

RADIO

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A C HOOK UPS

SHOWING ELECTRIC SETS
WITH CIRCUITS
IN COLORS

- 6 Tube Single Control Set
- 5 Tube Tuned Radio Frequency Set
- 4 Tube Popular Uncle Sam Set
- 4 Tube Screen Grid Set
- 3 Tube All Wave Set. (20 to 550 M.)
- B-Eliminator for A. C. Current



1929
EDITION
SIG. NEWMAN

Published by

THE RADIO CONSTRUCTOR



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AUTHOR'S PREFACE

The author was fortunate in prevailing upon the publisher to reproduce the circuits of his diagrams in colors, notwithstanding the considerable extra expense involved.

This color scheme is a unique and valuable feature as by its aid the different circuits can much more easily be followed by the eye. This must be evident especially considering the complexity of radio wiring.

The color scheme employed to distinguish the various circuits are as follows:

The **RED LINES** represent the **filament** connections.

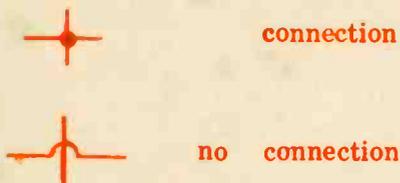
The **LIGHT BLUE LINES** represent the **Grid** connections.

The **GREEN LINES** represent the **plate** connections.

The **HEAVY BLACK LINE** represents the antenna connection.

S. NEWMAN.

Sept., 1928.



THE STORY OF RADIO

The signal or music, which you receive, is first broadcast from some transmitting station in the form of radio waves. These waves travel in all directions through the air. In order to pick up radio waves, an antenna is usually erected on a roof for that purpose. An antenna is nothing more than a single bare copper wire between 75 to 100 feet long suspended as high up in the air as possible. This wire must be insulated from its support by means of *insulators*. If it be impossible to have an antenna outdoors a No. 18 insulated bell wire or ribbon run around the moulding in a room or rooms will be next best. An insulated wire connects the antenna to the radio set. This is called a *lead-in*. A lead-in wire is most easily brought into a room by using a window strip connector which fits underneath the window sash enabling the window to be closed without any difficulty. A porcelain tube passing through a drilled hole in the window sash or frame is a better method to bring in the lead-in wire.

The interrupted radio waves reach the receiver by means of the antenna and lead-in. In the set the signal passes through the *primary* of an antenna coupling coil and then to the ground. This may be followed quite easily by tracing through the *Black* antenna wire to the coil, then back through the *Red* ground connection.

It should be noted that the use of colors to distinguish the three elements of a radio set, namely the *Red line* or Filament, *Light Blue lines* or Grid, and the *Green lines* or plate, helps to explain how a radio set works. Thus, a complete circuit is formed with the broadcast station.

A ground connection can be made on a radiator pipe, cold water pipe or by sinking a copper plate directly into moist earth.

In making connection, care should be taken to secure good contact; a soldered connection is best as the resistance of the joint is reduced to a minimum.

The primary on the coil is the small winding marked P, and B+. The signal is now *stepped-up* or boosted in the antenna coil by action of the secondary, which is the large winding adjacent to the primary and marked G, and F. This coil is also called a *radio frequency transformer*.

The G end of the secondary goes to the G post of the *vacuum tube socket*. Follow the *Light Blue line*. The F— goes to the filament of the tube through the *red* colored connection. A *variable condenser* is connected across the secondary. The *stator* (the fixed plates) to G and the *rotor* (the plates which revolve) to F—. Without this condenser it would be impossible to tune in a station separately. In conjunction with the secondary it tunes in or selects one station at a time according to the *wave-length*.

The *Red* or filament leads carry the current from a storage battery or an alternating current source (stepped down to the correct voltage, to heat or light up the tubes. Thus the sole function of the *filament circuit* is to light the tubes and nothing else.

The light blue lines follow the path of the signal voltage which controls the power from the tube. In other words, the grid is like the seat of a valve which controls the volume of water passing through it.

The *Green* lines trace out the *plate* leads. These transmit the output power of the tubes. This power is supplied by either a "B" battery or "B" *eliminator*.

The above combination of radio frequency coil, condenser and tube is called a *tuned radio frequency stage*. Two or more of these stages can be added to increase the signal strength and provide greater selectivity.

After traversing the radio frequency stages, the amplified signal passes through the *detector tube*. The function of this tube is to make the signal audible in a pair of phones if these be inserted in the plate lead.

In order to increase the insufficient volume from the detector so that a loud speaker can be operated, an *audio amplifier* is needed. A stage of audio amplification consists of a vacuum tube and *transformer*. This combination is known as *transformer coupled amplification*. Other systems of amplification are *resistance*, *impedance* and *push-pull*. Transformer coupled amplifiers are most efficient and if they be well designed, very good quality can be expected.

Every one of the sets described in this volume is up to date in every sense of the word. Drum control, power tube, output transformer, volume control, etc., are features of these receivers and are to be found in the best sets now manufactured.

The author believes that the drawings are sufficiently clear to need no extended explanation; the brief descriptions and instructions being ample. Instead of an extended treatment the author confines himself to the general methods and suggestions which follow.

In drilling the front *panel* use sharp drills. Locate the holes by following the proportions as indicated on the panel layout. Then start these holes with an awl and drill. This will insure easy and accurate drilling. In cutting the *drum opening*, follow the drilling template supplied by the manufacturer.

In mounting the drum be sure to countersink mounting screws below surface of panel so as to eliminate shorting opposite condensers through the escutcheon plate.

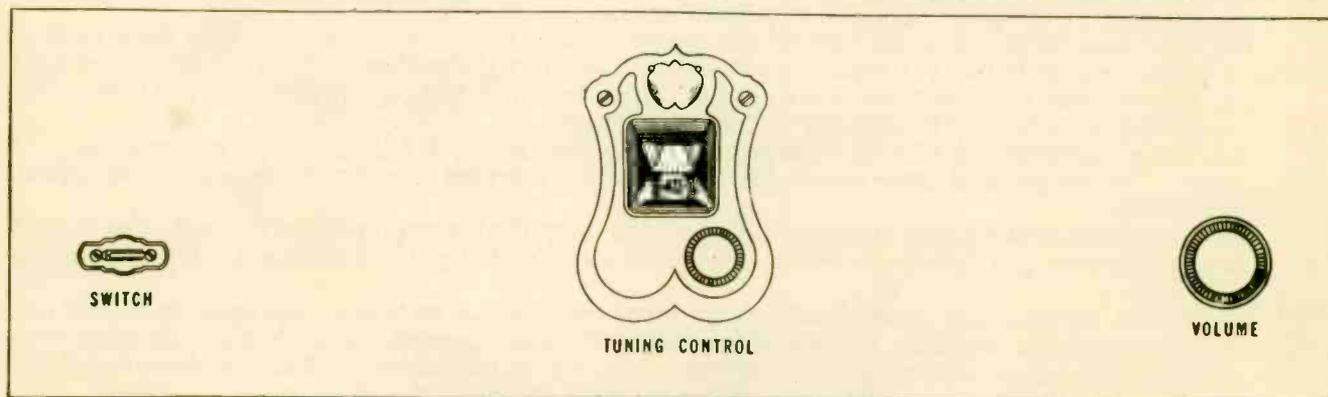
Although *baseboard* layouts only are shown, *sub-panel* construction can be readily used, by mounting on top of two brackets. The important thing to keep in mind is to run all exposed wiring underneath sub-panel. This can be easily done by running the wire through holes drilled in sub-panel for that purpose.

6 TUBE SINGLE CONTROL ELECTRIC RECEIVER

(With B Eliminator)

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REQ.	Name of Part
1	3	Plug-in or T.R.F. Coils.	16	2	1000 Ohm Fixed Resistances.
2	1	Single Drum Dial.	17	1	Output Transformer.
3	3	.00035 Mfd. Variable Condensers.	18	1	A-B-C Transformer.
4	9	4 Prong Sockets.	19	1	Buffer Condenser.
5	1	5 Prong Socket.	20	1	B-Block Condenser. 14 Mfd.
6	1	5 to 1 Audio Transformer.	21	2	30 Henry Chokes.
7	1	3 to 1 Audio Transformer.	22	1	13 000 Ohm Tapped Resistance.
8	1	.00025 Mfd. Grid Condenser.	23	2	Binding Posts.
9	1	2 Meg. Grid Leak.		1	BH Tube.
10	2	1 Mfd. Fixed Condenser.		4	226 Tubes.
11	1	Power Switch.		1	227 Tube.
12	1	2000 Ohm Potentiometer.		1	171-A Tube.
13	1	2000 Ohm Fixed Resistance.		1	7"x24" Panel.
14	2	20 Ohm Center Tap Resistances.		1	12"x23" Baseboard.
15	1	400 Ohm Fixed Resistance.			Miscellaneous Accessories.



FRONT VIEW OF PANEL

This fine receiver embodies all the features of the best factory built sets. Four 226 tubes, one 227 and one 171-A are used. The circuit consists of one untuned stage, two tuned R. F. stages, a non-regenerative detector and two stages of transformer coupled amplification.

A single drum dial is used for tuning. This is the only tuning control on the set.

A variable potentiometer of 2000 ohms is in series with the antenna and ground. The movable arm of the potentiometer is connected to the grid of the first 226 tube. This potentiometer makes an exceptionally fine volume control.

Although some amplification is obtained in the untuned radio frequency stage, that is not its main purpose. In order to use a single dial control, the antenna characteristics must not in any way effect any tuned circuit. Otherwise not only will the selectivity suffer but also the sensitivity of the receiver. The untuned circuit couples the antenna circuit with the first tuned stage. Thus the antenna characteristics have no importance. Any length of antenna may be used from a ten foot indoor antenna to a 150 foot outdoor antenna. The only thing affected would be sensitivity.

The baseboard layout on the opposite page shows the plug-in type of coils. While these are excellent there are many radio builders who prefer to use the plain solenoid coil. In the Five Tube Tuned

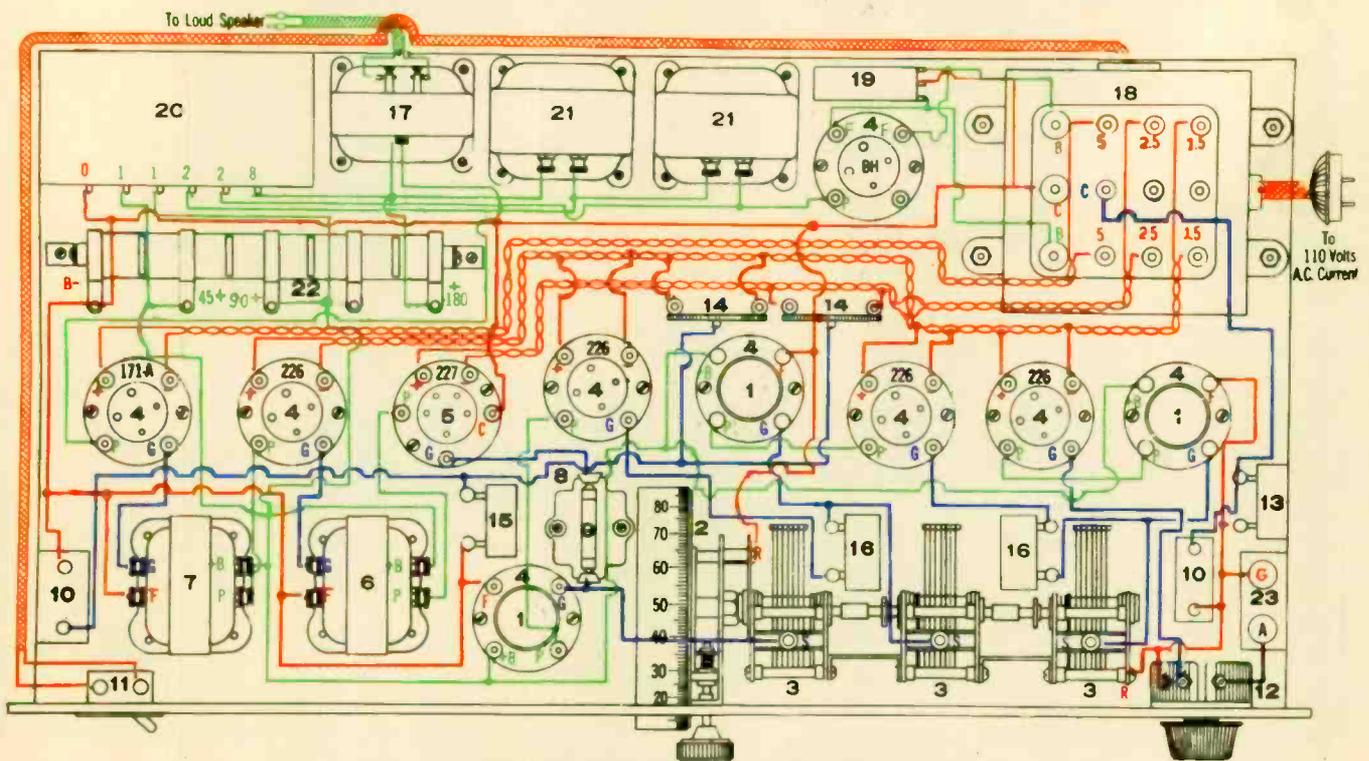
6 TUBE SINGLE CONTROL ELECTRIC RECEIVER

(With B Eliminator)

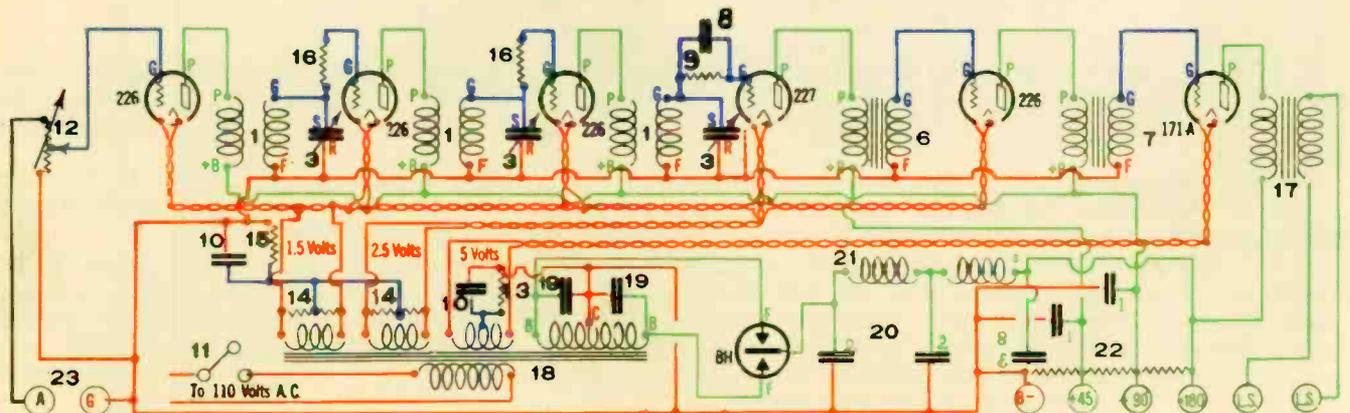
Radio Frequency article mention is made of using the latter coils. These coils should be mounted if possible at right angles. If the diameter of the coils be small, the spacing shown in the drawing will be sufficient not to cause any serious interaction. No matter what type of coil is used, the builder should assure himself that they are reasonably matched. The number of turns on each coil should be the same.

Grid suppressors prevent the tuned radio frequency stages oscillating. In some sets it is advisable to try other values than those given. This sometimes results in marked improvement in set performance.

The grid bias resistors or fixed resistances for both the 226 and the 171-A connect to the centers of mid-tap resistances. These resistances shunt the 1½ volt and 5 volt A. C. supply respectively. The reader has a choice of using the mid-tap binding posts on the A B C transformer instead of the center-top resistances. The editor prefers to use the resistances as it is difficult to obtain accurate centers off the transformer windings.



COMPLETE WIRING LAYOUT



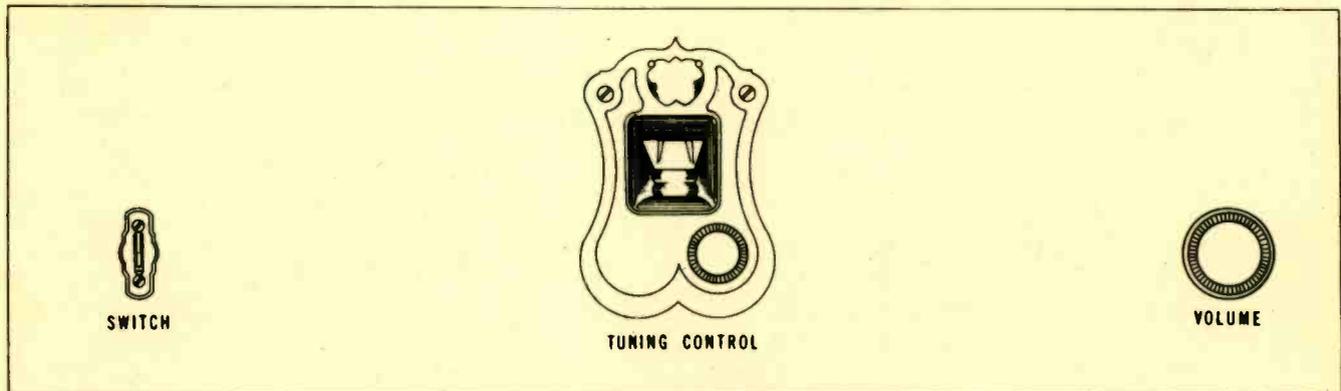
ELECTRICAL DIAGRAM

6 TUBE SINGLE CONTROL ELECTRIC RECEIVER

(Without B Eliminator)

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REQ.	Name of Part
1	3	Plug-in or T.R.F. Coils.	13	1	2000 Ohm Fixed Resistance.
2	1	Single Drum Dial.	14	2	20 Ohm Center Tap Resistances.
3	3	.00035 Mfd. Variable Condensers.	15	1	400 Ohm Fixed Resistance.
4	8	4 Prong Sockets.	16	2	1000 Ohm Fixed Resistances.
5	1	5 Prong Socket.	17	1	Output Transformer.
6	1	5 to 1 Audio Transformer.	18	1	A-Transformer.
7	1	3 to 1 Audio Transformer.	19	8	Binding Posts.
8	1	.00025 Mfd. Grid Condenser.	4	226	Tubes.
9	1	2 Meg. Grid Leak.	1	227	Tube.
10	2	1 Mfd. Fixed Condenser.	1	171-A	Tube.
11	1	Power Switch.	1	7"x24"	Panel.
12	1	2000 Ohm Potentiometer.	1	12"x23"	Baseboard.



FRONT VIEW OF PANEL

The A transformer model shown on the opposite page is exactly similar to the complete electric model with the exception of an external "B" eliminator. If the "B" eliminator be home made the reader may, if he prefer, rebuild it on the set baseboard. In that case he should follow the previous diagram.

The often repeated advice to install short grid leads and isolate them as much as possible, should be followed. The builder will notice on more than one occasion that leads can be made shorter than those shown in the drawings as they are exaggerated to show the parts clearly.

If the reader has available a 0-50 milliammeter a true test for quality can be tried. Insert milliammeter in series with power lead or 180 volt lead (if this be the power voltage). If reading be backward, reverse meter leads. Most sets draw between 30 and 45 milliamperes. Having tuned in the set with a broad-cast station, watch the milliammeter pointer. If it changes its position but slightly back and forth, there is no distortion present. If pointer fluctuates upward, "C" voltage should be increased. If downward, "C" voltage should be decreased.

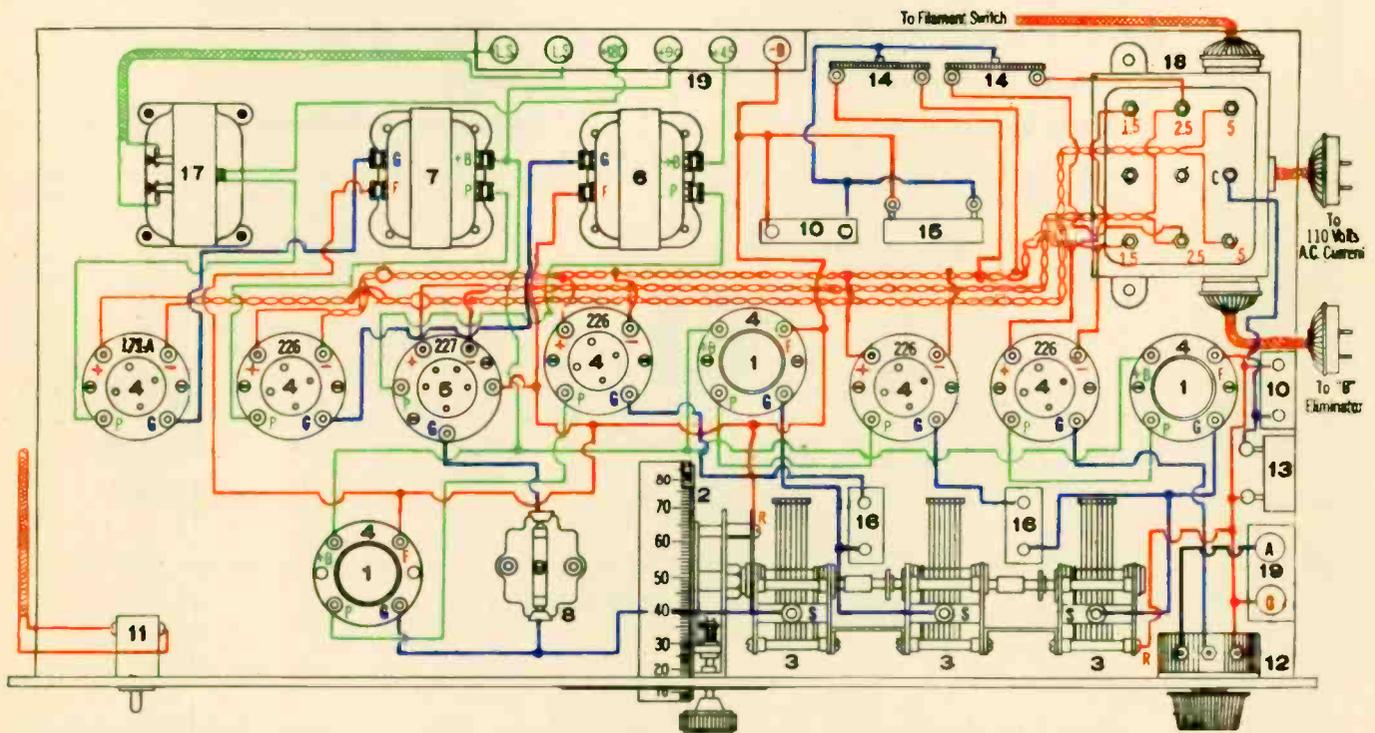
6 TUBE SINGLE CONTROL ELECTRIC RECEIVER

(Without B Eliminator)

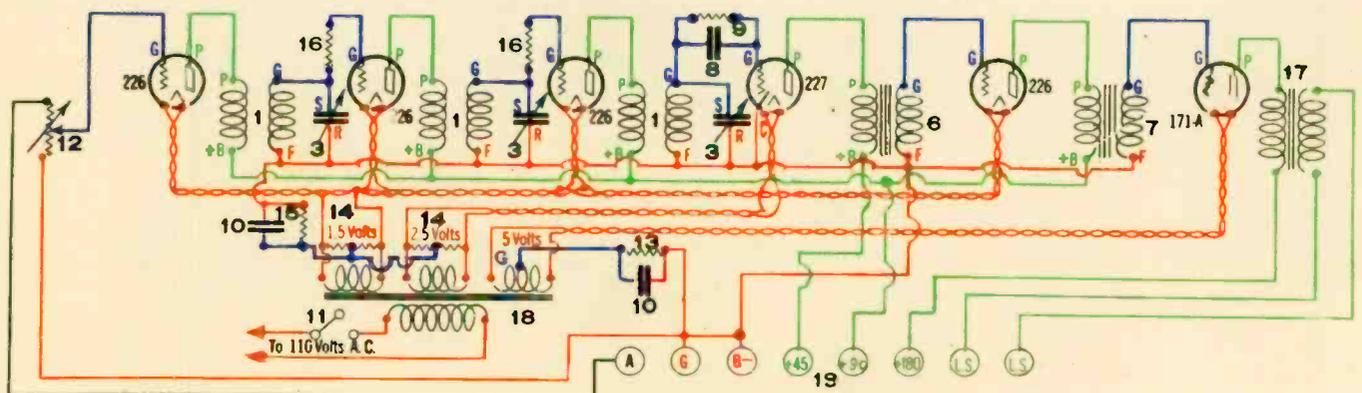
It is important in building any of the receivers here illustrated and described to use proper tools. Especially is it important to use a good bit or so called "soldering iron" and keep it at all times perfectly cleaned and tinned. A dirty iron is a time waster and a means of making high resistance connections. So important are good soldered joints to the success of a set that the author would advise anyone contemplating building a set to first master the art of soldering.

The builder should at least realize the importance of keeping the bit at the right temperature, neither too hot nor too cold. If too hot, the metal of the bit or soldering iron will be burned, requiring filing off to a clean surface and retinning; if not hot enough, the solder will not melt properly, that is, become sufficiently fluid enough to adhere to the parts to be joined.

It must be obvious that since the designer proportions the various parts without allowance for extra resistance due to poorly soldered joints, any extra resistance introduced into the circuit by poor soldering will cause unsatisfactory operation of the set. Rosin-cored solder should be used or plain solder with a non-acid flux employed. If an acid flux be used, the resistance of the joints will not remain constant.



COMPLETE WIRING LAYOUT

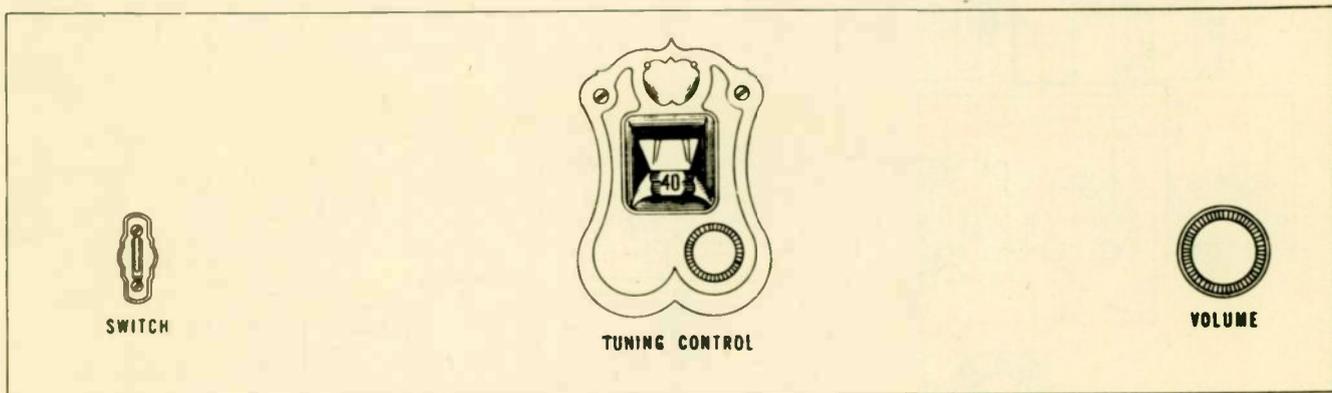


ELECTRICAL DIAGRAM

6 TUBE SINGLE CONTROL BATTERY RECEIVER

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REQ.	Name of Part
1	3	Plug-in or T.R.F. Coils.	11	1	Filament Switch.
2	1	Single Drum Dial.	12	1	2000 Ohm Potentiometer.
3	3	.00035 Mfd. Variable Condensers.	13	2	1000 Ohm Fixed Resistances
4	9	4 Prong Sockets.	14	11	Binding Posts.
5	3	Fixed Rheostats for 2-201-A Tubes.	5		201-A Tubes.
6	1	5 to 1 Audio Transformer.	1		171-A Tube.
7	1	3 to 1 Audio Transformer.	1		7"x24" Panel.
8	1	.00025 Mfd. Grid Condenser.	1		12"x23" Baseboard.
9	1	2 Meg. Grid Leak.			Cabinet.
10	1	Output Transformer.			Miscellaneous Accessories.



FRONT VIEW OF PANEL

The same method of stabilization is shown. Other values than those given for grid resistors, should be tried. It is preferable to use as small a value as possible without the set going into oscillation. There are two other popular methods (without resorting to bridge schemes) which the reader might want to try.

The first employs a 200 ohm potentiometer. This is wired in shunt with the "A" battery.

The center tap of the potentiometer is in contact with the movable arm. This should be connected to the grid returns of the two tuned R. F. stages as per sketch below. The grid resistors can be disposed with.

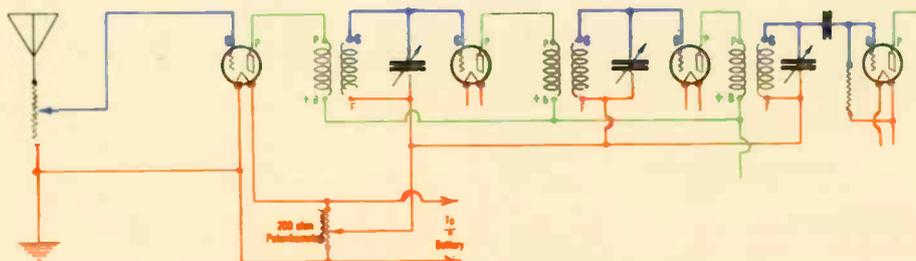
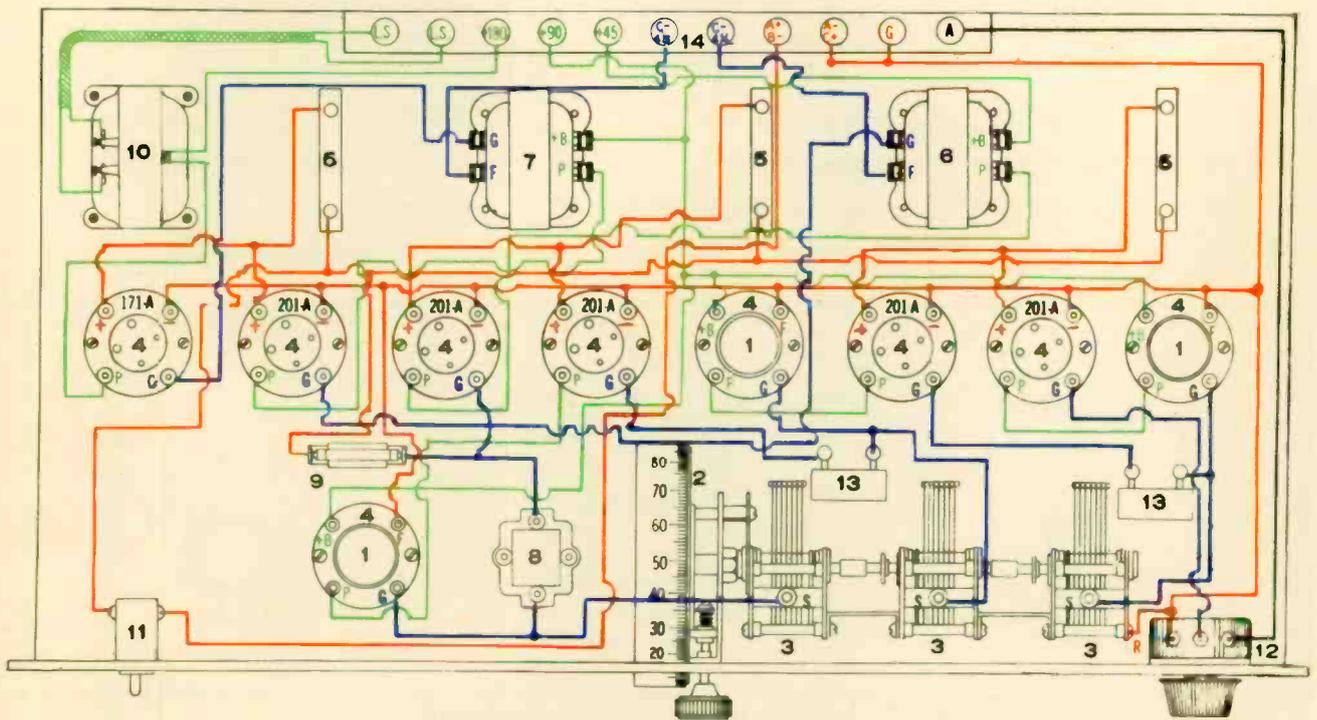


DIAGRAM SHOWING USE OF POTENTIOMETER

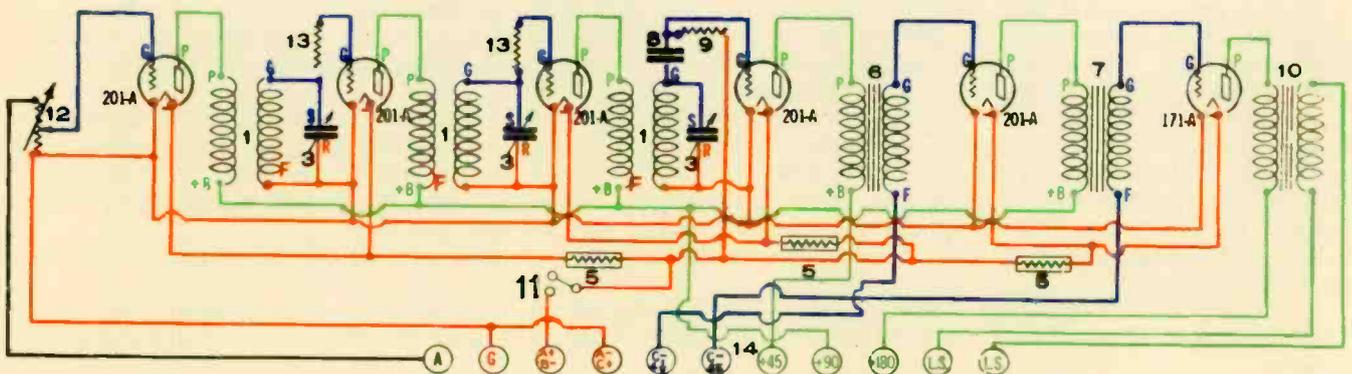
6 TUBE SINGLE CONTROL BATTERY RECEIVER

The other method is that followed in the Five Tube Battery Set. Connect in series with the plate voltage supply to the R. F. stages a 50,000 ohm variable resistance. Adjusting this control stabilizes the radio frequency circuit.

There is one set of adjustments to be made when the set is put into operation. The three condensers, which rotate on a common coupled shaft, must be set to tune accurately. A good procedure to follow is to first tune in to a broadcasting station. Use a local station for this purpose. Then loosen the couplings between the separate condenser shafts. Now turn condenser rotors until a maximum signal response is obtained, then fasten the couplings. No further adjustment is needed. The broadcast stations can now be logged directly and easily on the single drum dial. If finer adjustment of condensers be wanted than that above, midget condensers may be shunted across the variable condensers of the first two tuned radio frequency stages. Then follow same procedure as previously described but instead, adjust midget condensers.



COMPLETE WIRING LAYOUT



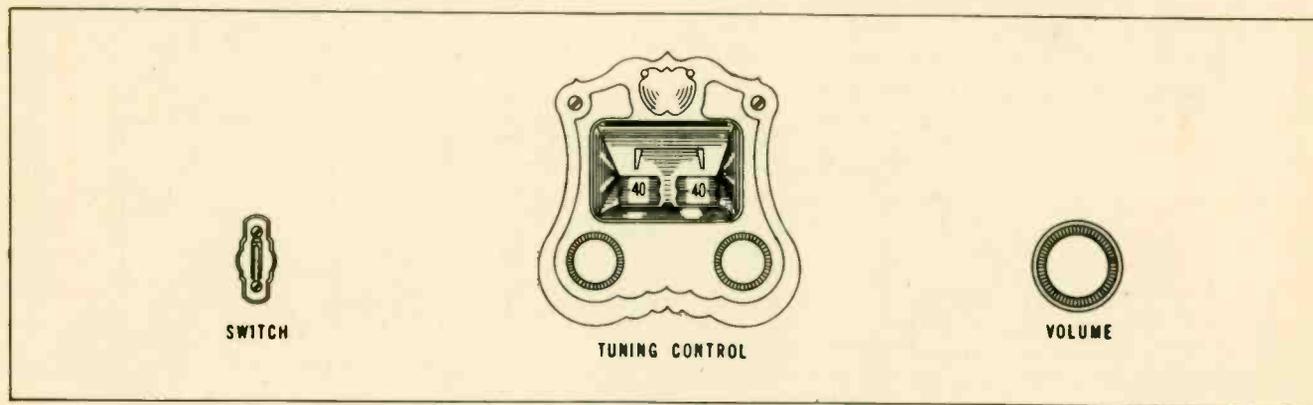
ELECTRICAL DIAGRAM

5 TUBE TUNED RADIO FREQUENCY ELECTRIC RECEIVER

(With B Eliminator)

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REG.	Name of Part
1	3	Plug-in or T.R.F. Coils.	16	2	1000 Ohm Fixed Resistances.
2	1	Double Drum Dial.	17	1	Output Transformer.
3	3	.00035 Mfd. Variable Condensers.	18	1	A-B-C Transformer.
4	8	4 Prong Sockets.	19	1	Buffer Condenser.
5	1	5 Prong Socket.	20	1	B-Block Condenser. 14 Mfd.
6	1	5 to 1 Audio Transformer.	21	2	30 Henry Chokes.
7	1	3 to 1 Audio Transformer.	22	1	13,000 Ohm Tapped Resistance.
8	1	.00025 Mfd. Grid Condenser.	23	2	Binding Posts.
9	1	2 Meg. Grid Leak.		3	226 Tubes.
10	2	1 Mfd. Fixed Condenser.		1	171-A Tube.
11	1	Power Switch.		1	227 Tube.
12	1	2000 Ohm Var. Resistance		1	BH Tube.
13	1	2000 Ohm Fixed Resistance.			Miscellaneous Accessories.
14	2	20 Ohm Center Tap Resistance.			Cabinet.
15	1	500 Ohm Fixed Resistance.			Aerial and Equipment.



FRONT VIEW OF PANEL

This five tube tuned radio frequency receiver makes for an ideal home set. It has been in popular use for years. Time has surely proven its worth.

All improvements of the modern set have been incorporated into its circuit.

A double drum dial controls the tuning. The left knob of the drum tunes the antenna circuit. This circuit is independent of the other circuits, to permit accurate tuning regardless of length of antenna used. The right hand knob tunes both the second radio frequency stage and detector circuit. Both condensers are mounted so as to turn on a common shaft.

In order to simplify the construction and operation, grid resistance suppressors are used in both tuned radio frequency stages. Although this scheme of reducing regeneration is a loss method it is a good one. The grid suppressors do not effect the selectivity of the circuits in any way since they do not add to the resistance of the coil and tuning condenser. Different values of grid suppressors may be tried. For some sets the values given could be changed for greater efficiency.

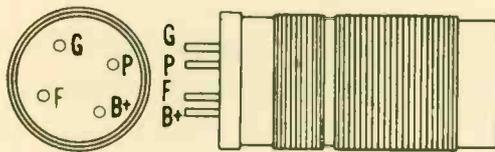
Interstage feedback is avoided by the design of the coils, the spacing of these coils in the layout and the wiring.

Plug-in coils are shown in diagram. Other coils, which are not of the plug-in type, may be used to advantage. When using these coils try and mount them at right angles to avoid stray inductive effects.

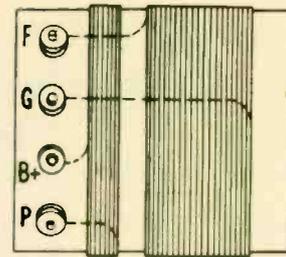
5 TUBE TUNED RADIO FREQUENCY ELECTRIC RECEIVER

(With B Eliminator)

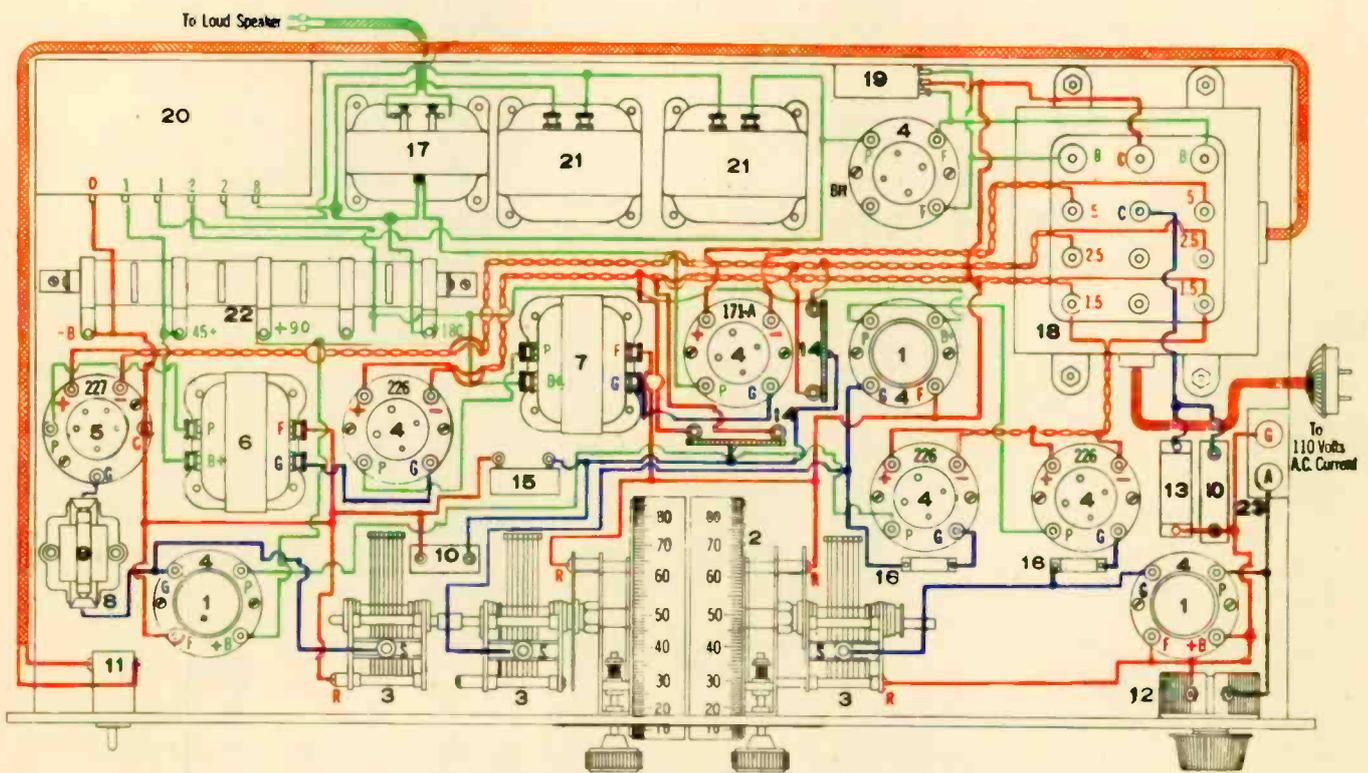
The sketch below is given to facilitate the reader if he prefers using other coils.



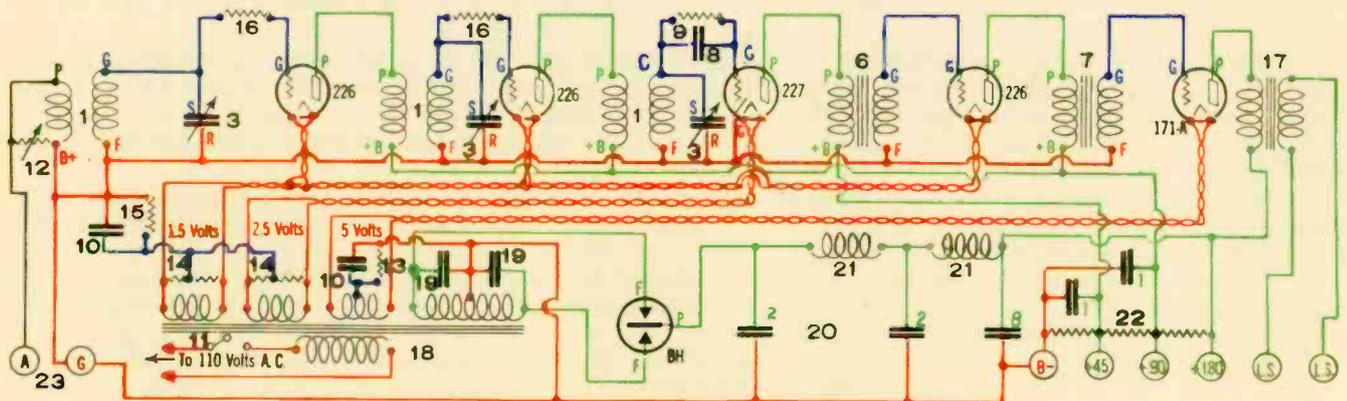
PLUG-IN COIL



TUNED RADIO FREQUENCY COIL



COMPLETE WIRING LAYOUT



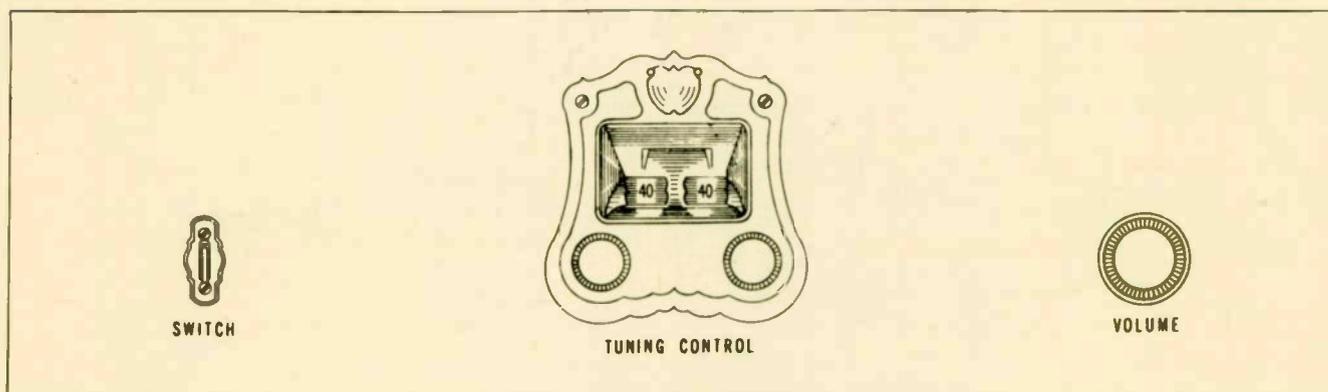
ELECTRICAL DIAGRAM

5 TUBE TUNED RADIO FREQUENCY ELECTRIC RECEIVER

(Without B Eliminator)

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REQ.	Name of Part
1	3	Plug-in or T.R.F. Coils.	14	2	20 Ohm Center Tap Resistance.
2	1	Double Drum Dial.	15	1	500 Ohm Fixed Resistance.
3	3	.00035 Mfd. Variable Condensers.	16	2	1000 Ohm Fixed Resistances.
4	7	4-Prong Sockets.	17	1	Output Transformer.
5	1	5 Prong Socket.	18	1	A-Transformer.
6	1	5 to 1 Audio Transformer.	19	8	Binding Posts.
7	1	3 to 1 Audio Transformer.		3	226 Tubes.
8	1	.00025 Mfd. Grid Condenser.		1	227 Tube.
9	1	2 Meg. Grid Leak.		1	171-A Tube.
10	2	1 Mfd. Fixed Condenser.		1	7"x24" Panel.
11	1	Power Switch.		1	12"x23" Baseboard.
12	1	2000 Ohm Variable Resistance.			Cabinet.
13	1	2000 Ohm Fixed Resistance.			Miscellaneous Accessories.



FRONT VIEW OF PANEL

In both the A. B. C. and "A" transformer models three A. C. 226 tubes are used, one 227 and one 171-A power tube. The manner in which these tube sockets are placed makes it simple to wire up the A. C. filaments.

An output transformer, whose characteristics match the 171-A power tube, is included in this layout and all others throughout the book. Although this output transformer can be omitted, it is not desirable to do so. The output serves to prevent speaker distortion and act as a protection.

The 226 tubes are all given the same grid bias. The 2000 ohm fixed resistance connects with the center top of the 1½ volt filament winding and —B.

It acts by reason of its voltage drop as a grid bias for these tubes. The 171-A power tube provides unusual volume without distortion. It is biased by the 2000 ohm resistor which connects to the center tap of the 5 volt filament winding.

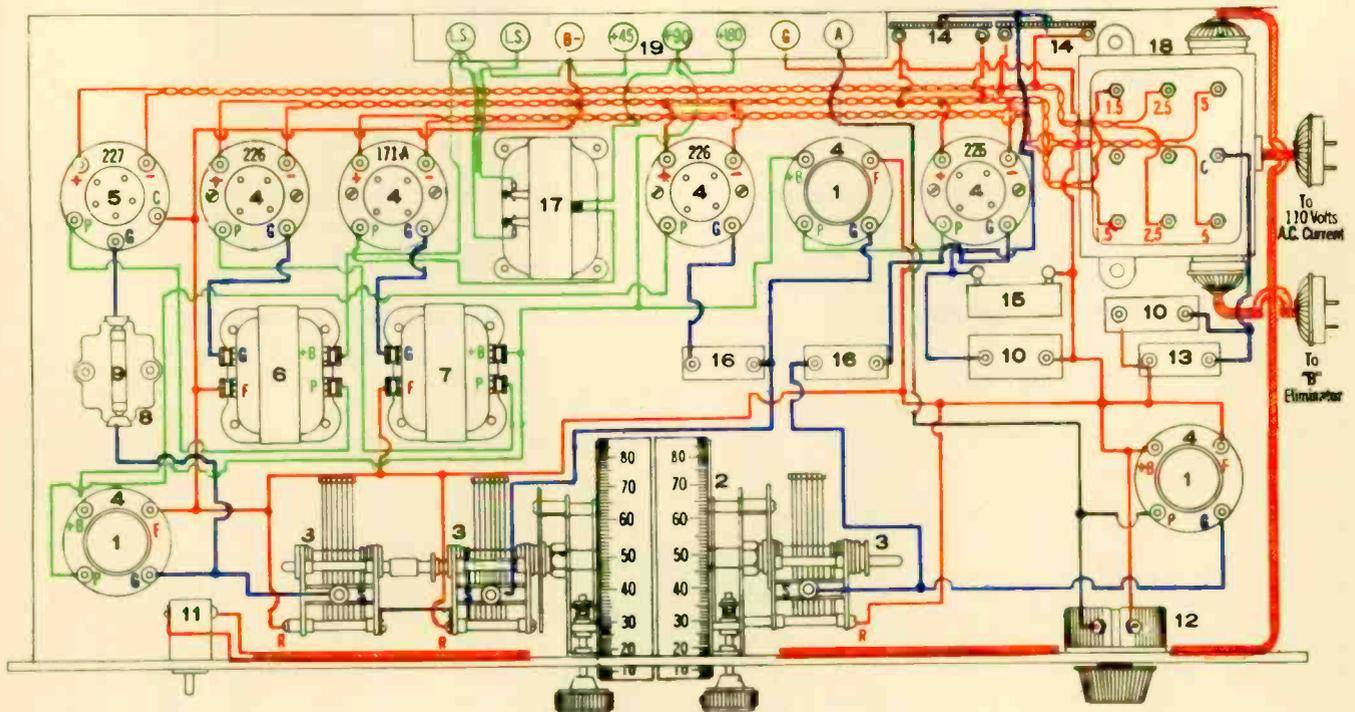
The variable resistance volume control which shunts the antenna primary is a good one. It not only controls the volume smoothly but does not introduce distortion. It helps to prevent overloading of the detector tube on unusually strong signals.

Upon putting the set into operation there is one set of adjustments to be made. Tune the receiver to a station. A local station is best for this purpose. Then shift one of the two condensers which

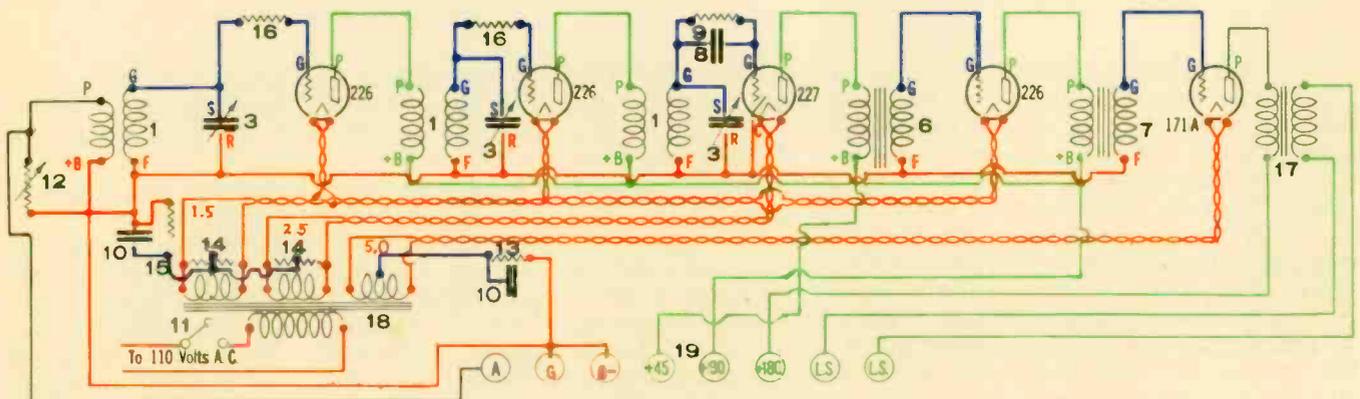
5 TUBE TUNED RADIO FREQUENCY ELECTRIC RECEIVER (Without B Eliminator)

turn on a common shaft. Fix this condenser in the position which produces the loudest signal. When this is carefully done the set is now ready for permanent operation. No further adjustment is needed. In setting the above condenser use a wooden stick shaped into a screw driver. This is desirable so as to eliminate body capacities. Otherwise the condenser will be overcompensated.

Tuning the five tube R. F. set is very simple in itself. By turning both drums to approximately the same settings all the local stations can be tuned in with ease. For distance reception much finer adjustment must be made. In many cases the left hand drum will not tune in step with the right hand drum. This is due entirely to the effect of the antenna on the first tuned circuit. If the reader wishes to compensate for this he may shunt a midget condenser across first tuning condenser. Then adjust for best position.



COMPLETE WIRING LAYOUT

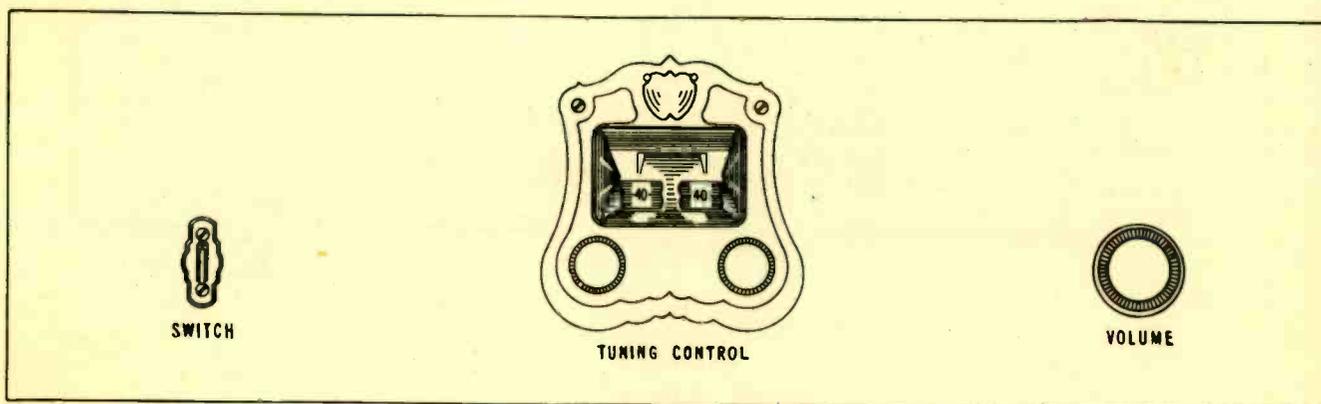


ELECTRICAL DIAGRAM

5 TUBE TUNED RADIO FREQUENCY BATTERY RECEIVER

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REG.	Name of Part
1	3	Plug-in or T.R.F. Coils.	11	1	Filament Switch.
2	1	Double Drum Dial.	12	1	50,000 Ohm Variable Resistance.
3	3	.00035 Mfd. Variable Condensers.	13	1	Fixed Rheostat for 171-A Tube.
4	8	4 Prong Sockets.	14	11	Binding Posts.
5	2	Fixed Rheostats for 2-201-A Tubes.	4		201-A Tubes.
6	1	5 to 1 Audio Transformer.	1		171-A Tube.
7	1	3 to 1 Audio Transformer.	1		7"x24" Panel.
8	1	.00025 Mfd. Grid Condenser.	1		12"x23" Baseboard.
9	1	2 Meg. Grid Leak.			Cabinet.
10	1	Output Transformer.			Miscellaneous Accessories.



FRONT VIEW OF PANEL

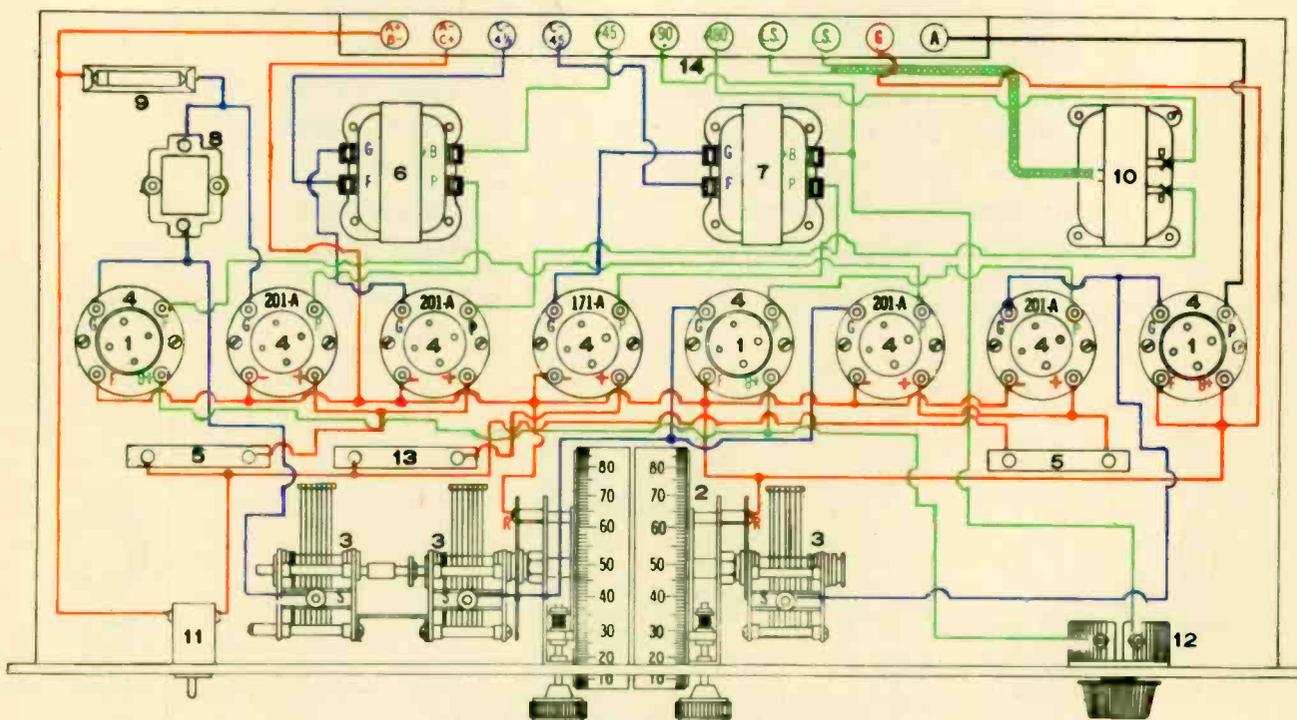
The battery model of the five tube tuned radio frequency set differs somewhat from the A. C. The principal change is in the volume control. A 50,000 ohm variable resistance is in series with the plate voltage lead to the two R. F. stages. This resistance controls both the volume and regeneration in the radio frequency circuits. No grid suppressors are used.

Ballast resistors or Fixed Rheostats maintain the proper voltage on 201-A tubes and 171-A power tube. High Mu tubes may be used in the radio frequency sockets to increase the amplification.

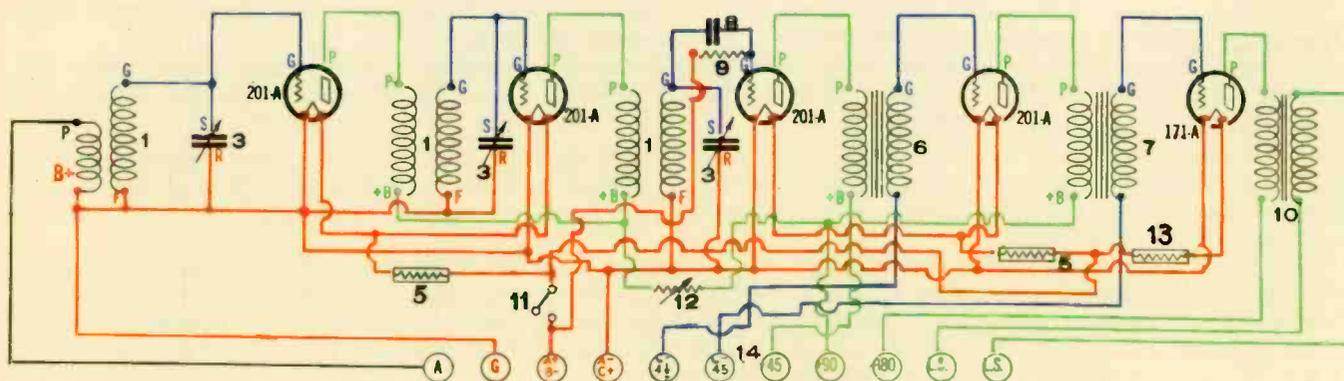
A "B" eliminator capable of delivering 180 volts under load will prove advantageous to use. If dry cell batteries are to furnish the "B" supply the maximum voltage should be 135 volts instead of 180 volts. This is the most economical procedure since a 171-A tube with 180 volts on the plate draws more than 20 milliamperes alone. With 135 volts on the plate, the "B" consumption is 16 milliamperes. A 112-A tube can be substituted which draws only 5.8 milliamperes at 135 volts. The table below gives the proper "C" voltages to use with different power tubes at various plate voltages and also the output current in milliamperes.

5 TUBE TUNED RADIO FREQUENCY BATTERY RECEIVER

TUBE Type	FILAMENT		PLATE		
	Volts	Amps.	Volts	"C" Voltage	Current MA
210	7.5	1.25	425	35	22
			350	27	18
			250	18	12
171	5.0	.5	180	40.5	20
			135	27.0	16
171-A	5.0	.25	90	16.5	10
			Same		
112	5.0	.5	157	10.5	7.9
			135	9.0	5.8
			112	7.5	2.5
			90	6.0	2.4
112-A	5.0	.25	Same		



COMPLETE WIRING LAYOUT



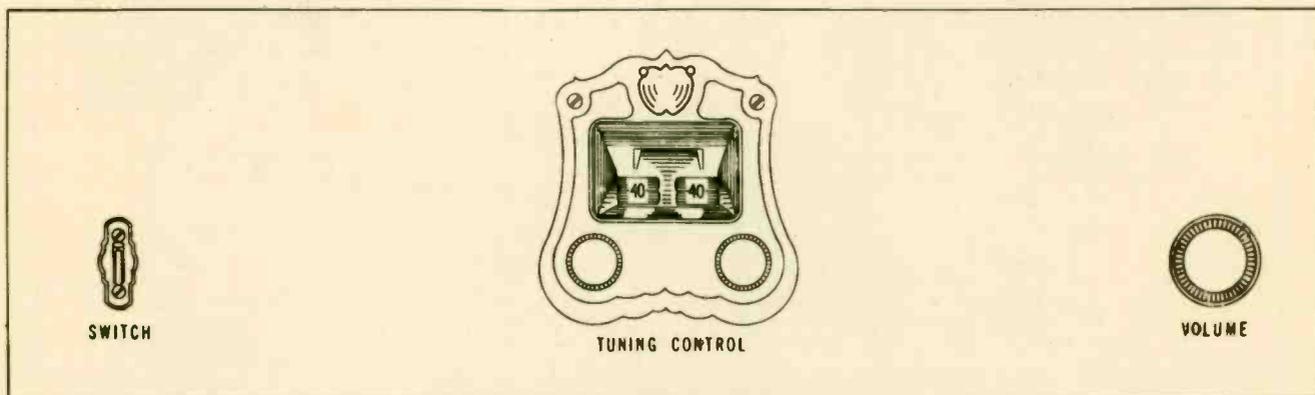
ELECTRICAL DIAGRAM

4 TUBE UNCLE SAM ELECTRIC RECEIVER

(With B Eliminator)

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REG.	Name of Part
1	1	Antenna Coil.	17	1	Output Transformer.
2	1	Double Drum Dial.	18	1	A-B-C Transformer.
3	1	Three Circuit Coil.	19	1	Buffer Condenser.
4	4	4 Prong Sockets.	20	1	B-Block Condenser. 14 MFD
5	1	5 Prong Socket.	21	2	30 Henry Chokes.
6	1	5 to 1 Audio Transformer.	22	1	13000 Ohm Tapped Resistance.
7	1	3 to 1 Audio Transformer.	23	2	Binding Posts.
8	1	.00025 Mfd. Grid Condenser.		2	226 Tubes.
9	1	2 Meg. Grid Leak.		1	227 Tube.
10	2	1 Mfd. Fixed Condenser.		1	171-A Tube.
11	1	Power Switch.		1	BH Tube.
12	2	.0005 Mfd. Variable Condensers.		1	7"x24" Panel.
13	1	2000 Ohm Fixed Resistance.		1	12"x23" Baseboard.
14	2	20 Ohm Center Tap Resistances.			Cabinet.
15	1	900 Ohm Fixed Resistance.			Miscellaneous Accessories.
16	1	.002 Mfd. Fixed Condenser.			Aerial and Equipment.



FRONT VIEW OF PANEL

This popular set has appeared in many different forms during the past five years. Fundamentally it is still the same. The 4 tube sets to be described here represent standard practice.

For several reasons this circuit is still the favorite. The combination of one stage of tuned radio frequency followed by a regenerative detector, is extremely efficient.

A high gain in amplification with stability is secured by the use of a single stage radio frequency stage. The amplification gain of this stage is greater than can be secured in any stage of a multiple radio frequency amplifier.

Coupled with this advantage the signal strength is greatly increased by using regeneration in detector circuit. Tube for tube the results obtained exceed that of any other set. For these reasons this set has proven that this circuit has proven ideal for D. X. reception. Practically all distance records have been made with just this type of set.

On the opposite page appears an A. C. 4 tube set which is to be operated from the light socket. It is self-contained. No batteries of any kind are used. The power units are mounted on the same baseboard of the receiver. They are so placed that the audio transformers are not near their magnetic fields. This is done to prevent induced A. C. hum. The "A" transformer supplies 1½, 2½, 5 and 500 volts. Each of these windings have a mid-top connection.

4 TUBE UNCLE SAM ELECTRIC RECEIVER

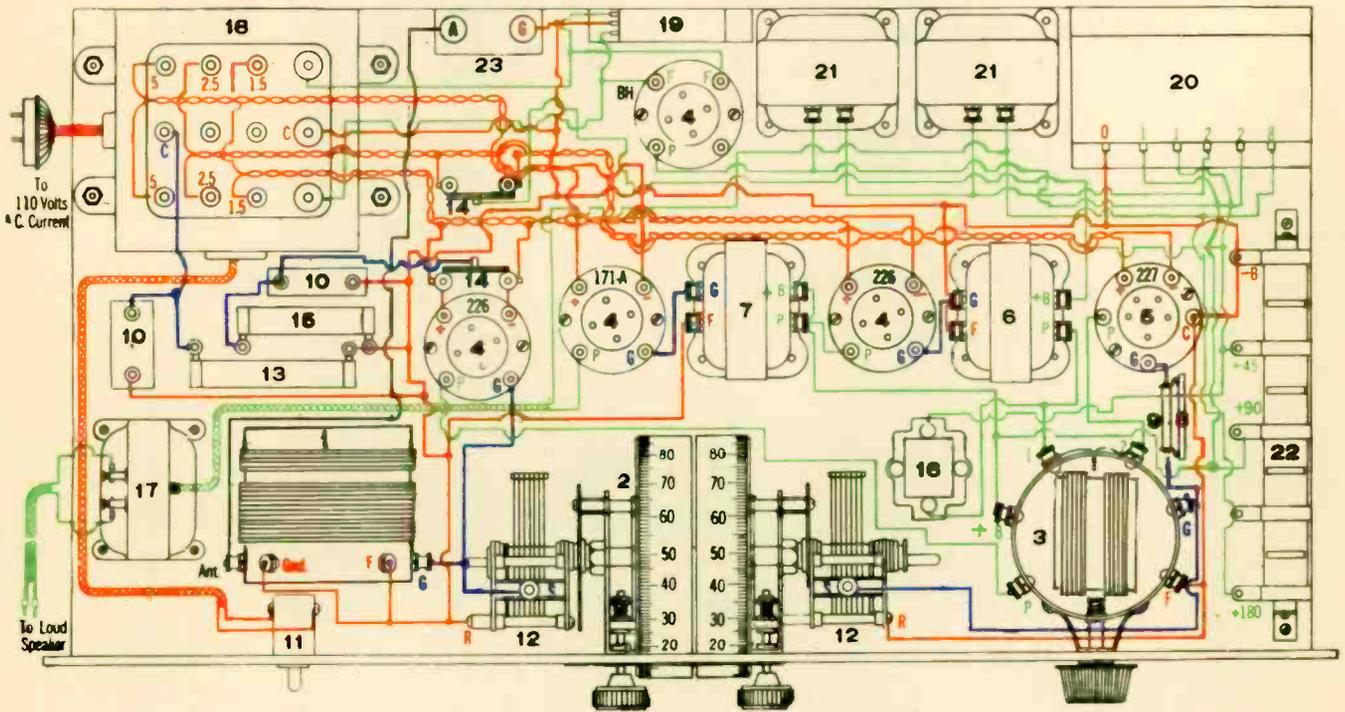
(With B Eliminator)

This set when completed is self-contained with the exception of antenna and ground connections and external loud speaker.

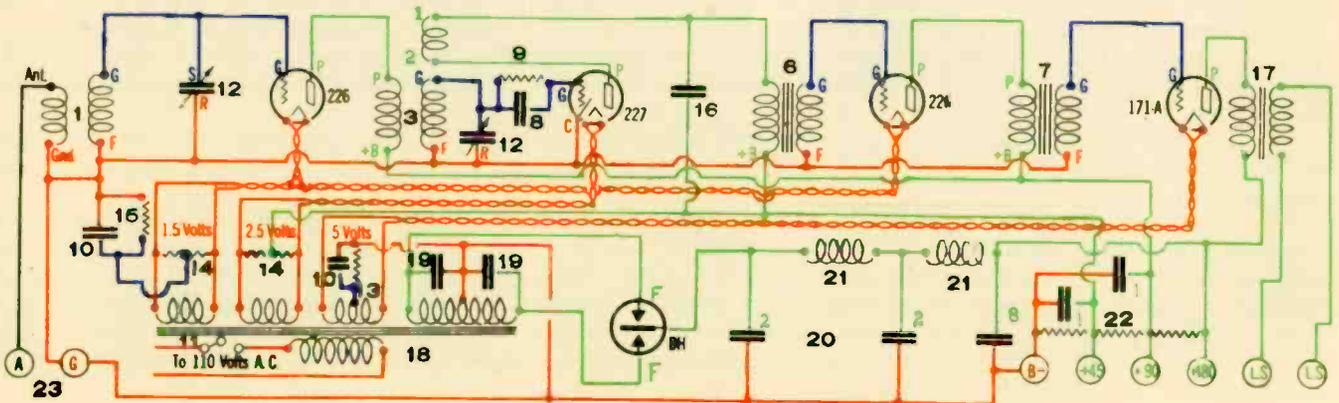
It is the equal in appearance and performance of any factory built receiver of its class. In a majority of cases it is far better. Of course it is decidedly cheaper.

The builder is assured of real quality reproduction with good volume. In this connection it is extremely important to use the best speaker that can be obtained.

The set is very sensitive and for most locations sufficiently selective. For those who are in highly congested radio districts and who have to face this problem the following suggestions will be helpful: Try using shorter antenna. If this be not practical, connect in series with antenna lead a .0001 mfd. fixed condenser.



COMPLETE WIRING LAYOUT



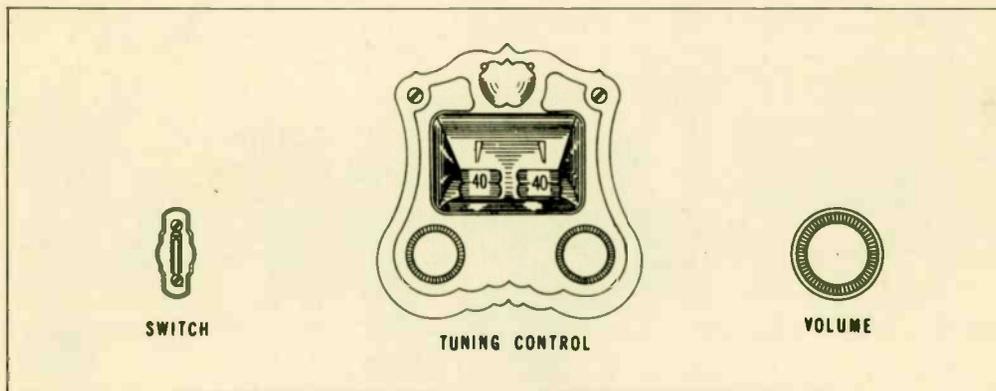
ELECTRICAL DIAGRAM

4 TUBE UNCLE SAM ELECTRIC RECEIVER

(Without B Eliminator)

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REQ.	Name of Part
1	1	Antenna Coil.	14	2	20 Ohm Center Tap Resistances.
2	1	Double Drum Dial.	15	1	900 Ohm Fixed Resistance.
3	1	Three Circuit Coil.	16	1	.002 Mfd. Fixed Condenser.
4	3	4 Prong Sockets.	17	1	Output Transformer.
5	1	5 Prong Socket.	18	1	A-Transformer.
6	1	5 to 1 Audio Transformer.	19	8	Binding Posts.
7	1	3 to 1 Audio Transformer.		2	226 Tubes.
8	1	.00025 Mfd. Grid Condenser.		1	227 Tube.
9	1	2 Meg. Grid Leak.		1	171-A Tube.
10	2	1 Mfd. Fixed Condensers.		1	7"x24" Panel.
11	1	Power Switch.		1	12"x23" Baseboard.
12	2	.0005 Mfd. Variable Condensers.			Cabinet.
13	1	2000 Ohm Fixed Resistance.			Miscellaneous Accessories.



FRONT VIEW OF PANEL

The receiver described here is exactly the same as the previous set with one exception. The "B" eliminator is not included on the same baseboard.

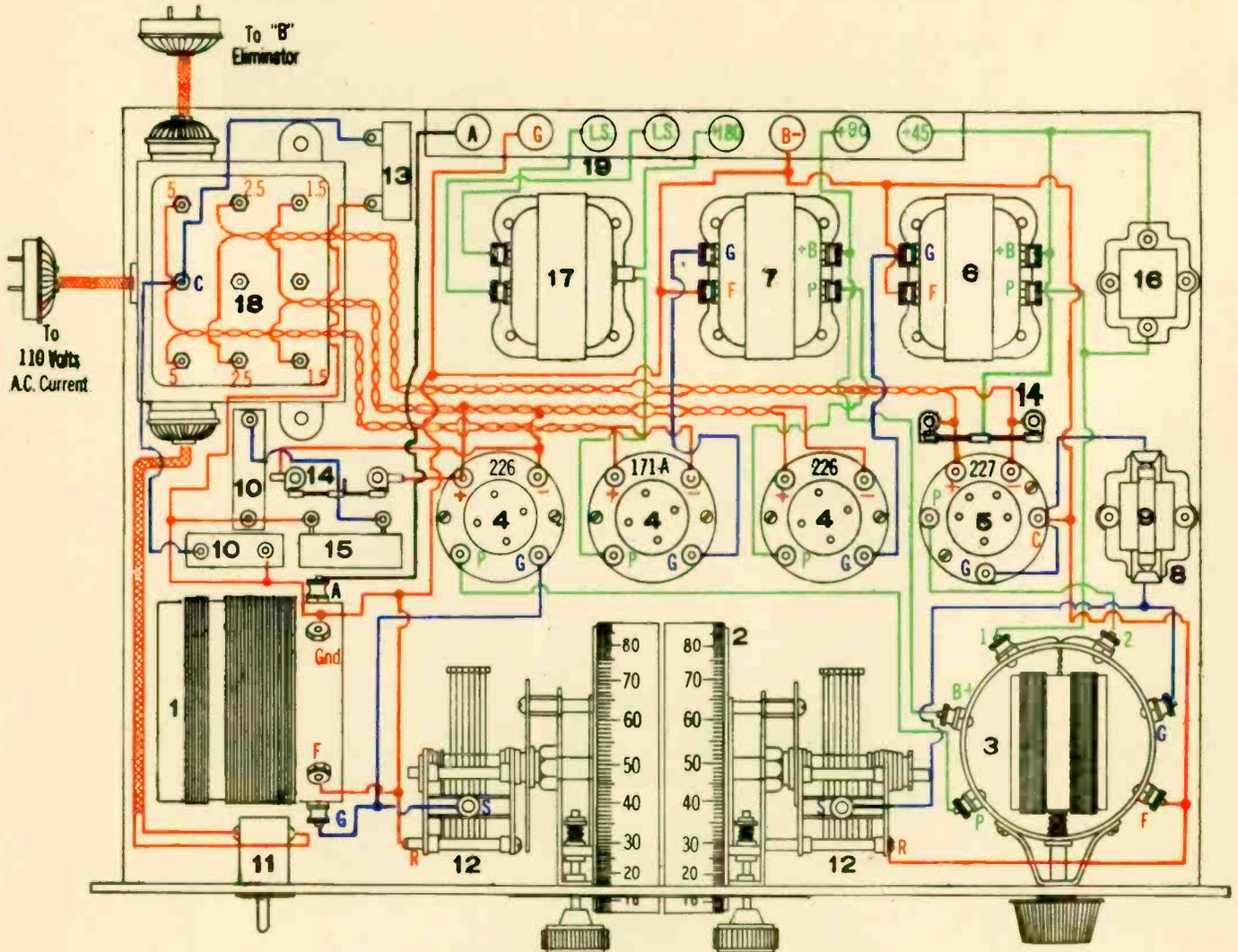
This layout is ideal for those who own a "B" eliminator and do not care to discard it. The reader may, if he wish, rebuild the "B" eliminator on the set baseboard as described on page 30.

However, this need not be done. There is at times an advantage in being able to place the "B" eliminator away from the set. Such a precaution will prevent any induced hum being present in the loud speaker.

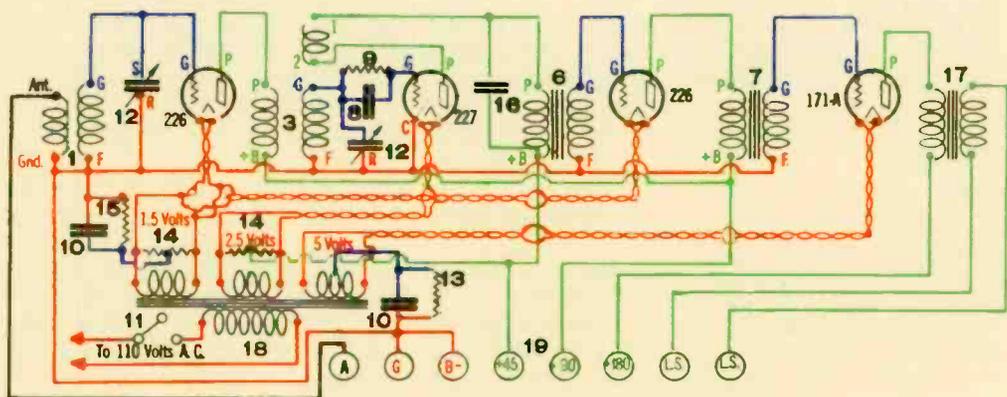
The "B" eliminator should be connected into the line supply by inserting plug into the receptacle of the "A" transformer. The same switch on the panel will now control both the "A" transformer and the "B" eliminator.

A "C" bias for the 226 tubes is obtained by the voltage drop through the 900 ohm resistance —. This resistance is by-passed by a 1 mfd. condenser. It is connected to the center tap of the 1½ volt winding of the "A" transformer and to —B. The 171-A power tube is biased by a 45 volt drop through the 2000 ohm fixed resistance. This resistance connects with the center tap of the 5 volt filament winding and —B. It is best to by-pass this resistance also by a one microfarad condenser. The set is now perfectly biased and no matter what the 110 volt supply does, the "C" voltage changes correspondingly.

4 TUBE UNCLE SAM ELECTRIC RECEIVER (Without B Eliminator)



COMPLETE WIRING LAYOUT

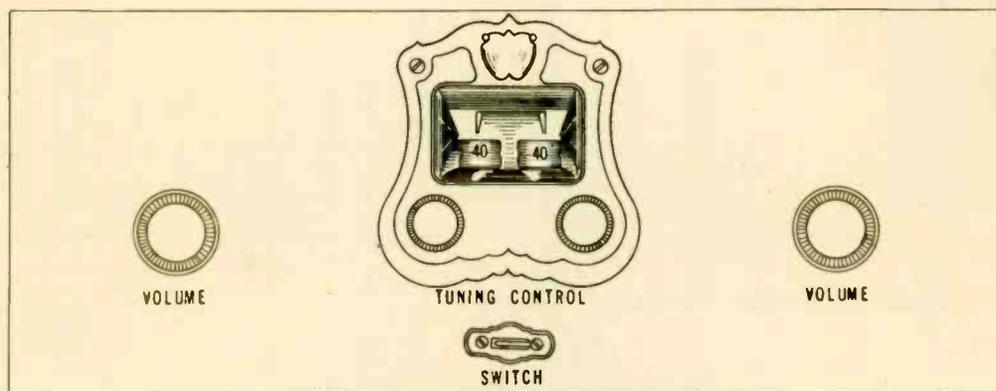


ELECTRICAL DIAGRAM

4 TUBE UNCLE SAM BATTERY RECEIVER

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REQ.	Name of Part
1	1	Antenna Coil.	12	2	.0005 Mfd. Variable Condensers.
2	1	Double Drum Dial.	13	1	Fixed Rheostat for 201-A Tube.
3	1	Three Circuit Coil.	14	1	Output Transformer.
4	4	Prong Sockets.	15	1	.002 Mfd. Fixed Condenser.
5	1	20 Ohm Rheostat.	16	10	Binding Posts.
6	1	5 to 1 Audio Transformer.		3	201-A Tubes.
7	1	3 to 1 Audio Transformer.		1	171-A Tube.
8	1	.00025 Mfd. Grid Condenser.		1	7"x18" Panel.
9	1	2 Meg. Grid Leak.		1	12"x17" Baseboard.
10	1	Fixed Rheostats for 2 201-A Tubes.			Cabinet.
11	1	Filament Switch.			Miscellaneous Accessories.



FRONT VIEW OF PANEL

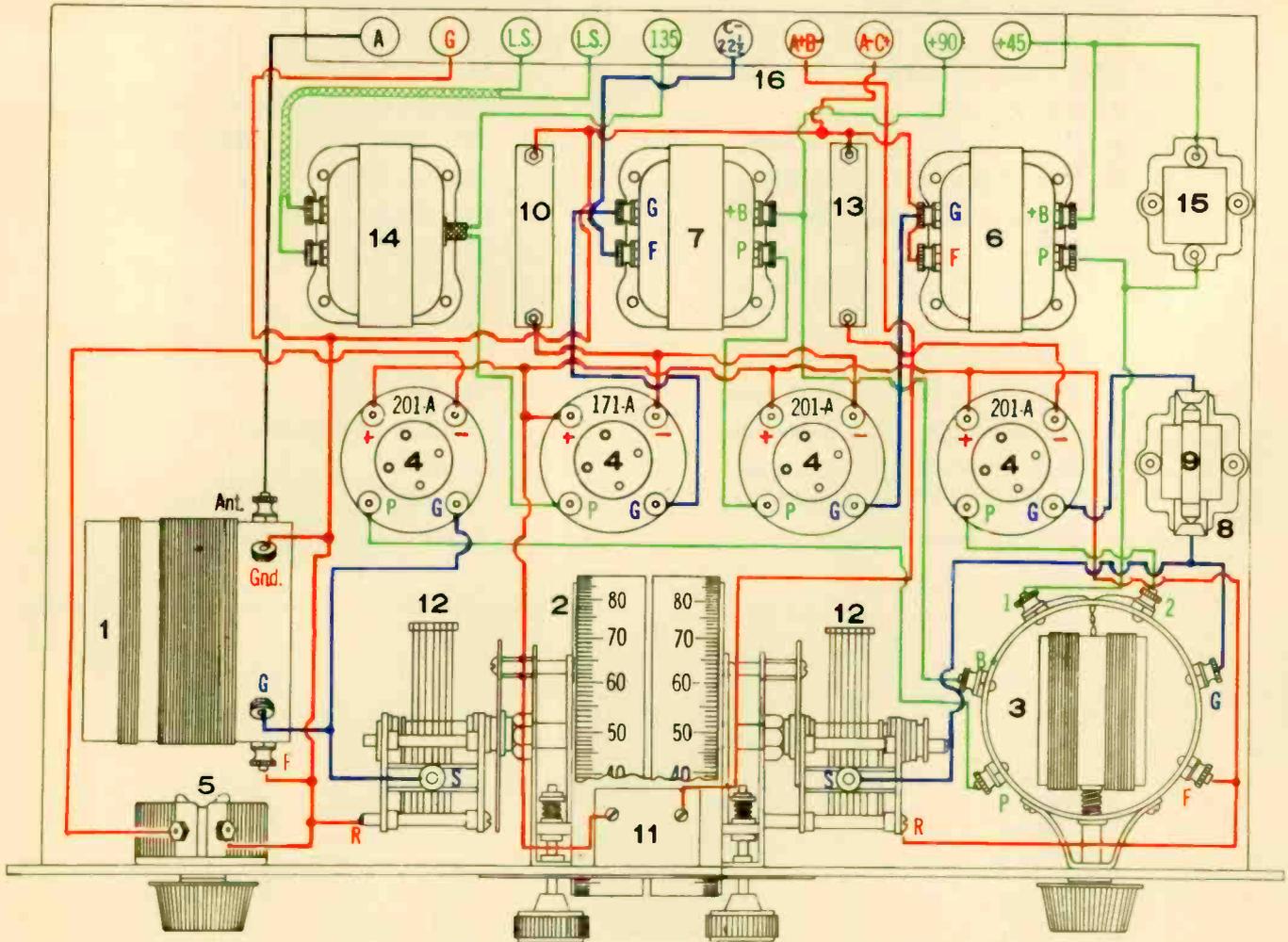
This is the original member of the family of "fours." Although battery sets are on the decline they still have many users. In some locations this is the only type of set that can be used. Battery sets possess some advantages over A. C. sets. The most important is that it is not as noisy as the A. C. set. There are no line noises, telephone interruptions and electric house elevators, bells, etc., to contend with in a battery set. There is no A. C. hum present in the loud speaker at all since there is no A. C. used. Moreover, it is more selective. The A. C. set is broader, due to the additional pickup of the long A. C. filament wires.

Here the advantages end. The upkeep of A. C. sets is much less than battery. The quality and volume of reception is usually far better. It takes up less room and requires practically no attention. Service troubles are few and far between.

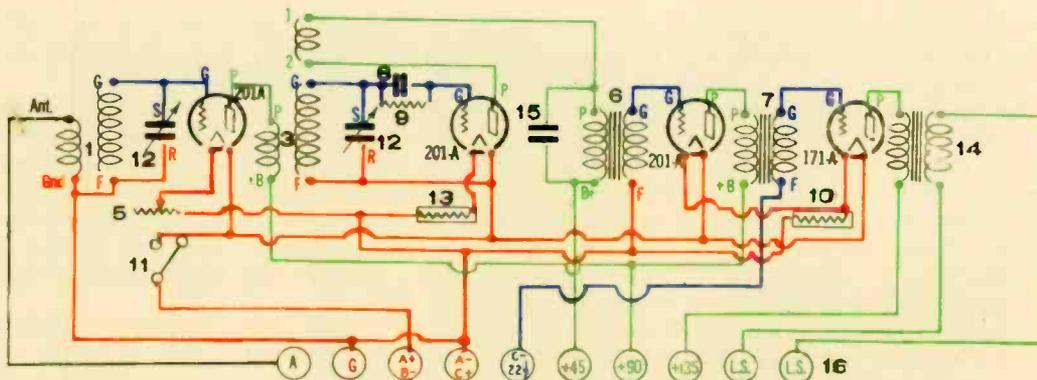
Considering now the battery set, tuning this receiver is the same for the A. C. models. Turn small knob on the right hand side of panel for maximum regeneration. The rotor of the three circuit should parallel to coil form in this position. Rotate both drum knobs together until a whistle is heard. Then turn regeneration knob backward until the whistle is out. Now retune with drum knobs. In most cases drum readings will not read alike. The antenna capacity will throw out left drum reading

4 TUBE UNCLE SAM BATTERY RECEIVER

slightly. The right drum reading will also change slightly according to the position of regenerative rotor. After the broadcasting stations have once been logged there is no need of tuning on the whistle. This method of tuning is far superior to any other in bringing in D. X. stations. The whistle really indicates the position of a station. It is extremely useful and important in logging distant stations. D. X. tuning with a set of this kind is thus made simple.



COMPLETE WIRING LAYOUT



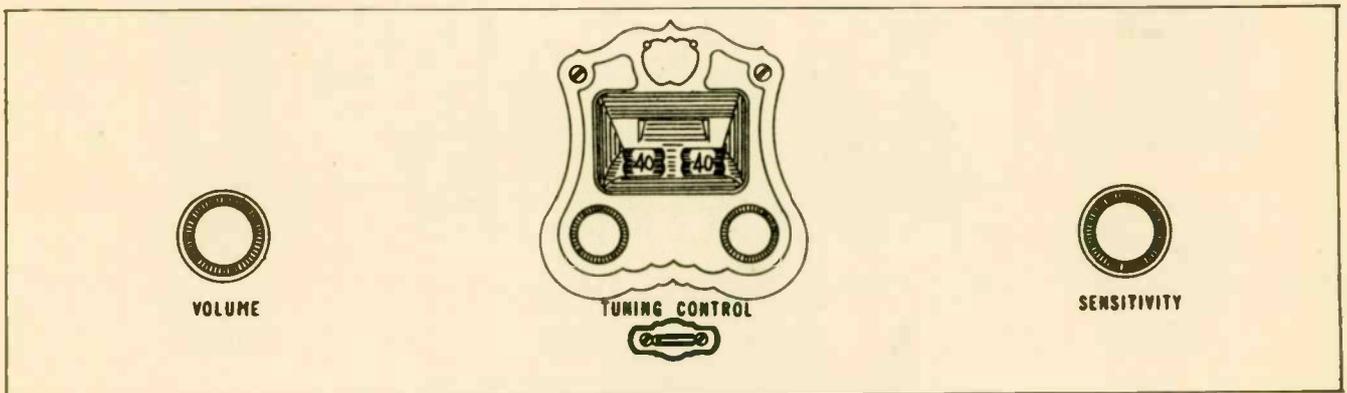
ELECTRICAL DIAGRAM

4 TUBE SCREEN GRID ELECTRIC RECEIVER

(With B Eliminator)

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REQ.	Name of Part
1	1	Variable Antenna Coil.	18	1	A-B-C Transformer.
2	1	Double Drum Dial.	19	1	Buffer Condenser.
3	1	222 Coil.	20	1	B-Block Condenser. 14 Mfd.
4	3	4 Prong Sockets.	21	2	30 Henry Chokes.
5	2	5 Prong Sockets.	22	1	13000 Ohm Tapped Resistance.
6	1	5 to 1 Audio Transformer.	23	1	.002 Mfd. Fixed Condenser.
7	1	3 to 1 Audio Transformer.	24	2	Binding Post.
8	1	.00025 Mfd. Grid Condenser.		1	226 Tube.
9	1	2 Meg. Grid Leak.		1	227 Tube.
10	3	1 Mfd. Fixed Condensers.		1	222 Tube.
11	1	Power Switch.		1	171-A Tube.
12	2	.0005 Mfd. Variable Condensers.		1	BH Tube.
13	1	2000 Ohm Fixed Resistance.		1	7"x24" Panel.
14	2	20 Ohm Center Tap Resistances.		1	12"x23" Baseboard.
15	1	1500 Ohm Fixed Resistance.			Cabinet.
16	1	1000 Ohm Fixed Resistance.			Miscellaneous Accessories.
17	1	Output Transformer.			Aerial and Equipment.



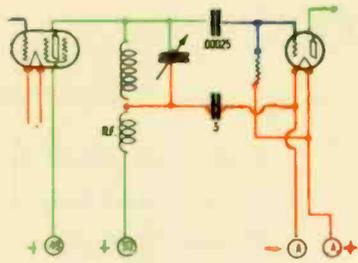
FRONT VIEW OF PANEL

The introduction of the screen grid (222) type of tube marks another step in radio progress. This tube offers promising possibilities. It is especially fit by its design characteristics for radio frequency work. It can, of course, be used as a detector and in audio amplifiers.

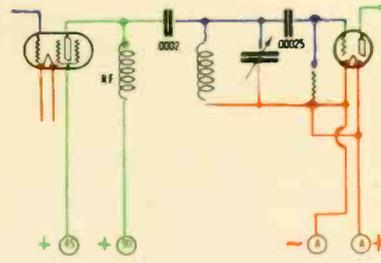
Every one is familiar with the difficulty of suppressing radio frequency oscillations using the three electrode tube. When we are successful in doing so we also succeed in cutting down the radio frequency amplification quite appreciably. For a number of years research has been carried on to eliminate this trouble. The principal cause for this is the capacity between the plate and grid of the three electrode tube. Some change or addition to the present tube had to be made to overcome this difficulty. The shielded grid (four electrode) tube was the result. An extra grid mesh was placed between the plate and the control grid. It serves to reduce to a negligible amount the plate to grid capacity. This tube permits a large amplification far in excess of any other tube.

As previously described the combination of a stage of tuned radio frequency with a regenerative detector has remained in popularity for more than five years. The introduction of the shielded grid tube will tend to further increase its use.

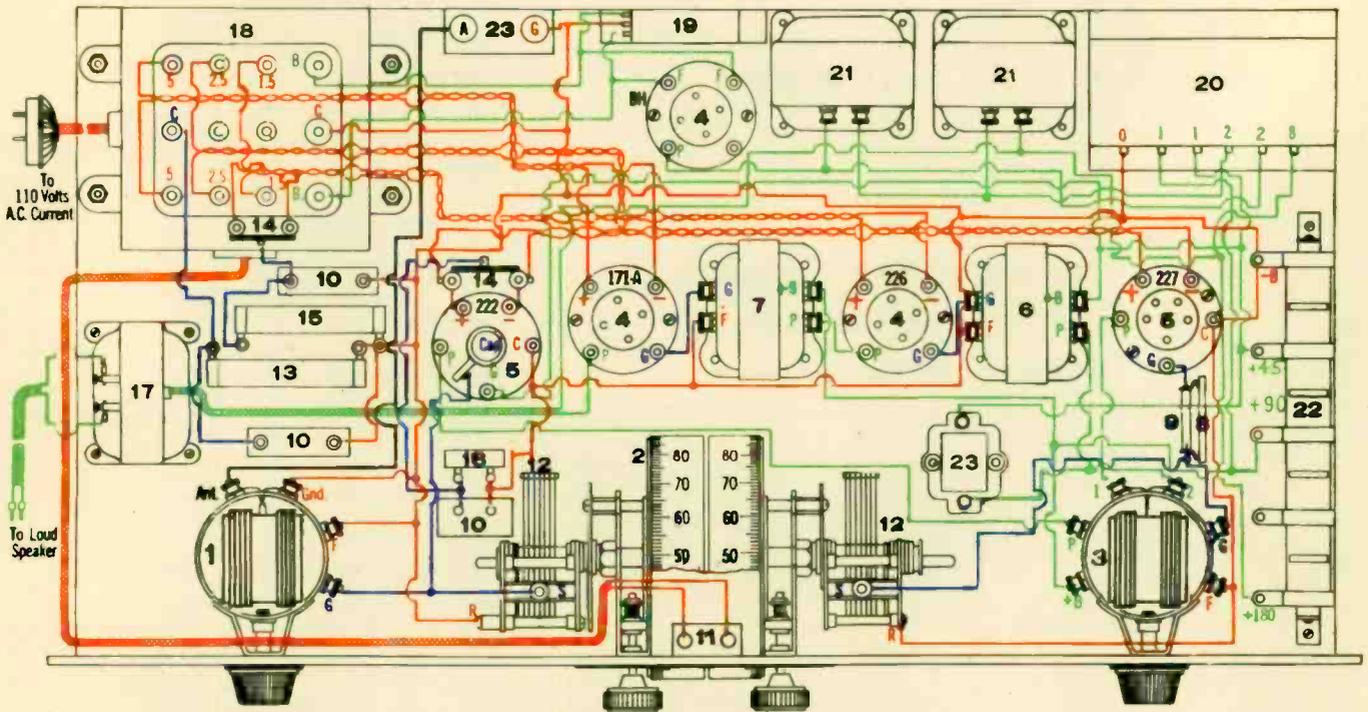
4 TUBE SCREEN GRID ELECTRIC RECEIVER (With B Eliminator)



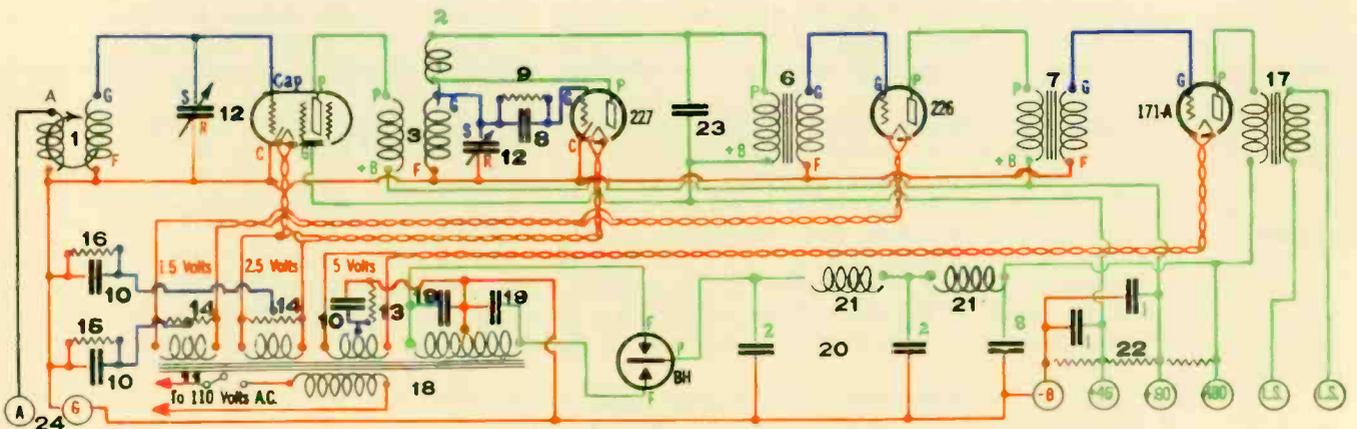
TUNED PLATE



TUNED GRID



COMPLETE WIRING LAYOUT



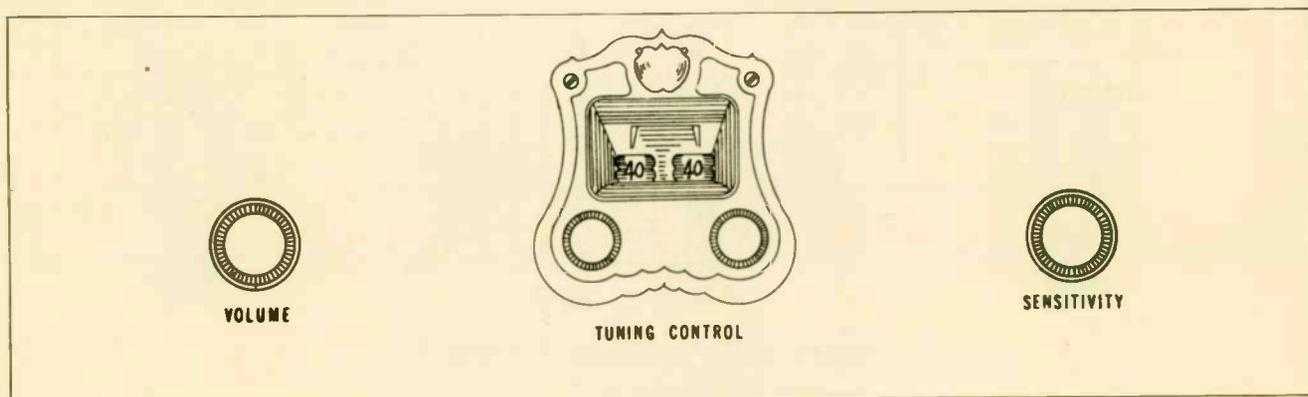
ELECTRICAL DIAGRAM

4 TUBE SCREEN GRID ELECTRIC RECEIVER

(Without B Eliminator)

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REG.	Name of Part
1	1	Variable Antenna Coil.	15	1	1500 Ohm Fixed Resistance.
2	1	Double Drum Dial.	16	1	1000 Ohm Fixed Resistance.
3	1	222 Coil.	17	1	Output Transformer.
4	2	4 Prong Sockets.	18	1	A-Transformer.
5	2	5 Prong Sockets.	19	1	.002 Mfd. Fixed Condenser.
6	1	5 to 1 Audio Transformer.	20	8	Binding Posts.
7	1	3 to 1 Audio Transformer.		1	226 Tube.
8	1	.00025 Mfd. Grid Condenser.		1	227 Tube.
9	1	2 Meg. Grid Leak.		1	222 Tube.
10	3	1 Mfd. Fixed Condensers.		1	171-A Tube.
11	1	Power Switch.		1	12"x23" Baseboard.
12	2	.0005 Mfd. Variable Condensers.		1	7"x24" Panel.
13	1	2000 Ohm Fixed Resistance.			Cabinet.
14	2	20 Ohm Center Tap Resistances.			Miscellaneous Accessories.



FRONT VIEW OF PANEL

An important advantage of the transformer coupling methods over the others is in selectivity. The impedance systems are much broader. This is not desired in a 4 tube circuit as selectivity is of paramount importance. The radio frequency amplification gain is slightly less using transformer coupling.

The close coupling between primary and secondary of R. F. transformer does not hurt the selectivity. The correct design of the transformer and of course the circuit will take care of this.

The same precautions used in isolating T. R. F. stages with three electrode tube must be followed here. Although the 222 tube eliminates internal capacity feed-back we still can be bothered with undesirable oscillations through external electromagnetic and electrostatic couplings.

Shielding the radio frequency stage with a metal housing is very effective. In the 222 tube circuits described here shielding of this type is not needed. The antenna coil and R. F. transformer in this case are over 12" apart. All grid leads especially that going to control grid of 222 tube are as short as possible. These connections should be kept away from plate leads and should cross the latter at right angles.

The diagrams on the preceding page, on page opposite to this and on following page present three types of four tube 222 receivers.

4 TUBE SCREEN GRID ELECTRIC RECEIVER (Without B Eliminator)

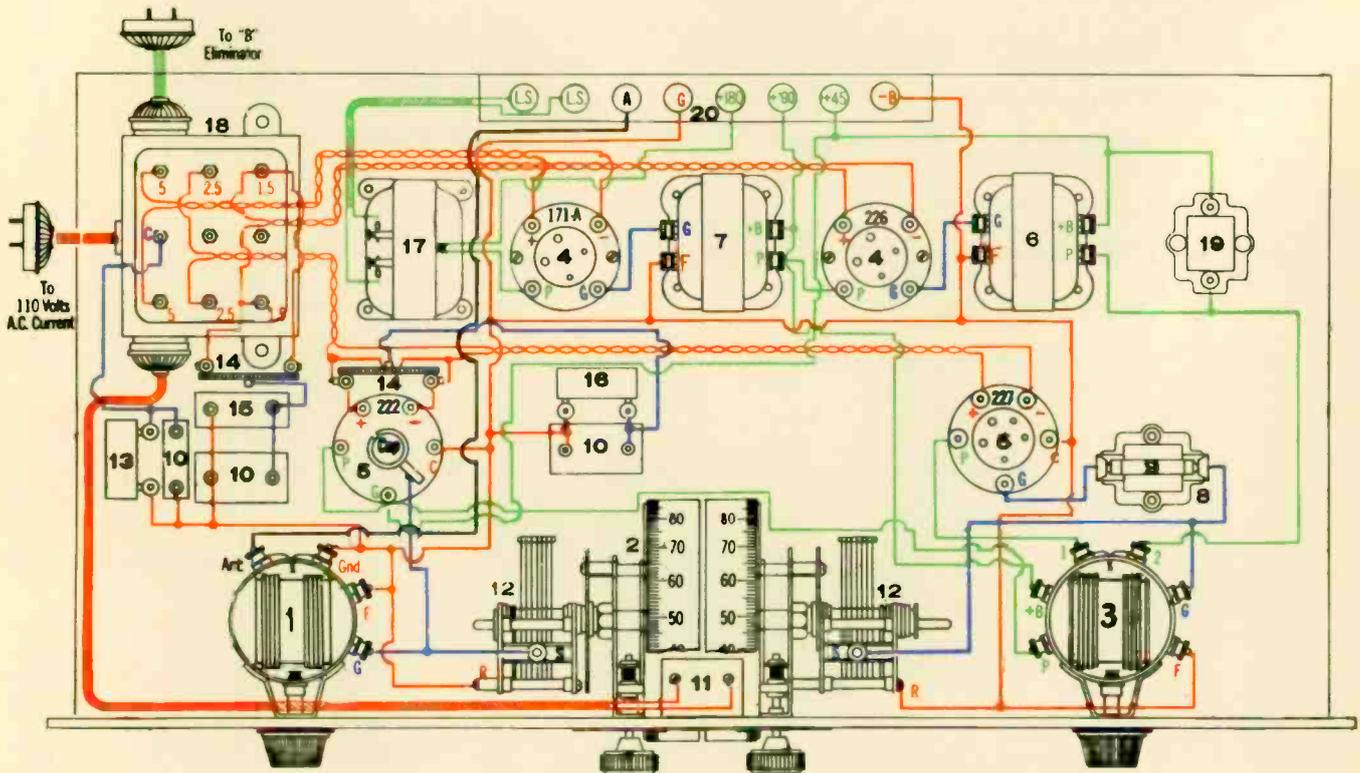
The first can be operated from the light socket directly. In the R. F. stage the new A. C. type 222 tube is used. This is similar to the UX227 tube as it is of the heater type. The filament voltage is the same 2.5 volts. Many experimenters have used alternating current on the present D. C. 222 tubes but the results are not encouraging.

The usual UX227 is used as a detector followed by a 226 stage of audio and a 171-A power stage. The power unit is assembled on the common baseboard. The usual precautions are taken to prevent electromagnetic coupling between set parts and A. C. leads and transformers.

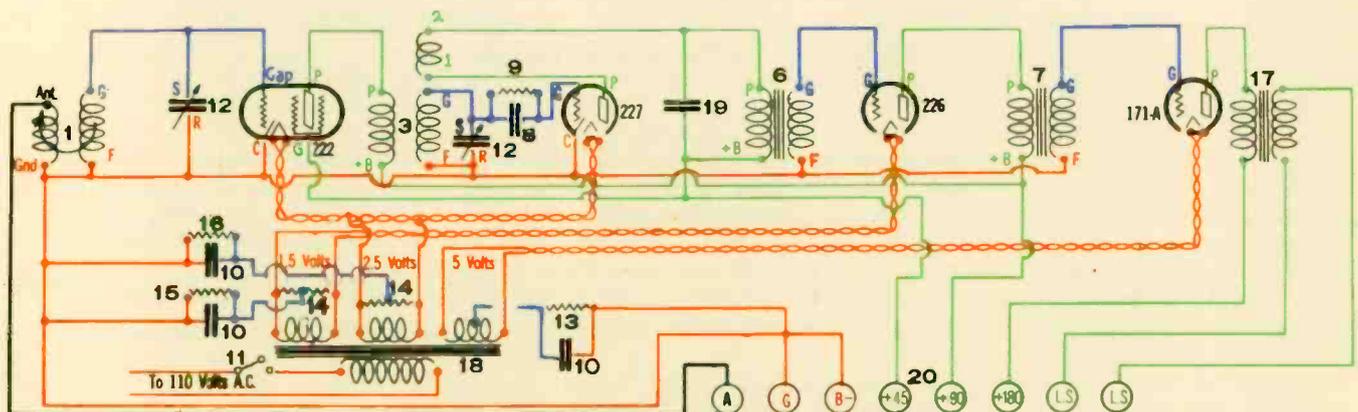
The circuit can be constructed as on opposite page to use a separate "B" eliminator and filament heating transformer which is mounted on the set.

The grid bias voltage of the A. C. 222 is obtained by use of a 1,000 ohm resistor. This should be varied for best results. A similar resistor of 1,000 ohms is used for biasing the 226 stage. It is best to try other values also as this will change in some sets.

A 2,000 ohm resistor furnishes the grid bias voltage for the 171-A power tube.



COMPLETE WIRING LAYOUT

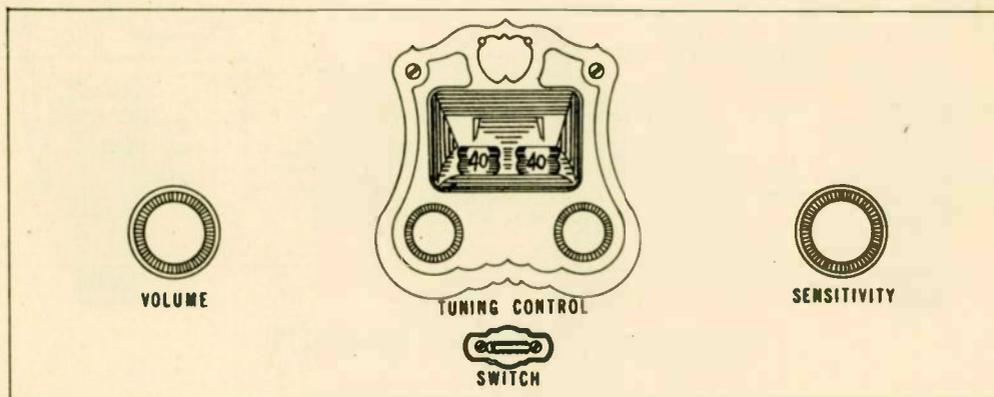


ELECTRICAL DIAGRAM

4 TUBE SCREEN GRID BATTERY RECEIVER

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REQ.	Name of Part
1	1	Variable Antenna Coil.	13	3	Fixed Rheostats for three Tubes.
2	1	Double Drum Dial.	14	1	Fixed Rheostat for 222 Tube.
3	1	222 Coil.	15	1	Output Transformer.
4	4	4 Prong Sockets.	16	12	Binding Posts.
5	1	.002 Mfd. Fixed Condenser.	2	201-A Tubes.	
6	1	5 to 1 Audio Transformer.	1	222 Tube.	
7	1	3 to 1 Audio Transformer.	1	171-A Tube.	
8	1	.00025 Mfd. Grid Condenser.	1	7"x18" Panel.	
9	1	2 Meg. Grid Leak.	1	12"x17" Baseboard.	
10	2	1 Mfd. Fixed Condensers.		Cabinet.	
11	1	Filament Switch.		Miscellaneous Accessories.	
12	2	.0005 Mfd. Variable Condensers.		Aerial and Equipment.	



FRONT VIEW OF PANEL

While the trend is decidedly toward complete A. C. operation there are still many who prefer, or must use battery sets. A D. C. shielded grid tube is used in R. F. stage. Either a 201-A or 200-A can be used for the detector tube. The diagram is for a 201-A tube. If the 200-A be used, make the grid leak return to negative side of filament circuit. The 200-A tube is a very sensitive detector. However, due to its instability and noise it is best to use the 201-A type of tube.

The battery diagram calls for a 171-A type of power tube. A UX112 can be substituted with good results. When using this tube, reduce the plate voltage to 135 volts and "C" bias voltage to 9 volts.

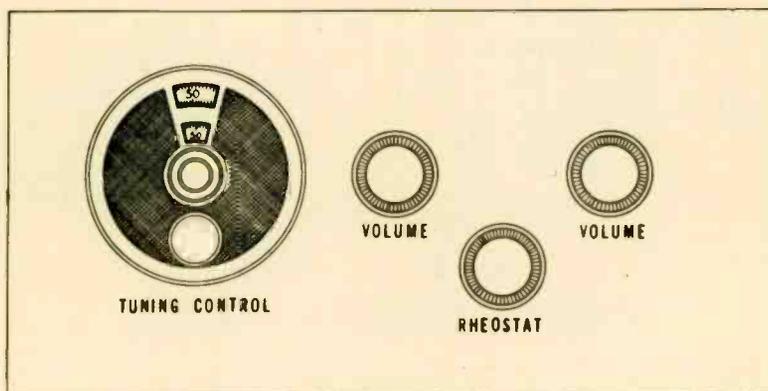
An "A" battery substitute (any good standard make) combined with a "B" eliminator will electrify a set very nicely. The next best management to an "A" battery substitute would be a storage battery with trickle charger. An automatic relay switch operated by the set switch will prove very handy. This will eliminate service for some time.

3 TUBE ALL WAVE BATTERY RECEIVER

(20 to 550 Meters)

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REQ.	Name of Part
1	1	Set Plug-in Coils.	10	1	.1 Meg. Leak with Mounting.
2	1	.00014 Mfd. Variable Condenser.	11	1	10 Ohm Rheostat.
3	2	.0001 Mfd. Variable Condensers.	12	1	.000015 Mfd. Variable Condenser.
4	3	4 Prong Sockets.	13	1	Radio Frequency Choke.
5	1	5 Prong Sockets.		3	201-A Tubes.
6	1	5 to 1 Audio Transformer.		1	7"x14" Panel.
7	1	3 to 1 Audio Transformer.		1	12"x13" Baseboard.
8	1	.00025 Mfd. Grid Condenser.			Miscellaneous Accessories.
9	1	10 Meg. Grid Leak.			Cabinet.



FRONT VIEW OF PANEL

Short waves at the present time offers radio's greatest possibilities. It is still in its infancy. Many are interested in short wave transmission, especially those who do not mind the expense of the set.

It is possible by using a set of four plug-in coils to cover from twenty meters to six hundred. In other words the same set can now be used for standard broadcasting and short waves.

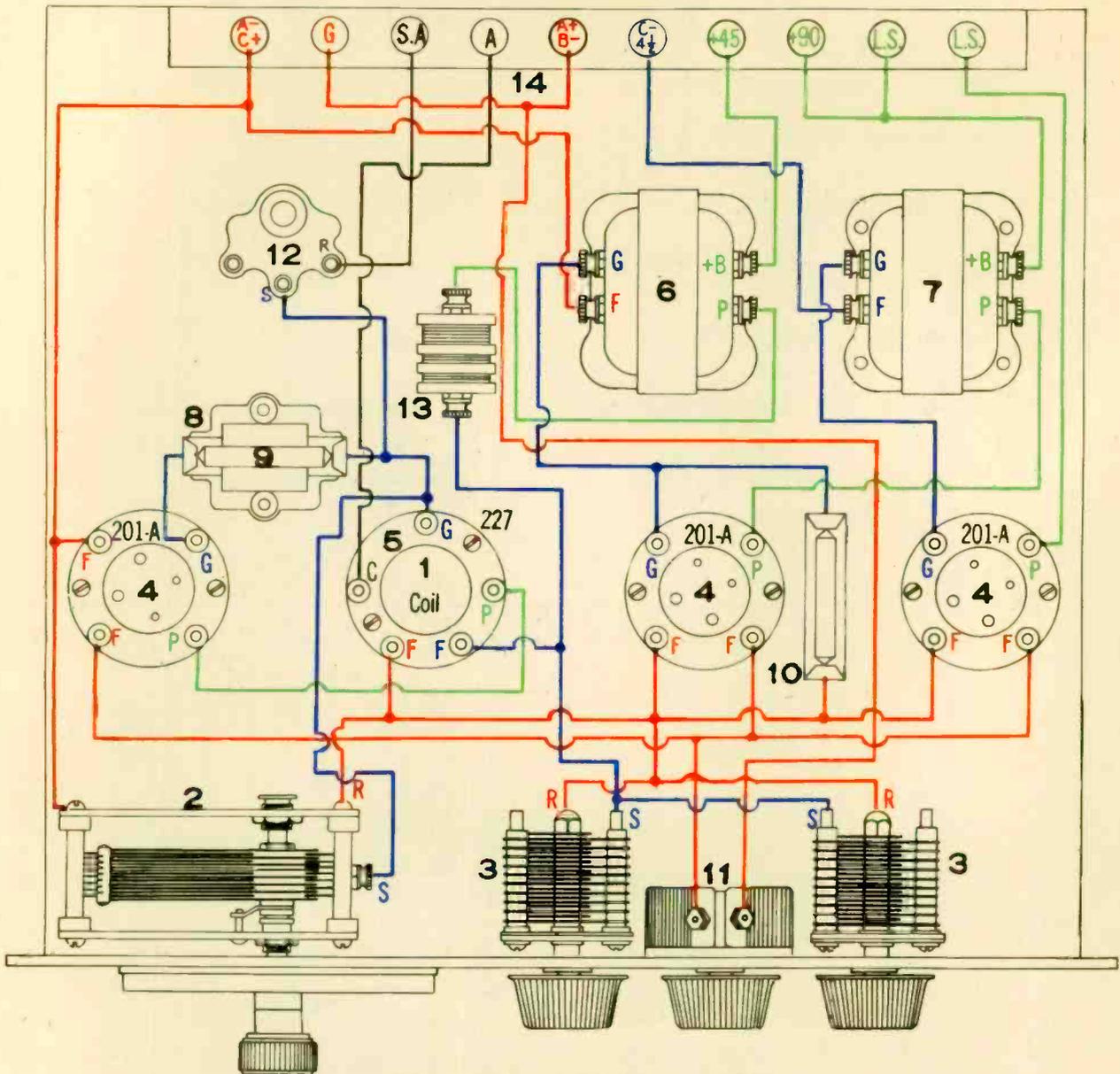
The completed set is very compact. It is only 7"x14"x12" and for this reason makes an ideal portable set.

The tubes used are of the 201-A type. The tube filaments are controlled by a common rheostat.

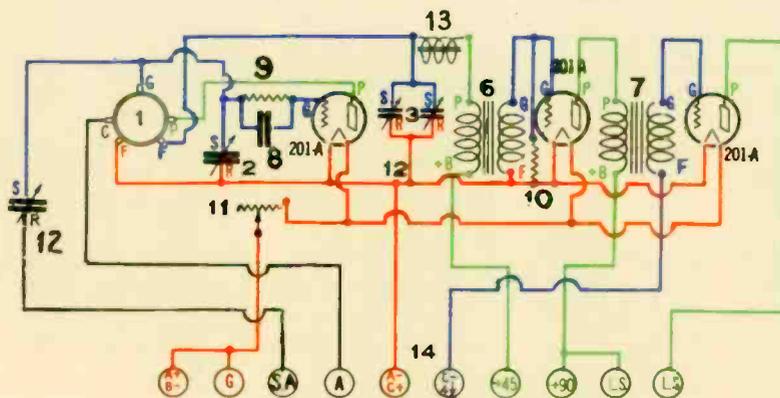
The .00014 mfd. variable condenser is the tuning control. All stations can be logged directly on this dial. Since this a regenerative set, the highest efficiency possible for three tubes is obtained. The two midget condensers on the right control the amount of regeneration wanted. The upper condenser should be set at zero and the lower condenser adjusted for regeneration on low waves. For broadcast waves set upper condenser to its full capacity.

3 TUBE ALL WAVE BATTERY RECEIVER

(20 to 550 Meters)



COMPLETE WIRING LAYOUT

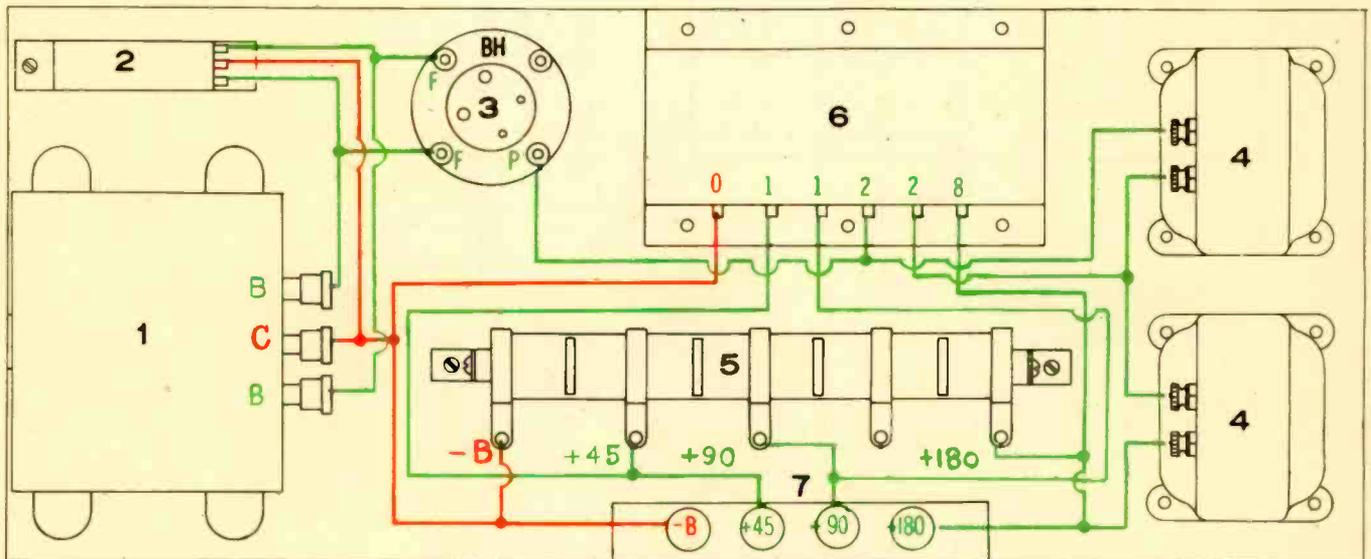


ELECTRICAL DIAGRAM

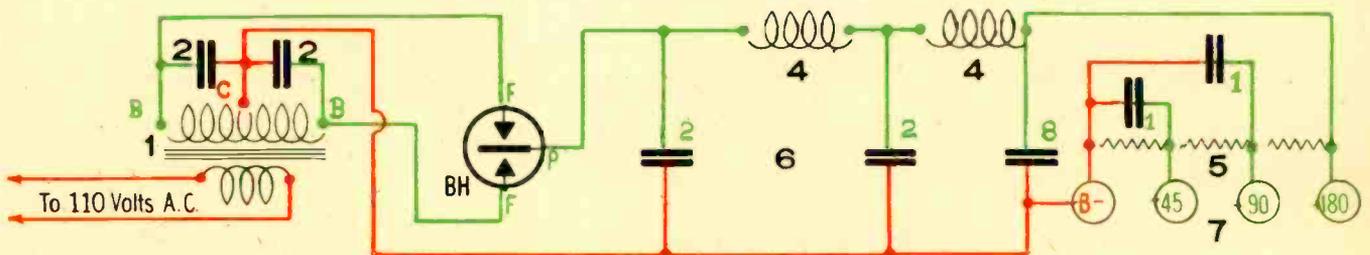
B ELIMINATOR FOR A. C. CURRENT

LIST OF PARTS

SYM. NO.	NO. REQ.	Name of Part	SYM. NO.	NO. REQ.	Name of Part
1	1	Step-up Transformer.	7	4	Binding Posts
2	1	Buffer Condenser.		1	7"x17" Baseboard.
3	1	4 Prong Socket.		1	BH Tube.
4	2	30 Henry Chokes.			Cabinet.
5	1	13 000 Ohm Tapped Resistance.			Miscellaneous Accessories.
6	1	B-Block Condenser. 14 Mfd.			Aerial and Equipment.



COMPLETE WIRING LAYOUT



ELECTRICAL DIAGRAM

