DIODE DETECTOR

NOV. 7
1931

RADIO WORLD
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The First and Only National Radio Weekly

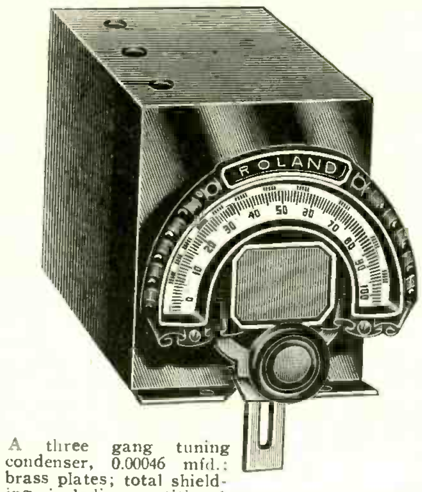
502nd Consecutive Issue

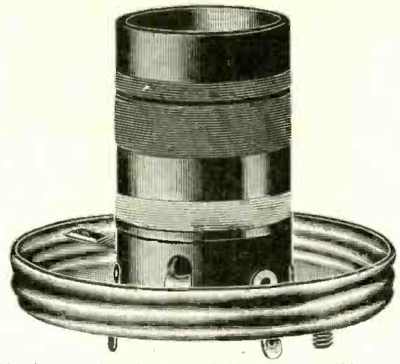
TENTH YEAR

SHORT WAVE SUPERS

8a

TUNING UNITS





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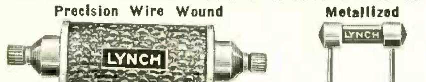

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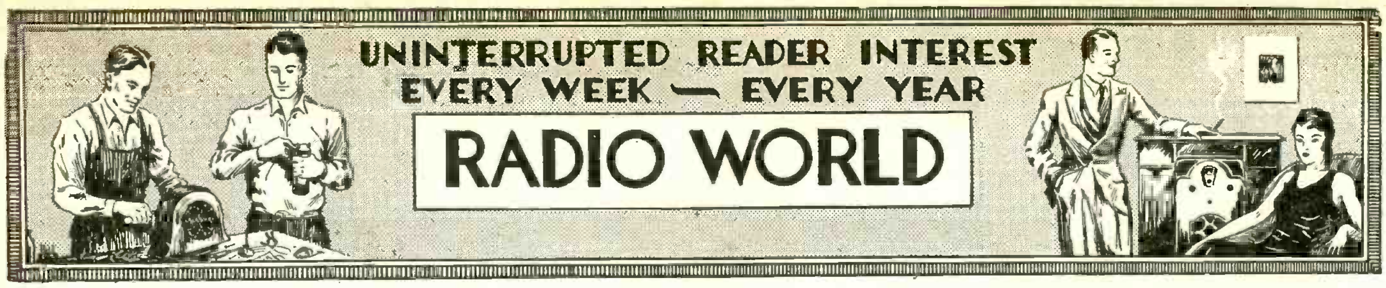

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A Short Wave Midget

15 to 200 Meters Covered by Simple Circuit

By Edward W. Wallace

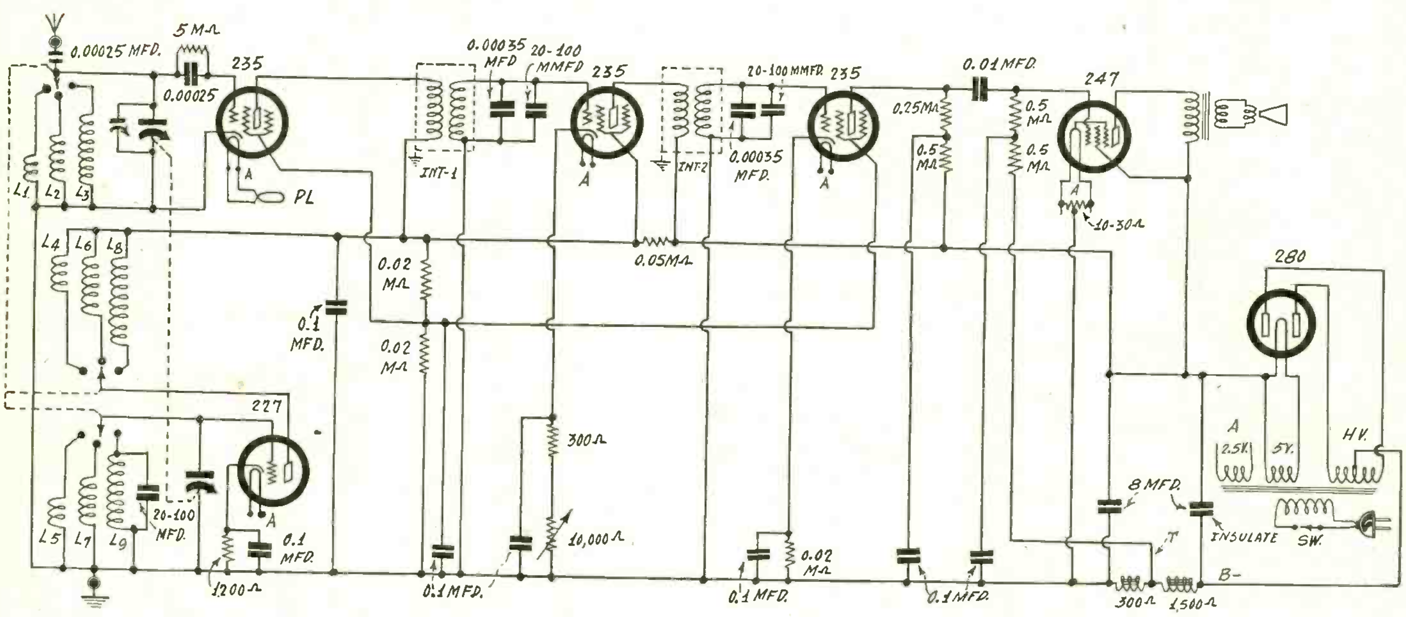

Fig. 1.

An extremely simple short wave set, both from the viewpoint of construction and operation. Standard broadcast coils with large primaries may be used for the intermediate coils. A condenser from detector plate to ground should be tried. See text.

SIX tubes may be used for short wave reception in the manner diagrammed in Fig. 1. A switch is used for band changing. The tuning condenser is a two gang 0.00035 mfd., which will cover from 15 to 200 meters with three coils for each tuned stage. Separate coils are used: three modulator inductances and three oscillator inductances, total six coils. However, as the modulator and oscillator coils are coupled inductively, they are wound on the same form, for each band, therefore three forms are used.

The oscillator coil has two windings, one for grid, the other for plate, while the modulator coil has only one winding. A suit-

(*Continued on next page*)

LIST OF PARTS

Coils

Three forms, with three windings on each form, as illustrated.
Two broadcast radio frequency transformers for 0.00035 mfd. tuning, INT.-1 and INT.-2.
One power transformer.
[Note: Speaker output transformer and B supply choke coil are specified subsequently, in connection with the speaker.]

Condensers

One 0.00025 mfd. fixed condenser. One 0.00035 two gang.
One 0.0015 mfd. fixed condenser.
Two shielded cases, each containing three 0.1 mfd. condensers.
Three 0.00035 mfd. fixed condensers.
Two 8 mfd. electrolytic condensers, with insulating washer and extra lug for one.
One 0.01 mfd. fixed condenser.

Resistors

Three 0.02 meg. (20,000 ohm) pigtail resistors.
One 1,200 ohm resistor. One 10-30 ohm, c. t.
One 0.05 meg. (50,000 ohm) pigtail resistor.
Two 0.25 meg. (250,000 ohm) pigtail resistors.
Three 0.5 meg. (500,000 ohm) pigtail resistors.
Three 20-100 mmfd. equalizing condensers.
One 300 ohm resistor.
One 10,000 ohm rheostat with a-c switch.

Miscellaneous Parts and Accessories

One chassis, 13 inches wide x 9½ inches front to back, x 3 inches high, drilled for seven sockets (seventh is for speaker plug).
One vernier dial with pilot lamp, bracket, escutcheon and scale.
One dynamic speaker, with pentode output transformer built in; 1,800 ohm field coil (used also as B supply choke) built in, tapped at 300 ohms.
One a-c cable and plug.
One five lead cable and plug for speaker.
Six UY (five spring) and one UX (four spring) sockets.
One cabinet.
Tubes used: one 227, three 235; one 247; one 280.

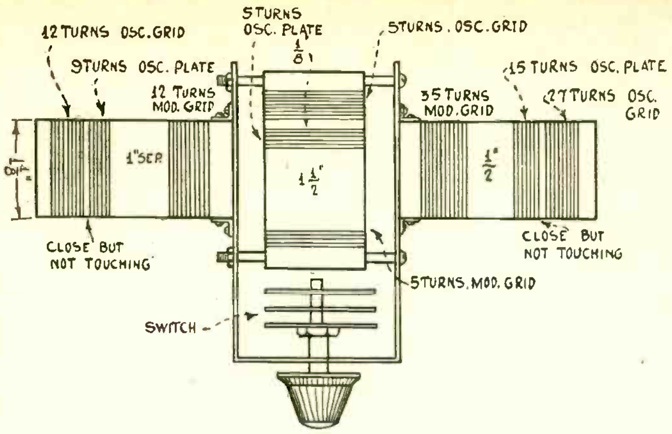

Fig. 2

The coil-switch layout. The switch is at bottom in the diagram. A U-shaped aluminum bracket, held to the front panel by the switch, may be used. The coil data are imprinted.

(*Continued from preceding page*)
able series condenser in the antenna circuit, which may be up to 0.00025 mfd., but may be as small as 0.00015 mfd., makes the single winding system entirely practical for modulator tuning.

On one form, therefore, is the coil system consisting of L1, L4, L5, to tune in the shortest wave band, on another form the combination L2, L6, L7, to tune in the middle short wave band, while on the third form are L3, L8, L9.

Plate Coupling is Different

L4, L6 and L8 are the tickler windings, with one terminal of each to B plus. The switch connected to plate picks up a different plate winding each time. Also it picks up a different grid winding, one for oscillator, the other for modulator. But the switch has only a single knob, as all three circuits are changed by the same rotation. The switch shaft must be of the insulated type, that is, not connected electrically either to the poles or the throws (indices or the points).

It is therefore a three circuit switch with three connections for each circuit, besides the three connections for the indices, which indices are at an odd distance from the other lugs.

The coils are alike for the two circuits tuned, except that the modulator coil for the highest waves (200 to 70 meters) has fewer turns than its modulator companion, and besides has a fixed trimmer across it. The plate windings for the oscillator are different, being of smaller numbers of turns as the frequency range increases, although the plate windings are a larger percentage of the grid windings as the frequency increases. This is necessary to insure oscillation.

Coil Location

A 227 tube is used as oscillator, as it is a good oscillator, and the plate windings are put on so that despite the reduced ratio of inductance to capacity for the higher frequencies there will be oscillation. So long as there is oscillation in the oscillator that is all one need ask, because this tube is called upon to furnish nothing else, the only condition being (assuming oscillation) that the amplitude be not too great. Or, to gain the same end, the coupling should not be too close between oscillator and modulator. For that reason the distance between the tuned windings increases as the frequency range of the respective coil systems increases.

The position of the coils is as follows: three forms are arranged so that one is at right angles to the two others, and between each of these two others and the first coil there is an aluminum or copper shield about 2.5 inches square. The two forms mounted on a parallel plane may be fastened to the shields, which are bracketed to the under side of the chassis. Then the middle coil also is fastened likewise to the chassis, simply by use of long machine screws and bushings, or may be adhered in the same manner to the two shields. Or a U-shaped shield may be used. See Fig. 2.

Position of Plate Winding

The coil windings are put on with the tuned inductances at extremes and the plate winding between them. The reason is resultant looser coupling, since there is far less power in the oscillator plate circuit than in the oscillator grid circuit. It is easy to get too much coupling, which results in the two circuits tuning to the same effect as if they were one, that is, the benefit of extra selectivity from modulator tuning becomes lost, since the circuits interlock. There must be always coupling between the circuits, but never such intense coupling as effectuates interlocking.

Assuming the modulator range of the coil for highest waves to be 70 to 200 meters, if the same inductance and capacity were used in the oscillator there would be no reception, since reception depends on the maintenance of a difference between the two frequencies. This difference is equal to the intermediate frequency. Therefore we must know the intermediate frequency to be used.

If we select broadcast coils intended for 0.00035 mfd. tuning, and put a 0.00035 mfd. fixed condenser across the secondary, then we would tune to about 530 kc. If we add an equalizing condenser, in parallel with the fixed condenser, we may adjust the capacity so as to take up any discrepancies between the two fixed condensers, and also lower the frequency, so we will be well below the broadcast band's lowest frequency, instead of just barely below. We may select an intermediate frequency of 450 kc in this manner.

Oscillator Adjustment

Now to tune in the lowest frequency carrier, say, 1,500 kc, the modulator would be tuned to that. The range would be to a little below 4,000 kc. Now the oscillator would have to start at 1,500+450 kc, or 1,950 kc, and, maintaining the same ratio, the highest frequency would be about a little below 6,000 kc. So the oscillator would far outrun the modulator, even though there is a front panel manual trimmer across the modulator tuning condenser. Therefore we use fewer turns for the oscillator and put an equalizer across the oscillator coil for this range. This equalizer has a capacity of from 20 to 100 mmfd. and is set at near maximum capacity. Thus the frequency range of the oscillator is reduced, by a method comparable to that used by amateurs in band spanning.

For the next two bands the manual trimmer will take up all differences adequately, even though the coils are equal. The intermediate frequency remains the same, of course. The original carrier frequency becomes higher and higher, also the oscillator frequency, but the difference between oscillator and modulator frequencies (the intermediate frequency) becomes a much smaller percentage of the radio frequency carrier.

We wound up previously at 4,000 kc, and will tune each circuit, on account of the 0.00035 mfd. capacity, to around 12,000 kc. At 4,000 kc the difference or intermediate frequency is only a trifle more than 11 per cent. of the modulator or radio frequency level, while at 12,000 kc the intermediate frequency, or difference, is only 3¾ per cent., and the manual trimmer can take care of the extremes, as well as of the still smaller percentage of difference for the smallest coils whereby we tune to 30,000 kc. That explains why the coils are different for tuning the largest coil, lowest frequency band, but the same for tuning the two remaining bands.

Intermediate Coils

The circuit is a superheterodyne, with modulator, oscillator, one stage of intermediate frequency amplification, detector (so-called second detector) and one stage of audio, with 280 rectifier. The modulator, or first detector, has a grid leak and condenser, while the second detector uses negative bias or power detection.

Many no doubt will wonder whether much can be obtained from a single stage of intermediate frequency amplification. If the intermediate primaries are large the sensitivity will be high enough, and therefore it is recommended that choke primaries be used. These consist of 200 to 300 turn honeycomb coils of a small enough diameter across total completed winding to fit inside of the form on which the tuned grid winding is put. The honeycomb coil may be near one end of the grid winding.

The choke primary alone gives a broad resonance around the low frequency end of the broadcast band, and this is sufficient in the case of the primary in the plate circuit of the modulator to detour the high radio frequencies or short waves without requiring a condenser from plate to ground, although a small one may be placed there, if desired, say, 50 mmfd.

Likewise the primary in the plate circuit of the intermediate frequency tube (second from upper left) should be of the same choke type, because the frequency handled is the same. Then there will be plenty of pep in the set, despite the single stage of audio, for it should be remembered that this audio stage is regenerated at audio frequencies by the method of dynamic field connection, to utilize the drop in part of the field coil for pentode bias.

Intermediate Regeneration

It will occur to many that the intermediate stage may be regenerated at radio frequencies, and this is wholly practical. An equalizing condenser may be connected from plate to grid of the same tube (second from upper left), or a condenser of 0.00035 mfd. may be connected from plate of that tube to a tap about two-thirds the number of turns down from the grid end of the secondary, or by having a plate winding in inductive relationship to the secondary for feedback, or by using any other method of regeneration, including a resistor and a condenser from second detector grid to intermediate grid, when it may be necessary to reverse the connections of primary or secondary of either circuit to insure regeneration, because of the phase shift in the coupling tube.

Regeneration in the intermediate stage is recommended for experimental trial, since there will be some extra volume and sensitivity, but is not shown in the diagram because it is simpler to omit it and the circuit works very well without such regeneration.

Looking out of the second detector, the capacity may be large enough inherently not to require a plate bypass on condenser, but one should be tried, from plate to ground, using from 0.00025 mfd. to 0.0015 mfd., any one of these values sufficing. Detecting efficiency will be aided if such a condenser is included, provided the inherent capacity is not itself large enough to serve the radio frequency bypassing object.

Fits Into Midget Cabinet

The plate load resistor is 0.25 meg. (250,000 ohms), and in series with it is another resistor, of 0.5 meg. (500,000 ohms), bypassed, however, by an 0.1 mfd. condenser, while a similar resistor-capacity filter is placed in the grid circuit. The object of both of these filters is to minimize the hum.

The pentode circuit and rectifier are hooked up in a manner consistent with the midget set models familiar to readers. In fact, the present set may be housed in a midget cabinet, as the chassis is only 13½ inches wide by 9½ inches front to back by 3 inches high. The height specified represents the right angle bends at front and rear of chassis.

The pentode tube has standard connections for power tube grid, plate and filament. The screen shown in the filament circuit is built into the tube and requires no external connection. The accelerator grid (sometimes called the suppressor grid) is represented by what would be the cathode connection for heater type tubes and goes to the maximum B plus lead after filtration.

27 Times as Great as 245's

The word accelerator is used to designate the screen of the pentode because the intended flow of the electrons is augmented by this element. The word suppressor is sometimes applied because the acceleration previously referred to is achieved by suppressing the secondary emission of the tube, representing the rebound flow of electrons from plate back to filament. The intended electron path is from filament to plate. When that path is immunized from rebound electrons the amplification factor of the tube becomes much greater. So we have a mu factor of 95 for the 247 pentode, as compared with 3.5 for the 245, and the amplification factor of the 247 is a trifle more than 27 times as great as that of its predecessor.

Instructions on Coil Winding

Here are the directions for winding all coils:

L1, L4, L5—Using 1⅛ inch diameter tubing, about 2.25 inch long, wind 5 turns at one end, and 5 turns at the other end. Leave ⅛ inch space, wind 5 turns. The wire is No. 28 enamel. About 1.5 inch separation will result. The modulator winding is placed toward the switch.

L2, L6, L7—Using 1⅛ inch diameter tubing, about 2.25 inches long, wind 12 turns of No. 28 enamel wire at one end, 12 turns at the opposite end, resulting in a little over 1 inch separation, and put on a 9 turn tickler winding directly adjoining the oscillator secondary, but without allowing the wires to touch, coil for coil. The plate coil may have any size insulated fine wire.

L3, L8, L9—Using 1⅛ inch diameter tubing, about 2.25 inches long, wind 35 turns for L3 of wire, No. 31 or thereabouts, at one end of the tubing, and 27 turns for L9, at the other end of the tubing, which affords about ½ inch space between, putting a 15-turn tickler, any insulated fine wire, directly adjoining the oscillator secondary.

Oscillation will result if the windings for oscillator grid and plate coils are put on in the same direction, and the adjoining terminals of either are connected respectively to plate and grid or respectively to B plus and ground, but will not result if these connections are made to grid and B plus or to ground and plate.

INTERMEDIATE COILS—Using 1⅛ inch diameter, 2.25 long, put on 127 turns of wire, No. 36 or thereabouts, and place inside, near one end, a honeycomb coil of 200 to 300 turns.

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A Seven Tube Mid

Single Tuning Control and

By Burton

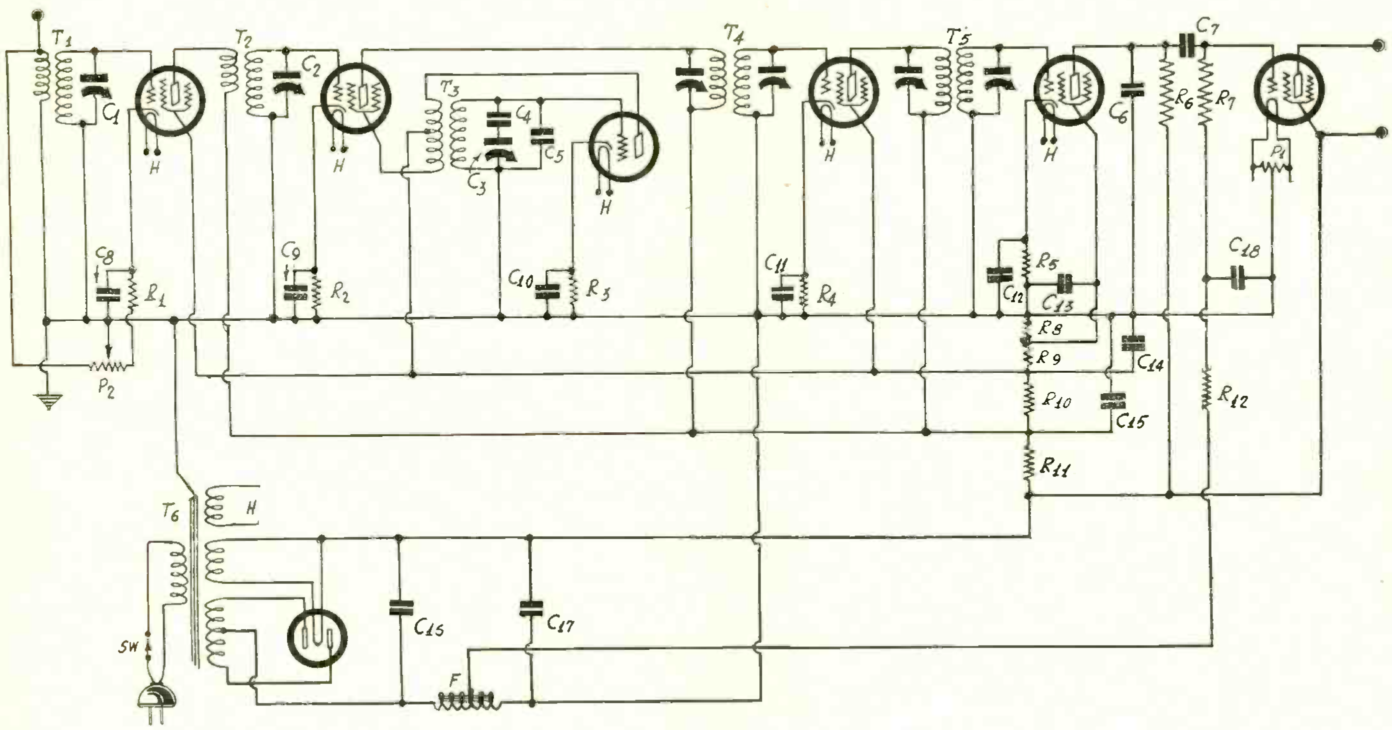


Fig. 1

The circuit diagram of a midget seven tube superheterodyne

LIST OF PARTS

Coils—

T1, T2—Two shielded radio frequency coils for 350 mmfd. condensers, as described.
T3—One oscillator coil, as described.
T4, T5—Two 175 kc intermediate frequency, doubly tuned transformers.
T6—One midget type power supply transformer.
F—Speaker field, 1,800 ohm resistance with tap ot 300 ohms from ground side. (This is part of the speaker.)

Condensers—

C1, C2, C3—One three section, 350 mmfd. tuning condenser.
C4—One 750 mmfd. condenser with a 100 mmfd. trimmer across it.
C5—One 100 mmfd. trimmer condenser.
C6—One 0.001 mfd. condenser, mica dielectric type.
C7, C8, C9, C10, C11—Five 0.1 mfd. condensers.
C12, C13, C14—Four 0.1 mfd. larger condensers.
C15—One 0.25 mfd. condenser.
C16, C17—Two 8 mfd. electrolytic condensers.
C18—One 0.1 to 0.25 mfd. condenser.

Resistors—

R1, R4—Two 300 ohm resistors.
R2—One 3,000 ohm resistors.
R3—One 2,000 ohm resistor.
R5—One 30,000 ohm resistor.
R6—One 250,000 ohm resistor.
R7, R12—Two 0.5 megohm grid leak.
R8—One 3,500 ohm resistor.
R9—One 5,000 ohm resistor.
R10—One 6,000 ohm resistor.
R11—One 3,000 ohm resistor.
P1—One 30 ohm, center tapped resistor.
P2—One 10,000 ohm potentiometer.

Other Parts—

One vernier, illuminated dial for tuning condensers.
Sw—One line switch, mounted on P2.
Six UY type sockets.
One UX type socket.
Four grid clips.
One special midget chassis.

THE midget seven tube superheterodyne is just a step from the midget five tube radio frequency set. But it is more sensitive and more selective and it is not subject to many of the difficulties which are encountered in the tuned radio frequency set, oscillation in particular. Unfortunately, the superheterodyne is subject to troubles all its own. But they are not serious any more because radio design has progressed to the point where the cause of the troubles is well understood, and when any trouble is understood the remedy usually suggests itself.

We show in Fig. 1 the circuit diagram of a seven tube midget which has been built on the chassis used for a five tube midget tuned radio frequency set. The two extra tubes are the oscillator and the intermediate frequency amplifier, a 227 and a 235, respectively. Each type of midget has three tuning condensers but in the superheterodyne one of them is in the oscillator circuit. Only one tuned radio frequency stage, and two radio frequency tuners are used. The two radio frequency tuners are identical and are closely trimmed. The oscillator has nearly the same inductance, but the total effective capacity is quite different, as is the rate of change of capacity as the tuning condenser is turned. The oscillator must always generate a frequency which is 175 kc higher than the frequency to which the t-r-f circuits are tuned. In order to bring about the right change in the oscillator capacity a condenser C4 is connected in series with the variable condenser C3 and another, C5, is connected in parallel. By proper choice of values of these condensers the oscillator can be made to track well throughout the tuning range. Thus one of the inconveniences of the superheterodyne, two tuning controls, is eliminated.

The treatment of the oscillator condenser in this manner is usually called padding. The series condenser is of the order of 750 mmfd. and the shunt condenser of the order of a 25 mmfd. While C4 is shown to be fixed, in practice it is usually necessary to put a trimmer condenser across it in order to permit closer adjustment of the capacity. C5 is a trimmer.

In case it is not possible to get close adjustment at 175 kc with the condensers at hand, it is also possible to adjust the intermediate frequency to a different value by means of the trimmer condensers built into the transformers. For example, with a given combination of C3, C4 and C5 it may be that an intermediate frequency of about 180 kc, or 185 kc, will make the adjustment just right. Another way of making the adjustment is to make small changes in the inductance of the oscillator. These adjustments can only be made experimentally, but they are not especially difficult once the method is understood.

The two radio frequency transformers T1 and T2 are regular

get Superheterodyne

175 kc Intermediate Used

Williams

midget tuning coils wound for 350 mmfd. condensers encased in metal shields. T3 is a special coil, not encased with a shield, but having nearly the same inductance value as the others.

Intermediates

The two intermediate coils T4 and T5 are standard doubly tuned transformers nominally tuned to 175 kc but adjustable over a small range both above and below that frequency.

The volume is controlled with a 10,000 ohm potentiometer, P2, connected between the antenna and the cathode return of the first tube. Ordinarily when two tubes are controlled in this manner the resistance of the potentiometer is made 5,000 ohms but when only one tube is on the control it is necessary to increase the resistance to insure a greater range of volume control. This is also necessary from the fact that the sensitivity of the super is much greater than that of the five tube midget tuned radio frequency receiver. The bias resistance R1 for this stage is 300 ohms.

The next tube is the modulator, a screen grid tube of the 224 type. Its bias resistance R2 is 3,000 ohms. This gives the best detection efficiency when the screen voltage is 75 volts and the plate voltage is 180 volts.

Oscillator

The oscillator, which is the third tube in the circuit, is of the 227 type. Its grid bias resistance R3 is 2,000 ohms. The fourth tube is the intermediate frequency amplifier and it is of the 235 type. The bias resistance R4 for this tube is 300 ohms.

The detector tube is a 224 with a bias resistance of 30,000 ohms, a screen voltage of 30 volts, and a plate voltage of about 270 volts, which is applied through a plate resistance R6 of 250,000 ohms.

The stopping condenser C7 has a capacity of 0.01 mfd. and the grid leak a resistance of 500,000 ohms.

The final tube is a 247 pentode for which the grid bias is obtained from a 300 ohm section of the field coil of the dynamic speaker, which is also used as the filter choke in the B supply. This is the same arrangement as is used in most up-to-date midget receivers.

Voltages

The power transformer used has an output voltage such that the net voltage on the plate and screen of the power tube and that on the plate of the detector about 270 volts and the voltage drop across the loudspeaker field is nearly 100 volts. The field has a resistance of 1,800 ohms and therefore the current is 55.5 milliamperes. Of course this varies somewhat with the bias on the tubes, for the current in the speaker field is the total current taken by all the tubes and the voltage divider.

The voltage applied to the screen of the detector tube is 30 volts, and this is the drop in R8, which has a value of 3,500 ohms. The bleeder current is therefore 8.6 milliamperes. The voltage on the screens of the 235 tubes and on the plate of the oscillator is 75 volts, so that the drop in R9 is 45 volts. Now only a slighly greater current flows through R9 than through R8. Let us assume it is 9 milliamperes. Therefore R9 should have a value of 5,000 ohms, that is, 45/.009.

The current flowing into the tap between R9 and R10 is about 8 milliamperes. Hence the total current in R10 is 17 milliamperes. The voltage on the plates of the screen grid tubes is 180 volts and therefore the drop in R10 is 105 volts. Hence the resistance value of R10 should be 105/0.017, or about 6,000 ohms. In a midget five tube receiver this resistance is often 12,000 ohms.

Resistance R11 drops the voltage from 270 to 180 volts, or 90 volts. The current in it is about 30 milliamperes. Hence R11 should have 3,000 ohms.

Averages Given

These values are not at all critical and those given are averages. The voltages may be varied over rather wide ranges, which means that the resistances in the voltage divider may be varied over wide wide ranges, too. The only voltage that is at all critical is the screen voltage on the detector, but even this is not so critical that commercial resistors cannot be used even if they deviate from nominal values as much as 10 per cent.

Wattages

In the design of commercial sets it is necessary for economical reasons to use the lowest wattage rating for resistors that will serve, because doubling the wattage rating nearly doubles the cost. For this reason we shall compute the wattage dissipations in all the resistances occurring in this circuit. In each case the wattage is the resistance multiplied by the square of the current, expressed in amperes, flowing through that resistance.

R1 has a value of 300 ohms and the current through it is about 8 milliamperes. Hence the wattage is nearly 20 milliwatts. Any resistor designed for grid bias use will do, as all have much higher rating. R2 has a resistance of 3,000 ohms and the current through it is less than one milliampere. Hence the wattage dissipation is less than 3 milliwatts. Again any resistor designed for grid bias use will do.

R3 carries a current of about 4 milliamperes and the resistance is 2,000 ohms. Hence the wattage is 32 milliwatts. There is no question about the adequacy of a grid bias resistor that is wire wound. R5 carries a current of only 0.1 milliampere and it has a resistance value of 30,000 ohms. Hence the wattage dissipation is 0.3 milliwatt. Resistances of the type suitable for this purpose comes in 0.5, 1.0, and higher wattage ratings. There is no need for using one of higher rating than 0.5 watt.

R6 has a value of 250,000 ohms and it carries a current of 0.1 milliampere. Therefore the dissipation is 2.5 milliwatt. This, also, may therefore be a half watt resistor.

Alternating Current Only

R7 carries alternating current only and the peak voltage across it never exceeds 16.5 volts, or the effective value does not exceed 12 volts. Since the resistance is half a megohm, the effective value of the current does not exceed 24 microamperes. This makes the wattage dissipation under the worst conditions less than 288 microwatts. Certainly it is not necessary to use a resistance of higher rating than one-half watt. The same applies to R12, which carries less current and has the same resistance value. This resistance, incidentally, is used, in conjunction with C18, a 0.1 mfd. condenser, to eliminate hum.

Voltage Divider Ratings

The voltage divider resistors require higher ratings. We found that the current in R8, a 3,500 ohm resistor, was 8.6 milliamperes. Therefore the dissipation is 0.26 watt. It is well to use a one watt resistor so that it will not heat up excessively.

R9 was 5,000 ohms and the current through it 9 milliamperes. Hence the wattage is 0.405 watt. We can get along with a one watt resistor of 5,000 ohms. R10 was 6,000 ohms and the current through it 17 milliamperes. Hence the wattage dissipation is 1.734 watts. A one watt resistor is often used at this point, but it is evident that it is overworked. A two watt resistor should be used.

R11 was 3,000 ohms and the current through it 30 milliamperes. Hence the dissipation is 2.7 watts. In many midget receivers this resistance is of one watt rating, and it is obvious why it heats up and burns out. Of course in a five tube midget the current is not nearly as great as that in this super and therefore the wattage dissipation is not so great. By proper choice of resistance values in the voltage divider it is usually possible to use a one watt resistor, but in this circuit it would seem that the lowest possible rating is 3 watts. Such a resistance may be obtained by putting three 1,000 ohm, one watt resistors in series. But it may be cheaper, and certainly better, to use a single resistor adequate rating.

No difficulty will be experienced with the 30 ohm center tapped resistor P1 and the 10,000 ohm potentiometer P2, for both are wire wound and the dissipation in each is negligible.

By-pass condensers are used mainly to provide short cuts for radio frequency currents, except those in the B supply, which are used to take out the ripple. C8, C9, C10 and C11 work at radio

(Continued on next page)

An Improved Six

Low Screen Voltage on De

By J. E.

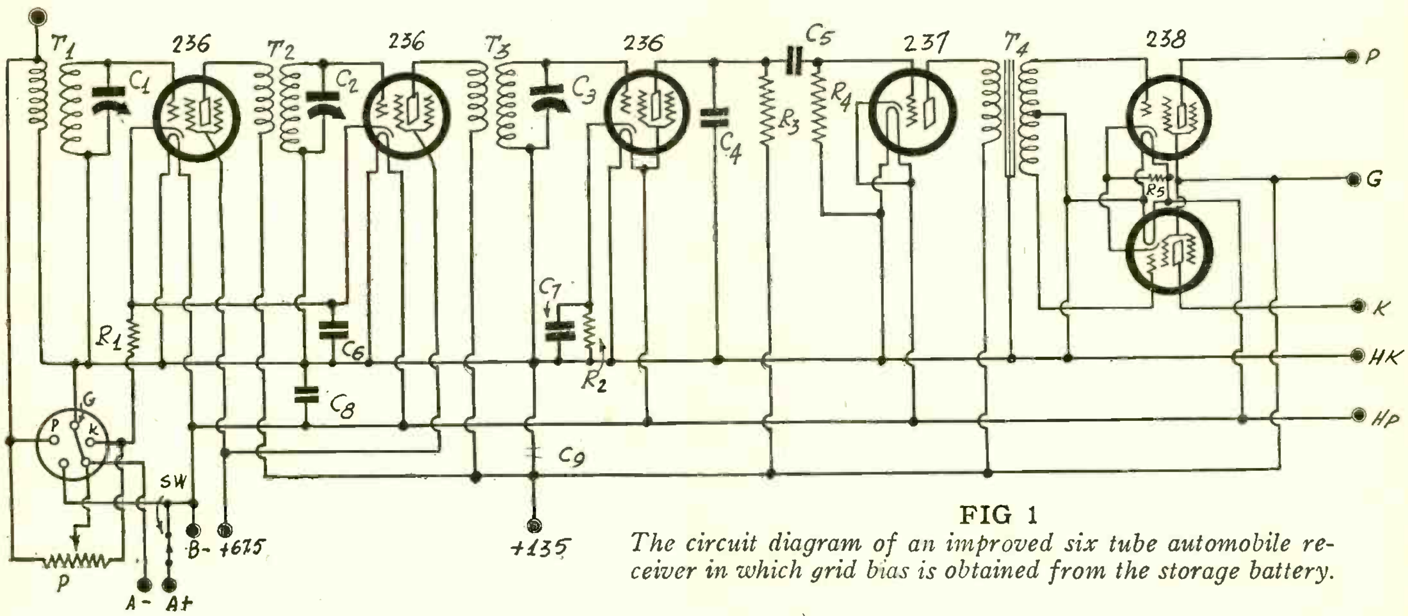


FIG 1

The circuit diagram of an improved six tube automobile receiver in which grid bias is obtained from the storage battery.

[*This is a continuation of auto receiver construction from last week's issue.*—EDITOR.]

MUCH improvement can be effected in the automobile receiver described last week by making use of the voltage in the storage battery for the bias on some of the tubes, and by making a few other appropriate changes. In Fig. 1 is the circuit diagram of the receiver after the changes were made.

The main changes were introduced in the audio frequency amplifier and the detector. It will be noted that the screen of the detector tube is connected to the positive end of the filament battery. Therefore the screen voltage is equal to the voltage of the storage battery, less the bias on the grid. Since this voltage is approximately one volt, the screen voltage is about 5.3 volts when the storage battery is fully charged. It would seem that such a low screen voltage would be entirely too low for efficient detection, but this is not the case. The detecting efficiency is greater with this screen voltage than with a higher voltage, provided that the grid bias is adjusted to the correct value.

It would be desirable to obtain the grid bias on this tube in such a manner that there is no high resistance in the cathode lead, but to effect this it would be necessary either to use a grid battery or else to use a potentiometer of low resistance across the heater circuit. Neither is as desirable as the use of a bias resistance with a condenser across it.

The grid bias is somewhat critical, but the value of the grid bias resistance is not. For example, a variable resistance of 100,000 ohms maximum value was used for R2 and the resistance was changed from maximum to minimum. It was found that 50,000 ohms was approximately the optimum value. But there was good detection efficiency all the way from 40,000 to 100,000 ohms. Below 40,000 ohms the decrease in the detection efficiency was rapid. A value of the bias resistance computed from the 6.3-volt curve in Fig. 1, pages 12 and 13, in the October 31st issue was 64,000 ohms. Of course, this depends on the assumed operating point judged to be the best for detection. Moreover, the curve was taken with 6.3 volts on the screen and not with 5.3 volts. Hence the agreement between the computed and the experimental values is very good. Condenser C7 across R2 with only 0.1 mfd. A value as high as 8 mfd. was put across it but there was no appreciable change in the output of the receiver.

LIST OF PARTS

Coils—

T1, T2, T3—One set of three shielded radio frequency transformers for 0.00035 mfd. tuning condensers.
T4—One push pull input transformer.

Condensers—

C1, C2, C3—Three 0.00035 mfd. tuning condensers in one gang.
C4—One 0.00025 mfd. fixed condenser.
C5—One 0.01 mfd. fixed condenser.
C6, C7, C8—Three 0.1 mfd. fixed condensers in one case.
C9—One 0.25 mfd. condenser.

Resistors—

R1—One 150 ohm resistor.
R2—One 50,000 ohm resistor.
R3—One 250,000 ohm resistor.
R4—One 500,000 ohm grid leak.
R5—One 300 ohm grid bias resistor.
P—One 5,000 ohm potentiometer.

Other Parts—

Eight UY type sockets.
Five grid clips.
Special remote control containing tuning dial and the potentiometer P.
Special loudspeaker with six volt field.
A special chassis.

Windings for Sev

(*Continued from preceding page*)

or intermediate frequency and each need not be larger than 0.1 mfd. C12 also works primarily at radio frequency and it was found that 0.1 mfd. was large enough. C13 and C14 may also be of this capacity, but 0.25 would be better. C15 should be a 0.25 and this must have a voltage rating higher than 200 volts. The others so far mentioned need not have a high voltage rating. C6 by-passes the intermediate frequency had a value of 0.001 mfd. is recommended. This must stand a high voltage and therefore it is best to use a condenser with mica dielectric.

Windings

C7 should either be a 0.01 or a 0.1 mfd. condenser. The larger value gives somewhat better reproduction on the low notes. C16 and C17 are eight microfarad electrolytics, and one of them, C16, it will be noted, must be insulated from the chassis. That is, the case of the condenser must be insulated as well as the center terminal.

Each of the intermediate frequency transformers is made of two 800 turn duolateral coils mounted at a distance of 1.125 inches between their centers. Across each winding is a 100 mmfd. trimmer condenser and each winding is tuned to 175 kc. Parts as well as the completed transformer are available.

T1 and T2 are equal coils. The secondary of each is wound on

Tube Auto Receiver

tector Increases Sensitivity

Anderson

The first audio frequency amplifier is given a grid bias equal to the voltage of the storage battery. This is simply provided by connecting the grid return, that is, the low end of the grid leak R4, to the negative side of the filament circuit and the cathode of the tube to the positive side. It is obvious that this is a very simple way of getting bias for the tube which makes for very simple connections. A bias of 6.3 volts on this tube, with an applied plate voltage of 135 volts is approximately correct and it is adequate when the tube is followed by a stage of pentode audio.

In the output stage, which contains two 238 pentodes in push-pull, the storage battery voltage is also used in part for the grid bias. However, this is not enough, and it is necessary to boost it by means of a bias resistance R5. It will be noted that the grid return is made to the negative side of the heater circuit just as in the preceding stage. The bias resistance is connected between the joined cathodes and the positive side of the heater circuit. R5 has a value of 300 ohms. The drop in this resistance is about 6.3 volts, which happens to be the same as the voltage of the storage battery. Hence the total bias on the power tube is 12.6 volts. On this voltage the output is satisfactory both as to intensity and quality.

Motorboating

This receiver was first operated with a B battery eliminator. When the power was first turned on there was motorboating, which lasted a few minutes until the circuit had attained its steady condition. The quality was very poor. Both these facts, that is, initial motorboating and poor quality, indicated lack of by-passing in the B supply. When an 8 mfd. condenser was connected across the high voltage line and ground the volume stepped up and the distortion disappeared. Also, when this condenser was connected across the output of the B supply there was no initial motorboating. Hence if this circuit is to be operated with a B battery eliminator, in the home, for example, condenser C9 should be an 8 mfd. electrolytic or other condenser of equal capacity. When the receiver is operated on a 135 volt B battery there is no need of using this large capacity. In the car, of course, a battery will always be used. In this case C9 need not be larger than 0.25 mfd. That was the value put in, and it was used only to by-pass radio frequency currents.

The receiver shown in Fig. 1 will work only when the heater current is taken from a battery. The circuit published last week, on pages 6 and 7, will work on either alternating or direct current on the filaments. But the present set is much superior for automobile use.

Control of Volume

The volume control used in the present circuit is exactly the same as that used in the set described last week, except that the fixed resistance R1 was reduced to 150 ohms. The maximum sensitivity was greater with this value, yet there was no oscillation at any setting of the control or of the tuner.

There is also a difference in the connection of B minus. In the present set it is connected to the positive side of the heater battery, whereas in the circuit last week it was connected to the negative side. There is not much difference between the two connections and they may be used interchangeably. The connection in the present set has the advantage that the storage battery voltage is added to the plate voltage and thus the drop in R5 is compensated for. That is, the voltage on the plates and screens of the power tubes is actually 135 volts. In the circuit last week the net voltage was about 10 per cent less than 135 volts because of the drop in the bias resistance. The voltage on the plate of the first audio amplifier is also 135 volts when this connection is made, since the cathode of the tube is connected to B minus. On the other tubes the voltage in the plate circuits is slightly higher than 135 volts.

Terminal Connections

At the lower left of the circuit diagram is an inverted socket containing the filament and remote volume control terminals. G and Hk are connected to ground. P picks up the antenna and one end of the volume control, and K picks up the lead to the cathodes of the radio frequency amplifiers and the slider on the volume control. Hp is reserved for the positive side of the heater circuit.

At the right are five terminals marked to correspond with the terminals of another socket. This socket is mounted at the rear of the set and is for speaker connections. The plates of the two tubes are connected to P and K on this socket, the G lug to the screens and to the high voltage bus. G, of course, goes to the center point on the output transformer in the speaker. Hp and Hk pick up the field coil of the speaker. It is not necessary to observe any polarity in respect to these terminals, but throughout the set, that is, all the eight sockets are wired the same way. Hk is negative and Hp positive. If this convention is observed connections are simplified and chances for error in connecting the grid returns and screens are lessened.

Results

The receiver was tried out under conditions simulating those met with in the average closed car and it gave excellent results. It was found that all local stations could be received with loudspeaker volume, in the middle of the day, without a ground and with an antenna only two feet long. With a ground the results were somewhat better and with an indoor antenna there was nothing to be desired.

The power tubes could be overloaded on all local stations, even without ground or antenna, other than the two foot wire, and it was always necessary to work the set considerably below the maximum sensitivity in order to clear up the signals. This augurs well for reception in a car in the day time as well as at night.

While the power tubes could easily be loaded up to the limit, as much volume could not be obtained with these two tubes in push-pull as with a single 247 tube. But there is more than enough volume for a car, or even for a home, even when the tubes are worked well below the overloading point.

Dimensions of Set

The chassis is almost the ultimate of compactness. It is only 8 inches long, 6 inches wide, and 7.5 inches high at the highest point. These diminutive dimensions are made possible by the use of the small automotive tubes, small coils and a compact tuner condenser unit.

Of course, the chassis is not the complete set. There is the remote control device mounted on the steering gear of the car, and there is the loudspeaker, and again the batteries. The remote control device occupies very little room and is entirely out of the way. The car battery is used so no extra room is needed for the filament supply. Only the leads need be provided.

The loudspeaker may be placed on the dash board behind the instrument panel where it also is out of the way. Only the plate batteries require considerable extra room, and they, by the way, are considerably larger than the chassis, even if medium size batteries are used. There are many places where the batteries can be tucked away and one of them is under the rear seat. Room may even be found under the front seat if the tools are packed carefully. Room could possibly be found in the engine compartment but this is not a desirable place for batteries because of the heat. Dry cell batteries should be kept in a cool place.

A good place for the chassis is on the dash board beside the loudspeaker. A special steel box fitting the chassis is used for housing the set. This box is arranged to mount on the dash board.

en Tube Midget

a one-inch diameter with 127 turns of No. 36 enameled wire. Each primary contains 50 turns of No. 40 silk enameled wire. The primary is wound over the ground end of the secondary and is separated from it by several layer of thin empire paper.

Oscillator Coil

The oscillator winding may be put on a form of the same diameter as the forms of the r-f coils, and the same size wore may be used. The tuned winding should also have the same number of turns as the tuned windings of the other coils, namely, 127. The primary or tickler winding should have at least 50 turns but not more than 85 turns. The number of turns on this winding is not important. They may be wound in the same manner as the primaries of the t-r-f coils. The pick-up winding should have 15 turns of the same wire as is used for the tickler, and it may be an extension of the winding. That is, the tickler may contain enough turns for both the regeneration and the pick-up. One end of this winding then should be connected to the plate of the oscillator and the other to the screen of the modulator, the tap going to the positive voltage.

The oscillator coil is mounted under the subpanel and it is not shielded like the radio frequency coils.

The Diode as a Detect

System Works Well with Tw

By Herman

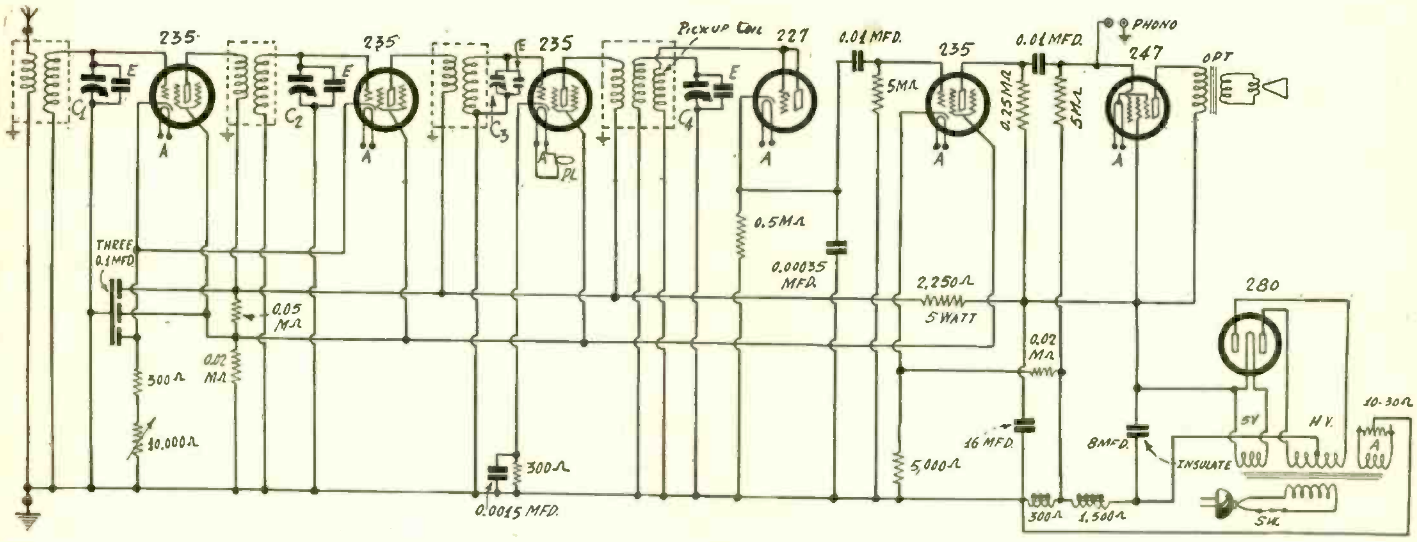


Fig. 1.

Excellent results were obtained from this circuit. The diode permitted true linear detection, in line with the 100 *per cent modulation of the principal broadcasting stations.*

ABOUT a quarter of a century ago John A. Fleming, an English scientist, gave the world the two element tube. Sometime thereafter he was knighted, and now he is known as Sir Ambrose, for the middle initial stood for Ambrose, and probably he believed that Ambrose, rather than John, was in keeping with the dignity of knighthood.

Anyway, John A. Fleming gave to the world something of extreme importance. Attempts to make progress with radio were retarded by many things, and one of them was detection. There had been the crystal, electrolytic and coherer detectors. The crystal was a mineral, critical of adjustment and of uncertain sensitivity. The electrolytic detector was messy and unstable. The coherer lacked sensitivity and the filings would stick together. Then came the detector tube and Fleming's worldwide fame. It was a detector only. It was left to Lee De Forest, of the United States, to give the world the three element tube, which amplified and oscillated and made present broadcasting possible.

A Kind Word for the Past

However, in all the furor of present developments in radio perhaps something is lost by failure to respect the works of the past. Our present detection is virtually exclusively of the leak-condenser or negative bias type, using amplifying tubes as detectors, and with the tide running strongly toward the bias variety. Yet either of these types will overload, one more quickly than the other, while the amplifying property leads to some feedback troubles, on occasion, and the situation gives us good ground to look into the workings of the two element tube, once again, as detector.

It may seem a strange combination to unite a sensitive and selective tuned radio frequency channel with a two element detector, and then use resistance coupled audio, for it would appear that the detector will not be so very sensitive, and that we will lose a great deal, compared to other methods.

However, let us give the earliest detector tube a trial. To do this we must use a three element tube with grid and plate tied togther, bcause diodes (two element tubes) are not generally available. So for an alternating current model set we select a 227 tube. The result is an actual diode.

Why Rectification Results

Another requirement is that the input be radio frequency and the output audio frequency, which is true of all types of detectors used in this position, but which requires special precautions in the case of the diode because the input is from anode to ground and the output is from cathode to ground. So we put a third winding on a radio frequency transformer, using this extra inductance as pickup coil, and connecting it with one side to the anode (grid-plate) and the other to ground. Since the tube will pass current in only one direction, the output, from cathode to ground, will be rectified.

The method used in building the circuit, Fig. 1, was to take a standard radio frequency transformer and mount inside its secondary a honeycomb coil of 300 turns, although almost any of the small honeycomb coils will do, or an extra winding can be put over the secondary, say, 20 turns.

The output from this receiver was measured. and then the detector was replaced with a power detector, by inserting a grid biasing resistor, using plate voltage, and resorting to the rest of the requirements. Now, the measured output of the system using the diode was 10 per cent. greater than when power detection was used, at the same selectivity level. Surely this was a surprise.

A Truly Linear Detector

The quality of the receiver was much better when the diode was used.

Can this be treason?

The diode was a truly linear detector. The output characteristic curve was practically a straight line.

Both the radio frequency and the audio frequency channels were more stable. This may be ascribed to the non-amplifying properties that, for radio frequencies, reduced feedback to below the oscillation point, and for audio frequencies did likewise. The full grounding of the detector circuit no doubt helped.

If the tube does not amplify, how can the output of the system be greater?

The answer must lie in the fact that the instability was removed, permitting greater gain, and also to the accompanying fact that the sensitivity of the system depends to some degree on the coupling from the radio frequency amplifier to the detector, and the diode supports the stronger coupling. The standard method of strengthening the coupling would be to increase the impedance of the plate winding of the previous radio frequency tube or tubes, hence the set is then brought nearer to actual squealing.

Diode's Virtues

The object is to present a report on the diode. A complete circuit is shown simply because many of the connections would

or in a Modern Set

o-Stage Regenerated Audio

Bernard

be required anyway, and the few extra ones are justifiable, since many may desire to build such a receiver. This is a worth while undertaking. Or, if one desires to change over an existing set, with the first purpose of improving the quality, then the detector circuit may be rearranged as shown, and it is advisable to use the audio channel exactly as presented.

While we are going back a quarter of a century in time, we are not sacrificing progress, for it has been shown that the diode has its virtues, particularly when hooked up to a sensitive radio frequency channel.

As to the audio channel after the detector, we have included improvements that have come to light only in the past few weeks. Readers have noted the articles in these columns about regenerated audio frequency amplification, using resistance coupling. Here is a two stage resistance coupled audio amplifier that is absolutely stable, and one that offers tonal attractions never exceeded.

The pickup coil feeds the radio frequency to the anode of the diode, the audio frequency is taken out through a resistor, marked 0.5 meg., but which may be of higher value without introducing trouble, as values up to 2 meg. were tried successfully.

Cathode Bypass Condenser

Across this resistor should be connected a radio frequency bypass condenser, marked 0.00035 mfd., but which may be anything from 0.00025 mfd. to 0.0015 mfd. Notice that the resistor goes to ground, the bypass condenser goes to ground, the tuned circuit is grounded, both as to coil and condenser, and the leak in the first audio stage is grounded at one end. This is a highly desirable condition for working any tube, but unfortunately can not be accomplished for most tubes. At least in the present instance the possibility of feedback trouble arising from the detector tube in conjunction with any other impedance is removed.

The first audio tube, shown as a 235, may be a 224 without any circuit change, and without any applicable difference in results. The biasing resistor is designated as 5,000 ohms, which would give a bias of about 3 volts negative, but this would be too small, because the applied plate voltage is the full B voltage, around 270 volts, less the bias, or 267 volts. A bias of around 6 volts produces more volume and better quality.

The current in the first audio tube is 0.6 milliampere. From the tap on the dynamic speaker field coil to ground the voltage difference is 18 volts. Therefore the voltage between the cathode of the first audio tube and the tap on the field coil, measured across any relatively high resistor, would be about 15 volts. So the current through 0.02 meg. (20,000 ohms) would be 0.75 milliamperes, so the current through the 5,000 ohm biasing resistor is approximately doubled, hence the voltage is approximately doubled, or is 6.75 volts.

This voltage is not measurable with ordinary meters, because such meters draw too much current relative to the current in the measured circuit.

How Audio Is Regenerated

But the object of the uniting resistor from tap to the first audio cathode is not to provide the correct bias, as that might be done by increasing the 5,000 ohm resistor to 10,000 ohms. The object is to provide audio frequency feedback. In this way the negative feedback through the 5,000 ohm biasing resistor is cancelled, and the effect is that of removing the signal from the biasing resistor, which is the only object in other circuits of using large condensers for bypassing. However, the condensers never can be practically large enough, therefore the regenerated audio system, while much more economical, is much more effective. It will be seen, of course, that there are no bypass condensers across the biasing adjuncts of the audio channel, for there are two bias providers: first, the 5,000 ohm resistor, with its augmented current, and, second, the drop in part of the dynamic field coil. This coil in its entirety is used as the B choke coil also, and regeneration takes place in the 300 ohm section also. Both Rola and Magnavox make speakers of the 1932 type that satisfy the requirements of this circuit.

From B plus to ground (at one end of the field coil) the filter capacity may consist of two 8 mfd. condensers in parallel, because the hum reduction is much more effective that way in a two stage audio amplifier. In single stage resistance audio 8 mfd. are sufficient in this position.

A point that many will notice is that the grid leak in the pentode circuit is 5 meg. This is not a misprint for 0.5 meg., either. The circuit fully supports the inclusion of the high value of resistance.

It has been said that 0.5 meg. is as high a resistance value as may be used with the pentode, and this is relatively true, although it is not so as a broad, general statement. When standard types of detectors are used there is a feedback condition that limits the value of the leak, as higher values bring about motorboating. But here we have a type of detector that rids us once and for all of feedback trouble in the detector, even with the high resistor load values recommended, and therefore it is better to say that 0.5 meg. is as high a resistance as one should use for the grid circuit of the pentode with standard detectors.

However, classification of the pentode grid leak value is not comprehensive either, since the audio channel must be rightly considered as a unit, represented by the single impedance Z, so if there are more than one stage of audio the leak value may be reduced in either a-f stage to effectuate the remedy where standard detectors are used. The discussion so largely surrounds the leak in the pentode stage because many circuits have only one stage of audio, or because (as an additional reason) full recognition of the singleness of audio channel impedance has not gained the widespread respect it deserves.

The tuner requires a four gang condenser, to follow the suggested layout, although for two dial operation either a single and a three gang or two doubles may be used. The primaries of the interstage couplers have fewer turns than ordinarily, because of the extra stage of r-f. Around 15 turns for any of the popular diameters (1 to 1.5 inches) will be sufficient. The primary of the antenna coupler may be an r-f choke coil that fits inside the secondary form.

LIST OF PARTS

Coils

One shielded antenna coupler and three shielded couplers.
One power transformer, filament rating 12 amperes; to afford 270 volts after reduction through 1,800 ohm field coil; 5 volt rectifier winding.
[Note: Pentode output transformer is built into speaker specified later.]

Condensers

One four gang condenser, 0.00035 mfd., 0.00046 mfd., or 0.0005 mfd.
One shielded block of three 0.1 mfd. (black to ground, reds interchangeable.)
Four equalizing condensers (E), but may be built into the four gang.
One 0.0015 mfd. fixed condenser.
One 0.00035 mfd. fixed condenser.
Two 0.01 mfd. mica fixed condensers.
Three 8 mfd. electrolytic condensers with brackets. Insulating washers for one of the 8 mfd.

Resistors

One center tapped resistor, 10 to 30 ohms.
Two 300 ohm electrad flexible biasing resistors.
One 2,250 ohm 5 watt resistor.
One 5,000 ohm Lynch pigtail resistor.
One 10,000 ohm rheostat with a-c switch attached.
Two 0.02 meg. Lynch pigtail resistors (20,000 ohms).
One 0.05 meg. Lynch pigtail resistor (50,000 ohms).
One 0.25 meg. Lynch pigtail resistor (250,000) ohms.
One 0.5 meg Lynch pigtail resistor (500,000 ohms).
Two 5 meg. Lynch pigtail resistors (5,000,000 ohms).

Miscellaneous Parts and Accessories

One chassis, 13.5 inches wide, 9.5 inches front to back, elevated by a flap 3 inches high at front and back; drilled for socket holes.
Seven five spring (UY) sockets and one four spring (UX) socket. The seventh UY socket is for speaker plug.
One vernier dial with pilot lamp bracket.
One dynamic speaker, with 1,800 ohm field coil, tapped at 300 ohms; pentode output transformer built in.
Antenna-ground, and phonograph twin jack assemblies.
One speaker plug (UY) with five lead connector cable.
One a-c- male plug and one a-c cable.

A Laboratory Type Se

Dimensions Given for Receiver Inspired

By Rola

[In last week's issue, dated October 31st, a new departure was instituted when a circuit was proposed for construction, with the statement that it had not been built, that it would be constructed, and a report rendered on the results. More than that, data will be given on the various troubles encountered, their solution, and on the necessity and effect of filtration at radio frequencies. A suggested diagram, with full filtration, published last week. It is expected that next week's issue will contain a report on results on the broadcast band.—EDITOR.]

WORK has been done on the seven tube tuned radio frequency set, 10 to 2,000 meters, since the promise was made in last week's issue that the suggested circuit would be built. However, as a test of radio frequency filters, these will be omitted in the preliminary construction, and added as needed. The object is to determine at about what frequencies the filters become imperative. Also, the resistor-capacity filter will be omitted from the audio circuit, and put in if needed.

The references are to a diagram published last week, showing the intended final circuit, which of course is subject to alteration as experiments require. Herewith is a diagram of the circuit as it is now being built, constituting few changes other than the omissions previously stated.

Inspired by World Range Circuits

Those who read last week's article will recall that the present circuit was inspired by the two sets used at the central frequency monitoring station of the Department of Commerce at Grand Island, Nebr., where three stages of t-r-f and two stages of audio are used for waves below 200 meters, while another set, four stages of t-r-f and two stages of audio, are used for waves from

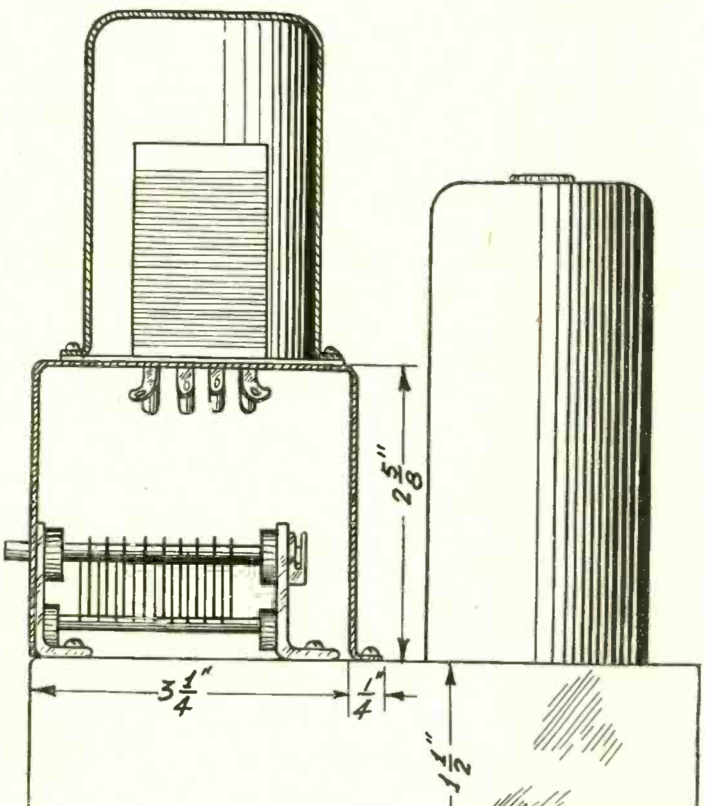
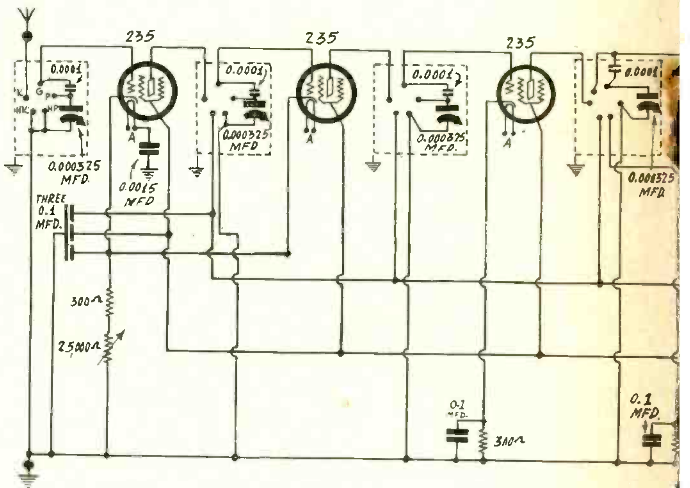


FIG. 1

Detail of end view. A metal chassis 1½ inches high is used. The tuning condenser is mounted on the front of a metal shelf. The top of this shelf has a socket to receive shielded plug in coils. At right is the tube shield.

Set Designed for



The all wave circuit, 10 to 2,000 meters, as it is being buil temporarily as a test of the freq

200 to 2,000 meters. Our confinement will be to a single set, of course, and therefore we select the three stage t-r-f circuit, of our own design, and a-c operated, whereas the sets at Grand Island are battery operated, at least as to filament power. Later we hope to show a battery model, too.

The Grand Island station, due to numerous directive antennas and to a specially selected location as free as possible from unnatural static, is able to receive stations, both code and voice, from every civilized country. This performance we need not expect to duplicate, but we can do as fuch as possible, lacking the inclination to locate at Grand Island and to erect numerous directional multiple doublet antennas.

The T-R-F Is Most Suitable

The main point is that a great many builders, experimenters and students of radio are keenly interested in a set that will give them the fullest possible results, in distance, tone and volume, with the least eccentricities in performance, and the widest latitude of wave coverage. The circuit best suited is tuned radio frequency, because the superheterodyne is not serviceable for wide wave range coverage, on account of the limiting nature of the intermediate frequency, and image interference and repeat tuning points Plug in coils will give the best satisfaction in the circuit, and while there will have to be plenty of them, probably 32, that number is accounted for, first, by the wide frequency coverage, and second by the inclusion of a series condenser to reduce the tuning condenser capacity to 76.5 mmfd., beginning, say, at the 80 meter band.

If the set is desired for use on the broadcast band only, no plug-in coils would be necessary, but shielded coils would fit right into the coil socket holes, with lugs protruding from beneath, for connections to plate, grid, ground and B plus, or plug-in coils may be used, though not removed, that is, the holes would have sockets in them and the pronged coil bases would be plugged in.

Side View of Layout

Fig. 1 shows a side view of the construction. The chassis is of

et, 10 to 2,000 Meters

by Frequency Monitor at Grand Island

nd Tookle

World-Wide Range

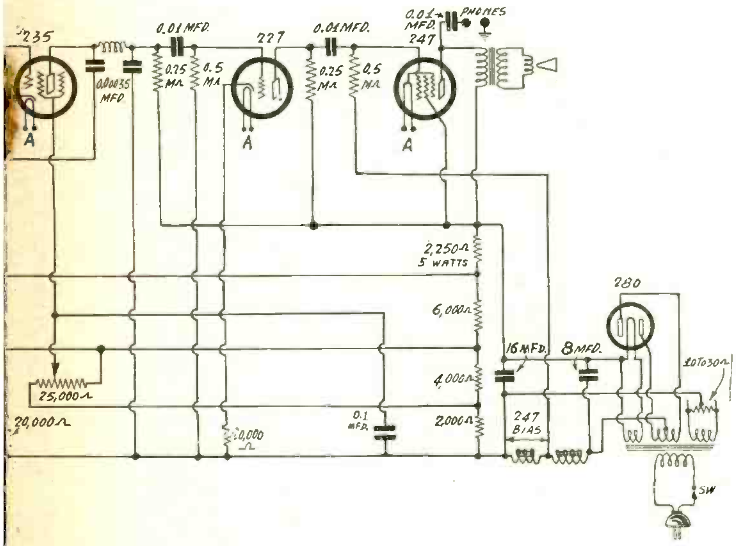


Fig. 2

experimentally. Radio frequency filters are being omitted uency that requires their inclusion.

metal and is 1.5 inches high. At front a U-shaped shelf is attached at its rear to the chassis, while underneath the chassis are drilled holes for further anchorage, by permitting 6/32 screws to engage the threaded holes in the tuning condenser frame. The dials may be simply plain ones without vernier, as the total dial diameter must not exceed 3 inches, and it was found impractical to obtain suitable vernier dials encompassed by that space. Also, due to the separate tuning of each stage with its own dial, and to the sharp reduction in the tuning capacity below 80 meters, a vernier should not be absolutely necessary. If it proves otherwise, a special dial will be made to meet the emergency.

The shelf has no partitions between respective condensers, therefore it is assumed that when the frequencies become high, say, above 5,000 kc, the field between the condensers will be great enough to cause coupling, hence squealing. If so, the partition shields, the ultimate necessity of which is not doubted, will be put in.

Chassis Top Dimensions

Not only is it the object to build the set, but also in building it to make tests of various orthodox and unorthodox methods, and to rely not at all on hearsay, but to work out every problem to its complete solution. In line with such open-mindedness of course will come the inclusion of regenerated audio, as that can be done in a two stage amplifier. Therefore the circuit must be regarded as being in a fluid state, but it will be solidified.

The layout of the chassis top, with an indication of the shelf at front, is shown in Fig. 3. The three electrolytic condensers, one 8 mfd. insulated from chassis, the two other 8 mfd. in parallel, would be located underneath. Hence they would have to be dry electrolytics. There is room, however, for using the wet inverted type also, but three extra holes on the chassis top would be necessary.

A single power transformer, if the 2.5 volt secondary will stand 10.25 amperes, may be located at center rear, where the cutout is shown, or, if you have a transformer that will not stand so much, you may put the first four tubes on a separate filament transformer. The single transformer of high rating makes for a neater and better layout.

Sensitivity Expected

As for what performance may be expected, experience gained from sets with two stages of t-r-f shows that the sensitivity can easily be made to be better than 12 microvolts per meter in the broadcast band, although with insufficient selectivity, using a three gang condenser, so that with three stages of t-r-f, instead of two, and each one separately tuned, there should be no difficulty at all in attaining a broadcast sensitivity of better than 1 microvolt per meter all over the band, with fractional microvolt per meter at the higher broadcast frequencies.

There will be some levelling of r-f amplification on the broadcast band if a choke primary is used in the antenna coupler.

The circuit is intended primarily for experimenters and for laboratory use. It will serve broadcasting stations as well, since many of them want to tune in other stations, particularly wave sharers for the cues derived therefrom, and as well as for checking up on stations operating simultaneously with them on the same frequency, besides picking up foreign stations for various purposes.

One of the best news gatherers in the world is a short wave set, for stations the world over tell something of what's going on in their countries, and in case of big news, devote appreciable time to it.

The Grand Vizier's Escape

A director would please his station's audience if able to report that the short wave station in Xylvanopak had just been tuned in and it was stated that the earthquake was not as disastrous as at first reported, and that the Grand Vizier had escaped in an aeroplane to Frmklopantakuj.

Advertising agencies would find a set useful indeed, as then a complete checkup could be made on chain broadcasts as well as on whether those special recordings really are being aired by the stations that are charging pleasantly for this assistance. Language students could tune in foreign stations to get their accent right.

These uses, of course, are besides the principal purpose of the receiver, that of providing for the home experimenter, the radio enthusiast, student and engineer, a laboratory type receiver of the highest practical attainment.

[*Readers desiring a quick report on first tests of this receiver may obtain it by addressing Mr. Roland Tookle, c/o* RADIO WORLD, *145 West 45th Street, New York, N. Y.*—EDITOR.]

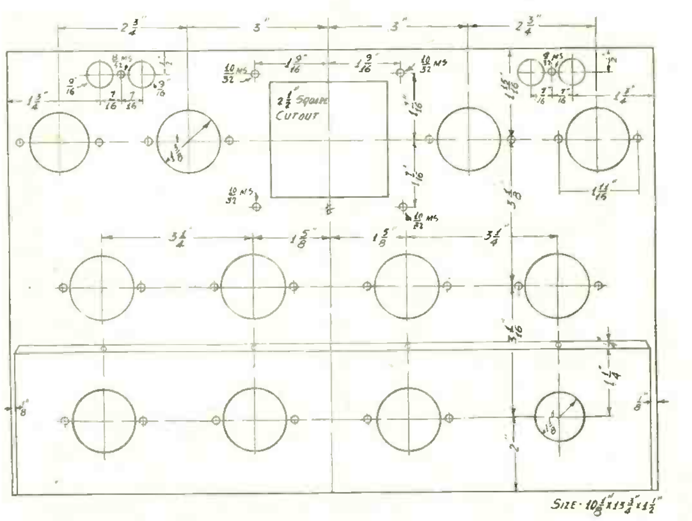


Fig. 3

Dimensions of the chassis used in building the 10-2,000 meter receiver. The rear flap has a hole to pass the a-c cable, while the front flap has two holes for the small rheostat and potentiometer, as well as one for the a-c switch.

Padding the Oscillator

Required change in relative capacities

By Brunsten

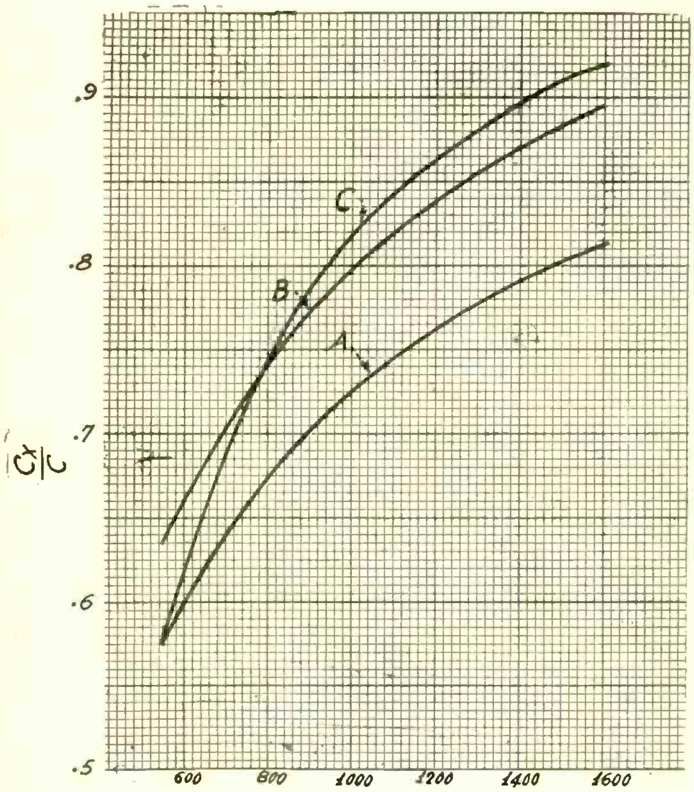


Fig. 1.

Curves showing the relative change in the capacity needed in the tuned radio frequency stages and in the oscillator when the intermediate frequency of the superheterodyne is 175 kc. Curve A shows the required ratio, Curve B the required ratio when the inductances are in the ratio of 11/10, and Curve C are the curve resulting from an attempt at padding.

WHEN the inductances in the oscillator and the radio frequency tuners are the same the required capacity in the oscillator is always smaller than that required in the radio frequency tuners and the ratio between the capacities depends on the relative values of the intermediate and the signal frequencies. If C is the capacity required at any frequency F and Cx is the capacity required at some other frequency F + f, f being the intermediate frequency, then $Cx = CF^2/(F + f)^2$. That is, the ratio Cx/C is equal to the square of the ratio F/(F + f). Therefore the capacity ratio can be determined as soon as the intermediate frequency is given.

The ratio Cx/C for any frequency F, that is, signal frequency, determines the oscillator capacity in terms of the capacity in the radio frequency tuner capacity, and hence a curve showing this ratio against frequency shows the relative change in the two condensers used for tuning. Both capacities decrease, of course, as the frequency increases.

Curve A in Fig. 1 is such curve computed for the frequency range 550—1,600 kc and an intermediate frequency of 175 kc. It will be noted that at 550 kc the oscillator condenser is only 0.575 as great as the radio frequency tuner condenser and that they are nearly equal at 1,600 kc, the oscillator condenser capacity being 0.813 as large as the other.

The shape of the curve has nothing to do with absolute values of capacity or with the shape of the plates of the condenser.

Padding of Circuit

The object of padding the oscillator condenser in a superheterodyne is to bring about the ratio shown in A of Fig. 1. That is to say, the object is to arrange the circuit so that the capacity in the oscillator circuit is Cx when the capacity in the other circuits is C. The capacity is changed by changing the capacity of a condenser which has the value C at all times. Usually, padding requires a condenser in series with the variable condenser and another in parallel.

Curve C shows the result of an attempt at padding. The series condenser capacity was 473.5 mmfd. and the shunt capacity was zero, which means that the minimum capacity in the oscillator circuit was the same as the minimum in the radio frequency circuits. The series capacity was determined so that there would be exact alignment at 550 kc. It will be noted that curves A and C deviate considerably, which indicates that the padding was not good. The rapid deviation at first indicates that the series capacity is too small in comparison with the variable capacity and that the shunt capacity also is too small.

Curve B is the result of changing the inductance of the oscillator so that it is 10 per cent less than the inductance in the radio frequency tuner. There seems to be no advantage in making the inductance different for curves A and B are nearly the same.

Change of Tuning Condenser

It has been supposed that the rates of change of the two variable condensers is the same in the oscillator and the t-r-f. This is not necessary, however, for we can connect a midget condenser across one or the other, or across both and adjust them differently. By connecting an adjustable midget across the variable condenser in oscillator, a fixed condenser of certain capacity in series with thjs combination, and then another adjustable midget across the entire combination, we have the means of lining up the oscillator at three different frequencies. If this is done, the divergence in between any two tie-down points cannot be very great. Suitable tie-down points would be 600, 900, and 1,400 kc.

The most satisfactory way of lining up a superheterodyne is with the aid of an oscillator. First a calibration curve is taken on the radio frequency tuner so that the frequency to which it responds is known at every setting of the gang condenser. Then with a given combination of padding condensers the frequency of the oscillator is measured at various settings. There will be a difference and the ideal arrangement is that which makes the difference 175 kc at all settings. For example, when the condenser is set so that the t-r-f circuit is tuned to 550 kc, the oscillator should generate a frequency of 725 kc. When the condenser is set at 900 kc the oscillator should generate a frequency of 1,075 kc, and so on for all other settings.

Adjusting the Padding Condensers

If there is considerable deviation frfom the 175 kc difference it is necessary to change the padding condensers. Make a small change in the series condenser and measure the frequency of the oscillator again at various settings of the gang condenser. Note the amount of the change. Do likewise for the shunt condenser, leaving the series condenser fixed. It will help a great deal to plot curves of the frequency against the condenser setting, labeling each curve according to the value of the series or shunt condenser used, either in capacity, if this is known, or in arbitrary units, such as turns of the adjusting screw on the adjustable condensers. These curves will show the effect of making certain changes and they will point the way to the final adjustment.

If any curve shows a constant difference from 175 kc the simplest way to adjust the circuit is to retune the intermediate frequency transformers to this constant difference, whatever it may be, provided that it does not differ so much from 175

Condenser
and operating
Brunn

kc that the intermediate cannot be tuned to it.

When the series condenser is reduced in value the effective capacity of the combination of condensers will be reduced, but this reduction will be greater at the maximum setting of the variable condenser than at other end. In order to make up for the reduction it is necessary to increase the shunt capacity. The change in the shunt capacity will effect the greatest change at the minimum setting of the variable condenser.

The series condenser should therefore be changed when the variable condenser is set near the maximum, for example, at 600 kc, and the shunt should be changed at a high frequency.

The simplest way of all to line up the oscillator in a superheterodyne is to put a variable midget across the circuit, accessible from the panel. With this it is always possible to tune the circuit accurately. If the padding is approximately correct this midget need not be large and it need not be touched except when maximum sensitivity and selectivity are desired. No padding can be as good as a variable trimmer. One objection to the use of a variable trimmer is that it adds another control. But this objection is only valid in commercial receivers. In a home built receiver there is really no strong objection, for the fan who builds his own will willingly add the extra control for the extra gain. Another objection is that it is not practical to calibrate the oscillator circuit. But this, too, is not serious for the t-r-f condenser or condensers can always be calibrated, and they will not be affected by the trimmer across the oscillator.

Last week was shown a padded oscillator different from those ordinarily used. C1 in the grid circuit of the 227 oscillator is the series condenser. This should be shunted with an adjustable condenser, or it could be a large trimmer type condenser having a range from about 200 to 1,000 mmfd. E is the shunt condenser, in case connected only across the variable condenser.

In Fig. 2 is the circuit of a typical superheterodyne in which padding is illustrated. Co is the series condenser. As in the preceding case it should be adjustable over a range of 200 to 1,000 mmfd. C3 is the variable condenser which is part of the gang. In most circuits the shunt condenser is connected across this alone, but in the present circuit is connected across Co and C3. That is, Ct is the adjustable trimmer.

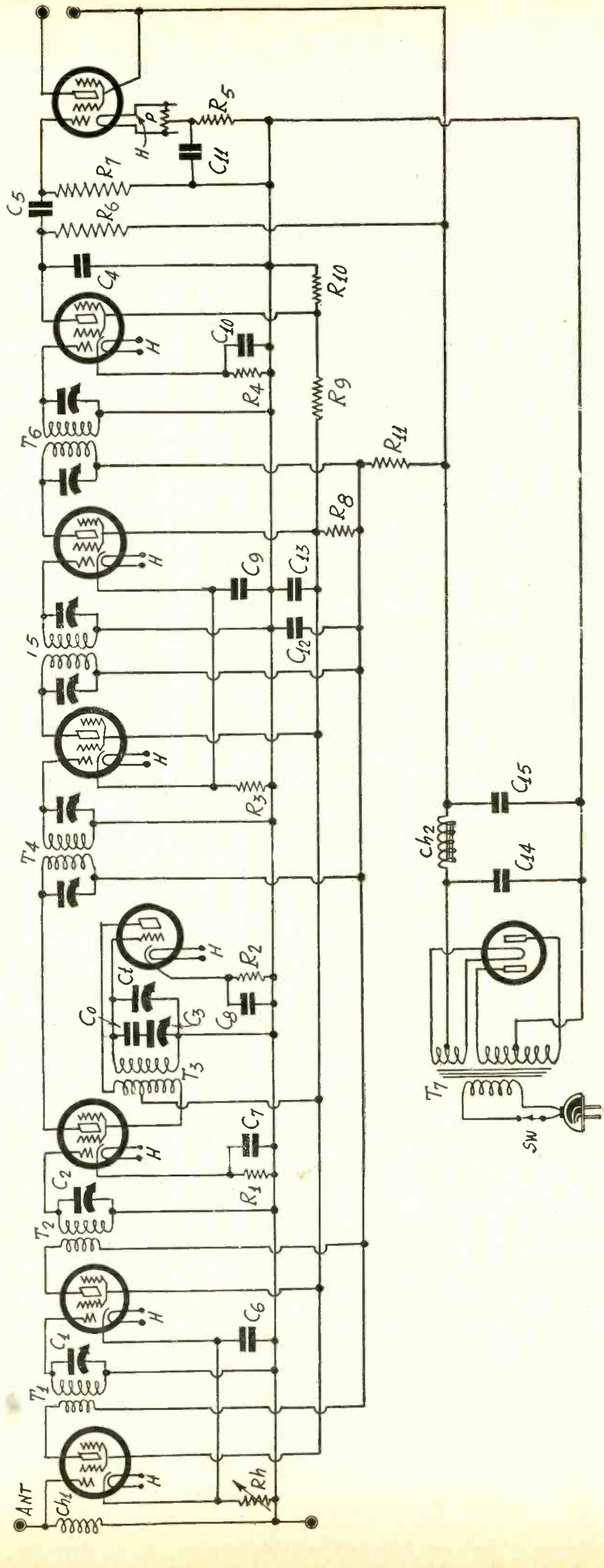


Fig. 2
A superheterodyne with the oscillator (fourth tube from upper left) padded in the manner generally utilized in commercial receivers. Co is the series condenser, Ct the tuner, C3 the tuning capacity.

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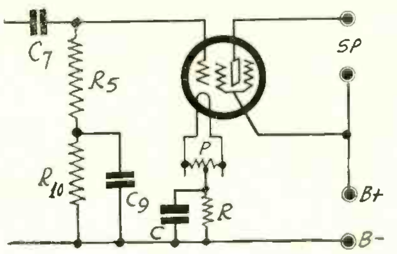
FIG. 964
A resistor capacity filter, used for hum reduction and stability, consisting of R10 and C9.



Wants to Improve Meter Sensitivity

HOW can I improve the sensitivity of my meters? I have current meters, 0-10 milliamperes, 0-100 milliamperes and 0-400 milliamperes, also two voltmeters, 0-6 volts and 0-100 volts. I would like to get higher voltage readings.—T. J. R.

There is nothing you can do to improve the sensitivity of your meters, as the sensitivity is built into the instruments as a part of the manufacture, and has to do with the current drawn at full scale deflection. The less current, the greater the sensitivity. It is usual to express the sensitivity in terms of ohms per volt, obtained by dividing the full scale voltage reading into the total resistance of meter and series resistor. Another way to express the sensitivity is in terms of the current at full scale deflection. Thus a 0-1 milliammeter would have a sensitivity of 1 milliampere. If it were used as a 0-100 volt voltmeter, there would be a total resistance of 100,000 ohms. Thus the sensitivity is 1,000 per volt, or 1 milliampere. The current value is computable from the ohms-per-volt value, since the current in amperes equals the voltage at full scale deflection divided by the resistance, or 100/100,000=0.001 ampere=1 milliampere. Extending the range of voltmeters has nothing to do with sensitivity. You would have to ascertain from the manufacturer or otherwise the full scale current of the meter and the meter resistance, and add series resistance, so many ohms for each volt extention, depending on the full scale current and the meter resistance.

* * *

Receivers, Today and Yesterday

HOW does the performance of receivers manufactured to-day compare with that of receivers made a few years ago? Has there been any marked improvement? Is full wave coverage practical and what is the best means of achieving it?—P. O. G.

Improvement in tubes, so that not only high amplification is obtainable from special types, but also troubles are averted that were present in the early high gain tubes, has made possible the building of receivers that do as much on few tubes as previous sets did with several more tubes. In alternating current sets the variable mu tube has made possible the minimization of crosstalk and crossmodulation despite the high gain, essentially by reducing the detecting characteristic of a tube used as a radio frequency amplifier. In battery operated and direct current line operated sets there has been comparable improvement, with more economical operation, and also tubes primarily intended for automotive use are practical in direct current line sets. Speakers have been improved, so that they are more sensitive and more faithful reproducers, thereby adding to economical and tonal achievement. A set made a few years ago may be as good as a set made to-day, but you will find that to attain parallel results the old set was larger, more expensive, had more tubes and used considerably more audio frequency amplification, which might mean considerably more distortion was present. Sets today generally favor a stage of resistance coupled audio, and many of them use regenerated audio, dispensing with the need for large bypass capacities. The hum level will be lower, as the radio frequency gain is high, the audio gain low, and the filtration is far more effective on the current flowing to the radio frequency tube plates, screens and cathodes. Coverage of wide wave bands is entirely practical. The separately tuned stages of radio frequency amplification with the plug in coils are preferable for best results on wide coverage, say, 15 to 2,000 meters, because ganging of tuning condensers reduces the sensitivity and selectivity and renders thorough shielding difficult. The superheterodyne system is not suitable for such wide coverage, because one must select a given intermediate frequency, yet the intermediate frequency should be high for short waves and low for long waves. A low intermediate frequency makes the tuning of modulator and oscillator almost identical for short waves, so it is hard to prevent interlocking, or separate frequency maintenance in these two circuits. A high intermediate frequency renders it awkward to arrange a suitable tuning combination for modulator and oscillator for long waves. Therefore sets of this type to tune from 200 to 2,000 meters favor frequencies around 90 kc, while sets to tune from 15 to 550 meters favor frequencies between 175 kc and 450 kc. The results from plug in coils can not be exceeded by coils using switching systems, although a few of the latest switching devices come very close to, or equal, the performance obtainable from plug in coils.

* * *

Layout for Small Set

I DESIRE to build two stages of tuned radio frequency amplification and one stage of audio in a compact assembly. Will you please suggest a layout?—G. D.

See Fig. 965. The first radio frequency tube is at left rear, the second r-f tube beside it, the detector tube at right front and the first audio tube behind it. This layout is for battery operation. If a rectifier is to be included, this tube may be placed at the rear of the three gang tuning condenser.

* * *

Lamp Indicator at 5 Meters

IN working around 5 meters is it possible to use a lamp as an indicating device (resonance) or would the lamp draw too much current?—L. G.

It is possible to use a lamp. The test is whether the inclusion of the lamp stops oscillation. If it does not stop oscillation then the lamp may be included. Many have worked pilot lamps in this way. At the New York radio show in 1925 William A. Bruno demonstrated in a booth a 5 meter oscillator with a lamp as resonance indicator.

* * *

Rectifier Type Detector

CAN you tell me whether the rectifier type of detector is any good? I have seen occasional mention of this type in your columns, but I did not see any performance characteristic.—J. H.

The rectifier type of detector is a good one, particularly as it will not be overloaded by radio signal. For instance, a 227 tube used in that fashion would stand 20 milliamperes quite readily, yet nothing even faintly approaching that current will flow through the tube. In a given test, with a 500,000 ohm resistor from cathode to ground, the voltage drop was 5 volts, measured with an electrostatic voltmeter. So only 1 microampere was flowing, and the station tuned in was a local, the receiver having a sensitivity of 20 microvolts per meter. The hookup consists of grid and plate tied together, a pickup coil going from this juncture to ground. The resistor is in the cathode to ground circuit with a 0.00035 mfd. to 0.001 mfd. fixed condenser across it. The hookup then continues as if the cathode were the plate. The sensitivity of such a detector is about the same as that of a negative bias or power detector, using the same type tube. The interstage coil has three windings, one for plate circuit of preceding tube, another for the tuned circuit, with one terminal of this winding grounded as is the condenser, and with the third or pickup coil grounded on one side and tied to plate-grid on the other.

* * *

Resistor Capacity Filter

FREQUENTLY I see diagrams of audio hookups where there is a resistor intercepting the grid return, with a bypass condenser. Please state the values and explain the inclusion of these parts.—D. M.

In Fig. 964, R5 is the grid load resistor, while R10 and C9 constitute the resistor capacity filter. The values are 0.5 meg. for both R5 and R10, where the output tube is a pentode. C9 is not critical and may be 0.1 mfd., 0.25 mfd. or a little higher. The object of such inclusion is hum reduction, as the ripple is restrained from backing up into the grid circuit. On the face of it, the filter looks like a low pass filter, as R10 increases the grid load resistance and C9 is ineffective on low frequencies. However, the height of the signal voltage makes the condenser more effective and the condenser also introduces a phase shift.

* * *

Neon Lamp Indicator

SOME sets have an indicating device in the form of a neon lamp to register resonance. Will you please explain the operation?—K. G.

The neon lamp is connected across a section of the voltage divider and more of the gas in the lamp becomes visible in proportion to the amount of current flowing. The change in current depends on the signal, since increase in the signal decreases the bias on the radio frequency tubes and increases the amount of current flowing. This sum current flows through the voltage divider, across a section of which the lamp is connected. The more current flowing, the higher the illuminated column. The highest attainable value of current is registered by the greatest rise of the column. This is kept within the working limits of the lamp by automatic volume control of the radio frequency tubes, which partly steadies the bias despite the signal voltage fluctuations. To obtain full benefit from the illuminator it is desirable to connect a good antenna and ground to the set, as these are intended to be present to safeguard the completely satisfactory working of the system.

* * *

Hum in Two Stage Audio

FIRST I built a small set, five tubes all told, including rectifier, and I was surprised at the sensitivity. I followed a diagram published in your paper, and covered by your blueprint No. 627. Then I tried adding another stage of audio, also resistance coupled, using a 227 tube for first audio. The volume went up, as I expected, but there was some hum, though not a great deal. Previously there had been no hum. Please suggest some remedies, as it is my intention to take off primary turns from interstage couplers, to be able still further to increase the practical selectivity, relying on the extra audio stage to retain the volume previously enjoyed. Now the volume is greater than I need but there is that hum.—J. E.

Where only one stage of resistance coupled audio is used the filter capacities, with suitable choke, may be 8 mfd. across the beginning and another 8 mfd. across the end of the choke, as in the five tube set you built. But when an extra stage of resistance coupled audio is added the capacity at the end of the choke (from B plus maximum connections of set to ground) should be 16 mfd., so put another 8 mfd. in parallel with the present 8 mfd. you have in this position. Then the hum level will be sufficiently low.

* * *

Calibration of a Converter

TUNING my short wave converter I have to use different intermediate frequencies, because my set is most sensitive in a particular region, from 1,000 to 1,500 kc, approximately, and locals and strong semi-distant stations go on the air in this region at different intervals, and I must change to avoid them. How may I calibrate the short wave converter nevertheless?—J. P. L.

There is no ready way to calibrate the converter for different intermediate frequencies because, as you know, when you change the intermediate frequency you must change the oscillator dial setting to bring in the same short wave frequency previously tuned in. Therefore see if you can confine your intermediate frequencies to a few, and then record the dial settings of the oscillator for the various short wave carrier frequencies for each of these few intermediate frequencies. This can be done on one sheet of plotting paper.

* * *

Intermittent Glow in Tubes

HEATER type tubes that I am using glow and then grow dull, and I am wondering if this discloses a defect in the tubes?—H. D.

No, the intermittent glow is not a defect in the tube. When in doubt about such a tube you should test it for performance, by changing the grid bias and noting the change in plate current, with the plate voltage held steady, or, if it is more convenient, leave the grid bias at its usual negative value, and increase and decrease the plate voltage. The extent of the change measures the amplifying property of the tube. You may use standard curves as comparison. Several of these are published occasionally in RADIO WORLD. For detection a different rule applies. You may test the tube as an amplifier, see that it checks all right, and then with 180 volts on the plate, and 22.5 volts negative bias, note the plate current. The tube with the smallest plate current will have the greatest detecting efficiency, as a power or negative bias detector. This applies particularly to 227 tubes.

* * *

New Set Brings in Interference

RECENTLY I have been troubled by interference due to man-made static. I don't know the reason, although I have made a new set, a superheterodyne, and I did not have any trouble with my old, small tuned radio frequency set. The interference is evidently caused by electric light lines, trolley lines, telephone lines and various electrical contrivances worked by neighbors. I live in a large city, so these neighborly troubles are plentiful. But I am perplexed over their sudden existence and also what to do about it.—J. G. B.

The greatly increased sensitivity of your new receiver, compared with the old one, results in the interference being plainly audible. It was present all the time, of course, only with your old set there was not enough sensitivity to occasion any trouble. You may enclose your aerial leadin in a metal sheathing, from near the aerial juncture to where the lead enters your home.

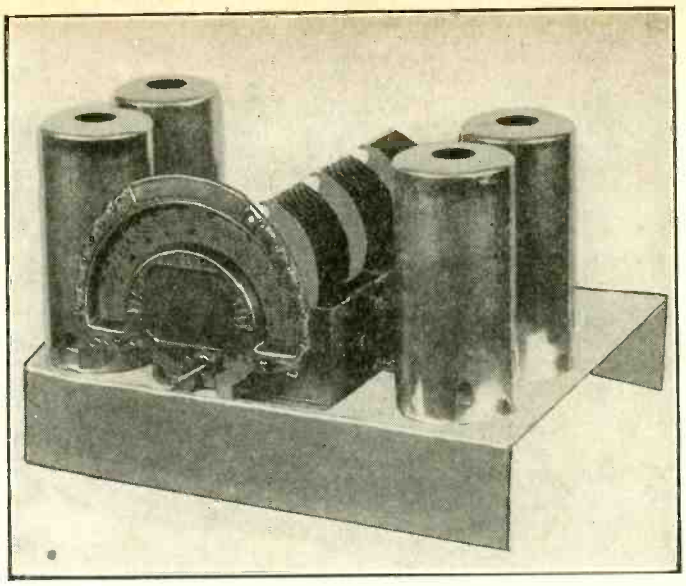


FIG. 965

Layout for a small set consisting of tuner and one stage of audio for broadcast coverage.

It is necessary to ground this sheathing, which may be done to a cold water pipe in your home, or, if this does not prove sufficiently effective, the grounding should be done at each floor and also at the terminal as previously stated. The pickup will be reduced a little, because of the negation of the leadin's aerial effect, but the reduction in interference will be very considerable, and, besides, a set as sensitive as yours does not require very great antenna pickup.

* * *

Frequency Limit of Standard Tubes

BEING greatly interested in frequencies above 30,000 kc, I ask you please to let me know how high I can expect to go in frequency, using standard tubes? I find that many of the scientific experimenters use special tubes for very high frequencies, including such tubes with positive grid and negative plate. But I can use only standard tubes just now.—J. D.

Not only the tube but the entire system of construction of the receiver, antenna and ground have a bearing on the extremity of frequency that can be tuned in. These factors will vary so much with different constructions that no definite limit can be stated. As a matter of information, however, it may be stated that home experimenters who have done considerable radio building have had no trouble in getting up to 60,000 kc (down to about 5 meters), and that some of the scientists, by special circuits and precautions, have been able to obtain results on waves a little above 1 meter with standard tubes. The tuning system then becomes vastly important, as it is difficult to attain a sufficiently high impedance, or ratio of inductance to capacity. The circuit too soon becomes nearly all capacity and virtually no inductance, and the coil works as a condenser rather than as an inductance. So, at the ultra frequencies, no coils can be used, but only Lecher wires and the like.

* * *

Selectivity Defined

WILL you please give me a definition of selectivity in terms of the actual exclusion properties?—V. M.

Selectivity is the relationship of voltage at resonance compared to the voltages at frequencies off resonance, or the ratio of the resultant current at resonance compared to the higher impressed voltages off resonance required to maintain the same value of current as at resonance. In everyday language selectivity is the degree of success with which a set tunes in one particular radio frequency at a time, to the exclusion of all other frequencies.

* * *

TRF and Supers

WHAT in general is the comparison between tuned radio frequency and superheterodyne sets?—F. J. McC.

In a t-r-f set the radio frequency is amplified at the same frequency always, therefore manual operation of all tuned stages is necessary, and multi-gang condensers are used. In a superheterodyne the radio frequency is amplified at two levels, first the t-r-f level as in t-r-f sets, then at a lower frequency. Hence the lower frequency tuning is fixed, as it must not vary. The t-r-f set is long on sensitivity, but does not come up to the superheterodyne in selectivity. It is possible to have a t-r-f set with a sensitivity of a fraction of a microvolt per meter. Both types can easily get down to the noise level. The superheterodyne has tuning pecularities that the other lacks.

A THOUGHT FOR THE WEEK

THERE'S a new Lillian Russell in the field. She is singing over the air for WNYC. May she prove to be a worthy successor to Her Majesty, Lillian Russell I, whose "My Evening Star" was one of the delights of the days when the blonde singer lent beauty and charm to the American stage.

RADIO WORLD

The First and Only National Radio Weekly
Tenth Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.

Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor.

The New Monitor

ONE of the most important advances in radio was the one quietly made by the Department of Commerce in the construction of the central frequency monitoring station at Grand Island, Nebr. This is the parent station for checking up on the frequency of all stations licensed by the Federal Radio Commissioners, as well as for reception of stations the world over. The range is from 10 to 2,000 meters, accomplished with two receivers, while there is special provision for higher waves. No doubt in time there will be a receiver for lower waves than 10 meters, particularly in view of licenses being issued by the Commission for point to point and experimental work on these lower waves. As it is, the Grand Island monitor is the outstanding one in the world.

The plant had to be just so. A one-story building of the small factory type was erected at this specially chosen location, and directional antennas were installed to serve the special receivers. The Government made a good job of it from start to finish, as it had the experts who could produce the necessary apparatus as well as the building constructional knowledge that permitted perfection to rule in every nook.

Thus to be able to cover the whole world dependably, and to institute a frequency check of an exceedingly high order of accuracy is an important step forward, since radio will be no better than its regulation.

Now the Department of Commerce, through its Radio Division, of which William D. Terrell is chief, is the radio police agency. The Commission is the licensing and administrative agency. The split functions are an inheritance from the time the department ruled radio entirely, and while there has been some talk now and again of consolidating the work under the Commission's jurisdiction, policing the air has been carried on so successfully by the Department's Radio Division that many have hesitated to molest the present system.

How much is due to the painstaking vigilance of the Radio Division few listeners realize. But the benefits they now enjoy of as clear reception as a crowded ether permits, are due largely to the work of the Division, since there are enough stations scientifically wayward, for financial or purely cussed reasons or for no reason, to create much disturbance unless they are kept in check.

Next year when the rule goes into effect limiting the stations to 50 cycles this side or that of their assigned frequency the measurements of frequency no doubt will be extended, and the monitoring substations will have more work on their hands, as well as will the central station. The reports show that not all the stations can be measured each month, but it is hoped that the checkup will be regularly applied to all.

Engineers Respected

FACTORIES have come to realize the importance of the engineering department to a greater extent. The decision to manufacture does not precede the selection of what to manufacture, but the engineering department turns out a product, and it is completely tested, whereupon the factory attempts to duplicate the laboratory model. The duplication is not always easy, sometimes changes are made during manufacture, and finally a few products are turned out, and distributed for test. Then, after kinks are removed, production begins.

It is agreed now that the factory is no better than its engineering department. This is a good thing for all, not only the manufacturer, but also the consumer and the selling agencies as well. Radio products as made today stand up better than any such products made in previous years, when one considers products of comparative types. This is true despite the much lower prices now prevailing.

There are still some manufacturers, however, who really do not know the radio business from any angle, and who have a guarded contempt for the necessity of large expenditures for preliminary engineering and subsequent testing and comparison. But they do not long remain as manufacturers.

One such adventurer went out of business recently when his sets failed to stand up. The reason was that a friction contact between shield and ground would work loose and the set would start to squeal badly. Since then it really was not shielded. He never did find out just why that trouble arose, although some users did, but meanwhile the manufacturer had folded up his tent and departed, with a few creditors anxious about his whereabouts.

Circuit Comparisons

DIAGRAMS of circuits popular this year look quite different, in general, from those of previous years. One fact that is outstanding is the lesser amount of audio amplification, or the same amount provided by fewer tubes. Another point is the absence of large bypass capacities from the biasing sections of audio channels, since audio regeneration is used instead, and is fully effective.

On the radio side two stages of t-r-f are common in midgets, and there is no radio frequency oscillation, despite primaries that have as many as 50 turns. where the secondaries have perhaps twice as many.

Superheterodynes do not show quite so much change in the radio frequency and intermediate levels, but concentration on 175 kc as the intermediate frequency for broadcast receivers continues, and, depending on the extensiveness of the set, there is more or less tuning at the radio frequency level. Padding of oscillators is still used, although some set manufacturers have condensers with a special tracking section for the oscillator, thus dispensing with padding.

It is interesting to watch the development of circuits and also to notice that a certain degree of standardization is setting in. Performance curves, as to sensitivity and selectivity, are pretty much the same for the same type of receivers, and the same number and type of tubes and tuned circuits.

All these factors point to the engineering stabilization of the radio industry, and it is expected that complete commercial stabilization soon will follow, since it has made a good start, spurred on by the depression.

Alice Remsen is Herself Quite a Personality

Did you know that Alice Remsen who is one of WOR's outstanding artists, is a notary public and has been for eight years? She can swear you to affidavits, witness signatures and can tell, when you raise your right hand and say "so help me," whether you are just stretching or telling the truth.

* * *

Did you know that Alice Remsen wrote the opening and closing signature poems used by Basil Ruysdael on his beautiful "Weaver of Dreams" program? (WOR). Besides being a fine singer she is a gifted poetess.

* * *

Did you know that Alice Remsen has two celebrations in November? On the 4th she will observe her first anniversary with WOR, and on the 24th is her birthday. She says that she doesn't eat candy (figure, you know), but is crazy about flowers, books and engravings.

KALEIDOSCOPE

Radio is inseparable from electrons. They are tiny inquisitive things. Visible? Oh, yes. These visitors are uninvited and will enter free every time the radio is turned on. Something for nothing.

* * *

When your neighbor proudly tells you that television has been projected on a ten foot screen, nonchalantly return the compliment and say you are waiting for a television camera, the portable kind.

* * *

Mr. Gandhi, India's philosopher, benefitted by the invention of radio, and made a trans-atlantic broadcast. Alas for Aristotle, Plato and Socrates, who were not allowed to tarry for wireless telephony.

—A. B.

Literature Wanted

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

L. L. Lachappell, 41 Ashley St., New Bedford, Mass.
Curtis R. Hammond, 121 West 23rd St., Owensboro, Ky.
J. H. Johnston, Jr., R. No. 2, Vaughan, Miss.
Gerald Iserman, Dakota, Ill.
C. F. Thomas, Forest Radio Rys. Co., 1333 Forest Ave., Middletown, Ohio.
Ernest J. Marshall (Service Parts & Radios), 64 Mt. Pleasant Ave., Gloucester, Mass.
John Gossland, 82 So. 8th St., Newark, N. J.
Harold Wilcox, 229 Jackson St., San Antonio, Tex.
L. Turner, 125 Ashley Ave.. Charleston, S. C.
E. L. Ballard, 1568 W. Becker St., Wilwaukee, Wis.
Clayton F. Kitchell, 225 Hubbard St., Allegan, Mich.
A. F. Crosby, 31 Church St., Girard, Pa.
F. B. Spurlock, 4600 E. 60 Terrace, Kansas City, Mo.
Herbert F. Lange, R. F. D No. 1, Fredonia, Mercer Co., Pa.
F. C. Skovic, 1114 - 2nd Ave., So., Great Falls, Mont.
Edw. Schultz, 2126 N. Lincoln St., Chicago, Ill.

Next Week's Feature

In next week's issue, dated November 14th, will be published a preliminary report on the broadcast range results of a seven tube 10-2,000 meter receiver. Be sure to read this article.

Station Sparks

By Alice Remsen

Savino's Tone Pictures are indeed beautiful. Melodic and colorful, they feature the special arrangements for orchestra and piano of the conductor, Domenico Savino, and the glorious contralto voice of Barbara Maurel.

* * *

Was delighted to hear the voice of Tommy Weir last Sunday morning, at 11:30 over Station WAAT, singing classical selections. His rendition of "Sal ve di Mora" from "Faust" was exceptionally good. Tommy was accompanied by the Florentine Trio, a very fine string combination headed by Ila Grange.

* * *

Richard Gordon, who plays Sherlock Holmes thrice weekly over NBC network, has his exclusive and unfailing dramatic critic. He is the postman who delivers the mail to the actor's home in Stamford, Conn. Regularly this mail carrier leaves scribbled on the back of a letter his comments on the previous night's performance. The severity of his criticism amuses Mr. Gordon very much, particularly when censure is indicated by an occasional, "What the deuce was the matter with you last night?"

* * *

"Jolly Bill" Steinke, the John Bunny of radio, who spins unbelievable yarns to Jane and other children over the NBC networks, has done various things in life. He was once a butter and egg clerk in Allentown, Pa. While working there he developed talent as a cartoonist. His store was known as the "comic supplement grocery" because Bill spent most of his time drawing funny faces and carving "Please Buy Me" on watermelons and potatoes. He gravitated naturally to the newspaper profession, but he began life (no foolin') as a pretzel bender in a pretzel factory—and Bill has been laughing ever since.

* * *

He is fast acquiring a reputation as a baby expert!! Who is? Why, Peter Dixon, of course, simply because he writes and acts in "Raising Junior" and also has two children of his own. Mothers write in and ask him all sorts of questions concerning the care of babies. Peter answers them, too. He has studied the subject extensively and knows his onions, or, I should say, his milk bottles.

* * *

It was with a great deal of pleasure that I heard to whom the plum of the season had fallen! Bing Crosby's commercial, the Cremo Cigar program, will be conducted by my old friend, Carl Fenton. He will have a twenty-five piece orchestra and I prophesy right here and now that Carl will not stop there. It's a wonder to me that radio has not uncovered this boy a long time ago. He has a very fine recording reputation and an excellent musical background. Good luck, Carl! I'm sure you'll go far in radio.

* * *

The regular "Footlight Echoes" program was augmented on Oct. 25 by members of the cast of "The Streets of New York," now playing at the 48th St. Theatre in New York. Lawrence Langner, director of the New York Repertory Company, and producer of "The Streets of New York," introduced the players. Sam Wren, the juvenile, who will be remembered for his work in "The Best of Families" and "This Is New York," sang "Captain Jinks of the Horse Marines," and did a good job. Eleanor Shaler, who does specialties between the acts, in the old traditional manner, sang "How Much Does the Baby Weigh?" and the villain, Anton Bundsmann, and the villainess, Fania Marinoff, did a couple of short scenes from the play. It was a very enjoyable interlude.

* * *

CORAL AND GRAY

(Tone Pictures, WABC, 10:30 p.m. Mondays)

Coral and gray, streaking the west,
Fading across the sky.
A lovely day's last sigh
Ruffles a tall tree's plumy crest

Into an unknown world; the sun,
Flinging itself to die,
Wrings from my heart a cry—
Would that I too were so soon done!

How gladly would I slip away
Into the storm-blown sea,
Setting my spirit free,
Leaving no trace upon the spray.

Then, in those cool green deeps, my clay
Would merge to coral and to gray.

—*A. R.*

SIDELIGHTS

LEE MORSE was once a choir singer in Kooski, Idaho. . . . EDDIE CANTOR would like to be an advertising man. . . . ARTHUR TRACEY was born in Philadelphia and really was a street singer at the age of ten. . . . EARLE PALMER used to be a broker in Wall Street. . . . FRANK READICK made his stage debut when he was two years old. . . . TITO GUIZAR was once a successful civil engineer. . . . ROGER KINNE once rowed on Cornell's crew. . . . KATHLEEN STEWART is an enthusiastic horseback rider. . . . MILDRED BAILEY was born in Spokane, Washington. . . . JACK MILLER originally started out to be an automobile racer. . . . JACK SMITH was once a photo-engraver. . . . VIRGINIA and MARY DRANE are from New Orleans. . . . GEORGE SHACKLEY has written more than 3500 voice arrangements for his "Choir Invisible." . . . NELSON EDDY wanted to be a drummer when he was fourteen. . . . PHIL THORN has had a play accepted for production. . . . MOLLY KLINGER is now working at Con Conrad's. . . . CHARLES PREMAC was graduated from the School of Music in historic Fontainebleau. . . . FRANK KNIGHT is a native of St. John's, Newfoundland.

* * *

Biographical Brevities

About Ann Leaf

Little Ann Leaf was born in Omaha, Nebraska, where she was known as a child prodigy. That's one reason she always feels so sorry for other child prodigies. When Ann was fifteen she had ambitions, plenty of them, but first and foremost she wished to be a composer, so she wrote a song with another girl. They each took twenty-five dollars of hard-saved money and gave it to one of those shyster concerns, which printed a few copies of the song and told the girls that the New York publishers would clamor for their song. Ann tried three of them and then gave up in disgust.

Ann's diminutive size is a source of worry to her. She would much rather be tall and striking—but doesn't want to become fat, so she doesn't eat much. She loves almond cookies, but is even afraid to eat more than three of those at one sitting. Is fond of dancing but doesn't get much opportunity to indulge. Likes to read; thinks Dostoieffsky's "Crime and Punishment" a wonderful lesson for thinking people. Reads a lot of poetry. Is a fine hostess, very hospitable, gets a great kick out of entertaining friends in her own home. Plays bridge—auction, not contract; afraid of that. Adores Russian rummy.

Likes bright colors, doesn't like to take medicine. Once made a lemon pie. The family is still talking about that pie. It was good, and ever since then all lemon pies are judged by the pie Ann once made. Has started modeling in clay, but doesn't know how long that will last. Inherits a talent for drawing and modeling, an uncle being quite a well-known sculptor and her brother, Maurey Leaf, a very well-known cartoonist and portrait painter. Ann likes to play tennis and golf but admits that she plays both games badly.

Admires every type of theatrical entertainment, particularly revues. Certain operas intrigue her, especially the Wagnerian Ring, but she thinks there is not enough stage movement in them. Thinks the librettos should all be rewritten and brought up to date. "Carmen" is her favorite; thinks it the most colorful opera.

Is crazy about new clothes. Likes to travel by water and plans a trip around the world some day. Has never been abroad but hopes to go next summer. Then she'll visit an aunt in England and will see France, Germany and Italy. Has a yearning to ride a bicycle through the Bois and has always longed to visit Bermuda so that she might ride a bicycle; is afraid to do so in New York.

Occupies a darling little apartment in New York quite close to the Paramount Theatre, from which theatre she broadcasts all her programs. Enjoys her work thoroughly, likes to sing and is planning both to sing and talk over the air, so Ann Leaf fans have a pleasant surprise in store for them.

Ann is a perfect little doll; dark, bobbed hair, brown eyes, well-marked eyebrows, perfectly arched; tiny hands and feet, weighs 101 lbs., stands 4 ft. 11 inches, has a sweet smile which discloses a beautiful set of teeth. Possesses a fascinating personality.

Spends as much time as possible at her Steinway or listening to her Atwater Kent. Is very proud of her cook, who makes perfect omelettes. Although she is known as Ann Leaf, signs her name Anne. Loves to receive fan mail and endeavors to answer the majority personally. Is a dynamic little person and an hour spent in the company of Ann Leaf is as good as a tonic.

* * *

SUNDRY SUGGESTIONS FOR WEEK COMMENCING NOVEMBER 8

Sun., Nov. 8: Melodic Interlude....WJZ—2:00 p. m.
Sun., Nov. 8: Music Along the Wires WABC—8:15 p. m.
Sun., Nov. 8: Footlight Echoes...WOR—10:30 p. m.
Mon., Nov. 9: Street Singer.....WABC 11:00 p. m.
Tues., Nov. 10: Julia Sanderson & Frank Crumit ....WEAF—8:00 p. m.
Tues., Nov. 10: Old Stager......WJZ—10:00 p. m.
Wed., Nov. 11: Singing Sam....WABC—8:15 p. m.
Wed., Nov. 11: Sherlock Holmes..WJZ—9:00 p. m.
Thurs., Nov. 12: Weaver of Dreams WOR—10:00 p. m.
Fri., Nov. 13: Theatre of the Air WEAF—10:30 p. m.
Fri., Nov. 13: Slumber Music....WJZ—11:00 p. m.
Sat., Nov. 14: Allan Broms.......WOR—9:00 p. m.
Sat., Nov. 14: Lew White........WJZ—11:45 p. m.

(If you would like to know something of your favorite radio artists and announcers, drop a card to the conductor of this page. Address her, Alice Remsen, care RADIO WORLD, 145 *West* 45*th St., New York, N. Y.)*

A NEW RADIO PAPER

"Radio Guide," a five-cent illustrated weekly featuring radio personalities and programs, giving full credit to commercial sponsors, appeared on New York newsstands recently. It aims to give the public the same intimate acquaintance with stars and artists on the air that is provided by the movie magazines for motion pictures.

Its publishers are M. L. Annenberg, Hugh E. Murray and Joseph D. Bannon. Associated with them will be George d'Utassy as president and E. M. Alexander, vice president.

HOOVER LAUDS THE AMERICAN RADIO SYSTEM

Washington.

President Hoover addressed the National Association of Broadcasters by telephone, praising the American system of radio. The broadcasters were in convention in Detroit. The President spoke from the Cabinet room of the executive offices. He said:

"It gives me great pleasure to greet the ninth annual convention of the National Association of Broadcasters meeting this week in Detroit. As Secretary of Commerce I had the pleasure of wide acquaintance with the purposes of your association in the annual national radio conferences which were called at that time for the development of the national policies in relation to radio.

"The decisions reached at that early date have been of unending importance.

Program Variety Attained

"The determination that radio channels were public property and should be controlled by the Government; the determination that we should not have Governmental broadcasting supported by a tax upon the listener, but that we should give license to use of these channels under private enterprise where there would be no restraint upon programs, has secured for us far greater variety of programs and excellence of service without cost to the listener. This decision has avoided the pitfalls of political and social conflicts in the use of speech over the radio which would have been involved in Government broadcasting. It has preserved free speech to the country.

"These principles are now strongly imbedded in our law and in our entire public system. The industry has constantly faced new and complex problems in developing policies and practices abreast of development and need. Your association has contributed greatly to their solution.

Responsibility Recognized

"I am confident that you recognize the responsibility which rests upon you in public interest. It is needless to mention the many-sided importance of radio in modern life. Its dissemination of entertainment, of knowledge, and of public welfare has become an essential element in the intellectual development of our country. It has brought most of the supposed values which were formerly available exclusively to life in the cities to every home throughout the land, for the treasures of music, of entertainment, and of information have been brought to the loneliest farm and the most remote hamlet. It is an incalculable extension of happiness and contentment.

"I extend to you my most cordial greetings and good wishes for your meeting, with the confidence that you will develop still further policies of sound management and public service."

President Silenced; MMS Blew Away

While President Hoover was reading his address at Yorktown, Va., at the 150th anniversary of the surrender of Lord Cornwallis to General Washington, the wind blew his manuscript off the lectern.

The President stopped speaking. Millions were listening in, as the speech was widely distributed by chains. Many listeners wondered why the president stopped.

One of his secretaries, Theodore Joslin, retrieved the manuscript and the President resumed talking.

WJZ KEEPS IN 50 CYCLE SHIFT

Washington.

WJZ, Bound Brook, N. J., maintained its frequency within less than 50 cycles during the month of September, according to the list compiled monthly by the Department of Commerce, and it headed the list in respect to the stations located in the New York service area. Ten others stations located in New Jersey were on the list for having remained withing 200 cycles per second or less of the assigned frequency.

WAAM, Newark; WABC, Wayne; WCDA, Cliffside Park; WKBO, Jersey City; WMCA, Hoboken; and WODA, Paterson, strayed less than 100 cycles per second from their assigned frequencies. WAWZ, Zarepath; WCAM, Camden; WOR, Newark; and WPAP, Asbury Park, strayed less than 200 cycles off their assigned frequencies.

The Government maintains a monitoring station at Grand Island, Nebraska, equipped with highly sensitive receivers and elaborate frequency meters with which any station in the country can be checked as to frequency stability.

J. L. BAIRD SEES TELEVISION ON WRONG TRACK

Dissenting from the present experimental trend in television in this country, John Logie Baird, Scotch inventor, who has been working in London on television improvements, said that a likely field exists for the transmission of television on the frequencies now allotted to broadcasting, and thought little of the promise held by the ultra frequencies for television work.

Mr. Baird was told by his physician to take a rest, so he visited the United States, and put up at one of the big hotels in New York, in a suite high above the teeming sidewalks. He took great delight in the view, and remarked about its television possibilities.

"The pictures I have seen of New York and its towering office buildings and hotels did not give me a full concept of the majestic sweep of the landscape," he said. "Television in the future will convey such realities to many lands."

Sees No Need for Wide Band

He expressed distinct disagreement with the present school of television thought about the necessity for a wide channel for passage of the sidebands, and said that the possibilities of the present broadcast band had not been exhausted by any means. He revealed he is working on a plan to use these lower frequencies, although he is tempted also to try work on ultra frequencies, from the Crystal Palace, London. He does not expect much in this line because of the confined distance of the wave's propagation.

The scanning disc will remain, he said, particularly for inexpensive installations, and he uttered a very firm prejudice against the possibilities of the cathode ray tube, which is intended to supplant the scanning disc, and which has been developed, although not to perfection, in this country, preparatory to expected release next year.

Finds Great Interest Here

He was surprised at the great interest in television in this country, and said that nothing like such enthusiastic response obtains in England, where, he added, there are about 8,000 television receivers in use.

He visited laboratories in the East that are engaged on experimental television work.

John Logie Baird is not related to the American inventor, Hollis Baird, who is also connected with a television company.

Converter Matching Called Important

By Walter S. Lemmon

Converters have been built for the last three or four years but their limited numbers show how much of a problem they have been. All newspaper radio departments and readers who have used converters have had their experience with these units. To say the least, they have been highly temperamental. Then they seldom performed well, for somehow or other they lost much of the signal they picked up in getting over to the broadcast set, so that better shortwave r. f. receivers usually outperformed them.

As short wave designers we know we must make a converter which would be simple to operate, foolproof in action, totally minus temperament, and at the same time with such kick that it would equal if not exceed a specially built short wave receiver. In other words, if we were going to wed a short wave receiver to a broadcast job it had to be a regular he-man affair.

The problem was solved and the converter has three tubes, since any less were found through much experimenting to give only mediocre results. The why of this is simple, once the answer is known. In feeding the output of a first detector into a broadcast set, the problem comes up of the high impedance of the screen grid tube used as a first detector trying to work into the low impedance of the broadcast set antenna circuit. Even the best tricks fail and much loss of energy occurs. Since the short wave signal is often weak in the first place, this combination makes for very mediocre short wave reeption. Unusually strong foreign stations may be heard but only a few of them.

This difficulty led to the introduction of the third tube, which makes for much better input impedance matching, it gives a tremendous gain in sensitivity and making tuning easier. This third tube is used as a fixed intermediate amplifier working at around 400 meters. Working on a single frequency as it does, a very high gain can be realized in this one stage.

The tube used for this stage is a 227, which has a very much lower impedance than the screen grid type of tube. This fact plus a specially designed antenna coupling circuit on our broadcast set gives a very high efficiency in the transfer of energy from the converter to the broadcast set.

PROBLEMS OF BROADCASTERS AND THE TRADE

By BOND GEDDES

Executive Vice-President, Radio Manufacturers Association

Radio manufacturers have a total investment of around $3,000,000,000, which is dependent on broadcasting. It is sometimes asked why, with our large interests, we do not give broadcasting more support in using radio as an advertising medium.

Two years ago, when were more plutocratic, radio manufacturers collectively were of all industries the principal sponsors on the air. Once there were twenty-seven Radio Manufacturers Association members with regular programs. Although times have changed sadly in this respect, the RCA interests, Philco and Atwater Kent are among our members who continue outstanding in broadcasting. In addition, for years a number of our manufacturers have divided expenses with jobbers in local broadcasting.

Also it is to be remembered that radio advertising for our manufacturers is largely to develop, not new customers, but merely a replacement market. But I am sure that in the better times ahead stations will have stronger and more supporters of broadcasting from among our manufacturers.

Business Is Improving

The much hoped for period of business improvement already has been felt by radio manufacturers. For a great many there is no business depression. A large number of our factories are on a full-time basis, furnishing employment, providing new listeners for the stations. A favored few are now in peak production, strangely surpassing, under present conditions, even the production records of the so-called radio boom period of two years ago.

One theory I have for the marked increase recently in radio sales is, perhaps strangely, the depression. Radio broadcasting is so entertaining and receiving sets so reasonable in price that I believe thousands of families are economizing by turning to radio for their chief entertainment.

In view of some past criticism of the midget receiving set, it is interesting to note that beginning last August and continuing until the present the proportion of midget sales to those of console sets has been declining. Less than half of the 2,500,000 or 3,000,000 sets which we expect to sell this year will be of the midget class. And the midget, which has a definite, established place in the market, especially under present conditions, has been greatly improved.

Improved Results At Reduced Prices

When the midget first appeared last year some broadcasters deplored its advent, saying it seemed unfortunate to spend vast sums on fine broadcasting equipment and put out fine broadcasts only to have them mangled by midgets. This is not fair criticism of the midget which has greatly enlarged the listening audience. The modern midget of the established national manufacturer is not feeble in performance qualities, considering its cost. The public, however, has demonstrated that it is willing to buy a larger proportion of console receiving sets and pay the difference in cost. The radio public today is getting a tremendously improved product at tremendously lower prices.

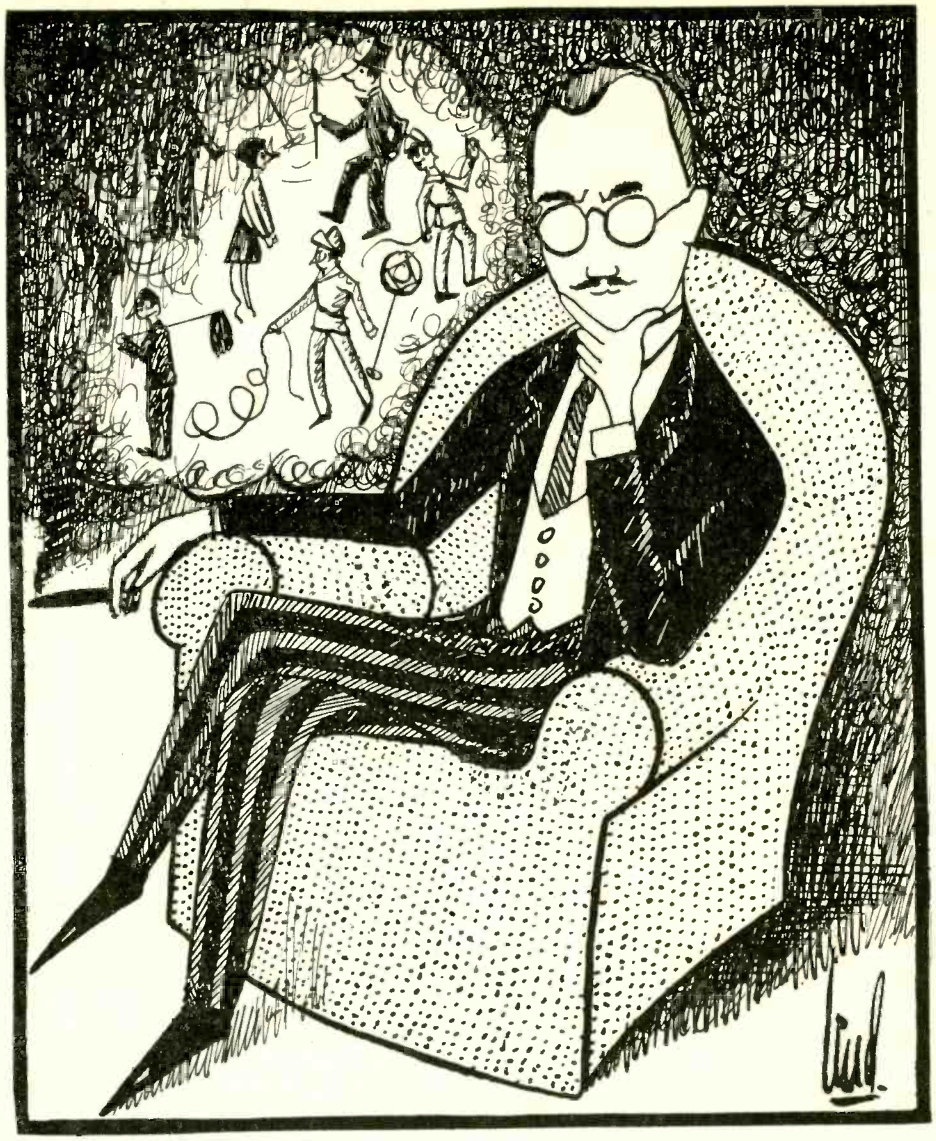
The audience also will be greatly increased during the next year by the use of motorcar radio. Several of the largest automobile manufacturers have just arranged to equip their future lines with radio sets.

While desirous of developing radio as an educational agency, I am sure of expressing virtually unanimous opinion in the Radio Manufacturers Association that it would curtail public service as well as do all of our interests an unnecessary injury to set aside, exclusively, any considerable portion of our present broadcast facilities and frequencies for educational purposes. I am sure that I can promise the full support of the RMA in opposition to any such movement, by educational or any other special interests or groups.

Also I am confident in promising our full support against any movement for allocation of broadcasting facilities by Congress, rather than by the Federal Radio Commission. To have special interests prevail upon Congress to act as an allocation distributor and then become an administrative body instead of a legislative body would entail all the disaster of ill informed and political interference.

We all stand or fall on our service to the public. And the public taste changes. Times and habits change. We must not forget that. The radio public expects progress and improvements, in programs as well as in our manufacturers' products. The history of both, in their rapid development, is replete with marks of public approval and confidence. But what satisfied the radio public last year and the year before will not meet their expectations and demands of the future. There undoubtedly has developed less tolerance and rising criticism of the advertising excesses of some sponsors. This is, in some cases, stating it most mildly but with all friendliness.

FUNNY MAN FACES SERIOUS TASK



Raymond Knight inventing new lunacies for his Ku-Ku Hour, heard over WJZ every Saturday at 10 p.m.

Houck Quits Dubilier; Joins Kolster Forces

After a ten-year association with the Dubilier Condenser Corporation and predecessor, Harry W. Houck has resigned to become assistant chief engineer of Kolster Radio.

Houck was associated with the development of the original superheterodyne circuit at the Research and Inspection Division laboratories of the U. S. Signal Corps in Paris during the World War. He has been granted numerous patents on radio inventions. His radio career dates back to 1910 as a wireless amateur. He operated one of the first licensed stations in Central Pennsylvania in 1912. He has been active in the Institute of Radio Engineers and Radio Club of America.

Never Before At These Prices!

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Farrand inductor dynamic for pentode tubes, chassis (no cabinet), for direct connection in plate circuit of single output tube, or for connection to secondary of an output transformer where push-pull pentodes are used. 9 inch outside diameter. Order Cat. 9-R.............................@ $7.00
Farrand regular dynamic, chassis (no cabinet), with built-in rectifier, for AC operations. 9 inch outside diameter. Order Cat. F-DNS......@ $7.00
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Ansonia magnetic speaker in Gothic cabinet of genuine walnut. Order Cat. AN-G.........@ $3.50
Ansonia magnetic speaker, in square cabinet, genuine walnut. Order Cat. AN-SQ...........@ $3.00
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Fixed voltage divider, total 17,100 ohms, affording twenty different voltages, including all bias voltages; for 245, 247 and similar circuits; 50 watts rating. Order Cat. MTVD................@ 1.95
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30 ohm filament resistor, 1 ampere capacity. Cat FR-30 ....@ .10
6.5 ohm filament resistor, 1 ampere capacity. Cat. FR-65. ....@ .10
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