1928

Engineering Data Book

for

Stromberg-Carlson Receivers Nos. 635 and 636

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By Stromberg-Carlson Telephone Mfg. Co.

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INTRODUCTION

The Stromberg-Carlson Nos. 635 and 636 Receivers are self-contained, the receiver apparatus and complete power supply equipment being mounted on one metal base with all units permanently wired together. This chassis contains two groups of apparatus; that in the center of the base, facing the dial, and on the left-hand side is the radio frequency amplifiers with tuning system, the detector, and the audio amplifier and output system; and that on the right-hand side is the power supply equipment, consisting of a power transformer, single tube full-wave rectifier, and filter system supplying "A", "B" and "C" voltages for the receiver.

The chassis base is made of sheet steel, of sufficient height to enclose all wiring and part of the apparatus, such as balancing capacitors, volume control units and hum balancing potentiometers.

The remainder of the apparatus is mounted above the base and each piece is enclosed in an individual metal casing. There is no exposed wiring, excepting the connections to the dial pilot lamp.

All tubes used in this receiver, with the exception of the audio output tube and rectifier tube, are the new improved long service, UY-227 heater type. The audio output tube is the UX-171-A type, and the rectifier tube is the full-wave UX-280 type.

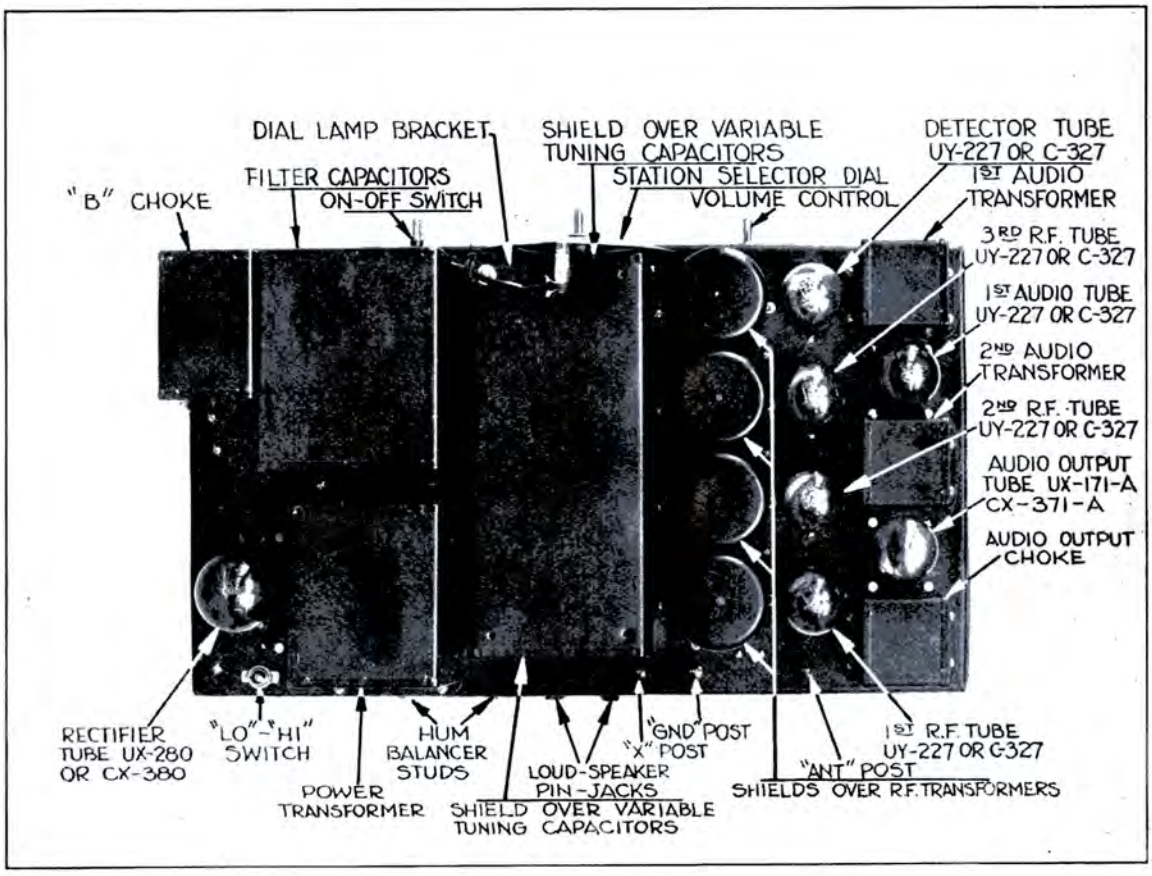


Fig. 1. Top View of Chassis

The tuning system consists of four tuned stages, using a new type antenna tuning stage and three stages of tuned and neutralized radio frequency amplification. The tuning coils are of an efficient compact type and are enclosed in seamless aluminum shields. The four tuning capacitors are in a single gang of rugged, durable construction and are enclosed in a metal shield.

The detector is of the "plate rectification" type, instead of the grid leak and condenser type. The audio amplification system is of the same high quality type used in receivers of the Stromberg-Carlson Nos. 523 and 633 types. It is very compact, all windings being enclosed in compact metal casings, and filled with sealing compound to afford protection from moisture and mechanical damage.

A phonograph pick-up jack is provided in front of the receiver, under the station selector (tuning), and operates exactly the same as that in the Stromberg-Carlson Nos. 523 and 633 type receivers.

The volume control is double and of new design, employing two variable resistor units; one in the antenna system to regulate the amount of signal admitted to the radio frequency amplifiers, and one in the third radio frequency stage to regulate the amount of signal admitted to the detector. These two units are on the same shaft and operate simultaneously by turning one control knob.

The tuning capacitors have plates shaped so that the channels at the low wave-lengths are spread more than in previous models of Stromberg-Carlson receivers, without impairing selectivity or unnecessarily crowding the channels at the longer wave-lengths. This affords greater ease of mechanical selection of station channels at the lower wave-lengths.

The amplification at the longer wave-lengths has been somewhat increased, so that the response curve is relatively flat for the entire broadcast band. The station selector (tuning) dial is calibrated in one hundred equal divisions, arranged so that, in turning the knob in a clockwise direction, the dial progresses in the same direction, and the numbering progresses from 0 to 100. The approximate wave-length in meters is also marked on the dial, so that any desired station may be quickly located. The tuning range of this receiver is from 200-550 meters, or 1500-546 kilocycles.

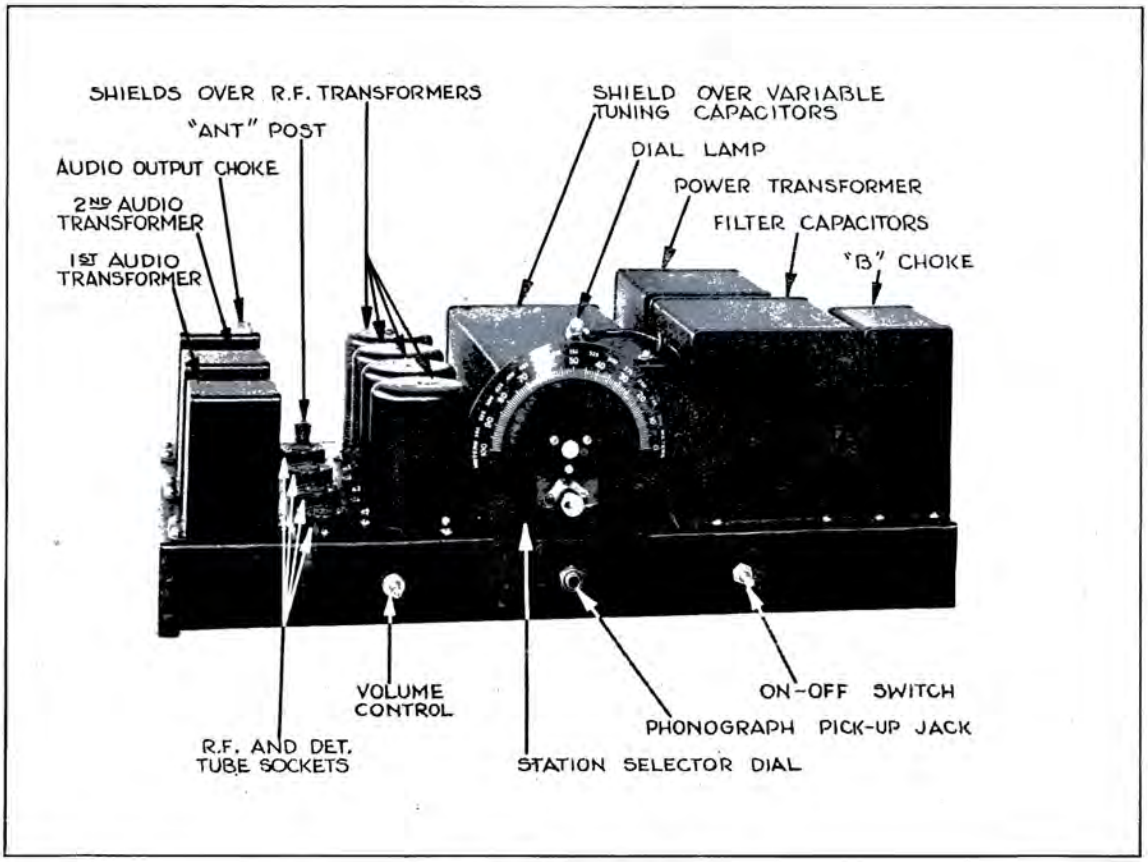


Fig. 2. Front View of Chassis

The name plate will be found at the left rear corner of the chassis base. It contains information such as the Piece Number and the Serial Number of the receiver, range of voltage and frequency over which the receiver will operate, and the power consumed.

The Nos. 635-A and 636-A Receivers with P-17897 chassis, are designed to operate efficiently on 105-125 volts, 50-60 cycle A. C.; the Nos. 635-B and 636-B Receivers with P-18039 chassis, on 105-125 volts, 25-60 cycle A. C.; and the Nos. 635-C and 636-C Receivers with P-18040 chassis, on 210-250 volts, 40-60 cycle A. C.

The receiver is equipped with a switch to compensate for low and high line voltages. With voltages lower than those recommended for efficient operation of the receiver, the receiver may operate satisfactorily, but the amplification will be decreased and the tone quality impaired; and, with voltages greater than those recommended, life of the tubes will be somewhat shortened. Line voltage fluctuations of fifteen or twenty volts will not make any appreciable change in loud-speaker volume, when such fluctuations do not exceed the rated maximum and minimum operating limits of the receiver.

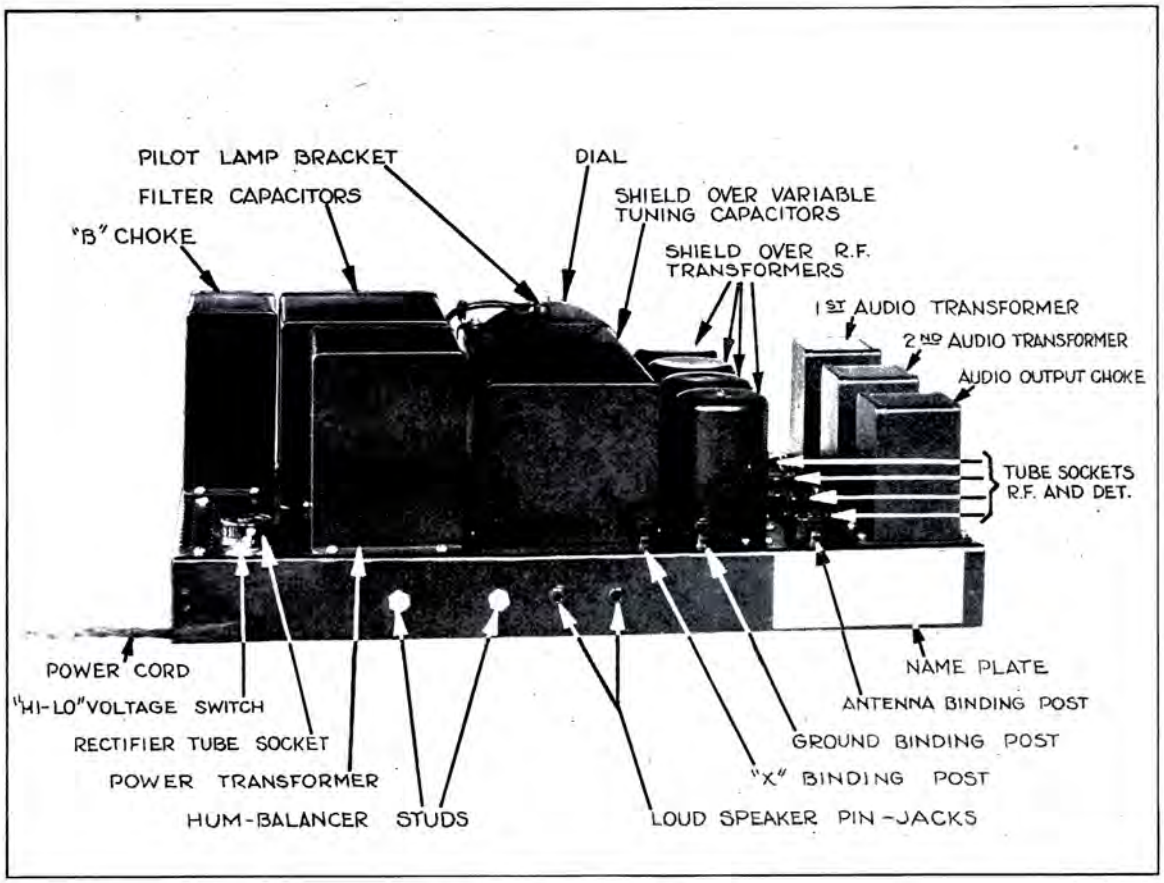


Fig. 3. Rear View of Chassis

A summary of the features of the Stromberg-Carlson Nos. 635 and 636 Receivers is as follows:

(1) Complete receiver and power equipment, arranged integrally in one compact unit.
(2) Fidelity of audio reproduction.
(3) Provision for phonograph operation.
(4) Rugged construction.
(5) Relatively flat response over broadcast band.
(6) Great ease of station selection.
(7) Total shielding.
(8) No exposed wiring.
(9) Operation direct from house lighting current using no batteries or liquids.
(10) Reasonable line voltage fluctuation will not affect operation of receiver.
(11) Single station selecting (tuning) control.

TECHNICAL DISCUSSION

I. THE TUNING SYSTEM.

(*a*) The tuning system of the Stromberg-Carlson Nos. 635 and 636 receivers consists of one tuned antenna stage and three stages of tuned and neutralized radio frequency amplification.

(1) The antenna stage is a tuned coupling stage of new, highly efficient design.
(2) The radio frequency transformers are completely shielded and are very compact and efficient.
(3) One control operates all tuning capacitors simultaneously.
(4) Tuning capacitors are aligned electrically by means of padding capacitors shunted across them.
(5) The radio frequency stages are stabilized by means of balancing capacitors, and neutralizing inductances which are part of the secondary coils of the radio frequency transformers.
(6) The neutralizing capacitor and the padding capacitor for each radio frequency stage are mounted on the same base, and have their stationary plates in common.

II. DETECTOR AND AUDIO SYSTEM.

(1) Plate rectification or "grid bias" method of detection is employed.
(2) Two stages of high-quality transformer coupled audio amplification are employed, the ratio of the first transformer being 4:1, and that of the second being 2.8:1.
(3) The secondary of each audio transformer is shunted with a one-megohm resistor to obtain the desirable audio frequency characteristic.
(4) The output of the audio system is coupled to the loud speaker by means of a sixty-henry choke and a two-microfarad capacitor. A correctly-designed "high-frequency cut-off type" of audio filter is included in the audio output system. Insulated pin-type jacks are provided at the rear of the chassis for loud-speaker connections.
(5) A phonograph pick-up jack is provided in the front panel of the receiver, which, upon insertion of the phonograph pick-up plug, connects the output of the pick-up to the audio system in place of the detector output of the receiver. The volume control of the receiver has no effect on volume when a phonograph pick-up is used; in this case the volume control provided in the No. 1 Magnetic Pick-up Outfit being used.

III. VOLUME CONTROL.

(*a*) The volume control consists of two separate units operated simultaneously by the same control knob.

(1) The primary of the antenna transformer has a 10,000-ohm potentiometer shunted across it, with the variable contact grounded. This controls the amount of signal admitted to the radio frequency amplifiers.
(2) The second unit is a 10,000-ohm variable resistor shunted across the primary of the third radio frequency transformer. This controls the amount of signal admitted to the detector.

IV. A STUDY OF THE CIRCUITS OF THE RECEIVER.

The following is a study of the component circuits of the receiver, including that of the power equipment. Fig. 5 is the schematic diagram of the complete receiver circuit.

(*a*) *The "A" or Filament Circuits.*

(1) Fig. 6 shows the filament circuits of the receiver.
(2) The heaters of the three radio frequency and first audio tubes are connected in parallel, but with separate twisted pair connections to each tube from the power transformer secondary, which supplies approximately 2.3 volts to each of these tubes. Separate connections to each tube insure the same voltage on each tube. The power transformer secondary which supplies these tubes is provided with a grounded center tap for hum balance.

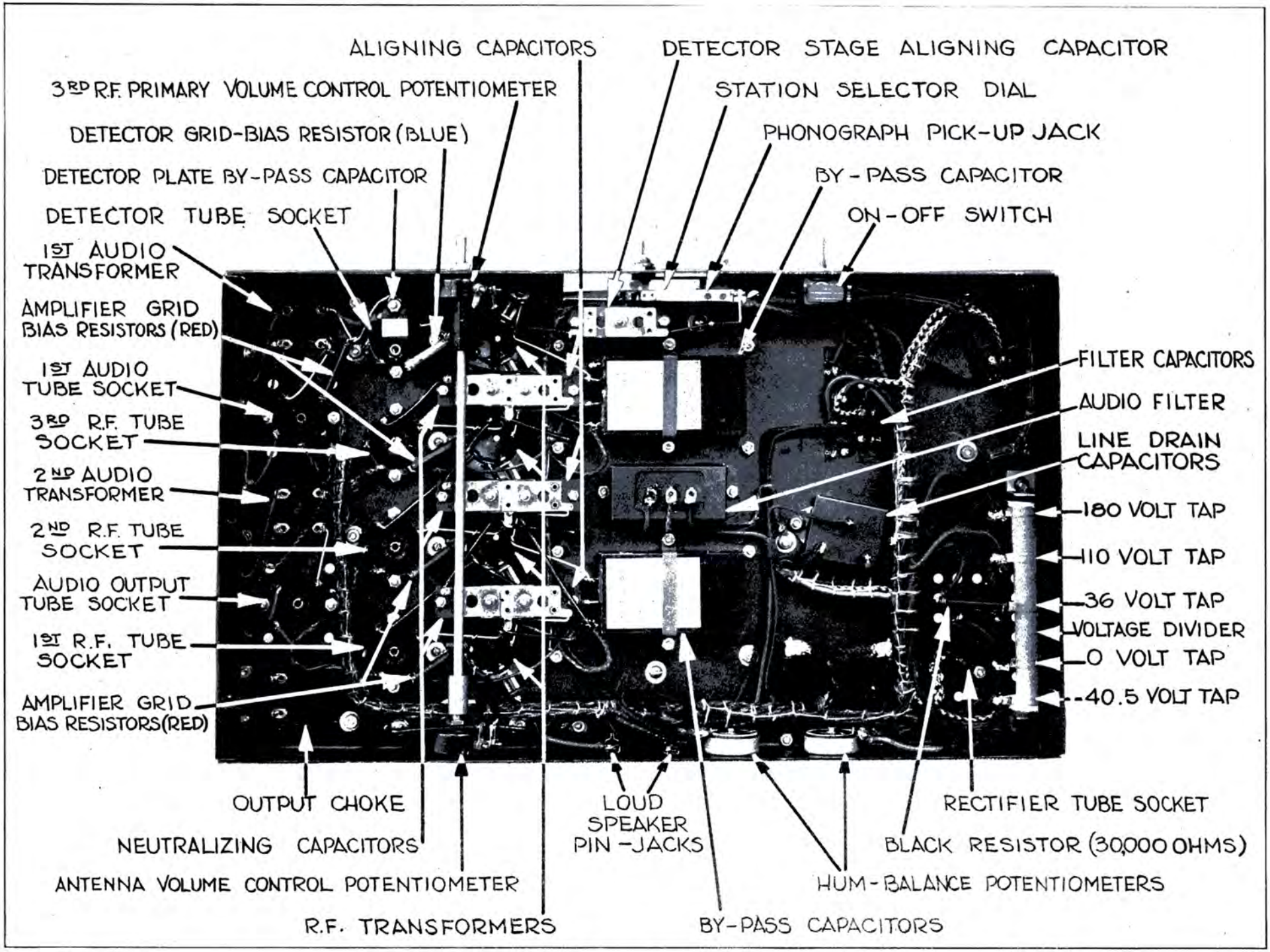


Fig. 4. Bottom View of Chassis

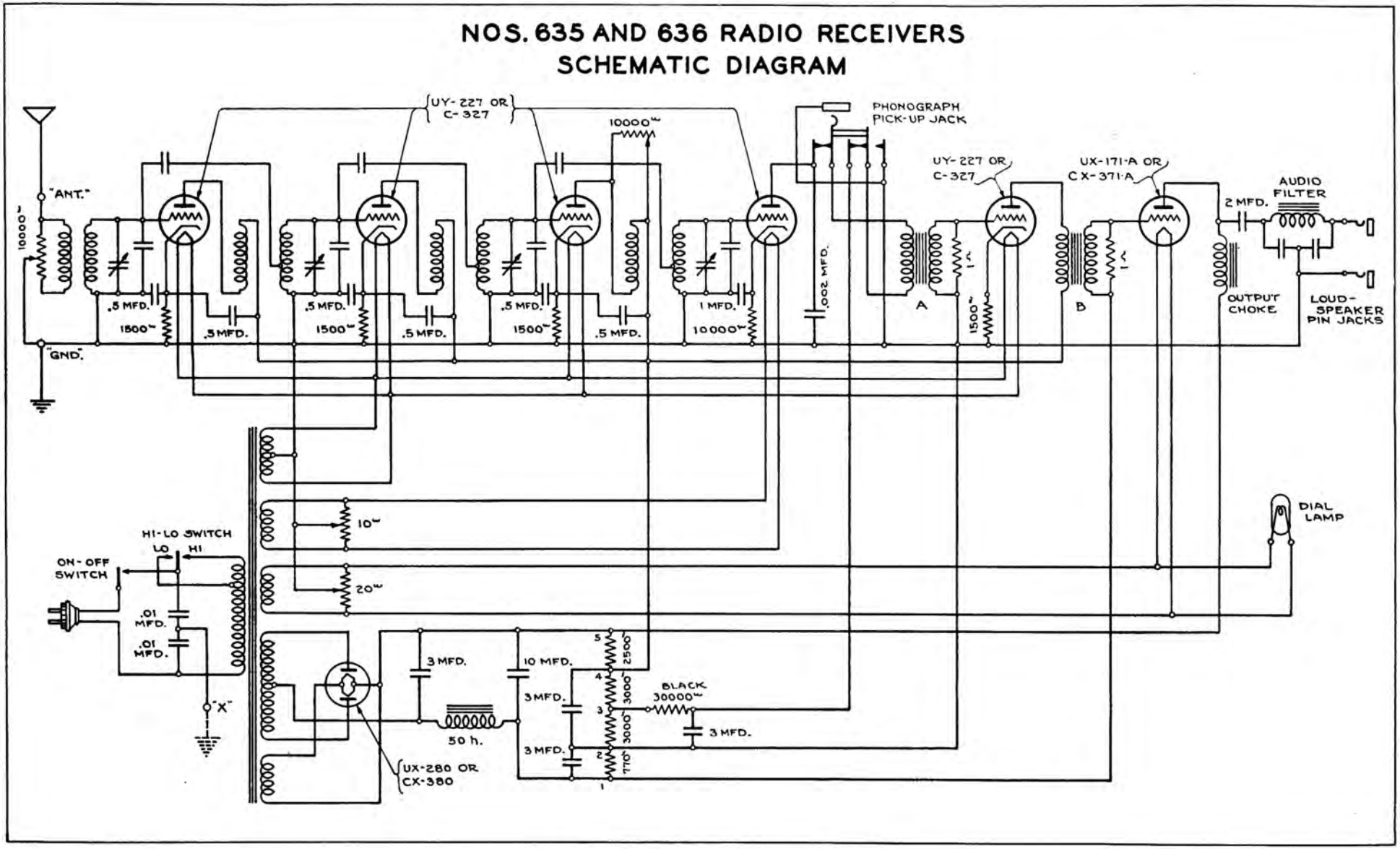


Fig. 5. Schematic Circuit Diagram

(3) A separate secondary of the power transformer supplies approximately 2.3 volts to the detector tube heater. This results in a better condition for suppressing hum. A 10-ohm potentiometer, with its variable contact grounded for hum balance, is shunted across the current supply to this tube.

(4) The filaments of the audio output tube and the dial light are connected in parallel and are supplied with approximately 4.5 volts from the power transformer. A 20-ohm potentiometer, with its variable contact grounded for hum balance, is shunted across this current supply.

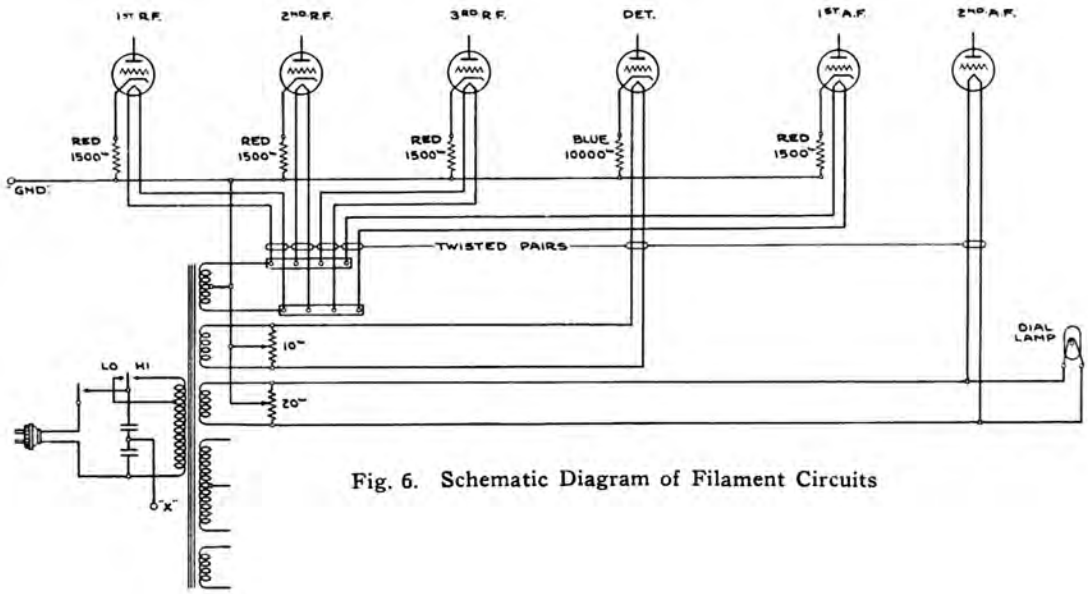


Fig. 6. Schematic Diagram of Filament Circuits

(*b*) *The "B" or Plate Circuits.*

(1) Fig. 7 shows the plate circuits of the receiver.

(2) The plates of the radio frequency and first audio tubes are supplied with approximately 110 volts D. C., from the power equipment. The detector plate is supplied with approximately 36 volts D. C. and the audio output tube is supplied with approximately 180 volts D. C. from the power equipment.

(3) The radio frequency and first audio plate supply is "by-passed" to ground by a 3-mfd. capacitor, which is contained in the power equipment.

(4) The plate supply to the radio frequency tubes is "by-passed" to the cathode at each radio frequency tube by a 0.5-mfd. capacitor.

(5) The detector plate supply is "by-passed" to ground by a 3-mfd. capacitor, which is contained in the power equipment.

(6) Any radio frequency current present in the detector plate circuit is "by-passed" to the cathode by a .002-mfd. capacitor.

(*c*) *The "C" or Grid Circuits.*

(1) Fig. 8 shows the grid circuits of the receiver.

(2) The grids of the radio frequency, detector, and first audio tubes are all returned to ground.

(3) The grids of the radio frequency and first audio tubes are biased negatively approximately 5 volts with respect to the cathodes, by means of a 1500-ohm resistor connected between each cathode and ground.

(4) The detector tube grid is biased negatively approximately 3.5 volts with respect to the cathode, by means of a 10,000-ohm resistor connected between the cathode and ground.

(5) These biasing resistors are "by-passed" by 0.5-mfd. capacitors in the radio frequency stages, and by a 1-mfd. capacitor in the detector stage. This prevents the resistors from having any effect on the radio frequency current and insures stability. It is, of course, unnecessary to by-pass the resistor in the first audio stage.

(6) The power equipment supplies approximately 40.5 volts negative bias to the grid of the audio output tube.

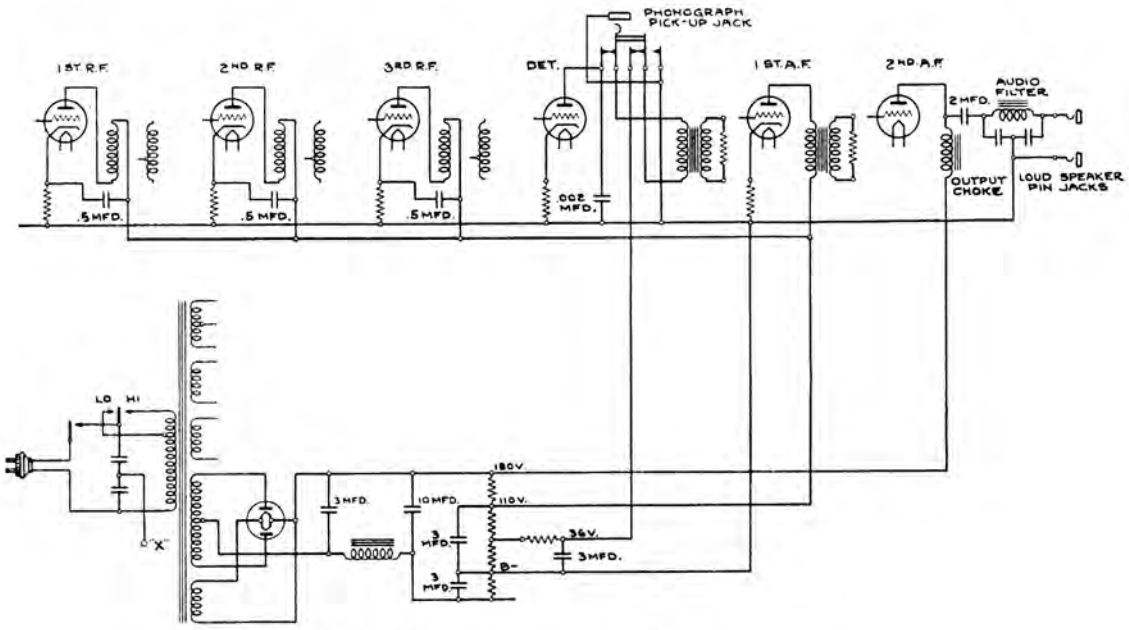


Fig. 7. Schematic Diagram of Plate Circuits

(*d*) *The Power Supply Circuit.*

(1) Fig. 9 shows the circuit of the power equipment.

(2) The primary circuit of the power transformer is provided with a "HI-LO" switch, which compensates for high or low line voltages.

(3) The power transformer consists of a primary winding and five secondary windings which supply the radio frequency and first audio tube heaters, the detector tube heater, the audio output tube and dial light filaments, the rectifier tube filament, and the high voltage which is rectified and filtered to supply the plate voltage for the receiving tubes. The grid bias voltage for the audio output tube is also supplied from this source.

(4) Full wave rectification is accomplished by one UX-280 Radiotron or CX-380 Cunningham rectifier tube.

(5) The filter system consists of a 50-henry choke, a 3-mfd. capacitor, and a 10-mfd. capacitor.

(6) A voltage divider connected across the output of the rectifier and filter system supplies the correct voltages to the radio frequency, detector and audio tube plates and to the grid of the audio output tube.

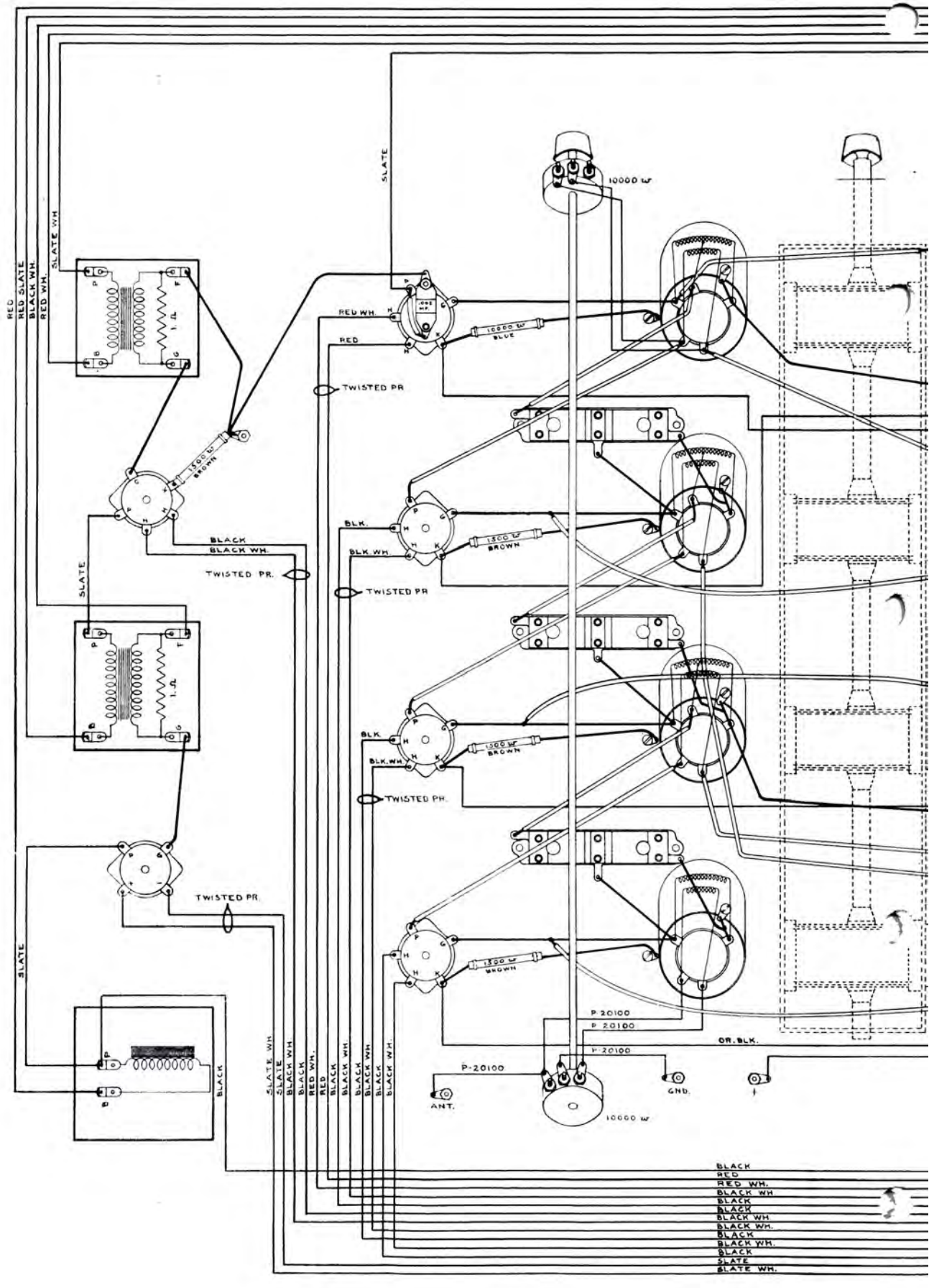
V. GENERAL.

(1) UY-227 Radiotron or C-327 Cunningham heater type tubes are used in the radio frequency, detector and first audio stages. A *UX-171-A* Radiotron or *CX-371-A* Cunningham tube is used in the audio output stage and a UX-280 or CX-380 tube must be used as the rectifier.

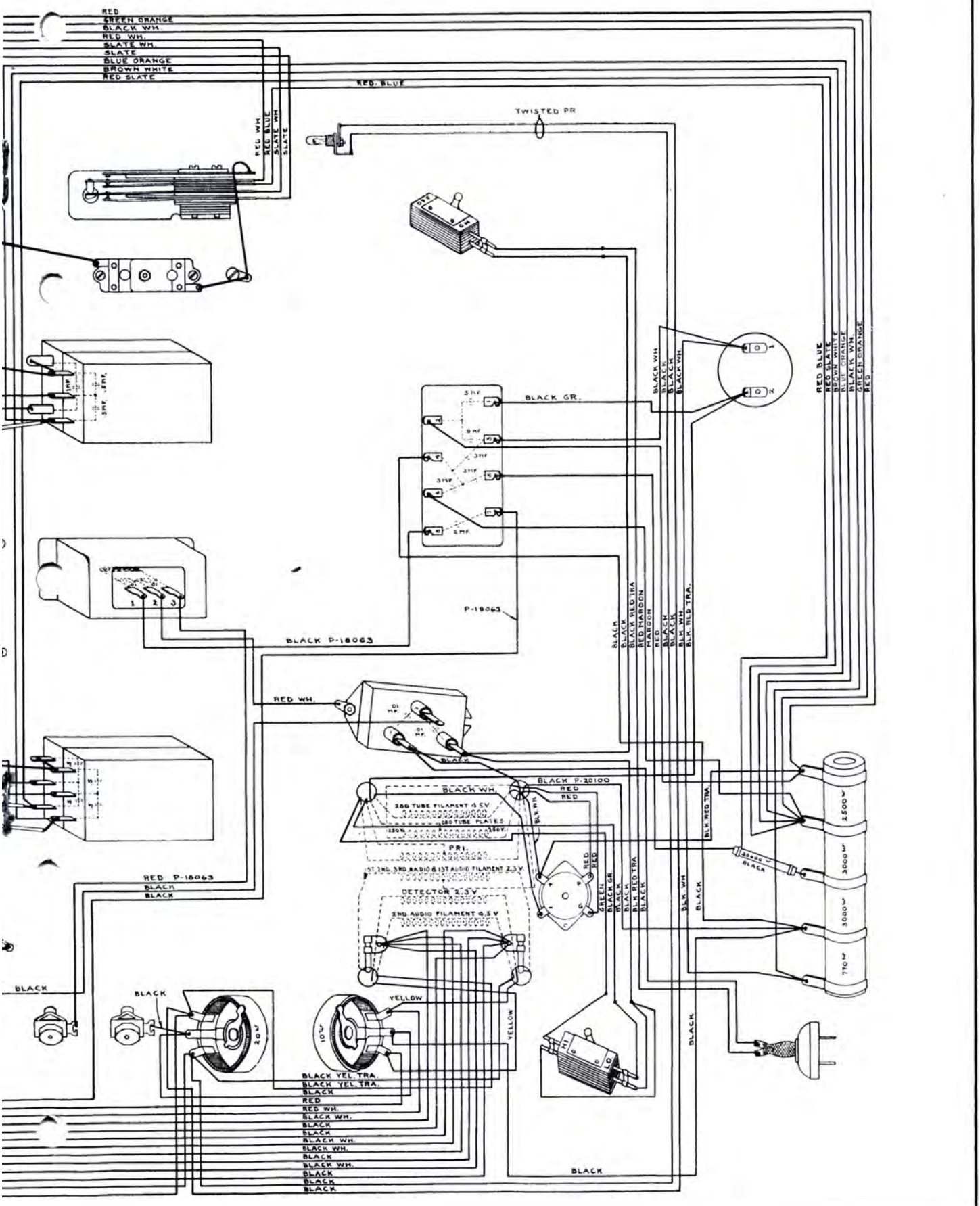
(2) The heaters of all the UY-227 (or C-327) tubes are operated at approximately 2.3 volts; and the filaments of both the UX-171-A (or CX-371-A) tube and the UX-280 (or CX-380) tube are operated at approximately 4.5 volts.

(3) The resistors connected between cathode and ground at the radio frequency and first audio tubes are colored red, while that at the detector tube is colored blue.

WIRING DIAGRAM O



NO'S 635 & 636 RECEIVERS.



(4) The voltage divider in the power equipment is a 9270-ohm resistor with five taps as follows:

	Resistance from Tap No. 1	*Voltage*	
Tap No. 1	0 ohms	— 40.5 volts	(Grid bias for audio output tube)
Tap No. 2	770 ohms	0 volts	(—B)
Tap No. 3	3770 ohms	+ 40 volts	(Intermediate voltage for detector plate supply)
Tap No. 4	6770 ohms	+110 volts	(Radio frequency and first audio plate supply)
Tap No. 5	9270 ohms	+180 volts	(Audio output tube plate supply)

These values of voltage are approximate and will vary slightly with different line voltages, which, however, has no appreciable effect on the operation of the receiver.

A 30,000-ohm resistor (colored black) is connected in series with Tap No. 3 of the voltage divider and the detector plate. This is a part of the detector plate supply filter and prevents low-frequency oscillation known as "motor-boating."

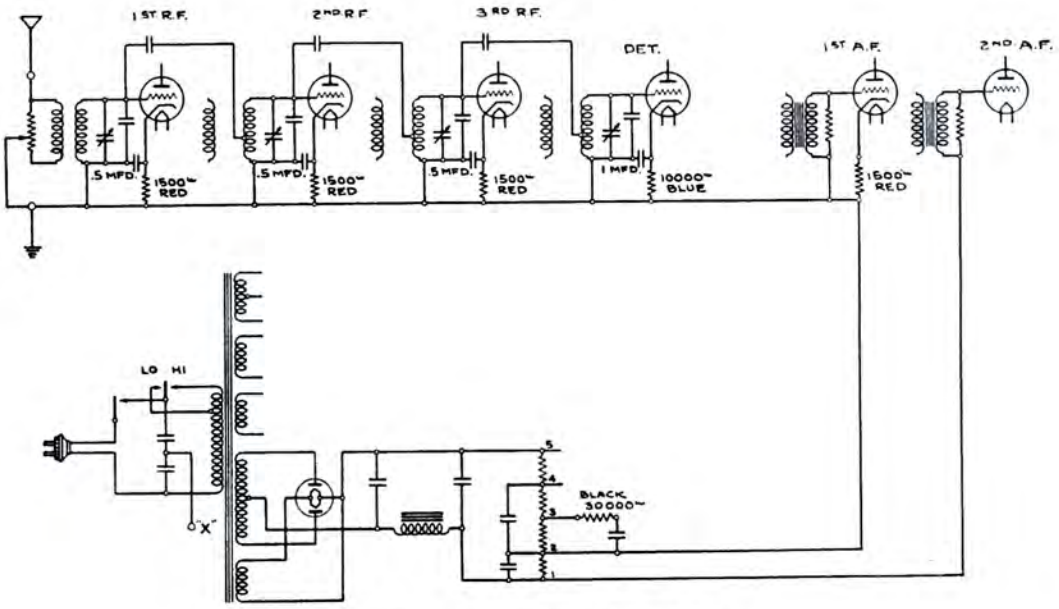


Fig. 8. Schematic Diagram of Grid Circuits

The plate and grid voltages of all tubes, measured at the tubes are approximately as follows:

R. F. plates	+110	volts
R. F. grids	— 5	volts
Detector plate	+ 36	volts
Detector grid	— 3.5	volts
1st audio plate	+110	volts
1st audio grid	— 5	volts
Audio output plate	+180	volts
Audio output grid	— 40.5	volts

These voltage values are approximate and will vary slightly with different line voltages within the specified operating range of the receiver. This, however, has no appreciable effect on the operation of the receiver.

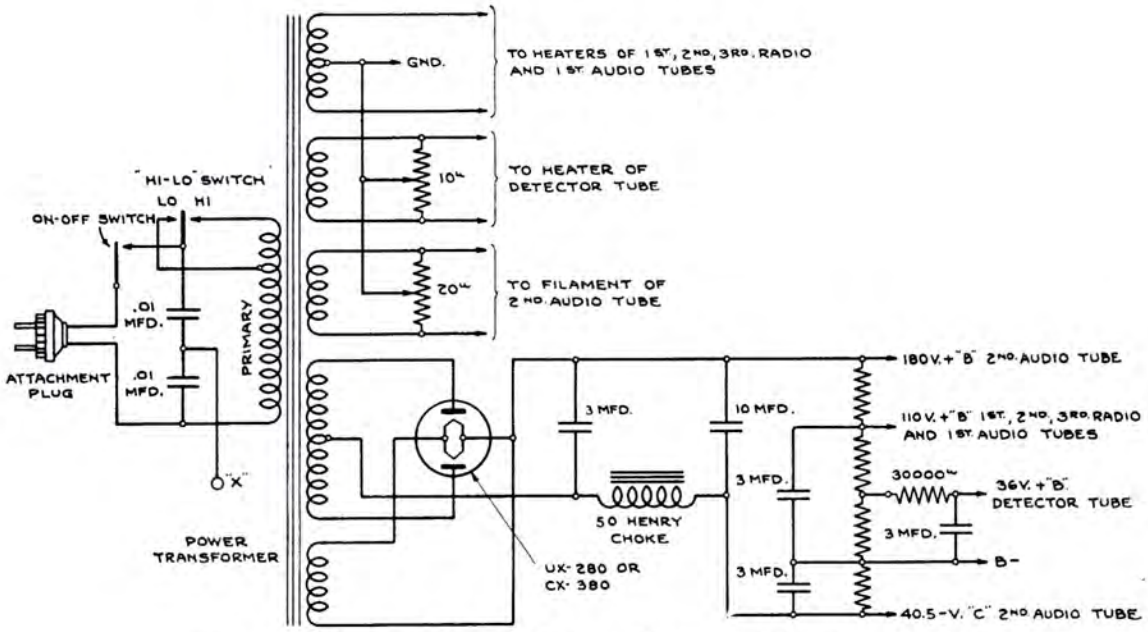


Fig. 9. Schematic Diagram of Power Equipment Circuits

The following table shows how the filament, plate and grid voltages vary with different line voltages, in the No. 635 receiver. The plate voltages are measured between tube plates and Tap No. 2 of the voltage divider. The grid voltages of the heater type tubes are measured across the cathode resistors; and that of the audio output tube is measured between Taps No. 1 and No. 2 of the voltage divider.

Line Voltage "HI-LO" Switch	105 "LO"	110 "LO"	115 "LO"	115 "HI"	120 "HI"	125 "HI"
UX-280						
Filament Voltage (RMS)	4.5	4.75	5.0	4.5	4.7	4.93
Voltage per anode (RMS)	236.0	248.0	259.0	236.0	248.0	258.0
Amplifiers						
Heater Voltage (RMS)	2.17	2.27	2.38	2.16	2.26	2.35
Plate Voltage	106.0	110.0	115.0	106.0	110.0	115.0
Grid Voltage	— 5.0	— 5.5	— 5.75	— 4.7	— 5.2	— 5.6
Detector						
Heater Voltage (RMS)	2.11	2.22	2.32	2.1	2.2	2.3
Plate Voltage	39.0	40.0	42.0	38.0	40.0	41.0
Grid Voltage	— 3.25	— 3.5	— 3.75	— 3.25	— 3.5	— 3.75
Audio Output Tube						
Filament Voltage (RMS)	4.5	4.75	5.0	4.53	4.72	4.94
Plate Voltage	167.0	175.0	184.0	165.0	174.0	182.0
Grid Voltage	—37.0	—40.0	—41.0	—36.0	—40.0	—41.0

NOTE—The grid voltage on the 1st audio tube will be slightly lower than that on the R. F. amplifier tubes, due to the drop in the secondary of the 1st audio transformer.

All D. C. voltages in the above table below 30 volts should be measured with the low scale on a 1000-ohm per volt Voltmeter (resistance 50,000 ohms), and the higher D. C. voltages should be measured with the high scale of the same meter (resistance 250,000 ohms).

SERVICE INSTRUCTIONS

The four most frequent conditions in any receiver, which require the services of the dealer's technical man, are as follows:

1—The condition where no signal is obtained.
2—The condition where a weak signal is obtained.
3—The condition where audio distortion occurs.
4—Receivers operated from an alternating current supply provide an additional condition, which is "hum".

1. A systematic course should be adhered to when endeavoring to locate the cause of faulty operation in the Stromberg-Carlson Nos. 635 and 636 Receivers. The installation should first be checked thoroughly, making certain that:

1—The house lighting current is not shut off by a burned-out fuse, or trouble on the line or at the power station.
2—The connection from the receiver to the house lighting system is properly made.
3—The antenna and ground connections are properly made.
4—The antenna is not open or grounded.
5—The loud speaker connections are properly made.
6—The volume control is not turned too low.
7—All tube filaments are burning.

About a half minute should be allowed, after the set is turned on, for the tubes to reach the proper operating temperature.

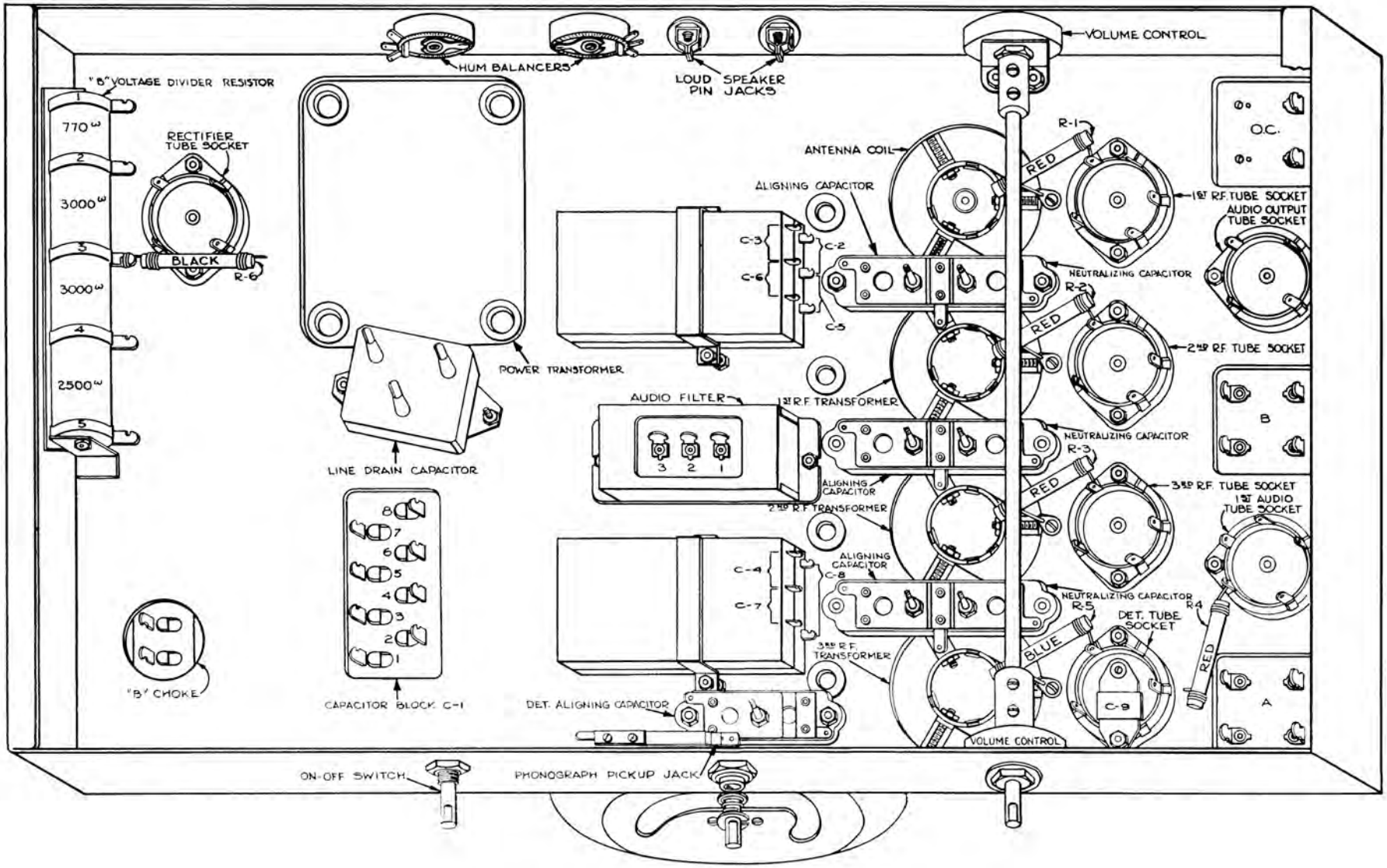
If a No. 1 Magnetic Pickup Outfit is at hand, insert the plug into the Pickup Jack in the front panel of the receiver. Then by operating the phonograph it may be determined whether or not the faulty operation is in the audio system. If it does operate correctly it may be assumed that the trouble is not in the audio or rectifier systems.

A list has been compiled, which contains possible causes of faulty operation of these Receivers. If thorough examination of the installation does not bring to light the source of trouble, this list should be consulted. The list is as follows:

A. No Signal in Loud Speaker.

1—Burned-out tube (UY-227 or C-327) in the first radio frequency, detector or first audio stages.
2—Burned-out tube (UX-171-A or CX-371-A) in audio output stage.
3—Burned-out rectifier tube (UX-280 or CX-380).
4—Shorted .5-mfd. by-pass capacitor for the plate supply in the first, second or third radio frequency stage. These capacitors are marked "C_2, C_3, C_4" in Fig. 10. This condition can be verified by the fact that the grid bias potential on the radio frequency tube which is affected by the shorted capacitor, will be increased from, approximately, —5 volts to, approximately —40 volts. At the same time the grid bias on the other radio frequency tubes will be decreased from, approximately, —5 volts to, approximately, —2 volts. The plate voltage on the affected tube will be dropped to 0 potential, while that on the other radio frequency tubes will be decreased to, approximately, one-half its normal value.
5—Shorted .002-mfd. detector plate by-pass capacitor. This capacitor is at the detector tube socket and is marked "C_9" in Fig. 10. An appreciable degree of hum will be noticed when this condition is present.
6—The primary of the first audio transformer may be open. This is the transformer marked "A" in Fig. 10, and if there is an open circuit between the "+B" and "P" terminals, the above condition is true.
7—The secondary of the same transformer may be open. These terminals are marked "F" and "G".
8—The primary of the second audio transformer may be open. This transformer is marked "B" in Fig. 10.
9—The output choke may be open. This may be tested by using the same method employed in testing the transformers.

FIG.10 BOTTOM VIEW OF CHASSIS OF NOS. 635 AND 636 TYPE RECEIVERS



10—Open or shorted audio filter. If either or both of the capacitors in the filter are broken down, a short circuit may be obtained between terminal No. 3 and terminals Nos. 1 and 2 on the filter. If the filter is open, an open circuit may be obtained between terminals No. 1 and No. 2.

11—Open or shorted output capacitor. This is a 2-mfd. capacitor, which is located in the capacitor block marked "C_1" in Fig. 10. Its two terminals are marked Nos. "7" and "8".

12—Shorted 3-mfd. or 10-mfd. capacitor of the filter system of the power equipment. These capacitors are contained in the capacitor block marked "C_1" in the Fig. 10. The terminals of the 3-mfd. capacitor are marked Nos. "1" and "2", and those of the 10-mfd. capacitor are marked Nos. "2" and "3".

13—Shorted 3-mfd. by-pass capacitor for the detector plate supply. This capacitor is contained in the capacitor block marked "C_1" in Fig. 10 and its terminals are Nos. "4" and "6".

14—Shorted 3-mfd. by-pass capacitor for the radio frequency and first audio plate supply. This capacitor is contained in the capacitor block marked "C_1" in Fig. 10, and its terminals are Nos. "4" and "5".

15—Any open or short circuit in the voltage divider resistor.

B. Weak Signal in Loud Speaker.

1—Burned-out tube (UY-227 or C-327) in the second or third radio frequency stages (when strong station is being received).

2—Defective tube or tubes.

3—Open .5-mfd. by-pass capacitor in plate supply to the third radio frequency stage. This capacitor is marked "C_4" in Fig. 10.

4—Shorted .5-mfd. by-pass capacitor for the 1500-ohm bias resistor in the first, second or third radio frequency stages. These capacitors are marked "C_5, C_6, C_7" in Fig. 10.

5—Open 1500-ohm bias resistor in the first or second radio frequency stage, or in the first audio stage. These resistors are colored red and are marked "R_1, R_2, R_4" in Fig. 10.

6—Shorted 1.0-mfd. by-pass capacitor for the 10,000-ohm bias resistor in the detector stage. This capacitor is marked "C_8" in Fig. 10.

7—The secondary of the second audio transformer may be open. The transformer is marked "B" in Fig. 10, and the terminals of the secondary are "G" and "F".

8—The outside spring on the phonograph pick-up jack may be jammed down so that it makes contact with the next spring. An appreciable amount of hum will be noticed, when this condition is present.

9—The 3-mfd. by-pass capacitor for the detector plate supply may be open. This capacitor is contained in the capacitor block marked "C_1" in Fig 10, and its terminals are Nos. "4" and "6".

10—The 5-mfd. capacitor in the filter system of the power equipment may be open. This capacitor is contained in the capacitor block marked "C_1" in Fig. 10, and its terminals are Nos. "1" and "3".

11—The volume control may be turned too low.

12—The tuning capacitors may be out of electrical alignment.

13—Open grid circuit. This condition can be verified by the fact that the potential across the biasing resistor of the affected tube will be increased to, approximately, 10 volts, whereas the potential across the others will remain normal.

C. Audio Distortion.

1—Defective UX-171-A or CX-371-A tube in the audio output stage.

2—The 1500-ohm bias resistor in the third radio frequency stage may be open. This resistor is colored *red* and is marked "R_3" in Fig. 10.

3—The 10,000-ohm bias resistor in the detector stage may be open. This resistor is colored *blue* and is marked "R_5" in Fig. 10.

4—Shorted 3-mfd. by-pass capacitor for the grid bias supply to the audio output tube. This capacitor is contained in the capacitor block marked "C_1" in Fig. 10, and its terminals are Nos. "3" and "4".

5—The receiver may be in an unstable condition. This may be determined by squeals varying in pitch when the station selector is rotated, and also by a low-frequency rattle in the loud speaker. The tubes should be changed around in the radio frequency stages, and possibly new tubes substituted for one or more of those in use. (See paragraph on Oscillation.)

6—The hum balance may be out of adjustment so that the hum is modulating the incoming signal and thus producing distortion. It may be that the hum balance has not been adjusted properly, or that one or both of the two hum balancing potentiometers are open.

D. Hum Reproduced in Loud Speaker.

All A. C.-operated receivers are subject to hum if not properly installed or adjusted. There are only two adjustments to make on the Nos. 635 and 636 receivers for the suppression of hum. These are made by adjusting the two "hum balancers" at the rear of the chassis, next to the loudspeaker pin jacks. The receiver should be tuned to a place on the dial where no station is heard, and the *volume control turned down to a point just above zero.* The adjustments should be made one at a time, until a minimum of hum is heard in the loud speaker.

It should be ascertained that only a UX-171-A or CX-371-A tube (Be sure it is marked "A") is used in the audio output stage, as any other tube will result in a condition in which desirable suppression of hum cannot be accomplished.

Should either of the hum balancing potentiometers be open, or should either side of the filament supply to any of the tubes in the receiver be grounded, suppression of hum cannot be accomplished.

This condition will occur if the dial pilot lamp bracket is too far forward. In this case one side of the dial pilot lamp socket will make contact with the dial, thereby grounding one side of the audio output tube filament supply. (See Fig. 6.)

A ground in the filament supply to the audio output tube can be detected by not being able to effect a hum balance with the "hum balancer" controlling that tube; and also by the fact that the dial pilot lamp will go out when the "hum balancer" is turned as far as it will go in one direction (try turning in both directions). The ground will then be found in the side of the audio output tube filament circuit, opposite to the side to which the "hum balancer" is turned.

The receiver should be thoroughly examined for loose or broken connections, and grounded filament, plate or grid circuits. If the .002-mfd. by-pass capacitor for the detector plate is broken down, an appreciable amount of hum will be noticed in the loud speaker. No signal can be obtained when this condition is present, however. Should the outside spring on the phonograph pick-up jack be jammed down so that it makes contact with the next spring, a great degree of hum and a weak signal will be obtained.

II. INSTABILITY OR OSCILLATION

Oscillation which is the result of an unstable condition in the receiver, may be recognized by squeals varying in pitch when the station selector is rotated, and a low-frequency rattle in the loud speaker. This condition may be the result of one or more of several causes. However, it is impossible to correct the difficulty in the field, unless the condition is the result of poorly-selected or worn-out tubes. The tubes in the radio frequency stages should be changed around and possibly new ones substituted. The receiver should be sent to the nearest branch office for re-adjustment, if changing the tubes around or substituting new ones, does not correct the condition.

III. RECEPTION OF ONE STATION AT TWO PLACES ON TUNING DIAL

(a) Reception of One Station at Two Widely Separated Places on Tuning Dial

The reception of a station at two widely separated places on the tuning dial is due to the receiver picking up the second harmonic (half wave-length) of the frequency upon which the station is broadcasting. It will be noticed that this second place is at half the wave-length of the station. This condition may occur when the receiver is located very near a powerful broadcast station. It will not occur with any station whose second harmonic frequency (half wave-length) is below the lower end of the tuning range of the receiver.

(b) Reception at Two Places Only Few Divisions Apart.

Reception at two places only a few divisions apart on the tuning dial, and with no null point between the two peaks, may be due either to the detector being overloaded, or to the tuning capacitors being out of electrical alignment.

The first condition is due to the fact that the *volume control is turned up too high for a nearby powerful station,* and can be corrected by cutting the volume down.

Instruct a new user to turn down the volume control, after bringing in a station signal, so as to make it possible to retune the station selector for maximum response (sharpest tuning), after which the volume control can be set for desired loudness of signal.

The second condition cannot be corrected in the field and the receiver will have to be sent to the nearest branch office to be re-adjusted.

IV. GENERAL.

(*a*) *Volume Control Adjustment.*

A double volume control is employed, both units being driven by one shaft and operated by one control knob. These units are insulated from each other by means of an insulation collar at one end of the shaft. This insulation collar connects to the shaft extension of the "3rd Radio Frequency Stage Volume Control Resistor," while a metal collar connects the other end of the main shaft to the shaft extension of the "Antenna Volume Control Resistor." These main-shaft connecting collars are held in place by set screws, clamping on flat surfaces provided on the main shaft and on the resistor shaft extensions. To adjust the two resistors for simultaneous operation, proceed as follows:

1—Loosen the hexagonal nut that holds the casing of the rear resistor to its mounting bracket.
2—Turn the volume control knob to its *full clockwise* position, holding the knob in this position.
3—Now, rotate the casing of the rear resistor *counter-clockwise* as far as it will go without causing the volume control knob to turn in the fingers. (See Fig. 11.)
4—Retighten the hexagonal nut so as to clamp the rear resistor casing securely to its mounting bracket, taking care not to turn this resistor casing when the nut is tightened.

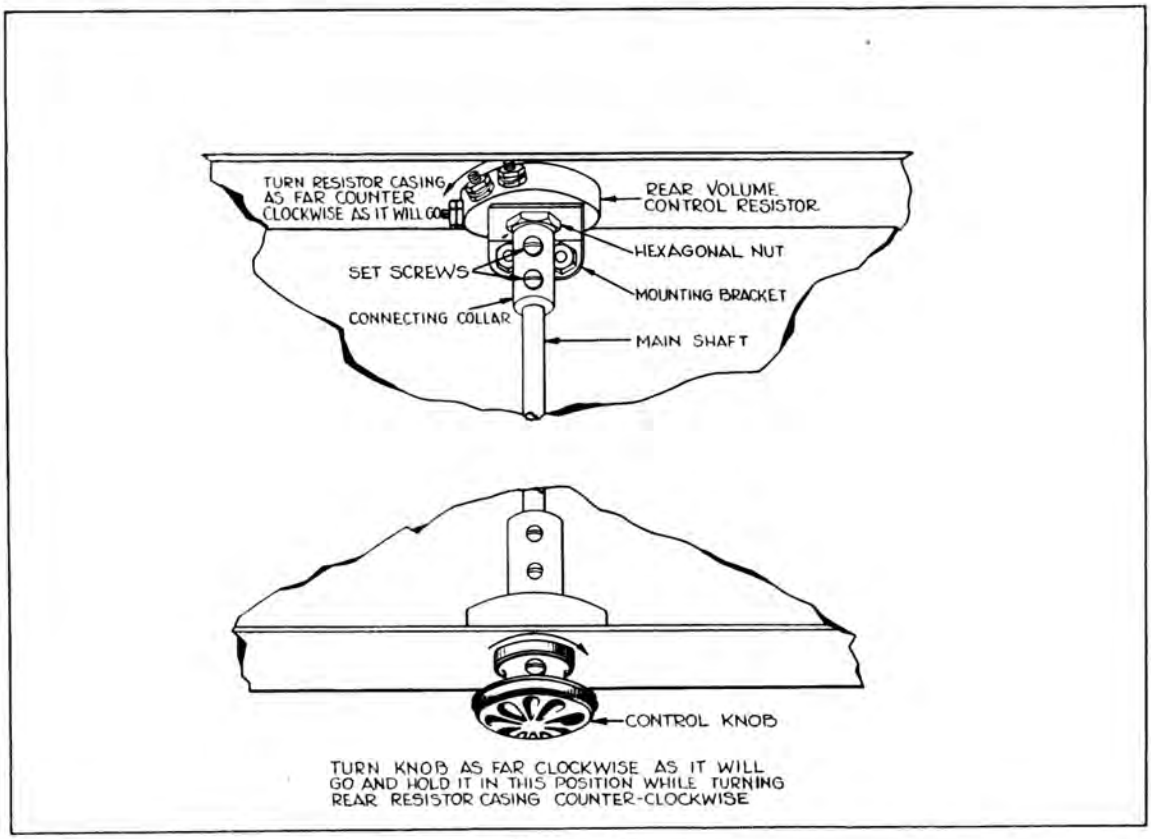


Fig. 11. Volume Control Adjustment

(*b*) *Variable Tuning Capacitors.*

The long casing in the center of the receiver shields the variable tuning capacitors. There are four capacitors in one gang. A small piece of solder between plates, two or more plates touching, or a broken pig-tail connection may cause faulty operation of the receiver. This should be carefully checked if reception is exceptionally noisy or if "dead spots" occur.

(c) *Noisy Alternating Current Supply.*

Provision has been made in this receiver to suppress noise arising from A. C. line conditions. A third binding post, marked "X", has been provided with the "ANT" and "GND" binding posts at the rear of the receiver chassis. If undesirable A. C. line noise is experienced a jumper wire should be placed between the "GND" binding post and the "X" binding post. A change in signal volume may be noticed when this is done, but there will be no effect on the ultimate operation of the receiver.

Reversing the plug on the A. C. supply cord, in its socket (house lighting system outlet), sometimes eliminates A. C. line noise.

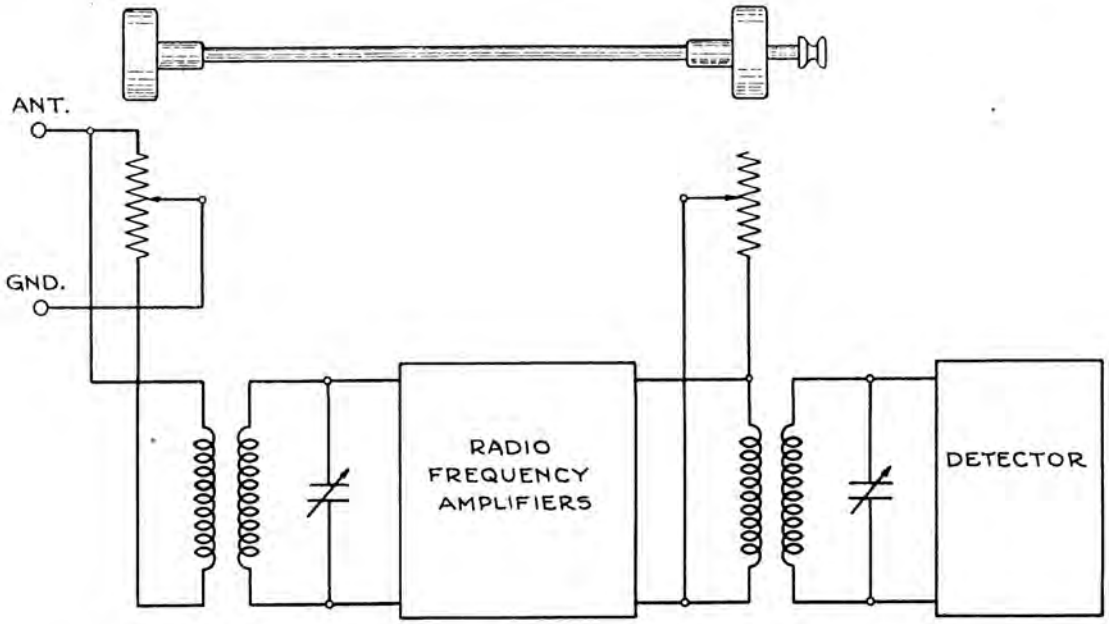


Fig. 12. Schematic Diagram of Volume Control

V. TESTS.

A good A. C. voltmeter, capable of measuring A. C. voltages accurately as low as 1 volt and as high as 300 volts, and a high-resistance D. C. voltmeter (at least 800 ohms and preferably 1000 ohms per volt), capable of measuring D. C. voltages as high as 250 volts are indispensable instruments for the dealer's technical man, when endeavoring to locate the source of faulty operation in a No. 635 or 636 Receiver. Filament, plate and grid voltages can be measured, and open, shorted and grounded capacitors, audio transformers, resistors, etc., may be located by the use of these instruments.

Using the D. C. voltmeter with 22½ volt "C" battery in series with it, no reading should be obtained through any capacitor (after it has been disconnected from its own circuit), unless it is shorted. Readings should always be obtained through primaries and secondaries of the audio transformers, through the output choke and through any of the resistors, unless they are open. The audio filter may be tested in the same manner. Undesirable grounds may be located by testing between ground and the circuit in question. The D. C. voltmeter may also be used to determine whether or not the plate and grid ("B" and "C") voltages are correct.

The A. C. voltmeter should be used to measure the house lighting line voltage so that the installation of the receiver may be done intelligently. The "HI-LO" switch on the receiver should be set at "HI" position where the A. C. line voltage is higher than 115 volts, and at "LO" position where the line voltage is lower than 115 volts. The "HI-LO" switch should be set at "HI" position if the line voltage is known to vary over a range of voltage, the highest point of which is over 115 volts. When in doubt as to the normal line voltage, or as to extent of maximum voltage fluctuation, be sure to set the "HI-LO" switch lever to the "HI" position. The A. C. voltmeter may also be used to determine whether or not the heater and filament voltages of the receiver are correct.