NEW ANGLE TO REFLEXING

RADIO WORLD

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The First and Only National Radio Weekly

Twelfth Year *589th Consecutite Issue*

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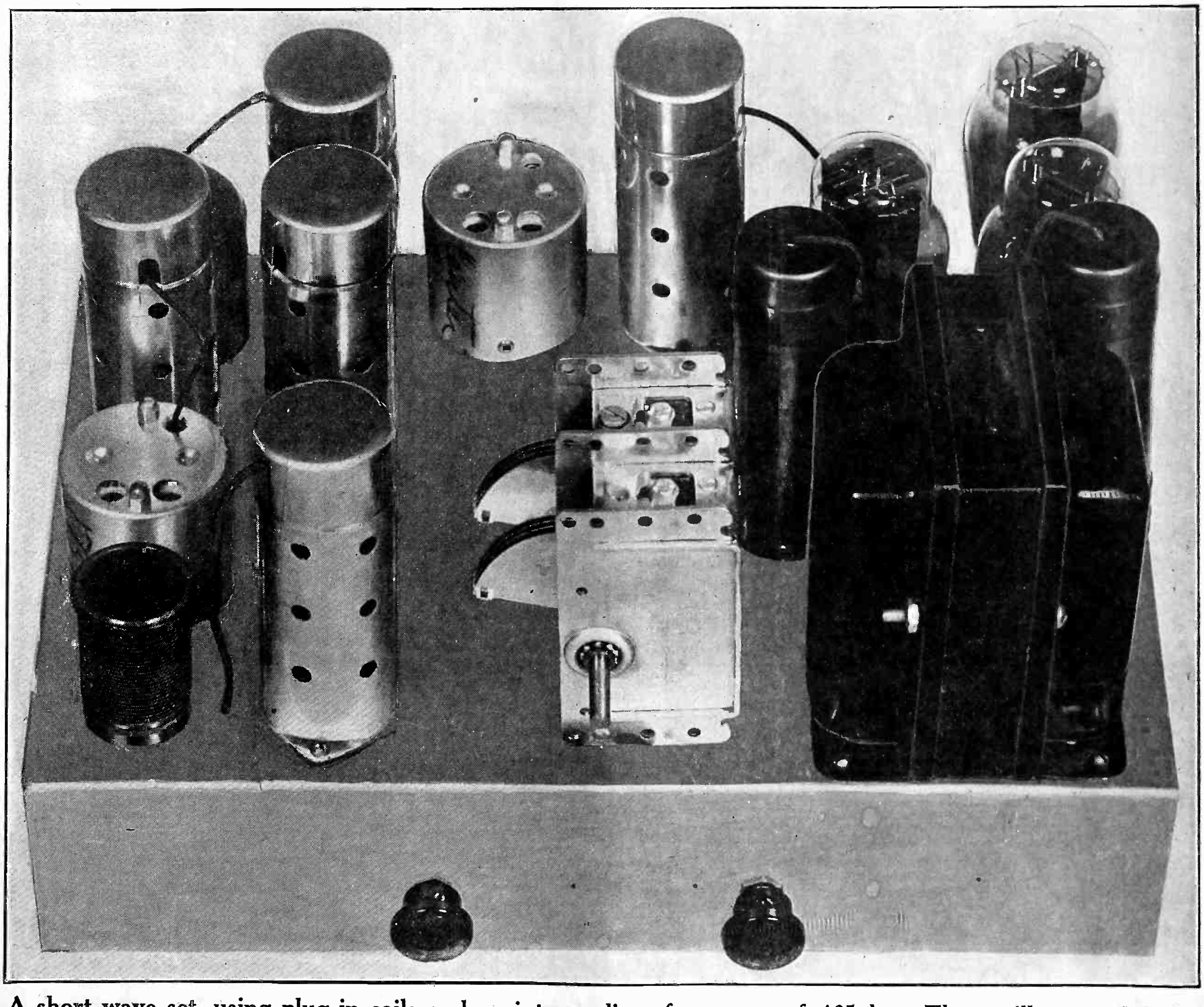
1,520 kc I. F. in Short-Wave Set

JULY 8th 1933 **15¢ Per Copy**



A short-wave set, using plug-in coils and an intermediate frequency of 465 kc. The oscillator coil is in foreground, the modulator coil hidden behind the front tube shield. See page 6.

ROLAND BURKE HENNESSY
Editor

HERMAN BERNARD
Managing Editor

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TWELFTH YEAR

J. MURRAY BARRON
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REFLEXING TO-DAY

Operating Economy with the Newer Tubes

A COPYRIGHT pamphlet entitled "Technical Discussion on Reflex Circuit Considerations" (Laboratory Series No. UL-6) has been prepared by RCA Radiotron Co., Inc., and E. T. Cunningham, Inc., and is reprinted herewith by special permission:

Reflex Circuits in the Past

Some years ago reflex circuits received considerable attention and extensive application. Because of the relatively high price of tubes, the high order of sensitivity required to receive weak or distant broadcast stations, and the heavy drain on batteries by the tubes then available, any circuit combination which gave greater sensitivity for a given number of tubes was considered meritorious. Consequently, reflex circuit-arrangements were used extensively since they answered many of the design problems encountered at that time.

Later the reflex circuit was dropped, disappearing from use almost entirely up to the present time. The reasons for its loss of popularity were primarily the poor stability obtainable with the available triodes, the poor quality of output, and the introduction of cheaper and more efficient tube types which permitted the use of more tubes in the set without excessive cost or excessive battery drain. Furthermore, the growing demand for a single-control receiver which would give approximately maximum sensitivity at any dial setting, did much to push the erratic and complicated reflex receiver of that time into temporary discard.

Reasons for Renewed Interest

The spontaneous public approval accorded the introduction of the "pocket size" compact receivers had led radio engineers to an almost frantic search for new circuits and new methods which would give improved performance without an increase in the size or cost of the set. The number of parts and tubes which can be put in the chassis space available in these small receivers is now, and has been, at the saturation point.

PRACTICALITY OF REFLEX, USING THE 2B7 OR 6B7

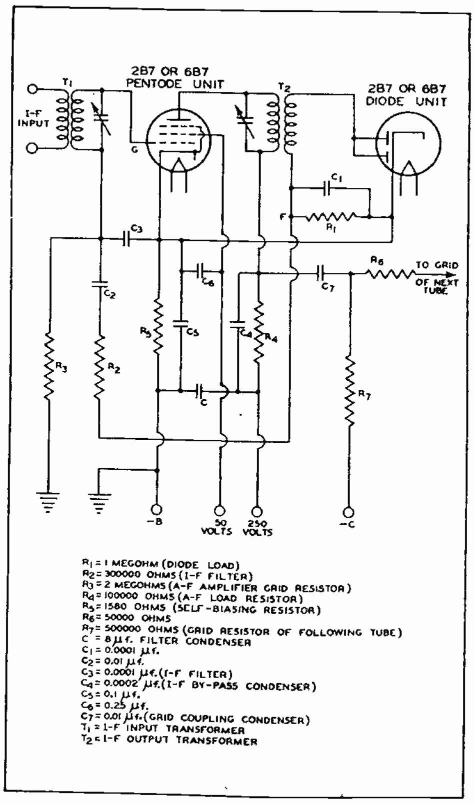
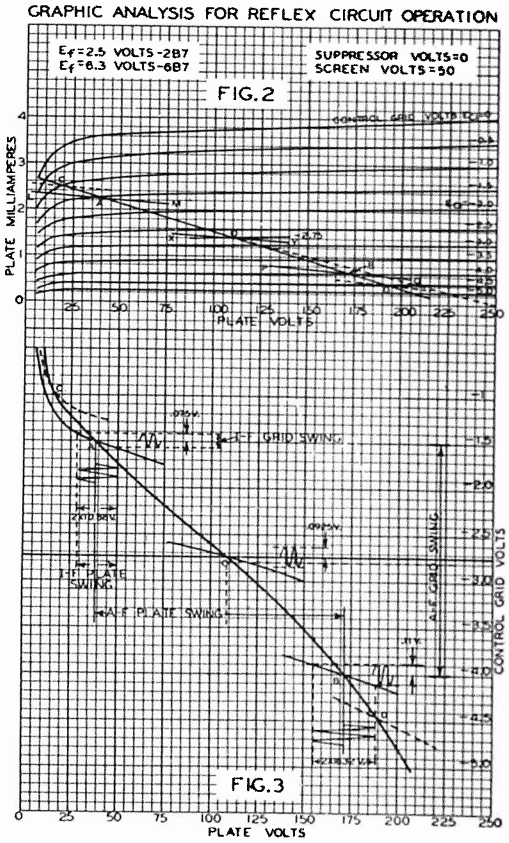


FIG. 1
A fundamental reflex circuit. A pentode and a diode are used. Since the two tubes are in the 2B7 and 6B7, either of these types may replace the two separate envelope tubes diagrammed.

GRAPHIC ANALYSIS FOR REFLEX CIRCUIT OPERATION



FIGS. 2 and 3
A typical family of plate current curves for a pentode amplifier. The plate supply is 250 volts, the screen voltage 50 volts. The 2B7 or 6B7 tube is in mind. Fig. 3 delineates the grid swing.

The use of duplex tubes has aided considerably the performance capabilities without an increase in chassis size.

In automobile sets the problem is to get the best performance possible with the smallest drain on the car's battery. Consequently, the next logical step is to make some of the tubes perform additional functions. Reflexing may be the answer to these problems.

With reflex arrangements, higher gains are attainable with a given number of tubes than with a straight circuit. The size of the chassis is not usually increased by the use of reflex circuits, while the weight and current consumption remain the same.

While fewer tubes are used with a reflex circuit to secure the same overall gain, the cost of circuit elements is slightly higher for a reflex arrangement, since filters must be provided to isolate the reflexed frequencies. The increased cost and complication of the circuit may offset the saving in tube costs over a straight circuit. Consequently, the principal advantages of the reflex circuit may be its economy of space and reduced power consumption.

Fundamental Principles

In Fig. 1 is shown a fundamental reflex circuit, employing a pentode and a diode. The pentode is reflexed so that it amplifies both r-f and a-f voltages. Using a duplex tube, such as the 6B7, the two tubes shown can be replaced by a single tube.

In operation, the incoming i-f signal is passed through the i-f input transformer (T_1) and amplified by the tube in the usual way. The plate circuit of the i-f amplifier also includes the a-f load (R_4), but a by-pass condenser (C_4) around this makes the impedance for i-f relatively low. Thus the i-f current flows through the condenser practically unaffected. The diode detector is coupled to the i-f amplifier through the i-f output transformer (T_2). Rectification, and consequently detection, of the signal takes place in the diode, producing an a-f output. The a-f output is fed through an i-f filter back to the control grid. This filter consists of the resistor R_2 and condenser C_3. It prevents any i-f component from being fed back to the control grid of the pentode. In passing to the control grid of the pentode, the a-f signal must pass through the i-f input-transformer secondary, but since this has relatively low impedance to a-f, the a-f signal is unaffected. The a-f signal is then amplified by the pentode, producing an a-f voltage across the a-f load (R_4) in the plate circuit of the pentode. Although the primary of the i-f output transformer is in the plate circuit, it has little effect on the a-f plate current due to its relatively low impedance to a-f. Thus it is possible to develop an a-f voltage across the a-f load (R_4), which can be fed to another stage of a-f amplification or to an output tube.

From this elementary discussion of a typical reflex circuit, it will be seen that the operation of the circuit depends upon its ability to separate the reflexed frequency from the other frequency. Naturally, it will be simpler to design circuits for frequencies which differ widely. For this reason, the reflexing of a-f voltages through an i-f amplifier is perhaps the simplest. However, it is possible, although considerably more difficult, to reflex i-f through an r-f amplifier.

Operating Considerations

In Fig. 2 is shown a typical family of plate characteristic curves for a pentode amplifier. The plate supply voltage for the tube is 250 volts, and the screen voltage is 50 volts. An a-f load line, A-O-B, representing an effective a-f load

Operating Curves for 2 B7 and 6 B7

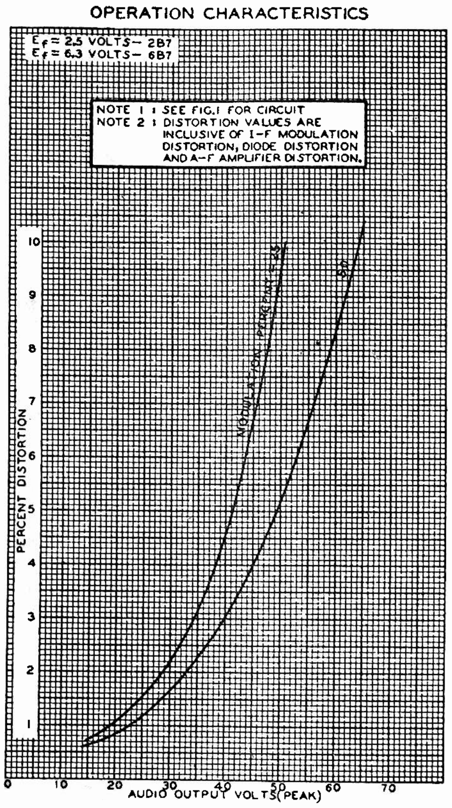


FIG. 4
Percentage distortion curves for the 2B7 and 6B7

of 83,400 ohms, is shown on the characteristics. The static center of the a-f swing is the point O, showing that a bias of —2.75 volts is required. The amplitudes of the a-f swing may be, for example, OA and OB.

Since the amplitudes of the a-f swing are much larger than the amplitudes of the i-f swing, due to the amplification of the system, the dynamic center of the i-f swing will be moved up and down along the a-f load line. The location of the dynamic center of the swing at any instant will depend upon the instantaneous value of the a-f voltage applied to the grid of the tube.

An i-f load impedance of 313,000 ohms is represented by the load lines, L-A-M and P-B-Q, at the extreme ends of the a-f swing. The i-f load with no a-f signal on the grid of the tube is represented by the line X-O-Y.

If the characteristics of the tube were absolutely linear over the entire range of the a-f and i-f swings, the tube would be ideal for reflex amplification. Since the characteristics are not absolutely linear, some distortion is introduced, and the selection of the proper load becomes important if stable operation is to be obtained.

Slight Distortion

It is apparent from the curves that the a-f voltage is distorted but slightly by the curvature of the characteristics. The dynamic center of the i-f voltage swing, however, is carried back and forth along the a-f load by the a-f grid voltage. Consequently, the i-f plate-voltage amplitude is subjected to considerable change with respect to the i-f grid-voltage amplitude. Hence the i-f voltage is distorted. An appreciable part of this distortion is eliminated by the tuned i-f circuit, but the percentage of modulation of the i-f signal is also changed.

When an unmodulated i-f signal voltage is applied to the input of the circuit shown in Fig 1, a d-c voltage is developed across the load resistance (R_1) of the diode. The point F (Fig. 1) becomes negative with respect to the cathode. An increase or decrease in the i-f amplitude due to modulation increases or decreases the negative potential at the point F. The changes in potential occur at the modulating frequency (a-f). The a-f voltage is directly effective at the grid of the reflexed tube through the coupling connection R_2 and C_2. The changes in potential at the grid and at F are identical in sign with respect to the cathode.

It is evident that when the modulation increases the amplitude of the i-f signal, the dynamic center of the i-f swing is shifted by the a-f voltage towards the point B. Similarly, when the carrier is modulated downward (decreased i-f amplitude), the a-f voltage shifts the dynamic center of the i-f swing towards the point A.

Modulation Decrease

The spacing of the grid voltage lines (Fig. 2) increases towards A and decreases towards B with respect to that at the point O at the central portion of the plate characteristics. This causes a decrease in the percentage of modulation of the i-f signal, since the small amplitudes are amplified more than at point O and the large amplitudes are amplified less. This decrease in the percentage modulation has a stabilizing effect on the system, while the gain and output are reduced slightly.

If the output of the iode detector were connected to the grid of the reflexed tube in the opposite phase, there would be an increase in the percentage of modulation. This effect tends to be accumulative and motorboating may result.

Consider the normal stable circuit arrangement with the loads shown in Fig. 1. Suppose a small, modulated i-f signal is applied to the input and its amplitude is gradually increased by means of a gain control operating on the preceding amplifier stages. When the positive a-f voltage swings the grid appreciably beyond the point A, the i-f amplitude no longer receives increased amplification as compared with that of the point O, due to the curvature of the characteristics near the point C. The amplification rapidly decreases beyond the point A, causing a further decrease in i-f amplitude to the detector, which in turn causes a more positive grid voltage on the reflex tube. The effect is accumulative so that an unstable motorboating action may result.

Stability Results

Stable operation is obtained, if the change in the i-f amplification over the operating range of the a-f grid voltage values produces a distortion of the modulated i-f which, when rectified by the diode, causes a considerably larger change in the a-f amplitude at the lower end of the grid swing than at the upper end (Fig. 3.) Even though the characteristic at the upper end tends to produce an increase in percentage of modulation, the characteristic at the lower end counteracts this effect.

In general, for stable operation in reflex circuits, the i-f voltage amplification over the operating range must either be constant, or tend to oppose the changing amplitude of the input carrier-voltage.

The limiting conditions for stable operation, therefore, depend upon the a-f load, the i-f load, the plate voltage, the screen voltage, and the grid-bias voltage. It is necessary to use a somewhat lower screen voltage than that normally used in i-f amplifiers in order to obtain high a-f voltage-amplification. The control-grid bias must be selected so that the tube operates near the central part of the plate characteristics in order to obtain maximum output and stable operation. High output requires high plate voltages, particularly when resistance-coupling is employed.

The i-f plate-load impedance and the a-f load impedance should not be too high. Low impedances give better stability, but, also, low voltage-amplification.

While it is possible to provide volume control on the reflexed tube, it is generally more satisfactory to use a volume control operating on preceding tubes.

Analysis of Fig. 1 Circuit

The 100,000-ohm load resistance (R_4 in Fig. 1) and a bias voltage of —2.75 volts place the static center for the a-f plate-voltage swing at a favorable point (O in Fig 2) on the plate characteristics for a plate supply of 250 volts and screen voltage of 50 volts. The grid resistor (R_7) in parallel with load resistor (R_4) constitute the a-f load (a-f R_p) of 83,400 ohms. This load is represented by the line A-O-B in Fig. 2.

The i-f output transformer (T_2) has a primary to secondary voltage ratio (N_e) of 1.7 to 1. The parallel resonance impedance of the primary (Z_{pr}) is 400,000 ohms. The secondary of T_2 is loaded by the diode. The diode impedance (Z_d) at the 175-kc. i.f. is approximately one-half of R_1, or 500,000 ohms. The resistance and reactance of the secondary T_2 are negligible in comparison with this diode load. Therefore, the total i-f plate load impedance is the parallel value of Z_{pr} and the reflected diode impedance, or 313,000 ohms.

The points A and B mark the limits of the assumed a-f plate-voltage swing on the dynamic a-f characteristic in Fig. 3 (Fig. 3 is obtained by projecting instantaneous values of grid voltage and plate voltage from the load line A-O-B in Fig. 2). The amplitude of the fundamental a-f plate-voltage swing is 67 volts. This corresponds to a grid voltage swing of 1.25 volts, giving a voltage amplification of 67/1.25 = 53.5.

Since the voltage produced across the diode load (R_1), modified by the voltage ratio of the network comprised of R_2, R_3, C_2 and C_3 gives the a-f grid voltage swing, the voltage across R_1 over the frequency range for which C_2 and C_3 are negligible must be equal to

$$1.25 \times \frac{R_2 + R_3}{R_3} = 1.44 \text{ volts}$$

For a diode efficiency of 90%, the amplitude of the i-f modulation on the secondary of T_2 is 1.44/0.9 = 1.6 volts.

Voltage Variation

With 20% modulation, the i-f signal voltage on the secondary of T_2 is 1.6/0.20 = 8 volts. The voltage on the primary of T_2 is the voltage in the secondary times the step-down ratio of the transformer = 8 × 1.7 = 13.6 volts. Since this voltage is 20% modulated, it varies between 16.32 volts and 10.88 volts.

Since the d-c voltage across the diode load (R_1) increases with increasing i-f voltage, the maximum value of a modulated wave causes the highest voltage, while the minimum causes the lowest voltage. The d-c voltage change across R_1 produces the instantaneous a-f grid voltage on the tube. Consequently, when the modulated i-f voltage swing is 16.32 volts the dynamic center is at B, when it is 10.88 volts the dynamic center is at A.

It will be seen by inspection of Fig. 2 and Fig. 3 that the i-f voltage amplification for a given i-f amplitude depends upon the instantaneous grid voltage. The voltage amplification is low at highly negative values of grid voltage and increases gradually as the negative grid voltage decreases towards point A. For negative grid voltages less than that at point A, the voltage amplification begins to decrease rapidly, until at C it is considerably lower than at A. The decrease in voltage amplification at the point C is due to curvature of the plate characteristics for low plate voltages.

Amplification Considered

The voltage amplification at the points A and B is found from the i-f load lines on the dynamic characteristics (Fig. 3) and equals the ratio of the peak-to-peak plate-voltage swing to the peak-to-peak grid-voltage swing. At point A, the voltage amplification is (2 × 10.88) / (2 × 0.075) = 145. At B it is (2 × 16.32) / (2 × 0.11) = 148.2.

As brought out in the discussion on the theory of operation of a reflex amplifier, stable operation can exist only when the i-f voltage amplification is constant or tends to oppose the changing amplitude of the input carrier-voltage.

Under the conditions obtaining at points A and B, the percentage modulation of the i-f signal is increased, due to the difference in voltage amplification at these points. Due to the distortion of the a-f amplitudes, the a-f grid voltage is not sinusoidal as assumed for the construction of Fig. 3. The point B actually should be more distant from O than point A, and not as shown. This is a more stable condition than that shown in Fig. 3.

With a slightly larger amplitude of i-f input, the stabilizing effect of the unequal a-f amplitudes no longer predominates and the system becomes unstable. Larger i-f amplitudes cause the points A and B to move away from O into regions of increasing instability until the tube draws grid current. As a result of grid current, the point O is shifted to a more negative value, restabilizing the system for an instant. The rapid reoccurrence of this phenomenon is usually termed "motorboating."

Modulation Percentages

For smaller a-f plate-voltage swings the voltage amplification in the direction of point A becomes greater than that in the direction of point B, producing slight demodulation. This condition adjusts itself instantly, so that stable operation is obtained.

Higher percentages of modulation have smaller i-f grid voltages for the same audio output. Therefore, larger audio-output voltages can be obtained without exceeding the i-f grid voltage swings which mark the end of stable operation. The following table shows the results of experiments illustrating this:

% modulation of i-f signal	Peak a-f output voltages for stable operation
10	45.3
20	64.0
30	79.0
50	105.0
80	116.0

The values for 50 and 80 per cent modulation show that the entire a-f dynamic characteristic (Fig. 3) is used. These values represent the maximum possible voltage-output obtainable without causing the tube to draw grid current.

The calculation shows that the i-f amplification is 145 and the a-f amplification is 53.5. Due to the step-down ratio of T_2, the overall i-f gain is 145/1.7 = 85.4. The gain of the entire circuit of Fig. 1 with an i-f signal of 20% modulation is 67/0.0925 = 725. For 30% modulation the overall voltage amplification is 1090, and for 100% it is 3625.

Harmonic analysis shows a distortion of 2.7% for the a-f amplifier alone, with a peak plate-voltage swing of 64 volts. The measured overall distortion is shown versus the peak a-f output in Fig. 4. The measured overall distortion is considerably higher than the calculated value for the a-f amplifier alone, since it contains distortion due to the change in percentage modulation of the i-f signal, and also distortion due to the diode detector.

General Comments on Design

There shoud be no audio-frequency coupling between the plate circuit of the pentode (Fig. 1) and the diode-detector circuit, if audio feed-back and audio rectification are to be avoided. The capacity between the i-f output-transformer-primary winding and secondary winding should be low in order to eliminate audio-frequency coupling.

There should be no i-f coupling between the plate circuit of the pentode, or the diode circuit, and the grid circuit of the pentode, since i-f feed-back will cause oscillation or degeneration.

In resistance-coupled circuits, the plate-supply voltage should be at least 5 times as high as the screen grid voltage. The audio load should be determined for low distortion and be such that the least negative required peak grid-voltage value does not occur at too low a plate voltage.

The reflexed a-f voltage must be returned to the control grid of the reflex tube in the proper phase. In resistance-coupled circuits such as that shown in Fig. 1, the correct phase relation automatically obtains. In transformer coupled circuits, the polarity of the a-f transformer must be correct.

For an i-f signal of given percentage modulation there may be a limiting amplitude beyond which instability results.

The plate-load impedances for i-f and a-f conditions have critical values which determine the limits for stable operation.

If the volume is controlled only by varying the a-f voltage fed back to the reflex tube, rectification of the i-f in the plate circuit of the reflex tube will, at low volume levels and high i-f input voltage, introduce some a-f voltages which may be appreciably distorted. For this reason it is generally advisable to control the volume on some other tube in the set.

Self-bias is recommended, since the operation with correct loads will remain satisfactory for considerable variation in plate-supply voltage.

Conclusions

It has been the purpose of this article to point out some of the difficulties normally encountered in the design of reflex receivers. Limiting conditions for the extreme range of the tube's performance capabilities have been discussed in order to present ways of analyzing and designing circuits. It is quite probable that in the design of a broadcast receiver some of these limits may never be approached.

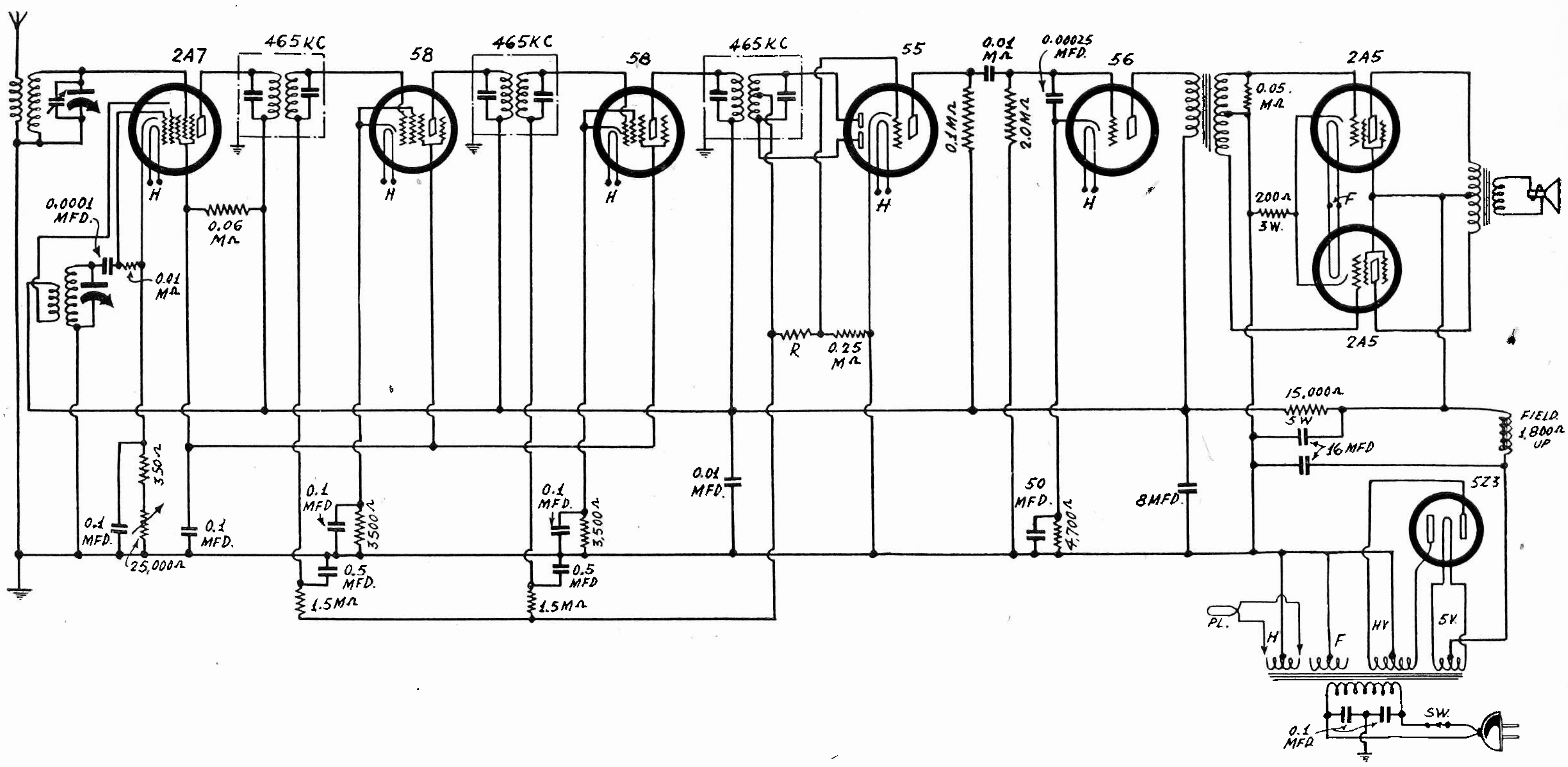
With the tube types now available, it is possible to design reflex receivers having sensitivity capabilities comparable with those of a straight receiver employing a larger number of tubes. The stability and output quality of the reflex receiver can be made to compare favorably with that of receivers employing straight circuits.

189 CHIP IN IDEAS

"Hints & Kinks" is an 80-page symposium of the best ideas of 189 experimenters. It has sold over 1,000 copies in the month it has been available. This is in line with the unprecedented success of "The Radio Amateur's Handbook," the most widely distributed and read book on radio ever published. Nearly 200,000 copies of this manual have been sold in ten editions.

A SELF-CONTAINED SHORT-WAVE SET WITH HUM ELIMINATED

By M. G. Woodward



The eight-tube short-wave superheterodyne from which hum has been eliminated. The two condensers across the same potentials, low side of 15,000-ohm series resistor and ground, are 0.01 mfd. and 8 mfd. Of these the 8 mfd. reduces hum and the 0.01 mfd. bypasses radio frequencies. Otherwise for the higher radio frequencies the impedance of the intended bypassing might be entirely too large. Plug-in coils are used.

THE construction of an a-c-operated short-wave receiver, with total receiver and power supply on one chassis, naturally brings up the subject of hum, to which short-wave sets seems to be subjected more than are broadcast receivers. The fact may be accepted even though the reason for it is not altogether clear.

In the diagramed circuit, four methods were employed to reduce the hum effectively, and a fifth incidental method that might yield a slight extra reduction.

An adequate filter in the B supply is taken for granted, and this consists of the field coil of a dynamic speaker used as B choke, with 16 mfd. next to the rectifier and 16 mfd. more at the end of this filter. Adding more capacity doesn't do any good at these positions, and indeed many would be satisfied that the hum was low enough. However, extra methods were utilized, and since they are not peculiar to this circuit, they may be tried (with confidence of their value being proved) on other receivers.

The Four Methods

First, a resistor was introduced in series with the tuner B feed, shown as 15,000 ohms, and at the low voltage side of this resistor an 8 mfd. condenser was placed. This further reduced the inherent hum, already low to begin with, and removed the existence of slight tunable hum.

Second, and in line with the use of the same resistor, the B voltage to the tuner tubes was kept low, around 100 volts, and the screen voltage whatever results from the series 60,000-ohm resistor. If you haven't 60,000 ohms you may use 50,000 ohms. The actual screen voltage will be between 40 and 50 volts, although it will read less than that, screen to ground, on most meters used by experimenters.

Third, the output tubes were of the heater type, so that the hum otherwise introduced into a filament, hence into the tube itself, is not amplified.

Fourth, a resistor of 50,000 ohms was connected between grid of one output tube and ground. Either tube may be selected, and in some instances the hum reduction is greater when the connection is made to one grid rather than to another, so try both. If both have resistors simultaneously in both, then the resistance had better be 100,000 ohms from each grid to ground. However, one resistor suffices, hence one of half that value is shown.

The Fifth and Incidental Method

The fifth, and incidental, method was discovered by accident. In using a potentiometer as the total resistance load on the diodes of the 55, the hum rose when one got near the extreme voltage (left-hand side of the load resistor, reading R and 0.25 meg. as one resistor in the diagram). Since the resistor is 0.25 meg., a potentiometer of equal value may be put in the circuit, arm to pointer, and the slider moved until this hum-increase point is reached, then the resistance measured between the arm and the left-hand end of the resistor in diagram, and when a fixed resistor of 250,000 ohms is used, then R is additional, and of the value determined by the experiment. The value is not so critical that this method does not apply.

A sixth aid is the filter in the power transformer primary, consisting of two 0.1 mfd. condensers, although there primarily for another purpose, that of keeping radio frequencies from getting to the rectifier by way of the a-c line input. If the power transformer is of the type without static shield, a terrific tunable hum may be experienced on any receiver (broadcast waves or otherwise), and the two condensers will get rid of this, if the cause is the stated one.

Drain Kept Down

Because of the low B voltages in the tuner, and the biasing that is around 5 volts, the B current drain is small, and the constructor should not be surprised if the total drain is only around 90 milliamperes.

Taking up the circuit in the order of the signal function, the mixing is done in the single envelope of the 2A7, with the modulator negatively biased by the drop in the 350-ohm resistor, plus any extra drop due to the 25,000-ohm rheostat (or potentiometer used as rheostat).

The oscilaltor portion is of the grid current type, with stopping condenser and grid leak, the value of leak having been determined experimentally at 10,000 ohms. This may seem like a low value, but it must be remembered that circumstances dictate the value of the leak. It should be as high as practical, yet should not cause blocking, and at the high frequencies blocking did occur even when the leak was 15,000 ohms. So while 10,000 ohms or more may be used, the maximum must be less than 15,000 ohms, and any who are assiduously experimental may try out various values between these two, or others may accept the 10,000-ohm value as final. This resistor is marked 0.01 meg. in the diagram.

Electron Coupling

Coupling between oscillator and modulator is effectuated in the cathode circuit, which is common to the two separate tubes in the one envelope, the pentode modulator and the triode oscillator. This is therefore electron coupling.

The connection for the 2A7 are, looking at bottom of socket, heaters toward you, go-

LIST OF PARTS

Coils

Two sets of standard short-wave plug-in coils for 0.00014 mfd. tuning; four coils to a set, total eight coils.
Two doubly-tuned intermediate-frequency transformers, 465 kc.
One doubly-tuned intermediate transformer, 465 kc, with center-tapped secondary.
One power transformer.
One dynamic speaker; field coil total 1,800 ohms or more; any existing tap on field may be ignored; output transformer for push-pull pentodes.

Condensers

One two-gang 0.00014 mfd. tuning condenser.
One 0.0001 mfd. grid condenser.
One 0.00025 mfd. fixed condenser.
Two 0.01 mfd. condensers.
Seven 0.1 mfd. bypass condensers, 200 volts minimum rating.
Four 8 mfd. electrolytic condensers (two in two pairs to constitute two 16 mfd.)
One 8 mfd. electrolytic condenser to be used separately.
One 50 mfd., 30-volt electrolytic condenser.

Resistors

One 200-ohm B-watt resistor (or two 400-ohm 1-watt resistors in parallel will do).
One 350-ohm pigtail resistor
Two 3,500-ohm pigtail resistors.
One 4,700-ohm pigtail resistor.
One 15,000-ohm, 5-watt resistor.
One 0.05 meg. pigtail resistor (50,000 ohms).
One 0.1 meg. pigtail resistor (100,000 ohms).
One 0.25 meg. pigtail resistor (250,000 ohms).
Two 1.5 meg. pigtail resistors (1,500,000 ohms).
One 2.0 meg. pigtail resistor (2,000,000 ohms).
One pigtail resistor, marked R in diagram, suggested around 100,000 ohms.
One 25,000-ohm potentiometer with a-c switch attached (used as rheostat). Reverse the connections to the rheostat if the volume control works in the wrong direction.

Other Requirements

One chassis.
Five tube shields and bases.
One seven-hole medium socket, five six-hole sockets, two five-hole sockets and one four-hole socket. (The extra five-hole socket is for speaker plug, although actually only four connections need be used).
One a-c cable and plug.
One vernier dial, escutcheon and pilot lamp.
One antenna-ground binding post assembly.
Four grid clips.
Tubes: one 2A7, two 58's, one 55, one 56, one 5Z3 and two 2A5's.

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ing right to left: one heater, other heater, plate, screen, oscillator plate, oscillator grid, cathode. The control grid of the modulator is the cap of the tube.

While the control grid is shown as negatively biased by cathode resistor drop, those partial to grid leak detection in the modulator may use 0.0001 mfd. and 75,000 ohms, connecting grid return then to grounded B minus, and shifting the volume control to an intermediate tube, as well as increasing the resistance, approximately doubling it. That is, there would be 50,000 ohms of rheostat at maximum in series with 3,500 ohms of fixed biasing resistance.

The coils used in the mixer are of the standard plug-in variety in conjunction with the 0.00014 mfd. tuning capacities. Both coils are the same as to number of base pins (four) and as to inductance for a single band, and the question arises how the difference in frequencies is struck between the modulator and the oscillator.

This is done by including a seven-plate junior condenser in parallel with the section tuning the antenna secondary. Since we desire the oscillator frequency to be higher, the modulator frequency will be lower, and to lower it extra capacity, as found in the manual trimmer, provides the result.

For the first band of tuning this capacity has to be relatively large, although it must be admitted that 50 mmfd. will more than take care of it. For the next band the capacity has to be much less, and for the next two bands it is scarcely necessary to move this manual trimmer's knob, but the condenser may be left at minimum, because the percentage of difference in frequencies is so small.

Percentage Differences

Even at 5,000 kc, the percentage of difference is only 10 per cent., approximately, so at 10,000 kc it is 5 per cent. and at 20,000 kc it is 2.5 percent. As we shall tune to around 30,000 kc, the difference finally becomes a little more than 1.6 per cent.

Some arguments may be raised against this small difference in relative frequencies at the higher frequencies, but the only remedy would be to use a still higher intermediate frequency than 465 kc, and one would soon get into the broadcast band, where there is trouble ahead, due to likelihood of interference by direct pickup, in the intermediate amplifier, from broadcast stations, so one would select perhaps 1,520 kc, which would render the coil problem somewhat serious for those not yet thoroughly versed in radio. On the other hand, the splendid short-wave supers with intermediate frequencies in the four hundreds may be cited, and also the excellent results obtained.

The intermediate transformers are of the doubly-tuned type, but if you have singly-tuned transformers, these may be used, and in fact may yield even a little more selectivity, for there is an inescapable band-pass filter effect in the double-tuned variety.

While the 55 is shown worked as a full-wave detector, it may be worked as a half-wave detector if you haven't the transformer with center-tapped secondary.

40% Off

Simply then connect one side of secondary to joined anodes, other extreme of secondary to one side of the load resistor, other side of which resistor goes to ground. R then might have to be somewhat higher than for the full-wave circuit, but this could be verified experimentally, following the directions previously given. As a generalized value, R may be recommended tried at 100,000 ohms, even though less than the full rectified voltage (40 per cent. of it in such instance) would be applied to the triode of the 55.

While this seems like a great deal off, the actual result in quantity of sound is not much, as the 56 gives more volume on strongest signals when less than the full voltage is taken off the 55 rectifiers.

If 4,700 ohms are used in the 56 cathode leg, the negative bias will be around 8 volts, although on meters less sensitive than 1,000 ohms per volt, the reading may be around 5 volts or so. Nevertheless the actual voltage is around 8 volts, and the current is a bit under 2 milliamperes. It is therefore not necessary to filter the a-c from the primary of the push-pull input transformer.

I-F Filter Condenser

The 0.1 meg. resistor in the 55 plate circuit is higher than usually recommended, but the output signal voltage is raised a bit thereby. The 2.0 meg. leak helps improve the sensitivity, and if slight hum increase is tolerable, this resistor may be raised even to 5 meg.

Across the grid resistor is a condenser of 0.00025 mfd., in a position that has much less effect on reducing the high audio frequencies than if this unit were across the diode load resistance (R plus 0.35 meg). The purpose of the condenser is to serve as an i-f filter. If the intermediate amplifier tends to be a bit squealy at maximum gain this condenser corrects for the condition.

The quality is improved by a large bypass condenser across the 56 biasing resistor, yet none is shown across the 200 ohms biasing the push-pull stage. This is due to the absence of signal from the smaller resistor.

The 0.05 meg. resistor as a hum-reducer has been discussed. There remains only the consideration of the power transformer, rectifier and speaker.

Optional Connections

The power transformer may be of the so-called 90 ma type (where the plate drain at d-c values is used as the transformer rating), otherwise a 50-watt transformer (if primary input is used as rating). The windings need not be exactly as shown. Perhaps there is only one 2.5-volt winding. It may be used nevertheless, provided it will stand around 10 amperes or so. The rectifier windings are the high-voltage supply (normally around 350 volts a-c between B minus and one side), and 5 volts. If the 5-volt winding is not center-tapped, use either side of the filament for the B feed.

The circuit is equipped with automatic volume control of the two intermediate tubes, but if desired this control may be extended to include the modulator, by making the modulator grid return to the 55 diode load resistance, as done in the other instances, through a high resistance bypassed by a large capacity, instead of directly to ground as diagramed. In case the change is made, separate the primary from the secondary, so that the primary is directly grounded. This refers to the modulator coil (extreme upper left).

Coil Connections

The intermediate amplifier is peaked in the usual way, by putting the oscillator voltage on the plate of the 2A7, with modulator and oscillator coils out, then resort restoring the circuit, and on a very weak signal received later, relining the intermediates carefully and slightly for maximum quantity of sound or greatest deflection of the needle, if output meter is used.

It has been stated that standard plug-in coils may be used. If machine wound, as they naturally would be, the windings are in the same direction, and the connections for modulator, top to bottom, would be: (secondary) grid and ground, (primary) ground and aerial. Oscillator coil: top to bottom (secondary), ground; B plus, plate. The connections to base pins will have to be traced out, but for commercial types in mind the code is: coil's positive filament to antenna or plate; coil's plate to ground or B plus; coil's grid is grid in both instances; coil's negative filament is ground for both. "Grid" in the case of oscillator represents the coil side of the 0.0001 mfd. grid condenser.

[Other Illustration on Front Cover]

3,000 AT STUDIO

More than 3,000 persons attended a recent broadcast of the Pontiac program, thronging the grand ballroom of the Waldorf-Astoria Hotel in New York City to applaud the comedy of Stoopnagle and Budd and the music and songs of the Kostelanetz Orchestra and Chorus, William O'Neal and Jeannie Lang. The special presentation was arranged to accommodate some of the many requests for personal attendance at the programs, and standing room only, with plenty of standees, was the order of the evening. After the program, the Colonel and Budd put on a special performance for their enthusiastic audience. A surging mob of autograph-seekers kept Stoopnagle, Budd, Announcer Louis Dean and the other principals busy with pens and pencils for a good part of the night after the performance.

HIGHER

TREND IN THAT DIRECTIO
DICTED—COIL DATA FO

By F. W.

IN the superheterodyne intended primarily for short waves, the intermediate frequency should be as high as practical, and while good results are obtained with 450, 465 kc, etc., no doubt the trend will be to frequencies higher than the broadcast band, just as the intermediate frequencies of broadcast superheterodynes were increased from 30 kc to the four hundreds.

Many will desire to be in the vanguard of such experimentation, and therefore some details will be given to guide them, although the engineering of the circuit diagramed herewith has not been completed by the author. The intermediate and audio amplifiers, and the B supply, have been completed, but there remains some work to be done on the mixer coils.

The inductance values may be stated on the basis of specified capacities. Suppose that a two-gang 0.00041 mfd. condenser is used. The frequency ratio will slightly exceed 3 to 1, but for overlap assurance the ratio will not be deemed to be greater than stated.

Different Frequency Ratios

Let us look for a moment at the highest frequency band. Suppose it ends at 30,000 kc (30 megacycles). Then if the same ratio prevails the low frequency tuning would be at 10 megacycles, a difference of 20 mgc. At the low frequency short-wave band the difference would be that between 1,540 kc and 4,620 kc, or 3,080 kc. It is clearly advisable to reduce the frequency ratio as the frequencies tuned in become higher and higher, band for band, so that no disparity like 20 and 3 mgc. will exist. As an arbitrary selection in the right direction, the 3-to-1 ratio may prevail for the first and second 2-to-1 for the two other short-wave bands. short-wave bands (lower frequencies), and

The fifth band represented in the coil system may be the broadcast band. although this would be simply an auxiliary service, in such a set, and the predominating consideration would be short waves.

As the frequencies become higher the difference between the modulator and the oscillator frequencies becomes less, that is, the two come closer to being the same, even with 1,520 kc or thereabouts as the intermediate frequency. So while series capacity padding would be required for two or three of the low frequency bands, a parallel manual condenser across the modulator will take care of frequency adjustment for the higher frequencies, where there would be no padding condenser, although for all save the highest frequency there would be some inductive compensation.

40 Mmfd. Minimum

The series padding condenser is selected on the basis of the low frequency tuning, the oscillator inductance on the basis of the high frequency tuning. Therefore to compute the coils it is necessary to know or assign the minimum capacity. This has been selected as 40 mmfd. for each of the two circuits, modulator and oscillator.

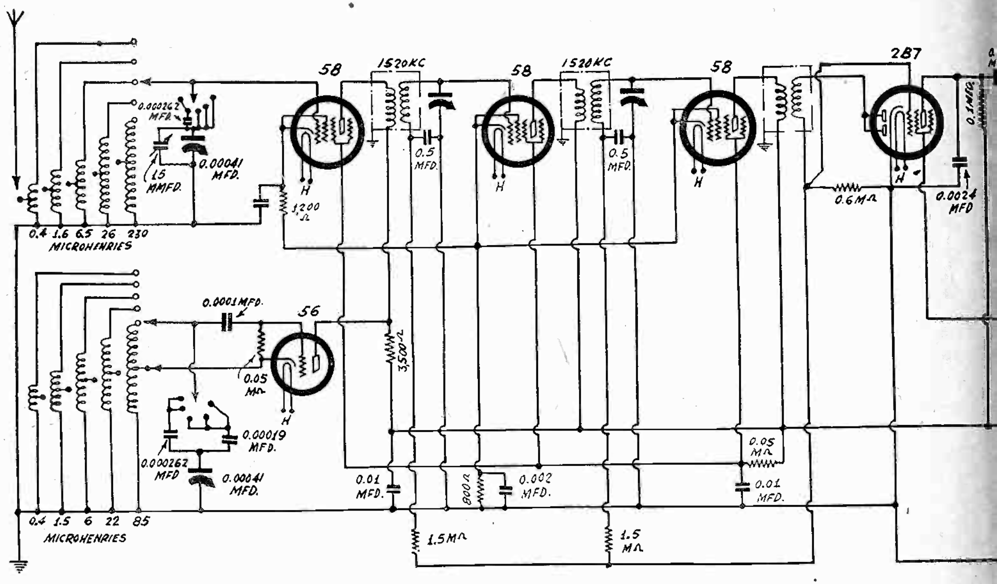
In broadcast practice we find the series padding condenser has little effect on the high frequencies of tuning, for a particular band, and in general if the series capacity is large the effect on the high frequencies is small.

Now let us consider the broadcast band. The modulator input coil has an inductance of 230 microhenries, tuned by 0.00041 mfd., while the oscillator has an inductance of 85 microhenries, and is tuned by a circuit consisting of 0.00041 mfd. and 0.00019 mfd., making the net result 0.00013 mfd. The tap on the modulator coil is at about one-eighth the total number of turns, whether honeycomb coils are used, as will be likely, or solenoids. The oscillator tap is at about one-quarter the total number of turns, and is not critical. Now, we find the first short-wave band is covered by a modulator coil of 26 microhenries inductance, tapped at one-quarter the number of turns. The companion oscillator coil has an inductance of 22 microhenries, and the padding condenser is the same as before, 0.00019 mfd., resulting in a net effective capacity of 0.00013 mfd. The tap is at one-quarter the total number of turns.

The inductance for the next band is 6.5 microhenries for the modulator, 6 microhenries for the oscillator; for the next band, the values are 1.6 microhenries for the modulator and 1.5 for the oscillator, while for the last band both coils have the same inductance, 0.4 microhenries. The taps on all these coils are at center. The series capacity for reducing the ratio to 2 to 1 should be 0.000262 mfd., but a commercial valu of 0.00025 mfd. may be used.

The best way to wind these coils has no been determined experimentally by the au thor and therefore no details are given although honeycomb coils are now being used for the lower frequencies, and perhap solenoids will be used for the higher ones by winding the solenoids, with their few required turns, on the small diameter hu or form on which the honeycombs ar wound.

The idea suggested is that the honey combs be wound on a 3/8-inch diamete dowel, placed one above the other, with th lowest frequency (largest) coil on top, etc



A short-wave receiver, using an intermediate frequency around 1,520 kc are electron-coupled. Automatic volume control is included. The i-f co

Listeners' Int

Indication that the intelligence of radio audiences is probably higher than the intelligence of the whole population, and that radio programs are probably pitched at too low an intellectual level, is given in a report published by Professor Frank N. Freeman, educational psychologist at the University of Chicago, who recently conducted an intelligence test by radio over an NBC chain.

Professor Freeman received 2,500 responses to his broadcast, in the form of answers to the examination questions. Three-quarters of the entire group made scores "representing superior ability," Professor Freeman reports.

The test, based on Army and school intelligence tests, had the "average adult ability" represented by the score 24. Dr. Freeman found that the average score of the whole group taking the radio test, ages 20 and above, was 32.

"This average is six points above average ability, and three points above the score of 29, which represents superior ability," he states. "In fact, three-quarters of the entire group made a score that was practically as high as the score of 29. Twenty five per cent of the group made a score o 32 or above, which represents very superio ability.

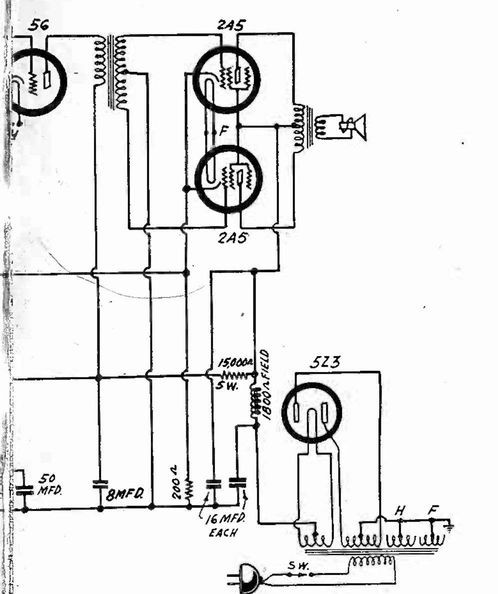
"The range of ages of persons taking th test was from 6 to 80. I was surprised a the large number of papers sent in by olde persons, and also at the high scores mad by these older persons. As some psycholo gists think that mental ability decrease sharply in the later years, this is encour aging to some of us who are approachin those years. The average score of person above fifty is exactly the same as that o the whole group of adults. Furthermor the average score of seventeen persons wh are 70 years of age or over is within on point of the average of the whole grou There is only a fraction of a point differenc between the scores made by men an women."

When these scores are interpreted in ter

. F. DUE

FOR SHORT WAVES PRE- PRELIMINARY CIRCUIT

Hedges



e 58 modulator and 56 oscillator ding the 2B7 diode is not tuned.

eaving the winding of the two highest fre- uency coils on the hub as solenoids.

The data given are not intended for use n connection with total shielding, although ome shielding evidently will be necessary, s for instance a shield partition between he two coils, but not too close to either of hem. Such shielding would change the nductance only a little. Total close shield- ng would reduce it sharply.

In fact, one result of shielding was that n tuning in around 20 and 30 meters there was stoppage of oscillation below numerical 70 on the dial (higher frequencies than represented by 70) when the shield was on he oscillator coil, but oscillation prevailed when the shield was removed. The oscillator then was a tuned grid feedback type, the usual inductive plate winding, but the Hartley proved a more reliable oscillator, and therefore is shown.

The intermediate coils are easily wound or obtained. If 1-inch diameter forms are used, 127 turns of No. 32 enamel wire may be put on, with primaries wound over the secondaries, primaries consisting of 30 turns of any fine wire, with insulating fabric between the two windings. The condensers tuning them may be regular shaft-type midgets, with or without knobs, two such condensers are on a side wall of the chassis and the third on the rear wall. Knobs greatly facilitate adjustment.

It was found on hooking up the circuit that there was audio-frequency feedback, but this was cured by using a 0.1-meg. resistor in the plate circuit of the 2B7, and putting a condenser of 0.00024 mfd. from plate to ground. Naturally, for this to be effective the feedback had to be at a high audio frequency, as indeed it was. As a further stroke in the same direction, the 2B7 resistor may be made somewhat lower than 0.1 meg.

Some radio-frequency oscillation in the intermediate amplifier was encountered, but this was found due to too low a screen voltage, which was corrected by lowering the limiting resistor for screens to the specified value, 0.05 meg. It was not clear why the lower screen voltage should cause oscillation, but it did just that.

Lining Up Intermediates

The problem of lining up the intermediate frequency without an oscillator will arise, but as it is supposed one has local stations at or near 1,450 to 1,500 kc, select the highest frequency among these, and, with oscillator tube removed from set, line up the intermediates by putting the aerial at plate of the modulator. The locals can be tuned in, if of high enough frequency. Of course the intermediate frequency will be too low, but you will know approximately where to line up, instead of being very far off, and when the set is restored the two intermediate condensers may be shifted to a bit less capacity and when a weak short-wave station is tuned in may be relined for loudest reception of that station. The displacement of the condenser for the higher frequency will amount to only one degree, or at most a few degrees, so do not make the intermediate frequency too high.

Making a Test Oscillator

Some sort of oscillator is needed for the rest of the adjustments, and a broadcast-band oscillator will suit the requirements. It may be a simple regenerative one-tube set of the grid-leak condenser type, with standard broadcast coil used for constant feedback, and the oscillator calibrated against a broadcast receiver, and if need be a curve drawn to ascertain frequencies not directly obtained.

This test oscillator may be used on short waves by its harmonics, which will yield, say, 1,060 to 3,200 kc for the second harmonics, 1,590 to 4,800 kc for the third harmonics, etc. If instead of covering the whole short-wave band, simply a 2-to-1 frequency ratio is desired, as that is sufficient for a harmonic oscillator, then a 50 mmfd. condenser junior may be used with an inductance of 1.7 millihenries, which will reach the lowest broadcast frequency at the low frequency end and twice that frequency at the high end of the test oscillator, or a range of about 530 to 1,060 kc.

The receiver uses the switching system, and for such purposes an excellent switch must be used. However, a few are obtainable on the market, and they may be judged in general by the positiveness and reliability of their contacts, for when this consideration is met the other requirements usually are attended to by the manufacturer in good fashion.

It may well be imagined that the audio gain is very high. The reason is to boost the sensitivity particularly on the weaker stations, as the signal strength from weak, distant stations, including foreign ones, otherwise would not be great enough. It is not to be compared with the signal strength from broadcasting stations, except the very remote ones.

The 2B7 has a very high gain pentode as the amplifier in the same envelope as the diode. The connection for the diode is that of half-wave detection, as the both diode plates are then paralleled, and the tube will better stand any heavy voltage delivered to the detector. The 2B7 feeds into a 56, which is the driver for the push-pull output stage, and while a large bypass capacity is shown across the biasing resistor of the 56 audio amplifier, if there is audio instability this condenser should be omitted.

The I. F. as a Signal Frequency

There are, as intimated, various problems connected with such a circuit, some of which have been specified, and the remedies given. However, one problem not mentioned is that due to the intermediate frequency being somewhere around 1,520 kc, so a signal frequency of the same value would result in a squeal, not in what might be termed reception. Therefore it is advisable to have the broadcast band go from its low frequency extreme to no higher than 1,500 kc, and then have the first short-wave band begin at 1,540 kc or thereabouts, thus skipping the intermediate frequency, and some surrounding frequencies, excluding them from the possibility of reception.

If this is not desired, a wave trap may be put permanently in the antenna circuit to kill off virtually all response at 1,520 kc, or if there is nothing usually receivable on this frequency, remedies may be ignored, as only a single squeal will result, and one squeal in a super is not so bad.

igence Rated

of the well-known age-intelligence ratios, used for persons under 18, they come out as follows: Average intelligence for age 17, average score should be 23 points; for 16 years, 22 points, for 15 years, 21 points, for 14 years, 18 points, for 13 years, 16 points, and for 12 years 13 points.

Eight persons taking the test scored a perfect 40, one of them a thirteen-year-old girl. Each question of the test required a one-word answer. A typical question is this, in a section on "opposites" in which the listener was asked to write the fourth word of a series: "Handle is to hammer as knob is to . . . . ." the correct answer being "door." Through comparing the test results in a number of ways Dr. Freeman was able to assure himself that the answers were honestly written, and not looked up.

"It seems to be a common opinion that the average intelligence of the radio audiences is only as high as that of the thirteen- or fourteen-year-old child. If this opinion is wrong the programs are pitched too low.

"Our results suggest that the intelligence of the radio audience is above the average although, of course, they do not prove it."

Occupations listed by those who responded to the test indicate that 26% of them were in some profession, whereas in the whole population, according to the U. S. census, only 3.4% are in the professions. Commercial occupations were listed by 39% of those who reported, whereas only 16% of the whole population are in commercial work.

"I am quite sure that there is a large group of highly intelligent radio listeners, and that it is advisable to keep this group in mind in planning programs." Dr. Freeman concludes.

A Federal Government pamphlet a few years ago listed the average intelligence of a radio listener as that of a thirteen-year-old person.

Educational specialists, not connected with the government, took complex topics as samples and prepared talks on the 13-year plane to show what should be done.

ANTENNA REMEDIES

SQUEAL ELIMINATION, LEVELLING OF CHARACTERISTIC, AND IMPROVING SELECTIVITY

By Thomas Parks

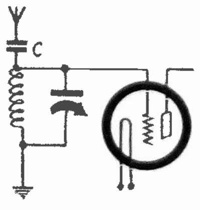


FIG. 1
C is an antenna series condenser, feeding directly to the secondary.

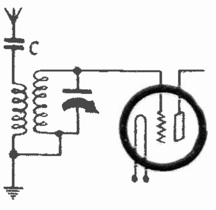


FIG. 2
Here a primary is used, and C has smaller detuning effects.

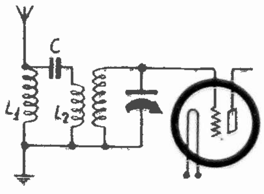


FIG. 3
L1 is a large inductance, C is a small condenser in this case.

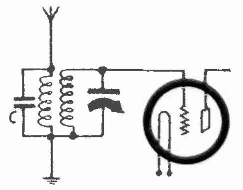


FIG. 4
C tunes the primary to a lower frequency than the set's lowest.

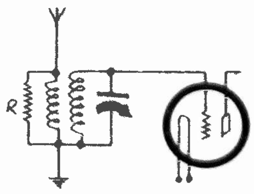


FIG. 5
R is a resistor to stop oscillation. It may be thousands of ohms.

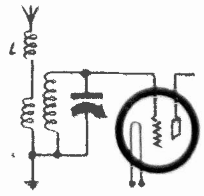


FIG. 6
The series choke L does no good. It only reduces input by choking.

THE antenna stage is more or less of a perplexing problem, in that the selectivity is greatly influenced by the method of circuiting and treatment, the antenna itself may have a detuning effect difficult to compensate for, and even occillation is governed to some extent by the antenna input.

Some form of coupling is necessary between aerial and coil, and usually this consists of the antenna capacity feeding the primary of a transformer with carrier voleage. However, the antenna may be coupled to the grid of a tuned circuit by a small condenser, omitting the primary, as in Fig. 1, although if there is gang tuning it will be almost impossible to track the subsequent sections, as the effect of the antenna capacity across the tuned winding is large enough to be of importance on the higher frequencies. For instance, if the first stage is peaked at a low frequency with the subsequent stages the first section will tune off, beginning at around 1,000 kc, so that at 1,500 kc it would be very seriously off, perhaps 50 kc.

In a two-tuned-circuit system this would be all right, if a manual trimming condenser were put across the second section of the tuning condenser.

Reduced Carrier Input

The series condenser should be small, and in that sense 50 mmfd. is rather large, though satisfactory as a rule. The detuning trouble would not be reduced enough unless the series capacity were around 10 mmfd.

Putting in a series condenser of such low value as even 50 mmfd. (low in the comparison to the antenna capacity itself), greatly reduces the input voltage, but at about the same rate it increases the selectivity. In fact, it is the simplest way to increase selectivity, if the method is consistent with a sufficient quantity of sound in the final output. In high-powered sets, including of course superheterodynes, the method well may be used.

Because it increases selectivity ahead of the modulator it is also a method of reducing squeals in supers where such squeals are caused by insufficient selectivity ahead of the modulator.

The receiver will normally have a former, that is, primary and secondary, and then the detuning effect is decreased by inserting the series condenser, because the equivalent capacity across the primary is the net capacity resulting from the prime antenna capacity (say, 0.0002 mfd.) and the series condenser (0.00005 mfd.), and the inductive coupling reflects little capacity in the next winding. Thus also the condition present in the following circuits in the set is more closely approximated, where the capacity across a primary is small.

Levelling Effect

In some instances, with receivers that have effective automatic volume control, the series condenser reduces the quantity of sound at the output very little. When noticed it is plainest regarding the lower radio frequencies, considering the broadcast band.

The series condenser in the primary circuit is illustrated in Fig. 2.

Sometimes the rising characteristic of tuned radio frequency amplification (greater amplification at higher frequencies) is sought to be overcome, and a rather even response attained. This may be at least approximated by using a large r-f choke coil as L_1 in Fig. 3, and coupling to the primary again through a similar small condenser as before. If the condenser is large the tuning of the tuned circuit is upset and perhaps nullified. Honeycomb coils of hundreds of turns (though only about 1 inch total diameter) normally would be used.

Another way to give the lower frequencies a break is to have a large enough primary, and tune it with a condenser, so that, aerial capacity considered, the primary would resonate at some frequency a little lower than the lowest frequency tuned in by the set itself.

Both these methods of favoring the lower radio frequencies make the set seem less selective at these lower frequencies, though actually the selectivity is not reduced but the voltage input increased, while the actual reduction in selectivity takes place at the higher frequencies, because of the equivalent increased resistance in the tuned circuits at such higher frequencies. Moreover, another treatment of the antenna circuit consists in the introduction of a resistor in parallel with the primary. Though this is a parallel resistance of some thousands of ohms, or perhaps even tens of thousands of ohms, in any instance it is equivalent to a much smaller series resistance in the tuned circuit, and there is a formula for determining the equivalent series resistance.

Of course such resistance reduces selectivity, but if a receiver oscillates at the r-f level, the extra resistance will be of benefit, instead of otherwise, since absence of oscillation is consistent with fine reception, and presence of oscillation is inimical to any decent reception. If there is any cross-modulation, however, the antenna resistor remedy can not be applied to correct squealing, without increasing the crossmodulation. Thus with 24 or even perhaps 35 tubes in the first stage the remedy would be inapplicable, but with triodes, and the later remote cut-off tubes, it could be used.

The stabilization by the parallel resistor requires that a variable be used or various fixed values tried, until the one is found that stops oscillation. The variable would be measured and a fixed resitsor of that value introduced. The resistor should be as high as practical, consistent with attainment of the desired result.

Series Choke

Series chokes have been shown from time to time, but they are of small use in correcting troubles in receivers. They reduce the input too much, without any compensating advantage. Thus if the choke L in Fig. 6 is large enough it would stop all radio frequencies from entering the receiver, in the range of frequencies a particular receiver is intended to cover.

It is obvious that various troubles therefore can be cured at the antenna stage. The reduced input due to a small series condenser can well be stood by nearly all of the latest type receivers having six or more tubes. Often a problem arising in servicing a set can be cured right at the antenna stage, by using some of the remedies herewith proposed.

EXPERIENCE

Reports on Short-Wave Sets

A GOOD MANY experimenters are building short-wave sets, and as I have built several, I would like to report my experience, as a guide to those who might like to follow me and thus perhaps save themselves a good deal of time, labor and some money.

Having tried both superheterodyne and tuned radio frequency-regenerative sets, I am bound to report that I have been able to do at least as well with the regenerative type, with about half the number of tubes required for a super.

Good results were obtained from supers, too, but as the sensitivity can not be developer very far for short waves without running into the noise level, the advantage of a superheterodyne for broadcast use does not seem to me to apply to short waves. As for selectivity, while a superheterodyne may surpass a regenerative set, all the required selectivity is obtained the simpler way. Besides, the superheterodyne's selectivity is non-uniform to a more considerable degree because of the popularity of low intermediate frequencies, where the difference between the oscillator and modulator (signal) frequencies soon becomes too insignificant to be worthy of attention.

My set, that is, the one I prefer, has a stage of t-r-f, a regenerative detector (57 tube), a 56 driver audio stage, and push-pull 2A3's as output. Greater sensitivity can be attained with pentodes in the output (47, 2A5 or 59), but I have intimated that it seems the better part of wisdom not to press the sensitivity to the utmost.

The t-r-f stage should be shielded, as should the detector stage, but the usual small shields should be avoided. Also it is good practice to make the shielding all-inclusive, so that there is a shield bottom piece for the chassis, and if possible a total shield enclosure for the top of the chassis, besides the individual coil and tube shielding there. By taking these precautions there is little, if any, danger of encountering radio-frequency oscillation. On the very shortest waves this oscillation otherwise might be present.

If a super is to be used for short waves, the double-tuned intermediate transformers will be all right, but for still greater selectivity to the point of sideband-cutting the transformers with only one winding tuned will be preferable. Next to the modulator the plate circuit should be tuned, rather than the following grid circuit, provided the coupling is one-to-one, or at least not step-down. In subsequent stages the grid circuits are tuned, and only two stages may be used, as the utmost, for the usual intermediate frequencies. That is, there are three intermediate coils.

I have tried a high intermediate frequency, which in theory should be preferable for a short-wave superheterodyne (1,520 kc as a starter), and at first with even one stage there was terrific oscillation and primaries had to be reduced to 20 turns wound over the secondaries. When two stages were tried the primaries had to be reduced to 12 turns. I believe that high-intermediate-frequency superheterodynes have possibilities, and when the i-f amplifier is stabilized there is no more noise than if the i-f were much lower, say, 450 kc or thereabouts. I can not quite see any advantage in a short-wave superheterodyne if the intermediate frequency is as low as 175 kc.

ADAM BRADWORTH,
San Antonio, Tex.

* * *

His Portable a Success

CONSTRUCTORS should notice that now there are two different kinds of seven-hole sockets, one of the medium size, as for the 59 and 53 (the new twin Class B amplifier tube) and the other of the small size, for the 2A7, 6A7, 2B7 and 6B7. The tubes and sockets are not interchangeable, although a socket has just come out, for tester construction, that takes both of the seven-pin types in the same receptable, by a special arrangement.

J. J. WORK,
Spokane, Wash.

Studio Notes

Who said that One-Eye Connolly had "retired"?

He crashed the gate at NBC Times Square Studio to see Ed Wynn's last broadcast for the season, and Graham McNamee was the unwitting accomplice.

McNamee arrived at the studio with a suit case.

"Carry your bag, Mr. McNamee? No charge," a man offered. McNamee handed over the bag and they went on up.

Once safely inside the studio the volunteer red cap deposited the bag on the floor and refused to carry it further. He thereupon introduced himself to McNamee. Much amused by the deception, the announcer took the world's champion gate-crasher back stage, introduced him to Ed Wynn and later fixed him up in a box seat for the show.

* * *

Russell Johns, lyric baritone heard weekly over a network, was born in Chillicothe, Ohio, also the home town of Clyde Beatty, the animal trainer. The two were boyhood chums and classmates in school. Johns says he cannot understand how Beatty came to go into lion-taming unless it was their eighth grade teacher who "inspired" him.

* * *

Frederic William Wile, Columbia political analyst at Washington, expresses a preference for the boisterous "Of Thee I Sing, Baby," from the political satire of that name. Colonel Stoopnagle registers a fondness for "Without a Song," which may be his actual preference or just a humorous implication. Edwin C. Hill and the Street Singer are both rooters for "Ol' Man River." Will Osborne is swept away by the strains of "Stormy Weather." Mildred Bailey, Columbia's glorifier of the blues, votes appropriately for "St. Louis Blues." Irvin S. Cobb reported "Swing Low, Sweet Chariot" is his choice. Freddie Rich's favorite is a selection from a bygone musical comedy hit, "Oh, Kay," entitled "Someone to Watch Over Me." Andre Kostelanetz declares allegiance to "Dancing in the Dark." Gypsy Nina votes for "Honey, Take a Look at Me." The "Night and Day" pluggers include Fred Feibel, organist, Gertrude Niesen and Irving Kaufman.

World Field Day a Success

Hartford, Conn.

An international experiment in emergency amateur radio communication was performed recently when members of the American Radio Relay League, the Radio Society of Great Britain, the Reseau Belge, the Nederlandsche Vereeniging voor Internationaal Radioamateurisme, and other national amateur radio societies held an international field day.

Taking complete portable radio stations into the field, hundreds of them in every state and province of the United States and Canada alone, these amateurs set up their equipment and established reliable inter-communication in a manner to do credit to any organized communications system.

Certain of the operators contacted as many as fifty other stations. Nearly all were using very low power, from one to fifty watts. Even the highest power is less than one-thousandth of the amount used by high-powered broadcasting stations. A great proportion of the equipment was designed to be capable of operation without power from the electric lines; in time of emergency this feature would be invaluable.

The great bulk of the work occurred on the amateur 3,500-4,000 kilocycle band, said F. E. Handy, communications manager of the American Radio Relay League, at the national headquarters here, although there was nearly equal interest in the newly developed 56-60 megacycle, or five meter, band. The most sensational work was accomplished in the neighborhood of 7,000 kc, or 40 meters.

Amateurs Thriving; Books Selling Well

Hartford, Conn.

In keeping with the unparalleled growth of amateur radio during the past four years, the sales records of the newly announced publications of the American Radio Relay League, "The Radio Amateur's License Manual," and "Hints & Kinks for the Radio Amateur," uphold the record-breaking tradition established by previous books in their series.

Announced approximately one month ago, the "License Manual" has already sold over 2,000 copies. The market for this publication, which covers the entire field of obtaining any one of the several kinds of amateur licenses issued by the Federal Radio Commission, consists of new amateurs and those seeking to enter amateur radiotelephony on restricted bands.

Strictly Commercial

R. L. Watkins Co., sponsor of Lyons tooth powder, is all set for its new broadcasting contract with National Broadcasting Co. Practically the same program will be used as under the old contract just expiring. The new deal starts early this month.

* * *

NBC has received a protest from St. Louis regarding a certain program, as local medical men do not like the idea as presented commercially, and it is probable that Station KSD in St. Louis has dropped this program for good.

* * *

A big new beer program for NBC is about ready to be signed and it is said to represent the biggest money venture of its kind since the beer barons have been able to go after business via the ether.

* * *

Columbia Broadcasting System recently signed a substantial contract with the Household Finance Corporation, the programs to be broadcast from Chicago.

* * *

The new Amalgamated Broadcasting System is said to be signing 'em up so fast that the other chains are taking sharp notice of what is going on. ABS was not considered a very important business proposition when Ed Wynn and his associates first announced their plans.

New Pick-up Tube Puts Television Well Forward

Chicago.

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He explained that the main feature of transmitting under the new system is the pickup equipment for converting the image into radio signals without the use of mechanical or moving parts, adding that this involves a new system that greatly increases the output.

Image Retention Increased

Whereas disc systems, using good optical methods, deliver only 60 electrons during the period the picture point is active on the photo-electric cell, the Zworykin method produces 420,000 electrons, due to the 7,000 times greater duration. He explained this duration has been achieved in practice, but that it is theoretically possible to increase the present result ten-fold by still longer retention of the image by the cell.

However, in the new method the ordinary photo-electric cell is not used, but a mica sheet in a cathode ray oscillograph tube is treated in a secret manner to constitute 3,000,000 photo-electric cells, and the picture acts on the cell structure all the time.

The transmitting device is called the iconoscope, meaning "image observer."

The receiving device is also a cathode ray tube, but with a fluorescent screen instead of the cell structure, and is called a kinescope, or "motion observer."

At present the image is 4 square inches and the pictures are divided into 250 elements per scanning inch, or a total of 250 x 4, equalling 1,000 elements. The size of the spot or crater of the beam should be 1/125th of an inch, or 0.008 inch.

The two counterparts of the system have been likened to the human optical system, representing the pick-up and transmitter, and the human brain, representing the receiver, while the greatly increased rentitivity has been referred to as "memory." The photo-cell arrangement is in some respects more sensitive than the human eye, because it responds to higher frequencies, including ultra-violet and infra-red, which are in the human eye's invisible spectrum.

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The intention is to develop the system for use on a high carrier frequency, around 50 megacycles (6 meters) to avoid interference with existing radio transmissions, and also meet television requirements for a wide modulation band width to insure picture quality.

In connection with this new tubes are being developed, much smaller in size than those in broadcast sets, so that 50 megacycles may be amplified even at radio frequencies, at present impossible with the standard tubes. The iconoscope, or transmitting system, makes possible satisfactory amplification, because of the high quantity of output, whereas under present methods the signal hasn't much more vigor than the inherent noises in an amplifier, so that amplification is limited.

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"During this period a photo-cell of the highest sensitivity will deliver only sixty electrons to the amplifiers, an amount so small that good amplification is impossible. In the iconoscope the picture acts on a photo-electric cell all the time, and there is provision in the structure which collects the energy of the light, or, so to speak, memorizes it, and then transmits it, point by point, twenty-four times per second.

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"Thus it can be seen that the amount of energy stored or 'memorized' in the new photo-cell is, as compared with the old system, in the ratio of one divided by twenty-four as against one divided by 1,500,000, a 'memory' 70,000 times greater. At present, however, we are able to obtain only 10 per cent efficiency, or 7,000 times increase of output from the picture possible with the disc-scanner under identical conditions.

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Where to Put Volume Control

IS THERE any decided advantage in one form of volume control as against another? I have been used to putting the control ahead of the detector, but I find more and more circuits have the control in the audio amplifier.—P. O.

The type of volume control and its placement will depend considerably on receiver design. Thus, if the detector (or second detector in superheterodynes) is fully protected from danger of overload, it is permissible to put the control in the audio channel, although this should be done in a manner not to constitute change in volume a control of tone as well. One advantage of such location is the avoidance of detuning effects, otherwise inevitably present. However, in a superheterodyne these would not be serious in the intermediate amplifier. Grid bias variants have shown detuning to as much as 20 kc for the controlled circuit near the high frequency end of the broadcast band. Theoretically at least, the volume control should be a gain control and an input control, because the amount of gain should be cut down to reduce the noise, and the amount of signal input cut down to prevent cross-modulation and overloads of other types. So compound controls are sometimes used. There is no altogether satisfactory volume control, so far as we know, and most engineers must feel mildly stumped when they come to the control feature. Perhaps the day will come when constant output tubes will be developed, so that one may make a permanent setting, and the volume will come up to that in nearly all instances, at least will not exceed the predetermined value. A close approximation to this could be made with the present duo-diode tubes, using the rectifier for auxiliary biasing of each tube (automatic volume control), and the amplifier section (whether triode, quadrode or pentode) for gain. However, the circuit would be awkward, and no doubt the constant output tube will see the light of day some time.

* * *

Radio and Electricity

DO YOU BELIEVE that radio has made any vitally important addition to the knowledge of electricity, and is that knowledge in a definite form now?—T. H.

Radio can not be said to have contributed anything vital to the fundamental knowledge of electricity, as the electron theory, that lifted knowledge of electricity from a hazy plane to one of sense and nuderstanding, was known long before radio became practical. At present other aspects of electricity are yielding to human research, and we know the electron, positron, neutron and, according to Compton, may expect some new divisibility. Knowledge of electricity is still in a formative state, though much advanced over that of half a century ago, when pupils were taught that electricity was a fluid, because it flowed through a circuit. Now we know that electricity is the phenomenon of electron action, and that the electron, or negative particle, is in a state of orbital motion. Thus the old idea of flow of electricity is supplanted by the realization of the bombardment of atoms and the drift of electrons. These electrons are agitated by electromotive force, i.e., voltage, and the intensity of the bombardment, the constitution of the mass, and other considerations, affect the net drift. The electron theory can not be regarded as a theory any more. Radio is a branch of physics, as is electricity, but physical branches intertwine so much that demarcation is not so easy. Radio's great contribution may be regarded as one toward the means of using electricity, rather than vital contribution to the understanding of electricity. The phenomenon of tuning was derived exclusively from radio, though now used in various branches of electrical work. The vacuum tube still remains the supreme radio contribution to electrical use. These matters are largely ones of opinion, hence debatable.

* * *

Wire for Short Waves

FOR SHORT-WAVE wiring, is it desirable to use extra-heavy wire for grid and plate leads, rather than thinner wire? Is it a fact that losses should be kept as low as possible, despite regeneration?—T. H. D.

It is not necessary to use awkwardly thick wire for the leads you mention. No. 18 or equivalent is sufficient. Especially is this true since the coils themselves hardly would be wound of coarser wire. It is assumed that you refer to frequencies no higher than 30 megacycles. For ultra frequencies thicker wire should be used, say, No. 14, 12, or even 3/8-inch diameter hollow copper tubing. The circuit losses should be kept as low as possible, and regeneration should not be relied on to come to the rescue, because, strangely enough, the results are better with a low-loss circuit, using regeneration, than with the other type, where regeneration is also included. This does not seem consistent, since regeneration may be expressed as a state of negative resistance, and it would seem therefore that all r-f resistance has been overcome. Another consideration is that in short-wave reception the frequency range to be covered is enormously wide, and the so-called regenerative circuit may become non-regenerative at the higher frequencies unless due precaution is taken to constitute the circuit losses as low as practical. As a general rule, the simplest regenerative circuits work best, and that means circuits with the fewest parts and most sensible layout. A great deal more depends on the layout than most short-wave enthusiasts realize.

* * *

Directional Aerial?

I HAVE a roof aerial, about 10 feet above the tin, and it is 40 feet long. Also I live on the second floor of a six-story house in New York City, so the lead-in, straight up and down, is 36 feet, and the horizontal portion, from window to set, is three feet. Is this aerial essentially directional, since it points in a certain directon on the roof? The lead-in is taken from the high end (the aerial slants about 20 degrees, and the 10-foot height is the lowest point).—M. H.

The aerial is not essentially directional, particularly as the principal component of the aerial is the downlead, which picks up more than does the horizontal portion on the roof. Vertical antennas are not directional.

* * *

The 6A7 Tube

PLEASE give me some directions for use of the 6A7 pentagrid tube in an automobile receiver.—I. D.

This tube has the usual 6.3-volt heater, uses a seven-hole socket, and is connected as is its a-c counterpart for 2.5 volts, the 2A7. The overhead grid should be biased minus 3 volts. This is the modulator control grid, numerically 4. Up to 250 volts may be used on the plate and 100 volts on the screen. The plate resistance is very high, 0.3 meg., and therefore if an intermediate frequency transformer is used that has only one winding tuned, that winding preferably should be in the plate circuit of the modulator.

* * *

Wants Infallible Remedies

MY SET hums too much. There are a 30-henry choke in the B filter and two 8 mfd. at each end. Also, when the set is turned on the wet electrolytic condensers make a boiling sound. This disappears as soon as the signal is audible. The set fades on distant stations. There is some squealing at the high frequency end. Please give me unfailing correctives.—A. W.

The hum may be reduced by putting 8 mfd. more next to the rectifier. The B voltage at the output will go up a little also. The electrolytic condensers "boil" because the voltage is too high at the start. You probably have a heater type output tube (or two such tubes), so the B current does not drain the rectifier at once, only after the heaters have warmed up. Put a bleeder reistor from rectifier filament to B minus, around 15,000 ohms, 15 watts. Then the B current will be large at the start, consequent B voltage lower, and condensers won't "boil." Fading on distant stations is to be expected, and automatic volume control would not be a complete cure by any means. Squealing can be corrected by using parallel resistance in tuned circuits, thousands of ohms, or series resistance, tens of ohms. Infallibility is easy to ask but hard to achieve.

A THOUGHT FOR THE WEEK

MONTAGUE GLASS, of Potash and Perlmutter fame, has joined the literary folk of the air. He will be in good company, for he follows Booth Tarkington, Octavus Roy Cohen and Zona Gale, who already have been able to prove that there is room and opportunity at the microphone for our distinctly American writers. Mr. Glass has made a fortune from his Potash and Perlmutter stories and plays. At one time these two characters were outstanding on our stage and in our periodicals and there is no reason why Abe and Mawruss should not come to life again through the medium of radio. They are first cousins of the Goldbergs, albeit they are low comedy types and their philosophy is boisterous rather than deep throated—but their humanity is easily understood by all races.

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Radio and Electricity

DO YOU BELIEVE that radio has made any vitally important addition to the knowledge of electricity, and is that knowledge in a definite form now?—T. H.

Radio can not be said to have contributed anything vital to the fundamental knowledge of electricity, as the electron theory, that lifted knowledge of electricity from a hazy plane to one of sense and nuderstanding, was known long before radio became practical. At present other aspects of electricity are yielding to human research, and we know the electron, positron, neutron and, according to Compton, may expect some new divisibility. Knowledge of electricity is still in a formative state, though much advanced over that of half a century ago, when pupils were taught that electricity was a fluid, because it flowed through a circuit. Now we know that electricity is the phenomenon of electron action, and that the electron, or negative particle, is in a state of orbital motion. Thus the old idea of flow of electricity is supplanted by the realization of the bombardment of atoms and the drift of electrons. These electrons are agitated by electromotive force, i.e., voltage, and the intensity of the bombardment, the constitution of the mass, and other considerations, affect the net drift. The electron theory can not be regarded as a theory any more. Radio is a branch of physics, as is electricity, but physical branches intertwine so much that demarcation is not so easy. Radio's great contribution may be regarded as one toward the means of using electricity, rather than vital contribution to the understanding of electricity. The phenomenon of tuning was derived exclusively from radio, though now used in various branches of electrical work. The vacuum tube still remains the supreme radio contribution to electrical use. These matters are largely ones of opinion, hence debatable.

* * *

Wire for Short Waves

FOR SHORT-WAVE wiring, is it desirable to use extra-heavy wire for grid and plate leads, rather than thinner wire? Is it a fact that losses should be kept as low as possible, despite regeneration?—T. H. D.

It is not necessary to use awkwardly thick wire for the leads you mention. No. 18 or equivalent is sufficient. Especially is this true since the coils themselves hardly would be wound of coarser wire. It is assumed that you refer to frequencies no higher than 30 megacycles. For ultra frequencies thicker wire should be used, say, No. 14, 12, or even 3/8-inch diameter hollow copper tubing. The circuit losses should be kept as low as possible, and regeneration should not be relied on to come to the rescue, because, strangely enough, the results are better with a low-loss circuit, using regeneration, than with the other type, where regeneration is also included. This does not seem consistent, since regeneration may be expressed as a state of negative resistance, and it would seem therefore that all r-f resistance has been overcome. Another consideration is that in short-wave reception the frequency range to be covered is enormously wide, and the so-called regenerative circuit may become non-regenerative at the higher frequencies unless due precaution is taken to constitute the circuit losses as low as practical. As a general rule, the simplest regenerative circuits work best, and that means circuits with the fewest parts and most sensible layout. A great deal more depends on the layout than most short-wave enthusiasts realize.

* * *

A THOUGHT FOR THE WEEK

MONTAGUE GLASS, of Potash and Perlmutter fame, has joined the literary folk of the air. He will be in good company, for he follows Booth Tarkington, Octavus Roy Cohen and Zona Gale, who already have been able to prove that there is room and opportunity at the microphone for our distinctly American writers. Mr. Glass has made a fortune from his Potash and Perlmutter stories and plays. At one time these two characters were outstanding on our stage and in our periodicals and there is no reason why Abe and Mawruss should not come to life again through the medium of radio. They are first cousins of the Goldbergs, albeit they are low comedy types and their philosophy is boisterous rather than deep throated—but their humanity is easily understood by all races.

Directional Aerial?

I HAVE a roof aerial, about 10 feet above the tin, and it is 40 feet long. Also I live on the second floor of a six-story house in New York City, so the lead-in, straight up and down, is 36 feet, and the horizontal portion, from window to set, is three feet. Is this aerial essentially directional, since it points in a certain directon on the roof? The lead-in is taken from the high end (the aerial slants about 20 degrees, and the 10-foot height is the lowest point).—M. H.

The aerial is not essentially directional, particularly as the principal component of the aerial is the downlead, which picks up more than does the horizontal portion on the roof. Vertical antennas are not directional.

* * *

The 6A7 Tube

PLEASE give me some directions for use of the 6A7 pentagrid tube in an automobile receiver.—I. D.

This tube has the usual 6.3-volt heater, uses a seven-hole socket, and is connected as is its a-c counterpart for 2.5 volts, the 2A7. The overhead grid should be biased minus 3 volts. This is the modulator control grid, numerically 4. Up to 250 volts may be used on the plate and 100 volts on the screen. The plate resistance is very high, 0.3 meg., and therefore if an intermediate frequency transformer is used that has only one winding tuned, that winding preferably should be in the plate circuit of the modulator.

* * *

Wants Infallible Remedies

MY SET hums too much. There are a 30-henry choke in the B filter and two 8 mfd. at each end. Also, when the set is turned on the wet electrolytic condensers make a boiling sound. This disappears as soon as the signal is audible. The set fades on distant stations. There is some squealing at the high frequency end. Please give me unfailing correctives.—A. W.

The hum may be reduced by putting 8 mfd. more next to the rectifier. The B voltage at the output will go up a little also. The electrolytic condensers "boil" because the voltage is too high at the start. You probably have a heater type output tube (or two such tubes), so the B current does not drain the rectifier at once, only after the heaters have warmed up. Put a bleeder reistor from rectifier filament to B minus, around 15,000 ohms, 15 watts. Then the B current will be large at the start, consequent B voltage lower, and condensers won't "boil." Fading on distant stations is to be expected, and automatic volume control would not be a complete cure by any means. Squealing can be corrected by using parallel resistance in tuned circuits, thousands of ohms, or series resistance, tens of ohms. Infallibility is easy to ask but hard to achieve.

Station Sparks

By Alice Remsen

The Recipe

FOR LITTLE JACK LITTLE, WABC

9:00 *a. m.—Monday, Tuesday, Wednesday, Thursday and Friday.*

A little bit of laughter, a great big pinch of fun;
A cheery smile to keep the blues away.
A pint or two of happiness, a pound or two of sun,
And quite a bit of appetite for play.
A little sense of humor; sincerity, of course;
Three drops of kindness, just to make it jell;
A grain or two of wisdom, an ounce or two of force,
A touch of personality as well.
A measure full of harmony, a tune to make it sweet;
A charming voice to sing a lyric gay;
Mix well into the microphone, turn on a little heat,
And cook for fifteen minutes every day.
—A. R.

THERE IS THE RECIPE, or so it seems to me, of Little Jack Little's fifteen minute programs, which charm the listeners of the WABC-Columbia network. If you have never heard Little Jack, you've missed a treat. Tune in some morning!

* * *

The Radio Rialto

ALONG THE LINE

Let's take a stroll down the Radio Rialto. . . . Ran into Grace Donaldson, of the Don Hall Trio this week; she informs me that this pleasant little act opens on a new series very shortly; a commercial program, fifteen minutes three times weekly, sponsored by Molay, which is, I believe a shaving cream. Station and time are not yet decided upon at this writing; will let you know that later. . . . Grace also informed me that Otis Maddox, who made such a hit in the Middle West, over WLW, with his hill-billy songs, is in town, making records for Victor. . . . Popped into the Santly Brothers, to get a copy of their new publication, "Under a Blanket of Blue," and met up with that cute little trick, Peggy Healy, who chants the vocal choruses with Paul Whiteman; she's a pint-sized child, with a most intriguing smile, and a way of wrinkling up her nose like a friendly puppy; very sweet. Did you hear her with the great Paul on that two-hour Kraft Cheese broadcast over WEAF, on which Al Jolson did his stuff, and Deems Taylor prated of music and such? . . . Louis Conrad happened in before I left, and we reminisced of the time when he and I warbled together over WJZ on the Matinee Gems program; Louis expects to have his own band again soon; in the meantime he is singing with the Meyer Davis outfit at the Hotel St. Regis. . . .

RUDY VALLEE OF THE N. V. A.

Cannot resist telling you that I had the very great pleasure of proposing the one and only Rudy Vallee for membership in the National Variety Artists, Inc.; the organization is very proud of the fact that Mr. Vallee has joined us, and continues to extend a cordial invitation to all radio artists. . . . My dear pal, Ivy Scott, joined last week, as did Uncle Don Carney a couple of weeks ago. Get aboard children; we need every one of you. . . . Do you remember Hilda Clifton, who played piano for me over WEAF a few years ago? Well, the indefatigable Hilda is conducting an orchestra this season at one of those swell resorts up in the Catskills; what a clever girl she is; plays piano and organ like nobody's business, makes swell arrangements, writes original stuff and, what's more, she can cook! . . . Ann Brae, who has done lots of radio work on all the prominent metropolitan stations, has teamed up with that swell singer and pianist, Rae Zelda. The two girls, who bill themselves as "The Jingle Belles in Rhyme and Rhythm," may be heard every Wednesday at 10:15 a.m. on WOR, in a clever program of harmony and pattern. . . .

AT THE GOOD OLD NBC

On a recent morning, bright and early, I hied me to Studio D, at the NBC. There I rehearsed with Dave Grupp and his boys for the Morning Parade, a network program, under the direction of the tall and slender Harold Hackett. It was an enjoyable experience, for I met up with many of my old friends. Was surprised to find Edythe Handman on the bill, teamed up with a chap named Freddie Farber. They make an excellent combination, doing harmony, comedy patter, piano and guitar. . . . Then there was George Bennett, who possesses a warm and resilient baritone voice; he did some work with Berna Deane, soprano, one of the prettiest girls I've seen in a long time. . . . A funny incident happened during the course of the program. A colored lad, named Joshua, did a couple of songs, accompanying himself on the guitar. He eased up to the microphone, placed his foot on a chair and started; his foot tapped out the tempo, the chair wiggled and wiggled closer and closer to the microphone, imperilling the equilibrium of that sacred piece of mechanism; every once in a while Ben Grauer, the announcer, would dart forward and rescue the chair, but Joshua still tapped, and the chair still wiggled, and the noise of the tapping still penetrated above his singing. Ben tried holding Joshua's foot still, but it was no good. After the program was over Joshua mourned, "Dawgone it, Mr. Grauer, when you hol' mah foot I jes can't play!" . . . So many people have written and told me how much they like the Casa Loma Orchestra playing from the Glen Island Casino. I like it myself; think it's one of the most pleasing dance orchestras on the air; the special arrangements of popular tunes are particularly intriguing. . . .

WHEN AND WHERE

Yes, Rubinoff was born in Russia. Grodna is the specific place. . . . Rudy Vallee's birthday is July 28th, and he was born in 1901. . . . The Phantom Gypsy is Lou Raderman. . . . Jerry Kilgore, NBC announcer at KFI, San Francisco, was born in Toronto, Canada. . . . Madge Tucker, the Lady Next Door, was born in Centralia, Ill., and attended schools in St. Louis and Chicago. . . . Oliver Smith, NBC's Painter of Songs, was born in Flucom, Mo., in 1896. . . . Nick Nichols, sketcher of movie stars, and the idol of youngsters who draw cartoons on nursery walls, is very popular with the young listeners of WJJD, Chicago . . . Billy Sunshine, one-man entertainer at WJJD, handles a mean paddle and wrested the ping-pong championship from Bubb Pickard in three sets. . . .

You may now hear a new series of summer programs on WABC, featuring "The Road Reporter," under the sponsorship of the Shell Eastern Petroleum Products, Inc., of New York City. This program will be presented over the Eastern chain of WABC-Columbia network. "The Road Reporter" will chat about places and events of interest to motorists and travelers, introducing dramatizations of thrilling stories from real life. Tuesday and Thursday evenings from 7.30 to 7.45 EDST. . . . Stoopnagle and Budd just love to work, so they will spend their vacation making a personal-appearance tour. . . . Vera Van, a new song personality from California, has been signed by Columbia for a series of sustaining programs. She may be heard on Saturday at 8.15 p.m., Sundays at 5.45 p.m., and Thursdays at 8.45 p.m. . . . David Ross will spend the summer in a secluded spot in Connecticut; he will commute to New York for his Old Gold and Poet's Gold programs. . . . Burns and Allen are on their way to the Coast to make another picture, stopping off here and there to make personal appearances. . . . Ted Husing, Columbia's ace sports-announcer, has begun a new series of sports comment program, heard over the WABC-Columbia network each Monday at 6.45 p.m., under the title of "Sportraits." Rather a nifty title, what! . . .

3 A WEEK FOR MILDRED BAILEY

Mildred Bailey has an augmented schedule, which I think the portly songstress deserves; instead of two-a-week, she'll now be heard on a three-a-week basis. Mondays, Wednesdays and Fridays, at 7.00 p.m., which is a star spot. She will be supported as usual by Freddie Rich's Orchestra and the Four Eton Boys. . . . Jane Froman and Howard Marsh will be co-starred on a new series of twice-weekly broadcasts over the Columbia network under the sponsorship of the Frigidaire Corporation. The first program will be heard from 10.30 to 10.45 p.m. EDST, Friday, July 14th. Subsequent programs will be broadcast on Wednesdays and Fridays at the same time. . . . And now I think it's time to call it a day, drink a nice ice cold bottle of—well, what do you think?

DIRECTED SHORT WAVES

The first of six radio programs, specially prepared for reception in South America, was put on the air by the Columbia Broadcasting System and transmitted to the Argentine and Brazil by the short-wave facilities of the Radio Corporation of America. The first program, arranged by CBS in conjunction with the Pan-American Society, was heard from 9:15 to 9:45 p.m., E.D.S.T., June 24th, with the United States Marine Band as the entertainment feature. Announcements, heard only at the opening and closing of the program, were given in English on the Columbia network in the United States, with simultaneous announcements in Spanish transmitted over the short-wave unit to South America. The broadcast was directed to the Argentine. The July 1st broadcast will be directed to Brazil, and subsequent programs to both countries simultaneously.

BALL GAME ON AIR THURSDAY

Baseball's "game of the century," in which a team of National League stars will battle an all-star American League team, will be described over the WABC-Columbia network Thursday, July 6th, beginning at 2:00 p.m., E.D.S.T., with Pat Flanagan and Johnny O'Hara, Chicago sports announcers, alternating at the microphone. The "Game of the Century" will be played in Chicago as organized baseball's contribution to A Century of Progress, and proceeds of the game will go to retired players of both leagues who are in need of financial assistance. The broadcast over Columbia will be sponsored by the Prima Brewing Company of Chicago, but since it is a charity event, the network will turn over to the retired diamond men all but the actual cost of making the pick-up. The line-ups of the two all-star teams will be based on the votes of newspaper readers in a country-wide poll.

TRADE UNITES FOR SALES BY DUAL PROGRAM

A highly organized campaign to find a new prosperity for the radio industry will be staged this Summer and Fall under the leadership and stimulus of Radio Manufacturers Association, Inc. It will consist of two parts: an intensive sales drive during the month of September, and a week of special broadcasting from October 2d to 7th, which will be known as Radio Progress Week. The organizing of the industry for cooperation in this program will begin immediately.

Earl Whitehorne, of New York, has been engaged as director of the Radio Prosperity Campaign and Radio Progress Week. The major features of the plan as detailed by Mr. Whitehorne follow:

"The radio industry, of course, has been bowed down with hard times. Sales curves disappeared in the cellar, cut-price competition destroyed profits, dealers became disheartened and public interest in the radio reached a low ebb; but the business tide is turned; general prices are rising, and public gloom is changing to confidence and optimism. Men and women are now talking about the things they want to buy, and the spending will start soon. It is this reawakening market that this campaign is to capitalize.

Many Still Unsold

"There are now approximately 6,750,000 homes using radio sets that are obsolete, and 13,000,000 homes that have no radio at all, but the radio industry cannot expect to sit back and let the returning prosperity pour new business into its lap. For every other industry is going to be out after these same dollars from the family budget. Automobiles, refrigerators, travel, clothes, and other strong personal appeals will be scrambling for attention, and John and Mary are going to buy first the thing that they have come to desire the most.

"So the radio industry is entering a season of better business with an intense competition to fight, and it is not a competition between radio manufacturers or radio distributors or dealers as in the past four years of sweat and tears. It will now be a competition with other industries that will be out energetically selling the home market. Therefore the radio industry must organize to throw its united strength into the market place, first and strongest, so that radio will be the thing that John and Mary will buy.

Owners to Be Canvassed

"The Radio Prosperity Campaign will have two objectives. First, to canvass every radio owner and put his set into condition, by installing new tubes, parts or accessories, or to replace it with a new set. Second, to convass all prospects for new receivers. Through July local committees will be organized in all cities, so that manufacturers, distributors, dealers and service men will be prepared and ready to play their part in the concerted sales drive through the month of September. The cooperation of all branches of industry in all communities will be sought, and since every manufacturer, distributor and dealer has his eye in this awakening market and plans to do his utmost anyway to increase his sales, the RMA is confident that the industry will respond enthusiastically to secure the benefit that will come from massing the strength of the industry."

TRADIOGRAMS

By J. Murray Barron

It would not necessarily follow that all advertised products are superior to non-advertised ones. What is generally called advertising covers mostly publications, newspapers, billboards and radio broadcasts. However, constantly to keep one's name before the public through advertising requires public approval, and this in turn can only be achieved through merit. Therefore it follows that it is generally safer to buy nationally advertised goods. It seems the bigger the organization the more readily it appreciates the great value of advertising and the keeping of its name before the public. Possibly that may be one reason for the bigness.

* * *

One of the latest innovations in the retail radio stores is the testing outfit that has been installed at Thor's Radio Store, at 167 Greenwich Street, New York City.

It is now possible to have even the latest tubes thoroughly tested. This outfit is the only one of its kind now in downtown New York.

* * *

RCA Victor Co., Inc., is wide awake to the great possibilities of the summer business and is breaking into a special summer campaign to aid the dealer, featuring three specials, the RCA-Victor auto radio, the five-tube superheterodyne and the combination radio-phonograph.

* * *

In the New York metropolitan section nightly good catches are reported on DX reception. This covers not only the United States, but other points on this continent and includes the broadcast band. However, there are also records during the earlier hours of foreign short-wave reception. Folk one might not suspect of being real fans are often deeply interested and they do considerable experimenting to improve their receivers and conditions over which they have control. To those who take noises and peculiar conditions for granted, it might be well to look more deeply into the matter, for a little attention here and there may repay the trouble in added reception. The local radio retail storekeeper should not attempt to take it for granted that certain types of customers would not be interested in short-wave reception, as many big business men are ardent short-wave fans.

* * *

E. F. Johnson Co., Waseca, Minn., manufacturers of radio transmitting equipment, is now represented in New York City by Howard F. Smith, 142 Liberty Street. This line includes tube sockets, feeders, spreaders, antenna insulators and stand-off insulators. Those out of town may address the company direct.

* * *

The Fanning Radio Labs., 377 Eighty-seventh Street, Brooklyn, N. Y., have in preparation a limited edition of an attractive and interesting bulletin on short-wave kits, receivers, ac-dc sets and also the new manual by Don Wallace, the winner of the Hoover Cup.

* * *

Universal Microphone Co., Inglewood, Cal., announces it has gone into production of its new hearing aid device, which will be marketed solely through radio channels, including service outlets. These new Universal devices have been created primarily for home and office use.

* * *

Drake Mfg. Co., 452 North Ashland Avenue, Chicago, has an attractive and solidly-constructed jewel light assembly. This may be used for many purposes in radio: receivers, amplifiers, remote control, etc. Those desiring more information may write direct.

COUNSEL OF RMA QUESTIONS LAW

Chicago.

Revolutionary changes now faced in industrial competition were pointed out to Radio Manufacturers' Association members at their annual convention, by John W. Van Allen, of Buffalo, N. Y., general counsel of the association.

Government control of industry is to be substituted for the anti-trust laws and involves many sweeping and fundamental problems and changed conditions, Mr. Van Allen said. He added:

"Whether we have arrived at the period when we must be governed in all respects by the government itself, or whether people shall continue to govern as they have done in the past, or whether the departure upon which it is proposed we embark, is a manifestation of the way in which people desire to govern by extended powers to officers of the federal government, is a question fraught with the deepest significance."

Mr. Van Allen said that he looked with "great apprehension on the plan to license private business" and continue it only "by favor of a politically-minded public official."

NEW OHMITE BULLETIN

The Ohmite Mfg. Co., 636 North Albany Avenue, Chicago, Ill., has issued a new eight-page Ohmite resistor and rheostat bulletin that is free.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor, RADIO WORLD, 145 *West 45th Street, New York, N. Y.*

Earl T. Reaves, R.F.D. No. 5, Box 412, Watsonville, Calif.
Irving Anderson, Jr., Box 1027, Wallace, Idaho
Radio House, 131 Manchester St., Christchurch, New ealand
L. F. Rodgers, P. O. Box 154, GooseCreek, Texas
F. D. Enwright, 43 High St., Manchester, N. H.
John McNulty, 54 O'Connor St., Wellsville, N. Y.
W. B. Johnson, 1309 E. 31st St., Savannah, Ga.
F. W. Foust, Radio Sales Service, Ashtabula, Ohio
George Oldenbittle, 2954 School St., Chicago, Ill.
Paul C. McDaniel, Faucett, Mo.
E. W. Nelson, 81 Hereford, Hartwell, Cincinnati, Ohio
Max Stamm, 1527 Louden St., Philadelphia, Pa.
Edmund J. Ryan, Franklin Park, Mass.
Harry Tice, 23 Oak St., Newburgh, N. Y.
G. H. Gaillardet, 44 Vine St., Weymouth, Mass.
Serge Krauss, 906 Lumbard St., Napoleon, Ohio
A. B. Rice, Tekamah, Nebr.
Jos. Belick, Box 133, 63 Front St., Coplay, Penna.
N. Peterson, P. O. Box 182, Riverside, Calif.
J. M. Kaar, 125 Princeton Road, Menlo Park, Calif.
M. Stakan, Y.M.C.A., Lincoln, Nebr.
Charles J. O'Gara, 674 Wulnut St., Fall River, Mass.
Chas. M. Showalter, Jr., 332 Lawrence St., Sandusky, Ohio.
Fred E. Rebhun, 1002 Fairmount Ave., Tarentum, Pa.
W. Grundman, 384 Richelieu, Quebec City, Canada.
Henry E. Greer, San Rafael, Calif.
C. C. Clayton, 310 State Line Ave., Texarkana, Ark.
Geo. L. Heyer, Arcade Radio Shop, 1310 First Ave., Seattle, Wash.
Hector Graham, 2903 Floyd Ave., Richmond, Va.
Glenn Neely, Dolgeville, N. Y.
Wm. C. Gruner, Dri-Kap Mfg. Co., 1315 So. Michigan Ave., Chicago, Ill.
Paul J. Jachim, 3941 Wellington Ave., Chicago, Ill.
Clarence Harris, R. R. A. Camby, Ind.
A. J. Young, Bluefield, W. Va.
H. W. Hendricks, Columbus Junction, R. 2, Iowa.
O. W. Wendelburgh, care The Union Trust Co., Cleveland, Ohio.
A. R. Lebsack, Otis, Kans.
H. Walter Witt, care Linz Bros., Dallas, Tex.
E. H. Oliver, P. O. Box No. 178, Vinton, Va.
George J. Hucks, 1289 Church St., San Francisco, Calif.
J. R. Powers, 2339 Hondo St., Dallas, Texas.
Hugh W. Harrison, P. O. Box 377, Kimberley, South Africa.

DIAMOND PARTS

Tuned Radio Frequency Sets

FIVE-TUBE MODEL

A-C operated circuit, 50-60 cycles, 105-120 volts, using two 58 t-r-f stages, 57 power detector and 47 output, with '80 rectifier. Three gang shielded condenser and shielded coils in a sensitive, selective and pure-tone circuit. Dynamic speaker field coil used as B supply choke. Complete kit of parts, including 8" Rola speaker and all else (except tubes and cabinet). Cat. D5CK @..........$15.69
Wired model, Cat. D5CW (less cabinet) @.... 17.19

Kit of five Eveready-Raytheon tubes for this circuit. Cat. D5T 4.97

FOUNDATION UNIT, consisting of drilled metal subpanel, 13¾ x 8⅝ x 2¼"; three-gang Scovill 0.00035 mfd., brass plates, trimmers, full shield; shields for the 58 and 57 tubes; six sockets (one for speaker plug); two 8 mfd. electrolytic condensers; set of three coils. Cat. D5FU........$6.19

Super Diamond parts in stock.

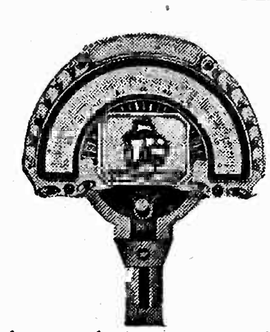
FOUR-TUBE MODEL

The four-tube model is similar, except that there is one stage of t-r-f, and a two-gang condenser is used. Tubes required, one 58, one 57, one 47 and one '80. Complete kit, including 8" Rola dynamic speaker (less tubes, less cabinet). Cat. D4CK $13.58

Kit of four Eveready-Raytheon tubes for this circiut. Cat. 4D.TK $3.89

FOUNDATION UNIT, consisting of drilled metal plated subpanel 13¾ x 2¼ x 7"; two-gang 0.00035 mfd. SFL condenser; full shield; two shields for 58-57; center-tapped 200-turn honeycomb coil; five sockets (one for speaker plug); two 8 mfd. electrolytics; set of two shielded coils; 20-100 mmfd. Hammarlund equalizer for antenna series condenser. Cat. D4FU $5.48

INDIVIDUAL PARTS



Travelling light vernier dial, full-vision, 6-to-1 vernier, projected indication prevents parallax; takes ¼" or ⅜" shaft; dial, bracket, lamp, escutcheon.

0-100 for 5-tube Diamond, Cat. CRD-0, @ $.91.

100-0 for 4-tube Diamond, Cat. CRD-100, @ $0.91.

[If dial is desired for other circuits state whether condenser closes to the left or to the right.]

8 mfd. Polymet electrolytic, insulating washers, extra lug. Cat. POLY-8 @..................$ .49
Rola 8" dynamic for 47 with 1800 ohm field coil tapped @ 300 ohms. Cat. FP @.......... 3.83
2 coils for 4-tube. Cat. DP @................. .90
3 coils for 5-tube. Cat. DT @.................. 1.35

DIRECT RADIO CO.

143 WEST 45th STREET
NEW YORK, N. Y.

TROUBLE SHOOTER'S MANUAL, Nos. I and II

Having assembled 2,000 diagrams of commercial receivers, power amplifiers, converters, etc., in 1,200 pages of Volume No. 1 of his Perpetual Trouble Shooter's Manual, John F. Rider, noted radio engineer, has prepared Volume No. 2 on an even more detailed scale, covering all the latest receivers. Volume No. 2 does not duplicate diagrams in Volume No. 1, but contains only new, additional diagrams, and a new all-inclusive information on the circuits covered.

Volume No. 2—Perpetual Trouble Shooter's Manual, by John F. Rider, Shipping weight 6 lbs. Order Cat. RM-VT @..........................$5.00
Volume No. 1 (8 lbs.). Order Cat. RM-VO @..$5.00

We pay postage in United States on receipt of purchase price with order. Canadian, Mexican and other foreign remittances must be in funds payable in New York.

RADIO WORLD
145 West 45th Street New York City

115 DIAGRAMS FREE

115 Circuit Diagrams of Commercial Receivers and Power Supplies supplementing the diagrams in John F. Rider's "Trouble Shooter's Manual." These schematic diagrams of factory-made receivers, giving the manufacturer's name and model number on each diagram, include the MOST IMPORTANT SCREEN GRID RECEIVERS.

The 115 diagrams, each in black and white, on sheets 8½ x 11 inches, punched with three standard holes for loose-leaf binding, constitute a supplement that must be obtained by all possessors of "Trouble Shooter's Manual," to make the manual complete

Circuits include Bosch 54 D. C. screen grid; Balkite Model F. Crosley 20, 21, 22 screen grid; Eveready series 50 screen grid; Erla 224 A.C. screen grid; Peerless Electrostatic series; Philco 76 screen grid.

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Works on 110-120 volts AC or DC, power, 50 watts. A serviceable iron, with copper tip, 5 ft. cable and male plug. Send $1.50 for 13 weeks' subscription for Radio World and get these free! Please state if you are renewing existing subscription.

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SALE OR TRADE: Early tubes suitable for radio museum or exhibit; also early National parts and miscellaneous. Box 965, Plainfield, N. J.

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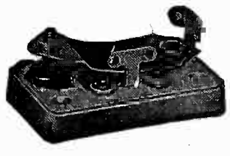

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The First and Only National Radio Weekly
TWELFTH YEAR

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Practical Push-Pull Resistance Couplers

DIODE DETECTION, WITH BOTH THE REACTIVE AND NON-REACTIVE LINKS—THEORY OF DIRECT-COUPLED SYMMETRICAL CIRCUITS

By Herman Bernard

PUSH-PULL resistance-coupled audio is one of the several topics in radio concerning which theoretical aspects have been treated over a period of years, with some reduction to practice, but without the production of any circuit regarded as standard, or, indeed, any circuit which is used much at all. There are practically no receivers with such a circuit. Yet, like television, ultra-wave DX and other topics in the same hopeful class, the push-pull resistance coupler is bound to arrive at a commercially practical stage. Besides, it gives experimenters meanwhile an opportunity to pursue a hobby that offers interesting possibilities.

Push-pull resistance-coupled audio, as considered in this text, relates to the development of the push-pull circuit without the introduction of an input transformer. It is familiar practice to have a push-pull input transformer working out of a normal detector and have the succeeding stages push-pull resistance-coupled, but such a circuit is not considered within the true category because the use of resistance coupling should be exclusive.

Omission of Stopping Condensers

Besides the foregoing considerations, one might bear in mind that true push-pull resistance coupling may be developed in leak-condenser coupling hookups, which are reactive, or in circuits that omit the stopping condensers, and are called non-reactive. The term non-reactive means, in effect, equality of amplification for all

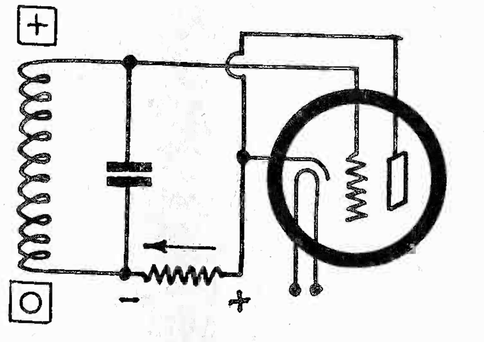


FIG. 1

The 56 used as a diode will stand 40 volts rms input. Diagram shows anode positive to a-c (sign in square), while direction of d-c current flow and d-c polarities of load resistor are designated.

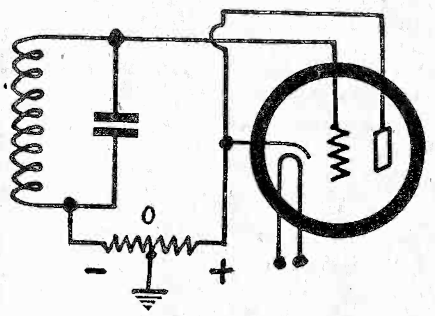


FIG. 2

The direct current through the load resistor is pulsating, so if the center of the resistor is taken as the reference point, at any instant the extremes have equal but opposite signs.

audio frequencies, which is true when a load is a pure resistance.

In actual practice true non-reaction is hardly possible, as effects are to be expected from unavoidable capacities, including even the elemental capacities of tubes used, capacity between wire connectors and capacity to metal chassis. These capacities, though small in quantity, are large in effect because of shunting of high tube or load impedances by small condensers. Nevertheless a circuit will be considered non-reactive if it omits the stopping condensers.

To realize the problem of push-pull resistance coupling we must understand the rectification fundamental. A typical rectifier is shown in Fig. 1, consisting of a 56 tube used as diode, plate tied to cathode, this combination constituting the operating cathode, while the element that otherwise would be grid is the operating anode. The object of the rectifier is to

(*Continued on next page*)

These Four Circuits Work All Right

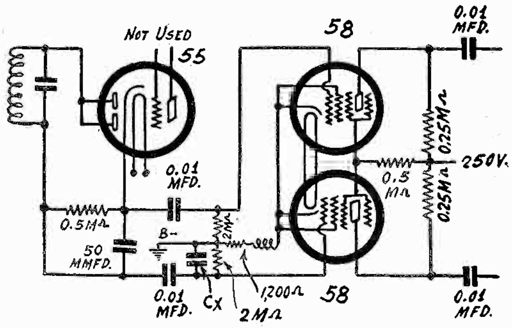


FIG. 3

This is a practical push-pull resistance-coupled circuit, using stopping condensers and grid leaks. The center of the load resistor may be grounded, if desired, but it is not strictly necessary, due to the subsequent leaks as parallel resistors with grounded center, the effect on the signal division being reflected back. Stopping condensers and grid leaks are used. This is a reactive circuit, that is, frequency affects the amount of gain somewhat. The 58's will drive 2A3 output tubes.

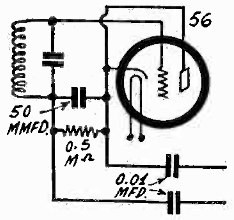


FIG. 4

The 56 used as a diode, with plate tied to cathode to constitute the operating cathode, and otherwise grid is anode.

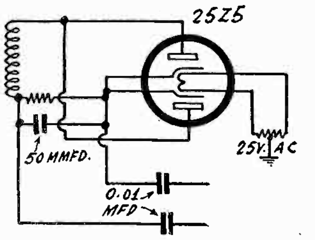


FIG. 5

The 25Z5 used as a half-wave rectifier. This tube requires a 25-volt feed to the heater. The 50 mmfd. condenser across the load resistor may not be necessary here or in Figs. 3 and 4.

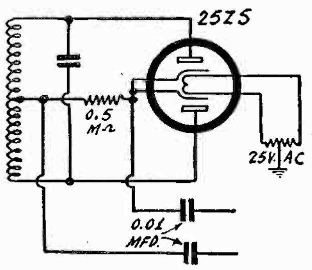


FIG. 6

Here full-wave detection, using the 25Z5, is illustrated, the circuit after the stopping condensers again being as in Fig. 3. By the full-wave method only half the voltage is achieved as by the half-wave rectifier.

(*Continued from preceding page*)
produce a direct-current output from an alternating-current input. The alternating current in this instance is radio frequency and in this sense all frequencies from the highest used in carrier radiation, to 20 kc, may be considered as radio frequencies.

Rectification Requisites

The alternating voltage in the primary of the transformer develops a voltage across the secondary. We are interested only in voltage except in power output tubes. Since it is alternating, no point along the secondary ever remains at any given voltage, but there is a fluctuation, measured in multiple cycles per second. During each cycle the voltage rises twice to maximum and falls twice to zero. The two maxima, however, are oppositely polarized during any cycle. Zero naturally is the same for both, being an identical quantity. Therefore the upper end of the coil will be negative maximum and positive maximum once each cycle.

The following are requisites for rectification: (1), an alternating-voltage input; (2), a positive anode; (3), a device capable of rectification; (4), a continuous direct-current path. Besides there must be a load to render practical the utilization of the rectification.

We have the a.c. The positive anode occurs once in each cycle, so we have that. The tube will rectify. A continuous current path is provided because the tube impedance is low, sufficient direct current can flow through it, and there is no discontinuity in any part of the external circuit. A load resistor is provided.

Half-wave Type

The rectifier in Fig. 1 is of the half-wave type, because rectification takes place only when the anode is positive, and it is positive only during half the wave period. On the diagram the alternating current signs are in squares, and the anode is shown as positive, bottom end of coil as zero, both a-c values.

The positive a-c sign does not represent a constant value of voltage, but during the alternation when the anode is positive it is so by the effective quantity of a-c voltage. This is obtained by taking the square root of the sum of the squares of the positive voltages during the alternation and is the familiar root-meant-square voltage (rms.).

Now that we have accomplished rectification we have to consider the flow of the new current, which is direct current. There may be residual fluctuation in the d-c, but a condenser will remove it. Although a-c flows in two directions, d-c flows in only one direction. That is, d-c does not reverse itself.

Direction of Flow

The direction of current flow in an external circuit of a rectifier is from cathode to anode and takes place only when the a-c is at a positive value on the anode. The signs ascribed to this direction are inherited from the earlier and erroneous theory of electricity, but because embedded in the recorded science, are still retained. We say therefore that in the external circuit the current flows from plus to minus. Inside the rectifier it flows from minus to plus, for that is in reality the same direction.

Take a clock as example, turn the hour hand through 360 degrees, starting at 9. The rotation is from left to right, until 3 is reached, when the direction is from right to left, and yet there has been only one actual direction, that of clockwise. The wheels of an automobile are always turning in the same direction at the same time, though by applying some other test, as left-and-right based on an arbitrary zero line, the same anomaly exists as in the case of direction of current flow in a rectifier and its external circuit.

Action During Positive Cycle

Taking the two extreme instances in the rectifier, when anode is positive and when it is negative, we know that rectification takes place only when the a-c voltage on the anode is positive, whereupon d-c flows in a known direction, but what happens when the anode is negative? Since no rectification takes place, nothing happens. The circuit is dead on the negative a-c alternation, just as if the rectifier tube were removed from its socket during each negative excursion of the carrier.

Broadly, there are two frequencies to consider, the radio-frequency carrier and the modulation of that carrier by the signal, hence the object of the form of rectification used on the carrier, called detection, is to eliminate the carrier and leave only the modulation or signal. When signal is referred to, audio frequencies are meant. When carrier is referred to, radio frequencies are meant. The fact that the modulation is impressed on the carrier need not prove confusing, since the effect is to change the frequency or amplitude of the carrier, which is a radio frequency, even though the rate of change may be at an audio frequency. At least the carrier, modulated or not, is inaudible. The detected component of a modulated carrier is audible to a suitable load.

Signs of the Circuits

The two signs for alternating current and the two for direct current in Fig. 1 have no intrinsic relationship whatever. For instance, the zero point for a-c at a given instant when there is rectification is the same point as negative of the rectifier. The secondary is a short circuit to d-c, therefore the point marked positive for radio frequencies (denoted by sign in square) is negative for audio frequencies, being the same for d-c at one end of the coil as at the other. The d-c signs are not circumscribed. They denote the polarities during rectification. The arrow shows the direction of d-c flow.

How far have we progressed toward push-pull resistance coupling? We have reduced a carrier to direct current and have a permanent d-c positive sign at one end of the load resistor and a permanent negative sign at the other end of the load resistor, for all purposes during full-wave or half-wave rectification, and permanent zero signs during non-rectification.

An Author's Contention

We have considered direct current, but not in its true light as existing in the circuit for detection of broadcasts. It is true that the current is unidirectional, but it is also true that direct current may be continuous or discontinuous. We found discontinuity during the alternation when

Two of These Are Duds and Two Ace-High

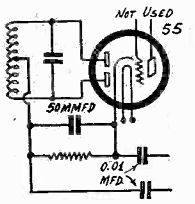


FIG. 7
Full-wave detection, using the 55. The triode elements can not be used, as there is no suitable method of making the B voltage effective without unbalancing the circuit.

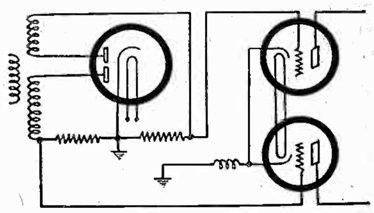


FIG. 8
Considering the omission of stopping condensers as constituting non-reactive coupling, a circuit like this might represent a first attempt. Either the driven tubes have simultaneously negative grids or alternately negative grids, neither instance representing symmetry.

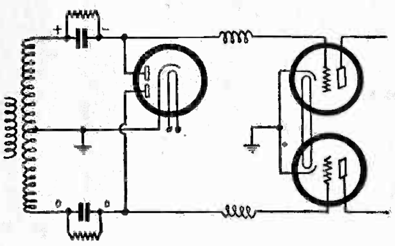


FIG. 9
The danger in non-reactive coupling is that one grid may be driven positive. When the upper diode is conducting the upper driven grid is negative, but the lower driven grid has zero bias, because grid is returned to grounded cathode through a non-current-carrying circuit.

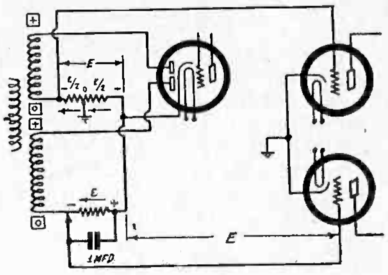


FIG. 10
A true push-pull resistance-coupled circuit. The d-c voltage across the load resistor (upper diode) is divided, center of the resistor grounded, and when negative signal cycles are applied to the upper driven grid positive ones, with bias suitably bucked, are applied to the lower driven grid.

the anode was negative. Likewise, though continuous, it may be steady, or unsteady. If it is unsteady it is called pulsating, and this is the type of direct current existing in detector outputs. The pulses are equivalent to amplitude changes in the steady state of d-c, and these changes are patterned by the original audio frequencies as put into the microphone at the station.

It is the author's contention that in a vacuum tube with only a resistive load in the plate circuit, or output circuit, there is never any alternating current but that there is pulsating direct current, and any presence of alternating current would be due only to a coil in the plate circuit, where reincarnation of a-c is effected by the electro-magnetism.

Whenever we have an a-c voltage or a pulsating d-c voltage across a load we may select the center of the load as the datum or reference point and then the push-pull effect is introduced if we take off the output from the extremes, for the voltages at any instant at these extremes will be equal in quantity but directly opposite in sign. Thus, in Fig. 2 the center point may be taken as zero. The left-hand branch would change from zero to negative maximum and then the right-hand branch from zero to maximum positive. It may be argued that the mid-point is not zero, but half of the maximum, but zero is an arbitrary point, and the termination of the impedance into which the whole works decides the zero point.

A Practical Circuit

So far we have the possibility of a push-pull input, using no transformer but simply a resistor. Now we shall introduce the method in a practical circuit, Fig. 3, and observe precautions that experience has taught.

The load resistor is 0.5 meg. and across it is a small condenser, 50 mmfd. This condenser is not always necessary, as there is usually sufficient inherent capacity to bypass the residual ripple. Two stopping condensers are used, 0.01 mfd. each, or larger, one connected from the coil side of the 0.5 meg. resistor to grid of the succeeding stage, the other connected from cathode of the diode to grid of the succeeding stage. Two grid leaks are used, 2 meg. or higher resistance, from respective grids to grounded B minus. It is therefore not necessary directly to ground the center of the diode load resistor, for since the grid leaks are in parallel with that load, grounding the center or common point in the leak circuit will suffice. A biasing resistor of 1,200 ohms will do for the two 58's, an r-f choke of 10 mlh. or higher inductance being used to help kill off r-f oscillation that otherwise might be present. If there is still oscillation, additional similar chokes would have to be used between each grid and its grid leak. The output is to be connected to the resistance-loaded grid circuits of push-pull power tubes.

Why the Stopping Condensers

The reason for including the stopping condensers is that the direct connection of one of the grids (upper in Fig. 3) would result in a positive grid. That is, the change would be by from zero bias to positive bias. A way of overcoming this would be to introduce an additional rectifier to buck out the positive bias, as was suggested by J. E. Anderson in the January 21st issue, 1933.

Instead of the 55 the 56 may be used as diode for the Fig. 3 circuit, as shown in Fig. 4, or the 25Z5 as in Fig. 5. These are half-wave rectifiers. For full-wave rectification the circuits are shown in Fig. 6 for the 25Z5 and Fig. 7 for the 55, of which the triode is rendered useless because of unbalance if B voltage is applied. Following the rectifiers there would be the same sort of circuit as in Fig. 3, and of course in addition the power stage would be included, biased as usual.

In connection with all of the foregoing circuits it will be found that the capacity to ground is unequal in the two legs, as represented by the leaks, or, if the load resistor of the diode is grounded at center, by one leg of that load. In general the capacity to ground on the cathode side is larger, and on the other side is compensated for by the additional capacity Cx, in Fig. 3.

Cx for All Circuits

Cx should be included in all circuits. It should be put on the side that results in appreciable increase in signal intensity. While the capacity value is not extremely critical, for fine adjustment it would be necessary to measure the capacity across each leg, and make up for the deficiency in the one leg. This measurement may be made with any oscillator having a known inductance and generating a known frequency. The tuning condenser capacity can be obtained by computation for this frequency, and the capacity for the new frequency likewise obtained when one and the other legs of the push-pull circuit are used in parallel with the tuning condenser. When the two differences are obtained the smaller is substracted from the larger, and the final difference is introduced across the smaller to equalize the capacity. All computation may be avoided by consulting "The Inductance Authority," a recent book by Edward M. Shiepe.

So far we have used stopping condensers and considered only half-wave rectifiers. Now let us see what can be accomplished if the condensers are omitted.

A Faulty Circuit

Fig. 8 shows the omission of the stopping condensers, but this is the same situation previously discussed as impossible, because of the positive bias on one of the grids. In direct non-reactive coupling the bias on the succeeding tube may be only that arising from the d-c flow in the carrier-rectified circuit, this being known as diode biasing. Obviously positive biasing of the grid is out of the question.

In Fig. 7 when the lower anode is positive to r.f. the left-hand resistor carries d-c, positive at cathode, negative at the other end of the resistor, so negative may be connected to grid of a following tube. If the upper anode is positive to r.f. at the same time, then the grid of the other tube may be connected to negative side of the second load resistor, to right. However, both grids are negative at the same instant, so the circuit is not push-pull. Let us reverse one of the coils. When one anode is positive the other is negative, so when one diode is conducting the other is not conducting, and the upper grid is positive. The circuit won't work.

(*Continued on next page*)

(*Continued from preceding page*)

What is required is that one grid be swung negative at one instant and the other grid be swung equally positive at the same time, but that the bias should not run positive.

Another Try

The more or less arbitrary designation of polarities makes it difficult sometimes to comprehend the aim, but if it is remembered that the requirements consist of making one tube at a time handle the load, without grid of either going positive, the fulfillment can be better gauged.

Using a conventional center-tapped secondary, the non-reactive method may be considered with the load resistors in the negative leg, Fig. 9. Center is connected to cathode and grounded. Also cathodes of the succeeding pair of tubes are grounded. Some question may arise as to where the positive voltage is. The answer is that the cathode is the positive and that the anode ends of the resistors are alternately zero and negative, so the grids of the pair of tubes after the rectifier, if tied to respective anodes, share the work alternately and equally during each cycle. To prevent the detection being communicated to the pair of tubes at right in Fig. 9 large radio-frequency chokes are used, 25 mlh, or greater inductance, and to enable the anodes to be polarized by r.f. large enough bypass condensers have to be used across the individual load resistors.

Not So Hot

A somewhat greater departure from non-reaction results because the condensers across the load resistors have to be large enough not to attenuate the input to the anodes, and the larger they are the more the circuit departs from non-reaction. Also the chokes have to be large enough to prevent any considerable amount of r.f. getting into the first audio tubes. The associated circuit and tubes have to be shielded and even the grid leads to overhead caps of the 58's shielded and shield sheath grounded. Otherwise there will be r.f. oscillation. To avoid excessive attenuation due to the resistance loads the resistors have to be considerably smaller than usual.

In this circuit full-wave rectification is used. One diode-to-cathode circuit rectifies at a time. The object is to avoid a positive grid. Let us see if this is accomplished. When the upper diode is conducting the resistor is negative at anode and positive toward cathode. Grid is connected to negative. All right so far. During the time the upper diode is rectifying the lower one is idling. The grid of the companion succeeding tube is connected to the plate of the lower diode.

If the lower section of the diode is not conducting, then any voltage arising will be in accordance with the upper diode, for this is when the positive-grid danger arises for the lower tube. Tracing the lower tube's d-c circuit, grid is connected to one diode anode through a choke and returns to ground through the lower half of the secondary. Since the grid voltage is that between cathode and grid, and since cathode is grounded and grid goes through a no-current circuit to ground, grid is grounded, and there is zero bias, but no positive grid. But there is no symmetry, no push-pull.

More Likely Circuit

To achieve push-pull it is necessary that when one grid is negative in respect to the signal the other is positive. We have avoided a positively-biased grid but we have not provided opposite signs at the grids at any instant, as no positive signal region is provided.

In Fig. 10 is shown a circuit that subscribes to the requirements. It is a half-wave diode detector, across which is developed the d-c voltage E when the upper anode is positive to radio frequencies. The center of this resistor is grounded, and as the cathodes of the succeeding pair of tubes are grounded, half the voltage across E is put into the upper driven tube. However, since half-wave detection develops twice the voltage of full-wave, by taking off half from the half-wave type we still have the same amount of signal voltage for the driven stage as if all the voltage from a full-wave circuit were used.

The midpoint may be taken as zero, so when the upper anode is conducting there is a condition across the resistor which develops opposite signs at the extremes. The left-hand end is put into the grid of the upper tube following, and being always negative, the tube is diode-biased exclusively, in the familiar manner, and the bias is equal to the signal voltage.

The Stumbling Block

The lower driven tube is the stumbling block. If its grid were returned to positive of the load resistor in the upper rectifying circuit, when the upper grid is negative the lower one is positive to an equal amount, considering the signal only. But considering also the d-c bias effect of the voltage, when the upper grid is $-E/2$ the lower grid is $+E/2$, whereas there should be a bucking bias introduced in the lower driven tube to keep its grid away from possibility of positive bias.

If we use the lower diode of the 55 as additional rectifier, operating in phase with the other, we can introduce a varying bucking bias that is proportional to the diode-bias above, and we have only to find out what that bucking bias should be and how to insure it. The total voltage in the upper rectifier is E, the input to the upper driven tube is $-E/2$, the unchecked condition of the lower driven grid is $+E/2$, which is a difference of E between grids, and therefore the bucking bias should be equal to E also, so that the biases on the two driven tubes will be the same at any instant.

Bias Adjusted

There is the signal to consider. There may be a little radio frequency in the load resistor of the upper rectifier, which a condenser will remove, as stated, and shown in Fig. 1, etc. In the bucking-bias circuit we do not desire any signal whatsoever, therefore put a large condenser across the load resistor in that circuit, 1 mfd. Thus a bucking bias is present that is always twice the value of the positive bias that otherwise would result from the signal alone. So the static operating condition of the lower driven tube is $-E+E/2$, or $-E/2$, and that is exactly the static operating condition of the upper driven tube. Thus as the positive cycle of the signal is applied to the grid of the lower driven tube the 1 mfd. condenser bypasses the signal to the grid, and the condition of equal but opposite voltages is achieved and "equal and equal" bias safeguarded.

An adjustment is necessary, and the bucking resistor is therefore made variable.

The transformer is predominantly used in push-pull audio circuits because no adjustment is necessary, the gain is generally greater and the servicing is easier. Such inclusion is more expensive as to parts but less expensive as to testing and adjustment, so that from a broad cost viewpoint the two may be considered about equal.

Servicing is very important, and the inclusion of the transformer simplifies this greatly. Few service men would have the equipment necessary to balance a resistance-coupled push-pull circuit, and possibly not many of them would be equipped with the technical knowledge, not that deep knowledge is required, but that there have been little data available to them. Hence the current articles, as well as previous papers in these columns, will prove of considerable assistance to those desiring to familiarize themselves both theoretically and empirically with this interesting circuit.

Other Circuits

The realm of push-pull resistance coupling is very large, and other circuits than those discussed this week may be used to advantage. Nothing has been written up this week about the phase-shifting tube, but the possibilities in that direction are inviting, rather, however, from the viewpoint of the reactive coupler.

One idea is to use the triode of the 55 or other such tube as the phase shifter, then have push-pull drivers and push-pull output. The 53, being two equal tubes in one envelope, may be used so that one of the tubes is a phase-shifter. Some experiments made with this tube in this manner have not proved successful enough. However, all the circuits shown this week, including those that are fallacious, have been tried out. Those stated as working do work and those stated as not working, while producing a signal, create considerable distortion, and are not even theoretically acceptable.

The increase in the amount of amplification ahead of the audio channel, which has been going on steadily for several years, makes for the reduction in the amount of audio amplification, so that there are many circuits that have the detector feeding directly into the power tube.

Can Drive Triode Output

Generally this consists of a screen grid detector driving a pentode output tube, in smaller sets, but there is no reason why, with higher r-f and i-f gain in larger sets, the detector can not be made to swing the output tube or tubes, provided that the detector will stand the 50 or 60 volts necessary to load up the output.

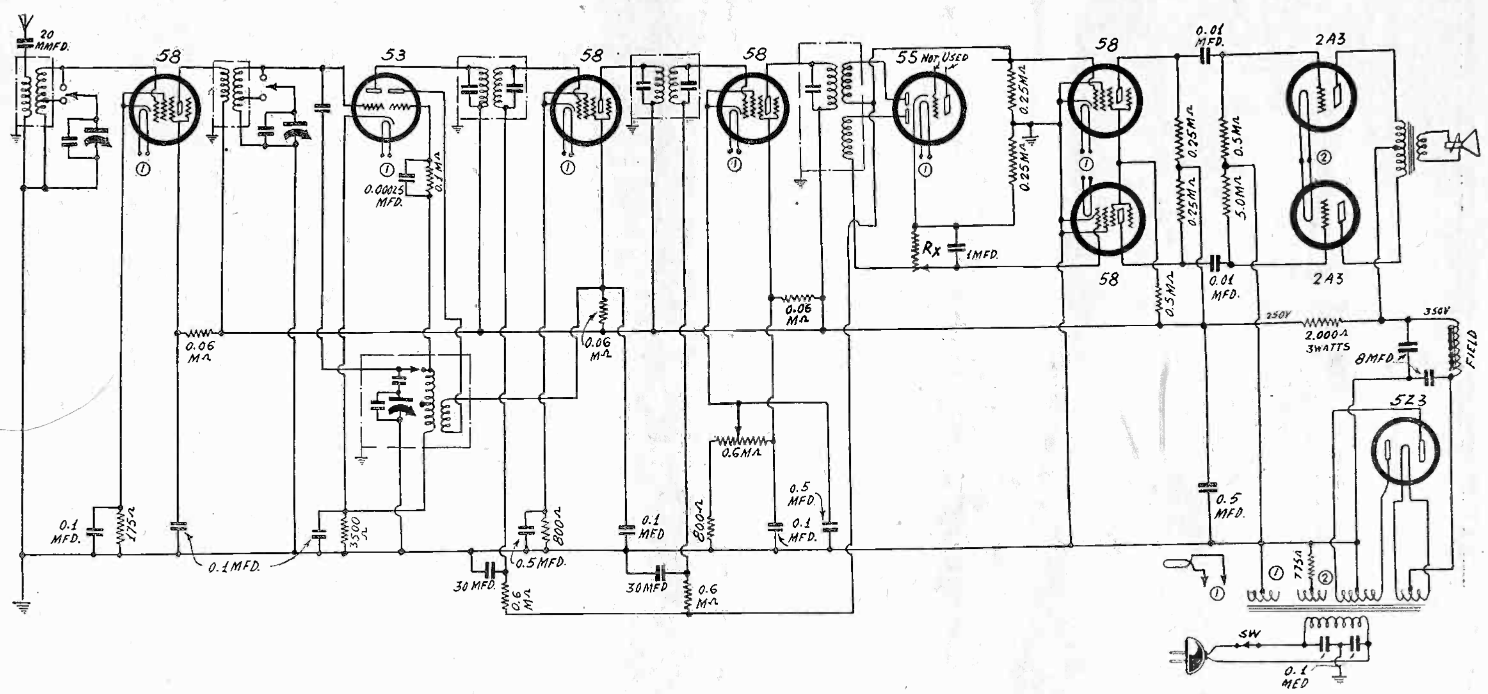
While the diodes of the duplex-diode-triode tubes will not fulfill this requirement, the rectifiers used for B supplies of course will. There are two considerations: the capacity of the tube elements should not be high, and also, for hum reasons, the rectifier should be of the indirectly-heated cathode type. Therefore diagrams show the 25Z5 used in this way.

Heater Rectifiers

There is also a 6.3-volt half-wave rectifier heater type tube, the 1-v, and a 12.5-volt half-wave heater type rectifier, 12Z3, concerning which some data will be found on page 11. Any one of these may be used. At present they are the only heater type rectifiers. The 1-v and the 12Z3 may be used only for half-wave rectification, the 25Z5 for either half-wave or full-wave.

A 10-TUBE SUPER

With True Push-Pull Resistance-Coupled Audio



One of the anodes of the 55 is used as the separate rectifier to supply a bucking bias to the lower driven 58, the grid of which otherwise would run positive. The grid and plate of the 55 triode are not used because the cathode has to be "left in the air" to support the push-pull circuit.

THE true push-pull resistance-coupled audio amplifier described in the foregoing pages is included in the complete receiver design shown above. Except for the 53 mixer tube, the circuit ahead of the detector is conventional.

The reason for the small series condenser in the aerial circuit is to improve selectivity ahead of the modulator. Only a three-gang condenser is used, therefore, as one section tunes the oscillator and another the modulator, the remaining one is for the t-r-f stage. One such stage without loose coupling between antenna and tuned winding would result in some squeals. These are absent when the selectivity ahead of the modulator is raised high enough, and loose coupling is one of the easiest and most effective ways of doing this, even though the input is reduced somewhat. If larger input, consistent with some squeals, is more satisfactory, the condenser may be made larger.

The 53 as a mixer has not been used much, but works well, when the operating conditions are right. It is critical, in that it will not work at all unless the voltages are right. Thus it resembles the 2B7 tube to this extent. It is advisable to have a low plate voltage, and this may be obtained from the screen of the first intermediate tube.

Tests of Biasing Resistor

The oscillator grid leak, shown as 0.1 meg., and the biasing resistor, marked 3,500 ohms, are critical. Since oscillator grid is returned to cathode, the oscillator bias depends on grid current through the leak. Hence both the leak value and the bias affect the operation, and in actual practice 3,100 ohms proved excellent, but various resistors around that value, say, 3,000 to 3,500 ohms coding, had to be tested before one was found of exactly the desired value.

The two intermediate tubes are subject to automatic volume control, and the filter circuits are shown with very large electrolytic condensers across the resistors (30 mfd. across 0.6 meg.). The reason for specifying the large capacity is that sometimes its inclusion boosts volume considerably. In other instances it does not, and if it doesn't, use 0.1 mfd. or somewhat higher capacity, but it is well first to try the very high electrolytic capacities, which come in small containers, about as long as your finger and twice its diameter. There is greater volume if the electrolytics in this circuit are connected in the a.v.c. filter with positive to a chassis and negative to the resistor.

There should be no trouble in the tuner, as it is familiar and besides follows authenticated lines. Neither should there be any trouble in the succeeding part of the receiver if directions are followed.

Fixing Up One Coil

Perhaps it is just as well to build the audio circuit as shown and try it out. To accomplish the construction with parts normally obtainable it is necessary to get a center-tapped intermediate coil, remove the interconnection of the two wires that create the center, so that you have two separate coils, both fed from the same primary, and also to remove the tuning condenser that was across the center-tapped secondary. This condenser removal consists merely of unsoldering the connections, or one of the connections, if the condenser is used as a surpporting bracket for the coil, as is true in some assemblies. Now you have a coil with the required three windings and the secondaries are connected with beginning of one coil to anode, beginning of other to anode, and ends to loads. Select your own "beginning."

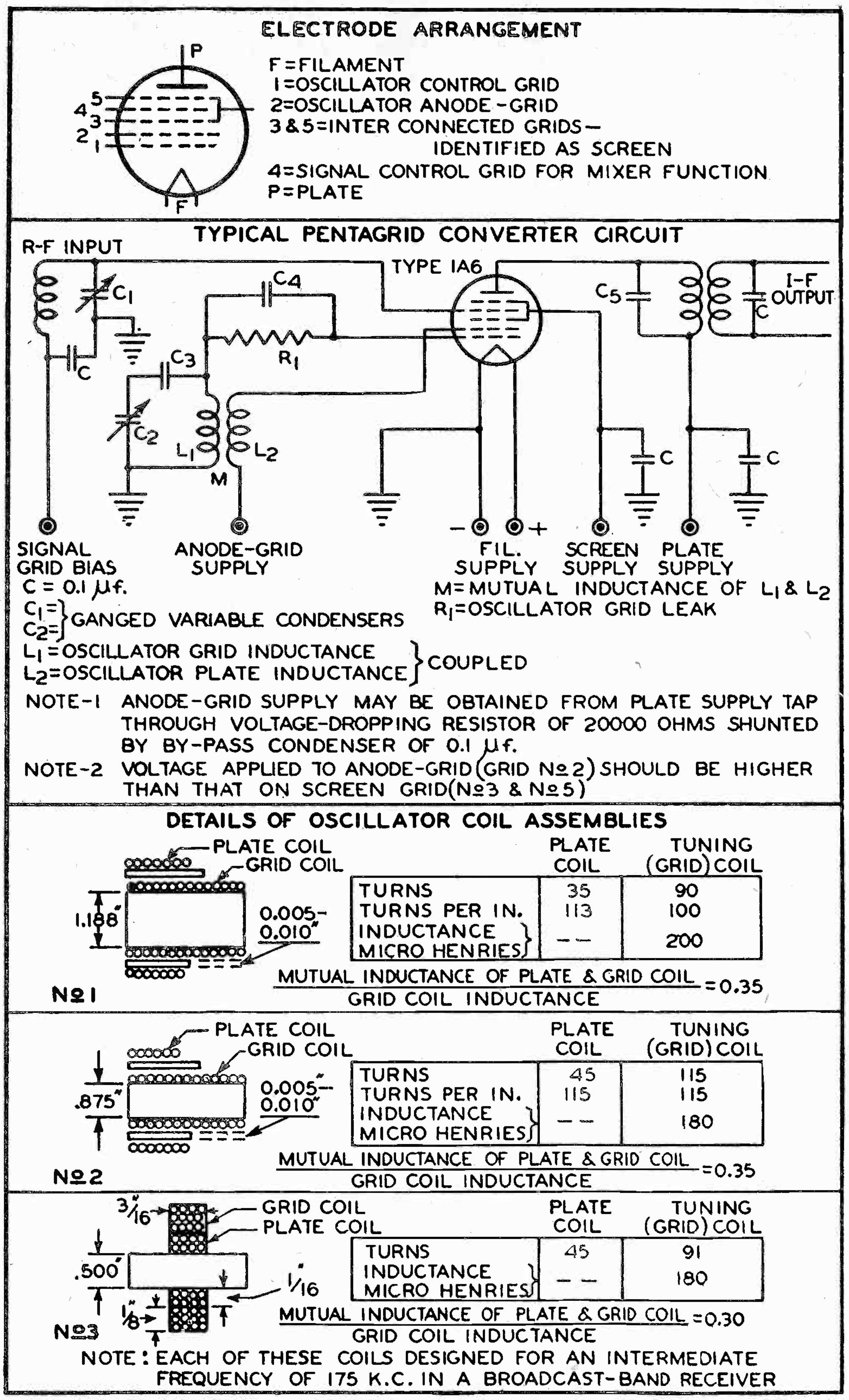
Unfortunately, the ratio is not favorable, as the input to each diode is only half of what it could be if each separate secondary had twice the number of turns it now has, that is, each had the same number as the primary. This is not a serious drawback, however, for trial of the circuit, but merely results in somewhat less quantity of sound than one might expect without knowing a cause of this reduction.

It would be advisable to have the winding serving the lower diode somewhat more closely coupled to the primary than is the other secondary, if this is practical in the coil assembly, because the voltage will tend to lag in the lower branch, where it is preferable to have it higher so that it may be adjusted to equal the other.

The audio resistors used should be measured and equal values included. This applies particularly to the 0.25 meg. and 5.0 meg. values. Then the resistor Rx, which may be 0.5 meg., is adjusted until the same plate current flows through each 0.25 meg. in the 58 circuit, when a steady-modulated oscillation is put into the antenna. This means that broadcasting stations may not be used for the test but a single-tone-modulated test oscillator should be.

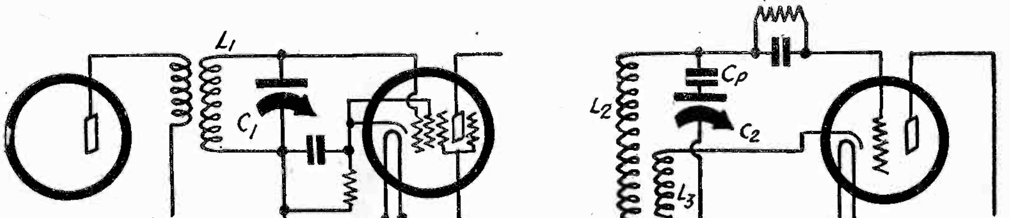
Hot Resistor Test

In the absence of instruments or knowledge about devising testing methods additional to what has been suggested, one may simply feel the 0.25 meg, resistors in the 58 plate circuits. The one in the upper branch can't be troublesome, so judge by it. Feel the other one. If it is perceptibly hotter there is grid current in the plate circuit of the lower 58, so use more of Rx, or, if fixed values are being used, include a higher resistance for Rx.



A typical circuit for the 1A6, with notation of socket connections. Details are given for oscillator coil assemblies.

Cathode Feedback in Oscillator



A modulator circuit, as at left, may be coupled with a local oscillator in a superheterodyne where the feedback winding in the oscillator is through the cathode circuit (right).

HOW T

Pentagrid Co

THE type 1A6 tube is a pentagrid converter designed primarily for use as a combined oscillator and mixer in battery-operated superheterodyne receivers. The 1A6 possesses many operating advantages over the oscillator-mixer combinations hitherto employed for battery-operated superheterodynes. Among these advantages are: Economy in A current drain, greater operating stability, higher and more uniform translation gain, volume-control effectiveness comparable with that of a super-control amplifier in an i-f stage, reduction or elimination of the intercoupling effect between the signal and the oscillator circuit, almost entire elimination of radiation from the local oscillator, simplicity of oscillator circuit adjustment, and economy in chassis space requirements.

Resembling the 2A7 and 6A7 in both function and operation, the 1A6 is subject to the same general operating requirements as those applying to other pentagrid converters. The circuit shows a desirable arrangement for the 1A6. An explanation of the various circuit elements is included.

Coupling Between Units

The design of a superheterodyne receiver employing the 1A6 is conventional. There are no unusual features which must be taken into consideration. The r-f input circuit, the i-f transformers, and the gang-tuning condensers are designed in the usual manner. No data are given in this note on the design of these parts, since they will vary greatly with the intermediate frequency used and the frequency band to be covered by the receiver.

In designing oscillator coils for the 1A6, the coupling between oscillator grid-coil and oscillator anode-coil should be slightly greater than that commonly used with triode oscillators. Tests have shown that for the 1A6 the ratio of M/L (the mutual inductance M between the oscillator anode-coil and the oscillator grid-tuning-coil to the inductance L of the oscillator grid-tuning-coil) should be approximately 0.35.

Higher values of coupling than that obtained with the above ratio may cause difficulty in tracking the oscillator frequency with the signal frequency, while lower values of coupling will result in reduced translation gain.

The diagrams show details for the construction of three oscillator coils designed to give good results with the 1A6. There are no unusual features involved in the design or construction of these coils. Two methods of construction are shown to enable the designer to choose the coil form better suited to his space requirements. Each of the three coils shown has an M/L ratio which will give satisfactory operation of the 1A6. The coils shown are suitable for use with an intermediate frequency of 175 kc in a broadcast-band receiver. The use of other intermediate frequencies will necessitate changes in the inductance of the coils. Usually coils which are suitable for the 2A7 or 6A7 will be found to be satisfactory for the 1A6.

The curve sheet shows the conversion transconductance of the 1A6 versus signal-control-grid volts. This curve was taken with 180 volts on the plate of the

) USE THE 1A6

verter Tube for Battery Sets

.6. With 135 volts on the plate, the conrsion transconductance usually will be out 90% of the value shown. The lume-control capabilities of the tube are early indicated by the curve.

Translation Gain Formula

The translation gain obtainable with the .6 is:

$$\frac{aS_cZr_p}{Z + r_p}$$

here
a = Voltage ratio of the i-f transfomer
$_c$ = Conversion transconductance
Z = Effective impedance of the i-f transformer across the input terminals
r_p = Plate resistance of the 1A6.

With transformers ordinarily used, the anslation gain of the 1A6 approaches 40. ith special high-impedance transforms, a gain of approximately 60 can be adily obtained.

TYPICAL OPERATING CONDITIONS

ate supply voltage	135	180	Volts
cillator grid leak (R1)	50,000	50,000	Ohms
cillator grid condenser	200	200	mmfd.
cillator anode-grid upply voltage	135	180*	Volts
reen supply voltage	67.5	67.5	Volts
nal control-grid ias voltage	-3	-3	Volts
cillator control-rid current	0.2	0.2	Milliamperes
cillator anode-grid urrent	2.3	2.3	Milliamperes
reen current	2.5	2.4	Milliamperes
ate current	1.2	1.3	Milliamperes
al cathode current	6.2	6.2	Milliamperes
cillator coil M/L atio	0.35	0.35	
onversion transconuctance at -3 volts n grid †4	275	300	Micromhos
onversion transconuctance at -22.5 olts on grid †4	4	4	Micromhos
ate resistance	0.4	0.5	Megohm

**The oscillator anode-grid voltage must not ceed 135 volts. If the oscillator anode grid is pplied from a plate-voltage source of more than 5 volts, a voltage-dropping resistor must be used. ith 180 volts plate supply, a 20,000-ohm voltage-opping in series with the oscillator anode-grid will uce the voltage to a permissible value.*

†Conversion Transconductance is defined as the io of the intermediate-frequency component of mixer output current to the radio-frequency nal voltage applied to grid †4. In determining performance of a frequency-converter stage, is used in the same way as gm (mutual conctance) is used in a single-frequency amplifier mputations.

Latitude Permitted

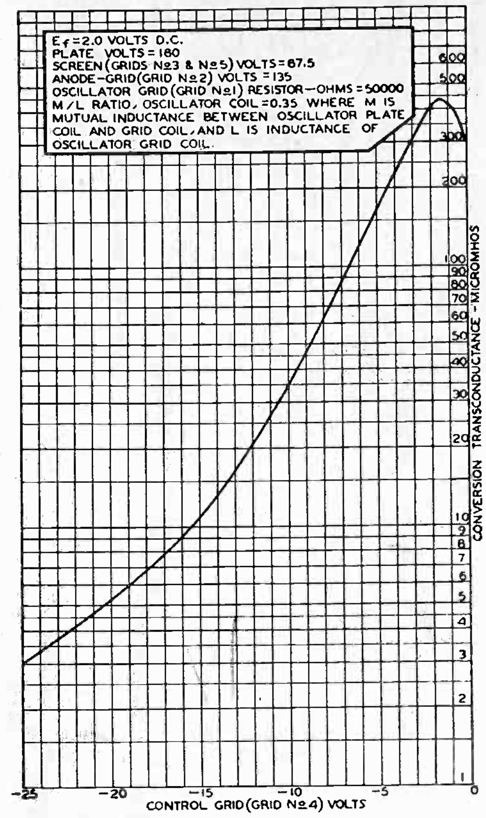
The tabulation gives typical operating nditions for the 1A6, but these condions do not necessarily provide the best sults obtainable. The voltages, resistors d coils may be varied within fairly wide nits to fit the conditions of a particular plication, provided that maximum ratgs are not exceeded.

In general, decreasing the voltage E_{c3} d E_{c5} from 67.5 volts will decrease the in. The screen voltage must, however, ever exceed 67.5 volts under any condions of operation. The optimum value of reen voltage is dependent on other elecode voltages and on circuit constants. l currents will increase with increasing reen voltage. A reduction in the oscilor grid-leak resistance R1 increases the in and, at the same time, the currents.

An increase in the M/L ratio of the oscillator coil operates in the same way.

The total cathode current in the 1A6 should never exceed 9 milliamperes. Varying operating conditions to raise the cathode current above the 6.2 milliamperes shown for typical operating conditions usually will not increase the gain appreciably. Consequently, more satisfactory operation of the 1A6 is obtained with approximately 6 milliamperes cathode current, since higher values tend to shorten the life of the tube.

The typical operating conditions for the 1A6 set forth in this note have given satisfactory results in our laboratory. In designing circuits for the 1A6, it must be remembered that a large number of variable factors is to be taken into consideration, say RCA Radiotron Co. and E. T. Cunningham, Inc. The tubes are quite flexible in their voltage requirements, so that reasonable care in the selection of the supply voltages and circuit constants will insure better operation than provided by combined oscillator-mixer circuits using tube types not especially designed for this dual function.



Operation characteristics of the 1A6. The control grid voltages are plotted against conversion transconductance in micromhos.

Right or Wrong?

QUESTIONS

1. Which gives the greater sensitivity, the 56 tube or the 53 as driver of output, transformer coupling between?
2. If a transformer has a skinny primary will the frequency coverage be greater or less than if the primary were large?
3. In a resistance-coupled audio amplifier, is it desirable that there should be a-f regeneration, or should the feedback filtration be made so complete as to eliminate all such regeneration?
4. What are the power output of the 33 and its amplification factor at standard operating voltages? What sort of a tube is it? Is it necessary to filter the output on account of the large plate current?
5. Is there a tube now available that affords a constant output? What is the requirement of a constant-output tube and what would be its advantages?
6. Is there a 1.1-volt amplifier triode, and if so, state its characteristics?
7. Can a B supply be utilized for sound trucks without B batteries?
8. Does a neon tube in television utilize a large percentage of the available light?
9. Is there a standard classification of short waves?
10. What improvements have been made in the 38, 41, 42, 89 and 2A5 and to what purpose?

ANSWERS

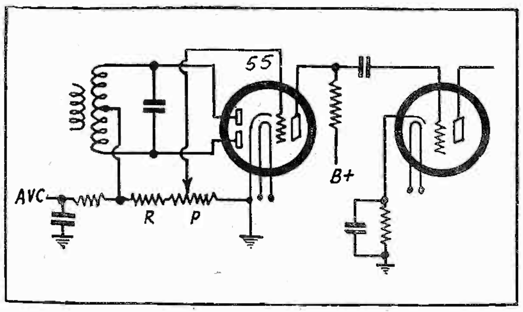
1. The 53 gives greater sensitivity. Its two plates may be tied together and its two grids tied together, to constitute a single operating tube, and the amplification factor will be around 16 instead of around 8 for the 56.
2. The frequency coverage, or ratio, will be greater in the case of skinny primaries than with large primaries, because the capacity between primary and secondary is less. This capacity appears as a lumped capacity across the coil terminals of the tuned secondary and therefore tends to reduce the frequency ratio.
3. It is imperative that there be regeneration to insure sensitivity. However, the amount of regeneration must not exceed a certain level, otherwise motorboating results. The feedback filtration therefore should not be so complete as to remove all possibility of audio regeneration. It would be impractical, anyway, to achieve such approach to perfection of filtration at audio frequencies.
4. The power output of the 33 is 0.7 watt and the amplification factor is 70. The tube is a battery-operated output pentode (power tube), of the 2-volt series. The plate current being small, there is no need of an output filter for the purpose of protecting a speaker winding.
5. There is no constant-output tube. The requirement of such a tube is that its amplifier should have automatic volume control applied in the same envelope, perhaps through special geometry of the single tube. The advantage would be the isolation of a. v. c. to each stage thus self-controlled.
6. Yes, the 864, a 1.1-volt filament type tube, 0.25 ampere filament current, 135 plate volts, 9 volts negative bias. It is a Class A amplifier triode.
7. Yes, an auxiliary generator can be hooked up to the fan belt and made to supply the plate voltage.
8. No, only a small amount of the available light can be utilized in usual practice, with the television neon tube.
9. There is no standard classification for short waves, but engineering committees are holding meetings with the idea of formulating a proposed standard.
10. These five tubes have been improved so that the grid emission is reduced considerably, thus permitting the use of higher values of grid leaks.

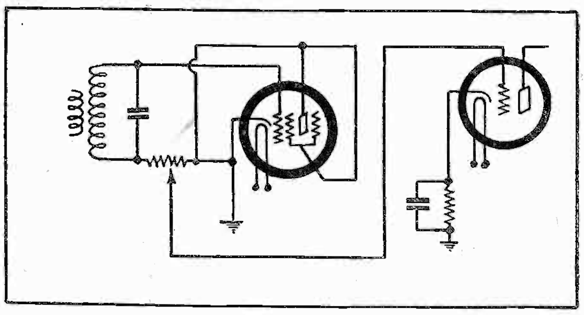
STABILIZATION OF I. F.

Method That Is Fool-Proof and Even Enables Three-Stage Amplifier

By Roger Beale Conant

At left R is a limiting resistor to prevent putting into the diode-biased triode all the rectified voltage. P is the manual volume control. A grid leak is needed in the next tube. In the drawing at right a 56 as diode works into an audio amplifier.





OSCILLATION in the intermediate amplifier is a common trouble these days, with two-stage high-gain amplifiers, and therefore some pains were taken to achieve a reliable cure that applies generally.

In brief, the cure consists of choke-condenser filtration of each plate circuit in the intermediate amplifier, and including the modulator plate, besides cathode choke-condenser filtration in the first intermediate amplifier, with a choke between the detector and the feed to the first audio, a small bypass condenser on the detector side but none on the audio side, and 1 mfd. for cathode bypass. This method was applied to three viciously oscillatory circuits and quieted them all.

Shielding Necessary, Too

Besides the foregoing, the usual shielding of coils and tubes, using standard tube shields, is necessary. Control grid leads to overhead caps should be shielded and shields grounded. Shielded wire suffices.

It was found that a common screen supply could be used for all tubes served, including r-f and mixer tubes, as well as i-f tubes, without introducing any trouble.

The bypass capacity in the cathode and screen legs had to be 1 mfd., and therefore some expense is incurred, but it is worth while, since the sensitivity is lifted to a high level, with a gain of more than 200 per stage using doubly-tuned coils, and no gain sacrificed to attain stability.

Although it was found preferable to filter the plate circuits as explained, tests showed that most of the trouble was in the cathode branches, which can be understood readily, since the cathode is common not only to the plate, screen and suppressor circuits, but is common to part of the grid circuit as well. That is why the cathode capacities are 1 mfd. for bypassing, and as an extra precaution the stage that has the greatest tendency to oscillate, the first i-f, has a choke in the cathode leg as well.

Three Stages Practical

Using the same fundamental parts, without the precautions outlined being taken to the fullest, the gain in the intermediate amplifier had to be held down considerably to insure stability, and yet when the remedies were introduced the gain could be as high as the circuit, constants and standard voltages permit, and the bias had to be no more negative than standard. It was even possible to use three stages of i.f. (four coils) without oscillation trouble. Anyone who has experimented with three-stage intermediate amplifiers must know that the stabilization problem is not very simple unless the reasons for the trouble are known and the remedies specifically applied to overcome the known sources of instability.

The full voltages were used on plates and screens, in fact, instead of the usual 250 volts and 100 volts, the values were 270 and 120 volts, respectively, just to make the solution a bit more difficult, and to safeguard freedom from oscillation when the method is reproduced in actual 250-volt and 100-volt practice.

The intermediate amplifier, therefore, can be completely stabilized, and it is not necessary to use large condensers, or even very large chokes, in the separate plate legs. The choke coils used were small honeycombs of 800 turns, inductance 10 millihenries, and the capacities recommended are 0.002 mfd. Larger may be used without any disadvantage, smaller ones may be used, but not so small that the frequency of the choking circuit is higher than that of the intermediate amplifier.

100 kc Maximum

The choking frequency should be considerably lower, as the necessity is to create a low-pass filter. If the capacity is as low as 0.00025 mfd., and the choke is 10 mlh., then the natural period is 100 kc, which is low enough for any of the popular intermediate frequencies, that is, for 175 kc or higher. The highest intermediate frequency used in this class is 520 kc, but even that is not so generally encountered, and is rather special to home-constructors of particular types of kit-sets.

It is obvious that the coupling in the screen circuits is not large, as a condenser gets rid of any tendency to back-couple, provided it is large enough, and 1 mfd. is sufficient. Just why any large capacity should be necessary for relatively high frequencies (and the intermediate frequencies are high compared to such a capacity) is not clear, but it is certain enough that the large capacity did the trick, when aided by the other devices.

Special Cases

The use of standard bias of course is consistent with full amplification. The difference between 800 ohms and 300 ohms as biasing resistors means a difference of almost 60 per cent. in the amplification, which is certainly important. Then, too, the second detector may be used in half-wave fashion, if desired, as this affords twice the voltage that is obtainable from full-wave detectors.

Some incidental aids are necessary, and if a diode detector is used with direct coupling to the triode, as in a 55, a 10 mlh. or higher inductance choke should be connected between the grid of the tube and the terminal of the coil from which pick-off is taken, and a small condenser put from pickoff point to ground, but none across the other end. Sometimes, in extreme instances, the value of this capacity has to be made consistent with stability, and while 50 mmfd. usually will prove sufficient, in some instances the value had to be doubled. This assumes a load resistor of around 0.5 meg. In the actual instance 0.6 meg. were used, because a meter was handy that had 2,000 ohms per volt resistance, and 300-volt scale, so the voltmeter setup could be used as a current meter directly, because of 600,000 ohms series resistance, and indeed as voltmeter, too, directly disclosing the amount of the rectified voltage.

It was found that with a long aerial the loudest local station developed 70 volts at the diode output, which is palpably too much, especially since any diode-biased audio amplifier, as the triode of the 55, stops doing business soon after 30 volts, and all one hears then is a lot of hash. It wouldn't improve the situation one bit if stopping condenser and leak were used, as the distortion would be just as bad, due to action of the tube on the positive portion of its characteristic.

58 as Diode-Biased Tube

The 55, 2B7, 2A6 and other tubes having diode elements are not the most satisfactory as diode-biased when one has a very sensitive set, uses a long aerial and lives near strong stations, because of the high voltage occasionally put into the first audio amplifier. Of course a volume control ahead of the first a-f tube would provide a check, but a tube with an extremely remote cutoff would be preferable, and therefore a 58 could be used separately as the diode-biased tube, and the 55 triode not used at all, or, if used, devoted to i-f amplification, as the third intermediate amplifier, if three stages are to be used. Even at 50 volts negative bias the mutual conductance of the 58 is something, whereas with the other tubes in the same general amplifier class, it is nothing.

It is advisable with all the diode-biased tubes to have a small starting bias, that is, some bias even if there is no signal. Otherwise there will be grid current at

(*Continued on next page*)

1-V OR 12Z3 AS RECTIFIER?

Which One Would You Choose and On What Basis?

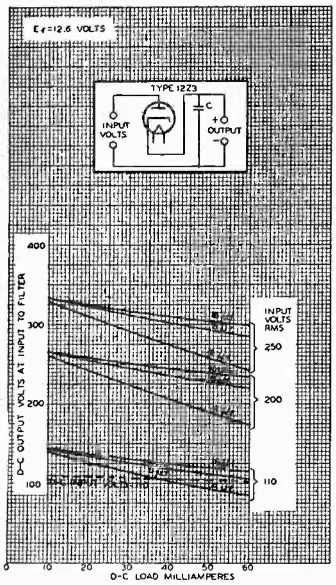


FIG. 1

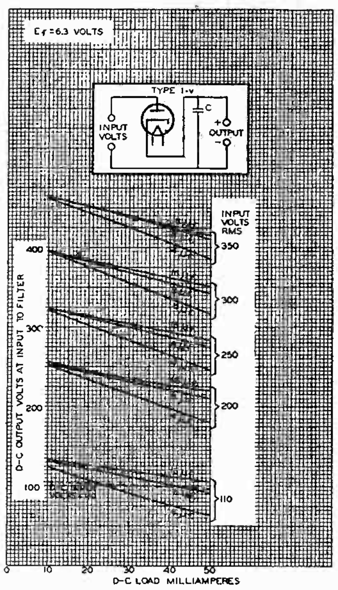


FIG. 2

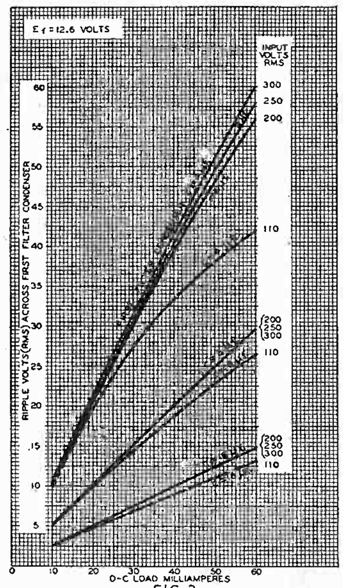


FIG. 3

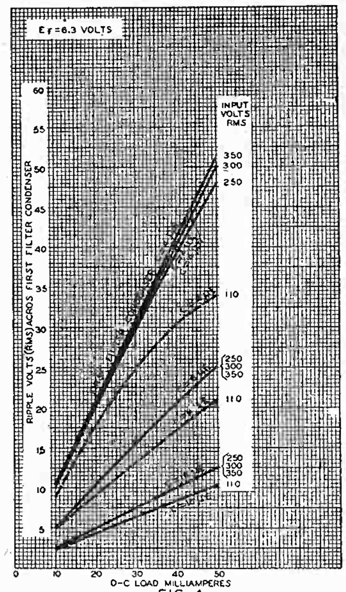


FIG. 4

THE type 1-v and type 12Z3 tubes are half-wave vacuum-type rectifiers having heater voltages of 6.3 and 12.6 volts respectively and heater currents of 0.3 ampere each.

A tabulation of their rated characteristics follows:

	1-v	12Z3	
Heater Voltage	6.3	12.6	volts
Heater Current	0.3	0.3	ampere
Maximum A-C Plate Voltage (RMS)	350	250	volts
Maximum D-C Output Current	50	60	ma.

These two rectifiers may be used in transformerless universal receivers having series heaters, for which application, the 12Z3 is perhaps the more useful since it has the greater voltage drop across the heater. The 1-v because of its 6.3-volt heater may be used in automobile receivers or in a-c operated receivers employing the 6.3-volt tubes. In general, in making a selection between these two rectifiers, the choice will be determined by the most suitable heater voltage, say RCA Radiotron Company, Inc., and E. T. Cunningham, Inc.

Figs. 1 and 2 showing regulation characteristics of the 12Z3 and 1-v indicate that the 12Z3 has slightly better regulation than the 1-v. The 1-v will supply at 350 volts rms input approximately 400 volts d.c. at 50 milliamperes, and the 12Z3 will supply at 250 volts rms input approximately 300 volts d.c. at 60 milliamperes.

Figs. 3 and 4 show the ripple, or rms voltage developed across the first filter condenser. This is observed to be practically the same for both tubes. From these curves it is apparent that doubling the first filter capacity will halve the ripple voltage developed across the condenser, and that to secure the ripple voltage for any load only one point need be known since these curves are approximately straight lines passing through the origin.

High Gain from I-F Channel

(*Continued from preceding page*)
small signal input or at no signal. The reason for grid current despite a small bias due to signal is that the heater type tubes of the medium amplifier class draw grid current at bias values less than 0.8 volt, so it is well to have 1-volt bias. If the no-signal plate current in the triode of the 55 is 2 ma, for instance, then 500 ohms will afford this single volt, and a bypass condenser across the resistor frees it from a degenerative effect on the circuit.

Time Delay

When the small self-bias is introduced the diode load resistor is returned to grounded B minus, as this is necessary to make the bias effective, for if return were to cathode the drop in the 500 ohms would not be utilized in the grid circuit. With a potential difference of 1 volt between cathode and ground and load resistor returned to ground, the tube naturally will not rectify until the signal is more than 1 volt, that is, until the anode has a positive radio-frequency value of input, measured from B minus.

This situation creates time delay, which means that the detector does not detect until the bias voltage is overcome by the signal, but the moment is is thus overcome, the bias resistor becomes less and less effective, since the plate current is being cut down.

Some Sacrifice of DX

Nevertheless, though strong signals are hardly affected by the 500 ohms at all, weak ones, below 1 volt, are wiped out, so some distant stations may be sacrificed, but they would not be of the type worth hearing, as less than 1 volt input, with no time delay, results in grid current, hence severe low-note attenuation, or raspiness.

Amplification of different frequencies being relative, the cure for the reduction of low-note intensity on weak signals is to have a volume control that is also a tone control, to cut down the high audio frequency response. This may be accomplished very readily by using a variable condenser across the load resistor. While the volume is not reduced as greatly as with other methods, the low notes continue to be heard well at very small total volume of sound. Some of the more expensive sets have volume controls that also are tone controls working in this direction. The suggested location of the condenser control is such as to reduce the input to the first audio tube, in line with protecting that tube from danger of overload and hence saturation.

With a minimum of 1 volt required at the detector, if there are two stages of i.f. at 200 gain per stage there is a gain of 40,000 between the modulator output and the detector input. With an r-f stage and good conversion conductance in the mixer (say, 200) there would be a gain of at least 2,000, or now a total of 80,000,000. Remember that audio amplification has not been included, and that has as well to do with sensitivity as has r-f or i-f amplification.

It can be seen, therefore, that large values of voltage can be fed to an output tube, or a pair of output tubes. Since we have found that a three-stage channel can be stabilized, with overall gain of sufficient value to load up a power tube, it is practical to use a diode rectifier and have the power tube direct-coupled by the diode-bias method. This comes within the suggestion of using the triode of the diode tube as last i-f amplifier, but the power tube, due to large plate current, would have to be independently biased, although not necessarily to the full amount usually recommended. The signal would take care of the extra bias.

Radio University

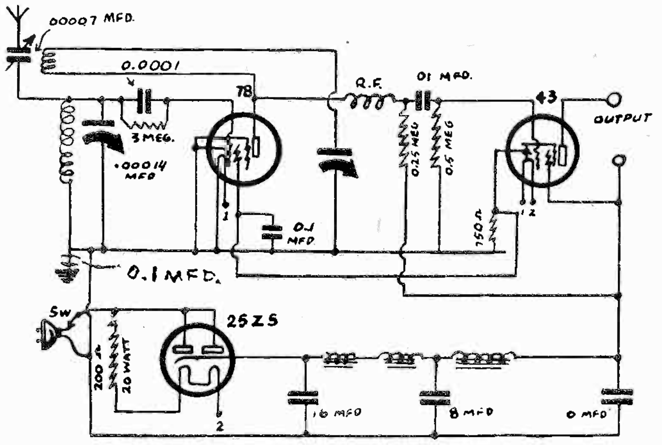
A QUESTION and Answer Department. Only questions from Radio University members are answered. Such membership is obtained by sending subscription order direct to RADIO WORLD for one year (52 issues) at $6, without any other premium.

RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y.

A Universal

CONCERNING the circuit printed on page 5 of the September 2nd issue, will you please let me know if it is correct to ground cathode of the 78 tube? Also please explain the heater circuit continuity. What are some of the advantages of using the 43 as an output tube? What is the actual voltage applied to the plate and the screen of the output tube, if not the full line voltage?—O. R. W.

One side of the heater of the 78 is connected to the chassis. One side of the power line is also connected to the chassis, the negative in the case of d-c. Hence we may say that the heater circuit begins with the 78. The other heater terminal of this tube, marked (1), is run to the correspondingly marked terminal of the 43.



A universal short-wave circuit for earphone use. This has 78 cathode grounded as any grid leak detector may be.

Terminal (2) picks up the heater of the 25Z5, and thence the circuit continues to the 200-ohm ballast resistor, which in turn goes to the "hot" side of the line. This does not mean that it goes to the ungrounded side of the d-c line, for in most instances the positive is grounded. In this case the chassis is really the "hot" side.

The tuning condenser is a 19-plate Hammarlund midget having a rated maximum capacity of 140 mmfd. The tickler condenser is of the same size and type.

The tuning condenser is controlled by a slow-motion mechanism. A large dial is attached to this mechanism and a long, moving pointer indicates the setting.

The 43 is a splendid power tube for a universal circuit. It will easily operate a dynamic loudspeaker if it gets adequate signal voltage. On strong signals it will in this circuit because of the fact that the first tube is regenerative. But it can also be used with a headset, and this is how most short-wave signals are received.

The 750-ohm bias resistor in the cathode head of the 43 slightly overbiases the tube, but that is all right for the excess bias is slight.

The full plate voltage available is applied to the plate and the screen of the power tube. This voltage is about 100 volts after allowance has been made for the bias and the drop in the filter chokes.

* * *

Diode Biasing

DOES NOT bias become zero at times on diode-biased tubes? Will sets be better though no new tubes come out?—A. S.

Where the tube is diode-biased it is well to remember that twice during each cycle there is no bias due to the signal, and this no-bias condition occurs much less frequently at audio than at radio frequencies, a point in its favor, whereas the static condition is that of no bias contributed either way by any signal, and only the self-bias would apply, so the static or self-bias should be within the capabilities of the tube.

In general, as the tubes that came out within the last year or so are used more and more, and effects noted, improvements result, so that even without any new tubes being imminent, it is still a fact that the circuits for the coming season are better than their predecessors.

* * *

Honeycomb Coils for T.R.F.

CAN NOT HONEYCOMB coils be used for tuned radio frequency amplification, especially as they are so compact, and a small shield is possible? For compact sets, such as used for automobiles, I don't see why this idea has not been taken up. Is the usual solenoid superior? What about the shape factor, whereby the diameter of all commercial broadcast solenoid coils is around half (or less) the axial length of the winding? I thought this developed a high r-f resistance. What is the effect of using Litz wire?—K. L. M.

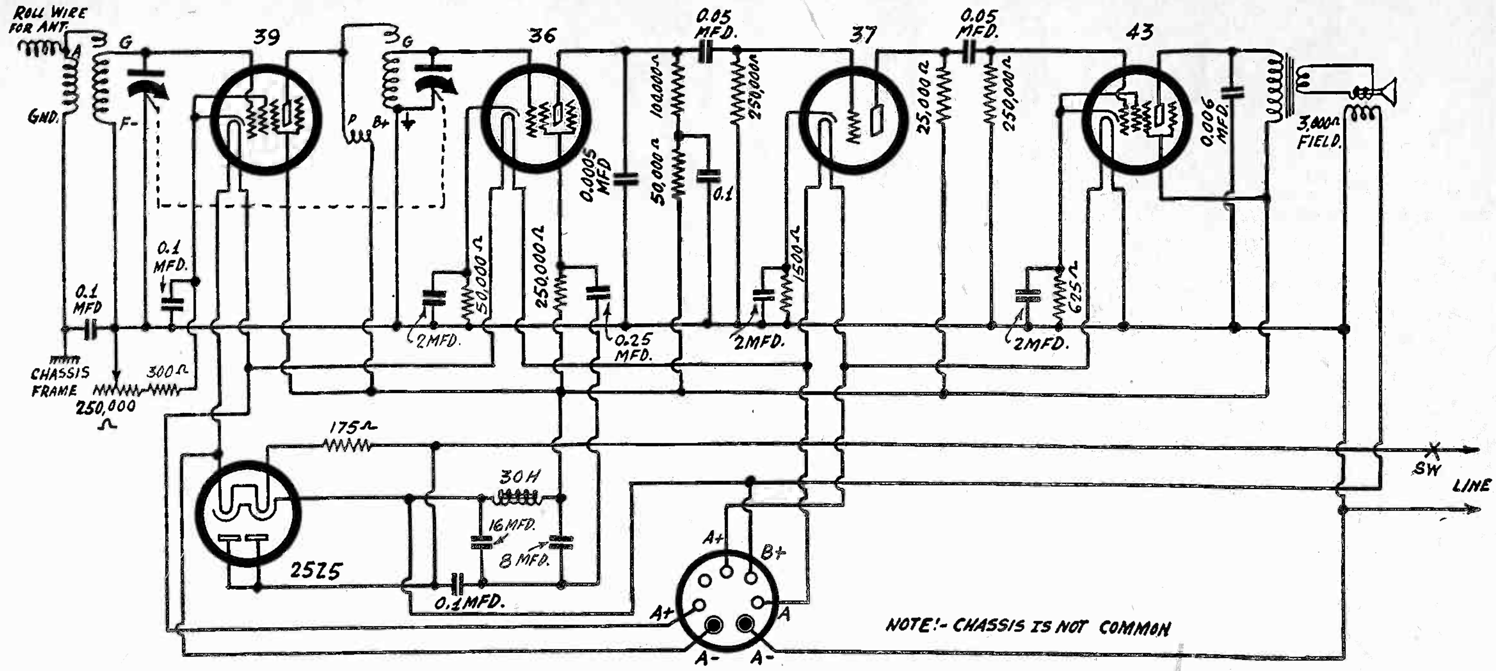
Honeycomb coils can be used, and there is one coil manufacturer producing them, but not in shielded form. They work well. The solenoid is in some respects superior. For compact sets, where much is sacrificed anyway, it is entirely feasible to use honeycomb coils for tuning circuits, and because of the little antenna pickup it would be practical to wind with Litz wire. This type of wire is better at the lower radio frequencies, hence winding a coil with such wire results in a more nearly even amplification. However, in car sets there is much to overcome, as the short aerial is particularly good for higher frequencies, but weak on lower radio frequencies. Thus equality of amplification would not result, without additional means of insuring it, but the effect would be in the right direction, anyway. The shape factor of coils as used commercially for broadcasts is out of proportion, but quite a latitude is permissible, as the performance change is small within a large factor change. However, there is no doubt that if the shape factor were somewhat better the coils would be somewhat better, also. Practical requirements dictate the factor—a small diameter and the necessity therefore of using a fine wire so as not to extend the axial length of the winding overmuch. The "ideal" coil has a diameter 2.47 times the winding space.

* * *

Marconi's Ultra Waves

MARCONI REPORTS that ultra waves travel father than others are willing to admit, some 170 miles, or beyond the horizon quite some. Is it a fact, or is it not, that the penetration of these waves is limited to the horizon? What is the extent of Marconi's contribution?—J. E. C.

Nobody doubts that Marconi's ultra



A five-tube universal receiver, using the 25Z5 as rectifier when a-c service is desired, and floating that tube on the line when d.c. is used. A precaution that should be taken is to observe polarity of connection to the outlet, so mark outlet and set plug, and warn the family to plug in the right way.

waves, around 45 centimeters, were received over distances of 160 and 170 miles in his experiments last year and this year, but how he has accomplished it is not definitely known to the science, for he has kept the details secret. It is agreed that ultra waves behave somewhat like light waves, and that is why they are called quasi-optical waves. The general impression has been that their radiation is limited to the horizon distance. This distance is not a fixed quantity but depends on the altitude of the point of radiation. Thus from a high tower the distance to the horizon would be greater than from the ground to the horizon, just as the hypothenuse of a right-angled triangle is always longer than the base. The curvature of the earth is regarded as the deterrent to any considerable distance penetration of ultra waves, but the similarity with light-wave propagation brings up the phenomenon of light "turning a corner," as it were. Einstein in his relativity theory pointed out the effect of magnetism and gravitation on light transmission, and the same condition may cause the ultra waves to go considerably beyond the technical horizon.

* * *

Transformerless A-C Set

IS IT PRACTICAL to have a good a-c set, using no transformer, but car type tubes, and heater rectifier? What output tubes would you suggest?—K. C. B.

Yes, it is entirely practical, for it simply amounts to building a universal type set and not using the d-c option. The rectifier may be the 25Z5, the amplifiers the 78's, with a triode detector push-pull-transformer coupled to a pair of 48 tubes. All heaters, including rectifier, would be in series.

* * *

Five-Tube Universal

PLEASE SHOW a design for a five-tube universal receiver, using the 25Z5 rectifier, with limiting resistor value noted (heater circuit).—O. H.

The circuit diagram is printed herewith and shows choke primaries not inductively related to tuned secondaries, but capacity coupled to the secondaries by the self-capacity of a very small winding (usually one, two or three turns over secondary). Thus one terminal of the small winding goes to plate or antenna, other terminal being left open, so to speak, although due to the condenser effect there exists a closed circuit in reality. The value of the limiting resistor is noted, as requested, and other values are values constants of other parts are given.

* * *

I-F Selectivity

IT HAS BEEN STATED that the doubly-tuned intermediate transformers are more selective than the singly-tuned-circuit intermediate transformers, but I can't understand why this should be, since it has been my experience (consistent with the theory I have studied) that an inevitable band-pass effect or double-hump exists, with the doubly-tuned circuit, and therefore the selectivity should be less. Which is right?—K. R. W.

Either one may be more selective than the other, depending on factors not disclosed. For instance, assume a singly-tuned transformer, untuned winding in the plate grid circuit, tuned winding in the grid circuit. If the coupling is loose the selectivity will be a certain amount, and may be greater than the selectivity of the doubly-tuned transformer of equal or even looser coupling. However, gain is another consideration, and to keep this high the singly-tuned type uses tight coupling, while the other invariably uses rather loose coupling, and besides affords excellent gain due to both circuits being tuned. When the peaking is accomplished both circuits of the double type transformer are tuned as near as may be to the same frequency, and while the result is not a single frequency, but a narrow band, the attenuation 10 kc off resonance for stated input may be better than in the instance of the singly-tuned transformer. The theory you suggest is of course correct, but the effect of the two types in respect to selectivity depends very much on the degree of coupling.

Station Sparks

By Alice Remsen

AUDITIONS AND CONTRACTS

Auditions and still more auditions for Fall programs! No less than nineteen contralto warblers competed for the Ex-Lax contract. Three made the grade for final auditions—two Columbia artists and one freelance. As might be expected, one of the Columbia staff won out and so you will hear the voice of Gertrude Neissen, combined with the music of Isham Jones' Orchestra and the comedy of Lulu McConnell, when the chocolate laxative reaches the air. . . . At the pre-showing of the Metro-Goldwyn-Mayer film, "Broadway to Hollywood," a great many radio stars were seen. Paul Whiteman was among them; first time I had seen him since the shrinkage; and has he shrunk? Well, rather! He looks great! Ted Husing was popping around all over the place, and so was Nick Kenny, the poetically inclined radio editor of the New York *Daily Mirror*; and music publishers? yes; they were there in droves. The film tells the story of a vaudeville family, from the 1880's to the present day; very true to life. Alice Brady and Frank Morgan give marvelous performances. The National Variety Artists, Inc. attended in a body; marched from the N. V. A. Club to the Capitol Theatre, with flags, torches and a drum corps. Lot of fun; eyes were wet before the end of film. . . . Understand that Rocco Vocco, for many years with the Feist Music, Inc., has left that firm to go with Bobby Crawford and the De Sylva, Brown & Henderson firm; wish him lots of luck! . . . Jack Pearl will retain the role of Baron Munchausen this season; same sponsor, but the show will be for one half hour only, Saturdays 9:00 p. m., WEAF; opening program, October 7th. . . .

* * *

WHAT THEY'RE DOING—AND WHERE!

American Oil Company (Amco) is the next new show to be auditioned. Style of program not yet decided upon; probably name band and singer, with comedy skit here and there; it will be heard over the Columbia air-waves. . . . J. C. Nugent, the playwright-actor-manager, has a thirty-nine week contract with Dill's Mixture, over NBC, starting some time in October. . . . It is quite likely that you will hear the voice of Patricola, erstwhile vaudeville headliner, on an NBC sustaining series very shortly; her audition was favorable. . . . Peter Dixon has caused considerable talk, and made many literary gents look to their laurels in the field of radio, since his "Children of Israel" skit on Al Jolson's broadcast the other evening, came over the air so well. You did one sweet job Peter! Congrats! . . . Did you hear Roy Atwell on WEAF last Friday evening at 9:00. He's as funny as ever. . . . Myrt and Marge are unlucky again. Myrt is in a hospital in Los Angeles after being seriously hurt in an accident; Marge is stranded in the Andes, where she went in search of local color for their skits during the coming season; snowbound, of all things. . . . To those of my readers who have been inquiring as to the whereabouts of Frank Knight, erstwhile Columbia announcer; he has been signed up by WMCA; which reminds me that Al Smith, our own beloved ex-governor of New York, is interested in the management of that station; and the new chain is materialising; within a week or so, WMCA expects to have eleven stations hooked up, reaching as far West as Michigan. . . . Virginia Rae. who was the Olive Palmer on the old Palm-Olive Hour, is scheduled to sing at one of the concerts to be held during September in the Madison Square Garden, New York. . . . Welcome Lewis is still playing in vaudeville. . . . Jack Arthur made such a hit during his engagement at the old Roxy Theatre, New York recently that a route is being laid out for him immediately at a big figure and Jack will make more money this season than ever before. . . .

* * *

ANOTHER NEW CHAIN

Another new local station tie-up has been announced; the Biow Advertising Agency and a noted watch manufacturer have united to establish a local chain, with WODA and WAAM as the nucleus of the hook-up. . . . And now it comes out that Conrad Thibault, the baritone, has so much radio work he is forced to turn down a few programs; he's a lucky man; there are plenty of excellent artists starving to death these daays. . . . Muriel Pollock is back from her European trip. . . . Great Moments of History goes into the discard on October 8th and a new show steps into its place, with Ozzie Nelson's Orchestra, singer Harriet Hilliard and comic, Joe Penner. . . . One of my favorite songwriters, Allie Wrubel, has a new song with the Berlin firm which will be heard plenty over the air-waves in the next few weeks; it is titled "And So Goodbye"; think it's a hit. . . . Arthur Pryor, Jr. will be a busy man early in October, when the famous program, "March of Time," goes back on the air; Pryor directs this series, and what a job it is; ten hours a day from Tuesday afternoon, to Friday evening he devotes to its preparation, but the result justifies the time spent and the hard work necessary for its production, for without a doubt it is one of the finest programs ever sent out over the air. . . .A new three-a-week series for housewives made its debut on September 11th, with Mrs. Mary Ellis Ames, widely known economics authority, in charge; each Monday, Wednesday and Friday, 11:30 a. m. EDST; WABC and network; under the title of "Kitchen Close-ups," with Mrs. Ames giving appetizing recipes, authentic tips on kitchen savings and short cuts in the day's routine about the home. . . .

* * *

SOME BIG BOYS AND GIRLS

Harriet Lee is back again on WABC, singing with the Happy Bakers program each Monday, Wednesday and Friday; associated with Harriet on the bill are the trio known as Men About Town, although their title in this particular production is Happy Wonder Bakers; they are Phil Duey, Frank Luther and Jack Parker; Joe Green's orchestra supplies the music. . . . The Church of the Air has entered its third year of broadcasting; each Sunday through the Fall and Winter a nation-wide network will carry two half-hour periods devoted to services conducted by outstanding leaders of the Protestant, Catholic and Jewish faiths, morning services at 10:00 o'clock and afternoon services at 1:00, EDST . . . Singin' Sam (Harry Frankel) is back from his Indiana home; with the other Hoosier member of the Barbasol program, Edwin C. Hill, Sam is warbling over WABC twice weekly, Mr. Hill talking three times weekly and Sam singing the Barbasol theme at each broadcast. . . . Kenneth Roberts, the CBS announcer, motored to Cincinnati for his vacation and spent some time there with his old friend, Paul Stewart, who is working at WLW, announcing, writing, acting and master-of-ceremony-ing . . . Swift & Company will open their new Fall series some time in October; the program will emanate from Chicago, and Olsen and Johnson, those two clever comics, will be starred; band and supporting cast not decided upon at this writing. . . . Those popular and dramatic episodes in the life of "Marie, the Little French Princess," will continue over a Coast-to-Coast network this Fall; Tuesdays, Wednesdays, Thursdays and Fridays, 1:00 p. m. EDST; this program is sponsored by Louis Philippe, Inc., and features Ruth Yorke as the Princess, and James Meighan, nephew of Tom Meighan, as the young American hero. . . .

* * *

AND STILL THEY COME

The "Bill and Ginger" program has a contract renewal. Very glad to hear it; these young folk are clever, and the script is fine, written by my old friend from WOR days, Arthur Q. Bryan. . . . Goldy and Dusty are still holding their own on WABC each morning at 9:15. . . . That unique person, known as The Voice of Experience, is back on the air-waves, giving advice to poor human sadly in need of that very useful commodity; he has an evening program now, coast to coast, which started on Tuesday, September 12th, from 8:30 to 8:45 p. m., EDST. . . . Walter Preston is singing just as well as ever; you can hear him in the new NBC Sunday night show, "Light Opera Nights"; this show will bring back memories to you of that fine old show of Philco, when Jessica Dragonette first started to sing over the air; the same theme song, "Memories," will be used; Harold Sanford will conduct, and Henry Neeley, the old stager, will be the musical master of ceremonies. . . . Betty Washington is doing some good work with her combination vocal and instrumental trio over WOR; each Wednesday, 10:15 a. m.; the three girls are Betty Washington, Myrna Westcott and Willa Renard, known as the Rainbow Trio; under the management of Vincent Sorey . . . Jerry Macey and Ed Smalle, with Roger Bower, have lots of fun during their Household Finance program over WOR each Wednesday at 9:15 p. m.; they dig up the funniest old numbers and put them on with all the trimmings. . . . Sidney Ten Eyck has been retained permanently by WOR and so his engagement with WCAU, Philadelphia has been indefinitely postponed; Sid is looking marvelous, and has developed into a regular Broadway Beau Brummel . . . Must run along now. See you here next week.

A THOUGHT FOR THE WEEK

THAT N. R. A. CODE is a great thing for radio, as it is for all other fields of American activities. We're just wondering what effect it will have on the efficiency of some of those sets that don't seem to be willing to do their share in entertaining the family or giving complete satisfaction to the technician. Can a set listen as well as make a noise?

TRADIOGRAMS

By J. Murray Barron

The Fansteel Products Co., Inc., of North Chicago, Ill., announces the appointment of Carl G. Howard as sales manager of the battery charger division. Mr. Howard was an early operator of an amateur radio station, from which he branched into the broadcasting and sales activities.

* * *

That the popularity of set construction is widespread was conclusively proved from a survey recently made in connection with the mail order business. A completely wired receiver was offered at a very low price, with little off for the parts to wire the kit yourself, yet the requests for diagrams and parts was so large in proportion that it left no doubt as to whether kits could be sold. In fact, to one who would specialize in kits the competition would be far less than in attempting to sell a wired receiver. With a few good numbers in the kit line, with a reasonable price and proper publicity, a substantial business could be created. The field is so large that the surface isn't even scratched.

* * *

After the lean years of both storekeeper and the public, now to see the decided change surely makes a fellow feel like living. It's like recovering from a bad illness, or the passing of a terrible storm, with the sun bright after it has been hidden for days. With the aid of the NRA, progress has actually been made and so many of us know dozens who have returned to work, besides other who have had incomes increased and hours shortened, that we just must believe times are on the uptrend.

* * *

RCA Radiotron Co., Inc., manufacturer of radio tubes, has signed the blanket NRA code.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

Harry E. Coy, County Assessor's Office, Omaha, Nebr.
Bertram F. Start (Radio Service Engineer), 110 Northumberland Park, Tottenham N. 17, London, England.
Pope Radio Service, James L. Pope, 1963 East 82nd St., Cleveland, Ohio.
H. S. Miller, Box 235, Spindale, N. C.
W. H. Crafts, 3050 West Euclid, Detroit, Mich.
C. B. Dickey, 1718 Monroe, Toledo, Ohio.
G. Pasquale, Wellsville S. W. League, 100 Main St., Wellsville, N. Y.
Aubrey E. Fales, 12 Marvin Ave., Shelby, Ohio.
Oval L. Robinson, 306 Tippett Ave., Morehead, Ky.
Harry Boerstler, 2619 Park Ave., Cincinnati, Ohio.
Joseph Ingentoff, 336 Locust Ave., Port Chester, N. Y.
M. H. Ryder, 257 So. Palm Drive, Beverly Hills, Calif.
Fred J. Haskell, 532 Ash St., Waukegan, Ill.
Gustav Harms, 1318 Addison Street, Chicago, Ill.
A. E. Philbrick, Roxbury, Conn.
C. M. Findley, 133 E. State St., Kennett Square, Penna.
C. A. Kemnitz, Eldorado, Wisc.
Frs. Coupal, Brebeuf Co., Terrebonne, P. Q., Canada.
G. B. Martin, 3328 Palmer St., Chicago, Ill.
John Meehan, 219 Genesee St., Utica, N. Y.
N. M. Dahlberg, General Merchant, Valemount. B. C., Canada.
Boris Tolmachoff, "Plum Cottage," Vance Ave., Lavallette, N. J.
Jack Litwin, 576 James St., N., Hamilton, Ont., Canada.
D. W. Rosenzweig, 124 Sterling Ave., Lafayette, Louisiana.
A. N. Horne, care Empire Pipe Line Co., Bartlesville, Okla.
E. L. Horne, General Radio Repairs, Batesburg, S. C.
W. M. Horton, Lock Box 462, Douglas, Wyoming.

CORPORATE ACTIVITIES

CORPORATION REPORTS

B. F. Keith Corporation and subsidiary companies—Net loss for quarter ended June 30, 1933, $187,127, against a net profit of $43,101 for the quarter ended March 31, 1933. The net loss for the six months ended June 30 was $144,025, compared with a net income of $233,424 for the corresponding period of 1932.

BANKRUPTCY PROCEEDINGS

Assignments

Lyman Radio Mfg. Co., Inc., address, 142 Liberty St., New York City, assigned to Fred S. Hare, of 15 Vanderbilt Ave., New York City.

Musique Radio Mfg. Co., Inc., 142 Liberty Street, New York City, also assigned to Fred S. Hare, 15 Vanderbilt Ave., New York City.

Petitions Filed—Against

Plaza Music Co., Inc., radio and music store, of 10 West 20th St., New York City, petition filed by Electric Motive Mfg. Co., for $624; by William Brand & Co., for $32; and by Concourse Condenser Co., for $389.

MAGNET WIRE TABLE

The magnet wire table herewith is useful for determining axial length of coil windings, or, if the length and wire size are known, the number of turns, and indirectly the inductance.

Another useful purpose is determination of the approximate amount of wire for current shunts across meters. Moving the decimal point three places to the left, under continuous current ohms per 1,000 feet, gives the resistance per foot. For instance, No. 40 wire has a c-c resistance of a little more than 1 ohm per foot. From the known meter resistance and sensitivity, the required shunt may be calculated, the approximate length of wire obtained from the table. For low resistance shunts do not use the finer wires.

Turns Per Inch

B. & S. Gauge	cc. Ohms per 1,000 Feet	Single Silk	Double Silk	Single Cotton	Double Cotton	Enameled	Enameled SS	Enameled DS	Enameled SC	Enameled DC
14	2.525			15.6	13.6	15.2			14.1	13.3
15	3.184	16.9	16.3	16.1	15.1	17.0			15.6	14.8
16	4.016	18.9	18.2	17.9	16.7	19.1	18.4	17.7	17.4	16.3
17	5.064	21.2	20.3	19.9	18.2	21.5	20.5	19.7	19.3	17.9
18	6.385	23.6	22.6	22.1	20.2	23.9	22.8	21.8	21.4	19.7
19	8.051	26.3	25.1	24.4	22.2	26.8	25.4	24.2	23.6	21.5
20	10.15	29.4	27.8	27.0	24.3	30.1	28.4	26.9	26.1	23.6
21	12.80	32.7	30.8	29.8	26.7	33.7	31.6	29.8	28.9	25.9
22	16.14	36.6	34.2	33.0	29.2	37.7	35.0	32.8	31.7	28.1
23	20.36	40.6	37.7	36.2	31.6	42.3	39.0	36.4	34.9	30.6
24	25.67	45.2	41.6	39.8	34.4	47.1	43.1	39.8	38.1	33.1
25	32.37	50.2	45.8	43.6	37.2	52.9	47.8	43.8	42.8	35.8
26	40.81	55.8	50.5	47.8	40.1	59.1	52.9	48.0	45.7	38.6
27	51.47	61.7	55.5	52.0	43.1	66.2	58.4	52.9	49.7	41.4
28	64.90	68.4	60.9	56.8	46.2	74.1	64.5	57.8	54.0	44.4
29	81.83	75.1	67.1	61.3	49.2	83.3	71.4	64.1	58.8	47.6
30	103.20	83.1	73.2	66.5	52.5	92.2	77.8	69.2	63.0	50.3
31	130.10	91.5	79.3	71.9	55.8	103.4	85.6	75.3	68.1	53.5
32	164.10	100.5	86.5	77.2	58.9	115.6	93.8	81.6	73.2	56.6
33	206.90	110.1	93.6	82.8	62.1	129.3	102.7	88.2	78.5	59.7
34	260.90	120.4	101.0	88.4	65.3	144.9	112.3	95.2	84.0	62.8
35	329.00	131.4	108.5	94.3	68.4	162.3	122.5	102.4	89.6	65.9
36	418.80	142.8	116.2	100.0	71.4	181.8	133.3	109.8	95.2	68.9
37	523.10	155.0	124.2	105.8	74.3	202.4	144.1	117.1	100.6	71.7
38	659.60	167.7	132.2	111.6	77.1	227.7	156.4	125.1	106.4	74.6
39	831.80	180.5	140.2	117.2	79.8	252.5	167.7	132.2	111.6	77.1
40	1,049.00	194.5	148.3	122.8	82.3	280.1	179.5	139.4	116.6	79.5

NEW MODEL SHIELDED TEST OSCILLATOR!

Either 50-150 kc Fundamental Model, a-c or battery; or 500 to 1,500 kc Fundamental Model, (broadcast band) a-c or battery, available.

AN improved modulated test oscillator, fundamental frequencies, 50 to 150 kc, enabling lining up of intermediate frequency amplifiers, t-r-f and oscillator circuits, is now ready. It is shielded in a metal box 9½" wide x 6¼" deep x 4½" high, with beautiful Japanese finish. The test oscillator is obtainable in two models, one for a-c operation, the other for battery operation. The same cabinet is used for both.

The a-c model not only is shielded but has the line blocked, that is, radio frequencies generated by the oscillator cannot be communicated to the tested set by way of the a-c line. This is a necessary counterpart to shielding, and a special circuit had to be devised to solve the problem.

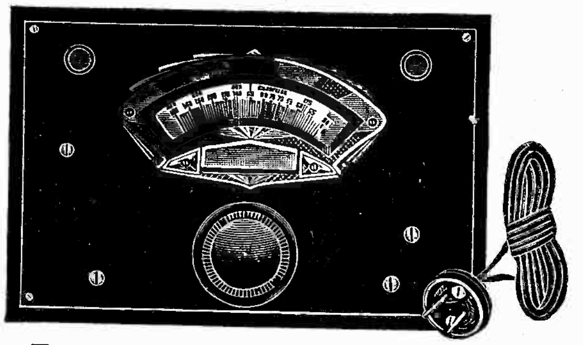
The modulation in the a-c model is the a-c line frequency, 60 cycles, effected by using the line voltage on the plate of the tube. In the cabinet there is a very high resistance between the shield cabinet and the a-c, a double preventive of line-shorting and application of a-c line voltage to the user.

The oscillator is equipped with an output post. No ground connection need be used, as the circuit is sufficiently grounded through the power transformer capacity to prevent body capacity effects in tuning.

The frequencies are more accurately read than normal use requires, being never more than 2% off, and usually not more than 1% off, many readings being right on the dot (no discernible difference). The frequency stability is of a high order from 100 to 50 kc, and somewhat less from 100 to 150 kc. Zero beats are guaranteed at all frequencies.

The oscillator was designed by Herman Bernard and is manufactured under the supervision of graduates of the Massachusetts Institute of Technology.

Either model FREE with two-year subscription for Radio World (104 issues) $12.00



The test oscillator has a frequency-calibrated dial, 150 to 50 kc, with 1 kc separation between 50 and 80 kc and 2 kc separation between 80 and 150 kc. Intermediate frequencies are imprinted on the upper tier. Broadcast frequencies are obtainable on tenth harmonics (500 to 1,500 kc).

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THE a-c model is completely self-operated and requires a 56 tube. The battery model requires external 22.5-volt small B battery and 1.5-volt dry cell, besides a 230 tube. The use of 1.5 volts instead of 2 volts on the filament increases the plate impedance and the operating stability. The battery model is modulated by a high-pitched note. Zero beats are not obtainable with the battery model.

Directions for Use

Remove the four screws and the slip cover, insert the 56 tube in its socket, restore the cover and screws, connect the a-c attachment plug to the wall socket, and the a-c test oscillator is ready for service.

For testing some particular set, follow the directions given by the designer or manufacturer. In the absence of such directions, use the following method.

Mentally affix a cipher to the registered frequencies on the lower tier (so 50 is read as 500, and 150 as 1,500), and set the dial for any desired broadcast frequency. Connect a wire from output post of test oscillator to antenna post of set. Leave aerial on for zero beats, off otherwise. At resonance the hum will be heard. Off resonance it will not be heard. For testing intermediate frequencies, connect the wire to plate of the first detector socket. The first detector tube may be left in place and bared wire pushed into the plate spring. The intermediates then are tuned for strongest hum response. If an output meter is used, tune for greatest needle deflection.

The battery model is connected to voltage sources as marked on oscillator outleads and is used the same way.

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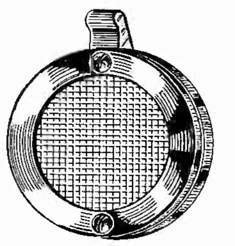

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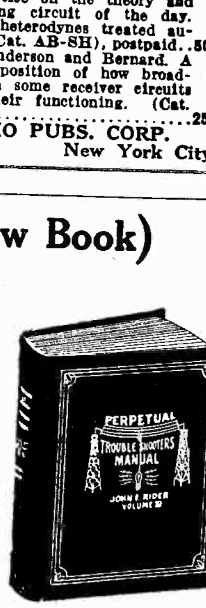

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