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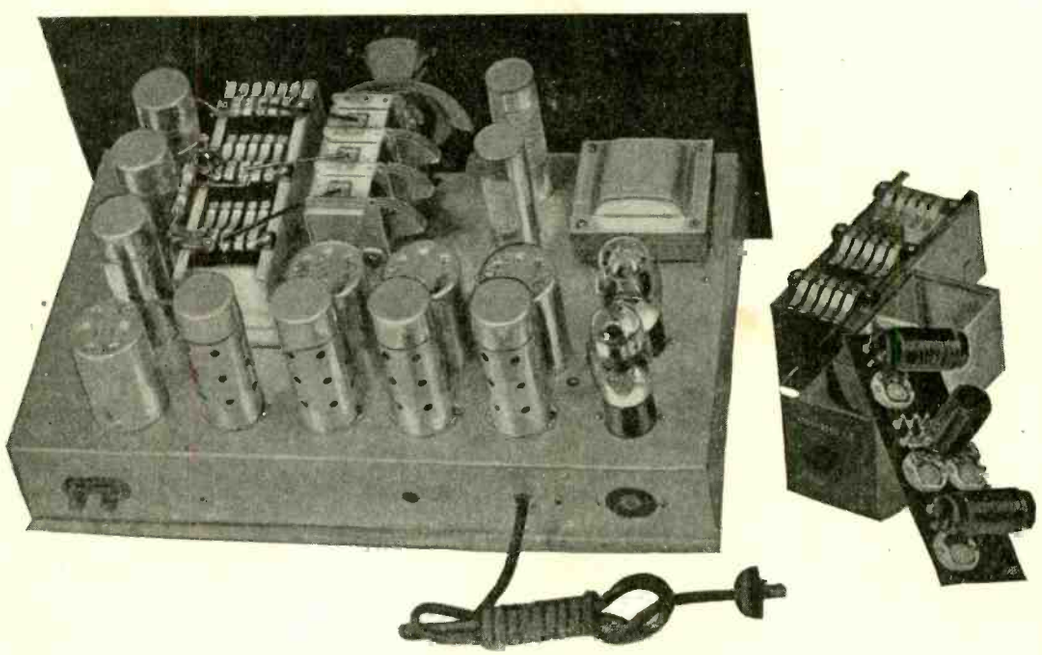

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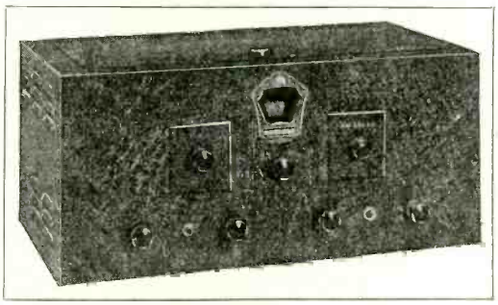

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TWELFTH YEAR

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SMALL MEASUREMENTS

A. C. and Even Distances Gauged; Multivibrator Harmonic Generator

By J. E. Anderson

BOLOMETER

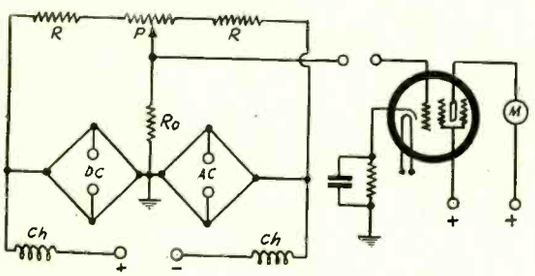


FIG. 1
The circuit of a bolometer bridge by means of which small alternating currents can be compared against an equal direct current. The bolometer works on the principle of changing resistance as a result of the heating effect of the current.

DUDDELL

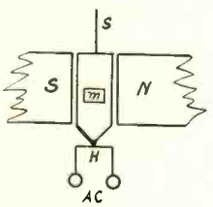


FIG. 2
This shows the principle of the Duddell thermo-galvanometer, by means of which small alternating currents can be measured. The heat principle is used.

DISTANCE

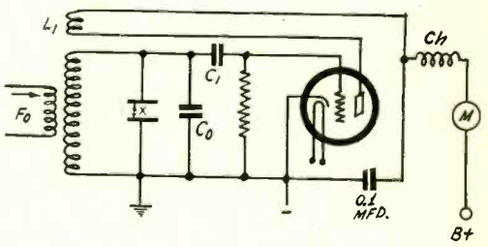


FIG. 3
This illustrates the vacuum micrometer. Changes in the distance X between the plates of condenser are measured in terms of the beat frequency it produces when this oscillator beats with a high standard frequency.

THE measurement of small alternating currents is quite a problem. If the currents to be measured are no smaller than about 5 milliamperes a thermocouple is satisfactory and is nearly always used. If the frequency is low, a rectifying type of meter will work satisfactorily to currents as low as 0.1 milliampere, but this type of meter is not satisfactory for radio frequencies.

There are several methods of measuring extremely small alternating currents that are applicable to both low and high frequencies. One is the Duddell thermo-galvanometer. But this instrument is expensive and is not available except in the more fully equipped laboratories. Another instrument is the bolometer bridge. This is not used much now but it can be constructed at home without great difficulty, and it is capable of measuring small currents of almost any frequency. We shall describe a variation of it.

Bolometer Bridge

The left part of Fig. 1 is a bolometer bridge. It is really composed of three bridges. First we have the main bridge consisting of resistance branches R,R,P and the two branches appearing in the form of squares. These two squares are the other two bridges.

Suppose that squares are pure resistance elements like the R,R,P branches. It is possible to balance the main bridge so that no current flows through the resistance Ro, and the balancing is done by moving the slider on the potentiometer P. As a test for balances a vacuum tube voltmeter can be used and its connected in indicated at the right of Fig. 1. If no current flows in Ro there is no voltage drop in Ro, and this fact can be determined by the vacuum tube voltmeter.

When this has been balanced suppose an a-c voltage is applied at the terminals marked AC. Alternating current will flow through the four branches of the secondary bridge. Hence the wires constituting this bridge will heat up and the resistance will increase. This will unbalance the bridge. To bring it back to balance a d-c voltage is connected across the left secondary bridge at the terminals marked DC. Now current will flow in the resistance arms of this bridge and it will heat them and thus increase the resistance. If the d-c current is adjusted until the bridge again is in balance the dc, as measured by a microammeter, is equal to the effective value of the a-c flowing in the right secondary bridge. The sensitivity of the arrangement is therefore

equal to the sensitivity of the microammeter used for measuring the d-c. The sensitivity of the vacuum tube voltmeter used for indicating balance can be made as sensitive as necessary.

Substitution Method

Greater accuracy, perhaps, can be obtained by a substitution method. In this the a-c and the d-c are measured in the same secondary bridge, the a-c first and the d-c afterward. When this is done the microammeter is not put into the circuit of the left secondary bridge, only a source of voltage and a variable resistance by means of which the current can be varied. The main bridge is balanced as before. The a-c is also applied as before in the right hand secondary bridge. Then the current in the left secondary bridge is varied until a balance is obtained. Now the a-c is removed and a source of d-c is applied in its place, together with a sensitive current meter. The d-c current in the right hand bridge is now varied until a balance is obtained. The d-c current will then be equal to the effective value of the a-c that had been used to establish the balance the first time.

Substitution methods are always recognized as the most accurate, because they remove uncertainties about perfect balance of the main bridge.

Avoiding Strays

The object of the radio frequency chokes in the supply leads to the main bridge is to prevent a-c from straying into the battery. The secondary bridges have the same object. If the a-c is applied to the vertices of a balanced bridge the current cannot stray out of that bridge. Similarly if the d-c used for "weighing" the a-c is applied to the vertices of a similar bridge, the d-c cannot get out of that bridge and upset the balance by stray potential drops.

Construction

The bridge is easily constructed. For the two small bridges start with a piece of hard rubber about two inches by four and at least 3/16 thick. Mark out seven points in two squares about one inch on the side. There will be only seven because the two squares should touch at the ground connection. Drill holes for 2-56 screws at the points and mount the screws. Now take a piece of fine resistance wire and attach one end to the ground, or central, screw. Run the wire around one of the squares back to ground and then continue around the other square, returning to ground, attaching the wire and cutting. If the mounting of the screws was done accurately the two small bridges will be balanced.

For the two resistance arms in the main bridge could be used a single potentiometer of around 200 ohms, or a potentiometer of 50 ohms and a couple of fixed resistances of 100 ohms each. Ro may be a resistance of about 1,000 ohms. The chokes are of comparatively little importance, but if they are used, 10 millihenries each will do.

Thermo-galvanometer

Fig. 2 shows the principle of the Duddell thermo-galvanometer. N and S are the poles of a strong permanent magnet such as is used in any galvanometer. Between these poles is a single loop of silver wire having practically no resistance. At the lower end of the loop is a small thermocouple, indicated by one heavy wire and one light wire. The junction of this thermocouple is directly over a platinum plate H. The junction is very close to this plate but not in contact with it. The plate is a heater element which is heated by the current to be measured. The plate is thin and small so that nearly all the resistance in the a-c circuit is in the heater. As a-c flows through the platinum the plates heat up and the heat is communicated to the couple by radiation.

The silver loop and the couple are suspended between the poles of the magnet and close to the heater plate by means of a fine silk wire S. A small mirror m is attached to the loop just as in any other galvanometer.

A silver loop of negligible resistance is used so that the largest possible current will flow for a given e.m.f generated in the couple by the heat, and a silk thread is employed so that the largest possible deflection will result from a given current.

A thermo-galvanometer of this kind can be used for measuring a-c down to a few microamperes.

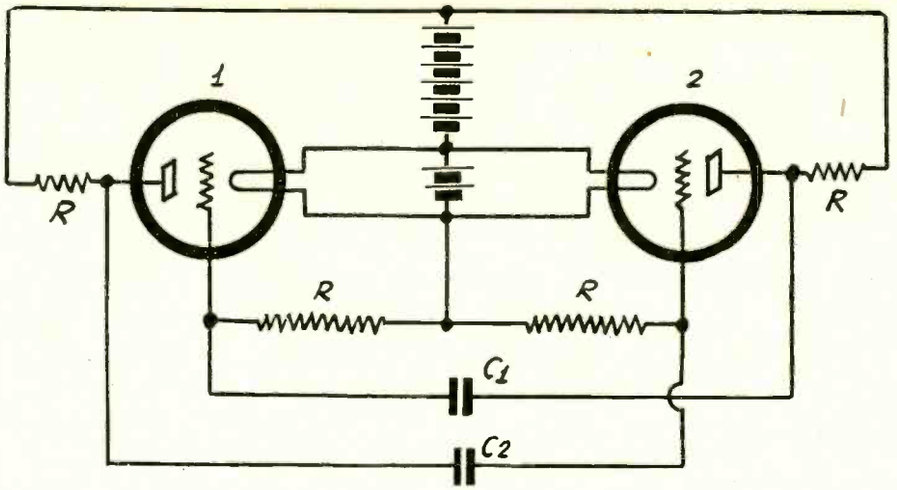


FIG. 4

This is the circuit of the multivibrator, the principal feature of which is that its output is very rich in harmonics. It is useful in the calibration of wavemeters. The frequency is determined by the resistances R and the capacities C1 and C2.

Measurement of Small Distances

A vacuum tube can be applied to the measurement of extremely small changes in displacement, and arrangements can be contrived for applying this to the measurement of current as well as temperature and many other quantities which can be reduced to a change in length of something or other. The method involves the use of two high frequency oscillators.

Suppose we have a source of high frequency oscillation of good constancy and let Fo be the frequency. It may be a laboratory oscillator or it may be the oscillator of a distant transmitting station. The circuit shown in Fig. 3 is a local high frequency oscillator of the tuned grid type. Co is an unavoidable capacity mainly the input capacity of the tube. The condenser indicated by X is composed of two parallel plates, the upper fixed and the lower grounded and movable. The quantity to be measured, whatever it may be, is made to change the distance X by moving the lower plate.

Theory of Micrometer

This device is known as a vacuum tube micrometer. Let us work out the theory on which it works and estimate its possible sensitivity.

The capacity of the condenser indicated by X can be expressed K/X, where K is a constant depending on the dimensions and on the dielectric. The total capacity across the oscillating coil then is Co+K/X. If X changes by dX, the capacity changes by a certain amount. For a very small change in X the change in frequency of the oscillator is $dF=-FdC/2C$. But dC is the change in the variable portion of the condenser and is $dC=-KdX/X_2$. Therefore the change in frequency is $dF=KFdX/2CX^2$. By substituting for the value of C and of K we arrive at the value $dF=(F-CoF^3L)dX/2X$, or $dX=2XdF/F(1-CoLF^2)$. Thus we have arrived at a value for the change in the distance between the plates of the condenser in terms of the original distance X, the change in the frequency dF, the frequency F, the minimum capacity Co, and the inductance L. If Co is small the second term in parentheses is small compared with unity, and we have $dX=2XdF/F$.

How short a distance can be detected by this means. Well, X may be 0.1 centimeter, F, 10,000,000 cycles, and dF, 0.1 cycles if it is observed on a milliammeter. The result is two one billionth of a centimeter. It is so small that it is impossible to conceive such a magnitude. It is astronomical in reverse.

Applications

This vacuum tube micrometer has many possible applications in physics. It might be used, for example, for the measurement of the expansion of metals and quartz with changes in temperature, the expansion of magnetostrictive metals with magnetization, changes in dimensions of piezo crystals with changes in voltage across them, and to a large number of other measurements.

The purpose of the meter M in the plate circuit of the variable oscillator is to measure the beat generated between the two high frequencies. If the choke in series with it is of the order of 10 millihenries it will not interfere with any beat frequency that is likely but it will stop the high frequency. For very low frequency beats the number of beats per second, or the number of seconds per beat, can be observed by watching the needle and a clock.

The Multivibrator

The multivibrator is a type of oscillator, due to Abraham and Bloch, composed of two equal tubes coupled together by means of resistances and capacities as shown in Fig. 4. Drawn in another way it would appear as a two stage resistance-capacity coupled amplifier in which the output of the second tube was put into the grid of the first. The principal feature of the multivibrator is that it generates a wave rich in harmonics. Because of this feature it is very useful in calibration of wave and frequency meters, for once it has been made to oscillate at a low frequency that is accurately known, all the harmonics, up to a very high order, are available with an accuracy equal to that of the fundamental.

Fig. 4 shows the circuit as it is usually drawn. But this is not all of it. If an attempt were made to analyze the circuit as drawn to determine the possibility of oscillation it would be found that it could not oscillate at any finite frequency. The

(Continued on next page)

BANDSPREAD In the Operation of

By J. E.

(*Continued from preceding page*)

omitted parts are the tube capacities. Of course, they are not really omitted when building such a circuit. They cannot be avoided. They must be taken into account in computing the frequency, for in the expression for frequency, not only do the resistances and capacities shown in the figure count, but also the tube capacities and the tube resistances.

Symmetry of Circuit

In building such a circuit it is best to make it as nearly symmetrical as possible. That is, the tubes used would be equal and so would be the two condensers C1 and C2. It is convenient to make the plate coupling resistors and the grid leaks equal in the two stages, but it is not necessary. However, the two plate resistors should be equal and so should the two grid leaks. In the figure all are indicated to be equal and are shown by R.

It can be shown that the harmonics in the circuit are practically of the same strength as they are generated by the tubes for the coupler is equivalent to a broadly tuned circuit having an extremely low selectivity. For certain combinations likely to occur in practice it required 10 harmonics before the harmonic was suppressed by 50 per cent. It was on this result that the statement that the harmonics are nearly as strong as they are generated by the tubes was based.

Determination of Fundamental

The fundamental frequency is determined by varying the values of the coupling resistances, grid leaks and the stopping condensers. For the case illustrated in Fig. 4, Moullin gives $F=1/R(C1+C2)$ as an approximate expression for the frequency. To the extent that this is correct, if R is 50,000 ohms and each of the two condensers is 250 mmfd, the frequency would be 40,000 cycles per second. This expression is obtained on the supposition that the time constant of the condensers and resistances determines the frequency. Thus in the figure if we go around the circuit containing the resistances and condensers we find two circuits, one containing two resistances and one condenser, C1, and the other containing two resistances and condenser C2. The time constants of these circuits are 2RC1 and 2RC2. The mean of these two time constants is $R(C1+C2)$, whence the frequency is as given above.

Continuously Varying Frequency

The complete expression for the frequency is quite different and results in a different frequency as well. But this expression is too complex for reproduction here. The important thing is that the frequency can be lowered by increasing the values of the condensers as well as of the resistances.

If the frequency is to be continuously variably it is necessary to vary the capacities continuously. But this is not convenient due to the fact that neither side of the condensers is grounded. However, since the grid capacities enter into the frequency as well as the condensers shown, small variable condensers could be put across the grid leak of each tube and then varying these capacities.

The grid leaks are also grounded. Hence it is conveninet to make the two grid leaks variable and adjusting them for frequency changes. Two equal variable resistances could be put on one shaft so that both are varied simultaneously. Thus there are two ways of varying the frequency continuously. Both could be employed.

Calibration Trouble

It is not feasible to calibrate the oscillator accurately because of the dependance of the frequency on the internal resistance of the tubes. Hence a calibrated oscillator should be used for setting the multivibrator.

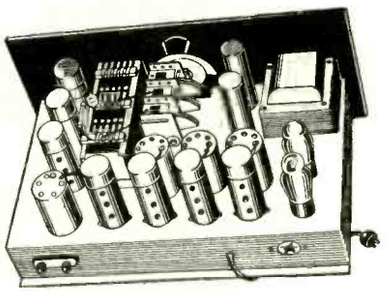


FIG. 1
Inside view of the nine-tube short-wave superheterodyne showing the arrangement of the parts. The location of the coil drawer is at the left of the tuning condensers.

USERS of the Postal International short-wave receiver are enthusiastic about their set, and among the users are found professionals who have tried many different receivers. One of the facts they always mention about the set is that it does more than had been claimed for it. If this is not direct praise of the set it is at least an expression of satisfaction with the performance.

Why is the performance of this set outstanding? We could explain it by saying that it is more sensitive than other similar sets. But that would hardly be the correct explanation, because many sets are so sensitive that they dip away below the noise level even when this level is at its lowest. To go far below the noise level is useless, for it is not noise that we are after but the clear signals. The correct explanation is the ease with which stations can be tuned in with certainty. There is no complicated tuning mechanism resembling in intricacy a time combination lock which only the initiated can open at the proper itme. There is but one main control for station selection, and that requires no more skill than that required turning a knob.

Beat Feature

There is a beat feature gadget in the set that is of great aid in picking up stations. It is an oscillator working at the intermediate frequency. When it is on—and it is turned on or off by a simple switch—it generates a steady frequency equal to, or slightly different from, the intermediate frequency, which in this case is 465 kc. Whenever a signal comes through which with the local high frequency oscillator will generate a beat equal to the intermediate frequency, an audio frequency beat is generated, and this is heard distinctly in the loudspeaker. In turning the main control dial, there will be many points at which this tone is heard, and at every point there is a station to be received. It may be a broadcast station, and amateur station, or a continuous wave code station of some kind. If it is a code station the 465-kc. oscillator is left on, for only then can the signals be heard distinctly. If the station is modulated with voice or music the receiver is tuned by means of the main dial until the tone is loudest and then the beat oscillator is stopped. The guiding tone disappears and the signals come through clear and loud. What could be more convenient than having each station that is receivable whistle at you and to tell you exactly where to stop the tuning condensers to get it loudest? This feature is of inestimalbe value in making a sensitive and highly selective receiver practical. Without it many of the stations would be passed over while tuning without the operator's having the slightest idea that they are on the air and receivable. And without it the continuous code stations could not be received.

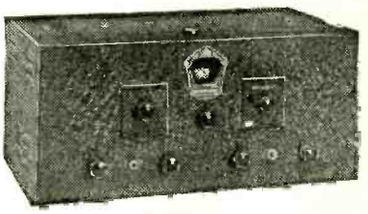


FIG. 2
Front view of the receiver. The window-like rectangle at the right of the tuning dial is the front of the coil drawer. At left is a similar rectangle to make the panel symmetrical.

R-F Stage

Another feature that really amounts to an essential in any superheterodyne is the tuned radio frequency stage ahead of the mixer. It has several advantages. First, it makes the set more sensitive by the use of one more high-gain tube and one more tuner where the signal voltage is stepped up. Second, it makes circuit more selective, thus excluding more external noise as well as all stations not desired at the moment. It is in respect to the second point where the extra tuner is essential, for if there is not a high selectivity in the radio frequency level, frequencies which cause heterodyne whistles would come through to the mixer and hence cause much squealing in the loudspeaker. This squealing is usually attributed to harmonics. A tuned radio frequency stage is the best preventive. In this receiver the squeals are not present.

The effectiveness of this tuner and amplifier to increase the sensitivity and the selectivity depends to a very large degree on how well the radio frequency tuners and the oscillator track. In this receiver there are separate trimmer condensers for every coil. Hence it is possible to trim each coil separately for perfect tracking. This and the precision coils used insure tracking not only of the radio frequency circuits but also of the oscillator. It should not be supposed that the many trimmers are so many added controls. As a rule, the less the operator of a set has to do with these trimmers the better the circuit will perform, for they have been adjusted in the laboratory. It takes skill and experience to make the adjustments, but it requires only a screwdriver to upset them. If the trimmers were to be tampered with a screwdriver would be supplied with the receiver, but it is not.

Drawer Type Coils

Imagine a plug-in type of receiver having two radio frequency tuned circuits and an oscillator for five different frequency ranges. That would make 15 plug-in coils to lose or get mixed up. Such an arrangement is obviously out of the question. Yet the plug-in system has numerous advantages over other systems. The coil arrangement in the Postal International combines the good features of the plug-in system and avoids all the disadvantages. The drawer system is em-

A BIG HELP

a Short-Wave Set

Anderson

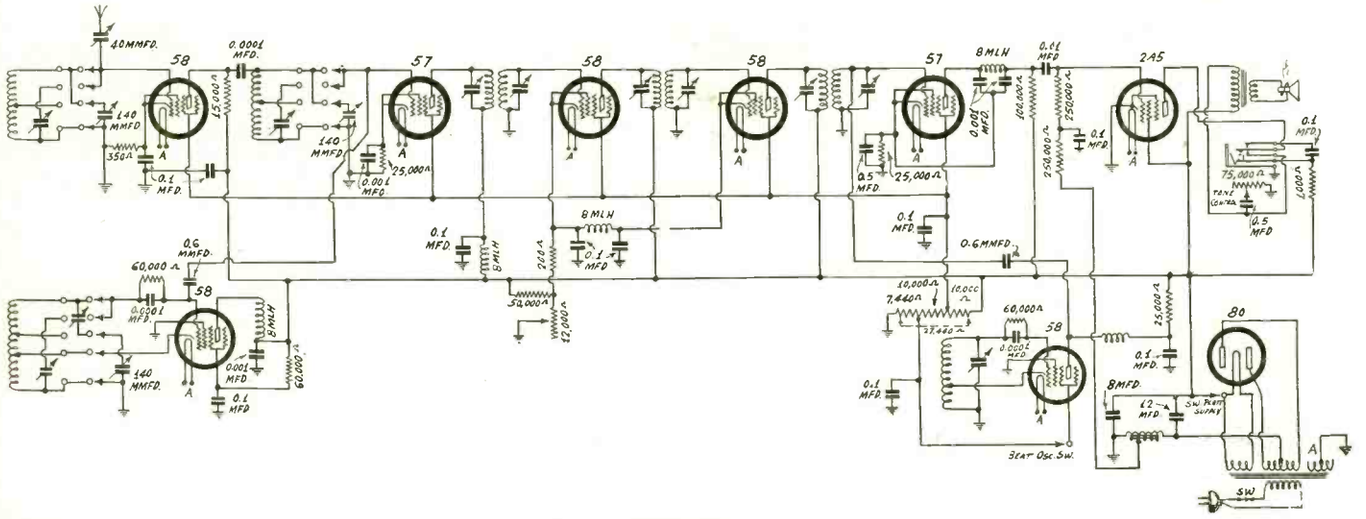


FIG. 3

This nine-tube short-wave superheterodyne has high gain and selectivity and is simple to operate. Heterodynes are excluded by the extra radio frequency amplifier-tuner and stations are located by a beat oscillator, which produces a whistle when a station is receivable. Once located the whistle is stopped with a switch. Band spreading is a specially attractive feature of the circuit.

ployed. In each drawer is a full set of coils and trimmers. That is, there are three coils and the required trimmer condensers.

The drawer slides in from the front panel. As it slips into its proper place all the necessary contacts are made, positively and firmly. They are of the wiping type and are always clean. There will be no high resistance joints. Since all the coils pertaining to a given wave band are contained in a single box, with the coils shielded, there is no chance of getting them mixed or of losing any one of them.

Band Spread Feature

An exceptionally valuable feature of this receiver is the band-spread arrangement. It is used on the 20 and 40-meter bands for spreading out a given narrow band ordinarily occupying 10 per cent of the dial so as to cover about 80 per cent. This is a convenience that amounts to a necessity in the amateur band and it is also a great aid in tuning in short-wave broadcast stations. This feature is also used on the broadcast coil unit in order to cover the entire broadcast band in two sections.

The mechanical arrangement changing the circuit from ordinary tuning to band spread tuning is such that the coil drawer is pulled out a notch when the band spread feature is desired. How this accomplishes the change in the circuit is evident from the circuit diagram. It will be noticed that in each of the radio frequency circuits are two vertical columns of four points in each. When the switch is in the position shown the band spread feature is not used. Hence that represents the position of the coil drawer when it is all the way in. When the switch points make contact with the left row of contactors the circuit is left as before except that a small variable condenser is put in shunt with a portion of the tuning coil. The added condenser is then available for making small changes in the tuning of the circuit.

The same arrangement is used in the other radio frequency tuner and in the oscillator, except that in the oscillator there are five contact points.

The Antenna Trimmer

Still another feature that is of great aid in tuning and in bringing out the highest sensitivity is the antenna trimmer condenser. The main object of this is to adapt the circuit to any kind of antenna that may be available. If the antenna is long, a small value of capacity is employed; if it is short, a larger value is used. Besides this it is an aid in varying the volume for any given antenna.

Normally the output of the receiver is delivered to a loudspeaker. But there is a provision for listening in with a headset. When the phones are plugged in a 1,000-ohm resistor is put in series with them to prevent the full output from being delivered to them. At the same time condenser is put in shunt.

This phone arrangement is a useful feature for there are many times when a short-wave fan wishes to listen in without disturbing anyone in the house.

Controlling Volume

The primary volume control in the circuit is a 12,000-ohm variable resistor placed in common cathode lead of the two intermediate frequency amplifiers. As a limiting bias a common 200-ohm reisstor is used. Between this and ground the variable is placed. To insure current flow in the variable resistance when the bias is so high that virtually no place current flows, a 50,000-ohm resistor is connected between the high plate voltage supply line and the junction of the limiting bias resistor and the variable.

A special filter arrangement is noticed in the intermediate amplifier, one designed

(*Continued on page* 10)

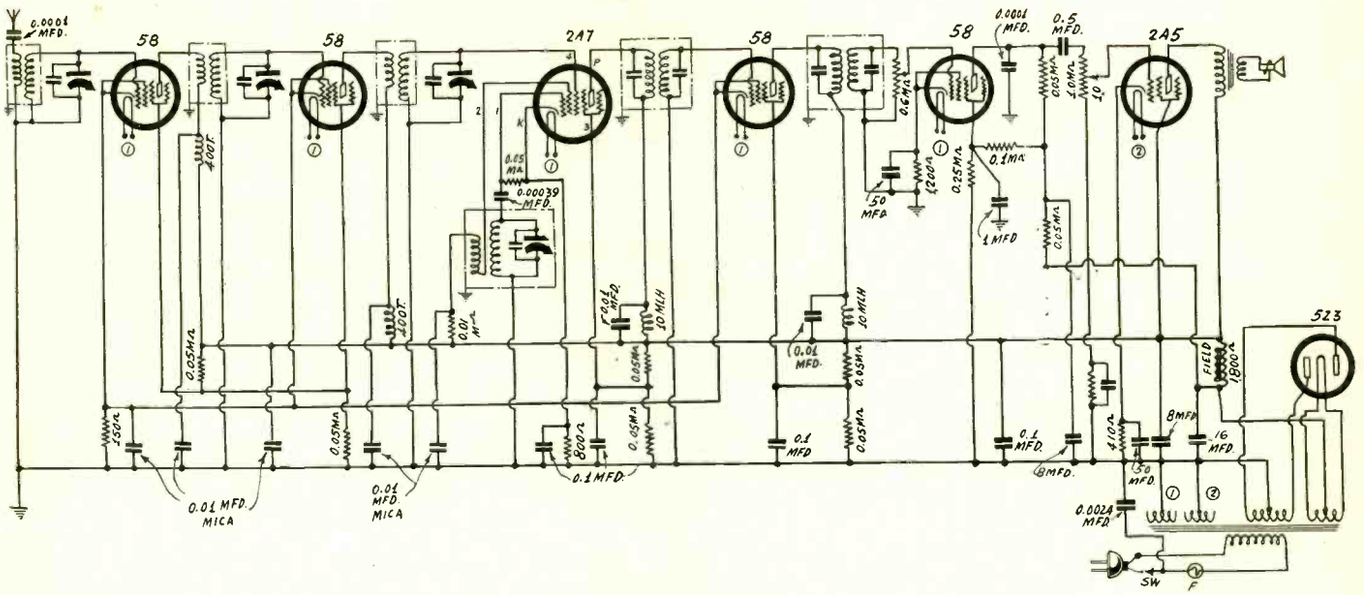
LIST OF PARTS

One—Postal Multiformer (band desired to cover).
One—Special Postal socket, for Multiformer.
One—3 gang 140 mmfd. Postal condenser.
One—40 mmfd. Ant. comp. condenser.
Three—465 kc i-f transformers.
One—Audio beat oscillator coil 456 kc.
One—Power transformer, to handle 9 tubes.
One—12 mfd. condenser 450 volt working v.
One—8 mfd. condenser 450 v. working v.
One—12,000 ohm volume control and switch.
One—75,000 ohm tone control.
One—Single circuit jack, with single pole double throw switch.
One—Toggle switch for "B" supply.
One—Rotor switch for audio beat oscillator.
One—Dial and front plate.
Five—58 sockets.
Two—57 sockets.
One—2A5 socket.
One—280 socket.
One—Speaker 5 prong socket.
Five—8 millihenry R.F. chokes.
One—Ant. Gnd. binding post.
Eight—.1 mfd. tubular condensers.
One—.05 mfd. tubular condenser.
One—.01 mfd. tubular condenser.
Four—.001 mica fixed condensers.
Three—.0001 mica fixed condensers.
One—.0000006 mmfd. condenser.
One—25 watt wire wound resistor 27,440 ohm, tapped 10,000 ohm, 10,000 ohm, and 7,440 ohm.
One—10 watt wire wound resistor 1,000 ohm.
Two—60,000 ohm. 1/3 watt pigtail resistors.
One—15,000 ohm 1 watt pigtail resistor.
One—60,000 ohm 1 watt pigtail resistor.
Three—25,000 ohm 1 watt pigtail resistors.
Two—250,000 ohm 1 watt pigtail resistors.
One—350 ohm 1 watt pigtail resistor.
One—200 ohm 1 watt pigtail resistor.
One—1,000,000 ohm 1 watt pigtail resistor.
One—Cord and plug.
One—Chassis 11" x 19" x 3".
One—Steel front Panel 9¼" x 20½".
Six—Knobs.

USE OF FEWER TUBES

Can Yield as Many Stations, or More; Latest Do-Dads Reduce Sensitivity

By Herman Bernard



A standard 7-tube superheterodyne that provides excellent DX results. This is an example of a receiver that gets as many stations as a set with several more tubes, or even gets more stations, but without latest wrinkles in it, like a v. c. and squelch, that reduce sensitivity. The 2A5 grid circuit filter consists of 0.1 meg. and 0.1 mfd.

SOME persons wonder why receivers having only a few tubes, say, six or seven, can bring in as many stations as a set with several extra tubes, or indeed even bring in more stations. There seems to be an opinion that bad design is the cause of the difference, but this is not necessarily so. It probably is false.

The simple rule for gaining the greatest sensitivity and selectivity is to work each tube almost to the limit of its compromise performance, since the two considerations of sensitivity and selectivity are somewhat contradictory. Thus, if one has a superheterodyne in mind, four tuned stages to account for the radio-frequency and oscillator levels will give sufficient pre-selection and mixing results. Then the intermediate amplifier may consist of a single tube, automatic volume control omitted from all stages.

The Second Detector

The intermediate amplifier would feed into a 57 for highest sensitivity, or into a 58, for greater voltage-handling capability. However, a point to watch here is that the plate load resistor may have to be much less than the usual recommendations, for higher sensitivity, and 50,000 ohms has given great satisfaction, compared to 0.25 meg. This applies to the 58 rather than to the 57, but is not entirely foreign to the 57, either, as a trial.

The tube following the detector may be a pentode output, as that is the best way to gain high sensitivity, all other power tubes being of low mu or amplification factor.

With such a receiver the sensitivity easily can be better than 10 microvolts per meter. The selectivity should be sufficient to meet everyday needs, even of those who live in centers surrounded by broadcasting stations, e.g., New York and Chicago.

The practical sensitivity is increased by increasing the aerial length and height, and if one lives at a considerable distance from broadcasting stations it is all right to follow this procedure, if there will be no serious trouble from heterodyne interference. But for users living in large cities, or near them, a shorter aerial is preferable, because the old argument that the greater the antenna input the less the noise does not hold for sensitive superheterodynes. It does not hold for two reasons: first, heterodyne interference is increased due to lowered selectivity, and this would be one of the most serious sources of noise; second, interference due to man-made static may result largely from the use of a long leadin made necessary by a high aerial.

Transposed Leadin

The leadin, being always closer to ground, picks up more interference than does that horizontal stretch of wire meant when aerial is commonly referred to, and therefore a very short areial, even not outdoors, will be excellent for cities.

The noisy pickup from leadins can be cancelled by use of the transposed leadin. This consists of bring down two wires instead of one from the roof. Wire A is the regular lead connected to aerial as usual, and in the house the other end of this same wire is connected to the antenna post of the set. Wire B at the roof is soldered to the most appropriate ground connection there, or to a ground clamp attached to a standpipe that connects to the cold water system. The other end of this wire is connected to the ground post of the receiver in the home, and to this ground post also is run a wire from the cold water pipe in the house. However, the two wires are crossed several times on the way down.

One way of introducing this system is to use a-c twisted pair cable, the same type as is used on receivers, where the plug at one end of the wire is to go in the wall plate or convenience outlet or lamp socket. Thus very numerous twists are automatically introduced. Also, the wire is coded, with a tracer in one lead to identify it from the other, so that you will not get mixed up when connecting in the home. However, any mix-up will be solved readily enough, as when the wires are connected to the set the right way you get reception, while when they are connected the wrong way you get little or no reception.

Transposition Blocks

Instead of using twisted pair it is practical to have a firmer installation and use transposition blocks. These are high-frequency insulators with grooved provisions for crossing the wire without touching. The number of blocks to use will depend on the severity of the interference from man-made static, the height of the antenna and the sensitivity of the set. At least half a dozen should be tried at first.

The object of both forms of leadin transposition is to have a grounded conductor neutralizing the pickup from aerial to set. Thus practically only the energy that the horizontal portion picks up is conducted to the receiver, as the otherwise pickup due to the leadin itself is neutralized. This is accomplished by the automatically-resulting phase inversion.

Many set-builders are DX fans, and often will obtain better DX results with receivers

of fewer tubes, and with a transposed leadin, than they will obtain with larger sets, with or without transposed leadin.

Fading Effects

There is no doubt about the drag on a sensitive receiver resulting from automatic volume control. The object of such control is to establish a certain level of sound volume that will not be exceeded within the limits of carrier-control, so that all locals come in with about the same volume, and some distant stations that otherwise would come in as fading stations are heard with the fading a bit reduced or less noticeable. However, for very weak signals a.v.c. lends little help as to fading, since there is little voltage developed, and little change in the negative bias on which a.v.c. always depends.

For a.v.c. the detector usually is a diode, and even if it isn't, some extra tube has to be used to give the a.v.c. Thus an extra tube is included, or a less sensitive detecting system introduced, so that a.v.c., which itself reduces sensitivity, may be enjoyed. There are undoubted advantages in a.v.c., but the whole circuit has to be gaited to it, and the sensitivity built up compensatingly at audio levels, if not at intermediate levels, or both. So with a.v.c. sets there would be two stages of i-f amplification, and yet the sensitivity might be no higher than from one stage where a.v.c was omitted.

Screen Grid Detector

The admission of reduced sensitivity may be read from the very construction of the diode tubes. They are invariably duo-diode amplifiers. i. e., there are two diodes and an amplifier in the same envelope. The presence of two diodes has no particular signficance in this connection, but the triode shows that the tube as a whole, with triode operating, is intended to reach approximately the sensitivity of regular pentode or quadrode detectors.

A screen grid tube as detector may not handle as much input voltage, but it requires so much less input voltage that there is no need for such a high level of safeguard. This condition may be reflected back to the antenna input, meaning that the aerial may be reduced to such a point that the selectivity effect of the antenna stage becomes quite noticeable on all stations, and most particularly on the weaker one, if that stage is experimentally tuned separately. The shorter the aerial the greater the apparent selectivity, and indeed the actual selectivity, for it means simply that there is looser coupling between receiver and pickup, and we all know what loosening the coupling does to selectivity.

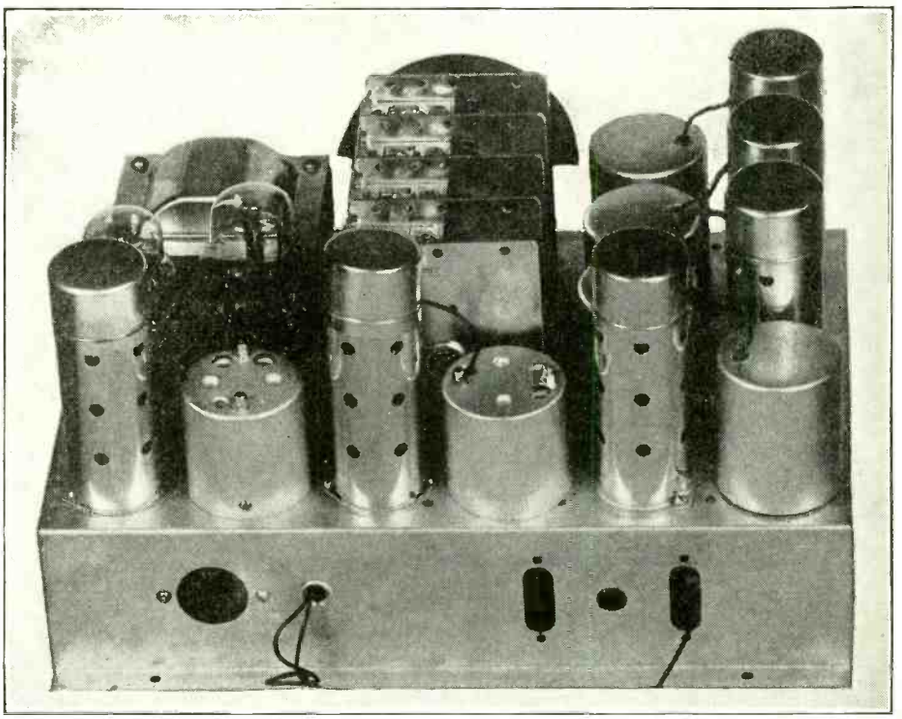
The more sensitive a receiver the better the shielding must be. Also, chokes should be in r-f and i-f plate circuits, bypassed by condensers. Overhead grid leads, to caps of tubes, should have shielded wire, with sheath grounded.

Shielding Precaution

The usual run of wire is not good enough for the r-f level, although acceptable for the intermediate level. At radio frequencies the resultant capacity to ground may be so great as to defeat covering the higher frequencies of the broadcast band, so wire that has a thick cotton covering, and then the sheath over the surface, had better be used for the r-f and oscillator levels (if the oscillator tube is of the overhead grid cap type).

On the subject of quality, it is a fact that the diode may be operated over a linear portion of its characteristic, if the load resistance is high enough, say, not less than 0.25 meg., for linearity comes from the high resistance load, as the tube resistance is only a small part of that. Therefore somewhat better quality is derived from the diode, indeed the best quality detection we have, but a properly-loaded screen grid tube as detector does not come much below the diode, and many persons, by aural test, could not tell the difference.

Layout for a DX Receiver



The circuit diagramed on the opposite page may be built according to this layout, either literally with single output or, as an 8-valve set, with push-pull output as shown above. The arrangement of parts is conventional and is consistent with short leads.

Pentode as Output

Moreover, the pentode tube is not as good in quality of output as is the triode, but the triode has hardly any sensitivity (maybe a mu of 3 to 4 on paper, which means half of that in practice, as a rule). The distortion attributed to the pentode is usually the high content of third harmonic, but most persons do not notice it at all, and besides the total harmonic content of the pentode output tube in an a-c set may be 7 per cent, which is not bad, especially as the second harmonic is present in an appreciable quantity.

To prevent the generation of second harmonics push-pull is used, but push-pull is not a means of killing off second harmonics previously generated. Also, push-pull multiplies the power output by about 4, not that it improves the sensitivity at all, but it permits the output stage to deliver 12 watts instead of 3 watts, for example. Yet the voltage input that it will stand is no greater, unless the bias is purposely increased, and this may be done to an extent where push-pull is used, most especially if accompanied by an increase in plate voltage.

More Out of the 55

If the 55 is in a circuit that has choke B in the positive leg, then, since the voltage is higher for B plus at the rectifier, the 55 can be made to accommodate a much higher voltage swing by returning its plate to the high-voltage end (rectifier filament). This results in severe hum, so a resistor is interposed, say, 50,000 ohms, while the 55 plate load remains 0.25 meg. Then a condenser of 8 mfd. is connected between the joint and grounded B minus. Hence a resistor-capacity filter is erected, and this leaves the hum at its original low level. The extra resistor should not much exceed 50,000 ohms, otherwise the effective voltage will not be much more than by the other method, due to voltage drop in the extra resistor.

It is therefore apparent that the DX hound will get a great deal of satisfaction out of a simple circuit and also will be able to use it for wide ranges of frequencies, e.g., covering the broadcast band and short waves with the same set.

And besides, with a.v.c. omitted, any dial calibration stands a better chance of staying put, or rather, the circuit is less likely to contradict the calibration on the dial from time to time, as change in bias, due to a.v.c. or any other cause, changes the tuning, especially if this change affects short-wave circuits.

Improvement Sought

In intermediate amplifiers this change is too small, compared to the frequency of the original carrier, to matter much, yet a.v.c. and complete frequency stability are inconsistent at the present stage, due to the absence of frequency-stabilized circuits from any commercial or kit receivers.

One of the improvements in radio in months (or let us hope it won't be years) to come will be frequency stabilization not only of the oscillator but also of circuits governed by a.v.c. or otherwise subject to bias alteration for volume and sensitivity control.

Such automatic control as is used today is almost exclusively at the inaudible levels, r.f. and i.f., though some venture a bit of inclusion of an audio stage as well, especially in a sort of squelch circuit manner. However, applying a.v.c. to audio, while it can be done, has its drawbacks, particularly as the crescendos of the music itself are subject to reduction the louder they are originally, and in theory at least this tends to make all musical or other rendition of the same sound intensity, no matter how differing before the microphone, which is ridiculous.

A BATTERY SUPER

Using 1A6 Pentagrid Converter and Push-Pull 33 Output—2-Volt Tubes Economical

By Jasper Edwards

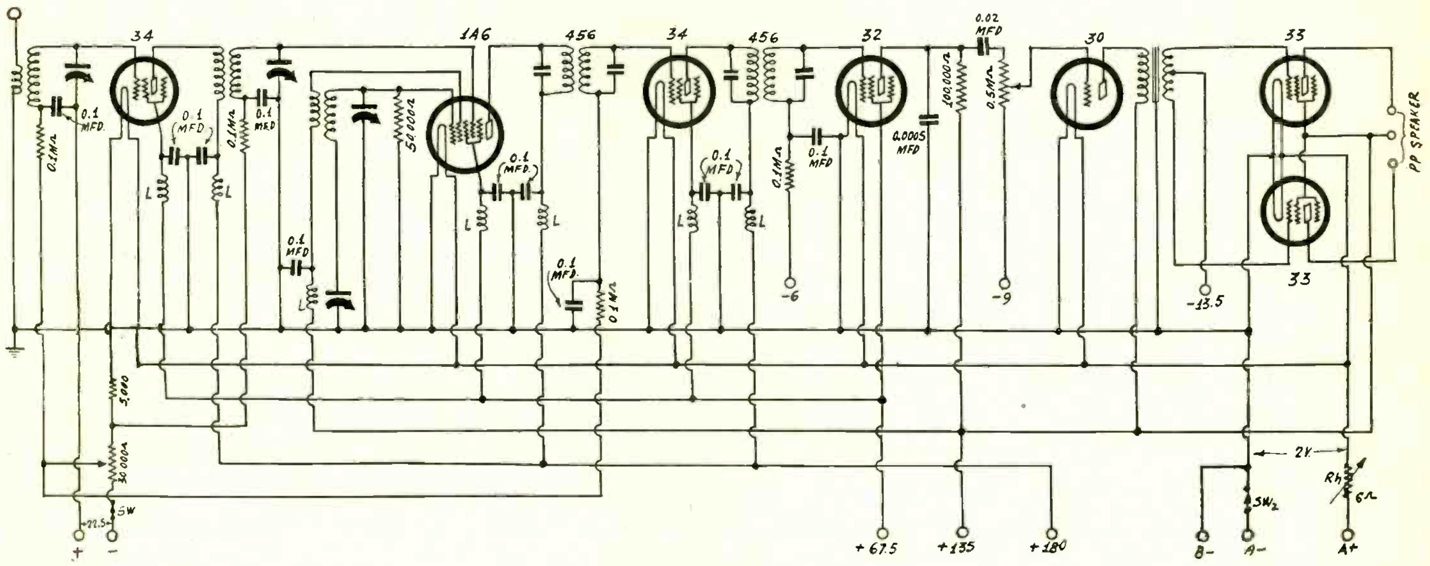


FIG. 1

This is a high gain, high selectivity superheterodyne employing seven battery type tubes. It is suitable for use in the country where electric power lines to not reach. The use of the pentagrid oscillator-mixer makes the circuit the equivalent of an eight-tube receiver.

BATTERY-OPERATED receivers are in demand, mostly for use in the country where electric lines do not reach. The fact that they are to be used in the country indicates that they will be far removed from broadcast stations. For that reason they must be sensitive, and they must be selective, too, for any receiver that is sensitive enough to pick up distant stations must be able to suppress all interference from strong stations not so far away. The logical choice, therefore, for a receiver to be used in the country is a superheterodyne, for that combines sensitivity and selectivity as does no other type of receiver.

There is little choice of tubes for a circuit for this purpose, for there is only one set that is suitable, judging by economy of operation and effectiveness, and that is the tubes of the two-volt series. Fortunately we have in this series every specialized tube that is necessary for a correct design. For radio and intermediate frequency amplification we have the super-control tetrode, 34; for detection by the grid bias method we have the 32 screen grid tube; for oscillation and mixing we have the new 1A6 pentagrid; for audio frequency amplification we have the 30, which is suitable for working into a transformer; for power amplification we have the 33 power pentode. Hence the gamut is complete and there is no necessity for using any tube not suitable for its function.

Economy of Filament Current

For a receiver that is to be used in the country it is highly desirable that the filament current required by the set is as low as possible. The combination of tubes above used in a seven tube superheterodyne, with two power pentodes in the final stage, will require a filament current of only 0.82 ampere. This can easily be supplied by a small storage cell of 2 volts, or even by a dry cell battery of three volts. If dry cells are used, it would not be economical unless there are four of No. 6 cells in parallel and two such groups in series. As small storage cell is much more economical.

The voltage across the filaments should never be allowed to exceed two volts. If a storage cell is employed there is no danger of exceeding it but if a three volt dry cell battery is used there is. Since the current is 0.82 ampere there should be a resistance of 1.25 ohms in series with the filament circuit. More may be used if the circuit gives good response. Hence a rheostat of 6 ohms is suggested. The rheostat is not necessary when a 2-volt storage cell is used.

The B and C Supplies

The radio and intermediate frequency amplifiers and the plate of the 1A6 are given a voltage of 180 volts. The plates of all the other tubes as well as the anode of the oscillator portion of the 1A6 are given 135 volts. The power tubes screens are also kept at 135 volts. All other screens are maintained at 67.5 volts. Since the highest plate voltage is 180 volts we will need a battery of this voltage. This battery should be tapped so that the lower voltages, that is, 135 and 67.5 volts, can be obtained. A heavy duty B battery will be the most economical if the receiver is to be used much.

The highest negative grid voltage is 22.5 volts, which is that required on the grids of the two 34 tubes when the amplification is to be the least. Hence we have to have a grid battery of this voltage. This battery should be provided with many taps so that the proper grid voltages for the other tubes can be obtained from it. Oscillator grid is not

Bandspread on Short Waves

(*Continued from page 7*)

to eliminate all undesired coupling between the two stages. In the cathode lead of the second intermediate frequency amplifier is a low pass filter consisting of two 0.1 mfd. condensers in shunt and one 8-millihenry choke in series. This is vastly more effective in filtering than would a single condenser be, even if the capacity of that condenser were several microfarads.

The mixer in the circuit is a 57-tube operated as a grid biased detector. It is coupled to the high frequency oscillator by means of a 0.6 mmfd. condenser connected between the grid of the mixer tube and the grid of the oscillator. This tiny condenser provides adequate coupling at all frequencies for which the receiver is designed.

The second detector is also a 57 operated as a grid biased transrectifier. The coupling between this detector and the beat frequency oscillator is of the same type as that between the high frequency oscillator and the mixer, that is, a 0.6 mmfd. condenser is employed, but in this case it is connected between the grid of the detector and the plate of the oscillator.

Four of the coil systems cover the wage range from 14 to 200 meters. The fifth, which may be obtained when desired, covers the broadcast band in two steps.

biased, except that the grid is returned to the negative end of the filament. The second detector is biased 6 volts, but other values may be preferable since one value will give the greatest detecting efficiency while another will enable the tube to take a higher signal voltage without overloading. If the grid battery is provided with many taps the detector bias can be varied to suit requirements.

The audio voltage amplifier takes a bias of 9 volts, for a plate supply voltage of 135 volts. Hence there should be a tap at 9 volts on the C supply battery. The power tubes require a bias of 13.5 volts when the plate supply voltage is 135 volts and the screens are maintained at 135 volts. Hence there should be a tap at 13.5 volts.

Volume Control

The bias on the two high frequency amplifiers is variable between about 3 volts and 22.5 volts. A resistance of 35,000 ohms is connected across the 22.5-volt battery. This 35,000-ohm resistance is made up of a 30,000-ohm potentiometer and a fixed resistance of 5,000 ohms. It is this that determines the minimum bias on the tubes and hence the maximum sensitivity of the receiver.

The 30,000-ohm potentiometer is the volume control and its range is sufficient to vary the gain from nearly nothing up to the maximum.

Since the 35,000-ohm resistance is across the grid battery, a current will flow during operation. While this current is negligible, it is too large to be allowed to flow when the set is not in operation. Hence there is a switch in series with the negative lead to the battery. This switch need not be represented on the panel with a special knob, for it can be put on the same control as the filament switch. Thus when the filament battery is turned off the grid bias battery is also turned off. Both switches may be attached to the volume control potentiometer.

Filtering of Circuit

As a means of preventing feedback, the plate, grid, cathode, and screen circuits are thoroughly filtered. In each screen and plate return lead of tubes operating at ratio or intermediate frequencies there is a choke coil L, which may have a value of 10 millihenries. For each of these chokes there is a condenser of 0.1 mfd. connected from ground to the lead that is to be filtered.

In each of the grid return leads of tubes operating at high frequencies, except the return of the oscillator grid, is a 0.1-megohm resistor and for each of these resistors there is a by-pass condenser of 0.1 mfd. Corresponding filtering of the leads in the audio frequency amplifier is not done because it is not necessary. However, if the plate supply battery is allowed to become nearly exhausted, there is a possibility of an audio howl developing. This can be remedied by a very large condenser across the B supply battery, or across one of the sections of it, especially the 135 volt section which serves the audio amplifier. A four mfd. condenser should be sufficient.

R-F Tuners

Two identical radio frequency tuners are used, one preceding the first high frequency amplifier and the other preceding the mixer. The condensers should have a capacity of 350 mmfd. and the coils should be wound to match. Of course, the coils should be shielded.

The oscillator coil, which also should be shielded, should be wound for a tuning condenser of 350 mmfd. and an intermediate frequency of 456 kc. There are standard combinations of tuners for 350 mmfd. gang condensers and 456 kc intermediate.

The series padding condensers in the oscillator is put between the coil and ground, thus putting the adjustable condenser next to ground and making it easy to effect padding adjustments.

There are two doubly tuned and shielded intermediate frequency transformers in the circuit and they are tunable to a frequency of 456 kc.

The Audio Amplifier

The audio amplifier consists of two stages, one using a 30 tube coupled to the detector by means of resistance and capacity and the other a push-pull power stage coupled to the first audio tube by means of a push-pull input transformer.

The plate coupling resistor has a value of 100,000 ohms. A higher value would not give good results in a screen grid tube circuit when the screen voltage is as high as 67.5 volts. With 100,000 ohms, however, and a high negative bias on the grid, the detecting efficiency is high and the detector will take a sufficient signal voltage to make the output more than enough to load up the 30 tube to the limit. A shunt condenser of 0.0005 mfd. is connected between the plate of the detector and ground to insure an easy path for the high frequency component of the output, that is, to insure a high detecting efficiency.

The stopping condenser between the plate of the detector and the grid of the first audio amplifier has a value of 0.02 mfd. This is a high enough to insure a high voltage gain on the lowest essential audio frequencies provided it is in series with an adequate grid leak. A sufficiently high grid leak resistance is 0.5 megohm. In the circuit drawing this is shown as a 0.5-megohm potentiometer the slider of which is connected to the grid. This variable is not essential to the control of the volume because the grid bias control on the high frequency amplifiers is quite adequate. However, it does furnish an extra control by which the audio gain can be controlled independently of the radio frequency. It is mainly useful in cases where the audio amplifier is used for phonograph reproduction. The amplifier can be used for this purpose by connecting the output of the phonograph pickup between the grid cap of the detector and a negative voltage that is suitable for amplification. A good voltage is 3 volts. Of course, when the phono pickup is connected to the detector the grid clip there before should be removed.

The Push-Pull Amplifier

The push-pull amplifier employs two 33 type power pentodes together with a push-pull input transformer. The bias, as has been stated, is 13.5 volts and the plate and screen supply voltages 135 volts.

A push-pull output transformer suitable to the 33 should be used. This is not shown because it generally is a part of the loudspeaker. The best speaker to use is a permanent magnet field dynamic, a type that is available for the 33 tubes. However, if some other magnetic speaker is available it may be used by interposing a suitable push-pull output transformer between the tubes and the speaker.

A magnetic speaker is the most practical because there is no simple way of providing a field current for a dynamic speaker. If, however, a storage battery is used for the filaments, it might as well be used for the field as well. In that case the battery should be of the six-volt type, which is the most usual and the most easily obtained. It can be recharged at any automobile service station. When a six-volt battery is used the filaments should be connected across the entire battery to equalize the drain on the three cells. This change demands a change in the rheostat value in the filament circuit, for now four volts will have to be dropped. A six-ohm rheostat would still be sufficient but it would be better to use one of ten ohms.

When the battery voltage is as high as six volts, great care must be exercised against the possibility of burning out the tubes. It would be advisable to put in a fixed resistance of 4 ohms as a permanent safeguard.

Adjustment of the Tuners

The four intermediate frequency tuned circuits should be tuned to 456 kc against a modulated, calibrated oscillator. The signal may be applied between grid and ground of the mixer tube. A strong signal is first applied. The first grid coil is then tuned until the 456 kc signal is loudest. Then the input to the circuit is reduced, or the amplification is reduced, so that the output is just barely audible. Then the second grid coil is tuned until the signal is again maximum. If the signal is now too strong, it should be reduced as before. Next the two plate coils should be tuned to the same signal. All this time the setting of the calibrated oscillator is not touched.

When all the intermediate frequency circuits have been tuned in this manner the calibrated oscillator should be moved so that its output is impressed on the input terminals to the set, and at the same time the frequency should be changed to a value about 15,000 kc. Set the tuning condenser at about 5 on the scale and then tune in the signal with the trimmer condenser on the oscillator. When it has been made as loud as possible with this, trim the two radio frequency circuits in the same way, reducing the strength of the signal whenever it becomes too strong. It is best to make these adjustments with the lowest possible signal level, one that is just barely audible.

Adjusting the Series Condenser

The simplest part of the adjustment is the tuning of the intermediate and high frequency radio which has just been explained. Next comes the adjustment of the series padding condenser, and this is the most difficult. The first step in the process is to find out where on the radio frequency dial a signal of about 600 kc comes in. To do this convert the circuit to a tuned radio frequency set by moving the grid clip on the 1A6 to the cap of the 32 detector, removing the clip that was on that tube. Next provide he 600 kc signal by resetting the calibrated oscillator on that frequency, or on one slightly lower, say 570 kc. Tune the main dial until this signal comes in loudest. Leave the dial exactly as it was when this signal was loudest and also leave the signal oscillator alone. Next restore the circuit to a superheterodyne by putting the grid clips where they belong.

BETTER POLI

In a Dual-Range Receiver Are Accomplished

By Frank X

IN this eight-tube a-c-operated superheterodyne the broadcast transmissions and police calls are covered in a manner that does full justice to both. The broadcast band is a familiar story by this time. The police band results are improved when the same treatment is given to it as is given to the broadcloth band. That means entirely separate coils—though in same shield—thus primayr and secondary individual to each band. Padding is different in the oscillator circuit. For the police band the padding condenser is larger; therefore an extra capacity may be switched in parallel with the other padding condenser for police reception.

The broadcast band coverage is from just a bit below 540 kc to 1,620 kc, or a utilized frequency ratio of 3 to 1. By starting the police band at 1,600 kc the highest frequency of response is 4,800 kc. Thus the range total is 540 to 4,800 kc, or 555.2 to 62.46 meters. There will be some police reception higher than 1,500 kc in the so-called broadcast band.

Coil Construction

Of course, in the police band itself there will be received more than police calls, as there are amateur, aircraft, passenger ship phone and even relay broadcast transmissions.

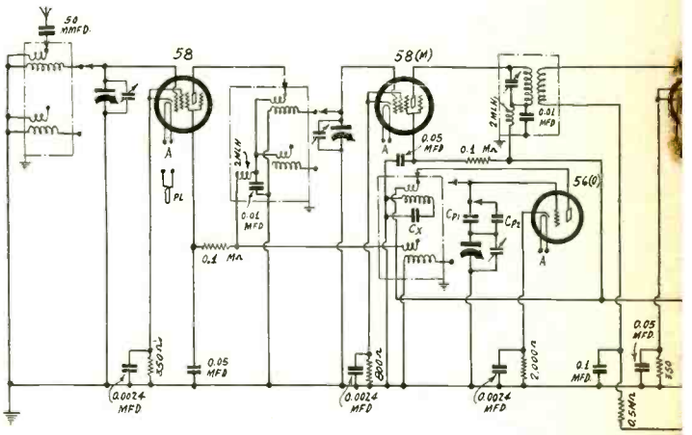
The broadcast coils may be layer-wound. A dowel ⅜-inch in diameter is the winding form. Two circular insulating discs are fastened to the ends of the dowell. One of these discs has two lugs on it for wire connections. There are two slots in the lugged discs, so the beginning of the wire can be brought out immediately, and not interfere with the actual winding. The excess may be wrapped around the lug a few times for holding. The wire may be No. 29 single silk, or other wire of about that size, even of other insulation, and the secondary requirements will be met for condensers rated at 0.00035 mfd. to 0.0004 mfd., if there are 125 turns. The primary is wound separately, and since there will be considerable distance between the primary and secondary, more turns would be used on the primary than ordinarily. About 100 turns will be satisfactory. Close watch must be kept on the number of secondary turns, but the number of primary turns is not critical.

For the police band the solenoid type of construction is preferable. The primary is wound on the ⅜-inch dowel, not in layers, but in a single layer, and may consist of fine wire, say, No. 32 enamel.

Insulation Ring

If one-half inch axial length is provided, there will be room for 56 turns. Since the winding does not require end pieces for prevention of slippage, because there is only one layer, after the primary is put on, an insulation device is slipped over it. If you have a one-half inch outside diameter tubing it will make a snug fit. Otherwise Empire cloth or other treated fabric will do. The inductance required is 23 microhenries for the secondary, and on ½-inch diameter, 42 turns of No. 30 enamel would be required, for which there is room on a one-half-inch winding space, since 45¼ turns could be accommodated (90½ turns per inch).

After the short-wave coil is prepared, the extra circular end piece is put on for reasons of lug anchorage, and the terminals of all coils soldered to the lugs. There should be a total of six coils (counting primary and secondary as only one coil), and care should be exercised to make the connections the same for all, for instance, outside of secondary to grid, inside to ground; outside of primary to plate, inside to B plus, and one winding mounted in respect to the other in the same way each time. The oscillator windings will be different.



Use of entirely separate coils, though they may be in tl performance. The reason is the suiting of the primaries be expected to be fully effective over a 9-to-1 frequency to 62.46 meters. Switching is used. Inst

Inside Chokes Practical

The coils are to be stacked, the short-wave coil on bottom, the broadcast coil on top, and leads brought down. The assemblies are put in shields of about 2.5 inches diameter or so.

If desired, the plate choke and even the bypass condenser may be put onto the assembly for the first r-f stage by using the small mica type 0.01 mfd. capacity and putting the choke at right angles to the rest of the assembly, anchoring the choke to extra lugs. In this way there need be only one lead coming out for the plate return, and that is the lead connected to B plus.

Oscillator Coils

The r-f turns have been given. The oscillator coils then would be wound as follows:

Broadcast band: secondary, 115 turns of approximately No. 29 single silk covered wire; tickler, 90 turns of any convenient wire.

Short-wave band: (21 microhenries), secondary, 40 turns of No. 32 enamel wire. Tickler, 30 turns of any convenient size wire.

Solenoids may be used instead for the broadcast band, as will now be discussed.

Winding Solenoids

As most experimenters will have better facilities for winding solenoids the data on these for 1-inch diameter, with extra turns included to allow for the inductance shrinkage due to shielding, follow:

Broadcast Band

Signal Level	*Oscillator Level*
115 turns No.	70 turns No.
32 enamel	32 enamel

Police Band

Signal Level	*Oscillator Level*
28 turns No.	26.5 turns
28 enamel	No. 28 enamel

The values given are for the secondary

LIST OF

Coils

Two shielded r-f assemblies for broadcast and police bands, and one shielded oscillator assembly for broadcast and police bands.

Three intermediate-frequency transformers, 465 kc, either singly- or doubly-tuned.

Four 2 mlh radio-frequency choke coils. If i-f and other coils are home-constructed, these chokes may be in three i-f coil cans and in one r-f coil can.

One 10 mlh r-f choke coil.

One speaker for 2A5 output, with field coil and output transformer built in. Field may be 1,800 to 2,500 ohms.

Condensers

One three-gang tuning condenser, rated capacity of 0.00035 mfd. sufficies.

Four 0.01 mfd. fixed condensers.

Five 0.00024 mfd. mica fixed condensers.

Two padding condensers, one 541 mmfd., other 586 mmfd. The smaller one is for the broadcast band. These condensers should be mica or air dielectric. (Cp1 and Cp2).

Nine 0.05 mfd. fixed condensers.

Three 0.1 mfd. fixed condensers.

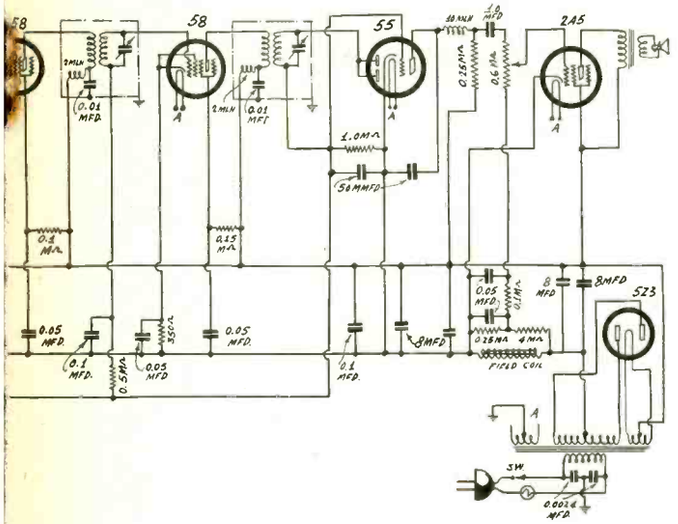
One 10 mmfd. fixed condenser (Cx).

One 1.0 mfd. fixed condenser.

CE RESULTS

by Use of Separate Coils for the Higher Band

Loughran



he same shield, for covering the police band improves to the frequencies covered, as no single primary could ratio. The set covers from 540 to 4,800 kc, or 555.2 uctions for winding the coils are given.

inductances. The primaries may be wound of any fine wire, being put over the secondaries for the broadcast band, both r-f and oscillator coils, with insulating fabric between, winding 30-turn primaries. For the police band the primary may be ⅛-inch away from the secondary, adjoining it, not over it, and consist of about one-quarter the secondary turns.

The shielding for the above purposes may consist of aluminum cans 2/16 inches outside diameter, 2½ inches high.

PARTS

Three 0.00005 mfd. fixed condensers (50 mmfd.).
Four 8 mfd. electrolytic condensers.

Resistors

Three 350-ohm fixed resistors.
One 800-ohm fixed resistor.
One 2,000-ohm fixed resistor.
Five 0.1 meg. fixed resistors.
Two 0.25 meg. fixed resistors.
Two 0.5 meg. fixed resistors.
One 0.6 meg. potentiometer with a-c switch attached.
One 1.0 meg. fixed resistor.
One 4.0 meg. fixed resistor.

Other Requirements

One vernier dial with pilot lamp and escutcheon.
One chassis.
Six six-hole sockets, two five-hole sockets (one of the fives for speaker plug), and one for four-hole socket.
One 1-ampere fuse and holder.
Four 58 tubes, one 56 tube, one 55 tube, one 2A5 tube and one 5Z3 tube.
One 2.5-volt pilot lamp.
One a-c plug and cable.
Five grid clips.

It is not absolutely necessary to have trimming condensers on the main tuning condensers of r-f and modulator input, but the oscillator must have a broadcast trimmer, because for the broadcast band the minimum capacity of the oscillator must exceed that of the others. This is because the oscillator and r-f capacity curves must cross for excellent tracking. And since the minimum capacities must be different, the difference is satisfactorily developed by omitting the parallel capacity for the police band, even from the oscillator for police calls.

Thus we must select oscillator or inductance values on the basis of the highest frequency to be tuned in, with different minimum capacities. For the broadcast band, if the intermediate frequency is 465 kc, the highest frequency of the oscillator is 1,620 + 465 or 2,085 kc, and for the police band it is 4,800 + 465 or 5,265 kc. The respective minimum capacities would be, for the broadcast band, signal level, 46, oscillator 54 mmfd., and for the police band 46 and 46 mmfd. The extra 8 mmfd. for the broadcast band oscillator must be supplied externally. So the respective broadcast inductances required are: r-f, 210 mh, oscillator, 110 mh.

The next consideration is the selection of the padding capacities. Assuming 0.0004 mfd. maximum, because of the distributed capacities, this has to be reduced for the oscillator's broadcast service to 0.00023 mfd., to make the lowest frequency 540 + 465 or 1,005 kc.

Series Capacities

The value of the series or padding capacity, when the effective capacity and the tuning condenser's capacity are known, is:

$$Cs = \frac{C1 \times C2}{C1 - C2}$$

where Cs is the unknown series capacity, and C1 is the larger and C2 the lower of the two known capacities. Changing the values to micro-microfarads we have

$$Cs = \frac{400 \times 230}{400 - 230} \text{ or } \frac{92{,}000}{170} \text{ or } 541 \text{ mmfd.}$$

For the police band the lowest oscillator frequency is 2,065 and the capacity required with 21 microhenries to reach that frequency is 258 mmfd., so

$$Cs = \frac{400 \times 258}{400 \quad 258} \text{ or } \frac{83{,}200}{142} \text{ or } 586 \text{ mmfd.}$$

Use as T.R.F. in Test

So if an adjustable series condenser is established at 541 mmfd., the extra parallel capacity for the higher frequencies (police band), would be 45 mmfd. This is switched across the other padding condenser. A 50 mmfd. air condenser therefore could be adjusted nearly to maximum to attain the correct value, while for broadcasts the 586 mmfd. could be achieved by using a mica fixed condenser of smaller capacity and adjusting with a small trimmer in parallel.

Since we have coils of known inductance, we can set up the circuit for a tuned radio frequency operation, not having a coil in the plate circuit of the 58 modulator (M), but connecting this plate to B plus through a resistor of 15,000 to 25,000 ohms, and connecting one side of the audio stopping condenser to this plate. Then using the broadcast oscillator coil with variable condenser of the gang disconnected from oscillator, and even the trimmer not in use, but grid in circuit of course, the tube will oscillate, and the frequency generated with different capacities can be put into the first 58 by wrapping a wire around part of the lead from the oscillator grid and again around the first 58 grid lead, no metallic connections. If modulation is desired, the grid return of the oscillator may be made to one side of its heater instead of to ground.

Approximation is Close

Now, since we have an inductance of 110 microhenries, we can compute the frequencies to result from 541 and 586 mmfd respectively. For 541 kc mmfd. and 110 mh the frequency is 650 kc, and for 586 mmfd. it is 610 kc. By using a calibrated oscillator additionally, or calibrating the t-r-f set against stations, we can adjust capacities across the oscillator to register the frequencies.

The test will yield capacities too low by the amount of the stray and tube capacities in the oscillator circuit, but as these are only around 10 mmfd., they may be neglected, and besides when the receiver is constructed, and it is borne in mind that the padding capacities are too low, the adjustment is made on the broadcast band by slightly increasing the series capacity when lining up the padded circuit at 600 kc. And for the short-wave band the same procedure of addition would be followed, with the lineup at 1,800 kc for the low-frequency padding.

The high-frequency padding, of course, is taken care of by the inductances except for the broadcast oscillator, when some 8 mmfd. of trimming is added in parallel, as diagrammed.

(*Continued on next page*)

(*Continued from preceding page*)

Using the same coil-winding method of layer construction as for the broadcast level, even the intermediate transformers may be built. With No. 32 enamel wire, put on 400 turns for secondary and 250 turns for primary, and tune with a 50 mmfd. condenser, either a compression trimmer, or preferably an air-dielectric condenser. However, the first i-f transformer is used backwards, to have the tuning condenser in the plate circuit to bypass the higher frequencies. If you like, the secondary of this particular coil may have as many turns as the primary, or even up to 100 turns more. The i-f coils are shielded, and if the shield is large enough, or condenser mechanically small enough, the condenser may be mounted on the top of the shield.

If doubly-tuned intermediate transformers are used the diagram may be followed nevertheless, as the inclusion of the condenser across the other winding is part of the assembly at the factory and does not require any change in the diagram, only the necessity of bearing in mind that double tuning is used.

The small condenser in series with the antenna is there because the selectivity is increased considerably. An antenna of considerable length may be used, as the condenser safeguards against interference due to long aerial, and also reduces, if not completely eliminates, heterodyne interference.

Half-wave detection is used in the combined diodes of the 55 because the voltage input will be rather high on strong locals, and doubling the plate area doubles the current-handling capabilities. As another precaution against voltage overload, with resultant high current, the load resistor is made 1.0 meg., or twice the commonly recommended value. Besides, with half-wave rectification the full rectified voltage is equal to the peak of the intermediate carrier, instead of being halved, as it is in full-wave hookups.

Diode Biasing

The full voltage is put into the 55 grid by diode-biasing, whereupon the signal voltage is at the same time the biasing voltage, so the bias can never be smaller than the signal. Also, the diode-biasing method, because getting rid of degenerative effects, is more sensitive than the method that requires bias derivation from the voltage drop in a cathode-leg resistor or bleeder resistor.

Nevertheless, the output of the 55 can not be of unlimited value. Two governing factors are the biases the 55 triode and the power tube will stand. Take the 55 triode. Up to 20 volts signal input the tube will function, but at much more somewhat more than 20 volts the volume declines due to incipient saturation, and if the signal overpowers the tube there is nothing heard. Also, assuming the 55 triode has a working mu of 4, which is about right (despite the theoretical mu of 8), the signal voltage input should not much exceed 5 volts. This value is easily attained. To lower any higher voltage reduce the 1.0 meg. resistor to 0.25 meg. or 0.5 meg. The output should not exceed the operating bias of the power tube.

The bias on the 2A5 is developed by connection of grid return of the tube to the joint of two resistors that divide the voltage dropped in the negative-leg choke. The proportion of 0.25 meg. to 4.0 meg. may be sustained by other actual resistance values. if the speaker has a 2,500-ohm field, but if the field is of lower resistance, the 0.25 meg. resistor there may have to be increased somewhat. The test is to put a milliammeter (0-50 or 0-100) in the plate circuit of the 2A5 and, at no signal, let the plate current run to 45 milliamperes. When a signal comes along the current through the choke increases, the negative bias increases, and the operating point will shift, in current terms, from, say, 45 milliamperes to 30 milliamperes, or, in volts, from about 15 volts negative bias to about 25 volt negative bias.

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Measuring Resistance

I AM interested in methods of measuring resistance quickly, but I should like a way of measuring which requires neither a calibrated resistance meter nor a curve. I do not want to figure if I can get away from it. Please suggest a method if there is one. —T. L.

The resistance bridge is one of the best ways of measuring resistance, but that requires the bridge as well as a set of standards that can be varied in small steps. Another way is to use a variable known voltage and a milliammeter, or ammeter. Suppose you have a source of voltage which can be varied continuously, as by a potentiometer. Connect a voltmeter across output voltage, that is, between the slider and the negative end of the resistance. As the slider is moved the voltage should vary from zero up to the highest there is in the source. In series with this variable voltage connect the unknown resistance and a milliammeter, preferably one that reads from zero to one. Adjust the voltage until the milliammeter reads one milliampere. The value of the resistance in series with the milliammeter is then 1,000 times the voltage. If the voltage is adjusted until the current is just 0.1 milliampere, the resistance is 10,000 times the voltage. This is the best way of measuring resistance when the variable voltage is available. To protect the milliammeter be sure to start with a zero voltage. If the milliammeter has several ranges of current, lower resistances can be measured by the same method. Suppose the full deflection is 10 milliamperes. Then the resistance is 100 times the reading on the voltmeter. A wide range of resistances can be measured by this method. Suppose, for example, that the voltage can be increased to 250 volts. Adjust to a current of 0.1 milliampere. Then the resistance is 2.5 megohms. Again suppose that the voltage is only one volt and that we use a milliammeter having a full scale deflection of 100 milliamperes. When the current deflection is full scale, the resistance is 10 times the voltage. Hence we can measure 10 ohms. This assumes, of course, that the potentiometer we used can carry 100 milliamperes plus the current required by the voltmeter, or at least that the major part of the potentiometer can carry this current.

* * *

Meters to Megacycles

PLEASE give a quick method of converting from meters to megacycles or vice versa.—W. B. C.

Divide 300 by either and you get the other. That is, if you have a wave of 5 meters, you have a frequency of 300/5, or 60 megacycles. Of if you have a frequency of 20 megacycles you have a wavelength of 300/20, or 15 meters.

* * *

Change of Frequency of an Oscillator

WHY does the frequency of an oscillator change as the load on the tuned circuit changes and also as the plate and filament voltages change?—W. N. B.

The frequency depends on the internal plate resistance of the tube and also on the resistance in the tuned circuit if the oscillator has not been stabilized. Since the internal plate resistance of the tube changes with changes in plate voltage and filament current, the frequency changes with changes in the voltages on the plate and on the filament. Since the load on the tuned circuit are changes in the resistance of that circuit, the frequency changes with the load. A modulating voltage will change the plate resistance whether the modulation is impressed on the grid or on the plate. For that reason the frequency changes with modulation in an unstabilized oscillator.

* * *

Converter Performance

WHAT has become of the short wave converters that were so prevalent two years ago? Much were claimed for them, but nobody seems to be interested. Are we justified to conclude from that fact that converters are not good? Just what was wrong with them?—S. G.

Well, converters are practically off the market. It is a fact that they did not perform to measure up with the claims. But what does? There is nothing wrong with the principle of the short wave converter. It is used every day in millions of sets. Therefore there must have been good reasons why they failed to hold interest. Yes, there are many reasons. First, the receivers with which they were used were often terribly overloaded by them due to insufficient modulation of the converted frequency. Second, frequently the coupling between the converter and the receiver was incorrect, making it necessary to operate the receiver at highest sensitivity in order to get the signals. This resulted in a great deal of noise. Third, the design of many converters was such that not only one frequency came through at a time, but many, very many. There were too many and too strong harmonics both in the converter and in the receivers with which they were operated. This is especially true when the receiver was of the superheterodyne type.

* * *

A Bolometer

WHAT IS a bolometer and for what purpose is it used ? Is it an instrument that can be utilized for radio purposes?—F. G. E.

A bolometer is a device by means of which heat or temperature or electric current is measured by means of the change in resistance it causes. For example, a certain resistor exposed to the atmosphere will have a certain resistance at a given temperature. As the temperature changes the resistance changes. The temperature change is measured in terms of this resistance change and it can be done accurately because resistance can be measured accurately on a bridge. By the same method the heat from stars and the heating effect of minute currents can be measured.

* * *

Generation of Harmonics

IF AN oscillator is operated with negative bias and a high plate voltage so that grid current does not flow during any part of the cycle. will there be harmonics in the output? How can you avoid harmonics?—W. E. B.

If the tube is operated so that the grid bias is that where the slope of the plate current grid voltage curve is steepest and if there is no grid current, the output current will contain the fundamental and all the odd harmonics. The even harmonics will be either absent or extremely weak. One way

of avoiding harmonics is to keep them from straying around the circuit. Confine them to the tube where they originate. If the mixer is coupled to the coil of the oscillating circuit by means of a mutual inductance there will be very little harmonic content in the voltage impressed on the mixer.

* * *

Floating Heaters in Auto Set

IS THERE any advantage in wiring an automobile so that the heaters are floating? If so, what?—U. D.

The main advantage is that the set can be installed in any car, regardless of whether positive or negative is grounded, without making any changes in the wiring. The second advantage is that less ignition noise is picked up.

* * *

Overloading and Modulation

IS IT MORE likely that a tube will be overloaded with a signal having a high degree of modulation or with a signal that has a weak degree of modulation?—W. L. N.

The peak voltage is greater for the modulated than for the unmodulated wave, and it is greater the greater the percentage of modulation. This would indicate that a modulated wave would overload a tube more quickly than an unmodulated wave, and that the greater the percentage of modulation the greater the overloading. But there is another phase of the matter. If the percentage modulation is low there has to be a very strong carrier before there will be enough audio output to be heard. Tubes may be overloaded by the carrier before the audio output is satisfactorily loud. If the test for overloading is by listening there is less chance of overloading when the modulation is strong, without knowing that there is overloading trouble.

* * *

Vacuum Tube Micrometer

WHAT IS a vacuum tube micrometer? My understanding is that a micrometer is an instrument for measuring very short distances. But how a vacuum tube can be used for this purpose is beyond me.—A. G.

There is a brief description of the vacuum tube micrometer elsewhere in this issue, together with an exposition of the theory underlying the device and the possible sensitivity pointed out.

* * *

Triode as Dynatron

IS IT possible to use a triode tube as a dynatron oscillator? I am asking this because many of the screen grid tubes now available do not function well as dynatrons. —A. G. M.

It is possible to use any tube as a dynatron oscillator provided it has more than two electrons. That is, the only tube that cannot be used as a dynatron is the diode. If a triode is used the grid should be positive and its potential should be greater than the positive potential of the plate. This arrangement is used in the Barkhausen-Kurz oscillator, which is a dynatron ordinarily called an electron oscillator. A screen grid tube that will not function with the ordinary voltages on the elements may be made to do so by making the grid positive by a small amount or by varying the screen voltage. A screen grid tube that has a suppressor that can be treated independently can be made to function by varying the voltage on the suppressor, or possibly by leaving it unconnected. A tube that has an internal suppressor may not oscillate but there is a good chance. The only condition for oscillation is that the tube has a negative resistance characteristic.

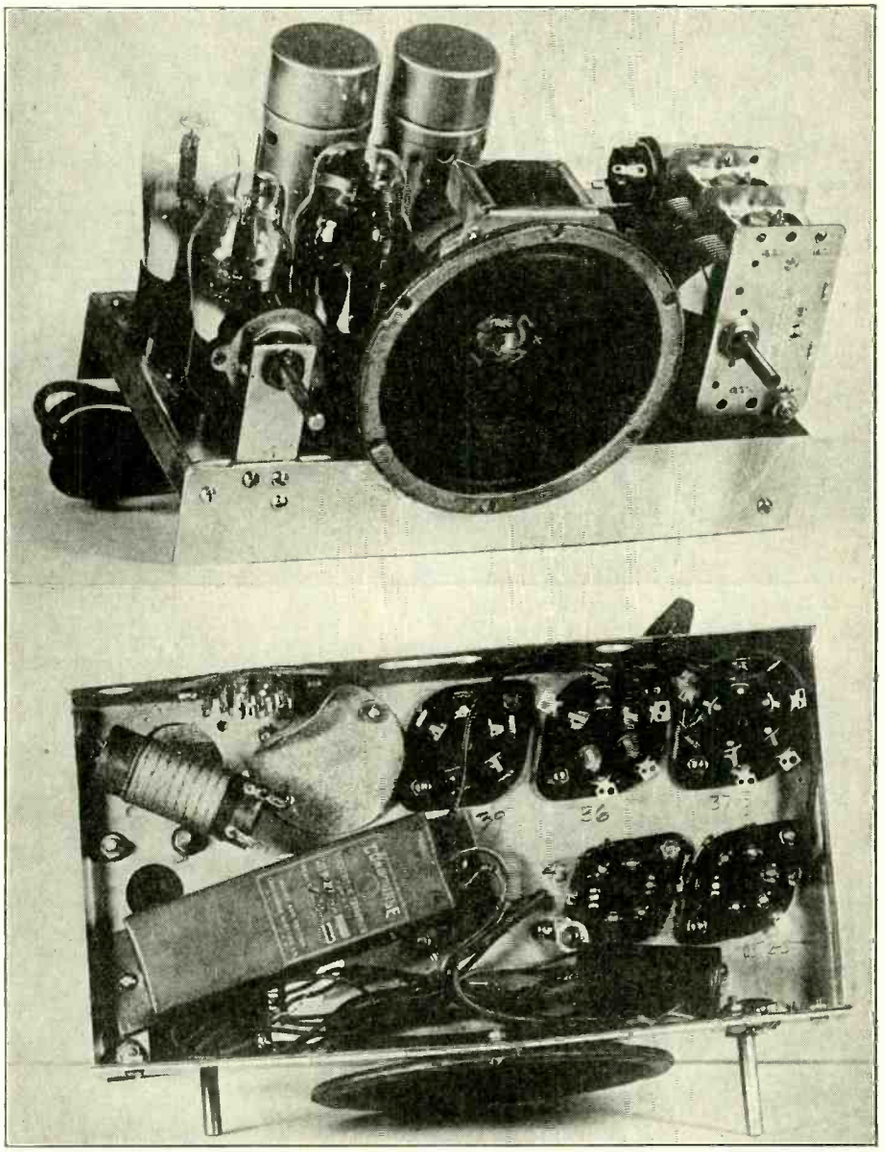
* * *

Rectifier for Pure D-C

A CERTAIN problem requires a steady d-c voltage without any trace of hum and it is to be produced without a battery. Can you suggest a method of getting it?—W. J.

One way is to set up an oscillator of high frequency and then use the output of this oscillator for input to a regular B supply circuit. If the plate supply to the high frequency oscillator is well filtered, and it is quite possible to filter it well, there will be no modulation on the output. Hence the rectified current will have high frequency pulses, all of which are equal. It is then only required to filter the output of the rectifier for high frequency. This can be done with small condensers and choke coils. The rectifier tube should preferably be of the cathode type so that the filament will not introduce a hum. If this outfit is to supply only a small current both the oscillator and the rectifier could be an 85 tube, using the triode for oscillation and the duplex diode for rectification. This tube could easily put out 5 milliamperes at a voltage of 100 volts or more. For higher current and voltage it would be necessary to use a power tube for oscillator and a regular rectifier for rectification. If the output voltage is to be variable the variation may be effected by varying the intensity of oscillation or by varying the high frequency input to the rectifier. The variation could be continuous if a variometer were used for varying the input, or rather a vario-coupler. If a 1,000 ohms per volt voltmeter be used for measuring the voltage, it would be feasible to use a 55 or an 85 for oscillation and rectification.

Layout for a Universal In Compact Assembly



Suitable layout for an ac-dc receiver, of usual small size. Six tubes may be used in a circuit encompassed by 8¼ x 4⅜ x 2″ (chassis size).

How to Get Harmonics

WILL YOU kindly give us an oscillator that will generate many and strong harmonics?—R. L. B.

The standard harmonic producer is the multivibrateur of Abraham and Bloch. It is nearly always used in calibrating wavemeters because all the harmonics are present and they are very strong. Elsewhere in this issue you will find a brief description of the circuit.

* * *

Universal Set Layout

WHAT is a simple, compact layout for a universal set, not more than 5x9x2 inches, using six tubes?—A. L.

The illustration at top of this page shows an excellent layout; speaker is included, of course.

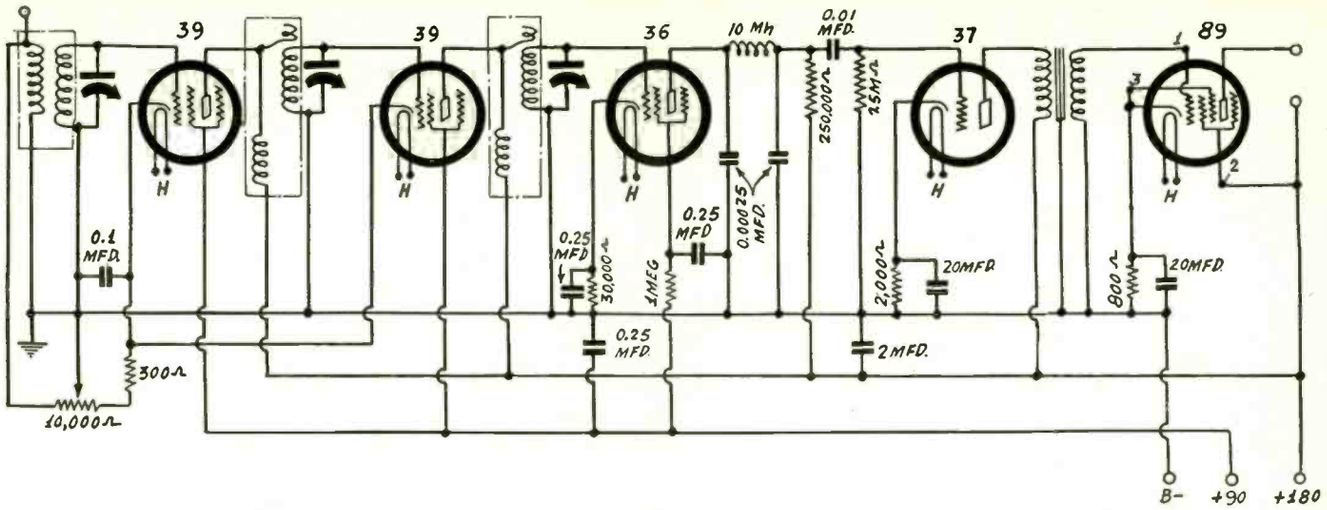
* * *

Use of Universal Voltmeter

COULD a universal voltmeter be used for measuring the output power of a power amplifier? If so, will you kindly suggest a a method of using it?—F. W. N.

You can measure a-c voltage with it. Suppose then that you apply a 60-cycle signal to the grid of the tube and that you

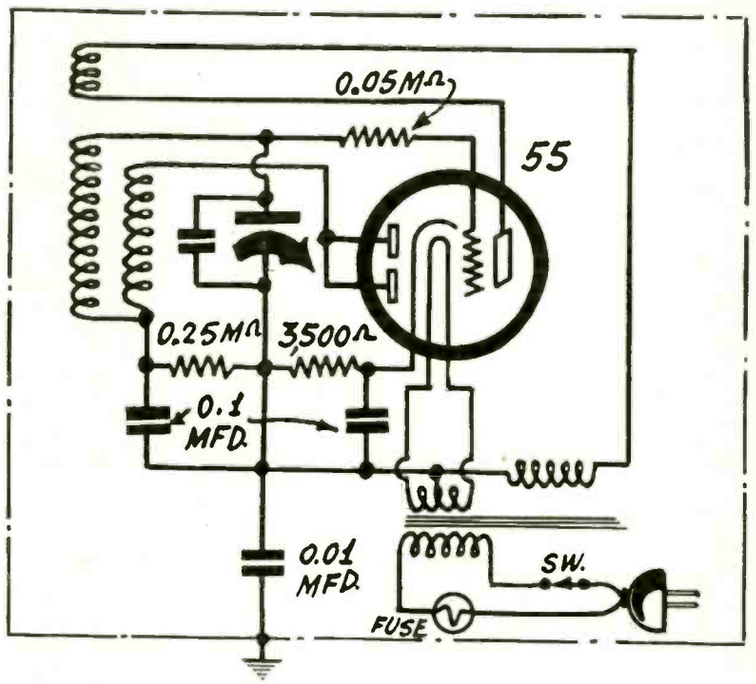
(*Continued on next page*)



Automotive tubes are used in this tuned-radio-frequency set, the interstage couplers having two-turn capacity-coupled winding, the plate loads enclosed radio-frequency chokes.

(*Continued from preceding page*)

put a pure resistance in the plate circuit of the tube, making this resistance equal to the recommended load resistance. Connect the a-c voltmeter across the resistance. However, use a high inductance choke and a very large condenser, 16 mfd. or so, to separate the a-c and the d-c. That is, connect the load resistance in series with the condenser. The meter across the resistance will indicate the voltage and this voltage and the known resistance are sufficient for computing the power output. The formula is V2/R. If one of the lower voltage ranges is used it will be necessary to allow for the resistance of the meter. The true resistance to use is RoRm/(Ro+Rm), in which Ro is the load resistance external to the meter and Rm is the resistance of the meter. If it should happen that the load resistance is equal to the meter resistance it is not necessary to use anything but the meter. This is not likely to happen because the voltage will be high enough, or should be made high enough to require one of the higher voltage ranges. Indeed, the proper load resistance will be so small in comparison with the resistance of the meter in most practical cases, that the meter resistance can be neglected. Suppose, for example, that the load resistance is 7,000 ohms and that the voltage across it will be 100 volts. For this the range must be such that the resistance is at least 100,000 ohms, assuming that the universal meter is a 1,000 ohms per volt instrument. Then the effective load resistance on the tube, with a 7,000-ohm external resistance, will be 6,550 ohms. That is close enough to the correct load.



A test oscillator wherein the bias is altered according to the intensity of oscillation, the idea being to establish linearity.

* * *

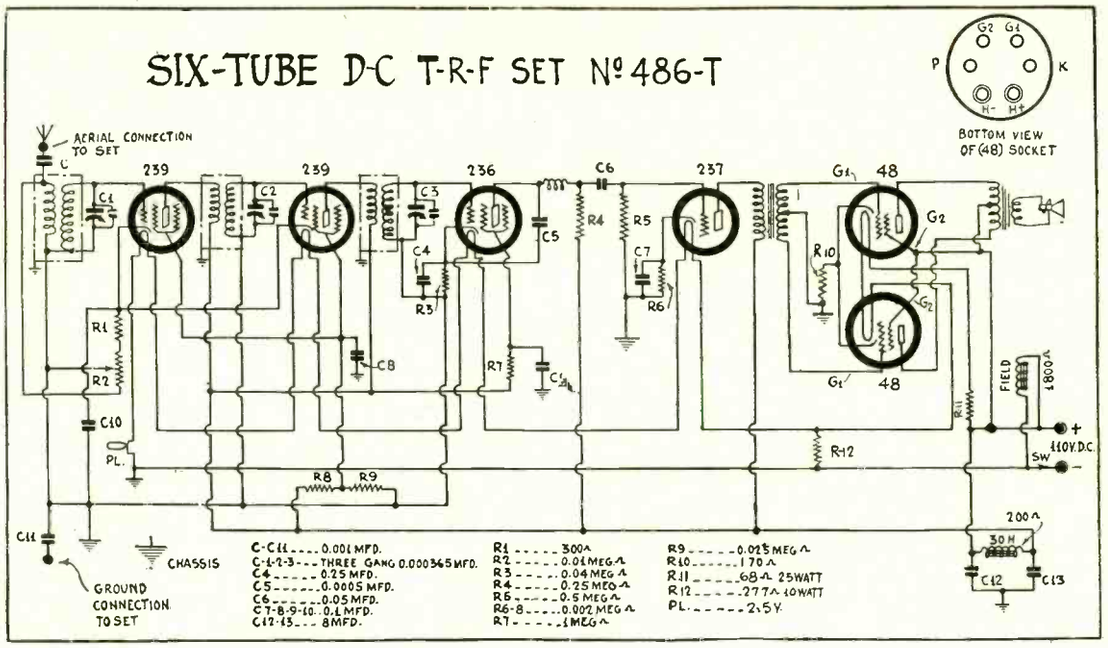
Coupling Transformers for Intermediate

MOST intermediate frequency transformers now used are of the doubly-tuned type. Could not better results be obtained by using either tuned grid or tuned plate transformers? What are the advantages of doubly-tuned transformers over the others? —P. J.

One advantage of the doubly-tuned transformer is that the two coils are so far apart that the capacity between the windings has no effect. This is not true of either of the other types for comparable gain. The main advantage, however, is that the doubly-tuned transformer is a band pass filter. It will give better quality for a given station selectivity, provided that the intermediates are tuned correctly. Just about as much gain can be obtained with any of these types, but for a given gain the selectivity of the doubly-tuned transformer is much higher than that of either of the others. Another advantage of the doubly-tuned transformer is that the

A Tested Direct-Current Receiver

For operation from the 110-volt direct-current line this circuit is very satisfactory. The constants are printed on the diagram.



tube capacities are added to the tuning capacities. The doubly-tuned transformer, therefore, is really tuned.

* * *

Using a Crystal Rectifier

THE CRYSTAL rectifier has passed out of use, but I still have some crystals and should like to utilize them for experiments, if possible. Can you suggest any applications?—W. L. J.

The crystal can always be used for detection when a head set is employed. It can also be used for measuring radio-frequency currents. But if it is used for this purpose it has to be calibrated. Some crystals are not suitable for this because of the unsteadiness of the contact. When the crystal is used for the purpose of measuring radio-frequency currents, a sensitive galvanometer is required for measuring the rectified current.

* * *

Harmonics in Oscillators

WHEN the purpose of an oscillator is to generate harmonics, which oscillator would you recommend? When the purpose of it is to generate a pure wave, which is preferable?—W. N. M.

The best oscillator for generating harmonics is the multivibrator. The Hartley is also good. For a pure wave oscillator the Colpitts is all right. For rich harmonic content the feedback should be strong, for a pure wave it should be weak. For a pure wave it is advantageous to arrange the circuit so that there is no grid current. It is possible to operate an oscillator without having grid current, and the method has been described in recent issues of RADIO WORLD.

* * *

Automobile Receiver

WILL YOU PLEASE show the circuit for a receiver that may be used on batteries either as an automobile set or in the home?—O. M. S.

A five-tube circuit that fits the requirements is diagramed atop of the opposite page. The heaters of the 6.3-volt tubes are fed by the storage battery, while the B voltage is supplied by B batteries. The little windings seemingly open are really two turns used for the capacity effect that they have in relationship to the secondary. The plate load is the radio-frequency choke coil that is put into the same can as the tuning coil.

Auxiliary Diode Bias

CAN NOT A DIODE-BIASED oscillator be used? There should be a linear effect in such a circuit, as the bias is proportionate to the amplitude of the oscillation. Are there any troubles in such a circuit?—T. H. W.

The 55 tube used in somewhat the manner you describe is shown on the opposite page. The cathode is returned through a resistor of 3,500 ohms to B minus, to develop a starting bias, and any additional bias results from the amplitude of the oscillation. The shield itself is actually grounded. It is hard to develop real linearity in such a circuit. Yes, there are troubles. The principal difficulty is avoiding grid current, because when that flows the bias rises enormously, due to the potential drop in the large resistor (0.25 meg.) You should try the circuit as an experiment only, and watch out carefully for grid current.

* * *

Direct-Current Set

CAN HALF-WAY decent results be obtained from a direct-current receiver, using six tubes, the output in push-pull?—P. E. D.

Yes, indeed. You will find the diagram atop this page. The constants are given on the diagram. The coils may be of the high-gain type, correctly wound for the capacity tuning condenser you intend to use. The ground symbol in the diagram represents the chassis. This circuit is used by a large manufacturer in his regular production.

The Review

Questions and Answers Based on Articles Printed in Last Week's Issue

Questions

1. State a method of measuring low resistances without requiring any more current flowing than if high resistances were being measured. With a 0-1 milliammeter, 1.5-volt dry cell, 27-ohm meter and 1,473-ohm series resistor, after stating the significance of all of these items, give the approximate ohmage range of the set-up.

2. State a method of measuring the resistance of a meter of the sensitive type such as would be used in the above application.

3. What type of instrument is suitable for measurement of the voltage across a plate load resistor of 0.25 meg., or a grid resistor of 5.0 meg.? Explain the reason.

4. If a measuring device is calibrated in peak a-c voltages, is it necessary to run a calibration to obtain rms values, or may these values be computed, and if so, how? What is a basic requirement that must be met before any computation method applies accurately?

5. Sometimes a small condenser suffices across a B line to ground. In other instances a large condenser must be used. State the reason.

6. Briefly describe the 79 tube and state some possible uses.

7. If a meter is in the plate circuit, and the direct current in the load circuit is high, how is it possible to have the meter register nothing except that effect of the signal?

8. It is desired to use a modern tuning condenser of rated capacity around 360 mmfd. or so. A wide band of frequencies is to be covered, including short waves. State a method of getting suitable frequency separation, without resort to external capacities for any condenser or section of a gang, save possibly padding an oscillator.

9. What is an advantage of paralleling two triodes in an oscillator?

10. Can manual and automatic volume control be combined? How would it be done? What would you do after the control has been set for least sensitivity and the signal is still too loud?

Answers

1. Low resistances may be measured by using an ohmmeter intended primarily for measuring higher resistances. Shorting the usual resistance-measuring terminals so there will be full-current deflection. Then shunt the meter with the unknown low resistance. Part of the current will flow through the shunt and part through the meter, but the total amount of current will not change, and the scale can be calibrated for low resistances. A 0-1 milliammeter in such a circuit would be the current-indicating device, the 1.5-volt battery would be the source of emf, the 27 ohms constitute the resistance of the meter that considerably determines the lowness of the meter-shunted resistances that can be read, and the 1,473-ohm series resistor is the limiting resistor, in conjunction with the meter's resistance, so the total is 1,500 ohms (1.5 volts at 1,000 ohms per volt). The approximately ohmage range of such a setup would be from less than 1 ohm to a little more than 1,000 ohms. This would nicely overlap the high-resistance-measuring circuit, which yields a reading of less than 1,000 ohms as low limit.

2. If the resistance of the meter is not known, it may be measured by shorting the usual terminals of the ohmmeter, getting full-current deflection accurately, putting a 100-ohm rheostat or the like across the meter, and adjusting this shunt until the meter reads half scale. Measure the resistance of the shunt alone, and this is also the resistance of the meter. because the adjustment equally divided the current.

3. A vacuum tube voltmeter is suitable for measurement of the voltage drop in a high resistance. The reason is that it does not draw any current from the measured circuit and therefore does not cause a change in voltage when the reading is being taken. The vacuum tube voltmeter can be used for measuring a.c., either peak or rms values, or measuring d.c.

4. If a measuring device, such as the vacuum tube voltmeter is calibrated in peak volts, it is not necessary to run a curve to obtain the rms values, as these values are 0.707 of the peak values. A basic requirement is that the calibration for peak volts shall have been made with a pure wave, and the computation based on the above factor for rms will be accurate only in respect to a pure wave. Or, if the wave was impure in the first instance, it must be of the same impurity in the second, but the meter's use then would be limited to accurate measurements only of waves of identical impurity.

5. The capacity of the condenser is related to the frequencies to be bypassed. If the frequencies are high, for instance radio frequencies, including intermediate frequencies, then the condenser may be relatively small, but if the frequencies are low, then the condenser should be large. In this sense 0.1 mfd. may be considered small and 8 mfd. may be considered large. If mixed frequencies flow, that is, radio, intermediate and audio, then the capacity should be large, because the presence of low frequencies determines the necessity for a large capacity.

6. The 79 tube is a 6.3-volt heater type tube, consisting of two equal triodes in one envelope, and having a common cathode. It may be used as a Class B audio amplifier, in about the same manner as the 53. It may be used also as Class A push-pull, as two triodes in parallel for any purpose within the input capabilities, as two-stage resistance-coupled amplifier and also as detector and resistance-coupled amplifier and again as detector and phase inverter in resistance-coupled push-pull.

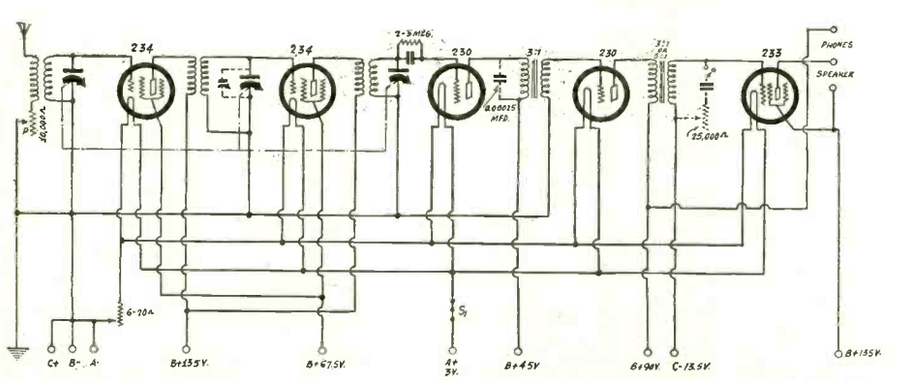
7. The method of accomplishing this is to buck out the plate current. If there is a bleeder resistor across the B line, and the tube's plate load is returned to the maximum B voltage, the current meter may be used in voltmeter fashion by connecting one side of the meter to the plate and the other side of the meter to a voltage on the bleeder resistor lower than maximum by the voltage drop in the plate load. Therefore at no input there would be no indication, and only the signal would produce a deflection.

8. To cover a wide band of frequencies, without crowding the frequencies too much, the full rotation of the condenser, for utilization of its entire capacity, hence a frequency ratio of about 3 to 1 per band, serves for the lower frequencies, and use of only half the rotation for the higher frequencies yields good frequency separation without external adjuncts. The oscillator in a superheterodyne would have to be padded for low frequencies, but not for high frequencies.

9. Two triodes, paralleled in an oscillator, increase the mutual conductance, and therefore the likelihood of suitable oscillation at very high frequencies is improved. The general effect is that the oscillation voltage is increased.

10. The method can be used, but it has limited possibilities. When the potentiometer slider is set at the negative end of the resistor the control is full and when it is set at an intermediate position there is little control. On weak signals it could be moved over toward the cathode and then there would be very little a.v.c. On strong signals it could be moved to the other end and then there would be all the a.v.c. available. But as a manual control it would not be much good. If the volume were too great when the slider is over on the negative end there would be nothing that could be done to reduce it. This would have to be manipulated with another control in the audio end, perhaps with a potentiometer connected in parallel with the first, the slider of the second going to the grid of the triode in the detector.

Circuit for 2-Volt Tubes



This tuned radio frequency receiver gives good results, although it requires only five tubes, takes few parts, and is extremely easy to build. The output is a pentode.

J. Andrew White Joins Visual-Sound Company

Major J. Andrew White, former president of the Columbia Broadcasting Company, has joined the staff of Visomatic Systems, Inc., 292 Madison Avenue, New York City, producers of a new visual-sound medium used in sales, education and entertainment.

Major White has been identified with radio broadcasting for almost twenty years, since his early days with the Marconi Wireless Telegraph Company. He reported, via radio, the Dempsey-Firpo, Dempsey-Carpentier and Dempsey-Tunney fights and the Democratic National Convention of 1924.

Major White is known as an athlete, cartoonist, business man, editor, writer and actor.

Station Sparks

By Alice Remsen

THAT SEVENTH BIRTHDAY

The National Broadcasting Company started off its seventh birthday with a bang on Wednesday, November 15th. Rosa Ponselle and John Erskine were the highlights of the program celebrating the event; but this was only one of the many special Radio City programs broadcast in connection with NBC's first week of broadcasting from the new quarters in Radio City. Most of the regularly scheduled sustaining programs were knocked on the head and lumped together into Radio City specials; some of them were not so hot. There were tributes from Great Britain, France, Italy, Canada, Germany, Russia, Hawaii, South America and Hollywood; yes, and organized labor, too, in the person of William Green, was represented in a tribute to RCA and NBC. . . . RCA, by the way, is no longer shy about acknowledging its dominance over NBC, but comes right out into the open and declares itself in on everything including programs; thereby hangs the tale of so many resignations from the fold of NBC, at least so rumor declares. Still more changes will be made in the near future, and so they're all holding their breath for fear the ax will fall on their particular heads, for when it falls it does a very quick job —here-today-and-gone-tomorrow sort of thing. . . .

WHAT OF THAT MERGER?

Meanwhile in Washington the Roosevelt Administration is toying with the idea of making a change in the Federal Radio Commission, with the present Commission the hub of a new centralized system to handle all commercial communications, broadcasting, and, in fact, every phase of the communication business. This will probably bring about the much-talked-of merger between the Postal Telegraph and the Western Union. The subject is supposed to be brought up for the consideration of President Roosevelt before the next session of Congress. . . .

THOSE 15-M. SYMPHONY PROGRAMS

This month brings us the long-awaited fifteen minute series of Stokowski nightly broadcasts of the Philadelphia Symphony Orchestra; each night, except Sunday, at 9:00 p.m. EST. over a WABC-Columbia network; no orchestra of this calibre has ever before attempted concerts of fifteen minutes duration, and it will be interesting to note the reaction of the radio audience, and also just what type of symphonic works Mr. Stokowski will attempt in such a short time; the broadcasts will emanate from a specially constructed studio at station WCAU, Philadelphia; Norman Brokenshire will be the announcer for the series. . . . H. V. Kaltenborn, the explosive, dynamic news commentator of the Columbia Broadcasting System, has also a new series of weekly talks which he calls "Leaders in Action;" in these talks Kaltenborn discusses prominent figures in the government; he takes an individual and discusses the man and his ideas, the work he is doing, and the place he occupies in the general government set-up; this very interesting series may be heard each Saturday at 10:45 p. m. EST. . . . Another new series to be presented over the WABC-Columbia network is "The Mystery Guild," which is being produced by Marion Parsonnet; each Thursday evening at 9:45 p. m. EST., a fifteen-minute radio version of crime stories by well-known contemporary writers will be dramatized. . . .

HERE'S A SONG STYLIST

Edith Murray is a new Columbia star; heard every Thursday at 5:15 p. m. EST.; Miss Murray is a song stylist with a remarkable vocal range; she was born in Chicago in 1906; has worked in vaudeville, sung in many movie shorts, and for two years played the lead in "Good News" in London, Chicago and Australia. . . . And now the sister of Kate Smith is a radio announcer; her name is Helene, and she is connected with Station WJSV, Washington; Helene obtained her position entirely unknown to Kate, as she had no desire to capitalize on her sister's influence. Jolly good luck to you, Announcer Smith! . . . Glen Gray's swell Casa Loma Orchestra will soon be heard on the new Camel Hour, which makes its bow to the radio audience very shortly; associated with Glen on the program will be the Do, Re, Mi Girls and Sylvia Froos, the vaudeville singer; there will also be a couple of comics. . . . Frank Gould, new and youthful radio actor, has had a varied assortment of roles in the "March of Time" broadcast to date; he it was who mimicked the voice of Dmitrov, the Bulgarian, in the Reichstag fire trial; Litvinov, the Russian envoy; Milo Reno, the farm leader; and the schnozzle-nosed Durante. . . . Canada gave us three of our ace radio bands: Guy Lombardo, Jack Denny and Glen Gray. . . . Conrad Thibault was born on November 13th and signed a contract on his birthday for his first New York stage appearance—so he has no fear of the dread number 13. . . .

ON THAT PETER DIXON PROGRAM

Billy Halop and Eddie Wragge. the "fellers" who play Bobbie Benson and Black Hart, respectively, on Peter Dixon's H-Bar-O Rangers program, were recently given complete cowboy outfits; they are so proud of the suits that they wear them during the broadcasts—and it makes them feel the script better, too. . . . Julius Tannen is busy these days writing movie scripts, and the beauty of it is that they'll be produced as soon as Julius has finished them. . . . George Beatty, the sensational new radio comic of the American Revue broadcasts, speaks of himself as "half serious and half wit." . . . Enoch Light, who is appearing at the Governor Clinton Hotel with his orchestra, likes to introduce new song numbers on his broadcasts; right now he is starting on its way a new tune called "Railroad Sam." By the way; Mary Danis, whom you may remember as a legitimate actress, sings the cute numbers with the Light aggregation; she finds there is more money, and fun, too, in singing than in acting. . . . Helen Morgan is now the featured artist at New York's smart supper club, the Simplon; Helen has been piano-sitting there for quite a while, broadcasting now and then, too. . . . Fred Waring's sponsor, "Old Gold," has listened to the prayers of the listeners-in and will henceforth feature the show as an all-Waring broadcast; every Wednesday at 10:00 p. m.; of course, his gang will still be with Fred as of yore, said gang consisting of the Lane Sisters, brother Tom Waring, Babs Ryan and her brothers, Poley (Frog Voice) McClintock, Johnny (Scat Singer) Davis, Stuart (High Tenor) Churchill, and all the Pennsylvanians; and I for one am glad. . . . William Merrigan Daly, whose orchestra will supply the music for the CBS Byrd Antarctic Exposition broadcasts, is a sort of all-around man; here are a few jobs he could do well: economist, international financier, ornithologist, politician, magazine editor, free-lance writer—in fact, almost anything but a three-base hitter. . . .

HANDS ACROSS SPACE

The fact that radio practically annihilates distance and keeps many a wanderer in touch with home, has been proven many times; WSM, Nashville, Tennessee, is giving exceptional service to the residents of Guatemala, Central America, many of whom are American citizens engaged there in business. . . . Charles Previn, musical director of the New York Paramount Theatre, is the latest maestro to place his business in the capable hands of the Mills Artist Bureau, Inc., of which Irving Mills is the head. . . . WMCA is forging ahead so far as talent is concerned; here are a few of its latest acquisitions: Charles Hackett, American star of the Metropolitan and concert stage; Louise Richardson, star of "Rio Rita," the American Opera Company and other productions; Beniamino Riccio, celebrated concert baritone; Madeline Keltie, European operatic soprano, and Nikolai Sokoloff, director of the New York Symphony Orchestra, which will give five concerts over WMCA, one a month until March. . . . Adele Starr is still charming the listeners of Station KYW, Chicago, with her lovely voice. . . . Leon Adger, leader and director of station WHOM's Southland Melody Quartet, has a prized possession which he keeps locked up in a safety deposit box; it is a letter from former President William H. Taft. . . . Cyrena Van Gordon has returned to the air for the Dier Kiss Corporation; each Thursday at 7:30 p. m. . . . And if you get a chance tune in on Station WOR, Mondays, Wednesdays and Fridays at 2:15 p. m. and listen to "Sally and Sue," and let me know how you like them. . . . Time for me to call a halt; I can smell something burning; I think it's my yorkshire pudding; if that gets burnt—bang goes my Sunday dinner—so I'm flying to the kitchen.

A THOUGHT FOR THE WEEK

THEY do move them around in radio casts. For instance, player Dawson, who, to us seemed to be very good in the title role of "Elmer Everett Yess," the Plymouth car air comedy, has been replaced by player Eldredge, now appearing in "Three and One," a current Broadway attraction. Mr. Dawson was excellent in a role which was not so good—and now he knows that sponsors change their minds at will and that the life of a microphone role is indeed fleeting. Perhaps later on Mr. Eldredge will be able to continue the story.

Immense Antenna Poles Shipped to RCA Stations

A shipment of wooden poles arrived in New York City on the San Lucas from Everett, Wash. The poles were transshipped to the RCA radio stations at Rocky Point and Riverhead, N. Y.

The shipment consisted of fifty poles, all of Douglas fir. One is 130 feet long and weighs 4½ tons. The others are 120 feet long and weigh somewhat over 3 tons each.

It is so rarely that objects of such length are transported over long distances that their handling presents many problems. It was necessary to ship the poles on the deck of the steamship, and the work of transferring them to a lighter required the simultaneous use of two ship's cargo derricks. The lighter was towed to Bay Ridge, where the poles were loaded on flat cars of the Long Island Railroad. Each "bundle" of poles required three flat cars and the poles rested on trestles on the front and rear car of each in order that the load might be free to pilot when the train rounds curves.

EDITORIALS

EARS THAT LAG

A RECENT reduced amount of listening-in has been noticed by stations, and also indirectly by lighting companies because of the lessened consumption of electrical energy, and the result has stirred up such encouraging activity in such numerous directions that it affords added evidence of the widespread effect of radio. For instance the stations, which, being conducted by human beings, fall into operating grooves almost without knowing it, at once got busy improving their programs. Novelties were quickly introduced, to take the edge of similarity and familiarity off many of the offerings. Even some changes in executive personnel were instituted in line with putting more pep into programs, and the trend toward increasing the educational type of program took a little punishment, for when the prime object is to enlarge the number of listeners at all costs, those programs not deemed to be attractive in a universal sense pay a temporary penalty.

Electric companies started advertising the wealth of program material offered nightly, and cited the names of celebrities who are heard repeatedly. The leaders of the radio set manufacturing groups renewed their long-standing efforts to concentrate on the stressing program excellence, rather than emblazoning a technical appeal to a lay public. Sponsors of programs, who felt the effect of diminished listening through the reduction of mail, concentrated on improved program production, and even famous artists had to listen to a few pertinent remarks and stifle any predisposition to a grimace.

Therefore a new quantity of energy came into the programs, and even the standard comedians did a little better than utter over the air the easy and silly puns on which they have been larcenously fattening.

The upheaval spread its effect also to the newcomer. Audition restrictions were relaxed a bit, although the random individual has been a source of disappointment to stations in their auditional quest of new material, so much so that leading chains and even some small individual stations have a rule that no individual auditions are given unless the prospect comes recommended by some authority as promising.

So the combined effort, widespread in its effect, at last finds itself concentrated on the listener. Any diminution of listening is a serious blow to the radio industry itself—the makers of sets, tubes, cabinets, speakers, coils, condensers, sockets, dials, wire, solder, resistors and numerous other items—as well as directly to the stations and to sponsors who buy advertising time on the air.

These waves of public action, these manifestations of unorganized inactivity, are unexpected and hard to follow, nor is there a real science for analyzing them, but the movement for new life in programs is certainly in the right direction. Even excellence of an established type, if permitted to endure in an unchanged form too long, proves as disastrous as mediocrity. If radio is becoming more and more ephemeralized, then it is certainly up to the stations not to permit even their most noted attractions to endure as endlessly as Tennyson's brook, but to change the subject, like an adept conversationalist would, when one topic that has been discussed so long that continuation would be boresome.

NEWS TALKS

THE Congressional press galleries have been barred to reporters of the Columbia Broadcasting System's News Service. This action, taken by a committee of accredited newspaper correspondents, was consistent with a standing rule defining those to whom the galleries were to be open. What Columbia sought, afterwards, was to have the rule changed, on the ground that the radio stations are just as fit to disseminate spot news as are the regular newspaper reporters, and besides the function of radio reporting is rather quick and sketchy facts, not the detailed information furnished by the newspapers, hence scarcely competitive.

The rivalry between the radio stations and the newspapers has existed as long as radio has existed, and it grew acute when stations became advertising media, and thus competed directly with the newspapers for appropriations from advertisers.

A glance at the programs as printed in the urban press shows the rivalry reflected therein. In New York City, for instance, some of the large newspapers are careful to conceal as much information as possible about sponsored programs of manufacturers who do not use these papers' own advertising columns. Pressed for space, newspapers in large cities practically suffocate, if they do not completely suppress, the programs of small stations. In New York City and environs, out of two score of stations, some five or six get what might be called a break.

Recently the question came before the convention of a newsgathering association, when objection was raised to summaries of news events broadcast by radio speakers. It is plain enough the information on which these news broadcasts are based is taken right from the complaining newspapers. The objectors were assuaged somewhat when the radio talkers repeated the advice, "See your newspaper for full details." If the newspapers feel they are being hurt by radio talkers who practically lift their news, they are certainly entitled to redress, and some suitable compromise must be arranged, because the newspapers and the newsgathering associations spend enormous amounts of money and time, and exercise extreme pains, to present a truthful account of events. The property right in news has been confirmed by the United States Supreme Court, so there should be no doubt on the subject. Yet as the radio listeners enjoy these news summaries, they can continue to have them, much as they get them now, if both sides will realize that the advantage of disseminating news briefs over the air is mutual.

ARTISTS' PLIGHT

THE radio artist is wishing as fervently as any one that the depression will lift completely and quickly. Not only are rehearsals and auditions performed without pay, but the rule is that the accepted artist does not get paid at all unless or until the program acquires a sponsor, and the programs thus picked up by a sponsor are probably less than 1 per cent.

Larger stations have staffs of artists, and stations so important as to be chain outlets or valued member-stations of chains, do not have any unpaid artists. But the exceptions that are numerically minor do not help the run of performer a bit. The wonder is that the entertainers can keep it up, that their expectancy does not give out, and that they do not withdraw almost as a body, and leave the nonpaying stations to fill the gap as best they can.

Some of the small stations have many hours on the air daily, and if the personal artist fails them, the only remaining resort is to phonograph records. There is no hesitancy about using records, except that practically every station is anxious to get more power, and if the best that can be said about the programs is that they consist practically exclusively of phonograph records, the power increase has no chance of realization.

On behalf of the small stations, it can be said that they are having their difficulties meeting expenses as the situation now is, and that they do not see any way of paying artists out of losses. Large chains, also suffering economically, may have a surplus as an endowment from a parent company, but the lone little station must be its own Santa Claus.

The plight of the small station is reflected also in the fact of the growing number of foreign-language programs. This type is regarded as of local value by some members of the Federal Radio Commission, but it is hard to follow the reasoning, since what we seek to do in this country principally is to instil Americanism and promulgate the English language. The foreign-language program is something consistent with the accentuation of foreign origin of the listener or his forbears, and as a matter of policy it would be expected that furtherance of our own American concepts and our own borrowed language would come first. Foreign-language newspapers abound, but the newspapers are not licensed by the Federal Government, which is not interested, either, in whether these newspapers circulate well or at all. But foreign-language program sent over Federally-controlled areas, necessarily limitaed audiences, present a different problem, and perhaps account for the inferior rating given to many stations who fill in so much of their time with adoration of the traditions of other lands, in an alien tongue, while we have our own traditions and history with which these listeners may not even be familiar, and perhaps can't even understanding the language of the land in which they live.

Broadcasters' Code Adds $1,328,000 Pay, NRA is Told

Washington.

The reaction of the National Association of Broadcasters, which is composed of the principal stations, is that the code of fair competition, proposed by the National Recovery Administration, will increase expenses out of all bounds, and at a time when the broadcasting business can not be said to be on a breaking-even basis. This is described as the financial predicament, even though the money spent on advertising over the air increased from $3,800,000 in 1927 to $70,000,000 in 1931.

There are now 11,000 full-time employes in broadcasting stations, and it is said that the code would necessitate an increase of 765, amounting to a payroll increase of $1,328,000 a year.

Alfred J. McCosker is president of the association, which includes more than half of the broadcasting stations in this country.

Frank Gillmore, president of the Actors Equity Association, said that of the 1,869 actors regularly employed in broadcasting, more than 1,000 are members of his association, and cited as an abuse of the artist the fact that rehearsals and auditions are required to be given without pay.

The general pay provisions of the code provide for a minimum to unskilled help of $15 a week, and a maximum working schedule of 40 hours per week.

UNIT ANTENNA FOR 1,200 SETS IN RADIO CITY

Foreshadowing the time when every modern business office will be equipped with facilities for the reception of radio programs, Rockefeller Center, Inc., announced the installation of a centralized radio receiving system in the 31-story RKO Building, Sixth Avenue and 51st Street.

The system, which is ready for immediate use by tenants of the building, provides antenna and ground connections for approximately 1,200 individual radio receivers operating from a single, scientifically constructed antenna.

The new equipment is known as the Antenaplex System, and is a recent development of the RCA Victor Camden laboratories. It was furnished by the Commercial Sound Radio Corporation, distributors for the RCA Victor Company, and installed by the Rockefeller Center electrical maintenance department.

Outlets in Wall Plates

A central antenna at the top of the RKO Building, high above any physical barriers, supplies radio frequency energy to a possible 1,200 receiving sets of any standard type.

Each outlet in the offices consists of a single wall plate in which are two plugs. One plug is the connection for antenna and ground. The other plug furnishes the power supply. Occupants of the building may simply plug in their receiving sets, without bothering about individual antennae and grounds, and be assured of efficient reception.

The central antenna consists of two 20-foot poles erected on top of the building. These poles are approximately 120 feet apart. Radio frequency energy is led from the antenna through specially shielded Cabloy cables. This Cabloy, which also supplies efficient ground connections and terminates in a wall plate socket, extends throughout the building in the underfloor ducts together with the telephone, lighting and other necessary wiring. Outlet connections can therefore be made anywhere in the building.

Interference Eliminated

Scarcely half an inch in diameter, this specially shielded Cabloy completely eliminates the electrical interference usual in large steel structures. Antensifiers along the Cabloy insure an even distribution of radio energy throughout the building.

Many of the tenants of the RKO Building are associated with entertainment and talent-booking enterprises, and the provision of modern radio reception facilities will be of great value to them. The radio also supplements the informational services of the newspapers and magazines by bringing to the business man brief quotations from the principal commercial markets and the views of statesmen and industrialists on questions of economic and political significance.

ERSKINE AT PIANO STOPS GAP

John Erskine, author, musician and college professor, cheerfully performed as a lowly "standby" pianist in an NBC emergency last week. Erskine was waiting to go on the air with a speech when John S. Young, the announcer, received orders for an emergency fill-in of three minutes. As no staff musician was around, the famous president of the Juilliard School of Music obligingly played a Chopin Nocturne, after which he delivered his scheduled talk.

Literature Wanted

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

Stanley W. White, Mundelein, Ill.
Jacob G. Greer (AC-DC Kit sets, with Gothic cabinets), 220 E. 35th St., New York City.
George Itzkourtz, 782 Home Street, Bronx, New York City.
J. F. Pehnnicie, Jr., 2427 E. 4th St., Waterloo, Iowa.
Albert Tefel, 2093 Webster Ave., Bronx, New York City.
G. A. Bain, c/o G. Lindsay, 304 Conway St., Deer-Lodge, Winnipeg, Man., Canada.
S. R. Montcalm, Consulting Engineer (equipment and material for service work), Chatham, N. J.
J. M. Schlagel, 815 West 54th St., Kansas City, Mo.
Jos. Belick, 65 Front St., Box 133, Coplay, Penna.
Chas. J. Hyman, 103 North Grove, Lock Haven, Penna.
Joseph Perzan, 913 East St., New Britain, Conn.
Wm. F. Howell, Chelyan, West Va.
W. D. Denton, Box No. 211, Babylon, L. I., N. Y.
Ernest Milligan, 3419½ Rhodes Ave., New Boston, Ohio.
Edgar R. Safarik, DeWitt, Nebr.
A. C. Hossel, 765 E. 93rd St., Cleveland, Ohio.
Thomas W. Draper, 299 Victoria Road, Walkerville, Ont., Canada.
E. L. Horne, Batesburg, S. C.
Chas. P. Smith, 326 Harvard St., Cambridge, Mass.
E. L. Murphy, 1311 Arabella St., New Orleans, La.
Walter M. Rogers, Fort Pierce, Fla.
E. A. Reimers, Reimers Radio Service, Fair Oaks, Calif.
W. I. Streeter, Keene, Calif.
Jack Holtz, M-W Restaurant, Morgantown Ave., Fairmont, W. Va.
John Kubica, 4512 Elston Ave., Chicago, Ill.
W. S. Buckley, 3830 Banks, Butte, Mont.
Oliver Fraser, Jr., 66 Dundalk Ave., Dundalk, Md.
Roger Demerritt, 3 Carter St., Newburyport, Mass.

Wallington Is Awarded Institute Diction Medal

James S. Wallington, of the National Broadcasting Company, was awarded the 1933 gold medal for good diction on the radio at a meeting of the American Academy of Arts and Letters. The presentation was made by Dr. William Lyon Phelps, chairman of the Academy radio committee.

This is the fifth award for good radio diction, previous winners being Milton J. Cross, Alwyn Bach and John Holbrook, all of the NBC announcing staff, and David Ross, of the CBS group. The winner each year is selected by a committee of speech experts in colleges throughout the country on a basis of excellence in pronunciation, articulation, tone quality, accont and cultural effect.

Wallington has been on the NBC staff for the past five years and came into prominence when he broadcast the programs which were heard by Commander Byrd in the Antarctic during the previous expedition. He is 26 years old and a native of Rochester, N. Y.

At the same meeting, the Academy's gold medal for good diction on the stage was presented to Lawrence Tibbett, Metropolitan Opera and NBC radio star. The six former winners of this award are dramatic actors, this being the first time that the medal has gone to a singer. The presentation was made by Charles Dana Gibson.

The National Institute of Arts and Letters announced that the twenty-fourth award of its gold medal is to Booth Tarkington for fiction.

A. H. MORTON APPOINTED BY NBC

Alfred H. Morton, formerly European manager of the Radio Corporation of America, is now business manager of the program department of NBC. Mr. Morton will operate directly under John F. Royal, vice-president in charge of programs.

KVOO USES NEW SENDER

A new 50,000-watt transmitter recently at KVOO, Tulsa, Okla., was dedicated with a special musical and dramatic program over an NBC-WEAF network.

Tubes Replace Generator in W. E. "6" Transmitter

Western Electric has produced a set of conversion parts for its 6 type (1 kilowatt) radio broadcast transmitters. This equipment, in addition to eliminating motor generators, will increase the modulation capability of transmitters of this type to 100 per cent. by increasing the plate voltage applied to the last radio frequency power amplifier from 4,000 volts to 5,000 volts.

The essential unit in the set is a 5,000 volt mercury vapor rectifier which replaces the existing 2,000/4,000 volt motor generator. The 5,000 volt supply permits operation of the final power amplifier tube of the transmitter at that part of its characteristic which allows full use of its capacity to pass all the power required for 100 per cent. modulation, with an attending audio harmonic content well within the requirements of the Federal Radio Commission. Eliminating the generator also increases dependability and ease of maintenance.

The conversion requires minor changes in the transmitter. Operation remains virtually unchanged. Stations operating not more than 17 hours per day can be converted in about three days without time off the air.

Bathrick Appointed NBC Manager in Detroit

Don U. Bathrick is the new NBC district manager in Detroit. Offices are located in the Fisher Building. Mr. Bathrick joined NBC after many years' experience in the automotive selling and advertising fields. He was with General Motors and the Ford Motor Company. At one time he was assistant general sales manager of the Pontiac Division of General Motors.

A native of Michigan, he attended the University of Michigan and played football. He served in the Marine Corps overseas and rose to captain.

WHOM Continues Its "Spotlight on Universe"

"Spotlight on the Universe," a question and answer service, is being continued from WHOM, Jersey City, N. J., 1,450 kc. Herman Bernard answers questions sent in by listeners.

The present daily schedule, entirely p. m., follows: Sunday, 6:30; Monday, 9; Tuesday, 5; Wednesday, 4:45; Thursday, 9; Friday, 3:15; Saturday, 6.

OUR ALICE REMSEN

"Remsen, whose work must be known to a lot of you, has one of the most effective contraltos we've ever heard come from a radio speaker. She can sing a cockney song in a very Bow Bells manner and turn around and croon a love ditty in a way that sends shivers up and down your back. There are a score of low-voiced women singers on the air today, all doing well financially, thank you, who can't compare with Remsen. But Remsen isn't on the air. Somewhere there must be a sponsor who wants a voice that will mean something to listeners. We wish he'd send for Alice Remsen."—*Peter Dixon in New York Sun.*

RADIO WORLD

The First and Only National Radio Weekly

Twelfth 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; 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, tech-

PUBLIC SHOWS TO BE BACKED BY RMA AGAIN

Aggressive and continued radio sales promotion during 1934, including the conduct of public radio and electrical household appliance shows next fall, was ordered by the Board of Directors of Radio Manufacturers Association, Inc., at their meeting Wednesday, at the Union League Club in Chicago.

Instead of a trade show, however, the Board decided that the RMA would hold two large public shows, in New York and Chicago, in the fall of 1934. It was decided that the shows would include electrical household apparatus as well as radio. The shows will be timed to stimulate fall buying and will also have events for jobbers and dealers, including meetings of the RMA and other trade organizations.

J. Clarke Coit, James M. Skinner, and Bond Geddes were appointed a committee of arrangements.

Code Reports

Reports on the NRA code were given by Arthur T. Murray and Leslie F. Muter.

Rather than impose a special assessment on RMA members for expenses of code enforcement and administration, the RMA Board of Directors decided that such expenses will be paid from the treasury.

Cooperation between the RMA and the Radio Wholesalers Association, in connection with the latter's proposed code of improved merchandising practices for jobbers and dealers, was arranged after presentation of the wholesalers' code situation by H. G. Erstrom.

Repeal or modification of the 5 per cent. excise tax on radio and phonograph apparatus will be urged upon the next Congress by the RMA and other branches of the radio industry. The directors reiterated their endorsement of a general but small manufacturers' sales tax, applicable without discrimination to all manufacturers.

Television Scrutinized

A special RMA engineering committee to confer with the Federal Radio Commission on future broadcast facilities for television facsimile and other special services was appointed. Walter E. Holland, of Philadelphia, is chairman of the special committee.

The committee will confer with Dr. C. B. Jolliffe, chief engineer, and other experts of the Federal Radio Commission, regarding the future broadcast frequencies to be assigned in developing visual broadcasting. Frequency assignments and other special services are regarded as a problem for engineers.

The NRA code of fair competition for the radio broadcasting industry, presented by the National Association of Broadcasters, has been completed after considerable negotiations with the NRA and was submitted for approval of President Roosevelt. The broadcasters' code provides a maximum week of forty hours and minimum wages of $14 in small cities, and ranging upwards.

Sound Trucks Called Source of Nuisance

Some complaint was registered in New York City that public address systems and sound trucks, for political and other advertising, create a nuisance.

TRADIOGRAMS

By J. Murray Barron

Kay's Radio, 179 Greenwich Street, reports a steady increase in business this Fall and is now completely stocked in replacement parts. There is also a complete line of short-wave kits, including battery models, and there are wired types.

* * *

There are still numerous calls for aluminum cans, also panels and tubing and in this respect experimenters, servicemen and dealers will be interested to know that Insuline Corporation of America, 23 Park Place, New York City, is taking care of this type business, even to the smallest order, and will send price list upon request direct.

* * *

A visit to a few of the mail-order houses show orders from all sections of the United States, Canada, Mexico and the West Indies and norhtern parts of South America. There are also orders from other foreign countries. American-made sets are in great favor all over the world and where the price is right and duties and "quotas" permit, there is a large field for an organization that gets after the business.

* * *

Greenwich Street, New York City, showed some additional progress by the enlarging of two radio stores, one on each side of the street. In both instances they each double their floor capacity.

* * *

Blan the Radio Man, 177 Greenwich Street has installed some new neon day lights in his large north window which attracted considerable attention on Greenwich Street. That the merchandise shows up to great advantage all asserted.

* * *

A. E. Stevens, formerly sales manager of the Lynch Manufacturing Company, is now assistant sales manager of Hammarlund Mfg. Co., Inc., 424 West Thirty-third Street, New York City.

* * *

National Company, Malden, Mass., announces an air-dielectric padding condenser in a shield and mounted on isolantite, also a stand-off insulator.

* * *

The Electrical Association of New York, sponsoring the "Buy Now" show window competition to tie in with local activities centering around the NRA, will give the retail merchants a chance to "strut their stuff" this week. At a meeting some 100 civic and merchants asociations in the metropolitan area were formally invited to cooperate.

* * *

Service technicians and radio engineers will be interested in the Radio Tube Base Connection Finder as put out by National Union Radio Corp., of 400 Madison Avenue, New York City. It is an out-of-the-ordinary gadget which, by a simple whirl of a dial, discloses the proper pin connections of any tube instantly. The local National Union tube distributor can supply those interested for the tops of six National Union Tube cartons.

* * *

Radio Service and Mfg. Co., 87 Cortlandt Street, specialist in auto radio installation and service, announces removal to larger and more complete quarters at 135 Liberty Street. Charles and Monas Seidman will continue in joint operation.

Stand Farther from Mike When It's Velocity Type!

When entertainers in Captain Henry's Show Boat went to their first rehearsal at the new NBC studios in New York, they found not only different surroundings and furnishings, but even ribbon microphones. They're smaller even than the old, condenser microphones and they're "alive" on two sides.

Over this new device, a phrase by Mary Lou to Lanny Ross came through in the control room much too loud. But a few experiments taught her that instead of standing as close to the microphone as she could get, as previously, she should get two feet away.

With two sound intakes, the new microphone also eliminates crowding.

ROXY ON AIR ELEVEN YEARS

S. L. Rothafel (Roxy) celebrated his eleventh anniversary on the air with a program from the new NBC studios in Radio City.

RCA Loss for 9 Months Totals $1,793,370.55

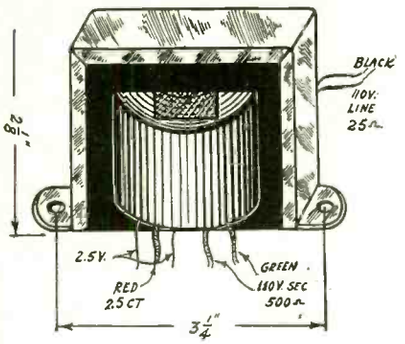
The report of Radio Corporation of America and subsidiaries for the third quarter of this year, and for the first three quarters, shows losses incurred. For the quarter the loss is $525,158.87 and for the three quarters (January 1st to September 30th) $1,793,370.55. The surplus is still above $8,000,000, however.

The following consolidated statement, besides giving the results of the third quarter, 1933, and the three quarters, 1933, also reveals the situation for the same three quarters of 1932:

	3rd Quarter 1933	*Nine Months Ended Sept. 30* 1933	1932
Gross Income:			
From Operations	$13,988,114.17	$41,137,938.67	$49,931,841.74
Other Income	236,998.11	606,611.88	864,958.21
Total Gross Income from all Sources	$14,225,112.28	$41,744,550.55	$50,796,799.95
Less: Cost of Sales, General Operating, Development, Selling and Administrative Expenses	$13,662,260.16	$40,377,380.24	$46,533,094.67
Net Income for the Period (before Interest, Depreciation, Amortization of Patents, and Federal Income Taxes)	$562,852.12	$1,367,170.31	$4,263,705.28
Deduct:			
Interest	$57,189.20	$173,425.21	$983,452.13
Depreciation	880,821.79	2,537,115.65	3,372,975.67
Amortization of Patents	150,000.00	450,000.00	450,000.00
Provision for Federal Income Taxes	.....	.....	50,000.00
Total Deductions	$1,088,010.99	$3,160,540.86	$4,856,427.80
Net Income for the Period Transferred to Surplus	$525,158.87	$1,793,370.55	$592,722.52
Dividends:			
On "A" Preferred Stock	.....	.....	343,019.24
Surplus for the Period	*$525,158.87	*$1,793,370.55	*$935,741.76
Surplus at Beginning of Period	$8,582,972.50	$9,851,184.18	$11,327,789.07
Surplus at End of Period	$8,057,813.63	$8,057,813.63	$10,392,047.31

*Loss.

SPECIAL
SMALL POWER TRANSFORMER



Filament-plate transformer, for oscillators, 1 or 2-tube sets, etc.
Primary, 110 volts a-c.
Secondary A, 2.5 volts, center-tapped; stands up to 3 amperes.
Secondary B, 110 volts, not center-tapped.
Excellent for test oscillators with a-c in plate.

Price, $1.10
RADIO WORLD
145 West 45th Street New York, N. Y.

175 KC TUNING UNIT FREE
WITH SUBSCRIPTION

For use with 175 kc intermediate frequency. Unit includes four-gang condenser, three r-f coils, the proper oscillator inductance and 800-1,350 mmfd. padding condenser. Send $12.00 for two-year subscription and order Cat. SUTU-175, which will be sent postpaid.

Radio World
145 West 45th Street
New York City

Quick-Action Classified Advertisements

7c a Word—$1.00 Minimum

NEW DEVELOPED CIRCUIT. Five-tube super. Gets 3000 miles. Demonstration free. Barreto Radio, 13 Peck Slip, New York City.

MACHINE WOUND COILS TO YOUR SPECIFICATIONS; reasonable prices; best materials. Box 82, San Clements, California.

MODERN TUBE INDEX, all tubes, all the dope, all manufacturers, socket connections, everything. Most complete of all. Sheet 21 x 27 inches. Price 25c. RADIO WORLD, 145 West 45th Street, New York, N. Y.

THE FORD MODEL—"A" Car and Model "AA" Truck—Construction, Operation and Repair—Revised New Edition. Ford Car authority. Victor W. Page. 708 pages, 318 illustrations. Price $2.50. Radio World, 145 W. 45th St., New York.

"THE CHEVROLET SIX CAR AND TRUCK" (Construction—Operation—Repair) by Victor W. Pagé, author of "Modern Gasoline Automobile," "Ford Model A Car and AA Truck," etc., etc. 450 pages, price $2.00. Radio World, 145 W. 45th St., N. Y. City.

"SWOOPE'S LESSONS IN PRACTICAL ELECTRICITY," 17th Edition, Revised by Erich Hausmann, E.E., Sc.D. Requires no previous technical knowledge; fully explains every question about the entire subject of electricity. New chapters on vacuum tubes, telegraphy, telephony and radio signalling. 709 pages, 542 illustrations, 5½ x 8, Cloth, $2.50. Radio World, 145 W. 45th St., New York, N. Y.

Just the Dandy Meters You Want!

O-1 MILLIAMMETER

A O-1 milliammeter is the outstanding measuring instrument in radio work. We offer a precision instrument of highest type manufacture, with large, easily-readable scale, with five marked divisions of 0.2, 0.4, 0.6, 0.8 and 1.0, each subdivided into ten divisions, a total of 50 subdivisions over the scale, or 20 microamperes per subdivision. The diameter is 3½ inches, the case is finished in dull black and has wide mounting flange, with three mounting holes, for which screws are supplied. The scale length is 2⅜ inches, contrasty black on a permanent white disc. This is a moving coil type of instrument with highest grade magnets. Meter resistance is 32 ohms. The milliammeter and mounting screws are supplied only, as a premium with a two-year subscription for RADIO WORLD, 104 issues, one each week. By using multiplier resistors the instrument may be used as a voltmeter (1,000 ohms per volt), or, by using resistance shunts, as a less sensitive current meter. Remit $12, order Cat. ZWMA, and meter and screws will be shipped prepaid.

Non-inductive multiplier resistors, wound on slotted ceramic spools, to convert the instrument into a voltmeter, are obtainable additionally on basis of outright purchase at following prices for resistance tolerance of only ½ per cent.:

Resistance of Multiplier	*Full-Scale Deflection Voltage*	*Net Price (Prepaid)*
1,000	1	$ 0.92
10,000	10	.98
100,000	100	1.56
1,000,000	1,000	4.11

(Current shunts, 10 ma, 58c; 100 ma, 69c; 1,000 ma (1 amp.), $1.26)

DIRECT-READING OHMMETER
Two Scales, 0-1,000 and 0-10,000 Ohms

A direct-reading ohmmeter with two scales, one reading 1,000 ohms at maximum, the other 10,000 ohms, either service accessible by throwing a snap switch to "Hi" or "Low," more than doubles the usefulness, compared to a single-scale instrument. This ohmmeter has a self-contained 4.5-volt battery and is provided with a zero resistance-reading adjuster. Two tipped flexible leads are furnished. The instrument is contained in a baked enamel case. Send $10 for an 86-week subscription for RADIO WORLD, order Cat. DROM, and get this excellent instrument free, postpaid.

NINE JUNIOR METERS

There is no necessity of going without a meter that your work requires. From the list below you may select any one meter and obtain it free, postpaid, by sending $1.50 for a 12-week subscription for RADIO WORLD (12 issues), or $3.00 for a 26-week subscription and get two meters, or $6 for a year's subscription (52 issues) and get four meters.

0-6 Voltmeter D.C.....No. 1326
0-50 Voltmeter D.C.....No. 1337
6-Volt Charge Tester D.C., No. 1323
0-10 Amperes D.C.....No. 1338
0-25 Milliamperes D.C....No. 1325
0-50 Milliamperes D.C....No. 1350
0-100 Milliamperes D.C....No. 1390
0-300 Milliamperes D.C....No. 1399
0-400 Milliamperes D.C....No. 1394

(Ohmmeter and Junior Meters Sent Prepaid)

RADIO WORLD and RADIO NEWS } $7.00

Get both of these mazagines for one year for $7.00, although the regular subscription price of RADIO WORLD alone is $6.00 a year and that of "Radio News" alone is $2.50 a year. Instead of paying $8.50 you pay $7 and you get 52 issues of RADIO WORLD (one a week) and 12 issues of "Radio News" (one a month). "Radio News" recently bought "Citizens Radio Call Book," and "Technical Review" and consolidated them with "Radio News." This offer at this combination price applies only to United States and possessions. Send $7.00 and order Cat. PRE-RWRN.

To Canadian and other Foreign subscribers the combination price offer is at $8.50 for these two magazines. Order Cat. PRE-FOR-RWRN.

RADIO WORLD, 145 West 45th Street, New York City

115 DIAGRAMS FREE

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

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

Circuits include Bosch 54 D. C. screen grid; Balkite Model F, Crosley 20, 21, 22 screen grid; Eveready series 50 screen grid; Hrls 334 A.C. screen grid; Peerless Electrostatic series; Philco 76 screen grid.

Subscribe for Radio World for 3 months at the regular subscription rate of $1.50, and have these diagrams delivered to you FREE!

Present subscribers may take advantage of this offer. Please put a cross here ☐ to expedite extending your expiration date.

Radio World, 145 West 45th St., New York, N. Y.

Beginner's Twin S. W. Receiver with Hammarlund Parts

Acclaimed by RADIO WORLD readers, who have purchased a "TWIN," as the finest short wave set to learn the mysteries of short waves. A letter to N.Y. Sun, May 20th, from one of our customers, states that he received stations in England, Germany, Italy, Africa, Geneva and Spain.

Economical—Uses two 2-volt 230 low current tubes.
KIT OF PARTS (blueprints, 4 coils, etc.) **7.95**
Wired, with 4 coils (15-200 meters).....8.95

RELIABLE RADIO CO., 145 W. 45th St., N. Y. City

Valuable Gifts with Subscriptions for RADIO WORLD

A *NEW* TEST OSCILLATOR

That Works A.C., D.C., or Batteries!

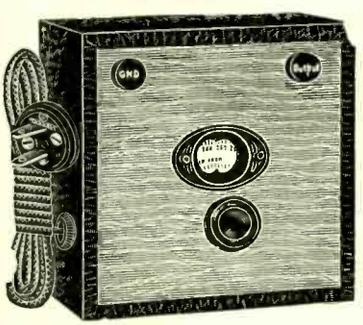
A NEW TEST oscillator, Model 30, has been produced by Herman Bernard, so that all the requirements for lining up broadcast receivers, both tuned radio frequency and superheterodyne types, will be fully and accurately met. This device may be connected to 90-120-v a.c., any commercial frequency, without regard to polarity of the plug, and will function perfectly. It may be used also on 90-120-volt d.c. line, but plug polarity must be observed. One of the plug prongs has a red spot, denoting the side to be connected to positive of the line. If you don't know the d.c. line polarity, you may connect either way, without danger. The oscillator will work on d.c. only when the connection is made the right way. Moreover, 90 volts of B battery may be used instead of either of the foregoing, simply by connecting two wires between the plug at the batteries, observing polarity. No separate filament excitation is required. The oscillator is modulated with a strong, low note under all circumstances. It uses a 30 tube.

THE dial of the Bernard Model 30 Test Oscillator is directly calibrated in kilocycles, so there is no awkward necessity of consulting a chart. The fundamental frequencies are 135 to 380 kc, so that nearly all commercial intermediate frequencies as used in present-day superheterodynes are read on the fundamental. The points for other intermediate frequencies, e.g., 400, 450, 456 and 465 kc, are registered on the dial also, two harmonics, with which the user need not concern himself, being the basis of these registrations. Besides, the broadcast band is taken care of by the fourth harmonic and the dial is calibrated for that band, also.

The divisions on the dial for the fundamental band, 135 to 380 kc, are 1 kc apart from 135 to 140 kc, 2 kc apart for 140 to 180 kc and 5 kc apart for 180 to 380 kc. For the broadcast band, 10 kc apart from 550 to 800 kc, 20 kc apart from 800 to 1,500 kc.

The test oscillator may be used also for short waves, by resorting to higher harmonics.

SHOWN ONE-THIRD ACTUAL SIZE



Over-All Size Is Only 5x5x3"! Dial Reads Frequencies Directly!

Send $12 for 2-year subscription for RADIO WORLD and order Cat. BO-30 sent free, with tube (prepaid in United States and Canada).
Another model, BO-30-S, same as above, except frequencies are ten times as high, hence instrument is for short-wave work only, is available on same basis.

540-4,500 kc Tuning Units

The Tuning Units consist of a four-gang 0.00046 mfd. condenser, with trimmers on it, ⅜-inch diameter shaft, 1⅛ inches long, mounting spades, condenser closing to the left; and a set of four shielded coils. The condenser is the same for tuned radio frequency sets or superheterodynes, but for superheterodynes a series padding condenser is supplied also. For t-r-f sets the four coils are alike. For supers three coils are alike and there is a different coil for the oscillator, with a selection for 175 kc, 456 kc or 465 kc intermediate frequency.

For t-r-f construction, three stages of t-r-f and tuned detector input, four equal shielded coils, tapped for the police band and properly matched to the tuning condenser which is supplied also. Order Cat. TRFTU, which will be sent free, postpaid, on receipt of $10.00 for 86-week subscription for RADIO WORLD (86 issues).

For superheterodyne construction, two stages of t-r-f, tuned oscillator and tuned input to modulator, three identical coils and an oscillator coil, with the proper padding condenser and the four-gang condenser, are supplied as noted below:

175 kc—For use with 175 kc intermediate frequency. Unit includes four-gang condenser, three r-f coils, the proper oscillator inductance and 800-1,350 mmfd. padding condenser. Send $12.00 for two-year subscription and order Cat. SUTU-175, which will be sent postpaid.

456 kc—For use with 456 kc i.f. order Cat. SUTU-456. Padding condenser is 350-450 mmfd.

465 kc—For use with 465 kc order Cat. SUTU-465. Padding condenser is 350-450 mmfd.

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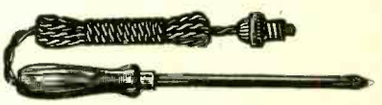
SOLDERING IRON



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By EDWARD M. SHIEPE, B.S., M.E.E.

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From the tri-relationship chart (either one), the required inductance value is read, since frequency and capacity are known by the consultant. The size and insulation of wire, as well as the diameter of the tubing on which the coil is to be wound, are selected by the user, and by referring to turns charts for such wires the number of turns on a particular diameter for the desired inductance is ascertained.

There are thirty-eight charts, of which thirty-six cover the numbers of turns and inductive results for the various wire sizes used in commercial practice (Nos. 14 to 32), as well as the different types of covering (single silk, double silk, single cotton, double cotton and enamel) and diameters of ¾, ⅞, 1, 1⅛, 1¼, 1⅜, 1½, 1⅝, 2, 2¼, 2½, 2¾ and 3 inches.

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RADIO WORLD, now in its twelfth year, is a weekly periodical devoted to the scientific side of radio, and presenting accurately and promptly all the news of the latest developments and circuits in radio, for broadcast and short-wave frequencies. Receiver and test oscillator construction are featured in its varied aspects. Testing in all its branches is given authentic and extensive treatment. Not only how to build, but how to measure what you've built, are featured regularly, and all receiver and test oscillator construction includes coil-winding data, if the coils possibly can be wound at home or in the ordinary laboratory or shop. Articles by leading authorities are augmented by carefully-checked station lists. A subscription for RADIO WORLD is one of the first requisites for the service man, home constructor, experimenter, student and teacher. Leading schools and laboratories subscribe for it and you will be in excellent company. Send in your subscription NOW.