d-c drop across the top diode load resistor and a positive afc voltage. A positive afc voltage will result in a lower grid bias on the control tube and more current will be drawn by the control tube. This is equivalent to making it appear like a smaller inductance and the frequency of the oscillator will be higher. Since the i-f was below resonance to begin with, this means that the oscillator frequency was too low. Thus, the desired action has taken place and the oscillator frequency has been increased.

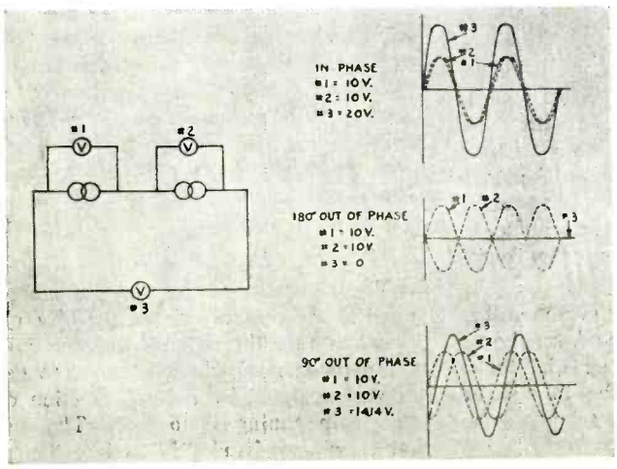


Fig. 3. Phase relationships.

General Data . . .

Sentinel-Erla 53A

The model 53A is an eight-tube, three-band superheterodyne receiver using some glass and some metal tubes. The first or weather band has a range from 140 to 390 kc; the second or broadcast band has a range from 540 to 1720 kc; and the short-wave band has a range from 5.8 to 18.1 mc. A complete circuit diagram is shown in Fig. 1, with the tubes used and their functions lettered on the diagram. The trimmer locations are given in Fig. 2 and an additional figure (No. 3) is shown giving the various voltages encountered on the socket prongs. These voltages were measured with a 1000-ohm-per-volt voltmeter, with the volume control on full, the wave-band switch in the broadcast position and the antenna shorted to the chassis. The line voltage measured 115-volts at the time the measurements were taken. Actual values may vary as much as 15 percent from those given.

Alignment Procedure

Before attempting to align the various circuits allow the chassis to heat up to normal operating temperature. Connect the output meter from plate to plate of the output tubes in series with an 0.25-mfd paper condenser. Turn the volume control full on.

I-F Alignment

Short the antenna lead to the chassis. Attenuate the test-oscillator output so that the indication on the output meter is readable. The signal in the speaker should be audible but not loud. Throughout the alignment procedure the signal from the oscillator should be reduced as the stages are brought into alignment so as to prevent avc action.

With the test oscillator set at exactly 465 kc connect its output to the control grid of the 6A7 oscillator-modulator tube through a 0.02-mfd condenser, with the tubes grid clip in place, and to the receiver chassis. Adjust the i-f trimmers for maximum output starting with the secondary trimmer of the second i-f transformer and working towards the primary trimmer on the first i-f transformer. Repeat the procedure to assure accurate alignment.

R-F Alignment

It is important when aligning the gang condenser, padder and trimmer condensers to follow the instructions carefully, otherwise the receiver will be insensitive and the dial calibration will be incorrect. The various trimmer condensers located underneath the chassis will be referred to by their function as indicated in Fig. 2.

Disconnect the receiver antenna lead from the chassis and connect the output of the test oscillator to the antenna lead through a 400-ohm carbon resistor and to the receiver chassis.

Turn the band-selector switch to the 5.8- to 18.1-mc band. Tune the receiver dial to exactly 18 megacycles. Set the test oscillator at exactly 18 megacycles and adjust the 18-mc trimmer for maximum indication on the output meter. When adjusting this trimmer two peaks, the fundamental and the image peak, will be noticed. Care must be taken that the fundamental peak and not the image peak is used for aligning the receiver at 18 mc. Always back off the trimmer to minimum capacity; then screw down the trimmer until the first peak is obtained. This peak is the fundamental and is the proper one to use. If the trimmer is screwed down beyond the point where this first peak is received the incorrect or image peak will be received.

After completing the adjustment of the oscillator trimmer at 18 mc always check to see if the proper peak has been used. To do this leave the test-oscillator frequency set at 18 mc increasing its output. Vary the receiver dial slightly to the right and left of 17 mc and if the fundamental peak was used in aligning at 18 mc the test-oscillator signal will be heard at approximately 17 mc on the receiver dial. If it is not possible to hear the signal then the fundamental was not used and the 18-mc oscillator trimmer must be readjusted.

With the band-selector switch still set on the 5.8- to 18.1-megacycle band tune the receiver and test oscillator to exactly 16 mc. Adjust the 16-mc trimmer for maximum indication on the output meter.

Replace the 400-ohm resistor in series with the test oscillator lead with a 200-mmfd condenser. Turn the band-selector switch to the 540- to 1720-mc band and set the dial and test oscillator to exactly 1720 kc. Adjust the 1720-kc trimmer for maximum indication on the output meter.

With the band-selector switch still set on the 540- to 1720-kc band, set the test oscillator and the receiver dial to exactly 1400 kc. Adjust the 1400-kc antenna and preselector trimmers for maximum output.

Tune the receiver dial and the test oscillator to approximately 600 kc. Adjust the 600-kc padder while rocking the tuning condenser rotor through the signal until the maximum output is obtained as a result of the combined operations.

(*Note:* The 600-kc padder may be adjusted easily in the manner described in the September issue of Service in an article entitled "Impact Excitation Generator.")

Turn the band-selector switch to the 140- to 390-kc band. Tune the receiver dial and the test oscillator to exactly 390 kc. Adjust the 390-kc padder for maximum output.

With the band-selector switch still set on the 140- to 390-kc band, tune the receiver dial and the test-oscillator signal to exactly 340 kc. Adjust the 340-kc trimmer for maximum indication on the output meter.

Tune the receiver dial and the test-oscillator signal to approximately 160 kc. Adjust the 160-kc padder while rocking the tuning condenser rotor through the signal until maximum output is obtained as a result of the combined operations.

(*Note:* The adjustment of this padder may also be accomplished by the method described in the September issue of Service in an article entitled "Impact Excitation Generator.")

Repeat the r-f alignment to assure more accurate adjustment.

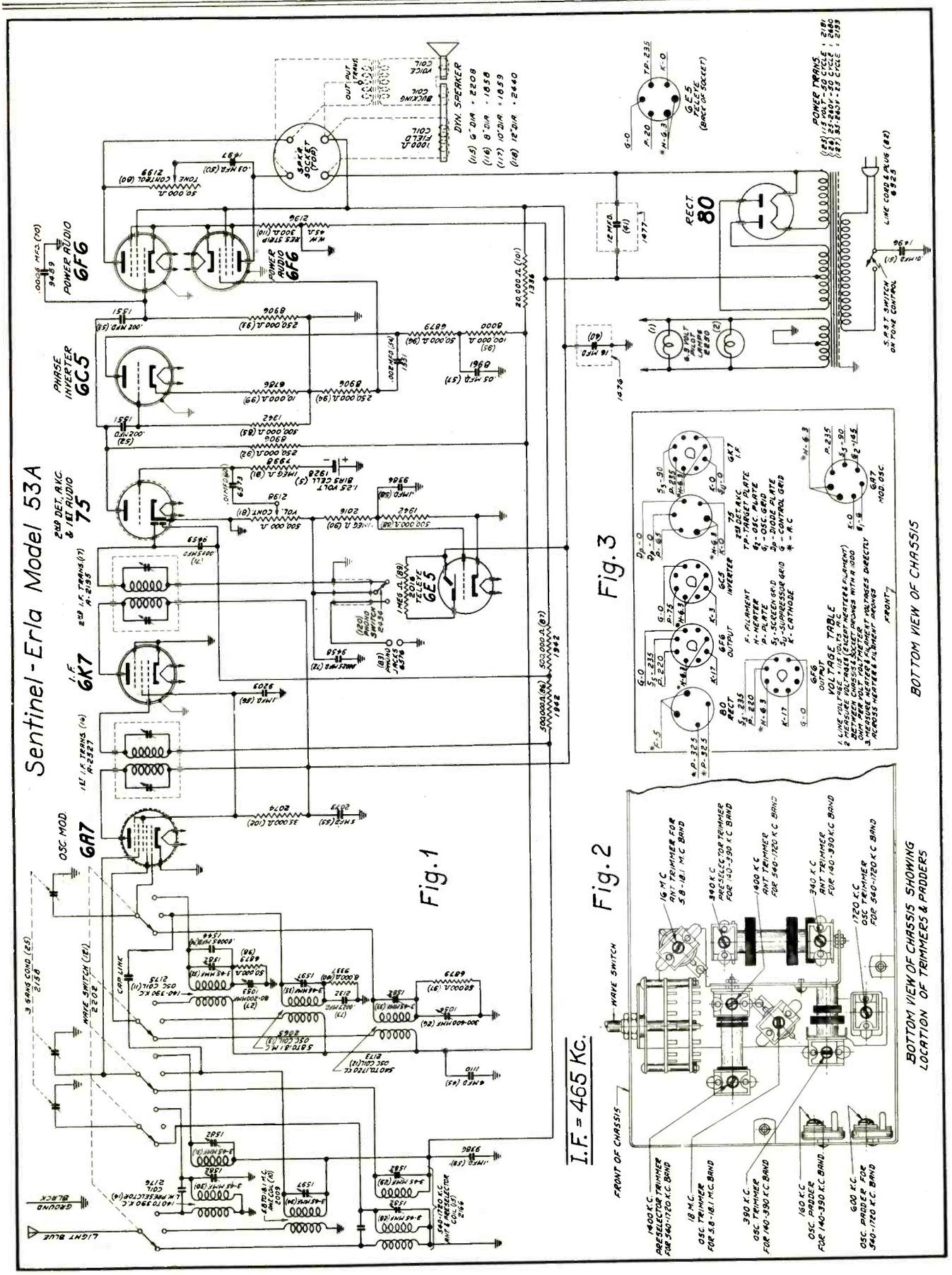
•

General Electric E-81 and E-86

Models E-81 and E-86 employ eight metal envelope tubes in a superheterodyne circuit, giving the sensitivity and selectivity inherent in this type circuit. The r-f section of this 8-tube chassis utilizes a type of construction known as the "Junior Sentry Box." This construction permits using short connecting leads and isolates each r-f circuit in its own particular shielded section. Separate groups of coils are used for each band in the oscillator section. The antenna and r-f sections are composed of two coils, a separate coil for the "D" band and a composite coil for the "B" band and "C" band. Operation on the "C" band is obtained by shorting out a section of the antenna and r-f "B" band coils. The entire frequency range from 540 to 18,000 kc is covered in three bands. An undistorted power output of 6.5 watts is available.

The Circuit

The signal from the antenna is applied to the control grid of the 6K7 r-f amplifier tube through the antenna coil, the secondary of which is tuned to the incoming signal by the rear section of the main tuning condenser. The antenna coil, for bands "B" and "C," con-



tains two primary coils connected for operation on the "B" band; however, when the band switch is turned to the "C" band position, the lower primary coil, L-5, is shorted out. The high-frequency trimming adjustment, for the "B" band antenna and r-f stages, is accomplished by two adjustable trimmers connected from the "C" band tap on each coil to ground. The capacity coupling coil, L-3, acts only on the "C" band and its function is similar to that of a fixed antenna stage trimmer for that band.

The amplified radio-frequency signal is impressed upon the signal control grid of the 6A8 converter tube through the r-f coil, the secondary of which is tuned to the signal frequency by the center section of the main tuning condenser. In the 6A8 tube, the incoming signal is combined with the local oscillator signal which is 465 kc different in frequency. The local signal is generated by the oscillator elements of this tube and the proper frequency difference is maintained throughout the tuning range by the front section of the main tuning condenser in conjunction with the oscillator coils and padding capacitors.

The combination of the signal frequency with the local oscillator frequency in the 6A8 converter tube produces the i-f of 465 kc. This particular intermediate frequency is chosen to reduce image response and improve short-wave performance.

The intermediate-frequency amplifier consists of a two-stage cascade section composed of three i-f transformers and two 6K7 amplifier tubes. Each i-f transformer has two tuned circuits. The first i-f amplifier 6K7 is operated on both self-bias and on avc for the broadcast band, since its grid return connects to the avc bus. On the two short-wave bands the self-bias resistor is shorted out by one of the band switch sections and this tube receives only avc bias. The second i-f amplifier 6K7 tube operates on self-bias for all bands. This enables the second i-f tube to provide maximum power to the 6H6 diode rectifier.

The output of the i-f amplifier is applied to one plate of the 6H6 diode rectifier, which is a combined second detector, initial bias and automatic volume control tube. The direct-current component of the rectified signal, through one diode of this tube, produces a voltage drop across resistor R-10. This voltage drop provides automatic bias for the r-f amplifier, converter and the first i-f amplifier, and thus gives automatic volume control action. The other diode of the 6H6 provides an initial bias for the tubes on the avc circuit under conditions of little or no signal. This initial bias diode, under conditions of small signal, draws current which flows through resistors R-9 and R-10. The resulting voltage is the required minimum operating bias for the tubes on the avc circuit. Upon receiving signals above the level of the initial bias, the initial bias diode stops drawing current and the automatic volume control diode takes over the controlling bias.

The audio frequency present across R-10 is impressed upon the volume control R-15 through capacitor C-34. The movable arm on the volume control selects the amount of audio signal applied to the control grid of the 6F5 audio amplifier tube and thus regulates the output of the receiver. Across the volume control, R-15 is placed a compensating network of capacitors and a resistor. The music-speech switch is found in this circuit, and when closed places capacitor C-38 in shunt with C-39, which results in the accentuation of the low audio fre-

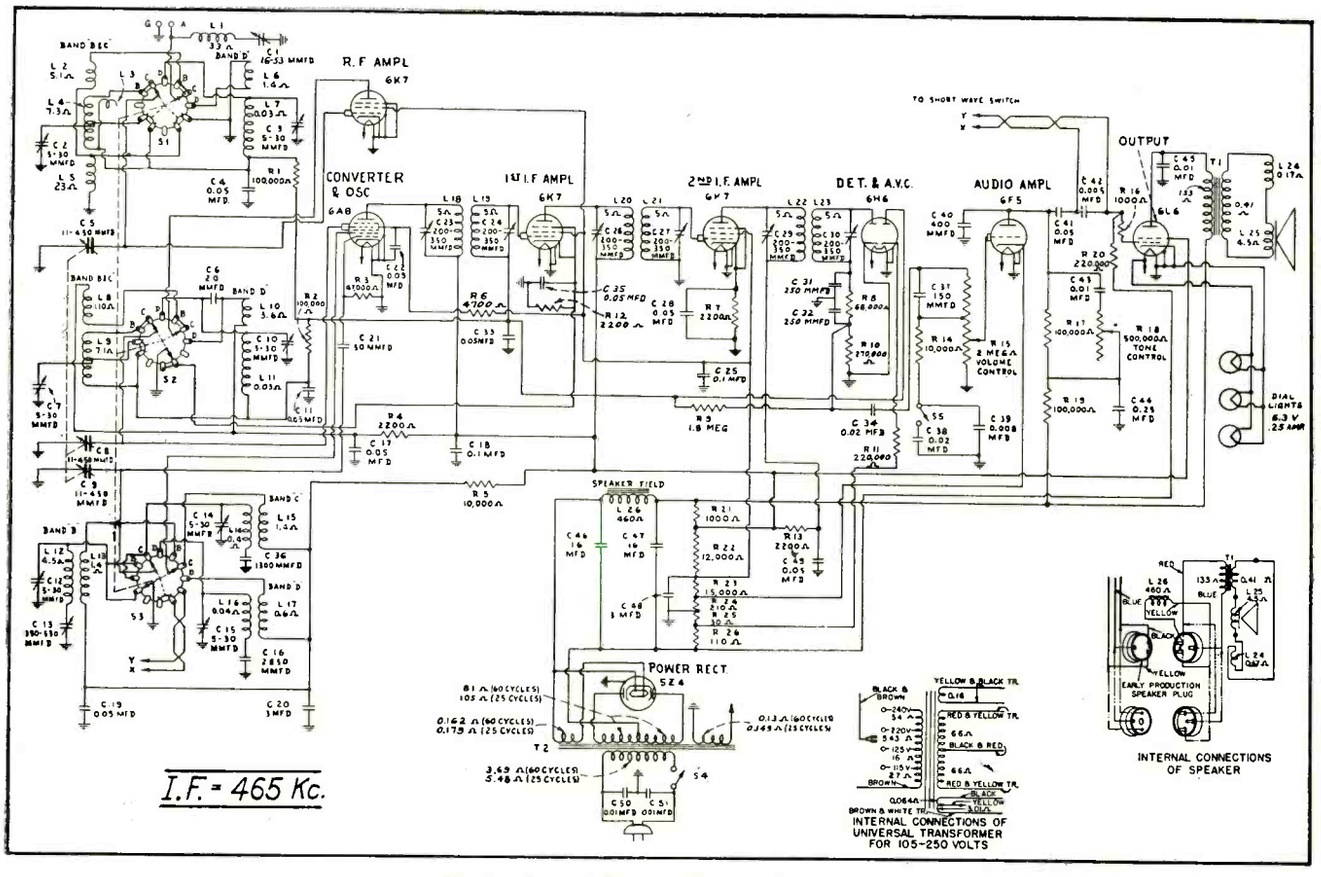


Fig. 1. General Electric E-81 and E-86 circuit.

quencies. The output of the 6F5 audio tube is resistance coupled to the grid of the 6L6 beam power tetrode. The plate circuit of the 6L6 is suitably matched to the electro-dynamic loudspeaker by means of a step-down output transformer.

The tone control is found in the plate circuit of the 6F5 first audio tube and consists of capacitor C-43 in series with a variable resistor R-18 across the 6F5 plate resistor R-17. Cutting out resistance in R-18 lessens the treble response of the receiver. Between the plate of the 6F5 first audio tube and the grid of the 6L6 tetrode output tube are found two capacitors in series, C-41 and C-42. The smaller capacitor, C-42, is shorted out by the wave band switch for operation on the broadcast band. On the two short-wave bands it is left in the circuit to attenuate the low frequency response and thereby lessen the tendency toward microphonic howl.

Plate and grid voltages for all tubes are supplied by the power supply system employing a 5Z4 full-wave rectifier tube; which, together with a suitable network of resistors and capacitors, supplies the required voltages and filtering action.

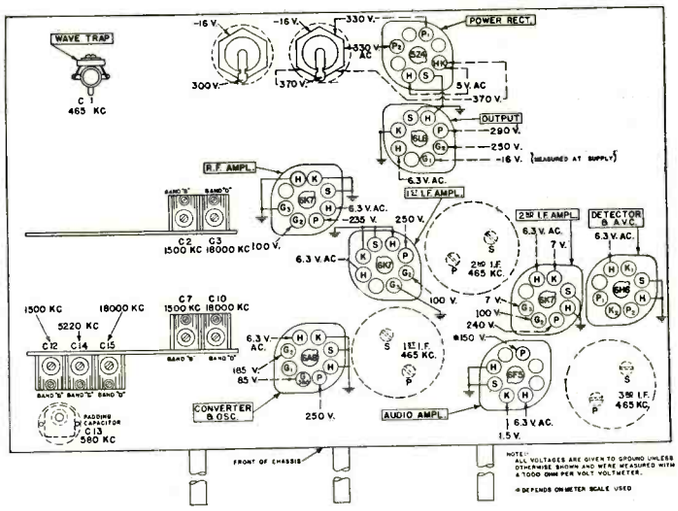


Fig. 2. Tube and trimmer locations.

Alignment Procedure

The receiver should first be allowed to run for fifteen minutes to reach its approximate normal operating temperature. Before making any adjustments, it is wise to determine the correctness of the existing alignment. This may be done by supplying a signal from the test oscillator to the receiver and inserting a "tuning wand" into the coil involved.

The location of the trimmer condensers are shown in Fig. 2.

I-F Alignment

Set the frequency band switch of the receiver to band "D," short circuit the antenna and ground terminals and tune the receiver to some point near maximum tuning condenser capacity where no signal is heard. Set the volume control at its maximum position and ground the chassis.

The i-f amplifier is tuned to 465 kc; set the test oscillator so as to produce a signal at this frequency. Connect the test oscillator output between the top grid terminal of the 6K7 second i-f tube and the chassis using a 0.05-mfd capacitor (RC-072) in series with the oscillator output lead to the top grid connection. First remove the grid lead connecting to the same point from the second i-f transformer. Provide a path for grid bias by connecting a 10,000-ohm resistor (RQ-083) between grid cap and top grid terminal of tube.

Connect the output meter across the voice coil of the speaker and adjust the test oscillator output control so that, with the receiver volume control at maximum, a small deflection is observed in the output meter. During both i-f and r-f alignment, the test oscillator signal should be maintained at the lowest level that will give a good readable output indication.

Adjust the secondary trimmer of the third i-f transformer until a maximum output reading is obtained. Maintain a small deflection on the output meter throughout alignment by adjusting the test oscillator output. Next, adjust the primary trimmer of the third i-f transformer for maximum output. This transformer is then adjusted and should not require readjustment when aligning transformers ahead of it.

Transfer the test oscillator connections to the top grid terminal of the 6K7 first i-f tube, replace the grid lead on second i-f tube and reduce the output of the test oscillator as low as possible consistent with obtaining an easily readable indication on the output meter. Adjust secondary and primary trimmers respectively on the second i-f transformer until maximum deflection of the output meter is obtained.

Transfer the test oscillator connections to the top grid terminal of the 6A8 converter tube and replace the grid cap connection on the 6K7 first i-f tube. It will probably be found desirable to set the tone control for minimum high response and reduce the volume control setting to lessen noise reproduced due to the high sensitivity of the receiver. Again adjust the test oscillator output to as low a value as will allow accurate adjustment. Adjust secondary and primary trimmers, respectively, on the first i-f transformer until maximum response is indicated on the output meter. The i-f alignment is now complete.

Wave-trap alignment: Set the band switch to band "B" and tune the receiver to about 1000 kc. With the test oscillator still set at 465 kc remove the shorting connections between the antenna and ground terminals and apply this signal to the antenna terminal through a dummy antenna consisting of a 400-ohm resistor and 250-mmfd capacitor in series. With the 465-kc signal applied to the antenna terminal, adjust the i-f wave-trap trimmer for *minimum* output indication.

R-F Alignment

First check the position of the dial pointer by rotating the tuning condenser to maximum capacity position, i. e., plates fully meshed. At this position, the pointer should coincide with the end mark at the left-hand end of the scale. If it does not, it may be reset by loosening the dial drum set screws and rotating the drum on the tuning condenser shaft. Hold the tuning condenser rotor while doing this, to keep it from rotating. Tighten the two set screws after the pointer is correctly set.

Band "B" (540-1680 *kc*): Set the test oscillator for operation at 1500 kc, and connect its output to the antenna terminal of the receiver through the dummy antenna described under i-f wave trap alignment. Tune the receiver until the pointer is at 1500 on the scale. Set the tone control for minimum high response and reduce the volume control setting so as to avoid excessive noise response. Adjust the band "B" oscillator, r-f, and antenna trimmers respectively (C-12, C-7, and C-2, Fig. 3) to give maximum deflection on the output meter. Maintain the test oscillator output at the low-

est level which will give an easily readable ouput indication.

Now set the test oscillator at 580 kc, and tune the receiver to resonance with this signal. Adjust the 580-kc padding capacitor, C-13, rocking the tuning condenser back and forth through resonance as the padding capacitor is adjusted and note the deflection of the tuning meter each time the receiver is tuned through resonance. Leave the padding capacitor at the setting which gives greatest deflection.

Retune the receiver to 1500 kc, and set the test oscillator for this frequency. Check the alignment by again adjusting the band "B" oscillator, r-f and antenna trimmers for maximum deflection on the tuning meter.

Band "C" (1680-6000 *kc*): No trimmers are provided for alignment of the r-f and antenna transformers in band "C" of these receivers. Correct tracking between r-f and antenna transformers is obtained by the action of the capacity coil, L-3, and between oscillator and the other tuned circuits by means of the adjustable oscillator trimmer C-14 and the fixed padding capacitor, C-54.

Turn the band switch to band "C." Set the test oscillator at 5220 kc and tune the receiver to resonance at this frequency. Adjust the band "C" oscillator trimmer, C-14, for maximum output indication on the tuning meter, rocking the tuning condenser back and forth through resonance while making this adjustment.

Band "D" (6.0-18-0 *mc*): Turn the band switch to band "D." Set the test oscillator at 18,000 kc (18.0 mc) and tune the receiver until the pointer coincides with the 18.0-mc mark. Adjust the band "D" oscillator trimmer, C-15, to give maximum output indication. It will probably be found that there will be two settings of the oscillator trimmer that will give an output response. The lower capacity setting of the trimmer is the one that should be used. To be sure that correct adjustment has been obtained, tune for the image signal at 17.07 mc with the test oscillator set at 18.0 mc. It may be necessary to increase the test oscillator output to obtain response at this point.

Retune the receiver to 18.0 mc and adjust band "D" antenna and r-f trimmers, respectively (C-3 and C-10), for maximum output indication. When adjusting the r-f trimmer, C-10, rock the tuning condenser back and forth through resonance as in the 580-kc padding capacitor adjustment.

Alignment of the receiver is now complete.

Fairbanks-Morse 100†

A complete description of the electrical circuit of the Fairbanks-Morse model 100 receiver is given below together with the alignment data, selectivity curves, power-transformer ohmages and circuit diagram.

Tubes and Circuit

The model 100 chassis employs a type 6D6 tube in the radio-frequency amplifier stage. The incoming signal is fed to this tube through the antenna coil on each of the four bands. Through the use of this stage, high image and signal-to-noise ratios are maintained on all bands. Amplification and some selectivity are also realized in this stage.

A type 6A7 pentagrid converter is employed. This tube serves the dual function of first detector and oscillator. The oscillator section of the tube, on all but the long-wave band, is connected to a McNabb constant voltage oscillator circuit. Through the use of both inductive and capacitative coupling, the output of the oscillator remains at a uniform level over the entire frequency range of the band in use. On the long-wave band, the oscillator tube works easily and with fairly constant intensity on all frequencies and, for this reason, only capacitative coupling is employed.

Two type 6D6 tubes serve as i-f amplifiers. These tubes, together with the 3 i-f transformers, comprise the i-f amplifier. Here most of the gain and selectivity of the receiver is realized.

A type 76 tube, connected as a diode, performs the dual function of second-detector and avc tube. Since no gain is obtained in this stage, the output is resistance coupled to another type 76 tube that serves as audio amplifier. The output of this tube is, in turn, resistance coupled to a type 42 tube, connected as a triode, driving two type 2A3 tubes in a Class A output stage.

The input transformer is of special design, being wound for low-leakage inductance, which makes for high-efficiency, high-fidelity reproduction. Condenser C-22 and resistor R-25 comprise an audio frequency equalizer circuit connected across the secondary of the input transformer. A type 5Z3 full-wave rectifier tube is employed in a conventional power-supply circuit.

Tuning Indicators

The tuning indicator on the model 100 is of the magnetic type operating a vane in such a manner as to cast a shadow of variable width on the upper portion of the dial. When the shadow is contracted to its narrowest possible dimension, the receiver is properly tuned. This indicator is connected into the circuit as shown in the circuit diagram, Fig. 1. It will be noted that the tuning indicator is only in the circuit when the third dimension switch is on the sharp position. This is intended to encourage tuning only on the sharp position.

Automatic Volume Control

A type 76 tube is employed as the second detector in a half-wave rectifier circuit, with the grid and plate tied together. Current flows through the tube to the cathode to ground. Here it is picked up at the point where resistor R-16 is grounded and flows through resistors R-16 and R-17, through the secondary of the i-f transformer back to the grid and plate of the 76 tube, thus forming a complete circuit.

The d-c component produces a voltage drop across resistor R-16 in proportion to the signal strength of the incoming signal. The grid returns of the r-f amplifier, the pentagrid converter and the first i-f amplifier are connected, through the isolating resistors R-6, R-7 and R-15, to the point of juncture between resistors R-16 and R-17, thus adding the voltage drop obtained across R-16 to the fixed bias on the three controlled tubes. The fixed bias is obtained from the individual bias resistors R-2, R-4 and R-11 located in the cathode circuits of the tubes. Resistor R-16 is also the manual volume control. The audio component of the voltage drop across this resistor is taken off on the sliding arm of the control through condenser C-18 and is applied to the grid of the 76 audio-amplifier tube.

Alignment Procedure

To insure obtaining the performance this receiver is capable of delivering, it is essential that it be aligned perfectly. For this reason, it is urged that the following instructions be carefully studied before any alignment adjustments are attempted.

Proper adjustment of the various tuned circuits will only be possible through the use of an accurate and reliable signal generator employed in conjunction with an output meter connected across the voice-coil leads of the speaker. In the adjustment of the third i-f transformer, it is recommended that a cathode-ray oscilloscope be used for more accurate results. Note: All adjustments, unless otherwise noted, should be made with the volume control on full. Any desired variation in

†From Rider's Volume VII.

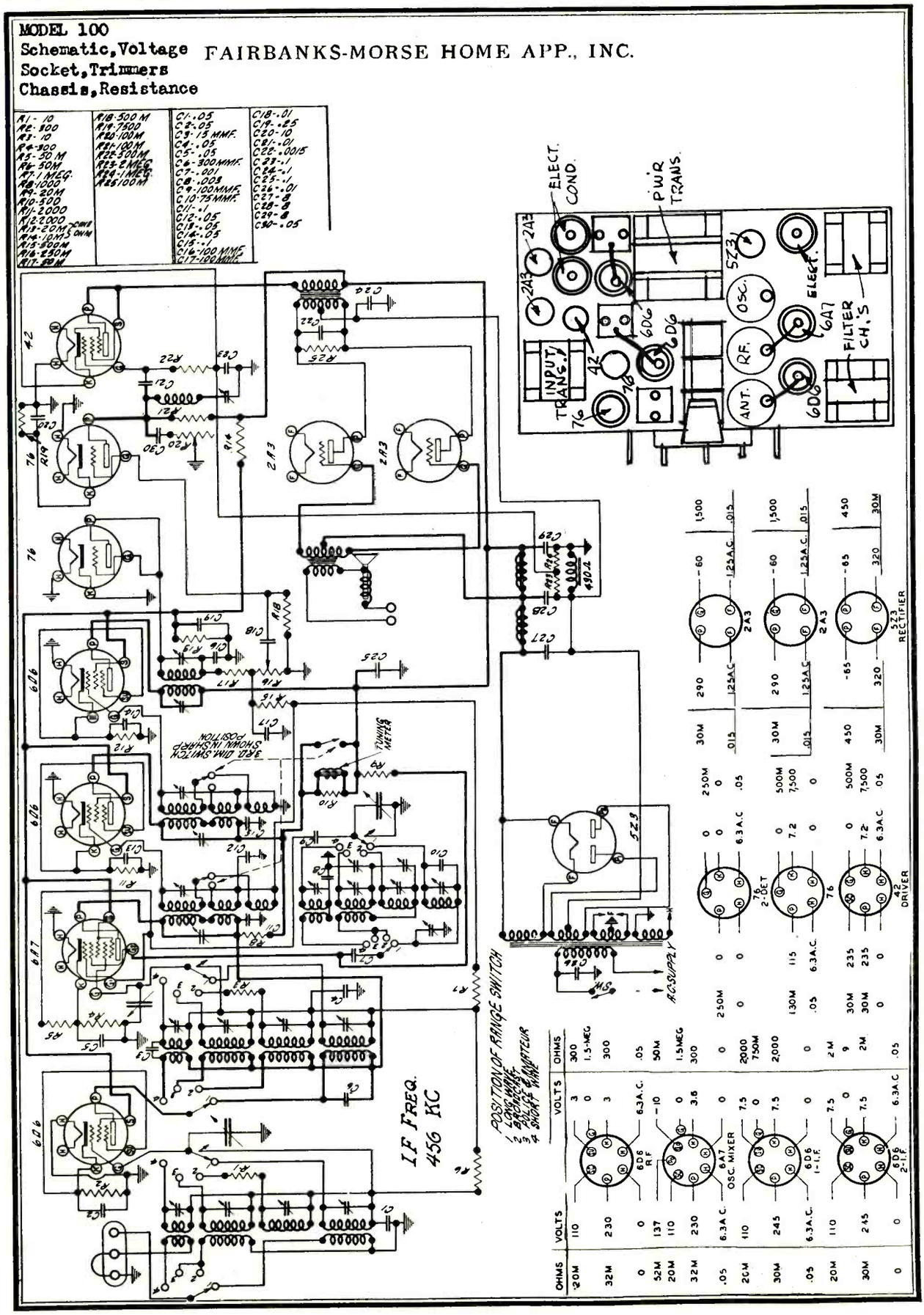


Fig. 1. Fairbanks-Morse 100 circuit from Rider's Volume VII.

the signal strength should be obtained by adjusting the output of the signal generator.

I-F Alignment

With the range switch in the broadcast position, the fidelity switch in the sharp (clockwise) position and the gang condenser closed (maximum capacity), supply a 456-kc signal, stage-by-stage, to the i-f amplifier, beginning with the grid of the second i-f tube. To accomplish this, a 0.1-mfd condenser should be connected between the generator supply lead and the second i-f tube.

The trimmers of the third i-f transformer should be adjusted for maximum output with minimum input from the signal generator. Then the signal generator lead should be moved to the first i-f tube and the trimmers of the second i-f transformer should be adjusted. The next step is to supply the signal to the grid of the first detector tube and adjust the trimmers of the first i-f transformer. This method of procedure is essential because of the extreme selectivity of the receiver. After each stage has been aligned, it is well to go back overall adjustments to make sure they are accurate.

The next step in the i-f alignment is to supply a very strong (about 1,000 microvolts) signal to the grid of the first detector tube through a 0.1-mfd condenser. *Caution*: Before the signal is applied to the receiver the volume control should be retarded to zero. After the signal is applied, the volume control should be advanced slowly and carefully until a suitable indication appears on the output meter.

The fidelity switch should be turned to the high-fidelity or "third dimension" position. Symmetrical double humps should appear, one on each side of where the sharp resonance point appeared on the "sharp" position (see Fig. 2), when the signal generator is tuned aproximately 8 kc on each side of the resonance point. The two humps must be of equal amplitude. If this is not the case, the trimmers of the third i-f transformer must be adjusted until a condition of equal amplitude is obtained. This may be found to be a very difficult adjustment unless an oscilloscope is used.

Use of the Oscilloscope

A signal generator with a sweep circuit must be employed in making this check. The output of the signal generator should be fed to the grid of the first detector tube in the receiver. The grid clip must be removed from the tube, but, since the first detector is one of the avc controlled tubes, it is necessary to complete the grid circuit. To accomplish this, connect a large resistor (about 50,000 or 100,000 ohms) between the grid clip and the grid cap of the tube. The low side of the signal generator should be connected to the chassis ground.

The "vertical" binding posts of the oscilloscope should be connected to the audio output of the second detector. The high side connection from the "vertical" plates should be made to the point of juncture between resistors R-15, R-16 and R-17. The low side connection may be made to ground. Thus, the audio voltage is applied to the "vertical" plates of the oscillograph.

With the receiver operating on the "sharp" position, the i-f amplifier resonance curve will appear on the screen. When the receiver is switched to the "third dimension" position, symmetrical double humps, approaching a wide flat top resonance curve, should appear in place of the "sharp" resonance curve (see Fig. 2). Each side of the curve should be of equal amplitude. If this is not the case, the trimmers of the third i-f transformer should be adjusted until the proper curve is obtained. The adjustment of one trimmer, in addition to affecting its own side of the curve, will reflect in the other side and, for this reason, great care must be exercised in making these adjustments.

R-F Alignment

The parallel or high-frequency trimmer condensers for each coil are housed in the same can with the coil. These trimmers are used for aligning the high-frequency end of each band. It is essential that the bands be aligned in the order they appear in the following instructions. In other words, the police band alignment must be completed before the broadcast band alignment is started because of the interlocking effect of the padding condensers on these bands.

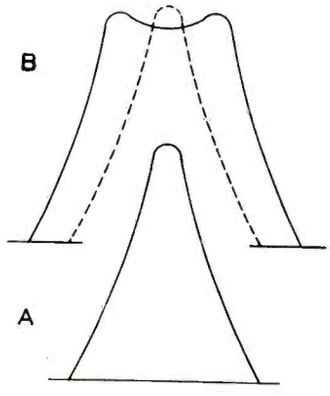


Fig. 2. Resonance curves.

Adjustable series padding condensers are used for tracking the oscillator at the low-frequency end of each band. The padding condensers may be adjusted from the top of the chassis, through the holes indicated. Since a fixed mica padding condenser is employed on the short-wave band, no adjustment is necessary. While making padding condenser adjustments, the gang condenser should be rotated back and forth across the signal to insure adjustment to the peak of greatest intensity.

Police Band

With the band selector switch on the police station and the fidelity switch on the "sharp" position, supply a 5-mc signal from the signal generator to the antenna of the receiver, using a 400-ohm carbon resistor in series with the signal-generator lead. Tune the receiver to 5-mc and then adjust the oscillator, r-f and antenna stage police band trimmers for maximum output with minimum input from the signal generator. *Warning*: Care must be exercised to avoid aligning the receiver to the image frequency as outlined under "short-wave band."

Supply a 1.8 mc signal to the receiver and tune the receiver to 1.8 mc. Adjust the police-band oscillator padding condenser for the signal of greatest intensity, rocking the gang condenser back and forth across the signal while making adjustment. Check at 5 mc and then at 1.8 mc to correct for any frequency change.

Broadcast Band

With the band selector switch on the broadcast position, supply a 1,500-kc signal from the signal generator to the receiver, using a standard dummy antenna or a 200-mmfd condenser in series between the signal generator and the antenna post of the receiver to serve as the dummy antenna. Make certain that the fidelity switch is on the "sharp" position.

Tune the receiver to 1,500 kc and adjust the r-f, antenna and oscillator stage broadcast-band trimmers for maximum output with minimum input from the signal generator.

Supply a 600-kc signal to the receiver through the same connections. Tune the receiver to 600 kc. Adjust the broadcast band oscillator padding condenser for the peak of greatest intensity while rocking the tuning condenser back and forth across the signal. Recheck at

Technical Features of 1937 Bosch Radio Receivers ····

Model No.	515	600	601	602C	602T	604	605	605C	610	620	625	640	650	660T	660C	670S	670C	680
Cabinet *	P	T	T	Ce	T	P	P	Ce	P	P	Ce	P	Ce	P	Ce	Ce	Ce	Ce
Power Supply	A.C.	6V.	Battery	Battery		A.C.-D.C.	A.C.		A.C.-D.C.	A.C.-D.C.		A.C.	A.C.	A.C.		A.C.		A.C.
Range (Kc.)	540-3600	540-1725 2000-7000	540-1725 2000-7000	540-1725 2200-16,000		530-3000	540-1700 2000-7200		540-1700 2000-7200	540-4500 5500-16,500		540-4500 5500-16,500	540-4500 5500-16,500	525-18,500		150-390 525-18,500		150-390 525-18,500
Power Consumption Watts	–					44	–		–	52		47	62	60		80		–
Audio Power Watts	–	–	–	–		1.1	–		–	1.0		3	3.5	3.3		6.5		–
I.F. Peak (Kc.)	465	465	465	465		465	465		465	465		465	465	465		465		465
CentrOmatic														Yes		Yes		Yes
Tone Control	–	–	–	–					–	Continuous		Cont.	Cont.	Continuous		Continuous		Cont.
Variable Condensers	2	2	2	3		2	2		2	2		2	2	3		3		3
Number of Tuned Circuits	6	6	6	7		4	6		6	6		6	6	7		7		9
R.F.				1A4										6K7		6K7		6K7
1st. Det.	6F7	6A7	1C6	1C6		6A7	6A8		6A8	6A8		6A8	6A8	6A8		6A8		6A8
Oscillator																6C5		6C5
Intermediate Frequency	6D6	6D6	1A4	1A4			6K7		6K7	6K7		6K7	6K7	6K7		6K7		(2) 6K7
2nd. Det.	75	75	1B5	1B5		6C6	75		75	6H6		6H6	6H6	6H6		6H6		(2) 6H6
A.V.C.																		6K7
1st. Audio										6F5		6F5	6F5	6F5		6F5		6F5
2nd. Audio			30	30														
Output	42	41	19	1J6G		43	6F6		25A6	25A6		6F6	6F6	6F6		(2) 6F6		(2) 6L6
Rectifier	80					25Z5	80		25Z6	25Z6		5Y3	5Y3	5Y3		5Y3		5Y3 5Z3

* T = Table P = Personal Ce = Console

POWER TRANSFORMERS

Part No. 5410	110 Volt	50-60 cycle
Lead Color	Voltage	Resistance
Black	2.5	.03 ohm
Black & Yellow	Center Tap (2.5 volt)	
Blue	5.0	.05 ohm
Green	6.3	.10 ohm
White	110 (Primary)	1.79 ohms
Yellow	High Voltage	115.3 ohms
Green & Yellow	Center Tap (Hi-Volt.)	
Part No. 5566	**Universal**	**40-50-60 cycle**
Lead Color	**Voltage**	**Resistance**
Black	2.5	.03 ohm
Black & Yellow	Center Tap (2.5 volt)	
Green	6.3	.10 ohm
Blue	5.0	.08 ohm
Yellow	High Voltage	115.3 ohms
Green & Yellow	Center Tap (Hi-Volt.)	
Black	Common Primary	
Red	100-125 Primary	2. ohms
Brown	130-155 Primary	2.2 ohms
White	200-250 Primary	6.2 ohms
Part No. 5589		**25 cycle**
Lead Color	**Voltage**	**Resistance**
Blue	5.0	.06 ohm
Green	6.3	.10 ohm
Yellow	High Voltage	154.5 ohms
Black & Yellow	Center Tap (Hi-Volt.)	
White	110 Primary	2.45 ohms

1,500 kc and then at 600 kc, and make any frequency corrections that appear necessary.

Long-Wave Band

With the band-selector switch on the long-wave position, supply a 350-kc signal from the signal generator to the antenna of the receiver, using a standard dummy antenna or a 200-mmfd condenser in series with the lead. Make sure the fidelity switch is on the "sharp" position. Tune the receiver to 350 kc and adjust the oscillator, r-f and antenna stage trimmer condensers for maximum output with minimum input from the signal generator.

Supply a 175-kc signal to the receiver through the same connections used in the previous adjustment. Tune the receiver to 175 kc. Adjust the long-wave oscillator padding condenser for the peak of greatest intensity while rocking the tuning condenser back and forth across the signal. Readjust at 350 kc and then at 175 kc as many times as may be necessary to obtain satisfactory tracking.

Short-Wave Band

Turn the band-selector switch to the short-wave position. Supply an 18-mc signal from the signal generator through a 400-ohm carbon resistor (dummy antenna) to the antenna post of the receiver. Tune the receiver to 18 mc on the dial. Adjust the short-wave band oscillator trimmer condenser for maximum output with minimum input from the signal generator, then adjust the short-wave band antenna and r-f stage trimmer condensers for maximum output, at the same time rocking the tuning condenser back and forth across the signal to insure the peak of greatest intensity. Check the calibration and, if necessary, readjust all three stages.

Warning: The image signal should be received at approximately 17 mc after the above adjustments have been made. If it cannot be located the oscillator has probably been aligned to the image frequency and the oscillator trimmer must be backed out until the proper signal comes in at 18 mc and the somewhat weaker image is received at approximately 17 mc. If this readjustment is necessary, it will also be necessary to again align all three trimmers for maximum output.

Gang-Condenser Plates

The adjustment of the various plates of the gang condenser is very critical, since it must be accurate on all bands. These adjustments are made in the factory with precision equipment and under no condition should it be necessary to change them by bending plates.

10-KC Audio Trap

Because of the band width necessary to obtain high-fidelity reproduction, if a station is operating on a channel adjacent to the station channel being listened to, a 10-kc beat (high-pitched whistle) may be heard in the background. To reduce the possibility of this interference, Fairbanks-Morse engineers have developed a 10-kc wave trap. This trap circuit consists of a large, air-core choke coil and a variable condenser, connected in series. This trap is connected from the plate of the first audio amplifier tube to ground.

It should not be necessary to adjust the trap circuit unless either the coil or the condenser has been replaced. To adjust the trap tune in on two adjacent channels on which two distant stations are operating. Turn the selectivity switch to the third dimension position. Tune the interfering whistle to its loudest point by tuning between the two stations. Adjust the 10-kc trap trimmer until the whistle is reduced to a minimum.

The secondary of the first and second i-f transformers is composed of three sections, the upper, center and lower (see schematic diagram). The primary is composed of two sections, the upper and lower. The upper sections of the primary and secondary are loosely coupled to each other and constitute the major portion of the primary and secondary inductance respectively. The lower section of the primary and the center section of the secondary are tightly coupled. The coupling between the lower section of the secondary and the primary is loose. When the switch is on the third-dimension position, the lower section of the secondary is out of the circuit and the secondary winding is made up of the other two windings, connected in series. Because the coupling between the lower section of the primary and the center section of the secondary is tight, a broad response will result.

When the switch is on the "sharp" position, the center section of the secondary is cut out of the circuit and the loosely coupled lower section is substituted, thus the selectivity is increased the desired amount. Since the inductance of the center section and the lower section of the secondary are identical, the tuning is not altered when switching from the "sharp" to the third-dimension position. Because of this very practical and unique design, it is possible to arrange the tuning eye circuit in such a manner that it is only engaged on the "sharp" position of the switch. This serves to remind the operator that all tuning should be done on the "sharp" setting to insure perfect resonance and most faithful reproduction.

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Stewart Warner R-149

The Stewart-Warner model R-149 chassis is a 12-tube, all-wave superheterodyne with an intermediate frequency of 456 kc. It has four tuning ranges which are 140 to 400 kc, 527 to 1750 kc, 1720 to 5600 kc, and 5.5 to 18.0 mc. Individual coils and trimmer condensers are provided for each band so that each circuit can be adjusted to give maximum efficiency on every frequency range.

The Circuit

The antenna coils are designed to give efficient reception with either a standard or doublet type antenna without the use of any additional coupling transformer. A small connector is provided on the

antenna terminal strip to short the D and G terminals when a standard antenna is used. If a doublet antenna is used, the connector should be turned or removed to open the connection between the D and G terminals.

Two degrees of selectivity are obtainable by means of the selectivity-sensitivity control operating on the first i-f transformer. When the control is in the sharp position (counterclockwise) the first i-f transformer functions as a typical transformer with sharply tuned primary and secondary circuits. When it is in the broad position (clockwise) the resonant frequency of the primary is decreased and that of the secondary circuit increased. At the same time the selectivity curve of the secondary is broadened and the amplification reduced. The combined effect gives a broad flat top to the intermediate frequency amplifier selectivity curve.

This chassis uses an amplified and dual avc action to keep the second detector signal more constant and still have sharp tuning. The diode of the 6H6 second detector tube which is capacity coupled to the second i-f transformer, produces the avc voltage for the i-f tube and the tuning eye only. The avc voltage for the r-f and first detector tubes is secured by means of the 6J7 avc amplifier tube and the second 6H6 tube. The control grid of the 6J7 tube is capacity coupled to the control grid of the 6K7 first i-f tube.

A five-point tone control permits variation of the frequencies present in the speaker from a minimum of treble and emphasized bass to a maximum of treble and normal bass.

Alignment Procedure

During calibration and alignment, keep the receiver volume control in the maximum volume position if noise is not too great, and adjust the oscillator output so that the output meter reads near the center of its scale.

Use the lowest output-meter scale that will provide a steady reading. For making trimmer adjustments, use a bakelite aligning tool which has only a small metal screwdriver tip.

Connect the output meter across the two plates of the two 6L6 power output tubes. *Important*: Do not connect from one 6L6 plate to chassis since this would unbalance the circuit and cause hum.

I-F Alignment

(a) Turn the volume control to the maximum volume position and turn the sensitivity-selectivity control to the sharp position (counterclockwise).

(b) Turn the range switch to the broadcast position (second from the right) and set the tuning dial to any point where there is no tuning effect on the oscillator signal.

(c) Connect the test oscillator output leads to the 6A8 control grid and the chassis with a 0.1-mfd or 0.25-mfd condenser in series with the lead to the 6A8 grid. Do not omit this condenser or alignment will be incorrect.

(d) Set the test oscillator to exactly 456 kc. Adjust the output of the test oscillator to give about half-scale deflection on the output meter.

(e) Adjust the four i-f transformer trimmers (trimmers Nos. 1, 2, 3 and 4) for maximum output-meter deflection.

AVC Amplifier Alignment

(a) Leave the test oscillator set at 456 kc and connected to the 6A8 control grid through a condenser.

(b) Turn the volume control down to protect the output meter and turn the output control of the oscillator up to give enough signal so that the tuning eye closes more than half way. If your

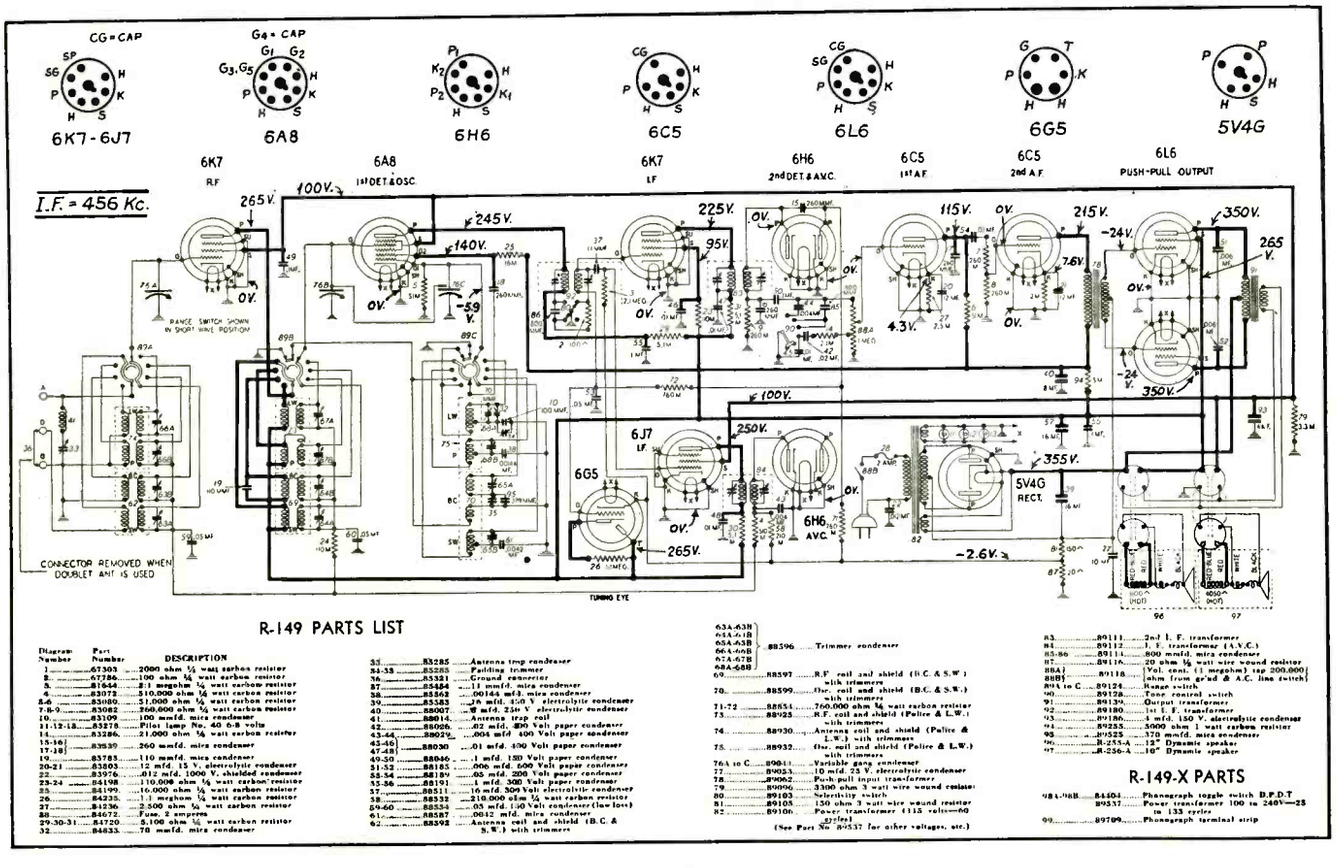


Fig. 1. Stewart Warner R-149 circuit diagram.

R-149 PARTS LIST

Diagram Number	Part Number	DESCRIPTION
1	67303	2000 ohm ½ watt carbon resistor
2	67286	100 ohm ½ watt carbon resistor
3	81644	2.1 megohm ½ watt carbon resistor
4	83072	510,000 ohm ½ watt carbon resistor
5-6	83080	51,000 ohm ½ watt carbon resistor
7-8-9	83082	260,000 ohm ½ watt carbon resistor
10	83109	100 mmfd. mica condenser
11-12-13	83278	Pilot lamp No. 40 6-8 volts
14	83286	21,000 ohm ½ watt carbon resistor
15-16	83939	260 mmfd. mica condenser
17-18	83785	110 mmfd. mica condenser
19	67286	100 ohm ½ watt carbon resistor
20-21	83805	12 mfd. 15 V. electrolytic condenser
22	83976	.012 mfd. 1000 V. shielded condenser
23-24	84198	110,000 ohm ½ watt carbon resistor
25	84199	16,000 ohm ½ watt carbon resistor
26	84235	1.1 megohm ½ watt carbon resistor
27	84236	2,500 ohm ½ watt carbon resistor
28	84672	Fuse, 2 ampere
29-30-31	84720	5,100 ohm ½ watt carbon resistor
32	84835	70 mmfd. mica condenser
33	83285	Antenna trap condenser
34-35	85265	Padding trimmer
36	85331	Ground connector
37	85484	.11 mmfd. mica condenser
38	85562	.00146 mfd. mica condenser
39	85583	24 mfd. 450 V. electrolytic condenser
40	88007	.8 mfd. 256 V. electrolytic condenser
41	88014	Antenna trap coil
42	88026	.02 mfd. 200 Volt paper condenser
43-44	88029	.006 mfd. 400 Volt paper condenser
43-46	88030	.01 mfd. 400 Volt paper condenser
47-48	88046	.1 mfd. 150 Volt paper condenser
49-50	88185	.006 mfd. 600 Volt paper condenser
51-52	88189	.05 mfd. 200 Volt paper condenser
53-54	88191	.1 mfd. 300 Volt paper condenser
55-56	88511	.16 mfd. 300 Volt electrolytic condenser
57	88531	210,000 ohm ¼ watt carbon resistor
58	88532	.05 mfd. 150 Volt condenser (low loss)
59-60	88534	.0012 mfd. mica condenser
61	88587	Antenna coil and shield (B.C. & S.W.) with trimmers
62	88592	Trimmer condenser
63A-63B, 64A-64B, 65A-65B, 66A-66B, 67A-67B, 68A-68B	88596	R.F. coil and shield (B.C. & S.W.) with trimmers
69	88597	Osc. coil and shield (B.C. & S.W.) with trimmers
70	88599	Variable gang condenser
71-72	88854	760,000 ohm ½ watt carbon resistor
73	88925	R.F. coil and shield (Police & L.W.) with trimmers
74	88930	Antenna coil and shield (Police & L.W.) with trimmers
75	88932	Osc. coil and shield (Police & L.W.) with trimmers
76A to C	89011	Variable gang condenser
77	89053	.10 mfd. 25 V. electrolytic condenser
78	89062	Push-pull input transformer
79	89096	3300 ohm 3 watt wire wound resistor
80	89103	Selectivity switch
81	89105	150 ohm 3 watt wire wound resistor
82	89106	Power transformer (115 volts—60 cycles) (See Part No. 89537 for other voltages, etc.)
83	89111	2nd I. F. transformer
84	89112	1. F. transformer (A.V.C.)
85-86	89114	800 mmfd. mica condenser
87	89116	20 ohm ½ watt wire wound resistor
88A	89118	Vol. cont. (1 megohm) tap 200,000 ohm from grid & A.C. line switch
88B		
89A to C	89124	Range switch
90	89128	Tone control switch
91	89134	Output transformer
92	89180	1st I. F. transformer
93	89186	4 mfd. 150 V. electrolytic condenser
94	89255	5000 ohm 1 watt carbon resistor
95	89525	370 mmfd. mica condenser
96	R-253-A	12" Dynamic speaker
97	R-256-A	10" Dynamic speaker
98A-98B	84504	Phonograph toggle switch D.P.D.T
99	89709	Phonograph terminal strip

R-149-X PARTS

98A-98B	84504	Phonograph toggle switch D.P.D.T
	89537	Power transformer 100 to 240V—25 to 133 cycles

oscillator cannot give this much 456-kc output, the avc amplifier can be aligned immediately after completing the broadcast alignment by means of a 1500-kc signal fed into the antenna terminal, with the receiver tuned to the signal.

(c) Readjust the volume control so that the output meter shows about half-scale deflection.

(d) Adjust the two avc amplifier trimmers Nos. 5 and 6 for *minimum output-meter deflection.* Readjust the volume control or oscillator output to the point necessary to obtain a clearly defined point of minimum output when adjusting the trimmers.

(e) Reduce the oscillator output to normal and turn the volume control full on and repeat the adjustment of the i-f trimmers.

Adjustment of Wave Trap

(a) Leave the test oscillator at 456 kc, but connect the oscillator output to the A and G terminals of the receiver with a 400- or 500-ohm carbon resistor in series with the oscillator output and the A terminal.

(b) Adjust the wave-trap trimmer No. 7 for *minimum output.* Increase the oscillator output as necessary to obtain a clearly defined point of minimum output. If some particular station with a frequency slightly different from 456 kc causes code interference, it may be advisable to adjust trimmer No. 7 on the actual frequency of the interfering station.

Dial Calibration

(a) Check the position of the dial pointer on its shaft by turning the tuning knob until the rotor plates of the gang condenser are in full mesh. The slow-moving dial pointer should then coincide with the low-frequency end of the dial scale. If it does not, hold the dial gear and turn the pointer to the correct position.

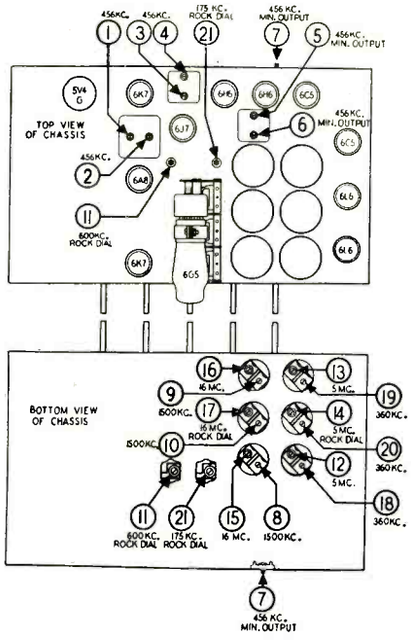
(b) Turn the range-switch control to the broadcast position (second from the right).

(c) Connect a 400- or 500-ohm carbon resistor in series with the test oscillator output and the receiver antenna terminal. *Note:* This resistor should remain connected for all subsequent adjustments.

(d) Ground the receiver.

(e) Adjust the test oscillator to exactly 1500 kc.

(f) Tune in the 1500-kc oscillator signal or a station above 1300 kc on the dial and determine whether the dial calibration is correct at the high-frequency end of the dial. If the calibration is correct, do not adjust the broadcast oscillator shunt trimmer No. 8. If the calibration is incorrect, adjust trimmer No. 8 to give proper calibration.



Figs. 2 and 3. Tube and trimmer locations.

Broadcast-Band Alignment

(a) With the test oscillator set at 1500 kc tune the receiver to the signal for maximum output and adjust the broadcast antenna and detector shunt trimmers Nos. 9 and 10 for maximum output. Do not touch the oscillator shunt trimmer No. 8 as this will change the calibration.

(b) Adjust the test oscillator to exactly 600 kc and tune the receiver to the signal. Adjust the broadcast oscillator series padder No. 11 for maximum output. Then try to increase the output by detuning the padder and retuning the receiver dial. If this reduces the output, detune the padder on the opposite direction. Continue detuning the padder and retuning the dial until a maximum output meter deflection is secured. This operation is commonly known as "rocking." The object of this adjustment is to find the combination of padder adjustment and tuning-condenser position which gives the maximum output. This adjustment should not be changed regardless of whether the dial reads exactly 600 kc or slightly off 600 kc for maximum output.

(c) Check the adjustment of trimmers No. 8, 9 and 10 at 1500 kc.

Police-Band Calibration

(a) Turn the range switch to the band No. 3 (green) position (second from the left).

(b) Adjust the test oscillator to exactly 5.0 megacycles.

(c) Tune in the 5-mc oscillator signal at or near 5 mc on the receiver dial to determine whether the receiver dial calibration is correct at 5 mc. If it is, do not adjust police band oscillator shunt trimmer No. 12. If the calibration is incorrect, set the dial pointer to 5 mc on the dial, and adjust the oscillator shunt trimmer No. 12 until the oscillator signal comes in at this point. If there are two peaks, the proper one is that with the trimmer screw farthest out.

Police-Band Alignment

(a) With the test oscillator set at 5.0 mc tune the receiver for maximum output.

(b) Adjust the police-band antenna and detector trimmers Nos. 13 and 14 for maximum output. After this is done try to increase the output meter reading by detuning the detector trimmer No. 14 slightly and retuning the receiver dial. If the output goes down, detune the trimmer in the opposite direction. Continue detuning No. 14 and retuning the set until maximum output-meter deflection is secured. Then readjust No. 13.

Short-Wave Band Calibration

(a) Turn the range switch to the extreme left (counterclockwise).

(b) Be sure that the D and G terminals on the antenna terminal strip are connected together.

(c) Adjust the test oscillator to exactly 16 megacycles.

(d) Tune in the 16-mc oscillator signal at or near 16 mc on the receiver dial to determine whether the receiver dial calibration is correct at 16 mc. If it is, do not adjust the short-wave band oscillator shunt trimmer No. 15. If the calibration is incorrect, set the receiver dial pointer exactly at 16 mc and adjust the oscillator shunt trimmer No. 15 until the oscillator signal comes in at this point.

(e) Check to see that trimmer No. 15 is adjusted to the proper peak by tuning the receiver to approximately 15.1 mc. If a repeat signal is not heard at this point, even with greatly increased oscillator output, retune the receiver to 16.0 mc and adjust trimmer No. 15 to the proper peak with the trimmer screw farther out.

Short-Wave Band Alignment

(a) With the test oscillator set at 16 mc tune the receiver for maximum output.

(b) Adjust the short-wave antenna and detector trimmers No. 16 and 17 for maximum output. After this is done, try

to increase the output-meter deflection by detuning the detector trimmer No. 17 slightly and retuning the receiver dial. If this causes the output to drop, detune the trimmer in the opposite direction. Continue detuning No. 17 and retuning the set until the output is at a maximum. Then readjust No. 16.

(c) Check the adjustment of No. 17 by tuning the receiver to the image at 15.1 mc and noting if the image is much weaker than the 16-mc signal. If the signal at 15.1-mc dial setting is equal to or stronger than the 16-mc signal, trimmer No. 17 is not set to the proper peak. Turn the trimmer in a turn or so, then readjust.

Long-Wave Band Calibration

(a) Turn the range switch to the extreme right position (clockwise).

(b) Adjust the test oscillator to exactly 350 kc.

(c) Turn the receiver dial pointer to 350 kc on the tuning dial and adjust the long-wave band oscillator shunt trimmer No. 18 for maximum output.

Long-Wave Band Alignment

(a) With the test oscillator set at 350 kc, tune the receiver to the signal for maximum output.

(b) Adjust the antenna and detector trimmers Nos. 19 and 20 for maximum output. Do not touch the oscillator trimmer No. 18 as this will change the calibration.

(c) Adjust the test oscillator to exactly 175 kc and tune the receiver to the signal. Adjust the long-wave oscillator series padder No. 21 for maximum output, then try to increase the output by detuning the padder No. 21 and retuning the receiver dial.

(d) Repeat adjustments of trimmers Nos. 18, 19 and 20 at 350 kc.

•

Crosley Model 1016

The Crosley model 1016 is a ten-tube superheterodyne receiver and is available either with a standard 110 volt—60 cycle power transformer or with a universal power transformer.

The tubes used are 6K7 r-f amplifier, 6A8 modulator, 6C5 oscillator, 6K7 i-f amplifier, 6R7 detector and first audio amplifier, 6C5 second audio amplifier, two 6N6 output tubes, 5Z4 rectifier and the newly developed phantom conductor or volume expander tube.

The tuning range of the receiver is from 540 to 19,000 kc and is divided into three bands as follows: the blue band from 540 to 1,900 kc; the red band from 1.9 to 6.5 mc and the green band from 6.0 to 19.0 mc.

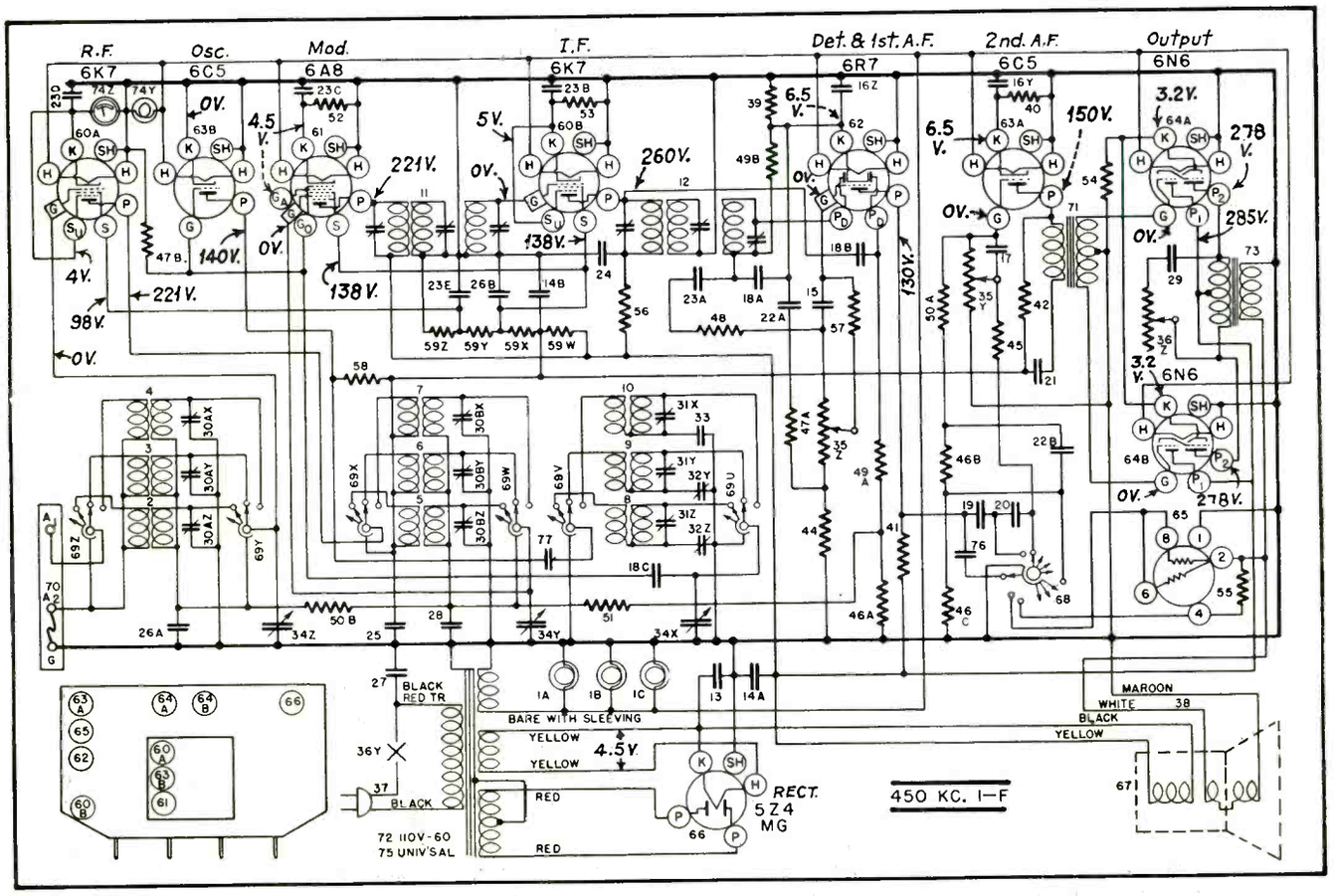
The Auto Expressionator

The auto-expressionator tube (phantom conductor) is connected across the voice coil of the speaker. When it is operating its resistance varies so as to increase the volume of loud tones, thus giving a wider volume range to reproduced music which tends to compensate for the electrical limitations of broadcasting equipment.

Socket Voltages

The tube socket voltages are measured from the tube socket contacts to the chassis with a 1000-ohm-per-volt, 500-volt voltmeter (except filaments) with the receiver in operating condition and no signal input. The a-c filament voltages should be measured with an accurate low-range voltmeter. Readings may vary plus or minus 10 percent of values given.

The model 1016 chassis for use on



Crosley Model 1016 circuit diagram.

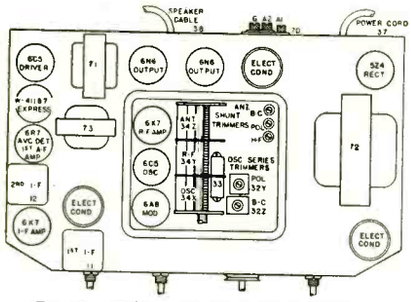


Fig. 2. Tube and trimmer locations.

other than 110 volts—60 cycles, is supplied with a universal power transformer designed to operate on a power supply of from 95 to 267 volts and any commercial frequency of 25 cycles or above. To adapt the set to a different line voltage it is necessary to remove the chassis from the cabinet, remove the bottom from the chassis, locate the terminal strip on the bottom of the power transformer and locate the wire leading from the power switch to the terminal strip. After careful measurement of the maximum values of line voltage, unsolder the wire described above from the lug on the terminal strip and solder it to the correct lug. The correct lug will be the one marked so as to cover or nearly cover the maximum line voltage. The maximum line voltage should not exceed the highest voltage stamped on the terminal strip beside the lug to be used by more than 3 percent.

Phonograph Pickup

Chasses equipped with a universal power transformer also have three terminals on the back for connecting a phonograph pickup. These terminals are marked "P C S" and the pickup is connected through a double pole—single throw switch to these terminals as shown in Fig. 4.

Alignment Procedure

This is a high-fidelity receiver and in order to secure maximum performance the alignment of its circuits should be done with precision instruments.

The i-f amplifier employs two triple-tuned i-f transformers and under no condition should their trimmer condensers be readjusted to determine if they are properly tuned.

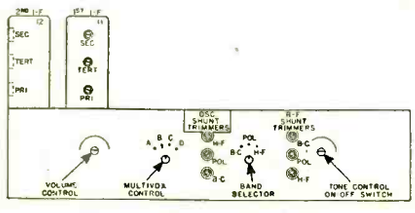


Fig. 3. Trimmer locations.

PARTS LIST (SEE FIG. 1)

No.	Condensers Capacity
13	35 mfd 400 v
14A	40 mfd 300 v
14B	40 mfd 300 v
15	.00001 mfd
16Z	12. mfd 25 v
16Y	12. mfd 25 v
17	.000025 mfd
18A	.0001 mfd
18B	.0001 mfd
18C	.0001 mfd
19	.05 mfd 400 v
20	.0005 mfd
21	.3 mfd 160 v
22A	.023 mfd 200 v
22B	.023 mfd 200 v
23A to 23E	.02 mfd 160 v
24	.02 mfd 400 v
25	.01 mfd 400 v
26A	.05 mfd 200 v
26B	.05 mfd 200 v
27	.01 mfd 400 v
28	.05 mfd 200 v
29	.05 mfd 400 v
33	h-f fixed series cond.
76	.036 mfd 400 v
77	.006 mfd 400 v

No.	Resistors Ohmage
35Z	Volume control 1st a-f 3 meg
35Y	Volume control 2nd a-f 1 meg
39	2,700 ohms ¼ w
40	1,100 ohms ½ w
41	65,000 ohms ½ w
42	20,000 ohms 1 w
44	1 megohm ¼ w
45	300,000 ohms ¼ w
46A	500,000 ohms ¼ w
46B	500,000 ohms ¼ w
46C	500,000 ohms ¼ w
47A	40,000 ohms ¼ w
47B	40,000 ohms ¼ w
48	150,000 ohms ¼ w
49A	400,000 ohms ¼ w
49B	400,000 ohms ¼ w
50A	100,000 ohms ¼ w
50B	100,000 ohms ¼ w
51	1.5 megohms ¼ w
52	350 ohms ½ w
53	500 ohms ½ w
54	40 ohms ¾ w
55	1. ohm 2½ w
56	2,000 ohms 1¼ w
57	60,000 ohms ¼ w
58	15,000 ohms w
59	Candohm

I-F Alignment

(a) Connect one terminal of the output meter to P2 of one of the 6N6 output tubes and the other terminal through a 0.1-mfd or larger, condenser (not electrolytic) to P2 of the other 6N6 output tube.

(b) Connect the output of the signal generator through a 0.02-mfd condenser to the top cap of the 6K7 i-f amplifier tube, leaving the tube's grid clip in place. Connect the ground lead from the signal generator to the "Gnd" terminal of the receiver chassis. Keep the generator output lead as far as possible from the grid leads of the other screen-grid tubes.

(c) Set the band selector switch to the broadcast-band and rotate the station selector to approximately 60 on the dial. Turn the volume control knob to the right (On), turn the tone control knob to the left (Treble) and turn the Multivox control knob to the auditorium position (third position in the clockwise direction).

(d) Set the signal generator to 450 kc.

(e) Close the middle trimmer condenser on the second i-f transformer (Tert. Fig. 3) so that it is moderately tight. (Do not force the adjustment screw).

(f) Adjust the top trimmer and then the bottom trimmer (Sec. & Pri) of the second i-f transformer for maximum output. Always use the lowest signal generator output that will give a reasonable reading on the output meter.

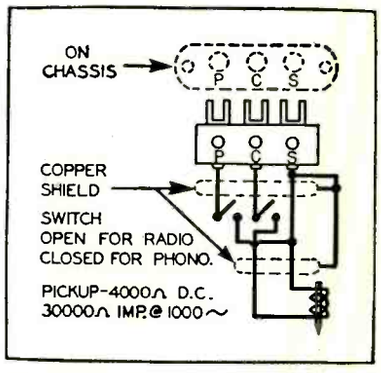


Fig. 4. Phonograph pickup connections.

(g) Transfer the output lead of the signal generator from the 6K7 tube to the top cap of the 6A8 modulator tube, leaving the tube's grid clip in place.

(h) Open the middle trimmer of the first i-f transformer three or four turns from the closed position. (Care should be taken that the adjustment screw does not become dislodged from the nut).

(i) Adjust the top trimmer and then the bottom trimmer of the first i-f transformer for maximum output.

(j) Transfer the output lead of the signal generator from the 6A8 tube to the "Ant" terminal of the receiver and increase the output of the signal generator, if necessary.

(*Continued on page* 580)

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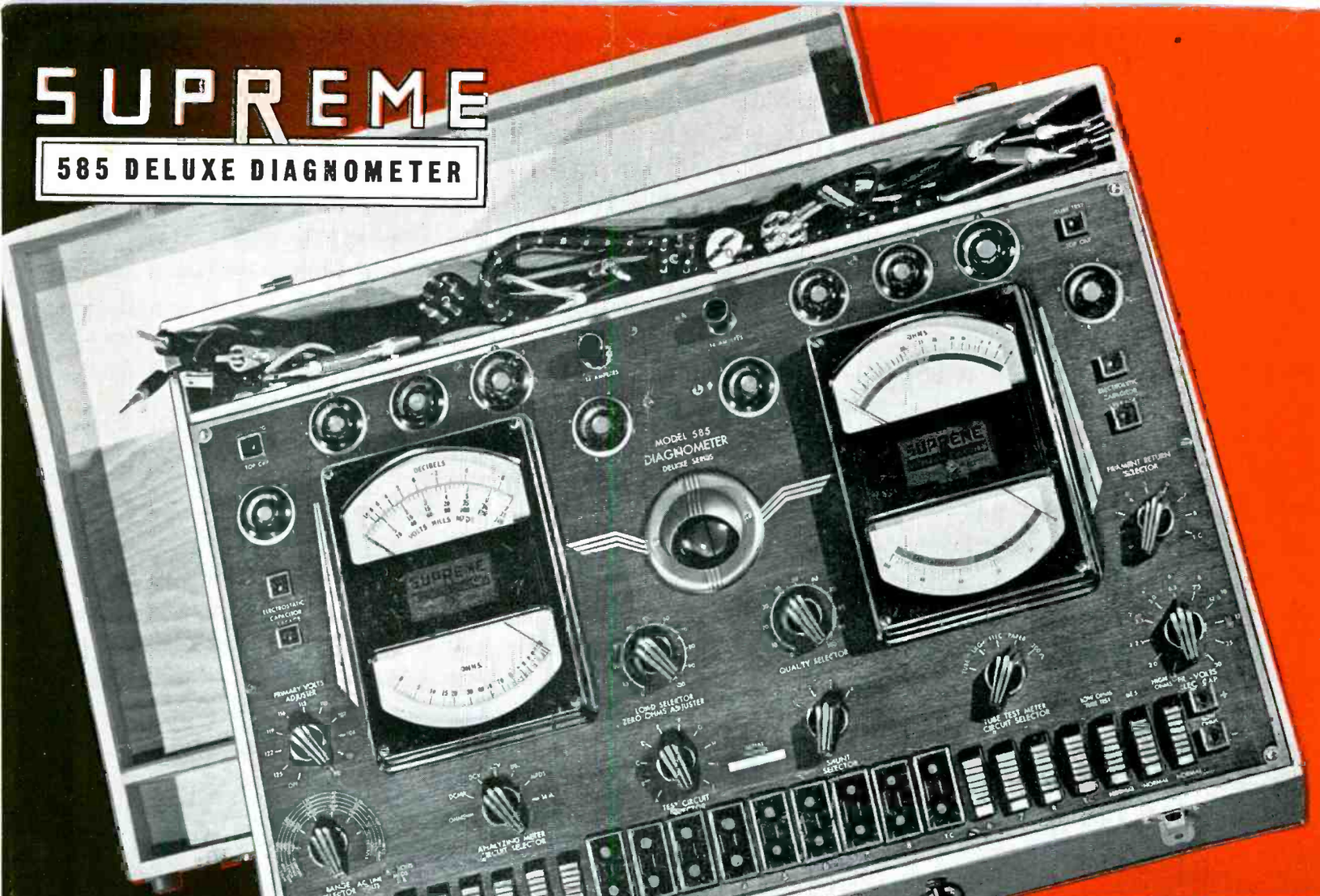

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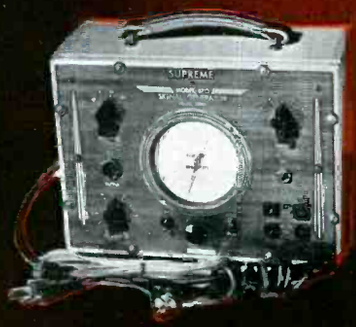

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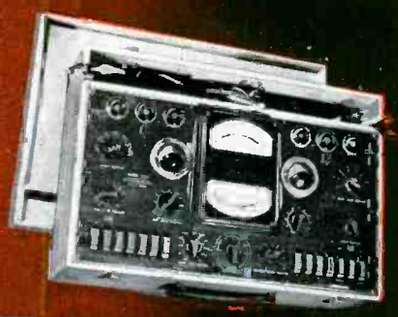

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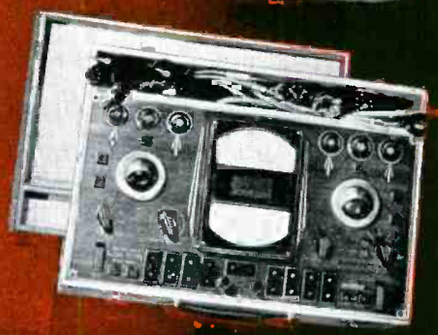

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Auto-Radio . . .

Studebaker Philco S-1431

The model S-1431 is a 6-tube superheterodyne auto-radio receiver in two units. Power for the operation of the various tube circuits is obtained from the 6-volt storage battery supply. The circuit diagram is shown in Fig. 1.

An r-f stage using a type 78 tube is employed ahead of the 6A7 combination first-detector-oscillator. The front section (nearest the control shaft) together with a padding condenser (No. 18, Fig. 2) tune the oscillator coil maintaining the frequency difference between the local set oscillator and the incoming signal. A single i-f stage is employed using a type 78 tube and a doubly tuned i-f transformer. Another doubly tuned i-f transformer is used to feed the diode plates of the 75 tube used as second detector, avc and first audio stage. A type 41 tube is used as an output amplifier to drive the loudspeaker.

Alignment Procedure

The output meter should be connected through an 0.25-mfd capacitor, by means of an adaptor, to the plate of the type 41 output tube and to the receiver chassis.

With the receiver and signal generator set up for operation at the prescribed frequency, turn the receiver volume control on full and set the signal generator attenuator so that the output meter gives a readable indication. The signal in the speaker should be audible but not loud.

The shielding on the signal generator output lead should be grounded to the receiver chassis.

I-F Alignment

Set the signal generator at exactly 260 kc. Connect the generator output lead to the grid cap of the 78-i-f tube in series with an 0.1-mfd capacitor (without removing the grid cap).

Adjust the secondary screw padder (No. 27, see Fig. 2) on the second i-f transformer for maximum reading on the output meter. Then adjust the primary screw padder (No. 25, Fig. 2) for maximum reading.

Remove the generator lead from the 78 tube to the grid cap of the 6A7 tube in series with a 0.1-mfd capacitor (without removing the grid cap). Adjust the secondary screw padder No. 23 on the first i-f transformer for maximum reading on the output meter. Then adjust the primary screw padder No. 21 for maximum reading. See Fig. 2 for location of the padding condensers.

Always maintain the signal generator attenuator at the lowest possible setting consistent with obtaining a readable indication on the output meter.

Repeat the i-f adjustments to assure correct alignment.

R-F Alignment

After padding the first i-f stage re-

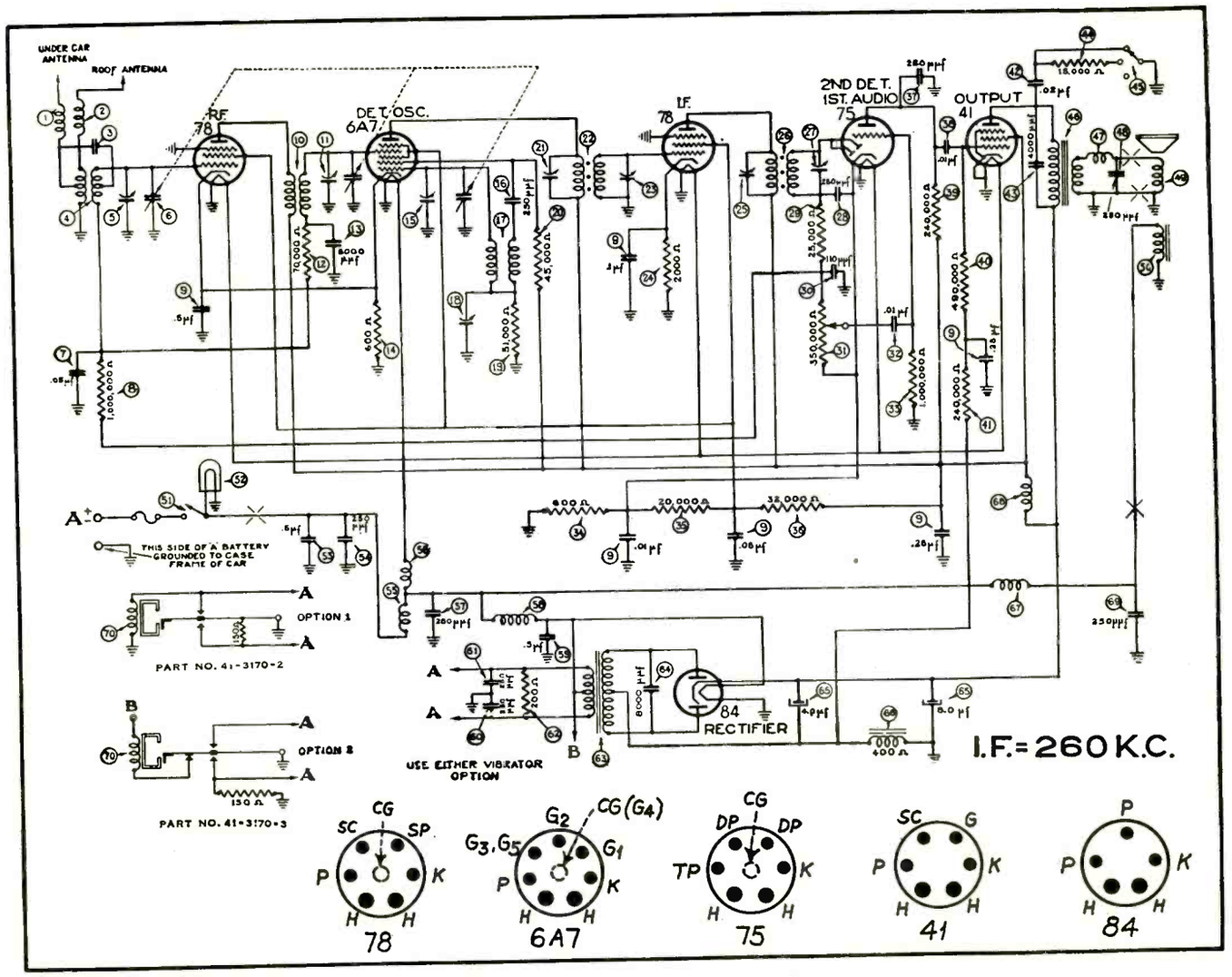

Fig. 1. Studebaker Philco S-1431 auto radio.

move the signal generator lead from the 6A7 tube. Set the signal generator to 1550 kc and connect its output lead to the grid cap of the 78 r-f tube in series with a 0.1-mfd capacitor (without removing the grid cap).

Using a piece of paper 0.006-in thick as a gauge between the heel of the rotor plates and the stator plates, turn the rotor plates until they strike against the paper.

With the tuning condenser in this position, adjust the high-frequency padder No. 15 and the r-f padder No. 11 until the maximum reading is obtained on the output meter. This is the true setting for 1550 kc, 155 on the dial scale.

Turn the tuning condenser plates in mesh to approximately 600 kc, 60 on the dial scale and set the signal generator to 600 kc. Roll the tuning condenser through the signal and adjust the low-frequency padder screw No. 18 until the maximum output is obtained as a result of the combined operations.

(Note: The low-frequency adjustment may be obtained easily by the means described in the article "The Impact Excitation Generator," featured in the September issue of SERVICE.)

After the low-frequency adjustment is completed the high-frequency adjustments should be repeated as follows: Turn the tuning condenser plates out of mesh to 1550 kc and set the signal generator at 1550 kc. Adjust the high-frequency padder No. 15 again for the maximum reading on the output meter.

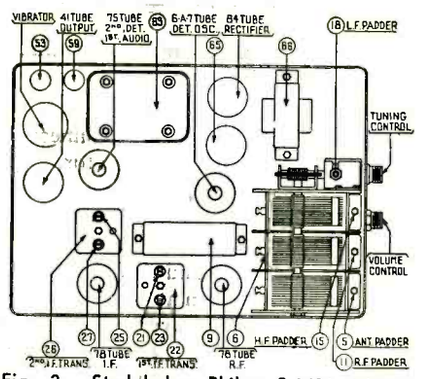

Fig. 2. Studebaker Philco S-1431 trimmer locations.

Remove the signal generator lead from the 78 tube.

ANTENNA ADJUSTMENT

When padding the antenna stage it is extremely important that the proper dummy antenna be constructed and used. Connect the signal generator lead to the antenna cable assembly (made up of part No. 2520 lead and a 64-mmfd capacitor in series with the lead and the signal generator). Plug the cable into the *roof antenna connector* on the end of the receiver. Follow this procedure regardless of whether the receiver is used with the roof or under-car antenna.

Turn the tuning condenser to 1400 kc and set the signal generator at 1400 kc. Adjust the padders Nos. 11 and 5 for maximum reading on the output meter.

When the antenna-stage adjustment is made with the receiver installed in the car, the receiver antenna lead must be connected in the usual manner. Connect the signal generator output lead to a wire placed near the car antenna, but not connected to it.

•

Wells Gardner 6K

This model is a 6-tube automobile receiver covering the standard-wave band. The tuning range is from 530 to 1575 kc. The total current consumption at 6.3 volts is 7.8 amperes. The maximum undistorted power output at 6.3 volts is six watts.

THE CIRCUIT

The signal is fed through an antenna transformer with tuned secondary into a 6K7 tube which functions as an r-f amplifier. A tapped connection is provided in the primary of the antenna transformer for installations in cars in which a high capacity antenna is used.

The output of the r-f tube is fed through another r-f transformer with tuned secondary into a 6J7 tube which functions as the first detector and oscillator. The oscillating circuit is tuned by the oscillator section of the gang condenser and is always resonant at a frequency 175 kc above the frequency to which the r-f circuits are tuned.

One stage of i-f amplification is employed using a 6K7 tube. The primary and secondary of the first i-f transformer and the primary of the second

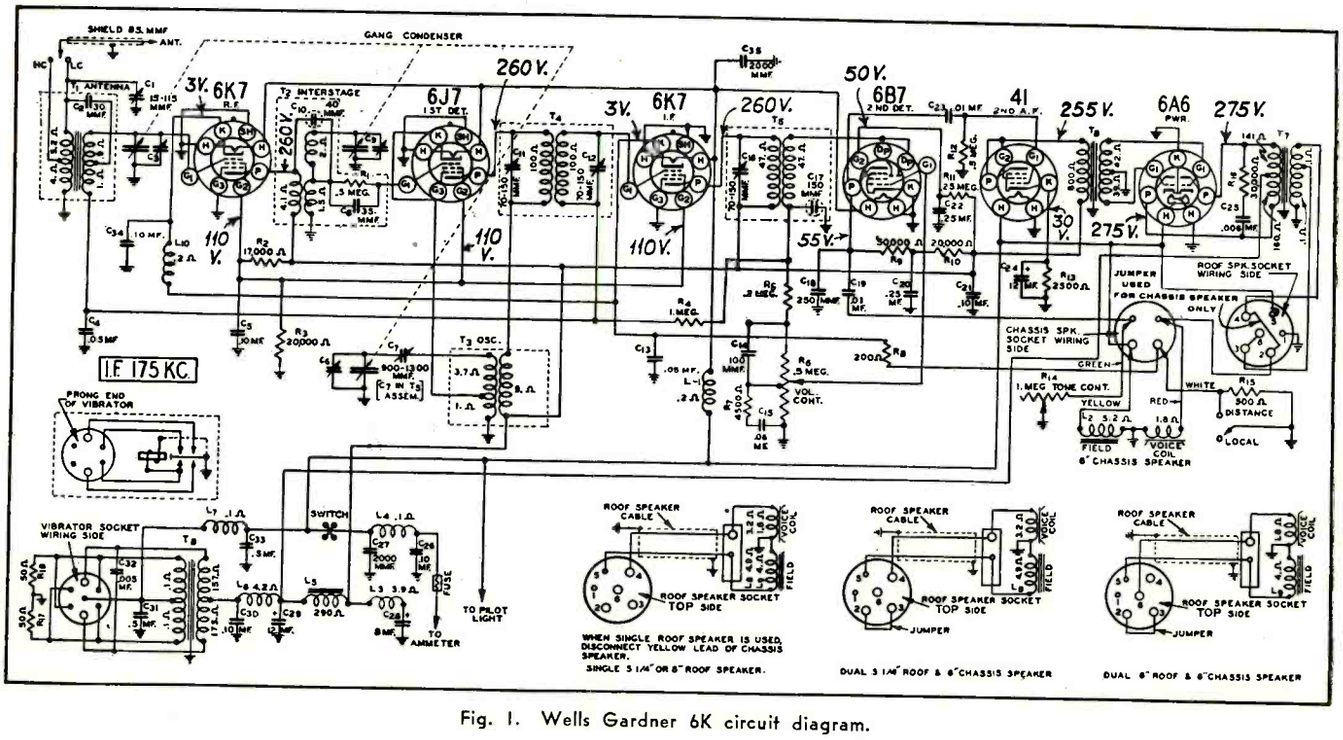

Fig. 1. Wells Gardner 6K circuit diagram.

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MANUFACTURING AFFILIATES IN LONDON, PARIS, BERLIN, MILAN

i-f transformer are tuned by small trimmer condensers.

A local-distance switch is employed to reduce the sensitivity for city driving. When the switch is in the local position, resistor R15 is in series with r-f and i-f bias resistor R8, causing a reduction in sensitivity. When the switch is in the distant position resistor R15 is short circuited and full sensitivity is obtained.

A 6B7 duo-diode pentode tube functions as a diode second detector, avc tube and a one-stage audio amplifier. Avc voltage is applied to the control grid circuits of the 6K7 r-f and i-f tubes. The manual volume control varies the audio voltage applied to the grid of the 6B7 tube.

Resistance coupling is used between the first audio stage and the second audio stage which employs a 41 tube. The latter is transformer coupled to the output stage which uses a 6A6 tube. This tube is a Class B power amplifier and combines 2 triodes in one envelope. A dynamic reproducer is used.

Provision is made for single roof speaker and dual speaker (chassis and roof) connections. The electrical connections for the different speaker installations are shown in the schematic. When single chassis or roof speakers are used the entire output-transformer secondary is connected to the speaker voice coil. When dual 5¼-inch roof and 6-inch chassis speakers are used, the 5¼-inch speaker voice coil is across the entire output transformer secondary and the 6-inch speaker voice coil is connected to the tap on this secondary. When dual 8-inch roof and 6-inch chassis speakers are used, the voice coils of both speakers are connected to the output-transformer secondary tap.

A synchronous type vibrator is used in the power unit. This vibrator interrupts the current through the primary of the power transformer and also rectifies the current in the secondary circuit.

Polarity in inserting the vibrator must be observed. It can be inserted in two ways, and the correct method depends on which terminal of the car storage battery is grounded. Full instructions are on the vibrator.

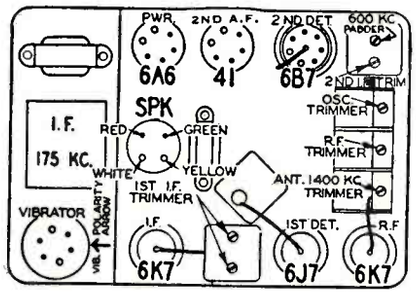


Fig. 2. Tube and trimmer locations.

Alignment Procedure

Misalignment of condensers generally manifests itself as broad tuning and lack of volume at portions or all of the standard-wave band. The radios are all properly aligned at the factory with precision instruments and realignment should not be attempted unless all other possible causes of the faulty operation have first been investigated and unless the service technician has the proper equipment.

A signal generator that will provide accurately calibrated signals over the standard-wave band and at the intermediate frequency, and an output meter are required for indicating the effect of adjustments.

Use a non-metallic screwdriver for the adjustments. The complete procedure is as follows:

I-F Alignment

Set the signal generator for a signal of 175 kc.

Connect the output of the signal generator through a 0.05-mfd condenser to the stator of the r-f interstage section of the tuning condenser. (See Fig. 2 for location of this section.)

Connect the ground lead of the signal generator to the chassis ground.

Turn the local-distance switch to the distance position and keep it in this position for all adjustments.

Set the volume control at the maximum position.

Attenuate the signal from the signal generator to prevent the leveling-off action of the avc.

Then adjust the three i-f trimmers until maximum output is obtained. The location of these trimmers is shown in Fig. 2.

R-F Alignment

1575 *kc adjustment:* Set the signal generator for 1575 kc. Turn the rotor of the tuning condenser to the full open position.

If a low capacity antenna is used, connect the shielded antenna lead from the chassis through a 150-mmfd condenser to the antenna post of the signal generator. (If high capacity, use 1500 mmfd.) The antenna plug must be correctly inserted, dependent on the capacity of the antenna used.

For this and all subsequent adjustments keep the volume control at the maximum position and attenuate the signal from the signal generator to prevent avc action.

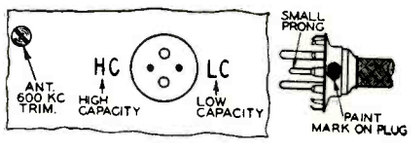


Fig. 3.

Adjust the trimmer of the oscillator section of the three-gang condenser until maximum output is obtained—see Fig. 2 for location of this trimmer.

1400 *kc adjustment:* Set the signal generator for 1400 kc. Turn the rotor of the tuning condenser carefully until maximum output is obtained.

Adjust the r-f interstage and antenna 1400 kc trimmers for maximum output.

Do not change the setting of the oscillator trimmer.

600 *kc adjustment:* Set the signal generator for 600 kc. Connect the output of the signal generator through a 0.05-mfd condenser to the control grid of the 6K7 r-f tube.

Turn the tuning condenser rotor until maximum output is obtained. Then turn the tuning condenser rotor back and forth, at the same time adjusting the 600-kc padder (see Fig. 2) until the peak of greatest intensity is obtained.

Re-connect the output of the signal generator to the shielded antenna lead through a 150-mmfd condenser (1500 mmfd if antenna is high capacity).

Adjust the 600-kc antenna trimmer to maximum. This trimmer is reached from the outside of the case—see Fig. 3.

Adjusting the 600-kc antenna trimmer: After the receiver is installed and the car antenna is connected, it will be necessary to adjust the antenna trimmer. Tune in a weak signal at approximately 600 kc with the volume control about three-fourths on. Turn the adjusting screw of the antenna 600-kc trimmer up or down until maximum output is obtained. See Fig. 3 for location of this trimmer.

As shown in this illustration, the antenna plug is inserted in one of two ways, depending on whether the car has a high or low capacity antenna.

Calibrating the Radio

To calibrate the radio, tune in a station of known frequency. At the back of the control head is the calibration screw. Remove the pilot lamp assembly. Insert a fine blade screwdriver and turn this screw until the pointer on the dial scale is at the frequency of the station being received. The knob must be held during this adjustment.

Public Address . . .

COMPLETE VOLUME EXPANSION†

(See Front Cover)

By C. M. SINNETT*

DURING the last two years, steady progress has been made in the recording and processing of phonograph records. Better tonal balance and lower surface noise are two outstanding characteristics noted in a direct comparison between older and present-day recordings.

In an effort to parallel this improvement in records the RCA Engineering Department has been engaged in developing a phonograph amplifier that would do justice to these record improvements. The RCA Victor R-99 High-Fidelity Phonograph is the result of this development work.

A complete schematic diagram of the amplifier is shown in Fig. 1. To facilitate a better description of the functions of the various parts the volume-expansion circuit is segregated (on the front cover). Nine db of expansion are provided with a maximum of ten watts output. The frequency characteristic of the amplifier (alone), feeding a speaker load, is flat within 5 db from 40 to 10,000 cycles. A peak approximately 5 db in height at 8,000 cycles, and a depression 3 db deep at 4,000 cycles, have been deliberately incorporated in the amplifier. Fig. 2 shows the overall frequency characteristic of the amplifier alone.

†From RCA Service News.
*RCA Engineering Dept.

Volume Expansion Employed

The characteristics of the type 6L7 tube permit its use in a comparatively simple volume-expander circuit. This tube has a heater, a cathode, five grids, and a plate. Two of the five grids are control grids; the first (G_1) has a remote cut-off characteristic and the second (G_3) has a sharp cut-off characteristic. Of the three remaining grids, two are screens and one is a suppressor.

The schematic diagram of a volume expander is shown on the front cover. The signal to be expanded is fed to the remote cut-off grid (G_1) of the 6L7 and also to the input of a 6C5, as shown. The output of the 6C5 is rectified by a 6H6; the positive terminal of the rectified output connects to the sharp cut-off grid (G_3) of the 6L7. The no-signal bias of this grid is such that G_1-plate transconductance of the 6L7 is low (under 50 micromhos). When a signal is applied, the rectified voltage fed to G_3 increases the transconductance, and hence the gain, of the 6L7. This increase in gain is approximately proportional to the rectified diode voltage and, hence, to the signal amplitude.

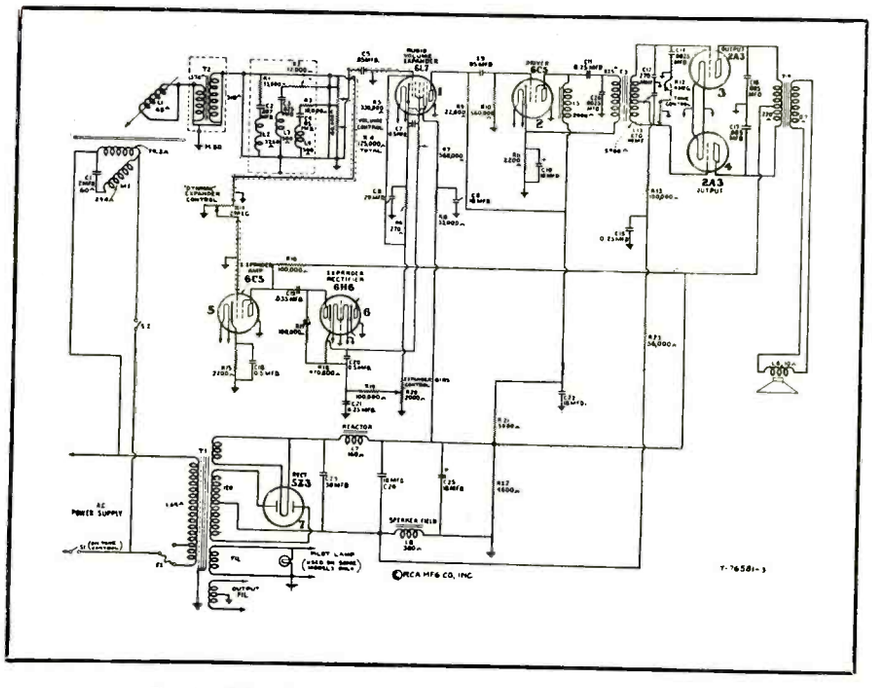


Fig. 1. RCA Victor R-99 high-fidelity phonograph amplifier.

The Amplifier Circuit

The first audio stage employs a 6L7 as the volume-expander tube. Several circuit changes will be noted if comparison is made with the circuit of the RCA Victor D-22, the major ones being a lower value plate resistor R9, self-bias for the No. 1 grid by means of resistor R6, static bias adjusting resistor R20 for the No. 3 grid connected in the 6L7 cathode return, and series feed to the screen through resistor R8. The result is a considerable reduction in the amount of distortion in the tube as an audio amplifier, together with a somewhat less critical adjustment of the expansion starting point or normal gain setting. The 6L7 is resistance coupled to the next tube, a 6C5, which is transformer coupled to the push-pull 2A3 output stage. The 6C5 employs parallel feed in its plate circuit for the purpose of maintaining low frequency response and at the same time insuring that maximum voltage step-up to the next stage is obtained. The leakage reactance of transformer T3 causes a high-frequency peak at about 9,000 cycles. Since a peak at 8,000 is desirable, the two shunt condensers C12 and C13 serve the double purpose of reducing the frequency of the peak and at the same time prevent parasitic troubles in the grid circuits of the 2A3's. The primary shunt condenser C26 serves to depress the curve ahead of the peak as previously mentioned.

As on the D-22 the control amplifier tube is a 6C5 but is operated at higher gain than formerly, since less output is available from the magnetic pickup and input transformer system. Also, it will be noted that the rectifier is now a 6H6, employing a higher value diode resistor to make up for this loss in voltage. Resistor R19 and condenser C21 serve as a filter to prevent hash from the rectifier getting back to the No. 1 grid through the adjusting resistor R20 and grid leak R5. The time delay constants R7 and C7 are the same as were employed on the D-22. The rest of the amplifier is essentially conventional, but it should be noted that throughout the design of this unit special care has been taken to insure a low hum level. The arrangement

the WHOLESALE WAY

SAVES TIME SAVES SHOELEATHER SAVES MONEY

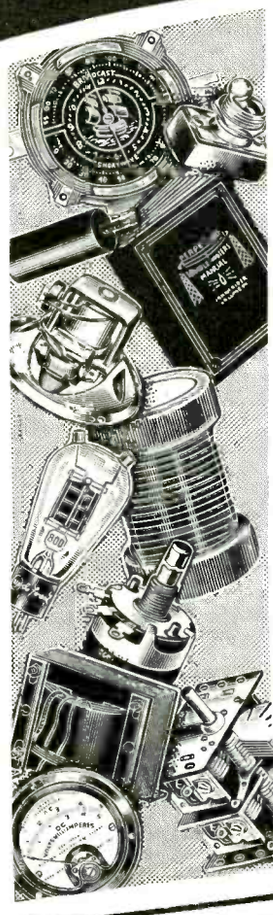
SANDY THE SERVICEMAN Says

If a few more servicemen could count pennies correctly, there'd be less worryin' aboot how the rent was goin' t' be paid on the firrst o' the month. Tak the case o' my competitor. We're good frriends, and I try t' help him when I can. I've figured that his time costs him $1.60 every hour his shop is open, and that he must get at least $2.25 an hour if he wants to stay off the bread line like me. He goes doon to the shops and wastes hours and hours shoppin' aroon — and he NEVER GETS PAID FOR THAT TIME. He had a job the otherr day, and here's how the bill should hae looked:

One Condenser	$1.20
Labor—1 Hour	2.25
(Time Spent in Shopping Around for the Proper Replacement Part Among Inadequate Stocks) 2 Hours	4.50
Gasoline—Wear and Tear on Car	.25
Total	$8.20

But the only charge he made was for $3.45 — and he *LOST MONEY*. But I've converrrted him now. He sent for a "WHOLESALE" catalog and he Shops in his Slippers—he worrks in the daytime and has his ease at night. Best of all, he has learrned the value o' a dollar!

He can see that Sandy is makin' a success of the serrvicin' game, and Sandy's best friend is the "Wholesale" catalog. Aye, Mon, 'tis smarrt to be thrrifty.



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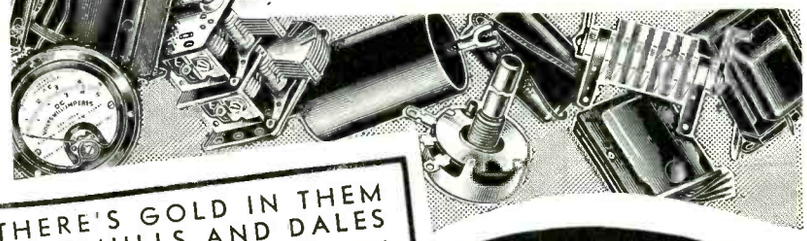

THERE'S GOLD IN THEM THAR HILLS AND DALES

The sale of phonograph records has increased 300% in the past 12 months . . . due to the vast numbers of radio owners who are having their receivers converted into phono-radio combinations. There's a swell profit margin in the sale and installation of turntables, pickups and automatic record changers. Dealers will find that a phono combination owner will be a steady customer for records.

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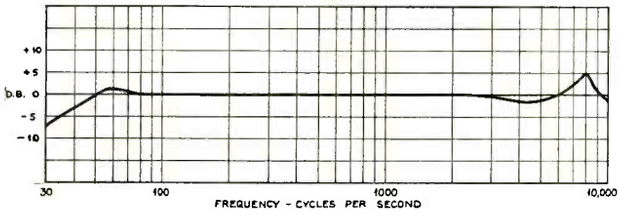

Fig. 2. Overall amplifier response.

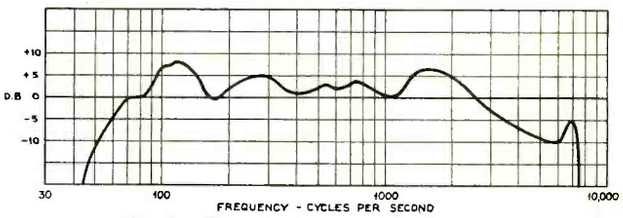

Fig. 3. Overall phonograph response.

of parts on the base, the use of many shielded leads and shielded capacitors have all contributed to an amplifier with a low hum level for the amount of amplification present.

Compensation Network Shielded

The input system employed is quite conventional. Transformer T2 is a 40:1 step-up ratio transformer in its own shielding can. The compensation network is also completely shielded in a special steel container to prevent hum pickup from stray fields generated by the power transformer and motor. The fixed compensation circuit, composed of R1, C2 and L2, takes care of the attenuation of low frequencies on the record during recording. Circuits composed of R2, C3, L3 and R3, C4 and L4 are the aural compensation circuits used in connection with the control R4.

The loudspeaker employed has an aluminum voice coil. Its response at the low-frequency end is good down to about 45 cycles. In respects other than the use of an aluminum voice coil, the loudspeaker is of conventional design.

Audio-Frequency Discriminator Used

In order that the best overall tonal balance could be obtained, at a commercial scratch level, use was made of a device called the audio-frequency discriminator. This device has a control system which permits quick alteration of its frequency characteristic through a division of the audio range (20-10,000 cycles) into eleven bands, each essentially one octave in width. The gain in each of the bands is individually controllable. In addition to this, it is possible to switch the discriminator in and out to obtain a direct comparison between the original and altered fidelities. All the variable controls are suitably calibrated to assist in making preliminary adjustments. An input gain control is provided as a means of adjusting the overall gain through the discriminator for comparison with another system as desired. Output from the pick-up and input system was fed to the discriminator and its output in turn fed to the R99 amplifier and speaker system. The results indicated that the overall fidelity curve should be essentially flat from 50 to 1,000 cycles, with a gradual decrease in response to 4,000 cycles, at which point it should be down approximately 8 db and then again rise to within 2 db of the 1,000 cycle level at 7,000 cycles. In this way the fundamental frequencies of the various instruments were not suppressed, the depression at 4,000 cycles reduced the bulk of the needle scratch and the rise above that frequency provided reproduction of the higher frequencies recorded on the record without appreciable increase in scratch level. A further reduction in surface noise was obtained, amounting to 6 db, by decreasing the pickup pressure on the record to 2 ounces instead of 4½ ounces as previously used. This reduction in pressure placed a further limitation on the stiffness of the pick-up armature suspension system since faulty tracking would occur unless this flexibility were obtained. A spring balance device is employed in the tone arm to overcome the undesirable effect of a large counterweight.

Fig. 2 shows the overall curve of the amplifier alone and Fig. 3 shows the overall sound pressure curves of the instrument. It will be noted that the sound curve is quite flat for an instrument of this type employing a single speaker for covering the frequency range required in this instrument.

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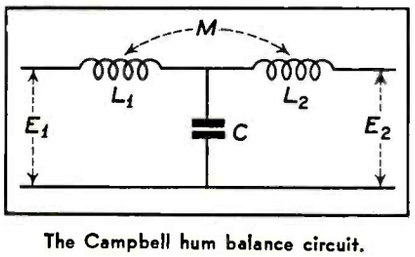
The Campbell Hum Balance

The Campbell balance circuit, shown in the accompanying illustration, has been long known. The circuit has found application in comparatively recent times in power supply circuits, measuring equipment, etc.



The Campbell hum balance circuit.

It can be shown by rather simple mathematics that by proper choice of the condenser C and adjustment of the mutual conductance of the coils L_1 and L_2, the ripple voltage (E_2) can be reduced to zero. Mathematically:

$$\text{If } 2\pi fMC = 1 \text{ then } E_2 = 0$$

Thus the hum (ripple voltage) in a power supply may be greatly reduced by a rather simple circuit while d-c can flow readily.

•

IMPROVING OLD POWER SUPPLIES

(*Continued from page* 547)

The effect of variation in the capacity of C_3 is the same as that of C_2 and the two results multiply. For instance, suppose C_2 was 8 mfd and C_3 was 8 mfd. If both condensers were replaced by larger ones of 32 mfd, the hum would be cut down to one-sixteenth of its original value with the smaller condensers. Or, multiplying the capacity of C_2 by four and the capacity of C_3 by four, results in a reduction of hum of four times four or sixteen times.

It should not be assumed that 32 mfd is an unreasonably large capacity. The trend of designers is towards very much larger condensers and sizes up to 70 and 80 mfd are being employed.

Summary

Increasing the input condensers to a power-pack filter will result in increased voltage as well as reduction in hum. The effects follow the law of diminishing returns; after one exceeds a certain value, further increase of capacity results in less and less improvement.

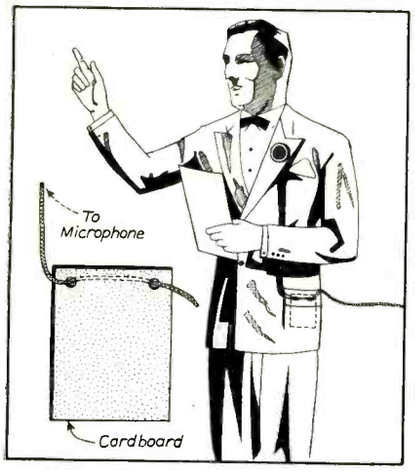
Increasing the second and third condenser reduces the residual hum in inverse proportion to the increase in capacity. Multiplying the capacity by any factor will divide the residual hum voltage by the same factor. This law holds, no matter how large the capacity becomes.

When more than one condenser is replaced, the total reduction in hum is equal to the product of the individual reductions.

ON THE JOB . . .

Keeping Lapel Microphone in Place

A five-inch square of stiff cardboard or some similar material (through which the microphone cable is threaded) placed in the side pocket of the speaker's jacket will prevent tangling of the lapel



microphone cable and also reduce the pull on the cable.

This device not only divides the pull between the lapel and the pocket, but, since the angle is changed to one more nearly along the direction of the pull, the actual amount of this pull is reduced. This allows the speaker a greater freedom of movement.

•

Color-Coded Resistors and Condensers

Some molded resistors look like small, narrow, mica condensers. These are ordinarily black and are marked with three colored dots. The dot colors are read in proper order the same as the body, end and dot colors on the regular carbon resistors.

Flexible fabric-covered wire-wound resistors are coded the same as carbon resistors. Some have the colors woven into the fabric. The smallest thread color is read as the dot; the larger thread grouping as the end, and the body color as usual.

Molded mica condenser values are expressed in micro-microfarads and also are color coded. A micro-microfarad (mmfd) is one millionth (0.000001) of a microfarad (mfd). To convert mfd to mmfd, move the decimal point six places to the right. To convert mmfd to mfd, move the decimal point six places to the left. For example: 0.00025 mfd is 250 mmfd, or conversely 250 mmfd is 0.00025 mfd. Similarly 0.000051 mfd is 51 mmfd or 51 mmfd is 0.000051 mfd.

On coded mica condensers the capacity in mmfd is marked on the case by three colored dots. The first color indicates the first figure, the second color indicates the second figure and the third color indicates the number of zeros. In order to distinguish the sequence of reading the colors some dots are pointed in the direction to be read, others have an adjacent arrow while some have no clue to the direction but the printing on the case.

Let us consider, by way of example, a condenser having a green, brown and black dot in that order. The green indicates that the first figure is a 5; the brown dot indicates the second figure is 1 and the black dot shows that no zeros should be added. The capacity of the condenser is therefore 51 mmfd or 0.000051 mfd. Similarly a condenser having yellow (first figure 4); red (second figure 2) and brown (1 zero) dots would be 420 mmfd or 0.00042 mfd.

Some condensers have a fourth dot or stripe, as, for example: orange, below the regular three dots. This indicates capacity tolerance—as in this case 3 percent.

All resistors and condensers necessarily are apt to vary somewhat from rated values. Parts are nominally held to plus or minus 10 percent. Some uses permit a wider tolerance of 20 percent. It is for this reason that a resistor or condenser may not measure exactly as it is coded.

Inasmuch as the color coding is universally adopted to cover all resistors and has been extended greatly to cover molded condensers at the risk of repeating, the code is printed below. Every Service Man should memorize the coding so that he can identify the values of the parts marked in code practically at a glance.

The color black represents the figure 0; brown, 1; red, 2; orange, 3; yellow, 4; green, 5; blue, 6; violet, 7; gray, 8, and white, 9.

J. N. Golten, Stewart Warner Corp.

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Radio Rotors

All installations of custom-built Chrysler, DeSoto, Dodge, Plymouth and Packard radios are supposed to be completed without the use of spark-plug suppressors. After following the regular procedure a high noise level may still exist. The final trick in clearing up the noise lies in the building up or lengthening of the rotor in the car's distributor. It is possible to purchase rotors, for these cars, which are already lengthened for this purpose. This eliminates the time and patience needed for a homemade job. These rotors can be obtained at practically any auto-supply dealer with the same serial number as the original shorter ones, but with the addition of an "A" after the number.

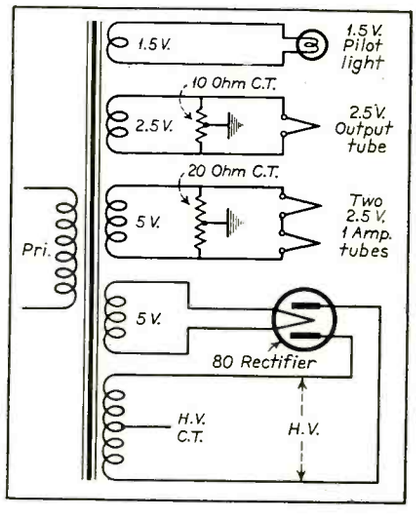
Eugene Triman

•

Using 226 Power Transformers

The older type power transformers designed for use with 226 and 71A type tubes usually hang around the shop their only purpose to collect dust. A profitable use is suggested in the following schematic. All the windings are used to advantage to supply filament and plate power for a four-tube amplifier or radio receiver.

The 1.5-volt winding is used to supply the voltage for a pilot light. Pilot lights with this rating are available at the same cost as the regular bulbs. The 2.5-volt winding on these transformers is usually designed for 1.75 amp for use with a 27 type tube. The more modern type output tubes such as the 2A5 draw only the 1.75 amp. Two 1-ampere 2.5-volt tubes, wired in series across the



5-volt winding originally designed for the 71A's, will not overload that winding. If this 5-volt winding is center-tapped, one tube can be connected across each half of the winding. The other 5-volt winding together with the high-voltage winding is used to operate a type 80 tube to supply plate power for the amplifier.

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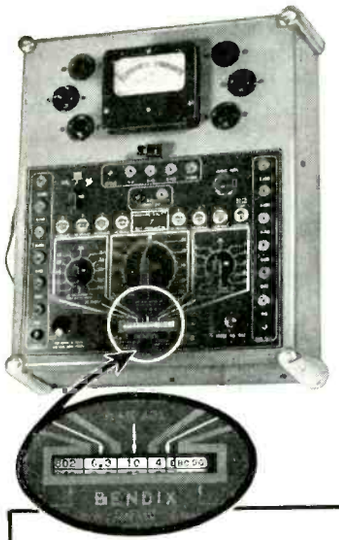

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TEST EQUIPMENT . . .

Triplett 1240 Condenser Checker

A condenser tester must do more than check capacity. In fact measuring capacity in service work is relatively unimportant since the capacity is generally marked on the condenser covering and very soldom changes. Also a shorted or open condenser will throw the circuit out of order making the trouble easy to find with even the simplest test equipment. By far the greatest amount of troubles which occur in condensers are not simple and require specially designed equipment to locate their defects. Intermittent shorts and opens are troubles that are only to familiar; however, a brief review will not be amiss.

Shorts

An intermittent short causes erratic operation, motor-boating, parasitic oscillation, fading and other troubles—the bane of the Service Man's job. An oft used method to remedy this type of trouble has been the cut-and-try substitution of each condenser found in the ailing receiver. Not only is this method tedious but the trouble is never positively cured—it may lie dormant to recur at some future date. To test a condenser for intermittent shorts the checker must have sufficient voltage available to present at least working conditions for the unit under test. For some condensers this will call for 1,000 volts. At these high voltages the condenser may be tested for both breakdown and leakage. Any intermittent short will burn through and the unit will show up as bad.

The short and breakdown test is accomplished in the model 1240 by applying a voltage to the terminals of the condenser under test as shown in Fig. 1. With a leaky condenser across the binding posts the current flows from the selected voltage tap of the transformer through the selector switch to one binding post. From here it passes through the condenser to the rectifier. The current is rectified and passed to the positive meter terminal, through the meter and shunt to the 1,000-ohm resistor, through this resistor and back to the common terminal of the transformer. Thus if the condenser is leaky the current flowing through it will register on the meter. The short-test button is used to complete this circuit and to discharge the condenser when the button is released. With the capacity-test button in the normal position the type 80 tube is placed in the circuit. Pressing this button connects the a-c circuit for the other tests.

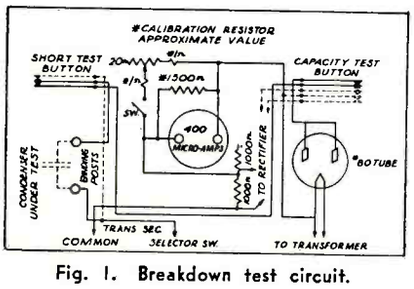

Fig. 1. Breakdown test circuit.

Opens

Intermittently open condensers will also cause erratic operation, motor-boating, parasitic oscillation, fading, etc., and in addition will cause blocking. A test for breakdown followed by a test for an open, using a-c, usually brings

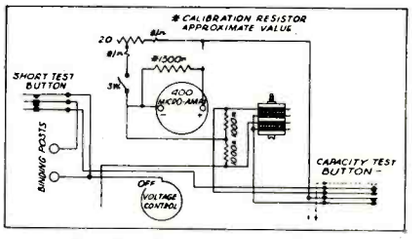

Fig. 2. Capacity test circuit.

this condition to light. Always test paper condensers for shorts or opens with voltages as high or slightly higher than the rated voltage of the condenser. Due to the leakage factor of the electrolytic condenser and the resistance used to protect the meter the voltage never exceeds the safe value of the electrolytic condenser no matter what voltage is applied within the range of the instrument. The circuit used for this test is the same as that used for capacity measurement. To make certain that the volt age and current conditions used during the testing of a unit for opens have not healed the unit temporarily the condenser leads should alternately be subjected to a slight pull and then slight pressure or even a twisting motion. During this procedure the indicating meter should be watched continuously.

Leakages

Condensers with a resistance of about 10 megohms used in critical circuits of the receiver often cause intermittent oscillation rather difficult to lcoate. The tests described above will locate such defects.

The condenser used in blocking circuits which shows a resistance of less than 100 megohms will cause the grid of the amplifier tube to be several volts more positive than that for which the receiver or amplifier was designed. This

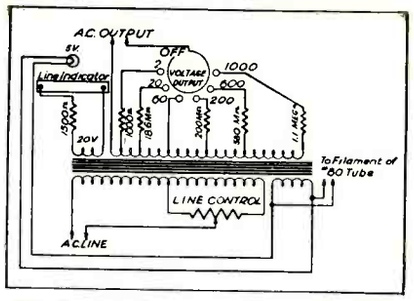

Fig. 3. Transformer circuit Triplett 1240.

naturally upsets the circuit. In high-gain amplifiers these condensers are even more critical. The same is true with avc circuits. The condensers in this type of circuit must have extremely low leakage (high resistance) since the small currents and voltages available in the d-c circuit are very easily upset by the bucking voltage which would be introduced by a leaking condenser.

The d-c leakage of a condenser causes a lower or higher voltage at the tube element and upsets the circuit. It is not possible, however, to set up a fixed resistance for the various functions of the condenser, but the Service Man's knowledge of radio and circuit constants must tell him when to discard. Due to the low resistance and high voltages involved in some by-pass circuits the leakage factor of such condensers can go as low as one megohm without seriously upsetting the circuit.

Capacity

After the above tests have been made on the condenser it may be tested for capacity on the model 1240. The circuit involved is illustrated in Fig. 2. For these tests a-c is applied to the condenser from the transformer. The type 80 rectifier tube is disconnected from the circuit by pressing the capacity-test button. This same button connects a copper-oxide rectifier to the meter for measuring the a-c drop.

Since all the current passes through the meter and the voltage is carefully calibrated it is possible to calibrate the meter directly in microfarads. The introduction of the condenser capacity into the circuit will change the total impedance and hence the current flow. Since the meter is used as a milliammeter is can readily be calibrated directly in capacity by dividing the voltage applied by the impedance of the circuit.

Electrolytic Condensers

It has been shown elsewhere in this issue that the filtering efficiency of a filter condenser depends upon the power factor or phase angle. As the Service Man is primarily interested in the filtering efficiency when testing electrolytics it is necessary that some means be provided to determine the filtering work these units will accomplish.

This is obtained in the model 1240 by

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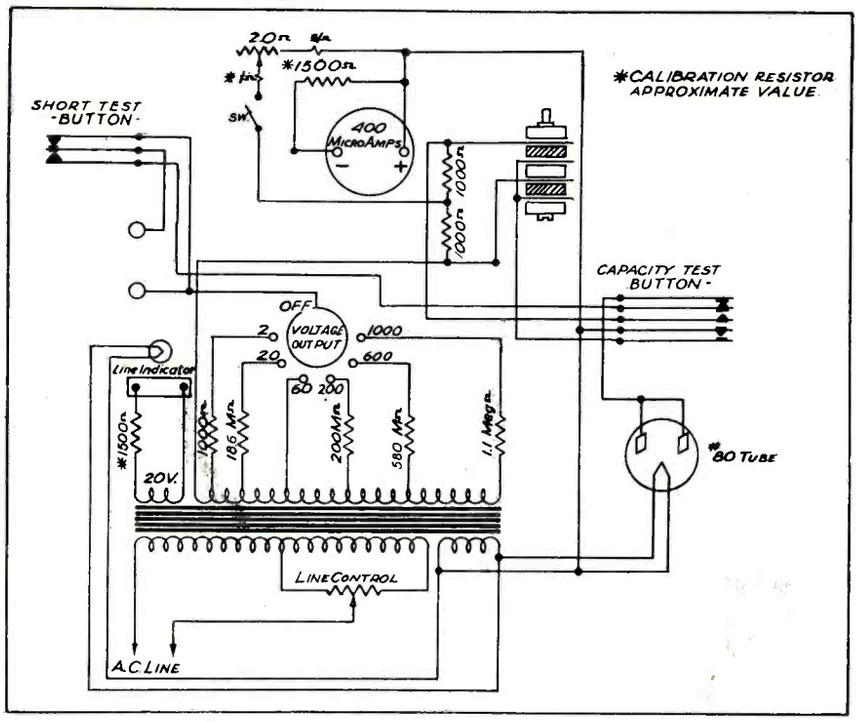

Fig. 4. Triplett 1240 condenser checker circuit.

connecting an unfiltered, half-wave rectified, 60-cycle voltage across the condenser and measuring the reactance of the condenser on the d-c meter scale as either a "Good" or "Bad" condenser.

The Circuit

The model 1240 condenser checker will perform breakdown, open and shorted tests, as well as capacity tests on a single meter. Up to 1,000 volts are available in d-c for breakdown tests, in steps of 2, 20, 60, 200, 600, and 1,000. Alternating voltages are available in the same ranges.

As shown in Fig. 3 voltages are supplied by a power transformer with the necessary windings and a selector switch to choose the proper range. The primary winding is tapped at 97 and 133 volts across which is placed the line-control potentiometer, which is used to set the shadow of the line-control meter directly beneath the red line. The capacity of a condenser can be determined by its reactance or impedance at a known frequency, with a known voltage across its terminals by measuring the alternating current flowing in the circuit. After the circuit has been determined for a given frequency means must be provided so that the voltage applied across the condenser will remain constant irrespective of line-voltage variations.

One secondary on the transformer provides 5 volts to light the filament of the type 80 rectifier tube and the filament of the pilot line-control lamp. Another secondary winding consists of a 1,000-volts, tapped at 2, 20, 60, 200 and 600 for the capacity, breakdown short and leakage tests of paper and electrolytic condensers.

The voltages are controlled and applied to the circuit through the contacts of the seven-position selector switch shown. Resistances are placed in series with these windings to safeguard the meter. When no current flows through the resistors there will be no voltage drop across them and hence, when the condensers have no shorts or leakages the full voltage induced in the secondary will be applied to the condenser. However, if there is a leakage or short current will flow and create a voltage drop across the resistance, thus lowering the voltage applied to the meter to a value which will not injure it.

A type 80 tube is used to rectify this voltage for use in the d-c tests. This tube is shown in Fig. 2.

A complete circuit diagram of the model 1240 condenser checker is shown in Fig. 4.

GENERAL DATA—continued

(k) Adjust the middle trimmer of the second i-f transformer by opening until maximum output is obtained. Do not readjust the top and bottom trimmers.

(l) Adjust the middle trimmer of the first i-f transformer by closing until maximum output is obtained. Do not readjust top and bottom trimmers.

R-F Alignment

The r-f amplifier can best be aligned in the conventional manner, using a modulated signal generator and output meter.

When aligning the r-f amplifier the output lead of the signal generator is connected to the antenna terminal of the receiver. For the blue and red bands a 0.00025 mfd condenser must be connected in series with the output lead of the signal generator and for the high-frequency band a 400-ohm carbon resistor should be used in place of the condenser.

Each band should first be shunt aligned and then series aligned, where provision is made for series alignment (blue and red bands). The band selector switch should be set for the band being aligned and the signal generator should be set to the frequency indicated (c) for each adjustment.

(a) Adjust the "Osc," "R-F" and "Ant" shunt trimmers in the order given for maximum output. Readjust the station selector slightly so that the generator signal is tuned in with maximum output and then check the adjustments of the "R-F" and "Ant" trimmers in the order given. Do not readjust the "Osc" trimmer.

Note: When shunt aligning the red and green bands care must be exercised so that the circuits will be aligned on the fundamental frequency rather than on the image frequency which is approximately 900 kc less than the fundamental. To check on this, increase the output of the signal generator ten times or more and try to tune in the signal both at the generator frequency as indicated on the station selector dial and at approximately 900 kc less than the correct frequency. If the circuits have been properly aligned the signal can be tuned in at both positions but much stronger at the correct position.

(b) To align the series trimmers, 32Y and 32Z Fig. 2, set the signal generator to the frequency indicated below and then tune-in this signal with the station selector for maximum output. At the time that any series trimmer is being adjusted rotate the station selector back and forth slightly until no further improvement in output can be obtained.

(c) Signal input frequencies for alignment follow: blue-band shunt alignment, 1700 kc; series, 600 kc; red-band shunt, 6000 kc; series, 2000 kc; green-band shunt, 18,000 kc; no series alignment.

RECEIVER CASE HISTORIES

Atwater Kent 275 A-C D-C

Inoperative: Check the triple electrolytic condenser (C-14) for open sections if the voltages are low or missing. Often all the sections have been found normal upon test, but the negative connections (which are brought out separately) sometimes short internally causing the speaker field to be shorted.

Howard J. Surbey

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Detrola Warwick Model

Low volume: The 50,000-ohm resistor connecting the plate return of the 58 tube to the screen grids of the 58 and 57 tubes often increases in value, reducing the voltage available for screen supply. A 2-watt resistor of good quality will prevent a recurrence of this increase. *Howard J. Surbey*

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General Electric Focused Tone Models

To Mount Escutcheon: Care should be taken to use a well-ground screwdriver of proper size for fastening the screws used to hold the escutcheon plate. Holes have been jigged in the panel to insure proper location of the escutcheon plate with respect to the scale housing.

To Replace Drive Cable: Remove the drive cable to be replaced. Referring to Fig. 1, rotate drive wheel (14) counterclockwise until condenser plates are open. Place the end of the cable having an eyelet in slot (A). Thread cable as shown, making sure cable passes *over* pin (B), and runs along the *correct* grooves, the looped end hooking over spring (16). Check the position of the drive wheel on the condenser shaft, making sure that the cable coming off the right-hand idler pulley lines up with the grooves in the drive pulley. Also, as the condenser plates become fully closed, the drive wheel (14) should just touch the bushing (D) of the tuning shaft (39). With the drive wheel in this position place the pointer on rail (E) and, with the tip of the pointer on the extreme left-hand scale division, crimp pointer tab on to the drive cable.

To Adjust Pointer for Scale Calibration: Three positions of the dial pointer cable are provided to adjust the pointer up or down scale. The position shown on Fig. 1, with the cable over pin (B), is the medium position. By changing the cable to the position between pins (B) and (C) the pointer may be moved *down* scale. The cable position below pin (C) moves the pointer *up* scale from the medium position.

To Replace Dial Scale: Remove the band change cable (12). Then remove the end support (8) held by a single self-tapping screw and withdraw the scale assembly from the housing. Replace the end caps on the new scale and re-assemble. Before attaching band change cable (12) to the gear (41), the spring (7) should be given two full turns to give the proper tension to the cable.

To Adjust Rotation of Scale: Bend tab (F) up or down to give the correct position of the scale divisions with respect to the pointer tip. The pointer should slightly overlap the divisions.

To Change Pilot Lamps: Be sure the *shipping screw* (G) *is removed.* Lift up the lamp bracket from the tabs under which it is clipped. Care should be taken that the lamp socket leads do not put an undue strain on the drive cable. With the lamp bracket laid back horizontally, the lamps may be replaced. The lamps used in this receiver are the mazda No. 46. When the lamp bracket is re-inserted, care should be taken to avoid the lamp bracket leads fouling the gang-drive mechanism.

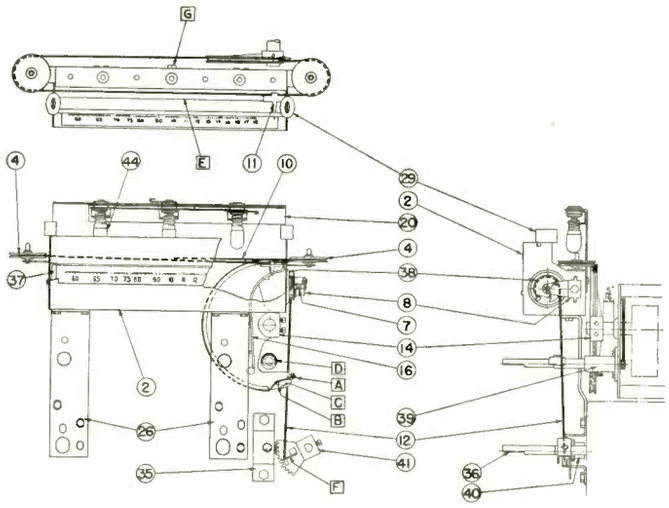

Fig. 1. General Electric focused tone dial.

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Philco 20

Inoperative: No voltage on the plate of the 24 detector tube or on the plate of the 27 tube caused by an open speaker field coil. The coil may often be repaired by resoldering the lead at the point where it attaches to the fine wire of the coil. *Howard J. Surbey*

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Stewart Warner 1495

Insufficient deflection of the tuning eye: Since the narrowing of the shadow in a tuning eye depends on the strength of the receiving signal, it will narrow the most for powerful nearby stations, while on distant stations it will close much less. If a set is used with no aerial or too short an aerial the eye will not close the normal amount.

In all models, if the tuning eye does not close enough and if this is not caused by the above reasons, be sure to check the tubes and the alignment.

In the later production of the model 1495 the circuit was changed slightly to give more deflection of the eye on weaker signals. You can determine whether this change has been made without removing the chassis from the cabinet.

Tune in a local station and then remove the 6H6 tube located next to the 6C5 tube. If the proper tube is removed, the radio signal will get louder or distort. In the latest production sets removing this tube should cause the tuning eye shadow to narrow or disappear. If removing the above 6H6 tube causes the shadow to widen to its full width then the eye is not connected properly.

To correct the wiring remove the chassis from the cabinet and trace the wiring of the tuning eye grid wire. This is the green and white wire in the tuning eye cable and will be found connected to the blank pin terminal on the 6H6 socket located adjacent to the 6C5 tube. Disconnect the green and white tuning eye lead from this terminal. This lead should then be connected to the blank pin terminal on the 6H6 tube located nearest to the 6J7 avc-amplifier tube.

The avc, i-f and broadcast trimmers should be realigned after these changes have been completed.

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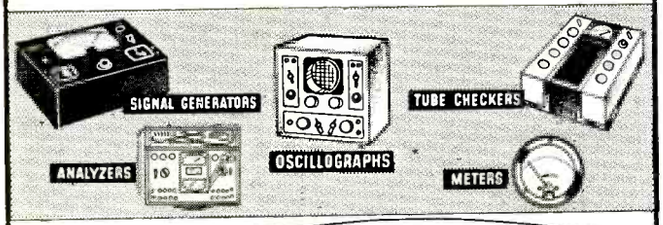

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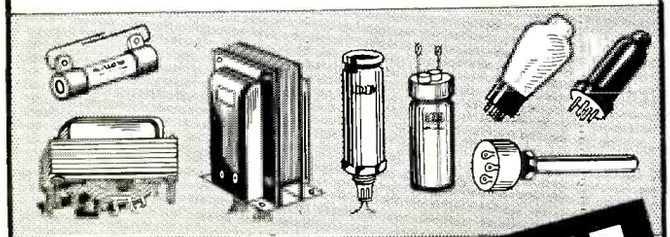

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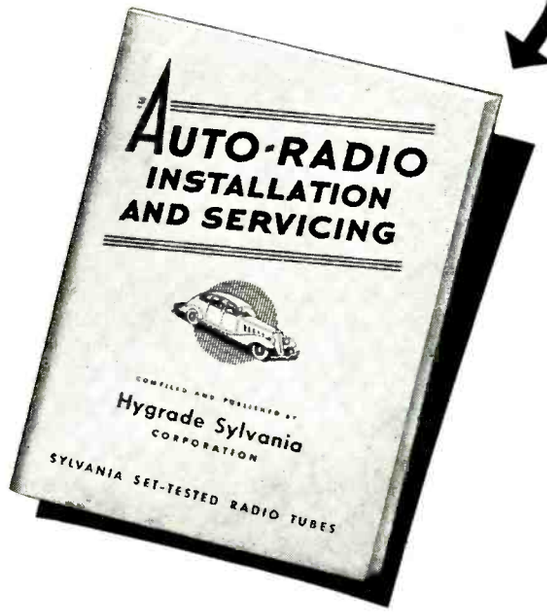

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Stromberg Carlson Models 126, 127, 130 and 140

Replacing dial glass: Dial glasses in early production had cardboard rings cemented to glass for cushioning against the dial pan. Later production used metal shims on bed-plates for point support under clamps. Shims are provided with replacement dial glasses and should be used as instructed.

Remove chassis from cabinet and place on back, with dial up. Loosen four screws allowing clamps to fall away from glass. (Model 140, only) Remove two screws holding center bar. Replace with new glass and center.

Centering dial glass: In some cases, dial glass may slip in transit, throwing receiver off calibration. If calibration is inaccurate at one end, only, of broadcast scale, check for electrical alignment of oscillator rather than dial-glass slippage.

High-frequency discrepancy is caused by shift of oscillator padding condenser and low-frequency discrepancy is caused by shift of oscillator series condenser. If the entire dial scale is off calibration, loosen clamps (and center bar, model 140). Then line up vertical and horizontal centers of glass scale with center marks on the metal dial pan. Dial scale is marked at edge of the glass, but a better alignment can be had by placing a straight-edge along the vertical scale, lining up the arrows on this scale with the center marks on the dial pan.

Replace all clamps (and center bar). Tighten all screws. Check calibration by tuning in several stations at different parts of the dial.

Dial drive (tuning knob) slips: Where a tuning knob rotates without positive drive to the dial check gang condenser against obstructions hindering movement or loosen drive assembly screws and shift drive assembly toward dial discs as far as screw holes will permit. Check dial discs for rubbing or binding against dial pan or replace dial drive if none of above are effective.

Improvements have been made in dial drive assemblies to increase their grip on the dial.

Vernier tuning knob binds or sticks: This usually indicates that vernier knob has been pushed too far on to shaft or that large tuning knob is not far enough on shaft, causing knobs to rub together.

Vernier tuning shaft ineffective or missing: This indicates breakage at welded joint where ball-bearing is welded to end of shaft. New highly tempered ball bearings have permitted stronger weld in recent drive assemblies.

When unpacking receivers shipped in cartons, be sure to lay the radio on its back when drawing it out of the carton, so that all control shafts will clear the packing material.

Tri-focal eye closes or overlaps: Almost without exception, this is due to variations in characteristics of the 6E5 tube, and is corrected by selection of a suitable tube.

First make sure that the 6E5 tube is not "soft" or "gassy," causing a blue glow in the lens of the tube, which can be seen by looking across the tube in a dim light.

Some "hard" tubes are also unsuitable. Any tube drawing in excess of 5-ma plate current *in the receiver circuit* (as measured by a set analyer, not a tube analyzer) should not be used. The percentage of such tubes is rapidly being reduced by the tube manufacturers.

Occasionally the 6E5 tube may be suitable and the difficulty caused by excessive plate current in the 6K7 tube used in the i-f stage.

Tri-focal eye does not close enough: If the shadow on the target of the 6E5 tube does not reduce on nearby signals, check the aerial and ground connections for open lead-in, insufficient pickup, high-resistance joints, etc.

Check sensitivity control knob on rear of chassis (models 130 and 140). Clockwise rotation increases sensitivity. Check for a faulty tube in the r-f system, causing low avc voltage.

Check for a grounded cathode bias resistor at 6K7 r-f or 6K7 i-f socket.

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Stromberg Carlson Labyrinth Models

Loudspeaker rattles: Distortion and rattles in these receivers may be traced to the usual sources, such as foreign particles in speaker: damaged or defective speaker cone; loose voice coil; coil off-center; loose grille cloth.

In addition, check the following: Foreign particles on top of labyrinth, or between labyrinth and cabinet; loose screen over labyrinth exhaust in bottom of cabinet; warped sound-spreading vanes striking against cone or leather.

Speaker rattles may not be the fault of the loudspeaker.

If the screen is loose in the bottom of the cabinet, tack it down so it won't rattle. Its purpose is to keep mice, etc., from nesting in the radio cabinet.

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Stromberg Carlson 140-P

Lack of undistorted phonograph output or acoustic coupling: If distortion, coupling or hum is complained of, or phonograph music distorts at low volume, make certain that the phonograph motor-board floats entirely clear of the cabinet.

Be sure all four mounting screws are loosened and, in excessive cases, remove the motor-board and cushion on live rubber (sponge rubber is best) at center of all four sides. This further damps the motor-board against vibration.

If distortion persists, check for dull or defective phonograph needle; old-style records, not electrical recordings; iron particles on pickup, near needle; damaged pickup head; proper mounting of counter-weight; tone control fully operated, limiting volume.

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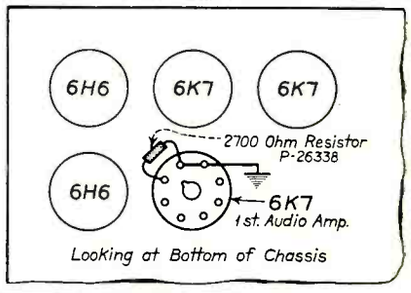
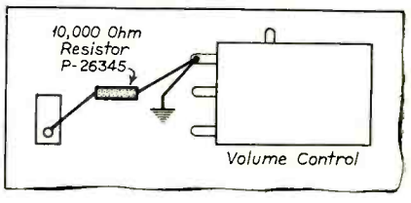
Stromberg Carlson 150 and 160

Improvement in volume control circuit: Variations in characteristics of the 6K7 tube cause some tubes to draw excessive grid current, which may lead to noisy volume control action as the volume knob is rotated; low power output or





overloading, or excessive bass compensation at low volumes.

To prevent this, circuit changes are being incorporated in all of the more recent receivers and the same changes should be made in receivers in the field, where noisy volume control action is observed.

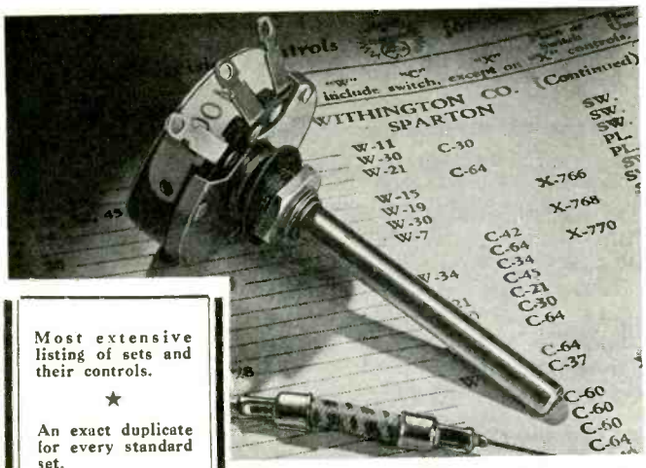
Two changes are made:

(a) Replace the 1,000-ohm bias resistor with one of 2,700 ohms for increased bias.

(b) Connect a 10,000-ohm resistor across the bass compensating capacitor for smoother bass at low volumes. This connection is made from the volume control to a terminal nearby.

These changes are shown in the accompanying diagrams.

Stromberg Carlson Telephone Mfg. Co.



Most extensive listing of sets and their controls.

★

An exact duplicate for every standard set.

★

Wire-wound and composition types.

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Any resistance, taper, taps and shaft.

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External resistor for required bias.

★

Ad-A-Switch snaps on rear of case.

★

Smooth, noiseless, dependable, long-lived.

Exact-Duplicate VOLUME CONTROLS

For repairs that must be *right* mechanically, electrically, visually, use CLAROSTAT Exact-Duplicate Controls. They save time, trouble, money. And they build good will.

FREE MANUAL: Big 80-page Replacement Guide—most extensive listing available—is yours for the asking. Meanwhile, your leading jobber stocks **CLAROSTAT** replacements.

CLAROSTAT
MANUFACTURING CO.
Incorporated
285 North Sixth St.
Brooklyn, N. Y.

NEW

THE latest power amplifier from the McMurdo Silver Sound Laboratories is the brand new 3A unit which delivers 32 watts undistorted (not over 2% total harmonic content), with an overall gain of 46 db. and any input impedance you ever need. Two of these units with two Super-Giant speakers, to which each 3A supplies 32 watts field power, "blew the roof off" the 18,000-seat Chicago Stockyards Auditorium when driven by a small preamplifier (ready now 100 db. gain, no hum, three-channel mixing, and *all* in ⅛ of a cubic foot!).

Whenever you need power equal to over 200 watts into ordinary speakers, one 3A amplifier and one Super-Giant speaker will give it to you at less than 35c. per watt—with broadcast station quality. You can drive one to eight 3A with *one* 76 driver—they need no driving volume—each having a driver stage self-contained. One 6J7 feeding a 3A will give nearly 90 db. gain, draw its operating power from the 3A, and turn out 32 watts of better P.A. quality than you've *ever* heard before.

Quite a lot?—Why not write for the details of this and other up-to-the-minute sound units? Just use a postcard.

McMURDO SILVER CORPORATION
2900-L So. Michigan Blvd. Chicago, Ill.

McMURDO SILVER
MASTERPIECE
RADIOS—AMPLIFIERS

BUSINESS
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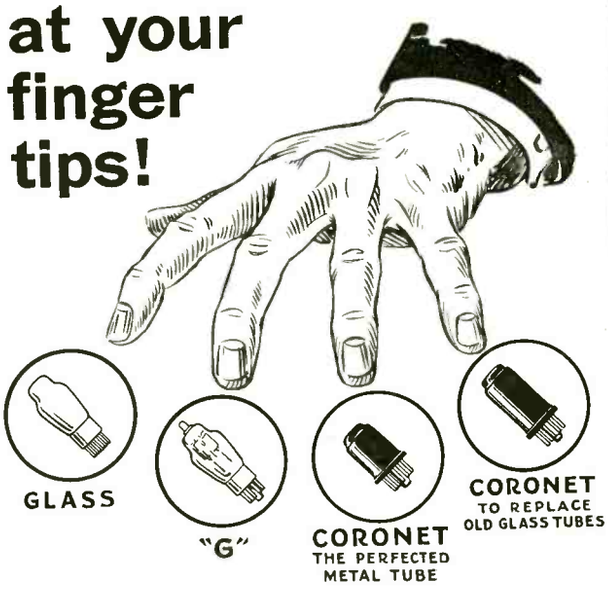

if you sell the ARCTURUS 4-WAY Line

Business is never turned away by the dealer who handles ARCTURUS. For here is the *one* line that enables you to meet the demands of *every* customer—the *only* line that gives you the 4 types of tubes set owners are asking for today!

ARCTURUS has pioneered 7 of the 8 fundamental developments in a.c. tubes. This company has won wide public recognition as a dominant factor in the quality field. And ARCTURUS alone provides a 4-way sales and profit set-up.

See your Arcturus Jobber or write today for full details.

ARCTURUS RADIO TUBE CO., NEWARK, N.J.

ARCTURUS

GLASS—"G"
CORONET—The Perfected Metal
RADIO TUBES

ASSOCIATION NEWS . . .

CLEVELAND CHAPTER IRSM

Our Fourth Annual Show is now history and will probably go down in the records as our most successful one (to date). In spite of the fact that we opened the day after Hallowe'en and closed the night before election, the attendance was within two hundred of our previous high in registration.

Then, too, it rained and when it rains it pours here. John Rider, who was due to speak on Sunday night, was grounded (his plane) at Kylertown, Pa. That didn't stop hizzoner, though—he was able to get to a phone. The Cleveland gang rewired a telephone switchboard in the hotel to make proper hookup to the p-a system in the auditorium and everything was okay. In spite of considerable mismatching in line and input equipment (John was using an old-fashioned side-wind wall phone) the lecture came through remarkably clear and distinct. The unusual hookup set the assembled gang on their ears and proved to be one of the highlights of the show.

Earlier in the afternoon and evening on Sunday several other speakers added to the interest of the meeting. Bob Herzog, Editor of SERVICE, opened the technical sessions with a discussion of "Noise Reducing Antenna Systems." Floyd Wenger of Triplett Electrical Instrument Company, demonstrated the uses of the vacuum tube voltmeter in the servicing of radio receivers. Mr. Jenkins of the Weston Electrical Instrument Company lectured on "Supersensitive Instruments for Present Day Service Work." The welcome address by Al Theriault, Chairman of the Cleveland group, and the Wirephoto Demonstration led up to the dramatic address by John Rider as mentioned above.

Monday's session included a discussion of "Automatic Frequency Control" by Ernie Koehler, Engineer of Ken-Rad Radio Tube and Lamp Company; a continuation of the Wirephoto Demonstration; A talk on "Trouble Shooting with Cathode Ray Equipment" by Walter Weiss, Engineer of Hickok Electrical Instrument Company, and the RCA Victor Service School conducted by Paul Smith of the RCA factory.

Numerous prizes were distributed at the sessions and in the auditorium. The technical talks were well attended and it was long after midnight before the place was clear of Service Men.

L. Vangunten, Sec'y.

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WASHINGTON CHAPTER IRSM

The Washington Chapter of the Institute of Radio Service Men held a regular meeting Thursday, October 22, at 1413 Park Road, N. W. Washington, D. C.

Don Craig of the Weston Electrical Instrument Corporation demonstrated the latest Weston equipment, describing its use in modern complex service work.

Bob Herzog, Editor of SERVICE, spoke on "Receiver Circuits"—explaining the function and relative value of each constant in the radio receiver.

A year's subscription to SERVICE was awarded as a door prize.

G. G. Larkin, Secy.

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MARYLAND RADIO SERVICE ASSN., INC.

A regular business meeting starting at 8:00 P. M., Friday, October 30, was held by the Maryland Radio Service Association, Inc., at the New Howard Hotel. After the business meeting interesting sound movies were shown and Mr. Henry Hickman, WFBR's Inquiring Reporter, gave a short talk on "Building Good Will."

Wm. A. Thompson, Secy.

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RADIO TECHNICIANS GUILD

Al Saunders is trying to prove that Providence Jake O'Leary can't put him under the table. (But we'll bet that Provost can).

We understand that the Hotel Lenox had to remodel the place to take care of the next R. T. G. Exposition—that's what we call looking ahead.

That electrical wizard from New Bedford, "Tarzan" Ted Kurgan, is another one of them there guys what has done a fadeout. Maybe he has holed in for the winter.

The way Frank Kennes and Farn Harling are boasting about their new families, we would think that it's dangerous territory out where they live.

We've got to take our hats off to Arthur Mayer, of the A. W. Mayer Co., for his interest in the Service Men. You boys really ought to look him up.

The above goes for Mr. Childs of the Electrical Supply Co., also.

Wonder if Sig Malo got out his overshoes yet in preparation for the coming winter. It seems he went for a slide last winter, and is death against the N. E. climate. (Seattle papers please copy.)

Joe "Chuckle" Cabral has taken the R. T. G. so seriously that he even dreams about it. The rest of "youse guys" ought to take a few lessons from "Chuckle."

For the benefit of those who are not affiliated with any service organization, we would advise that you hook up with one of your local Service Men's clubs, be it the R. T. G. or any other outfit. You will need their assistance now with so much new stuff coming into being.

George Feldman, Secy.

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RADIO SERVICE ASSN. OF CALIFORNIA

Perhaps other organizations would be interested in the way our meetings are conducted. We have found over a period of about five years that it is almost impossible to thresh out business matters at our regular meetings and still be able to hear the speakers, so this important task is delegated to, and carried out by, our executive board who meet for this purpose twice each month.

Because of the diversified interests represented, we confine our activities almost entirely to education and entertainment. At *each session* we have, in addition to a guest speaker, two fifteen-minute speakers appointed by the chair, from the membership, who talk on some subject of their own choosing. This is understood to be mandatory and has proven very satisfactory in that it gives everyone an opportunity to be heard and has uncovered some surprisingly good speakers.

We point with pardonable pride to an accomplishment sponsored and carried out by our organization under Carl Penther (then president) of having afforded all interested parties the opportunity of attending a class in radio communication conducted by Dr. Ruekema, professor of Electrical Engineering at the University of California. This attracted an opening attendance of some 300 and continued weekly for 18 months at which time 150 were still regular students. Dr. Ruekema, by the way, is a member of our association and a frequent guest speaker with a never ending choice of interesting and enlightening subjects on which to speak.

Herman A. Schmidt, Pres.

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RADIO SERVICE ENGINEERS ASSOCIATION, INC.

On the evening of October 27, at the Essex House, Newark, N. J., the Radio Service Engineers Association, Inc., held a regular meeting. Those present (including a group from distant Staten Island, N. Y.) were amply repaid for the time spent. Matty Hughes presided and introduced the guests of the evening—service engineers from the Emerson Radio and Television Corp. The gentlemen from Emerson not only presented a complete description of the new Emerson line but also distributed circuit diagrams and other service information.

A unique Service Forum was introduced and, from the enthusiastic response, promises to become one of the outstanding features of our new independent organization.

At the present writing we are looking forward to our next meeting to be held at the Essex House on November 10. A representative of the Philco Radio and Television Corp. will describe automatic frequency control.

Ralph Roe, Secretary

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NEW YORK CHAPTER NRIAA

The members of the New York Chapter are urged to attend the future meetings of the Chapter. The program committee has arranged a series of surprises. Every Service Man can be assured that his time will be well spent.

The regular meeting dates are the first and third Thursday of each month. The meetings are held at 12 St. Marks Place, New York City.

Allen Arndt, Chairman

HIGHLIGHTS . . .

NATIONAL UNION APPOINTMENT

National Union Radio Corp. announced this week the appointment of J. H. Robinson as Director of New Products Research. Mr. Robinson assumes the new title and duties, in addition to his regular work as Export Manager.

It is said that Mr. Robinson has been assigned the task of seeking out and analyzing the marketability of new products, patents and ideas having to do with radio, electronics, television and electrical industries.

Inventors are invited to correspond in strict confidence with Mr. Robinson, care National Union Radio Corp., 570 Lexington Ave., New York, N. Y. It is the belief of the National Union organization that an era of great development and advancement is at hand and they are prepared to encourage the promotion of new practicable ideas.

•

SHURE CATALOG

A 6-page 1937 catalog of microphones and accessories has been issued by Shure Brothers, 225 W. Huron St., Chicago. Copies are available upon request.

Among the latest additions to the Shure line shown in this catalog are the "Ultra"-wide-range crystal microphones, in spherical, swivel and "Grille-type" models, the model 85A high-fidelity sound-cell type crystal microphone, and a series of crystal and carbon microphones with 4-way utility features.

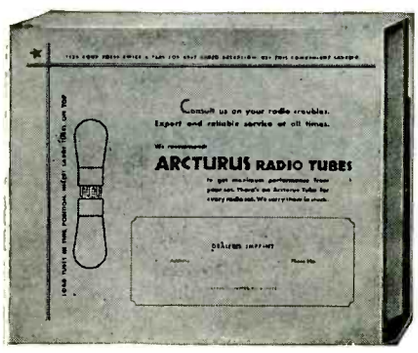
•

ARCTURUS CARRYING CASE

To help dealers and Service Men increase their tube sales, the Arcturus Radio Tube Company, Newark, N. J., has made available to the trade a cardboard carrying case for consumer's use in bringing complete sets of tubes to the store for testing.

This case comes flat and requires no assembling. Opening like a shopping bag, it contains compartments to hold ten tubes.

Space is provided for the dealer's imprint, making this case suitable as a business card or mailing piece for dealers. With the dealer's imprint, these Arcturus cases are available at a low price through Arcturus Distributors.



MANUFACTURERS REPRESENTATIVES

WHEN MANUFACTURERS of radio parts and accessories require representation in various parts of the country, they usually ask SERVICE for recommendations. Such requests have been especially numerous of late. As a result SERVICE is endeavoring to bring its lists up-to-the-minute. Representatives are urged to send a complete record of their territory and lines to SERVICE Magazine, 19 East 47th Street, New York City. With complete data on hand SERVICE may be instrumental in increasing the number of lines of many representatives.

AUDAK BROCHURE

A brochure entitled "Pickup Facts" has been released by the Audak Company, 500 Fifth Avenue, New York City. This booklet contains a treatise on Relayed-Frequency Pickups which is said to be of interest to every broadcast and sound engineer. Illustrations and details of the entire Audax line of pickups, which are built on the magneto-induction principle, are also included. Audak will mail a copy of "Pickup Facts" upon request.

•

AMPLIFIER CO. BOOKLET

A booklet illustrating and describing the ACA Citation Series Gold Medal amplifiers has been prepared by the Amplifier Co. of America, 39 West 20th St., New York City. It's full of data for public address and sound engineers. Copies may be had by writing to the manufacturer.

•

CONTINENTAL MOTORS REPRESENTATIVE

Continental Motors Corp., Detroit, Mich., announces the appointment of John J. Kopple, 60 E. 42 St., New York City, as Eastern District Sales Representative. Mr. Kopple will handle "Tiny Tim" portable battery charger and lighting plant, "Perm-O-Flux" permanent magnet dynamic speakers and "Kleen-Aire" portable air conditioner.

•

"KENYON ENGINEERING NEWS"

Vol. 1, No. 1 of *Kenyon Engineering News* will make its appearance at an early date. This monthly publication, which will be edited by J. B. Carter, is to be devoted entirely to the amateur, sound technician and experimenter. The first issue will feature, among other things, the following: a new combination mixer and preamplifier; tone equalization; audio amplifiers; modulation improvements in transmitters, and four handy engineering data charts, known as Ken-O-Grafs.

Kenyon Engineering News is published by the Kenyon Transformer Company, 840 Barry Street, New York, N. Y.

CURTIS CATALOG

The Curtis Condenser Corp., 3088 W. 106th St., Cleveland, Ohio, have published a catalog of their filter, by-pass and replacement condensers. Copies may had by writing directly to the manufacturer.

•

WEBSTER-CHICAGO APPOINTMENT

R. M. Gray (Rocky) has been appointed sales manager of Webster-Chicago.

Rocky is one of the best informed individuals in the sound-sales field, having been in sound work since 1929, and from 1931 to 1932 was manager of the parts and sound division of Silver Marshall, Inc. From the spring of 1933 until December, 1934, he supervised installation and operation of all p-a equipment at the Century of Progress, Chicago.

•

U. S. TRANSMITTER CORP.

Rocke International Electric Corp., 100 Varick St., New York City, announces the formation of the U. S. Transmitter Corp., an organization manufacturing all types of communication apparatus. Transmitters, receivers and amplifiers for the government and export market are now being manufactured at their plant, 75 Crosby St., New York City.

A. Pleasanton is plant manager. Frank Edmonds is chief engineer.

•

TERRA FIRMA LEON

One of the best customers the commercial airlines boast of is busy Leon L. Adelman, sales manager of the Cornell-Dubilier Corp., So. Plainfield, N. J. During the last two months, however, the flying personnel have missed Leon's smiling features. Result—personal cards from pilot pals (a couple from pretty hostesses, too), which called for an explanation.

Leon has been practically tied to his desk for more than 90 days. Both New York and Plainfield plants of the Cornell-Dubilier Corp. are said to be operating at full capacity and production of C-D condensers has reached 60 per cent above the peak of 1935.

THE MANUFACTURERS . . .

ARCTURUS 25B5 AND 25N6G

The Arcturus Radio Tube Co., Newark, N. J., has added to its line the 25B5 and its octal base counterpart, the 25N6-G. This is a duplex-triode power output tube particularly designed for a-c, d-c sets.

As a single ended Class A amplifier with 110 volts d-c supply, this tube will develop 2 watts of audio at 9 percent total harmonic distortion, about twice the output available from other pentode tubes in a-c, d-c circuits.

The tube operates without C bias, obviating the need for bias resistor with its necessary filter network. Because the grid does not draw current since an automatic bias is applied within the tube, the input impedance is high and the tube needs no special driving equipment such as is necessary for Class B operation.

The resultant reduction in cost of parts and the simplicity of its circuit recommends this tube as well in large receivers where greater power is desired by conventional push-pull operation.

•

SHIELDED TEST ROOM

The need for accurate information on the construction of an effective shielded test room, in which the Service Man may fully utilize modern test equipment without interference from strong local fields of either man-made static or broadcasting stations, is met by a set of specifications just issued by the Tobe Deutschman Corp., Filterette Division, Canton, Mass.

These specifications show the construction of a shielded test room approximately 6-ft. square, and enable the Service Man or any local builder to construct the shielded room without difficulty.

•

SOLAR REPLACEMENT LINE

An expanded exact replacement line is announced by Solar Mfg. Corp., 599 Broadway, New York City. Many of the types used in the current receiver models, such as the universal cardboard-tube units with

various mounting arrangements, are included in the line.

The quality of these replacements is equal to that found in other Solar products.

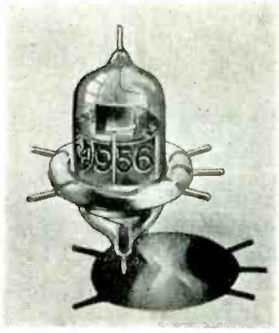
Literature will be furnished by Solar Mfg. Corp. upon request.

RCA-956

RCA-956 is a heater-cathode tube of the remote cut-off type for use by radio amateurs and experimenters as a radio- and intermediate-frequency amplifier, or mixer, in receivers operating at wave lengths as low as 0.7 meter.

The super-control feature of the 956 makes the tube effective in reducing cross-modulation and modulation-distortion over the entire range of received signals. This feature also makes the tube well adapted to circuits incorporating automatic volume control, without the necessity for using local-distance switches or antenna potentiometers.

At a wavelength of one meter, the 956 is capable of giving a gain of four or more when it is used as an r-f amplifier in circuits of conventional design. Higher gains are, of course, attainable at longer wavelengths. Operation at short wavelengths is made possible by means of an unconventional tube structure having small size, close electrode spacing and short terminal connections.



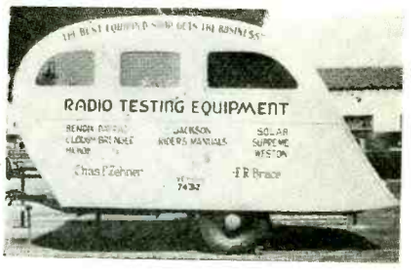
Tentative Characteristics

Heater voltage (ac or dc)	6.3	volts
Heater current	0.15	ampere
Plate voltage	250 max.	volts
Screen voltage	100 max.	volts
Grid voltage (min.)	—3	volts
Suppressor	Connected to cathode at socket	
Plate current	5.5	ma
Screen current	1.8	ma
Plate Resistance	0.8	megohm
Amplification factor	1,440	
Mutual conductance	1,800	micromhos
Mutual conductance (at —45 volts bias)	2	micromhos
Grid-plate capacitance (with shield-baffle)	0.007 max.	mmfd
Input capacitance	2.7	mmfd
Output capacitance	3.5	mmfd

The 956 may be held by means of a special socket or by means of a mounting using the clips supplied with each tube. The two small clips are for the control grid and the plate terminal at the bottom and top of the bulb, respectively.

TEST EQUIPMENT TRAILER

Chas. F. Zehner, manufacturers' representative, 5718 Keniston Ave., Los Angeles, Cal., uses the trailer shown in the



accompanying illustration to demonstrate radio test equipment to Service Men.

•

OPERADIO PRE-AMPLIFIER

The Operadio model 660 a-c operated microphone pre-amplifier is designed to mix two microphones of the velocity or grille type of crystal. It has an overall gain of 65 db with a low hum level. Electronic mixing of the microphones is provided with a tone control for shading.

The 660 is a two-stage amplifier with first stage tubes cushion mounted to decrease microphonics. The entire unit is housed in a steel carrying case with provision for plug-in connections at the input and output. Two units may be used together to form a four-position electronic mixer and pre-amplifier.

Additional information can be obtained from the Operadio Manufacturing Co., St. Charles, Ill.

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TURNER MICROPHONE

The model VT-73 is a crystal microphone being announced by The Turner Co.

This microphone has been designed to have suitable response for voice transmission. The output level is higher than on previous models.

Several new constructional features insure the microphone against adverse climatic conditions.

•

MEISSNER COIL ASSEMBLY

The Meissner Manufacturing Co., Mt. Carmel, Ill., has announced an all-wave coil assembly with air-dielectric trimmer condensers. Separate coils are used for each band in each stage. The coils are mounted directly on the band switch, with the coil terminal lugs serving as the connection and support. The assembly is designed to operate with a three-gang 410-mmfd condenser and 456-kc i-f transformers.

Additional information may be obtained from the manufacturer.

CONTINENTAL CARBON FILTERNOYS

The three different types of Continental Carbon noise elimination devices known respectively as Filternoys Rejectors for use between a radio receiver and the power supply line; Filternoys Diverters consisting of pure capacity units for connection across the power supply line and Filternoys Suppressors for use on equipment causing interference will be marketed by Continental Carbon, Inc., 13912 Lorain Ave., Cleveland, Ohio.

A booklet containing full information can be obtained by writing directly to the manufacturer.

•

POWERTONE VOLT-OHMMETER

The Powertone Electric Co., 179 Greenwich St., New York City, announce their model 801 volt-ohmmeter. The 801 is built in a 5- by 3- by 2-in. metal case and contains a 3-in. 1,000-ohm-per-volt meter.

Additional descriptive material can be obtained by writing to the manufacturer.

•

RAYTHEON TYPE 6H5

The 6H5 high-vacuum, tuning-indicator tube is designed to visually indicate the effect of changing the control grid bias. The 6H5 is similar to the 6G5 except that the current to the target is controlled by a grid tied to the cathode within the tube instead of by emission saturation as in the 6G5. The addition of this grid causes a fixed 90° shadow to appear on the screen opposite the controlled shadow.

Additional information as well as characteristics of the new tube can be obtained from the Raytheon Production Corp., 420 Lexington Ave., New York City.

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TRIUMPH INSTRUMENTS

The Triumph Manufacturing Co., 4017 W. Lake St., Chicago, has developed three new instruments. A 20-ounce pocket size volt-ohmmeter with a selective range switch and direct-reading scales designed around a bakelite-cased 50-mv meter; a 30 feature a-c signal generator calibrated from 100 kc to 75 mc and a multirange meter comprise the new additions.

More complete descriptions as well as electrical specifications can be obtained from the manufacturer.

•

TRIAD FREE TUBE

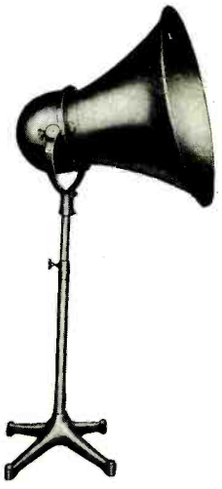
A radio-tube merchandising plan, announced by Triad, makes it possible for Service Men and dealers to obtain one free Triad tube. By distributing a great number of free tubes the Triad Manufacturing Co. expects to awaken the interest of dealers and Service Men to the profit possibilities of Triad tubes.

Additional details can be obtained directly from the manufacturer.

FOX BAFFLE HORN

Announcement of the Fox B-5 universal baffle type horn is made by The Fox Sound Equipment Corp., Toledo, Ohio.

Any standard 12-inch speaker can be



used. The horn is supported by a sturdy adjustable cradle complete with lock-screw adjustment.

The bell is made of Fox special alloy horn material and is designed for utmost ouput. The cast-aluminum throat collar reinforces the entire assembly, forming a foundation for speaker mounting and cradle.

The back cover is of heavy horn material and has an air by-pass so that the speaker can breathe. The B-5 is finished in standard aluminum gloss or special Fox wrinkle and is complete with adjustable stand.

•

WESTERN ELECTRIC 316A

The 316A vacuum tube, recently announced by the Western Electric Company, is shown in an accompanying illustration.

This tube, a filamentary air-cooled triode, is for use by experimenters and amateurs, and is suitable for ultra-high-frequency oscillator and amplifier applications, the frequency limit being 750 megacycles (approx. 0.4 meter).

As will be noticed no base is provided for the 316A. The grid, plate and filament leads are tungsten rods projecting from a flat face of the bulb, and the tube may be supported by these leads, providing flexibility is maintained so that no glass strains are produced. The nominal filament voltage is 2.0 volts, a-c or d-c, the nominal filament current is 3.65 amperes, and the average thermionic emission is 0.4 ampere.

The following performance data are based upon a typical tube and variations can be expected with different tubes of this type and with different circuits.

Average Characteristics at maximum direct plate voltage and dissipation (E_b = 450 volts, I_b = 67 millamperes).

Amplification factor	6.5
Plate resistance	2,700 ohms
Grid-to-plate transconductance	2,400 micromhos

Average Direct Interelectrode Capacitances

Plate-to-grid	1.6 mmfd
Grid-to-filament	1.2 mmfd
Plate-to-filament	0.8 mmfd

OPERATION

Maximum Ratings

Max, direct plate voltage	450 volts
Max. direct plate current.	80 ma
Max. direct grid current.	12 ma
Max. plate dissipation	30 watts

R-F Oscillator or Amplifier—Unmodulated

Max, direct plate voltage	450 volts
Max. direct plate current.	80 ma
Max. direct grid current.	12 ma
Nominal power output at 500 mc	7.5 watts

R-F Oscillator or Amplifier—Plate Modulated

Max, direct plate voltage	400 volts
Max. direct plate current.	80 ma
Max. direct grid current.	12 ma
Nominal carrier power at 500 mc	6.5 watts

The following table indicates the nominal output obtainable from the 316A as an unmodulated oscillator with an input of 400 volts and 80 ma d-c.

Frequency—mc	*Power Output—watts*
300	8.5
400	8.0
500	6.5
600	4.0
750	limit of oscillation

When the 316A tube is used at frequencies above 300 mc, several precautions must be observed in circuit design in order to obtain good efficiency. It is necessary to provide tuning in the filament to ground circuit. The use of adjustable concentric lines of approximately ¼ wavelength for each filament lead is probably the most satisfactory method. It is also desirable to avoid the use of dielectric material as much as possible and to confine that which is necessary for mounting circuit elements to points of low r-f voltage. The grid and plate supply leads should be connected at nodal points if possible.

WESTON LINE DESCRIBED

The complete line of Weston radio servicing instruments, including the new Model 772 analyzer which operates at a sensitivity of 20,000 ohms-per-volt, are described and illustrated in a new folder published by the Weston Electrical Instrument Corporation, Newark, N. J. Specifications for sixteen fundamental test instruments each designed to meet the requirements of some particular phase of service work, are included in the folder. The instruments described not only permit analysis of modern receivers and their component parts, but extend dependable direct-reading measurement to many other types of electronic circuits and equipment—television, public-address system, talking picture recording, and the like.

Fields of application, ranges, operating characteristics, size and price are shown for each instrument, thus providing the basis for selecting a coordinated group to meet specific needs. In addition, the new models are described point-by-point, with emphasis on features of design essential for servicing present and future receivers of increasing complexity.

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AUTO RADIO TESTING

The accompanying illustration shows an auto-radio Service Man making a complete diagnosis of a sick car radio as the owner watches. A Bendix Day-Rad (Model 200) radio testing device is being used. This unit—as well as a complete Day-Rad line of similar instruments—is the latest member of the large family of Bendix manufactured devices. This Day-Rad also tests a car's ignition

system and gives data upon modern radio tubes.

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ALADDIN TRANSFORMERS

A new series of Polyiron-core i-f transformers has been made available by Aladdin Radio Industries, Inc., 466 W. Superior Street, Chicago, Ill. These transformers are tuned by means of movable Polyiron cores, the resonant circuits being completed by high-quality fixed condensers. The gain and selectivity of the units are said to be entirely adequate for present-day requirements.

•

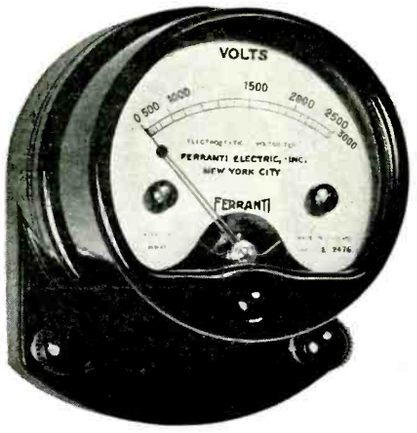
MUTER ZIPOHM

Zipohm, a wire-wound replacement resistor, designed for Service Men, is available in 5- and 10-watt sizes. This unit is noiseless, compact, accurate and impregnated with waterproof cement. Each resistor value is marked with an aluminum tag. The Zipohm Servicemen's Kit contains 57 units in 27 different values which have been selected from frequency charts to cover 80 per cent of average requirements. The Muter Co., 1255 S. Michigan Ave., Chicago, has prepared a bulletin giv-

ing complete details, which is available upon request.

FERRANTI R-F VOLTMETER

A new Ferranti instrument with a full-



scale reading of 3,000 volts and a (full-scale) capacitance of only 8 mmfd can be connected across r-f circuits up to 1,500 kc. Ten different full-scale readings of from 150 to 3,500 volts are available. Three models can be obtained: portable, projecting or flush, in 2½ in., 3¼ in. or 4 in. dials.

Complete description can be obtained by writing to Ferranti Electric, Inc., 30 Rockefeller Plaza, New York City.

HIGHLIGHTS—*Continued*

RIDER'S VOLUME VII INDEX

Time and again you may find it necessary to identify a receiver when you do not know the model number but have established the chassis nummer. In previous editions of the Rider Manual Index, the chassis number was always associated with the model number and oftentimes its presence in the index was completely missed. Each and every chassis number shown in the seven Rider Manuals is separately listed in numerical or alphabetical sequence, in addition to the regular listing of the receiver model number.

Another problem has been solved at considerable expense. Specific reference is made to manufacturers who have identified some of their chassis by certain model numbers, but never released any data concerning these models. Investigation during the past year disclosed that in many cases these specific models were identical in circuit arrangements to other models, but did not bear such identifying data. Rider has been successful in securing the required information from the manufacturers and this material is also identified in the Volume VII index.

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CENTRALAB CATALOG

A new catalog of controls, resistors and selector switches has been received from Centralab, 900 E. Keefe Ave., Milwaukee, Wis. Among the many items listed will be found the new Isolantite-insulated switches recently developed by Centralab, and a complete list of replacement volume controls.

GHIRARDI SERVICE DATA

A new service for Service Men is announced by Radio & Technical Publishing Co. in connection with the second revised edition of Ghirardi's "Radio Field Service Data." Supplement sheets will be issued periodically to keep the data up to date. The new edition of the book is in loose-leaf form to accommodate the supplements as they are issued.

The edition contains 436 pages, 81 diagrams, including 62 electrical wiring diagrams of automobiles, 27 data charts and tables, the i-f peak listings for 5,226 superhet receivers (representing the sets of 154 different manufacturers), etc. All sections of the book have been enlarged and revised—the new book is twice as large as the old one. A circular describing the contents of this latest "Ghirardi" book in more detail may be obtained by writing Radio & Technical Publishing Co., 45-S Astor Pl., New York, N. Y.

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AEROVOX CATALOG

An enlarged and revised catalog has just been issued by Aerovox Corporation, 70 Washington St., Brooklyn, N. Y., and is now ready for distribution. Known as the Second Edition 1936 Catalog, this literature covers an extensive line of condensers and resistors for radio and allied applications. Many new condensers are announced. A copy of the catalog may be obtained from the local Aerovox jobber or by writing the company direct.

ANNOUNCING
The New Fox B-5 Universal Baffle Type Horn

Outstanding features:

Quality construction.
Completely universal in directional characteristics.
Supported by a sturdy adjustable cradle complete with lock screw adjustment.
The Bell is made of FOX special alloy horn material and is correctly designed for utmost output.
The cast aluminum throat collar reinforces the entire assembly, forming a perfect foundation for speaker mounting and cradle.
All standard 12-inch speakers can be used.
The Back Cover is of heavy horn material and has the proper air by-pass so that the speaker can breathe, thus eliminating distortion.
Available complete with adjustable stand.
A perfect combination for indoor or outdoor work.
Finished in standard aluminum gloss or Fox special wrinkle.

Write for catalog sheets and prices.

FOX SOUND EQUIPMENT CORP.
3121 Monroe Street — Toledo, Ohio

ELECTRO-VOICE

Public Address men, everywhere, are standardizing on ELECTRO-VOICE microphones. Constant improvement resulting from unceasing research keeps this line ahead of the field. When you buy an ELECTRO-VOICE product, you buy the latest in engineering design.

Six Velocity models priced from $19.50 to $75.00 list. Carried in stock by leading distributors.

ELECTRO-VOICE MFG. CO., INC.
332 E. Colfax Ave., South Bend, Ind.
Export Office: 100 Varick St., New York, N. Y.

POWERTONE

Model 801 Volt-Ohmmeter

A sensitive, compact, and accurate volt-ohmmeter that in all probability will be the busiest piece of test equipment in your shop or out on jobs. Slips easily into the side pocket of your coat. D.C. Voltage readings 0-5-50-500-1000. Resistance readings from ½ to 500 and 200 to 500,000 ohms. Will also read from 0-1 Ma. Meter has 1000 ohms per volt sensitivity. Battery is self contained. Panel clearly engraved. Compensator provided for zero adjustment.

NET DEALERS PRICE With Battery **$5.75**

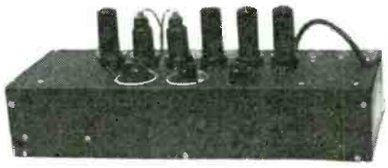
Send for Illustrated circular of POWERTONE test equipment.

Distributor: TRY-MO RADIO, 85 Cortlandt Street, New York City

POWERTONE ELECTRIC COMPANY
179 GREENWICH STREET — NEW YORK CITY

NEW SERIES METAL TUBE AMPLIFIERS

SSI — SOUND SYSTEMS, INC.



PA-7-C

FLEXIBILITY *PLUS*

Each "SSI" amplifier from 7 to 50 Watts is offered in from three to five models to meet every need of the dealer or ultimate user for permanent or portable installation.

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RADIO AMATEUR CALL BOOK

is the only publication listing all radio amateurs throughout the entire world.

It also includes a complete list of High Frequency Commercial Stations, International Abbreviations and "Q" Signals, High Frequency Press and Weather Schedules, "Q", "R" and "T" Signals, U.S. Radio Inspection Districts, International Prefixes.

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NEW ALL WAVE ANTENNA KIT with unusual features

Here is an all-wave antenna kit that really will improve your reception because it has been factory connected and soldered to eliminate incorrect and poor connections.

FEATURES include: Easy to Install. Antenna Transformer matches impedance to transmission. No signal loss in transmission to receiver coupler. No switching for s.w. or broadcast. 2 Models:
No. 375—All Wave Antenna ..... $4.25 ea. list
No. 376—All Wave Antenna for sets with built-in aerial selector ..... $3.50 ea. list

See your jobber. If he cannot supply you, write direct to Dept. S-11.

BIRNBACH RADIO CO. INC.
145 HUDSON ST. BIRCO NEW YORK, N. Y.

NEW ZIPOHM

A SUPERIOR WIRE WOUND REPLACEMENT RESISTOR

PIN THIS AD TO YOUR LETTERHEAD AND MAIL FOR COMPLETE DETAILS

Servicemen—learn the advantages of this new, different and superior resistor. It's flat, taking less room—noiseless — cement impregnated — equipped with adjustable leads. Zipohms are made in all standard values, clearly marked. Write for Special Introductory Kit offer today.

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AUTOMOBILE

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CANADA: ATLAS RADIO CORP., TORONTO, ONT
FOREIGN: LINCOLN EXPORT CO., N. Y.

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Ward Bldg. - Cleveland, O.
Send information of Ward's 1937 Auto Aerials.
Name .....
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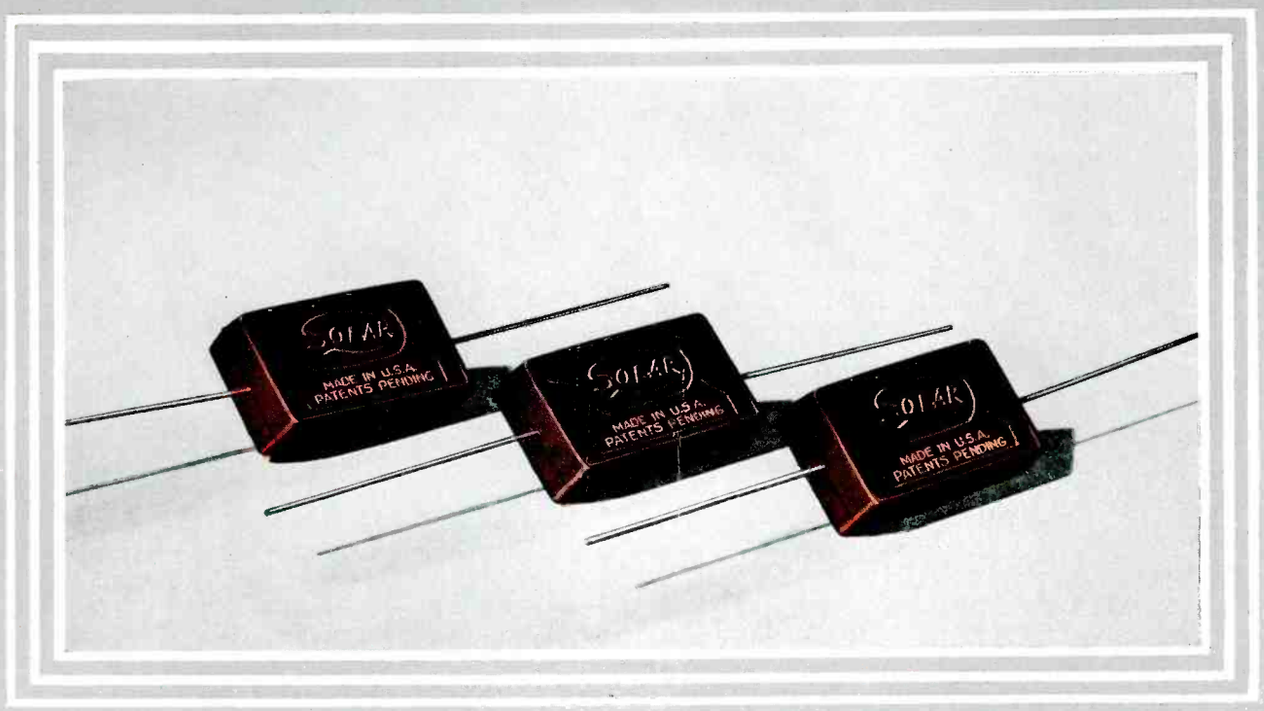
Check ☐ Dealer ☐ Jobber ☐ Service Man

INDEX TO ADVERTISERS



QUALITY ABOVE ALL

Solar
DOMINO
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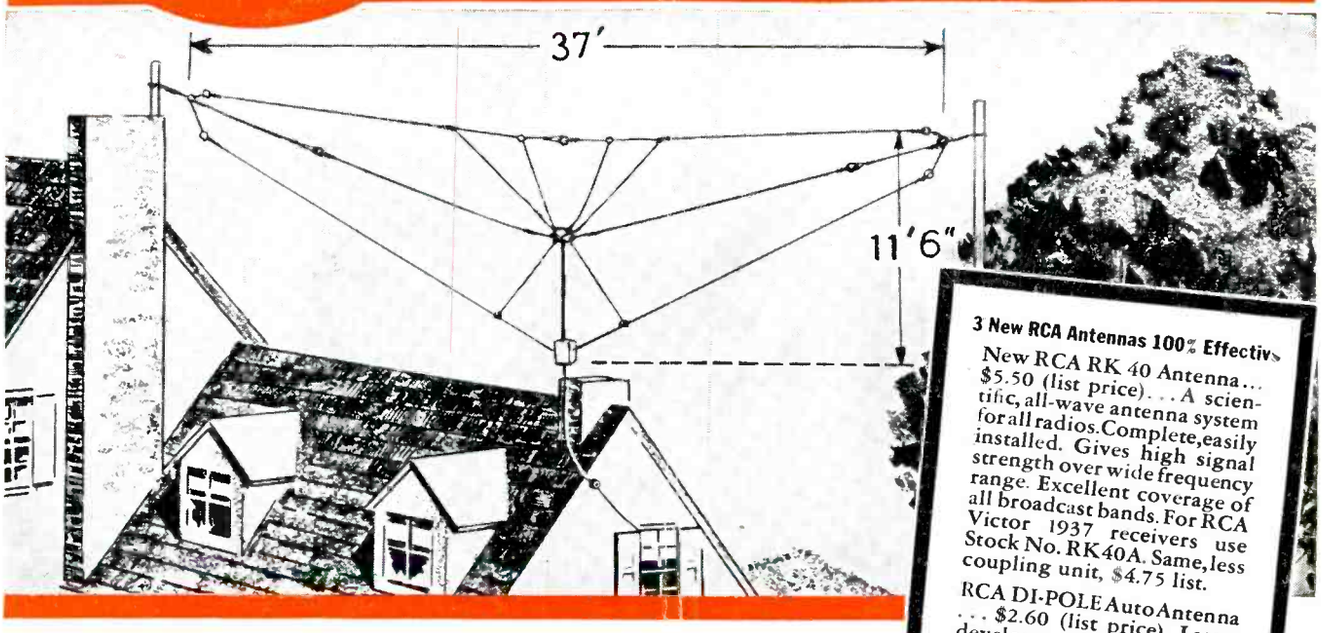
SOLAR MANUFACTURING CORP., 599-601 BROADWAY, NEW YORK

RCA'S OWN QUINTUPLET SENSATION THE

5 IN 1 SPIDERWEB ANTENNA



THE RCA Spiderweb Antenna is really five antennas in one. Operates as a T from 140 to 4000 kc., multiple doublet system above to 23,000 kc. With individual antennas for all important short-wave bands, it gives more signals, less noise and better reception on all wave bands. Stock No. 9689 high frequency kit extends coverage to 70 megacycles. This clears up 5-meter complaints that ordinary antennas will not reach.

The RCA Spiderweb Antenna is sensationally effective and remarkably easy to install. Requires span of only 38 feet and clearance of only 12 feet. The kit is completely assembled and soldered at the factory.

Without sacrificing efficiency, greater freedom from noise may be obtained by selecting the most ideal location for the antenna. The special transmission line, a unique feature of the RCA Spiderweb Antenna, permits the antenna proper to be erected at a considerable distance from the receiver. Stock No. 9685 system, $8.95; Stock No. 9689 high frequency kit, $1.50 (list prices).

3 New RCA Antennas 100% Effectiv

New RCA RK 40 Antenna... $5.50 (list price)... A scientific, all-wave antenna system for all radios. Complete, easily installed. Gives high signal strength over wide frequency range. Excellent coverage of all broadcast bands. For RCA Victor 1937 receivers use Stock No. RK40A. Same, less coupling unit, $4.75 list.

RCA DI-POLE Auto Antenna ... $2.60 (list price). Latest development especially effective on new steel top cars. Efficient station pickup. No ignition-noise pickup. Quick —simple installation.

RCA INLANTENNA—*Universal type... All cars except Oldsmobile. Stock No. 12322. $5.50 (list price).*

Oldsmobile Type... Oldsmobile cars only. Stock No. 12328. $6.00 (list price).

Ideal double running board type auto antenna, especially desirable for metal top cars at locations where broadcast signals are generally weak. Complete with all fittings in both types. Easily installed.

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