March 31st
1934

SHORT-WAVE CALIBRATION

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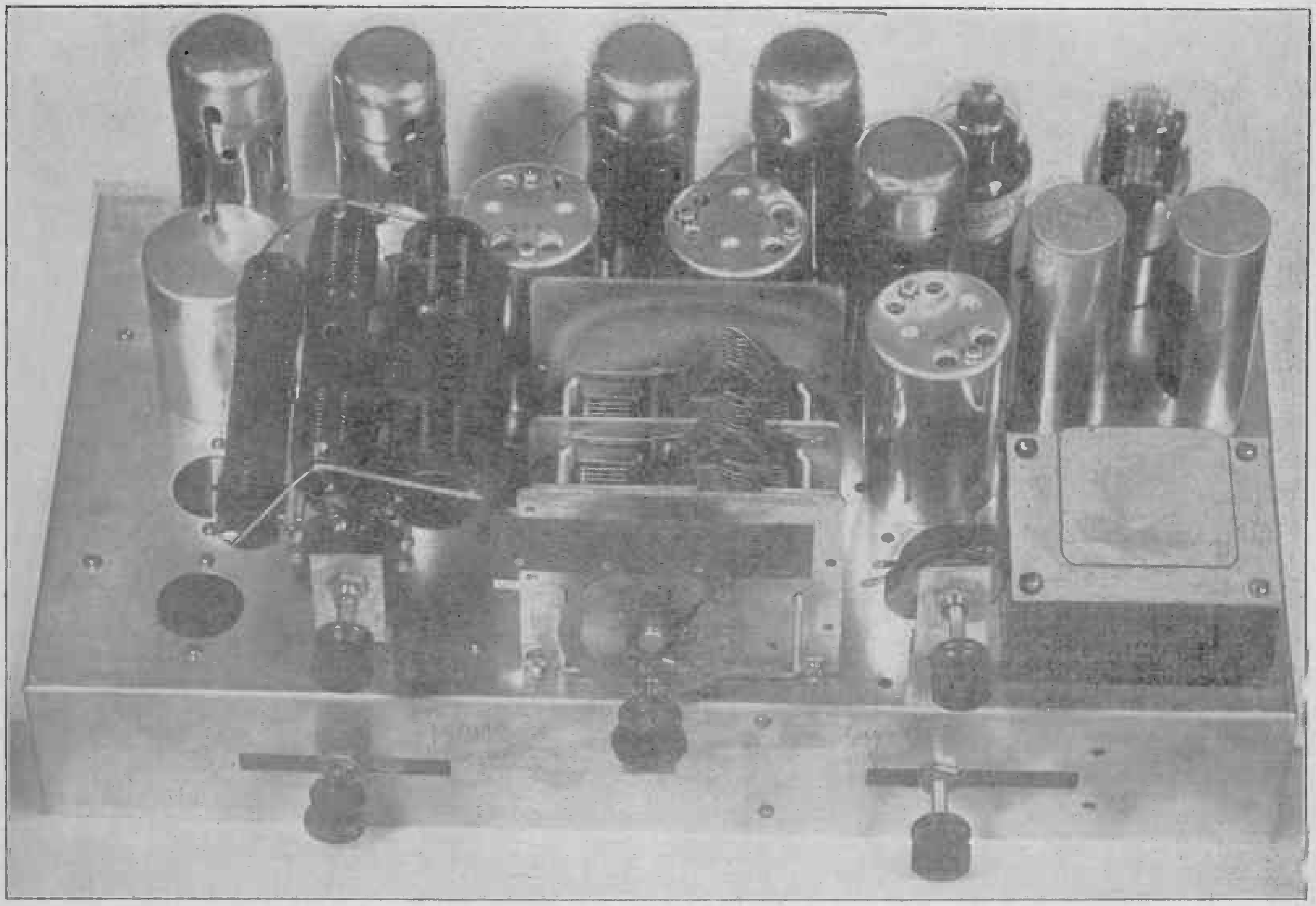
627th Consecutive Issue-Thirteenth Year

Automatic Volume Control

A 10-Watt Public Address System

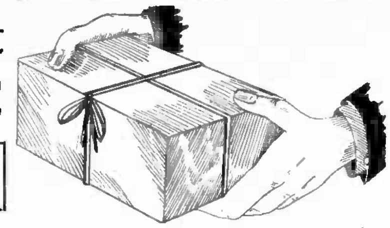
Antenna Coupling for High-Frequency Work

7-TUBE ALL-WAVE SUPER!

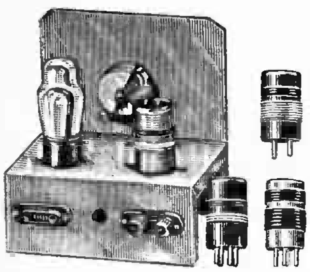


A switch-type receiver for covering the broadcast band, and down to below 15 meters.
See pages 12, 13 and 14.

Select the Gift You Want from An Inviting Array!



Kit for One-Tube Short-Wave Set



AMID the present furor over direct reception of short-wave foreign stations you don't want to be left, nor need you be, for a one-tube set will give you results that will amaze you. We offer the complete kit of parts for a one-tube battery-operated receiver (less 30 tube, less batteries, less earphones), and give you a clear wiring diagram, and at the same time welcome you to our list of yearly subscribers, whereby you will get in RADIO WORLD the short-wave data, including frequent station lists, that will enable you to improve your tuning technique and glory in thrilling foreign-station "catches." Coverage, 13 to 200 meters. Here's what your gift will consist of:

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One punched metal front panel.
Four small-diameter plug-in coils (not the large ones shown below).
One 50,000-ohm potentiometer.
One 10-ohm rheostat.
One switch.
One 0.0005 mfd. fixed condenser.
One output binding post assembly (for phones).
One battery cable.
One dial.
Two knobs.
One tube socket.
One coil socket.
One Hammarlund 0.00014 mfd. tuning condenser.
One 0.0001 mfd. grid condenser.
One 5.0-meg. leak.
One 0.0001 mfd. adjustable series antenna condenser (adjust with screw-driver at rear for keenest response once on each hand).

(Two ½-volt dry cells, 10c type, 22.5-volt B battery, 30-tube and phones not supplied.)

Order PR-SCK and remit $6.00 for one full year's subscription (52 issues, one each week) and kit of parts will be shipped promptly, small transportation charge collect.

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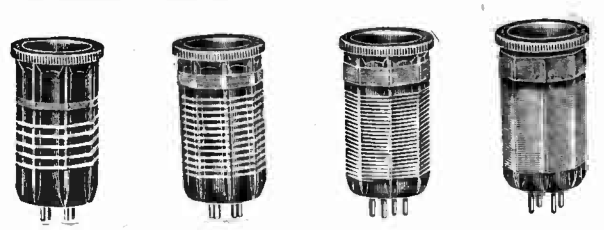
For the expert short-wave enthusiast precision type plug-in coils, wound on special forms, of special silver ribbon wire, prove valuable. Coverage, 12 to 200 meters, using 0.00014 mfd.

The four-prong coils illustrated reveal the special precaution of ribbed forms, so that the wire will touch only a minimum amount of the form, to reduce losses to a minimum. Diameter, 1.25 inches. Order PR-FPBC and send $4.00 for a 32-week subscription for RADIO WORLD. Postage prepaid.



Often an expert short-wave set constructor or operator desires precision coils for use as interstage couplers to a regenerative detector. It has been found by vast experimenting that the three-winding coil is far superior for this purpose than the two-winding coil with any of the makeshifts, like choke and stopping condenser. We offer a set of four 6-prong, 1.25-inch diam. coils (otherwise same as the four-prong illustrated at left). Ask for PRE-SPBC and send $6.00 for a full year's subscription (52 issues, one each week). Mailed postage prepaid.

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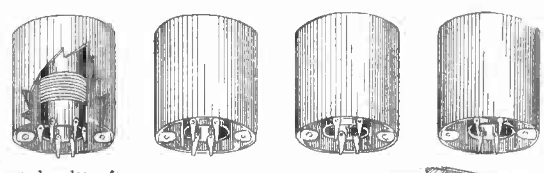
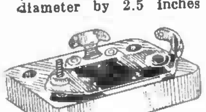
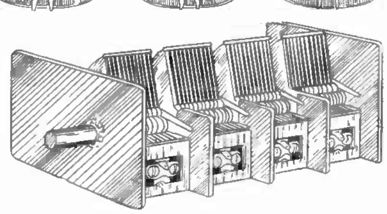


FOR broadcast eception, plus coverage to higher than 4,000 kc, thus yielding a total span of 540 to higher than 4,000 kc. We have an exceptionally precise combination, consisting of three r-f coils, one of which is used as antenna coupler, and one oscillator coil, also the necessary four-gang condenser and the correct padding condenser (Hammarlund adjustable type). The tuning coils for the r-f level have secondaries tapped so that the condenser stator may be switched from full inductance to just enough inductance to pick up the broadcast band where the full inductance left off. The oscillator coil is appropriately tapped, also, for this purpose. A four-pole, double-throw switch would be required (not furnished). Coils aluminum shielded, 2-1/16" outside shield diameter by 2.5 inches high. The four-gang condenser is very compact (5 x 2.25 x 2.75 inches). All material is specially made for this premium offer and is of highest calibre.





Order Cat. PR-BCTU-465 for use with 465 kc intermediates, and enclose $7 for 14-month subscription (60 issues, one each week), and four-gang condenser, four coils, and 350-450 mmfd. padding condenser, but no switch, will be sent. small transportation charges collect.

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RADIO WORLD, now in its thirteenth year, offers the super advantage of very latest news of circuits, tubes and station lists, covering ultra frequencies, short waves and broadcast waves. RADIO WORLD is written and edited by experts whose daily laboratory work is reported in the authentic columns of this first and only national radio technical weekly. Knowledge gained from RADIO WORLD enables you to improve the performance of the sets you build or service. Subscribe now!

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25KC SEPARATION

in the 25 to 40 Megacycle Band

SHORT-WAVE SWITCH-TYPE EARPHONE SET USES 36.4 MMFD. TUNING CONDENSER, 270-DEGREE ROTATION, AND EXTRA-LARGE DRUM

By Herman Bernard

NOT always does the best distribution of frequencies prevail in a short-wave or all-wave receiver. There have been several proposed solutions. The arguments in favor of betterment are very interesting and they show that the thought of receiver designers directed toward the establishment of a more satisfactory distribution.

Let us take an extreme example, that of a receiver designed primarily for coverage of the broadcast band, but going to short waves also, and having a condenser of 350 mmfd. or so for tuning. The frequency ratio will be around 3 to 1, lowest receivable frequency divided into the highest receivable frequency in the broadcast band. Then if no change or compensation of capacity is introduced the same ratio prevails throughout. Let us take the band at the other extreme, say, 30,000 to 10,000 kc. The difference here is 20,000 kc whereas in the broadcast band it is around 1,000 kc, hence the dial crowding is twenty times as great at the highest-frequency span as at the broadcast band, where already there may be some cause of complaint because stations between 1,300 and 1,600 kc are too closely crowded on the dial.

Why Sensitivity Wanes

As stated, this is an extreme case, and fortunately the practice is losing favor, despite its inherent simplicity. Moreover, the large capacity ratio is not consistent with best results, for during too much of the tuning at the higher frequencies the inductance is far too low, compared to the capacity, for high sensitivity. This accounts, too, for the drop in sensitivity during much of the tuning from 10,000 kc up.

One solution is to have two sets of condensers, one of 350 mmfd. maximum, and other of 140 or 150 mmfd. maximum, and for the broadcast band, which it is deemed desirable to cover at one switch point, use the large capacity condenser, and for all short waves use the smaller capacity. Again in the broadcast band the frequency difference, one extreme compared to the other, is 1,000 kc, more or less, and in the highest-frequency band the difference is that between 30,000 kc and 13,600 kc, or 16,400 kc, so the crowding is only 16 times as great, instead of 20 times as great, a small improvement, yet worthy of consideration because the objective is in the right direction.

It should be noticed that in this system for all short waves the same capacity span is used for tuning and the frequency ratio is therefore the same.

Split-Stator Condenser

Another and better method suggested is that of using different capacities for the different bands, as far as such capacities may be reasonably apportioned, starting with 350 mmfd. or so for the broadcast band, having the stator section split at 100 mmfd., so that in reality three capacities are afforded. There are (1) the total maximum, when the split stator is joined, (2) the larger of the two independen capacities when the split stator remains split and (3) the smaller of the two independent capacities when the stator remains split. By switching, the different capacities, 350 mmfd., 250 mmfd. and 100 mmfd., are picked up. This avoids, also, duplicating the condensers as mechanical units.

It is clear, of course, that the smaller the capacity the greater the number of coils, because the frequency ratio for some spans is reduced. We are dealing in reality with one ratio, that of the absolute maximum frequency, 30,000 kc, divided by the absolute minimum (say, 540 kc), or about 55.5.

Simplicity Retained

Confining the discussion still to the spreadout introduced by lowering the capacity, it is the author's suggestion that for types of tuned-radio frequency and regenerative circuits now popular, that the capacity ratio, or frequency ratio, be selected on the basis of what is satisfactory for the highest frequency band to be covered, and that the same ratio prevail for the rest of the tuning. In a sense the simplicity of the first-mentioned system, of using a large capacity condenser, is retained, as far as the condenser goes, but the number of coils is increased. Where there is one tuned circuit, as in the diagram, this increase is not bothersome, and even if there were two tuned circuits, the result could be accomplished.

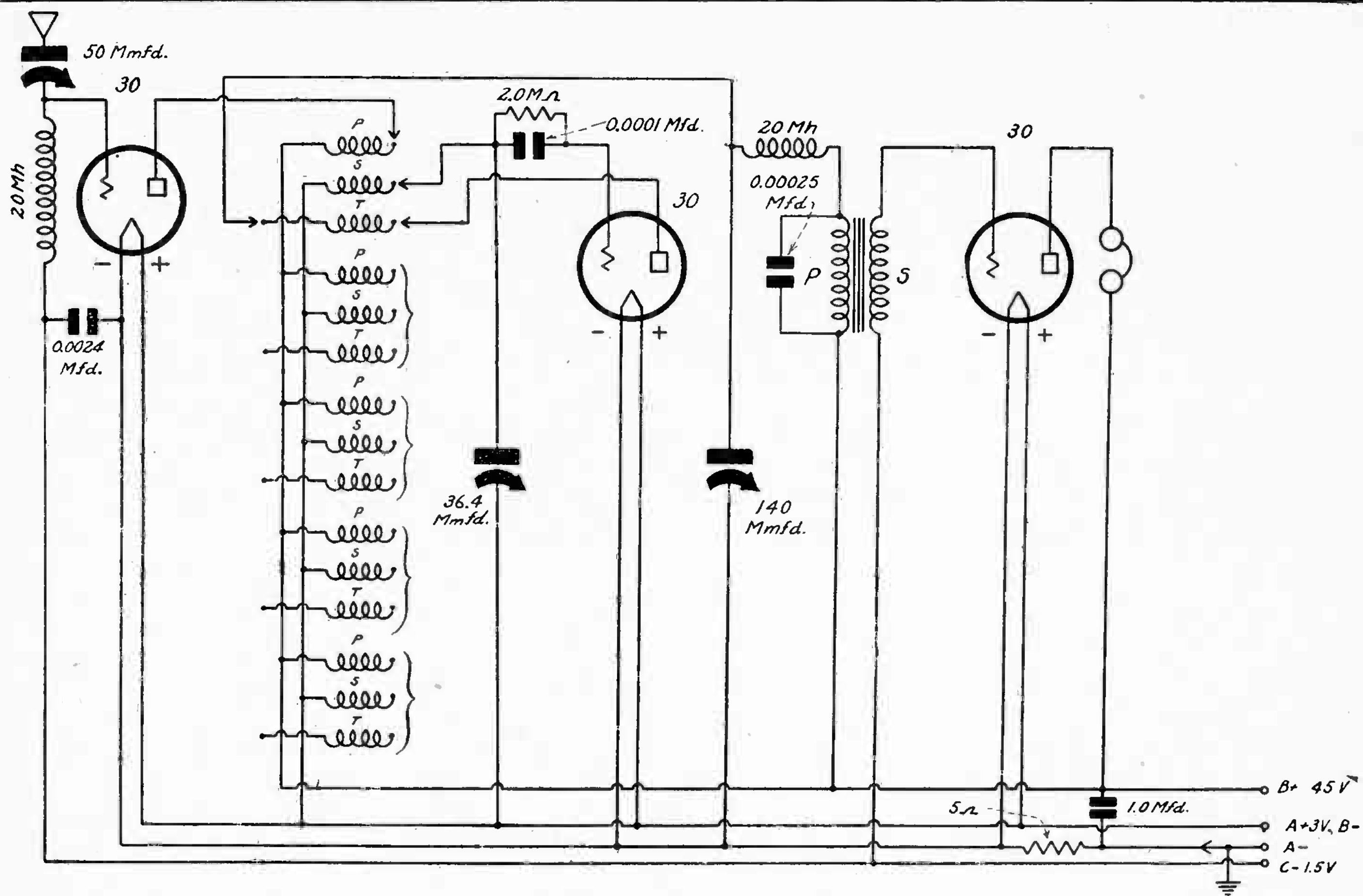
Present Methods Doomed

Working out the method for larger sets (three tuned circuits at the radio-frequency or radio-frequency and oscilator levels) would prove more of a task, yet since some solution is necessary, and this one has advantages, perhaps the sets of the future will adopt it.

Certainly there is room for improvement over present methods, and the prevailing systems will be superceded in time.

By determining the frequency or capacity ratio for the highest-frequency span, naturally if we got into the broadcast band we could not cover that band at one switch position, yet we could cover it with two. Say the capacity ratio is 2.52 and the frequency ratio is 1.587. For any two adjoining bands the frequency ratio would be 3.174, which is more than sufficient for 540-1,600 kc coverage, and the advantage of much greater

Blocking Tube Included to Preserve Calibration



Switch-type earphone short-wave circuit.

spreadout never can be too great in any band, and that it is wise to carry over the same small ratio from the highest-frequency band to the lowest-frequency band for that reason, and for the further reason that no makeshift such as a parallel bandspread condenser need be introduced. Indeed, the system takes on the aspect of total bandspread.

The frequency ratio can be achived by using a 36.4 mmfd. tuning condenser, although that is not a commercially-obtainable value.

Values Specified

Therefore, working on the basis of a total minimum capacity of 20 mmfd., looking into the inductance, and a maximum of 36.4 mmfd. + 14 mmfd. or 50.4 mmfd. (adding to the condenser maximum the circuit capacities, we may ascertain the inductance. Also we may check the ratio:

$$\frac{50.4}{20}=2.52$$

Since the capacities and their ratios are not to be changed, all we need do is ascertain the low-frequency inductance and divide that by the capacity ratio to obtain the subsequent lower inductances. The low-frequency inductance, to reach 1,600 kc with 50.4 mmfd., is 180 microhenries. The other extreme will be about 2,540 kc, which is 1.587x1,600 kc.

Applying the inverted capacity ratio the other inductances are obtained: 70¼, 27.9, 11.1, 4.4, 1.7, ¾. This accounts for seven coils, although normally only six would be used, the smallest omitted.

Coil-Winding Information

The following tabulation is for close winding on one-inch diameter tubing:

Band	*Kc*	*Micro-henries*	*Winding Data*	*TPI**
1	1,600- 2,540	180.00	98 T. 32 en.	112.0
2	2,540- 4,040	70.25	48 T. 30 en.	90.5
3	4,040- 6,410	27.90	33 T. 28 en.	73.0
4	6,410-10,170	11.10	21¾ T. 22 en.	38.0
5	10,170-16,140	4.40	11½ T. 22 en.	38.0
6	16,140-25,620	1.70	7.3 T. 18 en.	24.0
7	25,620-40,660	0.75	4.5 T. 18 en.	24.0

*Number of turns per inch

Mechanical Aspects

A first step has been taken when the foregoing method is accomplished, but it is not the complete solution. We now go to mechanical considerations.

Usually condensers turn 180 degrees, maximum to minimum, half a circle. However, there are condensers that rotate 270 degrees. Using them gives the mechanical assistance of 50 per cent. better spreadout, and since we are seeking spreadout, it is well to select the 270-degree condenser.

Next we turn to the dial. This has a scale, and if the frequencies are to be imprinted on the scale, that is, are direct-reading, then the disc type dial is ruled out, as the maximum distribution can be granted to only one band, since any other bands would have to be imprinted on tiers nearer the hub, hence the effective diameter is progressively decreased. This is known as the concentric vice.

However, if a drum is used, then each band of frequencies may occupy, must occupy in fact, as great a mechanical space on the scale as any and all other bands, and so the advantage accruing to one band is shared by all bands, and this is indeed the system to use.

If the drum is made large enough it is unnecessary to have any vernier mechanism, and the drum may be thumbed to the desired position from the front panel, directly turning the condenser shaft. A drum to be acceptable for such service should have a large diameter, and the author suggests nothing less than 8 inches.

A Drum 39 Inches Around

He has a drum of his own on such a set 9.25 inches in diameter. This yields a circumference of 39 inches, representing 360 degrees, but since the condenser rotates 270 degrees, the actual number of inches of the scale that may be used for calibration is 29¼. Assuming a straight frequency line, and the condenser has practically that, since the frequencies are related by the known ratio of 2.52, the highest-frequency band, taking as the "worst" example the seventh coil, say, 25,000 to 40,000 kc, the difference is 15,000 kc, or approximately 500 kc per inch, compared to more usual systems of 2,000 kc or more, per inch. The inch may be divided without much trouble into twenty equal parts, or the enormously-high frequency range, higher than that covered by practically any sets, will have a drum with gradations of 25 kc per division, or only two and a half times as great a frequency difference between divisions as exists in a frequency-calibrated broadcast receiver!

This, we submit, is something too obviously sensible to warrant immediate acceptance, but the prophecy still holds that present methods will be superseded, and not unlikely by the author's own method.

Some Objections

That about completes the discussion of the relationship of capacity to the frequencies to be covered, and the intro-

(*Continued on next page*)

AUTOMATIC VOLUME CONTROL

By H. K. Bradford
Technical Director, Capitol Radio Research Laboratories

Manual Methods of Adjusting Intensity

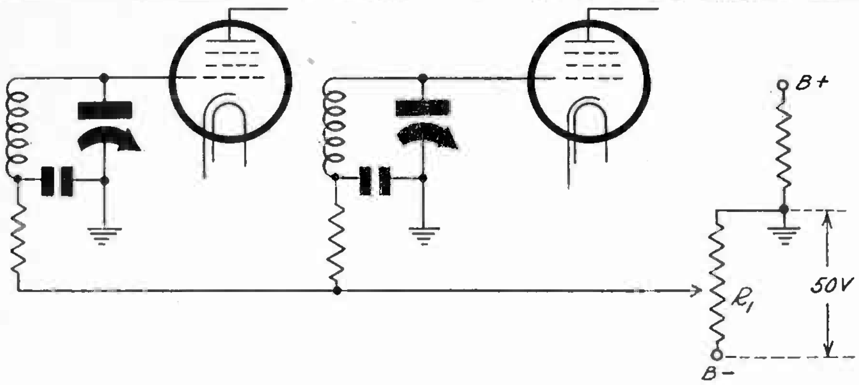


FIG. 1

Manual control of amplification by means of a potentiometer placed between ground and B minus. The cathodes are connected to ground and the grid returns to the slider.

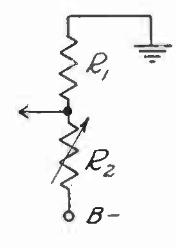


FIG. 2
Variable resistance control of volume.

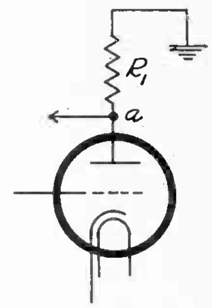


FIG. 3
Tube control of volume, another method.

OF THE many methods of manual volume control developed with the progress of radio design, the variable grid bias scheme lends itself most readily to automatic control. Undoubtedly, the widespread use of manual bias control suggested automatic applications.

The outstanding reason for the association of a.v.c. with controllable r-f and i-f grid bias voltages is that non-current-carrying circuits are involved in the system, allowing for large voltage changes through the use of an infinitesimal small amount of signal energy. This energy is used in the control grid actuation circuit and in charging condensers in the a-v-c system. Since a reasonable delay in the response of the circuit is essential, it may easily be appreciated that the amount of electrical energy required is quite small.

Two methods are employed for manually controlling grid bias voltages. These are variable cathode-to-chassis or ground resistors, and variable voltage divider sections from ground to chassis to the negative plate supply source. The first method cannot be used directly as it is not feasible to make a change directly in a current carrying circuit, but with the second method direct application can be made. Only minor changes need be made for this method.

The Gain

The amount of amplification which can be obtained from any tube is proportional to its mutual conductance or transconductance. By varying the bias from rated minimum to values beyond plate current cut-off, the transconductance is varied from rated value to zero. Those signals which remain in the circuit as far as the detector when this value has been reached may be attributed to "strays."

The total amplification of the complete signal circuit is proportional to the product of the transconductance values of the several tubes contributing gain to the receiver. Thus, by controlling two tubes instead of one, the effect of attenuating the signal is squared. This becomes an important factor when it is considered that input voltages to a receiver may vary through a ratio of 100,000 or more.

Actual Circuits

Let us now inspect some actual circuits. In Fig. 1, manual control is effected by the simple expedient of a potentiometer connected between ground and B minus between which there exists a potential difference of 50 volts. The assumption, of course, is that 50 volts will be sufficient bias to cause complete plate current cut-off of the tube in question.

In this arrangement the resistance R_1 is constant in value and the 50-volt potential will be divided in proportion to the resistance ratio of the slider to ground portion and the balance of the resistor.

Replacing this potentiometer with one fixed resistor and one variable resistor with the grid return connection at their junction as in Fig. 2 we may procure the same general result. As before, the voltages across the units are proportional to the respective values of the resistances, although the total circuit current varies with the adjustment of R_2.

Range of Variation

To obtain zero to 50 volts between ground and the tap in this case, R_2 must vary from infinity to zero. This should be clear as when R_2 is infinite no current flows through R_1 and it is at ground potential at every point. On the other hand, when R_2 is zero, a direct short is established between the tap and B minus.

Although the plate circuit of a vacuum tube cannot assume the two extremes outlined above, it is an excellent substitute for R_2. In Fig. 3, R_2 has been replaced with the plate circuit of a tube. Now let us follow its operation from Fig. 4. Consider a signal of average intensity being fed into the R-F amplifier. Originally the a-v-c grid is biased as indicated to cut-off, that is, so that no plate current can flow in the a-v-c plate circuit. Any carrier coming to the detector grid circuit will be fed through C_1 to the grid of the a-v-c tube. Plate current will flow and will be almost proportional to the carrier energy fed to the grid. Only positive grid swings allow plate current to flow and instead of rectified R-F in the plate cir-

Blocking Tube Safeguards Calibration

(Continued from preceding page)

duction of suitable type condenser and dial to protect the advantages gained and even greatly increase them. The only possible objections are to the size of the drum, which objectors may as well decide in favor of at once, unless winding-tape methods of dialling and scaling are to be used, and to the absence of vernier for readings so close as one-twentieth of an inch apart. The size of the drum is of itself a "vernier," for the larger the drum the larger the linear separation of equal-frequency division bars.

The circuit shows a blocking tube, with a high-inductance choke coil and a series condenser. The advantages of regulating the antenna with a series condenser for short waves need not be discussed again. The blocking tube prevents any serious radiation and also, more important, enables the maintenance of the frequency calibration, because removing the tuned circuit from the detuning effects otherwise inevitable, due to the series antenna condenser being adjustable and the aerial constants being an unknown quantity, and not always constants, as when the wind swings the aerial and thus causes some detuning.

A short-wave expert told me the other day of a case of swinging aerial where an output meter was used on a set and the periodicity of the aerial swing could be counted on the meter.

The diagram shows five coil systems, three windings to a coil. The other coils simply repeat the connections to those shown.

The change is made by switching, and the switch should have four poles and as many throws as bands to be covered.

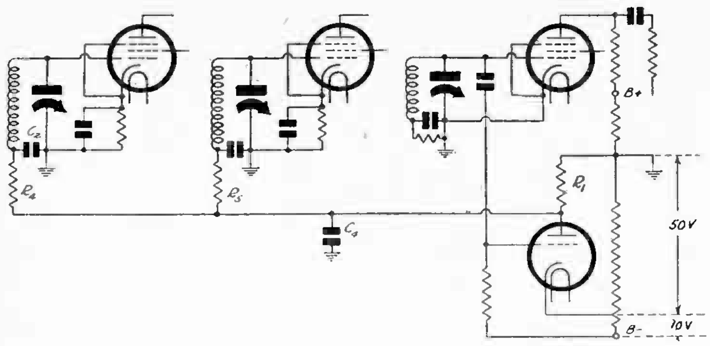


FIG. 4
In this circuit a.v.c. is obtained by varying the plate current in a tube, as in Fig. 3, the bias on that tube being varied by the signal voltage. The control tube functions as a rectifier.

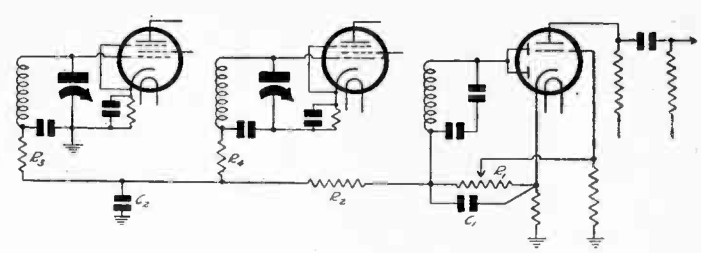


FIG. 5
In this circuit the rectifier which controls the bias is a diode rectifier. This is the latest method of obtaining automatic volume control, as it utilizes a 55 or similar diode-triode tube.

cuit we have provided C_4 to filter this into d.c.

This will make the potential at the a-v-c plate actually drop toward B minus from ground. The D-C plate resistance is of course varied by means of the grid and denoting this as resistance R_2 as before the voltage at (a) with respect to ground (the effective grid bias voltage applied to the controlled tubes) will be determined according to the relation:

$$\frac{V}{50} = \frac{R_1}{R_1 + R_2}$$

which gives us:

$$V = \frac{50 R_1}{R_1 + R_2}$$

Thus if R_1 is chosen to be ½ meg. and the grid charge makes R_2, 125,000 ohms, V will be 40 volts. When R_2 is driven to 2 meg. V will be 10 volts. In this manner V can be made to assume values from a fraction of a volt to about 45 volts or more. This is a voltage which cannot be measured by any ordinary means because of the high resistors in the circuit.

Ripple Removed

Condenser C_4 is 2 mfd. or sufficiently large to prevent rapid change of the a-v-c voltage. If it changes too rapidly it will respond to carrier variations due to modulation thus destroying the signal.

This brings us to modern detector developments which enable the receiver to use the actual signal energy for a.v.c., instead of an auxiliary voltage as described. In Fig. 5 we have a conventional a-v-c system making use of the duo-diode-triode tube. The a-v-c-controlled voltage is built up across R_1 in this figure due to half-wave rectification of the signal. Resistor R2 isolates the controlled tubes from R_1 in such a way that direct current proportional to the average energy of the carrier is available at the lower end of R_3 and R_4 while the audio signals is available across R_1. Although C_2 completely filters the audio frequency out of the controlling circuit it does not destroy the signal produced across R_1 because of the isolating value of R_2.

A complete discussion of a-v-c circuits of the modern types would be almost endless but this is the basic method of present-day a.v.c.

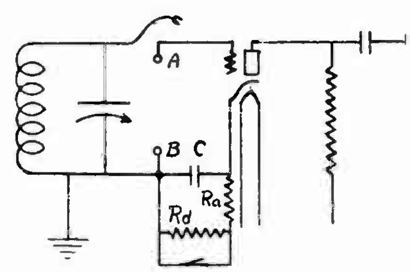
Dr. Brinckley Buys Yacht; May Send from High Seas

Miami, Fla.

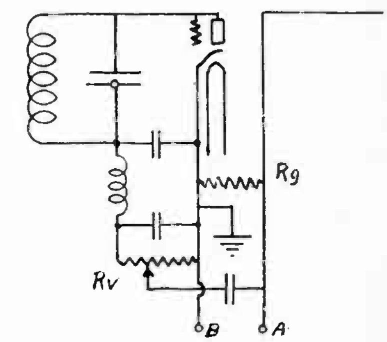
Dr. John R. Brinckley, who owned and operated KFB, Milford, Kansas, until he was ruled off the air by the Federal Radio Commission, and who later owned and operated XER, Villa Acuna, Mexico, has purchased a 150-foot yacht.

It is said that he intends to operate a broadcasting station on the high seas.

Detector Uses



A circuit of this kind can be used for a large number of purposes. It may be a detector, a voltmeter, or an amplifier, either of radio or audio frequencies. By calibration it can be used as a direct reading, non-current drawing r-f voltmeter.



A triode can be used advantageously as a diode rectifier by connecting the grid and the plate together. When coupled by resistance-capacity to the grid of an audio amplifier, very large signal levels can be handled.

The simple circuit on the left, above, has many uses. First it can be used as a radio frequency amplifier. As such the resistance Ro is short-circuited by means of the switch. The tube is then self-biased and any signal voltage applied between ground and the grid will be amplified. It can also be used as an audio frequency amplifier by leaving Ro shorted and impressing the audio signal between the points A and B, the tuned coil, of course, being left unconnected. Again the circuit can be used as a self-biased detector and amplifier. In this case the switch can be used as a self-biased detector and amplifier. In this case the switch across Ro is ouened and the grid cap is connected to A, or to the grid. Ro will now act as load resistance, or shall we call it grid leak, on the rectifier, the anode of which is the grid. The audio frequency voltage developed across Ro will no wbe amplified by the triode, the grid serving the purpose of controlling the plate current, and hence the output voltage across the load resistance in the plate circuit. It is assumed that the negative of the plate supply is connected to the junction of Ro and the bias resistance.

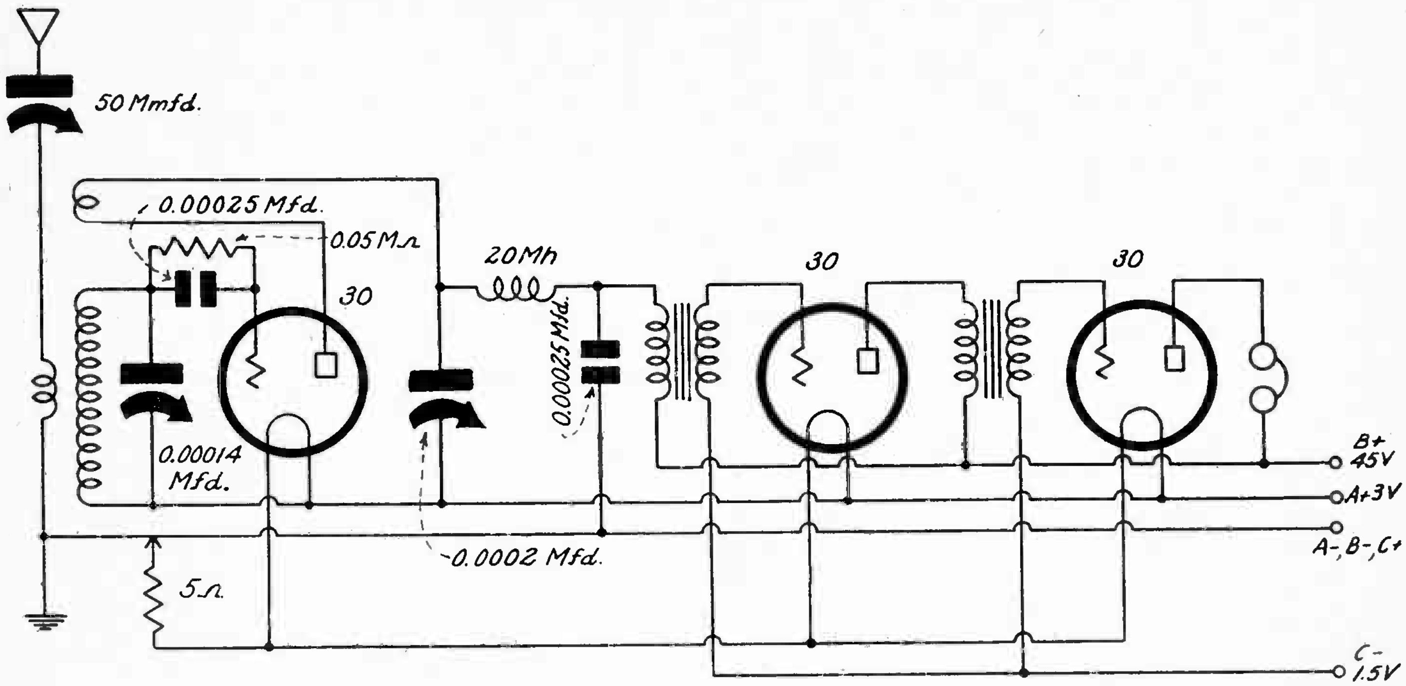
Another use for the circuit is measurement of signal potentials, especially where it is not important to prevent current being drawn from the source of the potential to be measured. For this purpose it is necessary to calibrate the circuit. A milliammeter is connected in series with the resistance i nthe plate circuit and a known, variable potential of radio or audio frequency is connected across AB. Suppose we connect a source of 5 volts across the terminals. This will cause a definite current to flow in the anode circuit, that is through Ro. A certain voltage will be developed, and this in turn will cause a certain plate current to flow. Now if a voltage of 4 volts is connected across AB there will be another value of plate current. In the same way the plate current resulting from many other known voltages can be obtained. When many observations have been taken a curve can be plotted with input signal voltages in one direction and plate currents in the other. Now if an unknown voltage is connected across AB, such as that existing across the tuned circuit, there will be a definite current in the plate circuit. From the curve plotted the value of that signal potential can be read off directly. When the arrangement is used in this manner, the self bias resistor should be shorted, for otherwise the signal must have a certain value before any change will be noted in the plate circuit. It is only because grid current flows that the plate current will be altered.

Still another way of using the tube is to employ it as a non-current drawing voltmeter. In this case a steady current should flow through Ro and of such value that no plate current flows when the AB terminals are shorted. This can be done by making Ro a part of the voltage divider. Or a battery of just sufficient voltage to cut the plate current to almost zero can be connected in the switch lead, with the negative toward B. As before, the circuit must be calibrated to obtain the current in the plate circuit for various known voltages across AB. Once the calibration curve has been obtained any radio or audio frequency voltage within the range of the calibration can be obtained.

R-F STAGE OMITTED

As Not Worth While in a Regenerative Short-Wave Set

By Colman Leddon



FOR a regenerative short-wave set there is very little, if any, necessity of using radio-frequency amplification ahead of the detector, because, in regard to sensitivity, the regenerative action boosts it so much that r-f amplification ahead is slight in comparison, and as to selectivity, regeneration can be made to cut sidebands, if pressed to its extreme of actual usefulness, and farther than this it is not necessary to go.

One Setting for a Band

Any system must be related to what is put into it, and therefore since we desire to have the tuning section as free as possible from extraneous effects, we couple the antenna loosely to the detector. This builds up the regenerative effectiveness, or, to put it differently, reduces the inherent resistance in the tuned circuit.

This looseness is accomplished in two ways: (1), by using a very small primary and (2), by inserting a series condenser of small capacity.

For some of the frequencies to be received, for instance, the capacity in series should be only 10 mmfd. or so, and the variable condenser permits such selection. It will be found that one setting of the condenser will be acceptable for an entire band, that is, all the frequencies covered by the tuning condenser in conjunction with any one of the plug-in coils, so that from station to station this condenser need not be molested.

Leak Selection

With small input, the detuning effect of the antenna on the tuning circuit is small. First, the series capacity limits the effect of the antenna capacity, which is reflected in the secondary as well as present directly as a parallel capacity across the primary, and secondly the effect of the antenna inductance is minimized by the same series capacity.

It has been said that the desire is to have the selectivity as great as possible, and this may be taken also as a desire not to have the sensitivity at the detector itself as great as possible.

There is some leeway about sensitivity in the choice of the grid leak value. If the leak is much higher than 0.05 meg. (50,000 ohms), say, 5 meg., the sensitivity will be greater. The reason is apparent. There will be a greater voltage drop across the leak for any given value of grid current. The fluctuations of this voltage will be greater, and the amplitude of the fluctuations is a measure of the sensitivity. However, the grid condenser has to be relatively low in capacity, around 0.00025 mfd. or 0.0001 mfd., for if it is increased too much beyond the maximum stated, with a high-resistance leak, there will be audio oscillation, a continuous sound. used in some test oscillators for introducing modulation. Here we do not want any modulation except that derived from the carrier itself.

Hence as we are limited in the value of the grid condenser we are limited in the amount of bypassing of the leak, and if the leak is very high, then we shall lose selectivity at least at the higher frequencies of tuning, and this is exactly what we do not want. Not only is a value of 0.05 meg. sufficient, but there may be still further improvement in selectivity by using a lower value than that.

Use Plenty of Audio

Whatever we do at the detector regarding selectivity, at the expense of sensitivity, we can make up in the audio channel, and that is why there are two stages of audio-frequency amplification, even though the intended use is in connection with a headset. Although it is a fact that some stations will be received with what is called "speaker volume," the results from a few stations rather intimately associated geographically with the reception point must not be taken as the standard of comparison. Rather, what happens when France, Germany, Italy and Spain are tuned in constitutes a more sensible criterion, and indeed even South American short-wave stations, and stations that are not heard regularly, or are not heard unusually clearly, no matter where they are located.

It has been found by experiment that for detection in a receiver, using the 30 tube, the grid return is more acceptably made to the positive filament, although in some types of test oscillators better results from that viewpoint are obtained when return is made to negative filament. At least, do not make the return to grounded B minus, which is minus A, as that reduces sensitivity a great deal, and often imperils regeneration.

Precautions Stated

The two variable condensers in grid and across plate connections are returned to positive A, so care must be taken if a metal chassis is used, not to have the chassis also as negative A, or negative filament, for a short-circuit that will put the A supply out of service will result. Of course the series antenna condenser is totally insulated from everything save aerial and one side of the primary, and therefore no particular precautions need be mentioned about that.

The 20-millihenry r-f choke coil is of the type cheaply purchasable, wound on ⅜-inch diameter dowel, and has a d-c resistance of 75 ohms. It is inevitable that the d-c resistance be in that region, as to get a high inductance compactly, small-diameter wire must be used. The main point is that the choke have small distributed capacity, and this element will be of the order of 1.0 mmfd. in a universal-wound coil (honeycomb).

The bypass condenser across the first audio transformer primary, to A minus, improves detection. It may be connected just across the primary instead of from P of the

(Continued on next page)

THREE CHEERS FOR THE SET

That Has Frequency-Calibrated Dial for Short Waves!

By Jack Tully

THE small battery-operated short-wave kits and receivers are selling fastest, no doubt because they cost the least and give good results, and the four-tube a-c short-wave set is next in popularity, and so on along the line, but it is characteristic of all the less expensive outfits that they are not frequency-calibrated. Evidently frequency calibration is beyond the scope of most of the kit suppliers or small manufacturers of sets, and it is no violation of confidence to say that even the larger manufacturers have their troubles with it.

If a person who knows very little about radio, hence very little about a branch of radio (short waves) concerning which those even who know much about radio know little, naturally he will be confused regarding the dial places where to find foreign stations. The first thing that causes him some perplexity is that some station lists refer to the frequencies of certain stations, whereas the user may be half-familiar with thinking in terms of wavelengths, and frequencies are quite beyond him. He feels they are intricate.

Converting One Form to Other

However, if the wavelength is given, and the frequency is not, and one prefers frequencies, or has a set concerning which he has some frequency knowledge but no wavelength knowledge, all that is necessary is to divide wavelength into 300,000 and the answer is in frequency by kilocycles. If the frequency is given in kilocycles and the wavelength is desired, divide the frequency in kilocycles into 300,000 and the answer is in wavelength in meters. If the frequency is given in megacycles and the wavelength is desired, divide the frequency into 300, or if megacycles are desired, wavelength being given, divide the wavelength in meters into 300.

It is very easy to remember, because the dividend is 300,000 in both instances of conversion, for dealing with kilocycles, and 300 for dealing with megacycles.

Even when the simple formula is appreciated, it is still something of a feat to change one's thinking method from wavelengths in meters to frequencies in kilocycles or megacycles. It is preferable to follow the frequency method, as that is in the ascendant, and it is more sensible. An appreciation of the difference between two waves can be gained instantly when they are identified as to frequencies, but there is not much significance to a difference in wavelengths, as for equal frequency difference the wavelength difference constantly changes as the tuning or the band is increased or decreased in frequency or wavelength.

Fundamentally, wavelength is easier to understand. A station generates a wave. There are two alternations in every cycle. A cycle is the number of times per second the wave changes polarity. So a measurement easily can be appreciated, made between the crest of one wave of the train and the crest of the next succeeding wave, on the same plane of course. This distance, for it is a distance, may be measured in inches, feet, yards, meters, etc., but meters are selected where distance is concerned in radio, because of the uniformity of definition and the internationality of the metric system.

Velocity Is Constant for All

In a given time, any radio-frequency wave being radiated will cover a certain distance, or wavelength. If a wave has a frequency of 1,000,000 cycles, 1,000 kilocycles, 1.0 megacycle, it is oscillating 1,000,000 times a second. It travels at the speed of light, approximately 186,000 miles a second, but as we desire the answer in meters and not in miles we use the factor for the speed of light as 300,000,000 meters per second. Remember, all waves, all frequencies, same velocity.

If we know how fast an automobile is traveling, and take a certain duration of time for transit over an unknown distance, we can ascertain the distance by dividing the time into the velocity. Say the car is going 100 miles an hour. In 12 minutes how far will it go? Twelve minutes are one-fifth of an hour, so the distance the car has traveled in 12 minutes is 20 miles. So in radio, frequency is the time element, or fraction of a second, instead of numbers of minutes or hours as applied to slower-moving devices like cars. The distance when expressed in wavelength in radio is the measurement made between wave peaks, of a train moving at a known speed. So the more rapid the repetition of the cycle, or higher the frequency, since the velocity is uniform, the smaller the distance between peaks, or the shorter the wave. Frequency being the number of times per second that the cycle is repeated, the frequency is nothing more than the number of peaks per second, as wavelength is the distance between those peaks.

It Is Indeed a Pleasure

When one becomes familiar enough with a short-wave set to be able to read a station list and ascribe at least approximately the dial position for that frequency, and of a certainty the band in which the frequency lies, he has made a start toward the real enjoyment of short waves, and that is by calibration of the set. Anything that discloses the positions on the dial where frequencies or wavelengths come in constitutes calibration.

The most pleasurable experiences in short waves do not arise from chance tuning, hit-or-miss operation, and ignoring of station lists, for it must be said again that the way to get real catches from abroad is to tune for a station when it is actually supposed to be on the air, and know just where the station should come in on your set.

It is impossible yet to know for a certainty that a station will be on the air, with few exceptions, since short-wave transmission is generally classified the world over as experimental, and all schedules are tentative and voluntary. Moreover, some stations, most of them when they do change, will change without notice, except perhaps notice given over the air. Hence, listeners have formed clubs, and other means have been adopted here, so as to ascertain changes from printed lists.

All Lists Fallible

The changes are numerous enough to constitute every list a fallible one, and while great care is exercised in the preparation of these time-schedule lists, and they are as nearly correct at the time of final profreading as pains and expense can make them, nevertheless the stations are scattered the world over, and there is no practically instantaneous clearing house for alterations and corrections.

It is suggested by the author that an effort be made to get all short-wave transmitters that are assigned to particular frequencies, or choices of particular frequencies, to notify some central authority in each large country of any changes of frequency or hours on the air, and that this central authority disseminate the information to the various publications, short-wave clubs, etc. At present, with each agency going it alone as best it can, the results are not fast and sure enough.

Daily Press Is Alert

The subject is becoming important, for even daily newspapers are printing modified short-wave schedules, something never before known in radio, and in their radio sections that formerly were devoted to news of broadcasting, studios, personalities, and the like, attention is being given to short-wave news, stations that happen to be coming in well on short waves in the immediate locality (though transmitted from abroad), and even personal information about announcers, operators, etc., in foreign short-wave transmitting plants.

There will be an even greater boom in short waves if serious effort is made in calibration, so that when a person buys or builds a receiver he can have a good recording of just where on the dial every receivable frequency will come in. If information he obtains as to a station's hours on the air is at fault he can check it himself, in a way, if the station is a "foreign local," by which is meant a station in a foreign country that usually lays down a dependable signal, day after day and night after night, in the particular general location.

There will be small changes in the actual reception frequencies, compared to the cali-

(Continued on next page)

3-TUBE SW SET

(Continued from preceding page)

transformer to grounded B minus, if more convenient.

Excellent satisfaction will be obtained from this receiver, and the standard plug-in coils may be used. Somewhat better results are obtained from the 1.25-inch diameter "precision" type plug-in coils, rather than from the 1-inch diameter coils, principally because the dielectric used for moulding purposes is usually of better caliber. The larger-diameter coils cost more than the so-called tube-base type.

A 15-WATT OUTPUT in Public Address System

By J. E. Anderson

AT TIMES there is need for a high-gain, high-power audio-frequency amplifier, one that will give out something of the order of 15 watts of undistorted sound power and which will amplify feeble impulses from condenser or velocity type microphones and photoelectric cells. Many stages are required to obtain the necessary gain and push-pull is usually necessary to maintain the quality. Push-pull is especially necessary in the output stage in order to obtain the necessary sound power.

Fig. 1 is the circuit diagram of a public address amplifier designed by a designer of transformers. The first stage contains two 57-type tubes, the second two 56-type tubes and the third stage two 2A3's, all stages being push-pull. The plate power is supplied by a rectifier utilizing a 5Z3 tube.

The 57 tubes have a very high internal resistance, and if good quality and high gain are to be obtained from the stage it is necessary that the load impedance be as high as possible. For that reason a special coupler is employed, which is part impedance and part transformer. As an impedance coupler we have two chokes, both center-tapped, and two condensers for transfering the signal from the primary choke to the secondary. Then we have also the transformer effect, for the two center-tapped chokes are on the same winding. A high impedance can be presented to the 57 tubes at all audio frequencies by this arrangement, and there will be a high gain. This will be uniform over the audio range and there will be comparatively little tube distortion of the wave form. Much better results are obtained from the 57's when there is a choke in the plate circuits than when there is a resistance of a value comparable with the reactance of the choke.

The Second Coupler

Between the 56 tubes and the 2A3's there is a regular interstage push-pull transformer, that is, one in which both the primary and the secondary windings are center-tapped. It will be noticed that the center of the secondary goes directly to ground. It has been found by experience that if a resistor of about 20,000 ohms is placed in the lead from the center to ground that the output is improved. Sometimes a resistor as high as 50,000 ohms is used. This resistor has an appreciable effect only when grid current flows, and the tubes should never be operated so that grid current does flow. However, it may be that during times of strong peaks of the signal the tubes will be overloaded a little, when grid current will flow momentarily. The use of the suggested resistance is optional.

In the output circuit of the 2A3's is a queer transformer. It has two taps on the primary aside from the center, and the secondary consists of three windings. On these windings there are also taps. The object of the primary taps is to adapt the transformer to other power tubes. If the transformer is obtained for the 2A3 tubes, the primary taps are not needed. The different windings and the taps on the secondary side are for adapting the transformer to different voice coils. In one winding there is a single turn between two taps. They are for use on speakers having a single-turn voice coils. The various windings can be connected in series aiding to increase the impedance and thus to adapt the transformer to speakers having higher-impedance voice coils. Two of the windings are also equal so that the transformer may be used for a push-pull speaker.

If a good loudspeaker is obtained that has a transformer built in that matches the 2A3 tubes, better results are usually obtained by connecting this transformer to the tubes directly.

Input Circuit

Now let us skip back to the first tubes. In front of these is also a tapped transformer. In the first place, the secondary is center-tapped. Across each half of the secondary is a resistor R1, the purpose of which is to smooth out the signal. That is, the resistors remove resonance effects. Values of the order of 100,000 ohms are suitable, although values as high as 250,000 ohms may be used. The lower values undoubtedly are preferable.

The primary of this input transformer has two windings together with one extra tap on each. This arrangement offers many possibilities. One windings, for example, can be used for one microphone and the other for another. These microphones do not have to have the same impedance since a tap on each winding is available. Two windings are also equal, and that offers a chance of using a push-pull microphone, such as a double-button type, and two different impedances are available. To make the input push-pull the two center terminals would be joined together.

Bias Arrangement

The two 57 tubes are biased by a resistance R2 in the common cathode lead. Its value should be about 1,000 ohms. This resistor is shunted by a condenser, C1, of 2 mfd. A resistor R4 is connected between ground and the center of the input transformer secondary. This resistance has two functions. First, it makes the 2 mfd. condenser much more effective in filtering out feedback through C1 and in the second place it prevents feedback from the B supply. Its value may be 100,000 ohms, although a value half as large would work all right.

The two 56 tubes are also self biased by a resistor R5 in the cathode lead. Its value should be 1,350 ohms, approximately. Of course, either 1,250 or 1,500 ohms would be all right, especially the higher value. In this case also there is a filter resistor, R7, which, as before, serves the dual purpose of preventing feedback both from the plate circuit of the tube itself and from the B supply. The value of R7 may be 50,000 ohms and the condenser C3 2 mfd.

The 2A3 tubes are biased by R10 which is connected between ground and the center-tap of the filament winding serving the two tubes. Its value should be 750 ohms and it should have a rating of at least 5 watts. The condenser, C9, should preferably be large, say 25 mfd., and it may be of the electrolytic type. If such a condenser is used and it is of the polarized type, the positive terminal should be connected to the transformer, the negative to ground.

Plate and Screen Supply

Plate and screen voltage, as well as bias values, are obtained from a rectifier circuit utilizing a 5Z3 tube. A bleeder resistance R8, is provided. Its value is arbitrary and is determined by the choice of bleeder current. The total voltage across R8 is approximately 360 volts. A reasonable bleeder current is 10 miliamperes, although a slightly larger current would help to stabilize the circuit and the voltages applied. If the voltage across it is 360 volts and the current through it is to be 10 milliamperes, we need a resistance of 36,000 ohms. This is rather high. Let us assume the bleeder current is 15 milliamperes. This would make the resistance 24,000 ohms. This is more suitable. Therefore, let us select a 25,000-ohm resistor, making the bleeder current 14.4 milliamperes. Since the voltage across it is 360 volts and the current through it is 14.4 milliamperes, the power expended in it is over 5 watts. To be safe we must use a resistor of 10-watt rating.

Now, 360 volts is too much for the other tubes in the circuit. The voltage on the 56's should be 250 volts. Since the bias is 13.5 volts, the total voltage applied to the tubes

Need of Frequency Calibration Cited

(Continued from preceding page)

bration, unless laboratory precautions are taken, but for the while these are not serious. Not until calibrated short-wave receivers become general will it be necessary to take up the subject of making the calibration stick like cement.

Once calibration becomes general, anyone who buys or builds a set has a meter, in a true sense, that measures the frequency of anything that is received. Then one need not think in terms of meters or wavelengths, but need only change meters to kilocycles or to megacycles, for the set will be calibrated in frequency of course, and the computation applied only if the information about the station is exclusively in meters. Practically all information, if metrical, is in addition to frequency disclosure, so there is no cause for worry or trouble there.

It is sad to note to what a low level of utility a short-wave receiver of some consequence will drop in the hands of a total layman (we nearly said "radio greenhorn"), simple because the set is not calibrated. But give the layman a calibration and he's off to a flying start and becomes a great booster for short-wave radio, and thus swells the ranks of radio users and buyers. Therefore calibration has something to do with NRA, recovery, prosperity and success, so let's all argue for it until it's practically universally supplied!

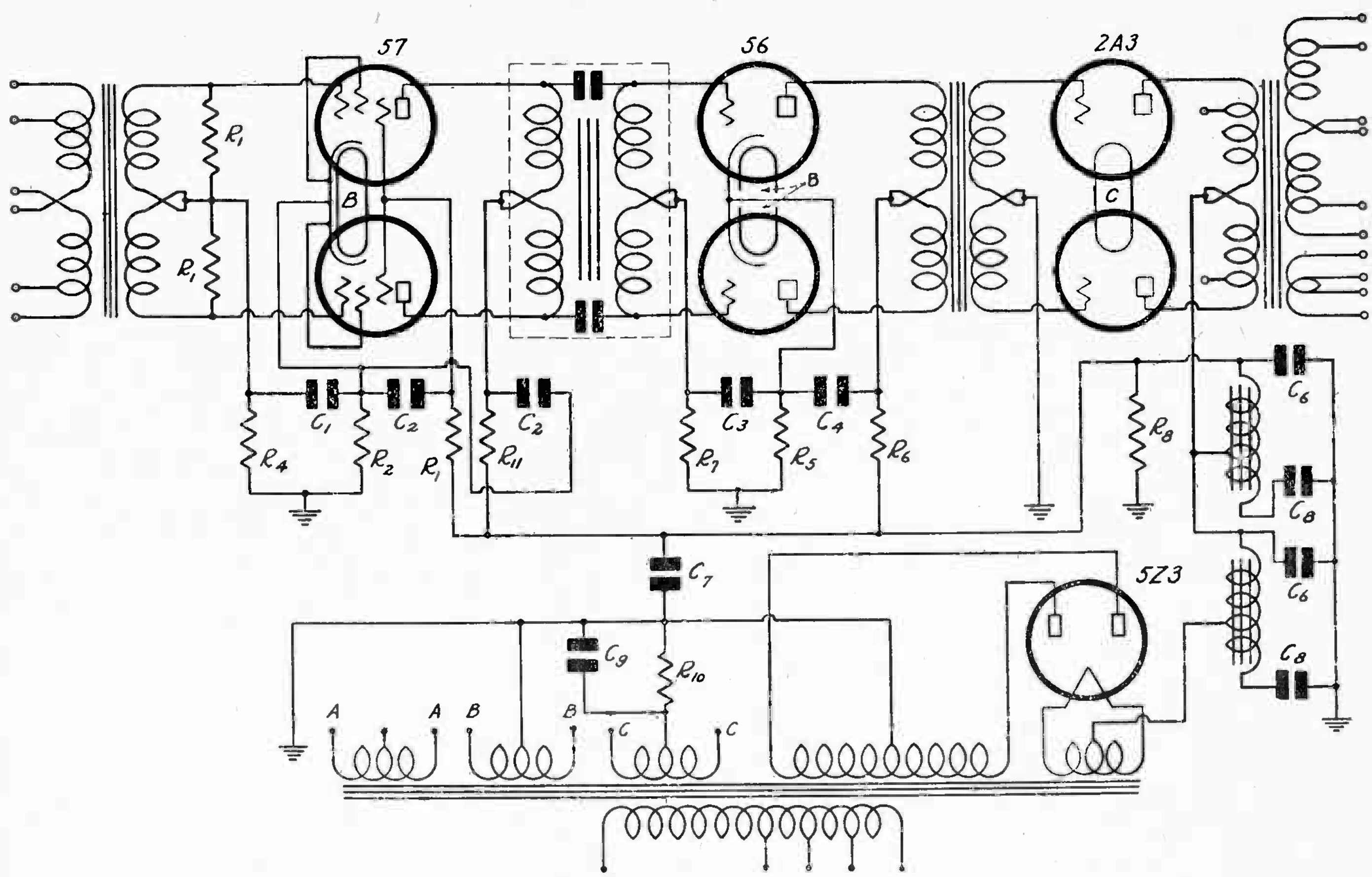


FIG. 1

A high-power, high-gain public address amplifier utilizing special transformers and couplers. Push-pull amplification is used in all stages.

is 263.5 volts. Hence, it is necessary to introduce a resistor in the plate circuit that will drop the excess voltage of 96.5 volts. This resistor is R6. The current in this resistor is the sum of the plate currents of the two tubes, or 10 milliamperes. Therefore, R6 should have a value of 9,650 ohms. The nearest commercial value is 10,000 ohms. A one-watt resistor will do, but it would be better to make it 2 watts.

A condenser C4 having a capacity of 2 mfd. is connected between the centertap of the transformer and ground for the purpose of filtering. It acts in two directions in conjunction with the voltage drop resistance. It prevents signal currents from entering the plate supply and it also prevents signal currents in the supply from entering the tubes.

Supply for 57s

The voltage available is also excessive for the 57 tubes, although not to the same extent. But let us suppose that the effective plate voltage on the 57 tubes is to be 250 volts, less any small drop in the plate chokes. The bias on these tubes is one volt. Hence, the voltage across the tube and bias resistance is 251 volts. The drop in R11, therefore, should be 109 volts. The plate current to the two tubes is about 1 milliampere. Therefore, R11 should be 109,000 ohms. The nearest commercial value is 100,000 ohms, and that is the value selected. The slight increase in the voltage resulting from choosing a smaller resistance is advantageous. Indeed, a considerably higher voltage can be used on the plates, and this is done simply by selecting a lower limiting resistance, say 50,000 ohms. The required change in the grid bias would be automatic.

As in the previous stage there is a condenser, C2, between the center of the tapped choke and the cathode. Again it serves the dual purpose of preventing current of signal frequency from getting into or out of the tubes.

Advantages of Filtering

It is customary to divide the voltages for the different stages by putting taps on the bleeder resistor R8. In this case this is not done, but the voltage is dropped independently for each stage. The object of this is to prevent interstage coupling which might lead to motorboating. Even in a push-pull circuit like this, it is almost impossible to prevent motorboating if there is any common coupling in the B supply. Especially is this true when one of the stages is a high-gain amplifier. The method employed here for preventing the coupling is about as good as can be achieved without actually employing a separate B supply for each stage.

In this connection it will be noticed that R8 is not connected to the centertap of the power stage output transformer. There is a choke between them. Therefore, any signal current due to unbalance in the output stage cannot appreciably change the voltage drop across R8, and consequently there is very little feedback from the power stage to the other stages. Thus there is a good filter in each stage. The only signal fluctuation that can exist across R8, and hence in the common voltage supply to two first stages, is the drop in condenser C6 connected to R8. This cannot be large due to the presence of the choke between the power stage plate return and the condenser. Incidentally, C6 also helps to remove ripple from the power supply but in respect to this function the condenser is not nearly so important as in eliminating feedback.

C7 is in shunt with C6 and therefore it is not necessary. Its inclusion would only mean that C6 is larger.

Filtering B Supply

A special type of B supply filter is used, designed more effectively to eliminate hum, both of the fundamental ripple and the har-

(Continued on next page)

LIST OF PARTS

Transformers and Chokes

One special push-pull input transformer.
One special high-impedance choke-transformer coupler.
One push-pull interstage transformer.
One special push-pull output transformer.
One power transformer.
Two tapped filter chokes, 100 m.a. capacity.

Condensers

Five 2 mfd. by-pass condensers.
One 25 mfd. electrolytic condenser, 60 volts.
Two 8 mfd. by-pass condensers.
Two special condensers to fit the chokes.

Resistors

Five 100,000-ohm resistors, one watt.
One 1,000-ohm resistor, one watt or more.
One 1,350-ohm resistor, one watt or more.
One 10,000-ohm resistor, one watt or more.
One 50,000-ohm resistor, one watt or more.
One 750-ohm resistor, 5 watts or more.
One 25,000-ohm resistor, 10 watts.

Other Requirements

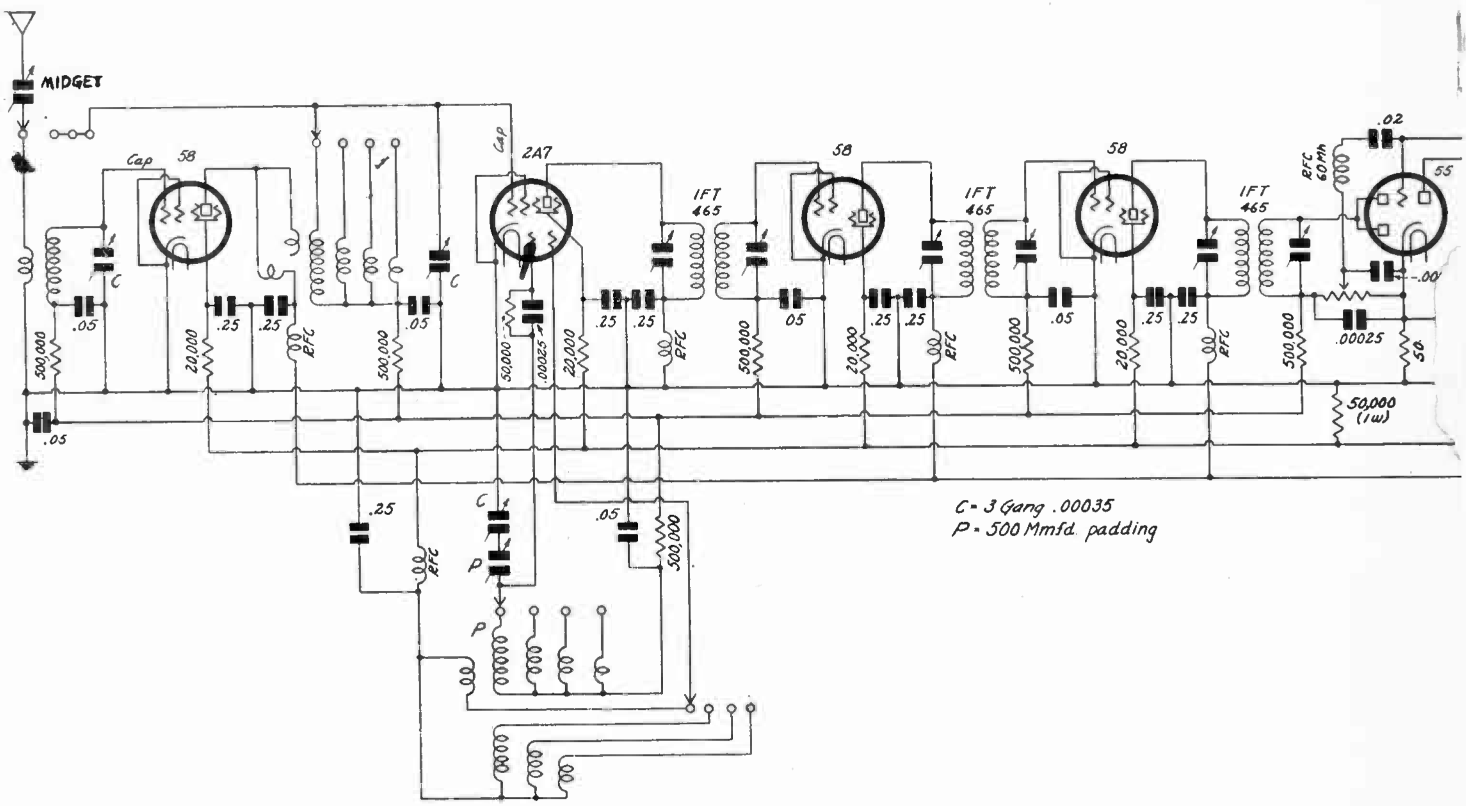
Three four-contact sockets.
Two five-contact sockets.
Two six-contact sockets.
Two 57 tubes.
Two 56 tubes.
Two 2A3 tubes.
One 5Z3 tube.
Two grid clips.

THE IMPROVED THOR

THE 55 IS USED FOR SECOND DETECTO MATIC VOLUME CONTROL. GREA

By

Engineering Staff,



The circuit diagram of the all-wave receiver that uses regular shielded coils for the broadcast band and spe All selection of bands is by switching.

WE ARE never satisfied with any receiver no matter how well it performs. Satisfaction would exclude improvement, and as long as new devices, new methods, and new ideas come out, there is always room for making anything good much better. By comparison, the Thorax seven-tube all-wave superheterodyne needed no improvement, but in the light of experience improvements could be made, and they have been made, thus placing the circuit much farther ahead on a comparative basis.

There are many criteria by which the performance of any all-wave receiver may be judged. Naming a few, it must have sufficient selectivity in all bands and at all settings of the tuning control, it must have a high and controllable gain, it must have an output sufficient to operate a loudspeaker, it must have a quality sensibly free from distortion, it must be entirely free from regeneration in those parts of the circuit which are supposed to be only amplifiers or detectors, it must be easy to tune.

The designer has succeeded in improving the circuit in respect to all these criteria. The changes in the circuit effecting these improvements are easy. Consider, for example, the question of stability. An infinitesimal amount of feedback may cause the circuit to be uncontrollable, yet from the nature of the case it may only take a minute of work to effect stability. This is true in an audio amplifier and it must be, and is, equally true in a radio- and intermediate-frequency amplifier.

It has been found by experience that a 55 tube as second detector and first audio amplifier when used also for automatic volume control is preferable to tubes having a greater theoretical gain. The quality is better, the a.v.c. has a greater range, and overloading does not begin nearly as quickly as when the triode, or pentode section of a duo-diode-amplifier tube has a greater amplification constant. That is the reason why we use a 55 in this improved circuit.

As a means of improving the stability, by-pass condensers have been increased in magnitude and others have been added. Also, chokes have been inserted in the leads where feedback might cause trouble. And when a radio-frequency choke is used, a by-pass condenser goes with it in order to provide a short path for the radio-frequency current where it should go and a very high impedance path where it should not go.

The wave coverage is the same as in the earlier model. It goes from the lower broadcast frequency limit up to the highest on which signals are receivable. In other words, the owner of one of these new receivers has the choice of any signal frequency on which there is likely to be a receivable signal. Since the receiver

A 10-Watt Po

(Continued from preceding page)

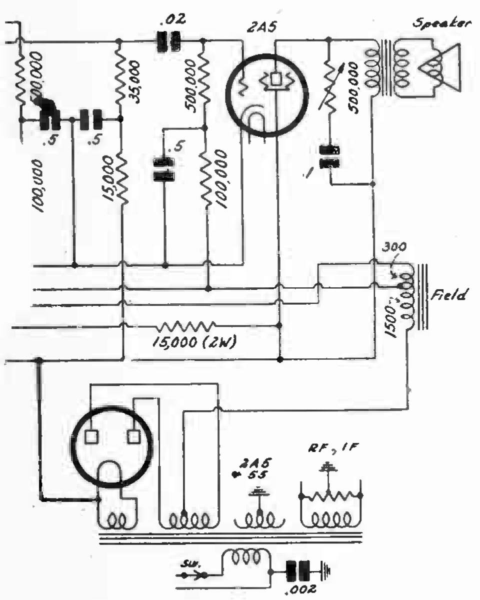
monics. The larger the audio bypass condensers are the better. But they must be able to withstand high voltages. A rating of 600 volts is none too high. The second choke is like the first, and there is also a condenser C8 used with this in the same manner as before.

The power transformer contains six windings. The primary has three taps aside from the two terminals. This provides means for three different line voltages. If the line voltage is low, the entire winding should be used. If it is high, one of the other taps should be employed. This is a feature not often found in radio power transformers at this time, but a few years ago it was

RAX ALL-WAVE SUPER

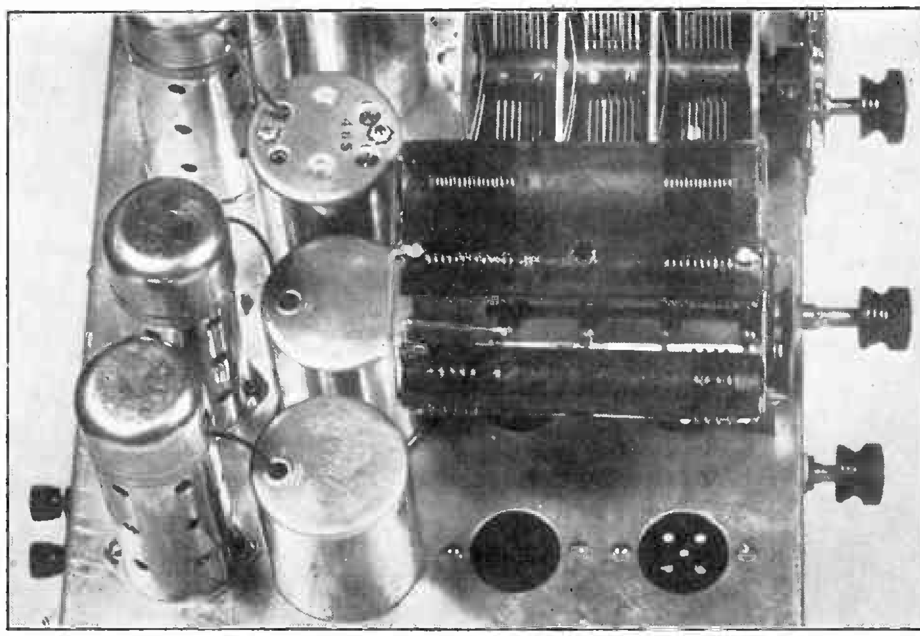
R, FIRST AUDIO AMPLIFIER AND AUTO-
TER STABILITY HAS BEEN EFFECTED

H. M.
Thor Radio Company



cial coil assemblies for short waves.

has been designed primarily for broadcast reception, there is always the possibility of turning to these reliable waves when weather and atmospheric conditions are unfavorable for short-wave reception. Yet it only takes a turn of a knob to bring in the short waves when they are wanted. The receiver is characterized by



The coil-switch assembly consists of four separate coil systems, three windings on each unit, to the secondaries of which the tuning condenser stators are connected by switching, while also the ticklers and pick-up windings are automatically selected. See front cover for other illustration.

simplicity of tuning, as it is a superheterodyne, hence free of the critical aspects attendant on regenerative tuning. The switch used is of the all-important positive-contact type, and the wire diameter on the short-wave coils is scientifically related to the frequencies covered, for best efficiency.

ower Amplifier

common in the better grades of receivers. The rectifier filament winding has a voltage of 5 volts, assuming that the proper primary tap is used for the line voltage obtaining. The winding is center-tapped, a minor point, to be sure, but a good one if the lowest output hum is to result.

The transformer has three other low-voltage windings, all three center-tapped. The winding CC is used for the power tubes only, and winding BB is used for the heatres of the four other tubes. Winding AA may be used for the heaters of any other tubes, such as the tubes in a radio frequency tuner. These windings should have a normal voltage of 2.5 volts to be most useful with present tubes.

LIST OF PARTS

Coils

One B.C. antenna coil.
One B.C. r-f coil.
One 465 kc oscillator coil.
Three 465 kc oscillator coil (Hammarlund).
Five Bud 10 mh. coils.
One Bud 60 mh. coil.
One power transformer (UTC-UM5).

Condensers

One gang of three 0.00035 mfd. tuning condensers.
One midget condenser (Hammarlund).
One 500 mmfd. padder condenser.
Two 0.00025 mfd. condensers.
One 0.0001 mfd. condenser.
Three 0.25 mfd. tubular, 300-volt condensers.
Two 0.02 mfd. tubular, 600-volt condensers.
One 0.1 mfd. tubular, 400-volt condenser.
Two 0.5 mfd. tubular, 400-volt condensers.
Two 8 mfd. electrolytic condensers.
Three dual 0.05 mfd. condensers.
One 0.0002 mfd. condenser.
One condenser block.

Resistors

One 500,000-ohm volume control.
One 500,000-ohm volume control with switch.
One 100,000-ohm, ½-watt resistor.
One 35,000-ohm, ½-wat resistor.
One 15,000-ohm, ½-watt resistor.
One 50,000-ohm, ½-watt resistor.
Four 20,000-ohm, ½-watt resistors.
Eight 500,000-ohm, ½-watt resistors.
One 10-ohm, center-tapped resistor.
One 15,000-ohm, 2-watt resistor.
One 50,000-ohm, 1-watt resistor.

Other Requirements

One 2A5 socket.
One 55 socket.
One 2A7 socket.
Three 58 sockets.
One 80 socket.
One speaker socket.
Five tube shields.
One four-deck, four-position switch.
One Crowe dial.
One chassis (10x18 inches).
One line cord.
Grid caps and hardware.
Birnbach hook-up wire.
Seven matched tubes.
Rola 1,800/300 dynamic speaker.

Fun, Education, Sentiment, Combine in Short Waves

Tuning in "the Old Country" Adds Zest to Combing of Earth for Startling "Catches"—Young and Old Flocking to High Frequencies as Receiver Sales Mount

By Jack L. Lawrence

ONLY a very small percentage of Americans ever have the opportunity to go to Europe, although many of them were born there, and practically all of them trace their ancestry to European countries. Those fortunate enough to have their mothers still with them usually will be interested in the "old country" for her sake at least, for likely she herself came from there, or at least one of her parents did. There are only 40,000,000 persons in this country whose ancestors were born a third generation back, leaving nearly 100,000,000 in the other class.

Therefore a means of tuning in foreign countries provides a sentimental appeal as well as entertainment and education. That means is the short-wave or all-wave receiver.

Promising Summer Ahead

The reception of broadcast programs on the usual waves has become a habit in a country that has more than 40 per cent of its homes equipped with receivers. Probably less than 5 per cent of the homes are provided with means for short-wave reception, but at the present pace this figure will be greatly increased in a hurry, and there will be considerable short-wave fun during the Summer, when the disturbances expected on DX on the broadcast band are not nearly so severe on short waves.

Those who have never tuned a short-wave set have some happy surprises in store, and also, it must be stated, a few disappointments. The rules about short waves are well known to the experienced radicist, even if his experience has been solely in the short-wav band, for he has been reading up on short waves even if he has not been listening to them.

One expectation that every one may look forward to without much pleasure is that there may be more noise than on the broadcast band. The reason is not far to seek. The programs come from great distances, and atmospheric disturbances along this gigantic route are cumulative.

Some Astonishment, Too

Even the local land path of the wave may result in the introduction of man-made interference as from motors, commutators, oil burners, sign flashers and the like. However, the noise-free occasions are numerous enough to warrant adoption of short-wave reception as a hobby. Sometimes it is astonshing how clearly a program comes in from a station 4,000 to 10,000 miles away.

Broadcast listeners are familiar with the fact that distant programs, even locals, come in better at night than during the day. The reason evidently is that sunlight causes dissipation of the radiated energy. In some locations semi-local stations are not heard at all during the daytime, but come in well at night.

On short waves this factor of day and night effect is more important still. The general rule is that the higher the frequency, the more daylight is required for the satisfactory transmission of the wave. The daylight referred to need to pertain solely to the listening location. Over a great distance there will be daylight, dusk and darkness, and the test is whether the wave must travel through much or little daylight or darkness. Therefore reception normally not expected from remote foreign points around 50 meters, a night band, may be enjoyed nevertheless if much of the wave's path is through darkness, hence mid-afternoon at the reception point sometimes will yield excellent results on this band.

Consider the Total Path

It is always good practice to try out the various bands in respect to stations known or reasonably expected to be on the air at that time, and with reference to intervening daylight and darkness. Simply looking up at the sky, or at the clock, is not sufficient, for, as explained, the total path of the wave must be considered, not the listening location alone.

It is obvious that some knowledge must be possessed about the sun's orbit. Daylight and darkness may be determined from the time at various foreign places, and there are tabulations of time differences. Besides becoming acquainted with these, it is well to familiarize one's self with latitude and longitude, and to prepare one's own rating of stations as to the most desirable hours to receive them. All one reads is helpful, but when one works out the problem as if on his own the fun increases.

Besides the sun there's the moon to consider. The effect of the moon on short-wave radio reception is not well established, and there has been much romancing on this topic. The full moon is said to be a retarding influence, because the moon is a satellite of the sun, and moonlight is only reflected sunlight, and the effect of sunlight on the various short waves is understood.

Careful measurements have been made by the leading laboratories, and the Bureau of Standards has been making special studies of short-wave results during the eclipse.

The Radio Ceiling

Related to all this are the regular measurements of the height of the radio ceiling, or reflecting strata which cause the radiated waves that dart skyward to be bounced back to earth, the height of the ceiling determining to a degree the distance to be covered by the wave without terrestial interference, as well as the distance on earth that the sky wave will skip during its travel from the transmitter to the ceiling and back to earth at an angle.

It is even true that the wave returned to earth is itself reflected from the earth back to the ceiling, which may have a different height at the new location, hence plotting all these factors is quite an undertaking, and is by no means complete.

Science Service maintains constant watch on the height of the radio ceiling, in respect to measurements on particular frequencies of transmission, and reports on other cosmic data, distributing its findings all over the world, including messages by radio stating the results. Exchanges of scientific information thus are made by various countries accurately and quickly.

He Will Get That Urge

The body of knowledge to be gained before short waves become a familiarity should not prove alarming, as the major work is left to the scientists, and the short-wave tuner-in simply may get as much fun out of what he "catches" as he possibly can, and assume to let it go at that. But some time he will feel the urge to get better acquainted, but as a starter he need know nothing more than enough to turn on the set and rotate the dial. Soon he will become convinced that the thing to do is to consult a station list and try to get some particular station. The fishing expedition days are over for any who really mean to bring in lots of foreign stations.

It is surprising how much one's knowledge grows as one deals with short waves. The world becomes one's workbench and one unconsciously becomes internationally-minded, in a radio sense. Foreign affairs may strike him lightly. Propaganda from Germany or Russia may be tuned in, and merely give the listener a laugh, especially if he's just gotten a raise in salary.

Familiar Characteristics

The characteristics of the leading foreign stations become familiar soon enough. The British programs are so unlike any others there is no mistake. The waits between announcements and selections are characteristic. GSB, Daventry, is coming in well just now—the author is listening to it—and the frequency is 9.51 megacycles.

Pointoise, France, is another standby. Call letters, FYA, frequency, 11.7 mgc. 12 RO, 11.81 mgc; DJD, Berlin, 11.76 mgc, are also favorites. One gets to know them not only by their frequency but by the characteristics of their modulation. Some stations have so much modulation personality that experienced short-wave listeners can tell what the station is simply by listening to the modulation. In general, the modulation is no compliment to the station, if the modulation is distinctive, as there is then usually too much of it, a form of distortion.

Programs Typical

Then, again, the type of program, such as the operatic music from Italy, the folksong fro mGermany, and the familiar-accented news from England, give excellent clues to identity, even when call letters and frequencies are seldom announced.

NEW INVENTION GIVES LISTENER THE LOST VOICE

Those who put on or pay for programs can find out how many are listening in, also whether those listening like the program or not, says Dr. Nevil M. Hopkins, who offers an invention which he says will do the trick, a three-push-button affair that can be installed on sets for 25 cents. However, before such a system can be introduced it is necessary that the stations or sponsors should desire it, and that arrangements be made with the power company, which is to be the recording angel of the ether voting machine. ...

In fact, Dr. Hopkins calls the operation of his device "radiovoting," and explains that the three buttons would enable the audience to vote as follows: (1) present, (2) yes, and (3) no. Thus if any sponsor were interested in the total number of listeners within a given area served by power companies, and saw to it that the radiovoting device was introduced, he could get an accurate idea of the number of listeners from the amount of power consumed when the "present" button was pressed.

They Take Their Chances

The "yes" and "no" buttons would represent thumbs up or down for the program, also on a power-rating basis, but of course the actors, directors, sponsors and stations would have to take their chances, as the good doctor can not guarantee a desired listener reaction. He is not a spychologist or mesmerist but a physicist.

The North American Company has taken up the proposition and promises to obtain a trial in Washington, D. C., and if the scheme works out, to try to extend the use practically throughout the United States, as the corporation has large resources and influential backing. However, it is admitted that there will be opposition, and some of it already has been expressed by stations whose executives have been approched. The reply has been, in some instances, that there is no interest by any one as to the number of listeners, but rather as to the effectiveness of the results from those who are listening, and that a vote of yes or no on a program could not be guaranteed to be free from whimsies.

Jiffy Straw Vote

One of the possibilities Dr. Hopkins points out is that a straw vote could be taken in a jiffy, and over wide areas, on political candidates. At present the general method is either to use the mails, which is vastly expensive, or to have readers of newspapers fill in ballots clipped from those journals. Both the newspaper and the mail methods are usually augmented by some canvassing, occasionally of the house-to-house type, and as a rule the predictions have been fairly accurate.

The doctor points out that the great expense of the other methods can be avoided. For instance, it has been pointed out that the mailing system is applied largely to telephone subscribers, as the telephone book is used as the list, so persons in the so-called higher brackets largely may be the voters, and some political-minded persons assume this result in a straw vote among too large a percentage of Republicans. Wherever the idea originated that the Democrats don't have any money or telephones is not clear, but the doctrine is well disseminated and seems to be believed.

A Voice for Listener

The radiovoting method would bring in all classes, both sexes, and prove more accurate even than the present methods, the backers of the radiovoting device assert.

"The listener has been practically denied a voice in programs," said Dr. Hopkins, "but with the adoption of this device at last he will be able to have his say. Of course the device will not be installed throughout the country overnight. For instance, officials of a broadcasting network tell me there is no value in counting the audience or having the audience vote on a program. However, that does not settle the matter."

Alterations and Corrections to Official Station List

The Federal Radio Commission has issued in booklet form lists of broadcasting stations in the United States, arranged by frequencies, by call letters and geographically, as of January 1st, 1934. The following alterations and corrections are announced:

SUPPLEMENT NO. 1

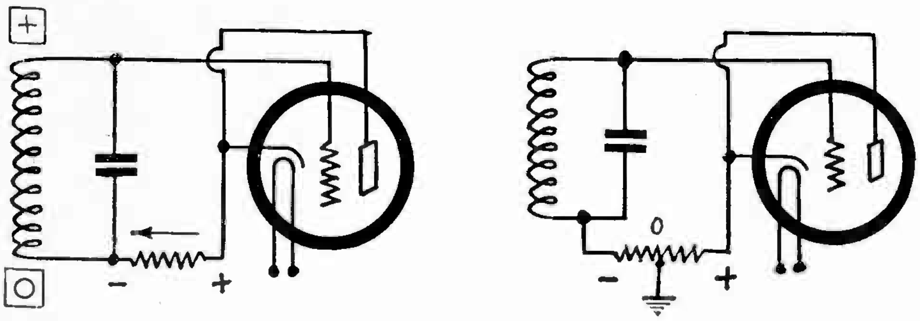
Call Letters	*Studio Location*	*Alterations and Corrections*
KGBZ	York, Nebraska	Licensee, KGBZ Broadcasting Company
KGFK	Moorhead, Minn.	C.P.—T and studio Duluth
KGHF	Pueblo, Colo.	Strike out Geo. J. Ikelman
KICK	Carter Lake, Iowa	Licensee, The Palmer School of Chiropractic—C.P. T and studio, Davenport, frequency, 1370 kc.
KWCR	Cedar Rapids, Iowa	C.P. consolidation of WIAS, power 250w, 500w-LS, frequency 1430 kc., quota units 0.5
KWFV	Hilo, Hawaii	C.T.—T and studio S. Hilo, Waiakea
KWTO	Grant City, Mo.	T and studio Springfield, power 500w, frequency 560 kc., D
WAVE	Hopkinsville, Ky.	T and studio Louisville
WAZL	Hazleton, Pa.	Quota units 0.21
WBBZ	Ponca City, Okla.	S.A. James F. Kyler to operate station
WCAH	Columbus, Ohio	Call letters changed to WBNS
WFAS	White Plains, N. Y.	Add S-WGNY
WFEA	Manchester, N. H.	Call letters WCAH changed to WBNS
WGBB	Freeport, N. Y.	Add S-WGNY
WGBI	Scranton, Pa.	S.A. Exp. power 250w additional
WGNY	Chester Twp., N. Y.	S-WJBI, WFAS and WGBB, quota units 0.05
WGST	Atlanta, Ga.	C.P. power 1 kw-LS, quota units 0.7
WHAD	Milwaukee, Wisc.	Licensee, WHAD, Inc.
WHAS	Louisville, Ky.	Power 50 kw.
WHEC	Rochester, N. Y.	Call letters WCAH changed to WBNS
WHET	Troy, Ala.	T and studio Dothan, frequency 1370 kc.
WHN	New York, N. Y.	U, quota units 0.4
WHP	Harrisburg, Pa.	Call letters WCAH changed to WBNS
WIAS	Ottumwa, Iowa	Quota units 0.0 see KWCR
WILM	Wilmington, Del.	Quota units 0.03
WJBI	Red Bank, N. J.	Add S-WGNY
WJJD	Mooseheart, Ill.	Studio Chicago
WKBV	Connersville, Ind.	T and studio Richmond
WLAP	Louisville, Ky.	C.P.—T and studio Lexington, frequency 1420 kc.
WMBR	Tampa, Fla.	T and studio Jacksonville
WMT	Waterloo, Iowa	Power 1 kw-LS, quota units 0.8
WNRA	Muscle Shoals City, Ala.	C.P. covered by license
WOAI	San Antonio, Texas	Licensee, Southland Industries, Inc.
WOKO	Albany, N. Y.	Call letters WCAH changed to WBNS
WOWO	Ft. Wayne, Ind.	Simultaneous D. S-WWVA night. Strike out S.A.
WPRO	Providence, R. I.	S.A. Exp. power 250w, frequency 630 kc. experimental period
WPTF	Raleigh, N. C.	S.A. Exp. operate simultaneously with KPO until 11:00 p.m.
WQAO-WPAP	New York, N. Y.	Strike out all particulars
WRNY	New York, N. Y.	Strike out all particulars
WWVA	Wheeling, W. Va.	Simultaneous D, S-WOWO night. Strike out S.A.

SUPPLEMENT NO. 2

Call Letters	*Studio Location*	*Alterations and Corrections*
KFAB	Lincoln, Neb.	Simultaneous D, S-WBBM night. S.A. Exp. to operate S.H. night synchronized with WBBM
KICK	Carter Lake, Iowa	Licensee, Red Oak Radio Corp. Strike out C.P.
KIEM	Eureka, Calif.	U, quota units 0.2
KLCN	Blytheville, Ark.	Power 100w
KTRB	Modesto, Calif.	C.P. Permittee, Thomas R.McTammany and Wm. H. Bates, Jr., frequency 740 kc, power 250w, D, quota units 0.2
KTRH	Houston, Tex.	S.A. Exp. frequency 630 kc, power 500w 1kw-LS. Strike out S.A. Exp.
KTUL	Chickasha, Okla.	T and studio, Tulsa
WAPI	Birmingham, Ala.	Strike out C.P. 25kw.
WATR	Waterbury, Conn.	C.P. Permittee, Harold Thomas, frequency 1190 kc, power 100w, D, quota units 0.1
WAVE	Louisville, Ky.	Licensee, WAVE, Inc.
WBBM	Chicago, Ill.	Simultaneous D, S-KFAB night. S.A. Exp. operate S.H. night synchronized with KFAB
WBNS	Columbus, O.	Licensee, WBNS, Incorporated, power 1kw-LS, U. C.P. T-Truro Township, quota units 0.8. Strike out S.A. Exp.
WCAC	Storrs, Conn.	Licensee, Connecticut State College, power 500w
WCAE	Pittsburgh, Pa.	T-Baldwin Township
WCAO	Baltimore, Md.	Power 500w, quota units 0.6
WCBD	Zion, Ill.	Quota units 0.92
WFAA	Dallas, Tex.	Strike out, The Dallas News and Dallas Journal
WFEA	Manchester. N. H.	C.P. Exp. T-Merrimack, frequency 1340 kc. S.A. Exp. to operate simultaneously with WOKO, WHEC, WBNS and WHP on 1430 kc.
WHAD	Milwaukee, Wis.	Licensee, Marquette University
WHB	Kansas City, Mo.	Strike out S.A.
WHDF	Calumet, Mich.	Quota units 0.11
WHEC	Rochester, N. Y.	Frequency 1430 kc, U, quota units 0.6. Strike out S.A. Exp.
WHP	Harrisburg. Pa.	S.H., quota units 0.72. Strike out S.A. Exp.
WIAS	Ottumwa, Iowa	Strike out all particulars
WIBA	Madison, Wis.	S.A. Exp. 500w additional night
WICC	Bridgeport, Conn.	Power 500w. quota units 0.59
WJDX	Jackson, Miss.	C.P. power 2½kw-LS, quota units 1.25
WJJD	Chicago, Ill.	Studio, Mooseheart
WKBC	Birmingham, Ala.	Call letters changed to WSGN
WLEU	Erie, Pa.	C.P., Permittee, Leo J. Omelian, frequency 1420 kc, power 100w, 250w-LS, U, quota units 0.3
WLNH	Laconia, N. H.	C.P., Permittee, Northern Broadcasting Company, Inc., frequency 1310 kc, power 100w, D, quota units 0.1
WMAS	Springfield, Mass.	Power 250w-LS
WMBI	Chicago, Ill.	Quota units 0.83
WOBU	Charleston, W. Va.	Call letters changed to WCHS
WOKO	Albany, N. Y.	Frequency 1430 kc. U, quota units 0.6. Strike out S.A. Exp.
WPFB	Hattiesburg, Miss.	S.H., quota units 0.07
WPTF	Raleigh. N. C.	C.P. T-Cary, quota units 2.75
WRAM	Wilmington, N. C.	C.P. T and studio Durham, frequency 1500 kc.
WSAZ	Huntington, W. Va.	Power 1 kw.
WSOC	Charlotte, N. C.	C.P. power 250w-LS. quota units 0.3

Radio University

ANSWERS to Questions of General Interest to Readers. Only Selected Questions Are Answered and Only by Publication in These Columns. No Correspondence Can Be Undertaken.



At left is a triode used as diode for detection. At right the circuit permits push-pull operation.

Diode to Push-Pull

REGARDING DIRECT resistance coupling from a diode for push-pull, I read an article in "Radio Engineering" by M. L. Muhleman, in which he said that RADIO WORLD has "recently given considerable space to details of a circuit arrangement employing a diode directly resistance-coupled to a pair of power pentodes in push-pull." The same circuit, he wrote, was used by Crosley in the Model 130 receiver, released in June, 1932. What is this direct-coupled circuit?—W. W. I.

The direct-coupled output from a single diode to feed a push-pull pair was devised by J. E. Anderson and published first in RADIO WORLD in 1929. Application to pentodes was detailed recently in a semi-review fashion. The fundamental idea is represented by the two circuits herewith, the type of tubes following being of no consequence. At left is a triode used as diode. The a-c voltage signs are in squares, the d-c voltage signs are not. This circuit could be directly coupled to a single diode-biased amplifier or output stage. If the center of the load resistor is grounded, as at right, then if the two grids of the following push-pull tubes are connected to the plus and minus signs, and a means introduced to buck out the positive bias on one of the following pair of tubes, direct coupling is enjoyed. In fact, if stopping condensers are used, the bias corrective becomes automatic, and the coupling still remains direct. The absence of the stopping condenser renders the one circuit non-reactive, that is amplification is independent of audio frequency. The Crosley circuit, mentioned by Mr. Muhleman, came out more than two years after the original presentation in RADIO WORLD, and while it is not assumed that Mr. Muhleman meant any invidious contrast between data published "recently" in RADIO WORLD and the Crosley circuit of nearly two years previous, it is nevertheless a fact that the Crosley circuit came three years after Mr. Anderson's, and had Mr. Muhleman known it he no doubt would have handled the situation differently.

* * *

Barkhausen-Kurz Oscillators

WILL you kindly indicate how a Barkhausen-Kurz oscillator can be hooked up so as to generate waves around one meter? If such waves can be generated by an ordinary receiving tube, how can they be radiated?—W. H. C.

The ordinary receiving tube can be used for generating Barkhausen-Kurz oscillations if the voltages on the elements are proportioned correctly. First of all there should be plenty of electron emission from the cathode. Therefore the tube should be operated with full rated voltage on the heater or filament. Second, the grid potential must be very much positive—just about as much voltage on the grid as it will stand. Third, the plate potential should either be zero or it should be a few volts negative. The plate and grid potentials should be applied through radio frequency chokes of a low distributed capacity as possible. Radiation from the oscillator may be obtained by connecting a short length of wire to the grid, either directing it upward or horizontally. This wire should not be more than about a foot or two. It is not so easy to detect the waves as it is to generate them. Due to the fact that a high positive voltage is applied to the grid, the grid current will be high and the temperature of the grid will rise. The tube will not last long.

* * *

Determination of Number of Coils

Is there not a simple way of determining the number of coils required for covering a certain short-wave band when the ratio of maximum to minimum capacity of the tuning condenser is known? If there is, will you kindly give it?—T. H. Y.

Yes, there is. Suppose that the ratio of maximum to minimum capacity is R. The frequency ratio covered by a given coil and this variable condenser is then ($R^{1/2}$). If the ratio of the highest to the lowest frequency to be tuned in is r and the required number of coils is n, then R = ($R^{1/2n}$). Taking the common logarithm of both members of this equation we have log r = $\frac{1}{2}n$log R. Therefore n is given by the equation 2log r/log R = n. As an illustration of this let the highest frequency to be received be 60 megacycles and the lowest 1.5 megacycles. Then r = 40. Suppose now that the ratio of maximum to minimum capacities is 4, such as 80/20. Twice log40 is 3.2042 and log4 is 0.6021. Therefore n = 5.32. Since we cannot have a fractional coil, we have to use 6 coils.

* * *

Amplifier Howls

I HAVE just completed a four-stage audio amplifier with two stages of push-pull and two resistance coupled stages. It howls terrifically. What can account for it?—H. R.

Chances are that the circuit is motorboating. Two stages of resistance coupling would not make it howl, for such a circuit is stable. Two stages of push-pull transformer coupled circuits should be perfectly stable if the amplifier is balanced. If it is not, howling might result. But with two stages resistance coupled and two stages of push-pull will almost certainly howl if there is the slightest unbalance in either audio stage. The remedy is to filter the supply leads in each stage. In the resistance stages this can be done with a resistor of 50,000 ohms, assuming a load resistance not less than 100,000 ohms, with a condenser of about 2 mfd. from the junction of the two resistors and the cathode of the tube supplied. Begin with the plate circuit of the first tube. Filtering this may be sufficient. If not, the next plate circuit should be filtered. If there is a transformer in the plate circuit of a tube, it is better to use a choke for filtering than a resistor.

* * *

Using Two Power Supplies

WOULD it be advantageous to use two power supplies in a highly sensitive audio amplifier, that is, one for the first tubes and another for the later tubes? It has been suggested to me that this is a good thing as a means of eliminating distortion.—G. E. N.

The best way in any audio amplifier is to have one power supply for each tube or each stage. The reason it is not done is that it is not very practical, when good results can be obtained with a single supply and filtering of the leads. But sometimes it is both practical and necessary to use two as you suggest. Suppose, for example, that there are five stages in the amplifier, with two stages resistance coupled. These two can be supplied by a separate B supply, and this need not use other than a small general purpose receiving tube for rectifier, for the current drawn by the two resistance coupled stages is very low. Nearly the same results as by using separate power supplies can be obtained by using a separate voltage divider for each tube. This, of course, is equivalent to filters.

* * *

Ionization in Tubes

WHAT is the reason a blue glow appears in some tubes when the voltage on the plate is excessive? I have observed this both in amplifiers and rectifiers. It seems to me that when a blue glow has appeared in a tube that tube is not so good as it was before. Is this only imagination or is there a sound reason for it—T. R. L.

The blue glow is the result of ionization by collision in the tube and is a direct indication that the gas has not been completely eliminated. Since the voltage at which the glow appears depends on the gas pressure, the glow point will not be the same in all tubes. It will be higher, in voltage, the less gas there is. Of course, if there is much gas in the tube it will not appear either. If overvoltage is great and if the ironizing condition remains for some time the tube will be permanently damaged. In some pentodes the blue glow is not due to gas.

* * *

Regarding Pocket Set

IN the Feb. 24 issue, on page 15, you have a pocket type set. Can this be used on batteries? If so, what changes should be made?—W. L. C.

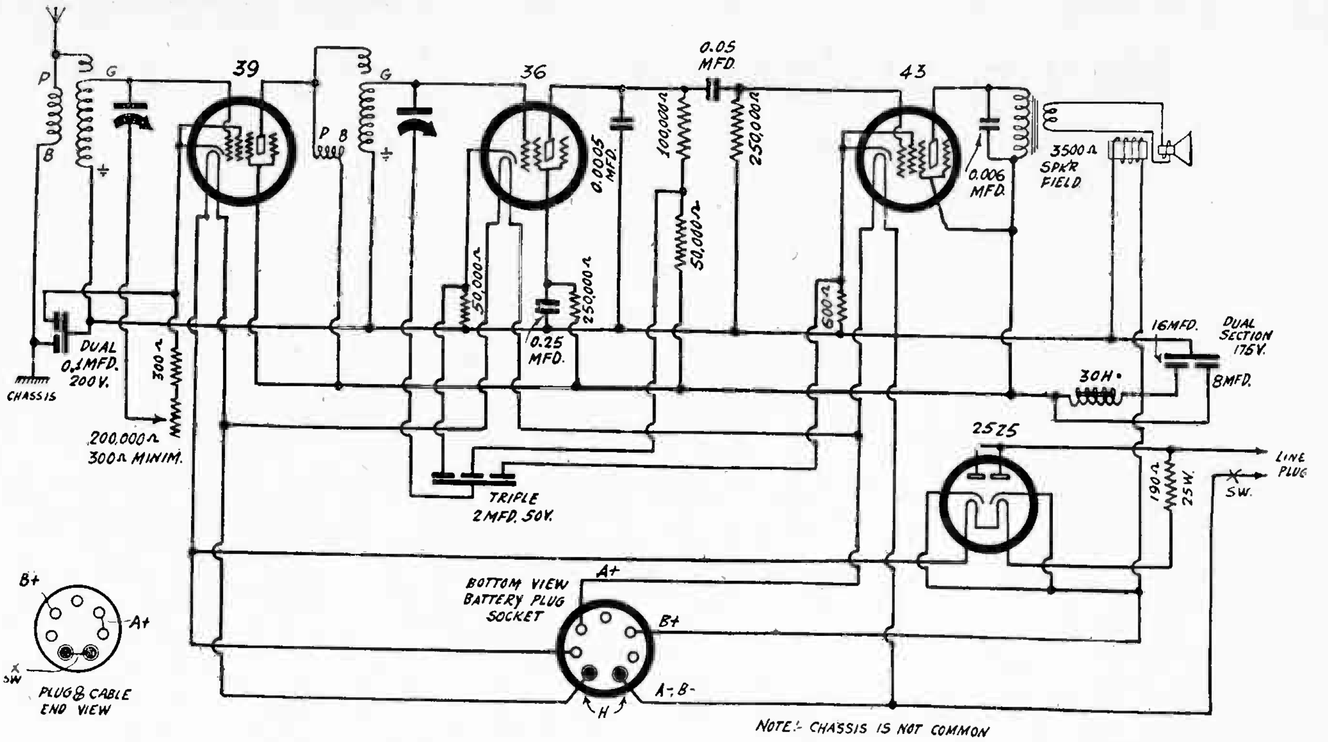
No, it cannot be used on batteries, but it can be used on either d-c or a-c lines. By "pocket type" refers to the size and not to its mode of operation. It would be rather awkward to carry a set of batteries in the pocket in addition to the set.

* * *

Inductance of Leads

IS there any way of estimating the inductance of leads running from one part of a circuit to another? I know that the inductance of these leads is small when broadcast frequencies are involved, but when the inductance of the coil is reduced to a minimum in an attempt to reach short waves it may be that the inductance of the leads must be taken into account.—F. W. E.

Yes, the inductance of the leads must be



A simple t-r-f receiver for broadcast waves, requiring only four tubes, one of these the 25Z5 rectifier. Such circuit is all right for local reception.

taken into account in ultra-high frequency circuits, for there is often no other inductance to consider. To compute these inductances from the shape and length of the leads, however, is beyond practical possibility. The inductance of a short, straight length of wire quite isolated from other conductors can be computed easily. So can the inductance of a pair of parallel wires of given length and distance apart. In fact, the inductance of any regular arrangement of the conductors can be computed by well-known formulas. But it is seldom that the conductors are placed regularly so that they can be brought under the formulas. To reach short waves the best practice is to make the leads as short as possible and then hope that the interelectrode capacities are small.

* * *

Two Universal Receivers

IS IT PRACTICAL to get satisfactory results from a four-tube universal circuit, and if so please show the diagram? Also, would it be advisable to add another tube or two, and should push-pull be used instead of single-sided output?—O. W. C.

The diagram of a four-tube universal t-r-f receiver is shown herewith, and the circuit will be satisfactory for reception of locals. It is unnecessary to use push-pull, in view of the small power-handling requirement, as the 43 will serve nicely alone. In fact, even if two resistance-coupled stages are used, as shown on the diagram on lower part of this page, the 43 still will be able to cope with it, especially as any unusually strong input, as from a proximate local, can be cut down by the volume control, which is properly positioned for this purpose. The 43 is often selected because of the simplicity of the limiting-resistor circuit. The heater current is the same as that for the other tubes, and also the 43 heats up at about the same speed. While the 48 is a better tube, in that it handles more power, it requires an independent limiting resistor, not because the current is slightly higher (which it is) but principally because the heater is slower in operation, and the starting voltage would be too high and remain too high for a short but dangerous interval if the heater circuits were dependent.

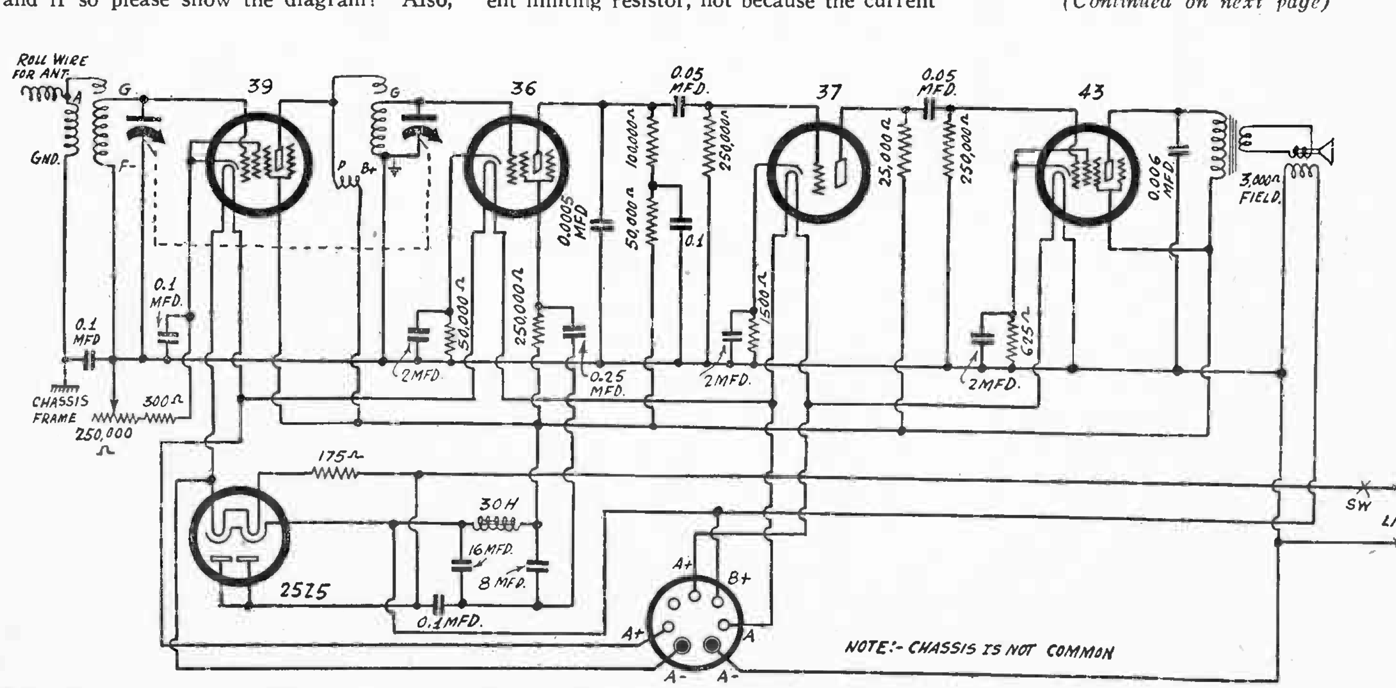
* * *

Interaction Between Elements

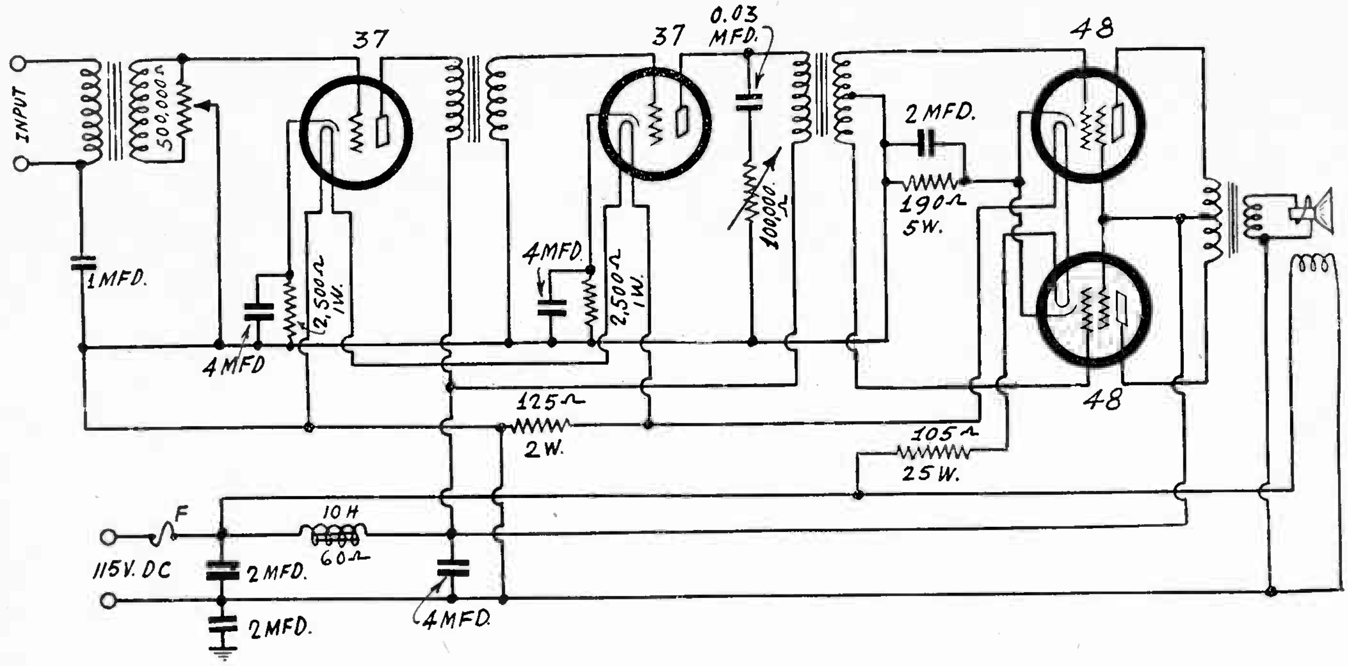
IF there are many elements in a tube and they are used for different purposes, is there not danger of causing serious coupling? I have in mind particularly such tubes as the 55, the 6F7, 12A7, and the like. Is it not better to use one tube for each function than to combine many functions in one tube? —F. E. A.

Yes, it is better to use one tube for each function, but this does not necessarily mean that two tubes cannot be placed inside the same evacuated space. Suppose the two

(Continued on next page)



Simplification of the limiting resistor circuit obtains when the 43 is the output tube, as the current is the same as that through the other heaters, and the heating pace is the same.



A d-c operated power amplifier. Two 37 tubes are used in the cascade ahead of the push-pull pentode output. The 48 is the best output pentode of the "automotive series," though requiring separate or series-parallel limiting resistor for the heaters.

(Continued from preceding page)

parts of the tube use the same cathode. If the electron streams pertaining to the two different parts are not actually intermingling, there is no appreciable coupling. It is not much greater than when all the cathodes of different tubes are connected to the same point outside the tubes, that chassis, for example.

* * *

Polarizing a Piezo Speaker

WHAT is the reason it is recommended that no polarizing force or voltage should be used with a piezo crystal microphone? Does it harm the circuit or the mike to do it?—W. H. T.

The piezo crystal develops voltages when it is twisted or compressed. In the condenser speaker the capacity is varied when the diaphragm moves. No voltage would be developed across the load resistance unless there were a polarizing potential. Because everybody knows that the condenser microphone must have a polarizing potential, the makers of the piezo microphone emphasize the fact that no voltage is needed with this type. This does not mean that the tube following the microphone should not be biased.

* * *

Method of By-Passing

WHEN a by-pass condenser is used in a plate or grid circuit, is it better to connect it to the cathode or to ground when there is a difference in potential between them?—W. H. L.

It is better to connect to the cathode when the condenser is used for a single tube, but to ground if it is used for two or more. If the cathodes are all connected it is better even then to make the connection to the cathode.

* * *

Distortion Factor

WHAT is meant by distortion factor as applied to an audio amplifier? Can it be measured easily? In what manner does the amount of distortion depend on the load resistance?—R. L.

The ratio of the sum of the squares of all the harmonic components except the fundamental to the square of the fundamental gives the square of the distortion factor. Thus the square root of this ratio is the factor. The sum of the squares is the square of the current that would be measured with an a-c milliammeter after the fundamental has been removed by filtering. The current measured with an a-c meter before the filtering would give the total. For small distortion this is not greatly different from the fundamental alone. In other words, the current measured when the fundamental has been removed divided by the distortion factor. The distortion is least when the optimum load resistance is used. At zero load the distortion is practically all second harmonic. It decreases rapidly as the load resistance is increased until a certain load value is reached, when it increases to high values. The third harmonic distortion begins to be considerable after the optimum load resistance has been exceeded.

* * *

Power Tube Chokes Up

IN a power amplifier I have constructed using resistance coupling throughout the power tube, a 2A3 chokes up. When I first turn the set on it works all right but gradually the volume dies down and there is terrible distortion. I have traced the trouble to the power tube, for when I connect a milliammeter in the circuit, it first remains steady but as the trouble develops the needle dances around lustily but the current is usually less than when the tube works right. What is the cause of this trouble?—G. K. L.

The symptoms indicate that there is grid rectification. Your grid leak should be reduced greatly, apparently. Perhaps if you connect a choke, such as the secondary of an audio input transformer, the trouble will clear up without any loss of output or any appreciable loss on the low frequencies. It is stated in the circuit pertaining to this tube that the grid leak should not exceed 0.5 megohm when the tube is self-biased and 10,000 ohms when the bias is fixed. The reason for these limitations is the grid current will flow and if the resistance is too high the effect you have observed will result.

* * *

D-C Power Amplifier

AS I DESIRE to get as much as possible out of a power amplifier or small public address system, for operation from the d-c line, will you please show a diagram that includes specification of the tubes? Transformer coupling is preferred.—U. E. D.

The diagram on this page may be followed. The 48 tubes will afford adequate output, as they have the greatest power-handling capacities in the 6-volt series. A tone control, consisting of a rheostat of 100,000 ohms in series with a fixed condenser of 0.03 mfd., is included, in case you desire this feature. The values of the other constants are imprinted on the diagram.

* * *

Oscillator Stability

IN SOME of your articles you have stated that frequency stability is desirable in oscillators, which I do not deny, and then you have shown methods, and advised a measurement of the plate current, to establish frequency stability on the basis of no change in plate current throughout the tuning in any particular range. For instance, for the broadcast band, steady plate current always should be the same, from 540 to 1,600 kc. Now, I have noticed that the plate current is steady in almost any oscillator to around 1,000 kc and therefore, from your own statement, there must be frequency stability in the region from 1,000 to 540 kc. I admit the needle wobbles between 1,000 kc, or a bit higher, and 1,600 kc. Is it not true, therefore, that for low frequencies the stability is excellent? Hence please state what is the real importance of frequency stability.—I. G. C.

The plate current results that you state for the band you discuss are correct, but the conclusion is not altogether so. The stability you point out as being present, true of a leak-condenser type oscillator, is present also if the frequencies are 54 to 160 kc, with stability from 54 to 100 kc, and instability from 100 to 160 kc. Also if the extreme frequencies are 5,400 kc and 16,000 kc there is stability between 5,400 kc and 10,000 kc, and instability between 10,000 and 16,000 kc. It can be seen, therefore, that the stability relates more reasonably to the capacity in the tuned circuit, for when that capacity is large the stability is excellent, and when the capacity is low the instabiliy is serious. In the sense that higher capacities represent lower frequencies you are right in stating that at low frequencies the stability is good, but the statement should be that comparatively low frequencies are meant. Absolutely, the frequencies may be high, as in the 5,400 to 10,000 kc example. The plate current steadiness is an unimpeachable indication of frequency stability, as it discloses that those factors which occasion instability are absent, and the oscillation amplitude therefore is uniform throughout the tuning range. In other words, the tube is used as a sort of vacuum-tube voltmeter, to measure the qualitative by the input amplitude, and this is unchanged. One reason for introducing some method of extending the stability over the whole run is that unless the oscillator is stable at all frequencies it can not be rated as stable.

Suppressor Use

WILL YOU PLEASE answer the following questions: (1) Can not the suppressor grid of the 57 or the 58 or similar tube with independently-connectable suppressor, be used as a rectifier in conjunction with use of the rest of the tube as amplifier or oscillator? (2) Does not the possibility of grid current flow exist at radio frequencies, intermediate frequencies and audio frequencies, and is such flow restricted to conditions where the grid is positive in respect to the cathode, even if made thus positive by the signal which overcomes the negative bias? (3) What is the reason for a humped curve, where a regular formation was to be expected, when I calibrate an oscillator, using a home-made dial of large dimensions, consisting of a protractor mounted on a knobbed hub?—I. G.

The suppressor grid may be used as a small rectifier. Perhaps you have in mind using the rest of the tube as an oscillator, and having a separate coil feeding the suppressor, this coil inductively related to the regular secondary, somewhat as the tickler would be. Then if the suppressor is returned to cathode the suppressor always will be positive in respect to cathode when there is any oscillation, and a grid condenser and resistor in the suppressor circuit would serve as rectifier adjunct. The situation would be akin to that of diode-biasing of an amplifier tube, as is done sometimes with the 55. Remember, however, that the oscillator's tuned secondary would have to be returned to the negative side of the resistor, toward suppressor, hence the resistor would be between the low r-f potential end of the suppressor pickup winding and cathode. As for grid current possibilities at the various frequencies, they always are present, and it may be safely said that practically all sets draw some grid current during strong passages of reproduction. This would refer particularly to the audio channel. There is grid current in cathode type tubes even when the signal is not positive in respect to cathode, but is 0.8 negative, or not quite so negative, in respect to cathode. There is inherent grid emission during these negative values of 0.8 or less volt. The reason for the humped curve is that the hub is not exactly centered on the protractor.

* * *

Small Short-Wave Sets

DURING THE PRESENT recrudescence of interest in short waves I find that the radio magazines are featuring the one-tube set, the two-tube set (detector and audio) and the four-tube set. Can good results be obtained from these simple receivers, or are they featured because the cost is so low?—K. C.

These sets give good results. In fact, the simple regenerative detector can be engineered with such skill as to produce results that surprise even the old-timers. Usually for earphone use a stage of audio is desirable. If the selectivity has been increased in the detector by especially loose coupling, then two stages of audio would be advisable, even for earphone use, although some strong stations could be heard on a speaker even under those conditions. It is indeed a fact that the prices of these small sets, or of kits of parts to build them, are very low, but that is no denial of the assertion that the results are such as to give real satisfaction even to fastidious listeners. Perhaps the only thing to be said against these sets is that they are critical to tune, but as methods improve, this critical aspect no doubt will be removed.

* * *

Light Bulbs as Resistors

IS IT PRACTICAL to use electric light bulbs as resistors, and if so can I rely on the resistance being what is expected?—W. S.

It is practical to rely on these bulbs, but whether your expectations will come true will depend on whether they are scientific or romantic. The lamps have a metallic filament and therefore the resistance is lower when the filament is cold than when the filament is hot. Wherefore if you figure on the resistance under normal house operating conditions, and in a set you put so little current through the lamp that the lamp will not even light, the resistance will be less than you expect. At 0.41 ampere, house operating condition, the resistance of a 50-watt lamp might be around 320 ohms, but when the lamp is used as a limiting resistor in a circuit through which flows much less current, the resistance may be as low as 250 ohms. However, for d-c purposes, under conditions existing in the set in which the lamp is used, it is easy enough to determine the resistance. Measure the current and measure the voltage. The resistance in ohms is the voltage in volts divided by the current in amperes.

* * *

Saturation Current in Pentodes

WHY is it that the plate current in pentode tubes does not change as the plate voltage is varied? The characteristic curves for nearly all pentodes show that as soon as the plate voltage exceeds the screen voltage slightly, there is no further change in the plate current. There must be some reason for this. Why is not the same true for triodes?—W. R. N.

The difference between pentodes and triodes is that in the pentode there is a screen and a suppressor in addition to the control grid and the plate. In the pentode the number of electrons reaching the plate depends on the screen potential more than on the plate potential. Hence it is the screen that determines the plate current. The function of the suppressor is to prevent secondary emission from the plate, which would cause irregularities in the plate current for low plate voltages. The suppressor removes the irregularities in the low plate voltage region. As long as only the plate voltage is changed there is practically no change in the number of electrons reaching the plate. However, if the screen voltage is changed there is a large change in the plate current. Likewise, if the grid voltage is changed there is a large change in the plate current. The grid controls the current to the screen and the screen that to the plate. In the triode there is only the grid to control the plate current, which in this case corresponds with the screen current.

* * *

Use of Lecher Wires

I HAVE constructed a short-wave oscillator but I have no means for measuring the wavelength. I understand that Lecher wires are used for the purpose. What are Lecher wires and how are they made? How do you use them for measuring frequency or wavelength?—W.N.J.

Two parallel wires or rods are Lecher wires. Put them about four inches apart at every point. The size of wire is not important, but it should not be less than No. 14. For very short Lecher wires, say one meter long, brass rods 3/8 inch in diameter are all right. Connect one end of the wires to a small coil, which may be nothing but a short across the bars, and provide a movable bridge in which a thermocouple is placed. The bridge resistance and the thermocouple resistance should be as low as possible. Resonance is indicated by heavy current in the meter. Slide the bridge along the wires until a current maximu mis obtained and note the position. Then slide again and find the next maximum. The distance between this and the first point is half a wavelength. The shorted end of the wires should be placed near the oscillating circuit. A straight wire carrying the current the frequency of which is to be measured might be placed parallel to the short end-wire.

The Review

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

QUESTIONS

1. What is a prime requirement for good results on short waves in a single-tube receiver?

2. Does a variable series antenna condenser in a short-wave set help in the adjustment of the receiver to greater sensitivity on only some short waves, or on all short waves to which the receiving system can respond?

3. State a way of controlling regeneration in a triode by using a rheostat.

4. Discuss the values of grid leak and grid condenser in a short-wave set compared to a broadcast set, and if there is any difference, give the reason, and if there is no difference, state why not.

5. What is the object of a small variable condenser across a larger variable condenser in a short-wave tuning system?

6. How may sensitivity be improved in a short-wave set for earphone use, without the addition of tuned circuits or any radio-frequency amplification?

7. If a two-volt tube is used, and it is desired to obtain one volt of negative bias, how may this be accomplished without the use of a biasing cell?

8. Is it true that a stage of audio-frequency amplification increases the volume but not the sensitivity? Explain your answer.

9. What is the functional difference between the grid-leak-condenser type detector and the diode, if any, and does the fact that grid current must flow in the one affect the answer in any way?

10. Which can handle the greater output, the leak-condenser or the strictly diode detector, and what is the limiting factor and why?

11. State a likely cause of fringe howl and a method of tracking down and curing the trouble.

12. To what extent does automatic volume control remedy fading in a short-wave receiver?

13. Where volume is to be controlled at an audio level, why is it bad practice to regulate the voltage applied to a microphone, the plate voltage on a tube, and the like, instead of varying the amount of audio taken off?

14. Why is a resistance network used in controlling volume at audio levels?

15. What is approximately the smallest sudden loss in decibels that the human ear can detect?

16. What are Lissajou's Figures, and what do they represent?

17. How is it possible to calibrate a beat-frequency oscillator so accurately that the output may be used as a standard of sound frequencies?

18. In a high-powered broadcast or dual-wave superheterodyne, what is the most likely point at which overload will occur, and what is a corrective that does not rob the circuit of sensitivity?

19. How can a neon tube be used as an overload indicator?

20. How can gas cause the increase in current in a photo-tube?

ANSWERS

1. For a single-tube circuit to afford satisfactory results on short waves it is a prime requirement that the circuit be regenerative.

2. The variable series antenna condenser helps in the adjustment of sensitivity on all waves to which the receiver itself can respond, so much so that some stations that can not be brought in at all with a misadjustment of this condenser can be heard plainly when the condenser is in its correct capacitative position.

3. A rheostat may be used to control regeneration in a triode by using the usual feedback winding or tickler, terminating it in the usual manner, but putting the rheostat, about 50,000 ohms, between plate return of the tickler itself, and ground. To prevent shorting, or d-c flowing through the resistor, instead of connecting the rheostat directly to plate, connect it to one side of a fixed condenser of 0.0005 mfd. or higher capacity, other side of condenser to plate.

4. The values of the grid condenser and grid leak are no different for a short-wave set than for a broadcast set, because only audio frequencies are concerned, and these frequencies are the same, in general, regardless of the carrier's radio frequency. However, if the circuit is an oscillator, a limiting factor is that extent of grid leak resistance or grid condenser capacity, or both, may introduce audio oscillation known as "grid blocking," so reduction of values then would be in order.

5. Bandspread.

6. By adding a stage of audio-frequency amplification.

7. Connect the grid return of the tube to A battery minus and connect the filament resistor (16.67 ohms) between A minus and negative filament. Since the negative filament is the datum or reference point, the bias must be reckoned from that as scratch, so it will be found that the grid is returned to a voltage lower than negative filament by the amount of the potential drop across the filament resistance, or one volt. Hence one volt of negative bias results.

8. The answer to this question depends on what one means by "volume" and by "sensitivity." If by volume one means the quantity of sound, the accepted significance in this connection, and if by sensitivity one means a relationship to the amount of input necessary to produce audible output, then increase of volume and of sensitivity go hand in hand and are the same. It does not matter at what level the amplification is increased, for any increase in amplification, or volume, is an increase in sensitivity.

9. There is no functional difference between the grid-leak-condenser type detector and the diode detector. Both are diodes. In the case of the triode tube, or quadrode, pentode, grid current flows, and this current changes in value, and causes different potentials d-c potentials to be applied to the anode ("grid" is the diode anode in this example. But the polarity is always the same, grid being negative in respect to grid return, because the stopping condenser causes the accumulation of electrons (always negative particles) faster than they are discharged through the leak. Both types of circuits are current-drawing, hence power-consuming. Flow of grid current in one instance therefore is no different than flow of diode-rectified current in the other.

10. The strict diode can handle more output, because in the other case (triode, etc.) there is always a plate circuit electron-coupled to the detector circuit, and the limitation exists in the plate circuit because as the input rises, the plate current is reduced to the distorting point and finally "cut off," or saturation prevails, at much too strong input. The strictly diode detector is in general free from this limitation, as only the current-handling capacity of the diode itself is at stake, and the tubes as used will handle satisfactorily up to 100 micro microamperes or more. With a load resistor of 500,000 ohms, 100 microamperes result in a rectified voltage of 50 volts.

11. Fringe howl is likely due to some mechanical oscillation. Therefore a satisfactory method of curing the trouble is to put a 50,000-ohm resistor across the phones, whereupon the trouble may be expected to disappear, and then with a hammer lightly tap various parts of the receiver until the point is found where the howl may be introduced by this tapping. In fact, a tap or two in the critical spot will act as a trigger, and the receiver may go on howling, but you know the location of the trouble, and will tighten up the loose part. Remove the resistor.

12. With proper automatic volume control there will be no noticeable variation in the intensity of the received signals as long as the amplitude of the fading is not abnormally high.

13. Varying the biasing voltage on the condenser microphone or the voltages on the plate or grid of one of the tubes is poor practice, for such elements are designed to give the best results with the least distortion when used with stable electrical values.

14. A circuit possesses capacity, inductance and resistance. Of these three only resistance does not vary over wide limits of frequency and, therefore, must be adapted in the circuit for the purpose of reducing the volume. Resistance network be used for attenuation purposes without adding accountable distortion.

15. The minimum sudden change to which the normal ear responds is believed to be 3 decibels.

16. Lissajou's Figures are patterns read on the fluorescent screen of a cathode-ray oscillograph tube and represent the shapes, amplitudes and ratios of wave forms.

17. By having two highly-stabilized radio-frequency oscillators beating together, provided that the dial used for tuning is large and that it is coupled to the condensers without lost motion. The limitation on the calibration is mechanical rather than electrical, assuming that the oscillators are stabilized. If the frequency drifts a little, it can always be checked at some fixed frequency, say a 60-cycle line frequency, or better still, a tuning fork. The point on the dial where this standard should come in could be marked clearly, the oscillator dial set at that point, and then the beat frequency could be made to coincide with the standard tone by adjusting a minute capacity in one of the radio frequency oscillators.

18. The tube following the detector, hence usually the driver. This would be the triode if a 55 is used. A remedy is to parallel the triode with another triode.

19. By connecting it across a push-pull input or push-pull or single circuit output when the overload voltage about equals the neon tubes striking voltage.

20. Gas amplification is due ionization by collision of electrons with molecules of the gas. Suppose there is a certain voltage between the anode and the cathode. This voltage will give the electrons a certain velocity. If an electron has a chance to move far enough without colliding with a gas molecule, it will release other electrons when it does strike. As soon as these are released, they will start for the anode and they too might get up speed enough to release other electrons. The effect is cumulative. At a certain voltage the anode current becomes practically infinite, and the tube becomes luminous. The ionization occurs in every electron device but when it oc-

(Continued on next page)

Station Sparks

By Alice Remsen

'WAY UP AT THE TOP

When those sweet girls from Georgia, the Pickens Sisters, joined George M. Cohan, on the Gulf Headliners program, for the second time recently, they did a fine job. Jane, Helen and Patti are well known to NBC audiences. The range of their voices, their ability to produce orchestral effects vocally, and the blending of their harmonies have given their work a distinction which places them among the foremost headliners of the air.

Carolyn Rich, the blonde personality singer of NBC was a George Gershwin guest recently. Her voice is particularly adapted to the Gershwin type of song. Carolyn, by the way, was born in Hamburg, Germany, twenty-three years ago, but came to this country when she was three. She was educated in Boston, which accounts for her cultivated accent. . . .

EDGAR KOBAK AT TOP

Fulton Oursler, noted journalist, novelist, playwright, and editor of Liberty, will come to the NBC microphones under the sponsorship of McFadden Publications, commencing April 4th, and each Friday thereafter at 10:00 p.m. over an NBC-WJZ network. He will relate the stories behind current events. "Stories That Must Be Told" will be the title of the program. . . . NBC has a new sales vice-president. Edgar Kobak is his name, a widely known figure in the advertising world. Mr. Kobak is the president of the Advertising Federation of America, and has been vice-president and general sales-manager of the McGraw Hill-Publishing Company. He is also chairman of the Advertising Review Committee, composed of leading national advertisers, publishers and advertising agencies. According to the announcement made by Richard C. Patterson, Jr., Executive Vice-President of the National Broadcasting Company, Mr. Kobak will head the entire NBC sales organization, with the divisions in New York, Chicago and San Francisco reporting to him on sales matters. Roy C. Witmer, however, continues as vice-president in charge of Eastern sales. . . .

PISTOLS FOR NINE

Phil Harris and his band have changed their dance schedule; they're now heard each Sunday at 11:30 p.m., and each Wednesday at 12:05 a.m. over a WEAF-NBC network, and Tuesdays at 11:30 p.m. on a WJZ-NBC network. . . . Warden Lawes, the famous head of Sing Sing prison, vouched for the characters of nine sound experts, when the latter applied for pistol permits recently, the pistols to be used for studio effects. The Warden, who broadcasts over the NBC networks, testified that the NBC sound-men possessed gentle dispositions, and were not liable to shoot on sight; they obtained the permits. . . . After a long absence, Reinald Werrenrath, noted American concert and opera baritone, has returned to the NBC networks for a series of three weekly recitals, Monday and Friday afternoons at 5:15 p.m., and Wednesday evenings at 11:05 p.m. Programs will emanate from the NBC studios in Chicago. . . .

JIMMY ON A PULLMAN

If you have wondered why Jimmy Wallington sounds so freshly stimulated on those Eddie Cantor broadcasts, it is because Jimmy spends most of his time on a train traveling from New York to Miami, resting in a nice big Pullman chair, and after he gets there, goes deep-sea fishing during what spare time he can grab from rehearsal and broadcast. . . . The Three X Sisters are busy girls these days, playing vaudeville dates and broadcasting, yet they manage to keep up on their reading; last week I saw them reading "Anthony Adverse," "Mother" and "Oil for the Lamps of China." . . . Erno Rapee and his Orchestra have been signed for "The Big Show" heard over a nation-wide Columbian network each Monday night at 9:30 p.m. Gertrude Niesen is retained, and outstanding guest stars will continue to be heard each week. . . . A new series of broadcasts will be heard over WABC and networks sponsored by Chesterfield cigarettes, every Monday, Wednesday and Saturday at 9.00 p.m., commencing April 2nd. Rosa Ponselle will hold the spotlight Mondays, Nino Martini on Wednesdays and Grete Stueckgold, on Saturdays. . . The "Buck Rogers" contract has been renewed, effective April 2nd. The present schedule will continue, and the same artists will be retained. . . .

KEMPER ON THE JOB

Very glad to learn that Jimmy Kemper's contract with the Tide Water Oil program has been renewed. If you are not already acquainted with this clever artist's work over CBS, by all means listen to him. Jimmy Kemper is one of the cleverest of the present crop of radio singers. He dramatizes his songs very effectively—and old English variety trick, which I remember from my childhood; they called them song-scenes in those days. Jimmy probably learned that trick in Australia, where he made his radio debut. At any rate, be sure to listen in on this boy, Mondays, Wednesdays and Fridays, at 7:30 p.m. EST.; WABC and Columbia network. Bob Armbruster's excellent Travellers ensemble and orchestra, with the Humming Birds Trio, complete this fine program. . . . The Mystery Chef has also had his contract renewed for a long term, and he will continue his twice weekly broadcasts of tasty recipes each Tuesday and Thursday at 9:45 a.m., CBS. . . . Another CBS program to be renewed is that of Pedro de Cordoba and Will Osborne's orchestra, commencing April 9th. Their schedule will be changed at that time from 10:45 a.m. to 11:15 a.m. each Monday, Wednesday and Friday; sponsored by the Corn Products Refining Company. . . . Thomas "Fats" Waller, popular Negro entertainer and song writer-pianist, has been signed by Columbia, and may be heard each Wednesday and Friday at 11:15 a.m. and each Thursday at 10:45 a.m. EST., at which time he will share his entire program with himself—announcing thrown in. . . . Another artist to be signed by Columbia is Nick Lucas, the crooning troubador of stage and screen. His singing and strumming, augmented by a studio orchestra will be heard each Wednesday at 11:00 p.m. and each Friday at 6:30 p.m. EST. . . . Sylvia Froos, the diminutive singer who recently returned to Manhattan from Hollywood, will resume her radio career on the new "Freddie Rich Entertains" series, with Fray and Braggiotti and the Eton Boys, over the WABC-Columbia network each Wednesday at 10:30 p.m. EST. . . .

BIG BOYS BETWEEN COVERS

Both Alexander Woollcott and Edwin C. Hill had books published a few weeks ago and each tome includes considerable of its author's radio discourses. "While Rome Burns" is the name of the Woollcott work, and the Hill opus bears the same title as his radio series, "The Human Side of the News" . . . Ian Van Wolfe and Edwin Jerome of the "March of Time" playing parts in two Broadway productions—"Men in White" and "Roberta," respectively. . . . Herschel Williams, director of the "Roses and Drums" Civil War dramas, has left the studios on a tour of southern cities and Civil War battlefields to gather material for forthcoming scripts. . . .

IT'S NOT A SONG

With spring here, Jimmy Melton is working hard on "The Melody," which is not a song, but his yacht. The popular tenor is getting it in shape for excursions up the Hudson and down Long Island Sound when he's not busy with his Ward's Family Theatre broadcasts on Columbia, or concert engagements. "The Melody" is fitted out with showers, real beds, a piano, and all sorts of other comforts and luxuries. . . . Little Jack Little, the Do Re Mi Girls and Gypsy Nina have just finished a movie short together, to be released soon by Paramount. . . . Roger T. Krupp, WNEW announcer, is a distant relative of the great steel family of Germany that operates the Krupp Works. . . . New Zealand radio fans hear WLS, Chicago frequently according to fan mail received by the station from that faraway land. . . . Station KYW, Chicago, has a novelty broadcast, introducing a vital personality called "The Son of India," who lectures on psychology and constructive thinking, under the sponsorship of the Maybelline Company, 10:30 p.m. CST, each night except Saturday and Sunday. . . . Godfrey Ludlow, Australian violinist, has returned to the air via WOR, N. J. each Thursday night at 9:30 EST. . . . The Mystery Girl, who broadcasts for the Borden Company over WMCA, New York, each Monday, Wednesday and Friday at 9:00 a.m., actually wearing a mask in the studio.

A DILEMMA

Some set manufacturers face a problem. They are on the air on brodacast waves to sell their all-wave receivers, featuring the lure of tuning out their own programs.

THE REVIEW

(Continued from preceding page)

curs depends on the voltage and the amount of gas. If the gas pressure is too high, there can be no ionization, for a given voltage, because no electron has a chance to move far enough to cause ionization on collision. If the gas pressure is too low, there will be no appreciable ionization because there are too few molecules with which the electrons can collide. For this reason high vacuum photo-tubes and thermionic tubes do not show any ionization effects.

Sarnoff Leads Thousands To Aid Salvation Army

Plans to organize committees representing virtually every phase of business and industrial life in New York for the purpose of assuring continuance of Salvation Army activities were made public by David Sarnoff, president of the Radio Corporation of America who is serving as Trade & Industry Chairman of the recently initiated Citizens Appeal for the Salvation Army.

Mr. Sarnoff, who accepted the Trade & Industry chairmanship at the request of a volunteer citizens committee which recently completed a study of the Army's needs, contemplates the enlistment of several thousand men and women prominent in business, financial, commercial and industrial activity. There will be four major groups with at least 50 specialized trade committees.

Universal Short-Wave Device Is Introduced

The New York market has just seen the release of a new a-c and d-c short-wave receiver, the International Three. There are a number of unique features, including built-in speaker, a built-in power supply, quiet operation and the use of the new cathode type rectifier. There is no hum. The combination of the modern pentode power output tube and the vari-mu screen grid detector gives results reported as amazing. This outfit comes in two combinations: the kit, which includes the built-in speaker and two coils, and the laboratory-assembled and tested receiver. The testing is on actual foreign reception. Full detailed instructions and diagrams come with each kit. Experimenters Radio Labs., of 80 Cortlandt Street, New York City, are the manufacturers.

Light-Opera Series to Be Tried for a Year

A new weekly series of broadcasts will be begun by Colgate-Palmolive-Peet when on Tuesday, 10 to 11 p.m., EST, on the NBC red network, the first of 52 light-opera productions will be presented. It is "The Vagabond King." Other presentations will include "The Student Prince," "Showboat," and "Rose-Marie." An opera stock company, headed by Gladys Swarthout, Metropolitan Opera singer, and including Theodore Webb, baritone, John Barclay, Frank McIntyre, Peggy Allenby, Junius Mathews, Georgia Backus, Joseph Granby and Charles Waburton, will play.

A THOUGHT FOR THE WEEK

COLONEL CHARLES LINDBERGH did not disappoint his millions of friends and well-wishers when he appeared recently at the Senate air mail hearing in Washington. "Lindy" had been asked to appear as an expert on aerial matters having to do with mail delivery and not only did his voice come over the air clear and strong but his statements were straight from the shoulder. "Lindy" did not hesitate to let his hearers know where he stood on the big questions at issue and when he didn't know the answers he was not afraid to say so.

That's "Lindy"—the fearless, quiet, simple direct "Lindy." The more we hear and see of him the more he impresses us with the fact that he was exactly the man to do what he did and precisely as he did it!

TRADIOGRAMS

By J. Murray Barron

The serviceman who in his own community has a following for the sale of receivers and other radio merchandise should avail himself of the opportunity to sell short-wave kits. Short-wave radio reception is the livest in the radio field today, in fact is practically taking the country by storm. He will find many who will want a wired model, and this will give him additional profit, and incidentally permit him perhaps to hire some men.

* * *

From the office of the Picard Advertising Corp., 49 West Forty-fifth St., New York City,, comes the announcement that the new core solder put out by The Berry Solder Co. is meeting with considerable success. The solder is on spools that are packed in attractive boxes.

* * *

A new offering in the downtown section in New York City is the Super Thorax 2nd, a 7-tube all-wave superheterodyne kit from Thor Radio, 167 Greenwich Street.

* * *

H. D. James, control expert and long a consulting engineer of the Westinghouse Electric and Manufacturing Company, has opened an engineering consulting service specializing in industrial and building problems.

* * *

That the younger fellows, boys and Scouts, are interested in short-wave radio can be testified by the great interest they have shown since the event of the smaller kits. To those who perhaps have not enjoyed the thrill of assembling a kit and then tuning in a foreign station there is much in store. Today it is possibe to get a well-designed circuit, with punched chassis, all parts ready for putting together. In conjunction with these are other kits for the more advanced experimenters, or receivers are furnished completely wired ready for operation. This product is put out by Try-Mo Co., Inc. 85 Cortlandt St., New York City.

CORPORATE ACTIVITIES

FINANCIAL REPORTS

Claude Neon Electrical Products Corporation, Ltd. and Subsidiaries—Net profit for the year 1933, after depreciation, Federal taxes and other charges, $324,823, which after deduction of 7 per cent preferred dividend requirements, equals $1.15 a share on 262,303 no-par common shares, as compared with $400,659 or $1.42 a share, on 262,500 common shares, in 1932.

Pathe Exchange, Inc., and Subsidiaries—Net profit for the year 1933, after deduction of amortization, taxes, depreciation of costs of properties, interest, amortization of discount and expenses, $386,629. In 1932 there was a net loss of $109,834. Net profit for three months ended Dec. 30, 1933, $17,341.

Scovill Manufacturing Company and subsidiaries—Net profit for the year 1933, after depreciation, amortization, Federal taxes, interest, $577,059; special inventory reserve and other charges, $305,688, which equals 35 cents a share on 872,367 publicly-owned capital shares at $25 per share. For the year 1932 there was a net loss of $1,322,933.

Arcturus Radio Tube Company—Net loss for year 1933, after depreciation, taxes and other charges, $26,142. For the year 1933 there was a net loss of $464,603.

Literature Wanted

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

William Fritz, 13 Taft Ave., Lancaster, N. Y.
Henry Ilecki, 5 Taft Ave., Lancaster, N. Y.
Arthur Burden, 638 South 2nd East, Brigham City, Utah.
E. Anderson, Westwood Road, Lancaster, N. Y.
Howard Lee, 506 West Clinton St., Ithaca, N. Y.
Tommy West, Secy., Western States DX Club, 716 Jefferson St., Room 15, Toledo, Ohio.
James T. Redstone, 834 Ellice Ave., Winnipeg, Man., Canada.
Eugene A. Fattey (W8APO), Springville, N. Y.
Frank Folck, 128 E. Reel Ave., Vincennes, Ind.
J. R. Connor, 353 Elles Road, Invercargill, New Zealand.
Ira J. Walters, Lightning Laboratories, 410 Stradbrooke Ave., Winnipeg, Man., Canada.
F. W. Foust, F. W. Foust's Garage & Radio Shop, 103 West 46th St., Ashtabula, Ohio.
Joseph Lesmeister, Lesmeister's Radio-Electric Service, Harvey, No. Dakota.
Yoshinori Murata, 1917 Francisco St., Berkeley, Calif.
H. Hinebaugh, Box 194, Sta. C, 924 Montrose Ave., Toledo, Ohio.
Thos. W. Peavy, 202 Gadsden St., Columbia, S. C.
G. C. Thornton, 4821 Monongahela St., Pittsburgh, Pa.
M. C. Hornbeck, 1016 E. John St., Seattle, Wash.
J. A. Grice, 44 Perth St., Brockville, Ont., Canada.
A. J. McNally, N. E. Cor. 40th & Woodland Ave., Philadelphia, Pa.
Manuel Karlinsky, 5000 N. Troy St., Chicago, Ill.
W. P. Merritt, Box 56, Torrington, Conn.
W. Pelham, New Harmony, Ind.
Robert H. Fleming, 212 So. Washington St., Rome, N. Y.
Paul R. Lawson, 190 No. Quinsig Ave., Shrewsbury, Mass.
George Coplin, 222 Loomis St., Chicago, Ill.
E. H. Greene, 3300 16th St., N.W., Washington, D. C.
Chas. Mason, 133 Brookline Ave., Boston, Mass.
C. B. Hinea, 623 Main St., Lafayette, Ind.
N. M. Dahlberg, Valemount, B. C., Canada.

Midwest Chain Opens; Nine Stations on List

The North American Broadcasting System, consisting of nine radio stations serving listeners in five states, has been instituted.

Composed, as present, of Wisconsin stations WHAD, Milwaukee; WCLO, Janesville; WHBL, Sheboygan; WHBY, Green Bay; WKBH, La Crosse; WOMT, Manitowoc; WIBU, Poynette; WTAQ, Eau Claire, and WRHM, Minneapolis, Minnesota, this new chain got under way to a good start.

Eddie Dowling, a figure in the enterprise, said: "We must get rid of network monopoly."

Concentration of talent in a few big centers will thus be broken up and better supervision of the smaller units made possible, he added.

Paul M. Titus is president of the new system.

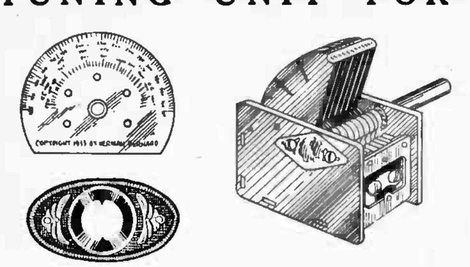
British Radio Head, Expecting to be on Spot, Gets Welcome Surprise

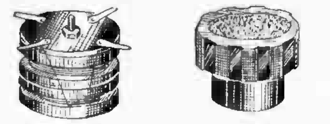
London.

Sir John Reith, director general of the British Broadcasting Corporation, a Government-chartered unit, has been under the fire of Conservatives for over-discipline at the broadcasting center. He appeared before the House of Commons, where it was expected that members, voicing the sentiments of hurt broadcasting employes, would put him on the gridiron.

A bulky document was handed to Sir John, to his momentary alarm. It proved to be an expression of confidence and love, signed by all the employes who had been supposedly subjected to "military discipline."

TUNING UNIT FOR TEST OSCILLATOR





HERE is your very first opportunity to get the parts for constructing a universal, modulated test oscillator to cover fundamentals from 135 to 380 kc. and read higher intermediate frequencies and the entire broadcast band, by harmonics, all imprinted right on the dial. That is, the oscillator will be direct frequency-reading. The parts consist of one metal-etched scale, one metal escutheon, one 0.000406 tuning condenser with trimmer built in. one oscillation transformer (secondary inductance accurate to 0.1 per cent.), and one knob for condenser. Circuit diagram supplied for universal model modulated test oscillator (90-120 volts a.c., d.c. or batteries, same oscillator works on all three). Instruction sheet for lining up at broadcast and intermediate frequencies included. Line up the oscillator with one adjustment on broadcast band, beating with some station on 1,200 to 1,400 kc. Whole dial then will track. Order PRE-TUTO and send $6.00 for one-year subscription for (52 issues). Sent postage prepaid.

MICA-DIELECTRIC

Intermediate Transformers

For 465 kc or 175 kc i.f. we offer doubly-tuned transformers, with mica-dielectric condensers built in, all enclosed in 4-inch high aluminum shield, 2-1/16-inch diameter. Quantity is at left. Sent postpaid.

Single Transformer

(1) PRE-MD-465... } $2.00 subscription,
(1) PRE-MD-175... } 16 issues
(2) PRE-MDD-465.. } $4.00 subscription,
(2) PRE-MDD-175.. } 34 issues
(3) PRE-MDDD-465 } $6.00 subscription,
(3) PRE-MDDD-175 } 52 issues

Complete Selection of Tubes

AIR-DIELECTRIC

Intermediate Transformers

For unequalled maintenance of the frequency to which the intermediate channel is adjusted, air-dielectric tuning condensers must be provided. These are supplied on Isolantite forms, and are made by one of America's premier precision radio parts manufacturers. Quantity at left.

(1) PRE-AD-465.... } $6.00 subscription,
(1) PRE-AD-175.... } 52 issues
(2) PRE-ADD-465.. } $12.00 subscription,
(2) PRE-ADD-175.. } 104 issues
(3) PRE-ADDD-465. } $16.00 subscription,
(3) PRE-ADDD-175. } 156 issues

The following highest-grade, licensed, brand-new, 10-day-replacement-guarantee tubes are offered as premiums.

One Tube for $1.00 Subscription, 8 Issues. 01A, 01AA, 1V, 12Z3, 112A, 24A, 26, 27, 30, 31, 35, 36, 37, 38, 39, 45, 47, 51, 56, 71A, 80, 82.

Any two of above tubes for $2.00 Subscription (16 Issues), any three for $3.00 Subscription (26 issues), any six for one-year Subscription (52 issues).

One Tube for $1.50 Subscription, 13 Issues. 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, 483, 485. Any two of the $1.50 group for $3.00 Subscription (26 issues), any four for $6.00 Subscription (52 issues).

TUBES SENT POSTAGE COLLECT.

SPECIAL SHORT-WAVE TUBES AND SOCKETS

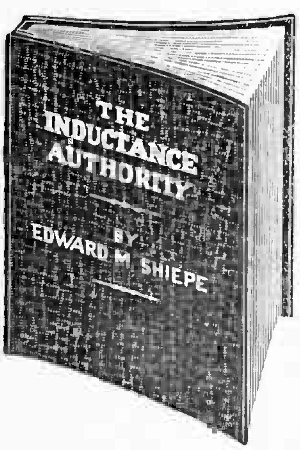
A new dielectric has been introduced that shows most remarkable properties for high frequencies. The heat losses are not discernible at 75 centimeters. The losses decrease as the frequencies increase, contrary to what hold for all other known dielectrics. The new material is called Victron. It was developed by the United States Rubber Company, although it is not rubber. Special processing is necessary to work this material, hence cost of production runs high, but the results are most astonishing, particularly as tubes that otherwise stop oscillating at 10 meters or so oscillate at lower than 5 meters when victron is used as tube base.

Send $2 for 16-weeks subscription and select one of the following Victron-base tubes: 30, 56, 57, 58, or any two for $4 subscription (34 weeks) or any three for one-year subscription (52 issues) or all four for $8 subscription (60 issues).

Four and five-hole sockets, made of Victron, are for use with Victron-base tubes for preservation of gain, and for use as precision, low-loss coil receptacles. Select one socket for $1 subscription (8 weeks), two sockets for $2 subscription (16 weeks), three sockets for $3 subscription (26 issues).

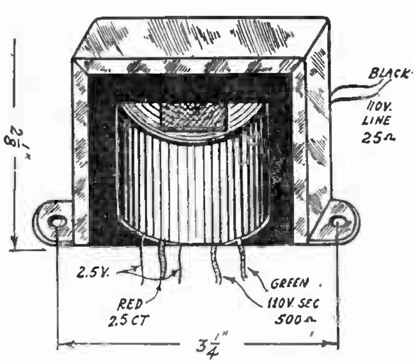
(Victron base tubes and socket sent postage prepaid.)

VITAL BOOK



The biggest help any one can get who desires to wind radio-frequency coils for any frequency from just below the audio range to the fringe of ultra frequencies is to have a book that tells just what inductance is required for the condenser one possesses, and just how many turns of any kind of wire on any sensible diameter are needed to produce that inductance. "The Inductance Authority," by Edward M. Shiepe, gives you just that information, to an accuracy of 0.1 per cent. Send $3 for a six-months subscription (26 issues) and order PRE-IA sent postpaid.

Small Power Transformer



POWER TRANSFORMER

Primary—105-130 volts.
Secondary A-2.5 volts, center-tapped.
Secondary B-110 volts, no center tap.

Splendid for powering a-c test oscillator or any other rectifier for not more than three small tubes.

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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.**

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