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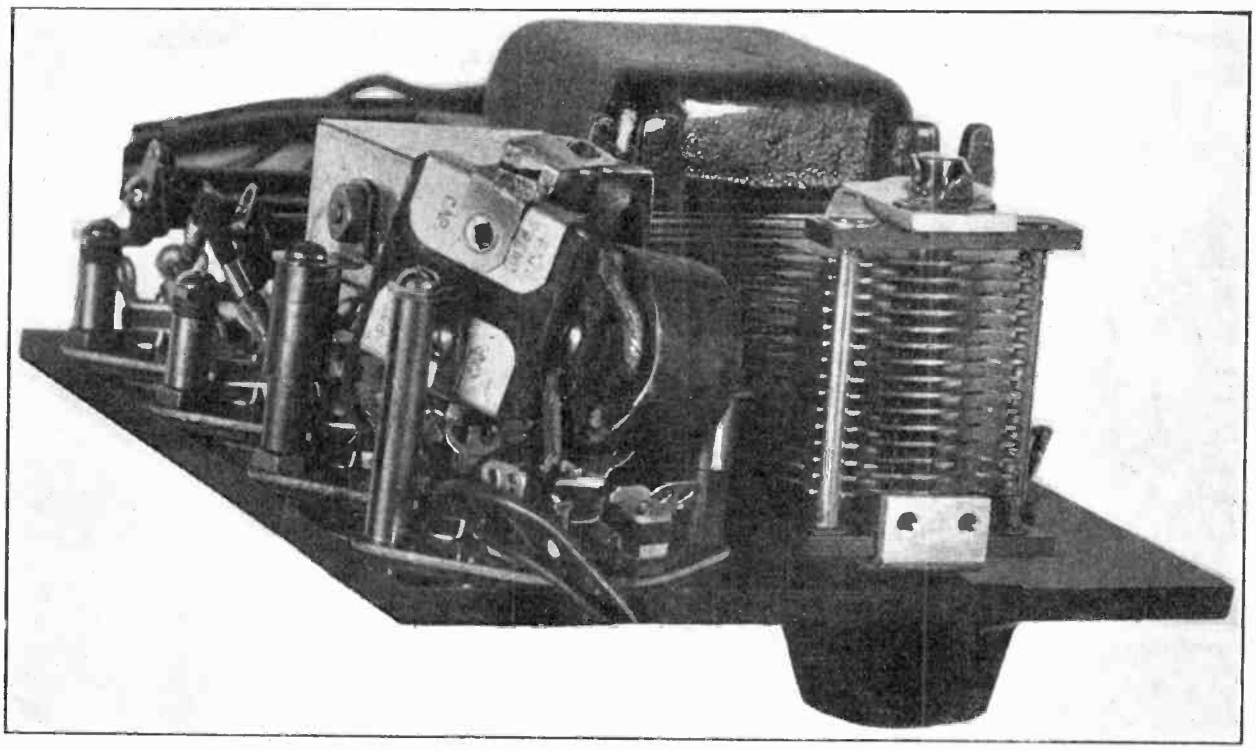
Short-Wave Converter with Filament Supply



View of a short-wave converter with filament supply, on a 5 x 6½ inch panel. See article on pages 5, 6 and 7.

RADIO WORLD, Published by Hennessy Radio Publications Corporation. Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager, all of 145 West 45th Street, New York, N. Y.

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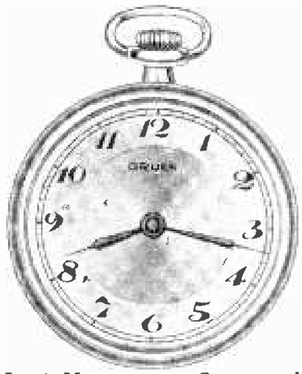

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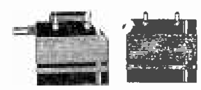

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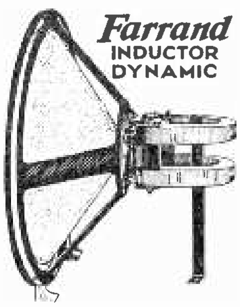

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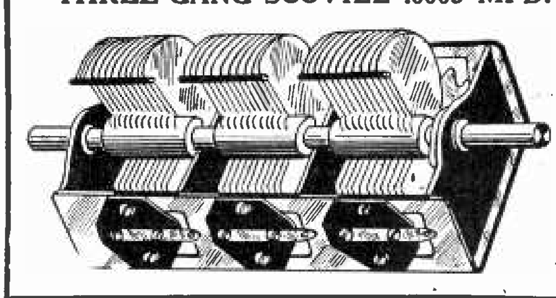

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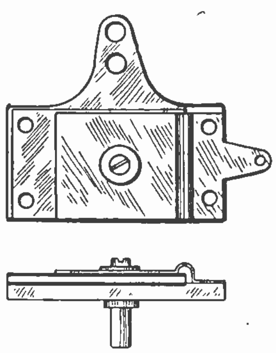

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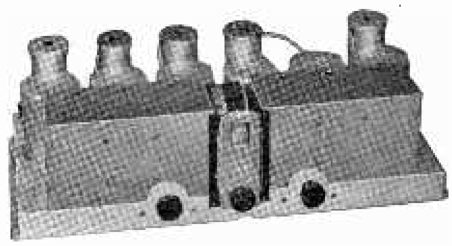

NEW NATIONAL DE LUXE MB-30 SCREEN GRID TUNER—This is one of the most sensitive tuners ever developed, averaging 1 microvolt per meter, and at some frequencies attaining ¼ microvolt per meter. Its selectivity is most remarkable, and without material sideband cutting, due to use of Vreeland band pass filter and pre-selector circuits. Six tuned circuits, perfectly aligned and tested with laboratory equipment that cost more than $1,000. The circuit, which is for AC only, uses four 224 and one 227 tubes and requires a power amplifier that will power the heaters as well. All parts mounted on chassis, ready for wiring. Steel chassis, 21⅞x10⅜x1⅛". Order Cat. MB-30-P, list price $85 less tubes; net price..............................$48.97

WIRED MODEL, Cat. MB-30-W, list price $95 less tubes; net price..............................$54.66

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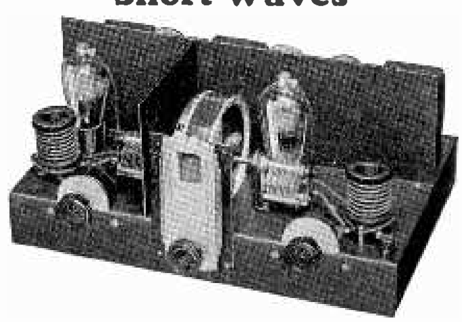

NATIONAL 5-TUBE THRILL BOX—A remarkably sensitive short-wave outfit, noted for reception of foreign stations. Uses 224 RF, 224 detector, 227 first audio, 227 push-pull second audio. A separate A and B supply is required. See below. Standard set of four pairs of coils included (21.2 to 2.61 megacycles). Humless operation, even on earphones. Single tuning control. No grunting, no backlash, no hand capacity. Order Cat. AC-SW-5, list price, less tubes, less B supply, $79.50; net price..............................$46.74

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Vol. XVIII. No. 12 Whole No. 454
December 6th. 1930
[Entered as second-class matter, March, 1922, at the Post Office at New York, N. Y., under act of March, 1879]
15c per Copy, $6.00 per Year

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A Short-Wave Converter with Filament Supply

By Herman Bernard

[In consecutive preceding issues were published data on the construction of a short-wave converter for AC or battery operation. This converter used a .00035 mfd. tuning condenser, covering 30 to 110 meters, by using a wave band switch to cut out some of the inductance for the lower wave range. The AC model required an external filament transformer, or other source providing 2½ volts AC, as there was no room inside for the filament transformer, owing to the large tuning condenser. The battery model used three 227 tubes, also, but with heaters in series, across a 6-volt storage battery. This week an article is begun herewith on the construction of an AC model converter with filament supply built in, and using somewhat less inexpensive parts. Battery-operated equivalents will be published soon.—EDITOR.]

IN the construction of a short-wave converter it is desirable to have radio frequency amplification ahead of the modulator, and for this purpose a stage of untuned radio frequency amplification is included, as shown in Fig. 1. This builds up the incoming short wave, so that the amplitude is magnified about six times.

Then the input is made to the modulator, or so-called detector, and since an oscillator is coupled to the detector, the two frequencies mix, that is, the short-wave frequency and the oscillator frequency. The output of the modulator is the difference between the two frequencies, and this difference is maintained the same, while only the oscillator frequency is changed. Hence only one tuning control is used, a single condenser, in this instance the new Hammarlund junior, of 200 mmfd. capacity, having a midline characteristic.

Mustn't Amplify Too Much

While it is desirable to build up the amplification of the incoming signal, there is a limit to which this can be pressed. This limit results from the reduction in apparent selectivity when there is amplification without selection, as in an untuned RF stage. The limit must be respected where the receiver to be worked is an unknown quantity.

However, a modified degree of selection does obtain, due to the use of a ¼ millihenry choke in the grid circuit of the first tube and also in its plate circuit, so that the higher frequencies are favored.

It has been a mistake to include choke coils in these positions, where the chokes are of inductance values designed for broadcast work. All models of converters discussed in the November 8th, 15th, 22d and 29th issues used the ¼-millihenry chokes.

The amplification, therefore, is not made any more than it is, simply to sustain the use of a single tuned circuit in conjunction with any broadcast receiver. The selectivity will be found ample.

This explanation also covers the question, sometimes asked, why a screen grid tube is not used.

Smaller Tuning Condenser Requires Plug-in-Coils

Inclusion of the filament transformer in the short-wave converter makes it impossible to use a .00035 mfd. tuning condenser, as was done in the previous model, since there would be no room in the cabinet for both, and the smaller condenser re-

(*Continued on next page*)

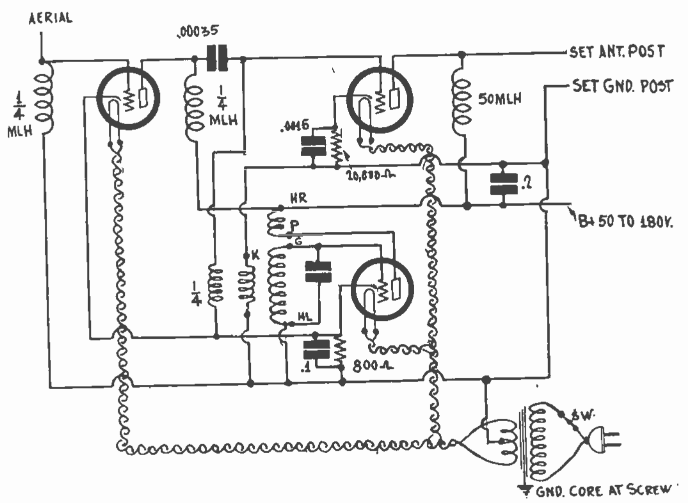


FIG. 1.
POWER MODULATOR, WITH THE BERNARD SYSTEM OF MODULATION, IS USED IN THIS AC MODEL SHORT-WAVE CONVERTER, WHICH HAS FILAMENT SUPPLY BUILT-IN.

LIST OF PARTS

One Hammarlund special junior midline condenser, 200 mmfd: single hole panel mount
Three ¼-millihenry radio frequency choke coils
One 50-millihenry radio frequency choke coil
Two plug-in coils constructed on tube base forms
Four UY sockets (three for 227 tubes, one for coil)
Two .00035 mfd. mica dielectric fixed condensers
One .0015 mfd. mica dielectric condenser
One three-in-one 0.1 mfd. condenser (three 0.1 mfd. in one case; two reds paralleled to constitute 0.2 mfd.)
One 20,000-ohm metallized biasing resistor with pigtails
One 800-ohm flexible biasing resistor with lugs
One 5 x 6½-inch panel, drilled for sockets, condenser and switch.
One walnut finished wooden cabinet to fit panel.
Two knobs with pointers moulded at rim
Two engraved scales, one for switch (On-Off) one for tuning (0-100)
One filament transformer, 2½-volt secondary center-tapped; 8 ampere capacity.
One Hart and Hegeman AC switch of the shaft type; single hole panel mount
One AC cable with male plug
One four-lead cable

A Power Modulator

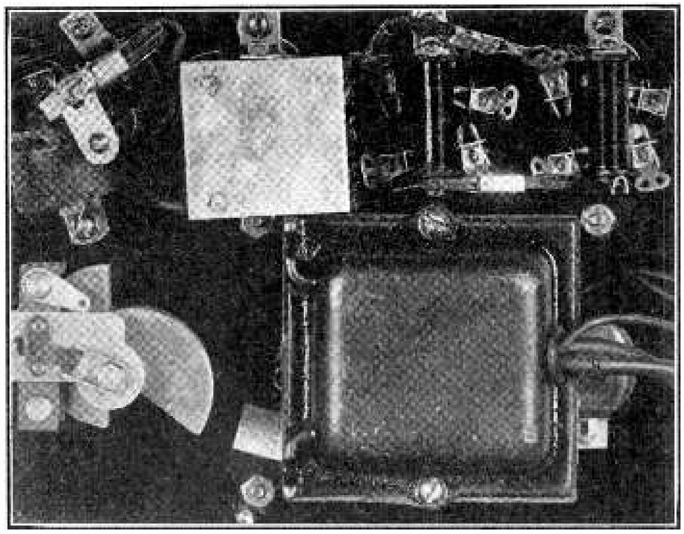


FIG. 2.
HOW PARTS WERE DISPOSED IN ONE PHYSICAL ARRANGEMENT. SLIGHT CHANGES WERE MADE IN THIS TO CONSTITUTE THE FINAL DESIGN.

(Continued from preceding page)

quires plug-in coils. Two coils, with this capacity, will cover from 15 to 120 meters.

Also, with smaller tuning capacity, as here, the physical distribution of the frequencies over the dial scale is enlarged, which is a vernier effect, resulting therefore in greater dial separation between stations, although this has no bearing on selectivity whatever.

The coupling between modulator and oscillator is made by the same system used in the previous model, and which has proved very effective, making for high sensitivity. The cathode lead of the modulator is interrupted on its way to ground by a small winding in inductive relationship to the secondary of the oscillator coil.

In Fig. 1 it can be seen that the first connection in the cathode lead is that of a resistor of 20,000 ohms, bypassed by a .0015 mfd. fixed condenser. This is a biasing resistor, and it is placed in the position shown so that the end of the coil in the cathode lead may go to ground, enabling use of a five-prong coil plug that will fit into a UY socket. If the biasing system were moved below the coil, then special six-prong bases and special six-spring sockets would have to be used for the coil plug-in system.

The 20,000-ohm resistor affords excellent modulation, even though the plate voltage may be anything from 50 volts up to 180 volts. This is because increase in plate voltage increases the plate current, hence the voltage drop in the biasing resistor, hence increases the bias, since the plate current flows through this resistor to the pickup coil and to ground.

So, with 180 volts applied you will have real power modulation.

The 800-ohm resistor will provide the correct bias for the 227s used as RF amplifier and oscillator, as here, too, any increase in plate voltage will increase the bias. Of course decreased plate voltage will have the opposite effect, but in any instance the bias will be correct.

If the plug-in coils, of which two are needed, are wound on standard forms that have plug-in bases that fit UY sockets, the diameter will be about 1⅜ inches.

Coil Connections to Prongs

It would be a happy circumstance, indeed, if there were some standard for the method of connection, so that coils purchased or made for one circuit could be used in another, but there is no such standard, and perhaps the multiplicity of circuits with dissimilar requirements makes the establishment of a standard very difficult. However, it is proposed that for circuits resembling the present one, the prongs of the bases should correspond to the following connections:

G—To grid of the tuned circuit, in this instance the oscillator.
HL—To grounded B minus.
HR—To B plus.
P—To plate.
K—To the pickup circuit.

In the foregoing, G stands for grid, HL and HR for heater left and heater right, respectively, when the grid prong is held toward you; P for plate and K for cathode. These do not represent tube connections at all, but coil connections to circuits working the tubes, since the sockets under discussion are used as coil receptacles, not as tube receptacles.

The circuit diagram identifies these leads in respect to the two coils to be used. The phases will be right if the windings are in the same direction, and oscillation will result.

The modulator cathode circuit is a high current density circuit compared with the strictly grid circuit of the same tube, hence to effectuate suitable coupling fewer turns need be used. In the present case only two turns were used for the larger coil and one turn for the smaller coil. Experiments with larger numbers of turns proved the inadvisability of continuing in this direction, while reduction in the specified numbers of turns reduced the volume a little. A fraction of a turn was tried in place of the single turn specified, and this reduced the volume about 25 per cent.

A danger ever present in increasing the number of turns of the pickup coil is that oscillation may be rendered doubtful, particularly at the higher frequencies tuned in with the smaller plug-in inductance.

The mixing is well accomplished, and the only question remaining, in regard to the modulator circuit, is what type of modulator to use, whether of grid bias (power) type, or of the leak-condenser type.

In the previous model grid-leak-condenser modulator was used, and of course this works very well indeed, but with the AC model now under consideration, in view of a superior order of parts used, the somewhat lessened sensitivity of power detection may be resorted to, in the interest of quieter reception.

"The air seems clearer," said a listener, concerning the circuit worked on the principle of Fig. 1.

He did not know anything about radio, but his remark states the case nicely.

Costs Less Than $10

Considering the improvement in the calibre of parts and the inclusion of the filament supply, it can be said that the model now under discussion represents an excellent choice for a converter costing less than $10, exclusive of tubes.

Not only is the filament transformer snugly fitted inside the small cabinet, but there is an AC switch, made by Hart and Hegeman, on the panel to balance the knob used for tuning. The tuning knob, by the way, has a pointer, used as reference to an engraved scale.

No vernier action is provided by the tuning knob, but if any circumstance should arise whereby a vernier effect is required, this may be obtained from the broadcast receiver in conjunction with which it is necessary to work the converter. Slightly readjust the receiver dial for vernier effect.

The broadcast receiver is depended on, (1), to furnish the intermediate frequency, which may be any frequency on which there is no broadcast station within the sensitivity range of the receiver, preferably a high frequency, if possible; (2), to afford the grounded B minus connection, which is done simply by running the ground cable of the converter to the ground post of the set and leaving ground connected to set; and (3), a positive B voltage of 50 volts or more, which may be picked up from the screen grid of the radio frequency tube next to the detector in the set, or may be obtained otherwise from the receiver.

The previous series of articles, already cited, described various methods of obtaining this B voltage.

The coil winding for the larger inductance might be readily computed, since the diameter of the form is known, the size of wire may be selected, and the maximum capacity of the con-

(Continued on next page)

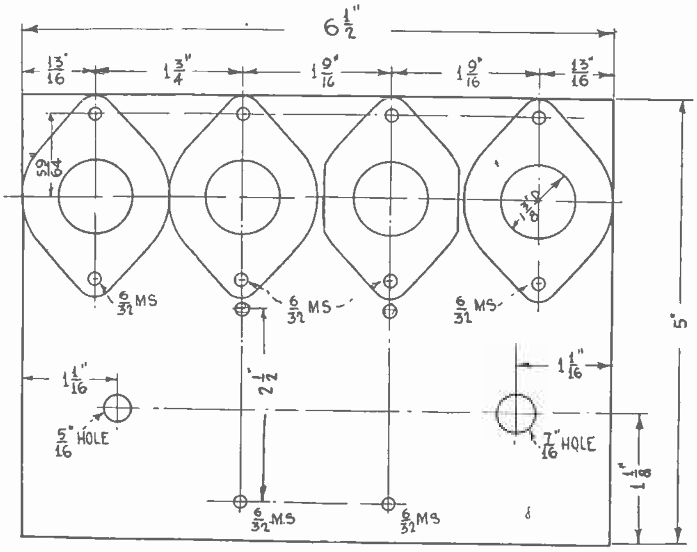
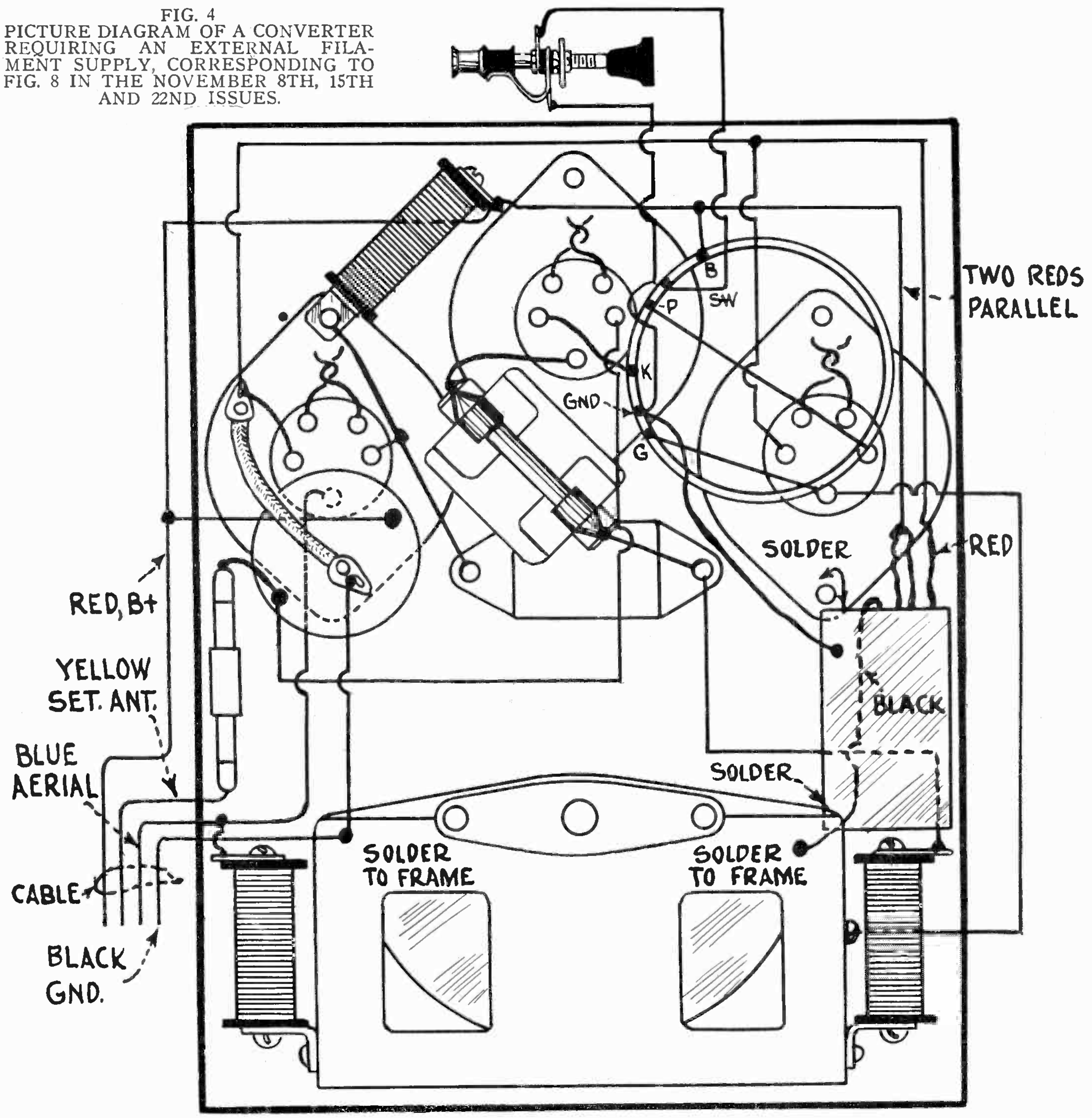
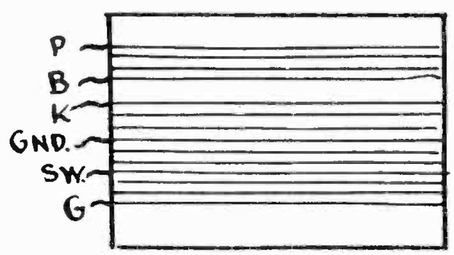


FIG. 3.
ARRANGEMENT OF THE TOP PANEL OF THE CONVERTER WITH BUILT-IN FILAMENT SUPPLY.

FIG. 4
PICTURE DIAGRAM OF A CONVERTER REQUIRING AN EXTERNAL FILAMENT SUPPLY, CORRESPONDING TO FIG. 8 IN THE NOVEMBER 8TH, 15TH AND 22ND ISSUES.





This diagram is full-scale.

(Continued from preceding page)

denser is 200 mfd. However, the minimum capacity of the condenser is not known at this writing, although might be assumed not to exceed 10 mmfd. The smaller coil could be designed only by the cut-and-try method, due to several capacities not being known, or even computable, including capacity between wire leads in the converter. Hence the coil data will be given next week, in the issue of December 13th, by which time the new Hammarlund condenser will be in hand long enough for this purpose.

What the condenser looks like may be seen from the photographs of one of the models on which the present circuit was based. The particular model used grid-leak-condenser modulator, and had the three tube sockets and the coil socket in a row, although later experiments proved the advisability of arranging the sockets slightly differently, to allow more room between adjoining tubes, and also to move the tuning condenser nearer the bottom, and put the coil between two tubes, so the hand doing the tuning would be as far out of the field as practical, resulting in absence of body capacity.

The panel size is only 5 x 6½ inches, and it might be supposed there is hardly room inside for all the parts. However, a few hours of "playing checkers" with parts resulted in a fairly good solution, which was improved upon from an operating viewpoint by a few changes such as those outlined.

All-Wave Reception

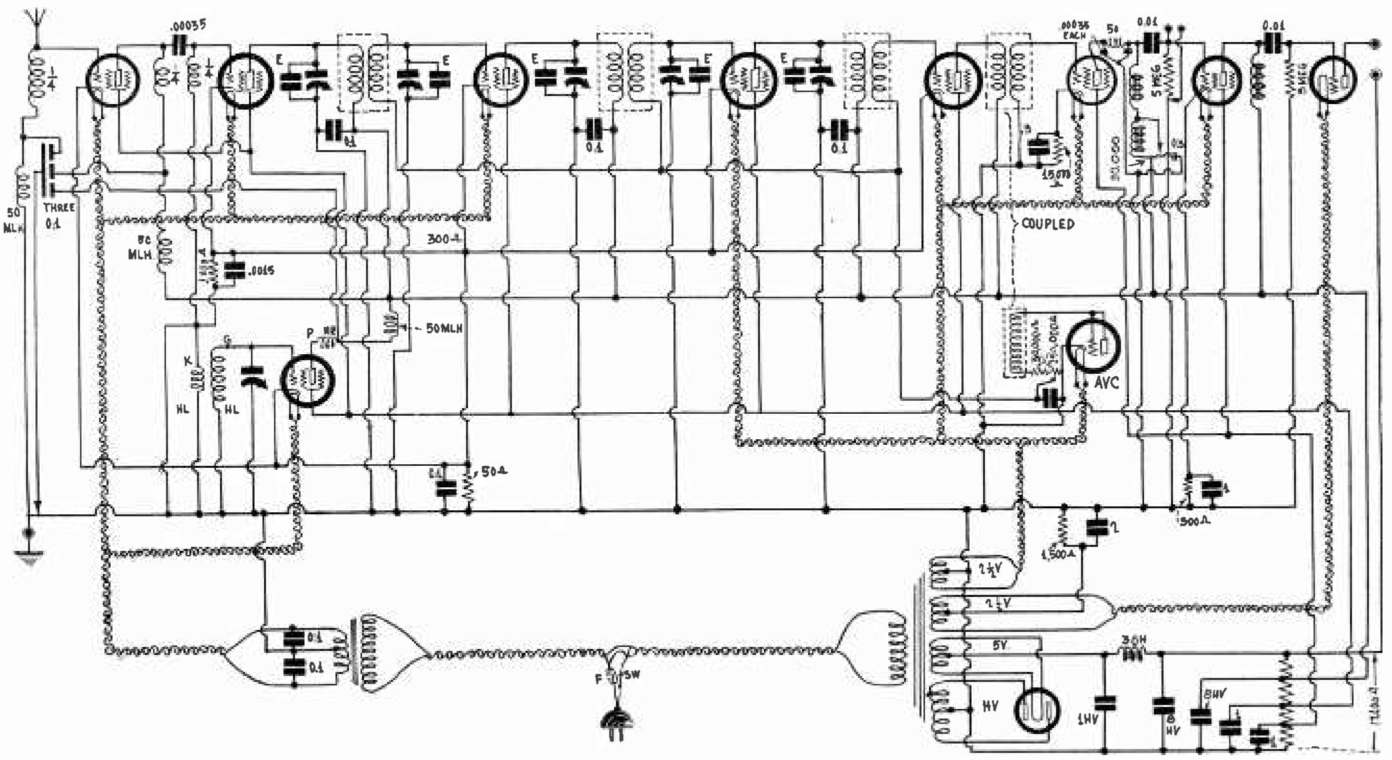


FIG. 1
AN ALL-WAVE RECEIVER, WHICH TUNES IN SHORT WAVES OR BROADCAST WAVES BY THE FLIP OF A SINGLE-POLE, SINGLE-THROW SWITCH.

VARIOUS attempts to gain all-wave reception, some of which have been published in the preceding three issues, have resolved themselves into a system that embodies a tuned radio frequency set with a short-wave adjunct, all tubes being lighted at all times the receiver is "on," and only one single pole single throw switch being used to change from short waves to broadcast waves.

The diagram of a complete receiver embodying this system is published as Fig. 1 herewith.

The single-switch operation is as follows:

A stage of untuned radio frequency amplification, using tiny chokes such as are most suitable for short waves, feeds another stage with untuned input, after which a regulation tuned radio frequency receiver is operative.

When the switch, which goes to ground at left, is thrown to "on" position, three bypass condensers are cut across three large radio frequency chokes, and thus the effective load is that presented by the small series chokes alone. Short waves are favored in the untuned amplification, and the oscillator tube, lower left, will oscillate, because the choke in the B plus lead thereto is bypassed.

Worked on Broadcasts

When the switch is thrown to "off" position, the loads are the sum of the small and the large chokes, the three 0.1 mfd. bypass condensers are cut out, and broadcast waves are favored. Also the oscillator doesn't oscillate, and serves no useful purpose now that broadcast waves are to be tuned in. It is advisable to stop the tube from oscillating so as to avoid danger of interference that might arise otherwise.

That constitutes the entire solution of the mechanical problem of switching from short to broadcast waves, and takes care of some of the electrical features.

The principal remaining features are (1) the fact that the oscillator, when functioning for short waves, is tuned by one of the sections of a gang condenser and when not functioning, for broadcast waves is out of circuit; and (2) that the second frequency of amplification, pertinent when short waves are received, is changing all the while the dial is turned, since the same dial on the receiver is used in both instances.

This feature, an ever-changing intermediate frequency, constitutes one of the main novelties, and indeed, the backbone of the invention. The amplification, with the small chokes cut in exclusively, since the large ones are bypassed, is such that little if any transmission of broadcast frequencies is made to the intermediate amplifier.

Also, the fact that the mixing circuit for short waves is built into the receiver proper eliminates any long lead from the modulator output to the intermediate input that would function as a pickup or aerial for broadcast signals. Were broadcast signals to come through they would nearly always overpower short-wave signals obtainable at that intermediate frequency.

A fundamental requirement, also, is that the TRF part of the receiver shall have a fairly uniform sensitivity over the broadcast band of wavelengths. This is accomplished by the untuned stage feeding the "second detector," broadly peaked around 450 meters, and by the automatic volume control tube, AVC.

Other Features

Aside from the dual frequency service of the tuning system, there are other attractions in the design. One is the new type of automatic volume control, operating on the principle of a C battery eliminator, developed by J. E. Anderson. No plate current from the automatically biased tubes flows through the resistor in the cathode leg of the control tube. Besides the automatic bias there is some additional bias, due to the drop in a 50-ohm resistor.

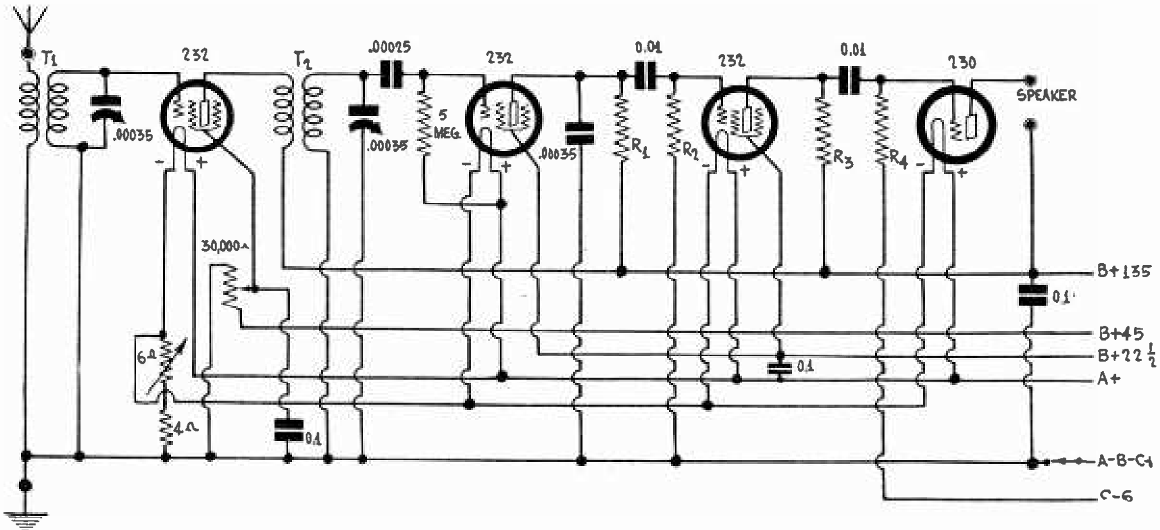
Also present are a tone control that does not cut the volume when adjusted to any position; a phonograph pickup connection; a band pass filter circuit for input to the TRF section; negative grid bias modulation (second tube from left), due to bias being detection."—Herman Bernard.

Suitable for Portable

By Herbert E. Hayden

FIG. 1.

THE CIRCUIT DIAGRAM OF A FOUR-TUBE RECEIVER WHICH MAY BE USED IN A PORTABLE. IT IS CAPABLE OF GOOD QUALITY AND HIGH SENSITIVITY AND MAY BE ASSEMBLED COMPACTLY.



WHEN midget and portable sets are to be built, the new two-volt tubes are highly suitable for the purpose. And these tubes are good amplifiers and detectors so that good results may be expected from a circuit built with them. The output tube in this series is large enough for a portable set.

When a set is to meet the demands of portability, what should its make-up be? That is, how many tuners, what type of detector, what kind of audio frequency amplification, and how many tubes should there be in the circuit?

Meets Portable Needs

The number of tuners and the number of radio frequency amplifiers depend on the places where the set is to be used and whether or not the condensers are separately tuned.

If the condensers are separately tuned at least one tuned stage less will do the work because at all points of the dials the receiver can be tuned accurately, and the selectivity will often be greater than if several additional tuned circuits were used and put on the same control.

If we use good tuning coils, separate tuning of the circuits, and screen grid amplification, a circuit like that shown in Fig. 1 is well suited to the needs of the portable set fan.

We have a high-gain radio frequency amplifier utilizing a 232 screen grid tube. Then we have a screen grid tube detector working on the grid leak and condenser principle, which is the most sensitive. Following this we have a stage of audio frequency amplification utilizing another 232 tube and coupling to the tube ahead of it as well as to the tube behind it by means of resistance-capacity.

Obtainable Amplification

The final tube in the circuit is a 230 general purpose tube, which feeds into the loudspeaker, supposed to be a magnetic because this matches the impedance of the tube better than a dynamic without an output transformer. Heavy output transformers, or any transformers, have no place in a portable receiver. Neither does a dynamic speaker, for that matter.

When the voltage applied to the plate of the 230 is 135 volts, the required grid bias is about 6 volts. Thus to load up the power tube the signal amplitude should be 6 volts. By suitable choice of coupling resistances the amplification obtainable from the 232 is about 50 times, a conservative estimate. This means that the amplitude of the signal voltage on this tube should be 6/50, or 0.12 volt, which can be obtained from the detector without any trouble at all, provided, of course, that the amplitude of the radio frequency signal impressed on the detector is high enough.

To get this signal, it is only necessary to provide a good antenna and ground, good tuners, accurately adjusted, and a good screen grid radio frequency amplifier.

Voltages on the Tubes

The applied voltage on the plates is the same for all the tubes. This is done to insure simplicity of the circuit. The maximum screen voltage on the first tube is 45 volts and may be varied down to zero by means of a 30,000 ohm potentiometer. This control serves to adjust the volume to the desired level.

A rheostat in the negative filament lead common to all the tubes is an additional volume control, and more particularly is an addition to a fixed resistor the value of which should be 4 ohms when the voltage of the filament battery is 3 volts. Ballast resistors for one 201A tube and a six volt battery are 4 ohms, and these ballasts are plentiful. The value of the rheostat might be six ohms. The object is to keep the filament voltage right despite battery changes.

The screen voltage on the detector and the first audio frequency amplifier is 22.5 volts. This voltage is tentative and different values should be tried because it may be that better quality and greater amplification will result from different values, say between 10 and 15 volts. This is true particularly when the plate coupling resistance R1 and R3 have high values, and they should have high values if good detecting efficiency and high amplification are to be expected from the tubes. In place of a lower value of applied screen voltage, a resistance of 100,000 ohms may be put in series with each screen grid of these two tubes, but in that case the applied voltage should be considerably higher, say between 45 and 67 volts.

The reason for the permissible use of a high resistance in the screen circuit of these tubes is that as the plate current increases, the screen current also increases. Hence the actual effective plate and screen voltages decrease together, and the point is not reached where the screen voltage is equal to or greater than the plate voltage. This condition must not be approached for as soon as the two voltages are equal the tube ceases to function. It may be prevented from occurring in the operating range of either of the two methods suggested above, that is, by a low fixed screen voltage or a high value with a high resistance in series with each screen grid lead.

Coupling Resistances

The values recommended for R1 and R3 are 250,000 ohms, and the values for the grid leads R2 and R4 about 2 megohms. There is little danger of blocking due to too high values of grid leaks, provided that the values are not in excess of 5 megohm. By blocking is meant here the drift of the grid toward the positive.

Motorboating might occur in a circuit of this type for it has an odd number of plate circuits, but the oscillation, if it does occur, will not be at a very low and sub-audible frequency. It will be rather in the neighborhood of 100 cycles. This oscillation is amenable to treatment by by-pass condensers and series chokes in the plate leads. There should be no danger of motorboating if the B supply is well by-passed or if it is a set of new dry cell batteries.

The grid bias on all the tubes except the detector is variable,

(Continued on next page)

LIST OF PARTS

T1, T2—Two radio frequency transformers with secondaries would for .00035 mfd. tuning condensers.

R1, R3—Two 250,000 ohm plate resistances with mountings or pig-tails.

R2, R4—Two 2 megohm grid leak with mountings or pig-tails.

Two variable .00035 mfd. condensers.

One fixed .00035 mfd. condenser.

One .00025 mfd. fixed condenser.

Two 0.01 mfd. fixed condensers.

Three 0.1 mfd. fixed condensers

One 5 megohm grid leak

Two dials for the tuning condensers.

One 4-ohm ballast resistor.

One 6-ohm rheostat.

One 30,000 ohm potentiometer.

One Filament switch

Four UX sockets.

Neon Lamp for Tele

By J. E.

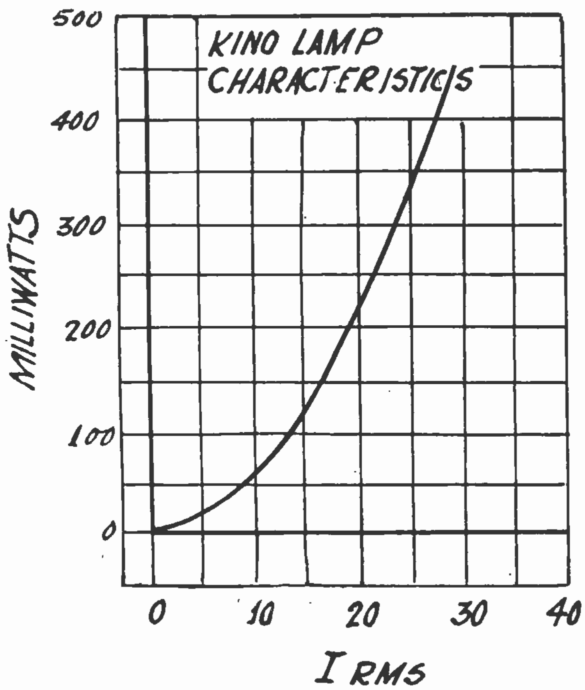


FIG. 4
RELATION BETWEEN THE POWER THAT MUST BE DELIVERED TO THE KINO LAMP FOR VARIOUS VALUES OF AC CURRENT

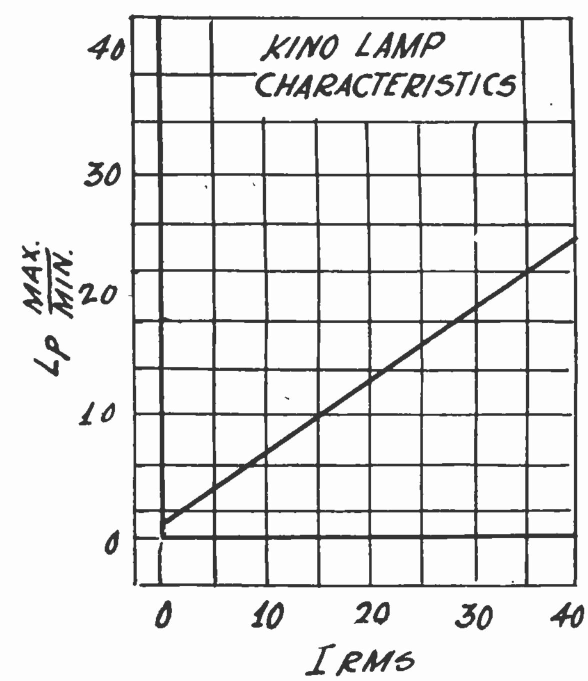


FIG. 2
BRIGHTNESS VARIATION WITH CHANGE IN AC CURRENT OF THE KINO LAMP.

THE neon glow tube may be classed as a modern tube because of its use in television receivers. In one form of neon tube as used for television purposes there are two flat, parallel plate electrodes immersed in a rarefied atmosphere of neon gas, and this tube is exemplified by the Eveready Raytheon Kino Lamp.

The neon tube has certain peculiar and desirable qualities. First, the luminous intensity of the plates varies directly as the current flowing between the plates, and second, the response is instantaneous, or the lag of the response after the voltage is so short that it is not measurable.

This instantaneity of response and this direct proportionality between the light output and current through the tube make the tube suitable for television reception.

Before the meaning of the characteristic curves to be realized it is necessary to understand the terms used for ordinates or abscissas. One term is *candle power,* the standard unit for quantity of light and another is the *lambert,* which is the unit of brightness of a luminous surface whether the light flux arises on the surface or is the result of reflection, and a third is the *lumen.*

The candle power is the unit of light and is the luminous flux given out by a standard candle, as determined by international agreement and as maintained by the Bureau of Standards.

One standard candle gives out 4π lumens of light flux. That is, the lumen is the light flux that radiates from the standard candle through each unit of solid angle, assuming that the light radiation was uniform in all directions.

The lambert is a measure of surface brightness and is the surface brightness which will give one lumen per square centimeter when viewed in a direction at right angles to the surface.

In Fig. 1 is shown the relation between the direct current through the Kino lamp and the surface brightness of the plates and the candle power of the lamp. The curves are perfectly straight, showing that the direct proportionality holds between the current and the light emitted or the brightness, that is, the light emitted per unit area.

Fig. 2 shows the variation in brightness with changes in AC current through the tube. The ordinates give the ratio of the brightness at maximum current to that at minimum current, and the abscissas the effective value of the current. This curve gives an indication of the relative brightness of light and dark portions of the picture as received with various values of AC current through the tube.

The smallest change in brightness that can be perceived by the eye is directly proportional to the instantaneous brightness. For this reason the best way to express visual contrast is to give the logarithm of the ratio of the maximum and minimum brightness. Fig. 3 will give the logarithm of the Fig. 2 ratio. The ordinates in Fig. 3 may be taken as a measure of the relative visual contrast between the bright and dark surfaces.

Absolute Values Unimportant

In viewing the luminous plate of a neon tube during the reception of television signals, the absolute brightness of the plate is of little importance. It is only the relative brightness of the various areas that counts. A spot that by itself may appear to be bright may in fact be a dark spot in the picture because other areas and spots are much brighter. The absolute brightness of the plate is important only in seeing the picture in competition with stray light from other sources.

A neon tube like the Kino lamp always carriers direct current, and the variation in the brightness is caused by the alternating current superimposed on the steady current, just as in an ordinary amplifying tube the sound results from the alternating current superimposed on the steady current flowing through the tube. The direct current is either the plate current of the tube that feeds the neon tube, or a part of that current, or else it is a current driven through it by an auxiliary battery.

A tube of this type is inherently unstable and it is always necessary to have a current-limiting resistance in series with it. This resistance may be the internal resistance of the vacuum tube amplifier feeding it, the resistance of a choke coil in series with the neon tube and the source of potential, or it may be an adjustable resistance used expressly for the purpose of adjusting the current through the neon tube and hence the brightness of the plates.

Fig. 4 gives the relation between the power that must be delivered to the Kino lamp for various values of effective value of current. The curve is parabolic and therefore to double the current through the tube it is necessary to increase the power

FOUR TUBE SET DRAWS LESS

(*Continued from preceding page*)

since it is obtained in whole or in part from the drop in the 4-ohm ballast and the 6-ohm filament rheostat. When the rheostat is set at zero the bias on the three screen grid tube is one volt, assuming a 3-volt filament battery, and this is near the value which gives maximum amplification. As resistance is cut in the bias increases, and the amplification decreases both because the filament current decreases and because the bias increases. The bias on the output is 7 volts, the six being obtained from a grid battery.

The total normal filament current of this circuit is 0.24 ampere, which is within the current capacity of a No. 6 dry cell. Therefore the filament battery may consist of two No. 6 dry cells connected in series. If it is desired to have a little more

vision and Stroboscope

Anderson

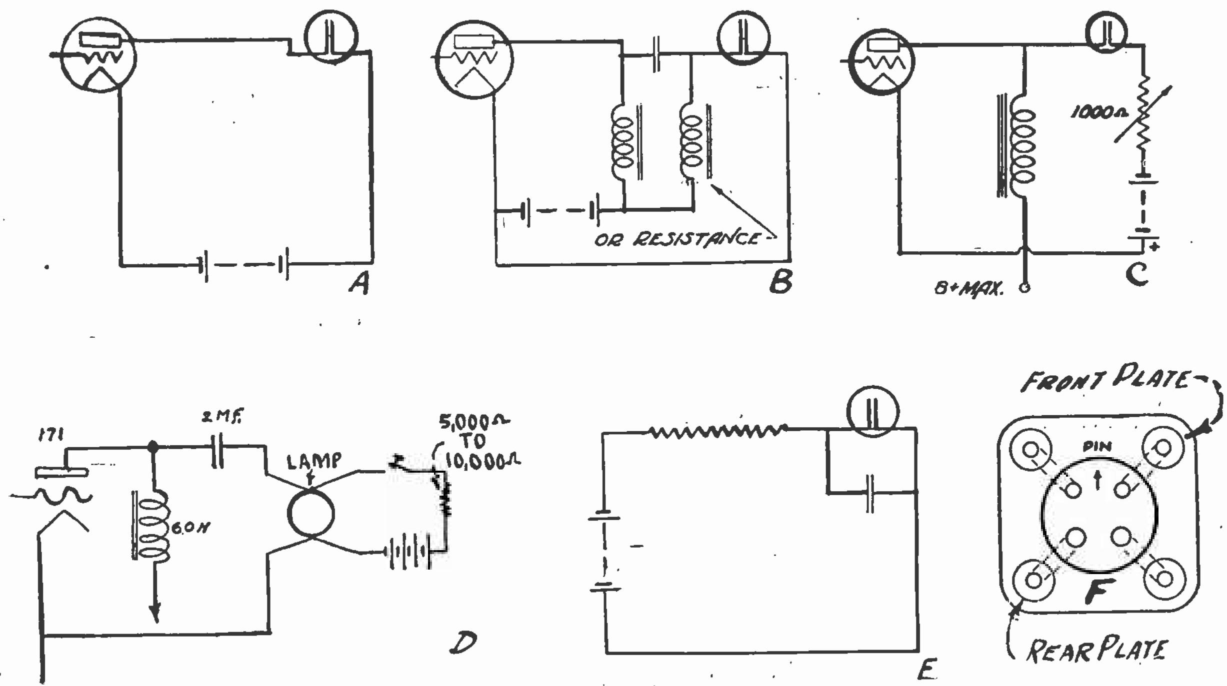


FIG. 5
DIFFERENT METHODS OF CONNECTING THE KINO LAMP TO THE POWER AMPLIFIER.

by a factor of four. Since the brightness is proportional to the current this curve shows that it is proportional to the square root of the power delivered to the tube.

Matching Kino Lamp and Tube

The average AC resistance of the Kino lamp is only 500 ohms. Therefore if the tube is connected directly in the plate circuit of a vacuum tube the matching will not be good and there will be considerable distortion. This is another reason why a resistance should be connected in series with the Kino lamp. Considerably more power must be delivered to the tube and the resistance than to the tube alone, but still for equal current through the tube the brightness of the plates will be the same. When very low frequencies are not involved in the signal, an impedance-matching transformer could be used advantageously between the Kino lamp and the power tube. But in television there may be a signal component as low as 15 cycles per second and the matching transformer would have to be effective at this frequency, as well as at higher frequencies up to 10,000 cycles. Few transformers can meet the demands.

In Fig. 5 are shown different methods of connecting the Kino lamp to the power tube. In A the tube is connected directly in the plate circuit. This arrangement has the best frequency characteristic because there are neither coils nor condensers to introduce any frequency discrimination. In B the lamp is coupled to the power tube by means of two audio frequency chokes and a stopping condenser, the current through the lamp being supplied by the plate supply for the receiver. The second choke is supposed to contain the current-limiting resistance. As indicated, this choke may be replaced by a resistance of suitable value. This circuit is subject to considerable frequency discrimination.

In C only one choke coil is used and therefore this circuit has a better frequency characteristic than that in B. The steady voltage on the lamp is the sum of the plate voltage and the voltage of the battery in series with the Kino lamp. A 1,000 ohm resistance is in series with the lamp to limit the current. A better arrangement is outlined in D. Here the signal voltage is impressed on the tube through the 2 mfd. condenser which stops the direct current from the tube. The steady current for the Kino lamp is supplied by an auxiliary battery in series with which there is a resistance of 5,000 to 10,000 ohms.

Special Use of Neon Tube

The fact that the neon tube is inherently unstable can be utilized for generating oscillations and a circuit diagram for this application is shown in E of Fig. 5. The tube is connected in series with a battery and a high resistance and a condenser is shunted across the lamp. The frequency of the oscillation can be varied by varying either the resistance or the capacity of the shunting condenser. The oscillation will either be a variation in the brightness of the lamp or an alternate flashing on and off of the luminosity. If the frequency of the oscillation is low enough the flicker may be observed.

This oscillator makes an excellent stroboscope for viewing movements which are too rapid to be seen directly. For example, suppose we wish to study the excursions of the armature of a loudspeaker when it is emitting a pure tone. If the armature be viewed in the light from the Kino lamp connected as in E, and if the frequency of the oscillation is adjusted to differ slightly from the frequency of the tone emitted from the speaker, the armature can be seen to move slowly back and forth. Another application would be to observing the motion of gears which spin so fast that the action cannot be seen directly. If the gears are viewed in the light of the oscillating neon tube, and if the frequency generated by the tube is right, the motion of the gears can be seen distinctly.

The Kino lamp can also be used as in circuits A to D for stroboscopic applications, provided it is fed by a vacuum tube oscillator. Since the response of the Kino lamp is instantaneous, it may be fed by currents of any frequency from the lowest sub-audible to the highest radio frequency. Comparison of frequencies by the stroboscopic method is the main use.

In F of Fig. 5 is shown the connections of the plates of the Kino lamp to springs on the socket. The two springs used are the F minus and the P.

Characteristics of the Kino Lamp

Minimum "B" battery voltage	180
Average dynamic impedance, ohms	500
Maximum recommended DC, milliamperes	20
Sensitivity, candles per milliampere	0.14
Sensitivity, lamberts per milliampere	0.03
Plate area, inches	1½x1½
Overall diameter, inches	2
Overall length, exclusive of prongs, inches	5½
Base, standard UX.	

THAN ¼ FILAMENT AMPERE

reserve and at the same time a little higher grid bias for the screen grid tube, which is desirable, another cell could be added, making the total voltage 4.5 volts. This would require changing the fixed ballast resistor to 10 ohms. The bias on the screen grid tubes will now be about 2.5 volts.

The values of those condensers and resistance which have not been specifically mentioned above are given on the diagram. While the by-pass condensers are given as 0.1 mfd. it is understood that larger values should be used if motorboating occurs.

A .00035 mfd. condenser is specified across the plate-ground circuit of the detector tube for by-passing the carrier currents of the signal. This condenser across the 250,000 ohms resistance is more effective than a condenser several times the size across the primary of an audio transformer.

The Star Raider and

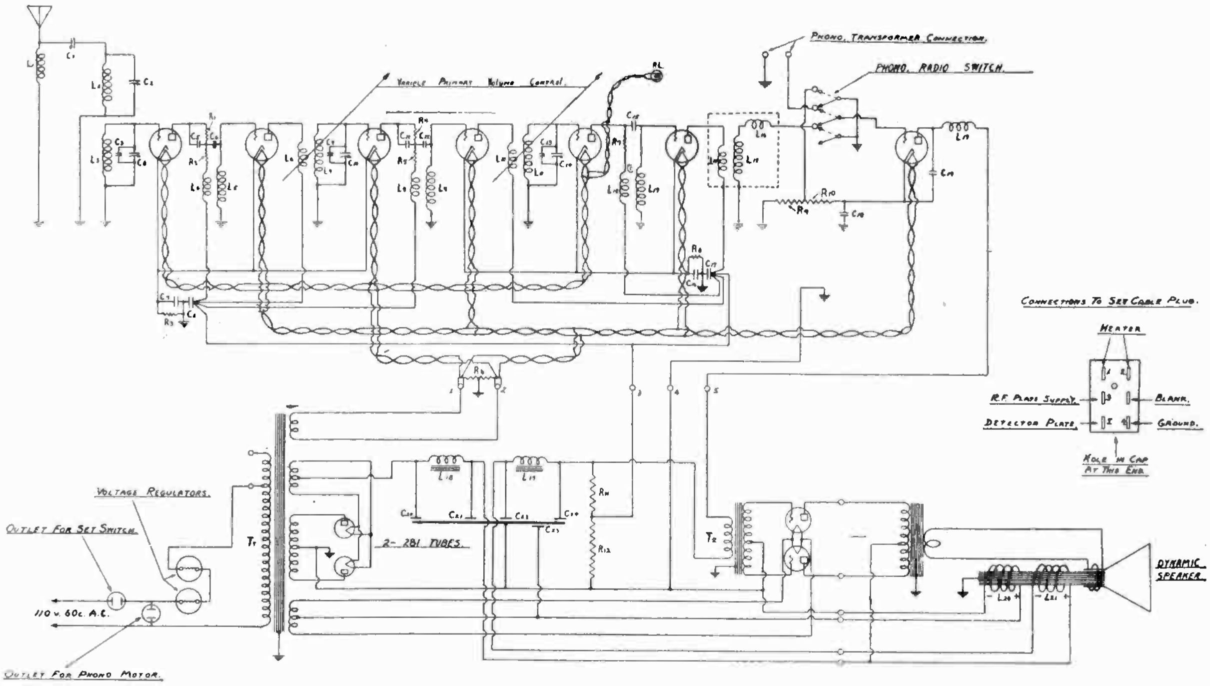


FIG. 1. THIS IS THE CIRCUIT DIAGRAM OF THE MODELS R-20, R-25, R-30, AND R-40 OF CONTINENTAL "STAR - RAIDER" SERIES.

THE circuit diagram of Models R-20, R-25, R-30, and RP-40 "Star-Raider" of the Continental Radio Corporation is reproduced in Fig. 1 herewith. This circuit contains several features not contained in many other modern receivers.

First, its tuner is of the T. A. T. type, that is, the couplers between the tubes are alternately tuned and aperiodic. There are seven couplers in all between the antenna and the grid of the detector, the first, third, and fifth being tuned and the others untuned.

Second, the primaries of the third and fifth tuned couplers are variable with respect to the secondaries by a common knob, and this variable serves as a volume control.

Third, there are voltage regulator tubes in the primary of the power supply transformer to maintain the voltage practically constant regardless of the variations in the line voltage.

Fourth, it utilizes two 250 tubes in push-pull in the output stage, and the use of these tubes calls for two 281 rectifier tubes in a full-wave circuit to supply the plate power.

The filter consists of three sections of three chokes and four by-pass condensers. The middle of these chokes is also utilized as part of the field for the dynamic speaker. An additional field coil is so connected that the DC voltage drop in it is the bias for the two 250 power tubes. Of course, the two field coils are so connected that they aid in establishing a strong magnetic field in the loudspeaker.

The coil used for bias on the power tubes is by-passed by a 3 mfd. condenser.

There is only one 2.5 volt heater winding on the power transformer to supply the six 227 type tubes, but the circuit is broken up into two parallel branches, one of which supplies the heaters of those tubes which have tuned input, the other branch supplying the remaining tubes. The hum balancer is placed at the junction of the two branches, and this balancer is a center-tapped 6-ohm resistance, the center of which is grounded.

The detector operates on the grid bias principle, the bias being so high that the radio frequency input voltage may be made large enough to load up the 250 power tubes without any audio voltage amplifier between the detector and the power stage, other than the step-up in the coupling transformer..

The grid bias resistor is 20,000 ohms with a tap placed at 2,500 ohms from the cathode end. This tap is for use when the detector tube is used as an amplifier for phonograph music.

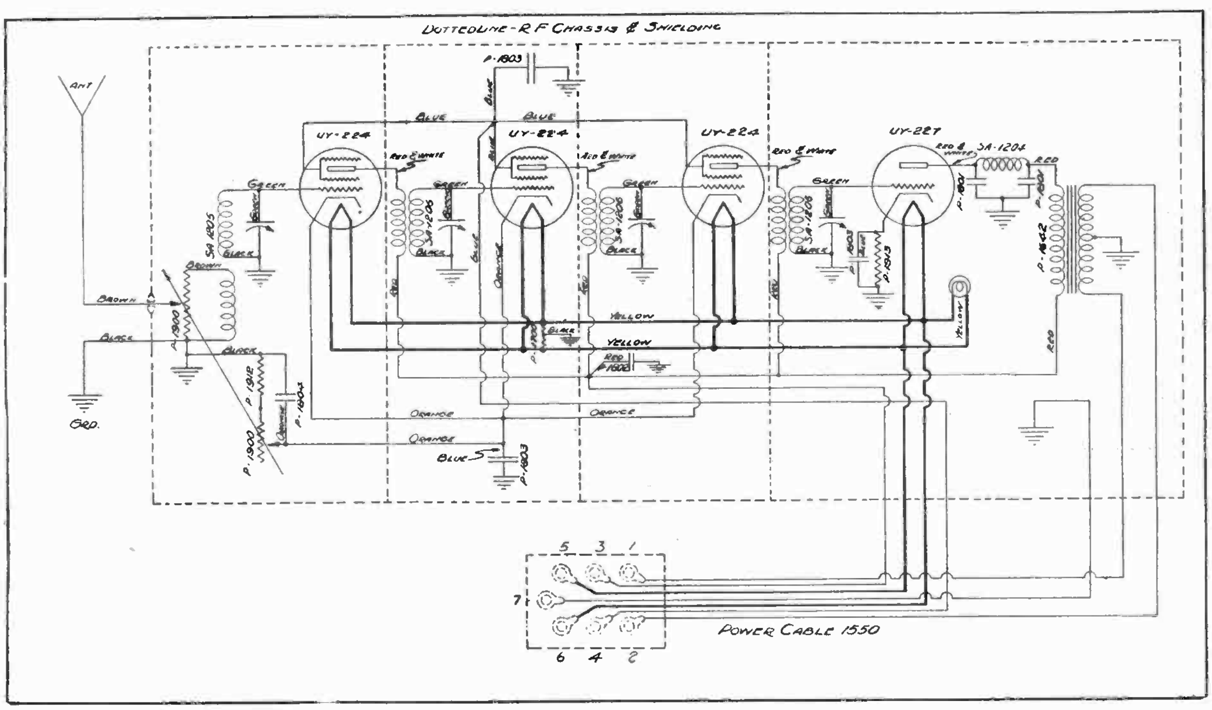
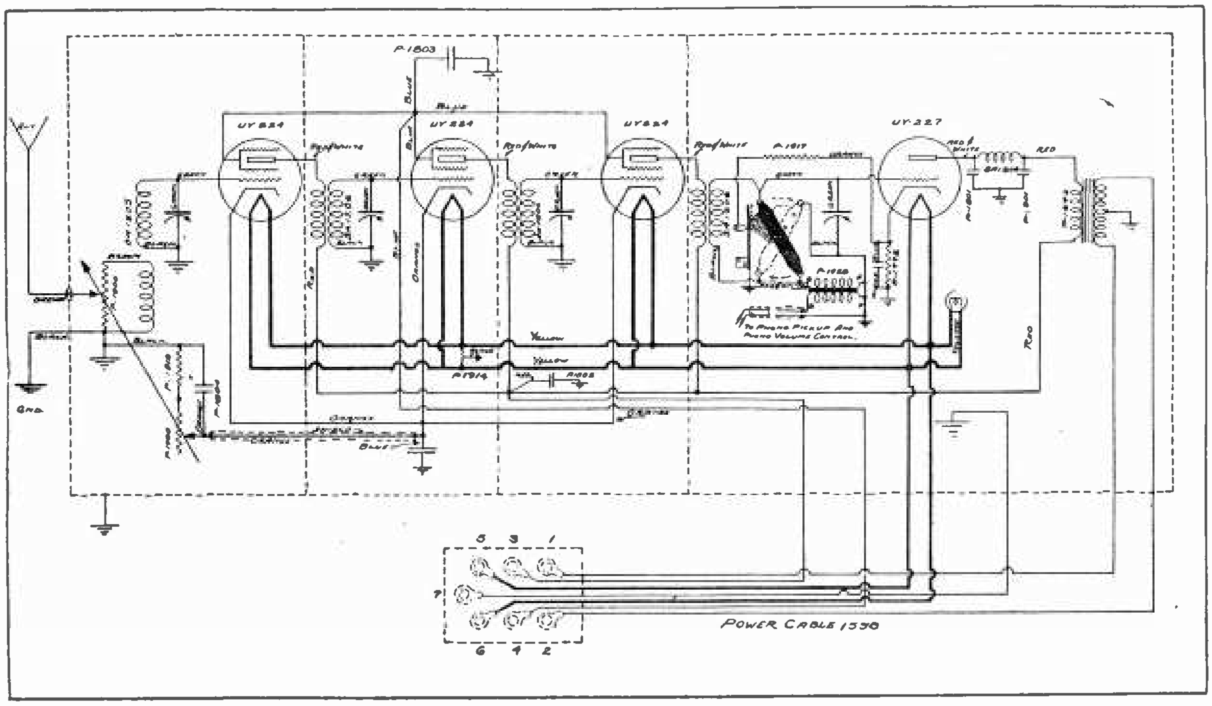


FIG. 2. THE CIRCUIT DIAGRAM OF THE HOWARD SGA RADIO CHASSIS, WHICH COMPRISES THREE SCREEN GRID TUBES AND A POWER DETECTOR TOGETHER WITH FOUR TUNED CIRCUITS CONTROLLED BY A SINGLE KNOB.

Howard Receivers

FIG. 3. THE CIRCUIT DIAGRAM OF THE HOWARD SGC RADIO CHASSIS, WHICH IS LIKE THAT OF SGA EXCEPT THAT PROVISION HAS BEEN MADE FOR A PHONOGRAPH PICK-UP UNIT.



A transformer is supposed to be used between the phonograph pick-up unit and the terminals provided for the pick-up in the grid circuit of the detector tube.

A switch is provided for throwing the tube to the radio amplifier or the phonograph signal source. The switch is triple pole, double throw and is arranged so that secondary of the last radio frequency transformer and the major portion of the grid bias resistance are short-circuited when the switch is thrown to the phonograph, and so that when it is thrown to the radio position the phonograph pick-up or transformer secondary is short-circuited.

The bias for the first three tubes is obtained from the drop in a 300 ohm resistance R3, which is by-passed by a condenser C7 of 0.5 mfd. capacity. The plate returns of these three tubes are made to a common point from which a condenser C8 of 0.5 mfd. capacity is connected to ground. The bias for the next three tubes is obtained from the drop in a 520 ohm resistance R8, which is by-passed to ground by another half microfarad condenser. The plate returns of these tubes are also joined at a point from which another half microfarad condenser is connected to ground.

The Untuned Couplers

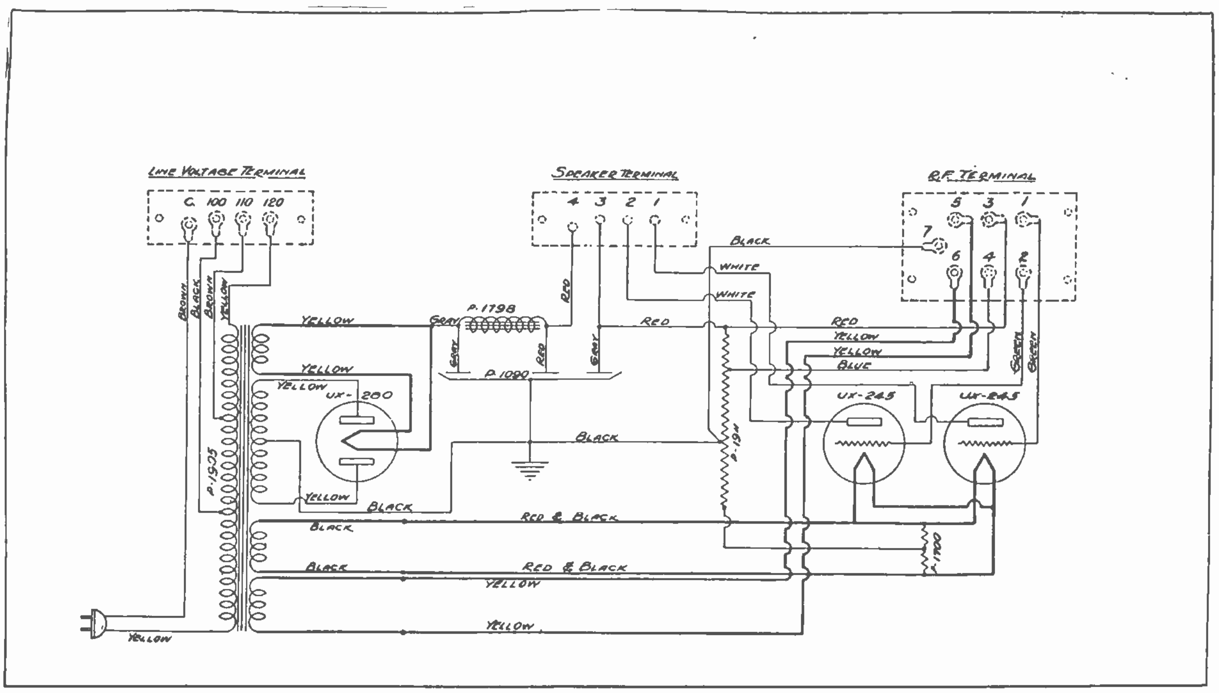
Each untuned coupler consists of two radio frequency choke coils. In series with the plate coil and on the plate coil is a resistor. Those in the first two untuned couplers are 1,250 ohms and that in the third, 1,600 ohms. A stopping condenser of .0001 mfd. is connected between the plate and grid coils in the first two untuned couplers and one of .00025 mfd. in the third. In series with the plate lead of each of the first two is also a 1,250-ohm resistor shunted by a condenser of .00028 mfd.

It will be observed that the plate supply of the 250 tubes is connected to the filter in such manner that the current flows only through the first choke coil, except after the current has passed through the power tubes it also flows through that choke which is used for bias resistor.

A special arrangement of tuning is used between the antenna

(Continued on next page)

FIG. 4. THE POWER SUPPLY AND AUDIO AMPLIFIER TUBES OF THE HOWARD MODELS SGA AND SGC RECEIVERS THE NUMBERS ON THE TERMINAL STRIPS CORRESPOND WITH THE NUMBERS ON THE TERMINAL STRIPS ON THE OTHER UNITS.



Howard Separates Units

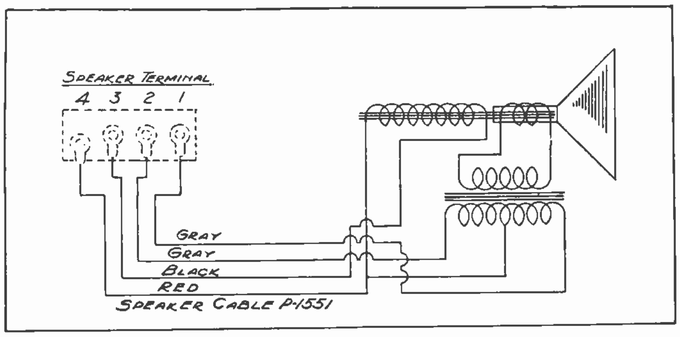


FIG. 5
THE WIRING DIAGRAM OF THE DYNAMIC SPEAKER OF THE HOWARD RECEIVER SHOWING THE CONNECTIONS OF THE VARIOUS LEADS TO THE TERMANUAL STRIP IN THE POWER SUPPLY UNIT.

(*Continued from preceding page*)

and the first grid. A coil L1 is in the antenna circuit proper and the top of this coil is connected to a small compensating condenser. Then follow two parallel tuned circuits, the inductances of which are coupled inductively. The circuit is therefore in the nature of a band pass filter.

Howard Receivers

The Howard Models SGA and SGC are built in three units, the radio frequency amplifier, the power pack and audio amplifier, and the loudspeaker. The principal advantage of such construction from the point of view of service is that in case of trouble a new unit may be substituted quickly.

The radio frequency stages are placed in separate shield compartments with the partitions so located that there is a minimum of stray coupling from the plate to the control grid or from any stage to a preceding stage. This is the type of construction often recommended but seldom seen in practice.

Each of these models contains three 224 type screen grid tubes as radio frequency amplifiers, a 227 type power detector, and one stage of 245 tube push-pull audio frequency amplification. The main difference between the two models is that the "A" does not contain any provision for a phonograph pick-up unit while "C" does. A transformer is provided for coupling the pick-up unit to the grid circuit of the power detector and the change-over switch is so arranged that when the circuit is set for the pick-up unit the effective value of the grid bias resistor is lowered by shunting another resistance across it. Thus the tube becomes an amplifier when it is needed for that purpose.

There are four tuners in these circuits, and each is of the simple tuned-secondary transformer type. All are controlled by the same knob and the setting is indicated on a horizontal scale which moves in front of a stationary index.

A low pass filter consisting of two condensers across the line and a radio frequency choke in series is placed between the plate of the detector and the primary of the push-pull input transformer. Thus all radio frequency currents are prevented from reaching the audio amplifier while the high audio notes are not suppressed.

Control of Volume

The volume is controlled by two simultaneous operations, one controlling the input voltage and the other controlling the grid bias on the radio frequency amplifier tubes. The antenna lead is connected to the slider of a high resistance potentiometer connected across the primary of the first radio frequency transformer, and thus when the control is turned the amount of signal voltage impressed on the circuit is varied. At the same time the bias is increased by increasing the grid bias resistor common to the three radio frequency amplifier tubes. The bias resistance consists of one fixed and one variable resistor, the fixed being proportioned so that when the volume is set at maximum the minimum bias is that which gives best amplification.

Power Supply and AF Amplifier

The power supply contains an over-sized power transformer which supplies the required filament voltages and the high voltage for the plate of the 280 tube. The primary of this transformer is tapped for 100, 110 and 120 volts to accommodate lines of different voltages.

The plate current for the two 245 tubes passes through the first choke in the filter only, a choke having a DC resistance of only 200 ohms. The current for the other tubes in the receiver and that through the voltage divider also goes through the field coil of the dynamic speaker so that the field acts as one of the chokes. The usual three condensers are used in the filter, and each is an 8 mfd. electrolytic. The by-pass condensers ordinarily put between the different taps on the voltage divider and ground are placed in the radio frequency tuner so they do not appear in the power supply circuit.

Terminal strips are provided for the primary of the power transformer to permit the selection of the proper voltage tap, for the loudspeaker, and for the radio frequency amplifier. The loudspeaker terminal strip contains two terminals for the field and two for the voice coil or output transformer, and the radio frequency terminal strip contains seven terminals, two for the heaters, one for plate voltage, one for screen voltage, two for the grids of the 245 tubes, and one for ground or B minus.

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Address: Industrial Dept., RADIO WORLD, 145 W. 45th St., N. Y. C.

SITUATIONS WANTED

YOUNG MAN 19, TECHNICALLY INCLINED, desires position as assistant in radio laboratory. Formerly connected with Pilot experimental tube laboratory. Write August L. Oechsli, 280 Linwood St., Brooklyn, N. Y., or phone Applegate 8631.

RADIO SITUATION WANTED. Radio Repair and serviceman, 21 years old, High School education, three years experience, would consider radio position of any kind, anywhere in United States. Kenneth P. Henderson, 115 Honeoye St., Shinglehouse. Pa.

YOUNG MAN WANTS WORK IN RADIO LABORATORY or radio repairing. Have had Technical School Training, and experience. Also have an Amateur Ticket. Matthew Ajeman, 75 Park Street, Rockland, Mass.

NATIONAL RADIO INSTITUTE GRADUATE, with three years' experience in building and repairing receivers. Would like to obtain position. William B. Floyd, Box 22, Monroe, Virginia.

30 YEARS OF AGE, A COLLEGE GRADUATE. Primarily a sound engineer (R.C.A.) with expert knowledge of installation, service, maintenance and repair of sound motion picture systems as well as all kinds of amplifiers and public address systems. Aso of acoustical problems (treatments of theatres, etc.). This knowledge is backed by eight years' experience in the electrical and radio field, enabling me to install, service and repair expertly any and all radio sets and accessories on the market. I am free to travel, speak several languages and am equipped with all necessary tools, meters and latest type analyzer and checker. Although I made, of course, a good deal more. I am willing to start at $30.00 per week. I am prepared to furnish excellent references.—Address Able. Box X, care of Radio World.

EDITORIAL or **CORRESPONDENCE** position desired by woman experienced in newspaper Editorial and Radio Departments; also has had sales experience. Steady worker. Phone Havemeyer 8996-J.

EXPERIENCED. Good general knowledge of technical radio work, construction and repairing. Am 36 years of age and married. Reference: Radio and Television Institute, Chicago, Ill. Steve Marko, 139 Brighton Drive, Akron, Ohio.

YOUNG MAN 19, TECHNICALLY INCLINED, desires position as assistant in radio laboratory. Formerly connected with Pilot experimental tube laboratory. Write August L. Oechsli, 280 Linwood St., Brooklyn, N. Y., or phone Applegate 8631.

WIRING AND ASSEMBLING MAN on radio sets desires prompt connection. Good character. Ben Schurman, 196 Bristol St., Brooklyn, N. Y.

EXPERIENCED RADIO SERVICE MAN wants position. Write Thomas E. Martin, Keota, Iowa.

Radio "R" in Season

By W. D. Terrell

Director of Radio, Department of Commerce

EVERYONE who has used a radio receiving set has suffered from interference with reception. We are all familiar (especially if our radio experience dates back a number of years) with squeals and howls, rattling and squawking, buzzing and crashing, as a result of interference. We were accustomed, at one time, to the tangling up of literary lectures with love-lorn ballads, and of sermons with syncopation.

Many listeners become exceedingly annoyed at that kind of thing—and with very good reason. The radio division has been called upon to investigate thousands of such complaints. Interference may be man-made or may arise from a source over which man has no control, such as lightning, or static (sometimes called atmospherics). This type of interference is most annoying during the Summer months.

You have often heard that oysters are in season during the months containing the letter R. This old saying originated before the days of radio.

"R" Months Best for Radio and Oysters

The modern interpretation is that the months containing the letter R are best for radio reception, at least in this part of the world. (Naturally, that would not apply in the countries lying south of the Equator, where the seasons are the reverse of ours.)

Man-made radio interference may come from electric sewing machines, electric signs, X-ray or violet-ray machines, heating pads, defective wire insulation, power wires running through tree tops, elevators, and numerous other devices.

In addition to these, there is the interference caused by radio transmitting sets. This is the only kind of interference which may be controlled under existing radio law. It is not unusual for complaints to be filed against amateur transmitting stations on the ground of alleged interference, which prove upon investigation to be caused by some electrical contrivance for which the amateur is not responsible. Often it is possible to locate interference by placing a portable receiving set in an automobile and driving around the neighborhood, taking bearings on the direction of the signals or interference. The strength of the signal and the direction from which it emanates will make it possible to locate it.

Uses Six Test Cars

The Department of Commerce has in use six radio test cars and has under construction two additional cars. These cars are portable inspection offices, being equipped with apparatus designed to measure the power and frequencies of radio stations, locate unlicensed stations, examine radio operators, and perform such other duties as may be necessary.

With the apparatus used to measure power it is possible to determine the service area of a transmitting station. If a station increases or decreases its power this may be detected without a personal investigation at the station. If a station is not serving its audience uniformly in each direction, the reason for this inequality can be found. A recent survey resulted in a change in the design of the antenna used. This change resulted in putting a good signal into a section previously poorly served, and reaching a larger audience.

The Department has set up a monitoring system which makes it possible to measure the frequencies or wavelengths of all classes of stations. The system comprises a constant frequency at Grand Island, Nebraska, practically in the center of the United States, and secondary stations at Boston, New York, Baltimore, Atlanta, New Orleans, Los Angeles, San Francisco, Portland (Oregon), Chicago, and Detroit. These stations are supplemented by the six portable stations on the test cars that I mentioned a moment ago.

Under United States jurisdiction there are 24,520 radio transmitting stations—the majority of them operating simultaneously. Besides these, the signals from foreign stations are intermingled with ours.

The radio inspectors on duty at the monitoring stations are reporting daily their measurements on the stations checked. These reports show the time the measurement was made and deviation in cycles, if any. During the last fiscal year 45,695 measurements were made. There were 1,020 measurements showing stations deviating 500 cycles or more from the frequency they were authorized to use.

When you realize that the signals from radio stations go out in all directions, often reaching thousands of miles, you will see that the problem of insuring orderly operation free from serious interference requires constant vigil on the part of the station operators.

A few years ago such freedom from interference was not possible. But now the refinement of transmitting and receiving sets and far greater precision in measuring instruments make this possible of accomplishment. With the perfection of synchronizing equipment some of the interference now being experienced will be removed.

Many of the listeners of today can remember when all of our broadcasting stations used one wavelength, 360 meters. When interference became intolerable another frequency or wavelength, 400 meters, was made available to stations prepared to meet the somewhat strict regulations at that time. In those days 500 watts was considered high power. Many of the programs were almost entirely mechanical reproductions. Roxy's Sunday night program was one of the exceptions.

Foundation Laid for Improvement

The Secretary of Commerce foresaw the danger of the broadcasting stations losing public interest if some way were not found to encourage higher standards of programs. He ordered the creation of a new class of license requiring a higher standard in equipment, studios, and programs which immediately stimulated interest in the programs and resulted in rivalry among station owners to improve their stations and obtain one of the new high-class licenses, known at that time as Class B.

Under these licenses stations were not permitted to use mechanically operated musical instruments. Thus was the foundation laid for the excellent stations and interesting programs of today, placing us far in advance of other countries, as indicated by the increase in the number of receiving sets in use—approximately 60,000 in 1922, as compared with possibly 13,000,000 at the present time. The census figures giving the exact number are not yet available.

When an event of general public interest is broadcast today, it is reasonable to assume that it is available to more than half of the people of this country, as well as a large number in other countries of the world.

Calls Our System Satisfactory

From the beginning it has been recognized that the basis of granting a broadcasting license should be service to the public, and in no other way can an audience be held or a station continue to prosper.

There is no financial support for the operation of broadcasting stations derived directly from the listeners through the payment of a fee, such as is the custom in other countries. Experience has shown that our method is generally satisfactory, and millions of dollars are being spent to improve it.

Electrons in Tube Go 600 Miles a Second

The radio tube has many peculiarities which to the average user seem nothing short of miraculous. One of the most interesting things, according to RCA Radiotron engineers, is the speed with which the electrons inside of a radio tube travel.

As the filament, or heater, increases in temperature, the motion of the electrons gradually increases until it reaches a velocity of about 600 miles a second. Then the electrons break away from the filament, or heater, jumping right off its surface into the vacuum that exists inside the tube. When this condition is eached, by turning on the filament current, the tube is ready to function. This tremendous speed of electrons that makes modern radio reception possible.

Action of Heater Is Greatly Speeded Up

When all-electrically operated radio sets first were introduced, the type of detector tubes then available all required a minute or so to become sufficiently heated to function. Eventually quick-heating detector tubes were developed.

Then came the screen-grid tube, so widely used, and again the long delay after "snapping" the switch, before anything happened. Now, several tube makers announce the perfection of screen-grid tubes so made that they become warm enough to work in about ten seconds.

Accordingly, if the detector tube is of the quick-heating type, as well as the screen-grid tubes, you can turn on the switch and you'll get results in a very few seconds.

How Tone Control

By Adam

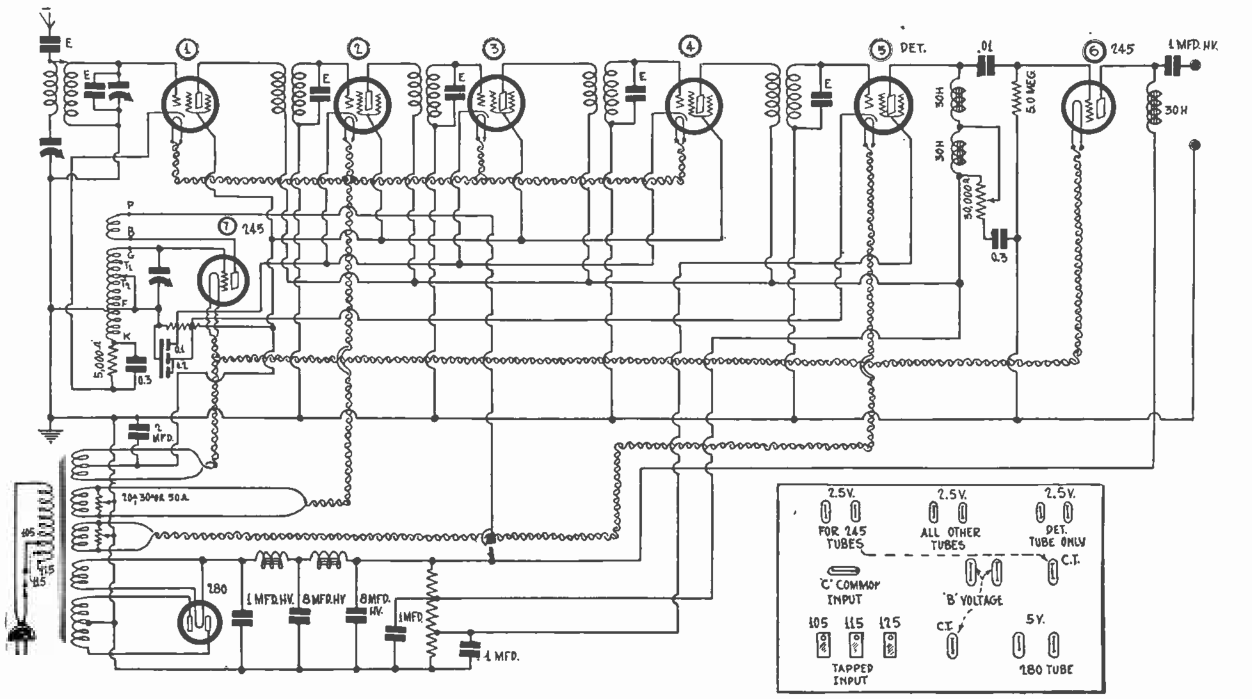


FIG. 1.
A SUPERHETERODYNE TYPE RECEIVER IN WHICH THE TONE COMPOSITION IS VARIED BY MEANS OF A POTENTIOMETER IN CONJUNCTION WITH A CONDENSER AND A CHOKE COIL.

ONE of the best tone controls that has been suggested is illustrated in Fig. 1 herewith, a Superheterodyne receiver with seven tubes. The control in question is a 30,000-ohm potentiometer connected in series with a 0.3 mfd. condenser one side of which is connected to ground. One side of the potentiometer is connected to the low side of the lower of two equal choke coils in the plate circuit of the detector tube. The slider on the potentiometer is connected to the junction of the two chokes. When the slider is set at one end of the resistance the lower of the two chokes is short-circuited and the high notes are amplified as well as the low, or better. When the slider is set at the other end of the resistance the high notes pass to ground through the 0.3 mfd. condenser and are not amplified so much.

Another type of tone control is exemplified in Fig. 2, which is a five-tube TRF set. Here condensers of various values are connected across the line. The larger the condenser shunted across the lower will the amplification of the high notes be. Since there are three different condensers and one open, four different tone combinations may be obtained.

Detection in the TRF set is effected by means of grid bias, which is obtained from a 30,000 ohm rheostat in the cathode lead of the tube. It is customary to use a fixed value of 20,000 ohms in this position but this does not permit any variation in case the tube and the voltages are such that a resistance of 20,000 ohms is not the value that gives best detection. A 30,000 ohm rheostat or variable resistance gives considerable latitude for finding the correct value in any instance.

Amplifier Bias

The bias for the first AF in a TRF set usually is obtained from a drop in a 1,000 ohm resistance in the cathode lead of that tube. This bias is not as high as is usual for a 227 tube but an excessively high bias is not needed in this position because the signal voltage is comparatively small. It should be remembered that if the bias is just high enough to prevent the grid from going positive during any part of the signal, it is high enough. It is not only high enough, but the resulting amplification will be higher and the distortion will be less than if the usual high bias is used. This statement may seem like heresy but it can be verified very easily by examining the characteristic curves of the tube.

The bias for the screen grid radio frequency amplifier tubes is obtained from the 700-ohm individual resistance in the cathode leads. These are abnormal values for these tubes and they give a bias of about three volts.

The modulator in the superheterodyne circuit in Fig. 1 is also working on the grid bias principle. The bias resistor is 5,000 ohms and it is shunted by a condenser of 0.3 mfd. This resistance gives a fairly high bias because there is no high resistance in the plate circuit of the tube to limit the current. The modulator works well on a moderately high bias because of the intensity of the local oscillation, the output being proportional to the product of the signal carrier and the oscillation voltage.

Loose Coupling Between Tuned Circuits

In Fig. 2 we have a five-tube receiver in which a high order of selectivity, as well as a high sensitivity, is obtained by tuning both the primary and the secondary of the coupling impedances. A very small capacity coupling is introduced by leading insulated wires connected to the live sides of the tuned circuits and twisting these wires together a few times. The looseness of the coupling between the two tuned circuits in each coupler makes it practical to tune both windings.

The six tuning condensers in this circuit may be put on one shaft to make the circuit one-control. It is possible to include the antenna circuit in this because a high order of selectivity is not possible in the antenna circuit and because a trimmer condenser is put in which may be adjusted independently of the main tuner. But this trimmer is only necessary when there is interference between some weak distant station and a strong local.

In common with the circuit in Fig. 1 there is also a tone control in this circuit. It is put in the plate circuit of the detector tube and consists of condensers of different capacities and a switch by means of which any one of them may be connected across the line. These condensers are placed on the output side of the carrier suppressor choke in the plate circuit.

Grid bias detection is also used in this circuit and the bias resistor has a fixed value of 20,000 ohms. In this circuit the bias afforded by this resistance is ample to sustain a signal that will load up the tubes in the push-pull amplifier because there is considerable amplification at audio frequency.

The same volume control is shown in Fig. 866 on page 19, with fine audio. The direct current component of the plate circuit in the first audio tube is kept out of the push-pull input transformer by means of a choke and a condenser and the low side of the primary is connected directly to ground. Thus saturation effects are avoided and feed-back that might result due to the use of a common plate voltage source is eliminated by the grounding of one side of the primary.

Two-tuner Circuit

The secondary of the push-pull transformer, Fig. 866, is split into two equal parts and are joined first by a 2 mfd. condenser and then by two 50.000 ohm resistances, one in the return of each grid lead. These held in equalizing the input voltages. The output is taken by connecting the speaker of the primary of a matching transformer from plate to plate across a center-

Systems Work

Odell

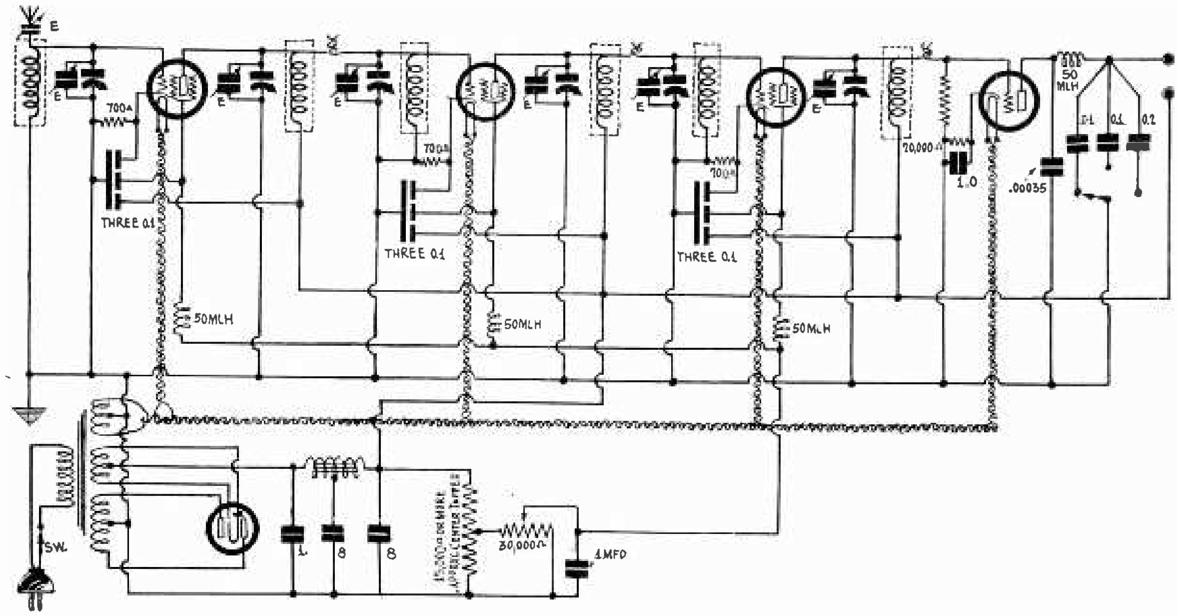


FIG. 2.
A TRF CIRCUIT IN WHICH THE TONE COMPOSITION IS VARIED BY MEANS OF SHUNT CONDENSERS OF DIFFERENT CAPACITY.

tapped, high inductance choke coil. High grade quality can be expected from this circuit.

The B supply in this case is a 280 type rectifier and a Polo 245 type power transformer. The filtering is done by a Polo 245 choke and electrolytic condensers.

There is much demand for receivers for the reception of local stations when sensitivity and selectivity need not be especially great but when quality must be of the very highest order. In such cases a circuit like that in Fig. 3 is suitable. Adequate selectivity is obtained by four tuned circuits and adequate sensitivity by the use of one screen grid radio frequency amplifier and a grid leak detector utilizing the same type of tube.

Resistance Coupled Audio

First rate quality is assured by the use of resistance coupling in the audio amplifier. There is no better type of coupling when quality is the first consideration. Unfortunately, resistance coupled amplifiers have acquired a bad reputation for instability and even for bad quality. Such an amplifier can be just as bad as it is possible to make an amplifier, but it is not difficult to make it work the way it should. It is only necessary to adiust it properly, a process not at all difficult.

One thing that goes wrong with a resistance coupled amplifier is that it might start to oscillate. The brute-force cure for this is to use plenty of capacity in the B supply filter, especially that of the last condenser. In this circuit this is specified at 8 mfd. In most instances that is sufficient. In rare cases it is necessary to add more.

Another trouble with resistance coupled amplifiers is grid drift. The grid bias, usually of the last tube, gradually goes positive until the signal voltage produces no change whatsoever in the plate current. The amplifier is dead under these conditions. It can be restored by turning the set off for a few moments or by conecting a wire from the grid to ground for an instant. The drift period may be a small fraction of a second or it may be several minutes. The cause is insufficient leakage from the grid to ground, or too much leakage from the positively charged elements near the grid, and the cure is to use a lower value grid leak. In any case the highest value leak resistance which will work should be used. It may be half a megohm or it may be five megohms.

Much of the leakage from the positive elements to the grid may be inside the tube, for during the flashing process metal may have been deposited on the insulator sparating the plate and the grid. A different tube might be tried for that reason with a good chance that the trouble will cease.

The cure for drift is also a cure for slow oscillation. That is, if the grid leak resistance is lowered the amplification on the sub-audible frequencies is reduced so that the amplifier cannot sustain oscillation and the trouble stops.

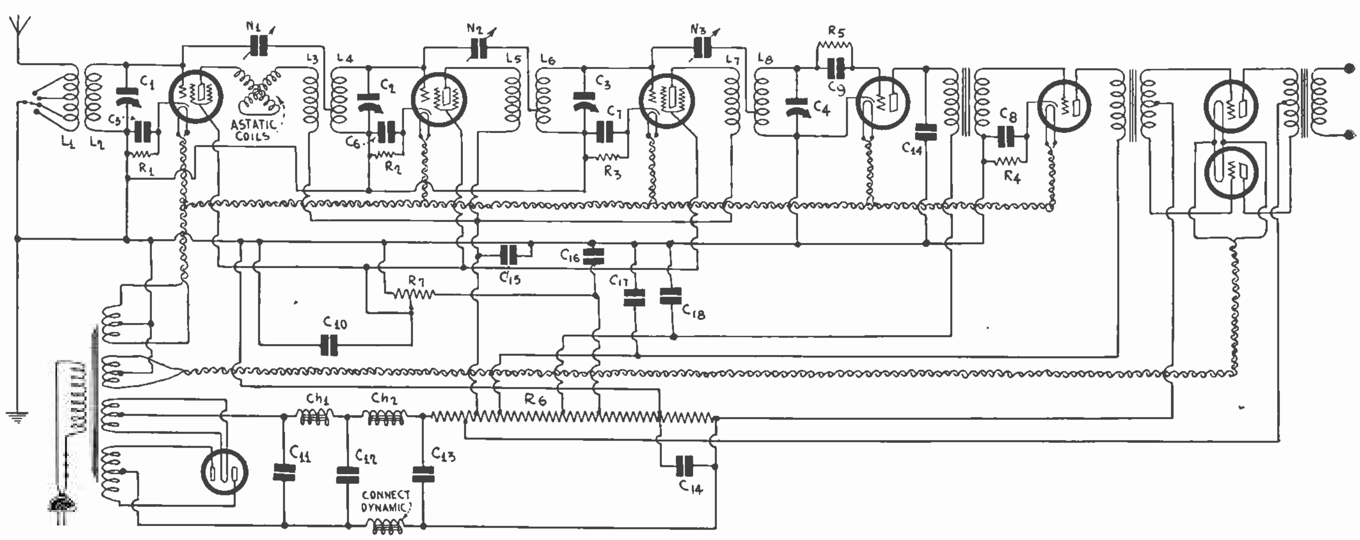


FIG. 3.
MANY BUILDERS OMIT A TONE CONTROL, AS ABOVE, BECAUSE THEY DEEM IT A DISTORTING DEVICE.

The Making of Home Recordings

IN making your own phonograph records at home, you may preserve for future use either a program received on your radio set, or voices or songs of the children and family. Special wax type records are now available for this new field of home radio and phonograph work, and aluminum ones as well. They may be ordered by your radio or phonograph dealer, who may not have them in stock thus far. A special recording needle is required, one needle sufficing to record one side of a disc record. The records either are already grooved, or, in some models, the recording head cuts its own groove.

The radio set used for this purpose must have a good audio frequency amplifier, with a power tube at least as large as the 171A. Better results are to be obtained with the 245 type of tube.

The Pick-up

Ordinarily, the phonograph pick-up is used to play records through the radio set. In recording, however, the pick-up becomes the driving force which impresses the vibrations into the grooves of the record. The pick-up is connected to the output of the radio set just as if it were the loudspeaker, but an ordinary pick-up will not serve for recording.

The special needle for recording is inserted in the pick-up. In order that the vibrations of this needle may fully actuate the recording process, it is necessary to add some weight to the recording head. This is done in the manufacture.

As so far outlined, home recording may be used to impress upon a phonograph record anything broadcast by radio, such as the latest song or dance hit, or a talk by a famous personage. The cord tips of the loudspeaker may be touched to the usual output terminals temporarily so you will know when you want the record to commence, and they are then removed. Better yet, a pair of headphones (in series with a high resistance) may be used to listen in while you are recording, so you can tell when to start and stop.

For Home Talent

In order to record your own voice, or the voices of the children, family or friends, it is necessary to have a microphone. This is an important unit, because it converts the air vibrations into electrical impulses so they may be amplified to sufficient power actually to "cut" the vibrations into the wax of the record.

Accordingly, a good microphone is advisable, although some results may be had with simple "buttons" costing less than a dollar. Suitable microphones for this job cost from $8 up.

The wires of the microphone may be connected to the set through a special coupling transformer. Dry cells may be used to operate the device. Instructions for this work are usually furnished with the mike or with the wax record equipment.

Battery Elimination for two DC Voltages

Substituting a B battery eliminator for B batteries is a well-known expedient when the home is supplied with 110 volts alternating current. Similarly, using an A eliminator will replace the storage battery, if there is 110 volts AC at hand.

The A eliminator is made up of a rectifier, usually of the dry disc type, a filter system, composed of inductance and very high capacity condensers, and a voltage control that may be adjusted by hand so that a voltmeter shows 6 volts.

Certain types of trickle charger may be converted into very good A eliminators by the addition of the correct filter system. The A condensers are specially constructed to have an extremely large capacity, and they are the same type that is used to remove the hum from a dynamic loudspeaker.

When the home is powered with 110 volts DC, or with 32 volts DC, as from farm lighting plants, it is a little more difficult to obtain a satisfactory arrangement.

One fairly good method of replacing the storage battery is to employ a fixed resistor of the proper resistance value (according to the number and kind of tubes in the set) to take up the excess voltage.

In some instances, special sets are available in which the tubes are wired in series, so that the amount of current drawn is kept at a low value. Or, the existing set may have the filament circuit rewired with this idea in view. Some listeners who have 32-volt DC plants run heavy wires to the battery room, and tap in on 3 cells for the radio purpose, obtaining the necessary 6 volts. By changing the taps every week so as to use the sets of cells in rotation, they manage to equalize the otherwise unequal drain on the cells.

The DC supply is hardly worth while using, for B battery voltage in the case of a 32-volt system, since a maximum of 32 volts is too low. With a 110-volt DC system, the voltage may be used successfully, although it requires care in making the connections. A suitable filter circuit is essential, preferably protected by means of a series lamp which will light up should any short develop.

Another means of energizing a standard model 110 AC radio set from the 32-volt or 110-volt DC line is by a special midget motor-generator which generates its own 110 volts AC. This is an efficient and satisfactory method, growing in use because it permits one to own a standard model radio and use it anywhere.—Brainard Foote.

ELECTROLYTIC CONDENSER ACTION

Electrolytic condensers used in many types of radio power supplies have a special advantage in that they do not permanently puncture and burn out. Should excess voltage occur, they will become shorted temporarily, but quickly heal and continue to function.

Tube "Hospital" To Study "Diseases"

Plans for a radio tube "hospital," a technical clinic for the study of disease of the vacuum tube, have been made by the Radio Manufacturers Association.

While most radio tubes have a life of a thousand or more broadcasting hours, the radio doctors will study measures to extend even this amazing mortality rate. The clinic for radio tubes is under the direction of George Lewis, of Newark, N. J., chairman of the Vacuum Tube Committee of the Radio Manufacturers Association, and is under immediate charge of George Rishell, of Emporium, Pa., chairman o fthe Sub-Committee in charge of "life testing" of tubes.

The manufacturers' clinic is preparing a list of diseases of the vacuum tube for laboratory diagnosis. When a radio tube dies the radio scientist is as much interested in this fatality as a medical scientist is interested in a human demise. The radio doctors expect to discover means to prolong the useful and vigorous life of the radio tube.

1,000 Television Sets in Operation in U. S.

A recent survey shows that there are now 1,000 television receivers in operation in the United States. For the time being the majority of these are being used for test purposes by the television officials and engineers in the developmental work now in progress.

It is reported that the manufacturers of this type of equipment are rapidly getting prepared for the inauguration of the expected flood of sales. At present broadcasts are being made from about a dozen laboratories throughout the United States.

A THOUGHT FOR THE WEEK

GOLDEN GOLDEN, a manager in the legitimate field who has rendered excellent service to American theatregoers, has been engaged by the National Broadcasting Company to take charge of the presentation of its radio serial playlets. This means skilful direction, good casting, fine taste—and not a touch of vulgarity. That's the kind of a manager and director Mr. Golden is!

Sonora's Finances Aired in Bankruptcy

Schedules in bankruptcy were filed recently in the Federal Court in New York by Sonora Phonograph and Sonora Products, following last year's bankruptcies. The schedules follow:

SONORA PHONOGRAPH CO., INC., 50 west fifty-seventh Street.—Liabilities $1,646,226, assets $4,740,395, main items being plant and equipment located at Saginaw, Mich., $1,645,408 stock of merchandise, $1,346,996; accounts receivable. $933,932; furniture and fixtures, 691,679. Principal creditors listed are Merchants and Manufacturers Securities Corp., $135.000 (secured); Commercial Credit Corp., $42.190 (secured); Columbia Broadcasting System, $14,932; Arcturus Tube Co., $18,458; United Reproducers Corp., Rochester, $119,725; Valley Appliance Co., Rochester, $67,554; Eugene McGuckin Co., Philadelphia, $62,036; Radio Victor Corp. of America, $69,529; Radio Corp. of America. $27,157; General Instrument Co., $19,292; Hartman Electric Co., Mansfield, Ohio. $164,787; Sprague Electric Co., $18,743; Atlas Plywood of Boston, $27,886; Babcock Lumber Co., Pittsburgh, $22,042; Glidden Co., Cleveland, $14,833.

SONORA PRODUCTS CORP. OF AMERICA. 50 West Fifty-seventh Street.—Liabilities $736.410, assets $5,222.998. main item being accounts receivable $4.790,288. of which $4.765.611 is due from the Sonora Phonograph Co., Inc. Principal creditors listed are Hayden Stone & Co., $500.000; W. T. Botsford (as receiver of the Federal Telephone Manufacturing Co. of Buffalo). $122.083 (secured); Equitable Trust Co., $27.208; Maurice Minton, $20,000; Liberty Electric Corp., $23,737.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Those not answered in these columns are answered by mail.

RADIO UNIVERSITY

Annual subscriptions are accepted at $6 for 52 numbers, with the privilege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

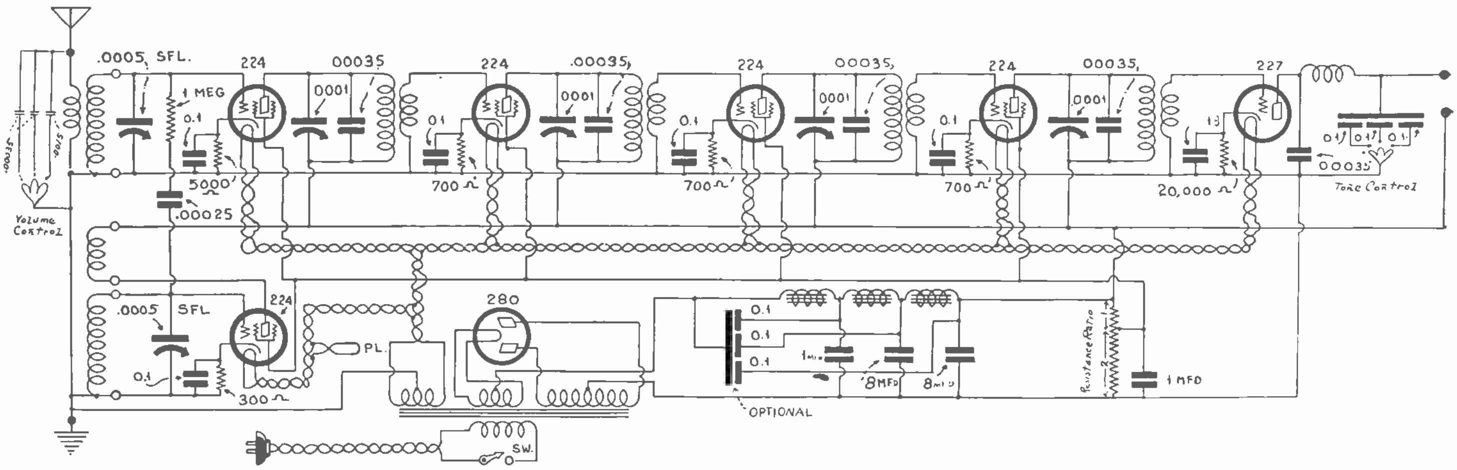


FIG. 866.
THIS AC SUPERHETERODYNE CIRCUIT CONTAINS FIVE SCREEN GRID TUBES, ONE OF WHICH IS THE OSCILLATOR. THE DETECTOR IS A 227 AND IS ADJUSTED FOR POWER DETECTION.

Six-Tube Superheterodyne Tuner

WILL you kindly publish the circuit of a Superheterodyne tuner having about six tubes in addition to the B supply rectifier. I have a good audio frequency amplifier without B supply which I wish to use with the circuit. The tubes in the circuit should be of the 224 type, except the detector, which should be a 227, arranged for grid bias detection.—L. D. F.

Fig. 866 is a circuit like that you ask for.

* * *

Method of Tone Control

IF you have a circuit in which there is a tone control I should like to see it published. I am looking for a diagram of a six-tube tuner and radio frequency amplifier in which the tone control is put in the output of the detector.—J. B.

Fig. 867 is a diagram of this kind. It has two screen grid tube radio frequency amplifiers, a power detector, and a 280 power supply with audio. The tone control is shunt condensers across the primary of the audio transformer, as shown. By means of a switch one of several condensers of different capacity may be connected across the output of the detector and so pass on different proportions of the high notes.

* * *

Push-Pull Resistance Coupling

I BUILT a push-pull resistance-coupled amplifier such as you described. I am not getting the results that I expected. There seems to be a great deal of distortion. What do you think is the trouble?—L. T. F.

There are many things that could be wrong, but most likely the trouble lies in the voltages. Probably the tubes are different so that the bias, when righ on one tube, is wrong on its mate. Then you may not have the proper input, so that the signal voltage is not divided equally between the two sides. Again, you may operate the two sides in parallel and take off the output in push-pull, in which case you would not get anything but distortion.

* * *

His Power Amplifier Clucks

I BUILT an audio amplifier such as described by Herbert E. Hayden in the issue of Nov. 29, but I am not getting any results from it. It clucks like an old hen. What do you think is the trouble?—L. C. B.

Chances are that you have left a lead open. If you have connected it to a radio frequency amplifier it may be that you have not provided for a B return by making the ground of the two parts common, or it may be that you have left a grid leak open. What you call clucking may be an oscillation which is usually called motorboating. This might result even if all the leads are connected properly.

* * *

Grid Leak Trouble

IN my set the volume will diminish soon after turning the set on, and then I can get volume to come back only by shutting the set off for a few seconds, or by touching various parts, especially around the detector tube with my hands.

You require a new grid leak or else one of lower resistance value than the one you are now using.

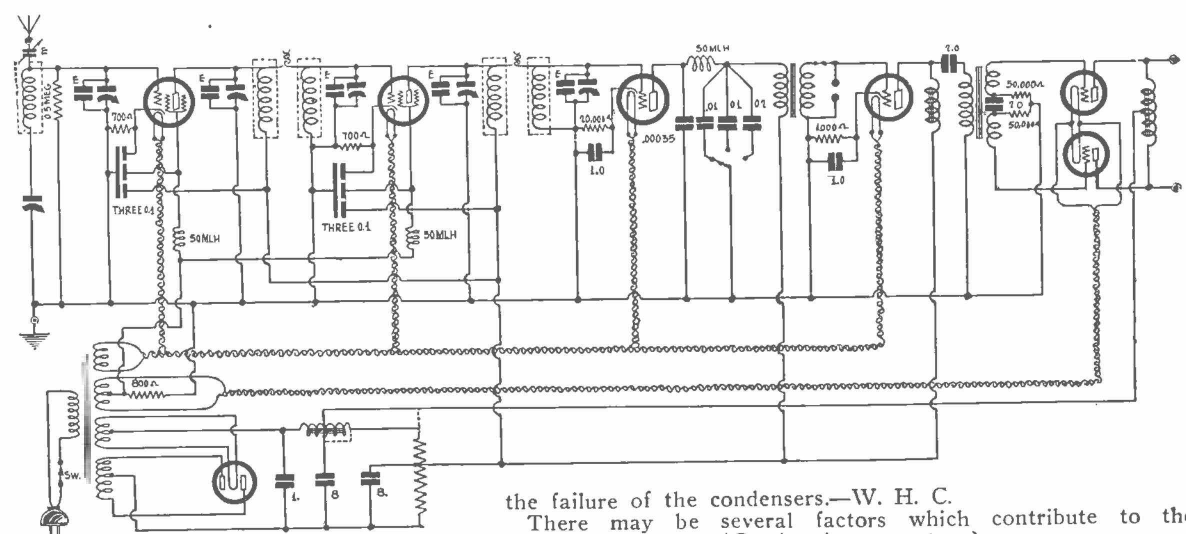
* * *

Condensers Blow

IN a B supply that I have built the first condenser next to the rectifier tube blows just as soon as I turn on the power. The transformer is rated at 350 volts and the condensers I put in at 1,000 volts. What is wrong and what should I do to stop this expensive trouble? I might say that I have burned out several 280 rectifier tubes as a result of the failure of the condensers.—W. H. C.

There may be several factors which contribute to the

FIG. 867.
TONE CONTROLS ARE USUALLY DEMANDED IN UP-TO-DATE RECEIVERS, AND THIS DIAGRAM SHOWS ONE SIMPLE METHOD OF SUPPRESSING THE HIGH NOTES WHEN DESIRED THE METHHOD CAN BE APPPLIED TO ALMOST ANY RECEIVER IN WHICH THE PLATE OF THE DETECTOR IS AVAILABLE.



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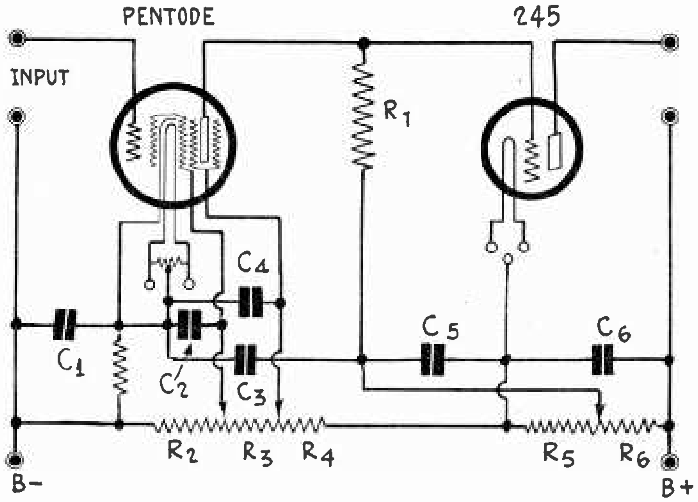

FIG. 868.
THE PENTODE TUBE CAN BE USED IN THE LOFTIN-WHITE TYPE OF AMPLIFIER IN THE MANNER SHOWN IN THIS DIAGRAM.

(*Continued from preceding page*)

trouble. The line voltage may be higher than it is supposed to be, so that the voltage across the secondary is higher than 350 volts; the condensers you put in may have been overrated greatly; you may not have provided for any bleeded current. If no current flows in the filter current, the highest voltage that the first condenser will be subjected to is nearly 500 volts. If it does not blow quickly, the other condensers across the line will also be subjected to this voltage. The voltage will not rise to this value if you draw any current. It may well be that you draw no current because of an open in the voltage divided. The thing to do is to insure that there is some current flowing just as soon as the rectifier tube gets going. Otherwise get condensers for the filter, which will stand 1,000 volts, not condensers which merely have been rated at 1,000 volts. It is well to get condensers that are guaranteed to stand 1,000 volts. As a precaution against blowing the rectifier tube when a short develops in the secondary, it would be well to put in a one ampere fuse in the primary of the transformer. If a short circuit occurs in any one of the windings in the secondary, the fuse will blow and thus protect the rest of the apparatus. Automobile type fuses may be obtained in one ampere sizes.

* * *

A Pentode Amplifier

WILL you kindly publish a circuit of the Loftin-White in which a pentode tube is used in the first stage and a 245 in the second? How should the voltages on the elements of the pentode be adjusted for best results?—P. L. A.

Fig. 868 is a Loftin-White type amplifier in which the pentode and the 245 tubes are used. The best way to adjust the voltages for best results is to return the elements to a voltage divided, the contacts of which may be moved about. First make the grid bias on the pentode about 1.5 volts and the plate voltage almost as high as it can be made. Adjust the screen and space charge voltages until the circuit amplies the best. Attention must be given to the bias on the power tube and this is best done with the aid of a milliammeter in the plate circuit of the 245. If the plate current is more than 32 milliamperes, move the slider on R5R6 toward R5, and if the current is less than 32 milliamperes, move it toward R6. For every change that is made in the space charge and screen voltages, a new setting must be found for the slider on R5R6.

* * *

Best Method of Modulation in Converter

WHICH of the many different methods of modulation in short-wave converters do you regard as the best? You have shown modulators in which the oscillation was introduced in the screen circuit, others in the cathode lead, still others in the grid lead, and many other methods.—C. T. F.

There is one thing that should be kept in mind when selecting a modulator, and that is that the oscillator may impress a voltage so high on the modulator that that tube and the others following it may be overloaded before there is much signal coming through. Two methods which will stand a lot before overloading are the grid bias and the screen voltage method. There is little chance of overloading the modulator in either case, provided the pick-up coil is reasonably small. Of course, the overloading point depends on the grid bias on the tube. The higher this is the greater the signal may be before there is any appreciable overloading.

* * *

Roar in the Speaker

WHEN I first turn on my set there is a terriffic roar which lasts about 5 seconds. It is so loud that it seems like it will tear the speaker to pieces. What is the cause of it?—W. H. S.

A transient howl of this kind is usually due to motorboating which lasts while the detector tube is heating up, or during a portion of its heating-up period. If you get a quick heater detector tube you may be able to stop the noise, or at least reduce its duration and intensity. Again, if the by-pass condensers are large enough it may be that the roar occurs only during the charging up period of the condensers.

* * *

Use of RF Amplifier for IF Amplifier

I HAVE a redio frequency tuner and amplifier comprising 5 tubes and 5 four tuners. The condensers cannot be lined up by means of the trimmer except at one frequency at a time, but when they are lined up the sensitivity is very great. It occurred to me that I could use this circuit as an intermediate amplifier by tuning it to about 550 kc. Could this be done, and what would I have to do to make a good superheterodyne?—A. B. F.

The simplest way to get a satisfactory superheterodyne would be to provide an oscillator and a modulator, with a tuned circuit for each. Couple the oscillator loosely to the modulator and put the output of the modulator, through a condenser, into the input of the 5-tube tuner. Look up the connections of a short-wave converter for the method of making the connections, for they are the same. The oscillator should be designed so that the tuning covers a frequency range from 1,100 to 2,050 kc. This means that the oscillator coil should be much smaller than the RF coil used ahead of the modulator. This is an ordinary tuning coil for the condenser you have. If you want to make the circuit more elaborate, put another tuned RF amplifier ahead of the modulator.

* * *

Current Travels in Both Directions

IN one of your answers in the Nov. 29th issue you said that the current could travel in both directions at once in a conductor. I don't see how this could possibly be true, but suppose it is. Would the effect not be the same as if the difference current traveled in one direction in that wire?—K. C. D.

In wave motion it is the normal thing for the movement to be in opposite directions at the same time, at different points. Shake a rope, for example, and you can see that in one place the rope moves in one direction and at another place it moves in the opposite. The same thing can be observed in water. The crest of the wave moves in one direction and the trough in the opposite. Even in a river you can see the water move in one direction near the bank and in the opposite direction in the center, under certain conditions, for example, when there is a whirl.

Some effects outside the conductor would be the same as if the difference current flowed in one direction. Also, if we could measure the average current that flowed past a given cross section of the conductor in one direction by counting the electrons, the net result would be the difference current.

* * *

Automatic Volume Control

CAN you tell me where I can obtain an automatic volume control for my set?—J. C. N.

It is not available yet as a "unit" for separate attachment. The automatic volume control is a special circuit incorporated by the manufacturers in certain sets, to level the amplification inversely to the carrier intensity.

Stations in United States and Canada, Corrected to Press Time

Star before Call Letter denotes new station.
Star before Station Frequency denotes new frequency.

CANADA

Station	kc
CFAC	690
CFBO	890
CFCA	840
CFCF	1030
CFCH	600
CFCN	690
CFCO	1210
CFCR	960
CFCT	630
CFCY	960
CFJC	1120
CFLC	1010
CFNB	1210
CFQC	910
CFRB	960
CFRC	930
CHCA	690
CHCK	960
CHCS	880
CHCT	840
CHGS	1120
CHLS	730
CHMA	580
CHML	880
CHNS	930
CHRC	880
CHWC	960
CHWK	1210
CHYC	730
CJBC	580, 840, 960, 690
CJBR	960
CJCA	580
CJCB	880
CJCJ	690
CJGC	910
CJGX	630
CJHS	910
CJOC	1120
CJOR	1030
CJRM	600
CJRW	600
CJRX	1120
CJSC	580
CKAC	730
CKCD	730
CKCI	880
CKCK	960
CKCL	580
CKCO	890
CKCR	1010
CKCV	880
CKCF	730
CKGW	690
CKIC	930
CKLC	840
CKMC	1210
CKMO	730
CKNC	580
CKOC	880
CKOW	840
CKPC	1210
CKPR	930
CKSH	1010
CKUA	580
CKWX	730
CKX	540
CKY	780
CNRA	630
CNRC	690
CNRD	840
CNRE	580
CNRL	910
CNRM	730
CNRO	600
CNRQ	880
CNRR	960
CNRS	910
CNRT	840
CNRV	1030
CNRW	780
CNRX	690

UNITED STATES

Station	kc
WAAF	920
WAAM	1250
WAAT	940
WAAW	660
WABC	860
WBOQ	860
WABI	1200
WABO	1440
WABZ	1200
WACO	1240
WADC	1320
WAGM	1310
WAIU	640
*WALR	1210
WAPI	1140
WASH	1270
WBAA	1400

Station	kc
WBAK	1430
WBAL	1060
WBAP	800
WBAX	1210
WBBC	1400
WBBL	1210
WBBM	770
WBBR	1300
*WBBS	1370
WBBY	1200
WBBZ	1200
WBCM	1410
*WBEN	900
*WBGF	1370
*WBIG	1440
WBMS	1450
WBNY	1350
WBOW	1310
WBRC	930
WBRE	1310
WBIS	1230
WBSO	920
WBT	1080
WBTM	1370
WBZ	990
WBZA	990
WCAC	600
WCAD	1220
WCAE	1220
WCAH	1430
WCAJ	590
WCAL	1250
WCAM	1280
WCAO	600
WCAP	1280
WCAT	1200
WCAU	1170
WCAX	1200
WCAZ	1070
WCBA	1440
WCBD	1080
WCBM	1370
WCBS	1210
WCCO	810
WCDA	1350
WCFL	970
WCGU	1400
WCHI	1490
WCKY	1490
WCLB	1500
WCLO	1200
WCLS	1310
WCMA	1400
WCOA	1340
WCOC	880
WCOD	1200
WCOH	1210
WCRW	1210
WCSC	*1360
WCSH	940
WCSO	1450
WDAE	1220
WDAF	610
WDAG	1410
WDAH	1310
WDAY	940
WDBJ	930
WDBO	1120
WDEL	1120
WDGY	1180
*WDIX	1500
WDOD	1280
WDRC	1330
WDSU	1250
WDWF	1210
WLSI	1210
WDZ	1070
WEAF	660
WEAI	1270
WEAN	780
WEAO	570
WEBC	1290
WEBE	1210
WEBQ	1210
WEBR	1310
WEDC	1210
WEDH	1420
WEEI	590
WEHC	*1200
WEHS	1420
WELK	1370
WENR	870
WBCN	870
*WELL	1420
WEVD	1300
WFW	760
*WEXL	1310
WFAA	800
WFAN	610
WFBC	1200
WFBE	1200
WFBG	1310
WFBL	1360
WFBM	1230

Station	kc
WFBR	1270
WFDF	1310
WFDV	1370
WFDW	1420
WFI	560
WFIW	940
WFJC	1450
WFKD	1310
WFLA	620
WSUN	620
WGAL	1310
WGBB	1210
WGBC	1430
WGBF	630
WGBI	880
WGBS	600
WGCM	1210
WGCP	1250
WGES	1360
WGH	1310
WGL	1370
WGMS	1250
WGN	720
WGR	550
WGST	890
WGY	790
WHA	940
WHAD	1120
WHAM	1150
WHAP	1300
WHAS	820
WHAT	1310
WHAZ	1300
WHB	860
WHBC	1200
WHBD	1370
WHBF	1210
WHBL	1410
WHBQ	1370
WHBU	1210
WHBY	1200
WHDF	1370
WHDH	830
WHDI	1180
WHEC	1440
WHFC	*1420
WHIS	1420
WHK	1390
WHN	1010
WHO	1000
WHOM	1450
WHP	1430
WIAS	1420
WIBA	1210
WIBG	930
WIBM	1370
WIBO	560
WIBR	1420
WIBU	*1210
WIBW	580
WIBX	1200
WICC	1190
WIL	1200
WILL	890
WILM	1420
WIOD	1300
WIP	610
WIS	1010
WISN	1120
WJAC	1310
WJAG	1060
WJAK	1310
WJAR	890
WJAS	1290
WJAX	900
WJAY	610
WJAZ	1490
WJBC	1200
WJBI	1210
WJBK	1370
WJBL	1200
WJBO	1420
WJBT	770
WJBU	1210
WJBW	1200
WJBY	1210
*WJDX	1270
WJJD	1130
WJKS	1360
WJR	750
WJSV	1460
WJW	1210
WJZ	760
WKAQ	890
WKAR	1040
WKAV	1310
WKBB	1310
WKBC	1310
WKBF	1400
WKBH	1380
WKBI	1420
WKBN	570
WKBO	1450

Station	kc
WKBQ	1350
WKBS	1310
WKBV	1500
WKBW	1480
WKBZ	1500
WKEN	1040
WKJC	1200
WKRC	550
WKY	900
*WKZD	590
WLAC	1470
WLAP	1200
WLB	1250
WLBC	1310
WLBF	1420
WLBG	1200
WLBL	900
WLBW	1260
WLBX	1500
WLBZ	620
WLCI	1210
WLEX	1410
WLEY	1370
WLIB	720
WLIT	560
WLOE	1500
WLS	870
WLTH	1400
WLVA	1370
WLW	700
WLWL	1100
WMAC	570
WMAF	1410
WMAK	*1240
WMAL	630
WMAQ	670
WMAY	1200
WMAZ	890
WMBA	1500
WMBC	1420
WMBD	1440
WMBF	1300
WMBG	1210
WMBH	1420
WMBI	1080
WMBJ	1500
WMBO	1310
WMBQ	1500
WMBR	1370
WMC	780
WMCA	570
WMMN	890
WMPC	1500
WMRJ	1420
WMSG	1350
WMT	600
WNAC	1230
WNAD	1010
WNAX	570
WNBF	1500
WNBH	1310
WNBO	1200
WNBR	1430
WNBW	1200
WNBX	1200
WNBZ	1290
WNJ	1450
WNOX	560
WNYC	570
WOAI	1190
WOAN	600
WOAX	1280
WOBT	1310
WOBU	580
WOC	1000
WOCL	1210
WODA	1250
WODX	1410
WOI	640
WOKO	1440
WOL	1310
WOMT	1210
WOOD	1270
WOPI	1500
WOQ	1300
WOR	710
WORC	1200
WOS	630
WOV	1130
WOW	590
WOWO	1160
*WPAD	1420
WPAW	1210
WPCC	560
WPCH	810
WPEN	1500
WPG	1100
WPOE	1370
WPSC	1230
WPTF	680
WQAM	560
WQAN	880
WQAO	1010

Station	kc
WPAP	1010
WQBC	1360
WODM	1370
WQDX	1210
WRAF	1200
WRAK	1370
WRAW	1310
WRAX	1020
WRBI	1310
WRBJ	1370
WRBL	1200
WRBQ	1210
WRBT	1370
WRBU	1210
WRC	950
WRDA	900
WREC	600
WREN	1220
*WRBX	1410
*WRDD	1370
*WRDL	1310
*WRDW	1500
WRHM	1250
WRJN	1370
WRK	1310
WRNY	1010
WRR	1280
WRUF	830
WRVA	1110
WSAI	1330
WSAJ	1310
WSAN	1440
WSAR	1450
WSAZ	580
WSB	740
WSBC	1210
WSBT	1230
*WSEN	1210
WSFA	1410
WSGH	1400
WSDA	1400
WSIX	1210
WSJC	1310
WSM	650
WSMB	1320
WSMK	1380
WSPA	1420
WSPD	1340
WSSH	1410
WSUI	880
WSVS	1370
*WSYB	1500
WSYR	570
WTAD	1440
WTAG	580
WTAM	1070
WTAQ	1330
WTAR	780
WPOR	780
WTAW	1120
WTAX	1210
WTBO	1420
WTFI	1450
WTIC	1060
WTMJ	620
WTNT	1470
WTOC	1260
WWAE	1200
WWJ	920
WWL	850
WWNC	570
WWRL	1500
WWVA	1160
*WXYZ	1240
KBGX	1310
KBTM	1200
KCRC	1370
*KCRJ	1310
KDB	1500
KDFN	1210
KDKA	980
KDLR	1210
KDYL	1290
KECA	1430
KELW	780
KEX	1180
KFAB	770
KFBB	1280
KFBK	1310
KFBL	1370
KFDM	560
KFDY	550
KFEL	920
KFEQ	680
KFGQ	1310
KFH	1300
KFHA	1200
KFI	640
KFIO	*1120
KFIU	1310
KFIZ	*1420
KFJB	1200
KFJF	1480
KFJI	1370

Station	kc
KFJM	1370
KFJR	1300
KFJY	1310
KFKA	880
KFKX	1020
KFKB	1050
KFKU	1220
KFLV	1410
KFLX	1370
KFMX	1250
KFNF	890
KFOR	1210
KFOX	1250
KFPL	1310
KFPM	1310
KFPY	1340
KFQD	1230
KFQU	1420
KFQW	1420
KFRC	610
KFRU	630
KFDS	600
KFSG	1120
KFUL	1290
KFUM	1270
KFUO	550
KFUP	1310
KFVD	1000
KFVS	1210
KFWB	950
KFWF	1200
KFWI	930
KFXD	1420
KFXF	920
KFXJ	1310
KFXM	1210
KFXR	1310
KFXY	1420
KFYO	1420
KFYR	550
KGA	1470
KGAR	1370
KGB	1330
KGBU	900
KGBZ	930
KGCA	1270
KGCI	1370
KGCR	1210
KGCU	1200
KGCX	1310
KGDA	1370
KGDE	1200
KGDM	1100
KGDY	1200
KGEF	1300
KGEK	1200
KGER	1360
KGEW	1200
KGEZ	1310
*KGFE	1420
KGFG	1370
KGFI	1500
KGFJ	1200
KGFK	1200
KGFL	1370
KGFW	1310
KGFX	580
KGGC	1420
KGGF	1010
KGGM	1230
KGHF	1320
KGHI	1200
KGHL	950
KGIQ	1320
KGIR	1360
KGIW	1420
KGIX	1420
KGIZ	1500
KGJF	890
KGKB	1500
KGKL	1370
KGKO	570
KGKX	1420
KGKY	1500
KGMB	1320
KGMD	1500
KGMP	1210
KGNF	1430
KGNO	1210
KGO	790
KGRS	1410
KGU	940
KGW	620
KGY	1200
KHJ	900
KHQ	590
KICK	1420
KID	1320
KIDO	1250
KIT	1310
KJBS	1070
KJR	970
KLCN	1290

Station	kc
*KLMB	1200
KLO	*1400
KLPM	1420
KLRA	1390
KLS	1440
KLX	880
KLZ	560
KMA	930
KMBC	950
*KMCS	*1120
KMED	1310
KMJ	1210
KMMJ	740
KMO	860
KMOX	1090
*KMPC	710
KMTR	570
KNX	1050
KOA	830
KOAC	550
KOB	1180
KOCW	1400
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KONC	1370
KOOS	1370
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KPJM	1500
KPO	680
KPOF	880
KPPC	1210
KPQ	1500
KPRC	920
*KPPS	1420
KPSN	1360
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KQV	1380
KQW	1010
KRE	1370
KREG	1500
KRGV	1260
KRLD	1040
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KRSC	1120
KSAC	580
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KUSD	890
KUT	1500
KVEP	1500
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KVL	1370
KVOA	1260
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KVOS	1200
KWCR	1310
KWEA	1210
KWG	1200
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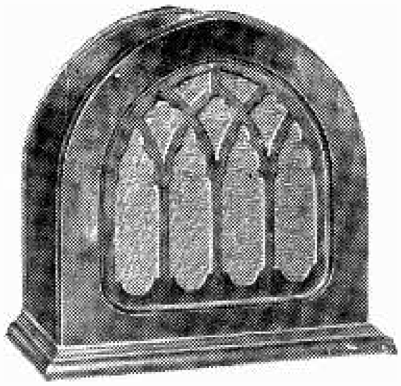

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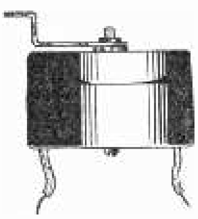

A 50-millihenry radio frequency choke coil, in a copper shield, with mounting screw and bracket attached. This choke is excellent for the plate lead of a detector, placed in series with the plate and the load impedance, for keeping RF out of the audio channel, broadcast receivers. Also excellent for RF plate lead, between the end of the plate load and B plus, and for screen grid leads, between screen grid and B plus, for thorough filtering and stabilizing. This choke will pass 25 ma. In all cases ground the shield. Order Cat. SH-RFC. List price, $1.00; your price.... **57c**

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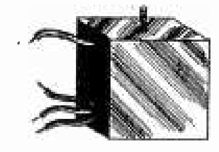

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Three Supertone non-inductive fixed condensers of 0.1 mfd. each, (250 v.) in steel case, provided with a 6/32 mounting screw, built in. The black lead is common to the three condensers, the three red leads are the other sides of the respective capacities. Size, 1⅜" square by ⅞" wide. Order Cat. SUP-31, list price, $1.00; net price, 57c.

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☐ 0-25 Milliamperes D.C. ....No. 325
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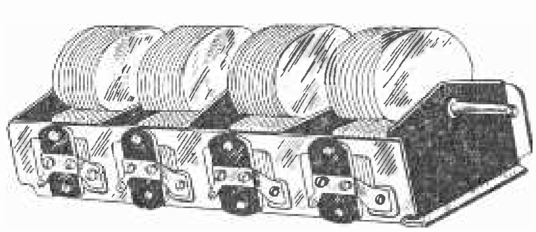
FOUR-GANG .00035 MFD. WITH TRIMMERS BUILT IN!



This condenser, each of four sections .00035 mfd., has aluminum plates that are removable and adjustable, also a ¼" diameter steel shaft that is removable. It is sturdy and is suitable for popular four-circuit screen grid tuners. Trimming condensers are built in. The condenser may be mounted on its bottom or side. Total overall length, including shaft, 11⅞." Overall width, 4". The frame is steel Order Cat. 4-G @...................... **$3.95**

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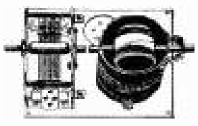

A tuning condenser with coil to match, mounted on an aluminum base that has socket built in. The condenser shaft goes in a dial (not furnished). The tuned circuit includes a fixed and a movable winding (rotor coil) in series. The moving coil is used as a trimmer, set once and left thus, so two separate dials are made to read alike, or gang tuning is made pactical. No equalizing condensers needed. Do not couple the adjoining shafts.

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Steel shield case for above, free with each order for complete parts

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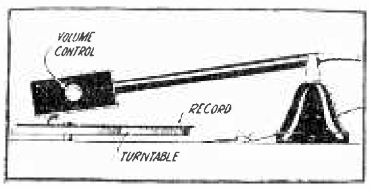

The famous Phono-link, made by Allen-Hough, enables playing phonograph records electrically, on your set. Volume control is built in.

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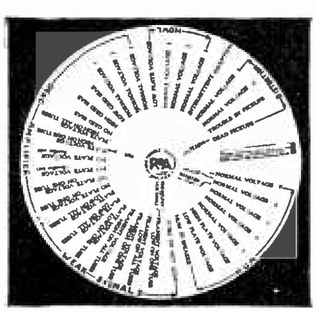

Here is an 8" diameter dial that you slide around to shoot trouble in an audio circuit or B supply or power amplifier. Trouble is divided into five groups: distortion, howl, dead amplifier, weak signals and hum. By sliding the dial to one of fifty different positions the cause of the trouble is read in the slotted opening. Invented by John F. Rider. Send $1.00 for eight weeks subscription for Radio World and get a Trouble-Finding Dial free with instructions on back. If extending an existing subscription please so state.

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.001	12c
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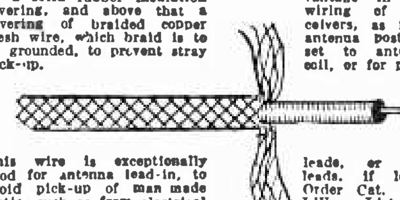

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Also used to advantage in the wiring of receivers, as from antenna post of set to antenna coil, or for plate leads, or any leads, if long. Order Cat. SH-LW. List 9c, net, 5c per ft.

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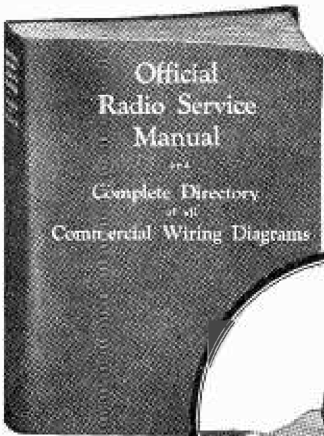

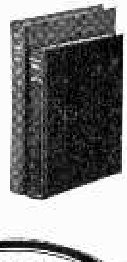

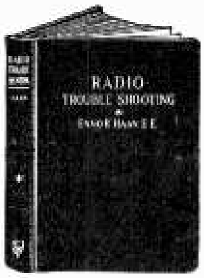

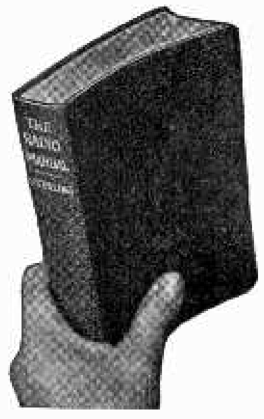

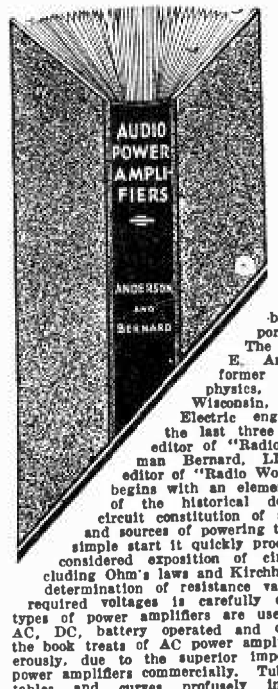

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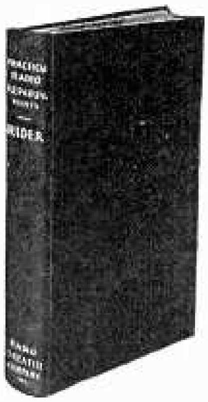

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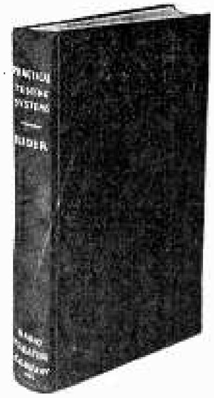

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