SUPPLEMENT No. 5

Index and Incidental Information

The index which follows includes only the diagrams found in the fifth supplement. Therefore, it should be consulted in conjunction with the main index which formed part of Supplement No. 3 and the separate index (on page 4-II) for Supplement No. 4. Insert this page in your manual directly after page 4H, so that it will be conveniently accessible along with the other indexes. Distribute the other pages as indicated by their respective page numbers.

"Orphan" Sets Still a Problem

All users of the OFFICIAL RADIO SERVICE MANUAL are urged to read the article on page 482 of the February, 1933 issue of RADIO CRAFT, for a detailed account of the difficulties that members of the service fraternity are experiencing with unbranded or "orphan" sets. Just as a reminder, please bear these considerations in mind: 1) we *must* have the model number and the manufacturer's name in order to look up service "dope" on any set. 2) If the name of the manufacturer is not marked anywhere on the set, and you cannot trace the wiring yourself, don't waste time writing to us or anyone else for service information. It is impossible to identify unknown sets merely from the tube combination or a description of the chassis. Save yourself money and aggravation and tell your customer frankly that the set is an unknown orphan.

* * * *

Those Colorful Resistors

Hundreds of thousands of fixed resistors were manufactured and sold long before the Radio Manufacturers' Association adopted its present color code. Theretore, don't be surprised if you encounter sets having resistors that don't check at all with the R. M. A. markings. Many resistor manufacturers had private color systems of their own, and no public record of them has ever been made available.

Incidently, many Service Men who have tried to work out the R. M. A. designations report they are unable to obtain correct values, and question the accuracy of the system. The answer is that the system is perfect; the trouble is in the previously unsuspected *color-blindness* of the Service Men who are doing the complaining. Some people live their whole lives without ever knowing they are color blind. It isn't a bad idea at all to have your eyes examined for this condition; you may save the doctor's fee on your next service job.

* * * *

25 and 60 Cycle Power Packs

Power transformers designed for 25 cycle operation are usually about twice the size of 60 cycle transformers for the same receiver. Therefore, do not undertake revision of 60 cycle sets for the lower frequency unless you are sure the chassis will accommodate the larger transformer.

Heavier chokes and larger filter condensers are also required for 25 cycle operation, as the lower frequency naturally needs more ironing out.

* * * *

Kill the Switch First!

Warning: do not remove tubes, particularly power output tubes, from their sockets with the juice on. With the load suddenly removed the plate voltages will shoot sky high, and are quite likely to puncture filter or by-pass condensers and throw an unnecessarily heavy load on the bleeder resistors. Play safe and kill the line circuit *first.*

* * * *

Corrosion of Condenser Plates

Many Service Men are under the impression that all variable condenser plates are made of aluminum. This is not so at all; a little probing with a permanent magnet will reveal that iron is quite commonly used. From the service standpoint this means that rusting and corrosion must be expected and guarded against.

UNITED AMERICAN BOSCH CORP.

BOSCH "VIBRO-POWER" TRIPLE-ACTION MODEL 312 12-TUBE "GRAND OPERA" SUPERHETERODYNE

(Dual reproducers, inter-station noise cutout, A.V.C., tone control, push-push power amplification, local-noise control, tuning meter, antenna compensator, hum control, mercury-vapor rectifier, band selectors, low-drain tubes.)

The term "Vibro-Power" undoubtedly has puzzled many persons who may have come in contact with this generalization of Bosch. The term refers to the Bosch receiver ensembles which incorporate the features enumerated above.

Triple action is obtained in the A.V.C. circuit as follows: Reduction of station noise by the application of time-delay operation; complete elimination of inter-station noise by adjustment of an auxiliary tube circuit, and; equal anti-fading or automatic volume control operation over the entire tuning band.

Following are the characteristics of the components: Resistor R1, manual volume control, 0.5-meg.; R2, tone control, 0.1-meg.; R3 hum control, 20 ohms; R22, "individual-location" noise control, 2,000 ohms; R4, R5, R17, R26, 0.1-meg.; R6, 500 ohms; R7, 0.5-meg.; R8, R10, R11, R13, 1.0 meg.; R9, 2 megs.; R12, R19, R21, 1,000 ohms; R14, R15, R16, R29, 10,000 ohms; R18, 1,500 ohms; R20, 30,000 ohms; R23, 2,800 ohms; R24, 2,400 ohms; R25, R27, 5,000 ohms; R28, 4 ohms; R30, 3,000 ohms.

Condensers C1 to C4, tuning units C1A antenna compensator and R.F. trimmer, C2A to C4A R.F. trimmers; C5 to C9, I.F. trimmers; C10, oscillator padding condenser; C11, C13, 0.1-mf.; C12, C14 to C22, C24 to C26, C30, C31, C37, C39, .05-mf.; C23, C36, C38, 100 mmf.; C27, 0.5-mf.; C28, C42, C43, 8 mf.; C29, C33, C34, C35, C41, 4 mf.; C32, .06-mf.; C40, C45, .01-mf.; C44, 2 mf.

Tube operating voltages (except filament), measured to ground, are as follows: Filament potential, all tubes, 2.4 V. Plate potential, V1, V2, 180 V.; V3, 75 V.; V4, V5, 195 V.; V6, 0.0 V.; V7, 120 V.; V8, 290 V.; V9, V10, 430 V.; V11, 2 V. Control-grid potential, except V8, 0.0 V.; V8, 30 V. Screen-grid potential, V1, 85 V.; V2, V4, V5, 90 V.; V6, 2 V.; V7, 25 V.; V7, 1.0 V.; V.8, 290 V.; V9, V10, 0.0 V.; V11, 25 V. Cathode potential, V1, 3 to 6; V2, 4.5 to 10 V.; V4, V5, 3.5 to 6 V.; V6, 40 V.; V7, 45 V.; V11, 0 to 45 V.

Tuning meter M operates over a range of 0 to 16 ma. The receiver consumes 80 to 150 watts, depending upon the A.F. volume; the Underwriters Laboratory rating (12% above minimum current drain) would be 90 watts. The sensitivity of the Bosch model 312 receiver is 1 to 2 microvolts absolute, at a power output of 100 milliwatts. The A. F. response characteristics of the two reproducers (one model C and one model G) are nearly identical; each field coil has a resistance of 2,500 ohms. The recommended antenna length is 40 to 80 ft. At the front left of the chassis is the combination off-on switch and manual volume control R1; in the center, the tone control, R2; and right, tuning control; condenser C1A is located in back of the tuning control. The "individual location" control (on the side of the cabinet) varies the proportion of program background noise; sensitivity above the noise level is not affected.

The triple-diode second-detector is so designated since it acts as three diodes, as follows.

The modulated I. F. output of the I. F. amplifier is applied to the control-grid and cathode of V6; the A. F. output is developed across R1 and applied to the control-grid of V7; this disposes of one diode. The modulated I. F. output of the I. F. amplifier is also applied to the plate (to which also is tied the suppressor-grid) and cathode of V6; the A.V.C. potential is developed across R8 and applied to the control-grids of V1, V2, V4 and V5 only when this potential exceeds the control-grid potential of 40 volts (the D.C. drop across the total resistance of R22, one end of which connects to the secondary of I. F. T. 3); this disposes of the second diode. The modulated I. F. output of the I. F. amplifier at the same time is applied to the screen-grid and cathode of V6; the inter-station noise suppressor potential is developed across R9 and applied to the control-grid of V11 only when this potential exceeds a pre-determined screen-grid potential between 0 and 40 Volts (the D. C. drop across the portion of R22 between the ground end and the moving arm); this disposes of the third diode.

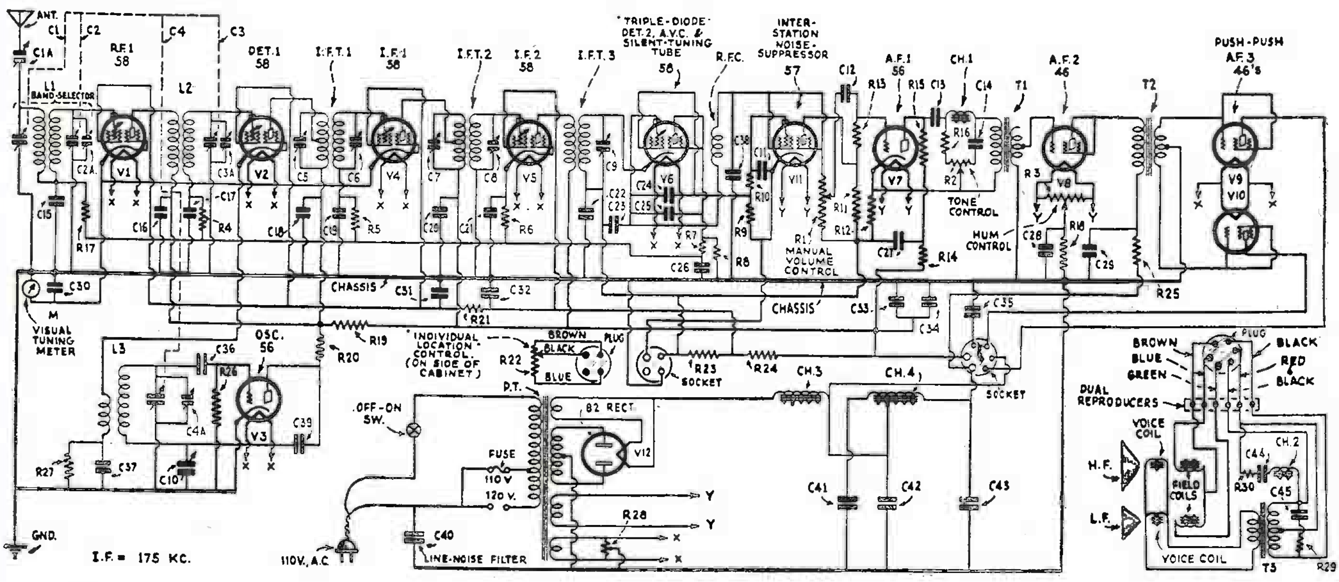
When there is no incoming signal, tube V11 has screen-grid potential, plate potential, and no control-grid potential. The plate therefore draws current and causes a drop across resistor R11; this potential is applied to the control-grid of V7, biasing it to plate current cut-off.

When there is an incoming signal the screen-grid of V6 draws current and the drop across R9 is applied to the control-grid of V11, biasing it to plate current cut-off, thus re-establishing the normal control-grid bias of V7. This action is assisted by the D. C. in R1 and to some extent reduces the screen-grid potential of V6 and V11.

Note that while making adjustments on the chassis the service oscillator signal should not be permitted to overload the tubes, as this will result in incorrect settings.

To make adjustments of the I. F. portion of the set, adjust R1 to maximum, set R2 on treble, and ground the antenna lead. Then, connect the 175 kc. service oscillator to the control-grid of V2, and align C9 for maximum output. Next, rig up an alignment "losser" consisting of a 25,000 ohm resistor and a 250 mmf. fixed condenser, and ground one of the two leads; the other end is to be connected either to the grid or the plate circuit of a tube, as directed. With the free terminal of the losser connected to the control-grid of V5, adjust C7; then, with the losser connected to the plate of V4, adjust C8. Finally, connect the losser to the control-grid of V4, and adjust C5; then, with the losser connected to the plate of V2, adjust C6.

To align the oscillator circuits, adjust trimmer C4A for maximum output (with the set pointer past 550 kc.) from a 1,400 kc. service oscillator connected to the control-grid of V2. Note that when adjusting C4A two peaks may be obtained; after tightening the C4A adjusting screw, release it about ½-turn until the peak at 1,575 kc. is obtained (otherwise the oscillator will not track in the center of the scale); then, align C1A, C2A and C3A. Finally, set the service oscillator for 600 kc. and adjust padding condenser C10.



CROSLEY RADIO CORP.

The Crosley Service Bulletin

The Crosley Radio Corporation, Cincinnati, Ohio

Model 47

Specifications

Model 47 is a midget receiver for operation from 110 volt, AC house lighting circuits.

Installation Notes

This receiver is designed primarily for the reception of nearby stations, and for that purpose an aerial 50 feet or more in length will usually be satisfactory. To increase the pick-up, aerials 75 to 100 feet or more in length should be used.

The earlier chasses do not have power switches. In installing them it is best to connect them, if possible, to a socket equipped with a switch. The later chasses are equipped with power switches.

Circuit

The circuit consists of a radio-frequency stage, a detector stage, and an audio stage. Type -24 tubes are used in the radio-frequency and detector stages, a type -45 tube in the audio stage, and a type -80 in the rectifier circuit.

The grid circuits of the radio-frequency and detector stages are tuned by separately-operated variable condensers. Since these condensers are not operated simultaneously, it is not necessary to equip them with aligning condensers.

An air-core auto-transformer couples the antenna circuit to the r. f. tube. An air-core radio-frequency transformer is used to couple the radio-frequency and detector tubes. Resistance coupling is used between the detector and audio tube.

The power supply for the various circuits is obtained from a transformer having an untapped primary and three secondaries. One secondary supplies the filament of the -80 type rectifier tube. A second secondary supplies the current for the filament of the audio tube and th heaters of the detector and radio-frequency tubes. The third secondary is the source of high voltage supply. It is connected to the plates of the rectifier tube. The middle of this secondary is grounded, and represents the negative side of the B supply circuit.

The positive B supply circuit is connected to one side of the rectifier tube filament. From this point it leads to the "Red" speaker terminal, and thence through the speaker field.

After passing through the speaker field, the B circuit branches, one branch connecting to the speaker voice coils and through them to the "Brown" speaker terminal on the receiver and the output tube plate. The other branch returns through the speaker lead with "Red Tracers" to the corresponding terminal on the receiver. From that point it continues through a 300,000 ohm detector plate coupling resistor to the detector plate, and through the primary of the inter-stage radio-frequency transformer to the plate of the radio-frequency tube.

A branch of the positive "B" circuit is connected through a 20,000 ohm resistor to the screen grids of the detector and radio-frequency tubes. The radio-frequency screen grid is connected to the heater circuit through a 11,000 ohm resistor. Bleeder current through these resistors maintains the screen grids at the appropriate potential. The detector screen grid is connected to the chassis through a 1-10 m. f. by-pass condenser.

The filter circuit consists of an 8 m. f. electrolytic condenser shunted across the B supply circuit, which, in conjunction with the choking effect of the speaker field, satisfactorily eliminates hum.

The output tube is biased by the previously mentioned 1100 ohm resistor connected from one side of the filament circuit to the chassis. Biasing of the detector and radio-frequency tubes is accomplished by a 40,000 ohm resistor in the detector emittor circuit, and a bias re-

Voltage Limits

	Volume Control On Full
Filament Voltages	
All Tubes but Rectifier	2.2 to 2.5
Rectifier Tube	4.5 to 5.0
Plate Voltages	
R. F. Tube	160 to 180
Detector Tube	100 to 120
Audio Tube	130 to 150
Control Grid Voltages	
R. F. Tube	1.8 to 2.2
Detector Tube	5.0 to 5.5
Screen Grid Voltages	
R. F. and Detector Tubes	60 to 80

The above readings are to be taken with the receiver in full operating condition, with the volume control on full, and with a line voltage of 117.5. Measure plate and grid voltages with a high-resistance D. C. voltmeter (at least 800 ohms per volt.) These voltages are to be measured from the plate or grid socket contact to the emitter contact or negative filament contact, unless otherwise noted in the table. The contacts must be reached from the bottom of the receiver (unless a set tester is used) with tubes, dial light, and speaker in place. Use a low-range A. C. voltmeter to measure the filament voltages.

CROSLEY RADIO CORP.

Page 2 **MODEL 47**

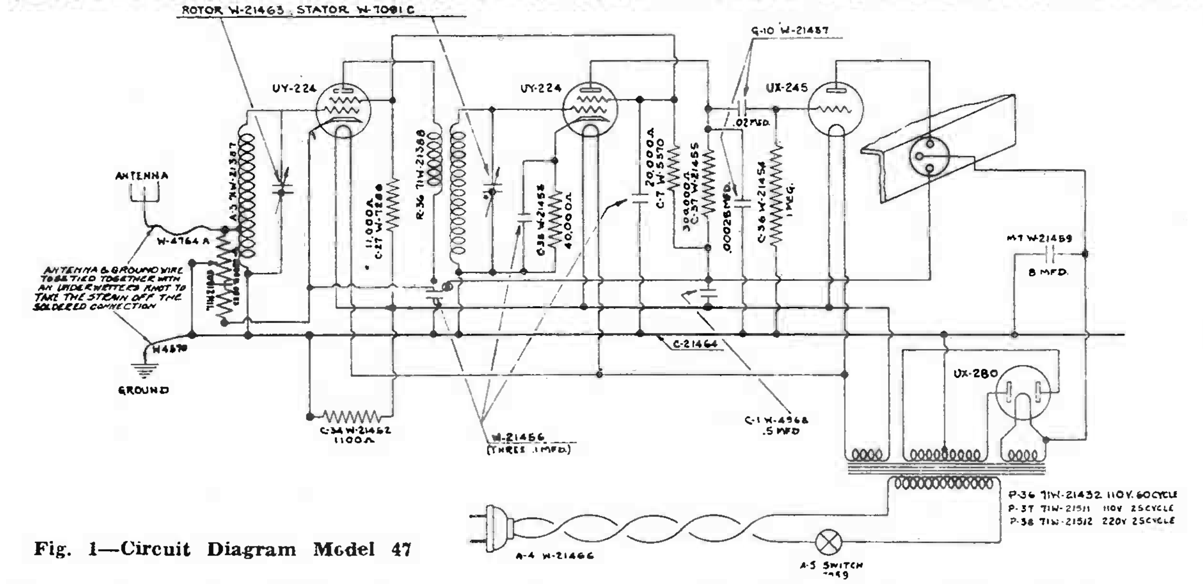


Fig. 1—Circuit Diagram Model 47

sistor and a portion of the volume control resistor in the radio-frequency emittor circuit.

Volume is controlled by a variable resistor, the fixed resistance unit of which is connected between the antenna lead and the radio-frequency bias resistor, and the variable contact of which is connected to ground. Variation in volume is thus accomplished by simultaneously changing the portion of the current in the antenna circuit shunted from the antenna lead to ground, and the biasing of the radio-frequency tubes.

Radio-frequency by-pass condensers of 0.1 m. f. capacity are connected from each cathode of the -24 tubes to ground and from the screen grids to ground. A 0.00025 m. f. r. f. by-pass condenser is connected from the detector plate to ground. A 0.02 m. f. coupling condenser is used between the detector plate circuit and the audio-frequency grid circuit.

Continuity Tests

NOTE—In order to make the test procedure as simple as possible, certain tests are omitted which are taken care of by the voltage limits in the accompanying table.

The following tests are to be made with a circuit tester consisting of a 45 volt "B" battery in series with a 50 volt, high-resistance voltmeter; a 1½ volt battery in series with a milliammeter of 1 m. a. range and a 1500 ohm resistor, or a similar arrangement.

Circuit	Remarks	Correct Test	Incorrect Test Indicates
Antenna to Ground	Reading should vary with setting of volume control	Part Scale	No reading indicates open circuit. Full scale indicates short
Operating Grids R. F. and Detector Sockets to Ground (Chassis)		Practically Full Scale	Open circuit in r. f. transformer or faulty connections
Grid Audio Socket to Ground (Chassis)		Slight Deflection	No reading indicates open circuit in grid resistor or faulty connections. Full scale indicates short
Screen Grids R. F. and Detector Sockets to Filament, Rectifier Socket	Speaker Connected	Part Scale	No reading indicates open circuit in resistor, speaker field, etc. Full scale indicates short.
Plates R. F. and Audio Sockets to Filament, Rectifier Socket	Speaker Connected	Part Scale	No reading indicates open circuit in r. f. transformer primary, speaker, etc. Full scale indicates short.
Plate Detector Socket to Filament, Rectifier Socket	Speaker Connected	Slight Deflection	No reading indicates open circuit in plate coupling resistor, speaker, etc. Full scale indicates short

COLUMBIA PHONOGRAPH CO.

COLUMBIA MODELS C-90A (Single Reproducer) AND C-90B (Dual Reproducer) 11-TUBE SUPERHETERODYNES

(Incorporates A.V.C., phase-reversing tube, reactance resonance indicator, "silent tuning" tube.)

A number of unusual features recommend the Columbia Model C-90A and C-90B receiver chasses to the close attention of Service Men. To maintain these chasses at maximum efficiency it is essential that the technician be thoroughly familiar with their individual features.

Following are the values of the components: Condensers C1, C2, C3, tuning condenser gang, shunted by trimmers C1A, C2A, C3A; C4 to C7, I.F. trimmers; C8, C10, C11, C12, C17, 0.1-mf.; C9, C29, C30, 0.25-mf.; C13, .02-mf.; C14, C15, C16, C19, C20, C21, .01-mf.; C22, C23, 500 mmf.; C24, 32 mf.; C25, 16 mf.; C26, 10 mf.; C27, 7 mf.; C28, 20 mf. Condensers C24 to C28 are dry electrolytic units. Condensers C8 to C12, and C29, C30 are contained in one can; C13, C14, C15, C18, in another.

Resistor R1, hum control, 20 ohms; R2, "silent tuning" control, 20,000 ohms; R3, manual volume control, 0.2-meg.; R4, tone control, 0.25-meg.; R5, 180 ohms; R6, 700 ohms; R7, 400 ohms; R8, 0.5-meg.; R9, 50, 50.000 ohms; R10, R12, R14, R15, R18, R19, 0.3-meg.; R11, R13, R20, 0.1-meg.; R16, 30.000 ohms; R17, 2,000 ohms; R21, 230 ohms; R22, 6,700 ohms; R23, 2,400 ohms; R24, 18,000 ohms. Resistors R5, R6, R7, R21, R22, R23, R24, multiple wire-wound unit.

Following are the tube operating characteristics; at a line potential of 115 V. and the "synchro-silent tuner" all the way counter-clockwise, (all D.C. potentials are to ground): Filament potential, all tubes, 2.5 V. Plate potential, V1, V2, V4, 255 V.; V3, 75 V.; V6, 200 V.; V7, 116 V.; V8, V9, 240 V.; V10, too small to measure practically. Plate current, V1, V3, 4 ma.; V2, 2.6 ma.; V4, 4.4 ma.; V6, V10, too small to measure practically; V7, 1. ma.; V8, V9, 60 ma.; V11, 160 ma., total. Cathode potential, V1, V4, 2 V.; V2, 9 V.; V3, 12 V.; V5, V10, zero; V6, 75 V.; V7, 32 V. Screen-grid potential, V1, V2, V4, 75 V.; V6, 120 V.; V7, 116 V.; V8, V9, 255 V.; V10, 73 V. Screen-grid current, V1, V4, 1. ma.; V2, 0.6-ma.; V6, too small to measure practically; V7, 0.3-ma.; V8, V9, 6.6 ma.; V10, 3.8 ma.

Because of the elimination of noise between stations, by means of the synchro-silent tuning connection, it has been possible to improve the sensitivity of the C-90 chasses to several times that heretofore used. In cases where low sensitivity is encountered, the adjustment of the synchro-silent tuning control should be carefully checked, as well as all the tubes in the R.F. end of the chassis. This should always be done before attempting to increase sensitivity by re-aligning the condensers.

The function of the silent tuning" or "synchro-silent tuning control" is as follows: One of the type C-57-S tubes is used as V6 because of its sharp plate current cut-off characteristic. By inserting a high negative bias on the surpressor-grid of this tube, it is "blocked," and no signal will come through.

To obtain this action a type C-57-S tube is used as the "silent-tuning" tube, V10. Its plate current through resistor R8 develops a voltage drop which is applied to the suppressor-grid circuit of V6, to which it is common. Tube V10 obtains its control-grid potential from the A.V.C. circuit. When there is no station tuned in, there is no A.V.C. potential, and hence the control-grid of the silent-tuning tube V10 is approximately at zero bias. The resulting high plate current passes through R8 and develops the high blocking potential which is effective on V6.

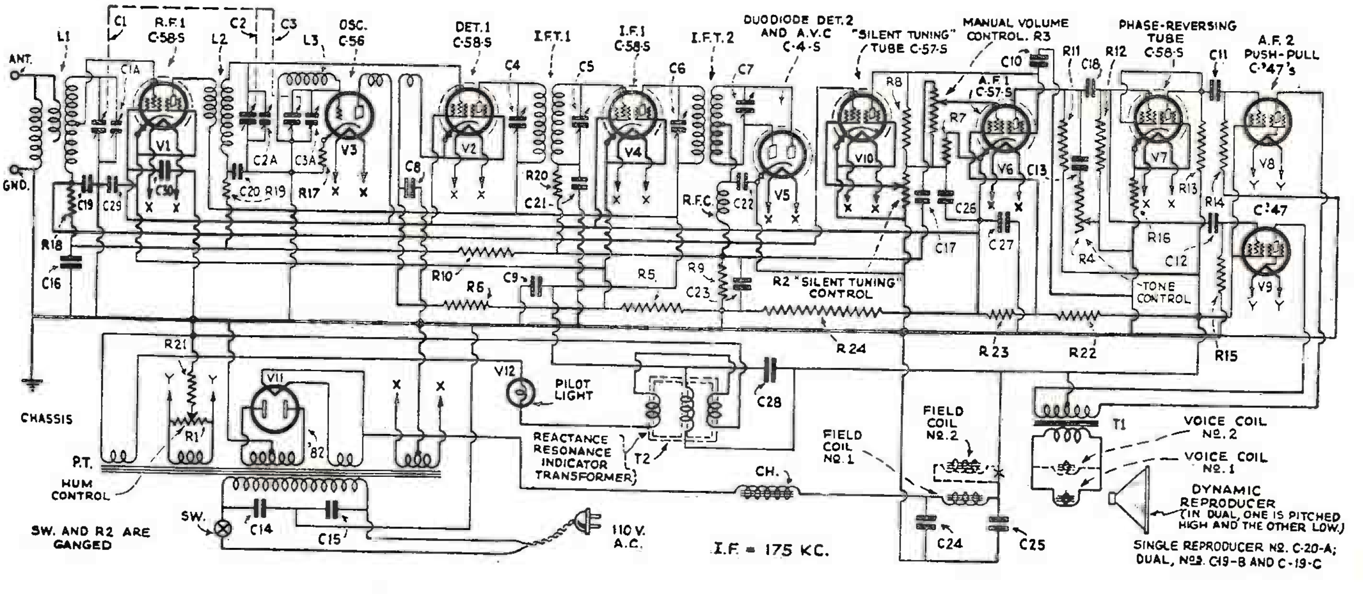
Now, when a station is tuned in, the A.V.C. potential develops across resistor R9 and is impressed on V10 in the form of a negative bias. The plate circuit of V10 therefore draws little or no current and hence the voltage drop across R8 disappears, leaving nothing but the normal operating bias on V6. In this condition the entire set is operative just as though there were no silent-tuning tube in the circuit. In fact, it is possible to tune in a station and remove V10 without any noticeable change. On the other hand, if V10 is removed when no station is tuned in, the customary background noises will be heard. Resistor R2 is provided to govern the point at which V10 "takes hold"; it compensates for local noise conditions and variations in individual antenna systems.

To obtain push-pull operation and yet retain resistance-capacity coupling, tube V7 is used to obtain a reverse-phase potential to actuate the control-grid of one power tube, V8. The circuit is carefully balanced to prevent a change in the magnitude of the voltage through V7.

The operation of the "reactance resonance indicator" circuit, which centers around transformer T2(is as follows: When the set is turned on and the tube filaments warm up, but no station is tuned in, a relatively large plate current flows through the center winding. This saturates the iron core, reducing the reactance of the two outer windings to a very low figure, which causes considerable current to flow through the pilot light, V12. When a station is tuned in, it operates the duodiode, V5, so that an A.V.C. potential is built up across resistor R9. This bias voltage is in turn, impressed upon the control-grids of V1, V2 and V4. The result is normal A.V.C. operation—amplification is decreased. However, their plate current is decreased, due to the higher negative bias on their control-grids. This reduced plate current flowing through the center winding of the reactor relieves the saturated condition in the iron core so that the reactance of the outer windings increases and the current flowing through the pilot light current supply is therefore reduced, causing the pilot light to dim when a station is tuned in.

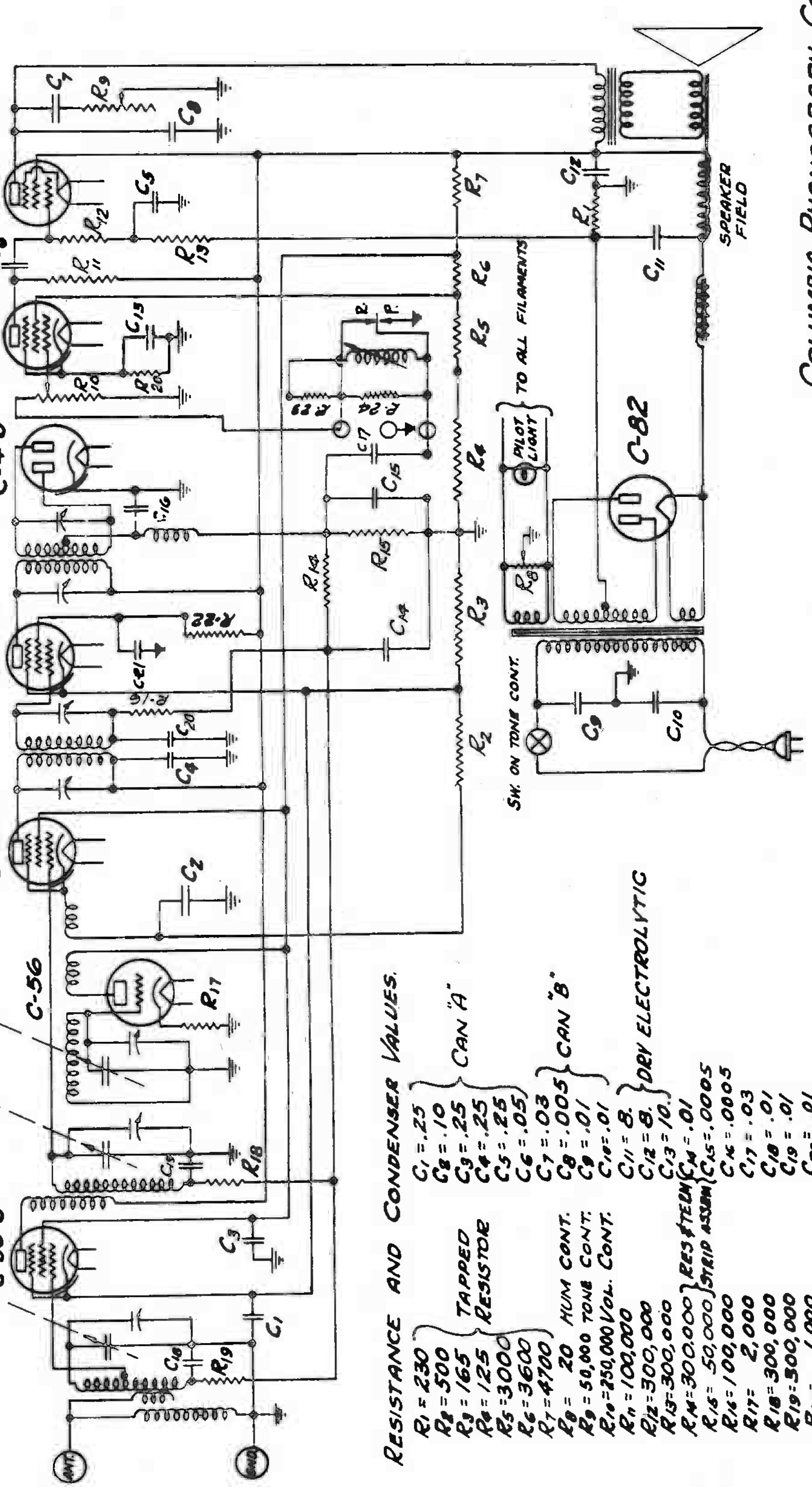
The two outer windings are connected so that they buck each other, insofar as the center leg of the core is concerned; hence, current is not induced into this center winding (which is in the plate circuit). Electrolytic condenser C28 compensates for slight unbalances.

Field coil resistance, 1,000 ohms (single); or, 520 ohms each (dual).



COLUMBIA PHONOGRAPH CO.

SCHEMATIC DIAGRAM OF COLUMBIA AUTOMATIC VOLUME CONTROL SUPERHETERODYNE
MODEL C-800



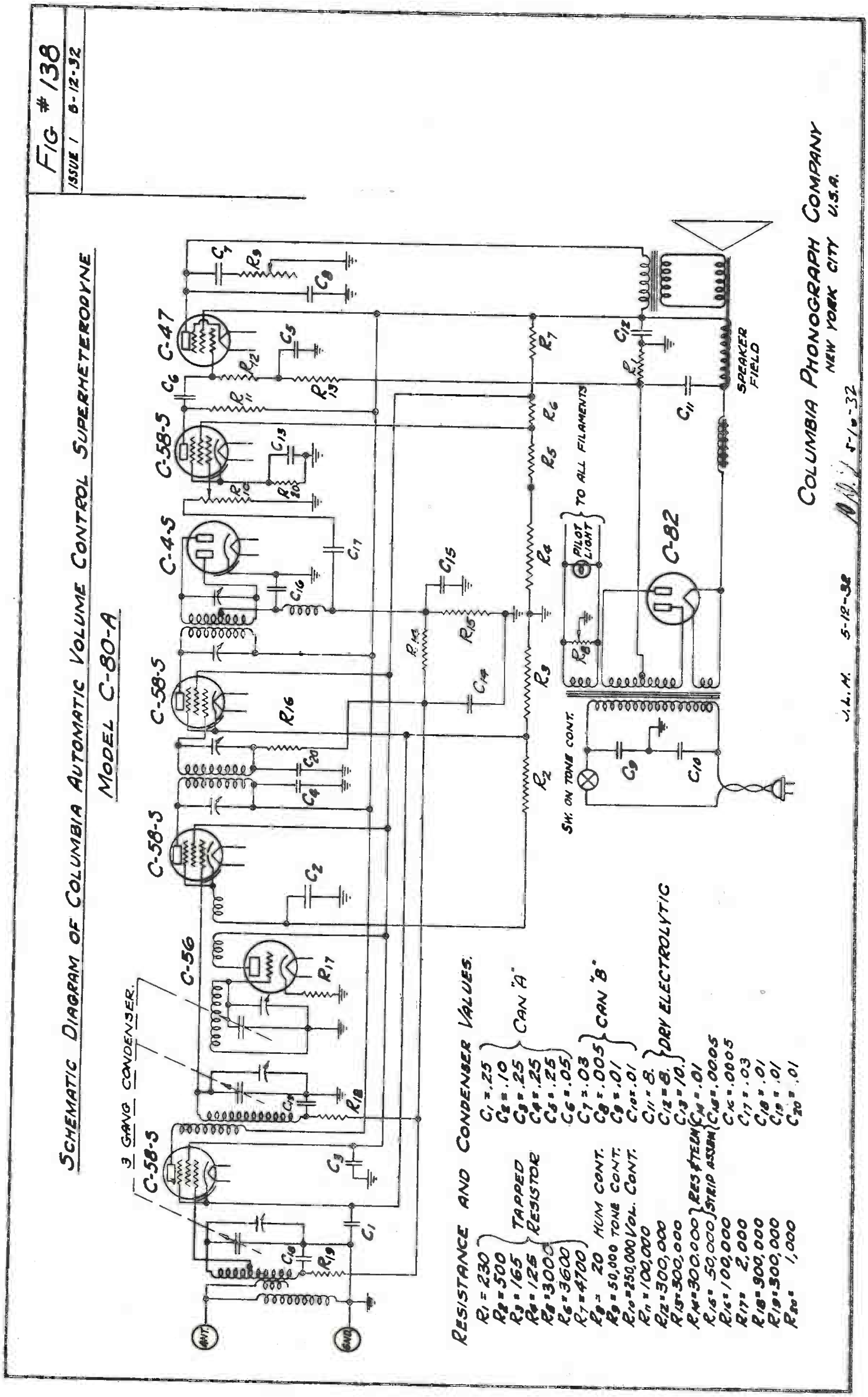
RESISTANCE AND CONDENSER VALUES.

R1 = 230, R2 = 500, R3 = 165, R4 = 125, R5 = 3000, R6 = 3600, R7 = 4700 — TAPPED RESISTOR
R8 = 20 HUM CONT.
R9 = 50,000 TONE CONT.
R10 = 250,000 VOL. CONT.
R11 = 100,000
R12 = 300,000
R13 = 300,000
R14 = 300,000, R15 = 50,000 — RES & TERM STRIP ASSEM.
R16 = 100,000
R17 = 2,000
R18 = 300,000
R19 = 300,000
R20 = 1,000
R-24 = 9,000
R-22 = 100,000
R-23 = 20,000

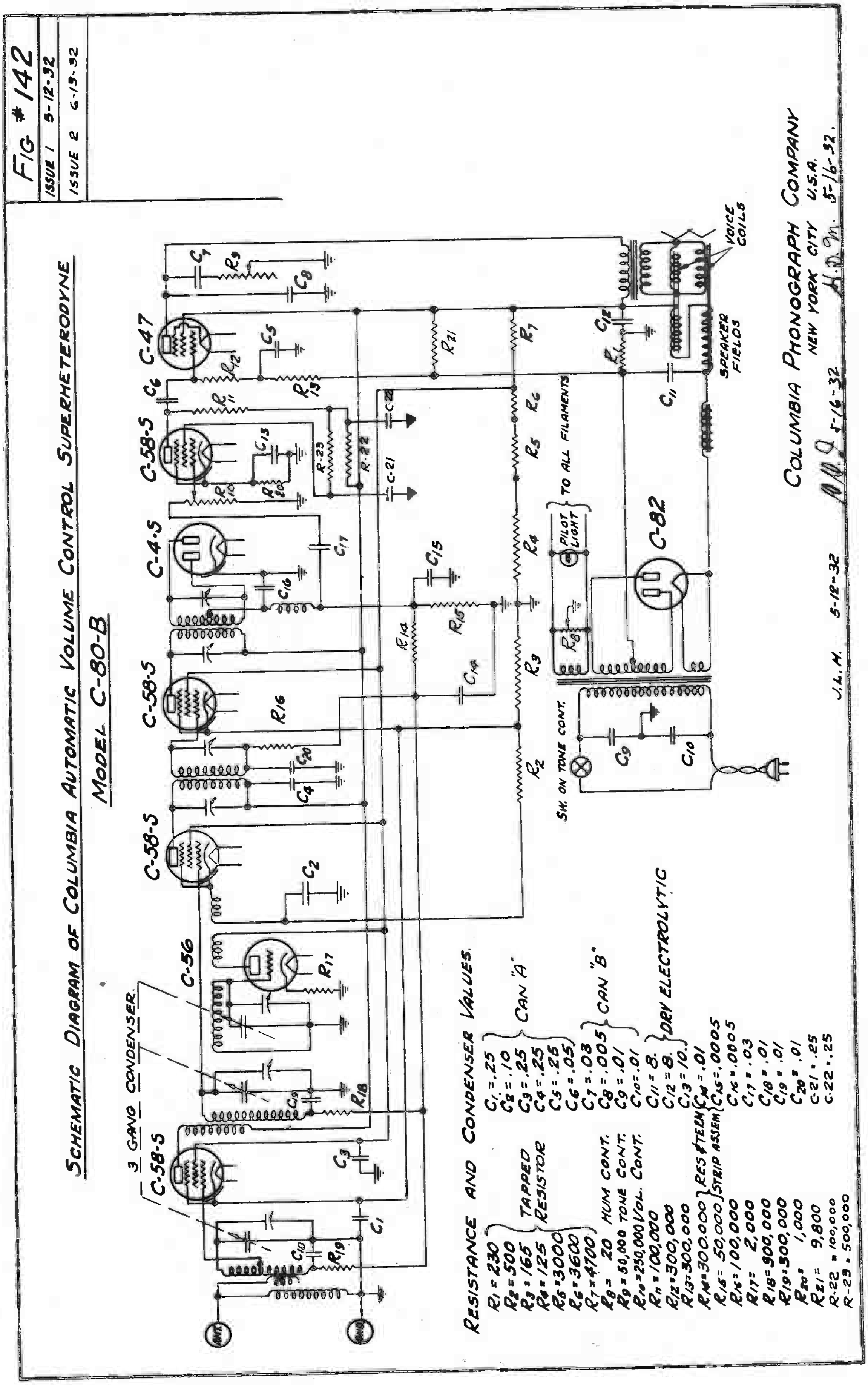
C1 = .25, C2 = .10, C3 = .25, C4 = .25, C5 = .25, C6 = .05 — CAN "A"
C7 = .03, C8 = .005, C9 = .01, C10 = .01 — CAN "B"
C11 = 8., C12 = 8., C13 = 10. — DRY ELECTROLYTIC
C14 = .01, C15 = .0005 — RES & TERM STRIP ASSEM.
C16 = .0005
C17 = .03
C18 = .01
C19 = .01
C20 = .01
C21 = .10

COLUMBIA PHONOGRAPH COMPANY
NEW YORK CITY U.S.A.

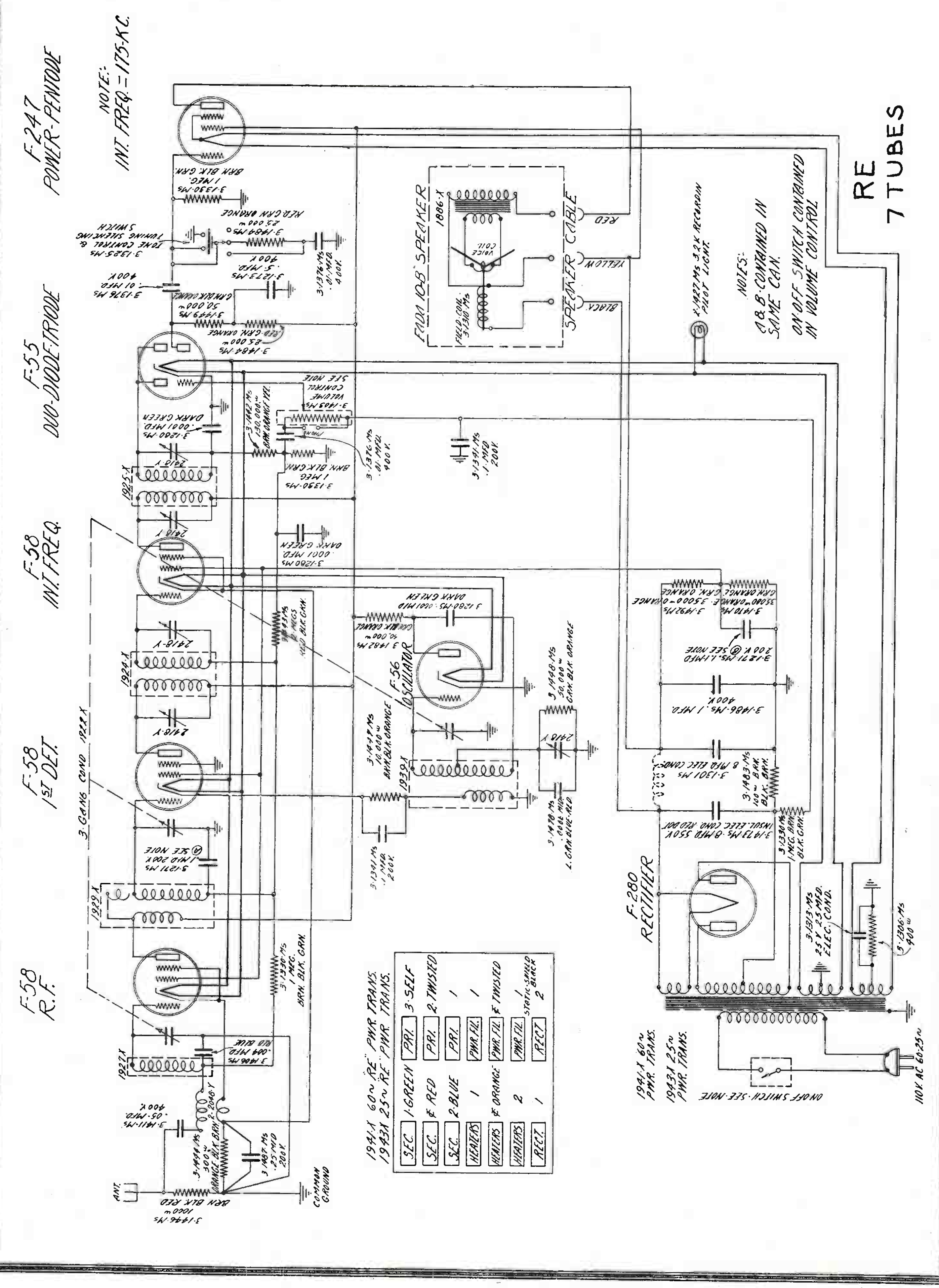
COLUMBIA PHONOGRAPH CO.



COLUMBIA PHONOGRAPH CO.



FADA RADIO & ELECTRIC CORP.



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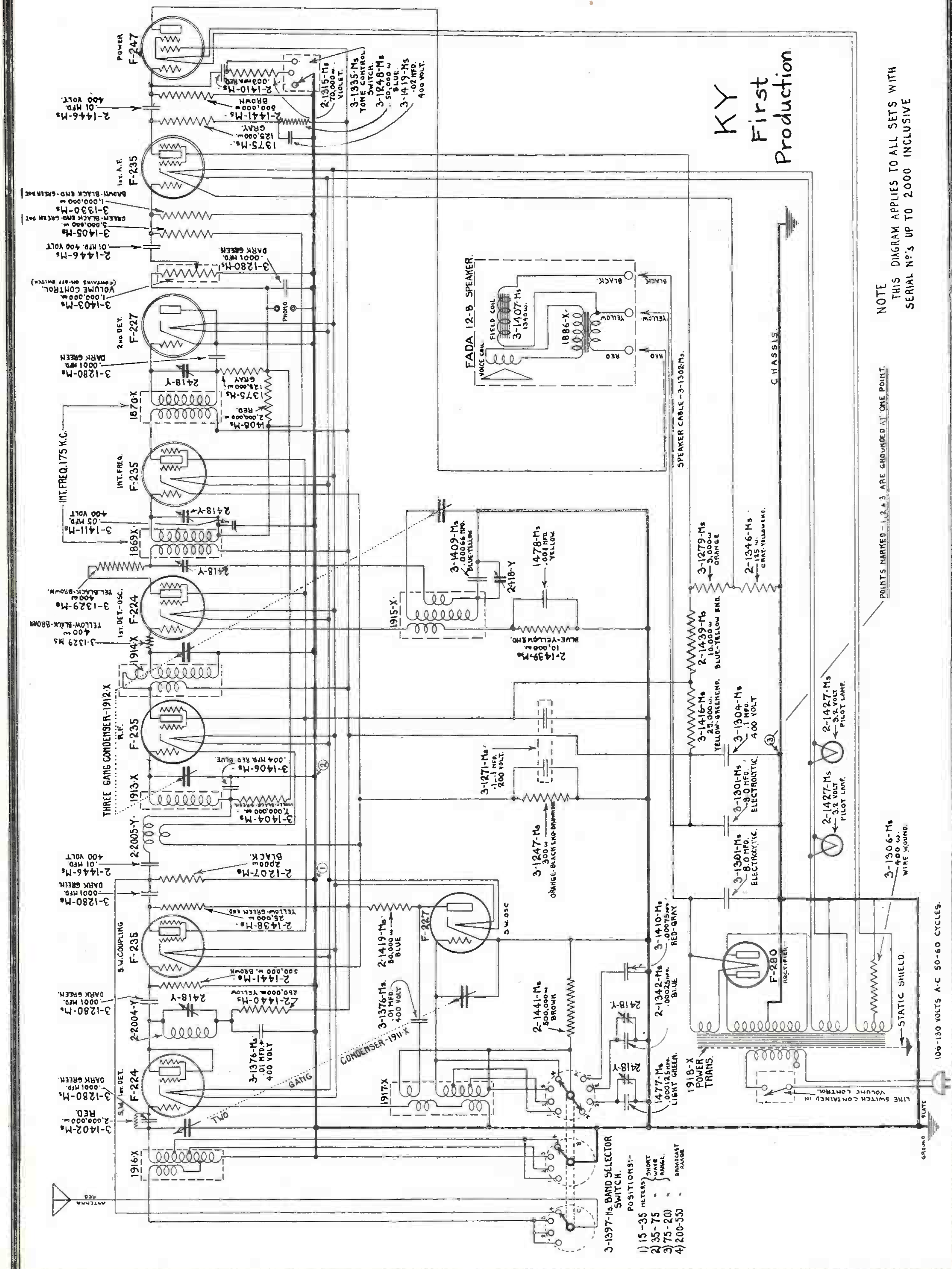

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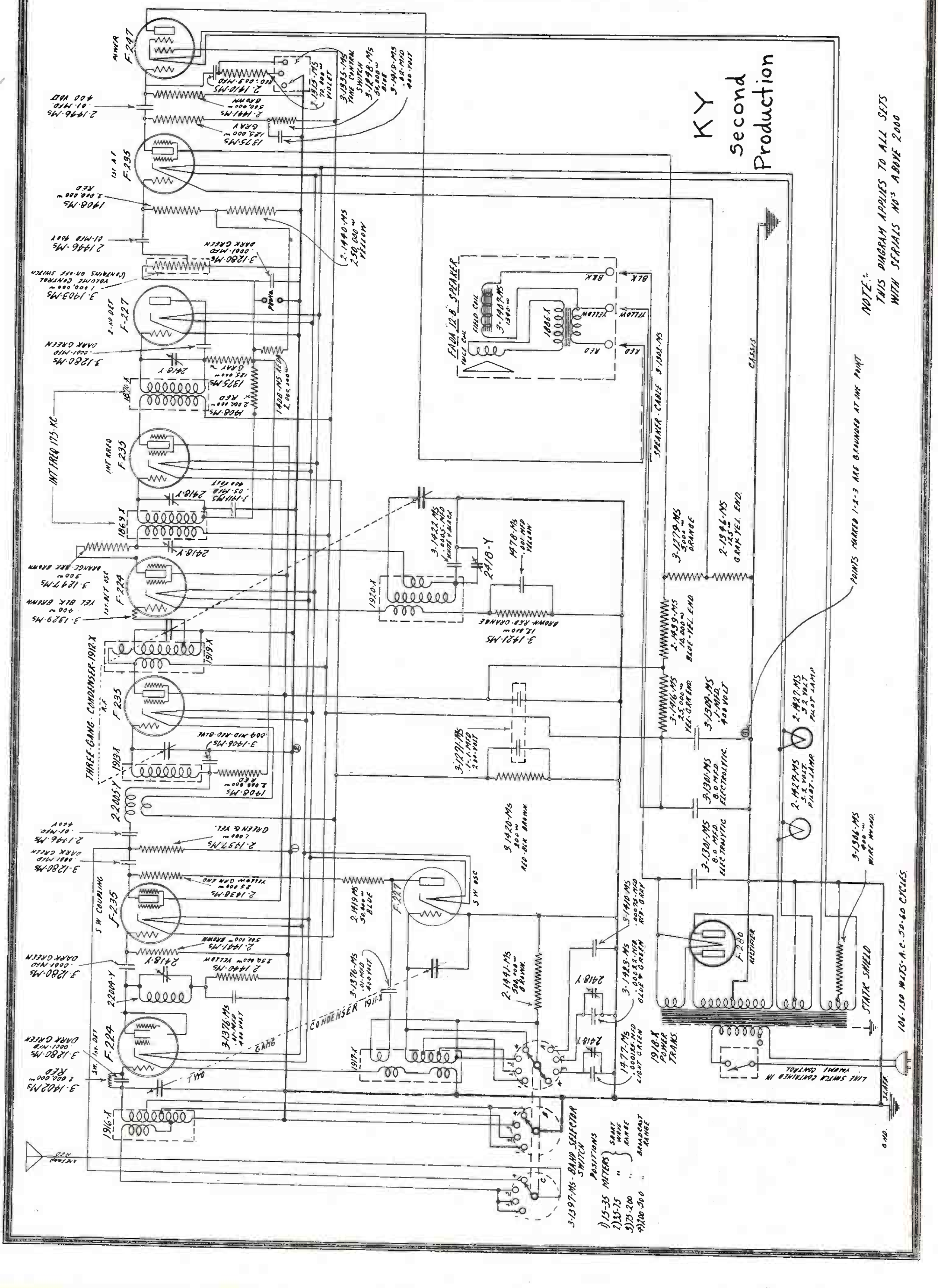

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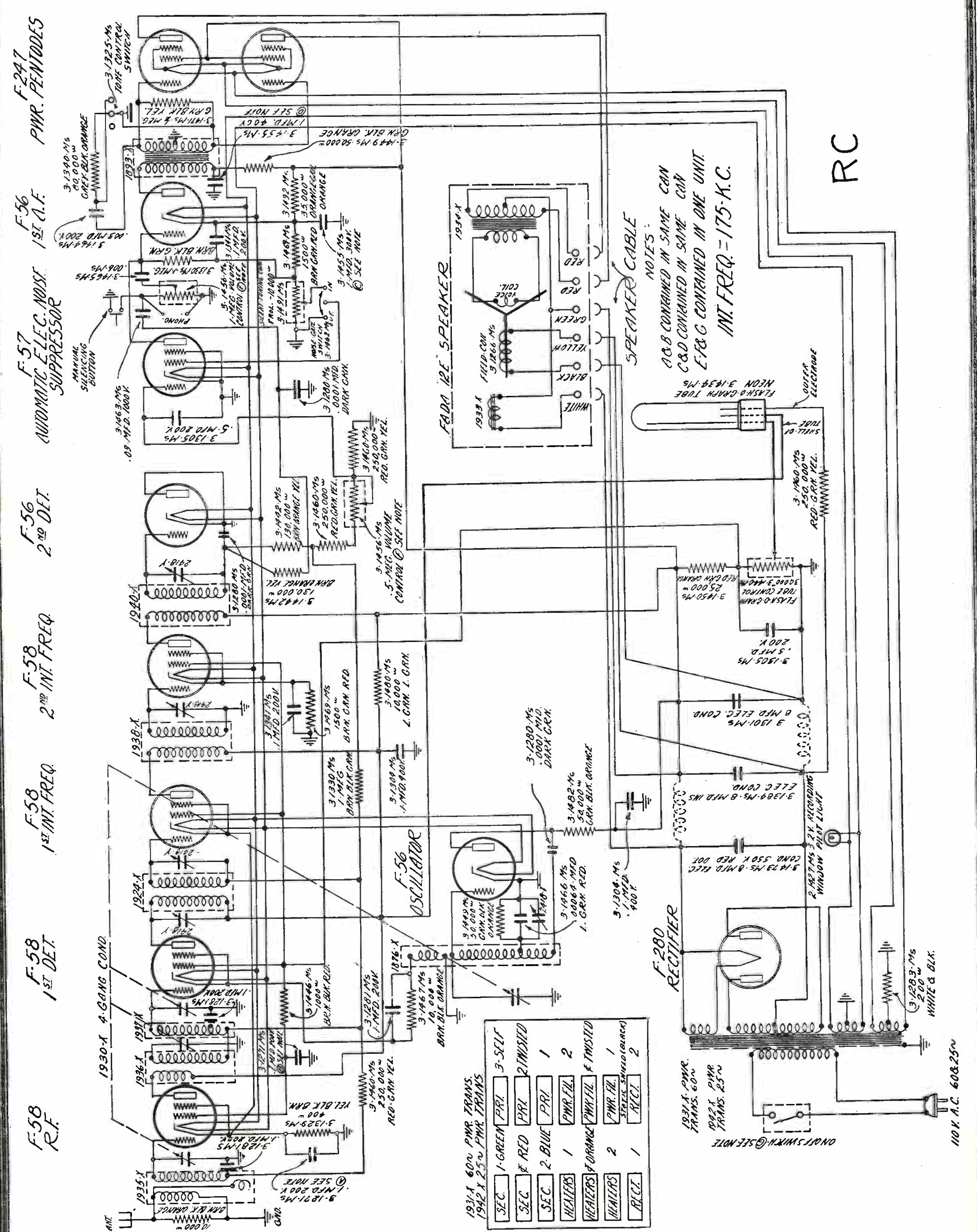

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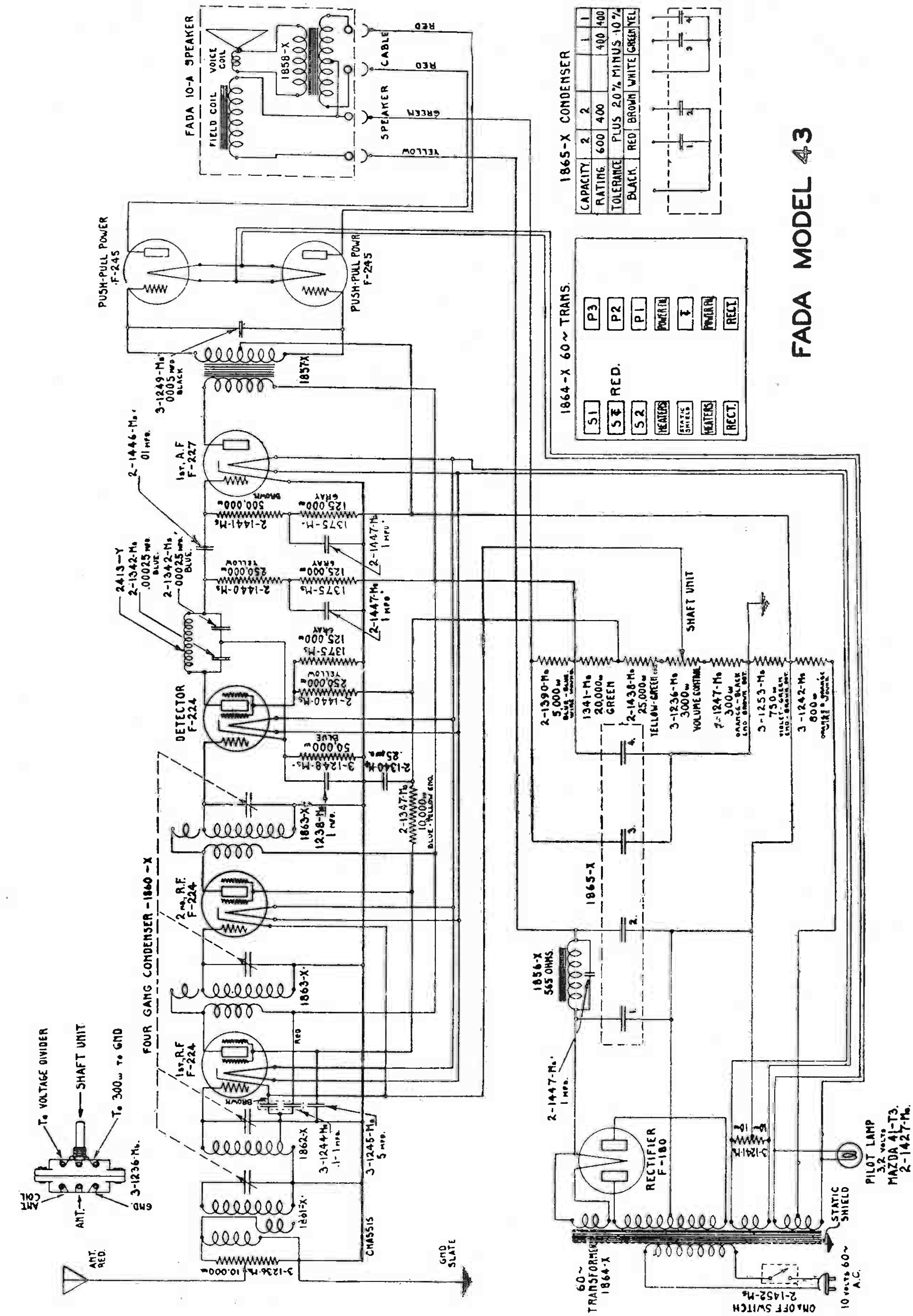
FADA RADIO & ELECTRIC CORP.



GENERAL ELECTRIC COMPANY

S-42-B

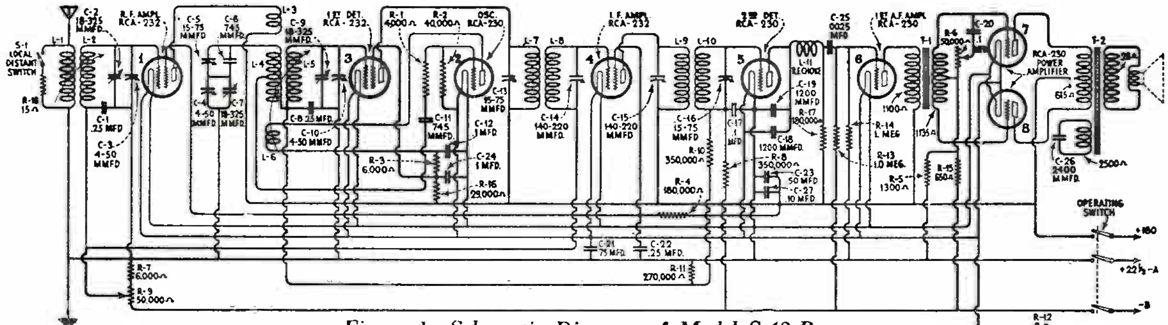


Figure 1—Schematic Diagram of Model S-42-B

RADIOTRON SOCKET VOLTAGES

BATTERIES AT FULL VOLTAGE—NO SIGNAL BEING RECEIVED

These voltages are those obtained with one of the usual set analyzers. The values indicated, therefore, are not necessarily the voltages that actually appear at the Radiotron Sockets when the voltmeter is not connected.

Tube No.	Filament to Control Grid Volts	Filament to Screen Grid Volts	Filament to Plate Volts	Plate Current M. A.	Filament Volts
VOLUME CONTROL AT MINIMUM					
1	22	55	155	0	2.0
2	—	—	50	3.0	2.0
3	0.5	65	150	0.5	2.0
4	22	55	155	0	2.0
5	5.0	—	90	0	2.0
6	2.0	—	150	1.5	2.0
7	15.0	—	150	0	2.0
8	15.0		150	0	2.0
VOLUME CONTROL AT MAXIMUM					
1	1.5	45	150	2.5	2.0
2	—	—	50	3.0	2.0
3	0.5	60	150	0.5	2.0
4	1.5	45	150	2.5	2.0
5	5.0	—	90	0	2.0
6	2.0	—	150	1.5	2.0
7	15.0	—	150	0	2.0
8	15.0	—	150	0	2.0

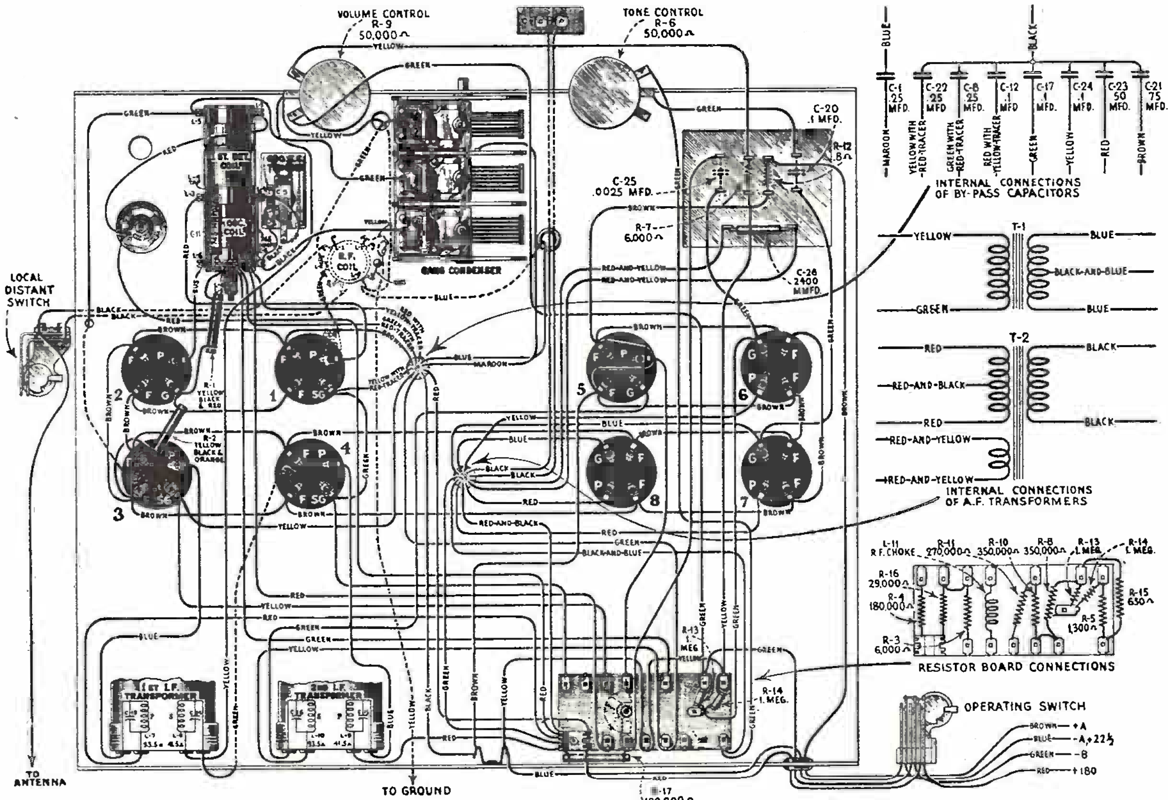


Figure 2—Wiring Diagram of Model S-42-B

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Technical Data Pertaining to Model 220 Chassis

The Circuit

The same chassis is employed in the Collingwood and Abbeywood models. The chassis designation is Model 220. In the Model 220 chassis there has been utilized all of the beneficial features of Chassis 35, 200 and 210. The circuit arrangement is as follows: Type G-35-S radio frequency amplifier stage, Type G-27-S oscillator, Type G-35-S first detector stage, Type G-35-S first intermediate frequency stage, Type G-35-S second intermediate frequency stage, Type G-2-S duodiode second detector stage, Type G-35-S compensated first audio stage, Type G-27-S second audio stage. Two Type G-50 push-pull high power output stage. Two Type G-81 tubes are employed for rectifiers, bringing the total number of tubes to twelve. Four gang tuning is employed in the radio frequency in this chassis, which makes for complete elimination of images and harmonics. Special highly selective I.F. transformers of the tapped type are used to insure adequate selectivity. The Type G-35-S audio amplifier stage is unique in that special means are provided for giving that deep, rich bass so desirable, but the obtaining of this bass is had without loss of the higher overtone frequencies. The use of push-pull Type G-50 power amplifier tubes gives that reserve energy necessary for the obtaining of full depth without distortion of overload.

Method of Biasing

The initial bias on the R.F., first detector, and first I.F. tubes is obtained by means of a common self-bias resistor of 180 ohms in the cathode circuit. The second I.F. tube makes use of a separate self-bias resistor of 700 ohms to insure its smooth operation into the duodiode circuit. The oscillator is of the grid leak type, and is, therefore, self-biasing. The screen Grid first audio stage obtains its bias from the voltage divider, while the G-27 second audio stage uses self-bias. The output tubes obtain their bias by the voltage drop across the resistance of one of the speaker fields, connected in the filament circuit.

Automatic Volume Control

The automatic volume control system employed in the Model 220 Chassis is of the exclusive Majestic type using the new G-2-S duodiode tube for a second detector. Automatic control is obtained by applying the second detector bias to the R.F., First Detector, and First I.F. stages to control their amplification. The second I.F. stage is not effected by the A.V.C. action to insure smooth working into the second detector stage.

The manual volume control is a 200,000 ohm potentiometer in the grid circuit of the first audio stage.

Power Supply System

The Power supply system of the Model 220 chassis consists of the power transformer, two type G-81 rectifiers, a filter choke which is tuned to the hum frequency, a 2 mfd. paper condenser, a 4 mfd. paper condenser, and an 8 mfd. electrolytic condenser. One of the speaker fields functions as a second filter choke.

Sensitivity

The sensitivity of this chassis is naturally of a very high order, because of the relatively large number of tubes employed. Special care has been taken in the design to prevent disturbing background noises, so common with many highly sensitive receivers. In cases where low sensitivity is encountered, the G-35-S tubes should be carefully checked before trying to remedy this condition by realigning the condensers.

Radio Phonograph Switch

Both the Collingwood and Abbeywood Models have a radio phonograph switch which is located below the central control or station selector. This switch is turned to the right for radio operation. and to the left for phonograph operation. There are pick-up terminals on the Model 220 chassis employed in both these sets, although the Collingwood is not a combination receiver.

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"Off" and "On" Line Switch

The "Off" and "On" line switch is attached to the acoustic control shaft. Turning the acoustic control completely to the left turns the receiver off. The first fifteen degrees of rotation of the acoustic control to the right will turn the receiver on. The balance of rotation to the right controls the tone, the treble position being at the extreme right, and the bass position at the extreme left, just before the switch is turned off.

Antenna and Ground Terminals

Terminals are provided on the Model 220 chassis for antenna and ground connections. Antenna and ground terminals are located at the rear of the chassis, and clearly marked. Normal antenna length should be approximately 30 to 40 feet. When the receiver is to be operated in localities several hundred miles distant from broadcasting stations, a longer antenna is recommended. In such cases where consistent long distance reception will be required, antenna length should be approximately one hundred feet.

Models G-10-E, G-14-E, G-14-C and G-14-D Dynamic Speakers Employed in Models Collingwood and Abbeywood

Both the Collingwood and Abbeywood Models are equipped with twin speakers. The Collingwood model employs the G-10-E, a small dynamic speaker (field resistance 765 ohms), to produce the high tones, and the G-14-E, a large dynamic speaker (field resistance 5500 ohms), to produce the low tones. The Abbeywood Model employs the G-14-C, a large dynamic speaker (field resistance 5500 ohms), to produce the low tones, and the G-14-D, a large dynamic speaker (field resistance 765 ohms) to produce the high tones. These speakers operating simultaneously produces an almost flat audio frequency response curve which gives these receivers a truly faithful reproduction.

Color Code of Power Transformer

Start of Primary	Black
Finish of Primary	Yellow
Start of 7.5 volt Rectifier filament	Black
Finish of 7.5 volt Rectifier filament	Black
Start of 2.5 volt Heater No. 1	Yellow
Finish of 2.5 volt Heater No. 1	Yellow
Start of 2.5 volt Heater No. 2	Black
Center tap of 2.5 volt Heater No. 2	Red
Finish of 2.5 volt Heater No. 2	Black
Start of 7.5 volt filament	Yellow
Center tap of 7.5 volt filament	Brown
Finish of 7.5 volt filament	Yellow
Start of Anode	Red
Center tap of Anode	Black
Finish of Anode	Red

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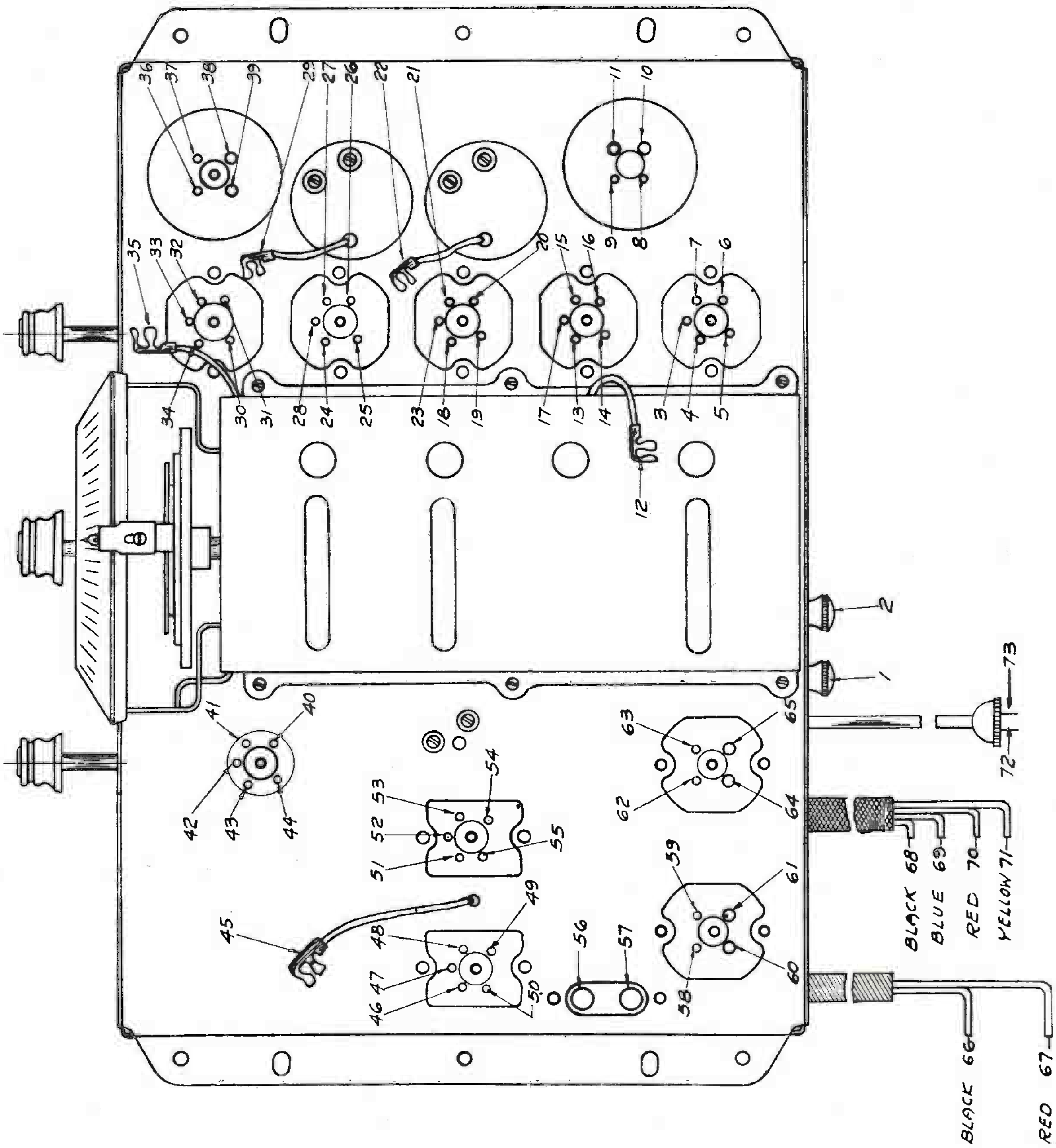

Continuity Diagram of Model 220 Chassis

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MODEL 220 CONTINUITY CHART

ALL CONTINUITIES TO GROUND WITH TUBES REMOVED, SPEAKER DISCONNECTED, AND VOLUME AND ACOUSTIC CONTROL IN MAXIMUM POSITION

Terminal No.	Continuity Meter Switch Position No. 1	No. 2	Normal Reading	If Meter Reading Differs Greatly from "Normal Reading" Investigate the Following:
1	H R	Open	.76	Ground Connection
2	L R	3	.12	Primary of Antenna Coil
3 and 7	L R	3	.74	2.5-Volt Heater Winding (R. F.) and Ground Connection
3 to 7	L R	3	.68	2.5-Volt Heater Winding (R. F.)
4	H R	Open	.6	Oscillator Coil, C_2, Phono-Switch and C_3
5	H R	Open	.16	R_{12}
6	H R	Open	.76	Ground Connection
8	H R	Open	0	No Connection
9	L R	55	.26	One-Half of High Voltage Secondary and Center Tap Ground
10 and 11	H R	Open	0	G-81 Filament Winding C_{17}, C_{18} and Filter Choke
10 to 11	L R	3	.5	G-81 Filament Winding
12	H R	Open	.02	Secondary of 2nd R. F. Coil, C_{12}, R_{11}, C_{21}, R_3 and R_4
13	H R	Open	.5	Primary of 1st I. F. Transformer C_{11}, C_{22}
14	H R	Open	.6	See Terminal No. 4
15 and 17	Same as Terminals Nos. 3 and 7			
15 to 17	Same as Terminals Nos. 3 to 7			
16	L R	Open	.82	Oscillator Coil C_6, R_1, C_1 and R_5
18	H R	Open	.5	Primary of 2nd I. F. Transformer, also see Terminal No. 13
19	H R	Open	.6	See Terminal No. 4
20	L R	Open	.5	See Terminal No. 16
21 and 23	Same as Terminals Nos. 3 and 7			
21 to 23	Same as Terminals Nos. 3 to 7			
22	L R	55	.28	Secondary of 1st I. F. Transformer, C_{14}, R_{13}, also see Terminal No. 16
24	H R	Open	.5	Primary of 3rd I. F. Transformer, also see Terminal No. 13

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MODEL 220 CONTINUITY CHART—Continued

ALL CONTINUITIES TO GROUND WITH TUBES REMOVED, SPEAKER DISCONNECTED, AND VOLUME AND ACOUSTIC CONTROL IN MAXIMUM POSITION

Terminal No.	Continuity Meter Switch Position No. 1	Continuity Meter Switch Position No. 2	Normal Reading	If Meter Reading Differs Greatly from "Normal Reading" Investigate the Following:
25	H R	Open	.6	See Terminal No. 4
26	L R	55	.22	C_5 and R_{22}
27 and 28	Same as Terminals Nos. 3 and 7			
27 to 28	Same as Terminals Nos. 3 to 7			
29	H R	Open	.1	Secondary of 2nd I. F. Transformer
30	H R	Open	.6	See Terminal No. 4
31	L R	Open	.42	See Terminal No. 16
32 and 33	Same as Terminals Nos. 3 and 7			
32 to 33	Same as Terminals Nos. 3 to 7			
34	H R	Open	.5	Primary of 1st R. F. Coil, also see Terminal No. 13
35	H R	Open	.02	C_{13}, R_{10}, also see Terminal No. 12
36	H R	Open	0	No Connection
37	L R	55	.26	One-Half of High Voltage, Secondary and Center Tap Ground
38 and 39	Same as Terminals Nos. 10 and 11			
38 to 39	Same as Terminals Nos. 10 to 11			
40	H R	Open	.06	Secondary of 3rd I. F. Transformer, C_{24}, R_{14}, C_8 and R_4
41	H R	Open	.76	Ground Connection
42 and 43	L R	3	.5	Ground at Center Tap of 2.5-Volt Heater Winding (A. F.)
42 to 43	L R	3	.6	2.5-Volt Heater Winding (A. F.)
44	Same as Terminal No. 40			
45	H R	3	.08	R_{20} and Ground Connection
46 and 47	Same as Terminals Nos. 41 and 42			
46 to 47	Same as Terminals Nos. 41 to 42			
48	L R	55	.3	R_6 and Ground Connection

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MODEL 220 CONTINUITY CHART—Continued

ALL CONTINUITIES TO GROUND WITH TUBES REMOVED, SPEAKER DISCONNECTED, AND VOLUME AND ACOUSTIC CONTROL IN MAXIMUM POSITION

Terminal No.	Continuity Meter Switch Position No. 1	Continuity Meter Switch Position No. 2	Normal Reading	If Meter Reading Differs Greatly from "Normal Reading" Investigate the Following:
49	H R	Open	.68	R_6 and R_7
50	H R	Open	.28	C_9, R_{17}, Audio Choke; also see Terminal No. 13
51 and 52	Same as Terminals Nos. 42 and 43			
51 to 52	Same as Terminals Nos. 42 to 43			
53	L R	Open	.12	C_{10} and R_{16}
54	H R	Open	0	C_9 and R_{18}
55	H R	Open	.46	C_4, Primary of Input Transformer; also see Terminal No. 13
56	H R	Open	.76	Ground Connection
57	H R	Open	.34	R_{15} and C_{20}
58	L R	Open	.18	Secondary of Input Transformer and Center Tap Ground
59	H R	Open	0	Plate Terminal of G-50 Tube Socket and Speaker Cable
60 and 61	H R	Open	0	7.5-Volt Filament Winding and Center Tap
60 to 61	L R	3	.46	7.5-Volt Filament Winding
62	Same as Terminal No. 58			
63	Same as Terminal No. 59			
64 and 65	Same as Terminals Nos. 42 and 43			
64 to 65	Same as Terminals Nos. 42 to 43			
66	H R	Open	.76	Ground Connection on Speaker Cable
67	H R	Open	0	See Terminals Nos. 60 and 61
68	H R	Open	.48	See Terminal No. 13
69	H R	Open	0	G-81 Filament Winding, C_{17}, C_{18} and Filter Choke
70	H R	Open	0	See Terminal No. 59
71	H R	Open	0	See Terminal No. 59
72	H R	Open	0	C_{15}, C_{16}, Primary of Power Transformer and A. C. Switch
73	H R	Open	0	See Terminal No. 72

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CONTINUITY WITH SPEAKER CONNECTED

ALL CONTINUITIES TO GROUND WITH TUBES REMOVED AND VOLUME AT MAXIMUM POSITION

Terminal No.	Continuity Meter Switch Position No. 1	No. 2	Normal Reading	If Meter Reading Differs Greatly from "Normal Reading" Investigate the Following:
66	H R	Open	.76	Ground Connection
67	L R	Open	.46	765-Ohm Field Coil
66 to 67	L R	Open	.46	765-Ohm Field Coil
68	H R	Open	.5	See Terminal No. 13 Above
69	H R	Open	.44	5,500-Ohm Field Coil; also see Terminal No. 69 Above
68 to 69	H R	Open	.64	5,500-Ohm Field Coil
70 and 71	H R	Open	.44	Primary of Output Transformer; also see Terminal No. 69
70 to 71	L R	55	.1	Primary of Output Transformer

*Note that the readings vary according to the polarity of the test leads. Use the polarity giving approximately the same results as given above.

MODEL 220 CHASSIS TABLE OF VOLTAGE AND CURRENT READINGS

ALL D. C. VOLTAGE READINGS ARE TO GROUND

Tube Purpose	Type Tube	Filament Voltage A. C.	Plate Voltage D. C.	Filament to Ground D. C.	Cathode to Ground D. C.	Plate Current M. A.-D. C.	Screen Voltage D. C.	Screen Current M. A.-D. C.
R. F. Amp.	G-35-S	2.5	250	0	3	4.8	100	.5
Oscillator	G-27-S	2.5	100	0	0	8.5	....	....
1st Detector	G-35-S	2.5	250	0	6	5.0	100	.7
1st I. F. Amp.	G-35-S	2.5	250	0	3	9.2	100	1.0
2nd I. F. Amp.	G-35-S	2.5	250	0	3.5	3.5	100	.6
2nd Detector	G-2-S	2.5	0	0	0	0	....	....
1st Audio	G-35-S	2.5	185	0	2	1.5	46	.3
2nd Audio	G-27-S	2.5	280	0	20	4.5	....	....
Power Amp.	G-50	7.5	500	84	....	40	....	....
Power Amp.	G-50	7.5	500	84	....	40	....	....
Rectifier	G-81	7.5	....	550	....	60	....	....
Rectifier	G-81	7.5	....	550	....	60	....	....

First Condenser—550 Volts D. C.
Second Condenser—520 Volts D. C.

Third Condenser—250 Volts D. C.
Line Voltage—115 Volts

Volume Control—Maximum
Phono Switch—Radio Position

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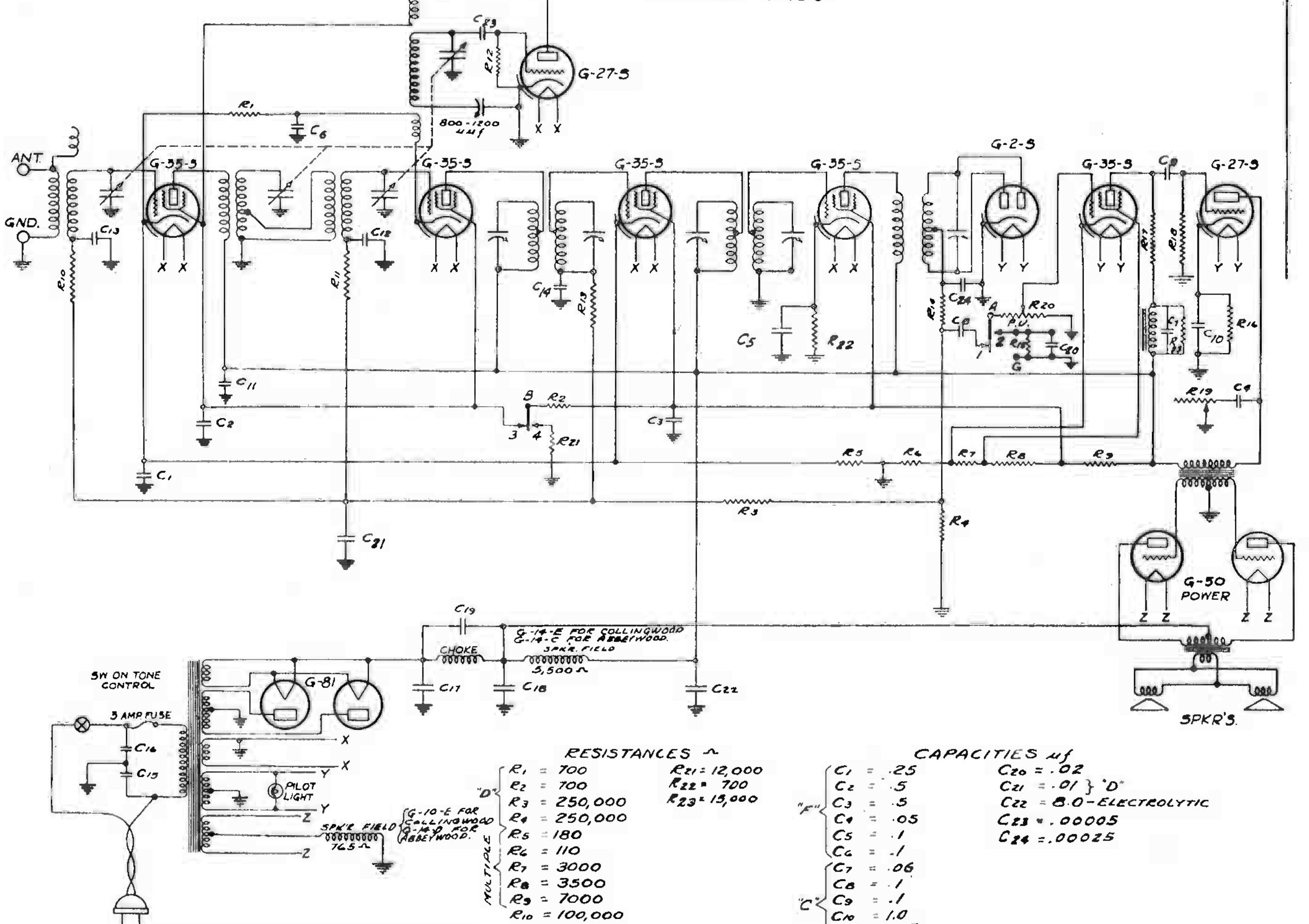
Fig 132
2-2-32-133.1
2-12-32 133-2

Schematic Diagram of Majestic Automatic Volume Control Superheterodyne Receiver
Model 220



115 VOLTS - 60 CYCLES - 200 WATTS.

"A" & "B" = PHONO-RADIO SWITCH
"E" = FILTER COND. CAN
"F" = R.F. BY-PASS CAN
"C" = A.F. BY-PASS CAN
"D" = RESISTOR STRIP

RESISTANCES Ω

"D"	R_1	= 700
"D"	R_2	= 700
"D"	R_3	= 250,000
"D"	R_4	= 250,000
MULTIPLE	R_5	= 180
MULTIPLE	R_6	= 110
MULTIPLE	R_7	= 3000
MULTIPLE	R_8	= 3500
MULTIPLE	R_9	= 7000
	R_{10}	= 100,000
	R_{11}	= 100,000
	R_{12}	= 100,000
	R_{13}	= 100,000
	R_{14}	= 25,000
	R_{15}	= 30,000
	R_{16}	= 4000
	R_{17}	= 25,000
	R_{18}	= 1,000,000
	R_{19}	= 50,000
	R_{20}	= 200,000
	R_{21}	= 12,000
	R_{22}	= 700
	R_{23}	= 15,000

CAPACITIES uf

"F"	C_1	= .25
"F"	C_2	= .5
"F"	C_3	= .5
"F"	C_4	= .05
"F"	C_5	= .1
"F"	C_6	= .1
"C"	C_7	= .06
"C"	C_8	= .1
"C"	C_9	= .1
"C"	C_{10}	= 1.0
"C"	C_{11}	= .25
	C_{12}	= .01
	C_{13}	= .01
	C_{14}	= .01
"E"	C_{15}	= .01
"E"	C_{16}	= .01
"E"	C_{17}	= 2.0
"E"	C_{18}	= 4.0
"E"	C_{19}	= .25
"D"	C_{20}	= .02
"D"	C_{21}	= .01
	C_{22}	= 8.0-ELECTROLYTIC
	C_{23}	= .00005
	C_{24}	= .00025

GRIGSBY-GRUNOW CO.
CHICAGO, U.S.A.

HAMMARLUND MFG. CO.

Operating Instructions for

HAMMARLUND ALL-WAVE RECEIVER "THE COMET"

[SECOND EDITION: Revised to include Improvements]

The following tubes are used in the Comet: Four 58's; two 57's; one 247, and one 280.

The tube sockets are correspondingly numbered and care should be taken to see that the tubes are inserted in the proper sockets. The two Isolantite sockets in the center of the chassis are for the plug-in tuning coils.

Place plug into a 110 volt, 60 cycle Alternating Current outlet only. Connect the antenna and ground. No special type antenna is required and almost any length will prove satisfactory, except in locations where severe interference is encountered. Under such conditions a rather short antenna will generally improve matters. However, too much stress cannot be put on the need for experiment in the matter of antenna layouts for short wave reception. Each receiving location has its own peculiarities and since the receiver noise level in the "Comet" is so exceptionally low, any improvement in the signal to noise ratio of the antenna system will pay big dividends in the form of improved weak signal reception. Ground connections are also a matter for experiment. All variable or high resistance joints must be carefully avoided in both antenna and ground systems. The "Ant-Gnd" block in the "Comet" has three terminals. When the conventional Antenna and Ground arrangement is used a jumper should be connected from the "G" terminal to the adjacent "A" terminal and then to the ground wire. The remaining "A" terminal should then be connected to the antenna.

Various types of balanced antenna systems such as doublets often provide improved reception at high frequencies. For proper operation of such a system the primary of the antenna coupler in the receiver should not be grounded. In the "Comet" the two ends of this primary are connected to the two "A" terminals. The "G" terminal is connected direct to the chassis. The two leads from any balanced antenna system may therefore be connected to the two "A" terminals. The "G" terminal may or may not be connected to ground depending on which condition yields better results. In certain locations quieter reception may often be secured by the use of two separate ground connections and a conventional antenna. In this case the antenna should be connected to one "A" terminal, one ground connection to the other "A" terminal, and the remaining ground to the "G" terminal.

The "Comet" loud speaker has a three wire cable with a special connector terminal. This cable should be attached to the triple terminal block on the back edge of the chassis. The three spade lugs on the cable connector should be slipped under the screw heads from the rear and the three screws tightened. When properly attached the cable connector will be even with the back edge of the chassis. *Under no circumstances should the set be turned on with the speaker disconnected.*

Coils marked OSC go in left-hand coil socket. Coils marked W. L. go in right-hand socket. However, no damage will result if a coil is inserted in the wrong socket, but the set will not function properly.

Large knob in center is main tuning control. Upper left-hand knob is OSC vernier. Upper right-hand knob is W. L. vernier. Lower left-hand knob is combination switch and tone control. When turned far as it will go in counterclockwise direction the set is turned off. Lower right-hand knob is volume control. Toggle switch in center under main tuning knob controls the intermediate frequency oscillator. To the right—on—and to the left—off—.

To tune in a station say between 14 and 30 meters, insert the No. 11 OSC coil in the left-hand coil socket and the No. 11 W. L. coil in the right-hand coil socket. Turn on the set and turn the volume control about half way on. Then throw the toggle switch to the right starting the intermediate oscillator. Adjust the W. L. vernier until the rushing sound is loudest and then turn the main tuning control *very* slowly until a whistle is heard. If the whistle is continuous tune it to a low pitch and throw the toggle switch to the left stopping the intermediate oscillator. If the whistle was caused by the carrier wave of a short wave broadcast station speech or music should now be heard. A slight readjustment of both verniers should now be made and the volume control adjusted for clearest reception. It is extremely important that the dial be turned very slowly since otherwise stations will be passed over. Signals of other wavelengths may be tuned in in the same manner.

As stations are heard it is a good plan to keep a "log" or record showing the coils used, the dial setting, and the wavelength of the station. In this way a tuning list will gradually be built up which will furnish a guide for searching for other stations as well as locating these same stations at some subsequent date.

SHORT WAVE PECULIARITIES

The "Comet" Superheterodyne is probably the most outstanding recent contribution to the Short Wave Communication field. In addition to being the most reliable short wave receiver, it is also a high quality receiver for broadcasting, two really exceptional sets in one.

It is now entirely feasible to cover distances that would seem miraculous only a short time ago. This distant reception is most reliably accomplished on short waves and in

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many cases quality is better than on regular broadcast wavelengths, and with more freedom from static. Strange to say, reception from greatest distances is best accomplished in daylight rather than night-time, due to certain peculiarities of short waves.

An understanding of some of the peculiarities of short waves is essential if the capabilities of a short wave receiver are to be fully realized. The following has for the most part been taken from articles in radio publications fully cognizant with short wave receiving conditions throughout the world. To some readers there may not be much that is new, but to those starting fresh in the game it will be of immense help in enabling short wave reception from many foreign stations to be immediately enjoyed and will eliminate the hours of exasperation usually attendant to beginners' first efforts at operating a short wave receiver.

One magazine of prominence states, "At the outset, let us be frank and admit that the short wave *converter*, which is now in creasing vogue, is a temperamental instrument, and is not as efficient as a "pure" short wave set. The reason for the odd behavior of the converter at times must be ascribed direct to the broadcast set in conjunction with which it is used." "Comet" owners do not have this handicap to contend with for the "Comet" is a complete receiver, and of the very highest order of development.

The same magazine calls attention to the fact that every location is an entity by itself. This is particularly so in large cities, but is not so serious in the country. In large cities we have peculiarities in "dead spots" and poor reception from short waves due to "absorption" by large steel structures, and other freak conditions which no one can foretell. In the open country conditions are vastly better, but in the city short wave receiving conditions are "spotty" and must be studied. Sometimes the change of an aerial in a poor location will work wonders. The foregoing applies only to short wave reception. When the "Comet" is operated on regular broadcasting wavelengths it becomes a standard broadcasting receiver and is subject only to the well known limitations applying to any other receiver of equivalent quality.

HINTS ON SHORT WAVE TUNING

The magazine of the International Short Wave Club in their October, 1931, issue, published the best article on short wave tuning we have ever seen. The greater part of the following has been taken from it.

We are daily in contact with hundreds of listeners who do not seem to understand that certain details of tuning are necessary to get good results from a shore wave receiver. Tuning a short wave set is entirely different than tuning a regular broadcast receiver. A great many details make up this difference, as high frequencies or short waves have characteristics entirely unlike the long waves. Receivers, too, are made somewhat different inasmuch as the wavebands covered must be compensated for by different coils and not just one set of coils. All in all, it is simply a matter of the operator learning how to tune his set. A good receiver does not solve the question of results on short waves, for the operator must learn something about short waves and their peculiarities also. Once this is mastered, it is just as simple to get distant stations under ordinary circumstances as to get local stations.

As stated previously, the first thing a new listener should do is to log as many local stations as possible and mark down their dial settings. Since stations do not appear on every part of the dials, these stations will act as guides to locating distant stations. The operator should also find just what each dial on his set does when tuned, and what effect they have on the stations once they are tuned in. Locating the spot where stations are heard the best is a good idea.

We repeat that the wavelength dial should be rotated slowly, and by slowly we mean just that. Don't skim over the dials and expect stations to come rolling in. The "Comet" has a special easy tuning feature. This is the intermediate oscillator which permits stations to be located by the squeal method as described in the section of this folder devoted to special operating instructions for the "Comet."

In "fishing" for stations, the listener should time his reception, or tune on certain wavelengths at certain times of the day. From 14 to 20 meters all tuning should be done from daybreak till 3 P. M., local time. From 20 to 33 meters, stations to the east of the listener will be heard best from about 11 A. M. till 10 P. M. Stations to the west of the listener in this band should be heard best from midnight till about two hours after daybreak, when they will fade out. From 33 to 70 meters, distant stations can be heard only after darkness falls. Very little in the way of distance can be heard above 70 meters, although the ships, police, fire, coast guard and aircraft stations are all heard above that wavelength.

Short wave stations have a habit of changing in volume from time to time, these changes being affected mostly by the amount of daylight between the stations and the listener. For example, European stations are always best for American listeners during the summer months. In reverse, South Americans are best during the winter months. Each year we hear from hundreds of listeners arguing that winter months are best for distant reception and others that summer months are best. It depends mostly on the habits of the listener and his location. By habits we mean, the stations for which he generally tunes. There is not the least doubt that European stations are best during the summer months and stations like G5SW, I2RO, PCJ, Zeesen and OXY are best during these months.

Differences in time is one thing which is hard for short wave fans to understand. Listening to "Big Ben" strike midnight at 7:00 P. M. in New York brings this to mind, but still listeners who fail to hear this station at 8:00 P. M. wonder why it is not found. Almost all stations broadcast on schedules that conform with time in their part of the world. Europeans, with the exception of PCJ, who broadcast special programs for American and Australian listeners at times, close down as early as 6:00 P. M. South Americans are heard from then till midnight, Eastern Standard Time. Stations in Siam, Japan and that part of the world get busy while New Yorkers are thinking about breakfast. And people in Japan are getting ready to go to bed. It is, therefore, quite natural that listeners should tune for Euro-

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pean stations in the afternoons providing they live in the United States, and tune for stations in the Antipodes in the early mornings. Always keep a good station list on hand.

A few pointers for new listeners are:

Don't expect to find stations on all parts of the dials. Short wave stations are widely separated except in a very few places.

Don't expect stations to tune broadly. Most distant stations tune very sharp.

Don't expect to hear the world the first day you tune. It requires some knowledge of tuning to get excellent results.

Don't expect to hear a station simply because it is on the air. Many things govern short wave reception.

Don't get discouraged. If reception is poor one day, it may be fine the next.

Don't skim over the dials. Tune slowly.

Don't pass up any weak signals. Oftimes a weak program can be brought out plainly by a careful tuning.

Don't tune for stations when they are not on the air. Use a good station list. Refer to timely schedule information appearing in short wave magazines, such as the International Short Wave Club periodical.

Don't tune haphazardly. Learn where stations should be found on the dials of your particular receiver.

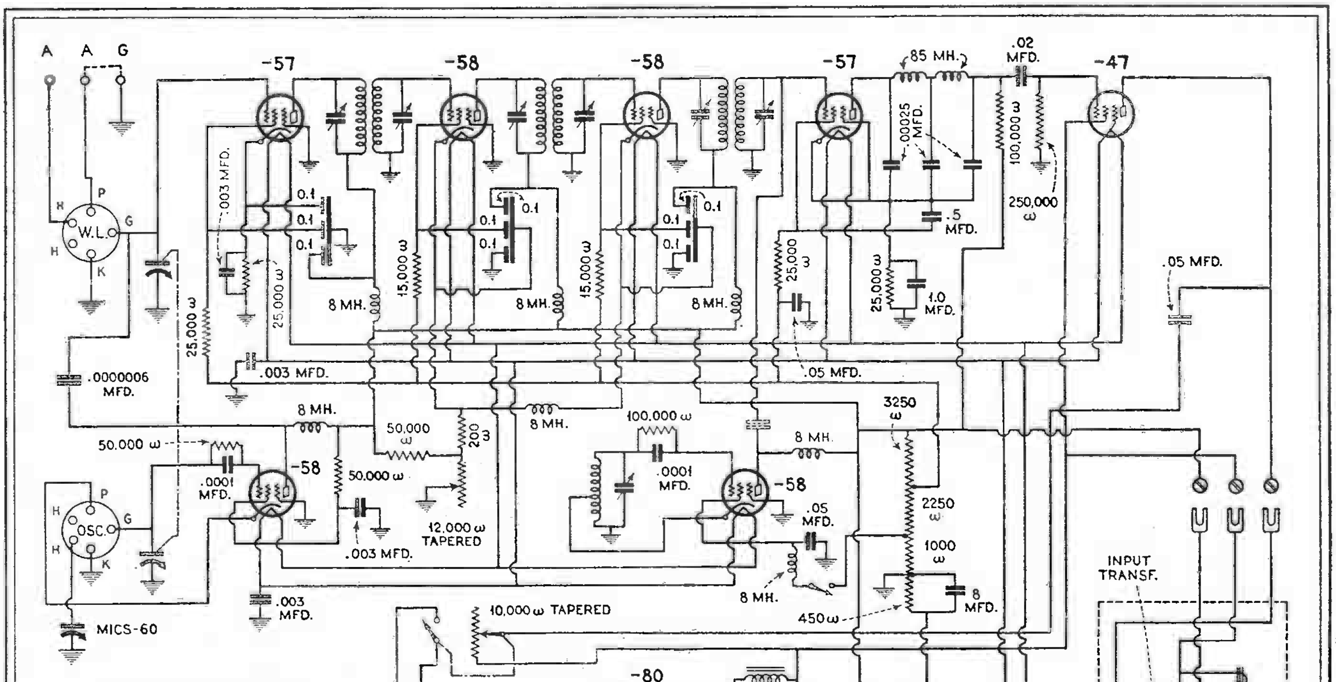
Don't expect wonderful results with a poor receiver. A good receiver is necessary for good results.

Don't tune above 33 meters for distant stations in daylight.

Don't tune below 25 meters for distant stations after dark.

The following tables show voltages at various points in the circuit of the "Comet." When checking up on these voltages, a high resistance DC voltmeter with 1,000 ohms per volt resistance, such as the Weston No. 489, should be used. Connect the negative terminal of this voltmeter to the chassis, turn on the set and adjust the volume control to minimum position. Attach a piece of wire to the positive terminal of the voltmeter. The free end of this wire is then brought to the terminals shown below.

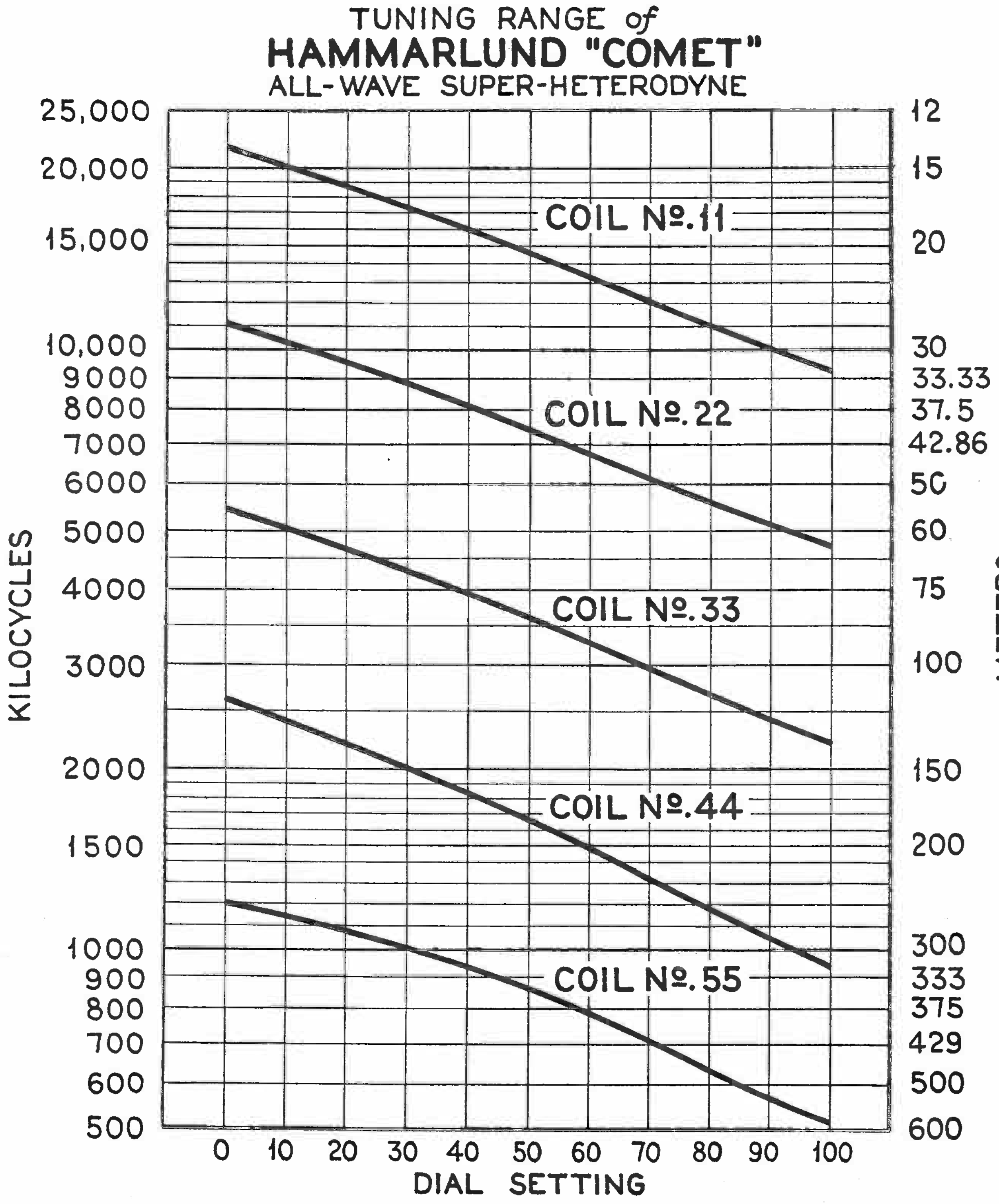
	Volts (Approximate)	
Top terminal of voltage divider	200	"
Second terminal of voltage divider	100	"
Third terminal of voltage divider	30	"
Fourth terminal of voltage divider	0	"
Bottom terminal of voltage divider	20	"
K terminal of first detector	5	"
K terminal of first and second I.F. (Max.)	35	"
(Varies with volume control) (Min.)	3	"
K terminal of second detector	5	"
P terminal of second detector	135	"
P terminal of H.F. oscillator, first and second I.F., first detector and I.F. oscillator	200	"
G terminal of first detector, second detector and first and second I.F.	110	"
G terminal of H.F. oscillator	90	"



HAMMARLUND
"COMET" ALL-WAVE
SUPERHETERODYNE

OCTOBER, 1932

HAMMARLUND MFG. CO.



This tuning chart will assist you greatly in finding broadcast and short wave stations. For instance, if you wish to tune in to G5SW, who transmit on 25.53 meters, look at coil No. 11 curve. You will find that this wavelength falls at about 72 on the tuning dial. Let us take OXY as another example. This station is on 31.51 meters. Looking at coil No. 22 curve, you will note that this frequency will be found at about 19 on the dial.

GALVIN MFG. CORP.

GALVIN MOTOROLA MODEL 61 AUTOMOTIVE RECEIVER

(Incorporating a type 85 duodiode-triode tube as a combination second-detector, automatic volume control and first A.F. amplifier.)

This automotive receiver incorporates the following tube combination: Tube V1, type '36 screen-grid as an R.F. amplifier; V2, type '39 variable-mu R.F. pentode as a combination oscillator and first-detector; V3, type '36 screen-grid I.F. amplifier; V4, type 85 duodiode-triode as a combination second-detector, automatic volume control and A.F. amplifier; V5, type 41 high-mu special automotive pentode second A.F.

High voltages are obtained from the storage battery of the car by means of an interrupter system and step-up transformer, in the manner described in the Sept. 1932 issue of RADIO-CRAFT, pg. 152. 152.

Following are the values of the components of this modern radio set: Condensers C1, C2, C3, tuning condenser gang; C4, C8, coupling condensers; C5, C6, C7, I.F. trimmers; C9, C13, C17 (buffer), .05-mf.; C10, 0.5-mf.; C11, 0.25-mf.; C12, 500 mmf.; C14, .002-mf.; C15, .01-mf.; C16, 1. mf.; C18, C19, 8 mf.; C20, C21, 0.1-mf.

Resistor R1, volume control potentiometer, 0.5-meg.; R2, R4, R7, R8, 0.1-meg.; R3, 75,000 ohms; R5, 5,000 ohms; R6, 500 ohms; R9, 0.2-meg.; R10, 50,000 ohms; R11, 0.7-meg.

It is not recommended that any repairs be made to a defective Elkonode (interrupter.) All such units should be returned to the factory (Galvin Mfg. Corp., Chicago, Ill.), or to the manufacturers of the Elkonode (see label on unit).

An open buffer condenser, C17, will be indicated by failure of the rectifier tube V6 to stay ionized. A purple glow in the tube is an indication of correct operation of this type of rectifier; a shorted C17 condenser will be indicated by spasmodic operation of the Elkonode, as well as failure of V6 to glow. As a general rule, when spasmodic operation of the Elkonode is observed it is an indication that the Elkonode is not feeding into the correct load; it either is underloaded or overloaded; two undesirable conditions.

After the Elkonode has been removed, it may be tested by applying 6 volts to the large terminals, with positive polarity to the brown wire; it is also necessary to connect a 5,000-ohm resistor across the red (or green) and black wires, together with an 8 mf. electrolytic condenser and a voltmeter. With this setup, the Elkonode should consume not more than 2.25 A.; the voltage drop across the 5,000-ohm load should be between 160 and 170 volts, provided the battery voltage is exactly 6.3.

The following precautions should be observed: Do not remove the receiver section of the set from the power pack, with the set turned on; the BR tube, V6, should not be removed from its socket unless the set is turned off. Since the "A" supply is polarized, it is necessary to make certain that the red wire connects to the positive terminal and the white wire to the negative terminal of the battery; do not operate the set with the "A" leads reversed, otherwise the Elkonode will be damaged beyond repair. For this reason, the polarity of the car battery should be double-checked by means of a voltmeter before the set is put into operation. (Reversed connection to the "A" battery will be indicated by low "B" voltage, spasmodic operation of the Elkonode and erratic flashing of V6.)

An ideal place for the reproducer is face-out, with the reproducer flush with the instrument board, but such a position is undesirable because of the space factor. Therefore, the first alternative is to leave it at the same level but to move it back to the bulk-head, for good operation.

If there is not room to mount the reproducer in that position, a second method is to face the reproducer toward the floor-boards, with the front-edge of the reproducer against the instrument board and the side against the side of the car, a position available in most cars.

It generally necessitates two holes being drilled through the instrument board to hold the reproducer and an additional bracket run from the adjacent side of the reproducer to the side of the car. This location is rather new to some installation men, but its acoustic properties are superior because of the additional baffle effect which results from the close proximity to the instrument board.

Following is a listing of the preferred location for automotive radio receivers to be used in the 1931 car models specified:

Ford, Model A: Motor compartment on the left side;
Chevrolet: Motor compartment on the left side or below the cowl on the right inside; (For 1932 model, remove carburetor and air cleaner, temporarily.);
Buick: Below the cowl on the right inside;
Chrysler: Right side of car under cowl;
Pontiac: Left side of motor compartment or right side of car under cowl;
DeSoto: Ditto;
Plymouth: Left motor compartment or right side of car, under cowl;
Cadillac: Ditto;
Lincoln: Center of motor compartment or right side of car, under cowl;
Packard: Ditto; (Light Eight, left side of motor compartment.);
Oakland, V8: Below cowl on right side or right side of car, under cowl;
Studebaker: Left motor compartment or right side of car, under cowl;
Oldsmobile: Right motor compartment or right side of car, under cowl;
Auburn: Right motor compartment or right side of car, under cowl.

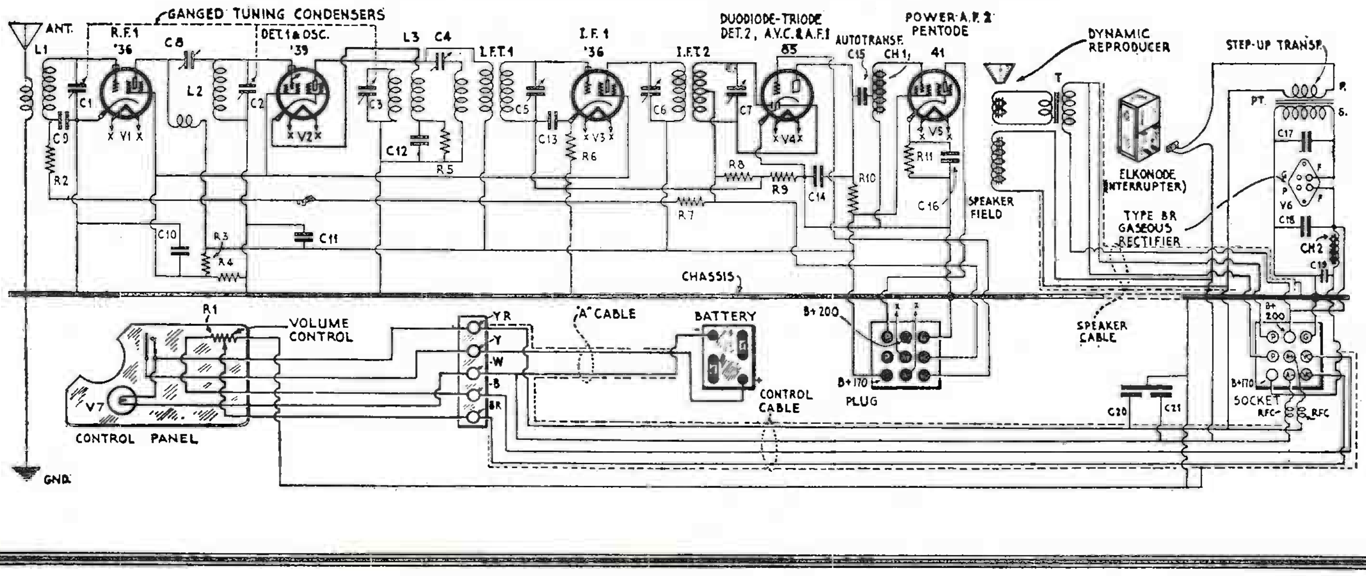
(The "bulkhead" is the partition in the car which separates the motor compartment from the driver's compartment.)

Car manufacturers have furnished the following data regarding their provisions, in 1932 models, concerning automotive radio antennas:

Chrysler: Roof antenna with lead-in and provisions for "B" battery box;
Dodge: Ditto;
DeSoto: Ditto;
Plymouth: Ditto;
Reo: Equipped with roof antenna and lead-in;
Rockne: Ditto;
Studebaker: Ditto;
Buick: All models, $6.00 additional for antenna installation;
Franklin: Roof antenna but no lead-in;
Ford: Ditto;
Cunningham: All models, additional charge for antenna installation.

Check the proposed antenna for ground by means of a 0-200 V. meter, of 1,000 ohms-per-volt type, and a 200 V. battery. Even on damp days the leakage should not exceed 2 V. Lack of peak resonance on the antenna trimmer indicates a leaky antenna, or one having too great capacity; in general, an antenna screen area of about 9 sq. ft. will be satisfactory.

The dynamic reproducer may be checked for a rubbing voice coil by applying 50 V., 60 cycles, to the two outside or "B" terminals of the output transformer; instead of a clear, steady hum, a rubbing noise will be heard, if the voice coil is not floating entirely clear.



KOLSTER RADIO, Inc.

KOLSTER MODELS K-140 AND K-142 10-TUBE SUPERHETERODYNE

(Dual reproducers, dual band-selectors, antenna transmission line, phono.-radio operation; A.V.C.; provisions for connecting remote control and an S.W. converter; neon-tube visual tuning.)

A radio receiver that excellently represents the advances which have been made in radio receiver design is the Kolster model K-140 (50- to 60-cycle) and the model K-142 (25- to 60-cycle) 10-tube superheterodyne.

Following are the condenser values employed in these chasses: C1, C2, C3, C4, 4-gang tuning condenser unit; C1A, C2A, C3A, C4A, R.F. trimmer condensers; C5, padding condenser, 600 mmf.; C5A, pad R.F. trimmer condenser; C6 to C11, I.F. trimmers; C12, tone control, 50 mmf. to .0045-mf.; C13, 0.5-mf.; C14, C31, 100 mmf.; C15, C16, C23, C24, C29, 0.1-mf.; C17, 1. mf.; C18, C25, 500 mmf.; C19, C20, C21, dry electrolytic, 8 mf.; C22, dry electrolytic, (25 cycles, only), 4 mf.; C26, C28, C30, 0.25-mf.; C27, .01-mf.; C32, .025-mf.; C33, electrolytic, 4 mf.

Resistor R1, manual volume control, 0.5-meg.; R2, 500 ohms; R3, R4, R5, R6, R9, R14, R23, 0.25-meg.; R7, 750 ohms; R8, 0.5-meg.; R10, R16, R19, R20, 25,000 ohms; R11, R15, 5,000 ohms; R12, 75,000 ohms; R13, 50,000 ohms; R17, 3,000 ohms; R18, 0.1-meg.; R21, 10,000 ohms (60 cycles), or 8,000 ohms (25 cycles); R22, 10,000 ohms.

Tube operating characteristics at a line potential of 115 V. are as follows: Filament potential, V1 to V9, 2.3 V.; V10, 4.7 V. (The following potentials are measured to the cathode of the respective tube indicated.) Heater potential, V1, V4, V5, 2.5 V.; V2, 6 V.; V3, V6, zero; V7, 10 V. Control-grid potential, V1, 0.2-V.; V2, V6, 1. V., and V7, 1. V. (with vol. control at maximum) to 10 V. (with vol. control at minimum): V3, 2V.; V4, 6 V.; V5, 3.6 V.; V8, V9, 4 V. Screen-grid potential, V1, 85 V.; V2, 80 V.; V4, V5, 110 V.; V8, V9, 245 V. Plate potential, V1, 130 V.; V2, 120 V.; V3, 90 V.; V4, V7, 175 V.; V5, 180 V.; V6, zero; V8, V9, 225 V.; V10, plate-to-plate potential, 725 V., A.C. Plate current, V1, 1. ma.; V2, 0.4-ma.; V4, 1.1 ma.; V5, 1.2 ma.; V8, V9, 5 ma.

Any attempts to align the I.F. circuits of the K-140 chassis in the usual manner will result in instability and poor over-all fidelity, if adjustments are made in the conventional manner and with a modulated oscillator, tuning for maximum output. In fact, no attempt should be made to vary these settings, which are determined by special test equipment at the factory for obtaining 10 kc. selectivity throughout the entire broadcast band, unless it is absolutely necessary. The procedure is as follows:

Remove the voice-coil shunt connection and connect the output meter to the secondary of transformer T2. Next, remove the oscillator tube and the cap lead of V5, and connect the output of a 175 kc. service oscillator to the cap of the tube. Then, adjust C10 and C11 for maximum output. Replace the cap lead, couple the service oscillator to V4, and adjust C8 and C9 for maximum output at 175 kc. Next, couple the service oscillator to V2 and adjust C6 and C7 for maximum at 175 kc. The oscillator output should be coupled directly to the grids, without a dummy antenna. If the oscillator is capacitatively coupled the open grid circuit may result in circuit oscillation; in this case the grid circuit may be completed to ground through 1,000 ohms.

Now, to obtain the full tone quality for which the reproducers and the balance of the set are designed, it will be necessary to flatten out the I.F. channel so that it presents uniform gain for frequencies of 170 and 180 kc. (The gain with the flat-topped adjustment is less than when the circuits are adjusted for peak resonance.)

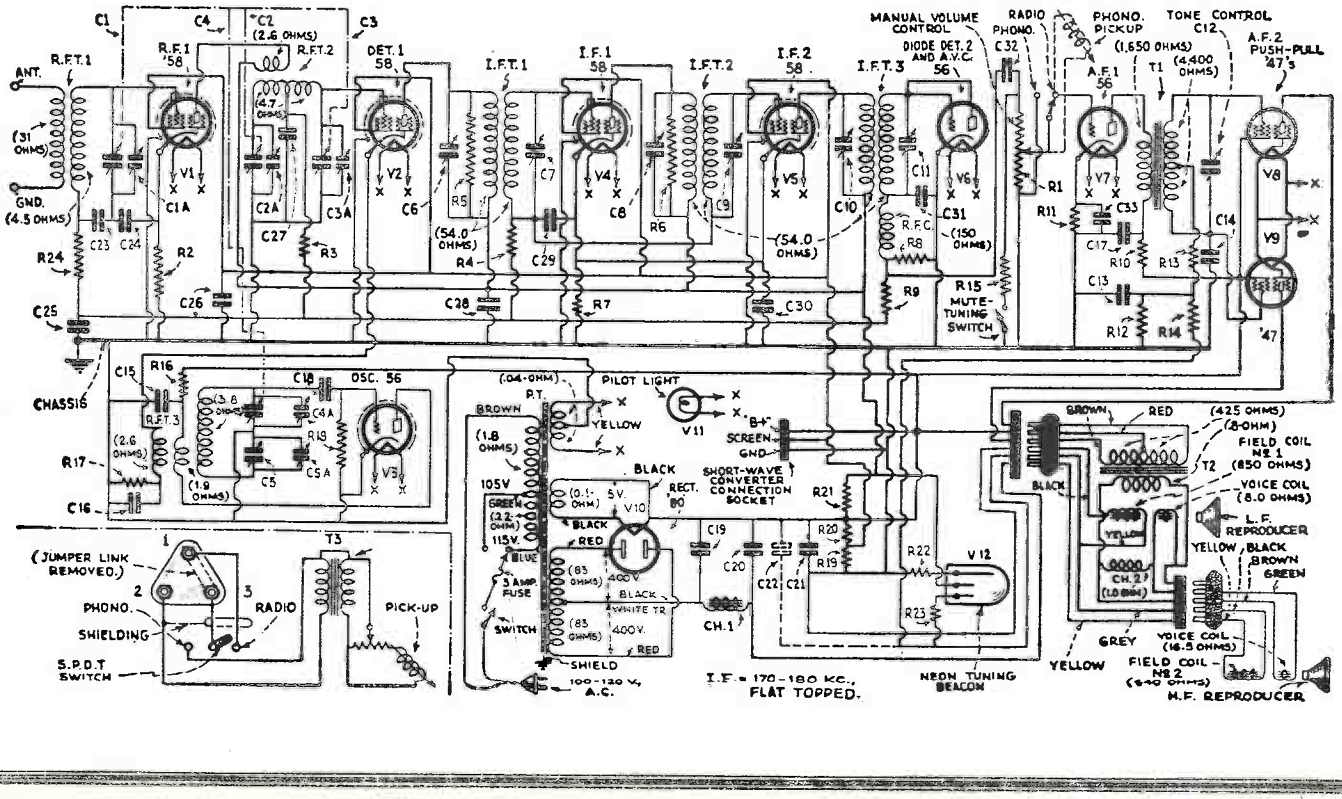
Set the service oscillator at 180 kc. and adjust the I.F. trimmers to obtain a preliminary output reading; repeat this performance, at 170 kc., to obtain the same output reading. (It will be necessary to go over the six trimmers several times.) When thus aligned the I.F. amplifier portion of the receiver should indicate the same gain at 170 and 180 kc., and less at 175 kc.

In aligning the R.F. circuits, it is necessary that the R.F. selectivity be superimposed on the middle of the I.F. selectivity graph in order that the overall selectivity figure will be symmetrical. Replace the oscillator tube and shield, couple the service oscillator to the antenna and ground terminals of the chassis (not the antenna terminal and the chassis), and operate the service oscillator at 600 kc. Adjust C4A for maximum output, while rocking the tuning dial across the 600 kc. setting, until the output remains fairly constant with a shift of several kc. either side of 600 kc.; then, finish by adjusting C1A, C2A and C3A. Reset the service oscillator to 1,400 kc. and align the oscillator circuit first. By adjusting the oscillator trimmer it is easy to locate the two peaks and the dip in the middle; the oscillator should be aligned for this dip. Finally, align the remaining R.F. circuits by adjusting C1A, C2A and C3A for maximum output. Alignment at 1,400 kc. should not affect alignment at 600 kc.

The insert indicates the circuit arrangement at the rear of the chassis for phono-radio operation; also, remote control (terminals 1 and 2). Transformer T3 and resistor R1 must be matched to the pickup, if it is of low-impedance type; T3 may be omitted if the pickup is of high-impedance type.

If the neon beacon tuning beam does not extend sufficiently high during the reception of distant stations, it may be necessary to reduce the value of resistor R2 to perhaps 7,000 ohms. If the value is made too low, the beam length will extend too far during the reception of local station programs.

A complete Kolster installation includes an antenna "rejectostat" (coupler), an R.F. transmission line (as contrasted with the relatively inefficient "shielded leadin" ordinarily used) up to 1,000 ft. long, and a receiver rejectostat" (coupler); this greatly reduces the proportion of noise pickup. The R.F. transmission line is No. 18 rubber-covered twisted pair, shielded with copper-braided sleeving, and protected with a 1/16-in. rubber covering; (or Beldin Transmission Line Shielded Cable may be used).



PHILCO RADIO & TELEVISION CORP.

PHILCO
REG. U.S. PAT. OFF

Service Bulletin—No. 141

Model 37

The Philco Model 37 is a five tube battery operated superheterodyne receiver.

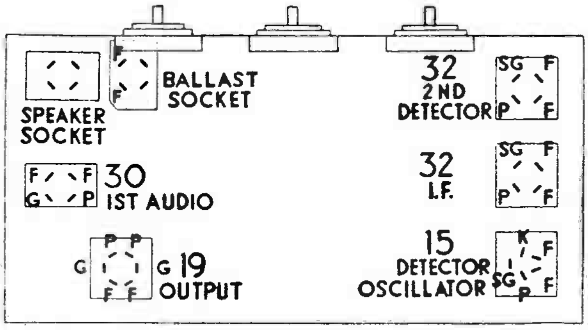
This model contains the new Philco type 15 r.f. pentode tube as detector oscillator, a type 32 screen grid intermediate frequency amplifier, a type 32 screen grid second detector, a type 30 first audio, and the new type 19 push pull (class B amplifier) output tube.

Volume equal to that of most A.C. receivers and economy in B battery operation are highly important features of the circuit. Unlike most receivers, the heavy B battery current drain, necessary to produce loud volume, is present only when such volume is actually coming through the speaker. At all other times, the current drain is small.

The filaments are supplied from the Philco Dry A battery. The chassis is equipped with an automatic voltage regulator tube which affords constant A voltage to the set throughout the life of the battery. The filament current drain from the A battery is 720 milliamperes.

The plates are supplied from standard Philco 45 B batteries. At 135 volts, the B battery current drain varies between 8 and 12 milliamperes.

The intermediate frequency of the superheterodyne circuit in this model is 175 kilocycles.



F—Filament SG—Screen Grid K—Cathode
P—Plate CG—Control Grid

Fig. 1—Tube Sockets, Under Side of Chassis

Caution.—Never connect the chassis to the power supply unless the speaker is connected and all tubes are in place.

Table 1—Tube Socket Data

Tube		Filament Volts F to F	Plate Volts P to F	Screen Grid Volts SG to F	Control Grid Volts CG to F	Cathode Volts K to F
Type	Circuit					
15	Det.-Osc.	1.9	120(P to K)	60(SG to K)	2.5(CG to K)	5.5
32	I.F.	1.9	120	60	2.5	...
32	2nd Det.	1.9	2.0	45	2.5	...
30	1st Audio	1.9	110	..	.4	...
19	Output	2.0	120/Plate	..	.4/Grid	...

Table 2—Resistor Data

No. in Figs. 3 and 4	Resistance (Ohms)	Color		
		Body	Tip	Dot
18 35	1,000	Brown	Black	Red
1	2,900	Red	White	Red
11	6,000	Blue	Black	Red
26	25,000	Red	Green	Orange
25	51,000	Green	Brown	Orange
27 29 32	99,000	White	White	Orange
31 34	490,000	Yellow	White	Yellow

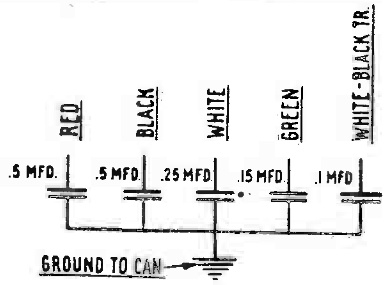
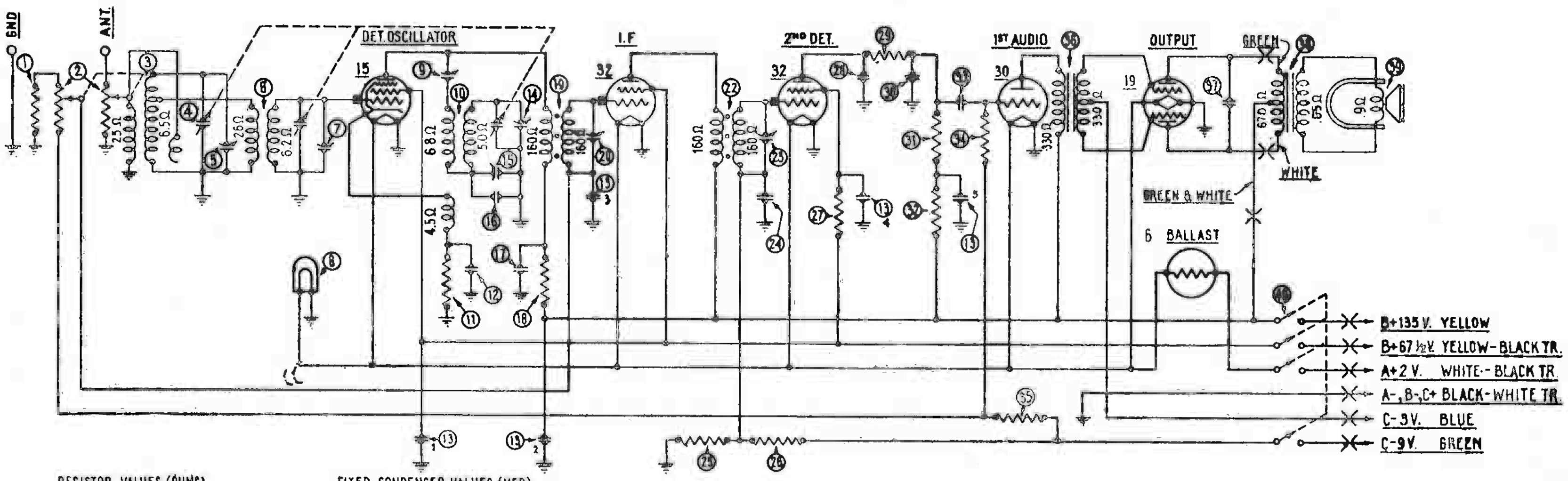


Fig. 2—Internal Connections Filter Condenser Bank

PHILCO RADIO & TELEVISION CORP.

Model 37



RESISTOR VALUES (OHMS)			
1	2,900	29	99,000
2	5,000 (DUAL)	31	490,000
11	6,000	32	90,000
18	1,000	34	499,000
25	51,000	35	1,000
26	25,000		
27	99,000		

FIXED CONDENSER VALUES (MFD)			
12	.00071	17	.05
13	-1 .5	24	.05
	-2 .15	28	.00025
	-3 .1	30	.00025
	-4 .2	33	.01
	-5 .5	37	.002
40	.00071		

Fig. 3—Schematic Wiring Diagram

PHILCO RADIO & TELEVISION CORP.

Model 37

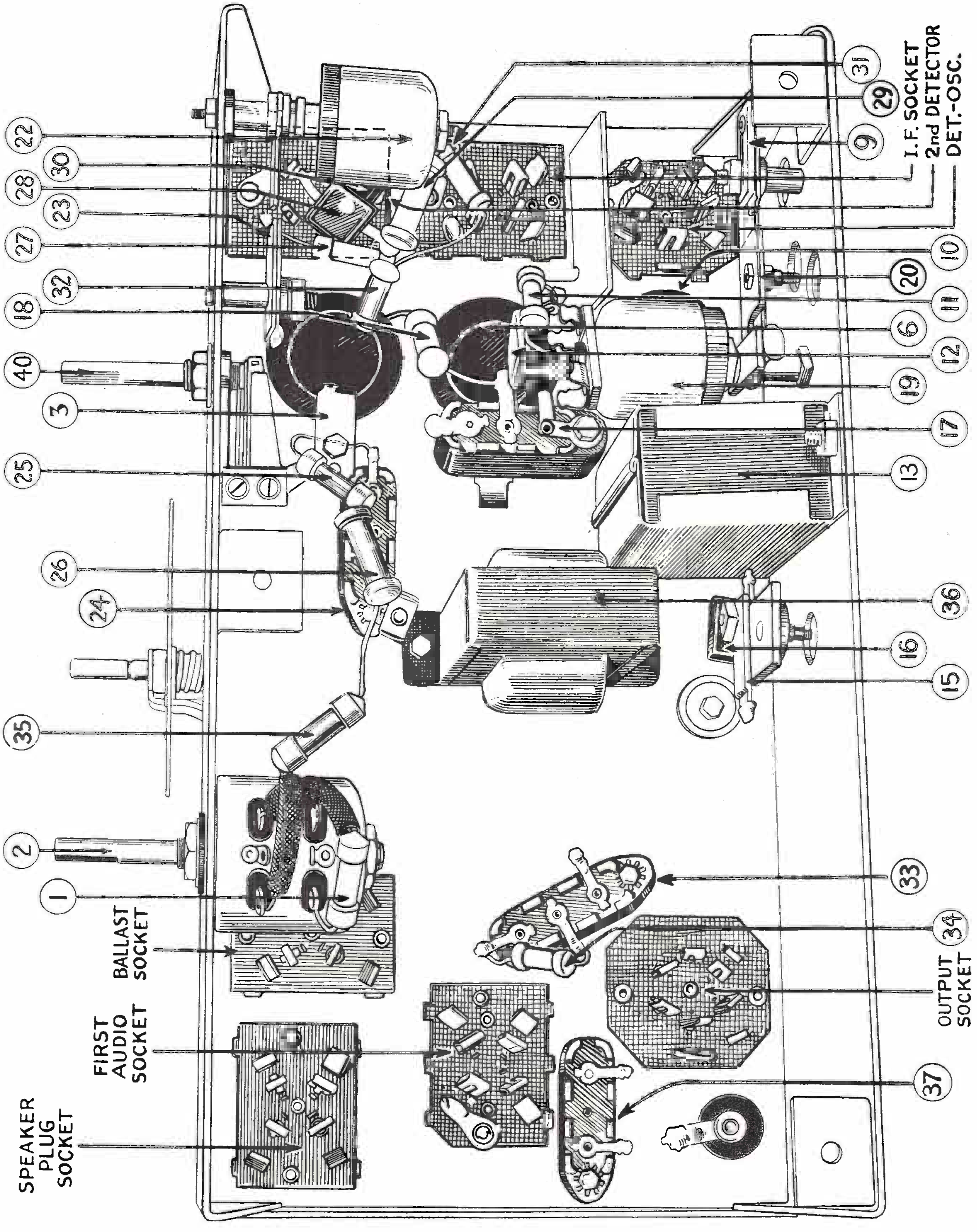


Fig. 4—Parts Diagram

PHILCO RADIO & TELEVISION CORP.

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Service Bulletin—No. 120E

Adjusting Models 80 and 37

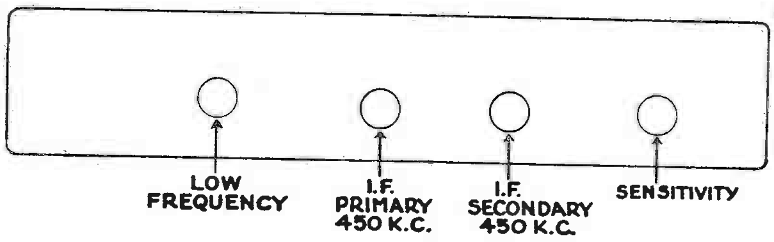


Fig. 1—Back of Model 80 Chassis, Showing Locations of Compensating Condensers.

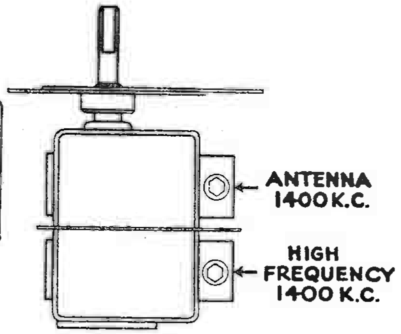


Fig. 2—Tuning Condenser, Model 80 Chassis, Showing Location of Additional Compensating Condensers.

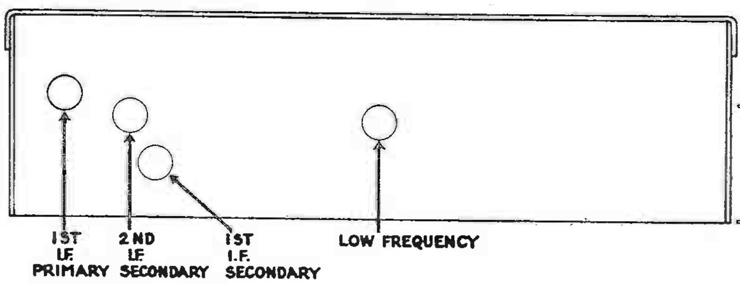


Fig. 3—Back of Model 37 Chassis, Showing Location of Compensating Condensers. The 2nd I. F. secondary condenser is mounted on the front of the chassis, but is accessible through the opening in the back as shown above.

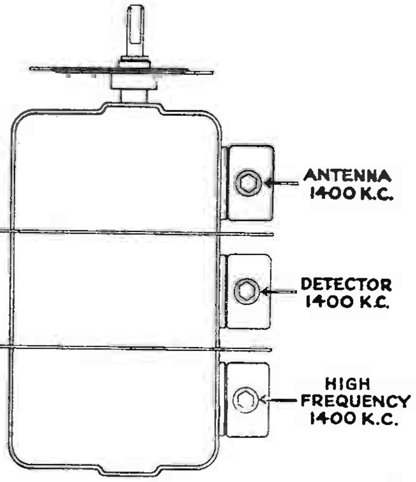


Fig. 4—Tuning Condenser, Model 37 Chassis, Showing Location of Additional Compensating Condensers.

The general method of adjusting the Philco Models 80 and 37 is the same as that for other Philco models as outlined in Service Bulletin No. 120-C. Adjustment of the I. F. compensating condensers is done first. This adjustment is then followed by the adjustment of the antenna and high frequency condensers; and finally the low frequency condenser.

It is necessary to have an accurately calibrated oscillator signal at 450 KC. for adjusting the I. F. compensating condensers in the Model 80. The Philco Model 095B Oscillator has been especially designed for this purpose, and will provide a 450 KC. signal in addition to other intermediate frequencies of 175 KC. and 260 KC. The Philco 095 oscillator can be changed readily so as to make it like the 095B. Complete instructions for this addition are outlined in Service Bulletin No. 139.

The adjustment of the "sensitivity" compensating condenser in the Model 80 should be done at the time of installation in accordance with the instructions accompanying the set.

The model 37 intermediate frequency is adjusted at 175 KC.

PHILCO RADIO & TELEVISION CORP.

Model 80

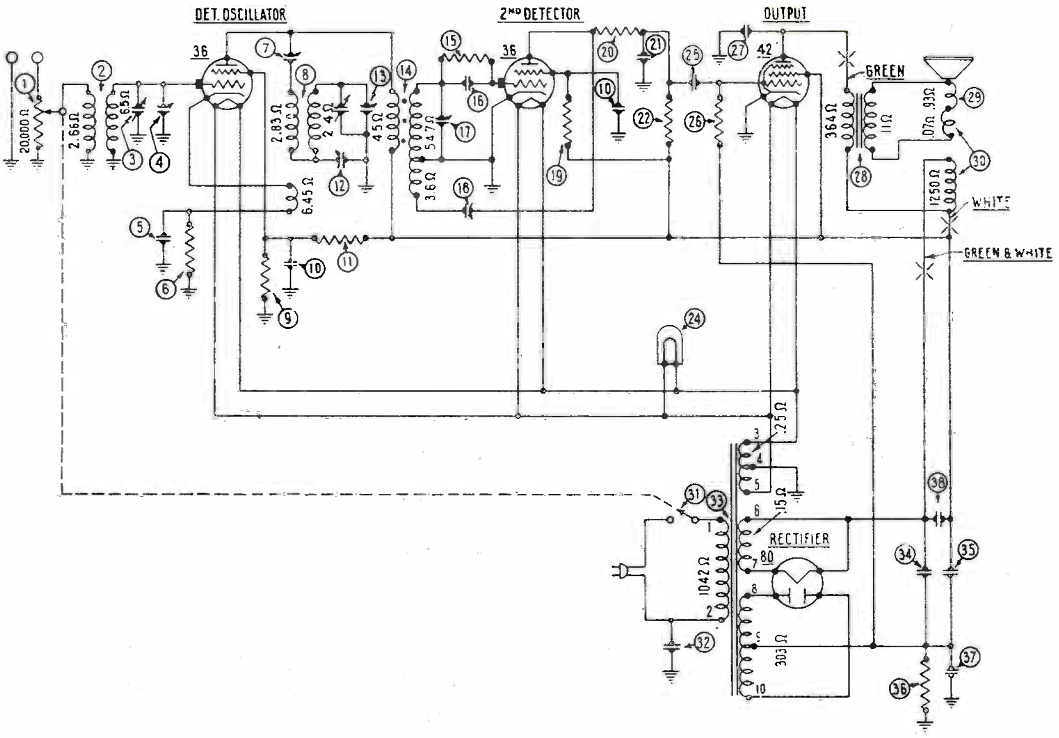


Fig. 2—Schematic Wiring Diagram

Model 80

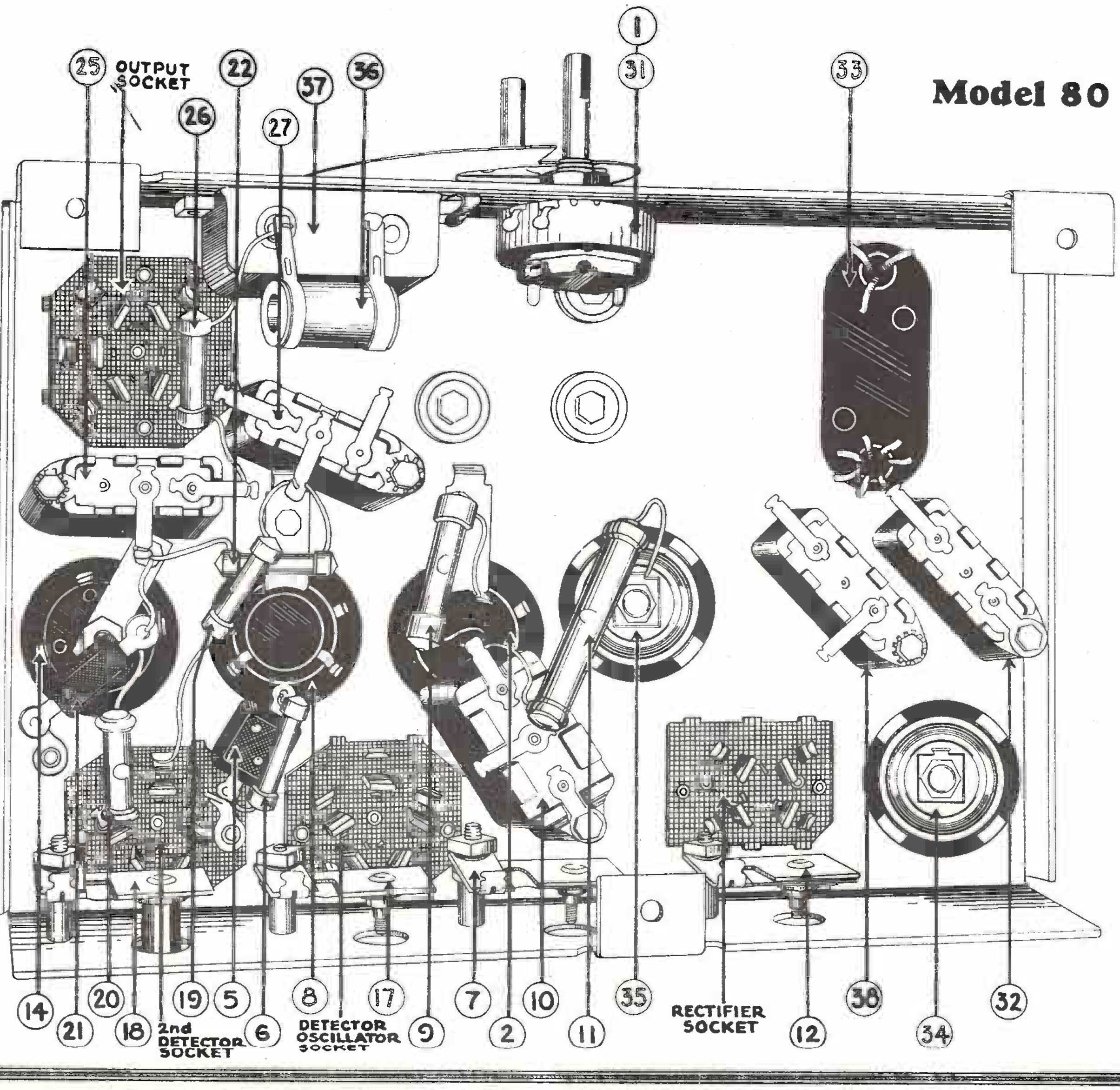


Fig. 3—Bottom View of Chassis, Showing Parts

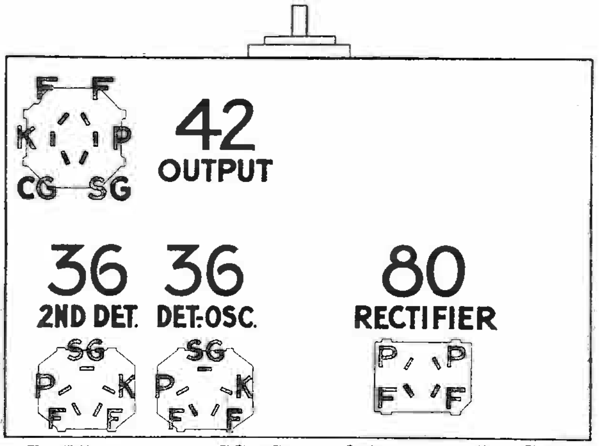
PHILCO RADIO & TELEVISION CORP.

PHILCO
REG. U.S. PAT. OFF

Service Bulletin—No. 140

Model 80

The Philco Radio Model 80 is a four tube superheterodyne, employing the new Philco high efficiency tubes with pentode output and electro dynamic speaker. The set uses a Philco type 36 tube as first detector and oscillator, a type 36 second detector, a type 42 output, and a type 80 rectifier. The intermediate frequency for tuning the I.F. transformer is 450 kilocycles. The power consumption of the Model 80 is 46 watts.



F = Filament SG = Screen Grid K = Cathode
P = Plate CG = Control Grid

Fig. 1—Tube Sockets, Under Side of Chassis

CAUTION: Never connect the chassis to the power supply unless the speaker is connected and all tubes are in place.

Table 1—Tube Socket Data*—Power Line Voltage 115 Volts

Tube Type	Tube Circuit	Filament Volts F to F	Plate Volts P to K	Screen Grid Volts SG to K	Control Grid Volts CG to K	Cathode Volts K to F
36	Det.—Osc.	6.3	245	165	6.4	8.4
36	2nd Det.	6.3	40	15	.4	0
42	Output	6.3	240	255	4	0
80	Rectifier	5.0	340/Plate	...	...	...

*All of the above readings were taken from the under side of the chassis, using test prods and leads with a suitable A.C. voltmeter for filament voltages and a high resistance multi-range D.C. voltmeter for all other readings. Volume control at maximum and station selector turned to low frequency end. Readings taken with a radio set tester and plug-in adapter will not be satisfactory.

Table 2—Power Transformer Data

Terminals	A.C. Volts	Circuit	Color
1-2	105 to 125	Primary	White
3-5	6.3	Filament	Black
6-7	5.0	Filament of 80	Blue
8-10	630	Plates of of 80	Yellow
4	...	Center Tap of 3-5	Black Yellow Tracer
9	...	Center Tap of 8-10	Yellow Green Tracer

Table 3—Resistor Data

Nos. on Figs. 2 and 3	Resistance (Ohms)	Power (Watts)	Color		
			Body	Tip	Dot
36	325		Wire	Wound	
9	9,000	1.	White	Black	Red
6 20	10,000	.5	Brown	Black	Orange
11	16,000	5.	Brown	Blue	Orange
22	240,000	.5	Red	Yellow	Yellow
26	490,000	.5	Yellow	White	Yellow
19	1,000,000	.5	Brown	Black	Green
15	4,000,000	.5	Yellow	Black	Green

PHILCO RADIO & TELEVISION CORP.

PHILCO
REG. U.S. PAT. OFF.

Service Bulletin No. 120C

THIS BULLETIN SUPERSEDES SERVICE BULLETINS NOS. 120 AND 120 B

Adjusting Philco Superheterodynes

The compensating condensers in every Philco Receiver are carefully adjusted before the set leaves the factory. Under ordinary circumstances they should never have to be re-adjusted in the field. Extremely rough handling during shipment, or a slight change in some of the electrical characteristics of the radio circuit may in some cases make re-adjustment necessary.

The indications that the set may require re-adjustment are poor sensitivity, poor selectivity and dial readings in kilocycles off more than 20 K.C. In some cases, an unstable condition of the set with a tendency to squeal or howl on certain sections of the dial may also be an indication of improper adjustment.

Under no circumstances should a re-adjustment be attempted unless the necessary equipment is available and unless the proper instruction has been received. Your distributor will gladly assist you in both of these matters.

The general method of adjusting the compensating condensers in all Philco superheterodyne receivers is the same. Once this procedure is understood for one model, it can be applied with but little change to the various other Philco models. By means of the instructions below and by reference to the different illustrations, the complete adjustments can be made on all Philco superheterodynes.

EQUIPMENT. The following equipment is needed:

1. Philco Model 095 Intermediate Frequency Oscillator accurately calibrated at 175 K. C. and 260 K. C., equipped with self contained output meter and batteries.
2. Philco fibre wrench, part 3164.

INTERMEDIATE FREQUENCY OR I. F. ADJUSTMENTS. The adjustment of the I. F. compensating condensers should be done in the following manner:

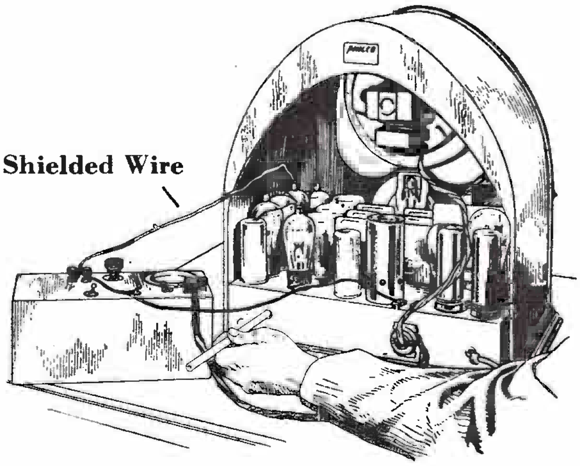


Fig. 1

1. Make the necessary connections between the oscillator and the receiver as shown in the illustration, Fig. 1. The connections consist of (a) the ground wire to the GND. terminal of the radio set and to the G terminal of the oscillator; (b) the A terminal of the oscillator through the necessary length of shielded lead, (shielding grounded) to the grid of the first detector tube (tube shield in place and first detector grid clip removed), (c) output meter terminals to the primary of the output transformer (this connection is obtained at the speaker plug and socket through the Philco plug-in adapter, part 6095); in the Philco models without a speaker plug, this connection is made to the primary of the output transformer, (d) power cord of receiver to the electric power outlet after all other connections have been completed.
2. Turn on the radio set and the oscillator. Place the oscillator switch in the 260 K. C. or 175 K. C. position, depending upon the Philco model being adjusted. See pages 3 and 4 for the intermediate frequency setting. When adjusting sets with a NORMAL-MAXIMUM switch, the switch should be placed in the NORMAL position. Turn the radio volume control to Maximum. Set the dial between 60 and 65 on the Philco scale. Adjust the oscillator control (attenuator) until a reading is obtained on the output meter of approximately ½ the scale deflection.
3. By means of the Philco fibre wrench, part 3164, adjust the various intermediate frequency condensers, one at a time, to obtain maximum reading in the output meter. Locations of all compensating condensers are shown in the illustrations on pages 3 and 4. It is desirable to start with the last I. F. compensating condenser in the circuit (3rd I. F. secondary in the case of the 11 tube models and progress in the adjustments toward the first. It may be necessary while the adjustments are being made, to lower the setting of the oscillator control from time to time so as to keep the output meter reading within the scale range.

PHILCO RADIO & TELEVISION CORP.

4. After these adjustments have been completed, remove the oscillator connection from the grid terminal of the first detector tube and restore the grid clip connection to this terminal.
5. The adjustment of the first I. F. primary (coupling) condenser may have a slight effect on the adjustment of the low frequency compensating condenser in the Philco models which have a combined oscillator and first detector tube---such as the 51 and 52 series, the latest 70 and 90 series, and the 71, 91, 15 and 47 series. After making the adjustment of the I. F condensers on these models, be sure to make the low frequency adjustment as described below.

HIGH FREQUENCY ADJUSTMENTS. Improper adjustment of the high frequency compensating condenser is characterized by weak reception and poor selectivity at the high frequency end of the dial and by dial readings being off by more than 20 K. C. at this end of the dial. Proceed in the following manner:

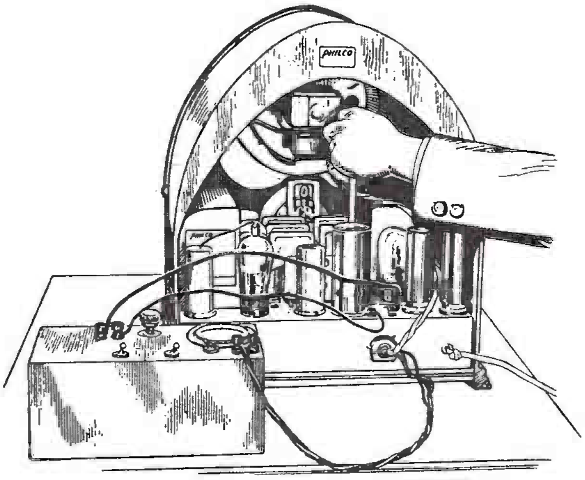


Fig. 2.

1. Connect from the A terminal of the oscillator to the ANT terminal of the broadcast receiver. All other connections remain the same as for adjustment of the I. F. compensating condensers. See Fig. 2 for complete connections.
2. Set the switch on the oscillator to 175 K. C. Set the dial of the receiver to exactly 140 (1400 K. C.). The eighth harmonic of 175 K. C. will be received at this point. Turn the volume control to maximum. Turn on the oscillator and adjust the control until a ½ scale reading is obtained on the output meter. If the receiver is badly out of adjustment, it may not be possible to obtain such a reading, in which case the meter reading must be disregarded temporarily and the adjustments made by ear.
3. Carefully adjust the high frequency compensating condenser for maximum reading in the output meter or for maximum volume if the output is not great enough to be read on the meter.
4. When making this adjustment, it may be found that a given position of the adjusting nut can be obtained at which maximum reading is noted, but that the meter reading decreases when the fibre wrench is lifted from the nut. Allow for this condition by turning slightly beyond the point of maximum reading, then when the wrench is removed the reading will go up instead of down.
5. After making the adjustment, turn the station selector slightly to note if any increase in volume is obtained as the set is being re-tuned. If such an increase is obtained, then the antenna, detector and r. f. condensers should be adjusted as described below. After this adjustment, the high frequency condenser can again be re-adjusted at 1400 K. C.
6. In some cases, when first starting to make the 1400 K. C. adjustment, it may be found that the signal from the oscillator cannot be heard at 140 because the set is so far out of adjustment. In this case, tune the set to the signal, and then adjust the Antenna Detector and R. F. condenser first. Re-adjust the high frequency condenser at 140 on the dial.

ANTENNA, DETECTOR, AND R. F. ADJUSTMENTS:
The adjustment of the antenna, detector, and R. F. compensating condensers is done at 140 on the dial in the same manner and with the same connections as for the high frequency adjustments.

LOW FREQUENCY ADJUSTMENT. The characteristics of improper adjustment of the low frequency condensers are weak reception, poor selectivity and dial calibrations off more than 20 K. C. at the low end of the dial. The low frequency adjustment is made with the same connections as for the high frequency and Antenna condenser adjustments. Proceed in the following manner:

1. With the receiver and the oscillator in operation, the latter at 175 K. C., set the Philco dial at exactly 70 on the scale.
2. With the volume control at maximum, adjust the oscillator output until the output meter reads approximately ½ scale deflection. Adjust the low frequency compensating condenser for maximum reading in the output meter.
3. If the signal comes in stronger at a position off 70 on the Philco scale, adjust for maximum output on the meter at this "Off K. C." position of the dial. Now re-tune the set slightly to obtain any further possible increase, adjusting the compensating condenser and re-tuning the dial each time so as to bring the point of maximum output as near 70 as possible.
4. Re-set the dial to exactly 140, and re-adjust the high frequency condenser. It is possible that the adjustment of the low frequency condenser has affected the high setting of the dial slightly.

PHILCO RADIO & TELEVISION CORP.

PHILCO

Service Bulletin — No. 134

Changes in Models 71 - 22L - 91 - 23X - 15

A number of changes, made in the various new models since the service bulletins were issued, are listed above. Since these changes represent minor constructional improvements, it will be unnecessary to alter any sets in stock except when difficulty is experienced. It is suggested that you mark up your copies of the bulletins so as to agree with the latest production. The changes noted can be easily understood if a bulletin is marked in this manner. All Philco Radio chasses bear a rubber stamped number on the back of the chassis. This is known as a "run number" and is used to designate minor constructional changes.

Models 71-22L

Refer to Service Bulletins 128—128-A.

Below run No. 4, unsolder top (ungrounded) connection of volume control (28) and substitute in the circuit a 240,000 ohm resistor, part 4410, one end grounded. Disconnect the condenser (32) .01 Mfd., part 3903-J, from the center tap of the volume control and from its common connection with the control grid of the detector amplifier tube and the ungrounded end of (33) resistor 1,000,000 ohms 4409. This resistor is no longer used, and can be removed.

Solder one side of the condenser (32) to top of volume control and other side of condenser to ungrounded end 240,000 ohm resistor. Solder the control grid lead of the detector amplifier tube to the variable arm connection of the volume control tube.

(48)-A Condenser .25 Mfd. part 04997, change to .5 Mfd. part 05150.

(45) Resistor 25,000 ohms 4516 used on both 121 and 221 models.

Dial complete, part 03031, change to part 04832.

Add tuning condenser drive cord, part 04834 and spring 6508.

Models 91-121-221 and Model 23X

Refer to Service Bulletins No. 129 and 129-A.

Below run No. 5-91-121-221 and run No. 4 Model 23X change (3) resistor 1,000,000 ohms to 2,000,000 ohms, part 5872. Change (28) resistor 1,000,000 ohms to 2,000,000 ohms, part 5872.

Below run No. 4-91-121-221, run No. 3 Model 23-X, add a 490,000 ohm resistor, part 4517, across the two outside terminals of the volume control.

Below run No. 3-91-121-221, run No. 2 Model 23 X change (47) condenser .001 Mfd. part 6773 to .002 Mfd., part 6853.

Change (54) power transformer 6557 to 6804.

All 91-221 and 23 chassis using power transformer part 6804, use B. C. resistor (46)-A part 6808. This new B. C. resistor does not use section 1-2 in series with center tap of high voltage secondary of power transformer. When replacing 6557 with 6804 use either 6808 B. C. resistor, or 6807 without connecting section 1-2.

Change (40) B.C. resistor part 6071 to part 6702.

(15) Shadow tuning, part 6477 change to part 6497.

Add tuning condenser drive cord, part 04834 and spring 6508.

Model 15

Refer to service Bulletin No. 130.

Below run No. 26 interchange the two outside wires of the input transformer secondary.

Below run No. 27 change (17) resistor 490,000 ohms to 1,500,000 ohms, part 7009. Change (28) resistor 1,000,000 ohms to 2,000,000 ohms, part 5872.

Below run No. 25, place a 490,000 ohm resistor, part 4517, across two outside terminals of volume control.

Below run No. 22 add .002 Mfd. condenser part 6853 across the plates of the pentodes.

Add tuning condenser drive cord, part 04916 and spring 6508.

(68) Electrolytic condenser (.6 Mfd.) part 6707 changed to 4916.

(70) Electrolytic condenser (.6 Mfd.) part 6706 changed to 4916.

Model 22L and 23X

Phonograph motor circuit controlled by radio A.C. switch. This is done by changing A.C. power leads to motor from live side of the radio A.C. switch to the transformer side. Change switch indicator 4227 to 4277.

In the Philco Parts Catalogue under Power Transformers change 71-221 part 6454 to 6457. Change 71-A-221 part 6455 to 6458. Change 91-221 part 6557 to 6804. Change 91-A 221 part 6558 to 6805. Under Input Transformers, add part 3241 for Model 3.

PHILCO RADIO & TELEVISION CORP.

PHILCO
Service Bulletin — No. 136

Adjustment of Shadow Tuning

Philco shadow tuning is one of the greatest aides to correct tuning ever developed so it is important that this device be properly adjusted on each set before being placed in operation. There are no adjustments inside the shadow box, but there are a few simple adjustments of the position of the box and the position of the pilot lamp.

INSTALLATION

The shadow tuning box is purposely moved back away from the bezel during shipment so as to avoid breakage. When the set is placed in operation, and after the chassis mounting bolts have been loosened, the two mounting screws at each side of the shadow box should be loosened by means of a short screwdriver, and the box moved forward to the bezel. The position of the box can be adjusted so that the shadow is centered with respect to the bezel opening.

POSITION ADJUSTMENTS

In some cases, it may be found that the position or the intensity of the shadow on the screen is not entirely satisfactory because of slight changes during shipment. The necessary re-adjustments can be made in the manner outlined below, first turning on the radio and removing the type 80 tube.

1. **Shadow too faint.** Move and focus lamp by bending the bracket slightly to obtain a sharp shadow of the smallest possible width exactly in the center of the screen.

2. **Shadow not centered on screen.** Move and focus lamp as described above.

3. **Shadow not sharp on one side.** Pry off the lamp reflector and adjust the lamp position by turning lamp and socket in a clockwise direction until the filament supports are parallel to the back of the shadow tuning box. Ordinary pilot lamps with inverted U shaped filament will not be satisfactory since they do not produce a concentrated light and a sharply defined shadow. The new Philco pilot lamps have a relatively straight filament which gives better light concentration. It may be necessary to make a further adjustment by bending the bracket as described in 1. above.

4. **No light on screen.** Adjust reflector on pilot lamp.

5. **White light between screen and bezel opening.** Loosen shadow tuning box mounting screws, and move box forward against back of bezel. Center shadow properly with respect to bezel opening.

Replace the 80 tube after completing the above adjustments.

RADIO ADJUSTMENTS

After the above adjustments have been made, the shadow tuning box may be checked for operation by tuning in a number of stations. The following suggestions are offered in case of difficulties:

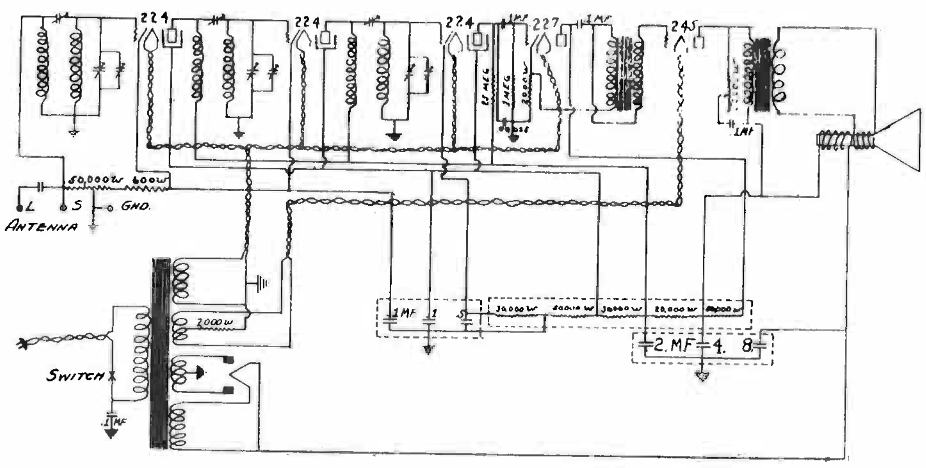
1. **No change in shadow width when tuning in weak signal.** Change first detector and first I. F. tubes in Model 15 and R. F. and I. F. tubes in Models 91 and 23.

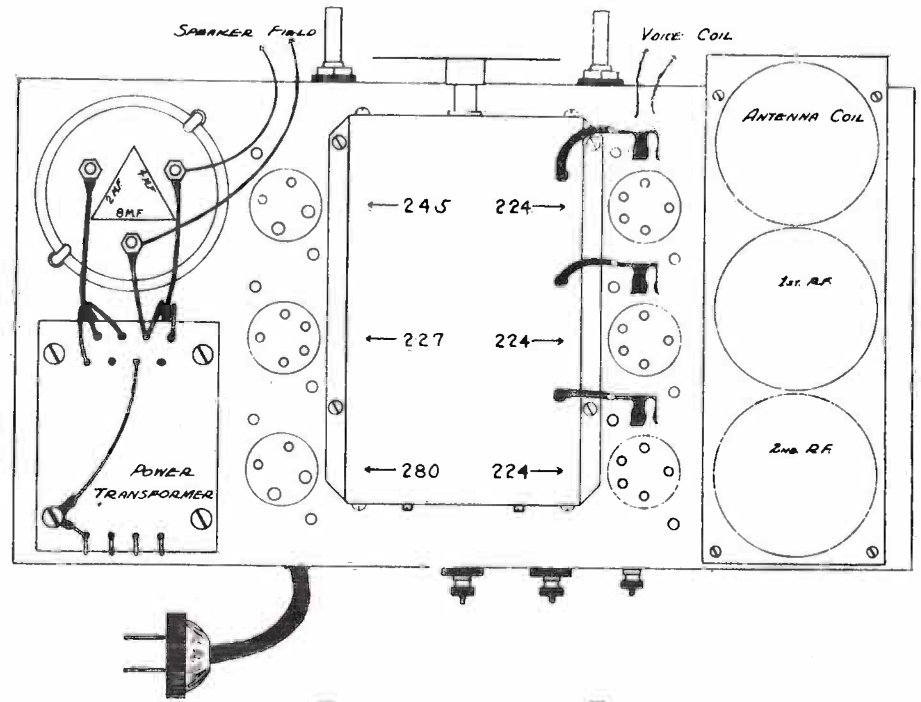
2. **Insufficient change in shadow width on all stations.** Look for faulty aerial connection or too small aerial.

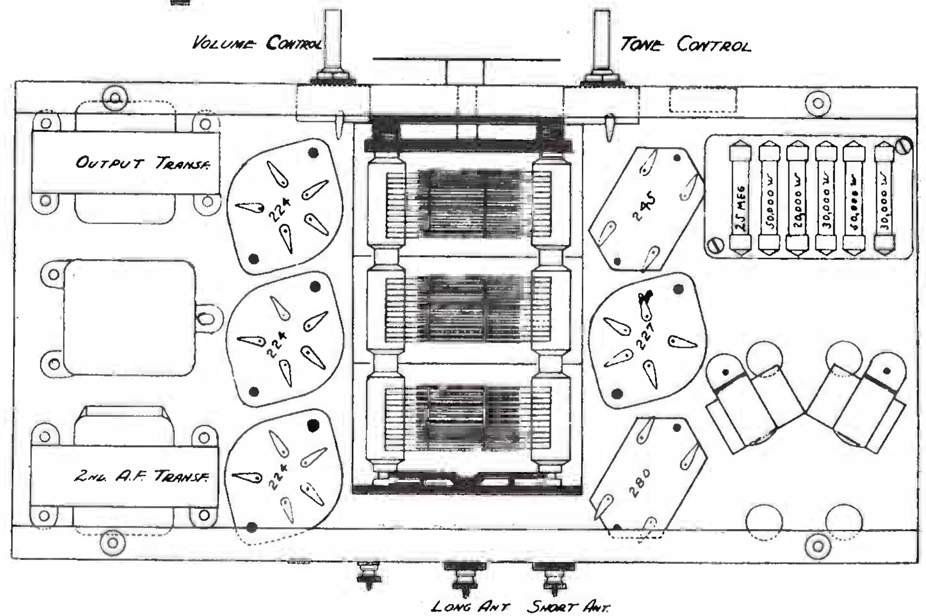
3. **Shadow remains at minimum width while dial is turned several divisions.** Compensating condensers out of adjustment, causing set to be broad in tuning; station signal extremely broad

DO NOT ATTEMPT TO MAKE ANY ADJUSTMENTS INSIDE THE SHADOW BOX.

REMLER COMPANY, Ltd.







WIRE COLOR CODE

RED - FILAMENT RECTIFIER - KATHODE A.F. - PLATE R.F. - PLATE POWER TUBE - SPEAKER FIELD
BLUE - FILAMENT POWER TUBE - PLATE DETECTOR - +B R.F.
GREEN - KATHODE DETECTOR - GRID POWER TUBE
BROWN - FILAMENT R.F. TUBES AND DETECTOR
BLACK - FILAMENT 1ST. A.F. TUBE - DETECTOR KATHODE - SPEAKER VOICE COIL
YELLOW - SHIELD GRID - PLATE 1ST. A.F. - PLATE RECTIFIER

VOLTAGE TABLE

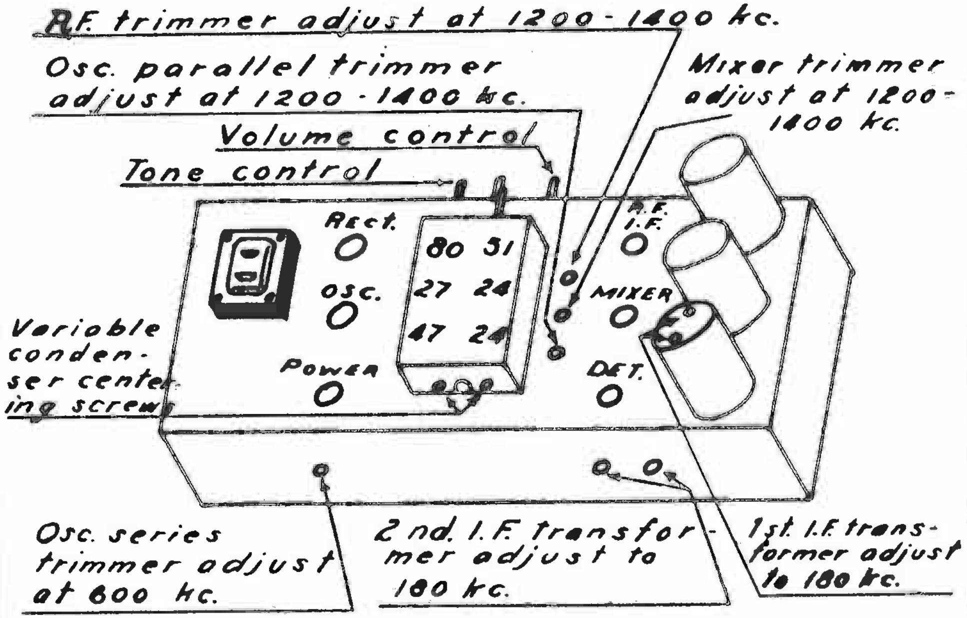
LINE 115 V. 60 CYCLES

TUBE	POSITION	FIL. V.	GRID V.	PLATE V.	S.G. VOLTS
224	1ST. R.F.	2.3	3-9	160-185	85-125
224	2ND. R.F.	2.3	3-9	160-185	85-125
224	DET.	2.3	4.8-8	75-115	85-125
227	1ST. A.F.	2.3	7	110	
245	POWER	2.4	47	235	
280	RECTIFIER	4.9		400	

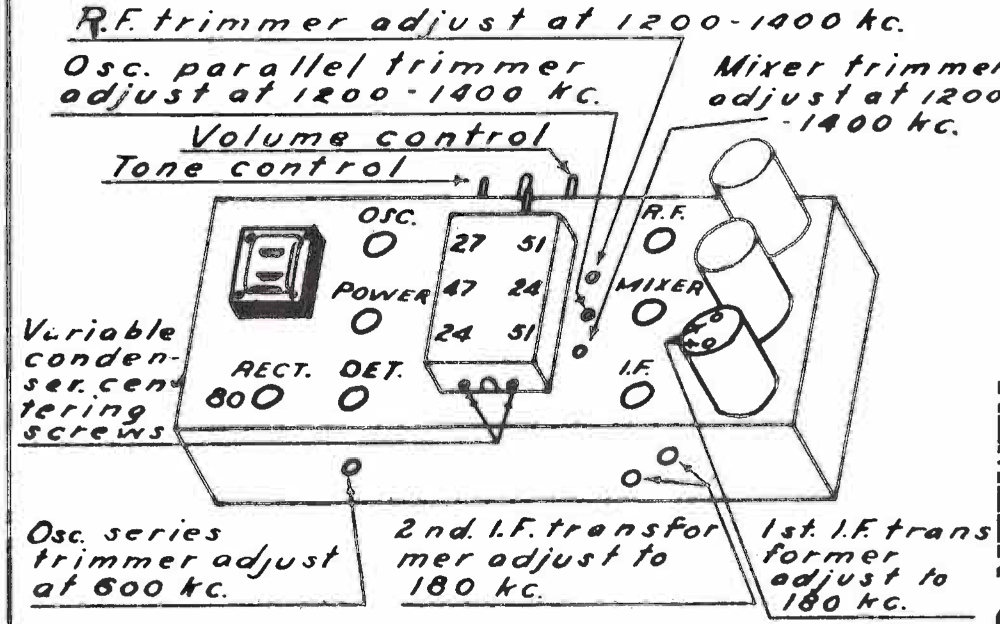
"CAMEO"

REMLER COMPANY, Ltd.

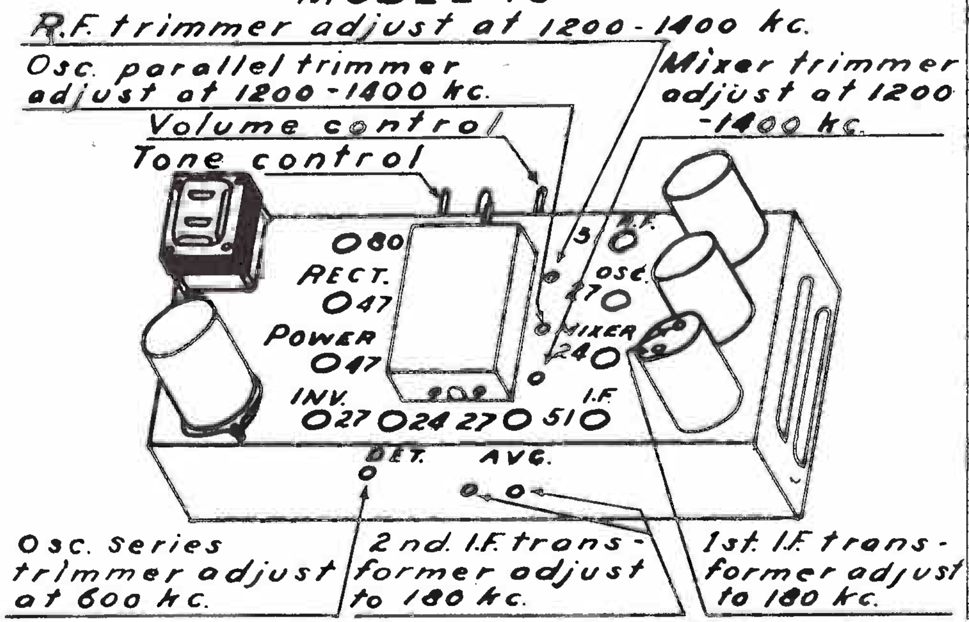
MODEL 10-11



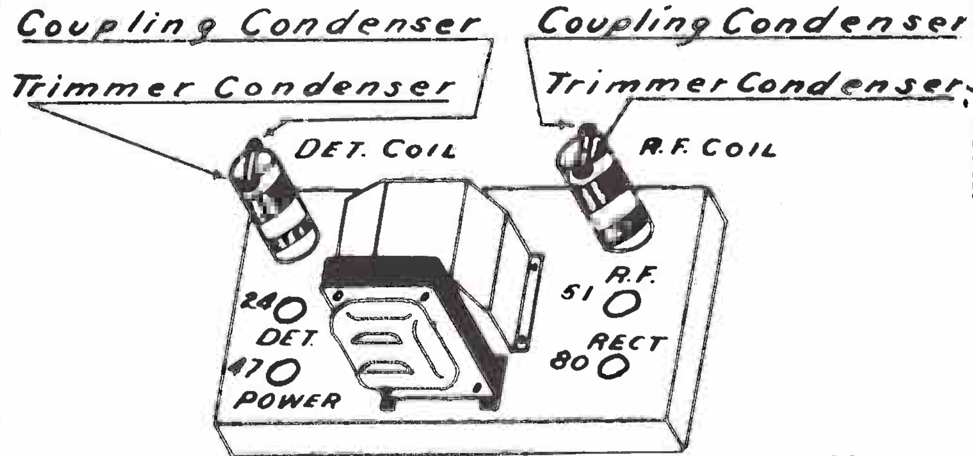
MODEL 15



MODEL 19

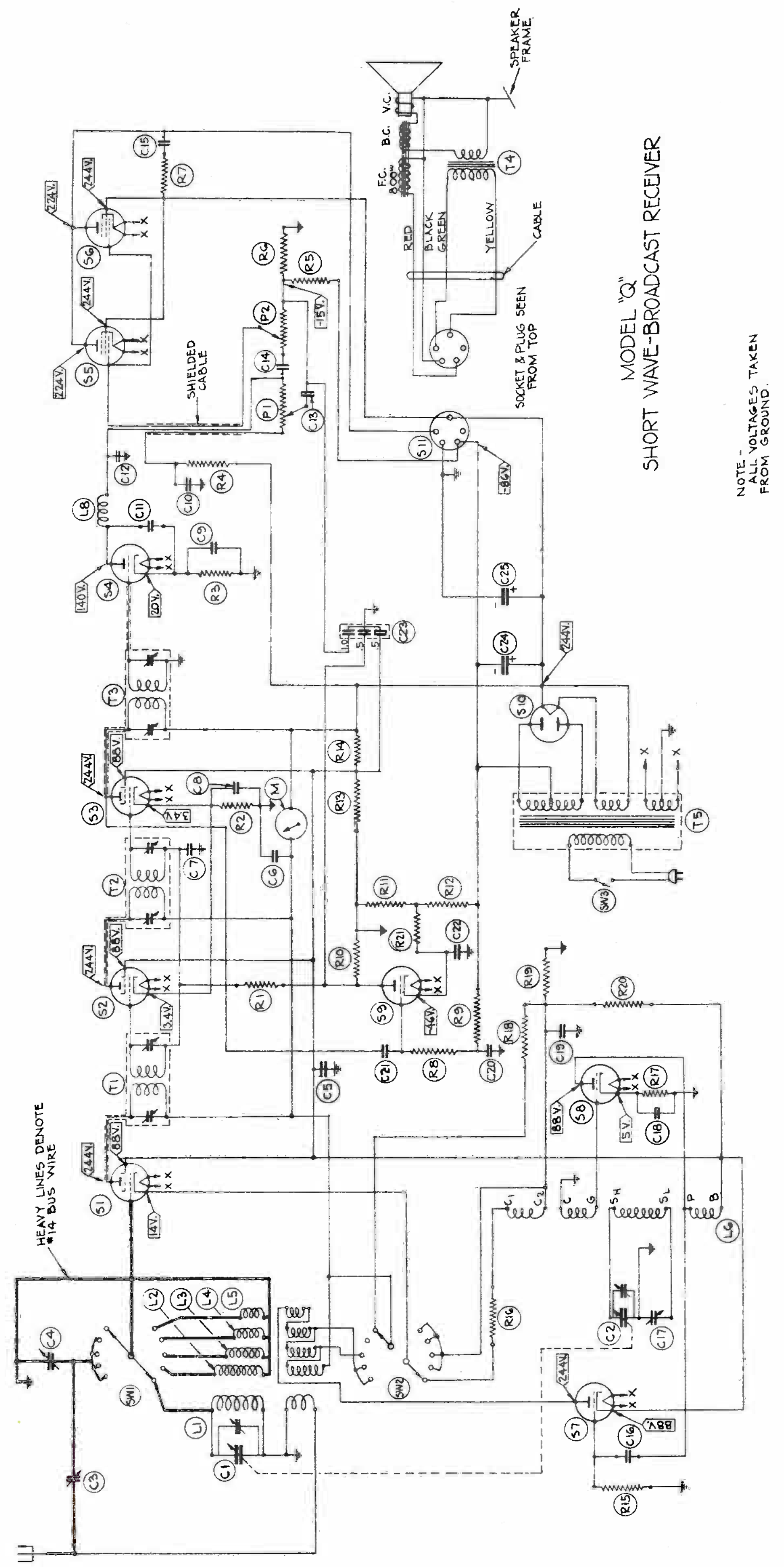


MODEL 21

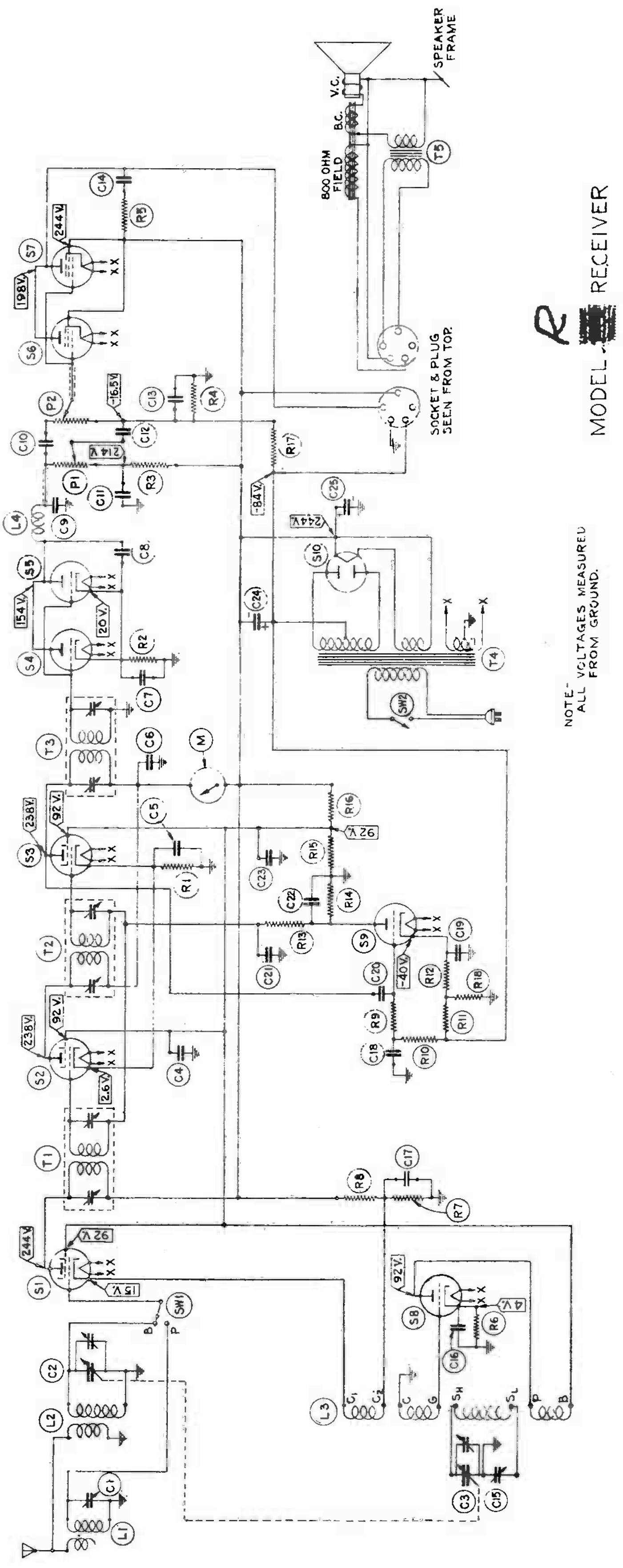


To increase selectivity loosen coupling condensers slightly and balance set at 1200-1400 kc. with the trimming condensers.

SILVER-MARSHALL, Inc.



SILVER-MARSHALL, Inc.



STEWART-WARNER CORPORATION

STEWART-WARNER, MODELS 50, 51 AND 58, "MAGIC DIAL" SERIES 105 CHASSIS 11-TUBE ALL-WAVE SUPERHETERODYNE

(Incorporates short- and broadcast-wavelength reception; local-distance switch; 33 and 78 r. p. m. phono.; dual reproducers; automatic volume control; tone control; push-pull pentodes; two-speed tuning.)

Latest in the Stewart-Warner line is the "Magic Dial" superheterodyne Series 105 receiver. The "Master All-Wave" console incorporates a single dynamic reproducer; model 50-A, 60 cycles and model 50-B, 25 cycles. The "DeLuxe All-Wave" console incorporates two reproducers; model 51-A, 60 cycles and model 51-B, 25 cycles. The "Radio-Phonograph" console incorporates phono., and dual reproducers.

The following values of the components are used in this receiver. Resistor R1, manual volume-control, 60,000 ohms; R2, tone control, 0.1-meg.; R3, R19, R20, 10,000 ohms; R4, 6,000 ohms; R5, 0.75-meg.; R6, 150 ohms; R7, R11, R14, R17, R25, 40,000 ohms; R8, R24, 4,000 ohms; R9, R22, 2,000 ohms; R10, 2 megs.; R12, 20,000 ohms; R13, 0.1-meg.; R15, 220 ohms, R16, 20 ohms; R18, 100 ohms; R21, R23, 45,000 ohms; R26, 1. meg.; R27, 540 ohms; R28, 1,760 ohms; R29, 4,600 ohms; R30, 2,700 ohms.

Condensers C1 to C5, tuning condensers; C1A, C2A, S.W. trimmers; C3A, C4A, C5A, R.F. trimmers; C6, trimmer; C7, C38, trimmers (one unit); C8, C16, C21, 500 mmf.; C8A, trimmer, C9, C15, 100 mmf.; C9A, trimmer; C10 to C13, I.F. trimmers; C14, trimmer; C17, C19, C27, C28, C37, .001-mf.; C18, .002-mf.; C20, C29, C40, .02-mf.; C22, C24, C30, C33, C42, 0.1-mf.; C23, C34, C41, .25-mf.; C25, 250 mmf.; C26, 1 mf.; C31, 0.5-mf.; C32, .003-mf.; C35, 8 mf. (25 cycles, 10 mf.); C36, 8 mf. (electrolytic); C39, 8 mf. (electrolytic).

In the phonograph models the circuit is open at X2, the dotted connections are made and the following values are used: RA, 0.1-meg.; RB, 2,000 ohms; CA, 0.1-mf.; CB, .25-mf. To use dual reproducers the circuit is broken at X3 and the extra reproducer socket is wired in as shown dotted.

Tube voltage readings must be taken with the set tuned to one of the short-wave ranges, and the local-distance switch Sw. 2 pulled out.

Filament potential, V1 to V5, V8, V9, 2.4 V.; V6, V7, 2.42 V.; V10, 2.44; V11, 4.9 V. Plate potential, V1, 21 V.; V2, 81 V.; V3, V4, V6, 188 V.; V5, 102 V.; V7, 70 V.; V8, V9, 177; V10, zero. Screen-grid potential, V1, 2 V.; V3, V4, V6, 102 V.; V8, V9, 188 V.; V10, zero. Cathode potential, V1, 1.9 V.; V2, 5.2 V.; V3, 2.4 V.; V4, 9 V.; V5 zero; V6, —89 V.; V7, —92 V.; V8, V9, —97 V. (to grid, 16.5 V). Line, 115V.

During broadcast reception interference from short-wave stations is prevented by applying a very high negative bias on V2, preventing it from functioning.

The range switch consists of 8 independent switch sections, each being provided with 5 contacts. Ordinarily, only 7 sections are used, and only 4 of the 5-per-switch; the remainder are wired into circuit only in the radio-phono. models.

1. The antenna is switched to the tuned input circuit of the short-wave detector; 2, the bias on the short-wave oscillator tube is reduced so that it can function; 3, the tuning condenser sections in the R.F., first-detector, and broadcast oscillator stages are cut out of the circuit and replaced by fixed trimmer condensers which are adjusted to tune these circuits to pass a 1,525 kc. signal. This frequency is used to prevent pick-up of broadcast-band stations during short-wave reception. The received short-wave signal passes through the short-wave detector where it is converted to 1,525 kc. by the action of the S.W. oscillator and it is then amplified at this frequency in the broadcast portion of the receiver.

The range switch operates in five positions as follows: 1, phonograph (this position cannot be reached in non-phono. models); 2, broadcast range (position 1 in non-phono. models); 3, 180 to 80 meters; 4, 80 to 33 meters; 5, 33 to 14 meters.

Reproducer part No. R-208-A has a field coil resistance of 460 ohms; No. RL-209-A (the L.F. unit in dual-reproducer sets), 230 ohms; No. RH-209-A, (the companion H.F. unit), 230 ohms.

In the model 105 receiver there are five circuits to be aligned, as follows: Broadcast R.F. amplifier 540 to 1,550 kc.; B.C., I.F. amplifier, 177.5 kc.; first S.W. circuit, 180 to 80 meters; second S.W. circuit, 80 to 33 meters; S.W. I.F. amplifier, 1,525 kc. The third S.W. circuit will be aligned correctly if the first two are correctly aligned. A sensitive output meter must be used to obtain sufficient indication at the low service-oscillator output level required to prevent the A.V.C. circuit functioning. Turn R1 full-on, pull Sw. 2 out and turn R2 right.

Looking at the front of the chassis, the trimmer controls are located as follows: R.F. trimmers, from front to back, top of ganged condensers; I.F. trimmers, along rear of chassis, top of I.F. transformers; S.W. trimmers, left-center of chassis (rear-right of 5-gang tuning condenser). In the factory manual these units are given the following reference numbers: R.F. trimmers, front to back, 5 to 9; I.F. trimmers, left to right, 1 to 4; S.W. trimmers, 10 to 12.

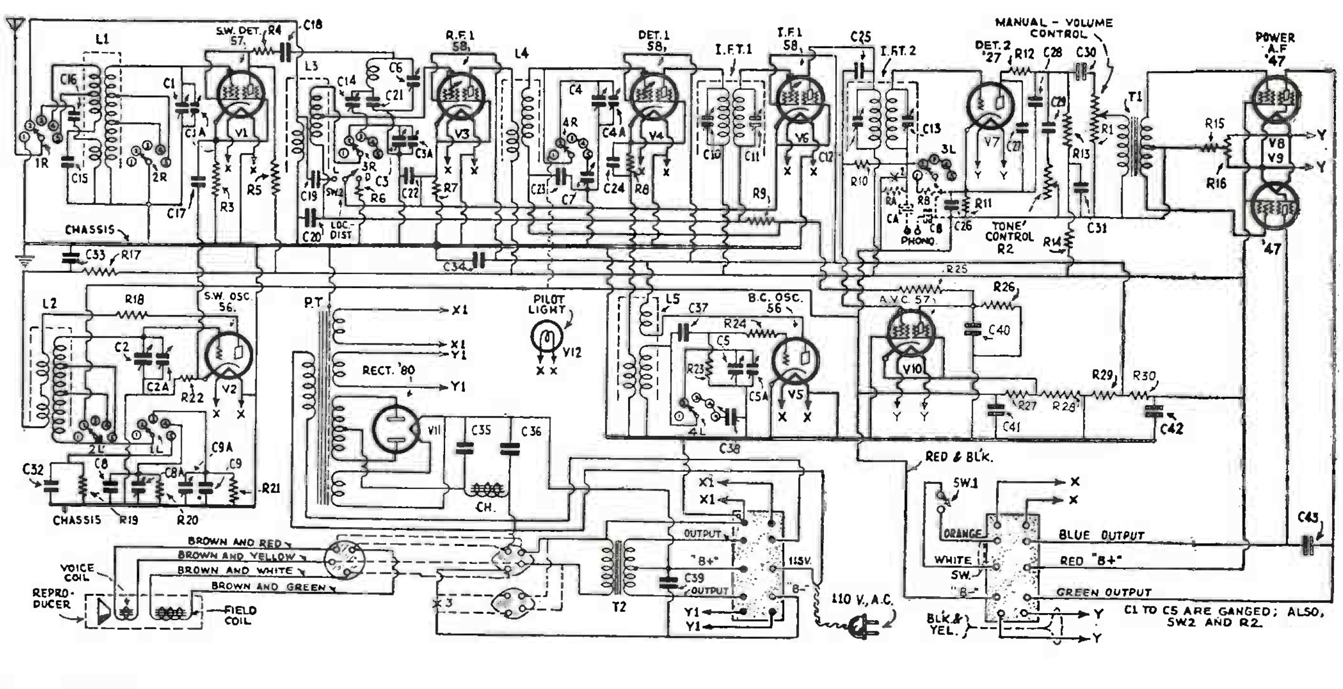
To align the S.W., I.F. circuits, tune broadcast receiver to 1,525 kc. then switch to the 80-to-33 meter range and align 10, 11 and 12. In rare instances it may be necessary to align the remaining sections of the short-wave unit; however, this should be done *only as a last resort*, as follows:

Aligning 180 to 80 meter band. Tune the broadcast receiver to 800 kc.; switch to 180 to 80 meter band and tune to 1,600 kc.; adjust No. 14 for maximum output. Next, tune service oscillator to 975 kc., turn range switch to 80 to 33 meters, tune to extreme right position (4th harmonic) and adjust No. 5 for maximum output. If it is necessary to appreciably vary No. 5, repeat the procedure in adjusting No. 14.

Aligning 80 to 33 meter band. Tune the service oscillator to 925 kc., shift range switch to 80 to 33 meters, turn pointer to extreme left (4th harmonic) and adjust trimmer No. 13 for maximum output.

Next, set the service oscillator at 1,500 kc., tune to about 50 meters (4th harmonic) and adjust Nos. 6 and 15; the latter control setting is not critical.

It is very important that the aligning frequencies given in these directions be exact, otherwise, calibration and sensitivity, partcularly at the third short-wave band, will be considerably below par.



STEWART-WARNER CORPORATION

Servicing the Model 801 Stewart-Warner Radio Receiver Using the Jewell Pattern 199 AC—DC Radio Set Analyzer

In the Model 801 and 811 Stewart-Warner radio receiver, as in practically all radio sets on the market, failure of the set to operate satisfactorily can be traced in most cases to some easily located defect in the filament, plate, or grid circuit of one of the stages of amplification. In servicing the set, therefore, the first step would be to make a thorough check of these circuits.

For this purpose the Jewell Pattern 199 AC—DC Radio Set Analyzer is exceptionally convenient. Before starting work, an examination of the wiring diagram is advisable.

PRELIMINARY STEPS

Read the Jewell instruction book carefully. It gives a complete test routine for any radio receiver which must be followed for best results. The material given in this leaflet is intended as a supplement applying particularly to the Stewart-Warner Receiver. It is not complete in itself.

Go through the usual preliminary tests as indicated in the Jewell booklet (pages 2 and 3) before connecting up the set.

MANIPULATION

Connect the set so that it is ready for operation. Take the A, B, and C voltage readings for the first radio frequency stages as indicated on pages 4 to 9 of the Jewell booklet. Values obtained should agree approximately with those given in the table headed "Typical Radio Set Analysis."

You will note that this tests all circuits in the first R. F. stage. If the readings obtained are correct, the trouble must be elsewhere. A departure from normal test values will give a very good indication where the defect lies, in accordance with the following analysis.

Zero A Voltage Reading:

(1) Poor socket contact.
(2) Open circuit. Use continuity test, as given in section headed "Continuity Tests" of Jewell booklet.
(3) Short circuit. Use continuity test to locate.
(4) Burnt out fuse. This will cause *all* readings to be zero.

Low A Voltage Reading:

(1) Defective power transformer. Check by taking filament voltage readings of 2nd and 3rd R. F. tubes.
(2) High resistance in filament leads. Use Continuity test to locate.
(3) Low line voltage.
(4) Short circuit in some other part of the test. This will show up in some later test.

High A Voltage:

(1) High line voltage.
(2) Fuse inserted in wrong clips.
(3) Defective power transformer. Check by taking filament readings of 2nd and 3rd R. F. tubes.
(4) Second or third R. F. tube filaments open.

Zero B Voltage:

(1) Defective rectifier tube.
(2) Open circuit. Use continuity test to locate.
(3) Short circuit. Use continuity test to locate.

Low B Voltage:

(1) Low line voltage.
(2) Fuse in wrong clips.
(3) Short circuit in one of the filament or high voltage circuits. This will show up in some later test.
(4) Defective rectifier tube.
(5) Open grid circuit. Use continuity test.
(6) Low grid biasing resistor. This will show up in C voltage test.

High B Voltage:

(1) High line voltage.
(2) Fuse in wrong clips.
(3) Some other plate circuit open. This will show up in some later test.
(4) Defective tubes.

Zero C Voltage:

(1) Grounded grid.
(2) Open grid circuit.
(3) Shorted by-pass condenser.

Low C Voltage:

(1) Low line voltage.
(2) Fuse in wrong clips.
(3) Defective tube in any R. F. socket.
(4) Defective grid bias resistor.

High C Voltage:

(1) High line voltage.
(2) Fuse in wrong clips.
(3) Defective grid bias resistor.

Zero Plate Current:

(1) Defective tube.
(2) Open plate circuit.

Low Plate Current:

(1) Defective tube.
(2) Low line voltage.
(3) High grid voltage.

High Plate Current:

(1) High line voltage.
(2) Fuse in wrong clips.
(3) Some other plate circuit open.
(4) Defective tube.
(5) Low grid bias.

STEWART-WARNER CORPORATION

It is obvious that the above test will show up practically any defect in the first radio circuit, or at least give a very good indication of what to expect. Running the same test for the remaining stages of amplification will clear up any doubts.

In testing detector circuits, it is of the utmost importance to allow sufficient time for the tube to warm up fully.

After all tube circuits have been checked in this way, and a fairly accurate idea of the trouble obtained the set may be taken apart for making the necessary continuity tests and repairs.

There remain a few defects that are not readily shown up by the standard circuit test. These are enumerated below.

POSSIBLE SOURCES OF TROUBLE NOT INDICATED BY JEWELL ANALYZER

Hum:

(1) Low emission 280 tube.
(2) Unbalanced 280 tube.
(3) Defective detector tube.
(4) Open center tap filament resistor.
(5) Open by-pass condenser.
(6) Defective power unit.
(7) Tubes not making good contact in sockets.
(8) A. C. line in close proximity to aerial, ground, or set.
(9) Unbalanced 112-A tubes.

No Signal:

(1) Aerial grounded.
(2) Lead-in strip broken or corroded.
(3) Aerial disconnected.
(4) Speaker leads not inserted properly.
(5) Speaker defective.
(6) Output transformer defective.
(7) Tubes not making contact in socket.
(8) Variable condenser shorted.
(9) By-pass condenser shorted.

Distortion:

(1) Oscillating set.
(2) Defective speaker.
(3) Defective transformer.
(4) Speaker out of adjustment.
(5) Defective grid leak.
(6) Defective power unit.
(7) Open by-pass condenser.
(8) Defective power tube.

Excessive Oscillation:

(1) Defective grid resistors.
(2) Short circuited grid resistors.
(3) Open aerial or ground circuit.
(4) Open by-pass condensers.
(5) Exceptionally lively R. F. tubes.
(6) Poor ground.

Schematic Diagram of Circuit for Stewart-Warner A. C. Radio Receiver with Power Unit; and Battery Radio Receiver given on back page

TYPICAL RADIO SET ANALYSIS

NAME OF SET STEWART-WARNER MODEL 801 — SERIES B

INPUT VOLTAGE 115

TUBE NO. IN ORDER	TYPE OF TUBE	POSITION OF TUBE 1 ST. R.F., DET., ETC.	READINGS, PLUG IN SOCKET OF SET — TUBE OUT OF TESTER: A VOLTS	TUBE OUT OF TESTER: B VOLTS	TUBE IN TESTER: A VOLTS	TUBE IN TESTER: B VOLTS	TUBE IN TESTER: C VOLTS	NORMAL PLATE M. A.	PLATE M.A. GRID TEST
1	UX226	1 R.F.	1.46	157	1.33	155	14.8	2.9	9.7
2	UX226	2 R.F.	1.46	158	1.33	156	14.8	2.3	9.2
3	UX226	3 R.F.	1.48	158	1.32	156	14.8	1.9	9.5
4	UY227	DET.	2.40	132	1.98	25	0	1.4	1.45
5	UX226	1 A.F.	1.62	175	1.42	146	12.5	3.3	4.1
6	UX112-A	2 A.F. Push-	5.1	175	4.93	158	12.0	9.9	14.9
7	UX112-A	2 A.F. Pull	5.1	175	4.95	158	12.0	9.3	14.2
8	UX280	Rectifier	5.7		4.78				

Note: Readings in the column headed "Normal Plate M. A." may vary as much as 50 to 100 per cent from those given, particularly for the UX-226 tubes. Readings in the last column may vary as much as 25 per cent. Such variations are caused by differences in line voltage, non-uniformity of tubes, etc. In general, however, the difference in milliamperes between the last two columns for any tube will approximate the value given in the table.

SPARKS WITHINGTON CO.

SPARTON "TRIOLIAN" 13-TUBE MODEL 28 3-SPEAKER SUPERHETERODYNE

(Inter-station noise suppressor, parallel push-pull pentodes, duo-diode detector with twin 56's, line-noise filter, tone control, hum control, Lafoy delayed A. V. C., parallel '80's, R. F. and I. F. band-selectors.)

Service Men will find after studying the schematic diagram of the new Sparton "Triolian" 3-speaker superheterodyne that although at first glance the circuit arrangement is apparently quite simple, there is incorporated in the ensemble a multiplicity of operations which make it essential for each component to have exactly its rated value, consequently, no tolerance from the specified values should be permitted when making replacements.

The Lafoy system of delayed A. V. C. discussed in RADIO-CRAFT Data Sheet No. 70, July 1932, page 37, in connection with the Sparton model 40 receiver, is incorporated in the Sparton model 28 superheterodyne. The sensitivity of the set is 4 microvolts absolute, across the broadcast band, with an undistorted power output of 20 watts. The combination first-detector and oscillator, V2, in addition to performing these functions also has a gain figure of 40 to 1.

Following are the values of the components: Resistor R1, manual volume control, 10,000 ohms; R2, tone control, 0.1-meg.; R3, inter-station noise control, 9 megs.; R4, 3,000 ohms; R5, 8,000 ohms; R6, R7, 15 ohms; R8, R10, 0.25-meg.; R9, R14, 0.5-meg.; R11, 0.75-meg.; R12, R13, 0.1-meg. Chokes RFC2 and RFC3 are 16 mhy.

Condensers C1 to C4, tuning units; C1A, antenna compensator and R. F. trimmer; C2A, C3A, C4A, R. F. trimmers; C5, .002-mf.; C6, to C9, I. F. trimmers; C10, 50 mmf.; C11, C12, C13, C27, C28, C30, 0.2-mf.; C14, C16, C17, 250 mmf.; C15, C26, .01-mf.; C18, .002-mf.; C19, .05-mf.; C20, C21, .006-mf.; C22, 4 mf.; C23, C24, C25, 5mf.; C29, 0.5-mf.

Transformer T1 has a step-down ratio of .7 to 1. for improved quality.

The three reproducers are pitched to reproduce low notes without accentuation. A 9 in. dynamic reproducer, resonant at 80 cycles, is used in the front grille, and a 7 in. dynamic reproducer, resonant at 130 cycles, in either side grille. It has been found that by positioning these two reproducers at an angle, a "three dimension" sound effect is obtained; that is, one experiences a sensation of depth when listening to the reproduction. Choke Ch. 1, 3,700 (left) and 2,400 ohms; Ch. 2, 250 (left) and 140 ohms; Ch. 3, 3,150 ohms, center-tapped; Ch. 4, 75 ohms.

The station selector of the model 28 set is directly below the illuminated dial; below this knob is another which operates the inter-station noise suppressor, R3. At the right of the latter control is another which adjusts the tone control, R2; and at the left, the combination power switch Sw. and manual volume control R1.

Resistor R3, which controls the inter-station sensitivity of the receiver, is operated as follows: Turn R1 full on; then, tune between the station wanted and an adjacent station, and bring in the undesired between-station noise; next, rotate the R3 control knob counter-clockwise until this noise is reduced to a satisfactory level, or until it disappears entirely; now, tune in the desired program and operate R1 to raise or lower the volume as required. When tuning for distant stations, or if use of R3 is not desired, rotate the control knob of R3 clockwise as far as it will go. However, for reception of local stations this control may be used as a manual volume control, and when operated in this manner the control knob of R1 should be turned to the full position; this eliminates the A.V.C. feature and permits the received signals to fade out and in if atmospheric conditions permit.

To adjust antenna equalizer C1A, tune in a weak station between 1,400 and 1,500 kc., and turn the volume control on full; then, adjust C1A (by means of a hex-socket wrench) for maximum output. Adjust C1A only when the aerial circuit is changed. The recommended antenna length is 50 to 100 ft., and height, 25 to 50 ft.

It is preferable to use as a replacement for V2 a tube of similar characteristics, so that the dial kc. readings for stations above 1,200 kc. are not altered. If the tuning dial goes off-scale, adjust trimmer C4A before any others, at 1,400, 900 and 600 kc., as required.

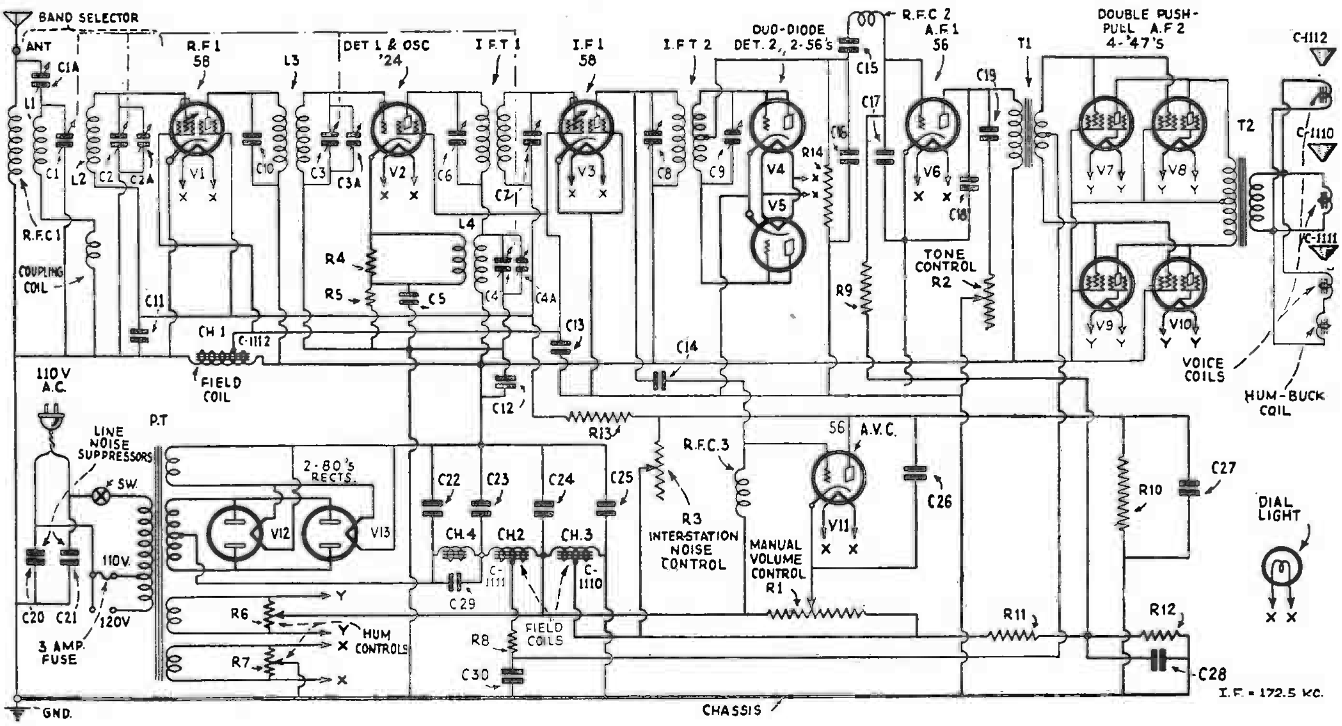
Before adjusting the oscillator, R.F. or I.F. circuits, set R1 full on, R2 full left (natural tone), and R3 full clockwise. It is preferable to use a crystal-controlled, A.F. modulated 172.5 kc. oscillator; its broadcast harmonics will be: 690, 862.5, 1,035, 1,207.5, 1,380, and 1,552.5 kc.

Two peaks will be noted within a one-half or three-quarter turn adjustment of trimmer C3A; the correct peak is obtained with the down adjustment (capacity increase). Unless the latter setting is obtained, tuning dead spots will occur at 1,300 and 1,450 kc., together with poor sensitivity at 900 and 600 kc.

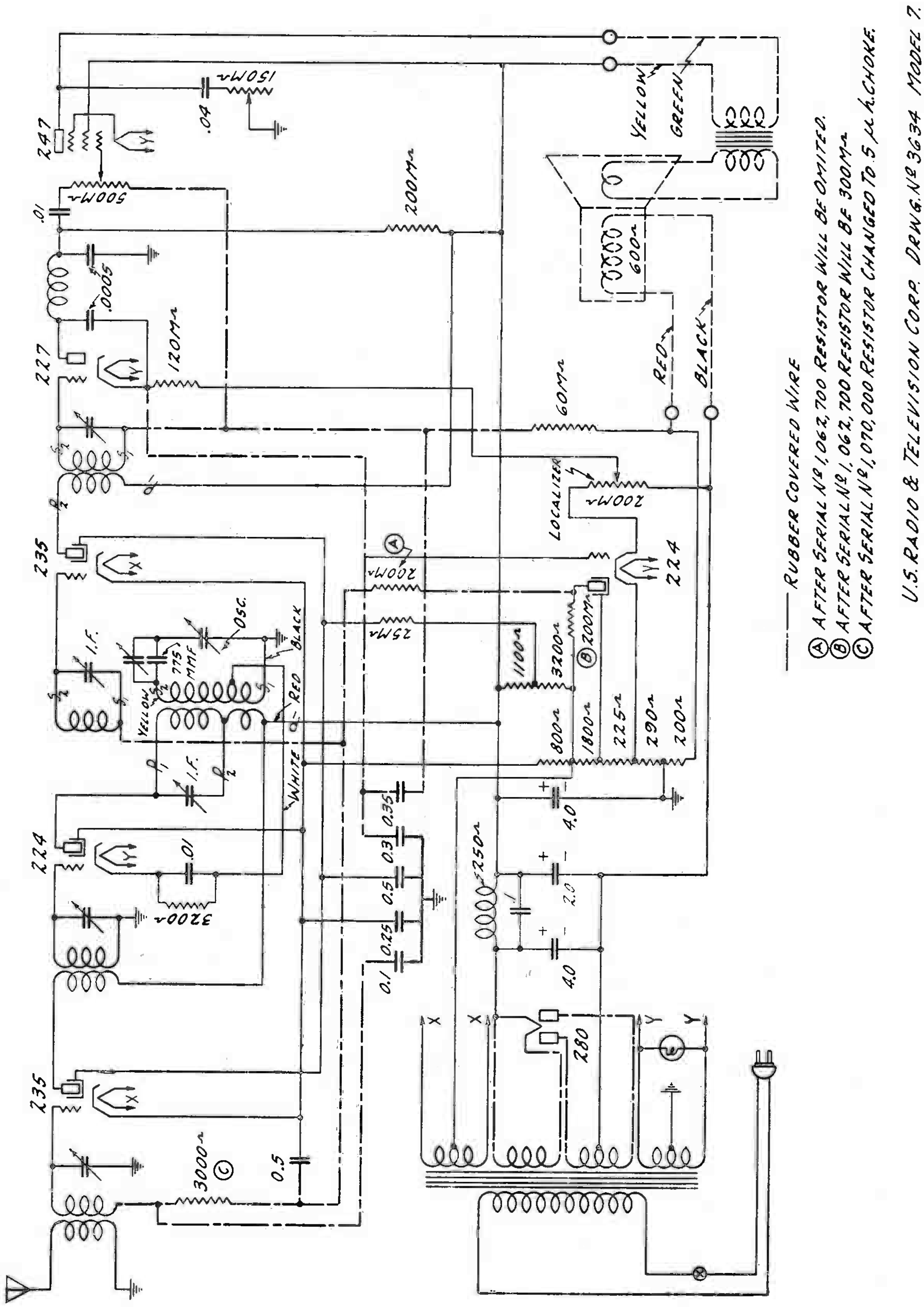
To maintain the A.V.C. inactive, (that is, to prevent the action of the A.V.C. from keeping the signal at one level), in order to obtain accurate condenser adjustments, set R1 to full on and R3 counter-clockwise.

Symptoms and remedies: Dial calibration incorrect; align oscillator. Weak reception, multiple peaks within a 40 kc. band from a loud local station, or hiss; align preselector circuits. When replacing an I.F. condenser or transformer, or when these circuits are out of alignment; align I.F. circuits.

Following are the Sparton model 28 tube average operating characteristics, with a line potential of 115 V. and R1 full on: Filament potential, V1 to V11, 2.4 V.; V12, V13, 4.4 V. Control-grid potential, V1, V3, 2.4 V.; V2, 7 V.; V4, V5, (*); V6, 9 V.; V7 to V10, 25 V.; V11, 65 V. Screen-grid potential, V1 to V3, 94 V.; V7 to V10, 295 V. Plate potential, V1, to V3, 173 V.; V4, V5, (*); V6, 9 V.; V7 to V10, 285 V.; V11, 40 V.; V12, V13, 348 V. Plate current, V1, V3, 6.5 ma.; V2, 1.1 ma.; V4, V5, (*); V6, 5.5 ma.; V7 to V10, 26 ma.; V11, zero; V12, V13, 39 ma. (per plate). (*) A potential is present only when a signal is applied.



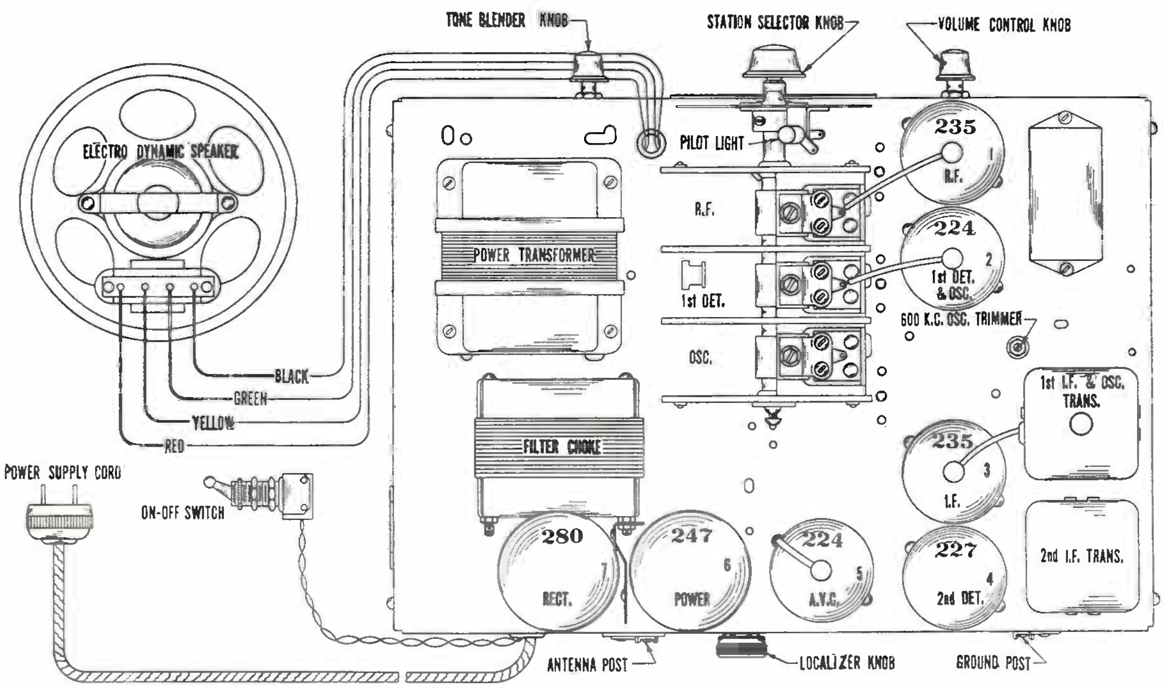
U.S. RADIO & TELEVISION CORP.



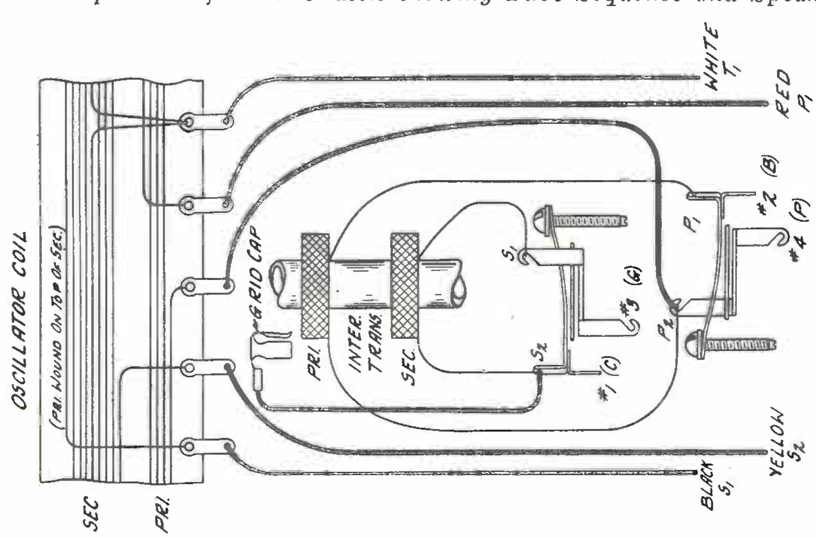
U. S. RADIO & TELEVISION CORP.

No. 7 CHASSIS—VOLTAGES AT SOCKETS—LINE VOLTAGE 115 VOLUME CONTROL AT MAXIMUM—LOCALIZER AT NORMAL SETTING										
Type of Tube	*Position of Tube*	*Function*	*Across Filament or Heater*	*Plate to Cathode*	*Grid to Cathode*	*Screen to Cathode*	*Screen MA*	*Cathode to Heater*	*Plate MA*	*Grid Test MA*
235	1	R.F.	2.35	150	4.5 (1)	70 (2)	.9	4.5	2.7	4.2
224	2	1st Det. & Osc.	2.35	240	6.4	93	.3	6.4	1.8	2.6
235	3	I.F.	2.35	150	4.5 (1)	70 (2)	.9	4.5	2.7	4.2
227	4	2nd Det.	2.35	150	12–24 (3)			0–10 (3)	.2–.5 (3)	.21–.51 (3)
224	5	A.V.C.	2.35	60	0–15 (3)	9	0 (4)	12	0 (4)	0 (4)
247	6	Power	2.35	220	16 (5)	240	6.4		34	40
280	7	Rect.	4.9						39 Per Plate	

(1) This voltage read across 800 ohm resistor.
(2) Voltage as read with 600,000 ohm meter.
(3) Varies with setting of localizer. Voltages read with high resistance meter.
(4) Current zero with no signal and localizer at normal position.
(5) The voltage read across 200 ohm section of voltage divider.



Top View of No. 7 Chassis showing Tube Sequence and Speaker Connections



Wiring Diagram, Osc. and I.F. Assembly

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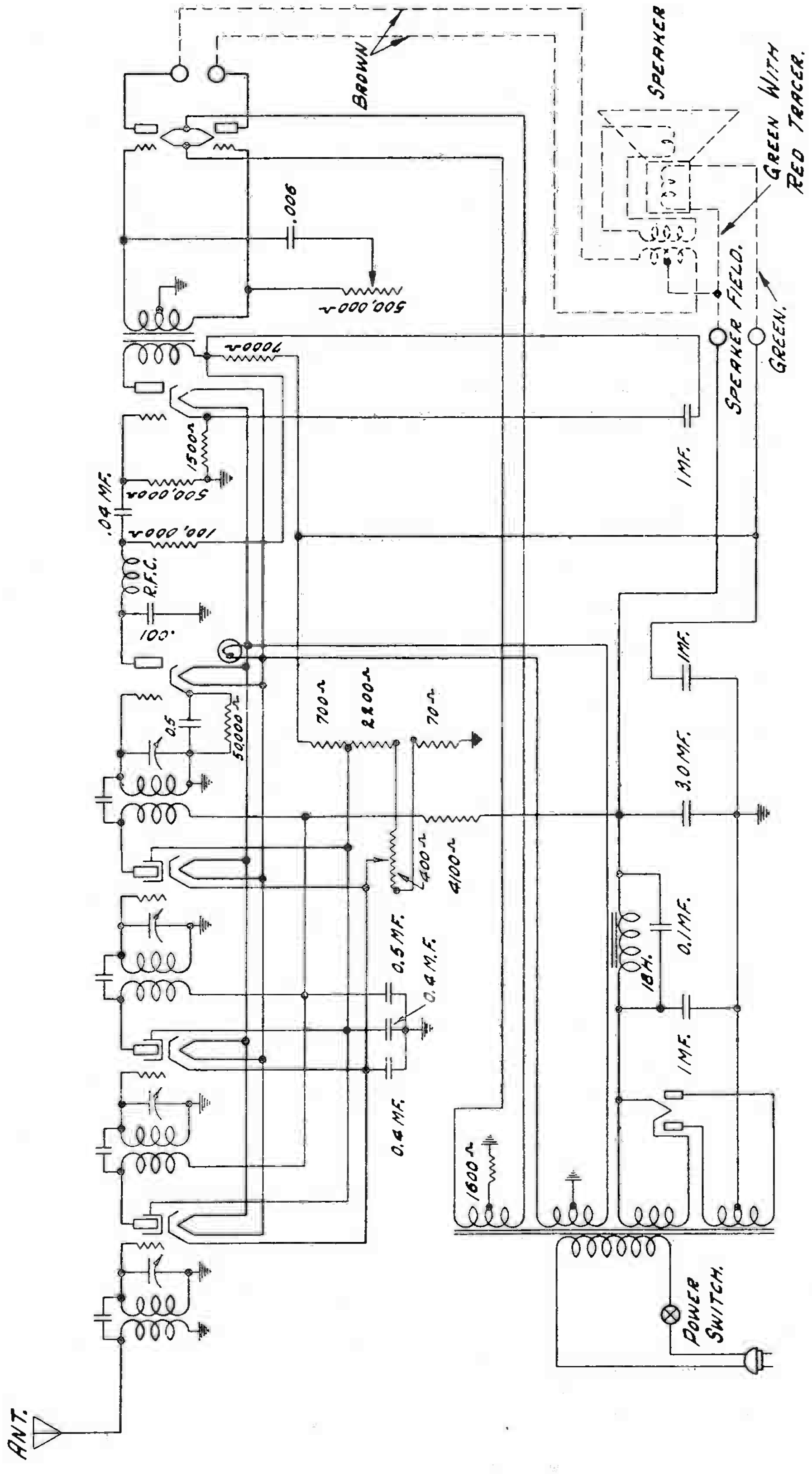
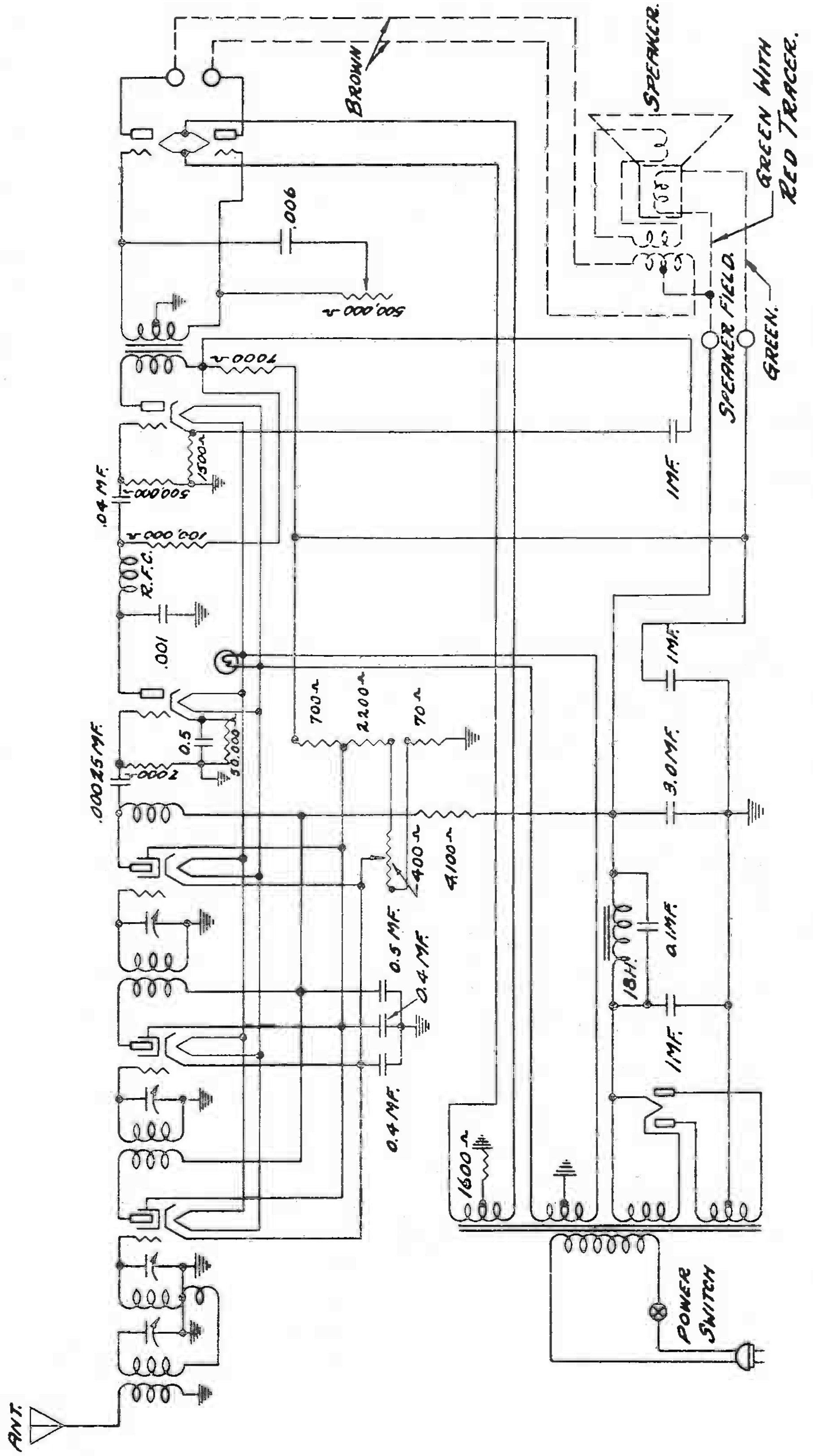


DOTTED LINES SHOWN ARE IN SPEAKER.

U.S. RADIO & TELEVISION CORP. DRWG. No 2011
MODEL 28

NOTE
ALL #28 CHASSIS WITH SERIAL NUMBERS ABOVE 373601 ARE MADE AS PER ABOVE DRAWING.

U. S. RADIO & TELEVISION CORP.



DOTTED LINES SHOWN ARE IN SPEAKER.

U.S. RADIO & TELEVISION CORP. DRWG. Nº 2011 MODEL 28

NOTE

ALL #28 CHASSIS WITH SERIAL NUMBERS BELOW 373601 ARE MADE AS PER ABOVE DRAWING

WELLS GARDNER & COMPANY

WELLS-GARDNER SERIES 062 AUTOMOTIVE SUPERHETERODYNE

(Incorporating types '36, '37, '38 and '39 tubes; also A.V.C.)

Numerous mail-order houses sponsor this chassis under their particular trade name; consequently, it is better remembered by its circuit connections than by the name of the chassis manufacturer.

In the No. 062 Series automotive receiver the following electrical values are used: Resistor R1, 0.5-meg.; R2, 7,000 ohms; R3, 1. meg.; R4. R13, 0.5-meg.; R5, R12, 0.1-meg.: R6, R7, R8, 2 megs.; R9, 1,000 ohms: R10, 20,000 ohms; R11, 15,000 ohms; R14, 350 ohms; R15, 1,300 ohms.

Condensers C1, C2, C3, equipped with trimmers, constitute the tuning gang; C4 is the oscillator padding condenser; C5, C6, C7, I.F. trimmers; C8, .006-mf.; C9, .02-mf.: C10, C14, 4 mf.; C11, .002-mf.: C12, C18, 05-mf.; C13, C15, C16, 0.1-mf.; C17, .001-mf.

Operating potentials are as follows: Filament potential, all tubes, 6 volts. Plate potential, V1, V3, 177 volts; V2, 173 volts; V4, zero; V5, 54 volts; V6, 159 volts. Screen-grid potential, V1, V3, 80 volts; V2, 76 volts; V4, zero; V5, 77 volts; V6, 165 volts. Control-grid potential, V1, V3, 3 volts; V2, 7 (depending upon dial setting); V4, zero; V5, 6 volts; V6, 15.5 volts. Plate current, normal, V1, V3, 3.6 ma.; V2, 0.9-ma. (depending upon dial setting): V4, zero; V5, 1.2 ma.; V6, 10 ma. All bias voltages must be read from cathode to ground.

Do not check the "A" and "B" potentials at the multi-point socket on the cable head, as the pilot light may be burned out when the switch is turned off. (This is due to the high inductance of the speaker field, which will increase the voltage at the break of the circuit.) Also, when the cable head and multi-point socket are taken off, the connections between the chassis and power unit are open so that readings are not made under load conditions.

To read the voltages at the sockets the chassis box, in most cases, will have to be removed from its mounting. In some instances, the cables, which may be attached to the dash or at other points, will have to be removed. The voltages can be read at the sockets with a long plug or with a pair of long, insulated test prods.

All tubes must be inserted and all units connected. A signal will effect the control voltages on V1, V3 and V5. If signals are received, ground the antenna and remove V4 to take the other readings.

The diode current establishes a drop across a resistor network; this potential is used as an additional bias potential on V1, V3 and V5, giving A.V.C. action.

The full control potential is applied to V1, two-thirds to V3, and one-third to V5. As the signal increases in intensity, the applied control potential is increased, thus giving uniform output as set by the manual volume control. The manual volume control varies the diode A.F. potential applied to V5.

The tone control is mounted on the dynamic reproducer, which derives its field supply from the storage battery in the car.

Aerials are preferred in the following order: Roof antenna; tape antenna on roof (this is not very effective where a grounded chicken-wire mesh remains inside the roof); plate antenna (strung underneath the running board); under-car antenna (A wire fastened from the right side of the rear axle to the lowest point under the motor, then back to the left rear axle, forming a V. At the vertex of the V is a spring to take up the slack. The lead-in is brought up from the vertex end.).

Do not turn the set on until all the wiring connections of the installation have been completed—this is extremely important.

To adjust the antenna trimmer, tune in a weak signal at the high frequency end of the dial with the manual volume control about three-quarters on. On one end of the chassis box is a small metal plate. Remove the two screws holding this plate. Directly under the hole in the chassis box is the antenna trimmer condenser screw. Adjust this up or down until maximum output is obtained.

Noise, in some instances, may be due to weak pickup caused by a poor antenna. The action of the automatic volume control, due to the low pickup, causes the set to operate at maximum sensitivity, thereby increasing noisy reception, due both to external pickup and internal conditions.

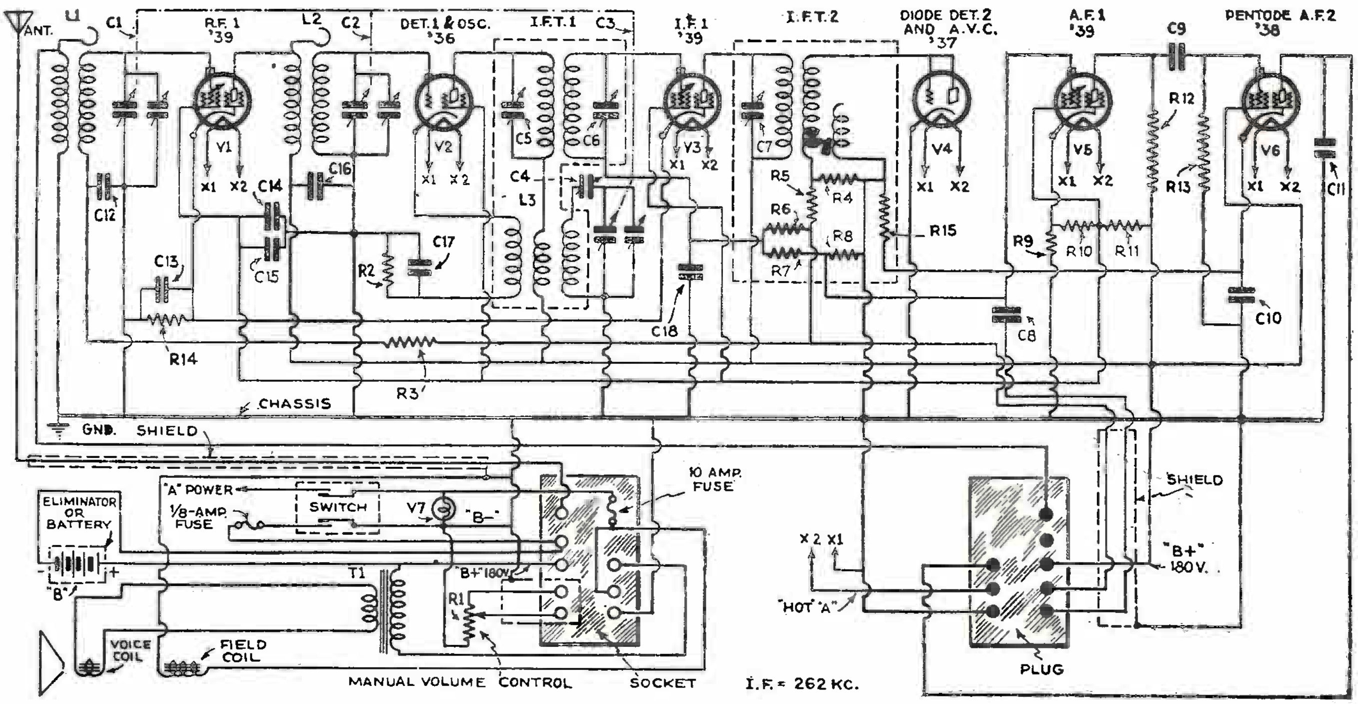
Noisy operation is also caused in some instances by loose parts in the car body or frame. These loose parts rubbing together affect the grounding and cause noises, due to the rubbing or wiping action. Tightening up the frame and body at all points and, in some cases, the use of copper jumpers, will eliminate noise of this nature.

Loose lamps or wiring are also a common cause of noisy operation.

Compensate for the increased battery drain occasioned by the radio set, by increasing the charging rate of the car generator. After a week of car operation, check the condition of the battery and re-adjust the charging rate accordingly.

Two fuses are used on this receiver. The 10 A. "A" fuse is located on the multi-point socket; the 1/8-A. "B" fuse, inside the control unit. The pilot lamp is a standard 6 volt No. 40 unit.

Poor operation may be due to moisture, from car-washings or storms, seeping into undesired places.



RADIO-CRAFT'S LIST OF TRADE NAMES AND MODEL NUMBERS

So much confusion exists in radio regarding trade names and model numbers that RADIO-CRAFT painstakingly collected the data below and presents it to its readers

ALL AMERICAN MOHAWK CORP.
Trade Name: LYRIC

Designation of chassis	*Designation of complete set*	*Alternative designations*
SA-65	Model SA-65 table	
	Model SA-66 console	
SA-91	Model SA-91	
SA-130	Model SA-130	Channel Control
SW-80	Model SW-80	Short Wave
B-7	Model B-7	Battery Model
B-80	Model B-80	Battery Model
S-6	Model S-6 Midget	
	Model S-61 Console	
	Model S-62 Clock Model	
S-7	Model S-7	
S-8	Model S-8	
S-10	Model S-10	
S-63	Model S-63	
S-80	Model S-80 Midget	
	Model S-81 Console	
DC-65	Model DC-65	Direct Current

ATWATER KENT MANUFACTURING CO.

Designation of chassis	*Designation of complete set*	*Alternative designations*
91	91-Auto	
93	93-Converter	
188	188-Lowboy	L Cabinet, 368 speaker
260	260-Semi-Highboy	M Cabinet
469	469-Lowboy	K Cabinet, 380 speaker
469D	469-D (D. C.)	K Cabinet, 469D speaker
469Q	469-Q Compact (Battery)	K Cabinet, 469Q speaker
480	480-Semi-Highboy	M Cabinet, 380 speaker
558	558-Compact	
558D	558-D (D. C.)	
558Q	558-Q Compact	
612	612-Semi-Highboy	M-2 Cabinet 1-324 speaker 1-326 speaker
627	627-Compact	
812	812-Highboy	B Cabinet 1-336 1-338

AUDIOLA RADIO COMPANY

Designation of chassis	*Designation of complete set*
4-T	4 Tube T.R.F. Midget
5-T	5 Tube T.R.F. Midget
5T-SW	5 Tube T.R.F. Midget with short wave attachment
8-T	8 Tube Super Console
8-T	8 Tube Super Midget
10-T	10 Tube Super Console
10-T	10 Tube Super Midget
11-T	11 Tube Super Console

BROWNING-DRAKE RADIO CORP.
Trade Name: BROWNING-DRAKE

Designation of chassis	*Designation of complete set*	*Alternative designations*
40 series	Model 40 (Console)	200-550 meters
	Model 42 (Mantel)	200-550 meters
	Model 44 (Phono Comb.)	200-550 meters
80 series	Model 80 (Console)	200-550 and
	Model 83 (Mantel)	1000-3000 meters
90 series	Model 90 (Console)	15-550 meters
	Model 92 (Mantel)	15-550 meters

CANADIAN MARCONI COMPANY
Trade Name: MARCONI

Designation of chassis	*Designation of complete set*	*Alternative designations*
Model No.	1932 Models	
26 A & B	Mantel	Same chassis used in 26-C
26-C	Console	26 A & B
26-SW	Console Short Wave	
27-SW	Console Short Wave	Similar to 26-A.B.C.
28	Midget	
29 A & B	Mantel	
31	Console	
31-SW		Similar to 31
32	Battery Console	
	1933 Models	
32-B	Battery Console	
33	Battery Console	
33-AW	All Wave Battery Console	Similar to 33
34	Console	
35	Console	
36	All Wave Console	
37	All Wave Console	Similar to 36

CANADIAN WESTINGHOUSE CO., LTD.
Trade Name: WESTINGHOUSE

Designation of chassis	*Designation of complete set*	*Alternative designations*
	RC	RA, DA
	Model 89	Consolaire 89
	Model 99	Consolaire 99
Model 99	Model 99A	Consolaire 99A
	Model 110	Consolaire 110
Model 110	Model 120	Consolaire 120
	Model 90	Consolaire 90
Model 801	Columaire 8	
Model 101	Columaire 10	
Model 801	Model 802	
Model 122	Consolaire Grand	

COLUMBIA PHONOGRAPH CO.
Trade Name: COLUMBIA

Designation of chassis	*Designation of complete set*	*Alternative designations*
C-80A	C-81	Table Model
	C-83	Console
C-80B	C-84	Console-Twin Speakers
C-800A	C-85	Combination
C-90	C-93	Console
	C-95	Console-Twin Speakers
C-100	C-103	Consolette
C-120	C-123	Battery Console

CROSLEY RADIO CORP.
Trade Name: CROSLEY

Designation of chassis	*Designation of complete set*	*Speaker Number*
127, 7-2	Adventurer	304
129-1	Alderman	318-3, 319-3
132-1	Ambassador	324-4, 325-4
124	Announcer	306
124-1	Announcer	321-5, 320-4
126-1	Announcer	298 or 308
77	Arbiter or 77B	264
125	Bigfella	291
135	Bigfella	312-4
131	Bonniboy	284
124	Caroler	306
133 & 7-2	Caroler	312-4
134	Caroler	312-4
134 & 7-2	Caroler	312-4
124	Cheerio	287
132-1	Chief	325-4, 324-6
128	Chieftain (Battery)	235J or 235M
132-1	Commissioner	324-4, 325-4
130-1	Congressman	320-4, 326-4
146-1	Congressman	327-4, 325-4
26	Crony or 26-J (Battery)	273
76	Director or 76-A (D.C.)	263
77	Director or 77-A (A.C.)	264
125 & 7-2	Discoverer	291
135 & 7-2	Discoverer	312-4
133	Forty-five	312-4
136-1	Governor	320-4, 326-4
127	Happy Hour	304
127-1	Happy Hour	322-6, 320-4
129	Judge	309-4
129	Justice	309-4
146-1	Legislator	327-4, 325-4
125	Litlboy	291
135	Litlboy	312-4
125	Litlfella	291
135	Litlfella	312-4
53	Mate or 53-E (A.C.)	272
130	Mayor	310-4
146	Mayor	315-4
128	Mayor (Battery)	235J or 235M
124	Merrymaker	287 or 306
124-1	Merrymaker	321-5, 320-4
126-1	Merrymaker	298 or 308
134-1	Merrymaker	320-4, 323-5
54	New Buddy or 54-G (A.C.)	274
141	Nomad	313-3
53	Pal or 53-F (A.C.)	272
26	Partner or 26-K (Battery)	273
77	Phono-Automatic or 77-L	264
124	Playboy	287
126-1	Playboy	298
134	Playboy	312-4
134 & 7-2	Playboy	312-4
128	Playboy (Battery)	
124	Playtime	306
124-1	Playtime	321-5, 320-4
126-1	Playtime	298 or 308
134-1	Playtime	320-4, 323-5
125	Playtime, Jr.	291
135	Playtime, Jr.	312-4
137	Pup	284-3
127	Reveler	304
90	Roamio	214
91	Roamio	279
92	Roamio	295
95	Roamio	286
96	Roamio	333
951	Roamio	332
84	Rondeau or 84-C	249
136-1	Secretary	320-4, 326-4
130	Senator	310-4
146	Senator	315-4
27	Showboy	234
28	Showboy	234
9	S. W. Adapter	
84	Sondo or 84-D	249
127	Tenstrike	301
127 & 7-2	Tenstrike S.W.	301
131	Tynamite	284
141	Vagabond	313-3
53	Wood's Desk or 53-M	272

DE FOREST RADIO CORP.
Trade Name: DE FOREST CROSLEY

Designation on chassis	*Designation of complete set*	*Alternative designations*
608A	Windsor Model Console	25 cycle
608B	Windsor Model Console	60 cycle
608C	Berwick Compact Model	25 cycle
608D	Berwick Compact Model	60 cycle
708A	Cavendish Console Model	25 cycle
708B	Cavendish Console Model	60 cycle
851A	York Console Model	25 cycle
851B	York Console Model	60 cycle
851C	Mayfair Compact Model	25 cycle
851D	Mayfair Compact Model	60 cycle

902A	Montrose Console Model	25 cycle
902B	Montrose Console Model	60 cycle
140	Balmoral Console Model	Universal 25 & 60
801	Embassy Console Model	Battery (Air Cell)
802	Embassy Jr. Compact	Battery (Air Cell)

ECHOPHONE RADIO MFG. CO.
Trade Name: ECHOPHONE

Designation of chassis	*Designation of complete set*	*Designation of chassis*	*Designation of complete set*
D	D	16	16
E	E	17	17
S-3	S-3	18	18
4	4	20	20
S-4	S-4	35	35
5	5	40	40
S-5	S-5	50	50, 55
10	10	60	60, 65
12	12	70	70, 75
14	14	80	80
15	15	90	90

FADA RADIO & ELECTRIC CORP.
Trade Name: FADA

Shop Type	*Designation of complete set*	*Type*
A	265-A & RR-65	Battery
AP	265-CA & RP-65CA	A. C.
B	475-A & 45/75-A	Battery
BP	475-CA & 45/75-CA	A. C.
C	480-B & 50/80-B	Battery
D	10, 11, 30 & 31	A. C.
DC	12	D. C.
E	50, 70, 71 & 72	A. C.
Rev. E	75 & 77	A. C.
F	460-A & R-60	Battery
G	16, 17 & RP-17	A. C.
GA	20	A. C.
GB	32	A. C.
GC	18	D. C.
H	480-A, 50/80-A & R-80	Battery
K	35	A. C.
KA	41, 42, 44, 46 & 47	A. C.
KB	81, 82, 84, 86	D. C.
KE	122	Air Cell
KF	43	A. C.
KG	761, 762, 764 & 766	A. C.
KO	51	A. C.
KO-220	251, 253 & 257 (257 comb.)	D. C.
KOC	53 & 57 (57 comb.)	A. C.
KOC-110	171, 173	D. C.
KOC-222	Chassis	
KOF	512, 532, 572 (220 volts)	A. C.
KU	45	A. C.
KW	48 & 49	A. C.
KX	61 & 63	A. C.
KY	66	
Rev. K	35-B	A. C.
M	25, M-180, 15-M, 35-M	A. C.
Rev. M	25, M-250, 35-C, 7-MA	A. C.
O	22	Battery
P	40	A. C.
RA	74, 76, 83, 87, 88, 89, 97	A. C.
RC	78 & 79	A. C.
RE	73 & 85	A. C.
RE-110	Chassis	D. C.
RE-220	Chassis	D. C.
RF	732, 852	A. C.
RG	55	
RX	93 & 95	

Besides the model number of the receivers there are letter designations. These letter designations are the letters which appear after the serial number of the receiver and they help designate the type chassis.

In other words, a receiver bearing serial number 0000-RE will indicate that the chassis could be one from either a model 73 or 85 as attested by the attached sheet.

FRESHMAN RADIO CORP.
CORRESPONDING MODEL NUMBERS EARL and FREED RECEIVERS

On the corresponding sets, as listed below, the mechanism is identical. There is a slight difference in cabinets.

Earl 21	equivalent to Freed 56
Earl 22	equivalent to Freed 55
Earl 31	equivalent to Freed 78
Earl 31-S	equivalent to Freed 78-S
Earl 32	equivalent to Freed 79
Earl 32-S	equivalent to Freed 79-S
Earl 41	equivalent to Freed 95
Earl 33	equivalent to Freed 90
Earl 33-S	equivalent to Freed 90-S
Earl 24	equivalent to Freed 65
Earl 121	equivalent to Freed 53

GRIGSBY GRUNOW CO., INC.
Trade Name: MAJESTIC

Designation of chassis	*Designation of complete set*	*Alternative designations*
10	11	Short Wave Converter
20	21, 22, 23	
30	31	
50	51, 52	
55	56	Ardmore
55	57	Berkshire
55	58	Viking (Short & Long Wave)
10	58	Viking
60	61, 62	
90-B	90, 91, 92, 93	1930 Models
90	91 & 92	1929 Models
100	101	
100-B	102, 103	
110	110	Auto
120	121	
120-B	123	
130-A	130, 131, 132	
15	151	Havenwood
15	153	Ellswood
15-B	154	Fyfewood
150	155	Castlewood
15	156	Sherwood
160	163	
180	181	
200	201	Sheffield
200	203	Fairfax
200	204	Explorer (Short & Long Wave)
10	204	Explorer (Short & Long Wave)
210	211	Whitehall
210	214	Stratford
210	215	Croydon
220	221	Collingwood, 1932
220	223	Abbeywood, 1932
230-A	233	
25	251	Cheltenwood, Oct. 1931
25-B	251	Cheltenwood, Nov. 1931
25	253	Brentwood, Oct. 1931
25-B	253	Brentwood, Nov. 1931
25	254	Brucewood, Oct. 1931
25-B	254	Brucewood, Nov. 1931
290	291	Madison
290	293	Adams
10	294	Monroe (Short & Long Wave)
290	294	Monroe (Short & Long Wave)
300	303, 304, 307	
310	311, 314	
320	324	
35	351	Collingwood, 1931
35	353	Abbeywood, 1931

GULBRANSEN COMPANY
Trade Name: GULBRANSEN

352	Model 3521
Five tube A. C.	Model 3525
872	Model 8726
Seven tube A. C.	
392, Nine tube Battery	Model 3925
322	Model 3225
Twelve tube A. C.	Model 3226
3622, Six tube Auto	Model 3622
3722, Seven tube Auto	Model 3722

HOWARD RADIO COMPANY
Trade Name: HOWARD

Designation of chassis	*Designation of complete set*
Style K	Model K
Style H	Model H
Style M	Model M
Style PH	Model 500
	De Luxe with Short Wave Model 501

KELLOGG SWITCHBOARD & SUPPLY CO.
Trade Name: KELLOGG

Designation of chassis	*Designation of complete set*	*Alternative designations*
504	504-505-506 Wave Master	
507	507-508	Battery Sets
510	510-511	
514	514-516-517	
515	515-518-519-520-521	
523	523-526†	
524	524-527†-528	
533	533-534-535-536	

†25 cycle

KOLSTER RADIO INC.
Trade Name: KOLSTER

All models carry combination letter-number symbols only.

LANG RADIO CORP.
Trade Name: LANG

Designation of chassis	*Designation of complete set*
AA5	Junior AA5 table model
	Senior AA5 table model
AA6	Junior AA6 T. M.
	Senior AA6 T. M.
DC6	Junior DC6 T. M.
	Senior DC6 T. M.
MA8	MA8 T. M.
MD8	MD8 T. M.
SA9	
SD8	

NATIONAL COMPANY, INC.
Trade Name: NATIONAL

Designation of chassis	*Designation of complete set*
SW58AC	5 Tube A. C. Short Wave Receiver
SW34DC	5 Tube D. C. Battery Short Wave Receiver
SW3DC	3 Tube D. C. Battery Short Wave Receiver
SW3AC	3 Tube A. C. Short Wave Receiver
NC5	5 Tube Short Wave Converter
NB32	5 Tube Broadcast R. F. Tuner
H. F. R.	5 Meter Receiver
H. F. C.	M. C. Converter

PIERCE AIRO, INC.
Trade Name: PIERCE AIRO-DEWALD

Designation of chassis	*Designation of complete set*
B.A.C.	B.A.C.-4, B.A.C.-7, B.A.C.-8
K.A.D.	K.A.D.-8, K.A.D.-4, K.A.D.-7
50	50-4, 50-7, 50-8
B.A.H.	B.A.H.-1, B.A.H.-2, B.A.H.-400, B.A.H.-212, B.A.H.-42
K.A.F.	K.A.F.-1, K.A.F.-2, K.A.F.-400, K.A.F.-212, K.A.F.-42
B.A.M.	B.A.M.-6, B.A.M.-212, B.A.M.-42

PILOT RADIO & TUBE CORP.
Trade Name: PILOT

Designation of chassis	*Designation of complete set*	*Alternative designations*
10	1010 Dragon Monarch	
10	8810 Dragon Emperor	
39	7639 Twentieth Century	
39	8239 Golden Arrow	
43	8443 Twin Coupler Brand	Liberty
43	8643 Armada	
51	9251 Twin Coupler Brand	Rainbow
55	9255 Corsair	
55	9855 Twin Coupler Brand	Captain Kidd

READRITE METER WORKS
Trade Name: READRITE

Designation of chassis	*Designation of complete set*
406	60 Cycle Tube Tester
407	60 Cycle Tube & Short Tester
408	25 Cycle Tube Tester
409	25 Cycle Tube & Short Tester
500	0 to 10,000 Ohmmeter
502	0 to 40, 0 to 10,000 Ohmmeter
550	Oscillator
610	Set Tester
710	Set Tester
900	A.C. & D.C. Current Measuring Device
1000	Point to Point Tester

SEARS ROEBUCK & COMPANY
Trade Name: SILVERTONE
1932-1933 line

Designation of chassis	*Designation of complete set — Name*	*Model*	*Alternative designations*
5 tube Battery Super		1620	Midget Cab.
8 tube Bat. Allwave Sup.	Wellington	1520	Midget Cab.
8 tube Bat. Allwave Sup.	Westminster	1574	Console Cab.

6 tube A.C. Super	Sussex	1590	Midget Cab.
7 tube A.C. Allwave sup.	Roland	1584	Midget Cab.
7 tube A.C. Allwave sup.	Warwick	1586	Console Cab.
9 tube A.C. Allwave sup.	Cromwell	1630	Console Cab.
12 tube A.C. Allwave sup.	Alexander	1640	Console Cab.
10 tube A.C. Super		1650	Console Cab.
12 tube A.C. Super		1652	Console Cab.
6 tube A.C. Super	Adrian	1592	Console Cab.

THE SIMPLEX RADIO COMPANY
Trade Name: SIMPLEX

Designation of chassis	*Designation of complete set*
Model P	Super
Model P-DC	Super
Model P–Battery	Super
Model R	T.R.F.
Model R-DC	T.R.F.
Model S	T.R.F. All wave

THE SPARKS-WITHINGTON COMPANY
Trade Name: SPARTON

Designation of chassis	*Designation of complete set*
Model 16-AW	Sparton Multi-Wave Receiver
Model 26-AW	Sparton Multi-Wave Receiver
Model 28	Sparton Triolian
Model 45	Sparton Visionola
Model 60	Short Wave Converter
Model 99	Sparks Ensemble
Model 101	Sparks Ensemble
Model 103	DeLuxe Ensemble
Model 109	DeLuxe Model 109
Model 110	DeLuxe Model 110
Model 410	Sparton Junior
Model 420	Sparton Jewel

STEWART-WARNER CORP.
Trade Name: STEWART-WARNER

Designation of chassis	*Designation of complete set*	*Alternative designations*
104A	40-A	Apartment Model
104A	43-A	Leader Console, without converter
104 & 301 Short Wave chassis	44-A	Leader Console with converter
104A	45-A	Standard Console without converter
104 & 301 Short Wave chassis	46-A	Standard Console with converter
104A	47-A	Portable Console without converter
104A & 301 Short Wave chassis	48-A	Radio-Phonograph Combination
105A	50-A	Master All Wave Console
105A	51-A	DeLuxe All Wave Console
105A	58-A	Radio-Phonograph Combination

TRANS. CORP. OF AMERICA
Trade Name: CLARION

Sets have numbers only. Model is designated by a label or sticker in cabinet, except 160C and 260C replacement chassis for modernizing old sets. 60 cycle sets are marked, for example, "AC-60"; the 25 cycle set would be "25-60".

UNITED AMERICAN BOSCH CORP.
Trade Name: AMERICAN BOSCH

Designation of chassis	*Name*	*Alternative designations*
Model 16	Amborola	
Model 27	Amborada	
Model 35	Cruiser	Imperial Cruiser Royal Cruiser
Model 66, 76	Cruiser	
Model 46, 126	Little Six	
Model 5	Personal	
Model 84	Cruiser	(Marine Receiver)
Model 100	9.20 Motor Car Receiver	
Model 200	Personal Chest	
Models 200, 205, 236, 242, 250, 260, 312	Vibro Power	

Note: Above are only sets having names. All others have model numbers only. When the same chassis is used in different cabinets the model number is never changed but a letter is added as cabinet designation—200A, 200B, etc.

WELLS-GARDNER & COMPANY
Trade Name: Regular trade name is Wells-Gardner but all receivers are supplied under private stencils such as Arcadia, Airline, Truetone, Fearnola, Mayola, Hudson, Gt. Northern, Coronada, Granada, LaFayette

Designation of chassis	*Designation of complete set*
052 5-tube AC Super	2522 Mantel 2525 Console 1520 Mantel
572 7-tube AC Super	7721 Mantel 7725 Console
502 10-tube AC Super	9027 Console 7025 Console
022 12-tube AC Super	2225 Console 2227 Console 2228 Console
92 5-tube Battery Super	925 Console 926 Console
092 9-tube Battery Super	2925 Console
062 6-tube Auto Super	1622 Auto Radio Remote Control

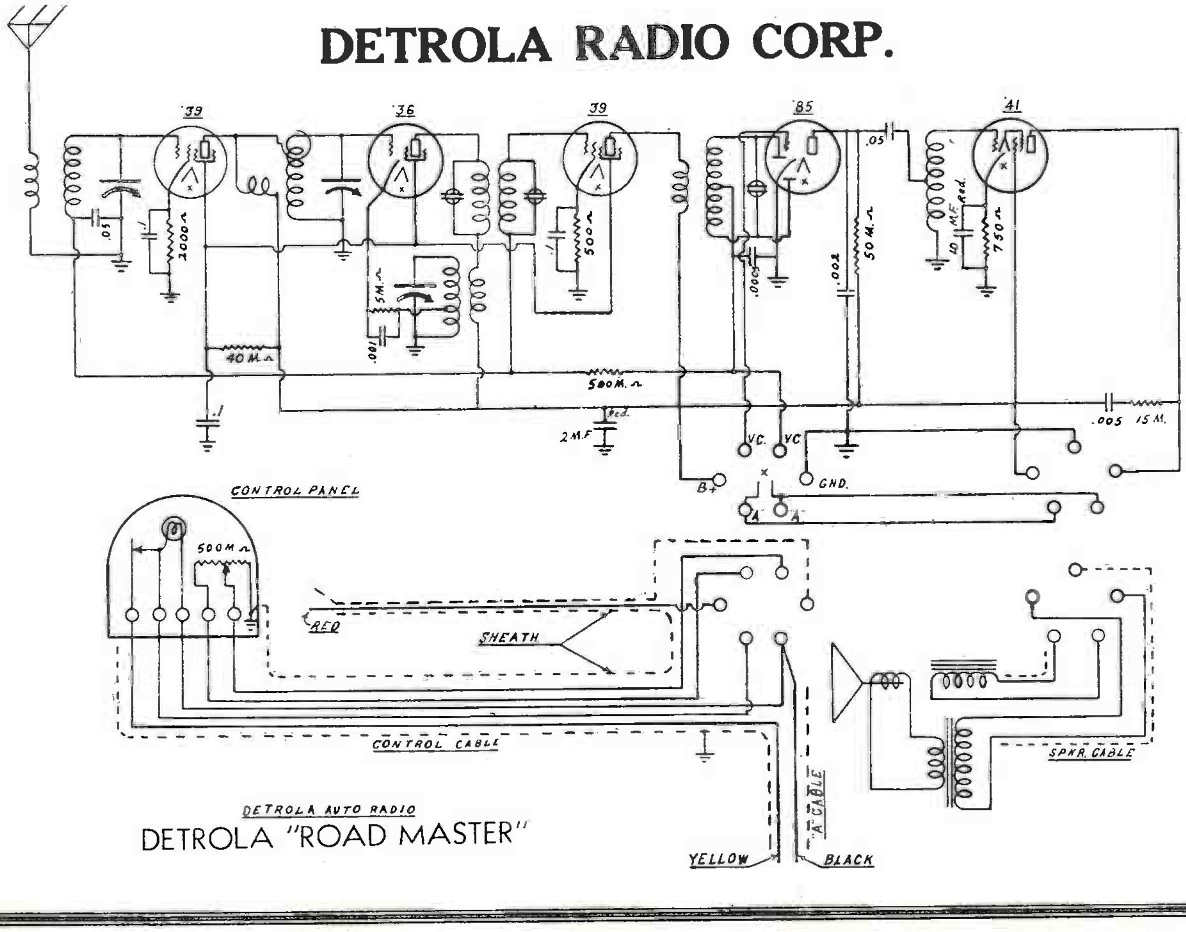
WILCOX-GAY CORPORATION
Trade Name: WILCOX-GAY

Designation of chassis	*Designation of complete set*	*Alternative designation*
2S5	2S5—30	Cameo
2T5	2T5—30	Cameo Hilo
2DB5	2DB5—32	Cantata
2EB5	2EB5—32	Cantata Hilo
2V7	2V7—31	Carillon
2V7	2V7—510	Coronet
2W10	2W10—515	Corona

ZENITH RADIO CORP.
Trade Name: ZENITH-ZENETTE

Designation of chassis	*Designation of complete set*
7 tube 2022A	Models 210-220
8 tube 2036A & B	Models 230-240-245
9 tube 2031 Short & Standard Wave	Models 250-260-272
10 tube 2030 / 0432	Models 410-411-420
12 tube 2033	Models 210-5, 211-5, 270-5

DETROLA RADIO CORP.



DETROLA AUTO RADIO
DETROLA "ROAD MASTER"

WHOLESALE RADIO SERVICE CO., Inc.

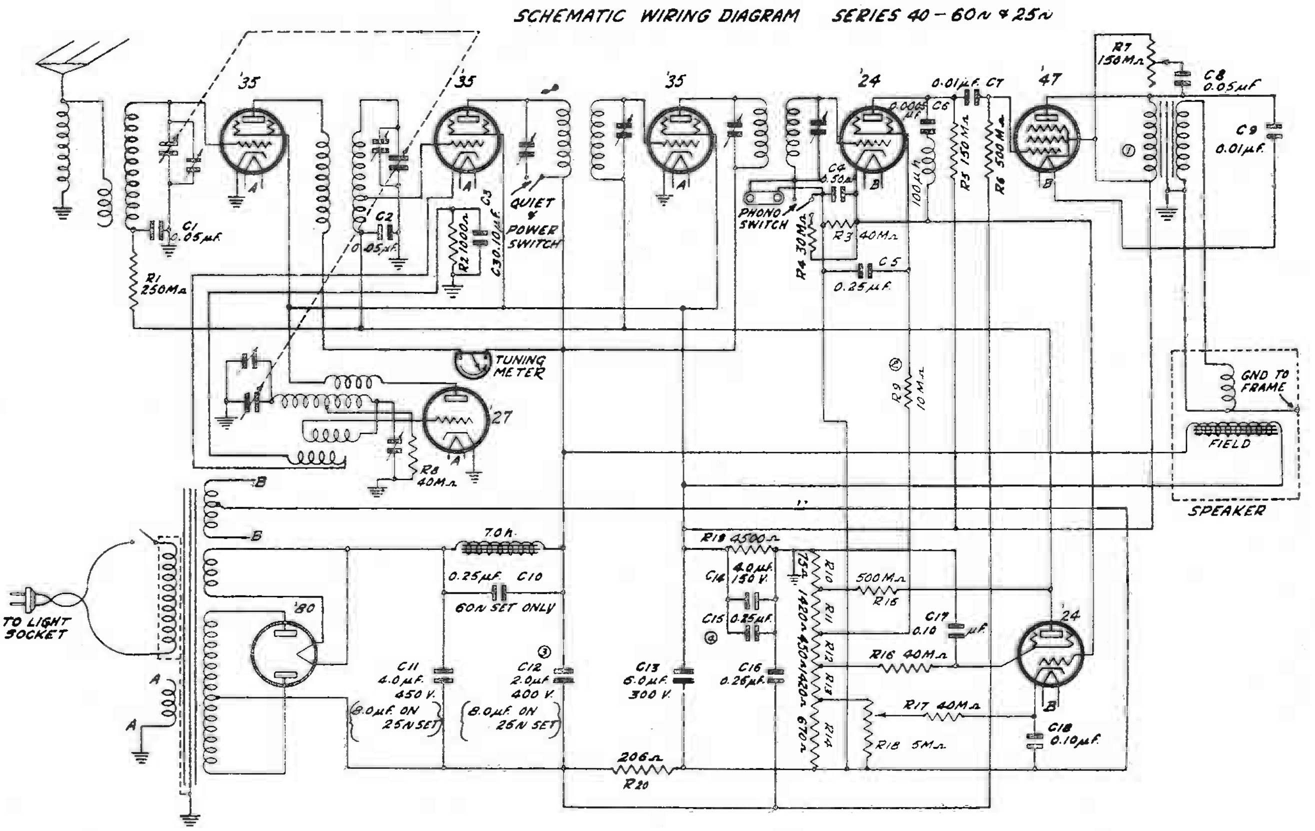


Fig. 1. Schematic Wiring Diagram. Series 40.

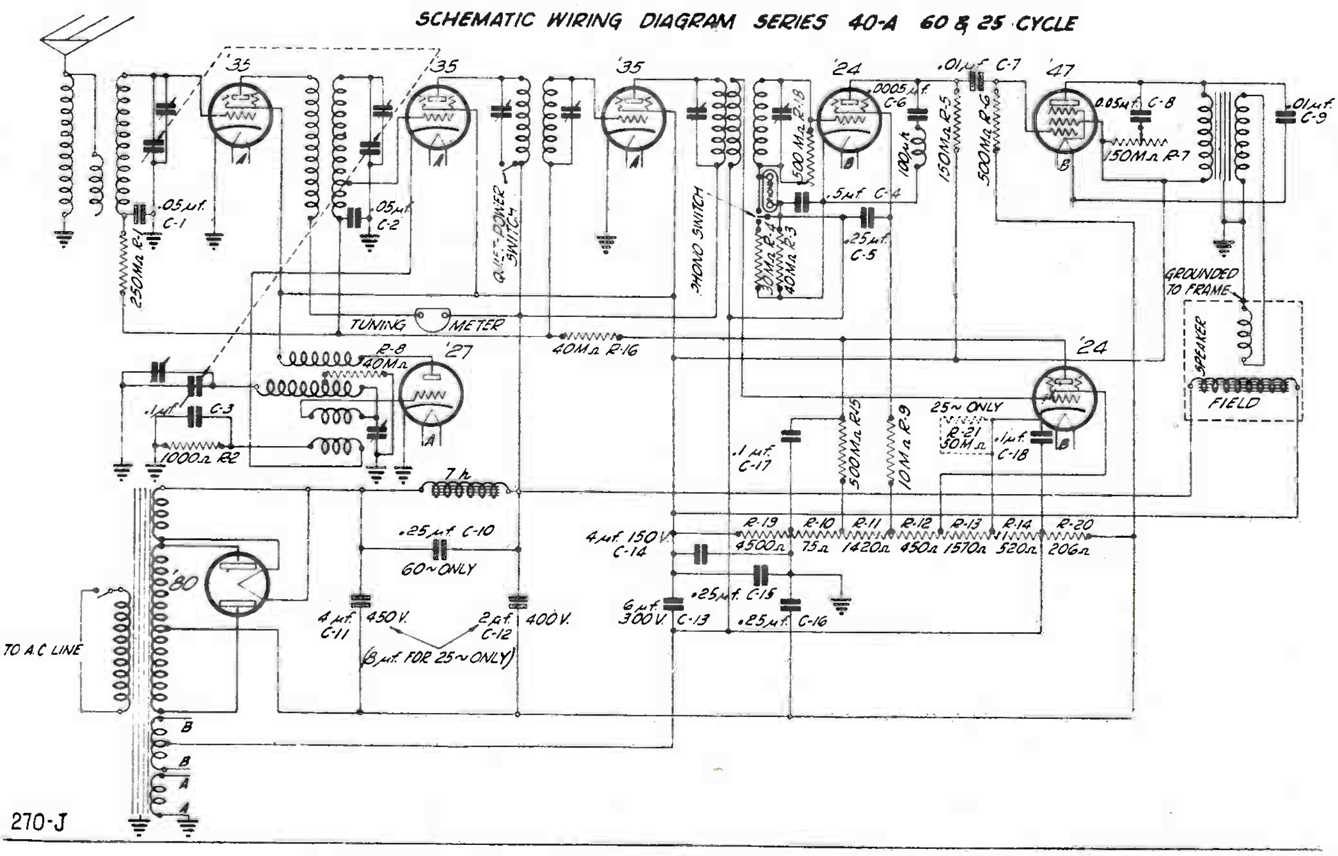


Fig. 2. Schematic Wiring Diagram. Series 40-A.

WHOLESALE RADIO SERVICE CO., Inc.

Tube and Voltage Tests

The tubes should be tested in a set analyzer and the voltage measurements taken on each tube before servicing the receiver in any other manner. Weak or defective tubes should be replaced.

The measurement of grid bias voltages is not recommended as this causes an abnormal rise in plate current which is injurious to the tube. When the receiver does not function properly, and the trouble is apparently due to incorrect grid bias on any tube or tubes, the cause of the incorrect bias may be determined by applying the proper continuity test.

CAUTION: DO NOT ATTEMPT TO TAKE VOLTAGE MEASUREMENTS OR TEST THE '47 PENTODE TUBE WITH A SET ANALYZER WHICH IS NOT DESIGNED TO TEST THAT TYPE OF TUBE. A SPECIAL ADAPTOR IS NECESSARY AND INFORMATION REGARDING SAME MAY BE OBTAINED BY WRITING TO THE MANUFACTURER OF THE SET ANALYZER. THE LATEST TYPE ANALYZERS ONLY ARE DESIGNED TO TEST PENTODE TUBES. THE UY SOCKET IN AN ANALYZER WHICH IS USED TO TEST '24, '35, AND '27 TUBES CANNOT BE USED TO TEST '47 PENTODE TUBES. A break-in adaptor and the external binding posts of the set analyzer may be used to take voltage measurements when an adaptor is not available.

Comparison of the voltage measurements taken and those shown in the chart below will show any irregularities. The cause of any variation may be determined by applying the proper continuity test. REMEMBER:—Voltage measurements will vary slightly with different sets of tubes, and also with different chassis. Unless the voltages are radically different than normal, they may be considered satisfactory.

The voltages shown in the chart were taken with a 1,000 ohm per volt voltmeter; voltage measurements taken with a voltmeter having a different resistance will, of course, differ from those shown.

TURN THE VOLUME CONTROL ALL THE WAY ON, CONNECT THE ANTENNA AND GROUND LEADS TOGETHER AND TURN THE GANG CONDENSER PLATES ALL THE WAY OUT. CHECK THE LINE VOLTAGE.

The voltages shown are measured to the cathode of the heater type tubes and to filament of the '47 Pentode.

Tube	Circuit	LINE VOLTAGE				
		90 V.	100 V.	110 V.	120 V.	130 V.
R. F.	Screen-Grid	70	78	85	92	100
'35	Plate	143	159	175	191	207
1st Det.	Screen-Grid	70	78	85	92	100
'35	Plate	143	159	175	191	207
I. F.	Screen-Grid	70	78	85	92	100
'35	Plate	143	159	175	191	207
Oscillator '27	Plate	70	78	85	92	100
2nd Det.	Screen-Grid	66	73	80	87	94
24	Plate	127	134	141	148	155
A. V. C.	Grid	14	15.5	17	18.5	20
'24	Screen-Grid	24	26.	28	30	32
Audio	Accelerating-Grid	199	221	244	267	289
'47	Plate	171	190	210	230	250
Rectifier	Current (both plates)	67 MA	75 MA	82 MA	89 MA	96 MA
'80	Plate to Plate Volt.	512	569	625	682	739

Continuity Tests

All these tests are for the Series 40 and the Series 40-A chassis except those which state under the test number "40 ONLY" or "40-A ONLY." The values given are the APPROXIMATE resistance in ohms and are for use with a continuity meter having a high and low scale. "High" or "Low" indicates the meter circuit used to measure high or low resistance. The tubes must be removed when making these tests, the speaker plug must be in its socket, and the volume control turned full on unless stated otherwise under "REMARKS." The possible cause of an incorrect effect is given under "No Deflection" (which indicates an open circuit) or under "No Resistance" or "If Reading Incorrect." The cause of incorrect effects due to loose connections, shorts, and other mechanical faults are not given as it is assumed the service man is capable of locating such faults. The candohm (bleeder) resistor should be tested (Test No. 35) before any circuits of which it is a part are tested as no part of it is given as the possible cause of any incorrect reading.

Test No.	Circuit Under Test	Position of Prods	Remarks	Meter Circuit and Resistance	No Reading	No Resistance	If Reading Incorrect
1	Antenna Coil Primary	Antenna wire to chassis		Low .50	Coil open or wire defective	Coil shorted	
2	Ground Wire	Ground wire to chassis		Low 0.0	Ground wire defective or disconnected		
3 #40 only	R. F. Grid	Grid terminal to AVC plate terminal		High 250,010	R1 or antenna Secondary coil open		
		Grid terminal to chassis		High 750,085	R1, R15, or secondary coil open	Gang condenser or its trimmers shorted	Res. of 85 ohms indicates C1 shorted
3 #40A only	R. F. Grid	Grid terminal to AVC plate terminal		High 290,000	R1, R16, or antenna coil secondary open		
		Grid terminal to chassis		High 790,085	R1, R15, R16, or antenna coil secondary open	Gang condenser or its trimmer shorted	Res. of 10 ohms indicates C1 shorted
4	R. F., 1st Det., and I. F. Screen-Grid	Each screen-grid terminal to chassis		High 4,500	Wiring open	Wiring shorted	
5	R. F. Plate	Plate terminal to speaker socket black terminal	Remove speaker plug	High 1,100	Primary coil or resonance meter open		Resonance meter or coil may be shorted
6	R. F., I. F. and Oscillator Cathodes	Each cathode terminal to chassis		Low 0.0	Wiring open		

WHOLESALE RADIO SERVICE CO., Inc.

Continuity Tests—Continued

Test No.	Circuit Under Test	Position of Prods	Remarks	Meter Circuit and Resistance	No Reading	No Resistance	If Reading Incorrect
20 #40A	AVC Grid	Grid terminal to chassis		High 4,100	Primary coil (tertiary winding) open		Primary coil shorted
21 #40 only	AVC Screen-Grid	Screen-Grid terminal to chassis		High 41,945	R16 open	C17 shorted	
21 #40A only	AVC Screen-Grid	Screen-Grid terminal to chassis		High 1,945	Wiring open		Wiring defective
22	AVC Plate	Plate terminal to chassis		High 500,075	R15 open		Apply tests Nos. 3, 7, and 10
23 #40 only	AVC Cathode	Cathode terminal to chassis	Volume control full off	High 43,955	R17 or R18 open		C18 shorted
23 #40A only	AVC Cathode	Cathode terminal to chassis		High 8,015	Wiring open		
		Cathode terminal to AVC grid terminal			Should show no deflection		C18 shorted
24	Speaker Voice Coil	Red and green speaker plug terminal	Remove speaker plug	Low very small	Voice coil open	Voice coil shorted	
25	Speaker Coupling Transformer Secondary	Red and green speaker socket terminals	Remove speaker plug	Low 600.	Secondary open	Secondary shorted	
		Red terminal to ground	Remove speaker plug	Low 600	Sec. open or one side of primary not grounded	Secondary shorted	
26	R. F., 1st Det., Oscillator and 1st I. F. Heaters	Prod on each heater terminal		Low, very small	Heater winding on power transformer or wiring open	Heater winding on power transformer or wiring shorted	
27	2nd Det., AVC Heaters and A. F. Filament	Prod on each socket terminal		Low, very small	Winding on power transformer or wiring open	Winding on power transformer or wiring shorted	One side of winding on power transformer or one side of wiring shorted
		Each socket terminal to ground		High 3,955			
28	'80 Filament	Prod in each filament terminal		Low, very small	Winding on power transformer or wiring open	Winding on power transformer or wiring shorted	

Test No.	Circuit Under Test	Position of Prods	Remarks	Meter Circuit and Resistance	No Reading	No Resistance	If Reading Incorrect
29	'80 Plates	Prod in each plate terminal		Low 300	Power transformer high voltage secondary open	Power transformer high voltage secondary shorted	Half or turns of high voltage secondary shorted
30	Power Supply Choke	One '80 filament terminal and black speaker socket terminal	Remove speaker plug	Low 200	Choke open	C10 shorted	
31	Power Supply Main Filter Condensers (C11 and C12)	On one '80 filament socket terminal and on one '80 plate terminal	Remove speaker plug		Should show no deflection		Resistance of 150 ohm[s] indicates C11 shorted. Resistance of 350 ohms indicates C12 shorted
32	Power Supply Filter Condensers (C13 and C16)	'80 plate socket terminal to chassis		High 4,160	High voltage secondary open		C13 or C16 shorted
33	Speaker Field	Black and yellow terminals on speaker plug	Remove speaker plug	High 1,400	Field open	Field shorted	Turns in field shorted
34	Power Transformer Primary	Each prong on line cord plug	Receiver line switch on	Low 5.0	Primary open or switch, cord, or plug defective	Primary, cord or plug shorted	
35 #40 only	Candohm (Bleeder) Resistor	Yellow speaker socket terminal to chassis	Remove speaker plug	High 4,500	R19 open	C14 or C15 shorted	
		'80 plate terminal to chassis		High 4,311	R10, R11, R12, R13, or R20 or high voltage power trans. winding open	Candohm shorted	R14 or R18 shorted or open. Lower resistance indicates a section shorted
35 #40A only	Candohm (Bleeder) Resistor	Yellow speaker socket terminal to chassis		High 4,500	R19 open	C14 or C15 shorted	
		'80 Plate terminal to chassis		High 4,241	R10, R11, R12, R13, R14, or R20 open	Candohm shorted	Lower resistance indicates a section shorted

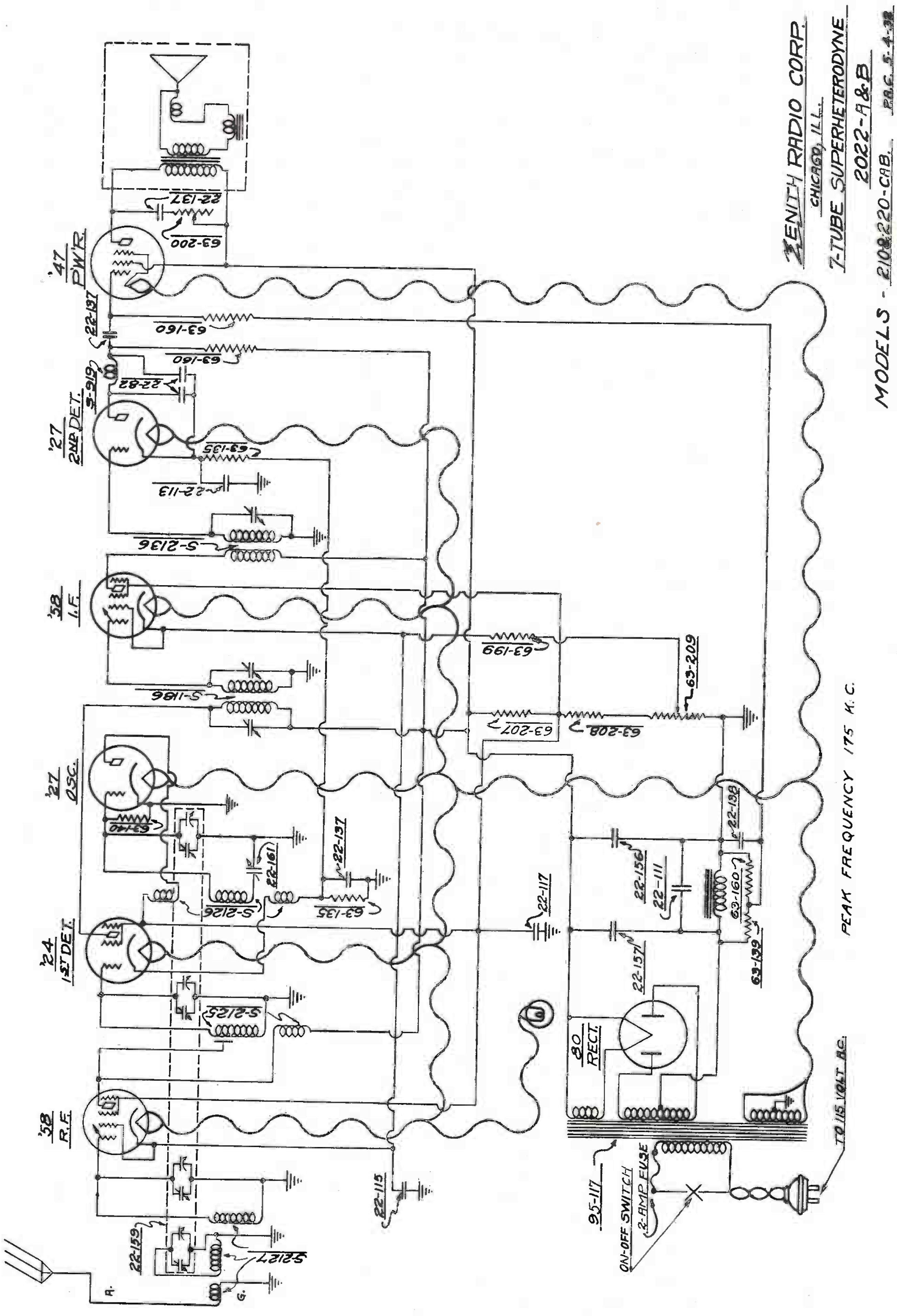
WHOLESALE RADIO SERVICE CO., Inc.

Continuity Tests--Continued

Test No.	Circuit Under Test	Position of Prods	Remarks	Meter Circuit and Resistance	No Reading	No Resistance	If Reading Incorrect
7 #40 only	1st Detector Grid	Grid terminal to AVC plate terminal		Low 10.	Secondary coil open		
		Grid terminal to chassis		High 500,085	R15 or secondary coil open	Gang condenser, its trimmer, or C2 shorted	
7 #40A only	1st Detector Grid	Grid terminal to AVC plate terminal		High 40,000	Secondary coil or R16 open		
		Grid terminal to chassis		High 540,085	R15, R16 or secondary coil open	Gang condenser or its trimmer shorted	Res. of 2 ohms indicates C2 shorted
8	1st Detector and I. F. Plates	Each plate terminal to speaker socket black terminal	Remove speaker plug. Test with switch on both "QUIET" and "POWER"	Low 80.0	Primary coil open	Primary coil or adjustable tuning condenser shorted	
9	1st Detector Cathode	Cathode terminal to chassis		High 1,000	R2 or pickup coil open	C3 shorted	
10 #40 only	I. F. Grid	Grid terminal to AVC plate terminal		Low 60.0	Secondary coil open	Adjustable tuning condenser or secondary coil shorted	
10 #40A only	I. F. Grid	Grid terminal to AVC plate		High 40,060	Sec. coil open	Adjustable tuning condenser or secondary coil shorted	
11 #40 only	2nd Detector Grid	Grid terminal to AVC grid terminal	"Phono-Radio" switch on "Radio"	High 40,050	R3 or secondary coil open	C4 shorted	
		Grid terminal to wire connecting phono jacks	"Phono-Radio" switch on "Phono"	Low 50.	Secondary coil open	Adjustable tuning condenser shorted	
11 #40A only	2nd Detector Grid	Grid terminal to 2nd detector cathode terminal	Rotate volume control from full off to full on	High 40,050 to 540,050			Sec. coil, volume control, C4, or R3 defective
12	2nd Detector Screen-Grid	Screen-Grid terminal to chassis		High 11,495	R9 open		Check C5, C17

Test No.	Circuit Under Test	Position of Prods	Remarks	Meter Circuit and Resistance	No Reading	No Resistance	If Reading Incorrect
13	2nd Detector Plate	Plate terminal to chassis		High 154,500	R5 open		Check C7, C14, and C15
		Plate terminal to 2nd detector cathode terminal			Should show no deflection	C6 shorted	
14 #40 only	2nd Detector Cathode	Cathode terminal to AVC grid terminal		Low 0.0	Defective wiring		
		Cathode terminal to chassis		High 43,950	R3 open		Check C4, C5, and R18
14 #40A only	2nd Detector Cathode	2nd detector cathode terminal to wire connecting phonograph jacks	"Phono-Radio" switch on "Radio"	High 40,000	R3 open	C4 shorted	Res. of 17,142 ohms indicates "Phono-Radio" switch on "Phono"
15 #40 only	Audio Grid	Grid to chassis		High 504,160	R6 open		
15 #40A only	Audio Grid	Grid terminal to chassis		High 504,241	R6 open		
16	Audio Accelerating Grid	Accelerating grid terminal to chassis		High 4,500		Check C14 and C15. Tone control may be shorted on chassis	Check C8, C9
17	Audio Plate and Speaker Coupling transformer primary	Plate terminal to chassis		High 5,300	Speaker coupling transformer primary may be open		Check R7, C8 and C9 for short on chassis
18	Oscillator Grid	Grid terminal to chassis		High 40,000	R8 open	Oscillator gang condenser, its trimmer, or 600 K. C. tracking condenser shorted	
19	Oscillator Plate	Plate terminal to chassis		High 4,500	Plate coil open	C14 or C15 shorted	
20 #40 only	AVC Grid	Grid terminal to 2nd detector cathode		Low 0.0	Defective wiring		
		Grid terminal to chassis		High 43,950	R3 open		Check C4, C5, R18

ZENITH RADIO CORPORATION



ZENITH RADIO CORPORATION

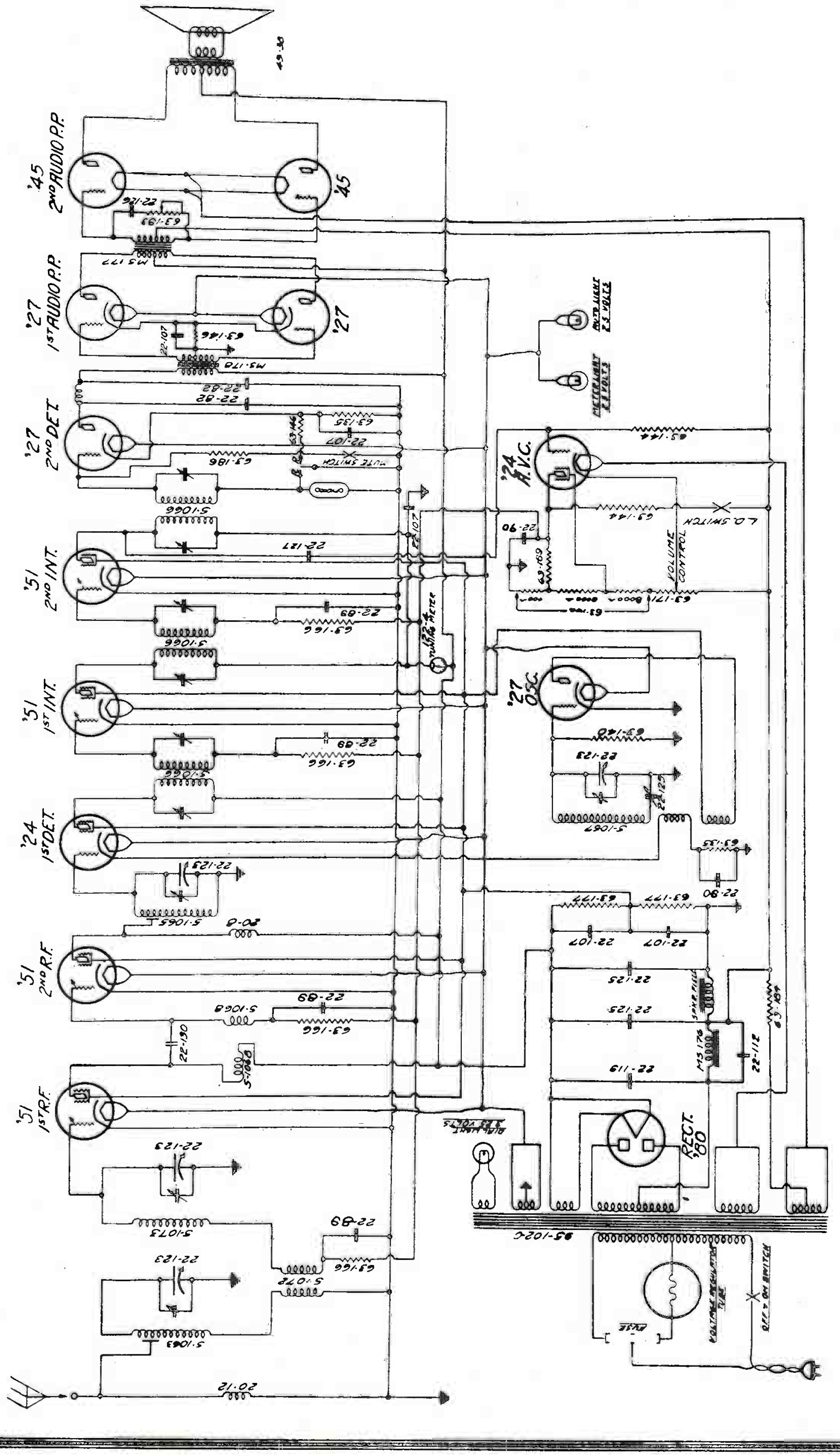
PARTS AND PRICES MODELS 210-220

	Variable Condenser Assembly		
22-159	Four Gang Condenser		$ 6.00
S-2121	Dial Drum Assembly		.80
11-3	Pulley String	per ft	.10
26-34	Dial Strip		.10
100-18	2½ volt pilot Lamp		.12
S-769	Dial Lamp Socket Assembly (Less Lamp)		15
	Fixed Condensers		
22-82	.001 mfd.	(2nd Detector Plate)	.30
22-111	.03 "	(Filter Choke Bypass)	.30
22-113	.5 "	(2nd Detector Cathode)	.50
22-115	.1 "	(R.F.& I.F.Cathode)	.35
22-117	.5 "	(R.F.& I.F.Detector Screen)	.50
22-161	Padder		.75
22-156	6. mfd.	(Power Filter)	1.25
* 22-137	.5 "	(3 used, see footnote)	.25
22-138	.2 "	(Power Grid)	.25
22-157	8. "	(Power Filter)	1.50
	Resistors		
63-135	25M ohm	(1st,2nd Detector Cathode)	.30
63-139	500M "	(Power Grid)	.30
63-140	1meg "	(Oscillator Grid)	.30
63-160	100M "	(2nd Det. Plate & Power Grid)	.30
63-199	150 "	(R.F.& I.F. Cathode, Flexible)	.30
63-200	Tone Control		1.00
63-207	10M ohm	(Voltage Divider, Wire Wound)	.35
63-208	12M "	(Voltage Divider)	.30
63-209	Volume control and switch Assembly		1.25
	Coils		
S-919	2nd Detector choke		.60
S-2127	R.F.Pre-selector		1.50
S-2126	Oscillator coil		.90
S-2125	Detector coil		.90
S-1186	1st I.F. transformer	(175 K.C.	1.50
S-2136	2nd I.F. "	(175 K.C.	1.40
	Miscellaneous		
49-44	Dynamic Speaker		8.00
46-58	Control Knobs, all sets, three used		.10
52-27	Speaker cable		.25
57-326	Escutcheon plate, all sets		.30
78-54	Z-58 Tube Socket		.20
78-37	Z-27 " "		.20
78-38	Z-24 " "		.20
78-39	Z-27 " "		.20
78-40	Z-80 " "		.20
83-228	Speaker cable terminal strip		.15
93-138	Felt Washer for Control Knob		.01
95-127	60 cycle 110 volt Power Transformer		4.50
95-130	25 " 110 " " "		6.75
95-128	60 " 220 " " "		6.75
136-2	2 Amp Fuse		.10
136-4	1 " "		.10
S-2124	Heat Insulating shield		.30
S-1183	Antenna and ground mounting plate complete		.25
S-2120	Variable condenser shield		.85
MS-187	Tube Shield Assembly		.60

IMPORTANT: GIVE SERIAL NUMBER OF RECEIVER ON ALL PART ORDERS

* A.F.COUPLING, TONE CONTROL, AND FIRST DETECTOR CATHODE.

ZENITH RADIO CORPORATION



ZENITH RADIO CORP.
CHICAGO, ILL.
14 TUBE SUPERHETERODYNE
MODEL 2012

MODEL 103

CIRCUIT DIAGRAM
(SERIAL NOS. 450,001 TO 450,450 ONLY)

ZENITH RADIO CORPORATION

Balancing Chassis

Each Zenith Superheterodyne receiver is carefully balanced on a temperature controlled Crystal Oscillator before leaving the factory and should require no further attention in this respect. However, in the event that a part of the R. F. circuit has been changed or the phasing adjustments shifted by mishandling, the chassis may be re-balanced as follows:

A test oscillator will give more accurate results and is, therefore, recommended in preference to use of a broadcast signal. It should be calibrated from 1500 to 550 K. C. and also provide a 175 K. C. signal. An output meter is not required since the tuning meter on the set is connected to the intermediate stages in such a way that it shows a variation during adjustment of any R. F. or intermediate circuit of the set. It is only necessary to watch the tuning meter for greatest swing to the right when adjusting the R. F. and I. F. trimmer condensers.

The chassis should be removed from the cabinet for this operation so that all adjustments are easily accessible. The test oscillator should be set to 1500 K. C. and attached to the antenna and ground posts. If a broadcast signal is used, tune to a station as near to 1500 K. C. as it is possible to hear. In this case the dial must point to the exact frequency on which the station operates.

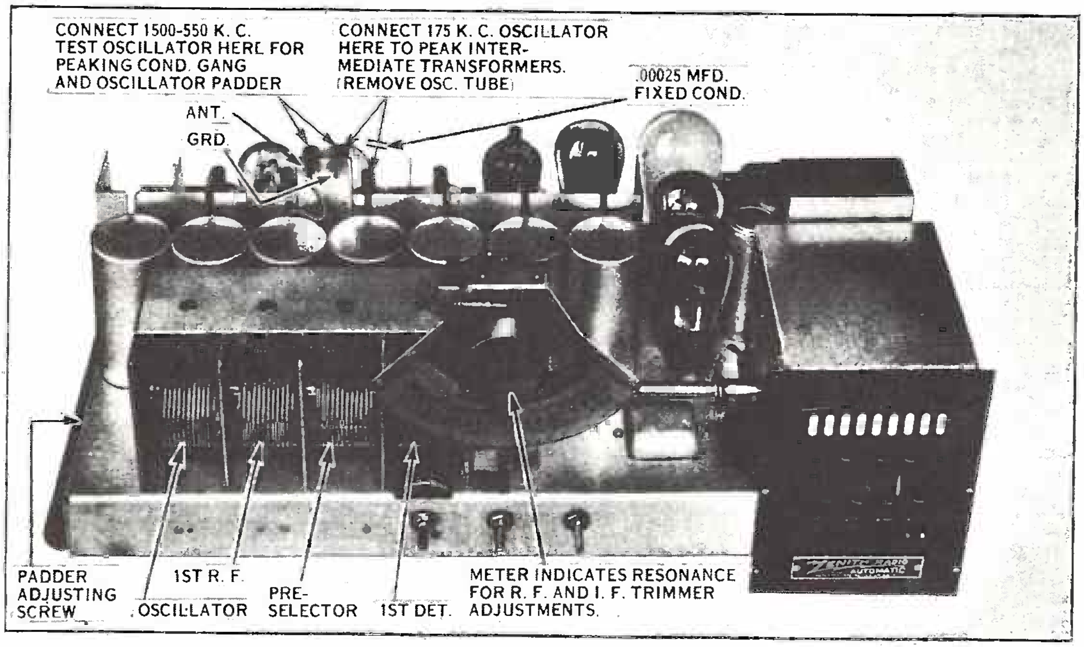


Fig. 2

First turn the trimmer provided on the oscillator section of the condenser gang (See fig. 2) and peak for greatest deflection, to the right, of the tuning meter. The second section from the left tunes the 1st R. F. stage and is next in order. Also peak for the greatest swing of the meter. The preselector or third, and the 1st detector or fourth sections follow in turn and are adjusted in the same manner. The second R. F. stage is of the fixed impedance type and therefore requires no adjustment. The untuned coils are concealed beneath the chassis in a small round shield.

When the trimmers have been resonated, set the dial to 550 K. C. and tune the test oscillator until it is heard clearly in the speaker. This may also be done by tuning to a station at or near 550 K. C. Turn the oscillator padding condenser screw for greatest swing to the right on the tuning meter, while rocking the dial back and forth over the signal. The padder adjusting screw will be found on the left side of the chassis base when looking from the front. (See Figure 2.)

The six intermediate adjusting screws provided beneath the chassis, directly under the intermediate transformers (See fig. 5) are to be used only when it is absolutely certain that trouble lies at that point. If it is necessary to change the setting connect an accurate 175 K. C. test oscillator to the ground post and to the 1st detector grid cap through a .00025 mfd. fixed condenser. The oscillator tube must be removed for this operation. Beginning with the first detector plate screw (the one farthest to the left when viewing the chassis from underneath with the control shafts at the top) each one is tuned for maximum swing of the tuning meter. The procedure applies to all but the last or second detector grid vernier. The meter is not effected by this circuit, therefore, it will be necessary to turn it to a point which gives greatest volume from the speaker.

ZENITH RADIO CORPORATION

ZENITH AUTOMATIC RADIO

Socket Voltages

Type	Position	Fil. Volts	Plate Volts	Control Grid Volts	Cathode Volts	Plate M. A.	S. G. Volts
Z-51	1st. R. F.	2.2	185	— 9.	0.	2.5	80
Z-51	2nd. R. F.	2.2	200	— 3.9	0.	3.	84
Z-24	1st Det.	2.2	185	0.	+ 7.	.25	70
Z-27	Osc.	2.2	80	0.	0.	7.	0
Z-51	I. F.	2.2	185	— 4.	0.	3.	90
Z-51	I. F.	2.2	185	— 4.	0.	2.	90
Z-27	2nd. Det.	2.2	185	0.	+17.5	.5	0
Z-27	1st. P. P.	2.2	165	0.	+12.5	3.	0
Z-27	1st. P. P.	2.2	165	0.	+12.5	3.	0
Z-45	2nd. P. P.	2.3	240	—48.	0.	36.	0
Z-45	2nd. P. P.	2.3	240	—48.	0.	36.	0
Z-24	A. V. C.	2.3	30	— .4	0.	0.	45
Z-80	Rect.	5	350	0.	0.	70.	0
	Vol. Reg.	Con-	tin-	uity	test	only.	

Voltage readings taken with a Weston model 566 type 3 tester. Manual volume control in maximum position and antenna and ground disconnected. Line voltage 112

Fig. 3

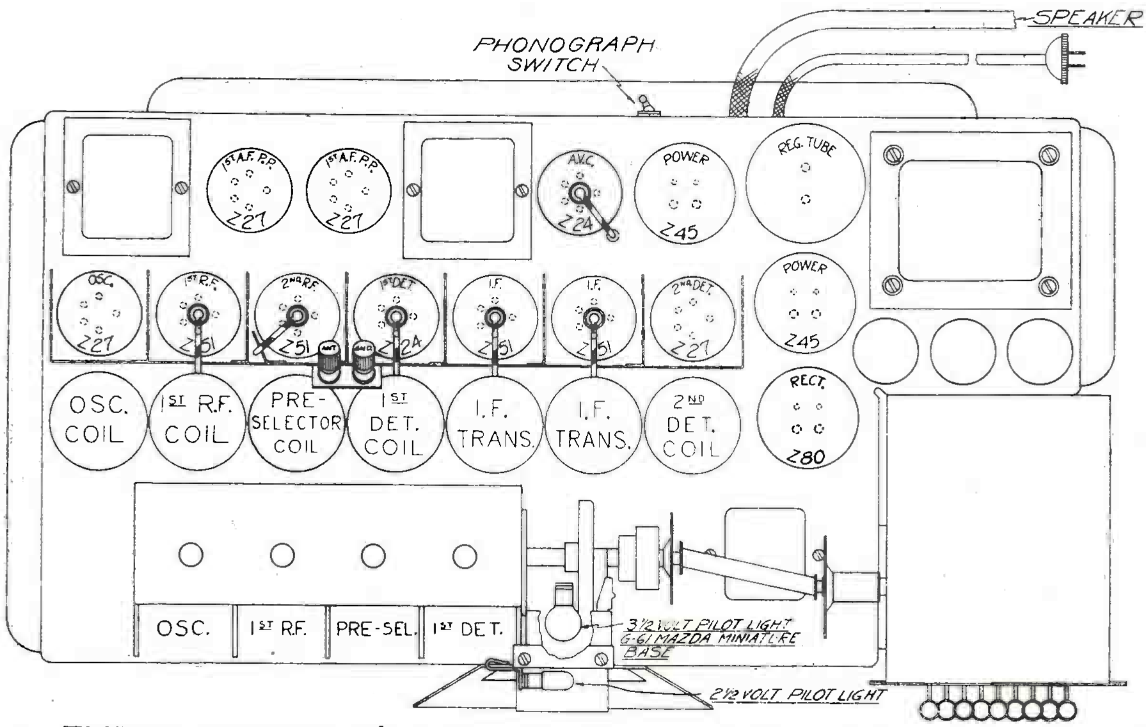
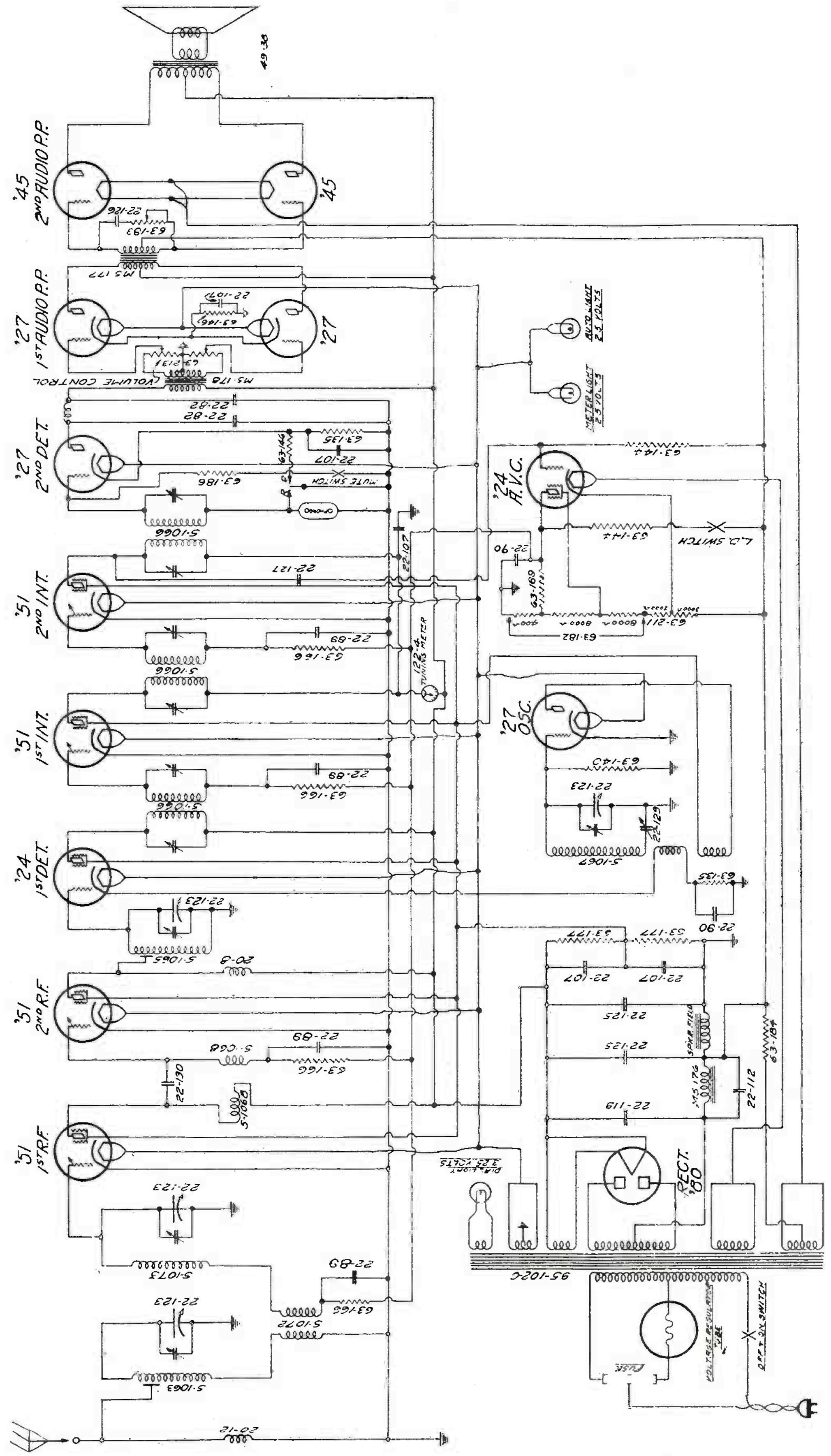


Fig. 4 TUBE LAYOUT - Showing Position and Circuit Function of each.

ZENITH RADIO CORPORATION



MODEL 103 No. 5B

ZENITH RADIO CORP.
CHICAGO, ILL.
14 TUBE SUPERHETERODYNE
MODEL 2012

CIRCUIT DIAGRAM
(SERIAL NOS. AFTER 450,451 ONLY)