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RADIO
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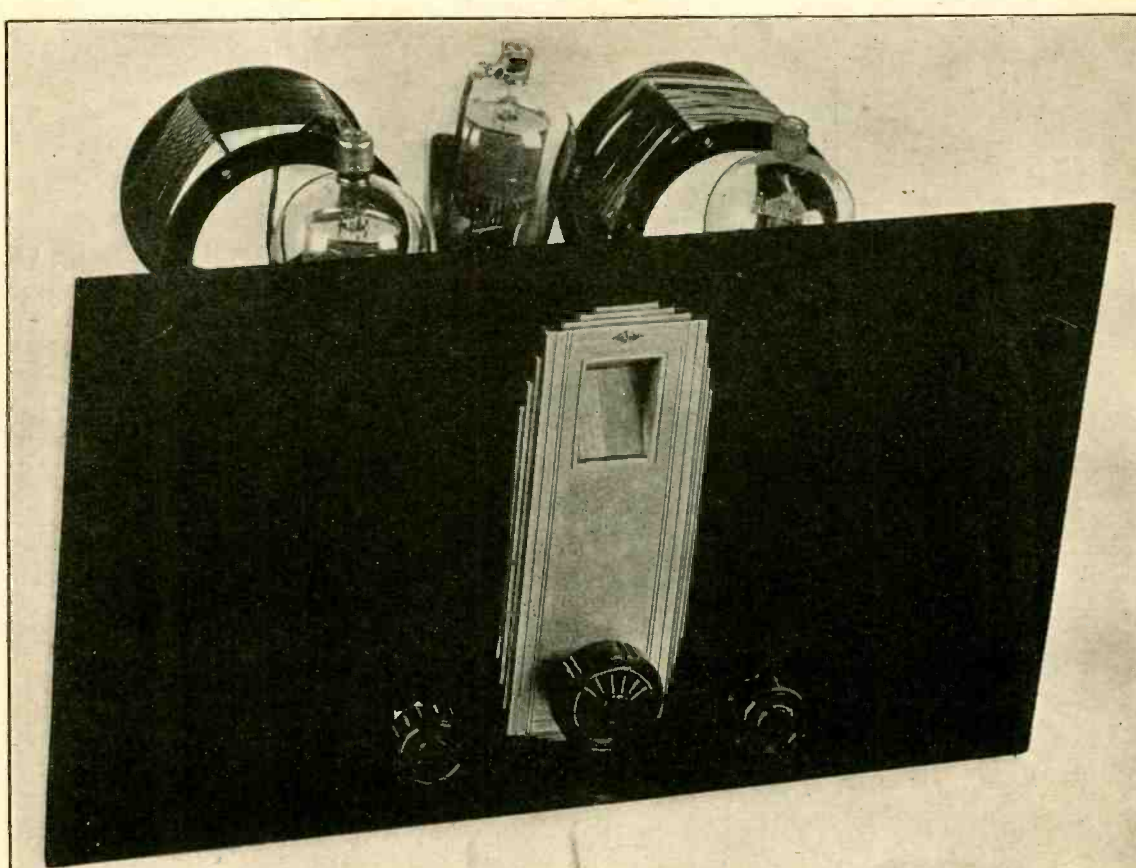
WORLD
The First and Only National Radio Weekly
459th Consecutive Issue—NINTH YEAR

TRIPLE SCREEN GRID, TWO TUNED CIRCUITED CONVERTER



Three screen grid tubes, two tuned circuits, and a total of only four plug-in coils for 15 to 600 meters. See pages 14 and 15.

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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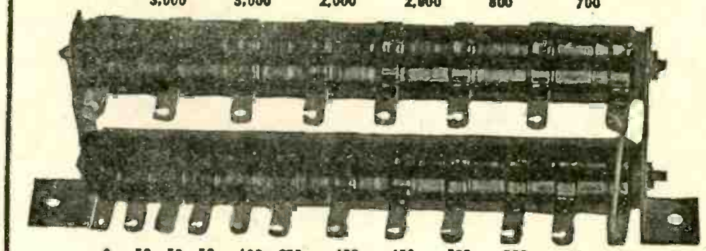

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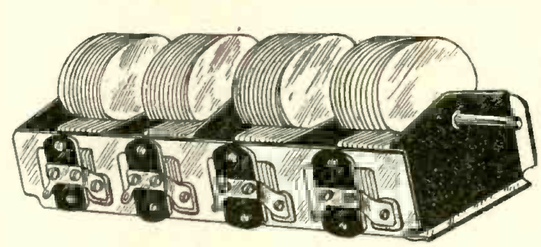

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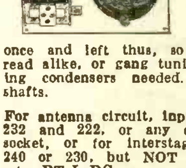

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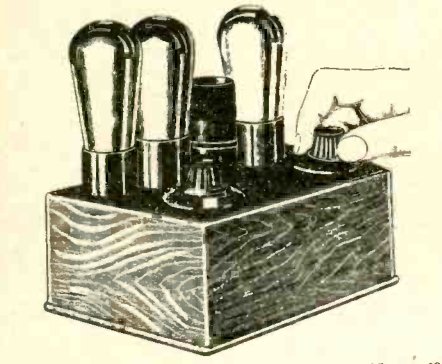

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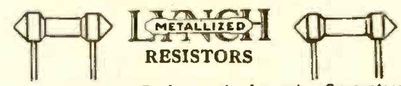

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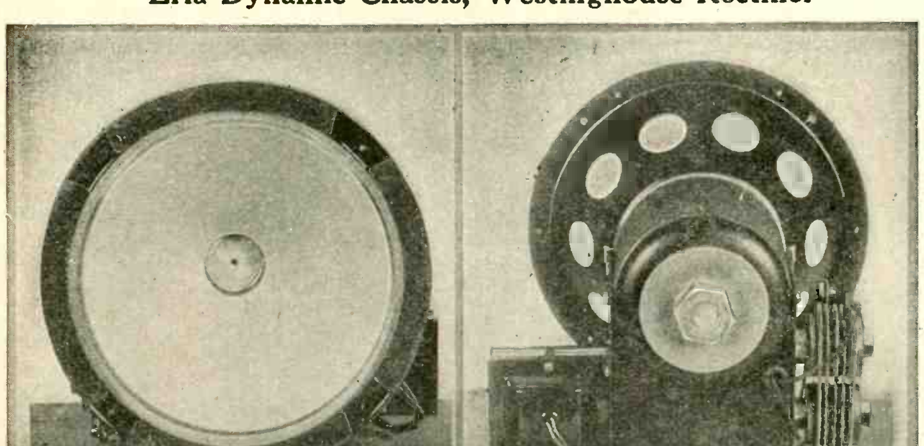
Erla Dynamic Chassis, Westinghouse Rectifier



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☐ 199-UX	2.50	59c	☐ 171A	2.25	59c	☐ 224	3.30	59c
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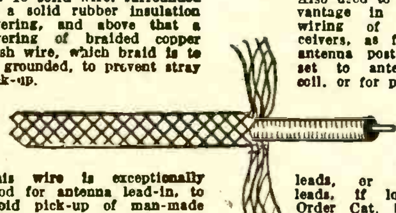

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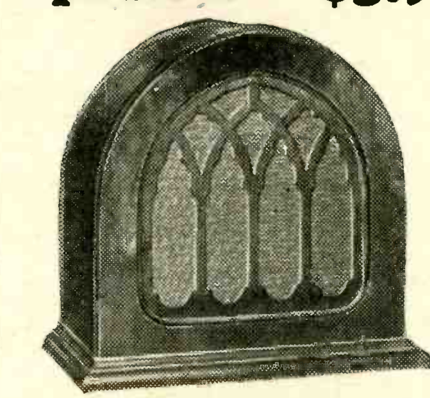

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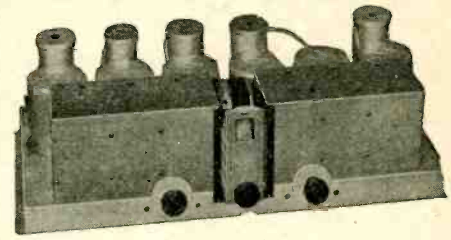

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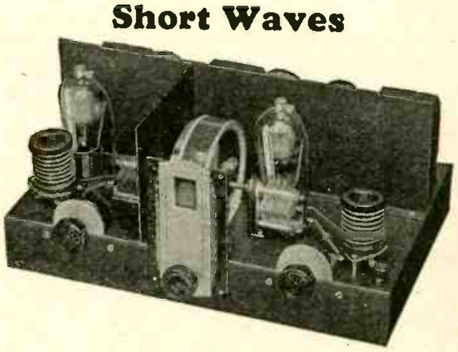

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Double Push-Pull AF In A New Form

By Henry B. Herman

DOUBLE push-pull amplification is most readily and economically accomplished by the use of a center-tapped high inductance choke coil followed by resistance coupling, so that finest quality is achieved in an audio power amplifier using parts costing less than $25.

The higher the inductance of the choke coil, half of which is directly in the plate leg of the detector tube, the better. For this reason an enormous inductance was chosen—1,000 henrys, with a DC resistance of about 15,000 ohms. While this DC resistance is large for any choke coil, it is small compared with the resistance of the plate circuit in which it is connected, therefore no compensation is necessary for inequality of load on the two sections, in only one of which DC flows.

The Push-Pull Action

Novelty attaches to this method of using a choke coil. It is assumed the detector is a 224 tube, since that imposes the highest inductance requirement one will encounter in ordinary practice. Assume a voltage drop across the upper section, with the current flowing from the B plus junction to the plate at any selected instance. Due to the series-connected windings being on the same core, the instant when the signal voltage is positive in the upper leg it is negative in the lower leg, and vice versa. The signal current, which alternates, is assumed to be flowing from B plus to plate. An equal signal current, but opposite in phase, will be flowing from the plate of the lower tube to B plus, at the same instant. If arrows were drawn they would seem to be pointing in the same direction, but of course the direction is in fact opposite, for in one instance the current is flowing toward the center tap and in the other instance away from that tap.

Thus is established the push-pull relationship. To achieve this practically, some form of inductance is necessary. Often a push-pull input transformer is used for coupling detector to the first audio stage, for double push-pull purposes, whereupon the next stage would have also a push-pull transformer, or push-pull resistance coupling.

The reason for requiring some sort of coil is that only a coil has a magnetic field, and to achieve push-pull, with its equal but opposite voltages and currents at any given instant, a magnetic field is essential. Simple resistors won't do, because both plates are effectively grounded. If the detector is a 227 a standard 30-henry center-tapped choke is all right.

Difficulties with Other Systems

Some experimental forms of push-pull, with straight resistance coupling, have been discussed from time to time, but none of them has proven wholly successful. It is necessary to change the phase. An extra tube could be pressed into service to accomplish this, or resistances back-coupled, with dissimilar values used in an attempt to equalize the input to a push-pull stage, but the equalization is a tender job, and few would succeed with it.

While the high-inductance choke coil is suggested, and there is a commercial one available, there is no reason why you may not use the secondary of push-pull transformer for which you have no other particular use. It may be a cheap transformer, and still results will be very good, since there is no coupling transformer action that would require highest type and permeability of the core, and the direct current will be less than 1 milliampere, hence no burden on the inductance. Whenever heavy direct current flows in a metal-core inductance the inductance falls sharply.

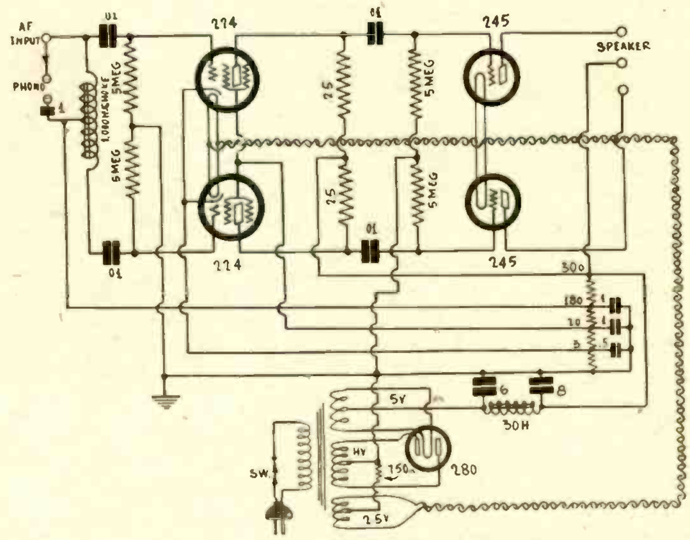


Fig. 1

A new method of introducing the push-pull relationship by means of a center-tapped choke coil is used in this double push-pull audio power amplifier.

The advantages of double push pull are well appreciated. They are the same in principle as for single-push-pull, to which

(*Continued on next page*)

LIST OF PARTS

One Polo type M power transformer with choke built in.
One Polo 1,000-henry center-tapped choke, type Z.
Four 0.01 mfd. mica fixed condensers.
Four 5.0 meg. grid leaks with pigtails.
Two 0.25 meg. plate resistors with pigtails.
One Multi-Tap Voltage Divider (17,100 ohms, 20 different voltages.)
One Condenser bank, 6.0, 8.0, 1.0, 1.0 and 0.5 mfd.
One Phono twin assembly.
One Speaker twin assembly.
One 1.0 mfd. bypass condenser.
One 750-ohm, 25-watt resistor.
Three binding posts, with bakelite terminal strip.
One bakelite socket strip, with three UX and two UY sockets.
One steel cabinet with removable top and bottom.
Twisted hair for 2½ volts AC output.
Hardware and hookup wire.

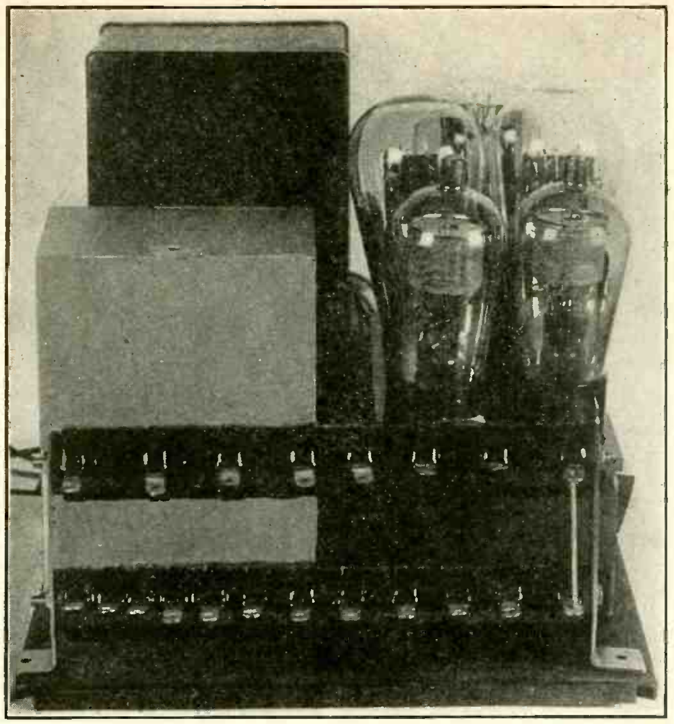


Fig. 2

View of some of the parts mounted on the bottom piece of the steel cabinet, showing bracket extended that is to be "toed in."

(*Continued from preceding page*)

nearly everybody is committed. The signal is purer, the maximum load that can be handled without distortion is greater, the stability is enhanced and the hum is much less.

2½-volt Consolidation

Despite the facility for ridding the circuit of hum by the push-pull method, high capacity is used for filtration, particularly as it is quite probable that B voltage to run a tuner will be taken from the power amplifier.

Also, the heaters of the tuner may be served by the power amplifier, up to five heater tubes in addition to the four tubes of both types used in the amplifier. It will be seen that the same 2½-volt winding is used for the 245s as for the heater type tubes, which is all right.

This double utility of the 2½-volt winding also makes for compactness. The new Polo power transformer therefore has room inside for the choke coil as well, built on separate core. All four windings of the power transformer (primary, 2½ volts AC, 5 volts AC and high voltage AC) as well as a choke coil of 30 henries, are inside a steel case finished in crinkle black.

There is room on the socket strip for the large inductance choke coil, the Polo type Z, and also for the miscellaneous parts, not including the condenser bank, power transformer and voltage divider, for which room is provided separately.

Placement Avoids Difficulties

The placement of parts is such as to avoid troubles otherwise hard to conquer. The condenser bank is far enough removed from the voltage divider and the 280 tube to avoid overheating which would affect the special wax compound in which the capacities are sealed. All condensers, except the .01 mfd. and one 1.0 mfd., are in this bank. which is provided with mounting feet, as are the power transformer and the voltage divider. In fact, the divider has special brackets already attached, and the one of these brackets is to be removed and turned about, so that the angle points toward the opposite end of the divider. This is necessary to prevent the bracket from extending beyond the steel base which is one of the component parts of the cabinet.

These component parts are: (1), the four-sided piece, 11⅜ inches wide, 8½ inches high x 9 inches front to back, outside dimensions. (2), the top cover, which slides over the outside; and (3) the bottom cover, on which the power transformer, condenser block, voltage divider and socket strip are to be mounted, and which bottom piece fits inside the main housing and is tapped for 6/32 machine screws, so that securing the bottom piece to the main part of the cabinet is easy.

Vent Holes Are Provided

Symmetrical ventilating holes already are drilled in the cabinet pieces, but holes for mounting some of the apparatus will have to be drilled by the builder. This is not obstructive, since an ordinary hand drill will make the necessary holes, without becoming too dull for further use.

The detector voltage is provided in the power amplifier, and it is assumed that negative bias detection is used, or so-called power detection. While a 224 detector is suggested, it is not imperative, as the system will work with a 227 detector, although the volume will not be so great.

Those desiring to incorporate screen grid detection in a tuner not already provided therewith may do so, by putting a positive bias of around 16 to 20 volts on the connection now used for control grid, but which will be the screen grid, and by bringing the connection from the juncture of tuning condenser and radio frequency transformer secondary, to a flexible lead, with grid clip thereon, for connection to the cap of the tube. The biasing resistor, usually around 20,000 ohms, would have to be increased, in most instances, because the plate current is less and the 224 takes a lower bias than does the 227. An easy solution is to put a resistor in series with the present one. If the one now used is 20,000 ohms, use 20,000 ohms more. The total should be around 40,000 to 50,000 ohms. The bypass condenser across the detector biasing resistor should include the total resistance.

Output and Speaker

The detector circuit is not diagrammed, as it is not a part of the audio power amplifier, except the plate circuit, and it is not practical to cover all the possibilities without a long series of diagrams. The directions given, however, may be applied to the tuner, as it is assumed that any one possessing a tuner will be sufficiently familiar with its circuit and constants to effectuate the recommended change.

It is true, also, that detection will result without enlargement of the biasing resistor, but it is preferable to move the bias up higher than could result under those circumstances.

The output shown has three leads, and the list of parts call for a twin output assembly for the speaker. The reason is that the two plate leads go to the tipped leads of the speaker, while the maximum positive voltage is supplied to a center-tap on the speaker coil, this simply being a lead of insulated wire. The speaker in mind for this particular power amplifier was the Farrand 12-G, which has a lug thereon representing the center of the speaker magnet coil. This lug is to be connected to the maximum voltage.

Where other types of speakers are to be used, if one is fortunate enough to have a reproducer with a push-pull primary on the output transformer, the connection would be the same as for the 12-G Farrand inductor dynamic. For the general run of speakers, however, a center-tapped choke coil would have to be used, with extremes to plates of the 245s, and center to B plus maximum. The speaker's tipped cords, again, go to the plates. There is no room in the power amplifier for this output choke, which may have a total inductance of 30 to 50 henries, so if the choke is required, place it in the speaker cabinet, or, if a console is used, anywhere near the speaker.

The maximum applied voltage is not the same in all instances. It so happens in this circuit that it is higher for the plate circuits of the screen grid tubes than for the plate circuits of the 245s, due to the distribution of the total 300 volts DC to include bias. Since the 245 tubes take 50 volts negative bias, the applied plate voltage is the total B voltage (300) less the bias voltage (50), or 250 volts. The total is therefore apportioned by connection of the reference point, to filament center of the 2½-volt winding, to a voltage 50 volts above ground potential.

With the screen grid tubes, however, the bias voltage is only 3 volts, so the applied plate voltage is the maximum (300) minus the bias (3), or 297 volts, or 47 volts higher than in the case of the 245s. The screen grid tubes are well able to stand this voltage, particularly as the current is very small, less than 1 milliampere, due in part to the high value of plate resistor, 250,000 ohms. This resistance value may be used safely, in respect to tone quality, because while the high resistor results in high gain, it does so without serious effect on the high frequencies, because the inter-electrode capacity is small. With 227 tubes this would not be true, for the load resistor then should be 100,000 ohms or less. The gain would be smaller with 227 tubes, and it is strongly recommended that the screen grid tubes be used.

20 Voltages from Divider

Whatever voltages are desired or needed may be obtained from the voltage divider. Even the power tube bias could be obtained therefrom, but it was deemed preferable to use a separate resistor because of the balancing effect of the signal current therein. Where the plate current of only the push-pull output tubes flows through the biasing resistor, as is true in this instance, no bypass condenser is needed, and, indeed, it would be objectionable, since the signal current through this resistor is neutralized by the push-pull action, and there is no sense in attempting to remove this valuable stabilizing agency.

Although only a two-stage amplifier, this circuit is one where the first stage is high gain, and requires one principal precaution. There should be no objectionable feedback, but if any is encountered, an easy solution is to use lower values of equal resistances in the grid circuit of either the first or second stage. At 1 meg. no trouble will croup up, but the low-note amplification will not be quite so strong. At 2 meg. there should be no trouble, and no serious effect on low notes. Only when 5 meg. is used in all four position in the grid circuits is there likelihood that there will be a little instability. The 5 meg. values are indicated on the diagram because it is well to use them, if possible, but if any trouble arises you know what to do Stability, once achieved, will be permanent.

A TRF Short-Wave Set

By Lester Chadwick

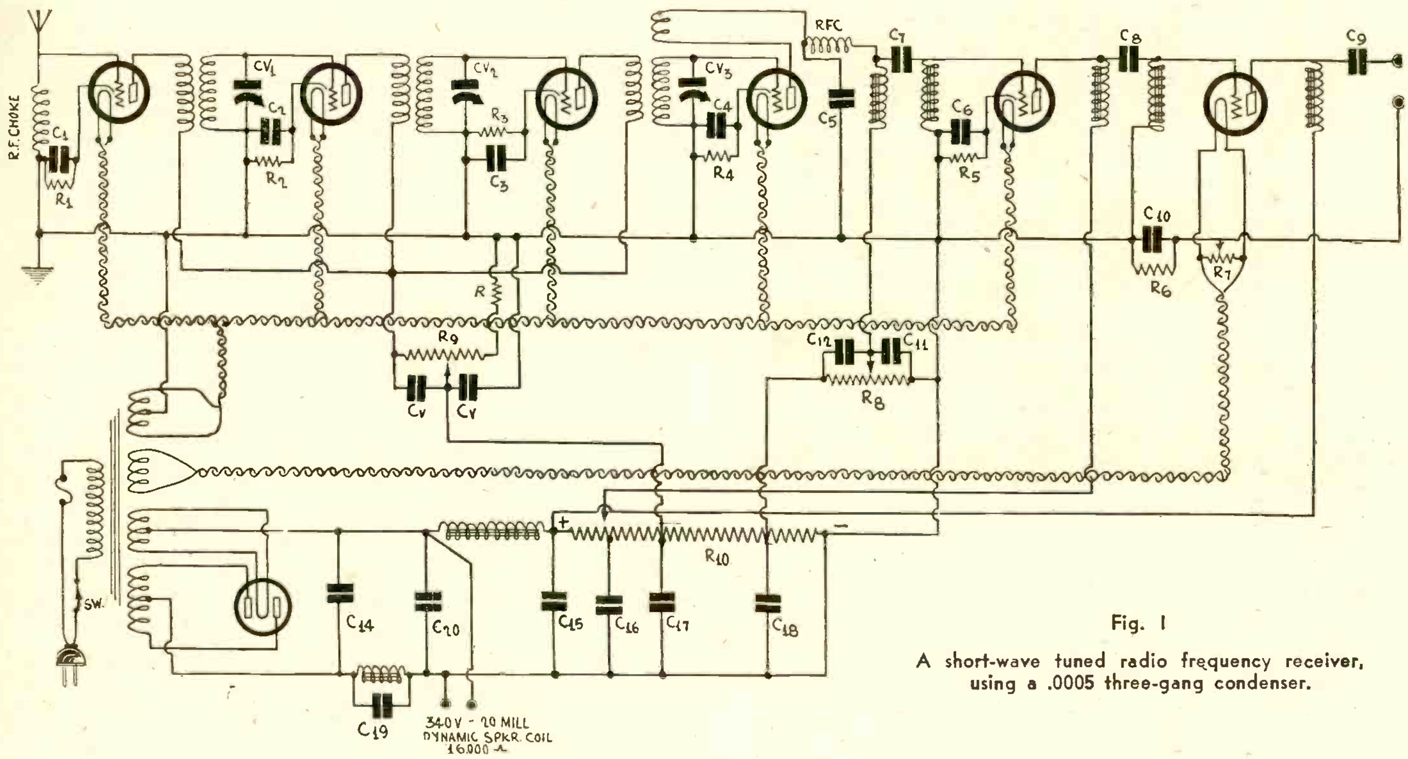


Fig. 1
A short-wave tuned radio frequency receiver, using a .0005 three-gang condenser.

THE short-wave set diagrammed in Fig. 1 is provided with a self-contained power pack. The output is rendered free of hum by means of a series hum trap. The effect of the trap is reinforced by the inclusion of a high impedance dynamic speaker field winding connected across the input to B choke. The DC resistance of such a field coil may range from 10,000 ohms to 16,000 ohms. The operative voltage will be between 300 and 320 volts. The resultant current at this voltage will range between 20 and 30 millamperes. The average field coil with which the pot magnet is energized (for sizes commonly used), is wound either with No. 35 or No. 34 plain enamel. The tabulated resistance of No. 35 is 3,352 ohms per pound, while that of No. 34 is 2,118 ohms per pound.

The coils are random wound, however, this resulting in the finished resistance being slightly higher than the tabulated values.

Between three to three and a half pounds of wire are required, and your present AC dry rectifier-operated speaker coil could be rewound with comparative ease with a breast drill clamped in a portable vise. The job might take a little time but it is worth while.

Fine copper wire is subject to a rather rapid change of resistance with change in temperature. This change in resistance may be as much as 250 ohms for the case of three and a half pounds of No. 34 enamel, after the wire has been operating on a 300-volt circuit for one and a half hours.

The change in resistance has no effect on the inductance value, so long as there are no turns of the field coil shorted. The divider load imposed by five 227s and one 245 is not excessive, hence no special mode of connection need be made to insure stability of the voltage supplied to the plates.

Multi-Tap Divider Used

A standard multi-tap voltage divider of 17,100 ohms, providing twenty taps, is used, giving the fullest latitude of adjustment in this regard. The largest change of distributed voltage occurs when adjustment of the plate voltage of the three radio frequency input tubes is made. With a volume control of the type shown to the right, the rather large change of plate load current would result in a change of distributed voltage of the divider system, which in turn would react unfavorably elsewhere in the set, hence we put a 30,000 ohm potentiometer, R9, in the circuit in series with a fixed resistor, R, of 7,000 to 10,000 ohms.

Regarding the power pack, there is a choice of two assembly arrangements that will work out all right, but the better one will depend on the general arrangement of units that the fan has in mind. The writer's plan is to place the power pack parts in a steel case. The connections are made to the set by a cable so bypassed that signal pickup from this source is impossible. The parts that compose the power pack are shown diagrammatically at the lower left of Fig. 1, and these parts are separately listed on the table of parts herewith. They are to be assembled to the base of the steel cabinet.

The second choice of power pack arrangement is that of enclosing the power transformer in the steel case that is used to furnish the plate voltages, and mount a separate heater transformer at a convenient point on the set chassis. This method applies where you have a power transformer without heater winding.

LIST OF PARTS

The tuner.

Six short-wave coils (Two sets, three to a set).
Three plug-in coil sockets (One with tickler mounted).
Two short-wave chokes (¼ mlh).
Five five-prong tube sockets.
One four-prong tube socket.
One 30-ohm potentiometer, R_7.
Three .01 mfd grid bias condensers, C_1, C_2, C_3.
Three 300-ohm flexible resistors, R_1, R_2, R_3.
One 20,000-ohm grid bias resistor with pigtail, R_4.
One 5,000-ohm grid bias resistor, R_5.
One 5,000-ohm grid bias resistor, R_5, with mounting.
Eight 1.0 mfd by-pass condensers, C_4, C_7, C_8, C_{10}, C_{11}, C_{12}, CV and CV.
One 2 mfd by-pass condensers, C_9.
Two feet of ¼-inch square bare copper wire, for common return ground lead.
One .00025 mfd bypass condenser, C_5.
One 1,500-ohm grid bias resistor, R_6.
One three-gang .0005 mfd variable condenser, CV_1, CV_2, CV_3.
Twelve binding posts.
Five 227 tubes.
One 245 tube.
Two 30,000-ohm potentiometers, one with AC switch. R_8 and R_9.
One 10,000-ohm fixed resistor, R.

The Power Pack.

One Polo 245 power transformer, 2½ volts, 16 amperes, 2½ volts, 3 amperes, 340 volts, 80 mills DC rectified output.
One Polo tuned choke.
C-19 is between 1 and 1½ mfd.
One condenser block, C_{14} to C_{18} (6, 8, 1, 1, 0.5 mfd).
One twenty-tap voltage divider, 17,100-ohms, R_{10}.
One AC switch.
One two ampere fuse and holder.
One pound of flux core solder.
One dozen 3¾-inch x 6/32 brass machine screws and nuts.
One dozen 1½-inch x 6/32 brass machine screws and nuts.
One 280 tube.

The 232 as Amplifier

By J. E.

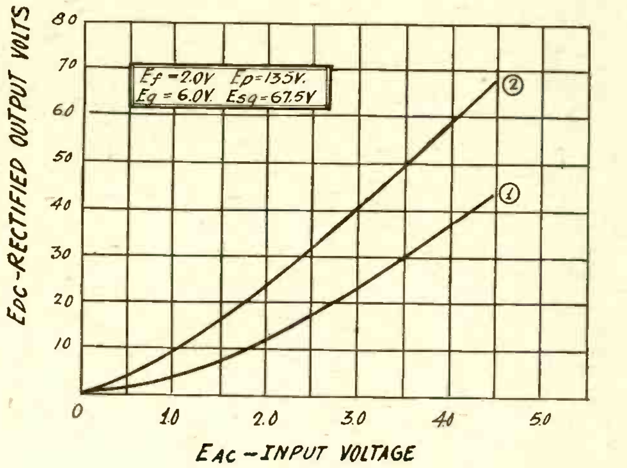


Fig. 1
Two curves showing the relationship between the rectified output voltage and the AC input voltage for the 232 screen grid tube when it is used as power detector. (1) is for a load resistance of 75,000 and (2) for 200,000 ohms.

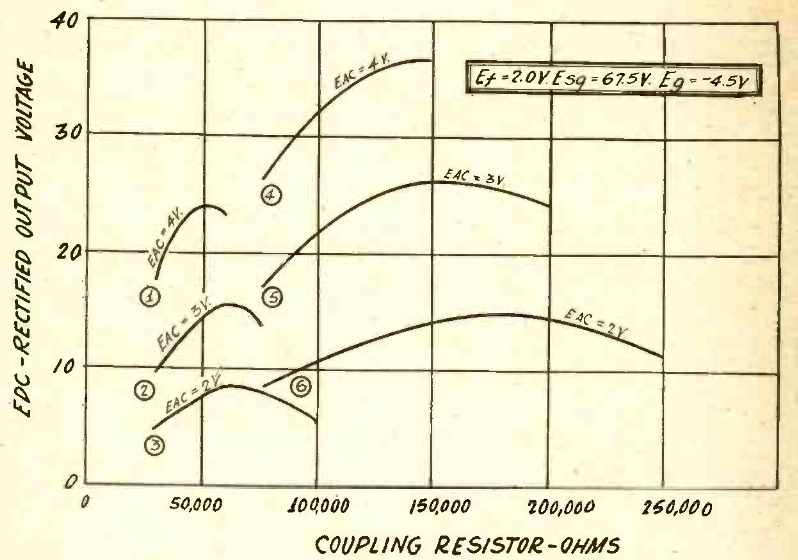


Fig. 2
These curves show the relationship between the rectified output voltage of a 232 power detector and the load resistance. The three curves at the left are for no screen resistance and the curves at right for a resistance of 100,000 ohms.

DETECTION and amplification by means of screen grid tubes in resistance coupled circuits are rapidly becoming more popular because it has been found that a high undistorted output can be obtained at low circuit cost. The majority of commercial receivers of the latest designs now utilize screen grid tubes both as detectors, and as amplifiers in conjunction with resistance coupling.

However, there is a tendency to use the screen grid tube as a high voltage detector so that no audio frequency amplification other than the power stage is necessary. In such cases the required voltage amplification is obtained in the radio frequency amplifier. That is, the tube that is omitted from the audio frequency amplifier is put in the radio frequency amplifier. This, of course, is in the interest of quality, since there is virtually no distortion in the radio frequency amplifier, while there would inevitably be some in the audio.

The 232 as Power Detector

Fig. 1 gives two curves which show the relationship between the rectified output voltage of a 232 screen grid tube for different values of AC input voltages on the grid. The various voltages applied to the elements are given on the graph. Curve (1) is for a load resistance of 75,000 ohms and curve (2) for a load resistance of 200,000 ohms. In both cases there is a resistance of 100,000 ohms in the screen circuit.

It will be noted that the maximum DC output voltage, when the effective AC input voltage is 4.5 volts, is about 67 volts when the load resistance is 200,000 ohms. Since this represents twice the amplitude of the input voltage to the next tube the peak value of the input to the next tube will be about 33 volts, which is more than required to overload a 231 power tube, for this tube requires a grid bias, hence allows a maximum peak signal input of 22.5 volts.

Even when the load resistance on the tube is only 75,000 ohms, the maximum output voltage is 42 volts, which is about sufficient to load up a 231 power tube with an effective AC input voltage of 4.5 volts.

It is important to use a 100,000 ohm resistor in the screen circuit because if it is not used the curves will be entirely different and the distortion will be much greater, that is, unless the applied screen voltage is considerably smaller than that specified on the graph.

Variation of Output with Load

Fig. 2 gives six curves showing the relationship between the rectified output voltage and the load resistance for different effective AC input voltages. It will be noticed that in each case there is one value of resistance which gives the greatest output, and that this resistance is higher the lower the effective AC input voltage. There are two groups of curves (1), (2), and (3), for no resistance in the screen circuit, and (4), (5), and (6) for a screen circuit resistance of 100,000 ohms. In each case the maximum output is greater when there is a resistance in the screen circuit, and the adjustment is less critical.

The reason for the wide difference between the two cases is that when there is no resistance in the screen circuit the screen voltage becomes equal to or greater than the effective value of the plate voltage. If the applied screen voltage were lower to start with, the two sets of curves would be more nearly equal.

As will be noticed on the operating specifications, the applied screen voltage is 67.5 volts. If this were reduced to 20 volts or less, it would not be necessary to use the 100,000 ohm resistance in the screen circuit. It will also be noticed that the operating grid bias is minus 4.5 volts. If this were somewhat greater there would be a different set of curves and the maximum output would not occur at the same value of load resistance.

Effect of Grid Bias Resistor

It is not usually realized that the plate current is different when the grid bias is obtained from a battery and a bias resistor, but this is a fact that should be taken into account when a circuit is designed. The reason that the current is different is clear. When the bias is obtained from a battery it remains constant for all values of plate voltage, but when it is obtained from a bias resistor it varies directly as the plate current. For example, when the plate current is high the bias is high, and when the plate current is very low the bias is also very low. This tends to check the variation in the plate current as the plate voltage varies. The effect on the signal voltage is similar, so that a self-biased tube appears to have a lower amplification constant than one in which the bias is independent of the plate current. Analysis will show that the bias resistor reduces the effective amplification.

In Fig. 3 are shown two plate current, plate voltage curves, for self bias and the other for battery bias. The slope of the one for self bias and the other for battery bias. The slope of the and plate load resistances.

The effect of the bias resistor on the signal can be reduced considerably by putting a condenser across the resistor. This will help to maintain the grid bias at a constant value, and the stabilization is more nearly complete the larger the by-pass condenser. The condenser acts as a filter or storage tank. When the signal current is high, the charge on the condenser is drawn on, and the voltage on the condenser does not change much. As the current is reduced, the condenser charges up again, and the voltage across the condenser once more remains practically constant. The nearly constant bias, therefore, is the voltage across the condenser.

Self-bias Filament Resistor

When the bias is obtained from a drop in a resistor in the filament circuit, there is little change in the effective bias because the change in the current due to changes in the signal is negligibly small. The filament current remains constant and the variable plate current which flows through the filament in addition is negligibly small in comparison with the constant filament current.

Plate current, plate voltage curves for the 232 tube are given in Fig. 4 for three different screen voltages. These screen voltages are the actual potentials on the screen, measured with respect to the negative end of the filament, and the plate voltages are the actual plate potentials measured with respect to the negative end of the filament. That is, the voltages are the applied voltages diminished by the voltage drop in the screen and plate load risistances.

It is the region to the left, where the curves drop, that must

and Power Detector

Anderson

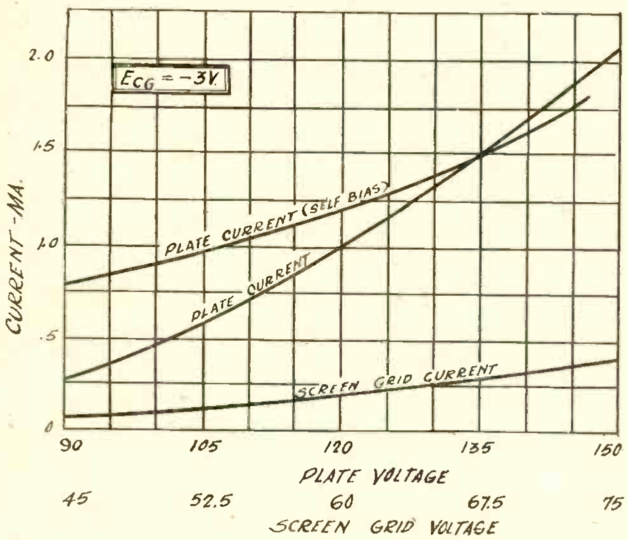


Fig. 3
Curves showing the difference in the plate currant of a 232 tube when it is biased by a battery and a resistance in the plate circuit.

be avoided if the tube is to amplify without distortion. This can be done by increasing the applied plate voltage to such a value that even after the voltage drop in the plate load resistance has been subtracted, the effective value of the plate voltage is still high enough to put the operating point well to the left of the irregular part of the curves. It may also be done by putting a resistance in the screen circuit so that the irregular portion is shifted to the left, or by lowering the applied screen voltage to a third or a fourth of the new value indicated on the graph. These conditions for distortionless amplification are reiterated because they are of first importance, and unless they are observed neither proper detection nor distortionless amplification can be obtained from the tube.

Simple Detector-Amplifier

In Fig. 5 is the diagram of a simple detector-amplifier in which the 232 tube is used as power detector and feeds directly by means of a resistance coupler the grid circuit of a 231 power stage. All the necessary voltages, resistance values, and by-pass condensers are shown on the drawing. A voltmeter is indicated across the filament circuit and a rheostat in series with the positive line to the filament battery. The rheostat should be adjusted until the meter reads exactly 2 volts. The value of the rheostat depends on the voltage across the "A" terminals. If the battery voltage is 2 volts, a 10 ohm rheostat is sufficient and in most instances it will have to bet set at minimum. If the battery voltage is 6 volts, that is, if a storage battery is used, the rheostat should be set at 21 ohms and it should have a maximum value of about 30 ohms. This assumes that the tubes in the radio frequency amplifier are on another

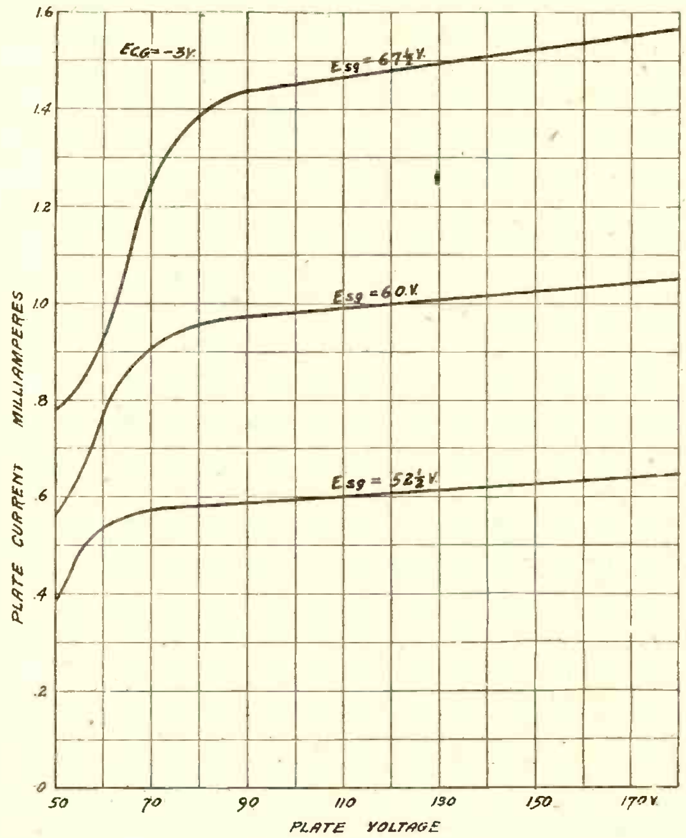


Fig. 4
Plate current, plate voltage curves for a 232 tube for three different screen voltages.

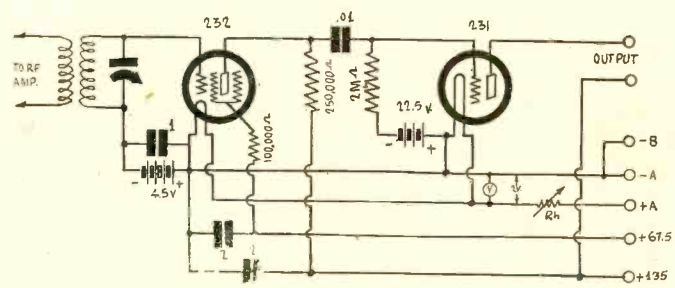


Fig. 5
A simple detector-amplifier circuit in which the 232 tube is used as power detector feeding a 231 power tube through a resistance coupler.

rheostat. If these tubes are also on the same rheostat, the resistance value would depend on the number of tubes, as well as on the voltage of the filament battery.

A Converter for N

By Einar

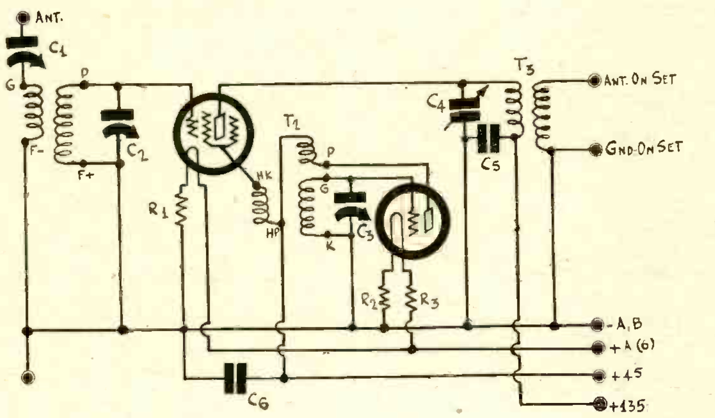


Fig. 1
The circuit diagram of a two-tube short-wave converter in which the 232 screen grid tube is used as modulator and the 230 as oscillator.

THOSE who live out in the country a long way from electric power line are in a fortunate position in respect to reception of short-wave signals from remote point, for they are relatively free from the most annoying aspect of short-wave reception, noises in the power line. They should be able to get clear signals from foreign countries almost any day or night when static is not filling the air, and if they operate on waves below 50 meters they should be able to get clear signals all the time, for on these short waves static is not serious even in the home of static, the tropics.

No doubt there are just as many of the battery set owners who are interested in short-wave reception as of electric set owners, and judging by the expressed interest, that includes everybody.

For those who have battery operated receiver sensitive enough to get most broadcast stations within a 1,000 mile radius can hook up a short-wave converter to operate in conjunction with it at a very small cost, and they will have a sensitive short-wave receiver of the superheterodyne type.

Short-wave Converter

In Fig. 1 is a simple diagram of a two-tube short-wave converter utilizing one 232 screen grid tube and one 230 general purpose tube. The screen grid tube is used as modulator and the 230 as oscillator. There are three tuned circuits in the hook-up. The first is tuned to the desired short-wave signal, the second to the signal that has a higher or a lower frequency by an amount depending on the setting of the broadcast receiver tuner, and the third is tuned to the same frequency as the broadcast receiver.

The first of these tuners is not critical at all, but may be made so when desired. The second, the oscillator tuner, is quite critical and may be regarded as the only tuner in the circuit, for the first may well be regarded as a mere tuning control. The third tuner is not tampered with once it has been tuned to the frequency to which the broadcast receiver is adjusted.

In the antenna circuit we have a condenser C1, a midget used to sharpen up the tuning of the input tuner. In most instances this condenser may be set at maximum. The first tuner is the secondary of T1 and condenser C2. For strong stations, and when there is no interference requiring sharp tuning in the antenna circuit, C2 may be set at minimum, while the stations are tuned in with the oscillator condenser C3.

Oscillator System

The oscillator consists of the coil T2, which has three windings, the tuning condenser C3, and the 230 tube. The oscillations are impressed on the modulator tube by way of the screen circuit of the modulator tube, a method which is effective when the voltages on the elements are adjusted properly. In this circuit the voltage in the plate circuit of the modulator tube is 135 volts, that in the screen circuit 45 volts, and that on the control grid about 4 volts, which is obtained from the drop in R1. It is assumed that the filament battery voltage is 6 volts and that the 4 volt excess is dropped in the negative leg of the 232 tube filament.

The plate circuit of the modulator tube is tuned to the intermediate frequency for three reasons. First, because the screen grid tube requires a high impedance load to work effectively; second, because a by-pass condenser is necessary to make it work effectively as a detector; and third, because it is desirable to couple the modulator most effectively to the broadcast receiver at one frequency only. The output is tuned by means of condenser C4, which may consist of a fixed condenser shunted by a small variable trimmer or a large variable condenser.

Sharpening the Set

When the primary of T3 is tuned with C4 to the frequency to which the broadcast receiver is tuned, there is very little signal pick-up in the broadcast range, except at the frequency to which the output circuit and the broadcast receiver are tuned, and it is always possible to select a frequency at which there is no interference.

Although the oscillator will tune very sharply, especially if the broadcast receiver is selective at the frequency stated, there may be a certain amount of interference due to cross talk and image intereference. The only way to reduce this, if it should occur, is to tune sharply ahead of the modulator, that is, by means of C2 and C1. When the signal has been located on the oscillator, with C1 set at maximum and C2 at minimum, it may be tuned in by adjusting C2. The signal may be made louder by tuning C2, but it may be that the selectivity on this tuner is not as great as it should be. In that case condenser C1 should be opened up and C2 retuned. It may be found that it is necessary to set C1 at minimum before C2 becomes sharp.

The Coil Set

It is also possible that the signal is loudest when C2 is set at minimum and that it disappears entirely when the condenser is closed up. If that is the case a smaller coil is needed in the T1 position.

To cover the short-wave band at least six coils are needed,

Right or

Questions

(1)—A 224 detector tube working into a resistance load of the order of half megohm will deliver an output voltage high enough to load up a 245 power tube when the grid bias on the power tube is 50 volts.

(2)—When two condensers are connected in series the capacity of the two is smaller than that of the smaller of the two so connected.

(3)—When two inductance coils are connected in parallel and placed far apart the inductance of the two is smaller than that of the smaller of the two coils.

(4)—When two condensers are connected in parallel the capacity of the two is equal to the sum of the two capacities.

(5)—When two inductance coils are connected in series and placed far apart, the inductance of the two is equal to the sum of the two inductances.

(6)—There is no advantage in putting fuses in the primary of a power transformer because before the fuses have time to melt the tube filaments blow out.

(7)—There is no use in amplifying the low notes because the loudspeaker will not reproduce them anyway.

(8)—In a resistance coupled amplifier with three-element tubes the high frequencies are not amplified nearly as much as the low because of the high effective input capacity to the tube that is followed by a resistance coupler.

(9)—The high frequency suppression in a resistance coupled amplifier is greater the higher the load resistance and also the higher the amplification.

(10)—When a screen grid tube is used in a resistance coupled amplifier there is comparatively little suppression of the higher frequencies because the plate to control grid capacity is negligibly small, and it is this capacity that is directly responsible for the suppression.

Answers

(1)—Right. Detected voltages over 100 volts may be obtained from a screen grid tube operating as a power detector and the signal required to load up a 245 tube is 100 volts, 50 volts in each direction. To get this voltage from a screen grid detector it is necessary to have a much higher voltage in the plate cir-

ew 2-Volt Tubes

Andrews

three for T1 and three for T2. This assumes that C2 and C3 ars 150 mmfd. condensers. While it it possible to cover the short-wave band with fewer coils if the tuning condensers are made larger, louder signals are obtained when the condensers are small and the coils comparatively large. Of course, plug-in coils should be used.

Coil Turn Errata

T1 is wound on a form that plugs into a UX socket and T2 on a form that fits a UY socket. There are such forms available which have diameters of 1.25 inches. The tuned windings on T1 and T2 may be the same when the tuning condensers C2 and C3 have the same values. Using No. 24 double cotton covered wire, the smallest winding should have 5 turns, the next 9 turns, and the largest 17 turns. The corresponding primary windings on T1 should have 2, 4, and 7 turns, and the corresponding tickler windings on the oscillator coil T2 should have 3, 7, and 15 turns. The tickler windings are not critical and it is better to have too many than too few turns.

The pick-up winding on T2 is not critical either. However, if too many turns are used the modulator might overload seriously. It has been found by experiment that the pick-up winding on the smallest coil, that is, on the 5 turn coil, that a single turn is satisfactory. Three turns for the middle oscillator coil and 5 for the largest also have proved satisfactory.

Coil Terminal Connections

The connections of the terminals of these coils on the forms are indicated on the drawing. Thus the antenna terminal goes to the G prong, the ground terminal to the F minus prong, the grid terminal to the P prong and the ground on the secondary to the F plug. Thus the live terminals are connected in the reverse order, which is done to shorten leads, and the two low potential prongs are connected together, either in the coil itself or externally. It is better to make the connection externally, for then it is possible to use the coil as an interstage coupler without any changes.

The terminals of the oscillator coil are made as indicated on T2. Hk represents that heater prong on the UY base that is nearer the K prong and Hp that prong which is nearer the plate prong. Note that two coil terminals are made to the Hp, the low potential ends of the tickler and the pick-up coils. The fact that the same voltage is used on the plate of the oscillator as on the screen grid of the modulator, makes it possible to use a five-prong form for a six-terminal coil system.

Intermediate Coil

The intermediate coil T3 may be an ordinary radio frequency transformer wound for a screen grid tube, with the large winding in the primary and the smaller in the secondary. However, there should be little difference in the number of turns on these two windings. With such a coil the tuning condenser should either be a .00035 or a .0005 mfd., depending on the number of turns on the primary.

Resistance R1 should have a value of 67 ohms and R3 and R4 each 33 ohms. Condensers C5 and C6 should be 1 mfd. condensers. Such large values are desirable in order to insure oscillation at all settings of the oscillator.

LIST OF PARTS

C1—One 100 mmfd. midget condenser
C2, C3—Two 150 mmfd. tuning condensers with dials
C4—One .0005 mfd. variable condenser
C5, C6—Two one mfd. condensers
T1—One set of three short-wave coils as described
T2—One set of short-wave oscillator coils as described
T3—One RF tuning coil with primary wound for .0005 mfd.
R1—One 67-ohm ballast resistor
R2, R3—Two 33-ohm ballast resistors
Two UX sockets, one for antenna coil and the other for oscillator tube
Two UY sockets, one for modulator tube and the other for oscillator coil

Wrong?

cuit, for the output voltage can never be as great as the applied voltage.

(2)—Right. The capacity of the combination is obtained by multiplying the two capacities together and then dividing the product by the sum of the two. The number thus obtained is always less than the smaller of the two entering the combination.

(3)—Right. Two inductances connected in parallel combine in exactly the same manner as two capacities in series, provided that the two coils are far enough away from each other that the mutual inductance may be neglected.

(4)—Right. They add together because the combination can hold as much electricity, for a given voltage across them, when they are tied together as when they are apart.

(5)—Right. If there is no mutual inductance between the two coils when ther are connected in series, the inductance of the two is just equal to the sum of the two inductances.

(6)—Wrong. Even if the statement were true in respect to the blowing out of the filaments, there would still be an advantage in using fuses because they would protect the installation in case of a short-circuit.

(7)—Wrong. Reproduction by a speaker is relative. There is no frequency in the audible range which is not reproduced to some extent. If the speaker reproduces the low notes weakly there is all the more reason why the audio amplifier should amplify these notes so as to compensate for the deficiency of the speaker.

(8)—Right. The suppression is due to reverse feed-back through the plate to grid capacity and this is greater the higher the amplification. The effect may be interpreted as due to an increase in the grid to filament capacity of the tube.

(9)—Right. The effective input capacity is greater the greater the amplification constant of the tube, the greater the load resistance, the greater the capacity between the plate and the grid, and the higher the frequency involved.

(10)—Right. The plate to control grid capacity in a screen grid tube is of the order of 0.02 mmfd., while that of a high mu three-element tube is of the order of 6 mmfd., a ratio of 300 to one. The other factors affecting the high frequency amplification are not in the same ratio but favor the screen grid tube so that the high note suppression in a screen grid tube circuit is not nearly as high as that in a circuit using three element tubes.

Condition of Battery Affected by Freezing

WHERE storage batteries for car or radio service are at all exposed to temperature conditions outdoors or in cold rooms or basement, be sure that they are maintained fully charged, or nearly so, during the winter time.

A fully-charged battery freezes at minus 80 degrees Fahrenheit! This is low enough for safety anywhere, but consider a fully-discharged battery. The liquid will freeze at 25 degrees. Even a partly run-down battery will freeze at temperatures above zero. So, watch the "specific gravity" of your battery by testing it with a hydrometer, and if the car battery or radio battery falls below 1,200, have it charged at once.

Where the radio battery is kept in the cellar, it should be on a high shelf, well off the floor so as to avoid dampness. Keep the battery clean. Wash it off well with a hose once in a while. With sandpaper clean the terminals, especially the positive pole, which so easily becomes coated with greenish substances. After replacing the connecting wires, cover each terminal with a thick coat of auto grease to retard further acid corrosion.

Be careful to keep sufficient liquid in the battery to cover the plates. Use distilled water only. Faucet water will ruin a battery in a short time, because of the minerals it contains. Rain water is ideal for a battery, as is clean melted snow. In collecting rainwater, wait until the rain has been falling heavily for an hour or so, to clear dust from the air. Snow may be used, if collected 2 or 3 inches above the ground, for the same reason as in the case of rain. Collect a gallon or two of rainwater or melted snow for your battery and keep it tightly corked for use the year round. Add water, every month, and test each cell with the hydrometer (before adding water) often enough to make sure the battery is kept in a charged condition.

How to Use Precision De Luxe Plug in Coils in an All-Wave Converter! See next week's issue, dated January 17th.

The 1931 Colonia

FIG. 1 is a diagram of Colonial Model 32 DC receiver, with four 224 screen grid tubes, one 227 detector, and two 245 power tubes. The heaters and the filaments of all the tubes are connected in series, a resistance R11 being connected in shunt with the filaments of the 245 tubes to allow for the difference in current requirements of the heaters and the 245 filaments. The total current in the series is 1.75 amperes, and since the 245 tubes require only 1.5 amperes, resistance R11 must carry 0.25 ampere. Since the voltage across this resistance is 5 volts, the value of R11 is 20 ohms.

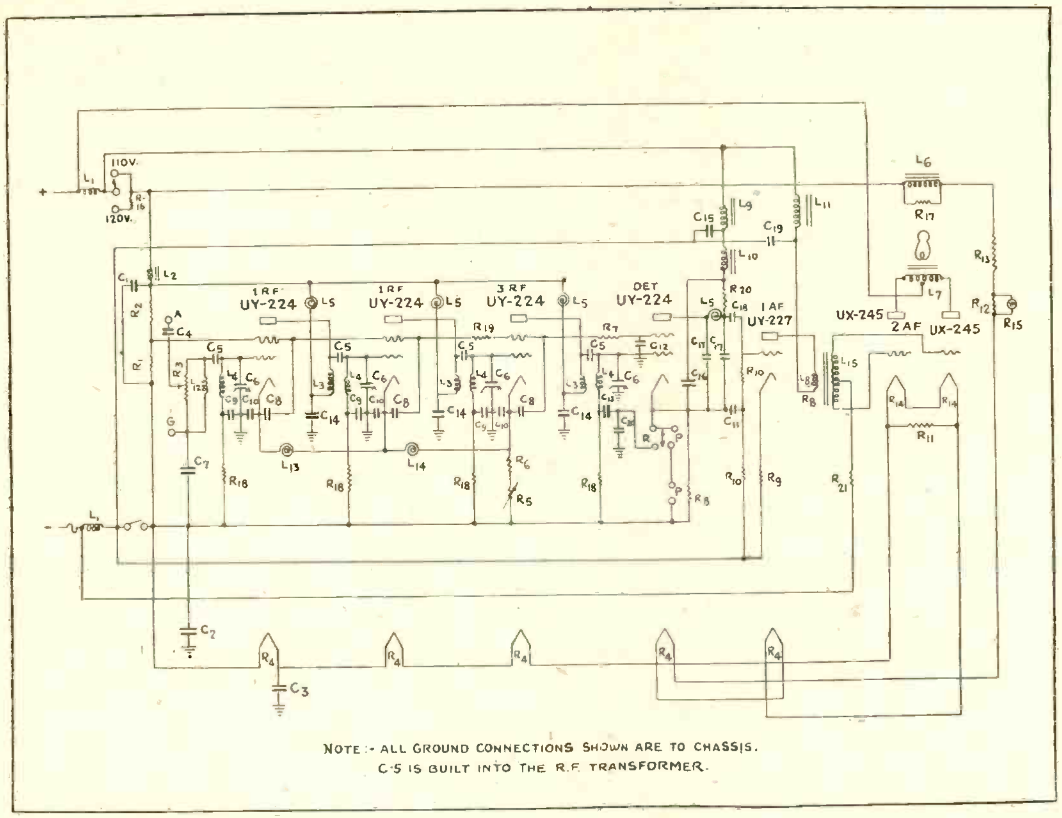


Fig. 1
The circuit diagram of Colonial Model 32 DC Receiver.

The series connection of the filaments of the two 245 tubes makes the grid bias on these tubes different by the amount of drop in one of them, that is, by 2.5 volts. This is not a serious difference when the total bias is so high as it is for the 245 tubes. Bias for the other amplifier tubes is obtained by suitably returning the grids to the heater line.

Thorough Filtration

Note the thoroughness of the filtering in the stages of both the RF and AF amplifiers. In each plate circuit there is a choke coil in series with the coupling impedance, and each choke is shunted to ground with a condenser. In the radio frequency stages these chokes are marked L5 and the corresponding by-pass condensers C14. In the plate circuit of the detector the choke is marked L10 and the corresponding condenser C16. There is a second choke L9 in this line and a second by-pass condenser C15. In series with the plate circuit of the first AF amplifier is a choke L11 and this is by-passed by a condenser C19. There is no choke in series with the B supply to the power tubes because they are in push-pull and the hum is balanced out. There are two coils, both marked L1, which carry the plate current of all the tubes except the power tubes and thus filter the supply. The lower of these coils also carries the plate current of the power tubes. An additional coil L2 is used to filter the plate and screen supply of the first three tubes.

Volume Control

There are two volume controls in the circuit. The first is the high resistance potentiometer R3 across the antenna coil L12. The antenna is connected to the slider of this potentiometer through a small condenser C4. The other volume control is the variable resistance R5, which varies the bias on the first three tubes, since it is in the common cathode lead of these tubes.

Provision for a phonograph pick-up unit is made in the cathode lead of the detector tube.

The field coil L6 for the dynamic speaker is connected in series with the heaters and the filaments. Thus it is not necessary to draw any extra current from the line for this purpose.

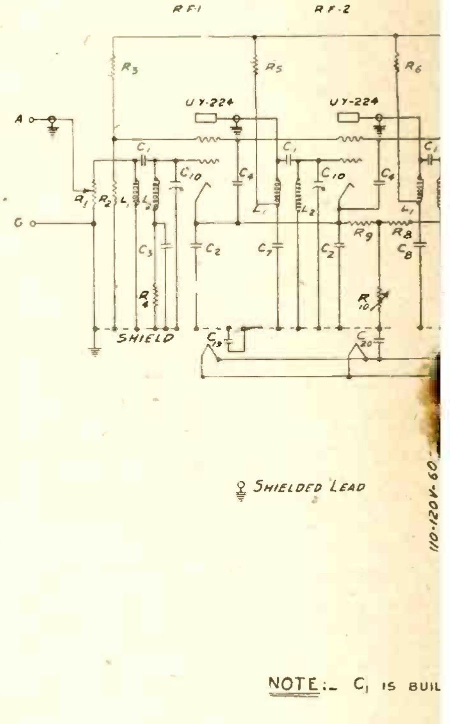
Colonial Model 32 AC

The AC model is similar to the DC model in so far as the circuit exclusive of the power supply is concerned. However, instead of using individual chokes for filters in the plate circuits, resistances are used. There are five of these filter resistors, R5, R6, R7, R15, and R16. R15 is also the plate coupling resistance in the plate circuit of the detector and R16 the feed for the plate of the first audio frequency amplifier.

The volume control in this receiver is also the same as that in the DC model. R1 is the antenna potentiometer for varying the input to the circuit and R10 is a variable grid bias resistor for the first three tubes in the circuit.

Provision is also made for a phonograph pick-up in the grid circuit of the detector. A single pole, double throw switch changes from radio to phonograph or in the opposite direction. The pick-up unit may be connected permanently to the terminals marked P. When the switch is thrown to the phonograph position the unit is connected in parallel with the bias resistor R14 and when it is thrown to the radio position the full value of this resistance is in the circuit. Thus the bias on the tube is automatically changed to suit the function of the tube, that is, as amplifier or detector.

The volume control for the pick-up is supposed to be built into that unit, as is the case in most instances, but there is a switch provided for changing the volume in case it is necessary.



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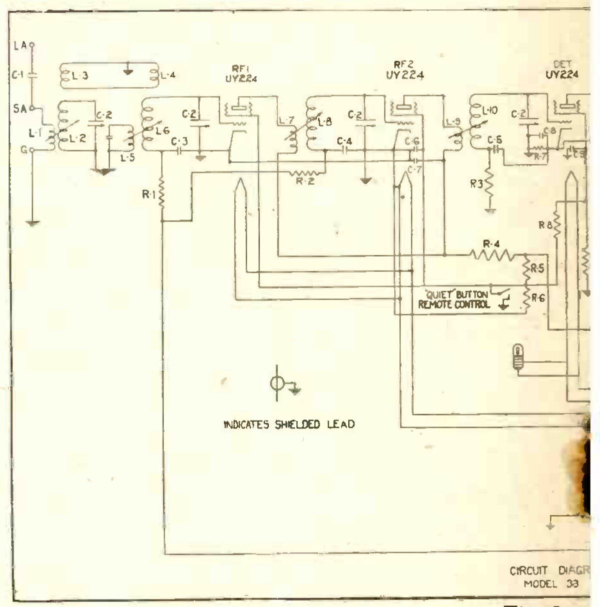

Fig. 3
The diagram of Colonial Model 33 DC. This is a six
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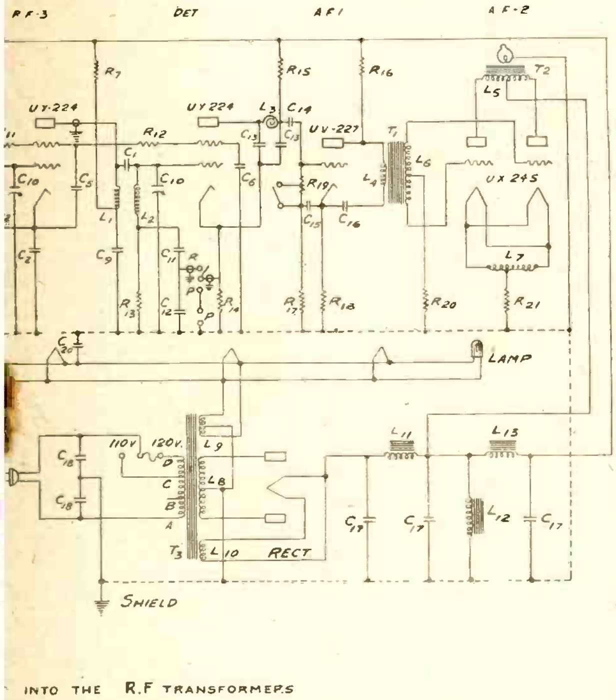
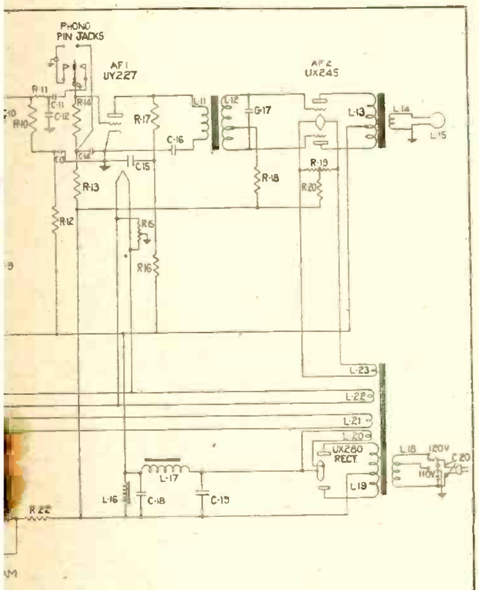


Fig. 2
ram of Colonial Model 32 AC.



-tube receiver in which the heaters and d in series.

witch is across a portion of the grid leak in the first amplifier. When it is closed part of the leak is shorted e amplification is reduced.

power input arrangement is noteworthy. The primary transformer is tapped for either 110 or 120 volts. To from one to the other it is only necessary to move the ting fuse from one position to another.

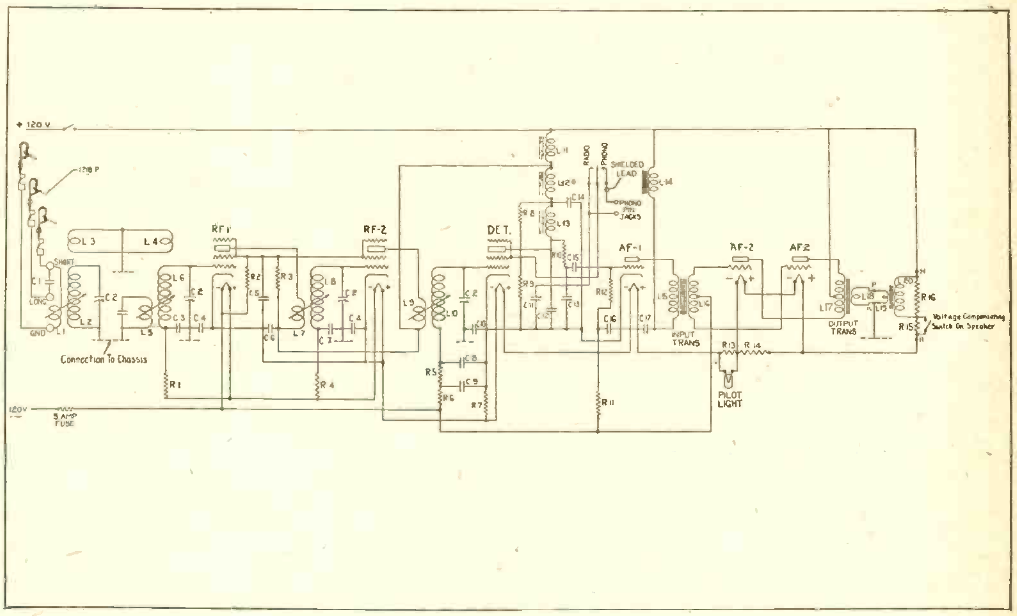
he primary there is also a noise filter to prevent line from entering the set. This filter consists of two con- s C18 connected in series with each other and across the The junction of the two is grounded. Thus noises picked either side of the line are shunted to ground. Small sers C20 are also connected from one side of the heater to ground. Since the center of this circuit is also ground sers C20 are connected across one-half of the 2.5 volt

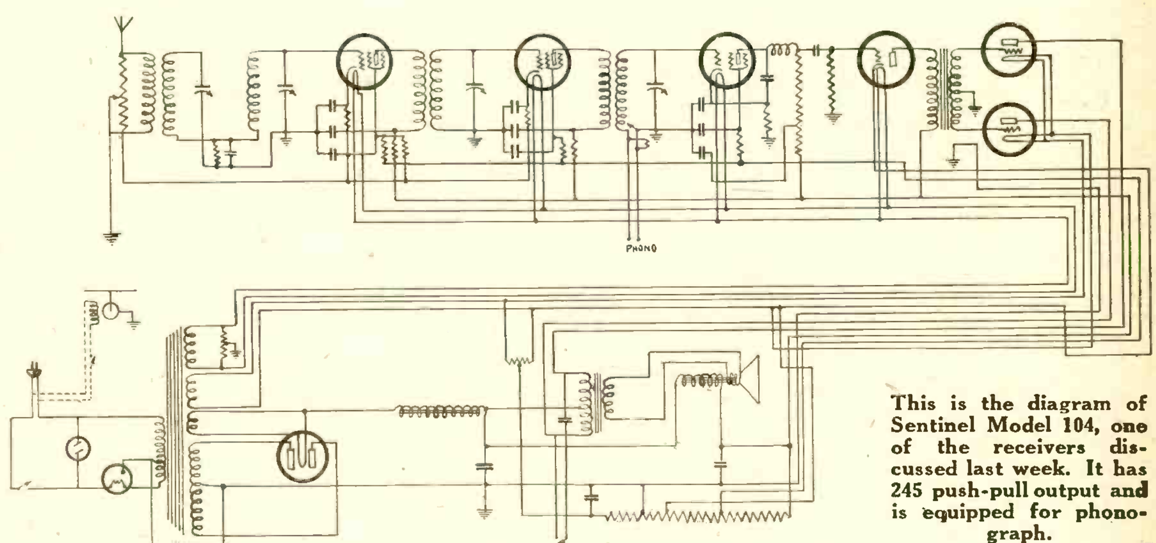
speaker field L12 is connected across the B supply line n the two filter chokes L11 and L13. Since this is across tire voltage it is a high resistance field winding.

plate current of the power tubes flows only through the first choke L11, while the plate and screen currents of the other tubes flow through both. All the plates and screens are returned to the same point but the screen voltage is dropped to the required value in resistance R3, and R2 is the bleeder which helps to determine the screen voltage. Indeed, the screen voltage is equal to the drop in this resistance, neglecting the small grid bias on the screen grid tubes.

Fig. 3 is the circuit diagram of Colonial Model 33 DC receiver. It makes use of three screen grid tubes of the 224 type, two as radio frequency amplifiers and one as detector, one 227 type as first audio frequency amplifier and two 245 tubes as power amplifiers in a push-pull circuit. All the heaters and filaments are connected in series as in the preceding DC model. The field

Fig. 3 (below)
The diagram of Colonial Model 33 DC Receiver.





This is the diagram of Sentinel Model 104, one of the receivers discussed last week. It has 245 push-pull output and is equipped for phonograph.

winding of the dynamic speaker is also on this series, a resistance R16 being connected across the field to pass the current not needed for the field.

The phonograph pick-up unit is connected in the screen circuit of the detector tube, which is a unique position for it.

The B supply and filter arrangement is the same as in Model 32 DC, most of the filtering being in the detector supply.

Model 33 AC is like Model 33 DC except that the power supply is different. There are three 2.5 volt filament windings, one serving the radio frequency amplifiers, another serving the detector and the first audio frequency amplifier, and a third serving the two 245 tubes in the power stage. The center of the winding serving the detector is grounded by means of a center-tapped resistance R15 and the winding serving the power tubes is similarly balanced by means of a resistance R19. The other winding is grounded on one side rather than in the center.

An interesting feature is that where by-passing is done in the plate circuits the connection is always made to the cathode rather than to ground. Thus in the second RF tube the by-pass condensers are connected from the screen and the plate return to the cathode of that tube. In the detector plate circuit condenser C10 which by-passes the radio frequency component goes to the cathode directly and likewise condensers C15 and C16 in the plate circuit of the first audio frequency tube are connected to the cathode. Thus the signal currents are always led back to the source by the shortest route. This minimizes feedback through the common elements in the supply circuit. The fact that the cathodes are also grounded does not alter the desirable effects of the by-passing.

Coil Data For An A

By Herman

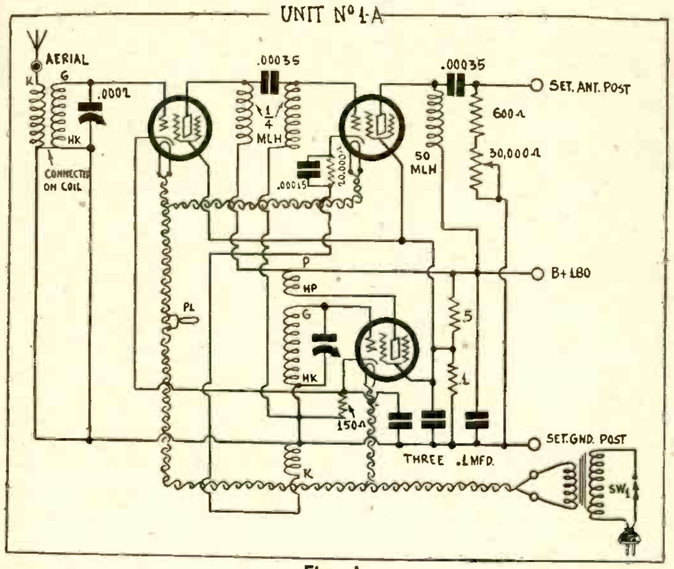


Fig. 1
The triple screen grid all-wave converter, using two tuned circuits. This may be worked with any type broadcast receiver. A total of only four plug-in coils is used.

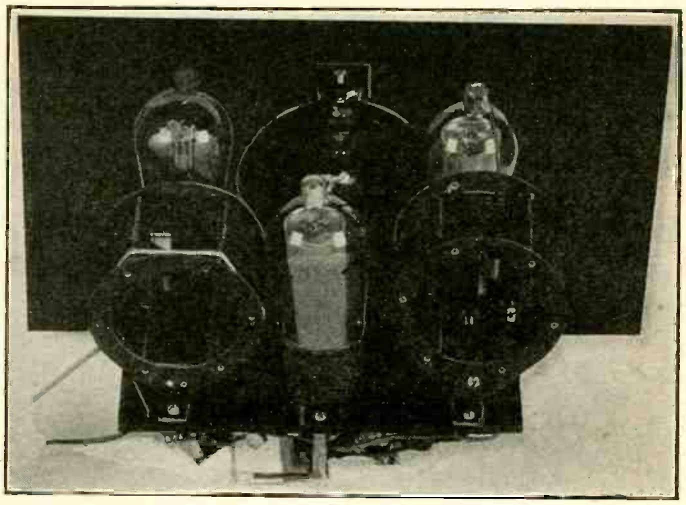


Fig. 2
Rear view of the converter. Either tube base type coils, or the illustrated precision air-wound coils may be used.

THE tuning curve of the all-wave converter diagrammed in Fig. 1 is such that, with an intermediate frequency of 1,500 kc, the lowest broadcast frequency comes in at 89 on the oscillator dial and the highest broadcast frequency at 42, using the larger of the two plug-in coils intended for the oscillator circuit. The principal tuning is done by virtue of the oscillator action, and it is the oscillator condenser alone that is actuated by the National dial. The other condenser, across the modulator grid circuit, while it is effective enough to tune out a weak signal, or to bring in a few different broadcast frequencies without moving the oscillator setting if the signals are very loud, is after all a secondary consideration in the tuning.

That the oscillator functions to make possible reception of the broadcast band of frequencies over 47 divisions of the dial is due simply to the fact that the oscillator frequency is higher than the station carrier frequency by the amount of the intermediate frequency, so the rate of frequency change is more rapid, since higher frequencies are involved.

Intermediate Frequency Compensation

The 1,500 kc intermediate frequency is cited, as it is assumed that users will prefer a high intermediate frequency, provided the broadcast set is sensitive in that region, but if such sensitivity is not present there, a lower intermediate frequency may be used. For this reason it is advisable to have some blank space at the lower frequency region of oscillator tuning, if a 1,500 kc intermediate is used, for as the intermediate frequency is lowered, the dial settings are numerically higher, for the same broadcast stations.

If it is decided to set the receiver dial with condenser plates fully enmeshed, which would give the lowest intermediate frequency, then if the lowest frequency broadcast stations don't come in, because the oscillator dial will not tune so low, a small fixed condenser may be placed across the oscillator condenser. A suitable capacity would be the Hammarlund equalizer, 20-100 mmfd. The set-screw should be turned until the lowest frequency station does come in, and the setting need not be disturbed thereafter. Of course, the highest broadcast frequency will come in, even if .0001 mfd., the maximum of the equalizer, is across the oscillator tuning condenser, which itself is a .0002 mfd. Hammarlund variable, a midget model with midline tuning characteristic.

Wide Turning Range Afforded

The oscillator coil, indeed, may be wound so that the broadcast band will be covered when the lowest intermediate frequency is used, with high dial setting for the lowest wave. Then, when it is desired to tune to higher frequencies, instead of using the same intermediate frequency as previously, the receiver dial may be turned to the opposite extreme, and 1,500 kc or a little higher frequency used, rather than 540 kc or thereabouts. In that way, without changing the oscillator coil at all, you can tune in the broadcast band of wavelengths at the lowest intermediate frequency the receiver affords, and simply by changing the intermediate frequency by 1,000 kc or so, rise right into the short-wave band, and begin tuning at 1,500 kc or so, at the setting of the oscillator dial that previously brought in 550 kc.

The tuning range is narrow for the broadcast modulator coil, being restricted the 1,500-500 kc band. With a .0002 mfd. or .00025 mfd. tuning condenser, about all that one can cover without changing coils, is the broadcast band. It is a simple example of tuned radio frequency, using a transformer and a variable condenser, where the transformer happens to be of the plug-in type, and the condenser one of relatively small maximum capacity for the purpose, although large enough to insure wave band coverage.

How Coil Connections Are Made

Assuming the use of coil forms of the tube base type, with diameters that vary from 1¼ to 1½ inches, the number of turns of No. 28 enamel wire to put on the oscillator secondary in any such instance, for an intermediate frequency of around 540 kc, or the lowest to which your set will tune, is 23. This is the winding across which the oscillator tuning condenser is connected. The pickup winding is in reality a continuation of the other, and the number of turns may be any number, from 1 to 8 or so, depending on the degree of coupling desired. The largest winding will afford most volume and least selectivity. So the coil may consist of 31 turns, tapped at the eighth.

The tickler winding need have only enough turns of the same kind of wire to insure oscillation. If coupling is tight, say, ⅛-inch separation between windings, the tickler may consist of 12 to 15 turns.

The winding terminals are brought out to prongs of the coil forms, and these prongs fit into a five-prong tube socket (UY type). The method of bringing out the leads for Fig. 1 was as follows, winding from bottom up: Antenna coil, cathode prong (K) to aerial; heater adjoining cathode (HK) to ground and grid prong (G) to grid. By this method ground is nearer to grid than is antenna, in a physical examination of the winding, and the antenna might be assumed to be grounded, pickup being prevented. If the number of antenna primary turns were very small this might be relatively true, but with a generous primary here, the effect is one of mutual induction, and the coupling is wholly adequate. The antenna primary therefore may consist of 20 turns and the tuned winding, 112 turns, using No. 28 enamel wire. These are equivalent to 132 turns tapped at the 15th.

Disposition of Turns

The oscillator coil, from bottom up, has pickup winding at bottom, grid winding next, plate winding at top. The secondary has cathode prong (K) connected to the cathode circuit of the modulator tube, as diagrammed in Fig. 1; heater adjoining cathode (HK) connected to ground; grid prong (G) connected to grid; heater adjoining plate (HP) to B plus, and plate prong (P) to plate, if the windings are in the same direction. If the oscillator plate winding and grid winding are put on in opposite directions, then HP goes to plate and P prong to B plus, as marked in Fig. 1. It is immaterial which method is used, but imperative that it must be one method when the windings are in the same direction, and the other when they are in opposite directions, otherwise the oscillator will not be what its name

ll-Wave Converter

Bernard

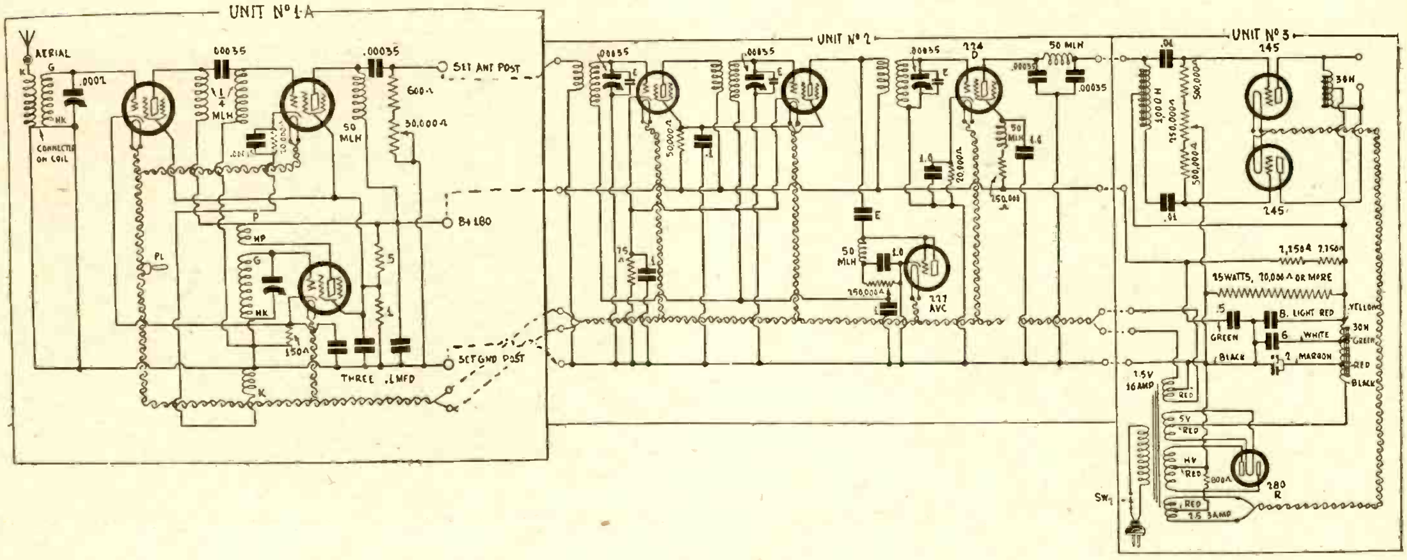


Fig. 3

The all-wave converter of Fig. 1 adapted to a complete AC Superheterodyne with automatic volume control, besides a manual volume control.

implies. For instance, it would be wrong to have both windings in the same direction and to connect as lettered in Figs. 1 and 3.

The above data refer to tuning in broadcast wavelengths at a low intermediate frequency, but as even use of the highest broadcast frequency will displace the required frequency of oscillation by only 1,000 kc or so, and the oscillator condenser covers a wide frequency band, the same oscillator coil will enable reception of broadcast frequencies through the set's intermediate channel, no matter to what frequency that intermediate is tuned. The dial readings will be displaced somewhat. The higher than broadcast frequencies will be tuned in at lower numercial dial settings, as outlined previously, when a 47-division span covered the broadcast band.

It can be seen that while the oscillator condenser has a wide range, and the modulator condenser for broadcast frequency reception has a relatively narrow one, so the modulator coil would have to be changed before the oscillator coil, for higher than broadcast frequencies.

The next pair of coils, using the same kind of wire, may consist of 13 turns for the oscillator secondary, 6-turn pickup winding, and 15-turn plate winding, the separation between secondary and tickler being ⅛-inch. For the modulator the antenna winding consist of 20 turns, with the tuned secondary of 13 turns, hence a coil of 33 turns is used, tapped at the 20th turn. The two inductances for the secondaries are alike, since with shortest waves being tuned in, the intermediate frequency, even if 1,500 kc, is only a small percentage of the original carrier frequencies, and dial differences are small. The small oscillator coil, for instance brings in WENR at 83½. The frequency is 6,020 kc (48.83 meters). The short-wave call, by the way, is W9XF, and the station is operated by the Great Lakes Broadcasting Company, Chicago. The highest wave that can be brought in with the smaller oscillator coil is about 55 meters, or lowest frequency of 5,500 kc. The highest frequency one can tune in under these circumstances is 20,000 kc, or 15 meters.

As you know the intermediate frequency, you know the oscillator range. It is the original carrier range plus the oscillator frequency, or 21,500 kc to 7,000 kc. The only confusing point is that some strong stations may come in at two settings, one representing the lower frequency of oscillation, but the higher one is to be preferred, as greater sensitivity results. The lower one may be used, however, if necessary to get rid of interference. The fact that the modulator circuit is tuned gets rid of most interference due to image reception. Image interference is caused by the oscillator setting required for bringing in the desired station also being the alternative setting that brings in an undesired station differing from the desired one by twice the intermediate frequency.

From the foregoing it can be realized that to bring in higher than broadcast frequencies, although the oscillator coil need not be immediately substituted for the smaller one, the modulator circuit must have a smaller coil. There is a small gap, not covered by the modulator coil directions, due to this very disparity, unless avoided, as may be done readily.

The solution lies in working three coils in the modulator to team up with only two coils in the oscillator. This would require five coils, but the winding directions make the oscillator coils interchangeable in the modulator circuit, though the opposite situation does not obtain.

Here is the procedure:

(1)—For broadcast wavelengths, use the larger modulator coil and the larger oscillator coil.

(2)—For the first short-wave band (1,500 kc up), remove the oscillator coil, put it in the modulator coil socket, and place the smaller oscillator coil in the oscillator circuit.

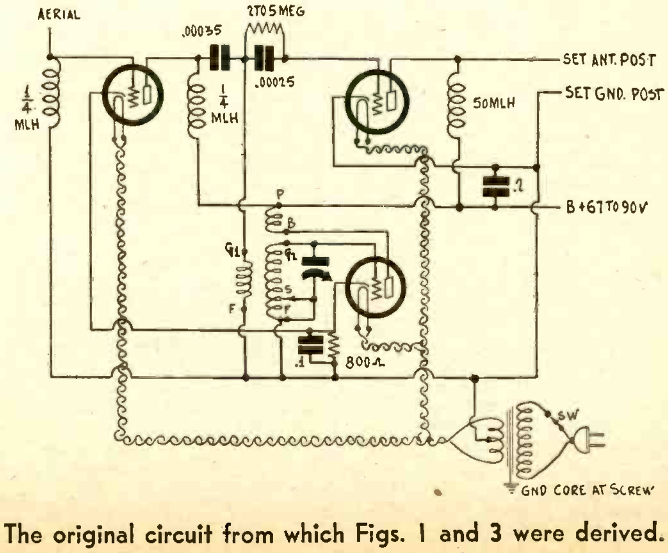
(3)—For the highest frequency band, put the smaller modulator coil, previously not used, in the modulator position, and leave the smaller oscillator coil where it is.

Instead of tube base type coils, one may use de luxe precision coils, space wound on air dielectric, with the wire insulation touching only thin bakelite ribs. Data will be given later.

The circuit, as diagrammed in Fig. 1, consists of a screen grid radio frequency amplifier, with tuned input, untuned coupling from the RF stage to the screen grid modulator, and a tuned screen grid oscillator coupled to the modulator. The choke coils in the plate and grid circuits of the RF and modulator are special ones, that safeguard against dead spots on the dial (of which there will be none). The inductance of these chokes is ¼ mlh, and their distributed capacity is extremely low, of the order of 1 mmfd.

The model has a filament transformer built in, while the volume control may have an AC switch attached, to restrict the panel knobs to three: one for the dial, one for the modulator condenser and one for the switch-volume control.

The same mixer circuit may be used with a complete Superheterodyne, as shown in Fig. 3. This is the same circuit as was presented last week, except that the RF stage has been added ahead of the modulator, to conform to Fig. 1, and plug-in coils are used instead of a switching device. Automatic volume control is included.



The original circuit from which Figs. 1 and 3 were derived.

Series and Parallel

By Brainard Foote

YOU often see or hear the words "series" and "parallel" used in connection with the method employed in joining together various units in a radio receiving set.

Let's consider a tube. A tube has a filament, the element composed of fine wire which becomes hot when current from the storage battery or the power transformer is passed through it. Each tube has its own filament.

In the simplest battery type radio set, all tubes are the same and the filaments are connected in parallel. This means that the corresponding ends of the filaments of all the tubes are connected together and also to one terminal of the battery. The other ends of the tube filaments are connected together, too, and to the other terminal of the battery, so that paralled connection is seen to increase the drain'

Thus the current from the battery flows to and through all the tubes simultaneously. The result is the same as if you had first connected the filament contacts of one tube to the battery terminals, and then had done the same with all the other tubes. Since each tube requires a certain amount of current, the total current drawn is the sum of the amounts taken by the individual tubes. If we have a 5-tube set, with 201A tubes drawing one-quarter ampere apiece, the total current taken would be 1¼ amperes. (Consideration of the rheostat is omitted for simplicity.)

Sometimes tube filaments are connected in series, that is, end to end. Where the house supply is direct current instead of the more common alternating current, series connection frequently obtains. Then the tube circuit is like this: One end of the filament of the first tube is connected to the power line. The other end of this filament goes to one end of the filament of the next tube, and so on, with the remaining end of the filament of the final tube being connected to the other terminal of the power supply line. You can then trace a continuous path through all the tubes, one at a time.

Condenser Situation

The amount of current needed for any number of identical tubes is therefore the same as that drawn by a single tube, but the voltage (or pressure) necessary to force the same current through a series of tubes must be as many times greater than the voltage for one tube as the total number of tubes. Five 201A tubes in series would draw one-quarters ampere, but the voltage would have to be 25 volts. Any excess voltage at the source is dropped in a separate resistance.

As a general rule condensers for radio sets are designed in advance with the correct capacity for the particular location in the set. However, the home builder or experimenter often wants a capacity, not a standard size, or he would like to use whatever condensers he has on hand. Either may be done by combining the condensers in series or in parallel to obtain the correct value.

In parallel connections of condensers the corresponding terminals are merely joined together, and the effect is that of a single condenser of larger size, equal in capacity to the sum of the capacities of the individual units. As many condensers as desired may be used. If we have condensers of 1 mfd., 2 mfd. and one-half mfd., the total in parallel is 3½ mfd.

In series connections of condensers the resulting capacity is less than that of either of the condensers so connected, according to a mathematical law known as the "reciprocal of the sum of the reciprocals." A common use of a series condenser is in a radio antenna circuit, giving a lower capacity and therefore creating the effect of a smaller aerial. If Y and Z are the series capacities, the resultant, X, is

$$\frac{X}{\frac{1}{Y} + \frac{1}{Z}}$$

Dry Cell Examples

Dry cells used in battery sets illustrate series and parallel connections nicely. Dry cells are used to light the filaments of dry cell type radio sets. With tubes like the 199, three dry cells in series are required. The voltage is then tripled (each cell is 1½ volts; total is therefore 4½ volts). The current capacity of the cell remains the same as that of one cell, however. For other tubes, such as the WD11, only 1½ volts are required, but one cell does not have enough current capacity to light all the tubes of the set. Therefore a number of dry cells, any number desired, is connected in parallel, that is, with their positive terminals joined together, and their negative terminals joined together. This acts as a single dry cell, still of 1½ volts, but of greater current capacity.

The storage battery, used in radio and car, itself is composed of three separate cells. Each cell gives 2 volts, and 3 of them are placed in a carrying box or case, and connected together to provide 6 volts.

The scanning disc is a vital element in present-day television broadcasting and reception. Its action is extremely interesting.

The disc is made of metal, as a rule, and is thin and rigid, a foot or more in diameter. There is a spirally located series of tiny holes drilled through the disc, and the disc is rotated by an electric motor which must be maintained at exactly the same speed as the corresponding motor at the broadcasting station.

The holes are placed a certain distance apart horizontally, that is, in the direction of rotation, and also a certain distance apart vertically, that is, toward the center of the disc. The horizontal distance between the holes determines the width of the picture, usually about 1¼ inches. The holes are spaced apart vertically a distance equal to the diameter of the hole (usually very slightly less).

How Television Systems Are Worked

Disc Between Screen and Lamp

In back of the disc we have a neon tube, which blinks bright and dim in accordance with the impulses from the transmitting station. In front of the disc we have a small ground glass screen on which we view the images. The disc passes between, so that no light from the neon tube may reach the screen except through a hole in the disc. And only one hole at a time can be between the bulb and screen. The top hole traces its path along the top of the screen, and during this brief passage, the neon tube may brighten and dim a number of times, making flashes of light at different places along the path of this hole.

Next comes the second hole, starting its quick trip across the picture just as the first hole leaves at the other side. Again the neon tube flashes up and off, sending further shots of light. Each hole in succession traces its path, each path slightly lower down than its predecessor, until all the holes have passed and "swept" the picture complete.

Persistence of Vision

Your eye retains the image of each flash of light some time after it has gone. This is known as persistence of vision. The whole process occurs a number of times every second, perhaps ten times or more. The eye does not realize that the light flashes which compose themselves together really came only one at a time in a series of flashes. The eye sees the complete picture.

If there are only twenty-four holes in the disc, the picture is less detailed, but the neon tube does not have to respond so fast. When wider bands are allowed for television purposes, larger and better pictures may be transmitted.

Naturally, the accuracy of speed control is highly important, for the picture would break up into a meaningless jumble of distorted light and dark spots should the disc get out of sychronism with that in the television broadcasting station.

Hence the best drive for the disc is a synchronous motor, with mechnical braking device as second choice.

New Frequency Standard

Washington.

The Department of Commerce has recently released for publication some interesting details regarding the extraordinary care that is exercised to devise frequency tests for the checking up on the accuracy of the frequencies of the broadcast spectrum which we now use nationally. This information is given by a representative of the Radio Section of the Bureau of Standards, and the gist of it is that chaos would be the result if the broadcasting stations of the Nation were not kept in their assigned places. This much most of us are aware of but of the means resorted to, to attain this degree of maintained precision we do not know much about. The present communications channels are now so crowded that if the frequency assignment is not strictly adhered to the resulting interference would defy description. The degree of accuracy that must be maintained these days requires that the transmitter be capable of being compared with a frequency meter of accuracy that a few years ago would have been thought only requisite in a laboratory. So it is clear that the modern laboratory standards must be extraordinarily accurate, and it is a fact that the degree of accuracy now attained compares with the order of spectroscopic precision, which are considered the final standards of measurement reference, the ne plus ultra of physical measurement.

Some Tips on a Super

By John C. Williams

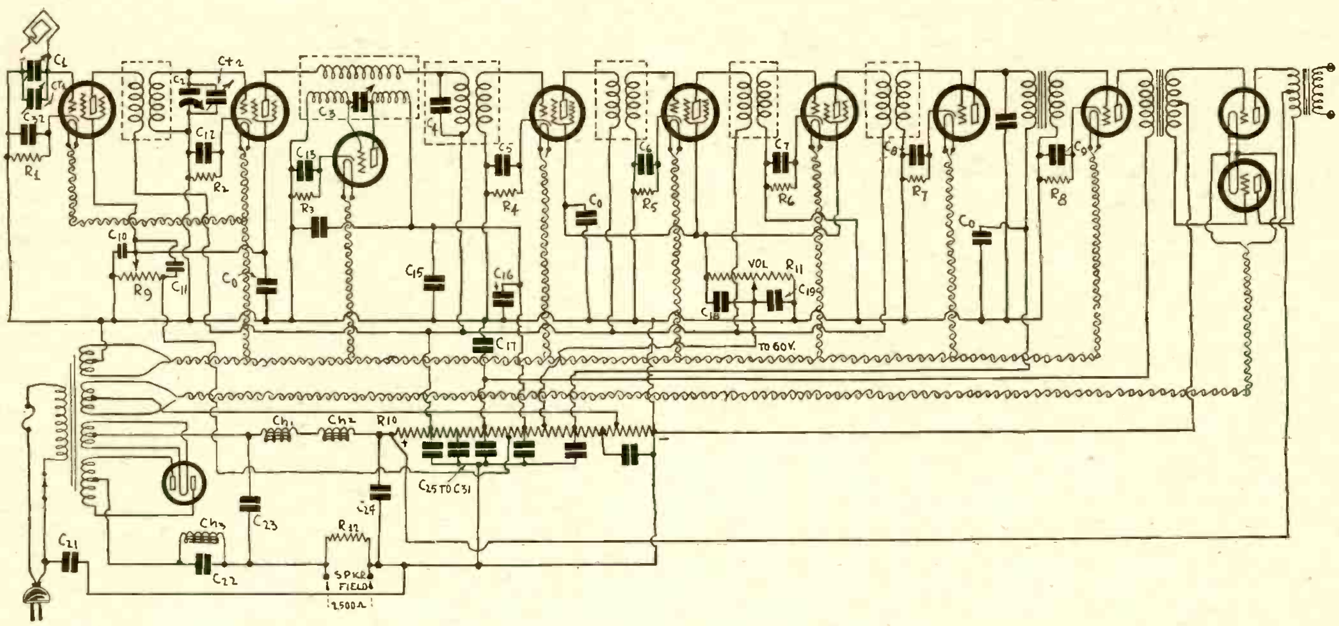


Fig. 1

Circuit diagram used for illustrating pointers on Superheterodyne construction.

THERE are two kinds of input to Supterherodynes, one adapted to an external antenna and ground, the other a loop. The prevailing cabinet styles, that permit the enclosure of the set and the speaker are in most cases large enough to house a loop antenna, whose turns may be stretched on insulating supports, as was the practice with commercial sets.

But a loop has directional qualities, which though not of value where the field density is high, are decidedly useful when distant signals are to be brought in. On this account a movable loop would be preferable to a fixed loop.

IF Transformers Designed for S. G. Tubes

The fan may choose whichever system he prefers, and it is easy to guess that the preference will be a regular aerial-ground system. All the 1931 commercial Supterheterodynes use that. Loops of all kinds have gone out of style in home installations.

The input stage tube, a 224, is biased as a radio frequency amplifier, and in series with the plate circuit of this tube is a high impedance primary as is customary with the screen grid amplifier, this primary being coupled loosely to the tuned secondary.

The second tuned stage that is that of the modulator, likewise a 224. The plate of this and of the first tube may be supplied from the 80-volt tap on the voltage divider, and the screen's applied voltage controlled by the potentiometer R_9.

Choke Cores Grounded

The third tube from the right is a 227, which is the oscillator, the frequency of which is controlled by the shunted variable condenser C_3. The return lead of the grid coil goes to common ground, and in series with the cathode are a 300-ohm flexible biasing resistor and a .01 mfd fixed condenser.

The potentiometer resistor that is marked VOL (R_{11}) is arranged so that the screen voltage is supplied to the slider, the screens connect to the left-hand end of the potentiometer, the right hand end going to common return. This arrangement helps to keep the distributed voltage value along the divider from fluctuating too much. In case two similar ratio audio transformers are used it must be remembered that the primaries must be connected in opposing phase. The plate voltage lead from the divider goes to plate terminal of one transformer, and to B plus terminal of the other one. The B plus terminal of the first one, and the plate terminal of the last ones goes to the plates of the 245s.

Assembly Test Useful

An additional tip is to ground the cores of the several chokes and transformers. This usually tends to allay noises due to induction, the effect obtained being due to the formation of a condenser to ground.

The usual plan followed by those who build up their sets from parts is to make a series of tests during the construction of the set, thus checking the functions of the separate parts of the receiver as far as possible. This plan is all right if you know what to expect of the partly assembled set.

Cable for Connection

No two fans will wire a given set in precisely the same manner, though they will make the same connections.

As the Superheterodyne layout is rather long, no matter how it is assembled, it becomes necessary to keep the heater leads as far away as possible from the RF leads, and in addition they are to be twisted.

The power unit used with the set is connected to the set with short leads. If the fan has a separate B voltage supply in mind, and intends to mount the heater transformer integral with the set, and keep the high current density leads short, the power pack will have to be connected to the set by means of a cable made of eight wires.

If on the other hand the power transformer is in the pack assembly, twelve wires will have to be used, two will carry the total 227 heater current, the filaments of the 2— 2455 being supplied by a separate pair. The 227 heater supply pair will have to be equivalent in conductivity to No. 9 B & S. The 245 filament supply pair should be similarly equivalent to No. 16 B & S. Thus with this arrangement four additional lead wires are used. Attention is directed to the apparent liberal use of by-pass condensers, which are essential in this design, at the points depicted.

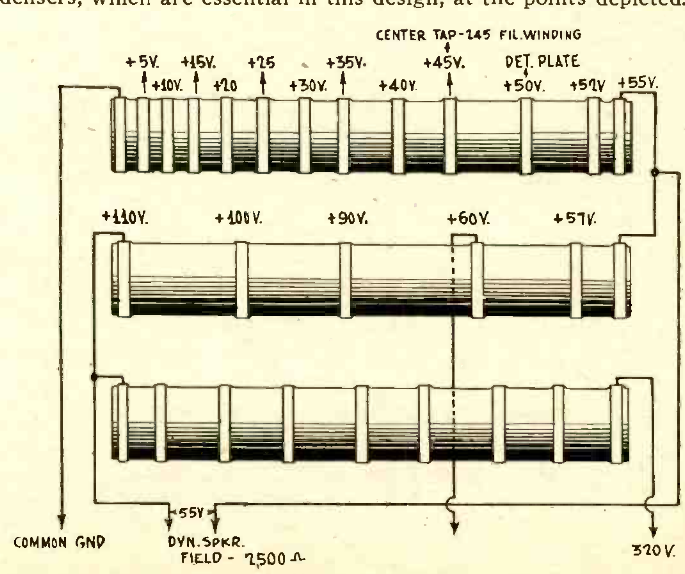


Fig. 2

Voltage divider connections and layout for the tuned choke type plate s supply that powers eight 227s and two 245s.

Radio University

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.

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.

Power Screen Grid Detector

IS it possible to get enough output from a 224 screen grid tube, operated as a detector, to load up a 245 power tube when a high resistance coupler is used between the tubes?—W. H. J.

It is quite possible. It is only necessary to have sufficient voltage in the plate circuit of the detector tube and the required control grid bias. A plate resistance of 250,000 ohms, a grid bias on the detector of about 10 volts, a grid leak ahead of the power tube of about one megohm, and an applied plate voltage of about 300 volts on the detector are suitable values.

* * *

Advantages of High Intermediate

WHAT are the principal advantages of a high intermediate frequency in a superheterodyne receiver? When supers first came out frequencies of 30,000 and 45,000 cycles were used in the intermediate frequency amplifier and the reason given for using such low frequencies was that the amplification was higher. Does this reason still hold good?—B. L. F.

The main advantage of a high intermediate frequency in a superheterodyne is the possibility of eliminating image interference by a simple tuner in the RF circuit. Suppose, for example, that the intermediate frequency is 500 kc. Interference might result from a station differing from the desired station frequency by twice the intermediate frequency, or 1,000 kc. It does not require much of a tuner to differentiate sharply between two stations differing by 1,000 kc. But suppose the intermediate frequency is only 30 kc. The interfering station, or stations, would then be 60 kc away. It requires a very sharp tuner to suppress one completely when the other is tuned in. If the suppression is not very great, there will be image interference. There is practically no difference in respect to amplification. Just about as great amplification per stage, with stability, can be obtained with a high intermediate frequency as with a low one. One of the disadvantages of a high intermediate frequency is that the selectivity in the intermediate will not be so high as when a low one is used. But if a broadcast receiver of the TRF type can be made selective enough, one of the superheterodyne type can be made so more easily.

* * *

An All-Wave Super

I AM planning to build an all-wave superheterodyne with a set of plug-in coils covering the range from 550 kc to 30,000 kc. I wish to use an intermediate frequency of 400 or 500 kc. Now I can cover the tuning range with a large tuning condenser in each circuit and a small number of coils in a set, or with a small condenser and a large number of coils in a set. Which is the better arrangement and why—L. B. F.

Since you are to use plug-in coils it is just as well that you use small tuning condensers and many coils in the set. The tuning will be less critical, a fact which you will appreciate when you tune in the very high frequency signals. A tuning condenser as small as 125 mmfd. will work satisfactorily.

* * *

Tuned Shunt in B Supply

I WISH to try a tuned circuit across the output of my B supply to reduce hum. If I use a 2 mfd. condenser, what should the inductance of the coil be to tune the circuit to the hum, the line frequency being 60 cycles—W. H. S.

You need 0.88 henry. To make the tune shunt effective, not only adjust the coil accurately but also wind it with heavy wire so that the DC resistance is as low as possible.

* * *

Low Frequency Oscillator

IS it possible by means of vacuum tubes and associated circuits containing no iron to build an oscillator which will generate a frequency less than one cycle per second? If so, will you kindly explain how it may be done?—W. A. J.

The simplest way of gettng an oscillator generating a frequency of this order, with or without iron, is to set up two radio frequency oscillators and adjust their frequencies until they differe by the desired amount. The best frequency can be made almost as low as desired. It is only necessary to couple the two oscillators very loosely to insure that they do not interlock before the best frequency has been lowered to the desired value. Since the frequencies of the two oscillators will change with changes in temperature and changes in voltages, the best frequency will not be very steady unless extreme precautions are taken to keep the oscillators constant. If the beat frequency must be kept constant, it may be necessary to control the frequencies of the beating oscillators by means of crystals, and to keep the crystals under constant temperaturs besides.

* * *

Removal of Resonance Peaks

IS there any way in which resonance peaks in a loudspeaker can be removed so as to improve the response? It is very unpleasant to listen to a speaker when certain notes come out many times stronger than they should be and persist longer than they should. Will an exponential horn or a large baffle board help in any way?—P. C.

Any load on the vibrating member of the loudspeaker will help to remove resonance peaks if these peaks originate in the speaker. A long exponential horn or a large baffle board forms a good load and in this respect helps. It may also be possible to locate the cause of the resonance and remove it. If the trouble is due to box resonance filling the cavity with cotton or some such substance will help to break it up. If the resonance is in one of the vibrating members an application of rubber tape at a suitable point might break it up. If the trouble is in the electrical circuit, little can be expected from treatment of the speaker, and putting a load like an exponential horn or a baffle board might make it worse. Any band resonance in the electric circuit is usually due to regeneration in the audio amplifier as a result of feed-back through the B supply, and this can be overcome by the usual remedies for motor-boating. If the resonance is at a high audio frequency, a tuned shunt across the B supply terminals should stop the trouble, if the shunt is tuned to the frequency at which the disturbance takes place.

* * *

Beat Oscillator with Single Crystal

IS it possible to set up a beat frequency oscillator controlled by a single crystal, that is, is it possble to make a crystal oscillator at two dfferent frequencies differing by an audible frequency? I am asking this because I have heard it said that it can be done but I fail to see how it could be possible.—J. C. M.

This has been done by scientists at the Bureau of Standards.

* * *

Estimating the Intermediate Frequency

IS there any way that I can estimate the intermediate frequency of my superheterodyne? The frequency is supposed to be 90 kc.—B. F. L.

You can measure it against broadcast stations by calibrating the oscillator dial. First connect a headset in series with the plate circuit of the first detector, so that you can hear the squeals when you turn the oscillator dial. Then calibrate your oscillator against broadcast stations. Set the modulator dial where a given station, say one of 600 kc. normally comes in. Turn the oscillator dial until you hear a loud squeal. Note the setting of the dial where the zero beat occurs. Put this down against 600 kc. Repeat for many stations over the entire scale, the more the better. Having found a list of dial settings on the oscillator against frequencies, plot a curve. When this curve is complete restore the receiver to its original condition. Now tune in any station in the middle of the band and note the oscillator setting where it comes in. Then tune in the same station on the other setting of the oscillator and note the setting. Look up the frequencies of these settings on the curve, subtract one from the other and divide by 2, and the result is the intermediate frequency. The more accurate the calibration and the subsequent reading the more accurate is its value.

* * *

AC Clocks

CAN I connect an electric clock with my house circuit? We have 60 cycles, 110 volts in the house.—N. O.

Call up your power company to inquire whether their generators are governed in accordance with Washington time. If not, the electric clock would be incorrect.

NEW BOOKS

"The Manual of Short Wave Radio," compiled by Zeh Bouck, is a collection of articles on short-wave reception by such well-known authorities as Bouck, James Millen, Edward W. Wilby, Robert S. Kruse, Fred H. Schnell, L. W. Hatry, Howard Allan Chinn, Thomas A. Marshall, Volney Hurd, Manson E. Wood, and John B. Brennan.

There are seventeen articles on the construction of different kinds of short-wave receivers, converters and adapters. Besides these there is a list of Characteristic Letters of International Amateur Calls, International Frequency and Wavelength Allocations, International Commercial Call Letter Allocations, Time Conversion Table for the entire world, The International Morse Code, and Call List of International S-W Stations. The book is published by National Company, Malden, Mass.

Forum

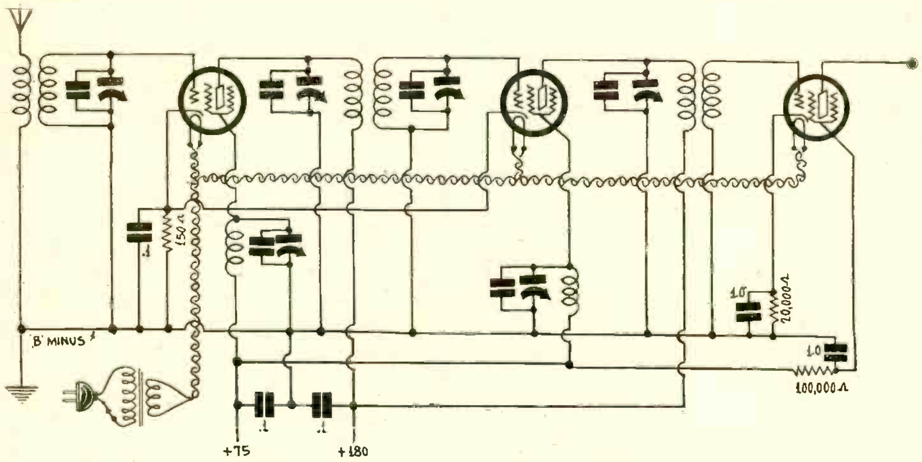
He Tunes Screens and Likes It

HERE is a circuit I've never seen anywhere else. It is a six-circuit tuner, using only three tubes. The novelty consists of tuning the screen circuits. I know this is unorthodox, but I tried it and it works. My opinion is that it works well. There are theoretical reasons why tuning the screens shouldn't do much good, in fact, may decrease amplification and selectivity. These reasons include the fact a high impedance is placed in the screen circuit and may kill the purpose of the tube. But listen to this:

When I tuned those screens I got more stations, got them louder and with better selectivity than when I did not tune them.

I would be interested in hearing from readers who try this stunt.

EDWIN STANNARD,
100 Old Amboy Road,
Eltingville, Staten Island, N. Y.



Tuning the screen circuits, a method theoretically considered taboo, proved a good method in practice, reports Edwin Stannard, who sent in the circuit diagram as published herewith.

* * *

Good Results from Crystal

A LINE to tell you of an experiment with a crystal, of the old cat whisker type, in series with the antenna. Solder a short lead to the top of crystal, another to bottom, connect one to antenna lead in, other to antenna post on set. That is all there is to it.

I notice that the selectivity is greatly improved. One evening between 7 and 9 p.m. I got three stations in Canada, two in Cuba, one in Mexico and KFI. I got KFI every evening before 9 p.m., with crystal, then took off the crystal, tried for a week and never received KFI a single time. I put the crystal back and picked up KFI the first evening. When my set was new and the tubes were new I had to wait until about midnight to get KFI. Now the set and tubes are fourteen months old.

I notice a great improvement over the whole range. I pick out Cuban and Canadian stations without interference.

I am wondering if some one who owns a quartz crystal will try it in the same manner and see what results can be had.

W. C. COOMBE,
1318 Hoefgen St.,
Indianapolis, Ind.

* * *

Cross-Continent with Converter

FOR some time I planned to build a converter to use with my broadcast receiver. Just finished it today and boy does it work, and how! The circuit used is Fig. 7, page 9, in the December 13th issue of RADIO WORLD,

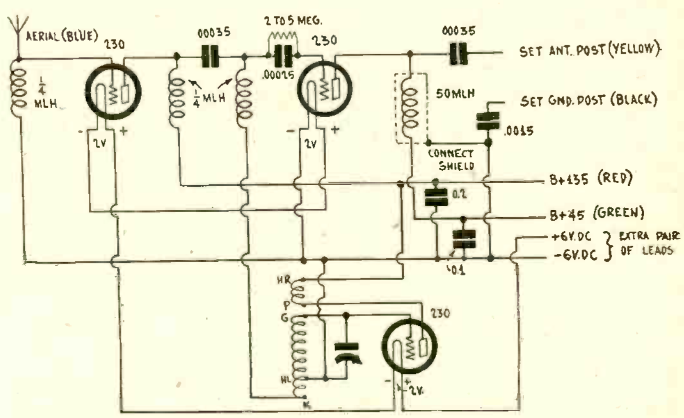
The ¼ mlh chokes were 100 turns of No. 36 enameled wire on an old resistor with the resistance removed.

The first station I picked up was W3XAL, at Bound Brook, N. J., to which I am now listening at 10 p.m. During daylight I have picked up a station in Winnipeg, also WENR (6,020 kc) at Chicago.

I read RADIO WORLD regular now and appreciate the dope published in it. Have read it at odd times, starting 'way back in the old days of the Superdyne, which was a go-getter also.

Am an old-timer at the game, serving R.C.A. three years in capacity of operator, and also two years with U. S. exclusively with Signal Corps and Air Service on portable tube transmitters and receivers.

FRANK ACKERMAN,
Box 363, Colfax, Calif.



The circuit used by Frank Ackerman, and with which he got excellent results, is that of a battery-operated converter, with three 230 tubes, filaments in series. The method of grid returns takes care of the biases. A 6-volt storage batery is recommended.

THE AIR SHAFT

A RECENT survey of listeners called for answers to numerous radio questions. One was: "Are you tired of listening to the radio?" About one per cent answered yes. The percentage of persons tired of living is also about one per cent.

* * *

LOWELL THOMAS, the radio voice of "The Literary Digest," in signing off says "so long." Recently he did it in what he assured listeners was Chinese. It's O.K. with us in any language, so long as it isn't farewell.

A THOUGHT FOR THE WEEK

WHO is America's most popular broadcaster? There's a query that leads to all kinds of interesting conjectures, for, after all, it's the listeners-in who should decide the matter. RADIO WORLD *might, if given sufficient encouragement, throw open its pages and give the American public an opportunity to go on record in the matter. If you are interested, drop a line to this paper and let us know what you think of the idea.*

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, **RADIO WORLD,** ***145 West 45th Street, New York, N. Y.***

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Band-Pass Filter Diamond of the Air, for AC Operation. See next week's issue, dated January 17.

MEXICO ADDS TO ETHER JAM; PARLEY LOOMS

Washington.

The Federal Radio Commission has been reasonably successful in its efforts at reducing broadcasting station interference within the borders of the United States, but now it has a new problem on its hands, says L. D. Batson, a radio specialist of the Department of Commerce. He calls attention to the recent licensing of sixteen new stations by Mexico, which, reception reports show, are causing no little interference with American stations. Also, at least two Canadian stations are said to be causing interference, due to frequency trespassing.

Records of the Radio Division of the Department of Commerce show that Mexico has thirty-five stations on the air, nine of which have 1,000 watts or more. Seven of the nine stations operate on frequencies assigned to United States stations. XEW, of Mexico City, operates with 5,000 watts, which is shortly to be increased to 50,000 watts, and XED, of Reynosa, Rio Grande Valley, operates with 10,000 watts. Both use frequencies assigned to Canada, XEW using 780 kc and XED 960 kc. The 960 kc frequency is supposed to be Canada's cleared channel.

Cases Cited

XEW, on 780 kc, is using the frequency assigned to CKY, of Winnipeg, which operates with 5,000 watts. This 780 kc channel is also reserved for six regional stations of the United States of low power. XED, on 960 kc, uses the frequency assignment of CJBC and CFRB of Toronto, Canada, and produces interference with the programs of comparatively low powered stations not far removed from this frequency.

It is declared that the granting of higher power to XEW will be ruinous to local reception of American stations by listeners located within the service area of both, to say nothing of the lower powered stations not far removed from this frequency assignment.

Conference in Prospect

The Federal Radio Commission has received reports by letter of the interference that the Mexican stations are producing from broadcasting listeners. The resulting checkup by the Commission's engineers and Mr. Batson corroborate the assertions.

Possibility of another North American broadcasting conference has been discussed by American radio officials with the Department of State. Under the existing "gentleman's agreement," Canada has exclusive use of six of the 96 broadcasting channels available and shares a dozen with the United States. Mexico is not a party to this agreement.

Beam for Aircraft Guidance Worked Out

Washington.

The Department of Commerce announced that the successful transmission of beam signals for aircraft guidance over a distance of 125 miles is the achievement of a new type radio beacon, the location of which is not yet public.

State Tax on Sets Again Challenged

Columbia, S. C.

Four resident petitioners of the State of South Carolina seek an injunction to compel the State to show cause why it should not be enjoined from further attempt to levy and collect a tax on receiving sets.

The South Carolina Tax Commission and the Assistant Attorney General, represented respectively by John Fraser Lyon and Cordie Page, appeared for the State. The attorney for the petitioners (George L. Buist) claims that the tax constitutes interference with interstate commerce, and amounts to regulation of radio communication by the State Government.

Federal Radio Commissioner Harold A. Lafount had expressed a decidedly negative opinion when his reaction was sought on the advisability of instituting a tax on radio receiving sets. The petitioners are: WBT, of Charlotte; Hugh A. Ray, a private set owner; The Louis D. Rubin Electrical Co., and a retail radio dealer. The tax is adjusted in accordance with the value of the set, as follows: fifty cents for sets costing less than $50, $1 for sets between $50 and $200, $2 for sets between $200 and $500, and $2.50 for sets costing more than $500.

SYNCHRONIZED AERIALS TRIED

Washington.

The Federal Radio Commission, represented by Commissioner Harold A. Lafount, points to impending improvements expected to revise present broadcasting standards.

Particular attention is focussed on the perfection of the synchronization of broadcasting plants, now in the advanced experimental stage. It has been the fear that with the advent of sychronization that the operation of a number of stations of high power on a single frequency would spell the climax of the small broadcaster, but Commissioner Lafount points out that there will be no monopoly of wavelengths permitted. Synchronization will call into being an old ally in a new form, called a booster station. The duty of such a station will be to maintain the signal level at a satisfactory value, at the synchronization frequency, to insure uniform coverage of the country, and to stimulate response to radio business and advertising.

One of the many technical improvements being worked on is the design of the transmitting antenna which has been found to affect the accuracy of synchronization. This will partake of the nature of synchronous aerials. The use of the ground wave is being developed. Experiments with the sky wave tend to show that it is more susceptible to elemental interference, such as atmospheric discharges.

Another problem now being worked on is a master frequency available to the broadcasting stations of the nation, as a means of checkup of their synchronization frequency. This service is under contemplation by the American Telephone and Telegraph Company, which plans to transmit the standardization frequency by wire to subscribing stations.

Blanket O. K. for Super Power Halted

Washington.

The recently proposed plan submitted to the Federal Radio Commission whereby the whole present quota of cleared channel stations was to receive en masse the privilege of using the present maximum output power of 50,000 watts has been returned to Chief Examiner Ellis. A. Yost, with instructions to submit a new report compiled on a different basis.

A resolution adopted by the Commission at the suggestion of its Vice Chairman, Eugene C. Sykes, instructs the Chief Examiner to report the number of the total of twenty stations that applied for the eight remaining assignments for the use of maximum power and make out a separate report for each of them.

This does not mean that the project is shelved, but that the Commission members desire to make a detailed examination of the material of the report to ascertain which stations should be allowed the maximum output power.

It will be recalled that under the Commission's existing order to date, only twenty of the forty cleared channels may be used by 50,000 watt stations, or only four channels in each of the five zones in which the Nation is at present divided. But with twelve of this total now preassigned (some of them being in actual use), there are eight places for which twenty applicants are bidding

Government Is Best Customer of Stations

Washington.

According to a recent survey the best customer of the broadcasting business during 1930 was The United States Government. The Government has used about 1,000 hours for the exposition of Federal activities, this time being divided between the networks of the National Broadcasting Company and the Columbia Broadcasting System.

A total of 328 Government officials has spoken over the networks, every department being represented. In addition to the above, foreign diplomats of 45 nations have been heard on the Conclave of Nations programs, heard via the Columbia network. President Hoover has established a new record by addressing the radio audience, via the National Broadcasting network, 27 times over a period of 22 months, equalling in that time the record of former President Coolidge over a seven-year period.

25 KW for KFAB, But No Full Time

Washington.

The Federal Radio Commission, through its chief examiner, Ellis A. Yost, has recommended that the application of KFAB, Lincoln, Neb., for full time operation on 770 kc., which it now uses for the equivalent of three days a week, be denied. The station's request for permission to increase its power from 5,000 watts to 25,000 watts was granted.

Allowing full-time would increase the present over-quota time assignment of Nebraska and the Fourth Radio Zone, hence the denial, Mr. Yost said. It was pointed out that public interest would not be served by this station taking the time now assigned to WBBM, Chicago.

The granting of the application for increased power will not cause undue interference to other stations, according to the Commission.

SHORT-WAVE SPECIALTIES

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RADIO WORLD, now in its ninth year, is the first and only national radio weekly, and publishes the latest, up-to-the-second news of circuits, both of kit types and of 1931 commercial receivers, as well as news of happenings in the broadcasting field. Lists of broadcast and short-wave stations are published regularly. You get your information weekly—which means quickly—and you get it accurately, so be sure to become or remain a subscriber for RADIO WORLD. We are able to offer now specially attractive premiums, and ask you to make your choice from the well-chosen variety of parts offered on this page and on the opposite page. When ordering, please use coupon.

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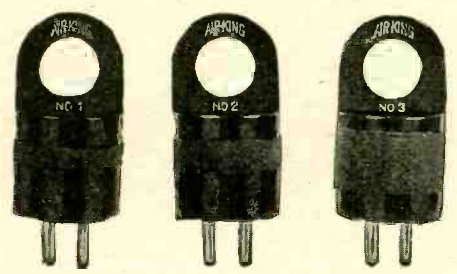

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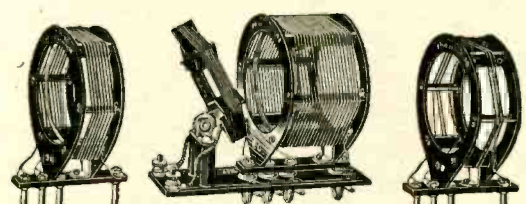

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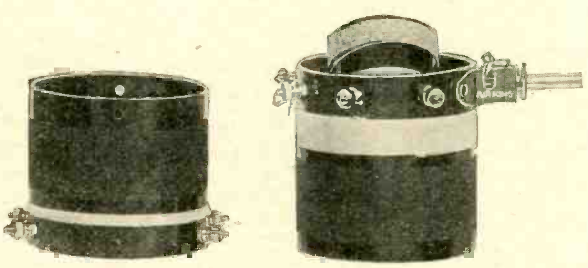

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These coils will give extreme satisfaction and are excellent for the Diamond of the Air, being specified by Herman Bernard, the designer of the circuit.

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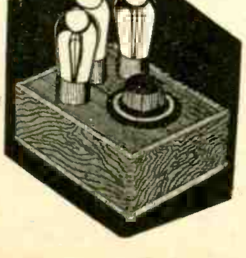

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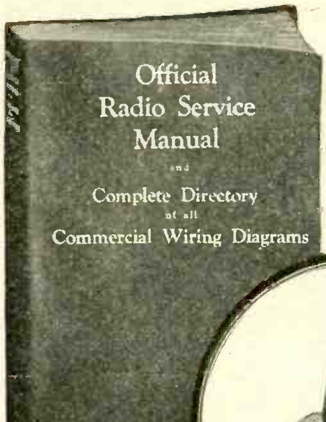

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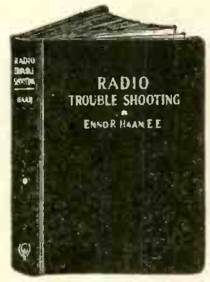

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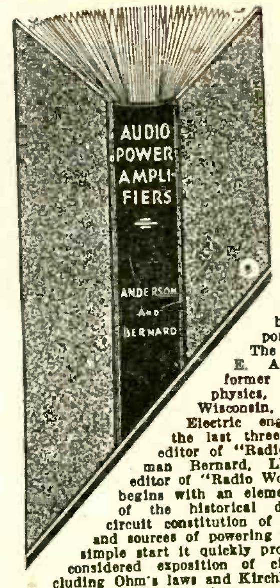

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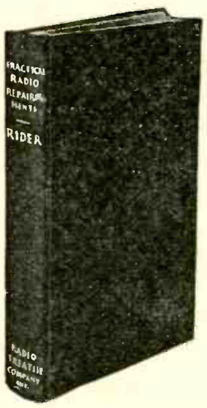

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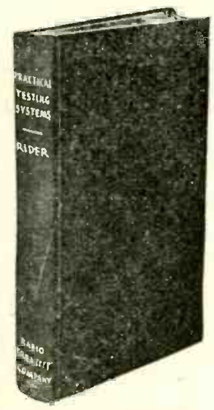

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Image inerference is discussed in detail and methods given by which it may be reduced.

A special method of ganging the oscillator to the radio frequency condensers is explained, a method which allows either the high or the low oscillator setting to be selected by means of a variometer in the oscillator circuit.

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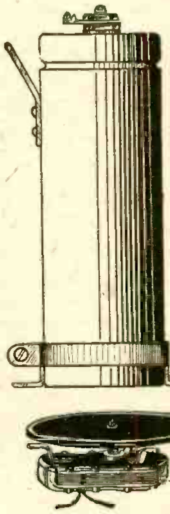
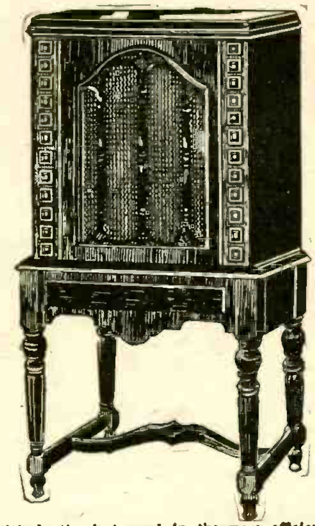


Now all the fans who build their own sets or service men who are making replacements are using the dry electrolytic condenser. It affords high, lasting capacity in compact form. The lug at top represents the anode and goes to the positive side (B+ or C+), while the aluminum case is to go to the negative side, usually ground. The capacity of the condenser is 8 mfd. The condenser, a product of Aerovox, is admirably suited for use in filter circuits, for use on rectified AC or pulsating DC. The condenser must not be used on raw AC. Maximum peak voltage, 500 volts DC. Normal operating voltage, 400 volts DC. Dry, self-healing, high capacity, low leakage, unaffected by moisture. Size, 1-5/16" diam. x 4½" overall. Mounts in any position. Brackets supplied. Order Cat. AV-8 @ $1.42

An outstanding example of the vastly popular midget receiver, not very much larger than any good speaker, yet it contains a very sensitive, efficient and powerful AC radio set, AC power pack and a speaker that would do justice reproducing the output of the most elaborate AC receiver! Startling statements, yes, but they are undeniable facts! Imagine, not even as large as most battery operated portable sets, and lighter in weight! The set will duplicate in performance (considering selectivity, sensitivity and volume) that of its much larger and more costly brothers! One dial tuning control, also switch and volume control knob (not illustrated.) Uses six tubes: three 224, one 227, one 245 and one 280. Perfect reproduction! Combined weight of entire set, speaker and tubes less than 20 lbs.! Entirely self-contained! 3 gang tuning condenser. Uses power tubes and push-pull electro-dynamic speaker! Durably built in handsome walnut case. For 110-120 volts, 50-60 cycle AC. Complete set, with the six tubes, cabinet, speaker—nothing else to buy! Order Cat. MDST @ $39.95



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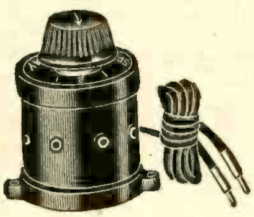

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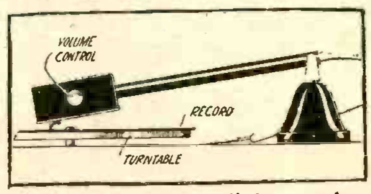

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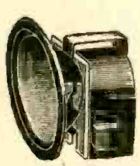

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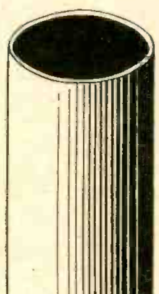

Natural bakelite tubing, made by Spaulding, in two diameters, 1¾ inches and 2 inches, outside diameters. One will fit inside the other even after wire is wound on the smaller diameter.

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The Temple 10 chassis in the fascinatingly decorative walnut cabinet, with carved grille ornament, as illustrated; both front and back finished. (Cabinet not sold separately). Order Cat. TEM @ $15.34

0-600 volts, high resistance; AC and DC (same meter reads both types). DC readings accurate to 2%, also AC readings 2% at 50-60 cycles, but accuracy is less on AC at substantially different frequencies.
Order Cat. F-600 @........................$4.95
0-300 volts, high resistance. Accuracy, 2%. Case is full nickel finish. Long connecting cords have especially ornamental tip holders. Meter should be read in perpendicular position.
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(Cat. SPEC-1)—Erla DC dynamic chassis, 9-inch cone, for operation from 6-volt storage battery. Connect speaker-tipped cords to output of set, and connect twisted pair to 6-volt storage battery. Draws ⅓ amp. from battery. Price........................ $9.00

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