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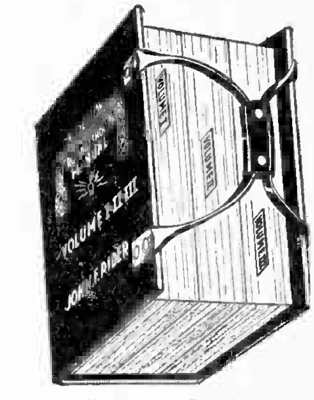

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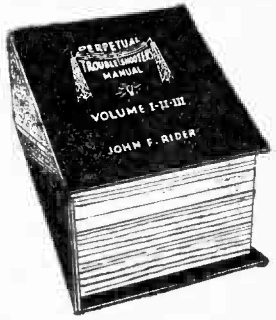

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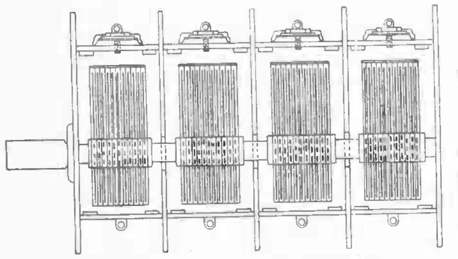

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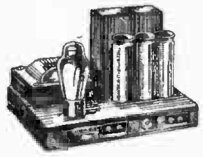

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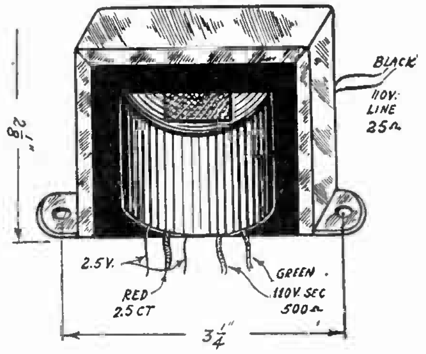

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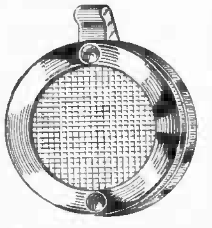

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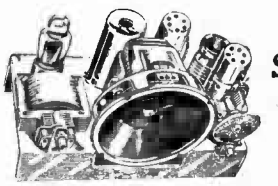

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WORLD
The First and Only National Radio Weekly
TWELFTH YEAR

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DIODE ADAPTATION

IN T-R-F AND SUPERS, FOR ACHIEVING THE IMPROVED QUALITY TYPE OF DETECTION

By Brunsten Brunn

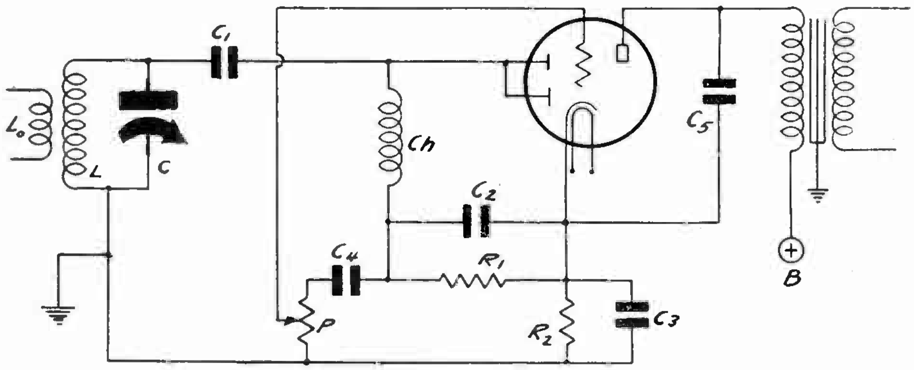


FIG. 1

A circuit showing how to instal diode detection in a receiver not so equipped. It is applicable either to a t-r-f or a superheterodyne detector.

NOW and then experimenters want to instal diode detection in circuits not so equipped, or diode detection and automatic volume control. How can it be done, especially when the tuning condenser preceding the old detector is grounded on the rotor side? There is a simple way that is often used in new receivers.

Consider Fig. 1. The tuned circuit LC is the tuner just preceding the old detector, and the condenser, as well as the coil, is grounded. If there is a grid condenser in the old circuit it should be left where it is. If there is not, one should be inserted, as C1 in Fig. 1. If there is a grid leak across the existing condenser, it should be removed and placed elsewhere in the circuit. It is always the load resistance and one is required in diode detection.

Instead of connecting the grid condenser, C1, to the grid, it is connected to the diode plates, joined together in this case since we cannot use full wave detection. A choke coil Ch is connected between these diode plates and the negative end of the load resistance R1. Condenser C2 across the load resistor is the usual filter condenser that takes out the radio frequency ripple. In this particular case, however, it is not really necessary, for C1, C, and C3 in series are across the circuit and they will filter the ripple. It does no harm, though, if C2 is used, provided it is not larger than 250 mmfd. For choke any coil of 10 millihenries or more inductance is suitable.

Self Bias on Triode

Since a transformer has been put in the plate circuit of the triode it is not practical to use self bias on the grid of the amplifier. For that reason a grid bias resistor, R2, of about 2,500 ohms is connected between the cathode and ground. The condenser, C3, across this resistor should be large, say 4 mfd. or more.

A stopping condenser, C4, of about 0.02 mfd. is connected between the negative end of the load resistance and the grid leak, which in this case takes the form as a potentiometer, P. The slider of this potentiometer is connected to the grid of the triode. Thus there is a volume control in the input to the audio amplifier. If the circuit is already provided with a volume control, P may be a fixed resistor of 500,000 ohms and the grid can be connected to the top of it, that is, to the condenser C4.

In the plate circuit of the triode is a condenser, C5, of about 250 mmfd. for bypassing to the cathode any radio frequency ripple that may have found its way across the tube. It is not absolutely essential, for there is some capacity in the primary and there is very little ripple left. However, many experimenters have found it desirable to use the condenser because of its effect of reducing circuit noise.

A. V. C.

Automatic volume control can be installed at the same time if desired, for the variable bias is already available. A resistor of one megohm would be connected to left end of R1, that is, to the negative end and the grid returns of the tubes to be controlled would be connected to it. How this can be done is shown in Fig. 2. But more will be said about that.

Some prefer to employ resistance coupling between the triode of the detector and the next audio amplifier. How this can be done is shown in Fig. 2. The circuit remains practically the same as before ahead of the diode-triode, except that in this case it is all right to use diode bias on the triode. The stopping condenser has been omitted and the potentiometer is used for load resistance on the diode. As before, the grid of the triode is connected to the slider on the potentiometer. Since the triode is sufficiently biased by the d-c component of the rectified current, there is no need for the bias resistance and the condenser across it.

The cathode, accordingly, is connected directly to ground.

The load resistance, R1, on the triode plate should have a value not less than 250,000 ohms, and not much larger either. C5 in this circuit is a stopping condenser between the plate of the triode and the grid of the next tube. Its value may be around 0.02 mfd., although much larger values can be used if it is essential that the extremely low notes should be amplified fully.

The Variable Bias

The bias on the grid of the triode varies directly in proportion to the signal voltage impressed on the diode and also to the resistance between the slider and the cathode. When the signal is zero the bias is also zero, but this does not increase the plate current in the triode greatly because of the presence of the high resistance R1 in the plate circuit. It is only because of this high resistance that diode bias is practical.

Since the bias voltage is always greater than the radio frequency voltage impressed on the triode, assuming that the modulation is not over 100 per cent., there is no danger that the bias will be insufficient for the audio signal. This is true regardless of the setting of the slider on the potentiometer.

The fact that the bias on the triode will always be sufficient for the signal does not mean that the tube will never be overloaded. If the radio frequency signal voltage is too high, the bias will also be too high, and it may be so great that the plate current is cut off during a large part of the audio cycle. When that occurs it is only necessary to move the slider of the potentiometer near the cathode.

In this circuit, as was stated before, the connections for automatic volume control are shown. R2 should be a resistor of one megohm and C4 a condenser of not less than 0.25 mfd. The main purpose of R2 is to prevent the audio signal from shorting through the necessary filter condensers associated with the a. v. c., particularly C4, and C4 must be used to prevent signal feedback, which might cause oscillation in the radio frequency amplifier. The lead marked A. V. C. goes to all the grid returns of the controlled tubes, either directly or through individual filter resistors.

Using Different Tubes

It has been assumed that the diode triode was the 55 or the 85. There are several other tubes that can be used just as well. For example, there is the 2A6 which can be used in place of the 55, and the 75 that can take the plate of the 85. Both these tubes are high mu tubes and should be operated in a circuit of the type shown in Fig. 2. That is, the load resistance on the triode element should be at least 250,000 ohms. This is to insure a high voltage gain in the high mu tube and its output coupler.

The high mu tubes are more easily overloaded than the 55 and 85. For that reason it is necessary to manipulate the volume control. Even with automatic volume control the signal may be so high at the input to diode that the bias developed across the load resistance P will cut off the plate current in the triode. This cannot occur if the slider is moved near the cathode. The potentiometer used should be provided with a slow taper near the cathode end so that the volume can be controlled.

There is little gain in using a fixed bias on the high mu tubes in place of diode bias, for even if the bias is fixed at the proper value, the audio signal may be so strong that the grid will be overloaded. In other words, if fixed bias is used, the potentiometer must be used just the same to prevent overloading.

Using Fixed Bias

If a high mu tube is used fixed bias can be installed in exactly the same way as it was done in Fig. 1. The only difference would be the value of the bias resistance and the type of load in the plate circuit. For the 75 and the 2A6 the bias resistor should be 5,000 ohms, or even more. Although the bias required is comparatively low, the current in the plate circuit will be very low also, first due to the high internal resistance and second because of the high load resistance.

While there are other tubes with diodes in them, it is doubtful that they are as good as those already mentioned because they are pentodes and the screen voltage would have to be adjusted carefully to give any results at all. These duplex diode pentodes are the

Sometimes it is desired to instal automatic volume control without changing the detector. For example, the grid leak type of detector may be used in the receiver and it may be desired to retain it because of its sensitivity. It can be done in exactly the same way as diode detection is installed. An extra tube will be needed for rectifier. Referring to Fig. 2, suppose that LC is the last tuned circuit, that is, the one that precedes the grid leak detector. Condenser C1 should be added, not so that it connects to the grid of the detector tube, but to the high potential side of the tuned circuit. Then this condenser shoulu be connected to the anode of the tube to be used as rectifier, which may be the plate of a diode or the plate or grid of a triode that takes the place of the diode. The choke is used just as it is in Fig. 2, bewteen the anode and the load resistance, and the load resistance is connected between the cathode and the choke. The values of the elements may be the same as those given for Fig. 2.

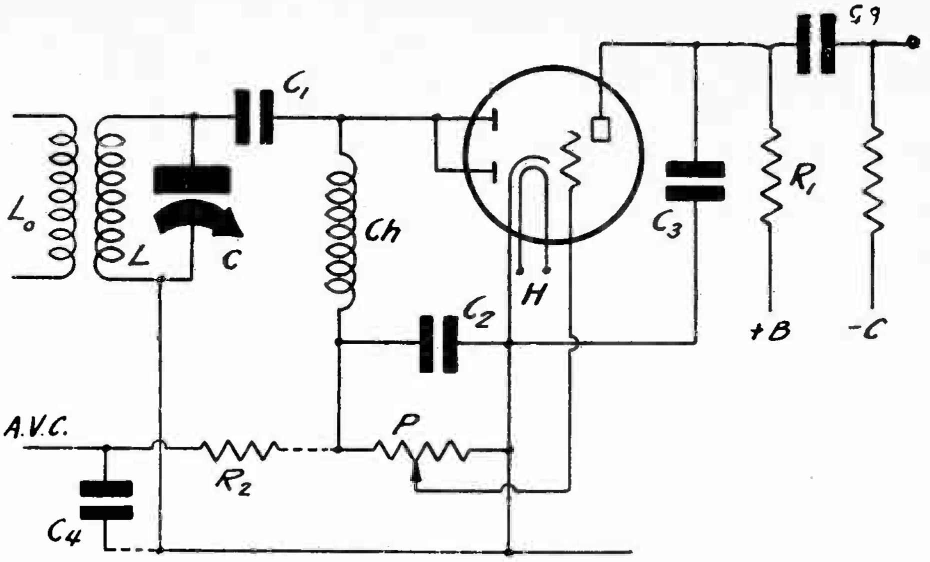


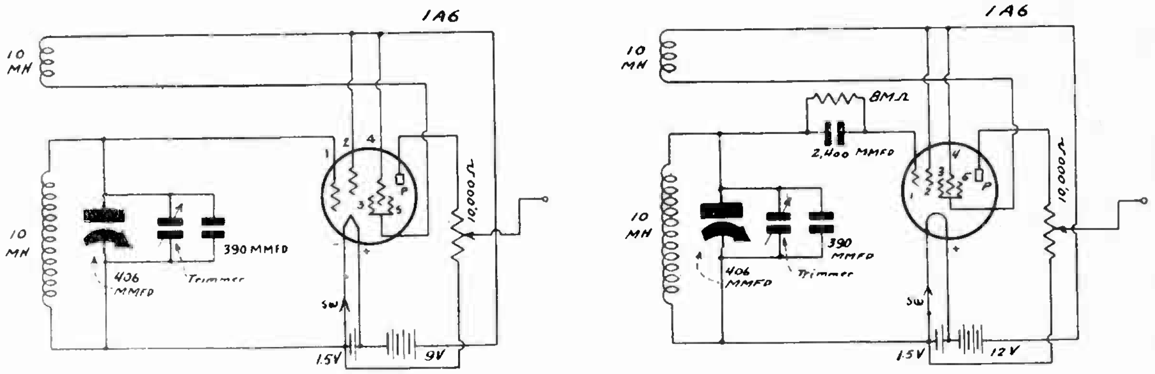
FIG. 2

This shows how to instal a diode detector and a.v.c. in a receiver using grid leak or grid bias detection, either a t-r-f or a superheterodyne type of circuit.

LOW FREQUENCIES

AS FUNDAMENTALS IN AN R-F TEST OSCILLATOR, USED WITHOUT MODULATION FOR ZERO BEATING, OR WITH MODULATION FOR PEAKING

By Herman Bernard



At left a test oscillator, without modulation, for zero beating, useful particularly when one is to calibrate oscillators. At right, with modulation, useful particularly for lining up intermediate channels. With the grid blocking method of modulation shown zero beating is not to be expected. Usually it is completely absent.

TWO 10-millihenry chokes for primary and secondary were used in a test oscillator, with a tuning condenser of 406 mmfd., across which was the usual built-in trimmer, and a fixed condenser of 390 mmfd., with the result that, though the ratio of frequency was very small, the curve was approximately a straight line.

Even though the frequency range was only from 56 to 76 kc, or about 1.36-to-1, the fundamental could be used whenever such frequencies were needed, and harmonics to include all other intermediate frequencies. A scale was prepared, showing how the straight-frequency characteristic was fairly closely achieved, and also giving the positions to be used for 175, 260, 400, 456 and 465 kc, the most popular intermediate frequencies.

These do not appear in a given order on the scale because different harmonics were used when necessary to avoid crowding, except that in two instances, 175 and 456, and 465 and 400 kc, the bars had to be close together, unless of course other bars were selected closer together to move the enumerated ones farther apart.

Fundamentals and Harmonics

The fundamental and harmonics and the harmonics within the intermediate range are listed below:

Fundamental	56 to 76 kc
Second Harmonic	112 to 152 kc
Third Harmonic	118 to 228 kc
Fourth Harmonic	224 to 304 kc
Fifth Harmonic	280 to 380 kc
Sixth Harmonic	336 to 470 kc

Therefore such an oscillator would be used for intermediate frequencies, not only because of the confusing multiplicity of responses when higher or broadcast frequencies are considered, but with modulation also because of the lack of sufficient harmonic strength in some instances in the broadcast band. This weakness of harmonic amplitude is intentional and is due to the high ratio of capacity to inductance. The capacity acts as a bypass to harmonics, but not sufficiently so to defeat their satisfactory generation for the harmonic frequencies recommended. Also the frequency stability is good, due to this high capacity.

As a Beat Oscillator

An important advantage exists for those who seek an instrument that will account for lower frequencies than would a commercial type oscillator. This one is not commercial. Its service is largely special, including use of a semi-standard of unmodulated frequencies when calibrating other oscillators, when beats may be established between this oscillator and an incoming broadcast station carrier, as the beats will be strong enough for audibility or observation on an output meter. Hence for beating purposes there would be no need of modulation. Should the device be intended for intermediate-frequency peaking, modulation must be included, but if for beating only, modulation should be omitted. If the grid blocking type of modulation is introduced, zero beats will be rarely, if ever, obtainable. If no modulation is used zero beats always are obtainable. So one should take his choice of the two diagrams. In any instance there would be a difference in frequency or calibration, modulation compared to no modulation, and so to avoid two scales either method should be selected. The curve exhibited herewith was run with grid-blocking modulation, the checking being done with a wavemeter feeding a 57 detector in the plate circuit of which earphones were inserted. Station beats were used as auxiliaries.

Testing Against Stations

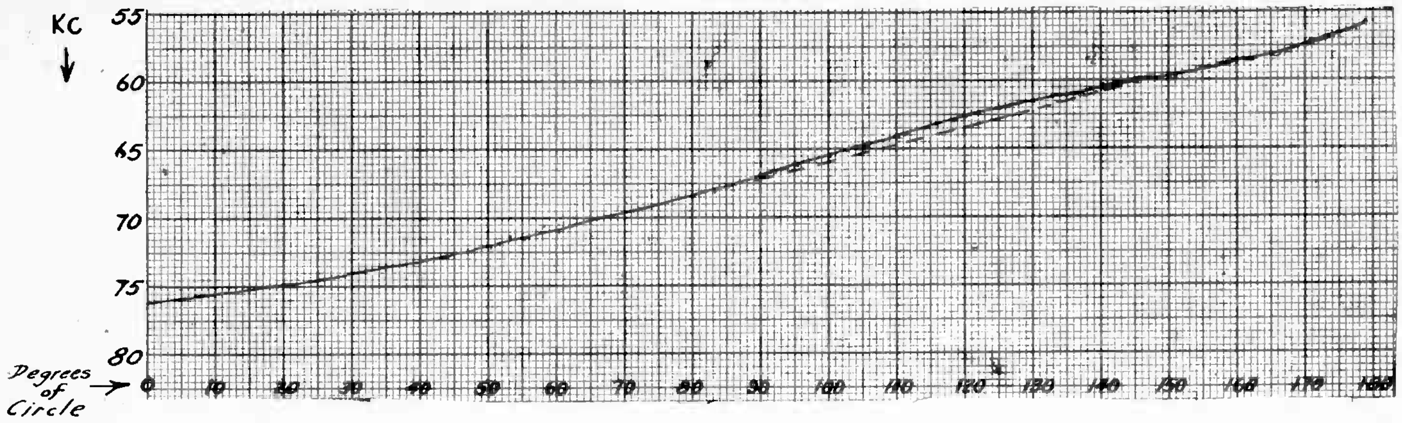
The frequencies being closely known from the curve or the scale, a check-up may be made by beating with a broadcast station carrier, or coinciding modulated output with such a carrier, if modulation is introduced.

The tenth harmonic of the fundamental will prove serviceable in conjunction with frequencies from 560 to 760 in the broadcast band, or the twentieth harmonic used for station frequencies from 1,120 to 1,520 kc, of harmonics between the tenth and twentieth may be used, either exclusively or additionally, although the harmonics then often would not be closely matched by broadcasting frequencies that are 10 kc apart. Some in this group are quite useful, however, including for instance the fifteenth harmonic, 840 to 1,140 kc. By using the tenth, 560 to 760 kc, the fifteenth, 840 to 1,140 kc, and the twentieth, 1,120 to 1,520 kc, all checking purposes are adequately served.

Extrapolated Scale

The scale given herewith is made symmetrical, as for a slight part of the curve, also printed herewith, there is a discrepancy between curve and scale. This is intentional, as the slight hump in the curve, in the fundamental region of 60 to 65 kc, may have been due to experimental error. The curve as run is reproduced, however, consistent with the author's practice of giving curves as they were found by him to exist. The dashed part of the curve represents the straightening effect introduced and which is used over this portion of the spectrum in protracting the curve on the scale. The abscissa of the curve-sheet (0-180) of course represents degrees of a circle, so any one who so desires may do his own protracting.

The most fun is derived from such work when, taking some one else's start as the example, the entire curve is run by the experimenter. This can be done conveniently by purchasing a large protractor for a quarter or so, securely putting a knob on it and affixing the knob to the condenser



Calibration curve of the fundamental of the test oscillator, 56 to 76 kc, using a tuning condenser of 406 mmfd., with built-in trimmer, and a 390 mmfd. fixed mica condenser across the tuning condenser. The inductance was 10 millihenries in both the grid and the plate legs and the coupling tight (1/8-inch separation). The curve in solid line is as determined experimentally, but the dashed line reveals the introduction of straightening, on the assumption slight experimental error might have produced the hump.

shaft by the usual setscrew. An indicator may be improvised by drawing a thin line on white smooth cardboard, bending the cardboard so that it may be glued to a temporary panel, and having the index raised very close to the back of the transparent protractor, to prevent parallax.

The Capacity Extremes

The minimum capacity is approximately 443 mmfd. and the maximum 840 mmfd., which can be computed from the frequency ratio, and the inductance, both already given. The coils, tuning condenser and accurate 390 mmfd. fixed condenser are commercially obtainable. Trade inquiries should be addressed to the Trade Editor, RADIO WORLD, 145 West 45th Street, New York, N. Y.

Broadcasting stations may be selected as already discussed. It is preferable to choose some frequency near or at the highest extreme of the oscillator, and beat with a broadcasting station, say, 760 kc station carrier beating with 76 kc, the built-in trimmer in this particular instance being adjusted so that the tuning condenser will be at minimum (0 degrees). The condenser closes to the right, by the way.

Then the dial will be rotated until 57.6 kc is registered, at about 74 degrees, representing close to the low-frequency end. This is the thirteenth harmonic of the test oscillator beating with 760 kc. The twelfth harmonic of 63.34 and the eleventh harmonic of 69.1 also will beat with 760 kc, so four points may be registered, and other points by selecting some other broadcasting frequencies.

By this time the experimenter has got his bearings, and will know approximately where any frequencies should come in, but of course will verify enough of them, using perhaps twenty points, to run the curve.

After the curve has been drawn several points should be rechecked, using broadcasting stations as standards, and having recourse only to the curve for verification of the condenser setting. If the curve is first drawn literally, using pencil, connections suggested by recheck may be included and then the curve inked in. Do not use French curves for "smoothing out" the result.

Tabulation of Points

Thus the fundamental is taken care of, but the harmonics to be imprinted as on the scale for i-f peaking would be selected by taking points on a lower tier that, considered as fundamentals and divided into the intermediate frequency desired, yield a whole number (integer).

Since degrees of a circle are used, a tabulation may be prepared even prior to establishing the curve, the tabulation representing merely the points obtained by the experimental method just outlined. An example of such a tabulation, based on the literal curve herewith printed, follows:

Specification of degrees of a circle for location of frequency markings on scale

Upper Tier

kc	*Degrees*	*kc*	*Degrees*
58.0	167.0	67.0	89.0
58.5	161.0	67.5	86.0
59.0	155.0	68.0	83.0
59.5	151.0	68.5	80.0
60.0	145.0	69.0	75.0
60.5	140.0	69.5	70.0
61.0	136.0	70.0	66.5
61.5	130.0	70.5	64.0
62.0	125.0	71.0	60.0
62.5	120.0	71.5	55.0
63.0	116.0	72.0	50.0
63.5	114.0	72.5	45.0
64.0	110.0	73.0	41.0
64.5	105.0	73.5	36.0
65.0	102.5	74.0	30.0
65.5	100.0	74.5	25.0
66.0	95.0	75.0	17.0
66.5	92.0		

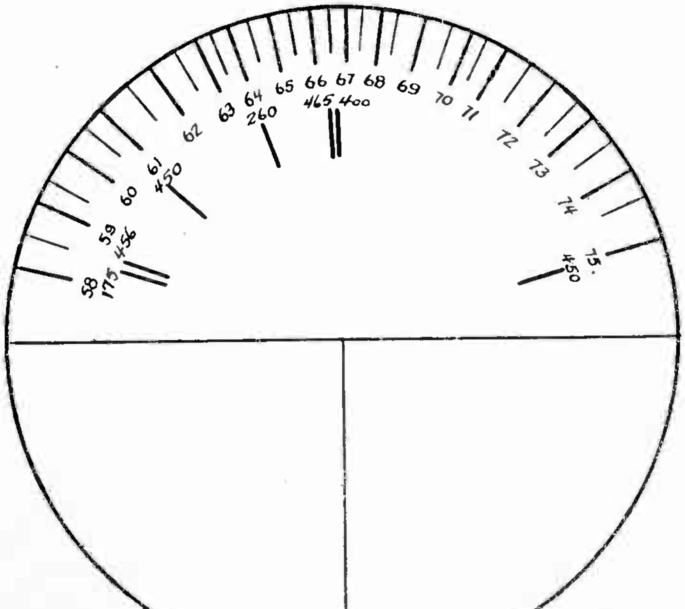
Lower Tier

175.0	162.5	450.0	17.0
260.0	110.0	456.0	161.0
400.0	91.0	465.0	92.0

The only differences between the two circuits shown is that in the one there are no grid leak and condenser and plate voltage is 9 volts, while in the other there are grid leak and condenser and the plate voltage is 12 volts. Since the total B current is only around 0.5 milliampere, flashlight cells of the smallest types may be used for B supply, and a 1.5 volt cell about 1½ inches diameter, 2¼ inches high, used for filament. A No. 6 dry cell for filament would last much longer. The tiny B supply will last for months of average use.

Sidney Flamm Joins Staff of WBNX

Sidney Flamm, formerly of WMCA, New York City, has joined the staff of WBNX as commercial director. Identified with radio since 1925, Mr. Flamm was secretary and commercial director of WMCA; before that he was the commercial manager of the Eastern District Branch for the Brooklyn "Daily Eagle." Prior to his advent into radio, Mr. Flamm was editor of the Flushing "News," and of a fishing magazine, "Ocean Life."



Scale prepared from the curve, using the dashed portion on the assumption there was slight experimental error in that region, and the solid portion for all the other locations. The scale does not include quite the frequency span actually covered, which is from 56 to 76 kc, leeway being provided in favor of the adjustment of the built-in trimmer.

A STABILIZED DYNATRON

RECTIFIER TYPE CONTROL USED FOR AMPLITUDE CONSTANCY, EVEN IF GRID CURRENT FLOWS

By J. E. Anderson

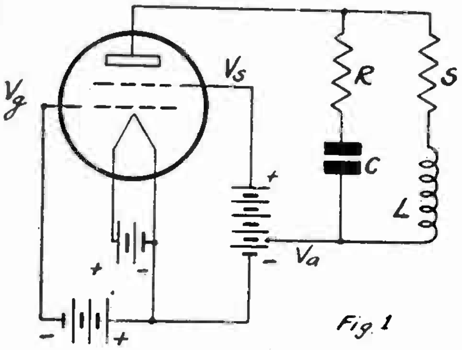


Fig. 1

The fundamental circuit of the dynatron oscillator. A parallel tuned circuit is connected in the anode circuit and the anode potential is made less positive than the screen potential.

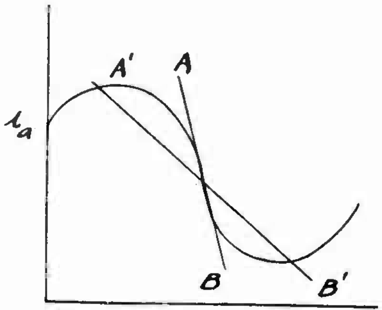


Fig. 2

This illustrates the meaning of negative resistance. As the anode voltage increases the anode current decreases. This relationship between the voltage and the current holds for limited range.

THE dynatron oscillator is now condemned, now praised. It is praised because it is the simplest of all oscillating circuits. It is condemned because it is an uncertain oscillator and also because when it does oscillate, the frequency is not constant.

The objections to this circuit are not valid. The dynatron will oscillate every time it is a dynatron. By merely hooking up a circuit looking like a dynatron one does not necessarily get a dynatron. In order to have a circuit of this type it is essential that the plate circuit have negative resistance. To produce negative resistance it is necessary that the plate be at a lower positive potential than the screen grid, or the control grid. That is one condition. There is another. There should be no suppressor grid, for that usually defeats the object sought in getting a negative resistance. That is the purpose of the suppressor grid. Even the objection to the dynatron on the ground that the frequency is not stable is not valid. It can be stabilized much in the same way as other oscillators.

In the February issue of "Proceedings of the Institute of Radio Engineers" for this year, Janusz Groszkowski, a Polish engineer, discusses the stabilization of the dynatron oscillator in some detail, and he does it from the viewpoint of the stabilization of the amplitude. If the amplitude can be held stable as the supply voltages or generated frequencies vary, the frequency stability will exist, and be as good for this circuit as for triode oscillators of the more usual kind.

Circuit of Dynatron

In Fig. 1 is the circuit of a dynatron utilizing an ordinary screen grid tube, such as the *222* or the *224*. The resonant circuit is the loop containing L, S, R, and C, R being the resistance in series with the condenser and S that in series with the inductance. Ordinarily the resistance in series with the condenser is so small that it can be neglected. It is included in this circuit merely to point out that when the two resistances, R and S, are equal, the circuit oscillates at the frequency determined by L and C even in the dynatron. This method of stabilization has its drawbacks, for when the resistance R is inserted in series with the condenser to balance the natural resistance in the coil, the resistance of the tuned circuit is doubled. There is another rule about frequency stability which this violates, namely, that the lower the resistance in the tuned circuit the more stable the frequency. There is only one reason why quartz crystal and magnetostriction oscillators are highly frequency stable, and that is that the effective resistance in these resonators is very low, not absolutely, but in relation to the effective inductance.

Screen Voltage Highest

It will be noticed on Fig. 1 that the screen voltage, V_s, is much higher than the plate voltage, V_a. That is the first condition that must be satisfied in order to have a dynatron. It will also be noticed that the control grid on the tube has a negative bias. It is an experimental fact about dynatrons that as the negative bias on the control grid increases the internal plate resistance of the tube increases. That this is the case can be seen from any family of plate voltage plate current curves for a screen grid tube having no suppressor. The curves for the lower bias values are much steeper in the negative resistance region than those for the higher values of bias. When the slope in this negative region is zero, that is, when the curve is horizontal, the internal negative resistance of the tube is infinite. This fact is made use of by the author of the article cited for the purpose of stabilization, that is, the fact that as the negative bias increases the internal negative resistance decreases.

The Negative Resistance Region

Just what is meant by the negative resistance region is illustrated in Fig. 2. Here V_a represents a variable anode or plate voltage and i_a the anode current. For low values of the anode voltage the current is high, as at A^1, and for higher anode voltages the current is less, as at B^1. In this region the plate resistance is negative because as the voltage increases the current decreases. When the resistance is positive, as is ordinarily the case, the current is directly proportional to the voltage, or at least the current increases as the voltage increases even if the direct proportion does not hold. It does not for ordinary vacuum tubes.

When a dynatron oscillates, the anode voltage varies between certain limits, as, for example, between the limits A^1 and B^1, as determined by the straight line passing through these points. If the amplitude of the oscillation could be confined within very narrow limits very close to the point of steepest slope, there would be practically no frequency variation, because it is the curvature that gives rise to fluctuations. There are several ways of controlling the amplitude of the oscillation so that the swing will be confined to a narrow region. One is by controlling the grid bias and another is to control the resistance in the load circuit, the load circuit being the resonant circuit and any other impedance that may be connected in series or in parallel with it. The amplitude of the oscillation is determined directly by the load resistance. Suppose, for example, that the resonant circuit has a certain L/CR ratio. There will be a certain amplitude of oscillation. If that resistance is increased by decreasing the value of C or of R, the amplitude will become greater, for any time the impedance of the tube, as determined by the slope of the straight line $A^1 B^1$, is equal to the load resistance. For any given value of L/RC there is only one value of the internal resistance that will match.

Adjusting the Internal Resistance

Suppose that for any reason the amplitude increases. If the internal resistance could be increased simultaneously, the amplitude could not increase as much as it would otherwise. There would be only a slight change in the frequency. And if the internal resistance could be increased automatically in the same degree as the load resistance, there would be no change, either in the amplitude or in the frequency. What is required is a device that will increase the bias on the grid in the same proportion as the increase in the amplitude of oscillation. Such a device is shown in Fig. 3.

This is essentially the same circuit as in Fig. 1 with the exception that a rectifier has been added, a rectifier operating from the oscillation and which controls the bias on the control grid. The rectifier is the tube K, a triode with the plate and the grid tied together. It has a load resistance r_2, shunted by a filter condenser C_2, and a polarizing battery V_p. It will be noticed that the grid of the dynatron tube is connected so that if any current flows in r_2, a negative bias is applied to the grid. There will be a current, of course, for there is a conductive path through the dynatron plate-cathode circuit, or through the tuned circuit if V_a is less than V_p.

A coil in the rectifier circuit is coupled

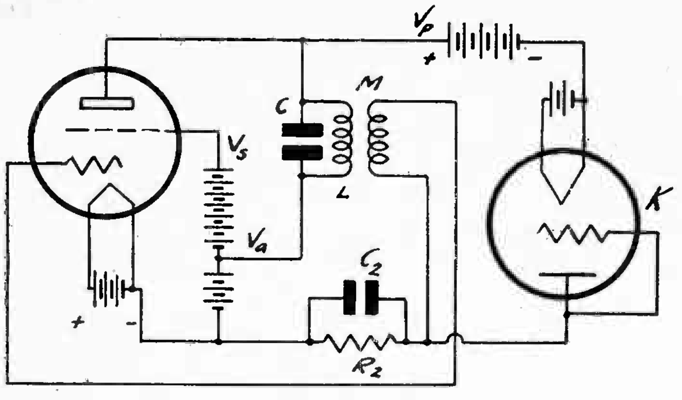


Fig. 3.

The circuit of a frequency and amplitude stabilized dynatron in which the amplitude is held constant by grid bias which varies as the oscillation voltage varies. Reaction is used to improved stability.

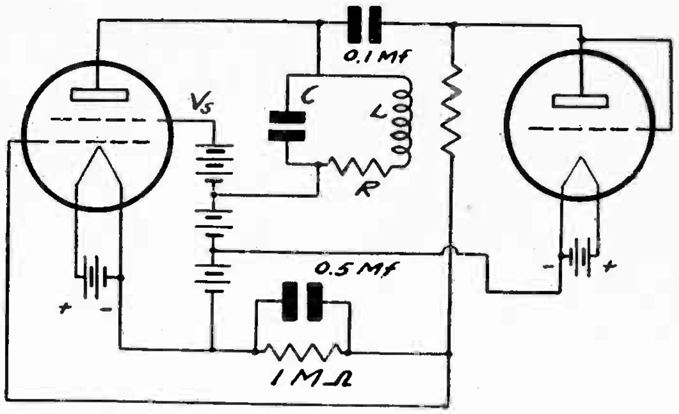


Fig. 4

A simplified stabilized dynatron in which the rectifier is coupled to the tuned circuit by capacity and resistance. The order of stability of this circuit is approximately one part in 100,000.

to the oscillating coil L. The voltage induced in the coil is in series with the polarizing voltage and it will increase the rectified current. The greater the oscillating current the more is the bias increased, and therefore there is a check on the increase in the amplitude. It works the other way too. When the amplitude decreases the rectified current in r_2 decreases, allowing the amplitude to increase. Therefore the amplitude is held constant, and when the amplitude is constant the frequency is also constant.

A Variation of Controlled Circuit

In Fig. 4 is a simpler and more practical automatically controlled dynatron. In this case the load resistance which establishes the bias on the dynatron has a value of one megohm and the condenser across is a capacity of 0.5 mfd. There is also a coupling resistor of 0.5 megohm value between the anode of the rectifier and the control grid. The tuned circuit in which the oscillating potential exists is therefore coupled to the rectifier by means of capacity and resistance, a method that is often used in detectors of the diode type.

It will be noticed that the cathode of the rectifier tube is connected to a tap on the dynatron anode battery. The polarizing potential is therefore negative. The oscillating voltage must therefore have a certain minimum value before rectification begins in the rectifier tube. This allows the oscillation to build up without hindrance from the bias. But as soon as the voltage has built up to that minimum value, rectification begins, the grid bias begins to be effective on the dynatron, and further increase in the amplitude is prevented. It is clear that the minimum value can be selected arbitrarily by connecting the cathode of the rectifier tube to suitable points on the battery.

400 Times Better

The frequency control of this circuit is exceptionally good. If the reference condition be expressed by filament voltage 3.5 volts, screen voltage 120 volts, and plate voltage 60 volts, a change in the screen voltage to 140 volts, the others remaining the same, the frequency change in the ordinary unstabilized dynatron is —8 points in 1,000 and in the stabilized oscillator, as in Fig. 4, the change is only —2 in 100,000, a four hundred-fold improvement. If the filament voltage is increased to 4 volts, the screen remaining at 120 and the plate at 60 volts, the change in the frequency of the unstabilized oscillator is —3 per 1,000 and that in the stabilized only —1 in 100,000, a 300-fold improvement. For other changes the control effect is similar, although for some combinations it is not quite so favorable.

Oscillator With Back Coupling

The circuit in Fig. 3 is stabilized even when the coupling between the two coils is zero, for the oscillating circuit is in the rectifier circuit, and the rectified current through r_2 will vary in proportion to the signal. The addition of the back coupling, however, improves the stabilization. This feedback makes the oscillator similar to a triode oscillator, although the plate potential is higher than the screen potential. Since the grid is maintained negative in this oscillator, the stability is improved on that account, for in any circuit in which there is no grid current, the frequency stability is greatly improved. In most triode oscillators it is very difficult to reduce the grid current to zero. The classical way of doing it is to use a grid leak and stopping condenser. The effect of this combination is very much similar to the operation of these stabilized dynatrons. The grid draws a little current and establishes a high bias across the grid leak. This is higher the stronger the oscillation. The amplitude therefore is checked. Not only does the grid bias established by the grid current increase the grid resistance but also the plate resistance. A negative bias does that in any case. When both the grid and the plate resistances are high, the frequency stability is also high. When both are infinite, the circuit is perfectly stable, but then, unfortunately it does not oscillate.

If there is another element in the tube that can be used for rectification it is possible to make a stable dynatron with a single tube. It is not necessary that the cathodes of the two parts be independent, it is only necessary that the anode be independent. Such tubes are the duplex diode pentodes, for example. However, the pentodes have suppressors and they are not especially suitable for dynatrons. The 12A7 is a tube that might be used since this has the necessary rectifier in addition to the screen and the plate that might be used for the dynatron. It is also possible to use tubes like the 1A6 by reserving one of the grids for anode for the rectifier.

In any case a requirement is that the tube will have negative resistance in the plate circuit when the plate is less positive than the screen. It is not every modern tube in which this requirement is met. Indeed, very few modern tubes satisfy the condition. However, if the suppressor is brought out to a terminal on the base, it can be given any potential necessary to make the plate resistance negative. It is only those tubes in which the suppressor is connected to the cathode inside the tube which cannot be manipulated.

"Last Roundup" Voted Most Popular Song

"The Last Roundup" was the most popular song of 1933, according to recently tabulated results of a poll conducted by WLS among its audience.

Nearly 4,000 listeners in 40 states and seven Canadian provinces expressed their musical preferences in the station's poll.

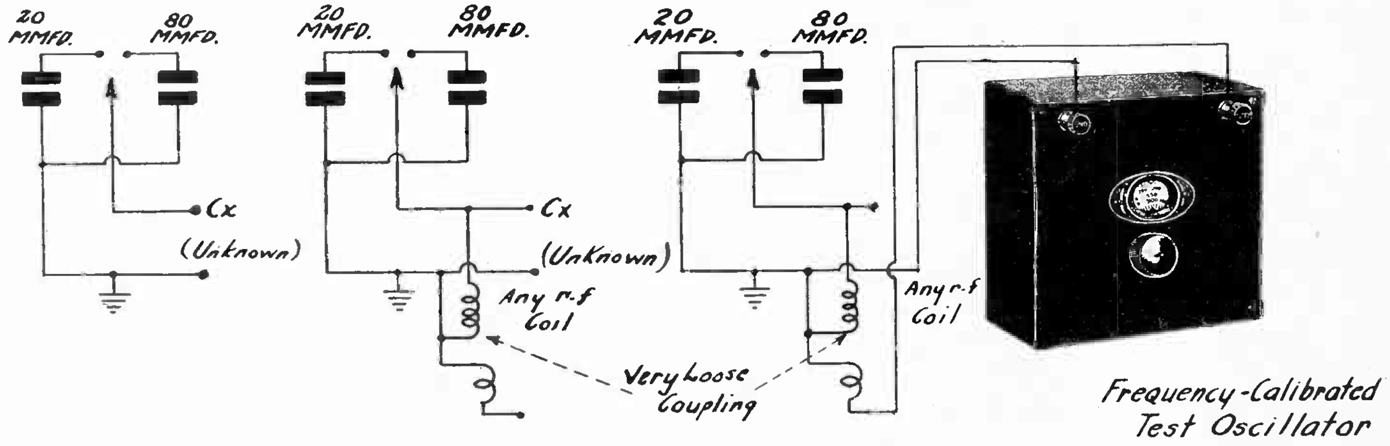
"Significant as perhaps pointing a trend in current music was the fact that heart songs or songs of sentiment were the most popular among the listeners who reported," said George Biggar, program director of the Chicago station. "The poll, which brought replies from 40 states and Canada, provides a good representative cross-section of the national taste in music on the radio. It indicates that it is the songs with a genuine heart appeal which endure in the public mind through the years.

"Although 'The Last Roundup' suffered the fate of so many good songs, in that it was 'played to death' in a short time, it nevertheless proves that the public is fundamentally the same as it was in 1890, as far as songs of sentiment are concerned."

Irish songs received 150 votes; old ballads, 119; mountain songs, 107; cowboy songs, 100; Texas songs, 97; spirituals, 82; railroad songs, 72; hymns, 70; plantation melodies, 61, and Hawaiian music, 50.

MEASUREMENT OF A COIL'S DISTRIBUTED CAPACITY

NEW METHOD DEVISED BY AUTHOR USES FREQUENCY RATIO REDUCTION FOR DETERMINATION OF BAFFLING QUANTITY



Left to right, the two starting capacities and position of the unknown capacity, Cx, the inclusion of any coil for empirical frequency ratio determination and the test oscillator for frequency-checking and ratio determination.

DETERMINATION of the distributed capacity of a coil is often a pesty problem, since there is no accurate formula for its determination. The evaluation has to be determined empirically. One good method is to take a coil that is wound on a form with dielectric constant X and immerse it in a wax that has a dielectric constant of 4X and note the capacity increase in a tuned circuit. The distributed capacity increase is equal to the distributed capacity of the coil.

However, if one has a calibrated condenser the distributed capacity of a coil may be determined on the basis of the diminished frequency ratio due to the introduction of this distributed capacity. The method is susceptible of good accuracy, depending, of course, on the accuracy of the calibrated condenser and on the accuracy of the observations of frequency.

First let us consider the calibrated condenser. Any capacities within range may be selected. Let us assume that the condenser is considered at two settings, one representing 20 mmfd. and the other 80 mmfd., taken as minimum and maximum capacities in a theoretical tuned circuit, in which the inductance L is imaginary. The capacity ratio, maximum divided by minimum, is 4, the frequency ratio the square root of 4=2. The fact that an actual tuned circuit is not being used should be borne in mind, for imaginary L is taken as something that never exists physically, a capacityless inductance. Were it not for this imaginary quantity the system would not work.

The only measurements we have thus far are two capacities. The ratio of capacity and of frequency are computations based on the known laws.

New Frequency Ratio

Now we insert a coil, putting the tuning condenser across it, and use this tuned circuit as a wave trap, in conjunction with a test oscillator. The trap circuit's frequency response at the same two settings may be ascertained from the calibration of the test oscillator, since the trap circuit will stop the oscillation at the resonant frequency. Very loose inductive coupling is used.

Now we determine exactly what are the new and lower frequencies at these same two settings, which formerly represented 20 and 80 mmfd. respectively, but now are increased as to capacity by the amount of the distributed capacity of the coil, which is X, the unknown quantity we are striving to determine.

As stated, we must ascertain the frequencies for these two identical settings, the ones calibrated as 20 and 80 mmfd. for the condenser alone, but which we know are now larger than that. Suppose the frequencies are 600 kc and 1,140 kc, respectively. We now have the frequency ratio, 1,140/600 or 1.9 and also the new capacity ratio, which is $1.9^2 = 3.61$. We have every item of fact now necessary for the determination of the distributed capacity of the coil, for this is the capacity that has caused the frequency ratio reduction.

Let us write down the values with which we started:

$$C_{max} = 80 \text{ mmfd.}$$
$$C_{min} = 20 \text{ mmfd.}$$
$$R_c = 4$$
$$R_f = 2$$

And let us add the newly-acquired facts:

$$\frac{C_{max} + X}{C_{min} + X} = 3.61$$

Therefore by adding X to each term of the original capacity ratio set off against 3.61 we have the complete equation:

$$\frac{80 + X}{20 + X} = 3.61$$

Multiplying out by 20X we get

$$80 + X = 72.2 + 3.61X$$

Subtracting X from each side we get

$$80 = 72.2 - 2.61X$$

Transposing and changing signs

$$2.61X = 7.8$$
$$X = 2.9885 \text{ mmfd.}$$

We can check this against our original 20 and 80 mmfd. and the experimentally-determined and computed capation ratio:

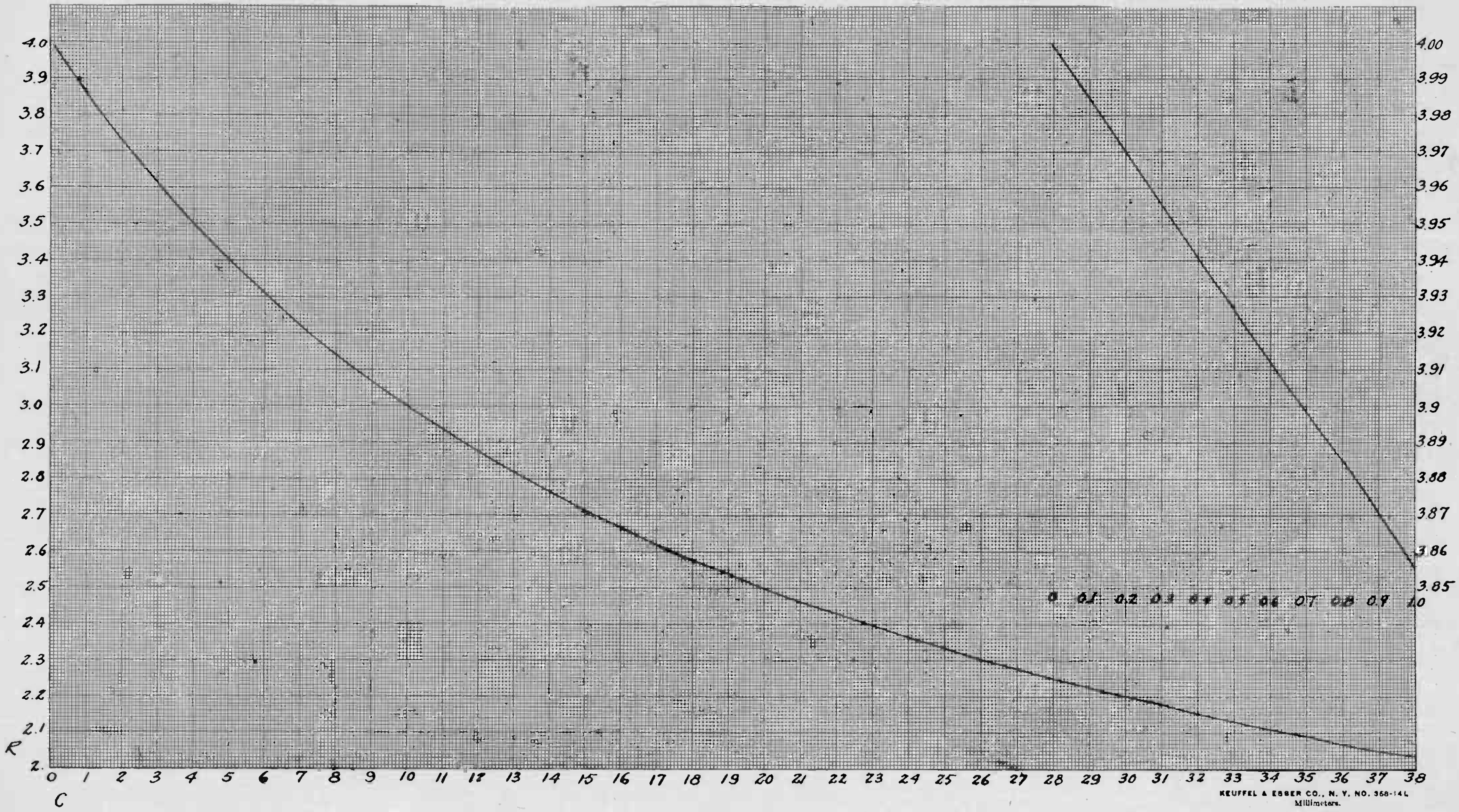
$$\frac{80 + 2.9885}{20 + 2.9885} = 3.61$$

(Continued on page 21)

Data Used as Basis for Plotting Curves

The accuracy obtainable from the curves printed herewith is sufficiently high, but for those who desire to do their own checking by longhand arithmetic the capacities and ratios obtained are given here in tabulated form, based on 20 and 80 mmfd. as the two selected starting capacities:

Capacity in Mmfd.	*Capacity Ratio*	*Capacity in Mmfd.*	*Capacity Ratio*
0.1	3.985	16.0	2.67
0.2	3.9703	17.0	2.62
0.3	3.9557	18.0	2.58
0.4	3.9411	19.0	2.54
0.5	3.927	20.0	2.5
0.6	3.912	21.0	2.46
0.7	3.898	22.0	2.43
0.8	3.885	23.0	2.395
0.9	3.8708	24.0	2.364
1.0	3.857	25.0	2.333
2.0	3.728	26.0	2.3
3.0	3.61	27.0	2.277
4.0	3.54	28.0	2.25
5.0	3.4	29.0	2.24
6.0	3.31	30.0	2.2
7.0	3.222	31.0	2.18
8.0	3.14	32.0	2.154
9.0	3.1	33.0	2.132
10.0	3.0	34.0	2.11
11.0	2.94	35.0	2.09
12.0	2.875	36.0	2.07
13.0	2.82	37.0	2.05
14.0	2.765	38.0	2.034
15.0	2.71	39.0	2.02
		40.0	2.0

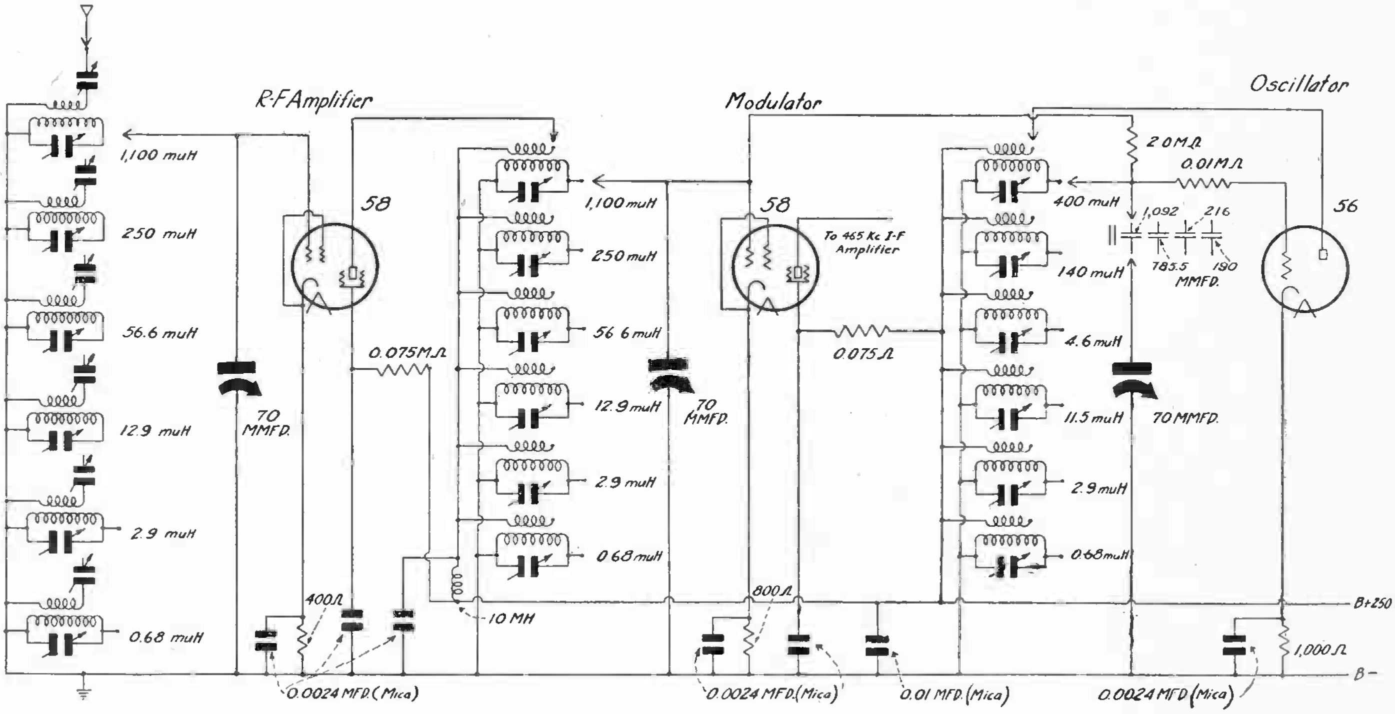


Curves relating the capacity of the unknown to the decreased capacity ratio occasioned by paralleled capacity, and based on two starting capacities, 20 and 80 mmfd. The original capacity ratio is therefore 4 to 1. Any small additional capacity reduces the capacity ratio. The new ratios are determined from a test oscillator. Then refer to the upright column at left on the large scale for values of the unknown capacity lying between 1 and 38 mmfd. The small scale at right is plotted for values between 0.1 and 1.0 mmfd. The capacities are at bottom in both instances.

FOR BETTER SPR
FREQU

A SMALLER TUNING CONDENSER IS USED IN AN

By Herm



Radio-frequency selector and oscillator in which the inductances and capacities are used as stated, for greatly improved spreadout in an all-wave set, and improved sensitivity due to increased L/C ratio.

IT is not pretended that short-wave tuning has reached anything like its ultimate goal. Obviously the frequency ratios are too high. An admission of this is contained in every instrument that has bandspread tuning. Those that do not have such tuning simply leave the situation as they created it without even an attempt at a makeshift solution.

If the frequency ratio is reduced, of course more coils are needed. The ultimate goal in this direction would be perhaps to have the tuning at the highest-frequency band cover a frequency spread only five or fewer times that of the lowest-frequency band, instead of fifteen or more times the first span. As the span is reduced as a general proposition, even without changing the ratio of tuning for the bands as will be done eventually, the necessity for bandspread at least begins to disappear, or, to put it differently, the tuning itself begins to approximate bandspread, without any adjunctive aid.

Six Coils Required

So as a step in the general direction of better spreadout the values have been computed for a coil-condenser system for broadcast and short-wave coverage, assuming a condenser that has a minimum of 6 mmfd., a maximum of 70 mmfd., and an external circuit with a minimum of 12 mmfd., for the r-f level. Thus the sum of the minima is 18 mmfd. (6 for the condenser and 12 for the circuit), and the maximum is 82 (70 for the condenser and 12 for the circuit).

With such an arrangement there would have to be six coils for each tuned circuit. The inductances for the radio-frequency or station carrier level are selected on the basis of the maximum capacity, 82 mmfd. The capacity ratio is 82/18, or 4.5 to 1. The frequency ratio will be the square root of that, or 2.12 to 1.

By ignoring the excess of 0.02 in the frequency ratio, suitable provision for overlap would result, and the frequency ratio is then taken at 2.1 to 1, capacity ratio at 4.41 to 1.

When the low-frequency inductance is selected, since the capacity ratio will not change from band to band at the radio-frequency level, the next smaller inductance, for the higher frequency part of the broadcast band and something additional, may be obtained by dividing the larger inductance by the capacity ratio. This rule applies for the other coils, too, at the r-f level.

Overlap Insured

Either by computation of inductance, where the capacity and frequency are known (82 mmfd. and 540 kc), or by consulting the supplemental inductance-capacity-frequency chart supplied with Edward M. Shiepe's book, "The Inductance Authority," the value for 540 to 1,134 kc is established at 1,100 microhenries (1.1 millihenries). This of course would have to be a honeycomb or similar winding, as small solenoids do not effectively lend themselves to winding of such a high inductance.

From the foregoing the values as given in the following r-f table may be computed by any one. Since the lowest-frequency inductance is known, also the frequency ratio, the highest frequency to be reached with the first-band coil will be 1,134 kc (540 x 2.1). The inductance for the next band may be derived from the previous inductance, which is divided by the capacity ratio, 4.41. So 1,100/4.41=249.43 microhenries. The literal result is given, although of course the coil would be wound for 250 microhenries really.

The frequency span can not be determined exactly from what has been stated, but there is a 14 kc extra difference allotted to overlap, and the succeeding bands have overlaps approximately 2.1 times that of the previous band. The computation becomes more exact than practice can achieve, therefore overlap values are selected at 14, 30, 60, 113 and 200 kc for the respective bands. These are in addition to the allowance of 0.02 in the frequency ratio, so there will be absolute certainty of avoiding missout. Thus, at 10,000 kc the 0.02 factor would produce 200 kc differential, and besides 113 kc are allotted, so there would be a total of 213 kc.

The inductance is reduced for each stage by less than the true capacity ratio, since instead of 4.5 as factor 4.41 is used, so we

EADOUT AT HIGH ENCIES

ALL-WAVE SYSTEM—SIX COILS FOR EACH CIRCUIT

n Bernard

Winding Data for R-F and Oscillator Secondaries

R-F Level

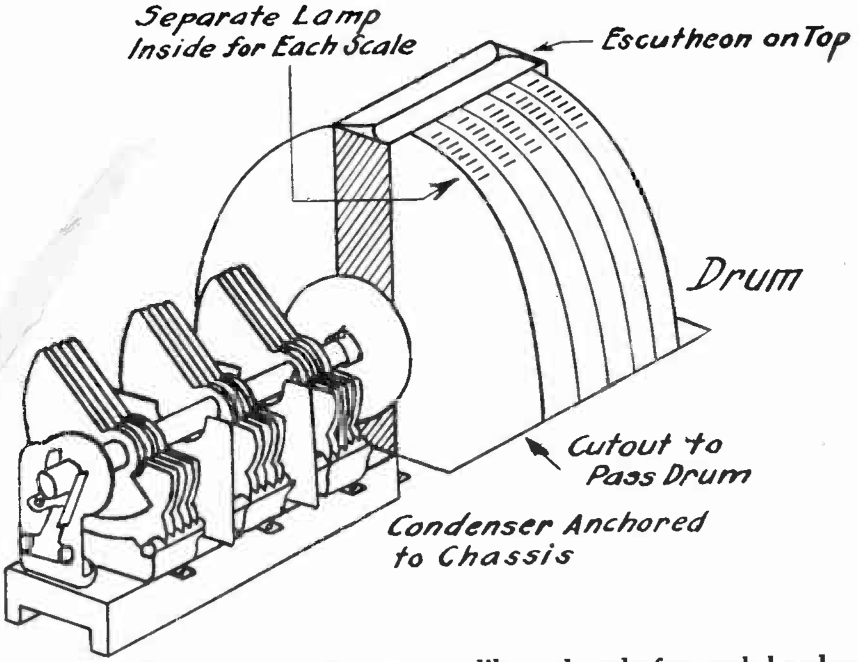
Inductance	1¼" Diameter *	1-5/32" Tube Base Diam. *
1,100.00		
250.00	95 t. 32 en	105 t. 32 en.
56.60	37.5 t. 30 en.	41 t. 30 en.
12.85	17 t. 22 en.	19 t. 22 en.
2.90	8.4 t. 18 en.	9.1 t. 18 en.
0.68	3.7 t. 16 en.	4 t. 16 en.

**Honeycomb coil or other layer-wound coil commercially obtainable.*

Oscillator Level

Inductance	1¼" Diameter *	1-5/32" Tube Base Diam. *
400.00		
140.00	63 t. 32 en.	70 t. 32 en.
46.00	38 t. 30 en.	36 t. 30 en.
11.50	13.75 t. 22 en.	19.5 t. 22 en.
2.90	8.4 t. 18 en.	9.1 t. 18 en.
0.68	3.7 t. 16 en.	4 t. 16 en.

**Honeycomb coil or other layer-wound coil commercially obtainable.*



If there is to be a separate frequency-calibrated scale for each band some sort of drum must be used to avoid the crowding that results on a flat type disc dial. Here is one method, whereby the drum is in the same plane as the condenser shaft. The escutcheon would be on top if the condenser were mounted usually, or could be on the front panel if the condenser is mounted upright.

can go right down the line as follows: 56.56, 12.85, 2.9 and 0.68 microhenries.

Radio Frequency Tabulation

The following tabulation accounts for the radio-frequency levels:

Condenser capacity	6 to 70 mmfd.
External circuit minimum capacity	12 mmfd.
Actual resultant tuning capacity	18 to 82 mmfd.
Tuning capacity ratio (actual)	4.5 to 1.
Tuning capacity ratio (utilized)	4.41 to 1.
Frequency ratio (actual)	2.12 to 1.
Frequency ratio (utilized)	2.1 to 1.

Band	Inductance in Microhenries	Frequency Coverage in Kilocycles
1	1,100.00	540- 1,134
2	249.43	1,120- 2,352
3	56.56	2,322- 4,876
4	12.85	4,816-10,113
5	2.90	10,000-21,000
6	0.68	19,800-41,580

The foregoing are secondary inductance values, for the tuning condenser specified, which is a commercial model. Primaries may be arranged to suit.

For the oscillator level there will have to be padding for four bands, the minimum capacity differently adjusted for each band by the parallel trimmers.

The oscillator inductance has to be selected on the basis of the high-frequency extreme for any band, contrasted to the practicality of selecting the r-f inductance for the low-frequency level.

A Leaf from Experience

Here, therefore, we must rely on experience. The minimum capacity in the oscillator circuit must be increased, compared to the r-f level, as the capacity tuning curve of the oscillator crosses that of the modulator or other r-f level. For such a circuit, from experience, we know that a value of 7 mmfd. extra will be satisfactory, so we select as capacity value 18+7 or 25 mmfd. and an inductance of 400 microhenries, since the frequency is 1,134+465 or 1,599 kc for an i.f. of 465 kc. The high frequency of course is taken as 1,600 kc. The next computation relates to the actual capacity required in circuit to strike the low-frequency end, or 540+465=1,005 kc. This is 61 mmfd.

The formula for obtaining the value of the series padding condenser to reduce the condenser and circuit maximum to the desired lesser maximum is

$$C_x = \frac{C_1 \times C_2}{C_1 - C_2}$$

where C_x is the series padding capacity and C1 and C2 are the maximum of the condenser and circuit, and the lesser maximum needed, identities assigned in the formula so that the smaller is to the right in the denominator.

Series Padding Capacities

One point has to be watched carefully. We increased the minimum from the steady 18 mmfd. value for r-f to 25 mmfd. in this oscillator instance, therefore we must increase the maximum by the 7 mmfd. So instead of 82 mmfd. we deal with C_1 as 89 mmfd. C_2 is 61 mmfd. $C_1 \times C_2 = 5,329$ mmfd. and C1 — C2 = 28 mmfd. So 5,329/28 = 190 mmfd., the value of the series condenser, C_x.

Let us obtain the inductance for the oscillator for the low-frequency part of the broadcast band. We said it was selected on the basis of the highest frequency reached, and with 25 mmfd. minimum capacity the inductance to strike 1,600 kc should be 400 microhenries. Knowing the inductance now and the low-frequency end, 1,005 kc. we ascertain the condenser maximum is required to be 61 mmfd., as already stated, and the series capacity was derived on that basis.

By using 23 mmfd. total minimum in the next band we strike 2,817 kc with 140 microhenries inductance. The maximum capacity required is 62 mmfd. We have a maximum, without series padding of 18 plus the 5 extra, or 23, so we add the 5 to the 82 and get 87. Thus 87 × 62 or 5,394/25 equals 216 mmfd., the value of this padding condenser.

The Other Bands

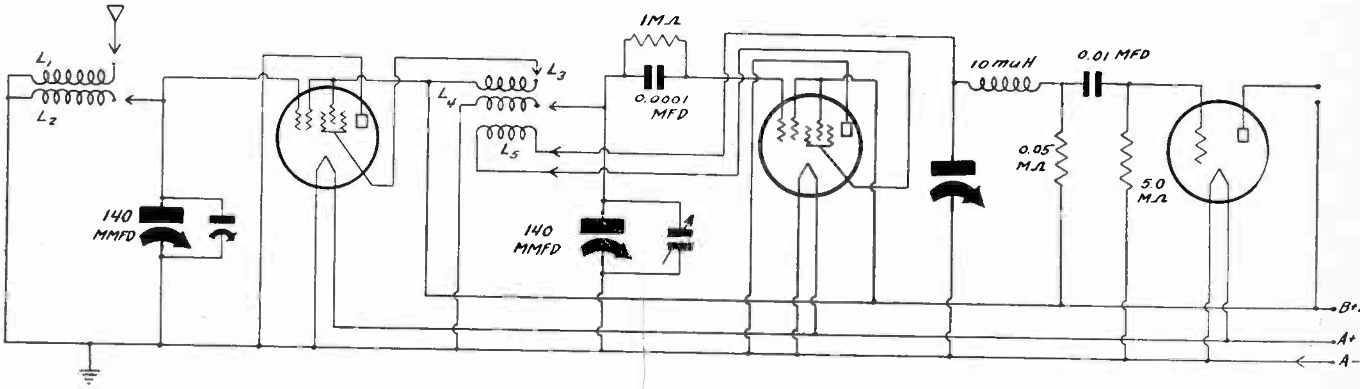
Using 20 mmfd. minimum next we require 46 microhenries to reach 5,341 kc. and require 76 mmfd. to reach 2,787 kc. The condenser and circuit at maximum would be 82 + 2 or 84 mmfd., and 76 mmfd. are required. so the series condenser would be 84 × 76/8 or 785.5 mmfd. Parallel capacity trimming alone would suffice for the remaining bands, by reducing secondary inductance a little; or padding may be used, 78 mmfd. being required in circuit. Using 20 mmfd. minimum for condenser, etc., 84 × 78/6 gives the series capacity as 1,092 mmfd.

(*Continued on next page*)

A BANDSPREAD SET

SHORT-WAVE RECEIVER USES 1.5-VOLT DRY CELL AND 22.5-VOLT B BATTERY—FREQUENCY RATIO ONLY 1.5 TO 1

By Jack Tully



Special connections for the 1A6 tube, used as radio-frequency amplifier and again as regenerative detector, with the same utilization of elements. The frequency ratio with such a system can not be expected much to exceed 1.5 to 1, but the circuit is useful especially for those desiring to hear a particular band. Amateurs will appreciate the total bandspread effect.

USING plug-in coils or a switching arrangement, the simple circuit shown herewith may be used for short waves. It includes the use of the 1A6 tube as r-f amplifier and another such tube as regenerative detector. The output tube for earphone service is a 30.

The special connections for the 1A6 result in a large minimum capacity and therefore, although standard plug-in coils would work, there would be entirely different frequencies from those expected, much overlapping and failure to attain expectedly high frequency values.

Therefore the coils had better be wound on blank forms, starting with the low-frequency coils on the basis of a total of 220 mmfd. capacity in circuit, at maximum, even though the tuning condensers are only 140 mmfd. or so. The frequency ratio will be around 1 to 1.5, and there will be abundant spreadout, and of course a greater number of coils would be required. The coils are wound for succeeding bands so that the lowest frequency of the new band is just a bit lower than the highest frequency of the previous band.

The object is to stress the simple circuit, which is operated from a 1.5-volt No. 6 dry cell for the filament, and has a 22.5-volt B battery. It is not necessary to provide tube bias under these conditions, except of course that there is bias derivation in the detector circuit from the grid leak and condenser action, due to grid current.

Tube Elements

The elements of the tube, taking grids left to right in the diagram, are Grid No. 1, ordinarily the control grid of an oscillator; Grid No. 2, positive-voltage companion grid to No. 1, Grids Nos. 3 and 5, between plate and Grid No. 4 and between Grid No. 4 and Grid No. 2; and Grid No. 4, normally a pentode control grid. The screen (Grids 3 and 5) is used as the effective plate. This is especially serviceable in the detector, as the mutual conductance is considerably increased, and this is aided further by tying Grids Nos. 4 and 2 to B plus.

If any one is interested in receiving only a particular band this type of circuit will prove especially attractive, as for instance amateurs, as the tuning is actually a total bandspread.

There may be a slight roaring sound. This trouble would be due to too high a leak value. Although 1.0-meg. leaks never gave any trouble in this circuit in that respect, sometimes leaks labeled 1.0 meg. may be considerably higher in resistance value, so try another similar leak in parallel with the existing one, for that reduces the leak resistance, and if the trouble disappears, leave the remedy as you applied it.

Circuit Modification

The usual circuits for two-winding interstage coils may be applied to the circuit, instead of the three-winding transformer, so that designs given by coil manufacturers may be followed except to adhere to the tube conn identities and connections as shown herewith.

Such an outfit was built in a very compact shielded cabinet, and gave excellent results. If a No. 6 dry cell is used the A cell will last for several weeks of more than average use, while the B current is very small indeed, not exceeding 3 milliamperes, hence the B battery is good for several months of service. Amateurs in particular might like to try the circuit. It is excellent for them.

Effect of Shielding On R-F Transformers

(Continued from preceding page)

For the two remaining bands the inductances are at the two levels and the parallel trimmers used for lining up at the high-frequency end. Series condensers much in excess of 0.001 mfd. are of no value in padding, as the large series capacity discloses that the full tuning condenser capacity may as well be used.

Tabulation for Oscillator

Now we may construct the tabulation for the oscillator.

Condenser capacity	6 to 70 mmfd.
External circuit minimum capacities	Vary, 12 to 19 mmfd.
Actual tuning capacity	Six different values
Tuning capacity ratio (actual)	Six different values
Frequency ratio (actual)	Six different values

Band	*Inductance in Microhenries*	*Series Condenser*	*Minimum Capacity*	*Frequencies in Kilocycles*
1	400.00	190.0 mmfd.	25 mmfd.	1,005-1,600
2	140.00	216.0 mmfd.	23 mmfd.	1,585-2,817
3	46.00	785.5 mmfd.	20 mmfd.	2,787-5,341
4	11.50	1,092.0 mmfd.	20 mmfd.	5,281-10,578
5	2.90	0	Exper.	10,465-21,465
6	0.68	0	Exper.	20,065-42,045

The close frequency specification for the higher frequencies of the oscillator will be ignored in practice, and the receiver lined up on the basis of maximum response at the highest frequency reached in the band, or nearly the highest frequency.

It is submitted that a system such as that outlined is more serviceable, although constructionally more cumbersome.

Plug-in coils may be used, and the winding data may follow those given herewith for unshielded coils. If there is to be shielding, with switching, then special experimental work has to be done so that the inductance values are truly represented, meaning turns added to what calculations yield when the calculations do not take into consideration either the increased capacity or the decreased inductance due to shielding.

In "The Inductance Authority" Mr. Shiepe says of this point:

"The prevention of oscilaltion in r-f amplifiers and the proper use of the screen-grid tube call for shielding of the radio coils. This shielding decreases the coil inductance and introduces additional capacity to the coil. By properly designing the shield, the additional capacity may be confined to a negligible value and the inductance will decrease only slightly. A good working rule is to make the diameter of the shield at least twice the coil diameter. Doing this, and centering the coil within the shield, reduces the capacity to a negligible value and reduces the inductance by only 1 or 2 per cent."

A POCKET TYPE SET

LOOKS LIKE A TWO-TUBE AFFAIR, BUT EACH ENVELOPE CONTAINS TWO SEPARATE VALVES

By Einar Andrews

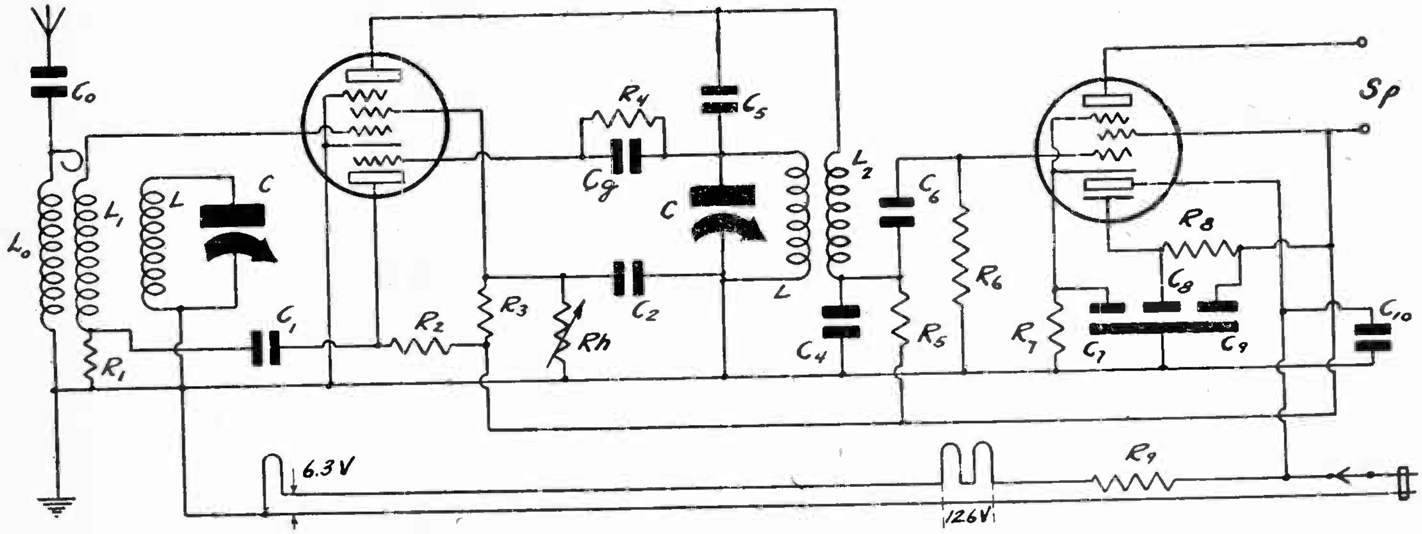


FIG. 1

The circuit diagram of a two-tube receiver in which the first tube is used for detection and audio and radio frequency amplification by reflexing. The second tube is power amplifier and rectifier.

NOW that tubes are comparatively inexpensive there is a tendency in radio circles to eliminate as many of them as possible—to make one tube do the work of half a dozen. The reason is not the depression either. No, it is the desire to make miniature things. The idea back of it is to have a complete radio receiver that can be slipped into the vest pocket. Well, into the coat pocket, anyway. It does not take a prophet to predict that as soon as the midget tubes designed especially for microwaves become available that receivers will be built that actually can be put in the vest pocket.

Just because a considerable interest has been shown in these miniature receivers, we show the circuit diagram of one and give the constants. There is no suggestion implied that a receiver like this can be put against a full-size radio and make that receiver sound like the rattle of a sack full of empty tin cans in comparison. But there is an implication that signals can be received with it and that it really performs better than one has a right to expect of it. There is no magic back of it, only utilization to the full of the properties of the latest tubes.

Duplication of Functions

Let us examine the circuit, how the circuit gets its sensitivity and power when there are only two tubes in the receiver. We are referring to Fig. 1. The first tube is a 6F7, which is really two tubes in one, not merely two or more grids for the same tube. This tube contains a triode and a pentode, each with its own elements, except that the two tubes have the same cathode. In the drawing, the lower elements are those of the triode and the upper elements those of the pentode.

The radio frequency signal is transferred to the control grid (cap) of the pentode by means of L_1. It is then amplified by the pentode in the usual way. It is then delivered to second tuned circuit by means of L2. The signal is tuned and then delivered to the grid of the triode. Grid leak and condenser type of detection is used, since we have the usual combination in the grid lead, that is, the leak R4 and the condenser C_g. We are now in the audio amplifier, but we have not left the first tube. The audio signal is picked up at the plate of the triode, R2 being a coupling resistor and C1 a stopping condenser. R1 is a grid leak in the second audio amplifier, if we consider the triode as the first. It really is, for grid leak detection is nothing but diode detection plus audio amplification with diode bias on the amplifier grid. But R1 is in the grid return lead of the pentode. Therefore the pentode is not only used to amplify the radio frequency signal but also to amplify the audio signal after the detection in the triode element.

We trace the audio signal from the plate of the pentode to the primary L_2 and finally to R_5, which serves as a plate coupling resistor for the audio frequency component only. The radio frequency signal that flows through L_2 is led off to ground through C4. Condenser C6 is the customary stopping condenser between the plate of one tube and the grid of the next. R6 is a grid leak in the second tube.

LIST OF PARTS

Coils

L_oL_1L—One high gain antenna coil consisting of a radio frequency choke, L_o, and a primary and secondary windings.
L2L—One radio frequency transformer. L in each case should be for 350 mmfd. tuning condensers.

Condensers

Co—One 0.0005 mfd. condenser.
CC—One gang of two 350 mmfd. tuning condensers.
C1, C6—Two 0.02 mfd. tuning condensers.
C2—One 0.1 mfd. by-pass condenser.
C_g—One 250 mmfd. grid condenser.
C4—One 500 mmfd. fixed condenser.
C5—One 50 mmfd. fixed condenser, or smaller.
C7, C8, C9—Three 8 mfd. electrolytic condensers.
C10—One 0.25 mfd. condenser.

Resistors

R1, R6—Two 0.5 megohm grid leaks.
R2—One 100,000-ohm resistor.
R3—One 50,000-ohm resistor.
R_4—One 1-megohm grid leak.
R5—One 250,000-ohm resistor.
R8—One 2,000-ohm, 10-watt resistor.
R9—One 320-ohm, 30-watt resistor.
Rh—One 50,000-ohm variable resistor.

Other Reqirements

One line switch (attached to Rh).
Two seven-contact sockets.
One grid clip.

The Second Tube

The second tube also serves two functions, audio power amplification and rectification. This tube is the new 12A7 which is composed of two entirely separate tubes, one a power pentode and the other a half wave rectifier. In this tube there are two different cathodes, as there must be.

The audio signal voltage is impressed on the control grid of the pentode. The suppressor in this tube is connected to the cathode of the pentode element and the screen is connected to the high voltage in the usual way. A small loudspeaker is connected to the output terminals marked Sp. Tiny speakers especially designed for such miniature receivers are available.

The rectifier cathode in the second tube is represented by the lowest horizontal

(Continued on next page)

Radio University

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

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

5-Meter Communication Tried on Freight Trains

With the cooperation of the New Haven Railroad Company, Westinghouse engineers installed an experimental 5-meter phone system on one of the road's regularly-operating freight trains. Complete two-way radiophone equipment is installed on both engine and caboose of the train permitting the engineer and brakeman to communicate at all times without difficulty.

Buzzer Excitation

A HIGH frequency buzzer can be used for exciting a wavemeter tuned to any given frequency. Why does not the freqeuncy of response depend on the frequency of the buzzer. It would seem that the tuned circuit would respond only to the harmonics of the buzzer, but this is not the case as far as I have been able to determine.—W.R.L.

If the buzzer frequency is in the audible range and the tuned circuit has a natural frequency in the radio range, the harmonics are very close to each other. Many of the harmonics of the buzzer would fall inside the resonance curve of the tuned circuit. In other words, a circuit composed of inductance and capacity is not selective enough to separate the harmonics, so the case cannot be proved in that way. Perhaps if you used a quartz crystal resonator it would not be excited by any but the harmonics of the buzzer. In order to test it, it would be necessary to vary the frequency of the buzzer, for the quartz crystal cannot very well be tuned to the harmonics of the buzzer.

* * *

Short-Wave Communication

WHAT are the shortest radio waves now used for regular radio communication? How are they produced?—W.E.J.

The shortest radio waves now used regularly are between 17 and 18 centimeters, or around 7 inches. A system has been installed for communication between England and France, and it is a development of the tests on an 18-centimeter wave carried out a few years ago between Calais and Dover.

Absolute Measurement of Resistance

WE have been given formulas and methods for measuring resistance using, in most instances, Ohm's law. But how is resistance measured in the first instance?—W.H.C.

The absolute measurement of resistance is a problem that cannot be undertaken in the radio experimenter's laboratory. That belongs to national standardizing laboratories like the Bureau of Standards, the National Physical Laboratory, the Physikalische Reichsanstalt, and the like. Two methods, at least, have been developed for doing it; one is a method in which the resistance is measured in terms of a velocity and the other, which is more common, measures the resistance in terms of the heat that is generated in it.

* * *

Victron in Condensers

WOULD the new insulating material Victron be suitable for use as dielectric in fixed condensers when these are to be used at high frequencies? If so, how would the capacity be estimated from the dimensions? —W.H.S.

The new insulator is supposed to be especially good at the high frequencies, and better the higher the frequency. Therefore it should be all right as a dielectric. No comparison with mica, however, is available. The dielectric constant of the amber colored Victron is between 2.5 and 3.0. Hence the capacity of a condenser with this material as insulator between the plates would be from 2.5 to 3.0 times greater than if air were used. Since the material does not have a definite dielectric constant, it is not possible to predict accurately what the capacity of a condenser will be. It would be necessary to measure the dielectric constant of the sample actually to be used in the condenser. The same thing applies to most insulators. If a condenser of given capacity is to be constructed it is easy to make the capacity a little large first and then file down the condenser until the value is exactly that desired.

* * *

Inductance of a Condenser

EVERY coil has a certain distributed capacity. Is it also true that every condenser has a certain distributed inductance? If so, how does it come about? Just what is inductance?—G.H.L.

Yes, every condenser has a certain inductance. The reason for this is that the capacity is not entirely lumped. Current flows into and out of the condenser, especially in the leads. Wherever current flows, there is inductance, for inductance is a property associated with electric current and not a property of the device ordinarily called an inductance. A coil in which no current is flowing has no inductance. When we figure the inductance of a coil we figure the inductance the coil will have when an electric current flows in it. Most of the distributed inductance of a condenser is associated with the leads to it. To make this small, the leads should be close together.

* * *

Computation of Inductance

THE formula usually given for the computation of inductance of solenoid applies to

Construction of a Pocket Type Receiver

(*Continued from preceding page*)

line. This connects with the filter resistor R_8 and Condenser C8. Another condenser, C9, is connected between the other end of the resistor and ground. The third condenser in the block, C7, is used for by-passing the signal current in the bias resistor. A small condenser C10 is connected between the anode of the rectifier and ground as an aid in filtering.

Tuning

There are two ganged condensers in the circuit, each controlling the natural frequency of a resonant circuit. A special arrangement is used in the first tuner to permit grounding of the tuning condenser without interfering with the audio signal voltage. First, L_0 is a radio frequency choke coil. The high potential side of this choke is coupled by a small capacity to the high potential end of L_1, the condenser consisting of a single turn of wire open at one end but conductively connected to L_0. Tuning is accomplished by reaction between the tuned circuit and the grid coil. It is only in this way that the radio and audio frequency voltages can be put in series in the grid circuit and at the same time ground the condenser. The second tuned circuit is regular in every way.

Volume Control

The volume is controlled by means of screen voltage variation on the first pentode. There is a variable resistor Rh between ground and the screen, and the screen voltage is always the drop in this resistor. This is effective because the lower the value of Rh, the greater the drop in R3, but the total drop across R3 and Rh is always the same. Since there are both audio and radio voltages in the first tube, variation of the screen voltage varies the amplification of both at the same time. The volume control does not affect the detector, for it has no influence on the emission of the tube, and the cathode is the only element common to the two sections of the tube.

Westinghouse to Make New Institute's Devices

W. C. Evans, manager, radio department, Westinghouse Electric and Manufacturing Company, announced Westinghouse will manufacture radio devices developed and perfected by members of the Washington Institute of Technology.

This tie-up links Westinghouse manufacturing with scientists formerly with the Bureau of Standards at Washington. These scientists were organized by Col. Sidney F. Mashbir into the Washington Institute of Technology. The purpose of the Institute as outlined by Col. Mashbir is to design, perfect and make commercially available radio aids to flying.

Using Higher Power

Seven of the National Broadcasting Company network stations have been granted power increases. The stations, with old and new comparative power follow:

WBZ (Boston) 50,000 watts from 25,000 watts.

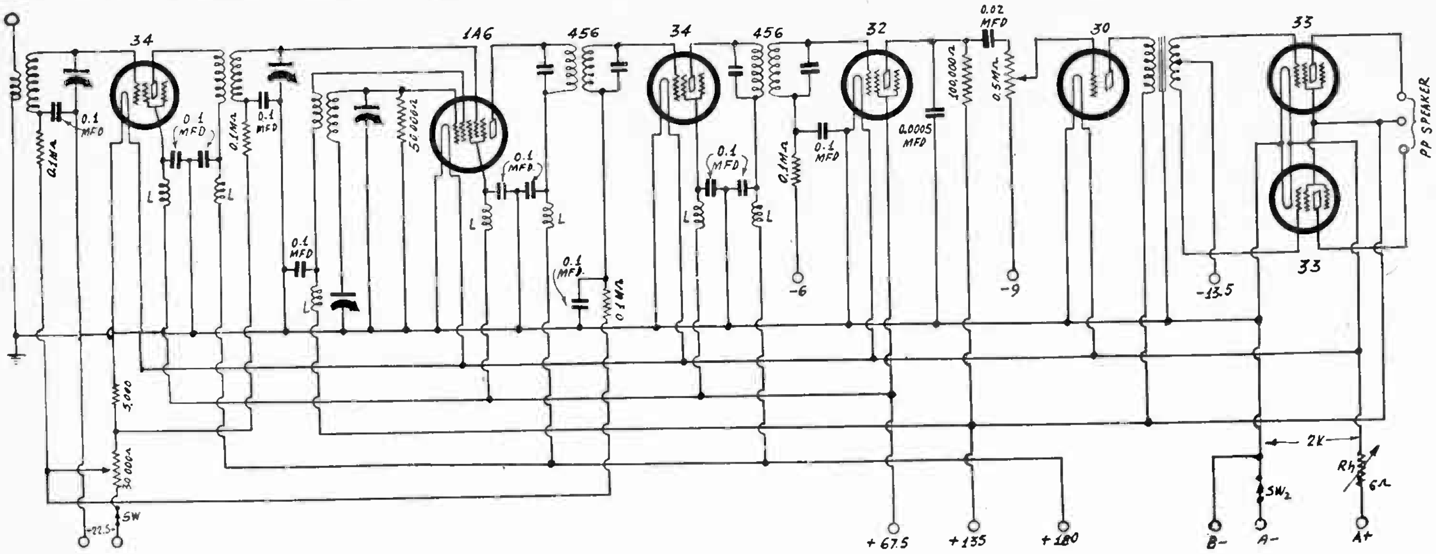
WHAM (Rochester, N. Y.), 50,000 watts from 25,000 watts.

KVOO (Tulsa, Okla.), 25,000 watts from 5,000 watts.

WFI and WLIT (Philadelphia) 1,000 watts from 500 watts.

WSAI (Cincinnati) 1,000 watts (night) from 500 watts, 2,500 watts (day) from 1,000 watts.

WTAG (Worcester, Mass.), 500 watts (night) from 250 watts.



The circuit of a seven-tube battery-operated superheterodyne utilizing two-volt tubes and intended for operation on a six-volt filament battery. A 22.5-volt battery is used to supply a variable bias on the high frequency tubes.

circular coils. Tables and charts for inductances are also based on circular coils. But there are many coils, especially those used in low-loss, short-wave coils, in which the form is hexagonal or octagonal. How can the inductance of such coils be computed in terms of the dimensions?—W.H.A.

The inductance of such coils can be computed with fair accuracy if the mean radius is taken as the radius of the coil, using the formula or table designed for circular coils. The mean radius can be obtained by taking the average of the radii of the inscribed and circumscribed circles of the polygon. If the cross section of the coil is hexagonal, the mean radius is 0.933R, where R is the radius of the circumscribed circle, or one-half the distance between opposite vertices. If the form is octagonal the mean radius is about 0.96R, where R has the same significance as before.

* * *

Battery Superheterodyne

IF YOU have the circuit of a battery operated superheterodyne utilizing the 33 in the output and the 1A6 as mixer and oscillator, will you kindly publish it? I wish to construct such a receiver to be operated entirely from batteries. I have a 6 volt storage battery which I can charge occasionally in my car, and I should like to use this if it is practical in a receiver using two-volt tubes.—W.J.L.

At the top of this page you will find the diagram of such a receiver. It employs seven tubes all of which are of the two-volt type. The rheostat in the filament circuit has been selected so that the extra four volts will be dropped. There are two volume controls in the circuit, one in the grid bias circuit of the two 34 high frequency amplifiers and the other in the grid circuit of the first audio amplifier. A 22.5-volt battery is required in the bias circuit in order completely to control the volume. The second detector is of the grid bias type, which is used because diode bias is not practical in battery operated sets, mainly for lack of proper tubes.

* * *

Increase of Resistance with Frequency

CAN you give me any reason for the increase of the resistance of a coil or of a piece of wire? Is it because the wire gets hotter when the frequency of the current is high?—R.A.

The wire might get hotter because the resistance gets higher but the resistance does not increase much just because the temperature is higher. Why should the temperature go up just because the frequency increases? The main reason for the increase of resistance of a wire as the frequency goes up is that the current travels in a thin layer next the surface and that this layer is thinner the higher the frequency. We know that the resistance of a fine wire is higher than that of a heavy wire because there is less metal in which the current can travel. If there is plenty of metal in which the current could travel but if there is something else that prevents it from traveling in it, we have the same effect as if the wire were thin. It is the magnetic field in the wire that prevents the current from entering the deeper layers of the wire.

* * *

Advantages of Meissner Oscillator

IN VIEW of the fact that in the Meissner oscillator the tuning condenser is not connected to anything but the coil which it tunes, and ground if required, would not this oscillator have advantages over all others? Would it not be easy to stabilize the circuit in regard to frequency?—W. E. L.

It has both advantages and disadvantages. If the circuit is to be stabilized, condensers are required in the grid and the plate leads, and for that reason the oscillator is not suitable for a variable frequency circuit, that is, if it is to be stable at all settings of the tuning condenser. Or else the two stabilizing condensers must be variable as well as the tuning condenser. Complications arise if the circuit is connected so that there is coupling between the grid and the plate coils. And if there is not, the tuning coil must be broken up into two parts connected in series but shielded from each other. In other words, two transformers, shielded from each other, must be used. The primary of one goes to the plate, the secondary of the other to the grid. The other two windings are connected in series and also in series with the tuning condenser.

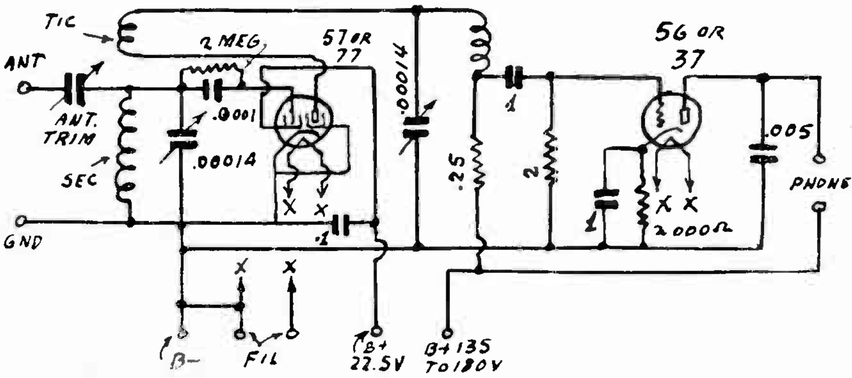
* * *

Chokes and By-pass Condensers in Tuners

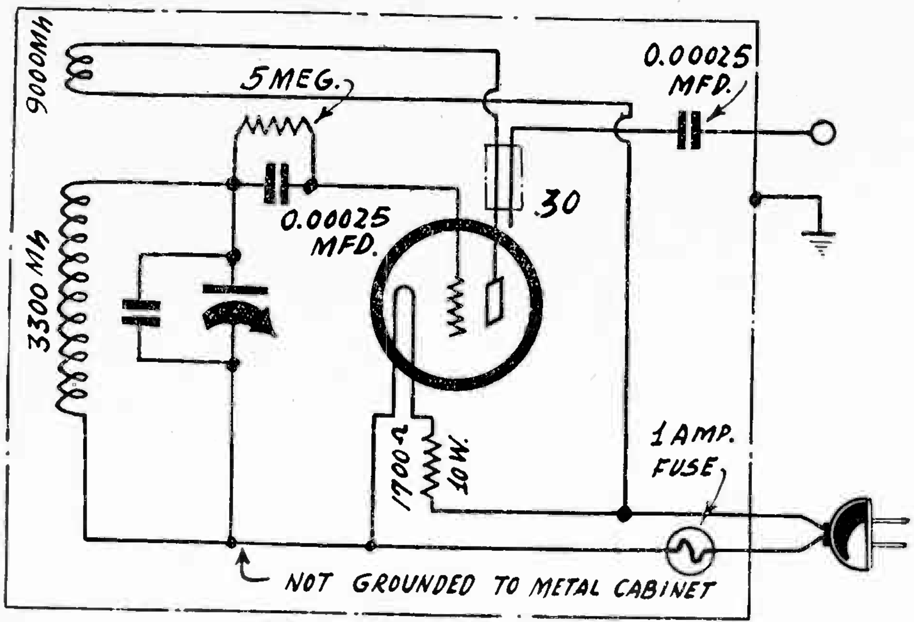
IF a radio frequency choke coil say of 10 millihenries is connected across a tuned circuit for the purpose of feeding the plate or to provide a grid leak for d-c only what is its effect on the resonance frequency of the circuit? Also, if a by-pass condenser of 0.1 mfd. is connected in series with a tuned circuit, what is the effect? These cases appear in nearly all radio receivers.—T. Y.

If you connect a coil of inductance L_o across another coil of inductance L, and if there is no mutual inductance between the two, the inductance of the combination is $LL_o/(L+L_o)$. The inductance of the combination is less than the inductance of the smaller coil. Hence the frequency of resonance is increased for a given value of capacity. It is necessary to increase the capacity to compensate for the reduction in the inductance. If L is 250 microhenries and L_o is 10 millihenries, the net inductance is 244 microhenries, or the reduction amounts to 2.5 per cent. A similar effect occurs when a by-pass condenser is put in series with a tuning condenser. If the resistance which the by-pass shunts is high, the effect capacity

(*Continued on next page*)



The circuit of a simple short-wave receiver utilizing only two tubes. It may be built with 2.5- or 6.3-volt tubes. Regeneration is employed and it is controlled by means of a 140 mmfd. variable condenser in the plate circuit.



The circuit of a simple test oscillator that will operate on either alternating or direct current. Loose coupling between the plate and the output lead should be used as indicated.

(Continued from preceding page)

of the two condensers in series is $CC_o/(C+C_o)$. If the tuning condenser is set at 250 mmfd. and the by-pass condenser is 0.1 mfd., the capacity of the series combination is less than C by 0.25 per cent., or by 0.625 mmfd. In most cases this change is negligible. A change as high as 2.5 per cent., however, would hardly be negligible.

* * *

Immersing Coil in Oil

IF a radio frequency coil is immersed in oil to eliminate the effects of moisture, will the self capacity of that coil be greater or less than when the coil is in air? What will happen to the losses in the coil? Will they increase or decrease? Would there be any advantage in doing it? That is, will the coil characteristics be more nearly constant when the coil is in the oil?—W. T. L.

The capacity of the coil will increase in direct proportion to the dielectric constant of the oil in which you immerse it. That is, if the dielectric constant is 2, which is about the value for paraffin, the self capacity would double. The losses in the coil would also go up a little, but they would be practically constant since variation in moisture would have no effect on the resistance.

* * *

Coil Winding Hints

WHEN coils are wound for radio frequency circuits, is it better to make long coils of many turns and small diameter or to make the coils in the form of loops? What are the advantages and disadvantages of each type of winding?—D. E. M.

The distributed capacity of coils that are long and narrow, with turns spaced, is much lower than that of coils that approach the loop form. Since the distributed capacity increases the losses in the coil and also limits the tuning range, the coils should be long and narrow. If the coil is to be used for picking up the signals directly, then they should be wound in the form of a loop, with the turns spaced as much as is practical.

* * *

Construction of Sensitive Meters

WOULD it be possible to construct a highly sensitive voltmeter or microammeter using permalloy field magnets instead of steel magnets, energizing them with a small battery? What are the objections to such a scheme, if any?—W. L. H.

There is at least one very serious objection to the scheme, and that is lack of constancy of the field. A certain deflection would mean one thing one day and something else the next. In other words, you would have something that looked like a meter but in reality would not be. Possibly if you had another meter that measured the field current, something could be done along this line. But they have very good magnetic steels now that have been developed especially for use in sensitive meters.

* * *

Cutting of Condenser Plates

IN MOST commercial condensers the outside rotor plates are cut radially at several places, leaving rather weak sectors. What is the purpose of these sectors?—P. L.

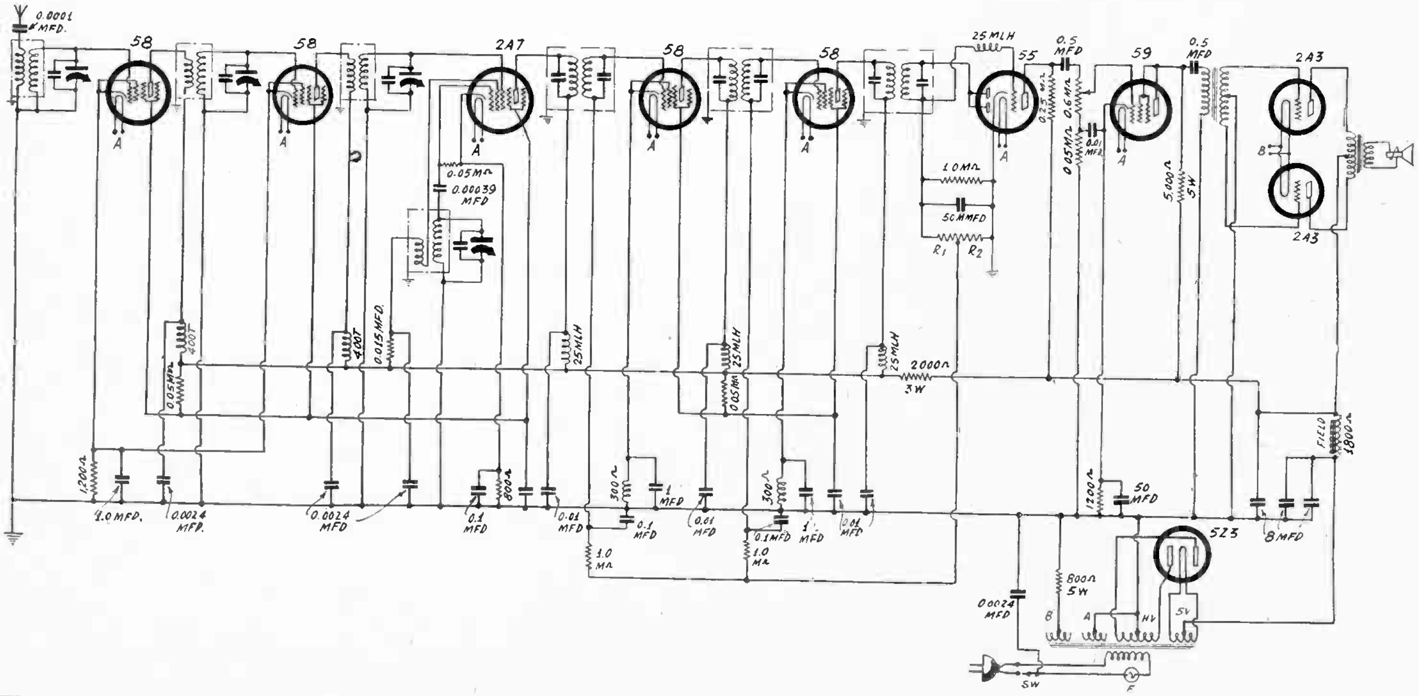
The object of the radial slits is to permit adjustment of the rate of change of the capacity to compensate for unavoidable differences. If one of these sectors is bent so that it is nearer the opposite rotor the capacity is increased, and if it is pushed away, the capacity is decreased. Since there are several of these sections the capacity can be increased or decreased in spots, so to speak, and the rate of change of capacity can be altered a little. This is just sufficient to make the rate of change of all the sections of a gang equal at all settings.

* * *

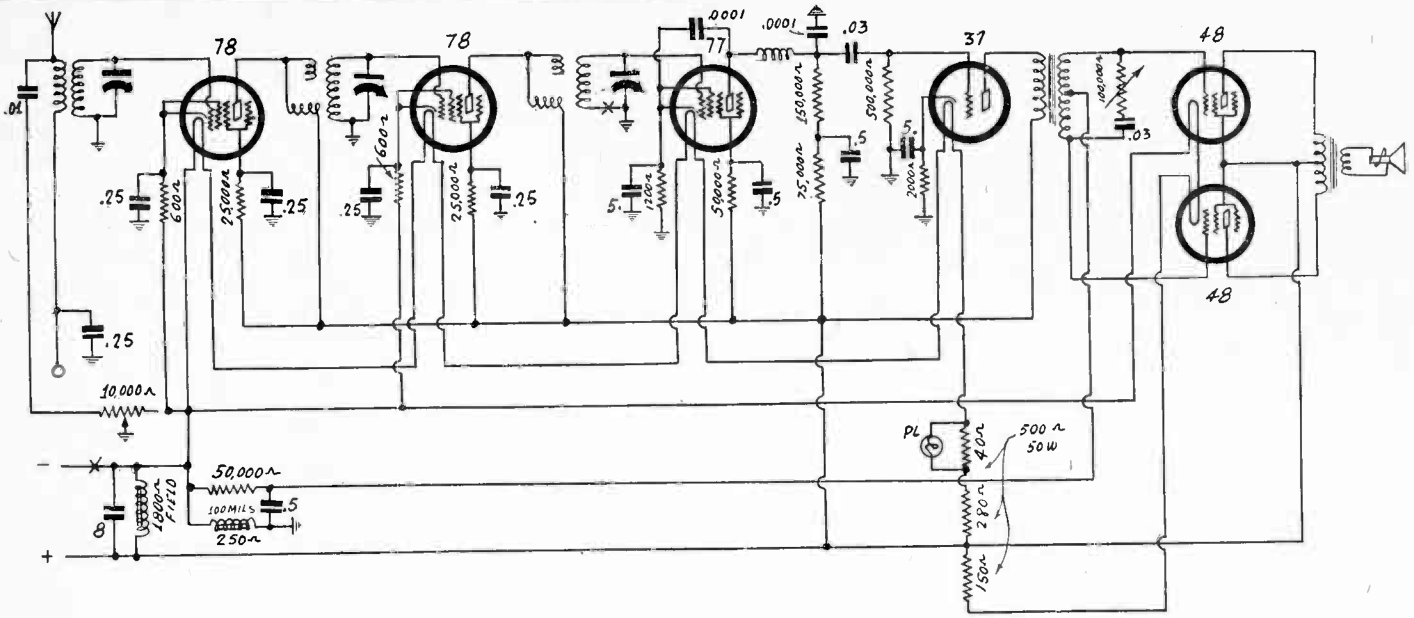
Partial A.V.C.

IF the automatic volume control is too effective, what can be done to prevent the bias from building up too much? I have a high-power superheterodyne with both manual and automatic volume control, and I want to arrange it so that I can control better with the manual control. Please show a circuit. Also give a simple test oscillator.—W.H. L.

Below you will find the circuit of a super such as you probably have. The range of the automatic volume control is reduced by returning the grids of the controlled tubes to a tap on the load resistance. By varying the relative values of R1 and R2 you can secure any degree of automatic volume control you desire. If you reduce the range very much you may have to make a change in the manual control by removing the 50,000-ohm resistance below the potentiometer. The test oscillator circuit is above. The 0.00025 mfd. output condenser is not vital, as two pieces of insulated wire inside of spaghetti provide adequate capacity coupling of the wires are about 3 inches long at least.



The effectiveness of an automatic volume control can be reduced by returning the grids of the controlled tubes to a tap on the diode load resistance and also by reducing the number of tubes on the automatic control.



This six-tube tuned radio frequency receiver has high gain, good selectivity, and high output power. It is socket powered for d-c lines. A tone control is built into grid circuit of the output stage to accommodate different tastes.

Use of 12A7

COULD the 12A7 tube be used as a universal oscillator, the pentode being in the oscillating circuit and the rectifier in the power supply? If so, could any of the standard oscillating circuits be used?—P. W. A.

Sure, the tube can be used in this manner. It could be used either on d-c or a-c, but not very well on batteries because the filament current is too high. While it is only 0.3 ampere, there is considerable in view of the fact that the terminal voltage would have to be 12.6 volts. Yes, any type of oscillator circuit could be used for the pentode and rectifier cathodes are independent. Using the Hartley, for example, the pentode cathode could be connected to the tap on the oscillating coil. If the tube is connected to a 115-volt line, either a-c or d-c, there should be a ballast resistance of 341 ohms in series with the heater. The dissipation in it will be about 30 watts so that a 50-watt resistor should be used.

* * *

Change of Inductance with Form Changes

IF THE inductance of a coil is computed on the supposition that form is strictly circular while in fact it is a little distorted, what is the effect on the inductance? The form may, for example, be a little elliptical instead of circular.—W. T. N.

Slight distortion of the form from the circular has little effect on the inductance, for the field that gives rise to the inductance is concentrated near the wire carrying the current. The distortion of the coil form may be considerable before the change in the inductance becomes appreciable. Hence when the coil form is just slightly elliptical there is no need for making any allowance for it. It is assumed, however, that the length of the wire in the coil is not changed appreciably.

* * *

Resistance of Choke

WHEN a choke coil is used in the plate circuit of a vacuum tube for feeding the plate, does it matter if there is considerable resistance in the coil or in series with it? Does the resistance affect the inductance of the choke?—H. L. R.

The inductance is not affected by the resistance and therefore it makes little difference as far as the choking effect is concerned. However, if the resistance is very high, the effective voltage on the plate will drop. Therefore, if the only purpose of the choke is to supply a d-c path for the plate current it is preferable that it does not have any more resistance than necessary. Just because the choke is wound with fine wire there is no reason for worry. The coil might have a d-c resistance of a few hundred ohms, and this will be in series with several thousand ohms in the plate, or possibly half a million ohms. Any practical coil would have a resistance that is entirely negligible. But if there is an external resistor in series with the coil, the conclusions might be different.

* * *

Varying Resistance Minutely

PLEASE suggest a method for varying the resistance of a resistor of 25,000 ohms in very fine gradations over a small range.—W. T. J.

Connect a small resistance in series with the resistor to be be varied and then connect a very large variable resistor in shunt with this. The smaller the fixed resistor in series is and the larger the variable across it, the finer the control of the resistance. Suppose, for example, that the resistance to be varied is 25,000 ohms. If a resistor of 1,000 ohms is connected in series with it and then a variable of one megohm is connected across the 1,000 ohms, a variation of 10 per cent. in the variable changes the resistance of the whole by about 0.25 per cent. In the same way a small change can be effected in a capacity.

* * *

D-C Operated T-R-F Receiver

I SHOULD like to build a tuned radio frequency receiver of about six or seven tubes with high undistorted output power. I presume it is necessary to use a pair of 48s in the output stage. Will you kindly show a suitable circuit with values?—J.W.G.

At the top of this page you will find a circuit of the type you are looking for. It is capable of giving several watts of undistorted sound power.

Station Sparks

By Alice Remsen

A THOUGHT FOR THE WEEK

EDWARD B. MARKS wrote "They All Sang," a book just published (Viking. $3.50). *Mr. Marks has been a successful song writer and publisher for forty years. He goes back to the merry time when he wrote "Mother Was a Lady" and other songs whose popularity have endured right up to the present time and which are heard over the air. Strangely enough, if you don't know about such things, many of them still have big sales value. Mr. Marks knew almost all the song boys who flourished in the days when a half million or a million sale of popular numbers was rather common. This was before the days of radio, which makes a song hit almost over night and then, through tiresome repetition, kills it before the printing runs up into the* 100,000 *class. Mr. Marks knows his song business so well and has so few illusions about it that he has been able to pack a lot of interest and facts into "They All Sang."*

Incidentally, Mr. Marks has been so busy for two or three decades in making hits for other song writers that he has not busied himself with turning out best sellers. He's one of those song publishers who believes a workman is worthy of his hire and the checks his firm has handed to the royalty boys would make Big Business sit up and take notice.

A Novel Program From the Coast

This month has brought a few new programs, and changes on old ones. For instance: the Pontias Surprise Parties started on February 10th from the Coast; a brilliant revue with Raymond Paige, leading musical figure of the Pacific Coast, and his 30-piece orchestra; Kay Thompson, singing pianist, with her Rhythm Kings male trio; an Hawaiian instrumental and vocal group, and the Black Rhapsody Chair, a negro choral group of ninety voices. A feature of each program is a surprise novelty. It may be a dramatic film preview, a guest artist from the movie colony, or other features that may be drawn from Hollywood, "The city of surprises." The programs emanate from the studios of KHJ, Los Angeles, and will be heard each Saturday at 9:30 p.m. . . .

Another new series started on February 9th, sponsored by the Hudnut Sales Corporation, is the Marvelous Melodies Revue, featuring Jack Whiting, musical comedy favorite, who embarked on his first long-term radio contract with this program; Jeannie Lang, with her squeak and giggle; the Three Rascals and Jack Denny's orchestra. Every Friday at 9:30 p.m. EST. WABC and Columbia network. . .

Alexander Woollcott As He Is

As "The Town Crier" of the WABC-Columbia network, Alexander Woollcott speaks his mind to a nationwide audience twice a week. For twenty years his chief business and pleasure has been to tell the world quite candidly what he thinks of people, plays, books, places, events, in fact, almost anything he finds interesting to himself, he passes along to his audience. Recently, if you were listening to him, you heard him tell his radio audience that it was his birthday, and that forty-seven years previously, over in Phalanx, New Jersey, the village doctor reported to the neighbors: "Another boy over at the Woollcotts' darn it!" Of course, I'm very glad that it was another boy over at the Woollcotts, for Alexander's colorful and complex personality has given me many a pleasant moment. Some who know him only through his writings, in which there is often a strong element of caustic wit, think of him as lying in wait to pounce on human weakness and hold it up to ridicule; but his friends, even casual acquaintances, tell a different story, for he really is the soul of kindliness and is always doing things for people. Among Woollcott's intimates are most of the literary and artistic lights of two continents. . . .

His Sunday morning breakfasts are famous. He gives them, whenever he is in town, at Wits End, a sun-filled apartment overlooking the East River. There, almost any Sunday, one may run into Beatrice Lillie, Neysa McMein, Noel Coward, Hope Williams, Alice Duer and Henry Wise Miller, Anne Parrish, Thornton Wilder, Dorothy Parker, or others of that vast fraternity who cherish Alex Woollcott for his gay and abundant wit and his spirit of deep and loyal friendship. The radio talks of Alexander Woollcott are a joy to the intelligent listener; his audience never know what is in store for them; he is no cut-and-dried news commentator, but a man filled with the warm joy of living and he has the power of conveying his own inner fire to others; so if you want to be sure of real entertainment, tune in on "The Town Crier," 9:15 p.m. EST, Wednesday and Saturday, WABC and the Columbia network. . . .

Chasins Will Tell Them

Beginning Saturday, February 24th, Abraham Chasins, young American composer-pianist, will come to the microphone in a series of informal recitals to be known as "Piano Pointers." A distinct departure in musical broadcasts, the recitals will combine the features of a concert performance with those of a master music class. During the seven year that he has been a member of the faculty of the Curtis Institute of Music in Philadelphia, Chasins has received many hundreds of letters from talented piano students in small towns asking if there is any way in which they might enjoy the privilege of studying under fine teachers. His broadcasts will be designed, in some measure, to answer such requests. Students all over the country will have the benefit of the knowledge and experience of an accredited master. His recitals also will be of equal interest to the uninitiated layman. Every Saturday from 12:30 to 12:45 p.m. EST, over a Coast-to-Coast Columbia network. . . . The new Camel Caravan is on its way with Connie Boswell and Stoopnagle and Budd co-featured with Glen Gray's Casa Loma Orchestra. The Colonel's friend, Mr. Bopp, and wife Quaintface, will pop into the program every once in a while, which should make it very pleasant for the listening public. . . .

Early in March, the scope and success of music activities in the public schools will be demonstrated in a series of concerts to be broadcast from six leading cities over a National Broadcasting Company network, in which school choruses, bands and orchestras will participate. . . . Ray Heatherton, good-looking and youthful NBC baritone, made his stage debut at the Roxy Theatre, New York, recently. Ray proved to have a definitely pleasant stage personality that won the hearty approval of the audience. He has long been known as the Ipana Troubador, besides broadcasting on his own programs over WEAF and network. . . . Percy Hemus is doing a lot of good work on various programs over NBC. Percy is an old-timer and an artist in whatever role he happens to be playing. . . . Vee Lawnhurst, sick for a while, is back again with her lively piano partner, Muriel Pollock. These two girls are "wizzes" at the ivory keyboard. . . .

The Philharmonic Needs Funds

The Philharmonic Society of New York is in desperate need of funds to carry on its good work for the next three years. It faces a half million dollar deficit and is appealing to the public for help to save the sterling orchestra from extinction. The campaign headquarters are at the Waldorf-Astoria, Park Avenue, New York City. The smallest of contributions are welcome and I am sure that genuine music-lovers will do all in their power to help this extremely worthy cause. . . . WGN, Chicago, will present all of the home baseball games of the Cubs and White Sox during the 1934 season. . . . WMCA, New York, announces the acquisition of an investment expert to advise and counsel the radio audience on investment problems. The expert is Erling G. Olsen, who has fifteen years experience behind him. He may be heard three times weekly, Mondays, Wednesdays and Fridays at 6:45 p.m. EST. . . . Peggy Rich, who has been publicised as the personification of flaming youth, has taken her blonde head and her society orchestra to WMCA; Wednesdays and Fridays at 8:30 p.m. EST. She will feature a new singer, Eddie Maxwell, on her program, and will conduct her own band. . . . Elmer Feldkamp is still singing with Freddy Martin's band. . . . And Harold Van Emburgh is doing good work with his singing over WABC. . . . Elton Britt, the yodeler with the Pappy, Zeke and Ezra Hillbilly program, brought his bride on to New York from Marshall, Arkansas.

Walton Butterfield, formerly a motion picture director for Paramount, is now the dramatic director and continuity head for Station WNEW, Newark, N. J. . . .

NOW WITH WSM

Salt and Peanuts, formerly of vaudeville and various broadcasting stations throughout the country, have joined the staff of Station WSM, Nashville, Tennessee. Hello, kids! You might send a line along once in a while, to let me know how you're getting on! . . . Peter Van Steeden, maestro on the Jack Pearl program, made a nifty wisecrack recently. It was very cold. Peter walked into an NBC studio for rehearsal. "Well, boys," remarked the slim, good-looking conductor, "I used to have an ear for music, but I'm afraid it's just been frozen off." . . . Sixteen more stations have been added to the network carrying the Ted Weems' Real Silk broadcast, raising the number of stations to forty. This begins a new series. Prominent musicians, singers and actors will be used as guest artists on each program. . . .

The Mills Brothers have been signed for a third picture to be filmed while they are on the Coast. . . . Glen Gray and his Casa Loma Orchestra are now airing their cigarette commercial from the Colonnades, the room which they pack nightly at the Essex House, instead of a CBS studio. No dancing will be allowed during the half-hour broadcasts, service will be suspended, and the diners will be asked to maintain a strict silence; however, they will be allowed to smoke (Camels, of course). . . Ruth Etting will be heard again soon on an automobile program. . . . Mildred Windell, popular musical comedy soprano, steps into the spot on WMCA

Metropolitan Opera tenor. Robert Hood Bowers will conduct the orchestra as usual. . . . Jan Garber's biggest program of the week, wherein he presents the newest songs from Talkie Land and New York's Tin Pan Alley, is heard over Station KYW, Chicago, each Sunday at 2:30 p.m., C.S.T. . . . Wyn Orr is doing fine work on his Fan Fare program over WLS, Chicago, each Tuesday at 2:15 p.m. C.S.T. Wyn broadcasts appeals for radio tubes, playing cards, books, puzzles, etc., for the invalid war veterans in an Oak Forest, Illinois, hospital. . . . Sylvia Blue, blues singer on WHOM, New York, 2:00 p.m. Sundays, has received a beautiful Russian wolfhound from one of her admiring fans. . . .

ALL THE WAY FROM CINCY

Margaret Maloney, editor of the Radio Dial of Cincinnati, was in New York for a few days recently. She had a jolly good time, combining business and pleasure. Dashing around town with Helen Nugent, who was a school mate of Margaret's—and dining and lunching with radio friends, including me; sorry we were both so busy we could not spend a little more time together. Anyhow, it was good to see a friendly face from dear old Cincy.

Radio Repair Taught in Sing Sing Class

An unusual phase of rehabilitation work in progress under the regime of Warden Lewis E. Lawes at Sing Sing Prison, Ossining, N. Y., was revealed through a letter received by National Union Radio Corporation of New York.

The letter, bearing the signature of Harry Masson, head teacher under Warden Lawes, disclosed that a course in radio construction and repair is included in the vocational training program of the Sing Sing Prison school. The letter stated in part:

"The work of this class is progressing very satisfactorily, but its scope is rather limited by the lack of sufficient working material. We are wondering if you might have on hand a few shields that could be used to shield a 58. If you should have some and would send them to this institution school, they would be very gratefully received."

The National Union Sales Department expressed a ready willingness to cooperate and forwarded a quantity of its form-fitting tube shields to aid the worthy cause.

DX Program in April from YV1BC, Venezuela

YV1BC, Caracas, Venezuela, announces that on April 14th, from 9:30 to 10:30 p.m., Caracas time, it will broadcast a special program in celebration of the Pan-American Day.

This program will include numbers by a choral organization of 80 voices and selections by a symphonic orchestra.

The program will be broadcast in the regular waves of 960 kc., 312.3 meters, and on 6,112 kc., 49.8 meters, and also will be retransmitted by YVQ, Maracay, on 6,672 kc., 44.96 meters.

6,000,000 Children Hear Music Hour Weekly

The radio sets in most of the schools in the United States equipped with them are used each Friday morning to bring the NBC Music Appreciation Hour concerts to the classrooms, according to records kept by the National Broadcasting Company.

Now in its sixth consecutive season, the course in the understanding of good music supplied by Dr. Walter Damrosch and a large symphony orchestra is heard by 6,000,000 children in the public schools throughout the country.

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.

Geo. W. Kelly, Amateur Radio Station W5BG, 300 West Harris St., Dublin, Texas.
Alex Kish, Prop., Radio-Electric Service, Gary, W. Va.
Anthony S. Yeouze, 32 Mulberry St., Buffalo, N. Y.
H. S. Robertson, Jr., Radio & Television Sales & Service, 13336 Woodrow Wilson, Cor. Davison, Detroit. Mich.
Arthur Enk (public address systems for study and educational purposes), 3448 N. Linder Ave., Chicago, Ill.
George Warner, Crescent City Radio Service, 2121 Marais St., New Orleans, La.
Jos. Belick, 65 Front St., Box 133, Coplay, Penna.
Edw. Behne. R.F.D. No. 1. Brainard. Nebr.
Frank Ziemkievice, Natrona Confectionery & Novelty Store, 53 Center St., Natrona. Penna.
Andreas Kramer, 220 Aileen Avenue. Toronto, Ont., Canada.
Hansel Williams. 1321 N. Cleveland Ave., Winston-Salem, N. C.
Michael Crake, 371 Lawrence St., Perth Amboy, N. J.
H. E. Lautsburgh, 618 Cleveland Ave., S.W., Canton. Ohio.
H. A. Sparks, 66 Jefferson Ave., Columbus. Ohio.
George J. Frost, 764 E. Jessamine St., St. Paul. Minn.
C. W. Langford. 129 Pine St., Pitman, N. J.
I. G. Campbell, 196 Van Houten Ave., Passaic, N. J.
H. A. Werner, 648 Adams Ave., Scranton. Penna.
L. F. Bennett, West Willington. Conn.
E. C. Rumble. P. O. Box 201. West Brownsville, Penna.
Charles E. Scull. 623 Main St., Honesdale. Penna.
Albert E. Hartwell, 213 West High Sreet. Aberdeen, Miss.
D. T. Jenkins, 35 Palm Ave., Los Gatos, Calif.
Edward W. Hughes, 614 East Buffalo St., Ithaca, N. Y.
Charles H. Jordan, 291 Bay St., Springfield, Mass.
J. E. Freeman. R. No. 2, Anderson, Ala.
L. Bernstein, 1607 N. Luna Ave., Chicago, Ill.
Edgar J. Witt. 1327 E. Rives St., Elyria, Ohio.
J. O. Price. 108 Broughton St., W., Savannah, Ga.

New Method for Measurement of Small Capacities

(Continued from page 11)

Sometimes the distributed capacities are inordinately large, and an investigation has to be made of the cause. The trouble shows up of course when an expected and necessary frequency ratio is not even nearly achieved.

The method just outlined, although recommended specifically for evaluating the distributed capacity of a coil, can be carried to greater service. Once the coil distributed capacity is known, the LC system may be applied to a tube circuit, and the tube elemental capacity determined as a difference, provided the wiring externally is so short and so carefully done that the capacity resulting from this may be ignored, or the wiring capacity itself similarly measured. The tube circuit with wiring capacities, etc., may be taken as a whole, and the quantty evaluated.

The total distributed capacity would be the sum of the coil, tube, socket and wiring, the tuning condenser capacity treated as a lump capacity. Now the new frequency ratio is determined in the total distributed capacity case, say, as 1.5, capacity ratio $1.5^2 = 2.25$. 2.25.

$$\frac{80 + X}{20 + x} = 2.25$$

$$80 + x = 45 + 2.25x$$

$$80 = 45 + 1.25x$$

$$1.25x = 35$$

$$x = 28 \text{ mmfd.}$$

The coil contributed 2.9885 mmfd., so the external circuit has a capacity of 25.0115 mmfd. By leaving wiring in place, but not terminated to socket, the wiring capacity may be ascertained, also tube capacities by similar differentials.

—Herman Bernard.

First Sub. Copy

PROPOSALS IN NEW CODE ROIL LABOR UNIONS

Washington.

Virtually a new code for the electrical manufacturing industry, under which radio manufacturers operate, was submitted to the NRA. Important changes in labor and almost all other provisions of the present electrical code were proposed.

Deputy Administrator H. O. King of the NRA conducted the hearing. Two more months may elapse before the new code is finally approved by the NRA and President Roosevelt. In the meantime, the existing code will continue.

The new amendments, submitted to NRA by the Board of Governors of NEMA but without previous submission to or consideration of the electrical or other industries, propose a national uniform minimum wage of 40c per hour for males and 32½c per hour for females (with a Southern differential), and would eliminate the July 15th, 1929, subminimum rate of 32c in the present code. In North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi and Louisiana, the newly-proposed rates are 32c per hour for males and 27c for females.

Open Price Under Attack

A 36-hour week is provided in the new code amendments but not until the metal working and capital goods industries effect a similar maximum week for similar employees. Until the metal working and capital goods codes become uniform, a 40-hour week would prevail under the proposed electrical code.

On overtime of employees, the amendments propose a 48-hour week limited to twelve weeks annually until the metal working and capital goods codes are uniform, and a 44-hour week for any 12 weeks annually thereafter, plus a controverted provision for special overtime arrangements in supplemental codes. The present unlimited "seasonal peak" overtime clause, of the existing code, would be abolished.

The "open price" plan of publishing prices and discounts has an amendment proposed to establish resale price maintenance by contracts with jobbers and dealers, but this and, in fact, the entire "open price" plan, is under sharp attack and is expected to be materially revised if not entirely eliminated.

Labor Voices Opposition

Labor representatives scored the proposed labor changes. They were declared to make drastic reductions in wages through the electrical and radio industries. On file with NRA also is a recommendation of the U. S. Labor Advisory Board for a 45c minimum hourly wage.

Representatives of the American Federation of Labor, electrical and also radio workers unions, joined at the hearing in severe criticism of the labor and also other code provisions. The proposed amendments, it developed, were drafted in consultation between the NRA officials and the NEMA Board of Governors.

A minimum weekly wage of $20. and a 30-hour week of five days, or 66⅔c per hour, was urged by the A. F. of L. Double time for overtime in excess of the 30-hour week also was demanded. Representatives of radio workers unions supported the recommendation of a minimum wage of 66⅔c per hour.

Tradiograms

By J. MURRAY BARRON

Servicemen and others handling and installing special amplifier systems, inter-office communicating outfits or other special radio equipment will be interested in the RCA-Victor Paging-Announcing system as distributed by Commercial Radio-Sound Corp., 570 Lexington Ave., N. Y. City. There is literature on the subject.

* * *

Another meeting was held this week of the Short-Wave Club of New York at the Sixty-third Street branch of the Y. M. C. A. where about fifty or more of the fans turned out, notwithstanding below-zero weather. Capt. Horace Hall showed moon graphs from various sections of the world, covering India, England, China, New Zealand and New York, giving the effect of the moon on short-wave reception. It appeared that the full moon was most favorable in all sections of the globe.

* * *

The past week showed some good buys in "as is" merchandise at some of the bargain establishments. Repairmen adjusted the apparatus at small cost, giving the buyer a real bargain. If one knows his merchandise many good buys are to be had in this way. That's the great point of lower radio row in New York City. The district sometimes offers exceptional buys.

* * *

As news of extraordinary worth to the custom-built radio practitioner, a new nine-tube tuner is now being offered as a made-to-order job. It defeats all efforts of the undesired wave to get by. For those who might be interested in real selectivity further particulars may be had by addressing Trade Editor, RADIO WORLD, 145 West Forty-fifth Street, New York City.

* * *

Among the new business placed through the World Broadcasting Systems by Ruthrauff & Ryan Agency is the Gillette Safety Razor Co. account, which adds thirty-two stations to its own present list of sixty-eight for electrically transcribed and dramatized one-minute announcements, and has doubled the number of announcements on all stations. Also through World System, Blackett Sample & Hummert, Inc., New York, have placed for their clients, Sterling Products, Inc., and Bayer Aspirin, thirteen weekly half-hour electrical transcription programs.

* * *

Short-wave followers will be glad to learn of a new release in supers. From the laboratories of Trv-Mo Radio, 85 Cortlandt Street, N. Y. City, comes a new 6-tube short-wave or all-wave plug-in coil Kit. The new type Bruno coils are used.

* * *

The users of the 2-volt tubes, and the number has increased considerably, have not always found the A source just to their requirements, especially with a receiver using five or six tubes. This problem is now taken care of in the new 400-hour dry A battery put out by the Burgess Co. and sold through the dealer. Thor Radio Company, at 167 Greenwich Street, New York City, has been featuring these successfully.

* * *

The New York Chapter of the International Short-Wave Club heard J. Kenneth Whitteker, chief instructor of the R. C. A., Institute, of 75 Varick Street, New York City. His subject was short-wave receivers and transmitters. Non-members as well as members were present. The meeting was held at Stuyvesant High School, Fifteenth Street and First Avenue.

* * *

Frank Van Der Meyer and Wm. W. Windrath have opened new headquarters at 72 Cortlandt Street under the name of Cleartone Radio Speaker Service. Already many of the larger radio organizations in New York City have their repair and replacement speaker work done here. To the trade an organization of this type is welcomed for cone and voice coil repair and replacements.

* * *

Frank Van Der Meyer, reproducer specialist, has opened a new establishment at 72 Cortlandt Street, New York City, and has with him as associate William W. Windrath. The new firm will be known as Cleartone Radio Speaker Service and will cater to the trade and serviceman and special work.

* * *

N. M. Haynes has just gotten together for the Radio-Amp. Publishing Co., 121 West Seventeenth Street, New York City, a complete amplifier and sound system treatise. It should be of great value to the man installing such systems or who has any idea of getting after this end of the business, as it deals with practically every angle of the business. Further information may be had at the New York address.

$504,038 Increase in NBC Business Reported

NBC gross time sales for January, 1934, amounted to $2,373,923, an increase of $504,038 over January, 1933. This is a 27% increase. Furthermore, says NBC, January, 1934, is about $50,000 better than December, 1933, which is the biggest December-January rise since 1929.

NBC (with 87 of the 190 major network stations under its banner) obtained 63% of all network revenue for the month, says the announcement.

Warner Promoted to Be Radiotron General Manager

J. C. Warner is now vice-president and general manager of RCA Radiotron Co., Inc., and E. T. Cunningham, Inc. Mr. Warner has held the post of vice-president in charge of engineering since December, 1932.

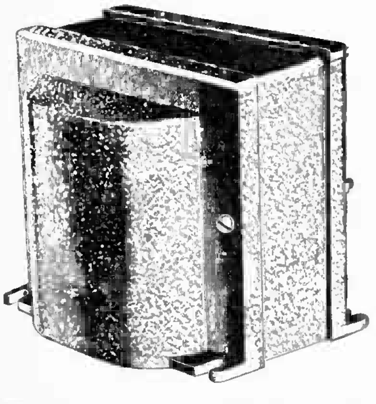
Mr. Warner announced the appointment of E. W. Ritter as manager of the research and development laboratory and of D. F. Schmit as division engineer in charge of the engineering division of the laboratory.

FINANCIAL REPORTS

Sonotone Corporation—Net income for 1933, after provision for depreciation, doubtful accounts, Federal taxes, interest and other charges, $90.963, which, after preferred dividends, equals 14 cents a share on 600,000 $1.00 par common shares, as compared with net income of $1,740 for 1932.

Noblitt-Sparks Industries, Inc.—Net profit, 1933, after taxes and other charges, $240,729, which equals $1.69 a share on 150,000 shares. For 1932 there was a net loss of $85.575.

Power Transformer for a BIG SET



INSTEAD of using undersized, overheating, inefficient power transformers for a big set, why not use a cool-running, efficient transformer and pay the little extra? The Reliable transformer, Model 104-SP, will work an 18-tube set. Provides also the voltage for a 25Z5 rectifier.

Primary = 115 v., 60 cycles
Secondary X = 14 amp., 2½ v., ct.
Secondary Y = 6 amp., 2½ v., ct.
Secondary R = 5 v., ct.
Secondary HV = 400-0-400 v., 200 ma.
Secondary Z = 25 v., 0.6 ma.
Lug terminals at bottom
Price, $3.95
Shipping weight, 13 lbs.
Immediate Delivery

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

115 DIAGRAMS FREE

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

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

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

Subscribe for Radio World for 8 months at the regular subscription rate of $1.50, and have these diagrams delivered to you **FREE!**

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

SOLDERING IRON FREE!

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

RADIO WORLD
145 West 45th St. N. Y. City

Selected Quality Tubes FREE With Subscriptions for Radio World

Here is your opportunity to subscribe for RADIO WORLD and get just the tube or tubes you want, made by a very large, reliable, licensed tube manufacturer; picked tubes you'll appreciate. On this offer you have five days after receipt to put the tube to any logical test, and if not entirely satisfied with its performance, return it for replacement.

For an 8-week subscription (8 issues, one each week), at the regular price, $1.00, you may select any one of the following tubes as free premium, or more at the same rate ($2, 16-weeks subscription for two tubes, etc.), from this particular list: 01A, 01AA, IV, 12Z3, 112A, 24A, 26, 27, 30, 31, 35, 36, 37, 38, 39, 45, 47, 51, 56, 71A, 80, 82, 199X.

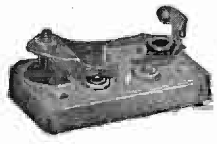
With a 13-week subscription (13 issues), at the regular price, $1.50, any one of the following tubes, or more at the same rate, from this particular list (two for a 26-week $3.00 subscription, three for 39-week $4.50 subscription, four for 52-weekly, yearly $6.00 subscription, etc.), 1A6, 5Z3, 2A5, 2A6, 2A7, 2B7, 6A4, 6A7, 6B7, 6F7, 25Z5, 22, 32, 33, 34, 41, 42, 44, 46, 49, 53, 55, 57, 58, 59, 67, 75, 77, 78, 83, 83V, 84, (6Z4), 85, 89, 199V, 483, 485.

For a $4.00 subscription, 34 weeks (34 issues), one No. 10 tube or one No. 50 tube may be obtained.

You may select any assortment of tubes desired and send in a subscription amount for the total required under the above classifications.

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

PADDING CONDENSERS



Either capacity, 50c

A HIGH-CLASS padding condenser is required for a superheterodyne's oscillator, one that will hold its capacity setting and will not introduce losses in the circuit, for losses create frequency instability. The Hammarlund padding condensers are of single-condenser construction on Isolantite base, with set-screw easily accessible, and non-stripping thread. For 175 kc. intermediate frequency use the 850-1350 mmfd. model. For i.-f. from 460 to 365 kc., use the 350-450 mmfd.

0.0005 HAMMARLUND S. F. L. at 59c.

A sturdy, precision straight frequency line condenser, no end stops. The removable shaft protrudes front and rear and permits ganging with coupling device, also use of clockwise or anti-clockwise dials, or two either side of drum dial. Front panel and chassis-top mounting facilities. True straight line. This rugged condenser has Hammarlund's high quality workmanship and is suitable for precision work. It is a most excellent condenser for calibrated radio frequency test oscillators, any frequency region, 100 to 60,000 kc., short-wave converters and adapters and TRF or Superheterodyne broadcast receivers. Lowest loss construction, rigidity; Hammarlund's perfection throughout.

Order Cat. HOS @ ....59c net

Reliable Radio Co., 143 West 45th Street, New York, N. Y.

BOTH FOR ONE FULL YEAR RADIO WORLD and "RADIO NEWS"

$7.00

Canadian and Foreign, $1.50 extra.

You can obtain the two leading radio technical magazines that cater to experimenters, service men and students, the first national radio weekly and the leading monthly for one year each, at a saving of $1.50. The regular mail subscription rate for Radio World for one year, a new and fascinating copy each week for 52 weeks, is $6.00. Send in $1.00 extra, get "Radio News" also for a year—a new issue each month for twelve months. Total 64 issues for $7.00.

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

"MODERN ELECTRIC AND GAS REFRIGERATION," by A. D. Althouse and C. H. Turnquist. A timely book of practical and usable information on installation, service, repair of all types of automatic refrigerators. 275 pages, 175 illustrations, diagrams in six and eight colors. Price $4.00. RADIO WORLD, 145 W. 45th St., New York City

FREE with a $1.00 8-weeks Subscription

NEW STAR MIDGET CONDENSERS

Choice of 15, 25, 50 and 100 mmfd. capacities. Single hole panel mount.

Here is your opportunity to get the latest product of Hammarlund, a Star Midget condenser. Send $1 for 8 weeks subscription and get any one condenser free. Select the desired capacity.

Any two condensers free with $2 for 17-week subscription.

Any three condensers free with $3 for 26-weeks subscription.

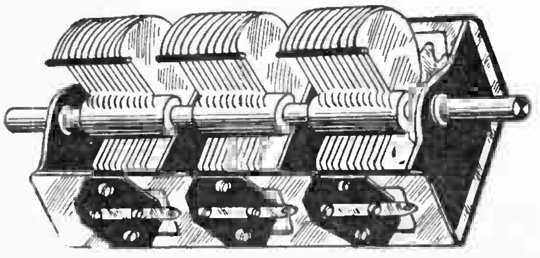
Any six condensers free with $6 for one-year subscription (52 weeks).

RADIO WORLD
145 West 45th St., New York City

An Extraordinary Bargain!

Three-Gang Condenser FREE with 13-week Subscription @ only $1.50

THE highest grade commercial gang condenser made, die-cast frame, brass plates, ⅜" diameter shaft extending at both ends. Condenser can be used therefore with either direction of dial rotation. Rigidity is of highest degree. Rotors can be shifted on shaft and locked tight for peaking at high-frequency end of band, thus dispensing with trimmers. Capacity, 0.0004 mfd. Full band coverage 1,500 to 540 kc (and more) with coils intended for 0.00035 to 0.00041 mfd. Premium sent express collect (shipping weight 5 lbs.) on receipt of $1.50 for 13 weeks subscription for Radio WORLD (13 issues).



The condenser measures 4 x 6½ inches, overall frame size; shafts extend 1 inch beyond frame.

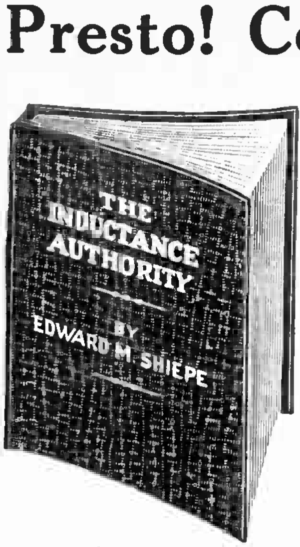
RADIO WORLD, 145 West 45th Street, New York, N. Y.

Subscribers! Important!

Note subscription expiration date on wrapper containing your copy of RADIO WORLD. If nearing expiration date, please send in renewal so that you will not miss any copies. Subscription Dept., RADIO WORLD, 145 W. 45th St., New York City.

RADIO WORLD AND RADIO NEWS. Both for one year, $7.00. Foreign, $8.50. Radio World, 145 W. 45th St., N. Y. City.

Presto! Coil Problems—*Solved!*



The book that tells you just what to do to wind accurate coils—and tells you at a glance. Page size, 9x12" Flexible cover. Price, $2.00 postpaid, with supplement inductance — capacity — frequency chart (18x20").

WITH present receiver trend toward all-wave models, with a furor of interest in short waves, with the coil problem always a stumbling block to the experimenter, the big need is for a semi-automatic means of solving the riddle: How many turns?

"The Inductance Authority," by Edward M. Shiepe, B.S., M.E.E. (Massachusetts Institute of Technology and Polytechnic Institute of Brooklyn), puts an end to all problems for all solenoids for all radio frequencies, from the fringe of audio frequencies to ultra frequencies.

The maximum capacity of the tuning condenser is known, the lowest frequency desired is known, so consult the big chart (18x20 inches) furnished as supplement to the book and read the inductance required.

How many turns of all popular sized wires, all insulation types, all popular tubing diameters are then read directly from number-of-turns charts.

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, 1¾, 2, 2¼, 2½, 2¾ and 3 inches. The two other charts relate inductance, capacity and frequency. One of these is the supplement.

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

REPLACEMENT PARTS FOR STANDARD SPEAKERS

Outside diameter of cones is given, also d-c resistance of field coils. If tapped field is desired, state ohmage of tap.

CONES

Airline	10"	$2.70
Atwater Kent 43, 46, 55, 60, 65, 66, 67, 64	10¾"	2.21
Atwater Kent 80, 82, 84, 55B, 627, 87, 90, 92, Early models 83, 85	8¾"	1.80
Baldwin Head Supplied	9"	2.61
Bosch 5 and 5A	6"	2.11
Bosch 48-58	9⅝"	2.11
Bosch	7"	1.70
Brunswick 10	8"	1.80
Brunswick D	8"	2.21
Brunswick 11 12, 15, 16, 18, 33	12"	2.21
Brunswick E	8"	1.90
Colonial 33-LL, 18	12¼"	3.50
Colonial 34, 35	12¼"	2.61
Colonial 36	10"	2.30
Crosley M45	9"	1.90
Crosley 40S	9"	2.00
Earl Inductor Dynamic	10"	1.01
Earl	10"	2.51
Edison R4-5-7-8	11¼"	2.11
Eveready	10"	2.21
Eveready	12¼"	2.30
Freed - Eiseman NR 80-95	10"	2.51
Fada Deep	8¾"	3.00
Fada Shallow	8¾"	3.00
Fada Deep	10½"	3.20
Fada Shallow	10½"	3.20
General Electric 31, 51, 71, 120, S22	10¼"	2.00
Hammarlund H1-Q 31-50	10¼"	2.00
Jensen	8"	1.44
Jensen D4, D5	9⅛"	2.11
Jensen D7, D9	11¼"	2.11
Jensen D11	8½"	1.69
Jensen D8	11¼"	2.61
Magnavox 142	9½"	2.11
Magnavox 143	11¼"	2.21
Magnavox 144	7½"	1.80
Majestic G1-G2	9"	1.69
Majestic G3, G4, G6, G7	10"	1.80
Majestic G5, G8, G9, G13, G14	12"	3.50
Majestic G10	8½"	1.69
Majestic G11	9½"	1.80
Majestic G14, G19, G21	10"	2.11
Oxford 2 and 3 point Spider	10"	2.11
Oxford 2 and 3 point Spider	12"	2.21
Oxford 7, 72, 70, 82, 83, 85, 86, 92, 93, 96, 97, 98, 99, 100, 101, 104, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 124, 128, 129, 139, 148	12¼"	2.21
Peerless Copper Coil	14½"	3.21
Peerless Copper Coil	12"	2.40
Peerless Copper Coil	10¾"	2.30
Peerless Copper Coil	8½"	1.90
Peerless Copper Coil wire wound	8½"	1.90
Peerless Copper Coil wire wound	10¾"	1.90
Peerless Copper Coil wire wound	14½"	3.00
Rola	6"	1.60
Rola F5, F6, F8	6¼"	1.70
Rola Series F and K	8"	1.80
Rola K9	11"	1.90
RCA 104, 105	10¼"	1.90
RCA 106, 46, 80	10¼"	1.60
RCA Superette	10"	2.00
Stewart-Warner 900 Series	9"	1.80
Stewart-Warner 950 Series	9"	1.80
Stewart-Warner Midget	6"	2.00
Stewart-Warner 200A	9"	2.30
Stewart-Warner 445A	10"	2.50
Temple	9"	1.90
Temple	11"	2.10
Temple Auditorium	14"	3.10
U. S. Apex Gloritone 26, 27	8½"	1.88
U. S. Apex Gloritone	10"	2.09
Victor RE 32-45-57-75-52	9"	.96
Westinghouse WR10-WR15	10⅛"	2.11
Wright DeCoster 155	6"	1.55
Wright DeCoster	8"	2.00
Wright DeCoster	10"	2.10
Wright DeCoster 107-207	12"	2.19
Zenith 52, 72, 50, LL18	12¼"	2.19
Zenith 87	9"	2.10

FIELD COILS

Airline 8"	1800	$3.04
Airline 8" tapped	1800	3.36
Apex Gloritone Lgt 49	11500	2.56
Apex Lgt 95, MD 549	11500	2.56
Atwater Kent 53, 55, 65	650	3.44
Atwater Kent 53, 55, 65	1000	3.92
Atwater Kent 53, 55, 65	1700	4.00
Colonial 33 A.C.	6000	3.92
Colonial 33 D.C.	550	2.64
Crosley M45	1500	3.04
Crosley M45	2500	3.04
Crosley 8½"	2500	3.04
Crosley 8⅛"	7500	3.92
Crosley Isodyne	2500	3.20
Crosley Isodyne	7500	3.52
Crosley Model 58	10000	3.92
Edison	4500	3.95
Fada	10000	4.40
Gloritone 8" tapped	1800	3.12
Jensen D4, D5	2250	2.88
Jensen D7, D8	1500	3.20
Jensen D9, D15	550	2.56
Jensen D9, D15	1000	2.40
Jensen D9, D15	1650	2.80
Jensen D9, D15	1800	2.80
Jensen D9, D15	2500	3.20
Jensen D12	2300	2.40
Jensen J2	1250	3.20
Jensen M20	3375	10.40
Jensen Auditorium	750	4.40
Jensen Auditorium	2250	4.80
Kolster International	100	3.20
Kolster International	1000	3.92
Kolster K43, K44, K70	900	3.20
Lyric 9"	3000	3.04
Lyric 9"	10000	4.66
Magnavox 9" medium	2500	3.04
Magnavox 9" Large	7500	4.66
Magnavox early models	2250	3.92
Magnavox 8½"	650	3.12
Magnavox 8¼"	2500	3.36
Magnavox 11"	650	3.20
Magnavox 11"	2500	3.44
Majestic G1, G2	2730	5.20
Majestic G5	1000	2.64
Majestic G6, G20	1000	3.68
Majestic G3	2750	4.66
Newcomb-Hawley	2500	4.66
Newcomb-Hawley	7500	4.80
Philco 65, 76, 77, 86, 87, 95, 96, 111 (Philco No. 2850)		1.95
Philco 20, 21 (Philco No. 2768)		.75
Philco 50, 51, 52 (Philco No. 02942)		1.05
Philco 70, 470 (Philco No. 02966)		1.35
Philco 90, 112 (Philco No. 02988)		3.00
Rola C	1500	3.92
Rola FK	1200	2.00
Rola FK	1500	2.00
Rola FK	1800	2.08
Rola FK	2500	2.08
Rola FK	6000	2.40
Rola L	2500	4.40
Rola L	15	2.80
Silver-Marshall 30	1500	4.40
Silver-Marshall 854	1800	4.40
Stewart Warner 950	10000	5.04
Stromberg-Carlson	2500	3.04
Stromberg-Carlson	7500	4.16
Steinite	15	2.80
Temple All Models	2250	3.92
Utah 8"	1800	3.12
Utah 8" tapped	1800	3.36
Utah Isodyne	7500	3.36
Utah Isodyne	2500	3.52
Utah Midget	2500	2.72
Victor RE-32-45-75	3000	2.25
Westinghouse WR-5-6-7	1250	3.28
Westinghouse WR-8	1330	3.28
Zenith 52	2500	3.92
Zenith 52 Special	2500	3.92
Zenith 52	550	2.80

The above prices are F.O.B. New York City. Shipments made express collect.

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Subscription Department, RADIO WORLD, 145 W. 45th St., N. Y. C.

As a GIFT

with a Subscription Order—

A Test Oscillator Accurate to 1%!

THE new model 30-N Test Oscillator produced by Herman Bernard has been improved by custom-making each coil to an inductance accuracy of 0.01 per cent (one part in 10,000), and using a non-warping etched metal scale, so that the guaranteed frequency accuracy is better than 1%. Bernard Test Oscillators are the only low-priced ones that carry any accuracy guarantee.

The features of the Model 30-N oscillator are:

(1)—Works on a.c. (any frequency), d.c. or B batteries, 90-120 volts, requiring no separate excitation of filament, hence is universal. Models for 180-240-volt use obtainable.

(2)—Has frequency calibrated dial, for lining up intermediates and broadcasts, 135 to 1,500 kc.

(3)—Contained in black crinkle finish metal cabinet, with Formica top panel having copper foil backing.

(4)—Constantly modulated in any and all uses.

(5)—Oscillator proper is isolated from cabinet, output is isolated from both oscillator and cabinet, and line is fused. Illustration above is one-third actual size, 5 x 5 x 3 inches. Weight only 3 lbs.

(6)—Oscillator ready for use when received.

(7)—Guaranteed frequency accuracy under all conditions, 1%. Calibration not disturbed by tube replacement.

The Model 30-N will be sent prepaid in United States or Canada, with tube inserted in socket, and direction booklet enclosed, on receipt of $12.00 for a 2-year subscription for Radio World (104 issues, one each week, at regular rate), plus $1.00 for the specially accurate calibration, total $13.00. For 180-240-volt use, Model 30-ND, $12.00 for subscription, plus $2.00 extra for precision and for special voltage, total $14.00.

RADIO WORLD
145 West 45th St., New York, N. Y.

NEW PRICES
TROUBLE SHOOTER'S MANUAL, Nos. I, II and III

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

Volume No. 3 (Recently issued). Order Cat. RM $7.50
Volume No. 2—Perpetual Trouble Shooter's Manual, by John F. Rider, Shipping weight 6 lbs. Order Cat. RM-VT @....................$6.50
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Rider's Trouble Shooter's Manual, No. IV. Brand new, up to 1934....................$7.50

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

RADIO WORLD
145 West 45th Street New York City

COMPLETE TUBE CHARACTERISTICS WITH SOCKET CONNECTIONS

In Radio World dated Sept. 9, 1933. 15c a copy; or start your subscription with that issue. Radio World, 145 West 45th St., New York City.