101 Radio Hook-Ups

Compiled by the Technical Staff of

RADIO NEWS

1930 Edition

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Prepared by the staff of

RADIO
NEWS

Vol. 1 No. 1

—1930 Edition—

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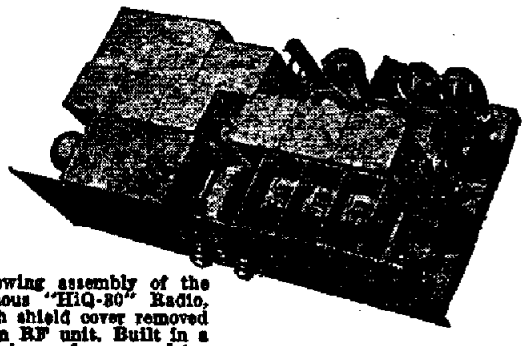

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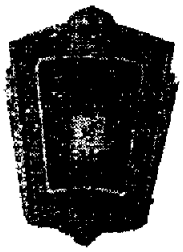

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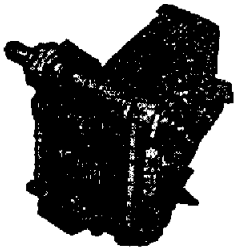

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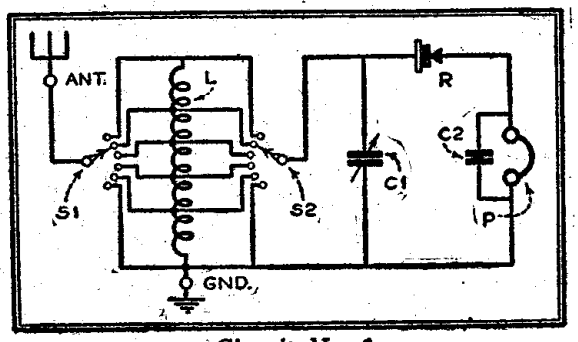
101 RADIO HOOK-UPS

CIRCUIT No. 1 is that of a crystal receiver using a tapped loose-coupler for tuning. In this circuit both the antenna and 'tuned' portion of the circuit is tapped permitting better selectivity than some of the simpler crystal radio receivers. Many types of crystals may be used as the detector or rectifier, two of the more common types

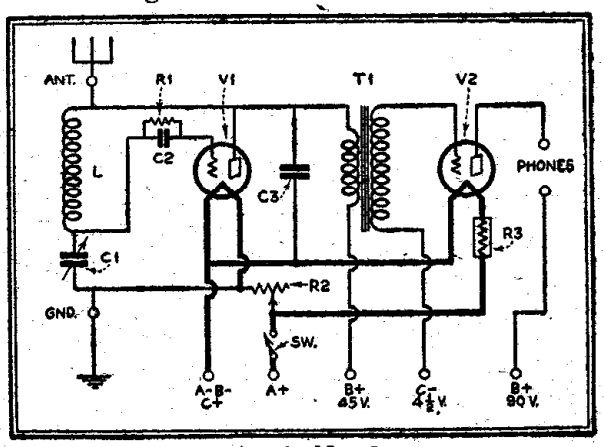


Circuit No. 1

however are, galena and carborundum. Crystal receivers may of course be constructed so that the primary and secondary circuits are separated. The secondary in such a circuit should be fixed, having the proper number of turns to tune over the desired wave bands when tuned by a variable condenser.

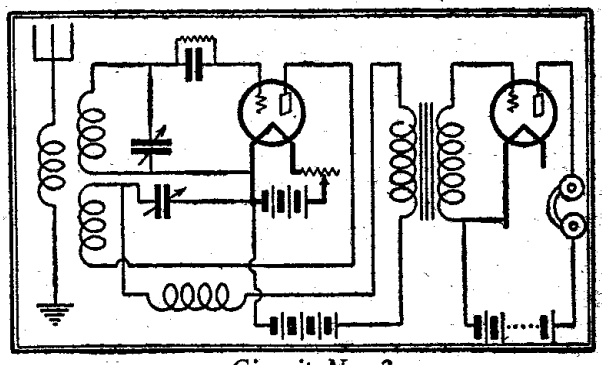
CIRCUIT No. 2 is that of one of the simplest of all circuits using the three-element tube, V1, as a detector or rectifier and a second tube, V2, in conjunction with an audio transformer, T1, as an amplifier of audio frequencies.

A fixed condenser C2 of .00025 mfd. capacity, is placed in the grid circuit between the grid of the tube and the inductance L1 and is known as a grid condenser. A grid leak, R1, is shunted across



Circuit No. 2

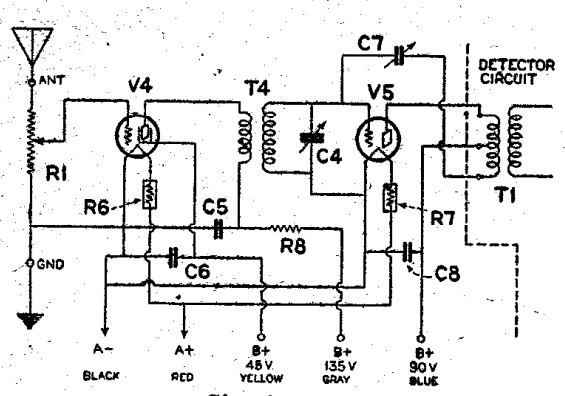
the grid condenser and should be from 1 to 5 megohms in resistance. The usual by-pass condenser, C3, is .001 mfd. and is connected across the primary of the audio transformer and the 'B' battery. A 'B' supply either a battery or 'B' eliminator is always used in a circuit employing the three-element tube. The voltage of this 'B' supply will depend upon the type of tube used. If a soft tube such as the -00 is employed, the 'B' potential will be between 16½ and 45 volts. With such a tube, when the rheostat R2, which in this case should have a resistance of 6 ohms, is turned up to a certain point, a slight hiss will be heard in the phones. For best results, the tubes should always be operated just under this hiss. The audio frequency amplifying tube, V2, should be the type of tube commonly known as "hard." Here the filament resistance, R3, is of the automatic ballast type. For audio frequency amplifiers voltages somewhat higher (90 volts)



Circuit No. 3

than will be needed for the detector should be employed. To prevent distortion, a 'C' battery has been incorporated in this circuit.

Circuit No. 3. This circuit is somewhat similar to circuit No. 2 in that three-element tubes are employed as a detector and an audio frequency amplifier. In this circuit, however, better selectivity as well as better sensitivity is obtained by use of a separate primary or antenna coil and a fixed tickler tuned by a variable condenser. A radio frequency choke coil of 85 millihenries is shown in this circuit in series with the tickler coil and the primary of the audio frequency transformer, its function is to prevent the radio frequency

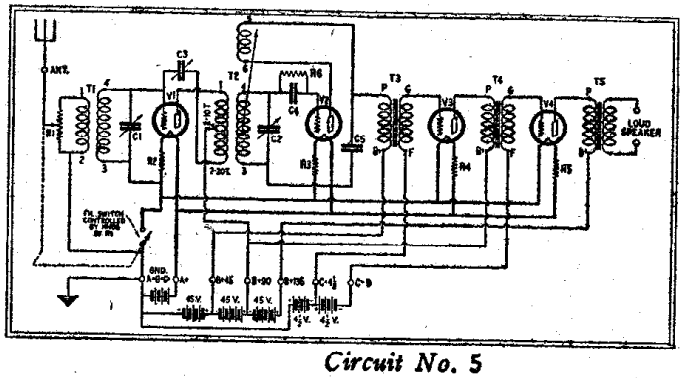


Circuit No. 4

currents entering the audio frequency amplifier thereby stabilizing the entire circuit. The tuning of a radio circuit of this type is extremely sharp. The close approach to the point of oscillation is evidenced by the fact that it does not spill over into oscillations as suddenly as in the case of nearly all regenerators. As the regeneration control condenser is increased, the amplification increases continuously, gradually working into the condition of oscillation. The approach is so close that both the incoming signal and the regenerative whistle can be heard at the same time when the tuning is very close.

CIRCUIT No. 4. To dwell at length upon the wonders of the neutrodyne receiver would be rehearsing an oft told tale. However, no series of circuits would be complete without one. The hookup shown in circuit No. 4 is the standard one invented by Professor Hazeltine, except that there has been added one stage of screen-grid as a blocking tube. Do not try to force loud signals by using too much 'B' battery. Ninety volts is usually sufficient and no more should ever be used. The condenser shunted across the secondary of the neutraformer has 17 plates and by careful adjustment the dial reading of this stage as well as the detector will tune approximately alike.

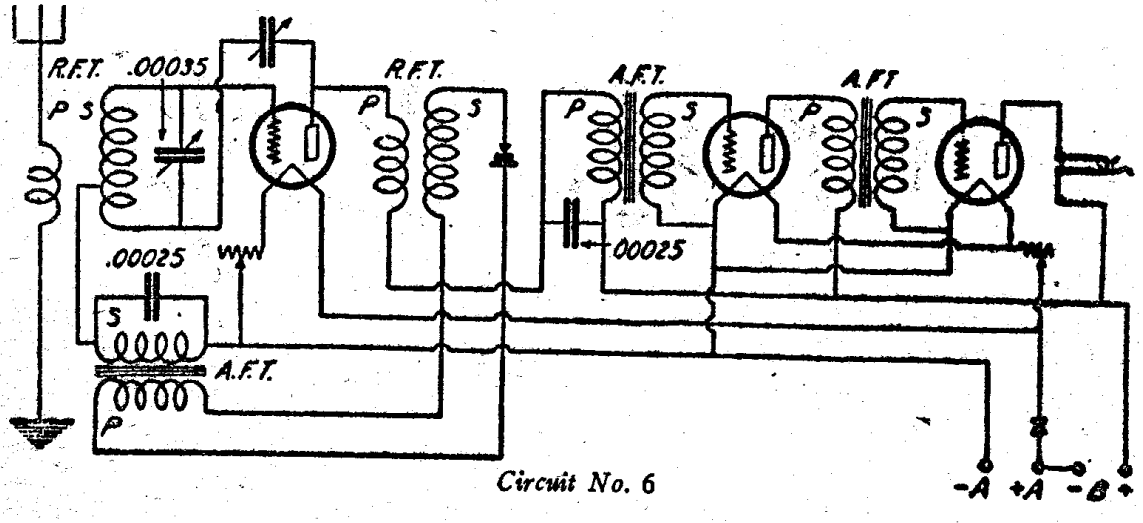
CIRCUIT No. 5. In this hook-up the screen-grid tube as a blocking unit has been eliminated, so that now the first tube is a straight tuned neutralized stage followed by a regenerative detector and then two stages of transformer coupled audio frequency amplification with an output transformer, T5, protecting the windings of the loud speaker from burn out. The volume control for this circuit consists of



Circuit No. 5

a combination unit, a switch for turning the set on and off as well as a variable resistance controlling the signal value from the antenna. This volume control unit, variable resistance R1, should have a value of 25,000 ohms and is known as a potentiometer.

CIRCUIT No. 6. So much has been said



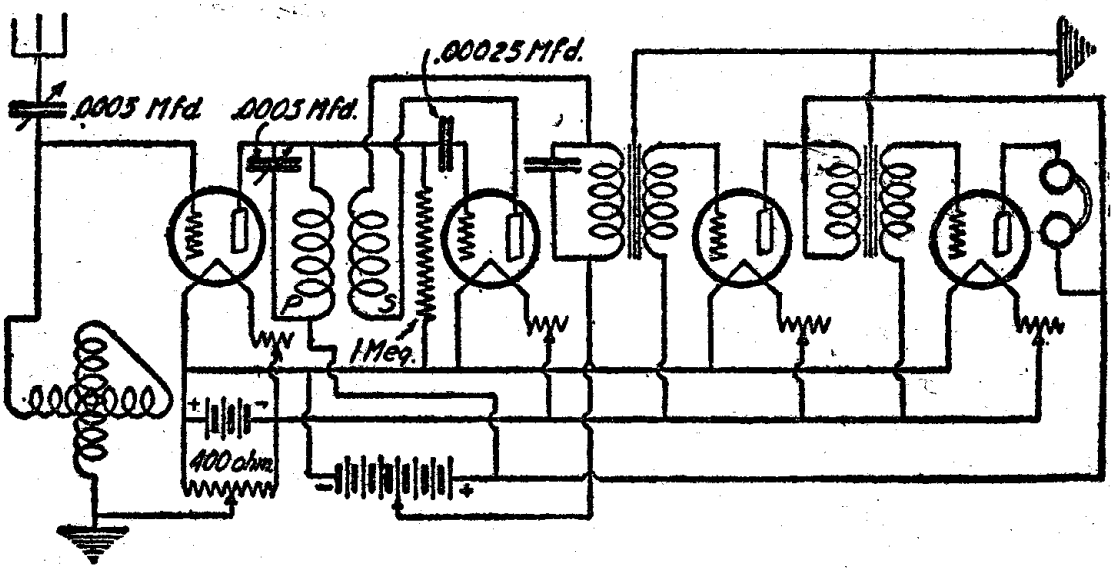
Circuit No. 6

about the popularity, low cost and faithful reproduction of the reflex circuit, that many people are beginning to realize its importance and are turning toward it. However, as there are so many reflex circuits it is often confusing to the layman as to just what circuit he should use. The Rasla reflex circuit as shown in circuit No. 6 is one of the simplest and most efficient receivers of this type it is possible to build.

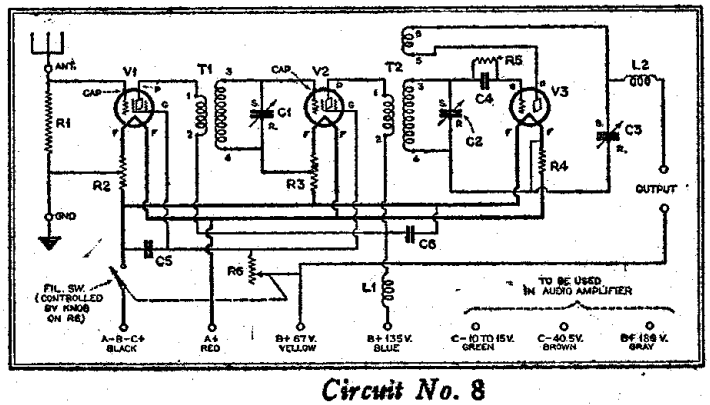
By reference to the diagram, it will be noted that the antenna system is untuned of a semi-periodic nature. The circuit is tuned by a .00035 mfd. variable condenser of the low-loss type but as will be noted, only a part of the secondary coil is included in the grid circuit. A small balancing condenser tends to obviate the undesirable creation of oscillations and also serves somewhat as a volume control. Analyzing the circuit, we see it consists of one stage of tuned radio frequency amplification, a crystal detector, a reflex stage of audio frequency and two stages of straight audio frequency amplification.

The radio frequency transformer is one that is designed so that its impedance matches that of a fixed detector, thus giving maximum transfer of energy and efficient coupling. A .00025 mfd. fixed condenser is shunted across the secondary of the audio frequency transformer which is used for reflexing. A 30-ohm rheostat is necessary for careful adjustment of the detector tube, while a 6-ohm rheostat will handle the audio frequency amplifier tubes very nicely.

CIRCUIT No. 7. For the fan who wishes a set that is stable and excellent for DX work, we can recommend the one shown in circuit No. 7. It is an English circuit built entirely of standard parts. The variometer in the antenna circuit and the variocoupler that is used as a radio frequency transformer, should be of a high grade, for the proper functioning of the circuit is depended upon their quality. A 400 ohm potentiometer is used to place the correct grid bias on the radio frequency tube. The cores of the audio frequency transformers are shown connected to ground, but this is optional. Connect the stationary plates of the condenser in the antenna circuit to the antenna binding post and those of the variable condenser across

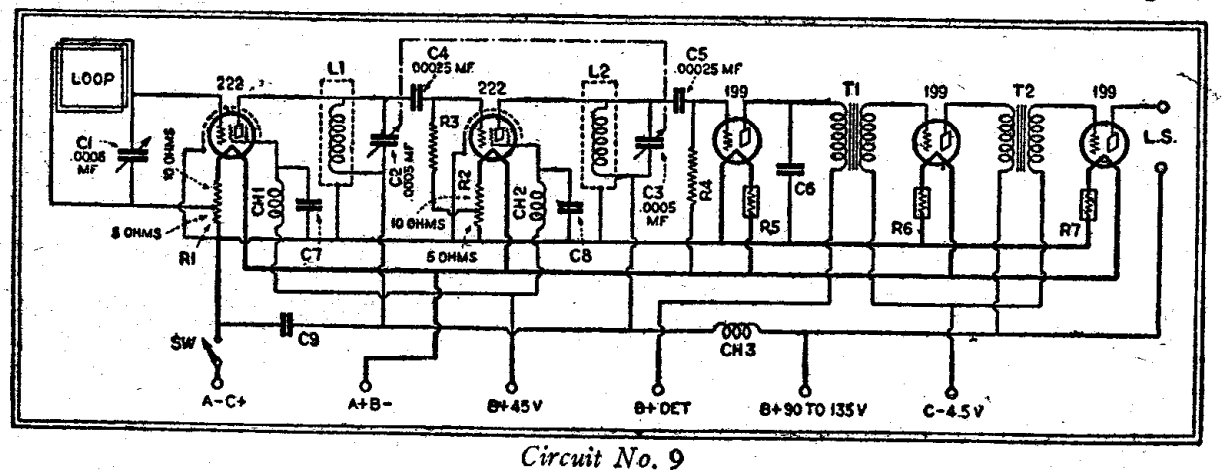


Circuit No. 7



Circuit No. 8

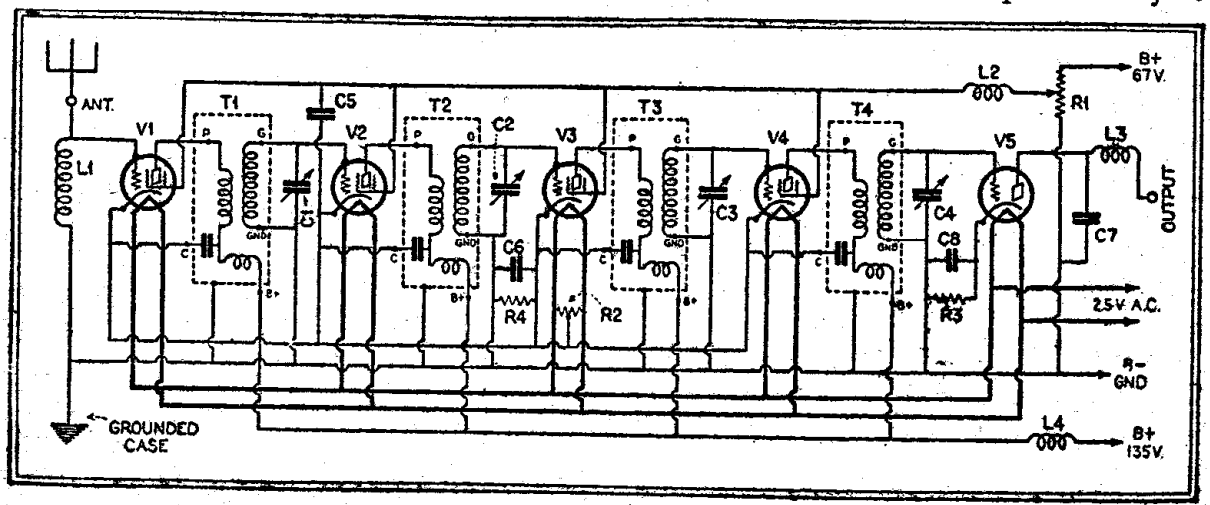
the stator of the variocoupler to the plate binding post of the tube. UX-99 tubes will work very well in this set but it is recommended that UX-01A tubes be used for the best results. The audio frequency transformers should have a ratio of 5 or 5½ to 1. At least 90 volts of 'B' battery should be connected to the plates of all tubes with the exception of the detector.



Circuit No. 9

CIRCUIT No. 8 is of two stages of radio frequency employing the new battery-operated screen-grid tube and a regenerative detector. In this circuit, the first screen-grid tube is used as a blocking unit and due to the extremely high amplification constant of this type of tube the signal is amplified before it reaches the radio frequency transformer, T1. Further amplification is provided in the second screen-grid battery-operated tube, V2, the signal is then rectified by the detector V3. This tube also being operated as a regenerative unit greatly increasing the sensitivity and selectivity of the receiver. Stabiliation is accomplished in a circuit of this type by the use of the choke coils of a radio frequency type, L1 and L2, and the by-pass condensers C5 and C6. The necessary 'C' bias for the battery-operated screen-grid tubes is automatically obtained by the tapped filament resistors R2 and R3. The coupling device to the first tube R1, is a fixed resistor of the grid leak type and should be 10,000 ohms. For loud speaker reception, a standard audio frequency amplifier should be connected to the two output terminals. This circuit, as is however, will provide satisfactory earphone reception over reasonable distances.

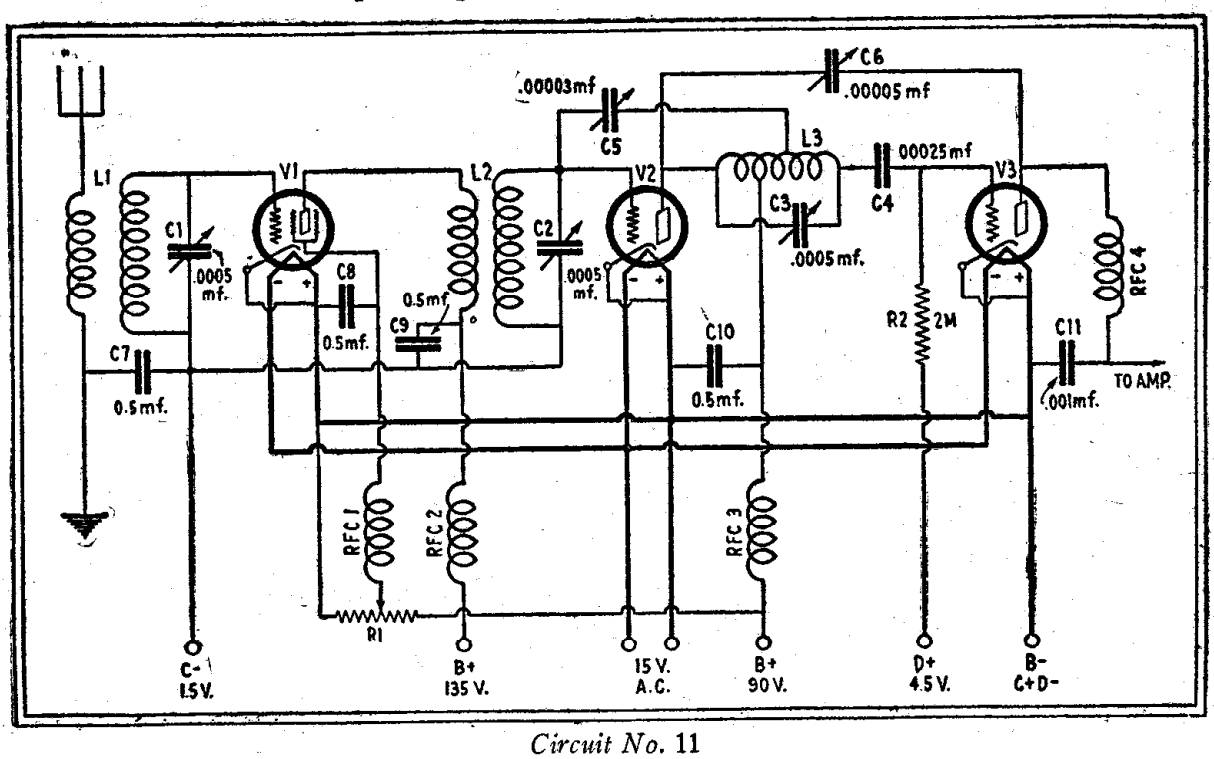
CIRCUIT No. 9 is especially suitable for use in a motor car or as a portable for locations where the signal pickup is necessarily poor. It is a five-tube circuit employing screen-grid tubes in the r.f. circuits and -99's for detector and audio. In the form shown, this receiver can be used with from 90 to 135 volts of 'B' and the total filament current required is just



Circuit No. 10

under ½ an ampere, permitting the use of a bank of dry cells if necessary, although the car storage battery is preferable. The advanced experimenter, of course, will instantly see the possibility of substituting the 120 tube in the second audio stage and it is perfectly feasible to use a screen-grid tube for the detector. Either one of these changes would only increase the filament current slightly.

CIRCUIT No. 10 is the National Velvetone 29 a.c. screen-grid tuner designed to work with a combined power pack and amplifier. The tuner is obtainable in kit form. This circuit has shown splendid results in distance-getting in congested locations without sacrificing quality. It makes use of an untuned antenna stage, three tuned radio frequency stages (using four of the type -24 tubes) with a tuned detector input (gang for single control) feeding into the ordinary heater type a.c. tube as a detector. Note the stage shielding and the careful isolation of radio frequency circuits by choke coils and condensers.

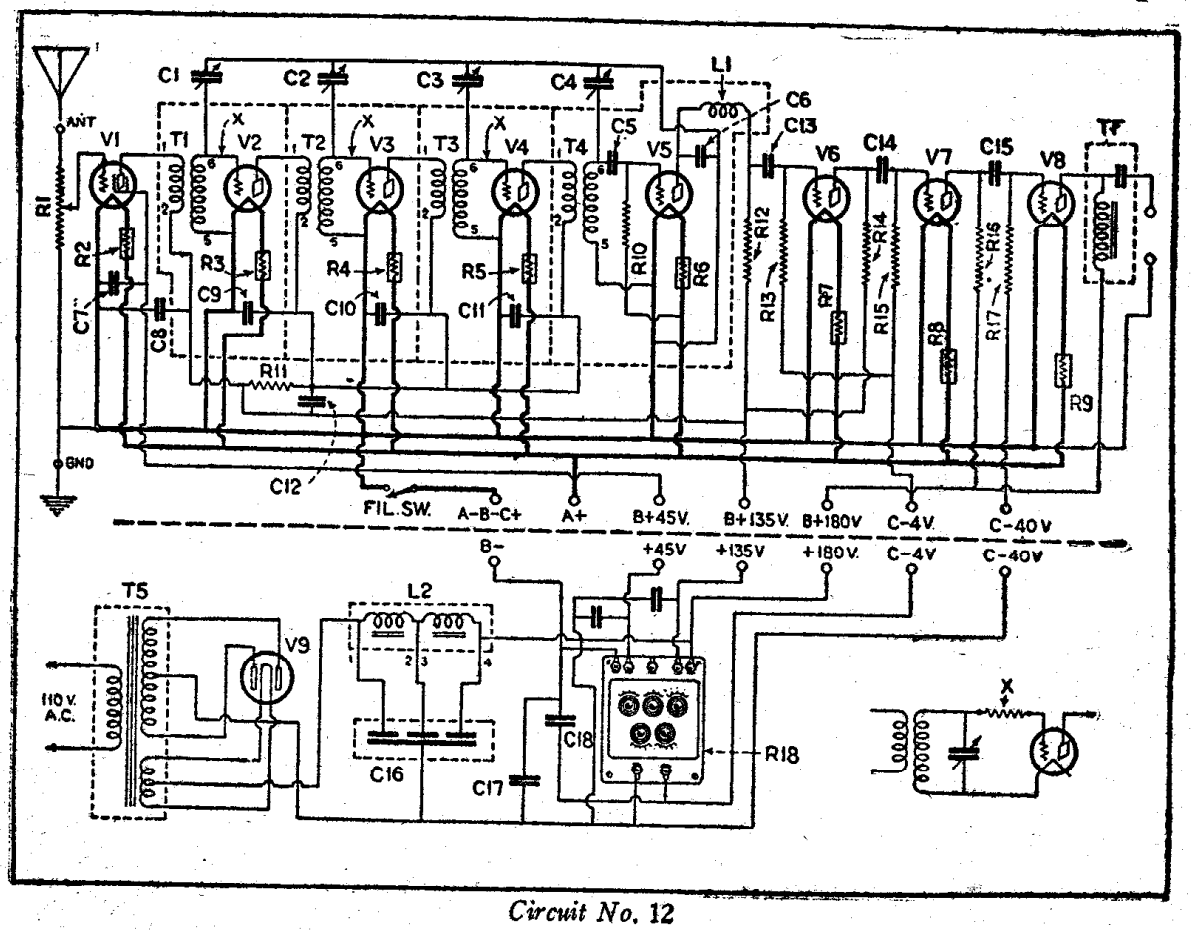


Circuit No. 11

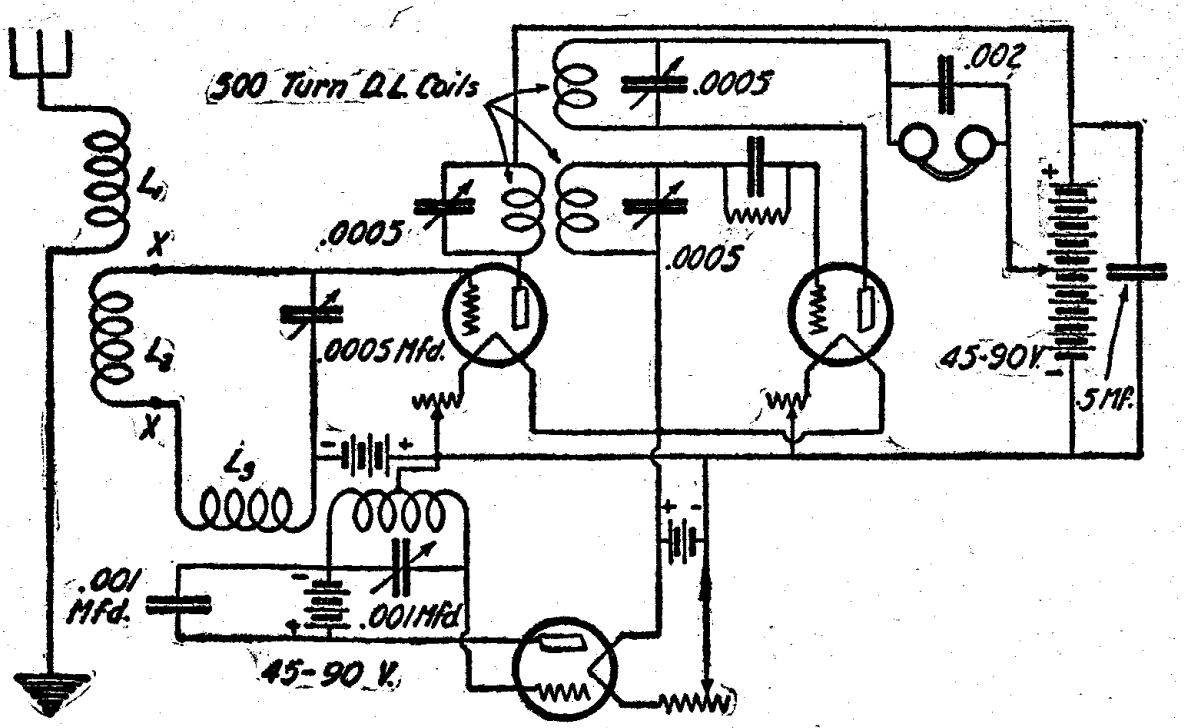
CIRCUIT No. 11 is a schematic diagram of the well known Everyman tuner revised for operation with 15 volt a.c. tubes. These tubes are of the heater type, V1 being the Arcturus a.c. 22 screen-grid, V2 the Arcturus a.c. 48 and V3 the Arcturus a.c. detector 26. The original Everyman tuner was designed for d.c. operation employing one stage of radio frequency amplification and regenerative detector, but here the circuit has been redesigned so that it now consists of two stages of radio frequency amplification and regenerative detector as well as using complete a.c. The circuit is extremely efficient in its pick-up and is of particular interest for its stability due of course to the generous use of radio frequency choke coils and by-pass condensers. Of particular interest also is that the primary and secondary of L1 are separated, thus necessitating a manual control of the variable coupling in place of the well known fixed coupling method. The inductance coils, L1, L2 and L3 are all wound on a 2-inch bakelite tube, the antenna primary of L1 consisting of 18 turns of No. 22 D.S.C., the primary of L2 is wound directly over the secondary of L2 and consists of 40 turns of No. 24 D.S.C., the secondaries of L1 and L2 consist of 70 turns of No. 22 D.S.C. while the coupler L3 is wound with 70 turns of No. 22 D.S.C. tapped at the 21st and 49th turns. The tuning capacities are as shown in circuit No. 11. The control R1 is a duplex clarostat while the radio frequency choke coils, RFC1, 2, 3 and 4 are the conventional 85 millihenry type.

While the Everyman tuner employs the regenerative detector, it must not be confused with the ordinary blooper circuit, as here we have two radio frequency tuning stages to prevent radiation in the antenna system. The regeneration is controlled by the small capacity C6. To the Everyman tuner may be added an audio amplifier using 15 volt a.c. tubes.

CIRCUIT No. 12 is a schematic diagram of a single control socket-powered receiver of unsuppressed tone quality and extraordinary amplification. Although the circuit is similar to many other tuned radio frequency circuits, the feature of the circuit is shown in the adequate by-passing and shielding to prevent interstage coupling. Also in this circuit will be noted the use of the screen-grid tube as a coupling medium between the antenna and first r.f. circuit. This allows single control of the tuning and is absolutely necessary to prevent antenna capacity being impressed on the first tuned circuit, causing a wide variation in the capacity of this circuit between the wavelength of 550 and 200 meters. The inductances, T1, T2, T3, T4 are wound on "air" bakelite forms and are designed for use with the tuning capacities C1, C2, C3 and C4. The tuning condensers are of the battleship type well known for their sturdy construction. Of particular interest is the resistance coupled amplifier where hi-mu tubes are used in the first and second stages with a power tube of either -71 or -45 type in the last stage. Here a plate audio choke is used with a by-pass condenser (more commonly known as the tone control) for protecting the speaker windings from the high d.c. current. The plate resistances in the amplifier are in the order of 100,000 ohms each, while in the first two stages the grid resistors are 500,000 ohms with a grid resistor in the power tube stage of 250,000 ohms. In each of the positive filament circuits are inserted amperites of the correct resistance value to correspond with the type of tube used. In some extreme cases, it may be found necessary, due to oscillation, to insert grid suppressors between the tuning inductance and the grid of each tube at point marked "X" as



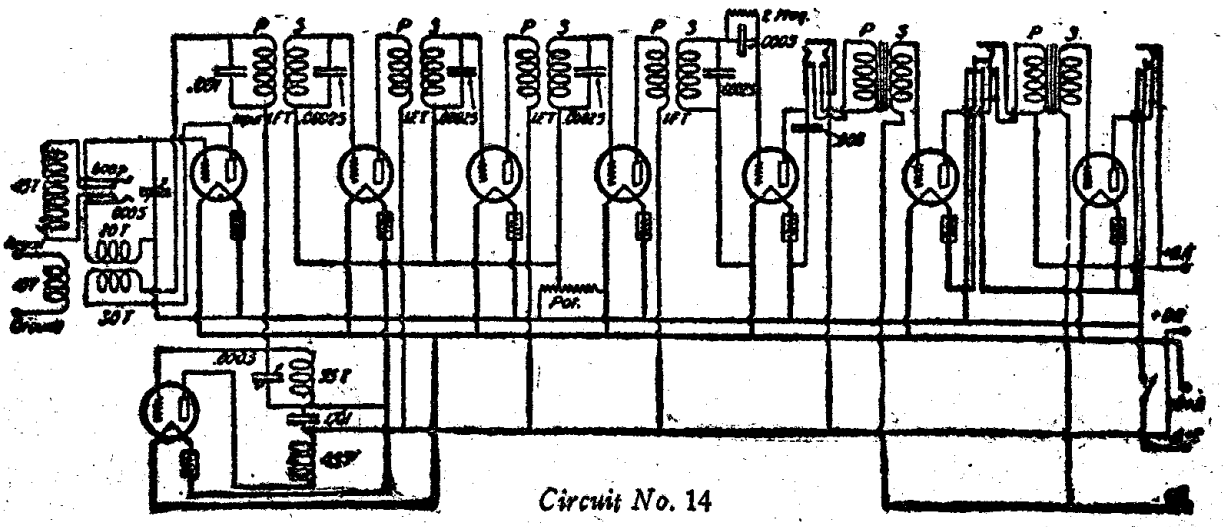
Circuit No. 12



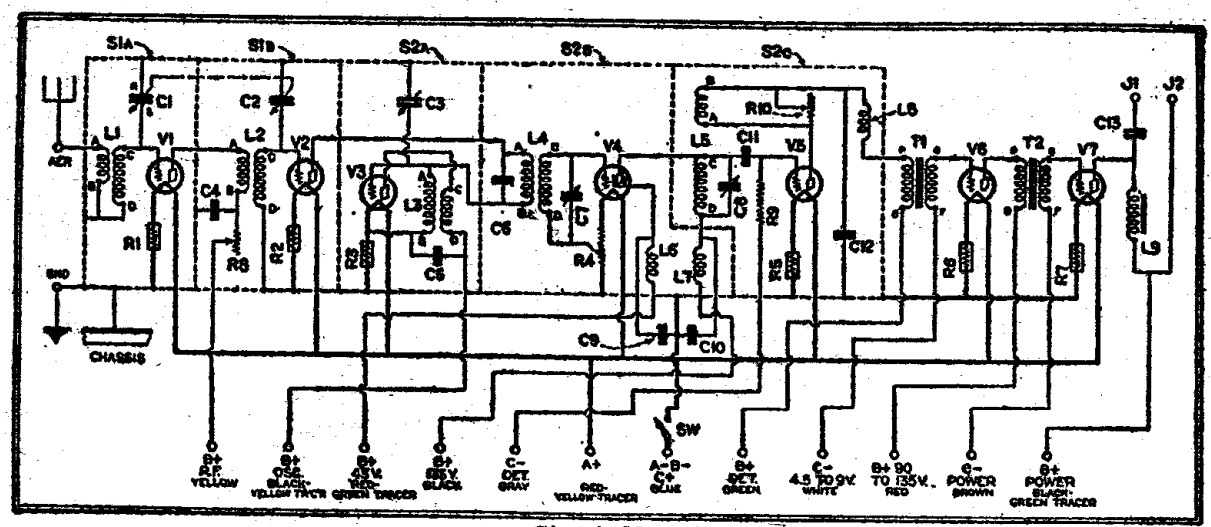
Circuit No. 13

shown in circuit No. 12. These grid suppressors are wire-wound resistors manufactured in a convenient form. The resistance wire is wound on a core covered with insulating material and the whole is encased in cambric cloth. Eyelets are located at the ends of wire for ease of connection. The 'B' and 'C' power pack for this circuit is of the conventional -80 rectifier tube with its associated filter circuit, comprising of condenser pack C16 and 'B' eliminator choke L2. A standard manufactured voltage dividing device, R18, is used for obtaining the various values of plate and grid voltages for the operation of the circuit. By-pass condensers are also connected across these various taps.

CIRCUIT No. 13. Many fans are anxious to experiment with the superheterodyne circuit but the expense of the equipment has prevented them. In circuit No. 13 is shown a diagram that has for its principle the superheterodyne method and the parts are relatively inexpensive. The constants of the coils are as follows. No. 20 D.C.C. wire is used for winding all the coils. L1 is 5 turns on a 4-inch tube, L2 is 35 turns on the same tube, starting ¼ of an inch from L1. L3 is 4 to 8 turns on a 3-inch tube and L4 is 27 turns on the same tube, the latter wiring being tapped at the 13th turn. The three honeycomb coils in the plate circuit of the two tubes should be placed in a regulation mounting so that



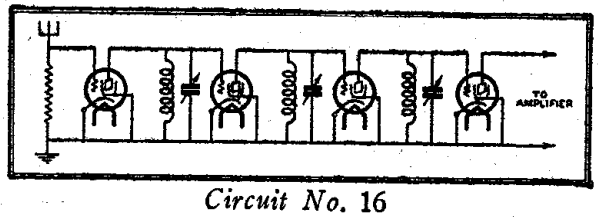
Circuit No. 14



Circuit No. 15

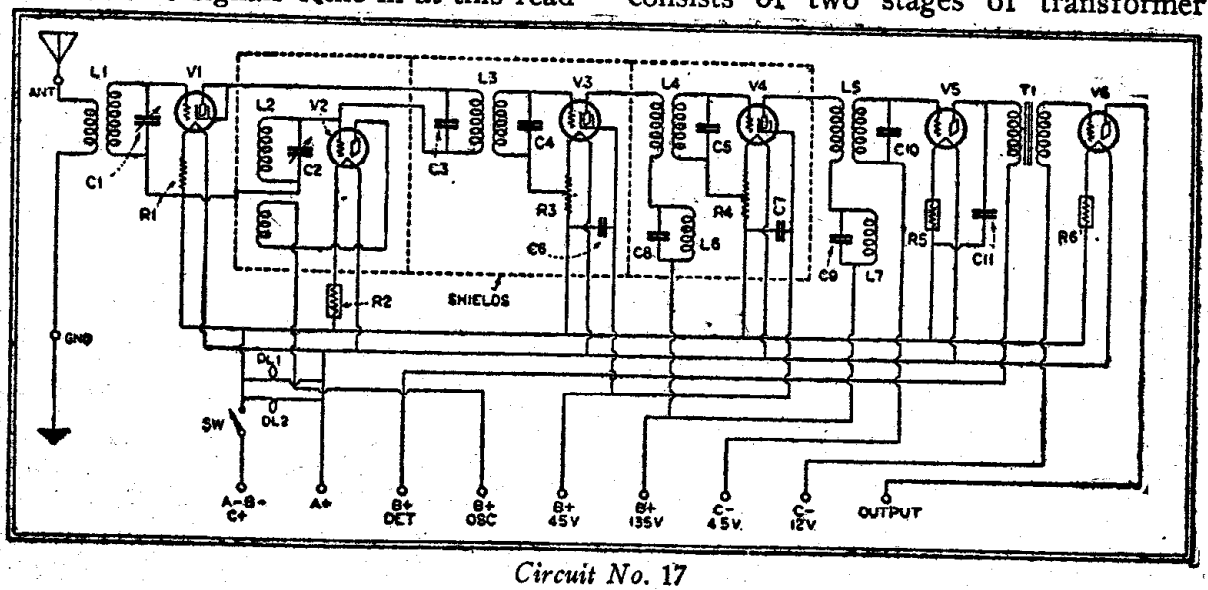
their inductive relationship may be varied. If a loop is used with this circuit, it is connected in the places marked "X" thereby eliminating the primary and secondary windings of L1 and L2. The set is tuned by a .0005 mfd. condenser across the secondary and a .001 mfd. condenser in the oscillator circuit. The three .0005 mfd. condensers are shunted across the honeycomb coils, needing very little adjustment after once being set.

The tuning of this circuit is not very difficult. Place the .0005 mfd. variable condenser in the L2, L3 circuit at a low scale reading and slowly turn the .001 mfd. variable condenser which controls the oscillator circuit until a hissing noise is heard. If no signals come in at this reading, raise one or two degrees and retune the oscillator circuit condenser until the hissing is again heard. This is continued until signals are heard.

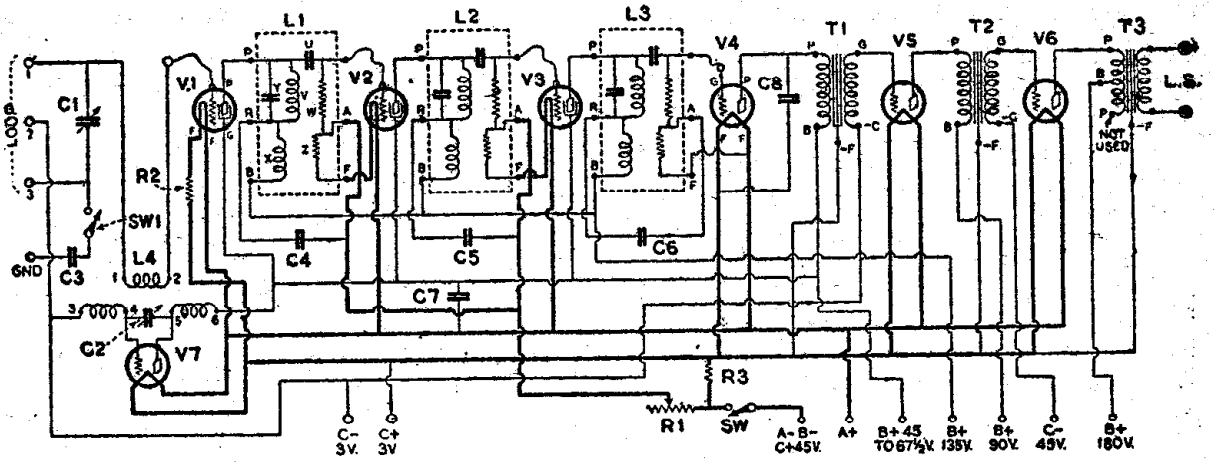


Circuit No. 16

CIRCUIT No. 14. In the circuit shown here, there is incorporated a different system of producing beat notes than that employed in any other superheterodyne radio receiver. Amperites instead of rheostats are used throughout. The 200 to 400 ohm potentiometer shown is used to give the proper grid bias to the intermediate frequency tubes. It is hardly necessary to say that the apparatus should be so placed that leads may be as short as possible. This circuit as shown consists of two stages of transformer



Circuit No. 17



Circuit No. 18

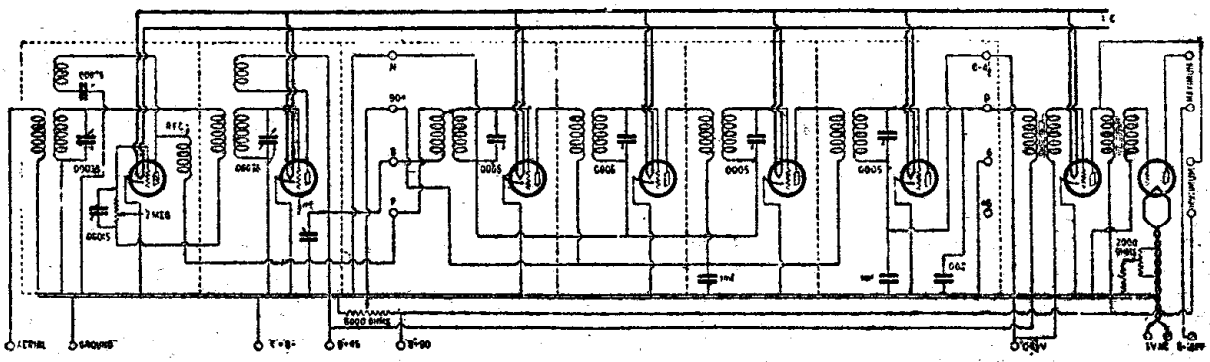
coupled audio amplification but by the use of jacks, signals may be taken directly from the plate of the detector tube or using one stage of audio frequency amplification.

CIRCUIT No. 15 is that of the popular and efficient superheterodyne receiver designed for the home constructor. It makes use of individual stage shielding and a metal subpanel. The single stage of intermediate frequency amplification using a screen-grid tube is equivalent to more than two stages of the ordinary type, while the additional stage of tuned radio frequency ahead of the first detector adds both selectivity and sensitivity. The shield cans and metal chassis save a great deal of wiring in making the construction an easier and quicker job. By a slight revamping, this circuit would also be suitable for use with a.c. tubes.

CIRCUIT No. 16. Recently the band-pass filter has come into its own, due of course to the number of high-powered broadcasting stations operating with very little separation. The band-pass filter shown in circuit No. 16 can be used either as a pre-tuning stage for a superheterodyne or a tuned radio frequency. The circuit is shown with a.c. screen-grid tubes so that a very high degree of sensitivity is obtained along with the selective feature such a circuit provides.

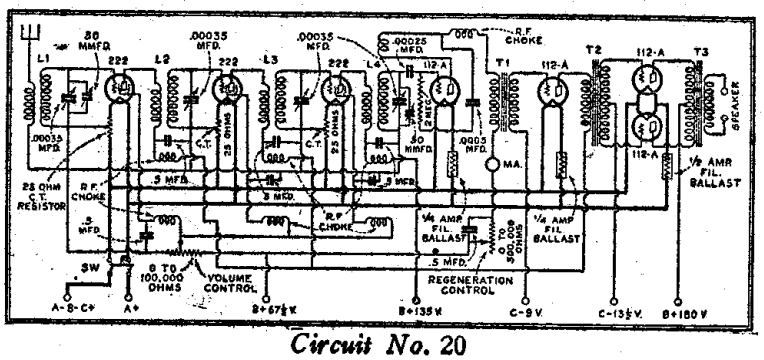
CIRCUIT No. 17 is that of the RE-29, the late R. E. Lacaults last contribution to the greater efficiency of the radio receiving circuits, incorporating the designer's well known frequency changing system (the Ultradyne). It is brought entirely up to date by the use of tubes throughout, three of these being of the screen-grid variety while the oscillator, second detector and first audio tubes are of the three-element type. The output of this circuit may be operated as is for medium distance but for extremely loud signals and greater distance should be fed into a stage of push-pull audio frequency amplification consisting of a pair -45 tubes.

CIRCUIT No. 18 gives the schematic details of the well known Tyrman shield-



Circuit No. 19

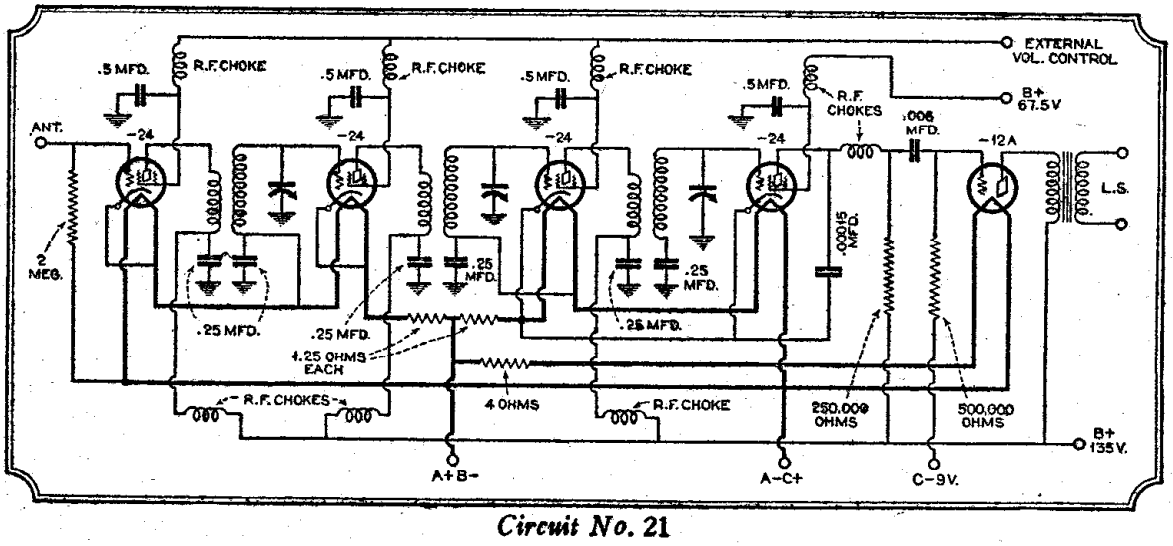
grid 7. This is a superheterodyne circuit utilizing a screen-grid tube as the first detector followed by two screen-grid intermediate frequency amplifiers, each stage being carefully shielded. The receiver employs a loop and is designed to operate from a d.c. filament supply, with the power pack capable of supplying the plate potential of 180 volts for the -71 output tube.



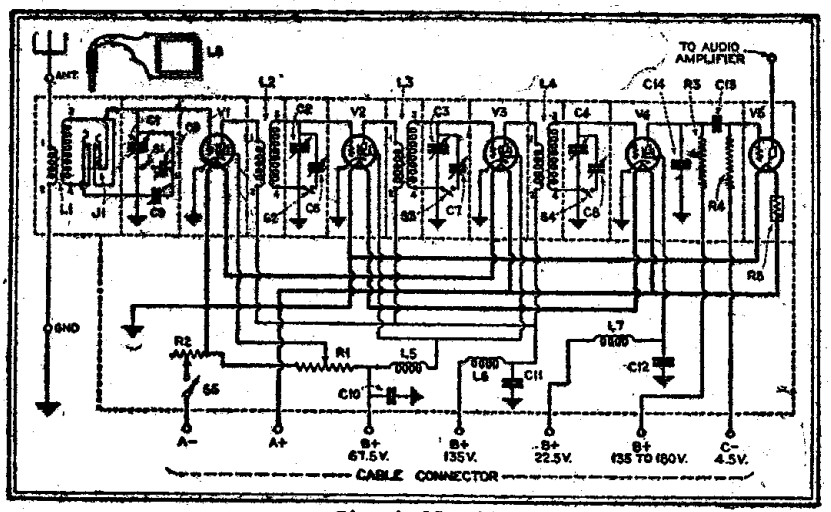
Circuit No. 20

CIRCUIT No. 19. Schematic diagram of a superheterodyne using the Silver Marshall time signal amplifier as an intermediate frequency amplifier, is here shown as adapted for operation with heater type a.c. tubes. The power tube of the -71 type is operated from the 5-volt secondary of the heater transformer. The grid bias for this tube is obtained automatically through a resistor. Although the a.c. leads to the heater type tubes are shown in this diagram in heavy straight lines, it should be remembered that all a.c. leads should be of twisted wire.

CIRCUIT No. 20 is a schematic diagram of a three-stage tuned radio frequency amplifier employing the d.c. screen-grid tubes and -12A tubes as a regenerative detector, a first audio stage of transformer coupled and a push-pull stage. Single dial control is permitted with a circuit of this type by making use of small compensating condensers of 50 mmfd. capacity across the tuning circuits of the first radio frequency stage and the detector stage. C bias for the radio frequency tubes is automatically obtained by the use of center-tapped resistors in the negative battery lead. Complete stabilization is effected by the generous use of radio frequency choke coils and .5MFD by-pass condensers in both the plate and screen-grid circuits of each of the radio frequency tubes. Volume is controlled by a potentiometer, its value being from 0 to 100,000 ohms, connected in the screen-grid circuit of the three radio frequency tubes. The -12A detector tube is made regenerative for better sensitivity and selectivity, regeneration being controlled by a variable resistor of 0 to 500,000 ohms by-passed by a .5MFD by-pass condenser. Visual tuning is incorporated in this circuit by making use of a milliammeter in the plate circuit of the detector. A circuit of this type may be laid out by the constructor to require a very small space, permitting its use as a portable unit for use in a motor car, motor boat or airplane.



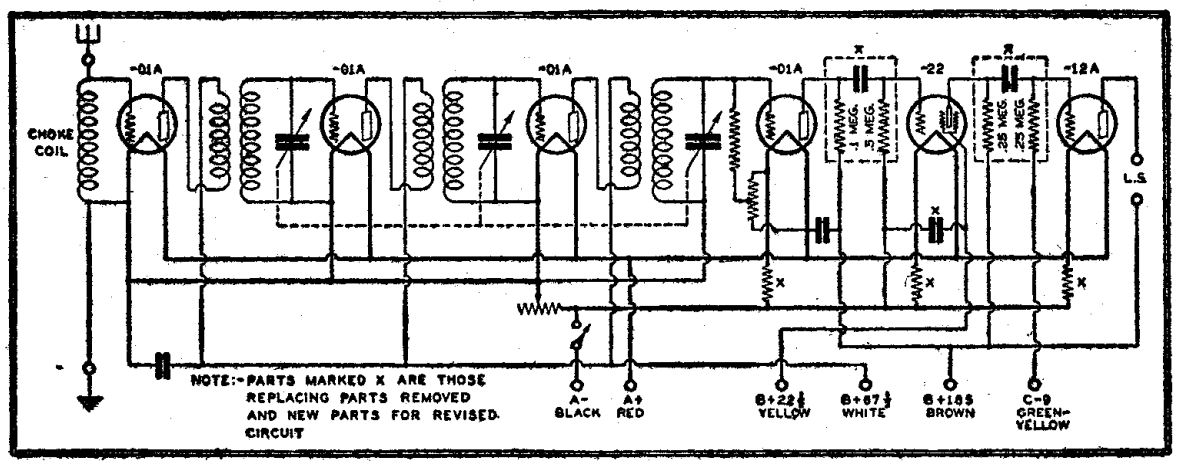
Circuit No. 21



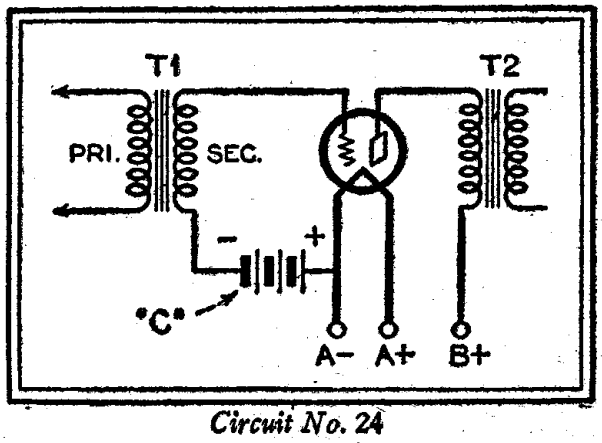
Circuit No. 22

CIRCUIT No. 21 is the circuit diagram of a radio receiver ideally suited for motor car work. Three stages of radio frequency amplification make use of the a.c. operated -24 screen-grid tube as well as a tube of a similar type in the detector stage followed by a stage of resistance coupling and a -12A tube as an audio frequency amplifier. Making use of the -24 a.c. heater type screen-grid tube is ideal for motor car work, due to the sturdy construction of the heater of this tube, eliminating entirely microphonic noises due to jars or sudden shocks. Sudden filament variations also have no effect on the output signal as there is a time limit in the cooling of the heater sleeve in such tubes. Single dial control is accomplished by using the first screen-grid tube as a coupling unit to the antenna circuit. Oscillation and unstable signals are entirely eliminated by the use of radio frequency chokes and .5MFD by-pass condensers in both the screen-grid and plate circuits of each of the a.c. screen-grid tubes.

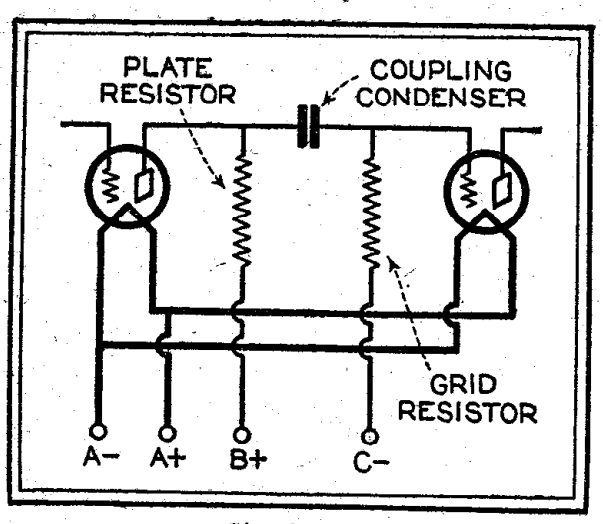
CIRCUIT No. 22 is that of a receiver especially designed for use on small motor boats. The a.c. screen-grid tube with its indirect heater is used in this circuit so that vibration from the engine or rough weather as well as battery variations would have no effect on the output signal. Provision was also made for tuning this receiver in both the broadcast band of from 550 meters to 200 meters and the radio beacon band of 1,000 to 700 meters by use of single circuit switches S1, S2, S3, S4, inserting additional capacities, C6, C7, C8, C9. To complete the radio beacon direction finding equipment, a double circuit jack was incorporated in the grid circuit of the first tuned radio frequency tube, permitting the use of a loop antenna.



Circuit No. 23

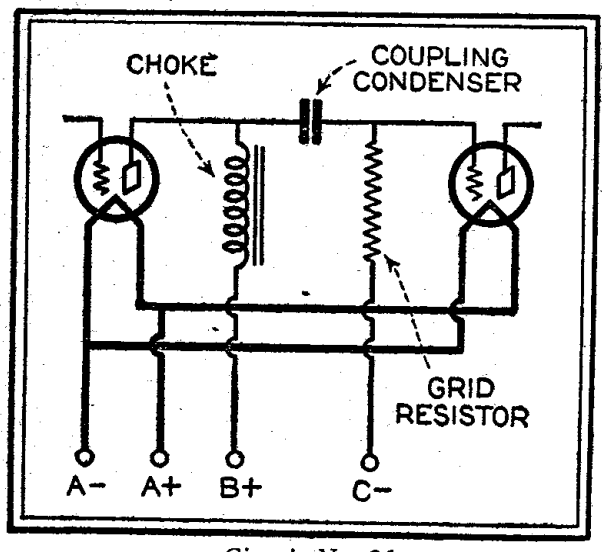


Circuit No. 24



Circuit No. 25

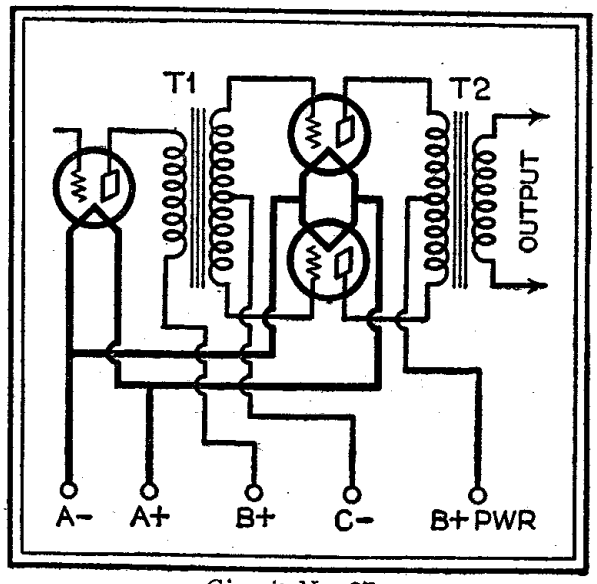
Each stage of this circuit was completely shielded, so that with the use of spark plug and distributor head resistors, the elimination of engine interference was effected. For good loud speaker reception, it is necessary to use an additional stage of audio frequency amplification which was built up as a separate unit. The resistor R1, a potentiometer of 100,000 ohms, served as the volume control and varied the screen-grid voltage of the first radio frequency tube V1.



Circuit No. 26

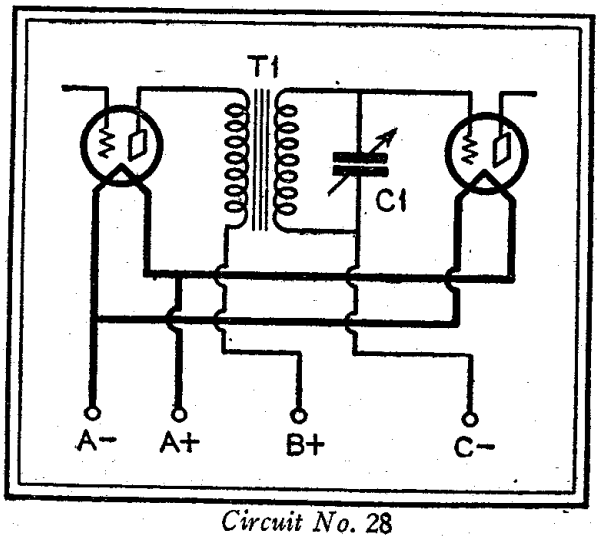
CIRCUIT No. 23 is of the standard Atwater Kent tuned radio frequency receiver in which the audio frequency amplifier has been revamped to resistance coupling employing a battery-operated screen-grid tube in the first stage and a -12A tube in the second or output stage. This receiver was revamped so that it may be used as a motor car receiver using standard parts now readily obtainable on the open market. Single dial control is accomplished by the use of a blocking tube stage using the -01A tube connected in the antenna circuit in conjunction with a small radio frequency choke coil. A material increase in volume was obtained by the use of the screen-grid resistance-coupling stage.

CIRCUIT No. 24 is a schematic diagram of a one stage audio frequency amplifier employing transformer coupling. Here

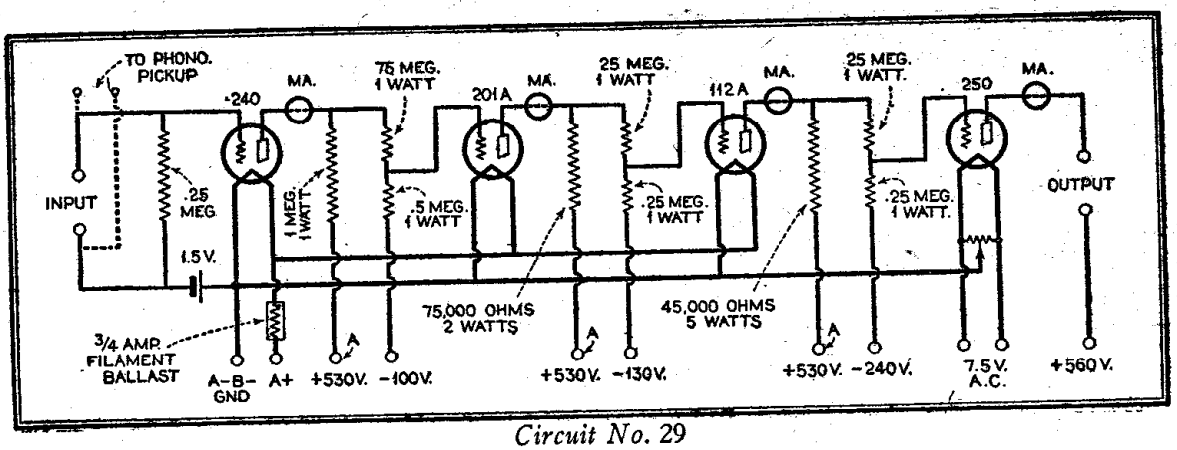


Circuit No. 27

T1, the input transformer, should have a ratio of 3½ to 1 while the output transformer T2 in the plate circuit of the tube if coupled to a succeeding tube, will require a ratio of 4 to 1, or if as a coupling device to a magnetic loud speaker, about



Circuit No. 28



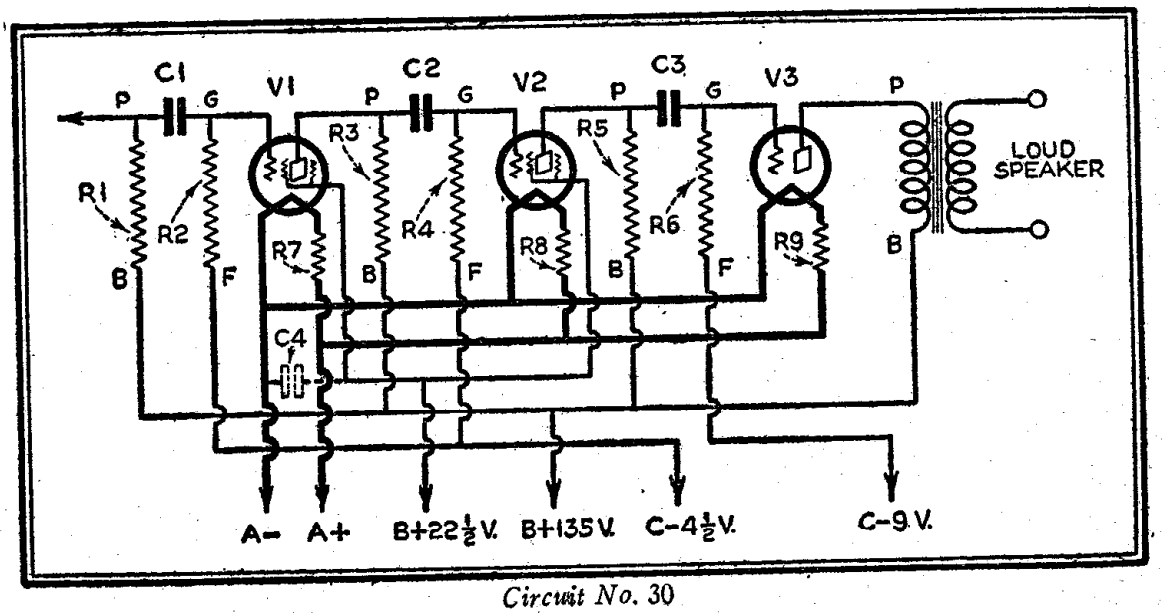
Circuit No. 29

1 to 1 ratio. To prevent distortion entering in an audio frequency amplifying stage of this variety, a C battery is employed to prevent positive grid swing. The standard transformer audio frequency amplifying system usually makes use of two stages employing this identical circuit.

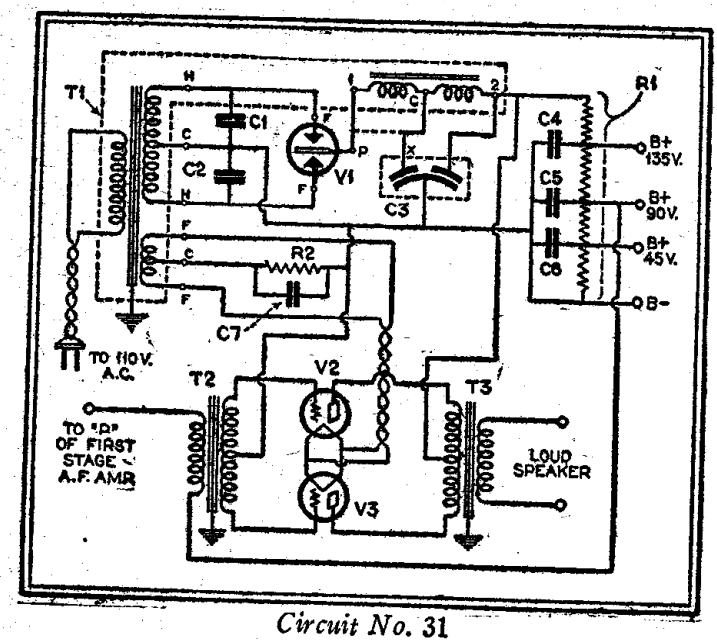
CIRCUIT No. 25 is that of a stage of resistance coupling audio amplification. Here the plate of the preceding tube is coupled to the B power supply through a plate resistor, its resistance depended on the type of tube employed. A coupling condenser also depended on the type of tubes used, separates the plate supply and the grid supply of the succeeding tube. A grid resistor of the grid leak type, whose value is usually from 500,000 to 2 megohms, provides C bias to the grid of the second tube. The general feeling has been and rightfully so, that resistance coupling provides excellent quality, its one disadvantage being, very little amplification other than that obtained from the tube itself, will result requiring at least three stages of this type of audio frequency amplification.

CIRCUIT No. 26 is that of an impedance coupled audio amplifying system. Here an audio choke coil replaces the resistor in the plate circuit of the resistance-coupled amplifier. The coupling condenser and grid resistor will, of course, here depend on the type of tubes used. In many cases, this type of audio frequency amplifier is preferred to that of the resistance-coupling shown in circuit No. 25 due to its ability to give some amplification over that obtained from the amplification of the tubes themselves. It is usual, however, to use at least three stages in this type of an audio amplifier.

CIRCUIT No. 27 is a schematic diagram



Circuit No. 30



Circuit No. 31

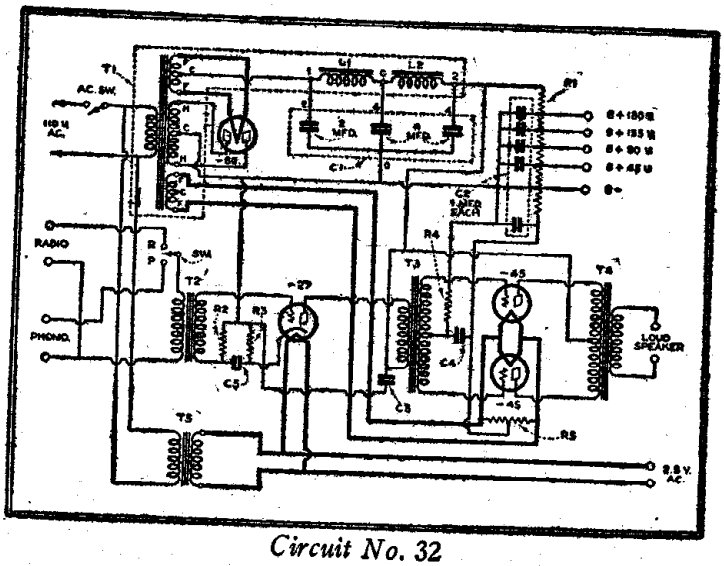
of a push-pull audio frequency amplifier generally used as an output stage. Here the secondary of the input transformer has two complete secondaries, which are connected to the grids of a pair of tubes, their centers being the grid return to minus C. The primary of the output transformer is also made up of two units, being connected to the plates of tubes and the center tap returning to the B plus power. Two types of this transformer are now available, one for coupling directly to the magnetic speaker, in which case the ratio of the primary and secondary is approximately 1 to 1, the other for the dynamic speaker in which the primary usually has at least 80 turns to 1 of the secondary. Such a system as this will handle large amounts of undistorted volume and is now universally accepted in the commercial broadcast receiver as well as the theatre talking picture amplifier.

CIRCUIT No. 28 is that of a transformer audio amplifier where the secondary of the transformer is tuned. A system of this type is of little value in broadcast receiver but is mainly used by commercial and amateur code operators to obtain a very definite peak, entirely eliminating unwanted signals and other interference.

CIRCUIT No. 29 is a schematic diagram of one of the latest resistance-coupled amplifying systems, where enormous amplification is required. This type of amplifier may be used as an output device for a radio receiver or as an amplifier in conjunction with a phonograph pick-up. It will be noticed, however, that high voltages are required for both the plate and grid potentials. A noteworthy feature of this circuit is the absence of coupling condensers, their place being taken by resistors.

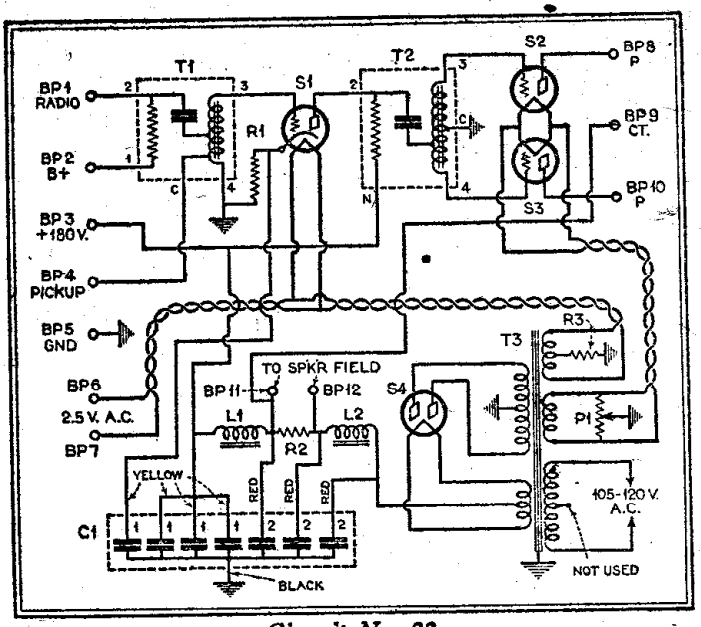
CIRCUIT No. 30 is that of a resistance-coupled amplifier employing as the amplifying tube the battery-operated screen-grid type tube. Due to the very high amplification constant of the screen-grid tube, a large amount of output volume is obtained from this system. This type of amplifier will work extremely well in conjunction with photoelectric cells for either television or talking movies. The frequency curve is reasonably flat.

CIRCUIT No. 31 is a schematic diagram of a B and C supply for the push-pull audio output stage shown and the B potentials for a radio receiver. Full-wave rectification is accomplished here by the use of a gaseous rectifier tube. The filter portion of this circuit consists of two audio frequency choke coils of the con-



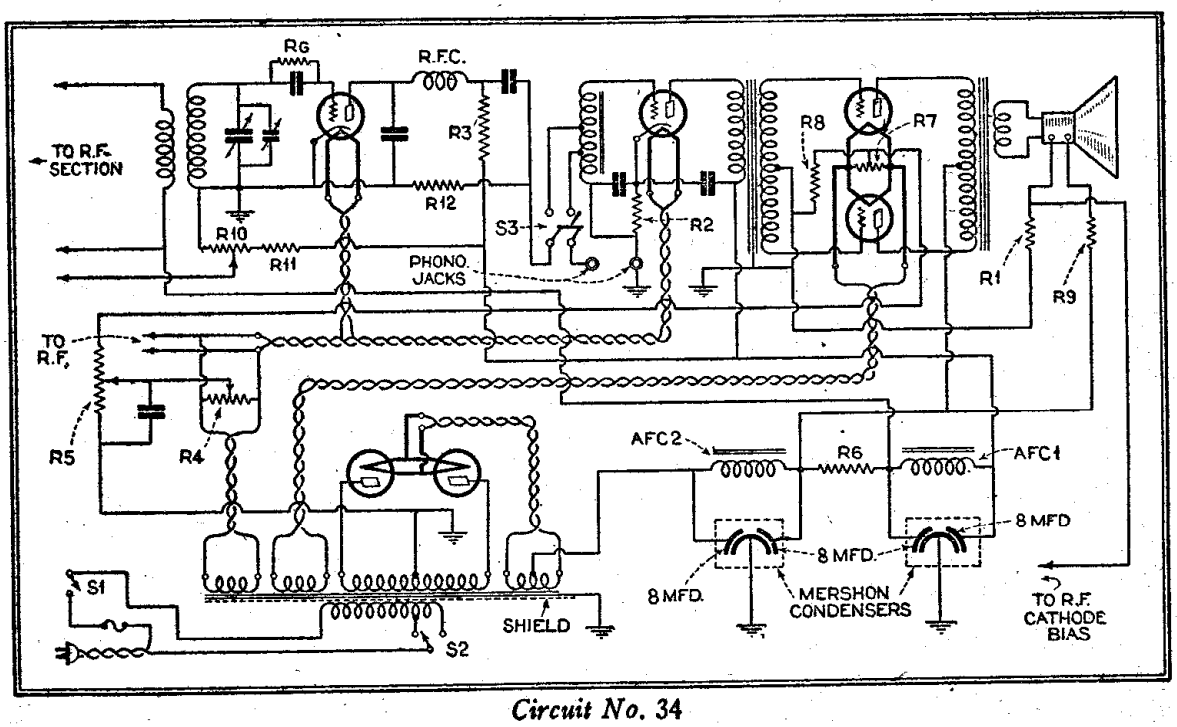
Circuit No. 32

ventional 30 henry type with a Mershon electrolytic condenser. Intermediate B potentials are obtained by the use of a voltage divider between the B plus and B minus terminals, each intermediate tap of course being by-passed by a 1 mfd. filter condenser. The push-pull stage makes use of the standard circuit for its grid and plate connections. The filaments of the tubes, however, are heated by an additional low voltage secondary of the power transformer. This secondary is center-tapped so that in conjunction with resistor R2 (its resistance depended on the type of tube used) and the by-pass condenser C7, provide an automatic C bias.

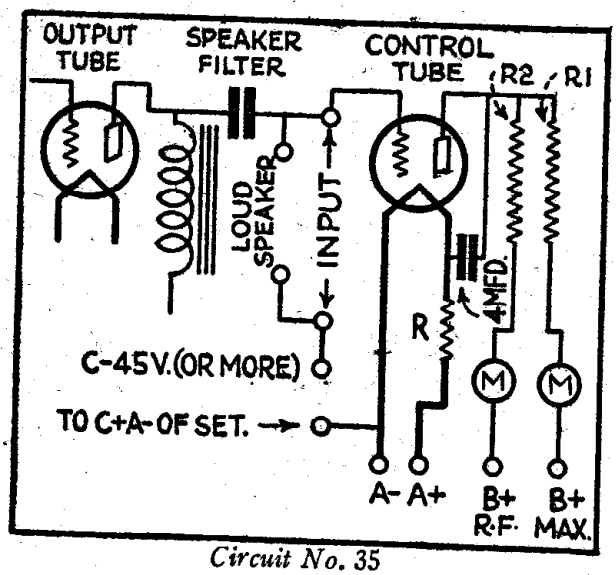


Circuit No. 33

CIRCUIT No. 32 is a schematic diagram of a power amplifier power supply device employing two -45 tubes in a push-pull circuit, as well as a -27 tube as the first audio amplifier and from which the supply for the plate voltage for the radio frequency, detector sections of the radio receiver may be obtained. The power supply makes use of a power transformer, T1 supplying approximately 350 volts to the full-wave rectifier tube, -80. The output of the rectifier is filtered by the usual condenser bank and filter chokes. The speaker is protected from the direct current by the output transformer, T4. R4 is a fixed resistor of 800 ohms shunted by a 1 mfd. condenser of the filter variety and provides the C bias for the grid of the power tubes. The resistor, R1, dropping the high voltage to the intermediate taps, 180 volts, 135 volts, 90 volts and 45 volts, should have a total resistance of 30,000 ohms and capable of passing 125 milliamperes. This wire-wound resistor may for ease of operation have sliding contacts for the above-mentioned intermediate voltages. Each of these intermediate taps, of course,



Circuit No. 34

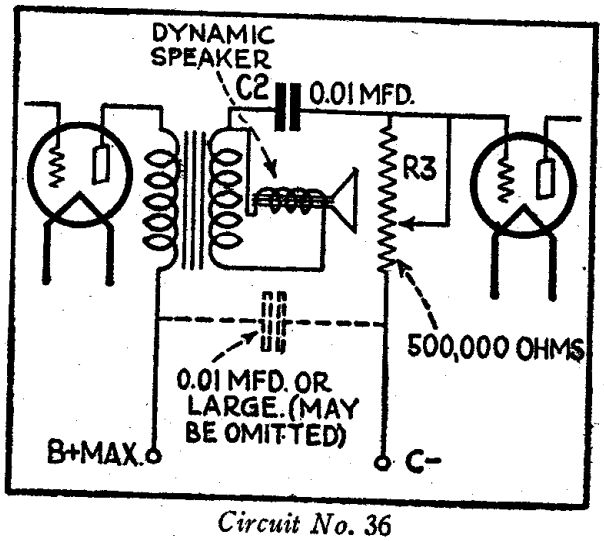


Circuit No. 35

being by-passed by 1 mfd. condensers, C2. Provision has been made in this amplifier for connection to a phonograph pickup for electrically playing phonograph records.

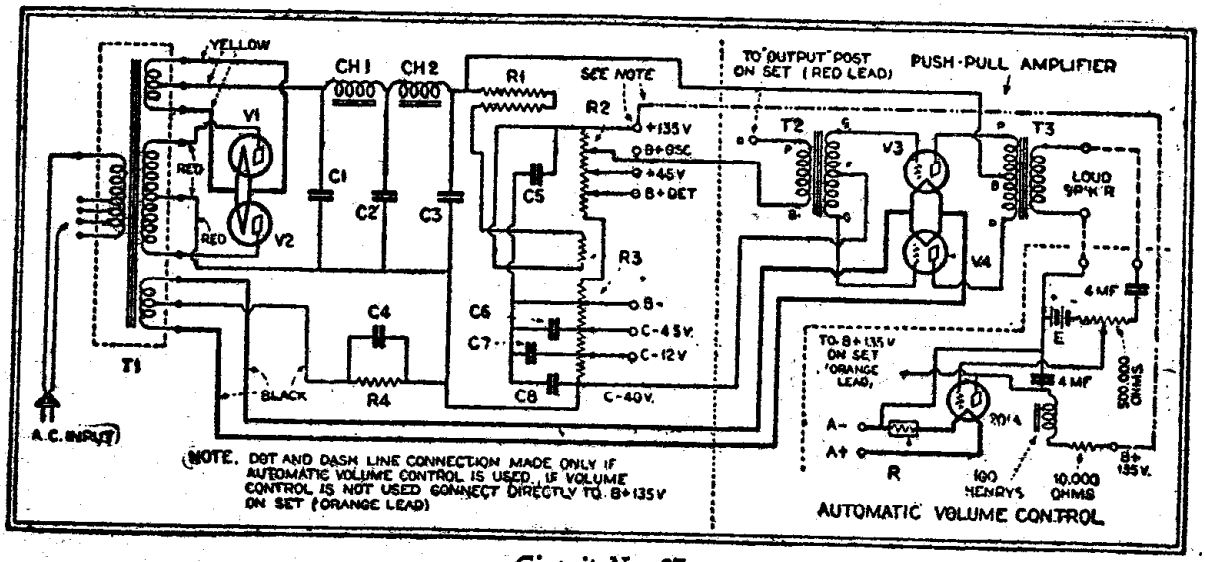
CIRCUIT No. 33 is a schematic diagram of a two step audio frequency amplifier and power supply somewhat similar to that in circuit No. 32. Here, however, the audio transformer is replaced by impedance coupling in both the first and second stages. It should be also noted that provision has been made for the energizing of a dynamic speaker field coil from the filter circuit of the power supply. The resistances, R1 and P1, will of course be depended on the type of tubes used. An amplifier of this type is satisfactory for connection to a radio receiver or the playing of phonograph records through the medium of a phonograph pickup.

CIRCUIT No. 34 is that of the detector unit of a radio receiver coupled to a straight stage of audio frequency amplification of impedance followed by a one step push-pull transformer coupled amplifier. Provision has been made in this circuit for the A, B and C potentials for a radio frequency tuning section to be incorporated, its energy, of course, being fed into the detector stage. The power supply in this circuit is rectified by two half-wave rectifier tubes -81 and filtered through the medium of the audio frequency chokes, AFC1 and AFC2, as well as two dual Mershon condensers having a

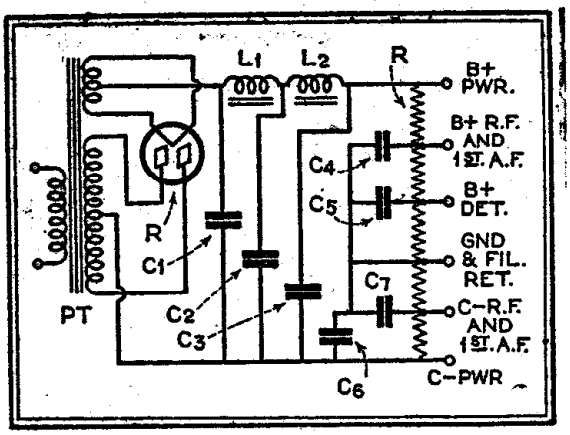


Circuit No. 36

capacity of 8 mfd. Field excitation of the field coil of the dynamic speaker is pro-



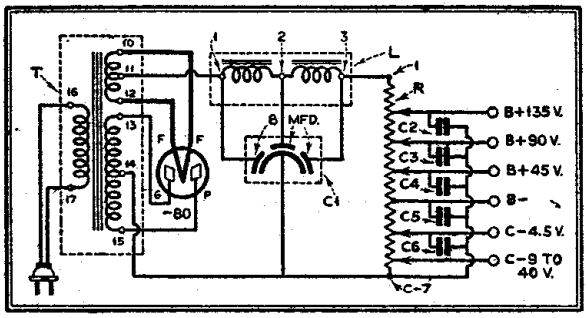
Circuit No. 37



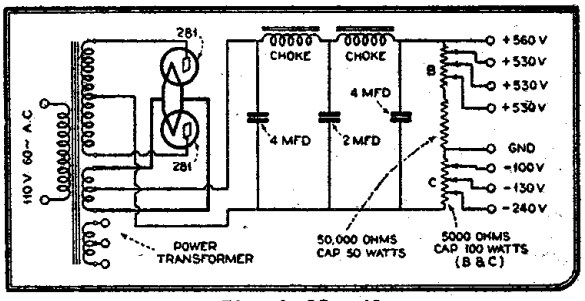
Circuit No. 38

vided for by the B power of the power supply through the resistors R1 and R9. The primary of the power transformer is so designed that line voltage variations may be taken care of by the switch, S2.

CIRCUIT No. 38 is a schematic diagram of one of the simplest of the B battery eliminator circuits. Here the -80 tube full-wave rectifier tube serves as the rectifying unit, being followed by the conventional audio choke coils, L1 and L2, and the filter condensers, C1, C2 and C3, to complete the filtering action required for smooth



Circuit No. 39

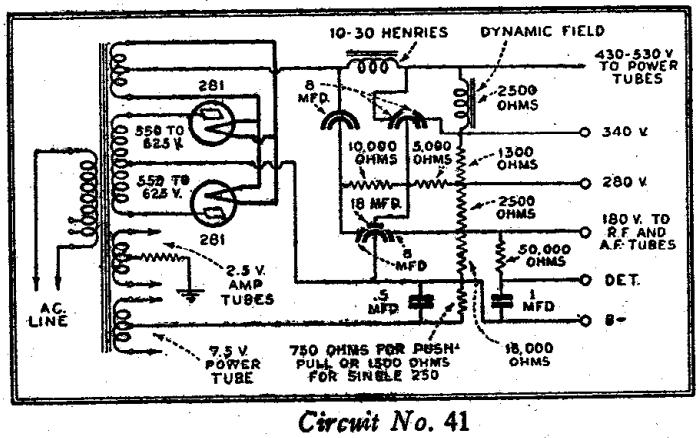


Circuit No. 40

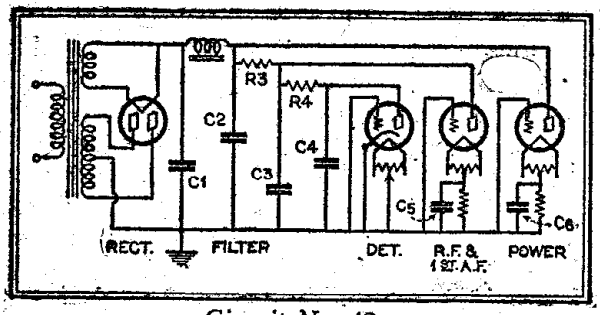
CIRCUIT No. 35 and 36. In these two circuits are shown methods of automatic volume control. Here the control tube is in both cases the -01A type. After the desired volume is controlled manually, the volume control tube will automatically hold the signal to this level over wide variations of swinging and fading. The resistors, R, in these two circuits will of course be depended on the type of radio receiver in which they are to operate.

CIRCUIT No. 37 is interesting not only because it gives a complete schematic circuit of the power supply and amplifier for the RE-29, (See circuit No. 17), but also incorporates the automatic volume control which was worked out by the designer, Mr. R. E. Lacault, shortly before his death. The constants for the latter are given as they are of special interest to experimenters. It will be noted here that rectification is by two -81 half-wave rectifiers and the filter consists of the conventional audio choke, CH1 and CH2 and the filter condensers, C1, C2, C3.

d.c. plate potentials. A voltage divider resistance, R, (sometimes known as a bleeder) is directly connected across the negative and positive terminals of the rectifier and filter system. In this particular circuit provision has been made for obtaining two sets of grid biases, commonly known as C minus potentials, as well as intermediate B battery voltages for correct operation of the radio frequency, detector and audio portions of the radio receiver. Each of these intermediate taps is by-passed by at least a 1 mfd. filter condenser, having a safety factor well in excess of the voltage applied across it.



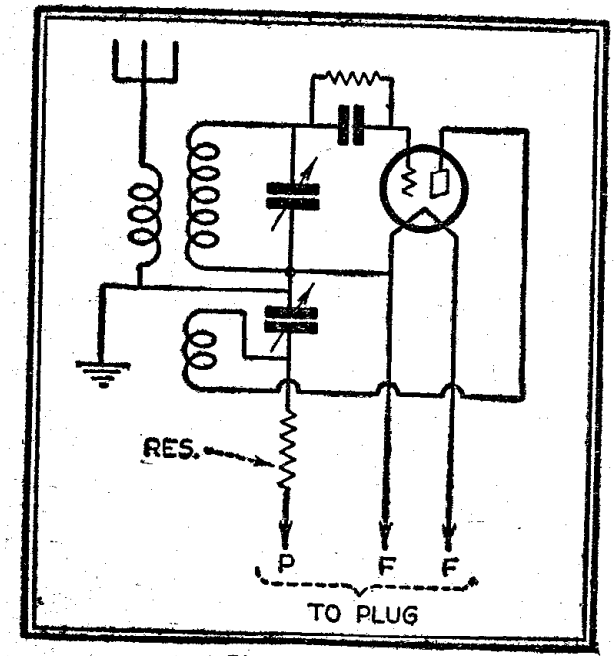
Circuit No. 41



Circuit No. 42

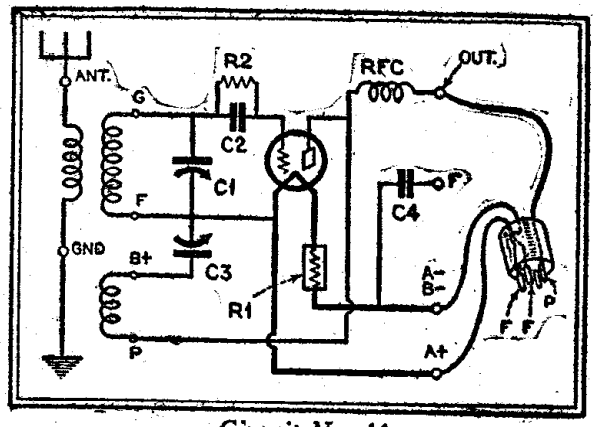
CIRCUIT No. 39 is a schematic diagram of a B power unit similar to that shown in circuit No. 38 except that here the compact electrolytic condenser has replaced the filter condensers across the audio choke coils. The power transformer, T, consists of a primary whose terminals 16 and 17, connect directly to the house lighting circuit. A low voltage secondary provides the 5 volts necessary for the heating of the filament of the -80 full-wave rectifying tube, while a high voltage secondary whose terminals 13 and 15 are directly connected to the two plates of the rectifier tube and the center tap 14, is the minus terminal of the entire system.

CIRCUIT No. 40 is that of a high voltage B power supply where the secondary having 750 volts per section, is fed to the plates of a pair of -81 tubes, followed by the conventional choke coils and filtered with the aid of a 4 mfd. and 2 mfd. and a 4 mfd. filter condenser. Provision has also been made in this power supply for obtaining high voltage grid biases. A power supply of this type is ideally suited for a high quality high power resistance coupling audio amplifier, such as illustrated in circuit diagram 29.



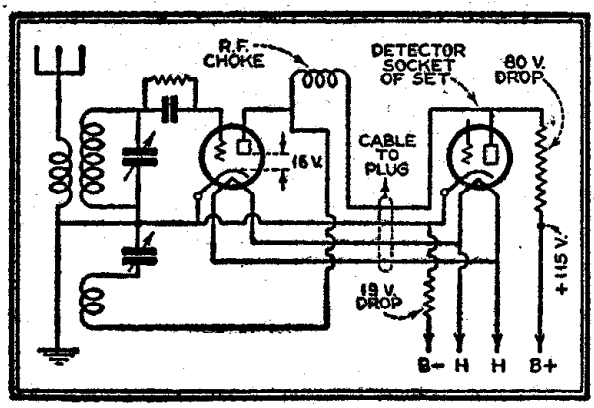
Circuit No. 43

CIRCUIT No. 41 is also a schematic diagram of a power supply using the -81 tubes in full-wave rectification, but unlike the circuit shown in No. 40, the filter condensers here are the high capacity electrolytic type. It will also be noted in this circuit diagram that allowance has been made for the energizing of the dynamic speaker field coil as well as an automatic C bias for either a single or push-pull -50 tubes in the output audio stage. An additional secondary of low voltage is part of the assembly of the power transformer and may be used for both a.c. screen-grid tubes and -27 tubes in the radio frequency amplifier, detector and audio stages of the radio receiver.



Circuit No. 44

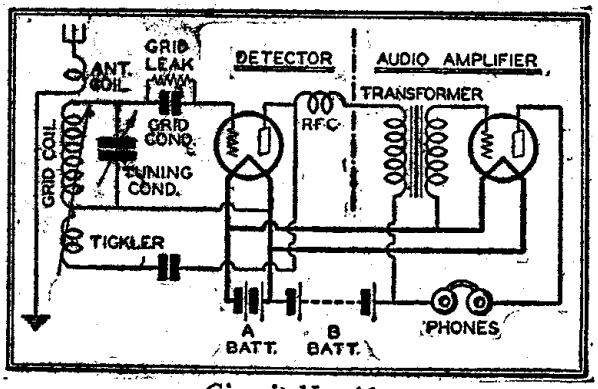
CIRCUIT No. 42 is a schematic diagram of how the B potentials and C battery biases are obtained from a B supply unit. The resistances R3 and R4, reduce the high B potential proportionately for operation on the plates of the tubes in the various sections of the radio receiver. The tube represented here as the detector tube, is provided with a center-tapped resistor across its filament terminals, the center-tap and the cathode being connected to B minus and ground, while the first and second audio tubes, both having center-tapped resistors across their filament terminals, require the proper value resistance



Circuit No. 45

in series with the center tap at ground. In all cases, these resistors should be shunted by by-pass condensers, as shown by the symbol C5 and C6.

CIRCUIT No. 43 is a schematic diagram of a short-wave adapter unit for use with the battery-operated radio receiver of the broadcast variety. Usually the diameter of the inductance coils for such a unit are smaller in diameter than those of the broadcast receiver and have many less turns as well as a smaller capacity variable condenser for the tuning. The grid leak and condenser in this circuit are of the conventional values while the resistance, RES, in series with the plate lead must necessarily be found by experiment.

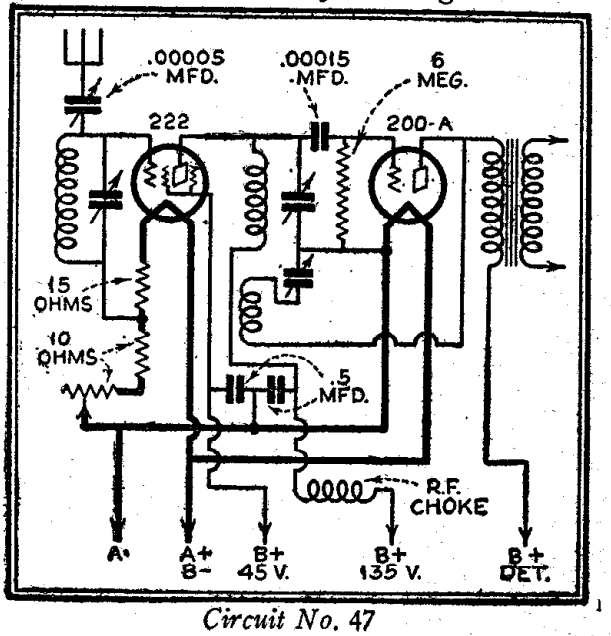


Circuit No. 46

CIRCUIT No. 44 is also a circuit diagram of a short wave adapter for battery-operated receivers. Here, however, a radio frequency choke coil has been included in the plate circuit and the actual connections to an adapter plug are shown. Usually, in short wave adapters, plug-in coils are used permitting the tuning over the entire short-wave spectrum.

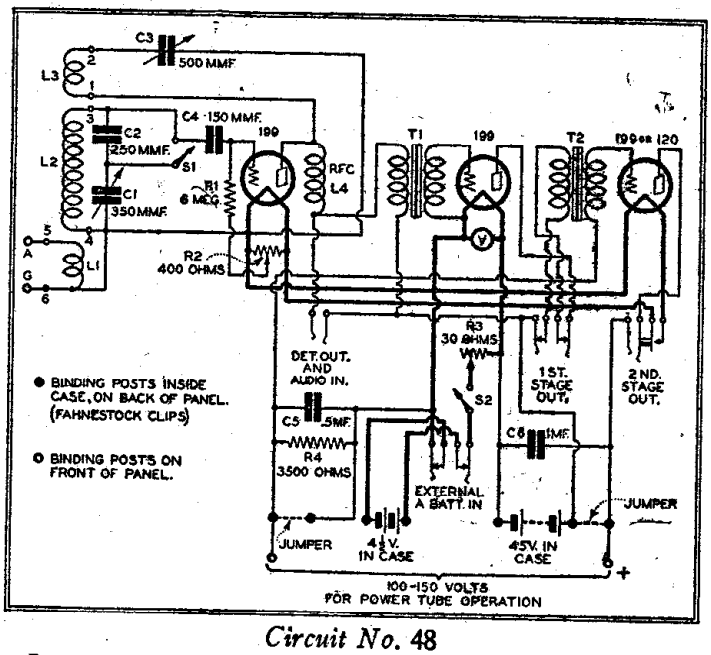
CIRCUIT No. 45 is the schematic diagram of a short-wave adapter for use on an a.c. operated receiver. Here the tuning unit is very similar to that shown in circuit No. 43 with the exception that the tube is of the indirect heater type -27. Particular attention is called to the fact that such a circuit as this will not provide satisfactory operation when the detector tube of an a.c. operated broadcast receiver is followed by a stage of resistance coupling. Here although a high voltage of 115 volts is supplied to the lower side of the plate resistor, it will be found that approximately a drop of 80 volts takes place in this resistor, and with an extra drop of approximately 19 volts between the cathode and B minus through the biasing resistor, the voltage between the plate of the detector and the cathode of the same tube in the neighborhood of 16 volts is not sufficient for correct operation. It necessarily follows therefore that for satisfactory operation, the first stage of audio frequency amplification must be transformer coupled.

CIRCUIT No. 46 is a schematic diagram of one of the simplest yet most efficient short-wave receivers consisting of regenerative detector and one stage transformer-coupled audio amplifier. The inductance coils in this circuit are of the plug-in variety, permitting quick and easy shifting from one



Circuit No. 47

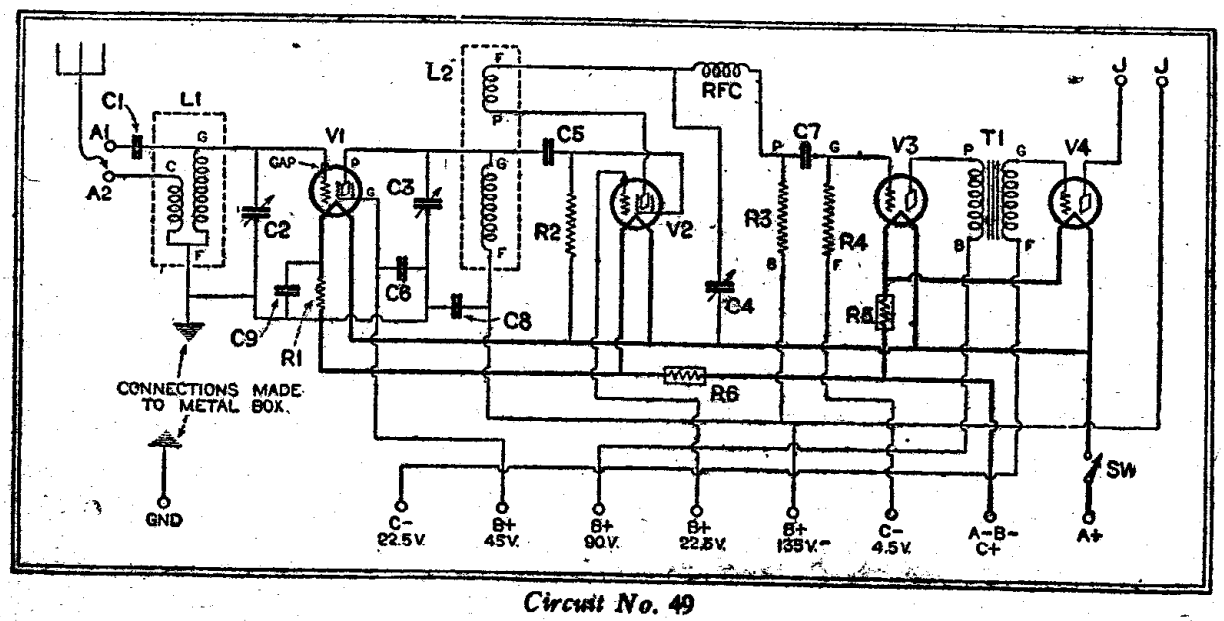
wave-band to another. A radio frequency choke coil is connected in series with the plate of the detector tube and audio frequency transformer preventing radio frequency currents in the audio frequency circuit. A blocking condenser in series with the detector plate and tickler coil eliminates the shorting of the B battery through the transformer, radio frequency choke coil, tickler and back to filament. With radio receivers employing a circuit similar to this, approximately 20,000 American and foreign amateurs have been able to hear signals half-way around the world. To this circuit, of course, may be added an additional stage of transformer-coupled audio frequency amplification.



Circuit No. 48

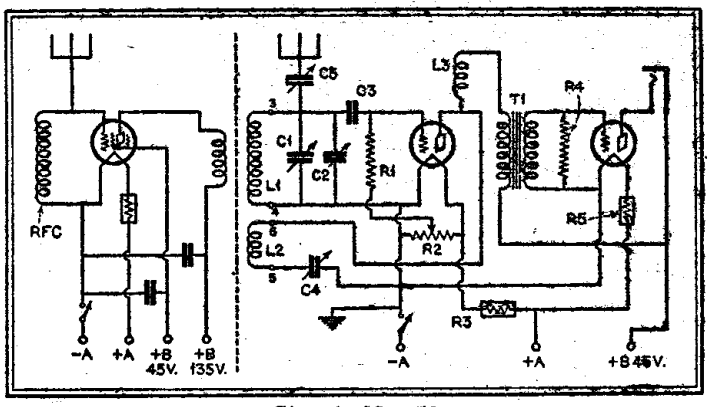
CIRCUIT No. 47 is that of a short-wave receiver making use of the battery-operated screen-grid tube as a tuned radio frequency amplifier, and a -00A super-sensitive tube as the detector. Due to the extremely high amplification constant of the screen-grid tube, a high gain is obtained with a circuit of this type. It will be noted that one inductance serves as the plate coil as well as the grid coil for the -22 and -00A tubes. Isolation of the plate potential on the -22 tubes is provided by the .00015 mfd. grid condenser, and the shunting of the grid leak between the grid of the detector tube and minus filament of the same tube. Stabilization of the r.f. stage is obtained by the use of the radio frequency choke and two .5 mfd. condensers. The correct automatic C bias for the screen-grid tube is obtained by tapping a 25 ohm resistor, 10 ohms (up) from the filament control rheostat. Regeneration on the detector tube is controlled by a variable condenser. A circuit of this type entirely removes the tendency of a large broadcast antenna effecting the regenerative qualities of the detector tube, eliminating dead spots as well as preventing re-radiation into the antenna system.

CIRCUIT No. 48 is a schematic diagram

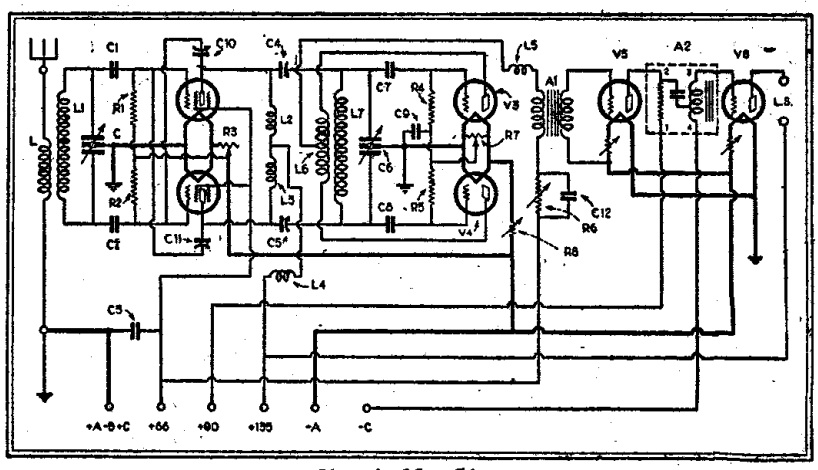


Circuit No. 49

of a short-wave receiver for the covering of short-wave bands as well as broadcast bands, by means of placing the fixed condenser C2 (250 mmfd.) in series or shorted circuit. A circuit of this type employing the small dry cell -99 tube can readily be constructed as a portable unit using extremely small B batteries for the B supply and 4½ volts C batteries as the A supply. When operated in conjunction with the short-wave transmitter shown in circuit No. 55, it is a truly portable short-wave station.



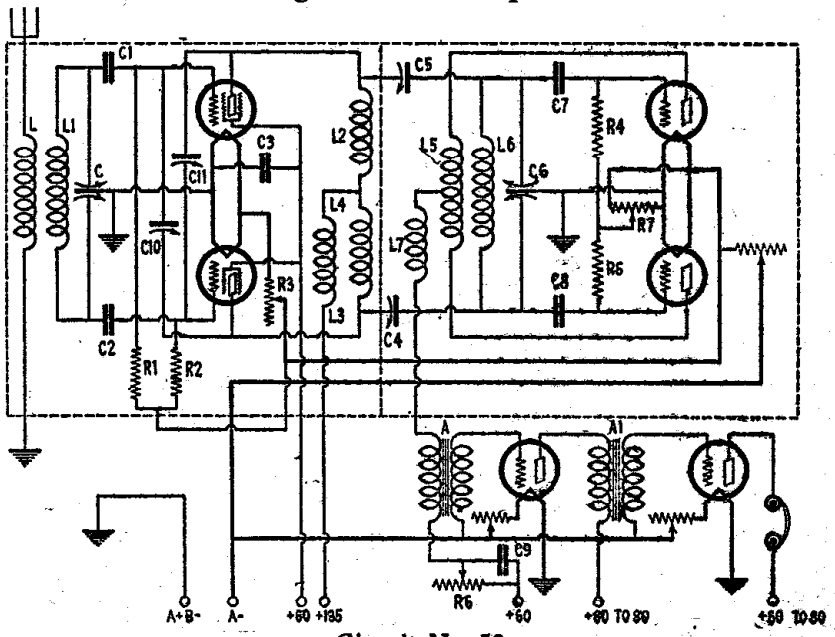
Circuit No. 50



Circuit No. 51

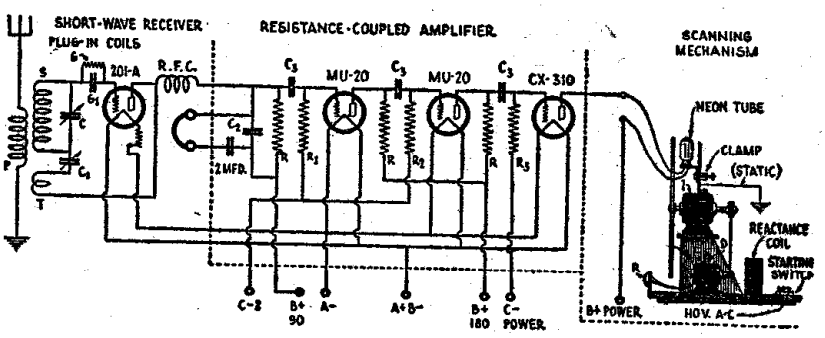
CIRCUIT No. 49 is a schematic diagram of one of the most efficient tuned radio frequency short-wave receivers ever developed. In this circuit the battery-operated screen-grid tubes are used in two distinct and separate methods. First, as a radio frequency tuned stage and second as a space charge regenerative detector. The radio frequency stage in this circuit is very similar in design to that shown in circuit No. 47. In the detector circuit, however, the screen-grid of the screen-grid tube serves as the tuning grid, and the tuning or control grid is connected directly to plus B 22½ volts, the plate, of course, having its conventional connections. A vast improvement has been noted in following such a detector by a resistance-coupling stage of audio frequency amplification, which may, of course, then be followed by a transformer coupled amplifier. Such a circuit as this, may easily be operated from dry A batteries, thus permitting its use as a portable unit.

CIRCUIT No. 50 is a schematic diagram of the well known Cornet short-wave receiver which is well known among the radio amateurs fraternity as a real distance-getter and stable unit. The original receiver consisted of a regenerative detector and one stage of audio amplification transformer-



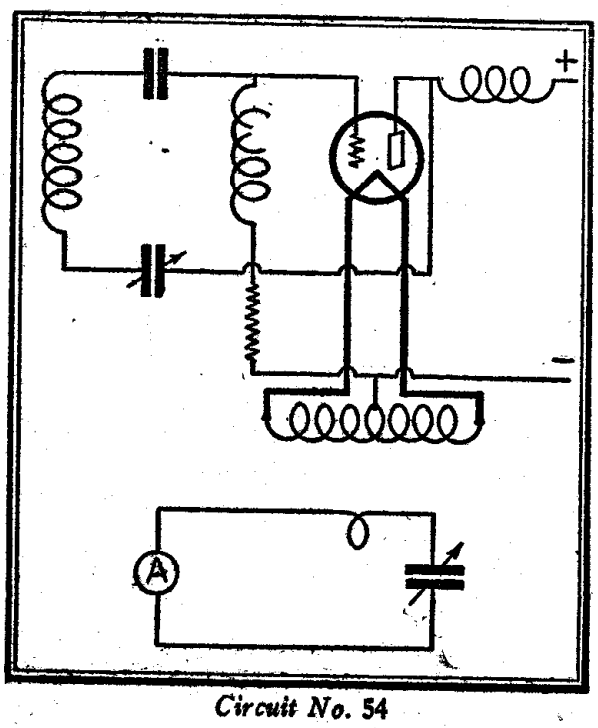
Circuit No. 52

coupled. To this, however, may be added an untuned radio frequency stage employing the screen-grid -22 tube coupled to the antenna circuit by a radio frequency choke coil. Extremely fine tuning is accomplished with this circuit by the use of a .000005 mfd. condenser, C2, shunted across the .00015 mfd. variable condenser, C1. Regeneration is effected by the condenser C4, having a capacity of .00025 mfd. The resistance, R2, is a 200 ohm potentiometer permitting the swinging of the detector grid bias from positive to negative filament. L3 is a conventional 85 millihenry radio frequency choke, while the resistance R4 is a 500,000 ohm grid leak type of resistor, eliminating tube noises.



Circuit No. 53

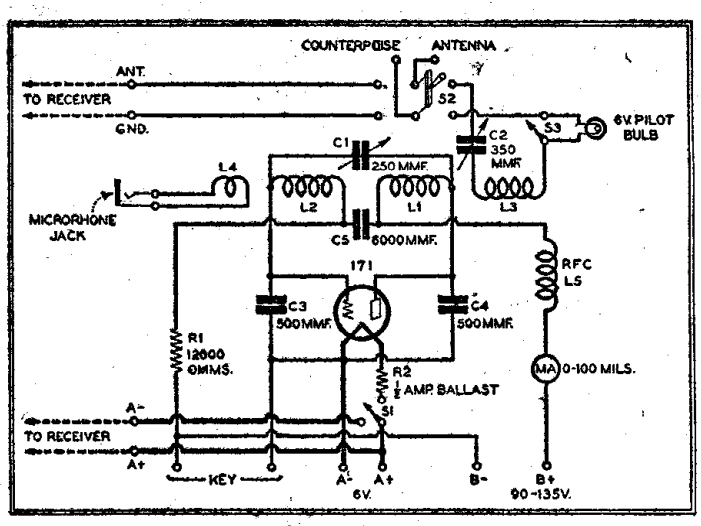
CIRCUIT No. 51 is a schematic diagram of a short-wave receiver employing push-pull radio frequency amplification as well as a stage of push-pull detector followed by a stage of transformer-coupled amplification and a stage of impedance audio amplification. One of the main advantages of the circuit of this type is the extremely stable operation in the short-wave band around 5 and 7 meters. It, of course, goes without saying that the condenser C and C6 should be as nearly a match as possible as well as the resistance, R1, R2, R4 and R5. Choke coils of 85 millihenries are employed at L2, L3, L4 and L5. A receiver of this type, although especially designed for the extremely low wave band, will provide its user with satisfactory operation in the short-wave broadcast band as well as the amateur bands.



Circuit No. 54

CIRCUIT No. 52 is also of a push-pull radio frequency stage and push-pull detector similar to circuit No. 51. In this circuit, however, the second audio amplifier stage has been replaced by a transformer. One noteworthy feature of this circuit is its operation on plate potentials up to and including 135 volts. Regeneration is controlled by the variable resistance R6 shunted by the by-pass condenser C9. Although rheostats are shown controlling the filament voltage in each section of the set, these may be replaced by the use of automatic filament ballasts.

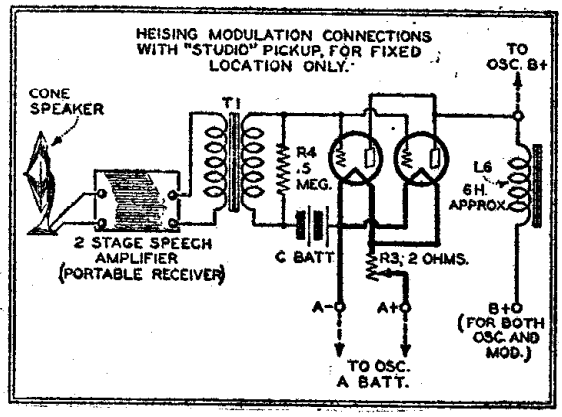
CIRCUIT No. 53 is a schematic diagram of the conventional short-wave receiver employing plug-in coils and a tickler for regeneration, followed by a resistance-coupled audio amplifier making use of the high-mu tubes in the first two stages and a -10 power tube in the output stage. Such a short-wave receiver and audio amplifier is intended to operate a television unit consisting of a scanning disc and its associated driving unit with a neon lamp as the light source. A resistance-coupled audio amplifier is ideally suited for television signals, due of course, to its extremely flat frequency curve. For satisfactory television signals, it will be necessary for the operator to know the disc speed at the transmitter as well as the number of holes on the disc.



Circuit No. 55

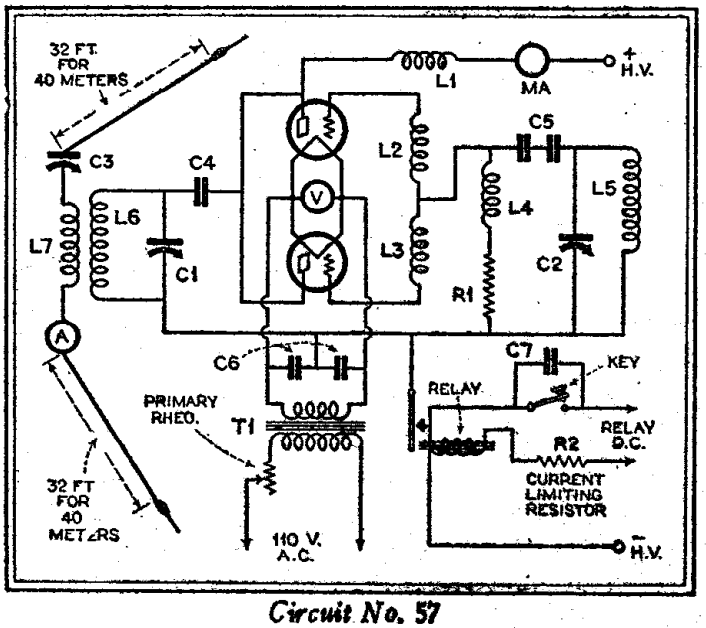
CIRCUIT No. 54 is a conventional circuit used for a short-wave transmitter. This circuit is the simplest of the transmitting circuits and is shown without its accessory units such as the plate supply unit, key or antenna circuit. The fixed condenser is used as a blocking condenser and should be of sufficiently high flash test to eliminate the danger of breakdown as should also be the variable condenser. Two radio frequency choke coils are necessary, one in the B plus lead to the plate of the tube, the other in series with the grid and the resistor which is also connected to the center-tap of the filament transformer and B minus. Included in this circuit diagram is that of a simple wavemeter having inductance coil and a variable condenser to tune the wave-length of the transmitter.

CIRCUIT No. 55 is a schematic diagram of a short-wave transmitter making use of the -71 tube as an oscillator. The plate and grid coils, L1 and L2 respectively, are sized according to the wavelength to be transmitted and are tuned to resonance by the condenser C1, having a capacity of .00025 mfd. L3 comprises the primary coil for the antenna and counterpoise systems. The antenna is tuned to resonance by a .00035 mfd. condenser, C2. This transmitter is intended for operation either as a code transmitter or for phone work. Loop modulation is made use of when phone work while the B negative supply is broken when used with a key. The circuit is intended for use as a companion unit to the short-wave receiver, circuit No. 48, and is ideally suited for motor car, motor boat or aeroplane use.



Circuit No. 56

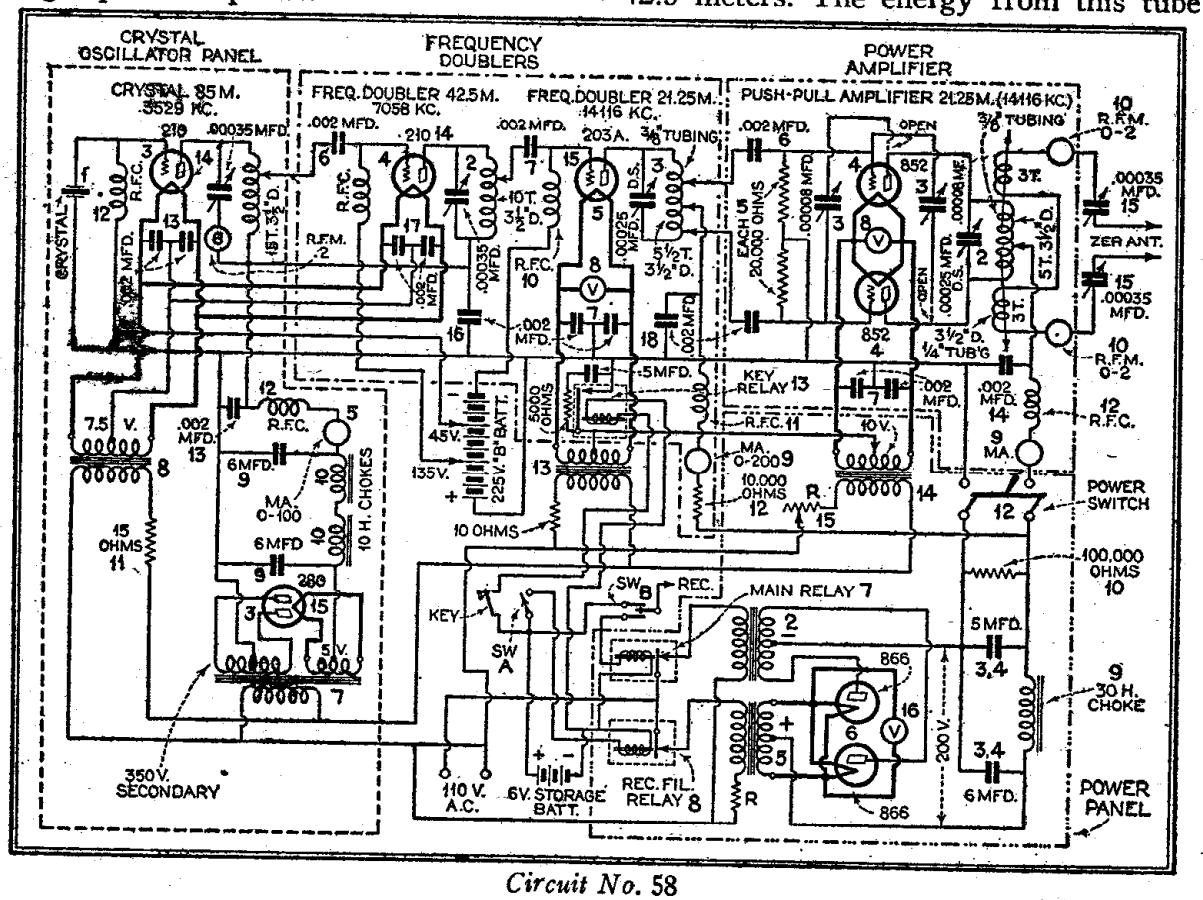
CIRCUIT No. 56 is a schematic diagram of a home constructed Heising modulation system for use on the short-wave transmitter for phone work. Here the cone speaker is used as a microphone, the energy being stepped up by a two-stage speech amplifier followed by coupling transformer, T1, and a pair of tubes, their grids



Circuit No. 57

and plates being parallel respectively. An audio frequency choke, approximately 6 henries, is inserted in the B supply to the plates of the modulator tubes as well as the oscillator tube in the transmitter. Such a modulation system is suited for studio work more than portable work, due of course to the additional weight of the improvised microphone and the amplifier modulator equipment. It is well worth noting that a resistance, R4, of .5 megohms is shunted across the secondary of the coupling transformer, T1, flattening out the frequency response curve as well as reducing tube noises from the two stage speech amplifier.

CIRCUIT No. 58 is that of a high power high quality crystal control short-wave transmitter. In this circuit, the crystal ground to a predetermined frequency of 85 meters is shown in the upper left. The crystal is used to stabilize the oscillator tube (-10) keeping it on its frequency. The energy from the oscillator tube is fed to a second -10 tube, known as a frequency doubler which reduces the wavelength to 42.5 meters. The energy from this tube

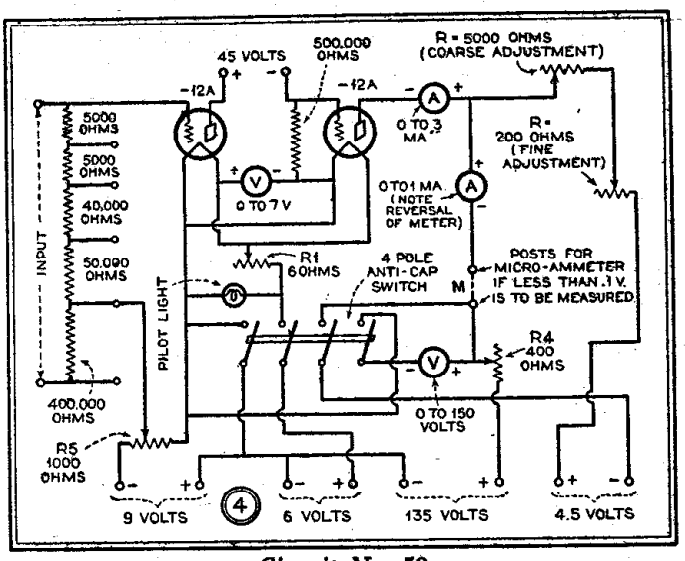


Circuit No. 58

CIRCUIT No. 57 is a schematic diagram of a short-wave transmitter for use on 40 meters employing two oscillator tubes in a parallel circuit. For this wave-length both the counterpoise and antenna should be approximately 32 feet in length the antenna being tuned to resonance by the variable condenser C3. The generous use of radio frequency choke coils, L1, L2, L3, L4, stabilize the transmitter eliminating almost entirely the tendency to swing from its wavelength. The circuit of this type may very easily be remotely controlled by making use of the relay in the minus B lead as shown. A circuit of this type is known as the tuned plate tuned grid.

being fed to a 50 watt tube -03A which is also a frequency doubler meaning the signal is now at 21.25 meters, which is impressed on the grids of a push-pull amplifier employing 75 watt tubes (852). The inductance in the plate circuit of the power amplifier, is inductively connected to a pair of inductances which feed directly to a zeppelin antenna, both sides of the antenna being tuned with .00035 mfd. condensers. A transmitter of this type is primarily intended for code work but may easily be used for phone work

by including a modulation system. In the circuit diagram No. 58 is also shown the power supply for this high power transmitter, along with the constants of each of the components which go to make up the completed unit.



Circuit No. 59

CIRCUIT No. 59 and 60 are the circuit diagrams and charts for a vacuum tube voltmeter. A unit of this type is of special interest and value to the advanced serviceman and laboratory. With the vacuum tube voltmeter it is possible for the user to read directly the overall gain of a radio receiver on any wavelength, as well as the tube amplification constant along with its associated audio amplifier over the audio frequency band. It is with vacuum tube voltmeters of a similar design as shown in circuit diagram No. 59, that the radio engineer finally passes and approves of a radio circuit.

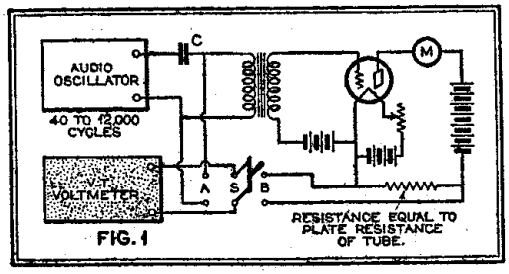


FIG. 1

FREQUENCY	INPUT VOLTS	OUTPUT VOLTS
25	2.0	40.5
50	2.0	53.1
65	2.0	56.2
100	2.0	59.1
150	2.0	61.7
300	2.0	62.9
ETC.	ETC.	ETC.

FIG. 2

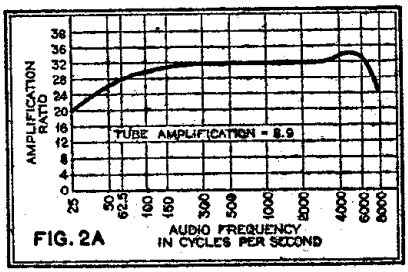
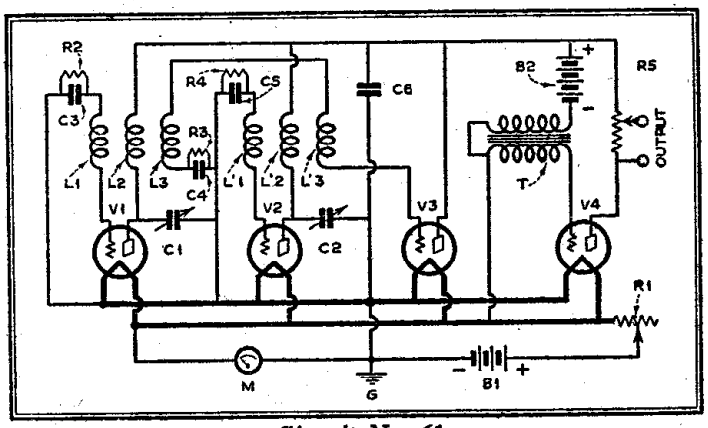


FIG. 2A

Circuit No. 60

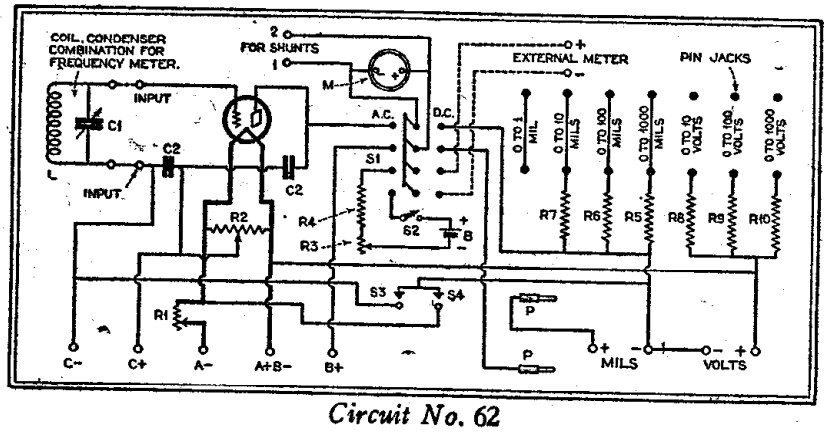
CIRCUIT No. 61 is a schematic diagram of an audio frequency oscillator. By means of the inductances and tuning condensers C1 and C2 in this circuit, audio frequencies over wide ranges can be obtained for use in testing audio transformers, loud speakers, etc. A unit of this type may be constructed as a portable unit, thus doubling its uses to the serviceman and the serious-minded experimenter. The oscillator circuit employs four tubes. Complete details of the parts are given as follows: The resistance R1 is a 1.5 ohm rheostat while the grid leak R2 is 5 megohms; R3 2 megohms and R4, 250,000 ohms. The potentiometer, R5, has a total of 12,000 ohms; M, a d.c. voltmeter has a maximum scale reading of 8 volts; the battery, B1, for lighting the filaments of four tubes is 6 volts, while the B battery, B2, is 135 volts. Iron core inductance, T, is an audio transformer or double impedance coupler, while the air-core inductances L1, L1, 500 turn honeycomb coils; L2, L2, 1500 turn honeycomb coils; L3, L3, 200 turn honeycomb coils; and C1, C2, three-plate variable condensers, C3, C4, C5 are .00025 mfd. and a by-pass condenser



Circuit No. 61

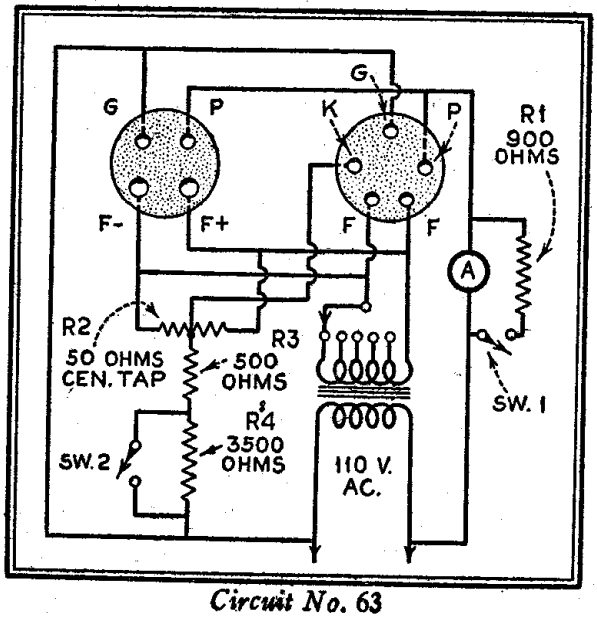
of 1 mfd. for C6. Four tubes of the -01A type are used in positions V1, V2, V3 and V4.

CIRCUIT No. 62 is a schematic diagram of a universal test unit which may be used as a frequency meter using the dip method by a combination of a coil and condenser. A vacuum tube voltmeter by the placing of an audio transformer across the input terminals and a multi-range volt and milliammeter in combination with the resistance R5, R6, R7, R8, R9 and R10 as well as employing shunts across the terminals 1 and 2.



Circuit No. 62

CIRCUIT No. 63 is that of a tube tester eliminating the need of batteries by the use of a multi-tapped transformer. In the circuit diagram No. 63 the terminals on the tube sockets are connected in parallel and, by means of a tapped switch, voltage of 1½, 2½, 3½ and 7½ may be obtained. The milliammeter, A, has a full scale deflection of 10 mils and is shunted by the resistance, R1, of 900 ohms tripling the scale reading. R2, a 50 ohm center-tapped resistor, is connected across the filaments, the center-tap going to two resistors, one being 500 ohms, R3, and the other a 35 ohm, R4. These resistors provide an automatic C bias. Shorting the resistor, R4, by means of the switch SW2 changes the C bias from 4 volts to 1½ volts. Screen-grid adapters can be made up easily by using old -27 and -01A tube bases.



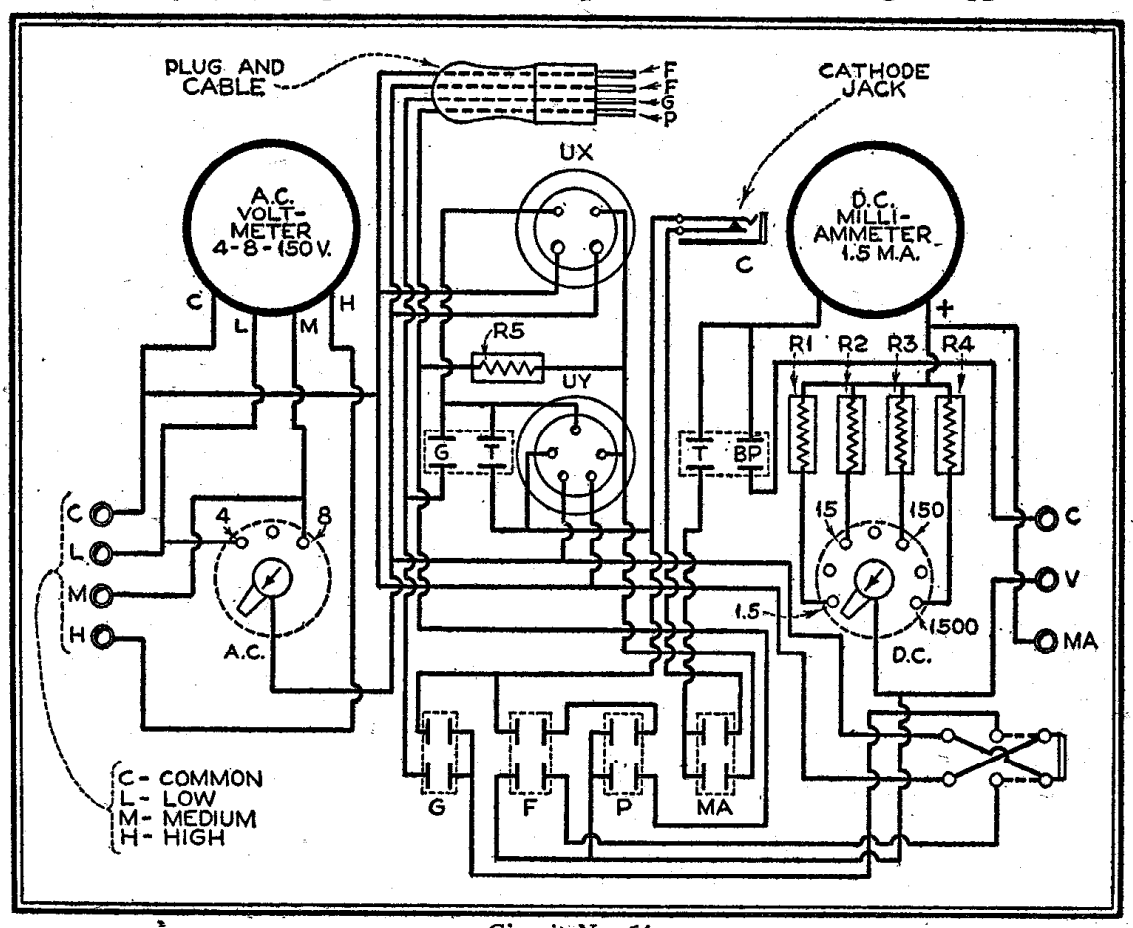
Circuit No. 63

CIRCUIT No. 64 is a schematic diagram of a radio set and tube tester, small enough to be placed in a portable typewriter carrying case. By means of the plug and cable, tubes may be tested while the radio receiver is in operation. The rotary switches in both the a.c. voltmeter and d.c. milliammeter provides readings of from 1½ mils. to 1500 mils. as well as 4 to 100 volts d.c. and the standard ranges of power supply potentials now being used on B eliminators and radio receivers. Provision has been made for testing both UX and the UY type of tubes.

CIRCUIT No. 65 is that of a test panel for the radio serviceman's shop or radio laboratory where a unit of high precision readings is required. The power supply for this tester is incorporated in the circuit, eliminating the necessity of an external low voltage transformer or storage A battery. By means of pin jacks and switches, voltages from 0 to 1000 volts may be read on a 1000 ohm per volt meter, as also may the plate readings up to and including 100 milliamperes. A test may also be made with this unit on the new a.c. screen-grid tube as well as the older models of tubes.

CIRCUIT No. 66 is a schematic diagram of the new Loftin-White direct coupling amplifying system. Economy is the outstanding feature of the Loftin-White

system as exemplified in circuit diagram No. 66. The constants for the amplifier are as follows: R1a, 425 ohms; P, 200 ohms; R1c, 775 ohms; R1d, 4700 ohms; Rc, 500,000 ohms; R3, 50,000 ohms; R5, 25,000 ohms; R6, 100,000 ohms; Cf, C2, C3, 1 mfd.; L, 20 henries; PU, phonograph pickup and VC the pickup's volume control. The input of VT1 is shown to include a phonograph pickup PU, connected

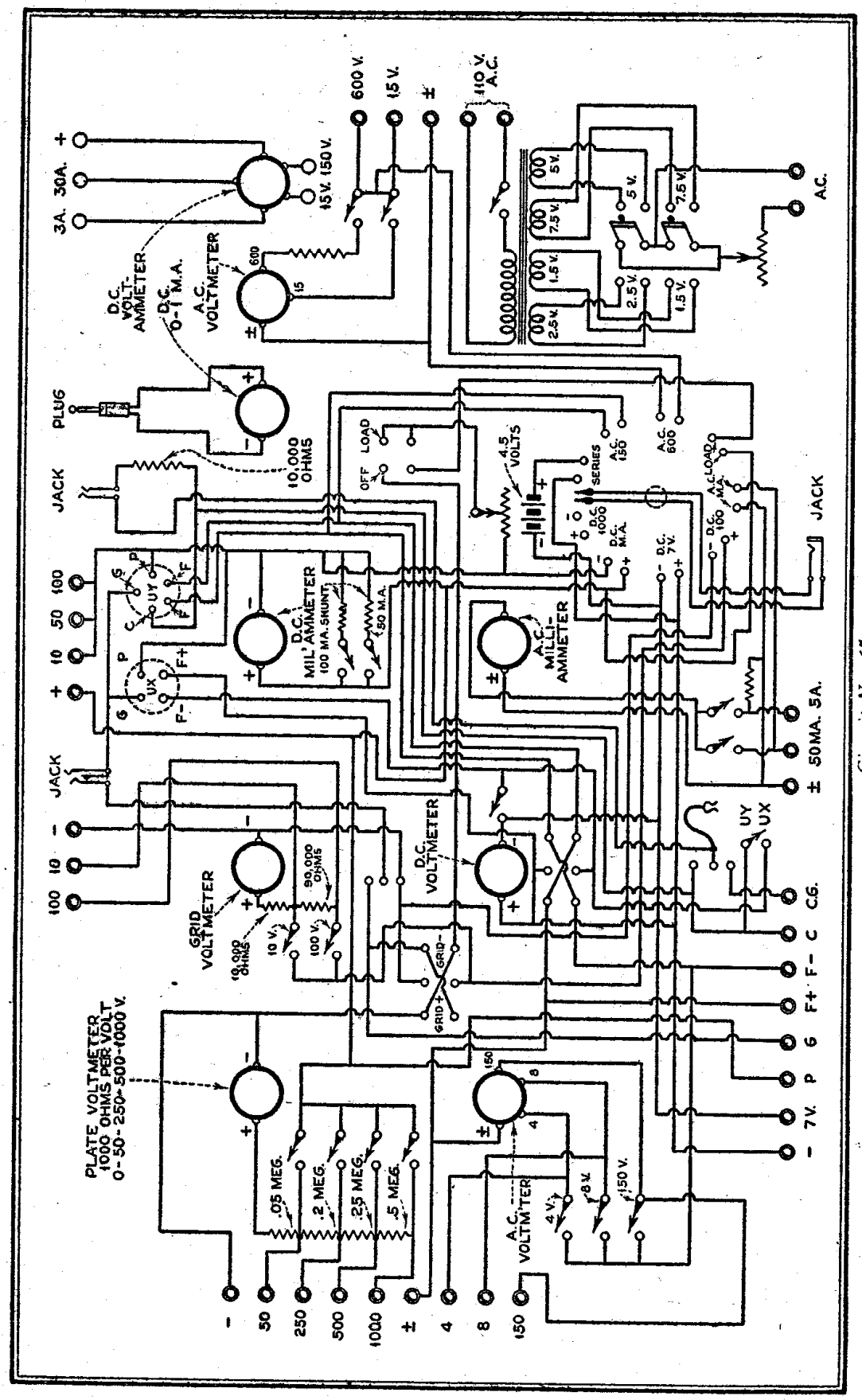


Circuit No. 64

through a conventional resistance volume control VC. Connections should be made directly in the input circuit as shown, a step-up transformer being both unnecessary and undesirable. The pickup may be substituted by a conventional tunable circuit for radio work.

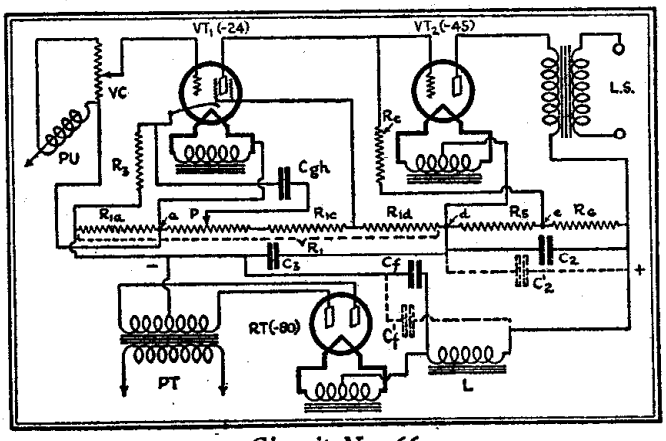
CIRCUIT No. 67 is that of the Loftin-White directly coupled amplifier employing the a.c. screen-grid -24 tube and the super-power tube -50. The constants which follow are slightly different to those given in circuit No. 66. VT1, -24; VT2, -50; R1, 5,000 ohms; R3, 25,000 ohms; R5, 100,000 ohms; R6, 300,000 ohms; Rc, 250,000 ohms; P, 400 ohms; Chb, .1 mfd.; C1 and C2, 1 mfd. In a.c. operation of directly-coupled cascaded tube systems, the characteristics depend upon or are influenced by the following features. First, maintaining the operation of all tubes at the midpoint of their operating or output current curves. Second, feedback phenomena at audio frequencies, hum problem, motorboating, trigger action, maximum gain of tube, providing current for auxiliaries such as speaker field, and last, increase to very high gain such as that required for photoelectric cell operation.

CIRCUIT No. 68 is a diagram showing the changes which were made in a standard radio receiver in order to incorporate the Loftin-White direct-coupled amplifier system. In referring to the circuit diagram No. 68, it will be noticed there is nothing unusual in the details of the three stages of tuned single dial control screen-grid radio-frequency amplification. The shaded base W, grounded at G, indicates the metallic chassis to which the various



Circuit No. 65

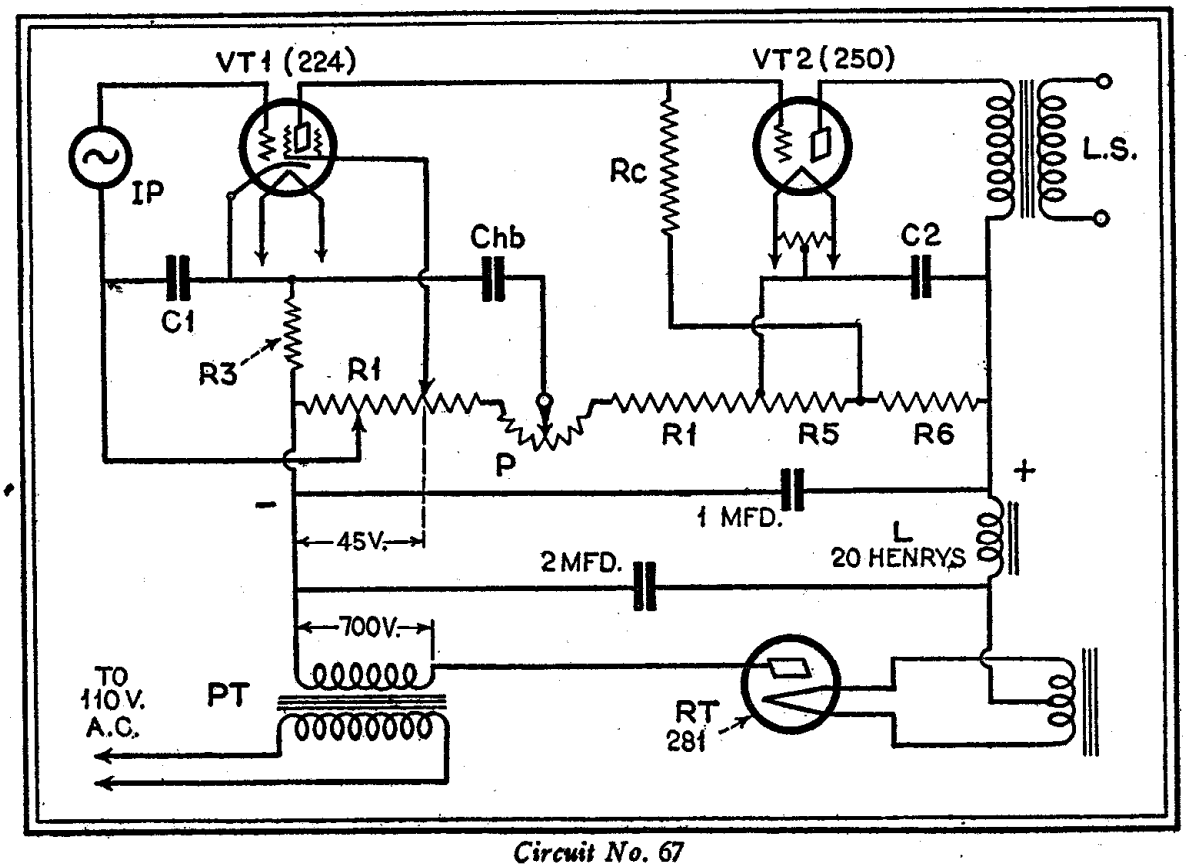
common ground connections are soldered. The antenna terminals, 1 and 2, provide for long and short antenna connections, the terminal 1 being arranged to bring the antenna condenser Ca in series with the antenna as the usual provision for a long antenna. The original commercial set here shown included before conversion a -27 power detector resistance-coupled to a -27 first audio stage in turn coupled to a push-pull -45 output stage, and an elaborate filter and power unit. We used the -27 detector socket for our input tube VT1, thus leaving a one -45 output tube to take the place of all that had to do with the resistance coupled first audio stage and transformer coupled two -45 output tubes.



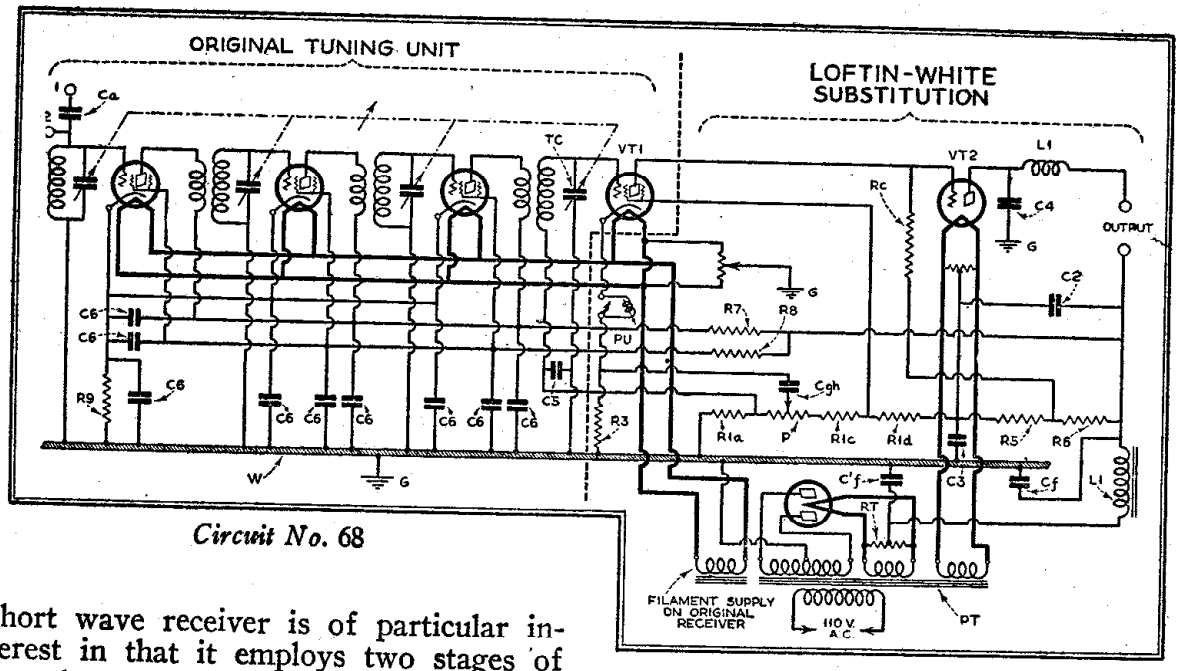
Circuit No. 66

CIRCUIT No. 69 is a schematic diagram of another method of adding one stage of radio frequency amplification to the Loftin-White direct-coupled amplifier. Any good radio frequency choke L1 and a condenser C4 of .0005 mfd. connected as shown in the output of VT2, are additions which are sometimes essential, but under favorable conditions will not be required. Here, V represents one or more tubes of a radio frequency system having one or more tunable circuits TC1. The plate circuits of the radio frequency tubes are energized from the filter through a potential reducing resistance, R7, of sufficient value to provide the required current for all of the tubes.

CIRCUIT No. 70 is that of the National screen-grid short-wave receiver which embodies two stages of audio frequency amplification. The audio amplifier in this



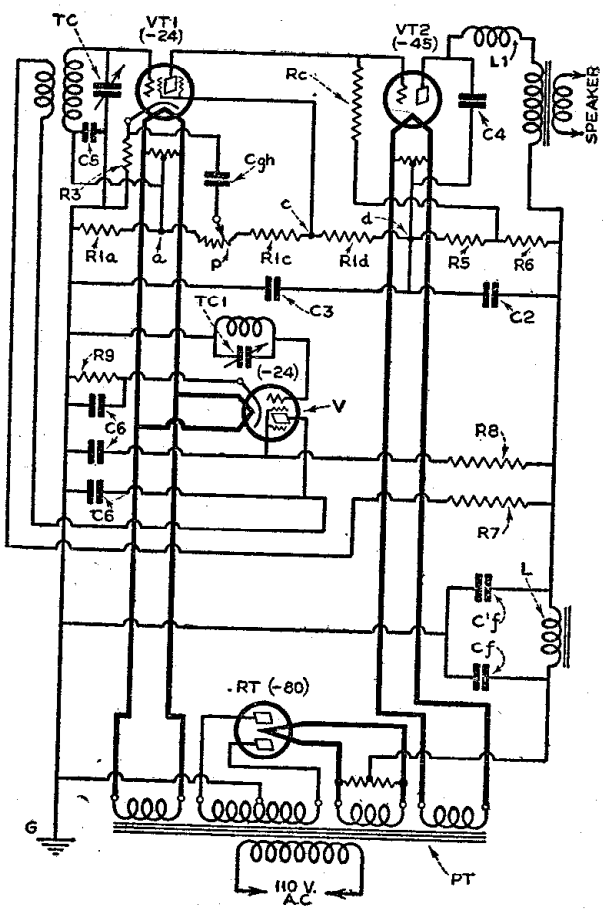
Circuit No. 67



Circuit No. 68

short wave receiver is of particular interest in that it employs two stages of impedance coupling, making use of one high-mu -40 tube and a power output -71A tube. Plug-in coils and a parrelleled variable condenser switch enable the operator to tune over a large number of wave bands.

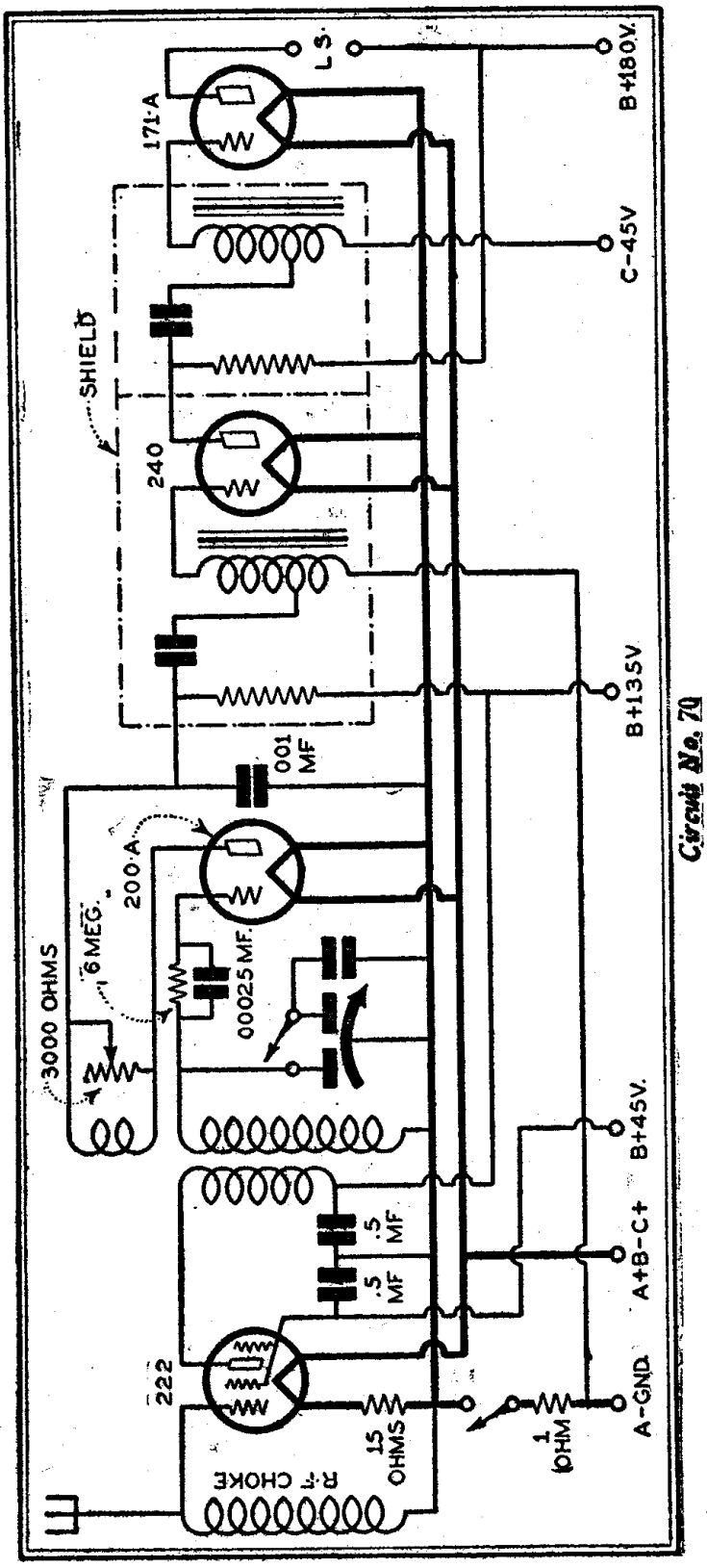
CIRCUIT No. 71 is a schematic diagram of a complete Silver Marshall auditorium power amplifier. The special circuit to permit either -50 tube plate current or some of their circuits to be measured is shown at the right hand side. The 2 mfd. 1000 volt condenser which is the first one in the filter system is housed in a separate can so it can be replaced if necessary without disturbing the large condenser bank. A momentary contact switch is closed when the cover and false bottom are in place. Jacks also permit the measurement of individual tube currents, the push-button switches and the -50 tube bias control are variable. This new S-M 692 amplifier was built with the requirements of uniform transmission over the entire usable audio range interpreting this broader frequency range in terms of the requirements of the new speakers and the insistent demand for amplifiers which are capable of reproducing speech faithfully.



Circuit No. 69

CIRCUIT No. 72 is that of the new Lincoln 8-80 superheterodyne employing 10 tubes in all, the final audio stage employing a pair of -45's. The arrangement of the other tubes are as follows. Oscillator -27, first detector and four intermediate frequency stages -24, second detector and first audio stage -27. One dial control is one of the many features.

CIRCUIT No. 73 is a schematic diagram of the Silver Marshall new band-pass tuner No. 712. The 712 band selector tuner is designed to use two electrically symmetrical circuits in band-pass or "siamese" antenna coupler arrangement. This circuit was placed ahead of the first radio frequency tube, due first to the fact that any slight misalignment which might arise in unusual cases, due to very large antennas, would least effect the general performance of the receiver. Three -24 screen-grid tubes are used as high gain radio frequency amplifiers and a -27 as a power detector to be followed by a high quality audio amplifying system.



Circuit No. 73

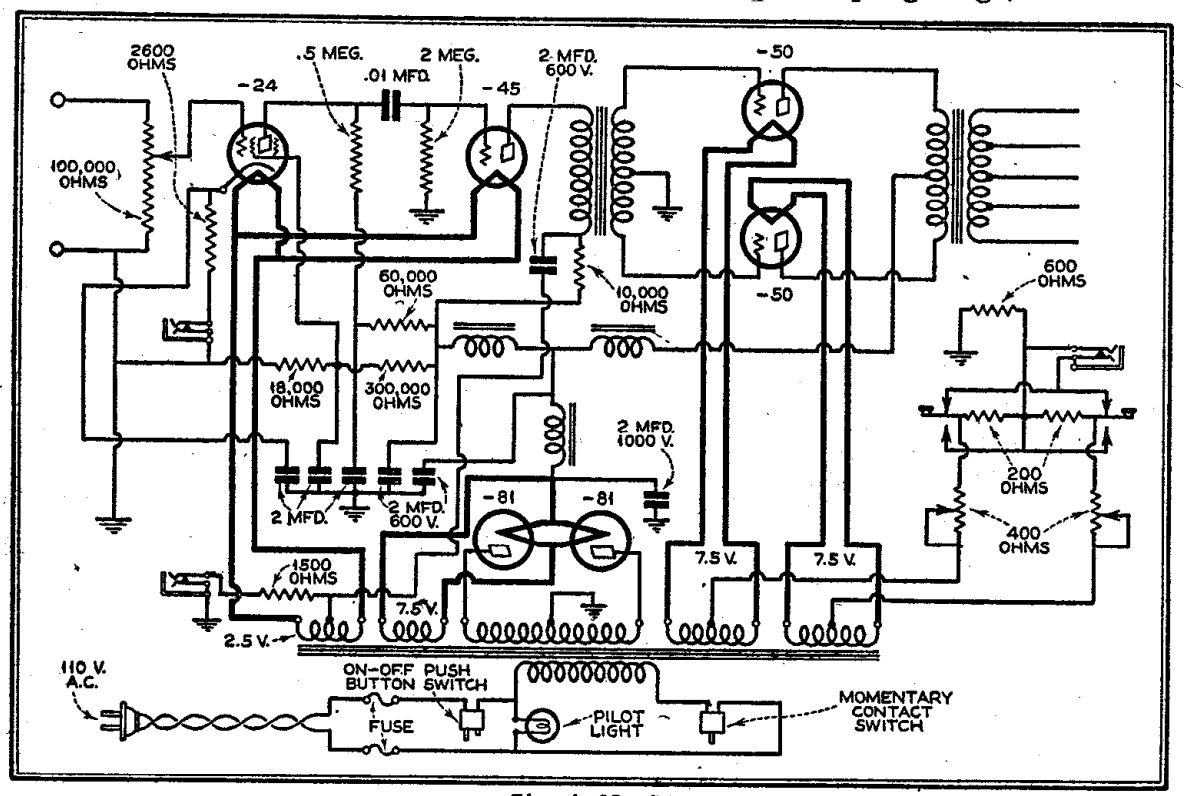
CIRCUIT No. 74 is that of the Atwater Kent screen-grid No. 55. This 7-tube receiver employs two screen-grid tubes as high gain amplifiers in the radio frequency circuit, -27's in the detector and first audio stages, a pair of -45's in a push-pull output audio circuit and a -80 full-wave rectifier for supplying the plate potential to the tubes in the receiver.

CIRCUIT No. 75 is a schematic diagram of the Silver Marshall automobile-radio receiver. Three -24 a.c. screen-grid tubes, a high-mu -40 tube and a -71A tube are those required in this receiver. Circuit connections illustrating the special by-passing and radio frequency choking features are shown in the diagram.

CIRCUIT No. 76 is that of the Pilot 110 volt d.c. line-operated 6-tube radio receiver. The tube performance are as follows; V1, V2, V3 and V4, 112A's; V5, V6 are 171A's. Several noteworthy features have been incorporated in this receiver. First, a complete push-pull filament circuit. Second, a radio-frequency grid-bias connection. Third, an audio channel grid

bias allowance. Fourth, a radio-frequency grid bias tap arrangement and fifth, a plate filter system.

CIRCUIT No. 77 is a schematic diagram of the Silver Marshall a.c. operated short-wave receiver, employing a -24 screen-grid tube as a coupling stage, -27 as detector and first audio and a pair of -45 tubes in push-pull as a second audio stage.

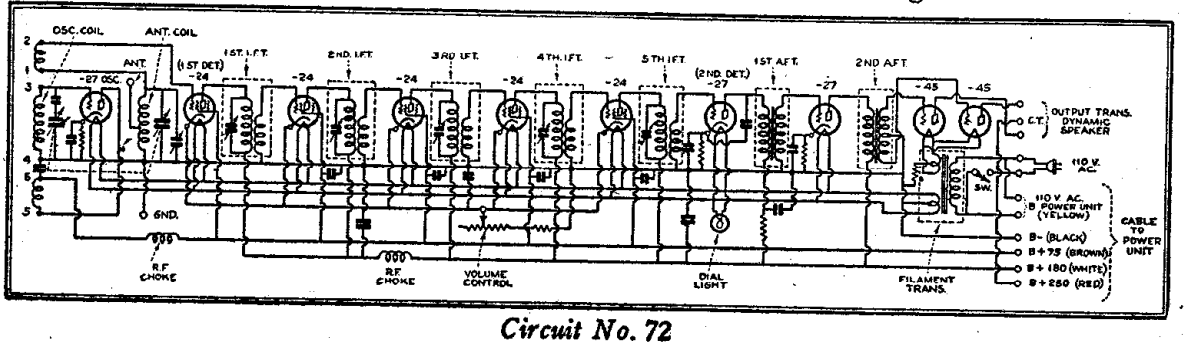


Circuit No. 71

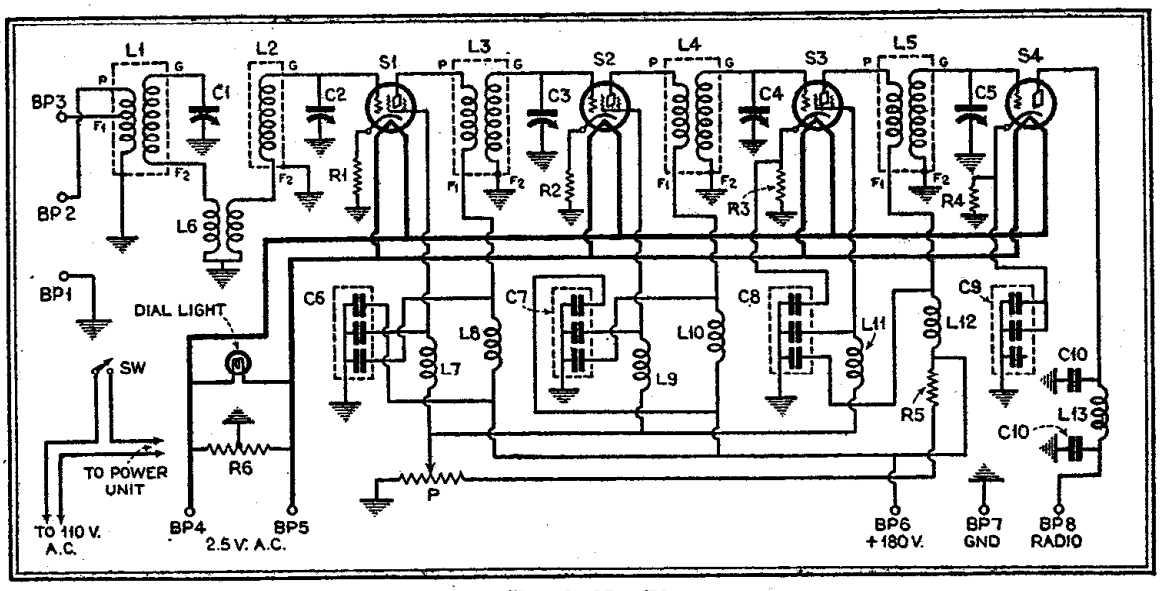
A -80 full-wave rectifier supplies the plate potentials for the proper operation of this receiver. Plug-in coils permit the user to tune this set from 17 to 600 meters.

CIRCUIT No. 78 is that of the Silver screen-grid 30 radio receiver, where four screen-grid a.c. tubes are used, three of them functioning as high gain r.f. amplifiers, the fourth as a screen-grid power detector. The first audio stage employing a -27 tube is coupled to the detector output through a resistance-coupling unit and a pair of -45 arranged in push-pull fashion complete the audio amplifier.

CIRCUIT No. 79 is a schematic diagram of the Continental Wireless Supply Corp. automobile-radio receiver. The circuit consists of one coupling stage, three tuned radio frequency stages and two audio frequency stages. Screen-grid tubes of the a.c. type, powered from a d.c. source, are used in the coupling stage, first and second tuned radio frequency stages and in the first audio stage, as is also the -27 detector. The fuses in the A plus and B minus leads are extremely important and insure the wiring of the car against serious damage which may result from a reversed ground. The antenna



Circuit No. 72



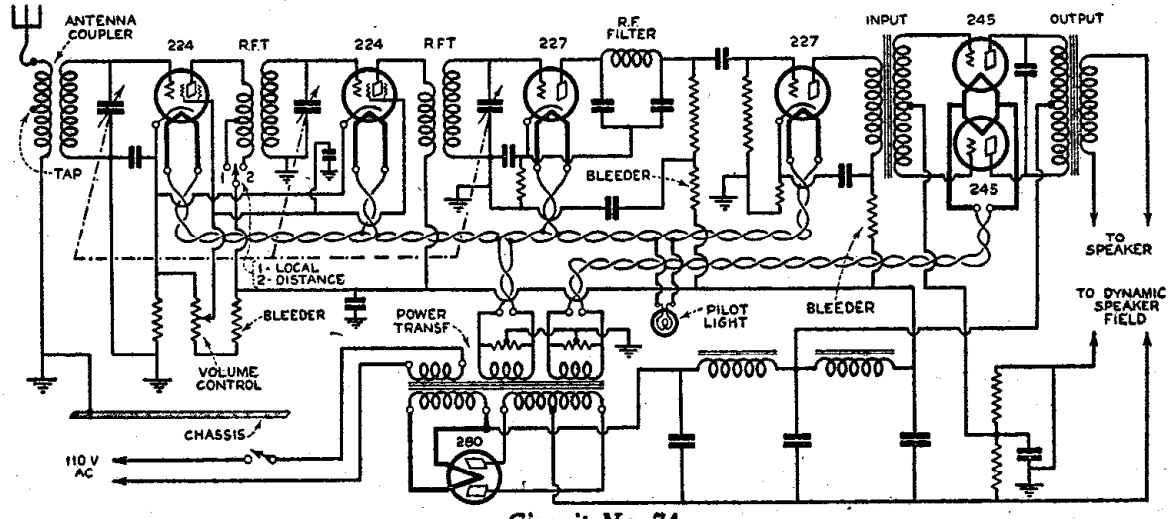
Circuit No. 73

is fed into the -24 tube through a 500,000 ohm resistance followed by the radio frequency amplifier, detector and audio amplifier systems. A receiver of this variety is intended for remote control operation by means of a flexible cable and accurately cut gears, having a ratio of 50 to 1.

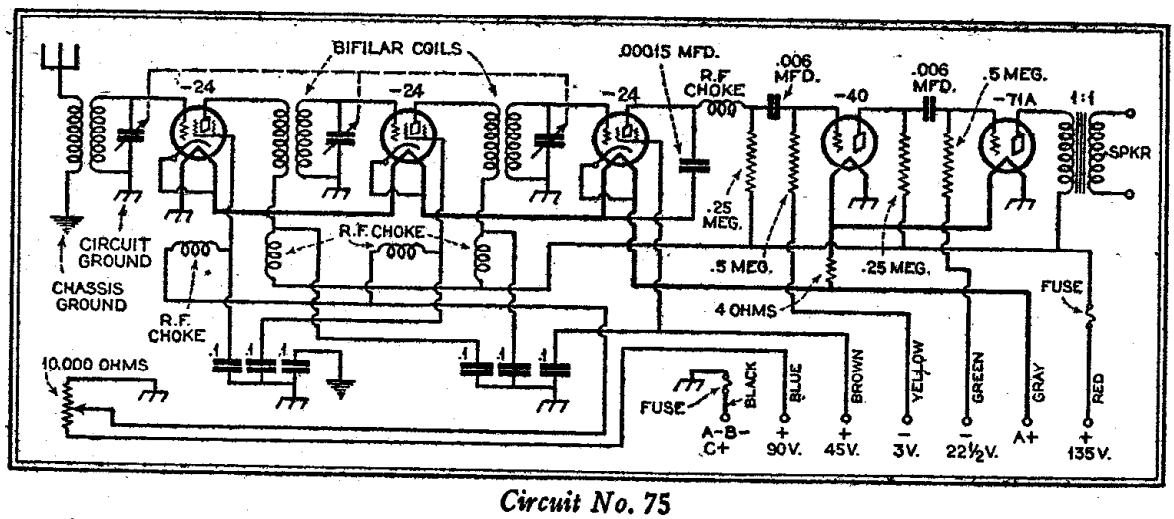
Volume is controlled in this circuit by varying the filament voltage in current on the three radio frequency tubes. Grid suppressors are employed in the grid circuits in the two tuned radio frequency stages to eliminate any possibility of oscillation due to variation in tube characteristics.

CIRCUIT No. 80 is a schematic diagram of the Atwater Kent No. 35 for operation on 6-volt A supply and either B batteries or a B eliminator. The antenna feeds, in conjunction with a radio frequency choke, directly into the grid of a coupling tube followed by two tuned stages of radio frequency amplification and a tuned detector. The first stage audio employing the -01A tube and a second audio stage having a -71A power tube.

CIRCUIT No. 81 is a schematic diagram of the Victor Radio Models R32 and RE45. Ten tubes are required in both these models, six of them being the -26 type, one -27, two -45 power amplifier tubes and a full-wave -80. By means of a variable resistance, R10, shunted across the secondary of the push-pull input transformer control of tone is obtained so that the high or low audio frequencies may be accentuated as desired. The tuner, am-



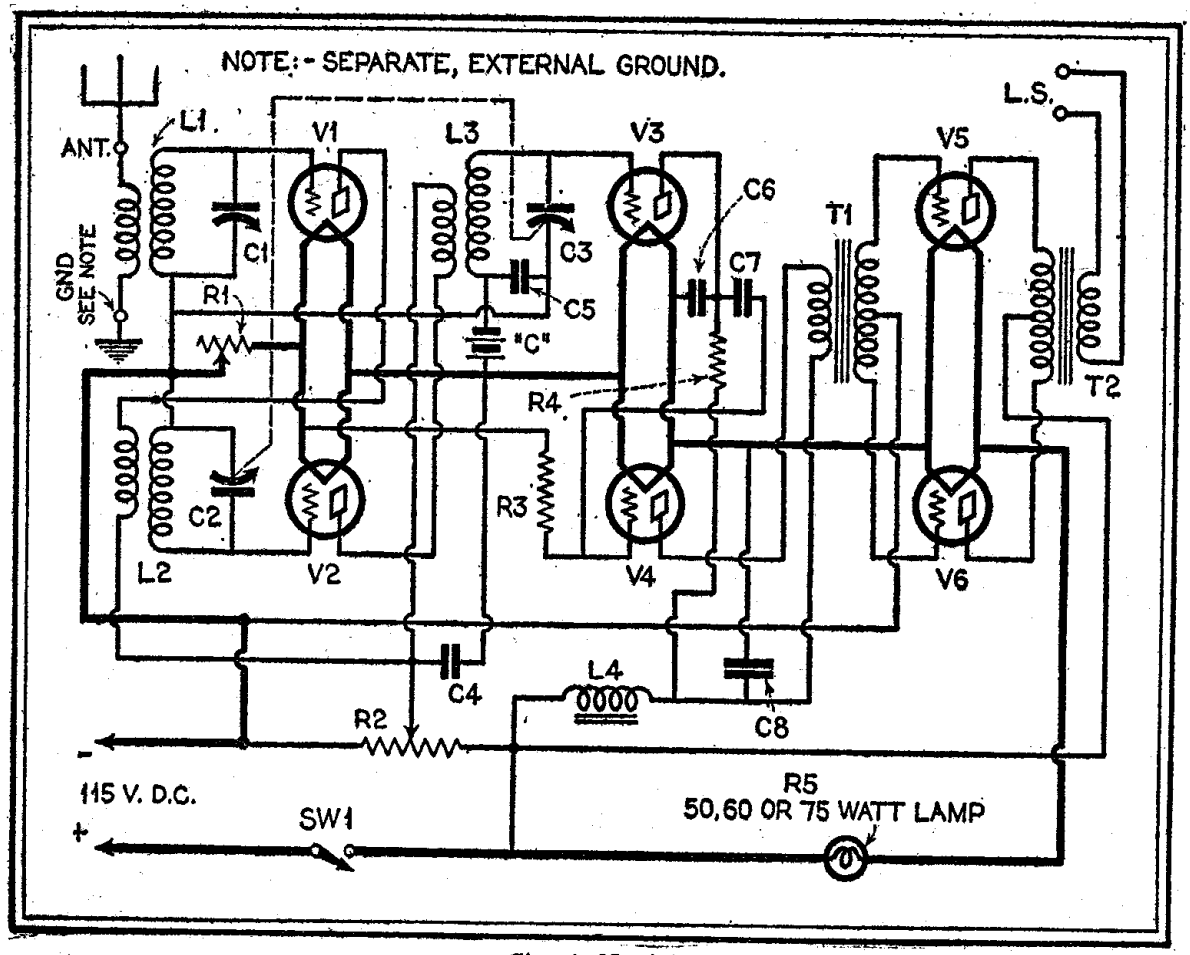
Circuit No. 74



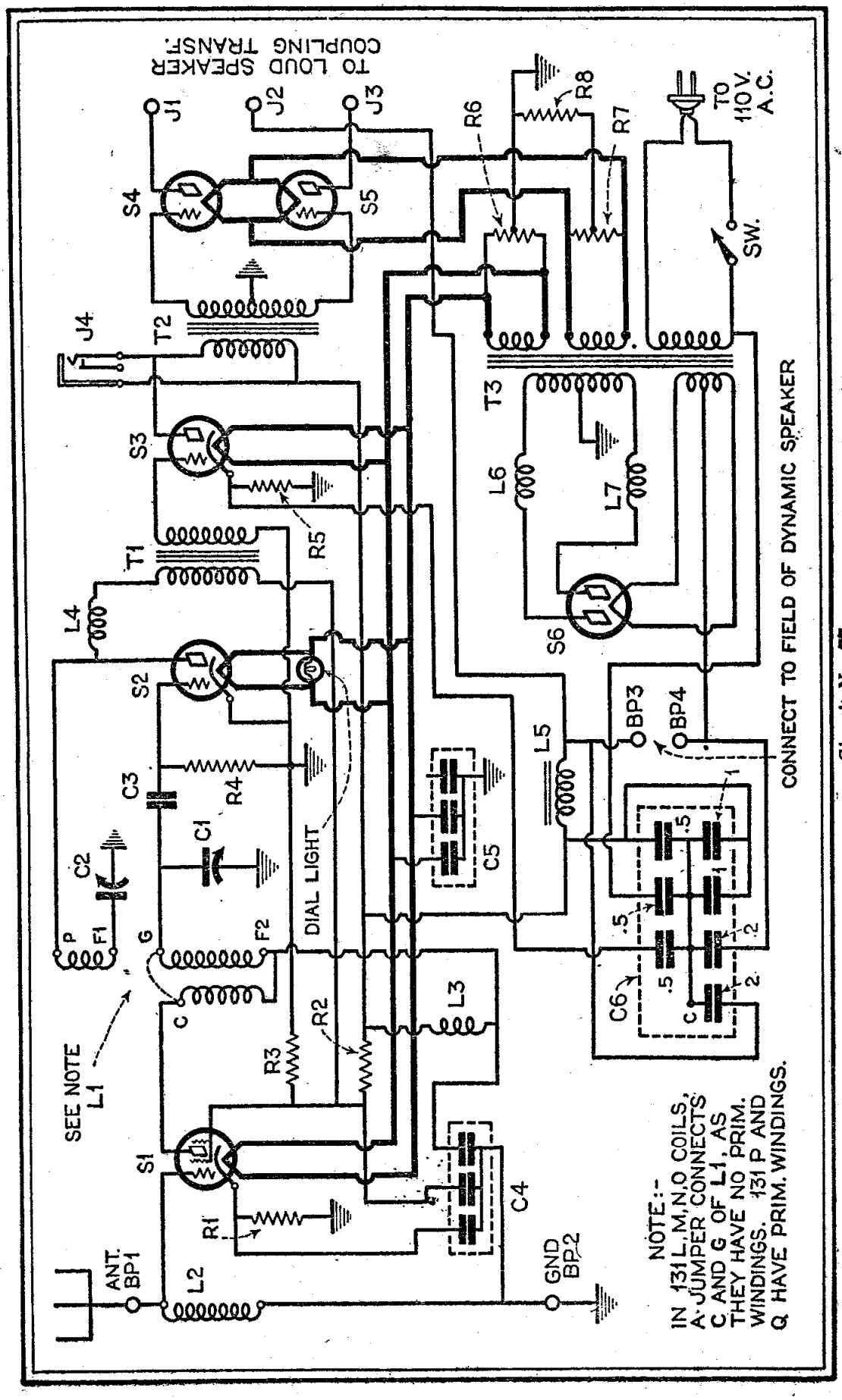
Circuit No. 75

plifier power supply and loud speaker are all wired separately and brought out to plug-in cables which connect to a terminal board, thus making installation a matter of simply plugging together three units. The model R32 is a radio receiver while the model RE-45 is a combination radio and electric phonograph.

CIRCUIT No. 82 is that of the Stewart-Warner Series 950. Three -24 screen-grid tubes, two -27 a.c. heater type tubes, a pair of -45 output power amplifier tubes and a single -80 full-wave rectifier are the tubes which are employed in this a.c. operated receiver. Three screen-grid tubes

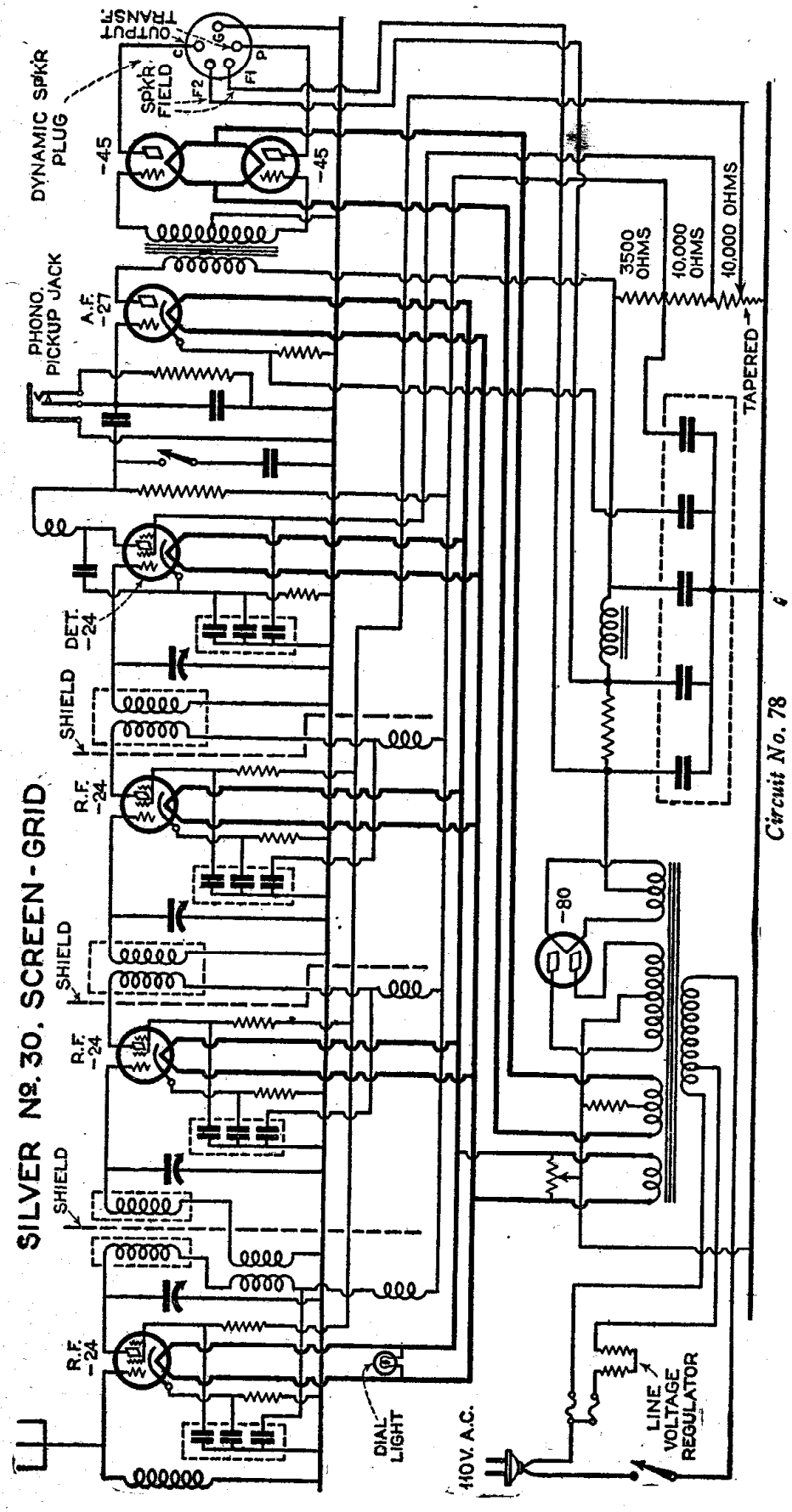


Circuit No. 76



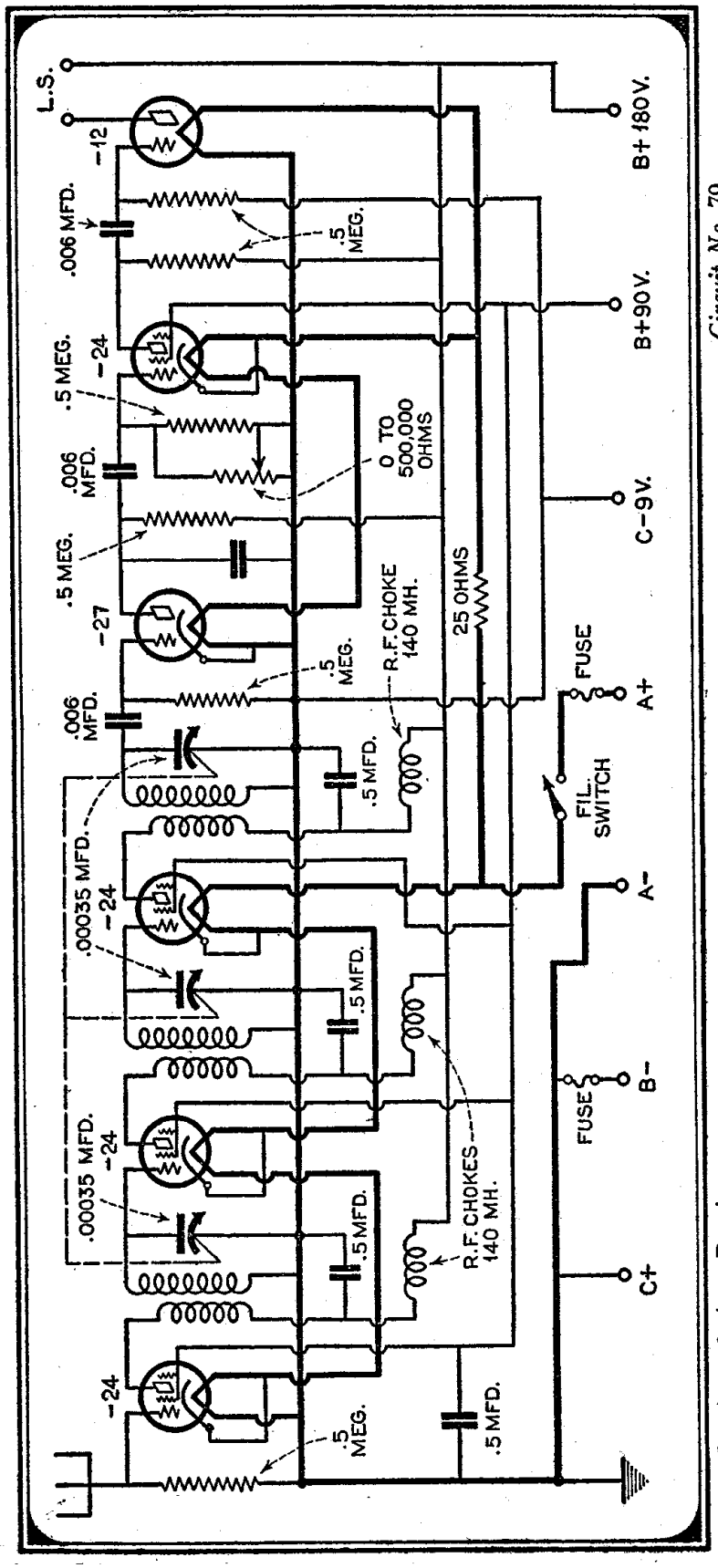
Circuit No. 77

are used in the three-stage radio frequency amplifier which is stabilized by the employing of neutralizing or stabilizing condensers. The tuning condensers are shunted with equalizing capacities so that perfect alignment of this portion of the receiver is obtained. Coupling between the detector and first amplifier tubes, both -27 type tubes, is accomplished through the use of a resistance-coupling unit.



Circuit No. 83 is that of the Majestic No. 180 a.c. operated radio receiver. In this 7-tube receiver, two -50 tubes are arranged in push-pull providing exceptionally fine tone quality with little or no possibility of distortion, due to overloading. Five -27 tubes make up the remainder of the circuit, three being used as radio frequency amplifiers, one as a detector and one as a first stage audio frequency amplifier. A drum switch allows change-over from a radio program to the playing of phonograph records by connecting a phonograph pickup in the secondary circuit of the first audio frequency transformer.

CIRCUIT No. 84 is a schematic diagram of the Crosley No. 608 a.c. radio receiver. Three -26 tubes are employed in two stages of tuned radio frequency and a first stage of audio frequency amplification, a -27 tube as a grid leak and condenser detector and a -71A tube in the second or out-put audio amplifying stage. A -80 tube is used to supply the plate potentials of this receiver while the filter system of the power supply employs the high capacity Mershon electrolytic condenser.



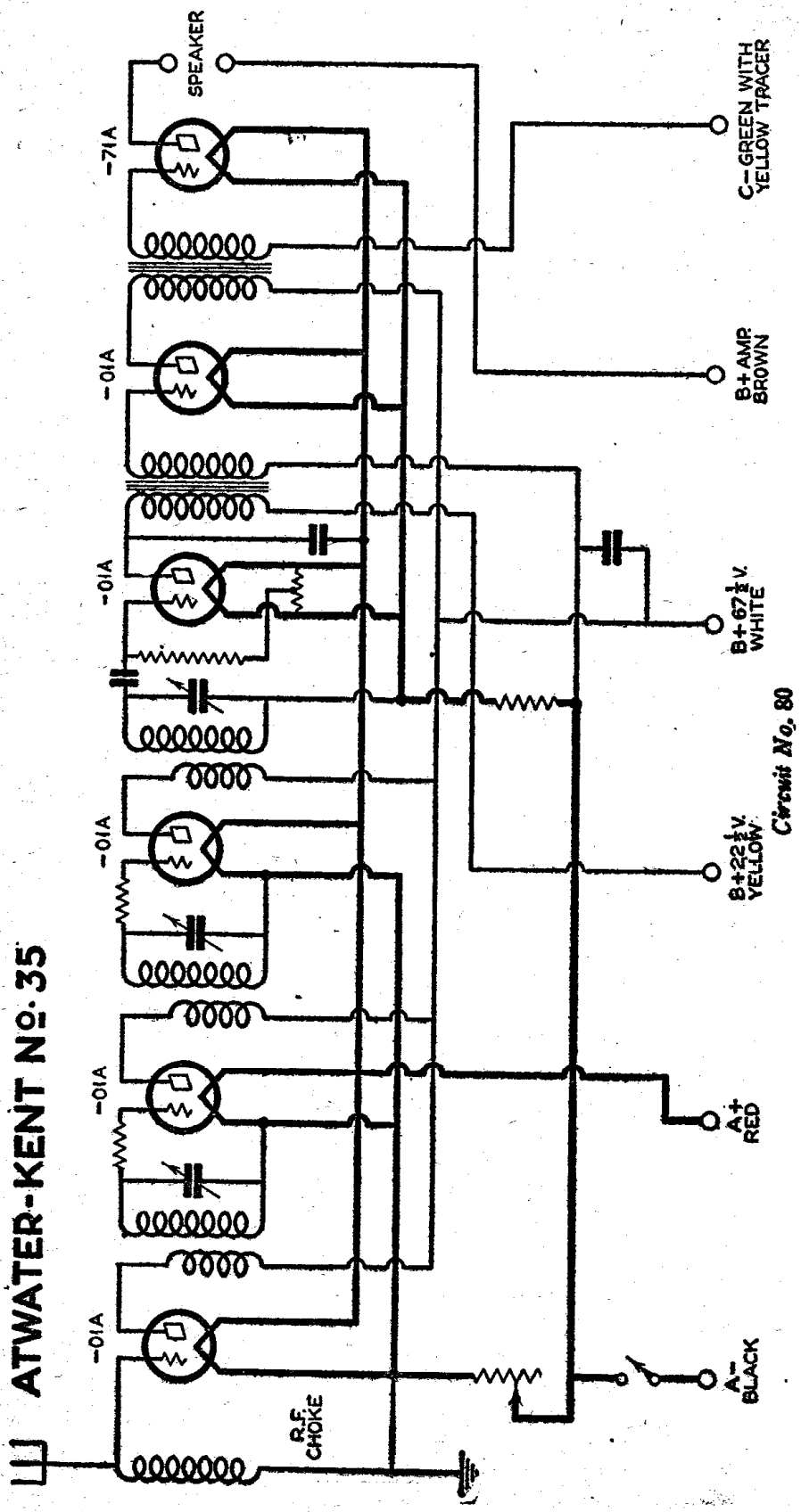
Circuit No. 79

Continental Auto Receiver

CIRCUIT No. 85 is that of the Kolster K-21 receiver. The a.c. filament type of tube, otherwise known as the -26, is used in the antenna coupling stage and three tuned radio frequency amplifier stages of the Kolster Series K-21. The heater type a.c. tube -27 is used in the detector stage. These five tubes complete the tuner portion of the receiver and are constructed as a separate unit. The audio amplifier consisting of two transformer stages and power supply unit comprise the second unit of the receiver. The first audio stage employs a -26 tube while the final audio stage makes use of the -71A. Provision has been made for plugging in a phonograph pickup for the reproduction of phonograph music.

CIRCUIT No. 86 is that of the Pilot a.c. short-wave Super-Wasp receiver. The circuit diagram is of a 4-tube receiver with its associated power supply unit. The tube equipment necessary for correct operation of this receiver includes -24 a.c. screen-grid, two -27 indirect heater type tubes as first and second audio amplifiers, a

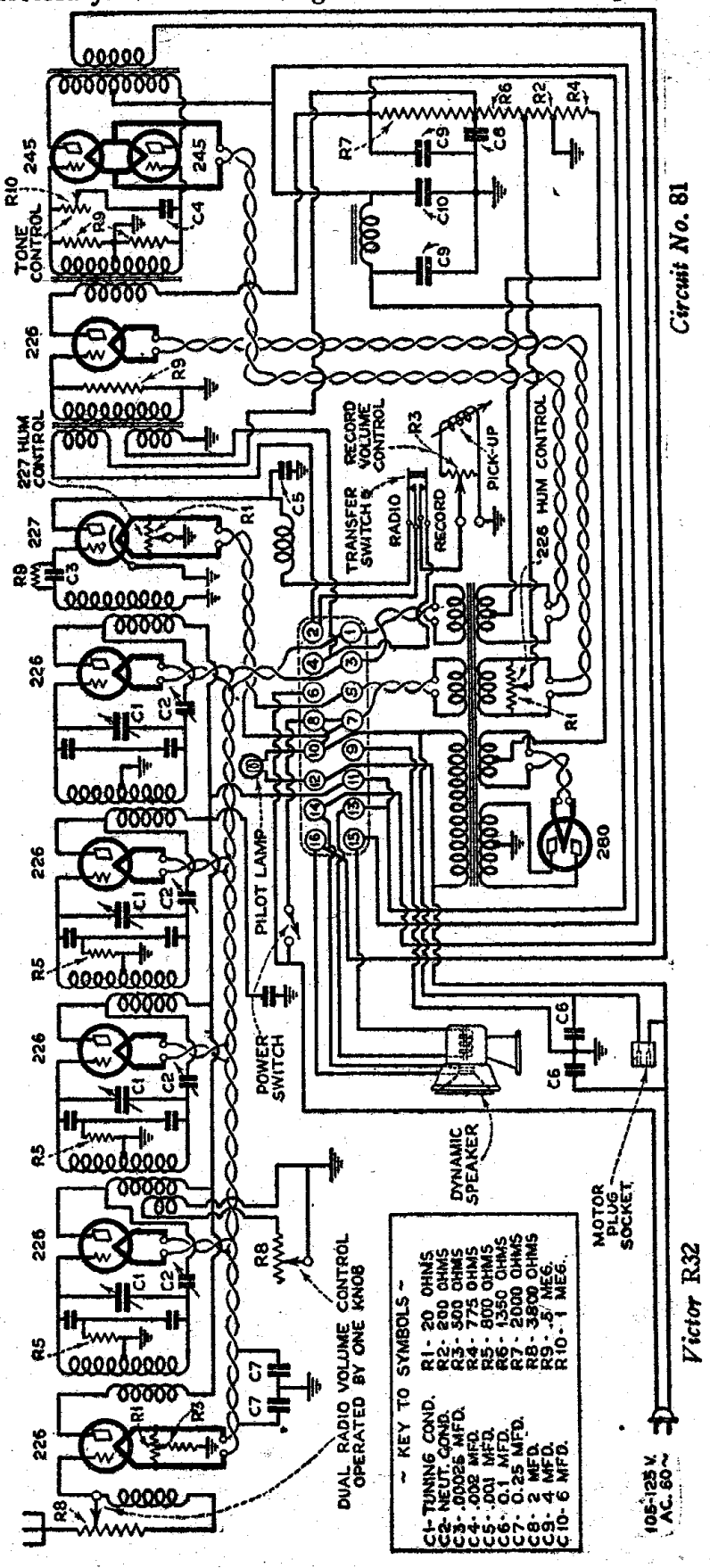
-80 full-wave rectifier supplying plate potentials and a -27 Pilotron as a detector. Tuning is accomplished by two main tuning dials for the .00016 mfd. condensers while regeneration is controlled by the .00025 mfd. variable condenser in the plate circuit of the detector tube.



Circuit No. 87 is a schematic diagram of the Pilot PE6 radio receiver employing two a.c. screen-grid tubes in the tuned radio frequency stages, a -27 in the detector and the first audio stage, and a pair of -71A's in the push-pull audio amplifier, while a -80 full-wave rectifier supplies the B voltages. Single dial control is effected in this circuit by employing a three-gang condenser each having a very small trimming condenser shunted across its rotor and stator connections.

Circuit No. 88 is that of the Jackson NJ-30 radio receiver. As is evident from the circuit diagram No. 88 the audio channel is resistance-coupled throughout. It is most interesting. A -24 tube is operated as a space-charge amplifier. This means that the usual grid connections are reversed. The signal is impressed on the outer screen-grid and a fixed voltage is impressed on the

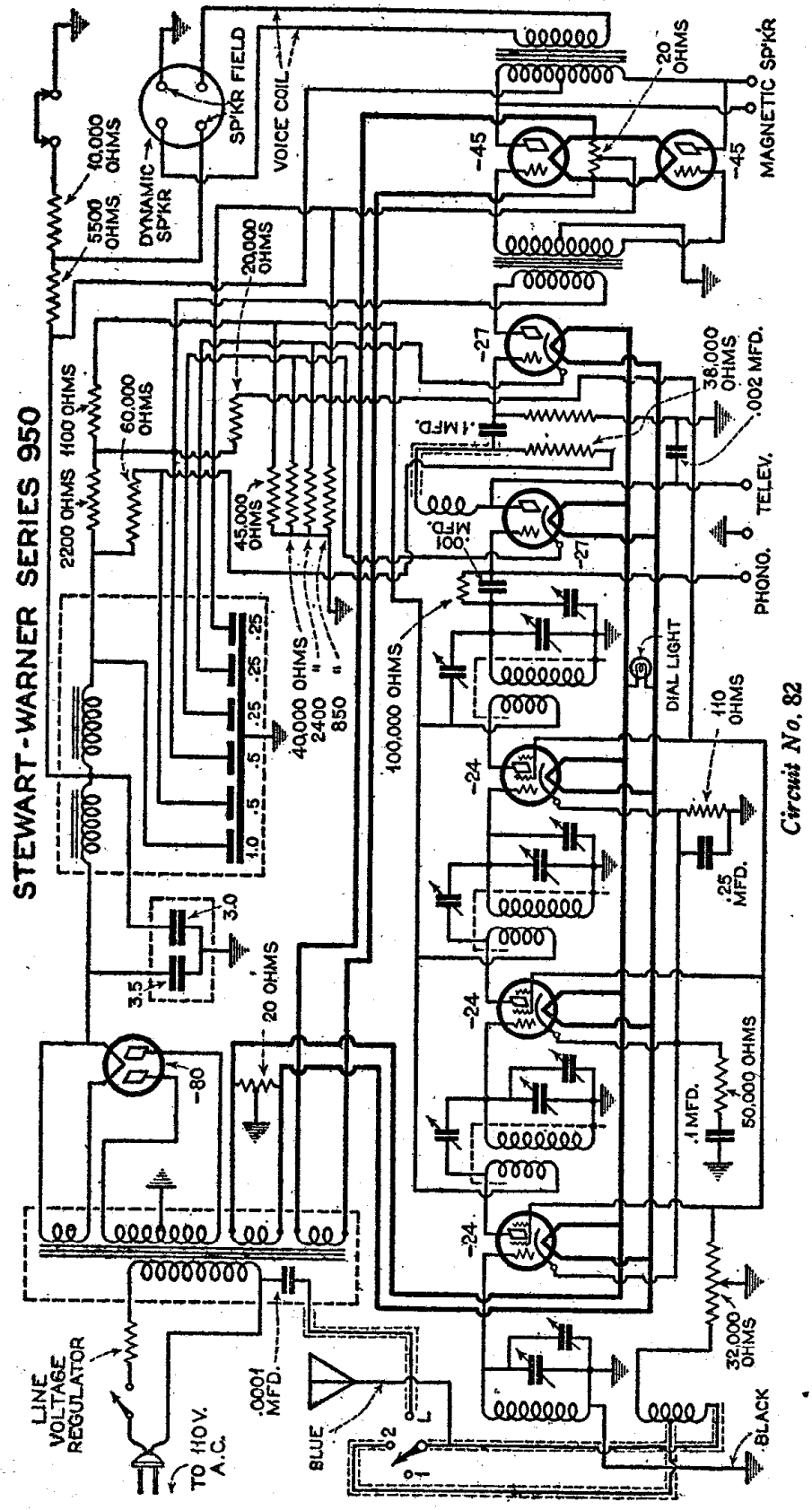
inner grid. This gives a very high gain (about 60) so that only two stages are necessary. The second stage is a -45 output tube. Although both tubes are supplied from the same B supply tap, the -24 is coupled through a 500,000 ohm resistor which provides the necessary impedance in the plate circuit and cuts down the voltage for the plate. Another interesting feature is that all filaments are supplied from the same transformer windings. If this were done with tubes connected in the usual way, it would impress a voltage between the cathode and filament of the heater tubes. This potential would be equal to the grid bias voltage of the -45 tube which is 10 times the maximum value that can be safely impressed. To avoid this the filament and cathodes of all tubes are operated at approximately ground potential and the B minus is operated at 50 volts below ground.



Circuit No. 89 is that of the Freshman Q15 a.c. operated radio receiver. In this circuit the first tube -22, a d.c. operated screen-grid tube, is used in the a.c. circuit having 3.1 volts raw a.c. filament, followed by a -27 tube as a detector, a -26 as a first transformer-coupled audio stage and a -71 as an output stage, also transformer-coupled. B potentials are obtained from a -80 full-wave rectifier tube and the conventional filter circuit employing an audio frequency choke coil and filter condensers. By means of two resistors, the correct operating voltage is supplied to the screen-grid of the radio frequency choke and the plate of the detector tube. Single dial control is effected by em-

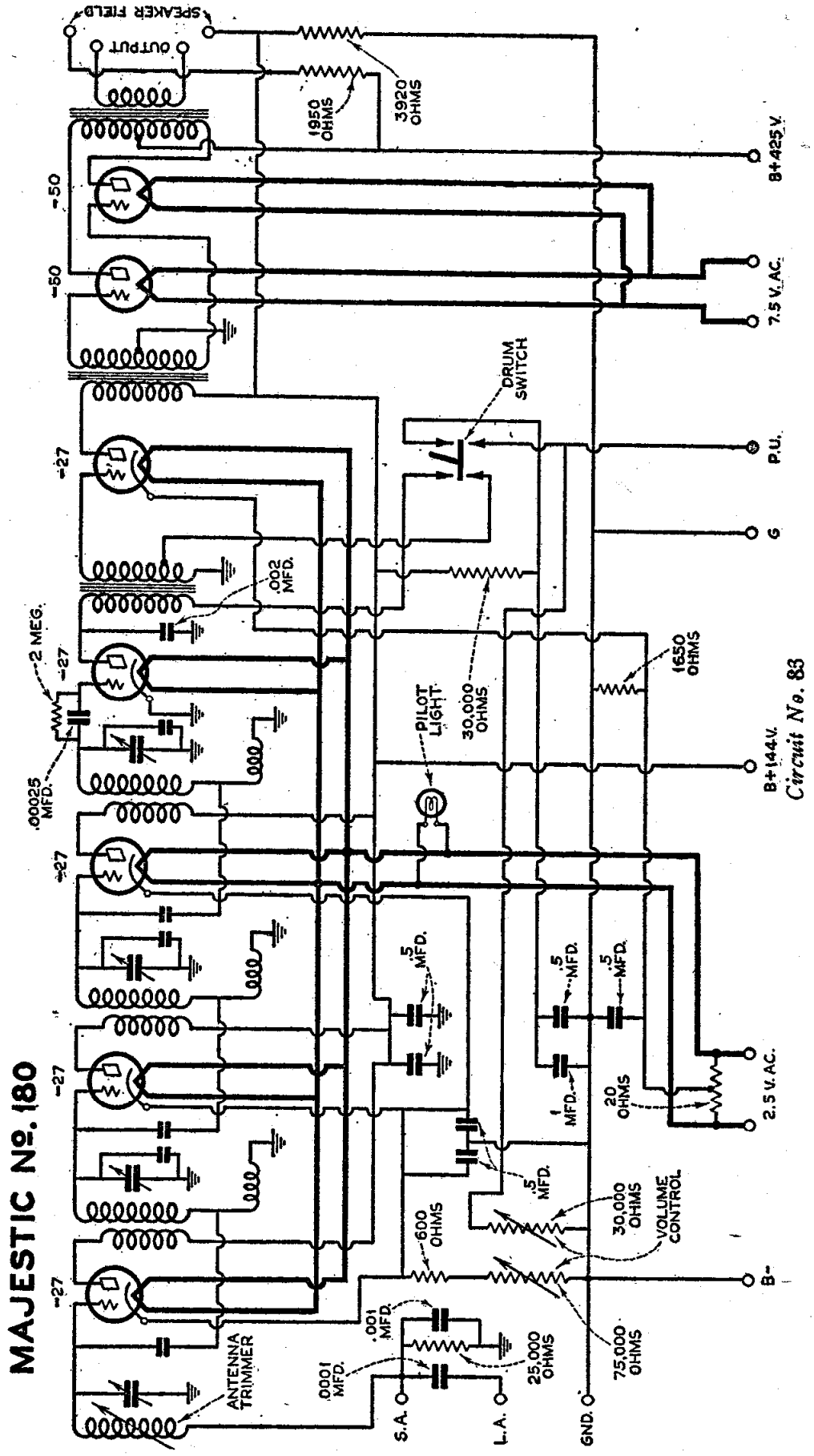
ploying the stator plates of the two variable condensers at ground potential.

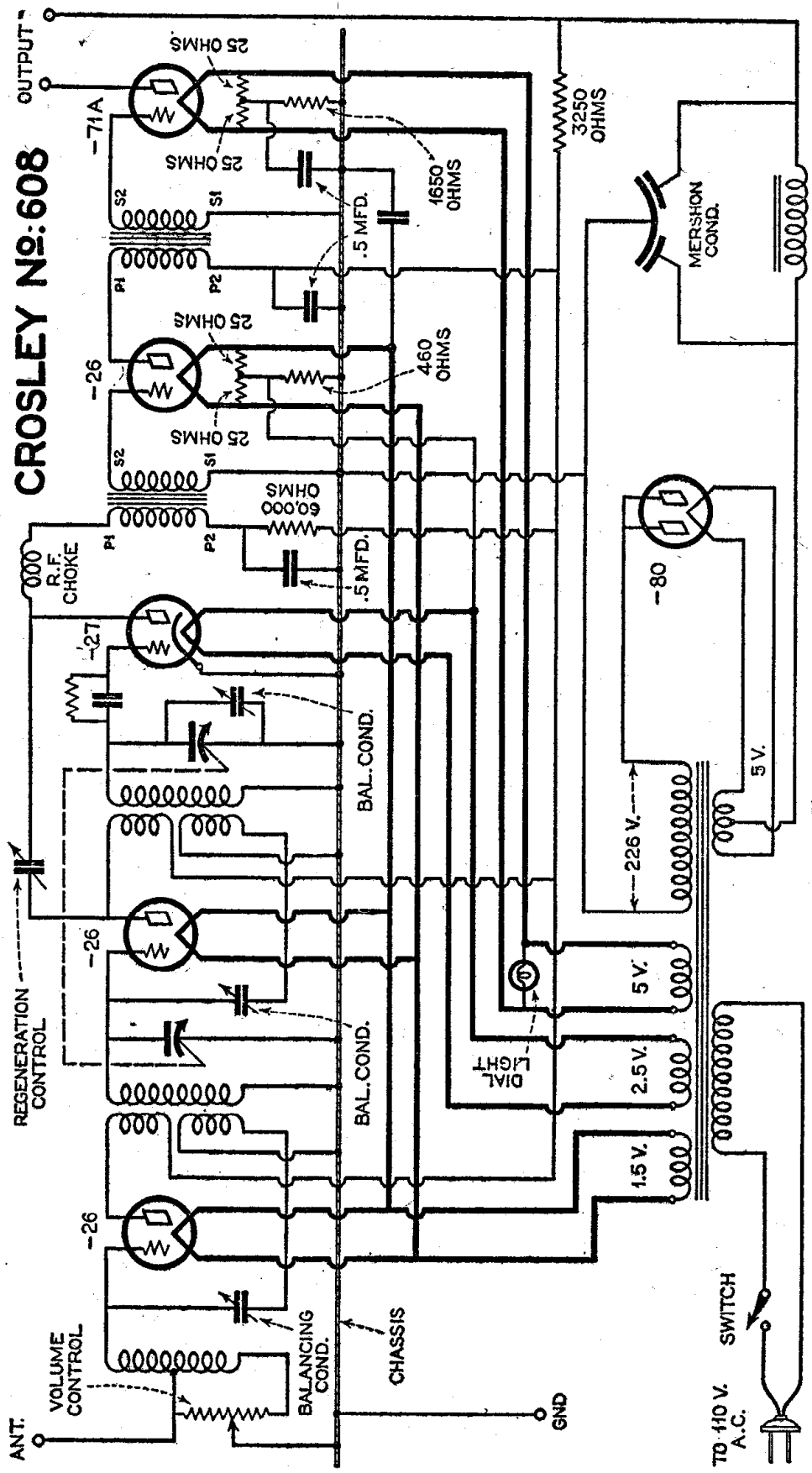
CIRCUIT No. 90 is a schematic diagram of the Fada No. 35B radio receiver, a.c. operated, embodying the following features. First, four tuned stabilized circuits; second, power detection; third, high quality two stage audio channel employing push-pull in the final stage; fourth, eight tubes as follows, 3-24, 2-27, 2-50, 1-80; fifth, provision for phonograph pickup attachment.



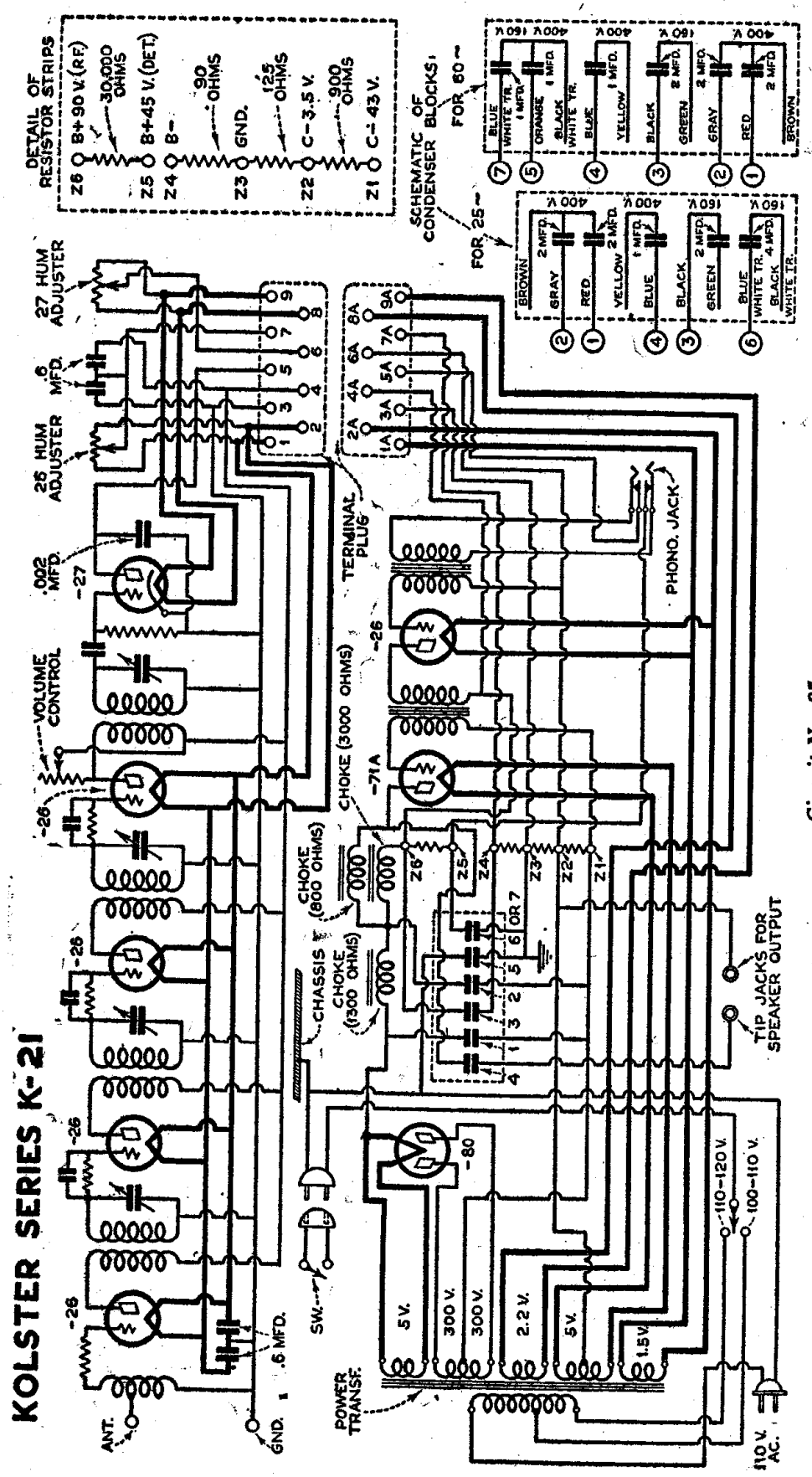
CIRCUIT No. 91 is a schematic diagram of the Bosch No. 48 radio receiver comprising of three stages of tuned radio frequency, making use of screen-grid -24 tubes, power detector, a -27 indirect heater type tube and followed by a pair of -45 in push-pull combination. Due to the extremely high gain obtained in the radio frequency portion of the receiver, it has been found unnecessary to use the conventional two stages of audio amplification. A -80 tube provides full-wave rectification in the power pack.

CIRCUIT No. 92 is a schematic diagram of the Grebe d.c. No. SK-4 radio receiver. This receiver for operation on the d.c. lighting circuit employs three -24 screen-grid tubes as radio frequency amplifiers, -27's as detector and first audio and a pair of -45's in the final audio stage. C potentials are obtained

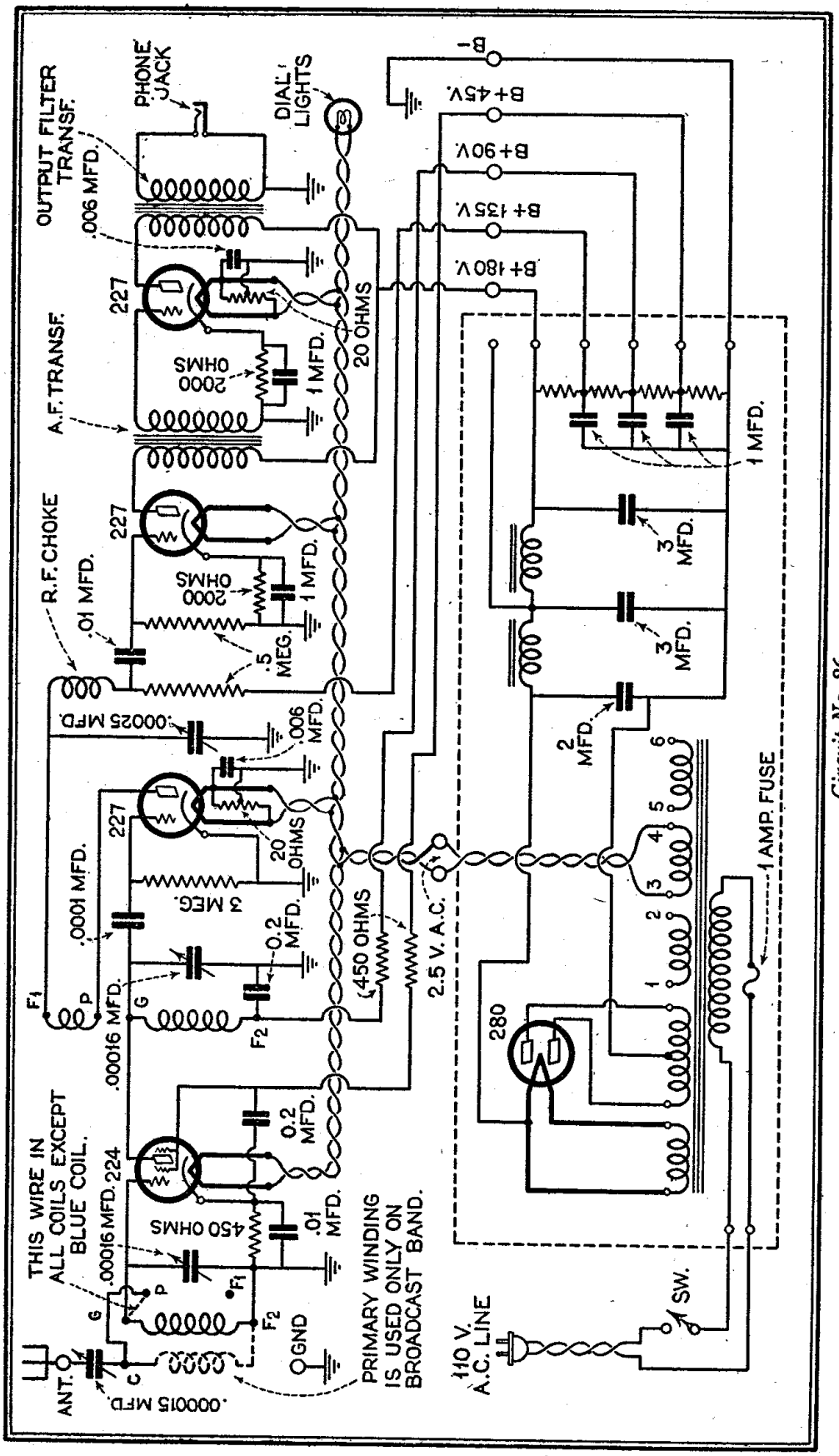

MAJESTIC No. 180
Circuit No. 83
SPEAKER FIELD
OUTPUT
1950 OHMS
3920 OHMS
B+425 V.
7.5 V. AC.
DRUM SWITCH
P.U.
G
.002 MFD.
2 MEG.
.00025 MFD.
PILOT LIGHT
30,000 OHMS
1650 OHMS
B+144 V.
.5 MFD.
.5 MFD.
.5 MFD.
.5 MFD.
1 MFD.
20 OHMS
2.5 V. AC.
600 OHMS
30,000 OHMS
VOLUME CONTROL
B-
.001 MFD.
.0001 MFD.
ANTENNA TRIMMER
25,000 OHMS
75,000 OHMS
S.A.
L.A.
GND.
-27
-50



Circuit No. 84

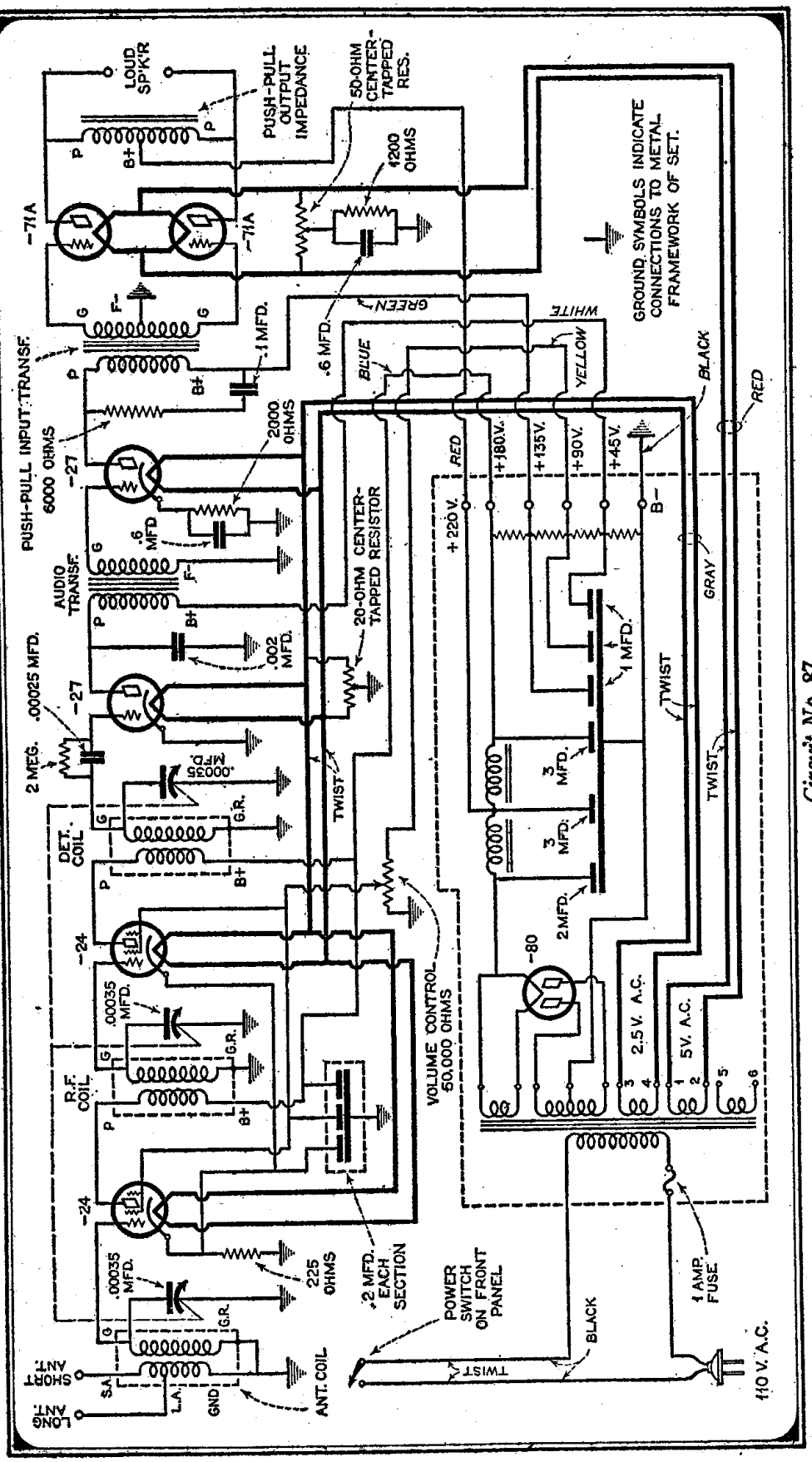


Circuit No. 85



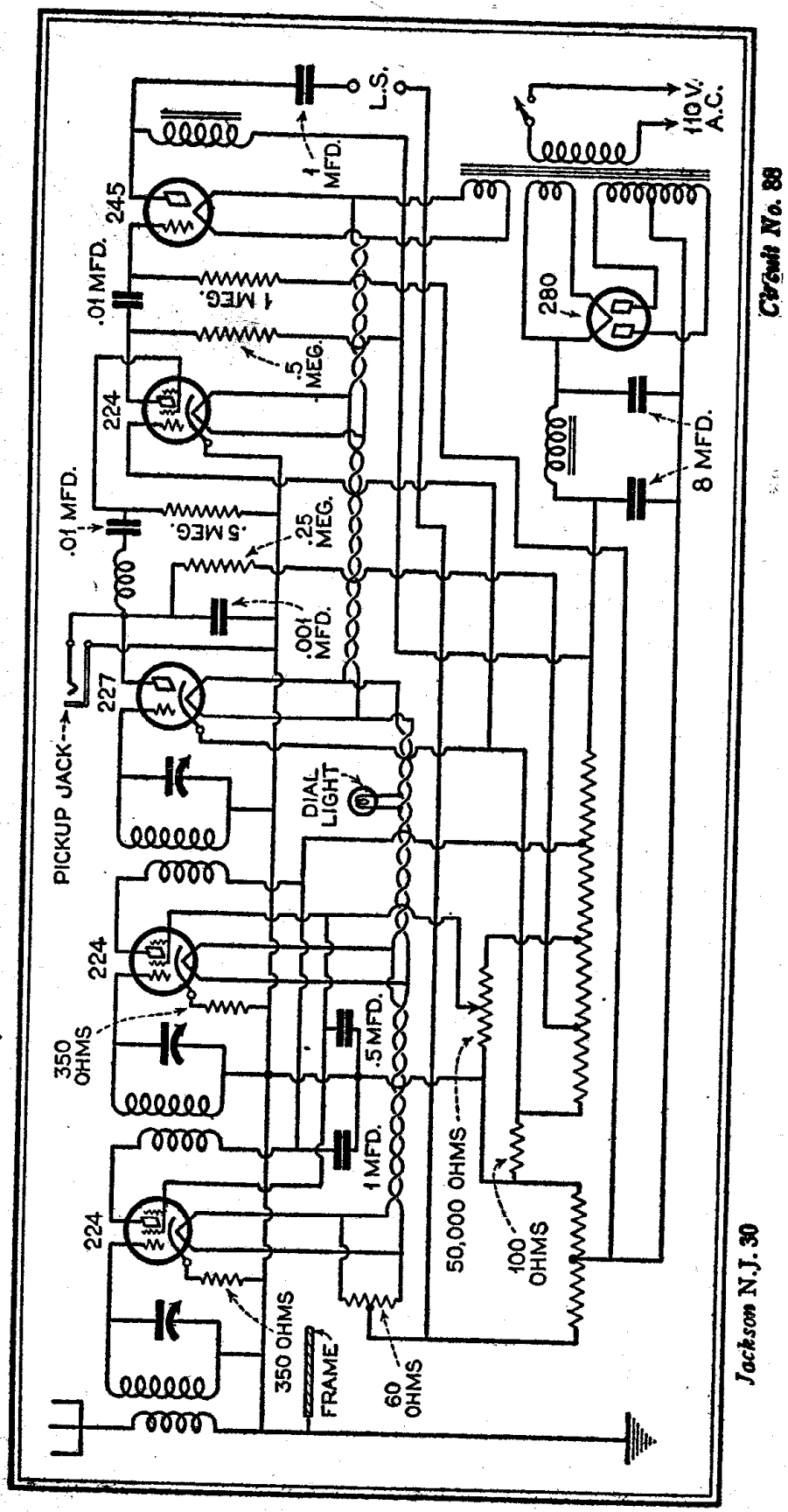
Circuit No. 86

Pilot A.C. Super Wasp



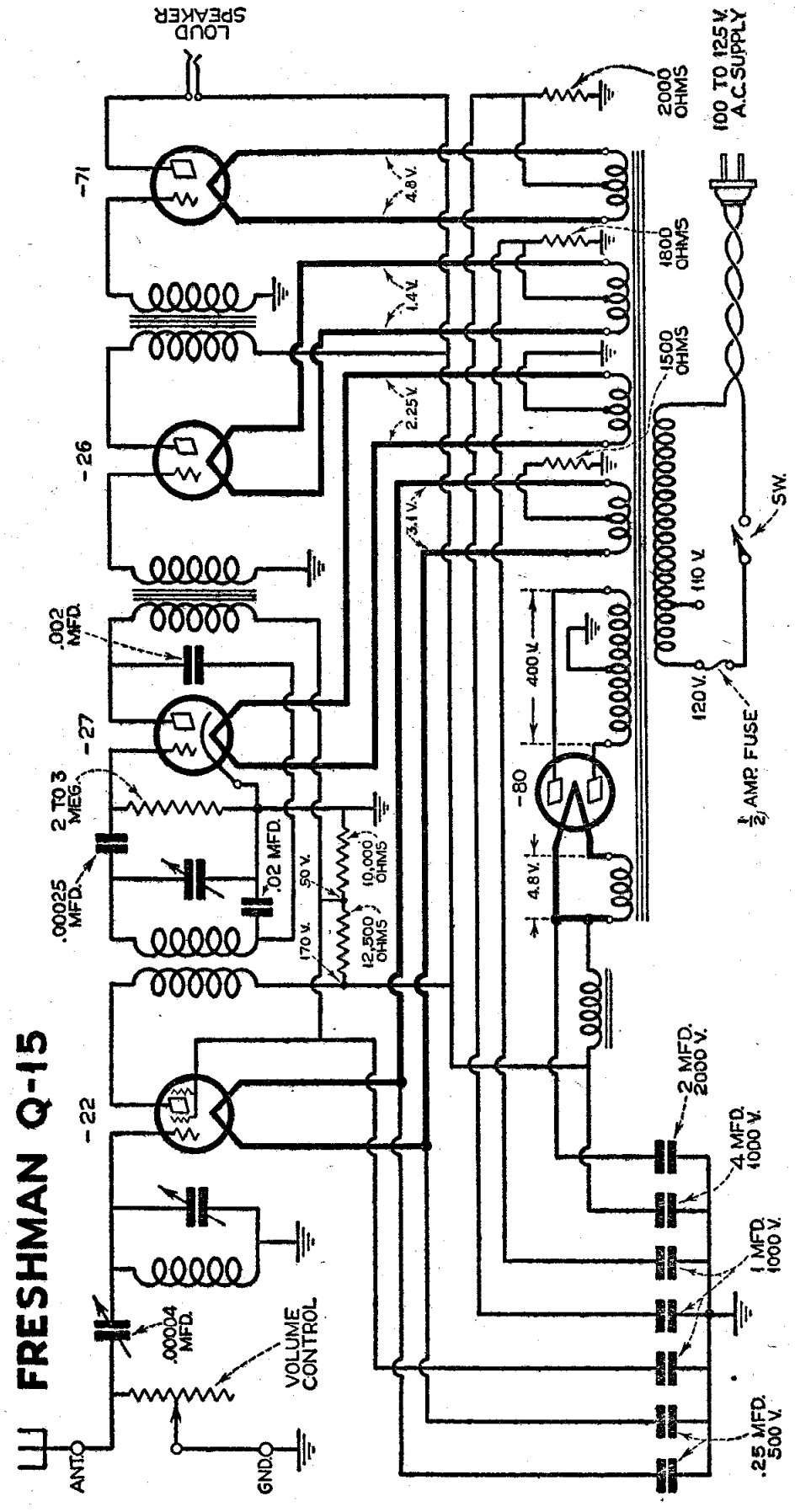
Circuit No. 87

Pilot PE 6

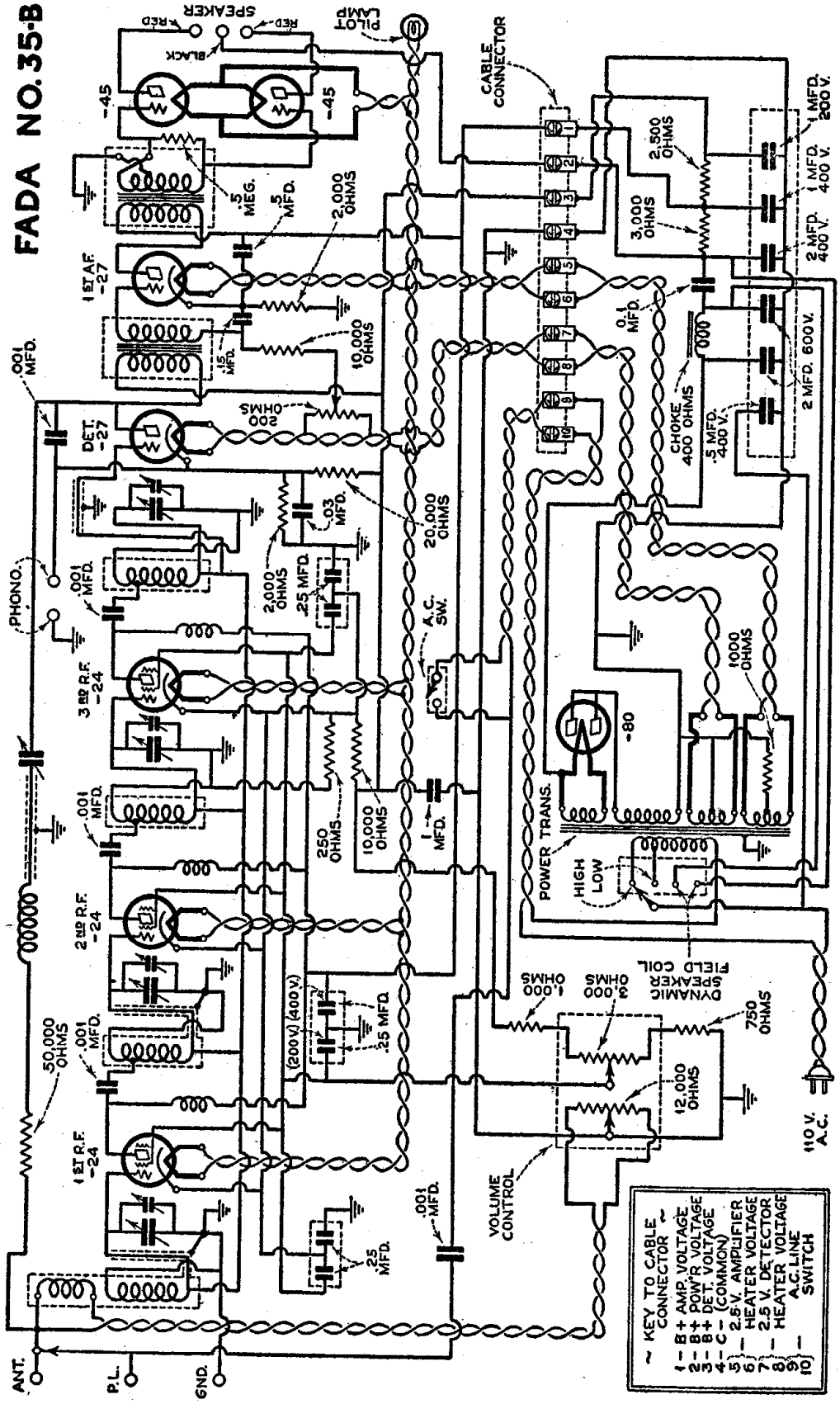


through the use of the conventional dry C battery, thus permitting the full 110 volts d.c. to be impressed on the plates of the -45 tubes. Provision has also been made in this receiver for the connection of a phonograph pickup unit for the playing, electrically, phonograph records using the audio amplifier and dynamic speaker. In using this d.c. receiver or any other, attention must be paid to the insertion of the attachment plug so that the positive terminal connects with the positive side of the line.

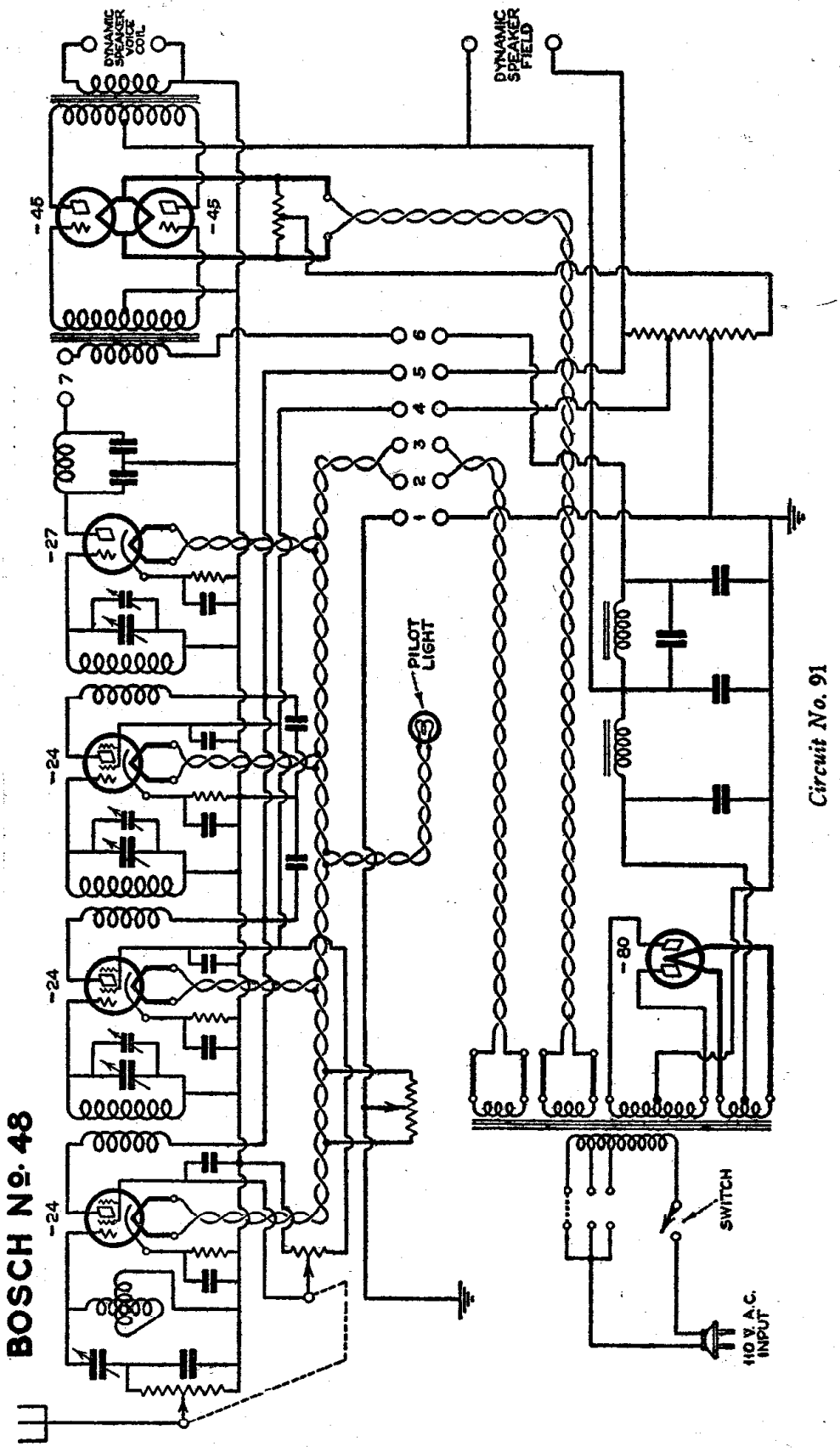
CIRCUIT No. 93 is that of the Hammarlund Roberts HiQ 30. radio receiver employing three stages of band selector three stages of radio frequency amplification using the -24 high gain screen-grid tubes, -27 tubes as detector and first audio and a pair of -45's in push-pull transformer-coupled audio stage. The power supply requires full-wave rectifier tube -80 as well as a regulator tube, eliminating B potential fluctuations from varia-



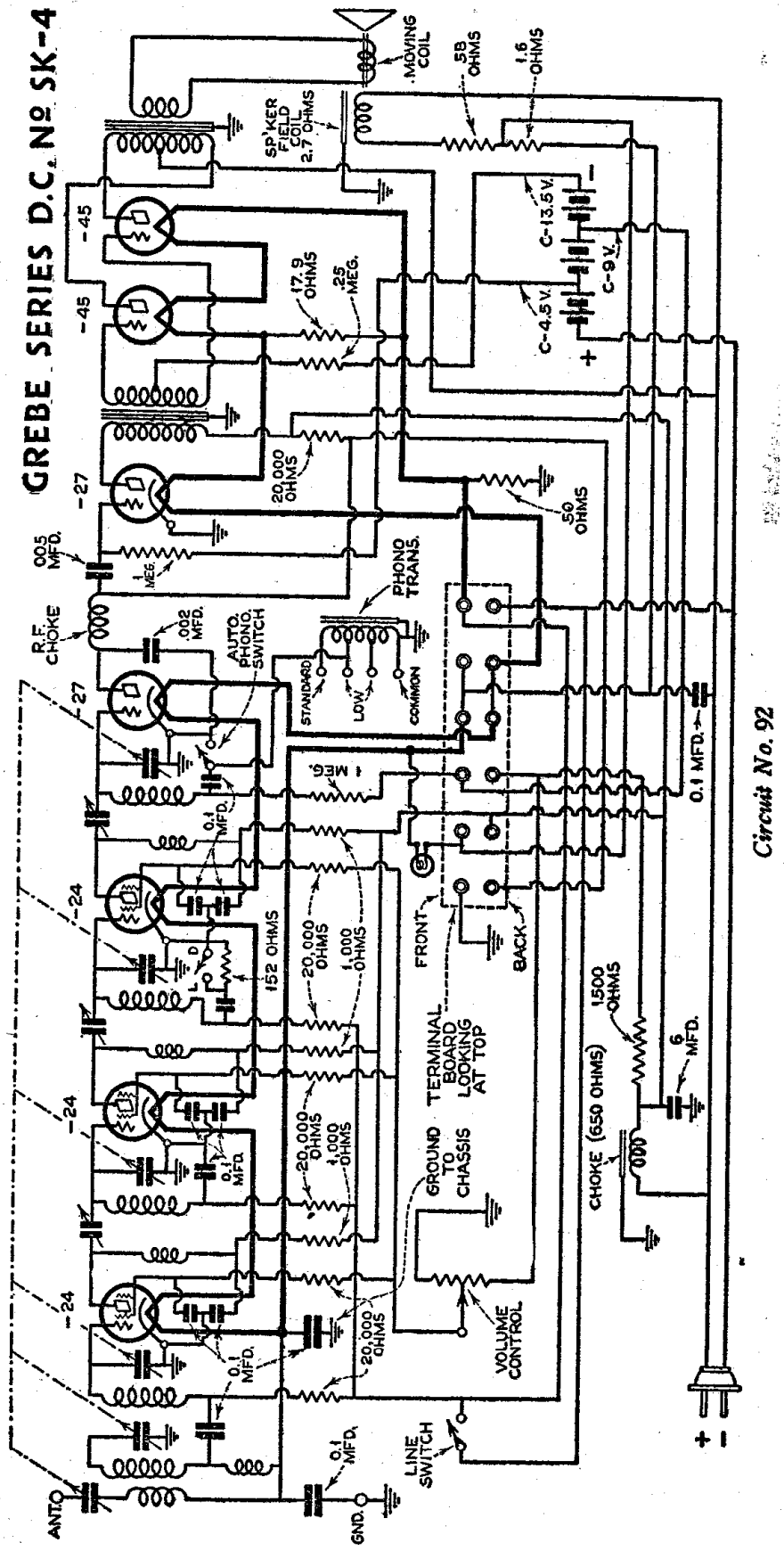
Circuit No. 89



Circuit No. 90



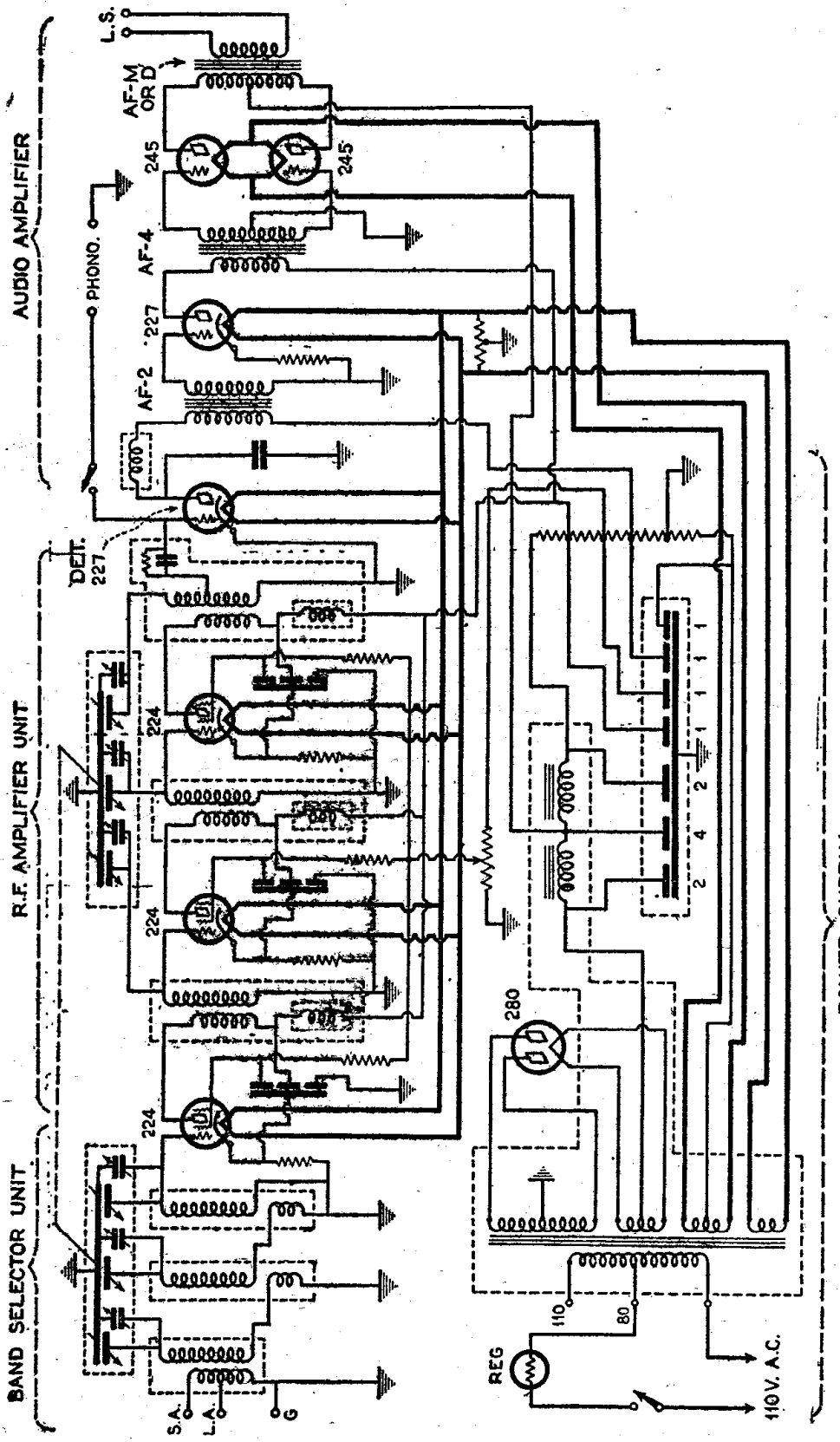
Circuit No. 91



Circuit No. 92

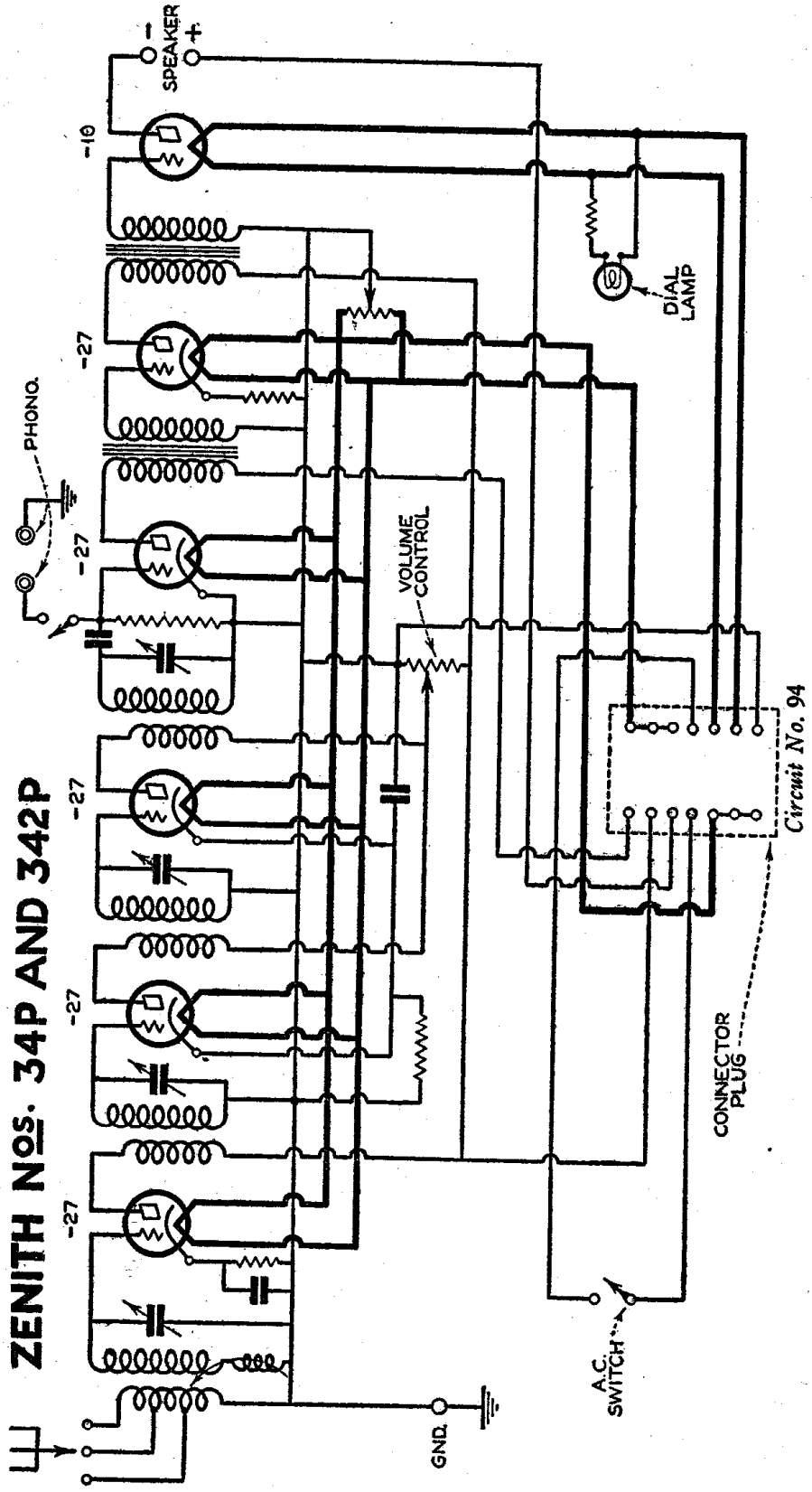
tions in the 110 volt a.c. lighting circuit.

CIRCUIT No. 94 is a schematic diagram of the Zenith 34P and 342P, a.c. operated radio receiver. This circuit employs five -27 indirect heater type tubes in three stages of radio frequency amplification, detector and a first transformer-coupled audio stage, followed by a -10 tube in the final output audio stage. Antenna resonance is effected permitting single dial control by a tunable coil in the secondary of the first tuned inductance circuit. Volume is controlled by varying the plate potentials on the second and third radio frequency tubes. This radio receiver is intended for operation in conjunction with one of



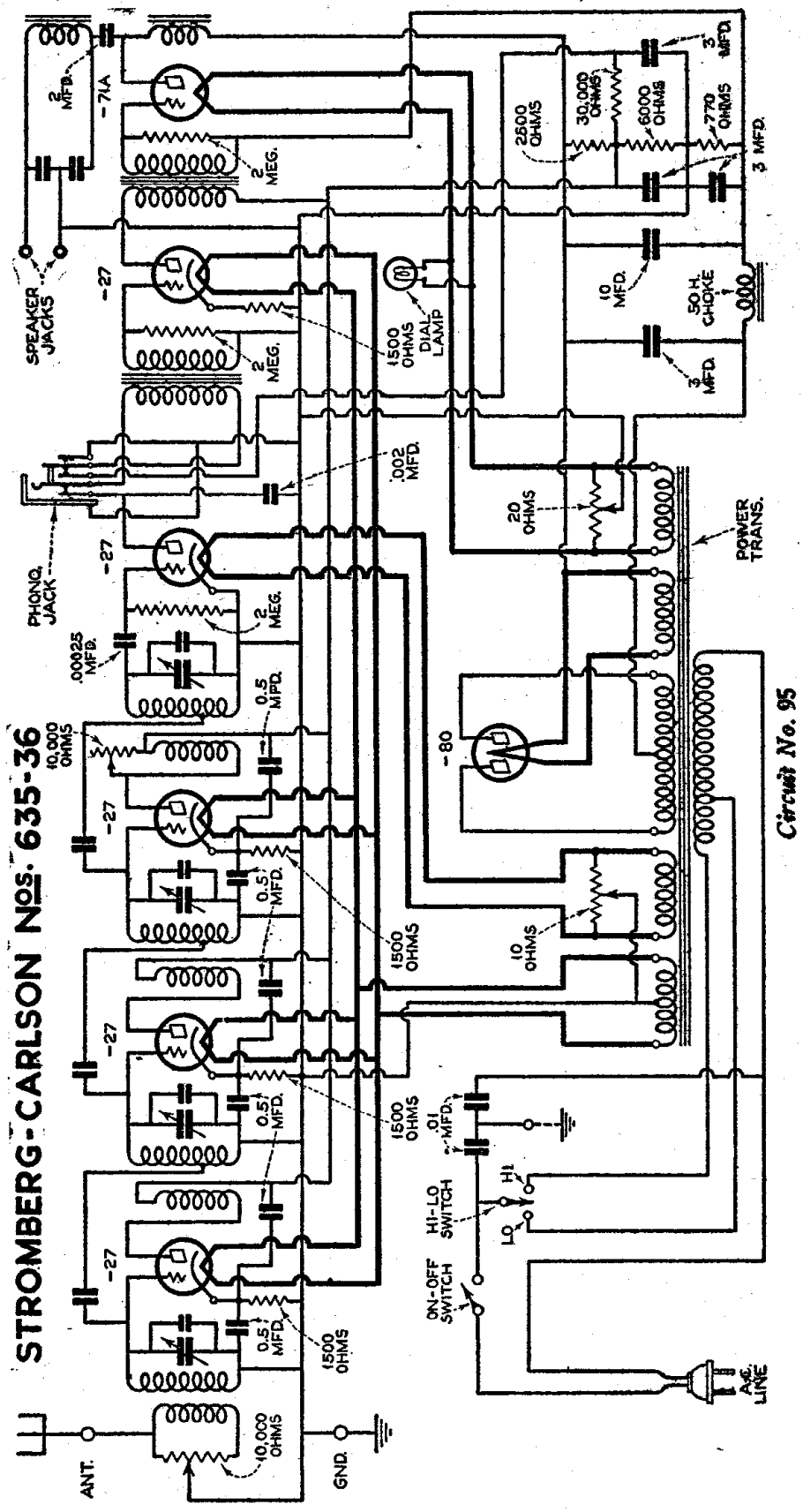
Circuit No. 93

Hammarlund "Hi-Q30"



the standard Zenith power packs, whose connections, in cable form, terminate at the connector plug of the radio receiver chassis. Provision has been made in this circuit for a phonograph pick-up for electrically playing phonograph records, making use of the detector, first audio and second audio tubes.

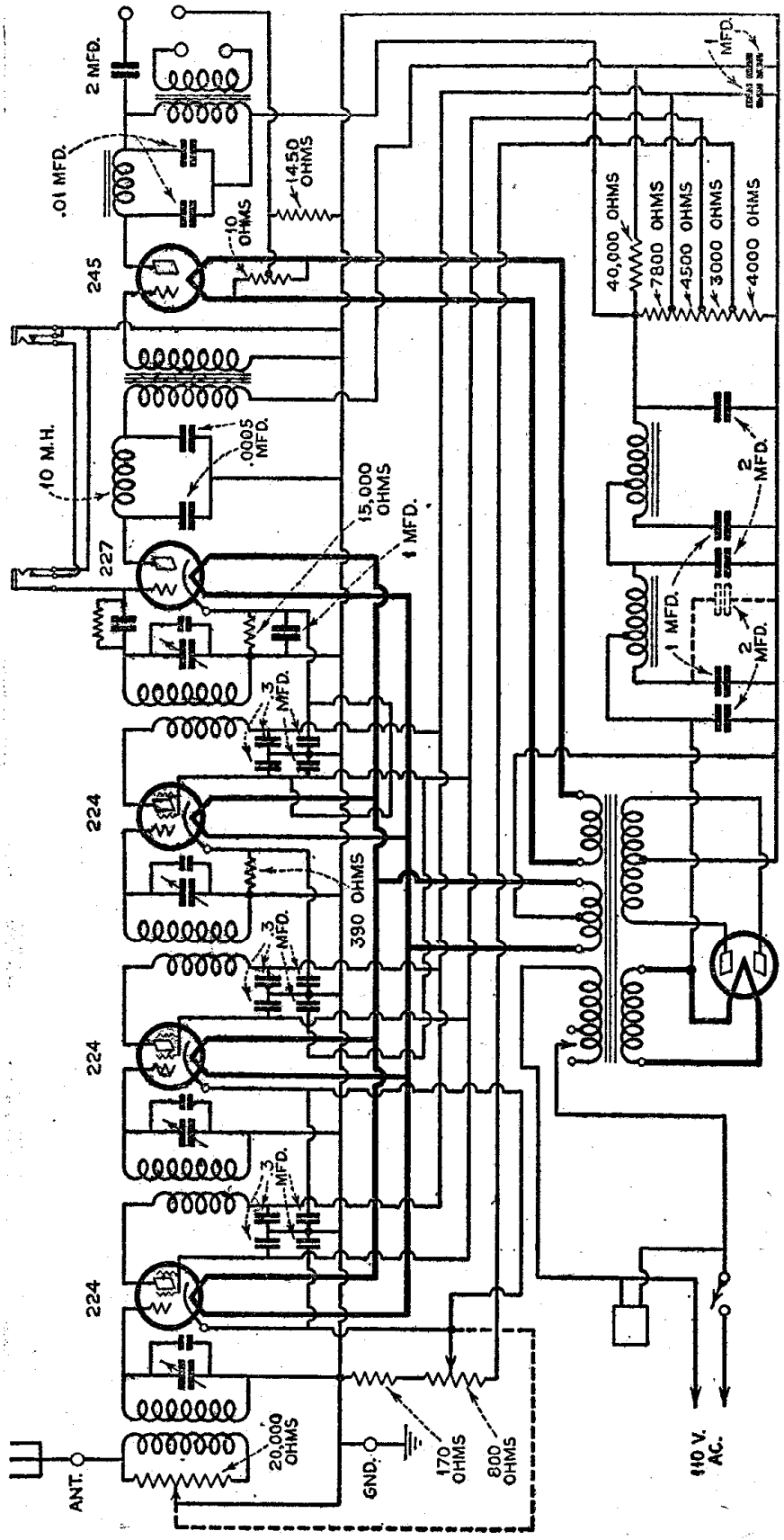
CIRCUIT No. 95, the Stromberg-Carlson model No. 635-36, five -27 indirect heater type tubes are employed in three stages of radio frequency amplification, detector and first audio, while a single -71A



tube is used in the second or output audio frequency stage. A full-wave rectifier -80 tube is employed in the "B" supply. Stabilization is effected by use of a modified neutralized radio frequency circuit. Provision has been made in this receiver for an external phono-pickup.

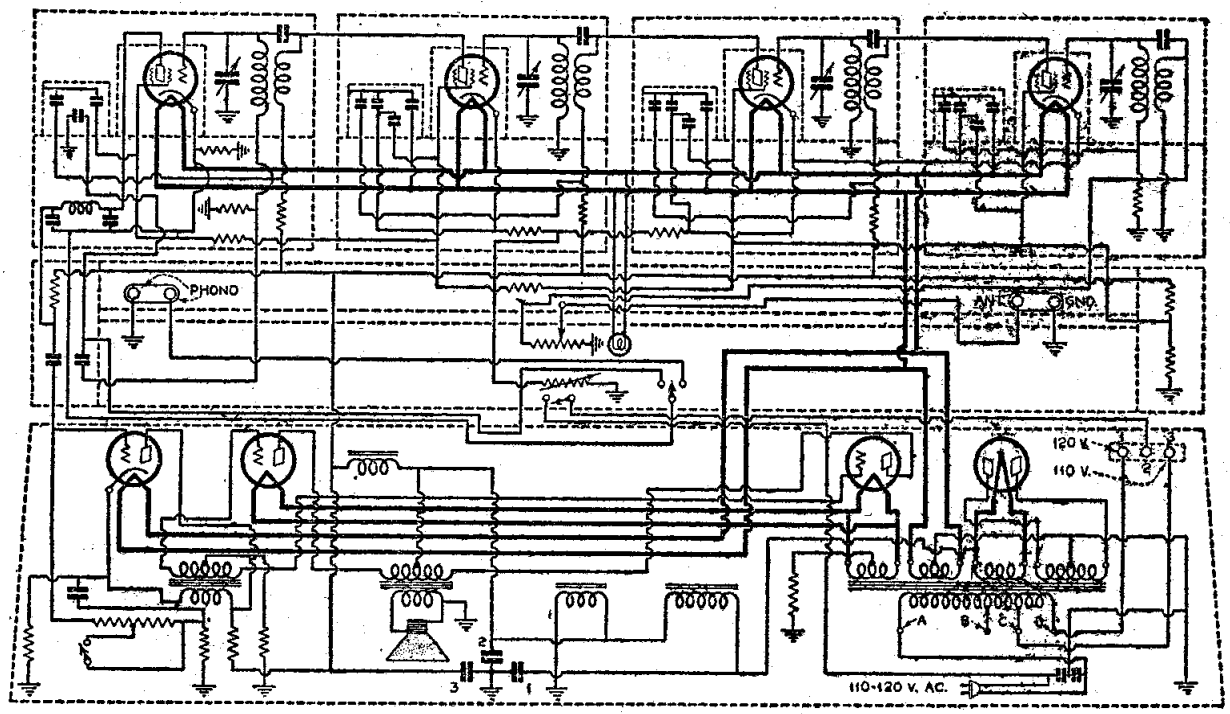
The Stromberg-Carlson screen-grid receiver No. 641 (circuit No. 96) employs complete shielding. As a means of stabilizing the radio-frequency circuits four filter condensers in groups of two, arranged in series-parallel are in each of the r.f. amplifier stages, to provide a by-pass for the screen-grid and plate circuits of each of these amplifiers.

The six tubes required for this radio receiver are as follows: three



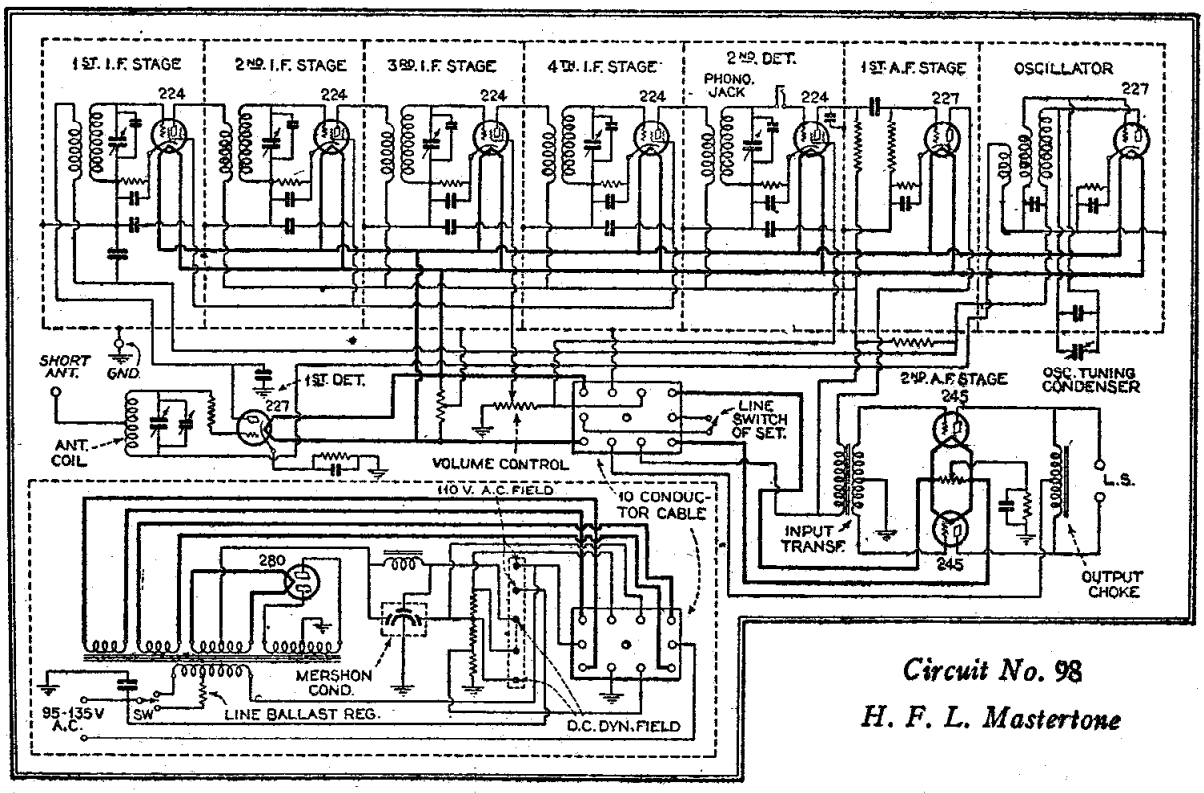
-24, one each -27, -45 and -80.

In the Colonial Model SG32 a.c. receiver (circuit No. 97) four sharply tuned circuits which are totally shielded from each other are "staggered" to secure a flat-top resonance curve. Automatic regulation of the audio channel allows equal quality of reproduction on both the low and high volume. The tuner comprises four shielded and filtered stages of high gain radio frequency amplification, employing four a.c. screen-grid tubes, one of which is used in the power-detector stage. The detector outputs to a resistance-coupled first audio stage employing the -27 type tube. The final audio stage comprises a power-amplifier employing two -45 tubes arranged in push-pull.



Circuit No. 97

Colonial SG32

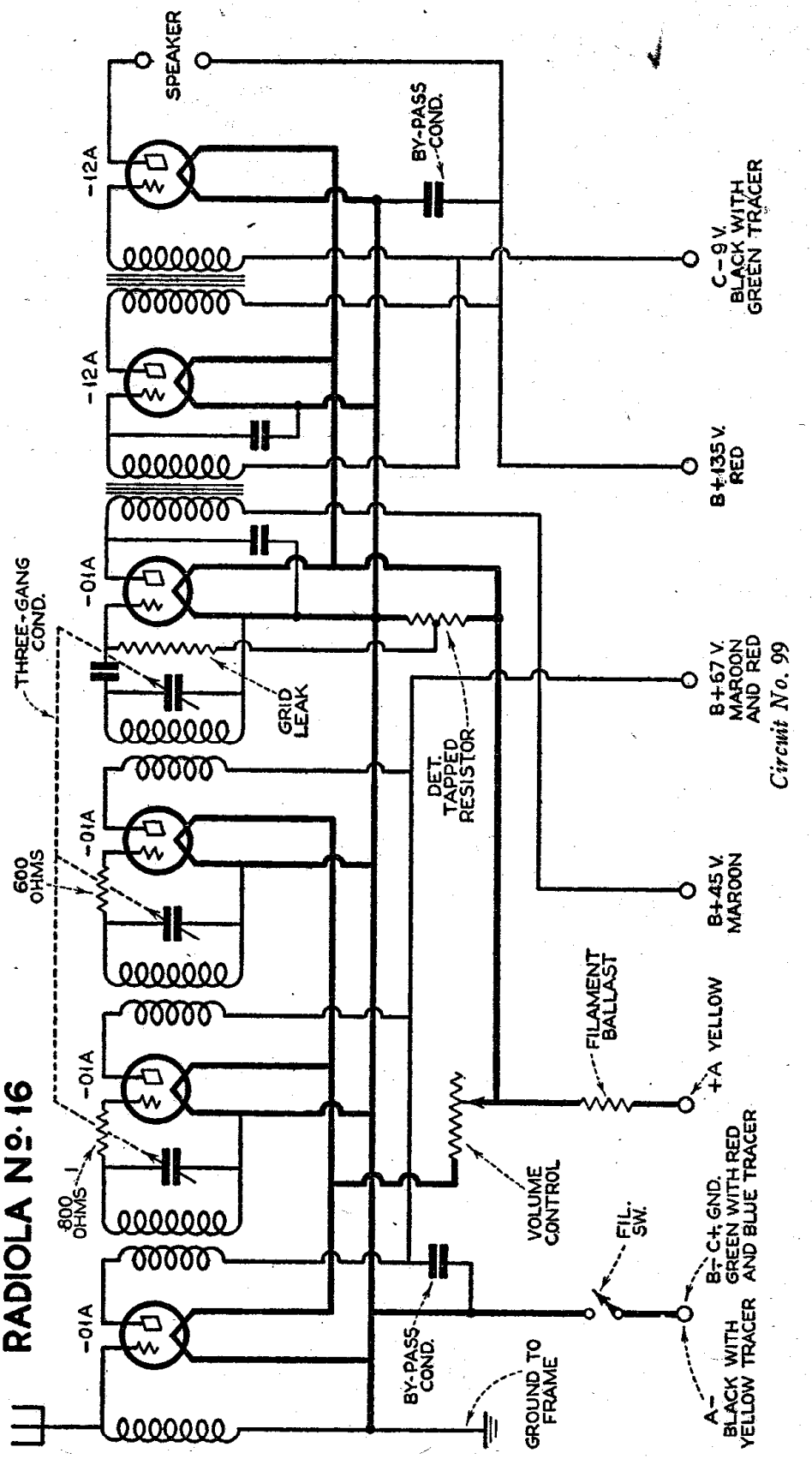


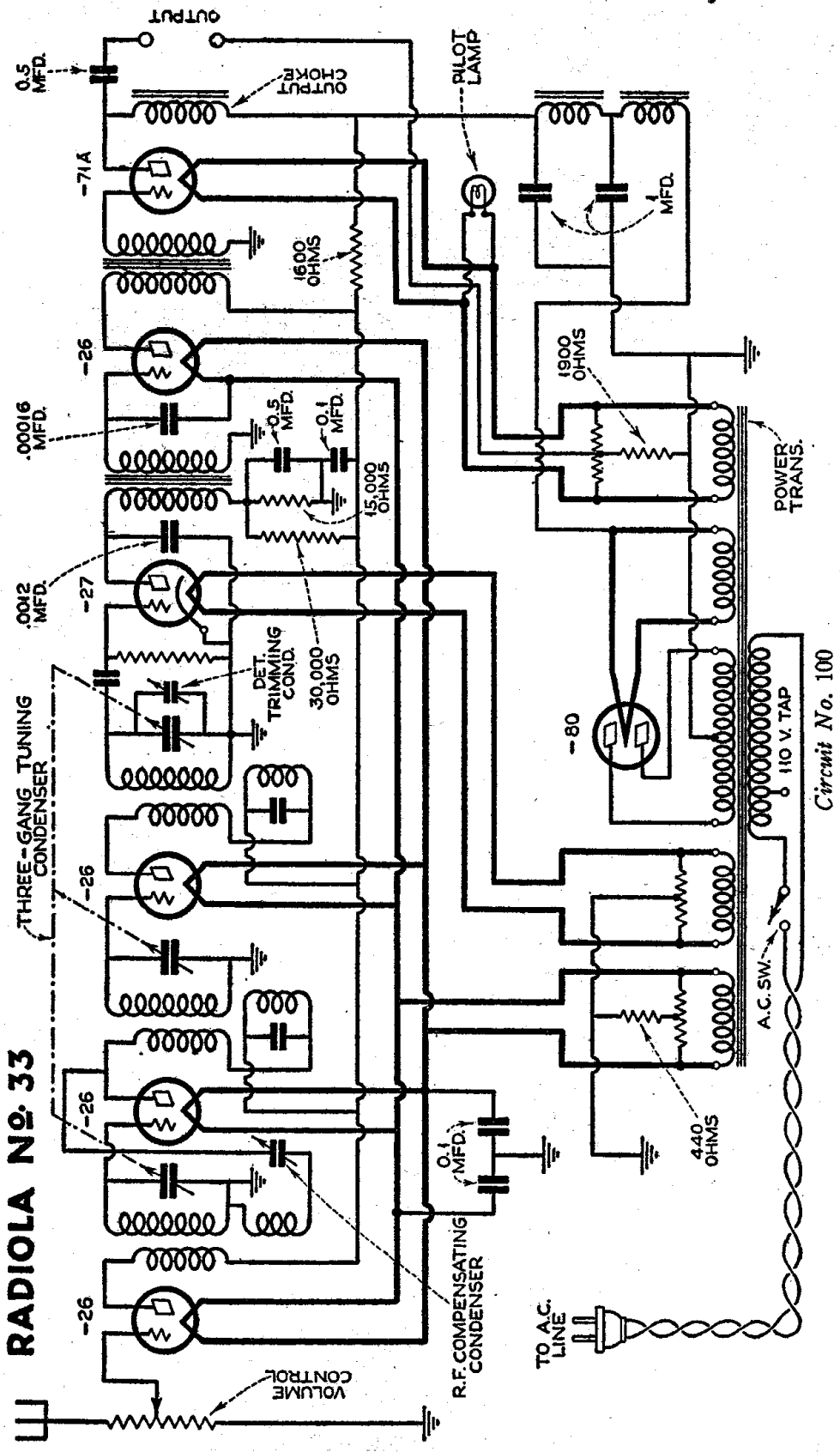
Circuit No. 98

H. F. L. Mastertone

CIRCUIT No. 98 is the diagram of the HFL Mastertone radio receiver including the power supply. Each tube in the intermediate and detector stages is individually shielded as are the individual coils. A pair of -45 tubes are employed in the power audio output stage.

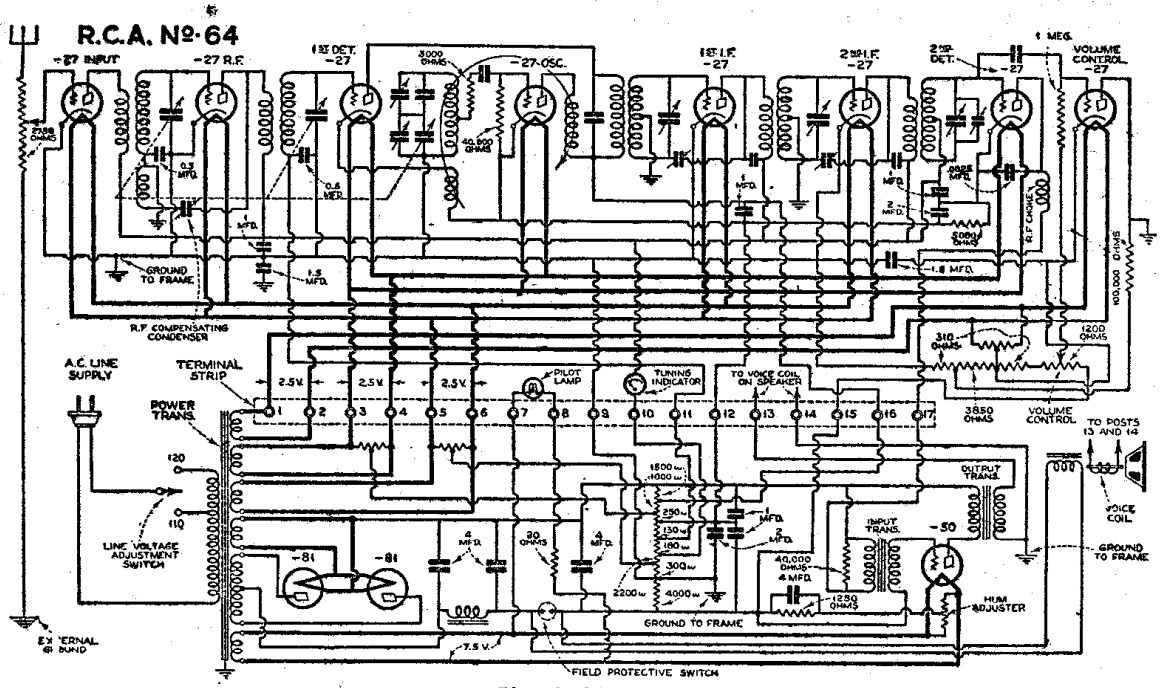
The battery-operated Radiola 16 (circuit No. 99) employs four -01A tubes in the radio frequency amplifiers and detector stage. A -12A tube in the first audio stage and a similar tube in the output stage. One dial control tuning is a feature of this receiver and is accomplished by using the first r.f. tube as a coupling medium. Volume is controlled by a rheostat in the positive filament circuit of the radio frequency amplifier tubes.





CIRCUIT No. 100 is a schematic diagram of the Radiola No. 33. Here three -26 tubes are employed as radio frequency amplifiers, -27 as detector, -26 first audio and a -71A as second or output audio amplifying stage. Full-wave rectification is obtained through the use of a -80 tube. This radio receiver is provided with one dial control although provision has been made for compensating on one of the radio frequency stages and a detector stage for extremely fine tuning.

In the Radiola No. 64 Superheterodyne (Circuit No. 101) -27 tubes are employed throughout up to the output stage where a super-power -50 tube is used. Two -81 tubes supply the "B" potential for the receiver and the field coil of the dynamic speaker.



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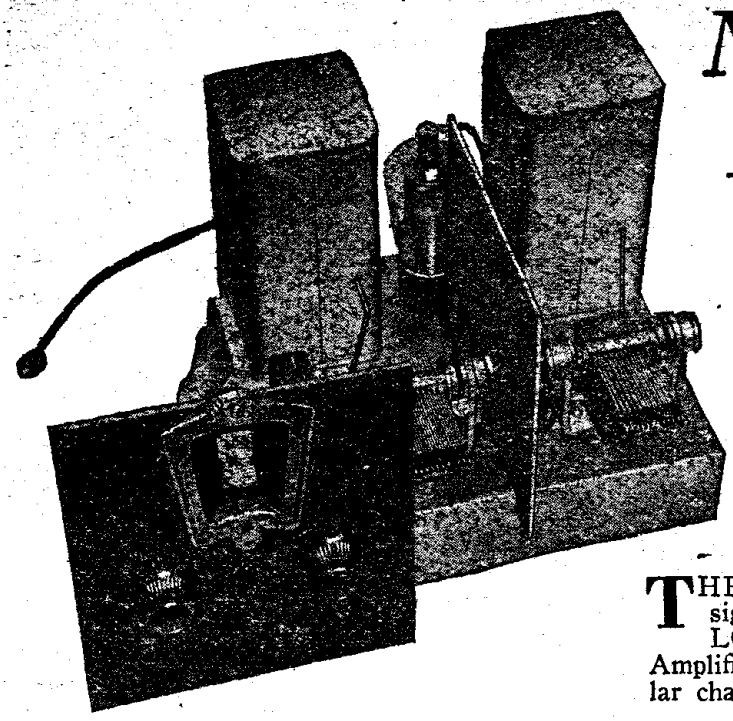

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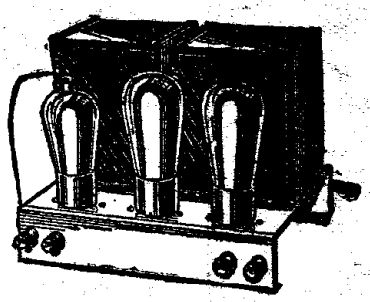

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