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RADIO WORLD

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The First and Only National Radio Weekly

444th Consecutive Issue—NINTH YEAR

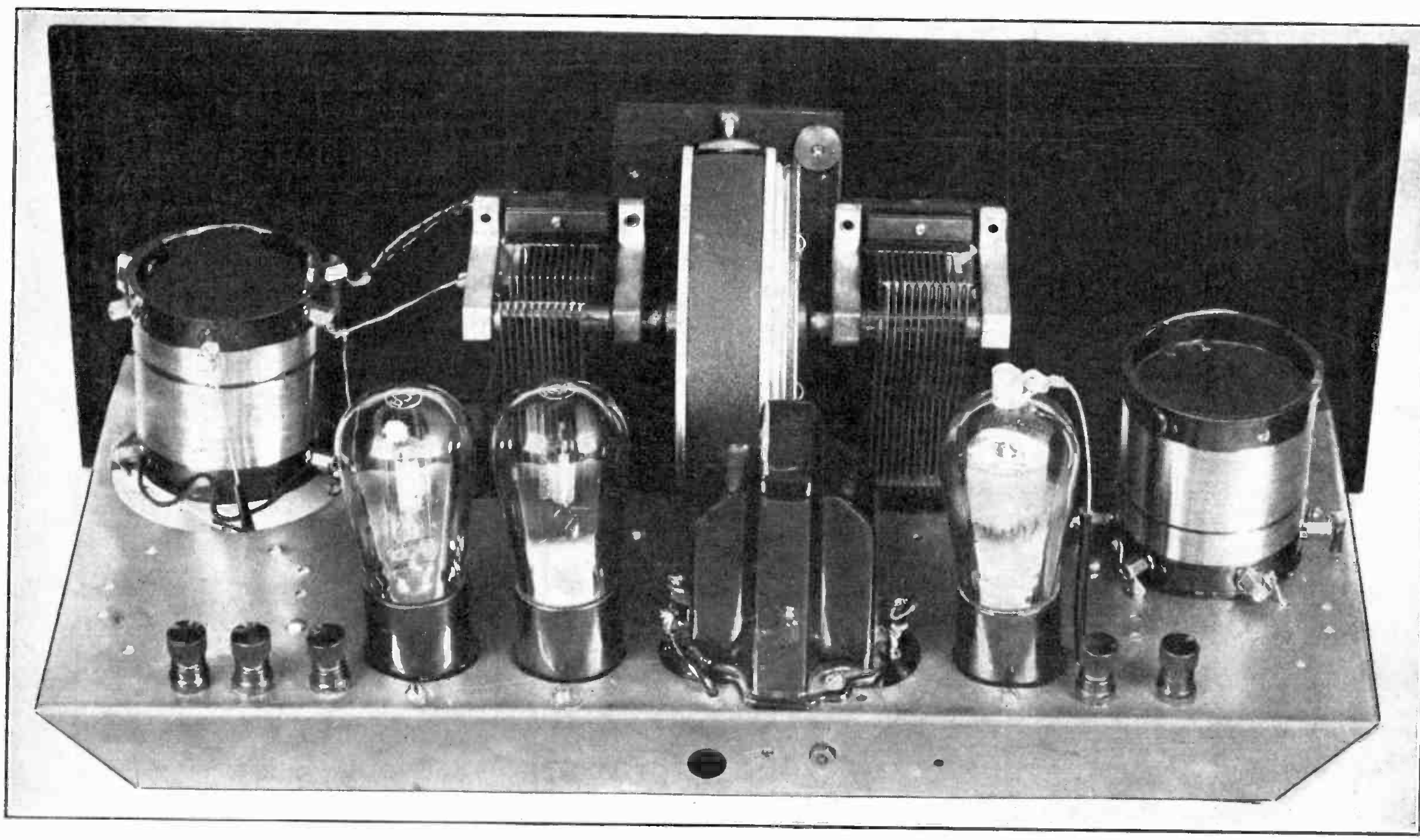
Continuous and Switch Type Tone Controls

Simple Mathematics for Use in Radio

The 224 Analyzed

Comparisons of Coils

TUNER AND SEPARATE POWER AMPLIFIER

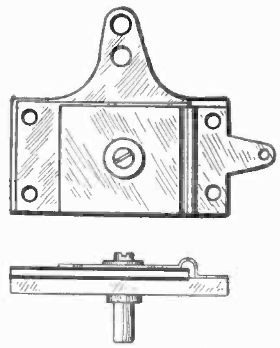


View of a two-tube tuner with a stage of audio built in. See pages 3 and 4 for articles on tuner and amplifier.

RADIO WORLD, Published by Hennessy Radio Publications Corporation; Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager, all of 145 West 45th Street, New York, N. Y.

Accurate Tuning Condensers and Accessories

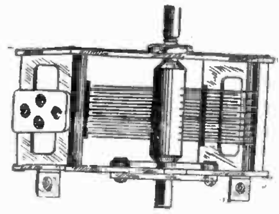
EQUALIZER



CAT. EQ-100 AT 35c

The most precise and rugged equalizing condenser made, with 20 mmfd. minimum and 100 mmfd. maximum, for equalizing the capacity where gang condensers are used that are not provided with built-in trimmers. Turning the screw alters the position of the moving plate, hence the capacity. Cross-section reveals special threaded brass bushing into which screw turns, hence you can not strip the thread. Useful in all circuits where trimming capacity of 100 mmfd. or less is specified. Maximum capacity stamped on

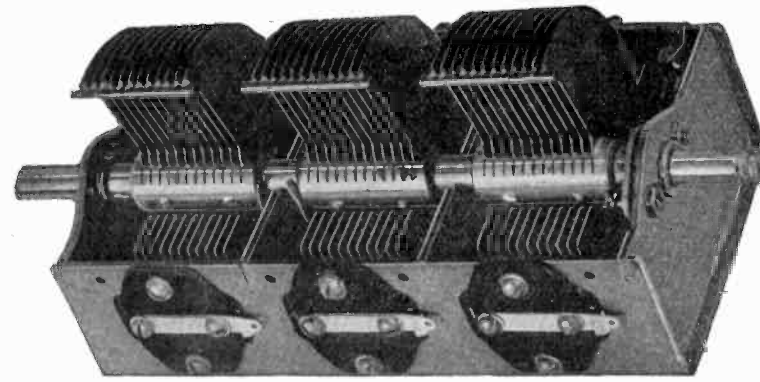
SINGLE .00035



CAT. KH-3 AT 85c

A single .00035 mfd. condenser with nonremovable shaft, having shaft extension front and back, hence useful for ganging with drum dial or any other dial. Shaft is ¼ inch diameter, and its length may be extended ⅝ inch by use of Cat. XS-4. Brackets built in enable direct subpanel mounting, or may be plied off easily. Front panel mounting is practical by removing two small screws and replacing with two 3/34 screws ¾ inch long. Condenser made by Scovill Mfg. Co.

THREE-GANG SCOVILL .0005 MFD.



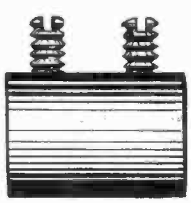
One of the finest, strongest and best gang condensers ever made is this three-gang unit, each section of full .0005 mfd. capacity, with a modified straight frequency line characteristic. The net weight of this condenser is 3¼ lbs. Cat. SC-3G—5 at $4.80.

HERE is a three-gang condenser of most superior design and workmanship, with an accuracy of at least 99¾ per cent. at any setting — rugged beyond anything you've ever seen. Solid brass plates perfectly aligned and protected to the fullest extent against any displacement except the rotation for tuning. It has both side and bottom mounting facilities. Shaft is ⅜ inch diameter and extends at front and back, so two of these three-gangs may be used with a single drum dial for single tuning control. For use of this condenser with any dial of ¼" diameter bore, use Cat. XS-8, one for each three-gang. Tension adjusters shown at right, either side of shaft.

SALIENT FEATURES OF THE CONDENSER

(1)—Three equal sections of .0005 mfd. capacity each.
(2)—Modified straight line frequency shape of plates, so-called midline.
(3)—Sturdy steel frame with rigid steel shields between adjacent sections. These shields minimize electric coupling between sections.
(4)—The frame and the rotor are electrically connected at the two bearings and again with two sturdy springs, thus insuring positive, low resistance contact at all times.
(5)—Both the rotor and the stator plates are accurately spaced and the rotor plates are accurately centered between stator plates.
(6)—Two spring stoppers prevent jarring when the plates are brought into full mesh.
(7)—The rotor turns as desired, the tension being adjustable by set-screw at end.
(8)—The shaft is of steel and is ⅜ inch in diameter.
(9)—Each set of stator plates is mounted with two screws at each side of insulators, which in turn are mounted with two screws to the frame. Thus the stator plates cannot turn sidewise with respect to the rotor plates. This insures permanence of capacity and prevents any possible short circuit.
(10)—Each stator section is provided with two soldering lugs so that connection can be made to either side.
(11)—The thick brass plates and the generous proportions of the frame insure low resistance.
(12)—Provision made for independent attachment of a trimmer to each section.
(13)—The steel frame is sprayed to match the brass plates.
(14)—The condenser, made by America's largest condenser manufacturer, is one of the best and sturdiest ever made, assuredly a precise instrument.

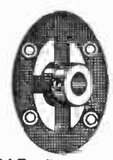
RIGID AND FLEXIBLE LINKS



CAT. RL-3 AT 12c

For coupling two ¼ inch diameter shafts, either coil shaft and condenser shaft, or two condenser shafts, a coupling link is used. This may be of the rigid type, all metal, where the linked units are not to be insulated.

The rigid link, Cat. RL-3, has two set-screws, one to engage each shaft, and is particularly serviceable where a grounded metal chassis is used, as the returns then need no insulation.



CAT. FL-4 at 30c

Flexible insulated coupler for uniting coil or condenser shafts of ¼ inch diameter. Provides option of insulated circuits

EXTENSION SHAFTS, TWO SIZES

CAT. XS-4 AT 10c

Here is a handy aid to salvaging condensers and coils that have ¼" diameter shafts not long enough for your purpose. Fits on ¼" shaft and provides ⅝" extension, still at ¼". Hence both the extension shaft and the bore or opening are ¼" diameter. Order Cat. XS-4.

For condensers with ⅜" diameter shaft, to accommodate to dials that take ¼" shaft, order Cat. XS-8 at 15c.

.00035 TWO-GANG

A two-gang condenser, like the single type, KHS-3, but consisting of two sections on one frame, is Cat. KHD-3, also made by Scovill. The same mounting facilities are provided. There is a shield between the respective sections. The tuning characteristic is modified straight frequency line. Order Cat. KHD-3 at $1.70.

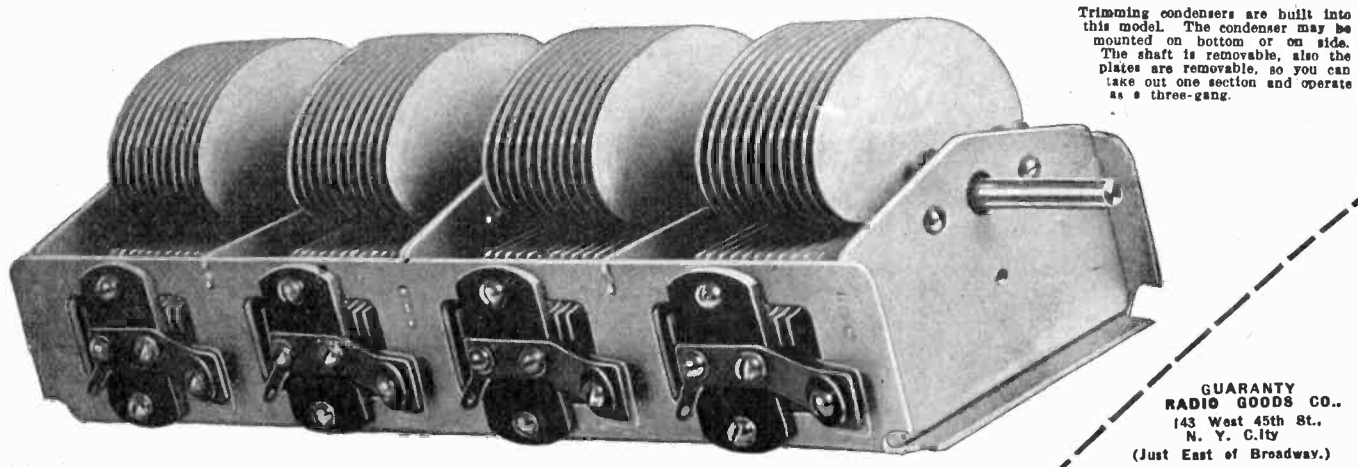
DRUM DIAL

CAT DD-0-100 @ $1.50

A suitable drum dial of direct drive type is obtainable for ¼" shafts or ⅜" shafts, and with 0-100 scales. An escutcheon, is furnished with each dial.

FOUR-GANG .00035 MFD. WITH TRIMMERS BUILT IN

Trimming condensers are built into this model. The condenser may be mounted on bottom or on side. The shaft is removable, also the plates are removable, so you can take out one section and operate as a three-gang.



Four-gang .00035 mfd. with trimmers built in. Shaft and rotor blades removable. Steel frame and shaft aluminum plates. Adjustable tension at rear. Overall length, 11 inches. Weight, 3½ lbs. Cat. SPL-4G-3 $3.95.

SHORT WAVES

Tuning condensers for short waves, especially suitable for mixer circuits and short-wave adapters. These condensers are .00015 mfd. (150 micro-microfarads) in capacity. They are suitable for use with any plug-in coils. Order Cat. SW-S-150 @ $1.50. To provide regeneration from plate to grid return, for circuits calling for this, use .00025 mfd. Order Cat. SW-S-250 @ $1.50.

A four-gang condenser of good, sturdy construction and reliable performance fits into the most popular tuning requirement of the day. It serves its purpose well with the most popular screen grid designs which call for four tuned stages, including the detector input.

Ordinarily a good condenser of this type costs, at the best discount you can contrive to get, about twice as much as is charged for the one illustrated and even then the trimming condensers are not included. The question then arises, has quality been sacrificed to meet a price? As a reply, read the twenty-six points of advantage. The first consideration was to build quality into the condenser. The accuracy is 99¾%.

GUARANTY RADIO GOODS CO.,
143 West 45th St.,
N. Y. City
(Just East of Broadway.)

Enclosed find $..........for which ship designated parts:

....

Street Address........................

City................ State................

the following merchandise as advertised:

☐ Cat. XS-4 @ 10c
☐ Cat. KH-3 @ 85c
☐ Cat. XS-8 @ 15c
☐ Cat. KHD-3 @ $1.70
☐ Cat. RL-3 @ 12c
☐ Cat. DD-0-100 @ $1.50
☐ Cat. EQ-100 @ 35c
☐ Cat. SC-3 G-5 @ $4.80
☐ Cat. SPL-4 G-3 @ $3.95
☐ Cat. FL-4 @ 30c
☐ Cat. SW-S-150
☐ Cat. SW-S-250

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Latest Circuits and News
Technical Accuracy Second to None

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Three Tube Diamond

By Mortimer Jones

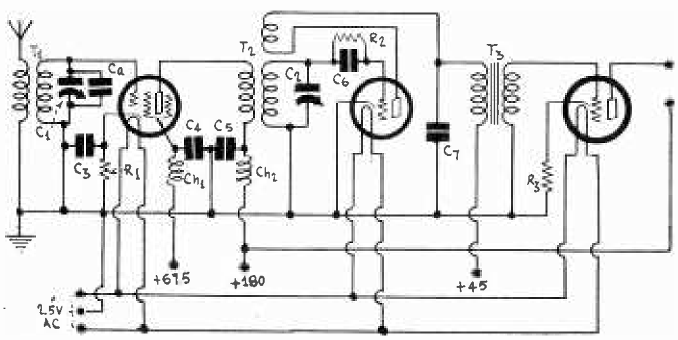


FIG. 1
THE CIRCUIT DIAGRAM OF A RECEIVER SUITABLE FOR USE WITH A PUSH-PULL POWER AMPLIFIER AND B SUPPLY. SEE FRONT COVER FOR PHOTOGRAPH OF THE RECEIVER.

THERE are many audio power amplifiers and B supply units in use, most of them of excellent quality. But such devices are of little use by themselves for they must be used either with a radio frequency amplifier and detector or with a phonograph pick-up unit. If they are used with a first rate signal source they are capable of giving fine performance.

There has been considerable demand for inexpensive and easily handled radio frequency tuners and detectors to go with these amplifiers and B supplies, especially regenerative circuits of the Diamond of the Air type. All who have used such circuits realize that such receivers give a better account of themselves than any other circuit having the same number of tubes.

In order to comply with the demand for such circuits we present one herewith. Fig. 1 gives the circuit diagram and the photograph on the front cover shows the arrangement of the parts. As will be observed from the diagram and the photograph, the circuit contains three heater type tubes. The first is a 224 screen grid tube, used as an effective radio frequency amplifier; the second is a 227 detector, used with grid condenser and leak and with regeneration; the third is a 227 audio frequency amplifier and is coupled to the detector with an audio transformer. The output of this circuit is supposed to be impressed on a power amplifier such as is described on page 4 of this issue.

Tuning Arrangement

The two-tuned circuits are controlled with the same knob but there is a rather large trimmer across the first tuning condenser to provide a means for compensating for differences in the tuned circuits. This trimmer is not critical so that it does not complicate the tuning of the circuit. It is used only to sharpen up the tuning after a signal has been tuned in with the main control on the drum dial, if it is found necessary or desirable to do so.

Not in every instance should the trimmer condenser be put across the tuning condenser in the first circuit, for sometimes it is found that it is needed across the second. In most instances, however, it is needed in the first circuit, and it was necessary to put it there in the receiver depicted on the front cover. Hence the diagram shows across C1.

The regeneration is controlled by a third knob placed symmetrically on the panel with respect to the center and the trimmer condenser knob.

The tuning condensers are of the straight line frequency type and each has a capacity of .0005 mfd. Since there is no shielding around the tuning coils the distributed capacity in each circuit is very small and the .0005 mfd. condenser will not only cover the entire broadcast range but will go beyond the 1,500 kc limit.

Coils Are Low Loss

The coils selected for the circuit are wound in grooves with uninsulated, silver plated wire. This insures high selectivity and permanence of inductance so that once a station has been tuned in at a given point on the dial it will come in at that place every time. This, of course, assumes that the trimmer be set the same way every time for each station, for the trimmer does affect the tuning a little, or there would be no need for using it.

Two different coils are needed, one an antenna coupler having two windings, and one three-circuit tuner having a rotatable tickler. The primary winding on the three-circuit tuner is large enough and closely enough coupled to the secondary to make coupler an efficient load on the screen grid tube, and thus to provide high sensitivity. The effectiveness of coupler is greatly enhanced by the reaction of the tickler. As everybody who has turned a tickler knows, regeneration increases the sensitivity of a receiver more than one or two stages of straight radio frequency amplification.

The two tuning coils are placed so far apart in the receiver that shielding is unnecessary. While it is possible to get oscillation by virtue of feedback through stray coupling, it is always possible to stop it by means of the tickler so that the stray coupling is not a disadvantage, as it would be in a circuit of the radio frequency type.

One Audio Stage

One audio stage is provided because most power amplifiers have only one stage of audio, which is usually a push-pull stage. Without one stage in the receiver there would not be enough output to operate a loudspeaker. The audio stage is coupled to the detector by means of a transformer because this results in greater audio frequency amplification as well as greater audio frequency amplification as well as greater detecting efficiency than resistance coupling would provide. If a first class transformer is selected the quality of the output will be excellent.

List of Parts

T1—One antenna coupler, Silver-plated coil.
T2—One three-circuit tuner, Silver-plated coil.
T3—One audio frequency transformer.
Ch1, Ch2—Two 50 millihenry shielded RF chokes.
C1, C2—Two Hammarlund .0005 mfd. straight line frequency condensers.
C3, C4, C5—One triple, .1 mfd. condenser.
C6—One .00025 mfd. grid condenser.
C7—One .0005 mfd. condenser.
Ca—One .0001 mfd. trimmer condenser with knob.
R1—One 300 ohm resistor.
R2—One 2 megohm metalized grid leak.
R3—One 2,000 ohm grid bias resistor.
Ten binding posts.
Three UY sockets.
One National drum dial.
Ca—One .0001 mfd. trimmed condenser with knob.
One tickler knob.

Push-Pull with Power

By Brunsten Brunn

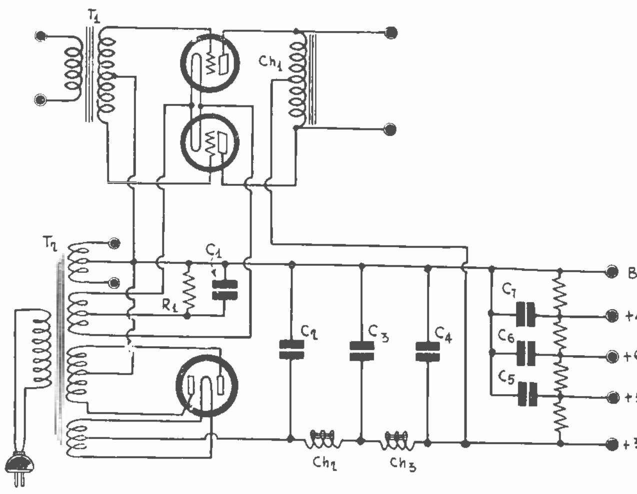


FIG. 1
THE CIRCUIT DIAGRAM OF A PUSH-PULL AMPLIFIER AND A WELL-FILTERED POWER SUPPLY.

FIG. 2
A PHOTOGRAPH OF THE ASSEMBLED PARTS OF THE PUSH-PULL AMPLIFIER AND POWER SUPPLY THE CIRCUIT OF WHICH IS GIVEN IN FIG. 1.

A CIRCUIT comprising a push-pull audio frequency amplifier with 245 tubes and a B supply capable not only of supplying this amplifier but also of supplying a radio receiver to work in conjunction with the amplifier is a popular unit. Many such circuits have been sold and many more will be sold the next season. It is popular because it is more flexible than the amplifier usually found in complete radio receivers and it is usually capable of greater output as well as better quality. As a rule it is never built to a price but to the best possible quality of signals. This applies not only to the audio power amplifier but also to the B supply.

A circuit of this type can be used for the amplification of signals derived from a phonograph pick-up unit and from a radio frequency receiver, which of itself does not have the required audio frequency amplification or enough output power to operate a loudspeaker as most people now want to operate speakers.

Circuit of Amplifier and Power Supply

The circuit diagram of the push-pull amplifier and the power supply is shown in Fig. 1, and a photograph of the assembled unit is shown in Fig. 2. As assembled the T1 is an Amertran push-pull input transformer, the primary of which should be connected to the source of signal, such as the output tube of the circuit given in another article in this issue. Ch1 is a center-tapped choke coil, which in effect amounts to a transformer having a ratio of unity. The filament current for the two power tubes is derived from a 2.5 volt winding on the Polo power transformer T2.

This winding is center-tapped and the grid bias resistor R1 is connected between this tap and ground. A condenser C1 of 4 mfd. is connected across the resistor to by-pass any signal current which may be due to unbalance of the signal in the push-pull stage. Some designers say that in a push-pull amplifier a by-pass resistor is superfluous since in a balanced circuit there is no alternating current flowing through it. It is true that in a balanced circuit there is no AC in the bias resistor and hence there is nothing for the condenser to do, but in practice it is difficult to get a really balanced push-pull stage. The unbalance may not be greater than 5 per cent. but even that small amount justifies a condenser. And it should always be remembered that the larger a by-pass condenser is the better it is. Hence 4 mfd. should not be considered the best choice of by-pass condenser. However, it is adequate.

The B Supply

The B supply employs a 280 rectifier, which will supply enough current to power both the push-pull amplifier and a radio receiver ahead of that amplifier. The Polo power transformer T2 contains four center-tapped windings, one of five volts for the filament of the rectifier tube, one of 600 volts for the plates of the rectifier tube, and two of 2.5 volts, one of which is used for the 245 tubes in the power amplifier and the other of which is used for the heaters of the receiver that is used in conjunction with the circuit. The winding intended for this purpose is provided with extra heavy leads and is rated so that it will supply as many as seven tubes of the 224 or 227 types.

The 600-volt winding is connected so that the voltage on each plate of the 280 tube is 300 volts. This supplies a rectified and filtered voltage of 300 volts across the voltage divider provided that the load taken from the circuit does not exceed the rated value of the rectifier tube. The output is ample for the push-pull amplifier and the three tube circuit described on page 3 of this issue.

The two choke coils Ch2 and Ch3 are new style Polo inductors of 30 henries each and are rated at 100 milliamperes. The resistance of each is only 200 ohms and therefore the voltage drop in the chokes is very small, from which it follows that the voltage regulation of the B supply is very good. This means that the output voltage will vary very little as the current drawn from the device is varied. This has an important bearing on the amount of hum in the output and also on the stability of the receiver powered by the B supply.

By-passing For Good Filtering

The condenser C2 next to the rectifier tube has a capacity of one microfarad, and the next condenser, C3, has a capacity of 2 mfd. C4 is a large condenser of 8 mfd. and is of the electrolytic type. The filtering is excellent so that when the tuner described on page 3 of this issue is used in conjunction with the power supply and push-pull amplifier there is no noticeable hum.

The assembly and layout of the amplifier and power supply are depicted in Fig. 2. The Polo power transformer is mounted at the extreme left and the Polo chokes at the rear center. Only one is distinctly visible because one is mounted directly over the other.

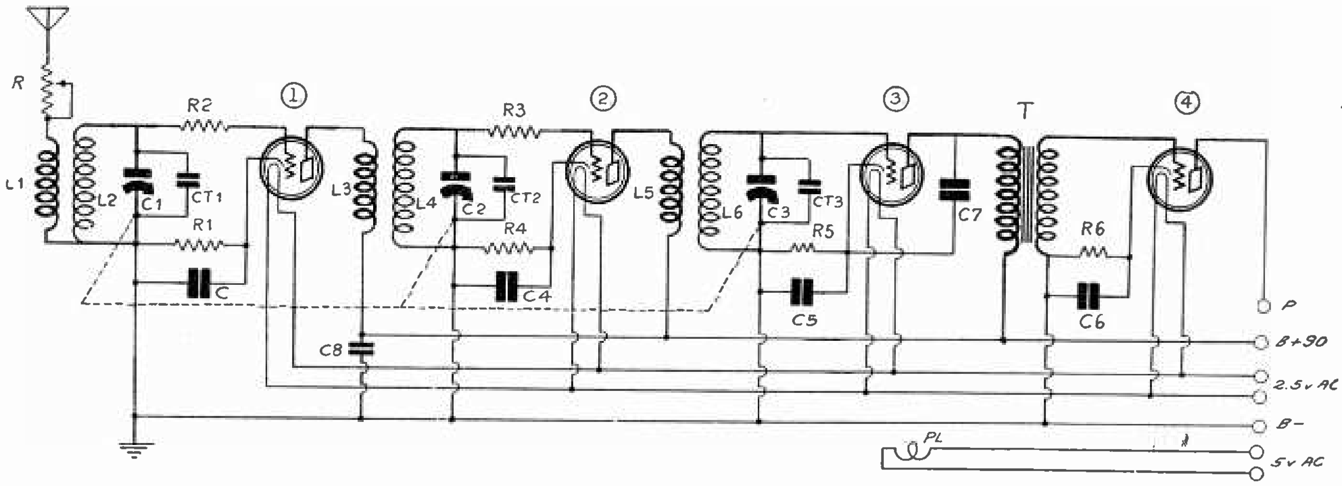
The voltage divider is at the rear and right. In the center row at the right are the push-pull input transformer and the output choke, the transformer being directly behind the two 245 tubes. Two of the by-pass condensers are visible, a small one at the left of the rectifier tube and the electrolytic at the right of it. The remaining by-pass condensers are mounted underneath the sub-panel. The capacity of each of condensers C5, C6, and C7 is one microfarad.

The voltage divider, which is composed of two units, has a total resistance of 17,100 ohms and it is provided with so many taps that almost any desired voltage can be obtained by selecting the proper taps. The taps should be selected so that the voltages are 300, 180, 67.5, and 45 volts. The plate return of the power tubes is connected to the highest voltage tap, namely 300 volts. When this is done the voltage is automatically divided so that the plates get 250 volts and the grids 50 volts. The 180 volt tap is provided for the radio receiver, which requires 180 volts for the plate of the screen grid tube and that of the audio amplifier. The 67.5 volt tap is provided for the screen of the 224 in the receiver and the 45 volt tap for the plate of the detector tube.

LIST OF PARTS

T1—One Amertran push-pull input transformer.
T2—One Polo 245 power transformer, 245-PT.
Ch1—One center-tapped output choke.
Ch2, Ch3—Two Polo shielded chokes SH-S-CH.
C1—One 4 mfd. by-pass condenser.
C2, C5, C6, C7—Four 1 mfd. by-pass condensers.
C4—One 8 mfd. electrolytic condenser.
One multi-tap, 17,100 ohm voltage divider.
Three UX (four prong) sockets.
Nine binding posts.
One special steel sub-panel.

Amplification with 227s



WHEN 227 TUBES ARE USED FOR RADIO FREQUENCY AMPLIFICATION IT IS USUALLY NECESSARY TO ADOPT SOME METHOD OF SUPPRESSING OSCILLATION. IN THE CIRCUIT ABOVE GRID SUPPRESSORS R2 AND R3 ARE USED.

ABOVE is a diagram of a radio receiver that is capable of being adapted to a variety of operating conditions, hence a study of it will doubtless inspire the experimenter to consider the following data.

Before discussing constants of parts for this circuit, let us show how it can be adapted to more than one source of operative voltage. Circuits originally intended for battery operation often don't lend themselves particularly well to AC modification, and the same thing is true of certain AC circuits, but the circuit diagrammed above is quite flexible.

An inspection shows that the input inductor L_2 is coupled to a series aperiodic circuit which includes a variable resistor R with the antenna coil L_1. This resistor serves as a volume control very effectively when its value is selected with due regard to the range of signal voltage variation it is supposed to control. By this is meant that if the resistor value is small relative to the prevailing signal voltage, then the controlling feature of it will be negligible, but also if it is very large, the controlling effect is likely to be too good, that is, it will be abrupt. Experiment has shown that a good average value is between 5,000 and 6,000 ohms.

The purpose of resistors R-2 and R-3 is doubtless known to most fans, since certain sets made back in the early days used them for suppressing undesired oscillation in radio frequency stages almost exclusively. R_2 and R_3 should preferably be of the non-inductive type. Their resistance is somewhat subject to the resonant characteristics of the tunable circuit with which they are associated, but usually their DC resistance is around 10 ohms. R_1 and R_4, the radio frequency grid bias resistors value, likewise depends upon certain factors such as the condition of the tube and the applied plate voltage, measured at the tube. If you use 180 volts on the plate, the bias resistors should be 2,000 ohms, and if you use as little as 90 volts, the RF bias resistors should be 300 ohms, indicating that a value of 500 ohms is about correct for average use.

If you contemplate using a power detector, the value of R5 should be 20,000 ohms, or it could be a variable one of 30,000 ohms. This arrangement would give some control of sensitivity, now more or less generally. Bias resistor R_6 is usually of 5,000 ohms resistance, as even if the plate voltage should go in excess of 100 volts, this being the output tube, some heavy current density won't be amiss, especially if you have a dynamic speaker. If you wish to use grid-leak and condenser detection, the resistor R_5 may be made 500 ohms or less, as previously indicated. The conventional 5 megohm leak and .00025 microfarad fixed condenser should be used. C, C_4, C_5, and C_6 may be of one microfarad each, and the value of C_7 will depend upon transformer T, that is, if it is a 1-to-5 ratio, the primary impedance may be high enough to require that C_7 be present but the use of a 1-to-3 transformer may mean that this by-pass condenser may be omitted entirely.

C_8 is a plate supply by-pass condenser of at least 1 mfd. It will be even better if it is 5 mfd. In any event, don't make it too small. L_1, L_2, L_3, L_4 are the usual fixed inductances, and it is recommended that these be selected for use with .0005 mfd. variable tuning condensers, as this combination insures waveband coverage.

No source of operative potential is shown, but as before stated, you may use either a filament transformer, or a storage battery, for the filament excitation, while for the plates, a dry cell type "B" battery or a regular tube operated eliminator is entirely practical.

This set operates unusually well as a 150 foot aerial, and with a good ground will bring in the kind of reception you have always wanted.

New Short-Wave Record

Pittsburgh, Pa.

A recent new two-way short-wave broadcast record was established when KDKA rebroadcast on short, and its regular broadcast frequency a program originating in Saigon, French Indo-China, and conveyed through VK2ME, of Sidney, Australia.

The received signals were also rebroadcast back to Australia again by KDKA. The Saigon station broadcast program was picked up by VK2ME on its regular frequency, and both this and KDKA's answer were rebroadcast locally from Sidney on regular and short waves.

The total one-way signal distance was 22,339 miles.

Measuring Plate Voltage

WHICH is the best way of measuring the plate voltage in a resistance coupled amplifier? I have tried to measure it with a high resistance voltmeter but I don't get any reasonable readings. The meter is all right when I test it on batteries.—T. O. N.

Connect the high resistance voltmeter across the B minus and B plus binding posts. The reading you get is the applied plate voltage and that is what counts. If you want to measure the effective voltage on the plate, you have to use a vacuum tube voltmeter, such as was described in the September 13th issue, on page 16, or a similar instrument.

TELEVISION PROGRESS MADE

A public demonstration of the Jenkins automatic synchronizer and talking television given in New York in the presence of radio engineers and representatives of the press showed that encouraging progress has been achieved toward making television ready for the public.

The pictures are broadcast by the Jenkins sight broadcasting station W2XCR in Jersey City, N. J., operating on a frequency of 2800 kilocycles or 107.1 meters. The sound portion of the transmission is broadcast through the de Forest experimental station W2XCD in Passaic, N. J., operating on 1604 kilocycles or 187 meters.

Simple Mathematics

By Manning

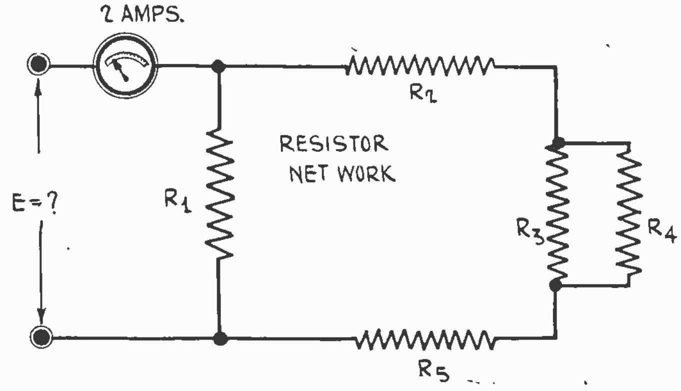


FIG. 1
A RESISTOR NETWORK, WHOSE TOTAL RESISTANCE VALUE IS CONSTANT IF THE TEMPERATURE IS UNCHANGED. THE VALUE OF E IS REQUIRED WHEN THE AMMETER READS 2 AMPERES.

The type of measurements that radio fans are most interested in pertains to resistance net works, of which Fig. 1 is an example. Probably the reason why interest in networks is claiming the attention of the experimenter is that so many have been interested in circuits such as the Loftin-White, various "B" eliminator "systems," including those that provide for the operation of dynamic speaker field coils, and charging of storage batteries, using vacuum tubes, mercury vapor tubes, generators and other devices. To all these a study of the circuit network of Fig. 1 is suggested.

Here we have a network consisting of R1, which could just as well be a "voltage divider," and shunted around it is a series circuit, including two resistors, R2 and R5, their circuit continuity being completed by R3 and R4, which are in parallel with each other, though they are (considered as a group) in series with R2 and R5.

An ammeter is placed in an externally placed part of the circuit and has for the time being no special relation to the network. In fact, if it were not there at all, and the connecting leads were absent, the conditions which we are about to investigate would be unchanged. That is, R1 could substitute for R2 and R5 could substitute for R2, and the R3-R4 parallel group could substitute for R, and the total resistance of the network would remain as it was initially.

This proves, then, beyond a doubt, that no matter how given single resistors are grouped, or no matter where grouped, arrangements of single resistor values are included in a series circuit, the final or resultant resistance value is the same.

The above statement of fact is based, not on any prolonged mathematical study, but on observation and the use of common sense, but its formulation as a law will shortly give it the convenient mathematical appearance which may be familiar.

Before presenting the formula (which by the way is not in numerical form), some few words are to be said about Ohm's law. There are two facts about resistance measurements of which experimenters should be reminded, and to which new readers should pay attention. These are that any resistor has a limiting current carrying value above which the "room temperature measured" resistance value increases rapidly, and also, Ohm's law as usually stated pre-supposes constant conductor temperature. Actually this change is small as long as you keep below the point where an increase of more than one degree above room temperature is involved. (Strictly speaking, the temperature of a conductor carrying a weak current does change, but the effect is such a small fraction of its total temperature that the change is neglected.)

The formula for expressing the resultant resistance of a number of similar resistance values in series relationship is given by the following:

$$R=r1+r2+r3 \qquad (1)$$

in which R is the resultant resistance of the resistances r1, r2 and r3. Stated in words the formula is: The resistance of a group of resistances connected in series is equal to the sum of the individual resistors so connected.

For resistors connected in parallel the formula is:

$$R=1/(1/r1+1/r2+1/r3) \qquad (2)$$

in which R is the resultant resistance of the three resistors connected in parallel. Stated in words this formula is: The resistance of a number of resistors connected in parallel is equal to the reciprocal of the sum of the reciprocals of the several resistors so connected. The reciprocal of a number, incidentally, is defined as one divided by that number. For example, the reciprocal of 2 is ½.

An inspection of Fig. 1 will show that there is both series and parallel networks and therefore the utilization of both formulas is indicated, which might cause some concern if the solution of the problem were a part of a mid-town college examination.

The form in which Ohm's law is used here is quite as common as in the cases often presented in RADIO WORLD's pages, but to save anyone needless trouble, all three variations are given:

$$R=E/I \qquad (3)$$
$$I=E/R \qquad (4)$$
$$E=IR \qquad (5)$$

Since the solution of Fig. 1 involves the use of (1) and (2), we may as well try first to decide whether there is any special advantage in the use of either one. Here, as before, we may as well pretend that the equations are "in series" also, and that being so, there is no reason why any preference should be shown, just so long as R_3 or R_4 are not combined with any other resistor in the network.

The problem is to find the value of large E, and since we are acquainted with the network by now, the solution is only a matter of course.

Let R_1 = 40 Ohms, R_2 = ⅜ R_1, R_3 = ⅛ R_1, R_4 = 1½. R_1 and R_5 = ½ R_1.

Then grouping terms,

$$R = \frac{1}{\frac{1}{40} + \frac{1}{60}} = 24 \text{ ohms}$$

and using (5)

$$R = 2 + 24 = 48$$

It is obvious that this solution applies to a particular case, but the formulas given previously are quite general, and may be applied to any similar case, or cases, where additional resistors are included in series or in shunt.

For practice, the experimenter may solve for the value of large E substituting other values, as this is the best way to impart self-confidence.

Next comes the case of a resistor and battery network, which introduces a new idea, namely, that of an "internal emf," that is, one that is effective without any "outside" help.

Battery source of internal emf

The problem here is to work out the current flowing in various parts of the circuit, and in particular to find out what current flows in R_1, and what the V_2 voltmeter indicates, what current flows in Resistor R_2 and the voltage drop across it, as well as the current indications of A_1, and A_4. The top lead of V_3, the battery voltmeter, is connected to the two battery positive terminals and the lower one is connected to battery minus (or negative).

We are to apply Ohm's law here, gnerally speaking, but in a form as yet unfamiliar, because the circuit must first be discussed.

Since we know briefly what is required, it should not take very long to work out a solution to this case, but the stumbling block is that we don't know what the battery emf is or what its effect is.

The explanation is that the voltage of the battery relative to the impressed 110 volts is such that the "effective impressed" voltage is reduced by just that amount, and with Sw connected to the junction of R_2 and B_1, minus, this is so, since V_2 will indicate the difference.

Assuming, therefore, that this is the present condition of the circuit, we have to do a little inspection work first to determine how Ohm's law will be applied.

Since we are dealing with two similar batteries which are connected in parallel with each other, the combined voltage of the group will be the same as that of the individual batteries. Let this voltage be 10 volts. Then according to what has just been said the effective impressed value is:

$$E_L - E_B$$

Where E_L = Line impressed voltage.
E_B = Battery opposing voltage.

Ammeter A_2 reads five amperes, and that is not the whole laod, but inspection shows that as R_2 is cut out the indication of A_3 will be the same, and each of the two ammeters indicates one-half of the total load current, since they are in series with similar circuits, it will be apparent that the total load current will be twice the indicated value of either A_2 or A_3, and by in-

for the Experimenter

Manwaring

specting the reading of A_1 this fact will be confirmed.

And so the total load is 10 amperes, and this is a circuit that is part series and part parallel, but the resistor that we are now interested in is in the series part of the circuit, and, therefore, the total current flows through it (R_1), and by Ohm's law we should be able to find the desired answer. Probably by this time the reader will have suspected the true nature of this circuit, which is nothing more than a battery charging device that is operating from a 110 volt lighting source. However, that is no reason why we should not learn something of use from it that we can apply to radio measurements later on, so let us operate on Ohm's law and see what happens.

In the above case (6)

$$R_1 = (E - e)/I,$$

and if we substitute values in the above equation as presented, the result is as follows:

$$R_1 = (110 - 10)/10, \text{ or } R_1 = 10 \text{ ohms}.$$

We know what the value of R_1 is now, and the top line of the above equation gives us the value of meter V_2 reading, which when multiplied by the current flow through the resistor gives a product that is called watts. Here the wattage is 1,000.

There is quite an assortment of meters used in this diagram apparently. Actually there are only three instruments used, namely, V_1, a 0-150 volt scale meter, A_1, a 0-50 ampere meter, and V_3, a 0-20 volt, low range voltmeter. All the others are merely substituted, and lettered accordingly, a device the experimenter who has few meters will most likely resort to, and in fact is what is commonly done when the source of voltage is known to be constant.

Let us now see what happens when we place point Sw as shown in the diagram.

Effect of Changing Shunt Resistance

Suppose in a circuit like that of Fig. 2 it is desired to retard the charging rate of B_1 by means of an added series resistance R_2. What would the general effect be? We know from previous discussion that A_3 and A_2 are in two branch circuits and that normally each indicates one-half of the normal load. Therefore if some additional series resistance is inserted in the system, the reading of A_3 will be affected, and, of course, the idea here is to find out how much the change will affect the whole circuit. So we gradually cut in resistance R_2, until A_3 reads 3 amperes, and then we stop to think out the best way of considering the effect of the additional resistance.

Since the change wrought by the addition of R_2 has resulted in a decrease in the load current, from 10 to 8 amperes, it is equivalent to what would have occurred if a resistor had been added to R_1, and such being the case, we can proceed to consider (6) again in this light.

To condense all this into the shortest space let us consider I in (6) to be 7 amperes and solve again. We get $(110 - 10)/8 = 12.5$ ohms.

But the original value of R_1 was 10 ohms and therefore R_2 is the added amount or $2\frac{1}{2}$ ohms. In its proper place in the branch circuit it carries three amperes and therefore V_4 reads 7.5 volts, the reading of V_3 remaining undisturbed. The total wattage supplied to the system is 110 volts times 8 amperes, and the two branch circuits of B_1 and B_2 are therefore subject to the previous calculation used to determine the wattage division of each.

This network, while illustrating the conditions met with where a divided resistor circuit includes an internal emf, is also applicable to plate voltage supply circuits when certain modifications are made.

Illumination Test Using Resistor Network

Other measurements beside purely electrical ones are made using forms of resistor networks, two examples of which are herewith presented. Fig. 3 is the electrical circuit involved in a simple portable illumination device called a "Foot-candle meter" or illuminometer.

The lamp is situated behind a specially made screen that is provided with several apertures that are equipped with semi-transparent screens which are graded in density to conform to standard incident light intensities, and since the illumination intensity of the lamp is controllable by the adjustable resistor, which carries a graduated scale whose graduations read in terms of filament input wattage to the lamp which is a "standard" one and whereby the relation between the lamp's light output and the light "input" of the measured source are compared.

These devices are employed by those whose business it is to measure lighting conditions in industrial plants, and especially where a quick and reasonably accurate survey of illumination requirements is indicated.

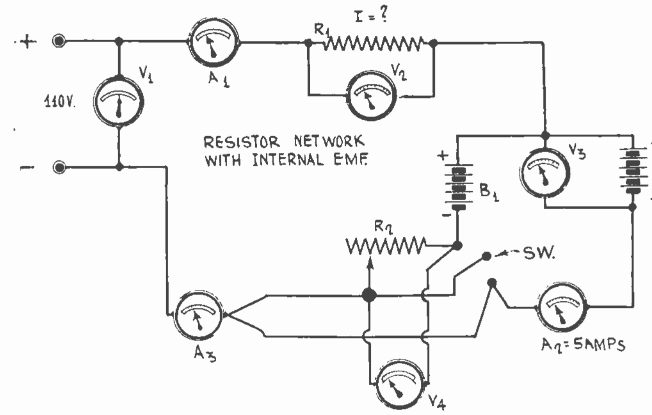


FIG. 2

A RESISTOR NETWORK THAT HAS A SELF-CONTAINED EMF IN OPPOSITION TO THE APPLIED EMF. RESISTANCE HERE IS NOT THE ONLY FACTOR.

A Photometer Circuit

Fig. 4 is really the basis of the device previously outlined, but being essentially a laboratory measuring instrument rather than a device to measure external illumination as the "foot-candle meter" is its description, or rather the points of interest about it in so far as we are concerned are confined to the difference between the circuits which can be observed readily by inspection.

The essential circuit arrangement is a network containing a "standard" lamp, and this lamp's filament has an ammeter in series with it, while a voltmeter is shunted across the filament. The lamp is previously calibrated in terms of foot-candles per unit power input expressed in watts at various voltages other than "standard" voltages, that is, for conditions other than standard, a table is supplied for the standard lamp whereby a constant check on its illumination is available at all times. The supplied table also indicates the maximum allowable input permissible without ruining the constants of the lamp.

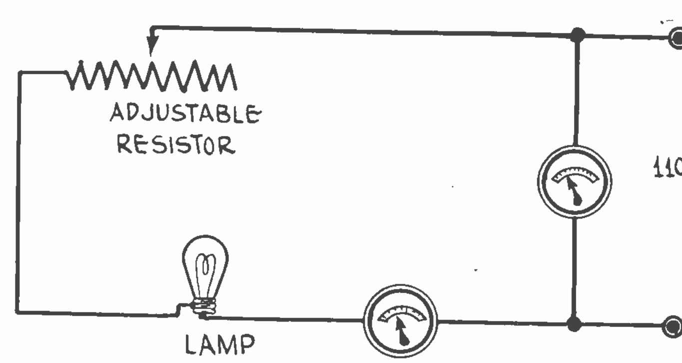


FIG. 3

THE NETWORK RESISTORS THAT ARE THE BASIS OF SOME ILLUMINATION MEASURING INSTRUMENTS, SUCH AS THE "FOOT-CANDLE METER" OR ILLUMINOMETER.

The other circuit is essentially similar to the standard one except that no table is necessary and a controlling resistance called a "comparator" is used to adjust the lamp under measurement to any desired condition of illumination.

The uses of the photometer circuit are principally those of determining the illumination efficiency of lamps and their relative power consumption.

The meters of the two circuits are identical in deflection characteristics, and where only one set of them is available the use of two double throw, double pole switches makes it possible to employ one set of meters in both circuits.

There are many instances in the art of measurement where electrical circuits are employed for the measurement of quantities of non-electrical origin and not all of them depend on a change in resistance as the basis of comparison from which values are derived.

(Continued next week)

Uses of the 224 Tube

By J. E. Anderson

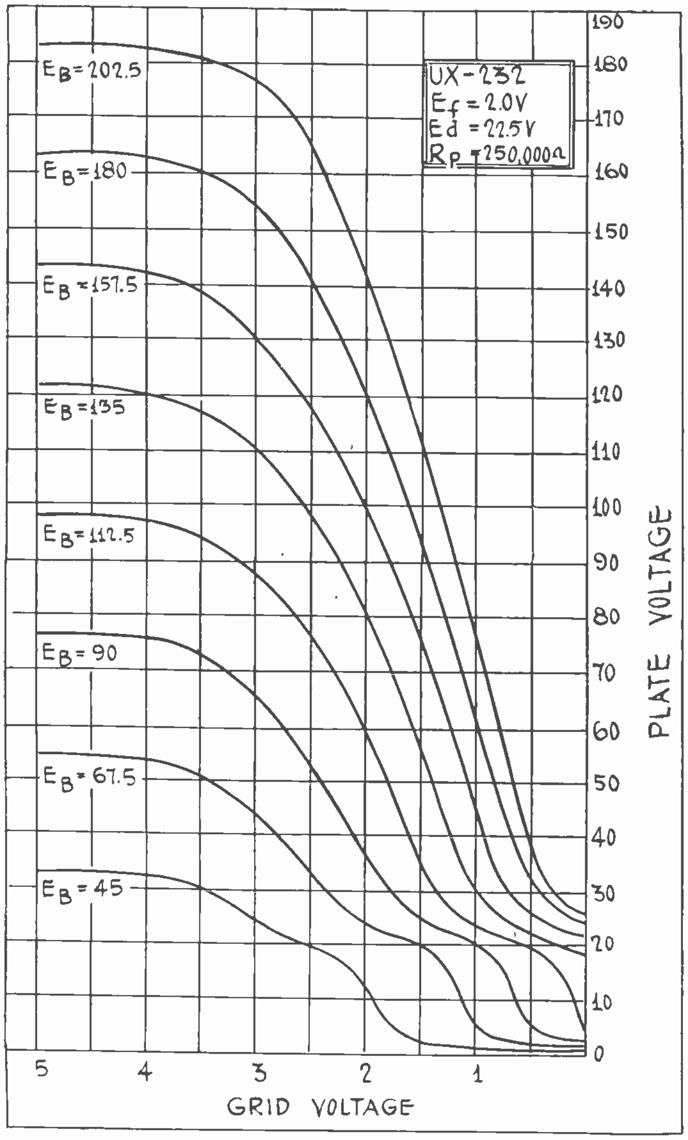


FIG. 62
A SET OF CURVES SHOWING THE RELATION BETWEEN THE CONTROL GRID BIAS AND THE EFFECTIVE VOLTAGE ON THE PLATE OF A 232 SCREEN GRID FOR EIGHT DIFFERENT PLATE BATTERY VOLTAGES AND THE OTHER CONDITIONS SPECIFIED

[This is the eighth instalment of "Modern Radio Tubes." The first instalment appeared in the August 9th issue in which the small battery tubes were discussed. Subsequent instalments have dealt with other battery tubes, including the new 2-volt tubes. In the next issue additional data on the screen grid tubes will be published.—EDITOR.]

LAST week we showed curves for the 232 screen grid tube for different screen voltages and a fixed plate battery voltage. Now we shall give a set of curves for a constant screen voltage and different plate battery voltages.

The family of grid voltage, plate voltage curves in Fig. 62 shows how the effective plate voltage varies with grid bias on the 232 screen grid tube for eight different plate battery voltages and the operating conditions stated on the graph.

These curves show plainly the importance of using a high voltage in the plate circuit when this tube is loaded with a high resistance. Take, for example, the curve for 45 volts in the plate circuit. There is no region on this curve where there is any appreciable voltage amplification. But on the curve for 202.5 volts in the plate circuit, on the other hand, there is a wide region where the amplification is good. Thus when the grid bias is 0.75 volt the plate voltage changes from 59 to 77 volts while the grid voltage changes from 0.5 to 1.0 volt, and therefore the voltage amplification is 76 times.

As the control grid bias is increased the amplification decreases a little but the possible input voltage amplitude increases. For

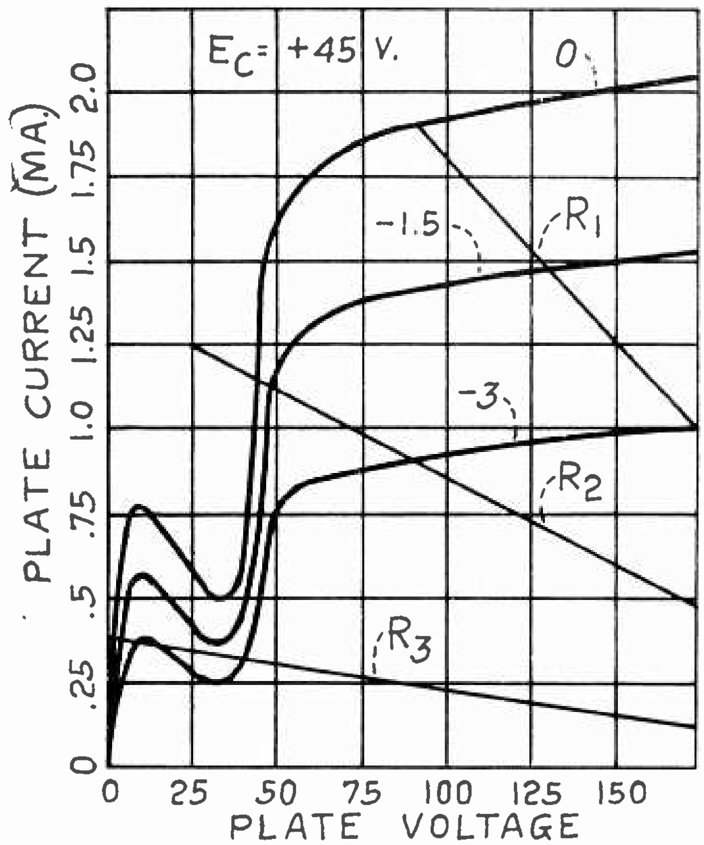


FIG. 69
PLATE VOLTAGE, PLATE CURRENT CURVES FOR THE 222 SCREEN GRID TUBE FOR A SCREEN VOLTAGE OF 45 VOLTS

example, when the bias is 1.25 volts the double amplitude may be as high as 1.5 volts, and the double amplitude of the output voltage is 101 volts. Thus the output would be sufficient to load up a 245 power tube with an input on the screen grid tube of only 0.75 volt amplitude. The mean voltage amplification is 67.3 times.

When the plate battery voltage is 67.5 volts the amplification is only fair provided that the operating grid bias is about 2.75 volts. A grid voltage change of 0.5 volt causes a change in the output voltage of 10.8 volts, whence the voltage amplification is only 21.6 times. The increase in the voltage amplification is gradual as the applied plate voltage increases. It is interesting to note that the required grid bias increases as the applied plate battery voltage decreases.

If the tube is to be used as a grid bias detector the required bias also decreases as the plate battery voltage increases, but the change is very small. It is clear that the detecting efficiency is greater the higher the applied plate voltage, just as the amplification efficiency is greater. For a plate battery voltage of 180 volts, the bias for best detecting efficiency is about 3.5 volts and when the plate battery voltage is 202.5 the greatest detecting efficiency comes at about 3.25 volts.

Characteristics of 222

In Fig. 69 is a family of plate voltage, plate current curves for the 222 tube when the screen voltage is 45 volts. Three load lines are drawn across the curves. Of these only the highest, R1, is practical when the recommended values of plate and grid voltages are used, and it represents a load resistance of 100,000 ohms. The applied plate battery voltage for this curve is 275 volts and the voltage amplification is only 27.7 times. This gain is no greater than that obtainable with a 240 high mu tube and therefore there is no marked advantage in using a screen grid tube under the specified conditions. It does not follow, however, that conditions cannot be brought about which will make the 222 tube yield a higher voltage amplification than the 240 tube. It is possible to increase the plate load resistance, lower the screen voltage, and adjust the control grid bias to match these conditions and in that manner obtain a worthwhile increase in the voltage amplification. For example, in Fig. 70 the 22-volt screen grid voltage curve at the control grid bias of 3 volts shows a voltage gain of 50. The load resistance in this case is one megohm. An even greater amplification could be obtained by

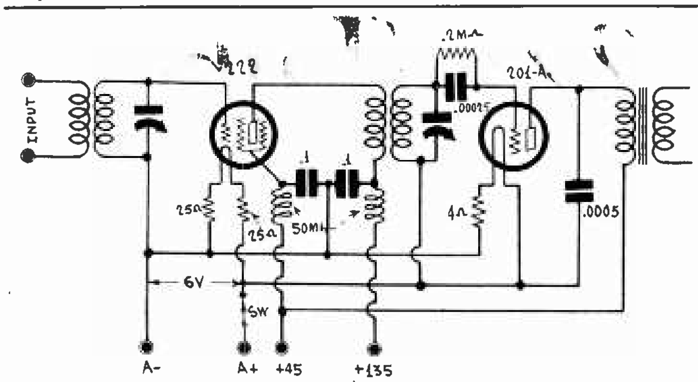


FIG. 71
A CIRCUIT DIAGRAM SHOWING THE PROPER METHOD OF CONNECTING THE 222 SCREEN GRID TUBE IN A RADIO FREQUENCY AMPLIFIER. THE TUNED CIRCUIT FOLLOWING THE TUBE SHOULD BE DESIGNED ESPECIALLY FOR THIS TUBE.

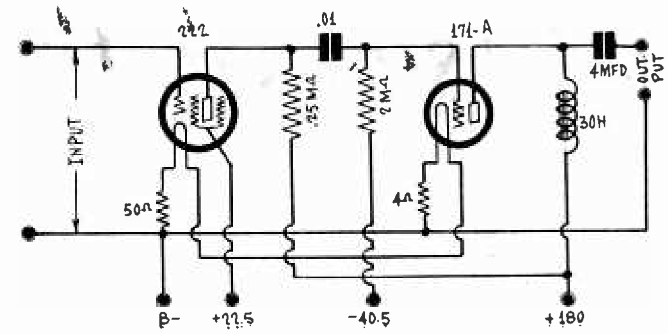


FIG. 72
A CIRCUIT DIAGRAM OF A RESISTANCE COUPLED AMPLIFIER SHOWING THE PROPER ADJUSTMENT OF VOLTAGES. A CONTROL GRID BIAS OF 3 VOLTS HAS BEEN PROVIDED.

increasing the plate battery voltage, decreasing the screen voltage, and lowering slightly the control grid bias.

In Fig. 71 is a circuit diagram showing the recommended adjustments of the voltages on the 222 tube when it is used as radio frequency amplifier. The control grid bias is 1.5 volts, obtained from the drop in the 25-ohm resistance in the negative leg of the filament. Since the filament supply battery voltage is 6 volts and the drop in the filament is 3 volts, a second 25-ohm resistor is placed in the positive leg of the filament circuit. The filament voltage here is specified at 3 volts whereas in the table of characteristics it is given as 3.3 volts. The tube will last longer if 3 volts are used and the performance of tube will be just as good as when 3.3 volts are used. The higher voltage is the maximum that should be applied.

222 in Resistance Coupled Circuit

In Fig. 72 the 222 screen grid tube is shown in a resistance coupled audio amplifier. The plate load resistance is 250,000 ohms, the applied plate voltage 180 volts, the screen grid voltage 22.5 volts, and the control grid bias 3 volts. This is obtained from the voltage drop in the 50-ohm resistor placed in the negative leg of the filament circuit. It may be that the combination of voltages are not quite optimum, but this condition can be brought about by varying the screen voltages a little. It is not convenient to vary the control grid bias or the applied plate voltage to bring about the optimum adjustment. Very little change in the screen voltage, if any, should be required.

The output voltage of the 222 tube in the setting shown in Fig. 72 is adequate to load up a 171A power tube and for that reason this tube is included in the circuit. The output circuit of this power amplifier is of the impedance type and it should be noted that the loudspeaker is returned to the filament of the tube and not to B plus.

CHARACTERISTICS OF THE 224

Heater voltage	2.5 AC or DC
Heater current, amperes	1.75
Plate voltage, maximum and recommended	180.0
Grid bias, volts	1.5
Screen voltage, maximum	75.0
Plate current, milliamperes	4.0
Screen current, milliamperes, not over	1.33
Plate resistance, megohm	0.4
Amplification factor	420.
Mutual conductance, micromhos	1,050.
Effective grid-plate capacity, mmfd	.01
Input capacity, mmfd., about	5.0
Output capacity, mmfd., about	10.0
Socket, standard UY, that is, five-prong	

The characteristics given in this table are average values and small variations may be expected when measuring a tube taken at random. However, the tube is held to specifications so closely in the manufacturing processes that circuits may be designed on the basis of the average values with the assurance that good results will be obtained with any tube that has passed all the tests. Of course, this may not be true of all the tubes of this type, but it is of all those made by reputable manufacturers and sold by them as first class tubes.

The tube has been designed primarily for AC operation in radio frequency amplifier circuits and the characteristics apply to such circuits without modification. However, the tube may also be used as detector either with grid condenser and leak or grid bias, and as grid bias detector it may be adjusted either for small signal detection or for power detection. It may also be used as voltage amplifier in a resistance coupled audio circuit. When the tube is used for any purpose other than radio frequency amplification, it is necessary to change the various applied voltage to suit the function it is performing.

Condenser-Leak Detection

When the tube is used as a detector with grid leak and condenser, the grid return should be made to the cathode, the grid condenser should have a capacity of .00025 mfd., and the grid leak a resistance of from 2 to 5 megohms. The applied plate voltage might well be 180 volts, the same as that used when the tube is employed as a radio frequency amplifier. The screen voltage which will give maximum detecting efficiency cannot be stated definitely for all cases as it depends on the type of load that is put on the detector. If the tube is followed by an audio transformer the screen voltage should not be much different from its value in a radio frequency amplifier, that is, from 67.5 to 75 volts. However, different values should be applied with a view of finding the voltage that gives the greatest output in any particular case.

When the tube is used as grid bias detector, either for small or large signal voltages, the applied plate voltage again may be 180 volts and the screen voltage approximately the same as if the tube were used as an amplifier. The grid bias required for maximum detecting efficiency cannot be stated, but in general it should be twice as great as if the tube were used as an amplifier. For any given combination of plate battery and screen voltages it is always possible to find one control grid bias which gives the greatest detecting efficiency, and the best way of finding it is to try different values with a grid bias battery.

Resistance Load on Tube

It is not recommended that the tube be used as detector or audio amplifier unless the load on it is a high resistance, say 250,000 or 500,000 ohms. When it is used in this manner it is not only possible to get a high detecting efficiency out of the tube but also a high amplification efficiency. However, to get the maximum output it is necessary to select the proper combination of grid, screen grid, and plate battery voltages, just as it was necessary to bring about the proper combinations for the 232 and the 222 screen grid tubes.

Curves giving characteristics of the tube in resistance coupled circuits will be published as soon as they can be prepared, and we hope to have them ready for the next instalment.

In Fig. 74 we have the circuit of a typical amplifier with all the voltages as recommended. The applied plate voltage is 180 volts, the screen voltage 75, and the control grid bias 1.5 volts. This bias is obtained from the drop in the 300-ohm resistance in the cathode lead, which assumes that the sum of the plate and the screen currents is 5 milliamperes. Since 75 volts on the screen does not always give the best results, different voltages should be tried, but no higher voltage than 75 volts should be applied. Only one of these screen grid tubes is shown in the circuit, but most modern receivers contain several. When more are used all are connected exactly the same way as the one shown, and this applies to by-pass condensers, isolating choke coils, bias resistors, and plate and screen voltages. When there are several tubes of the same type it will be found that a screen voltage somewhat lower than 75 volts will give better results because the maximum voltage may cause radio frequency oscillation.

(*Continued next week*)

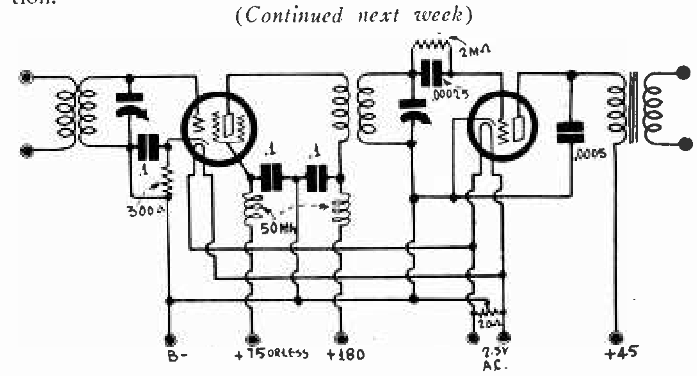


FIG. 74
A CIRCUIT DIAGRAM OF A RADIO FREQUENCY AMPLIFIER INCORPORATING A 224 TUBE WITH RECOMMENDED VOLTAGES ON THE ELEMENTS. THE TUNER FOLLOWING THE 224 SHOULD BE DESIGNED ESPECIALLY FOR THIS TUBE

A Comparison of R

By Lester

[*The following is a continuation of the article entitled "A Comparative Test of RF Coils" and is concluded here. The reader should refer to the September 20th issue of* RADIO WORLD *to consult diagrams mentioned below.*—EDITOR.]

The fact then that we of today are provided with measurement standards that are recognized by all who must measure in one form or another means that when we set out to learn how to measure we don't have to begin at the beginning, but can start right off using millimeters, meters, thousandths of an inch, degrees Centigrade, kilograms per meter or pounds per foot, ohms per meter, or microhms per foot, grams per cubic meter at standard pressure, as well as other scientific units, and thus begin to amass information with the aid of modern standards.

Returning to the subject of Fig. 3 again, it is well to point out that when you make, and having made your experimental coil, you should aim to keep "transformer" effect (observed by measuring induced currents) as large as you can consistent with reasonable coil size, all determinations being made without the use of shield cans.

Some readers will want to know why a condenser, or rather two similar condensers could not be shunted, one around the coarse coil and the other around the fine coil initially. The answer is that you don't complicate coil resonance current measurements by the introduction of parallel condensive reactance (or condenser losses) when you are trying to get the coil comparison data only.

A Final Test

Fig. 4 shows two methods whereby the final comparative tests with shield cans may be made, but right here it is pointed out that the test circuit about to be outlined is useless, from a comparative viewpoint unless the preceding tests have been done, because if you put either one or two unknown coils into the shield cans your comparisons are more likely to indicate merely shielding effects or defects, complicated with coupling and capacitive effects and by the time you are through, you won't know anything definite. But the likelihood of most of this is remote as most fans do believe in rational procedure above all else.

A comparison of Fig. 4 with Fig. 2 will be of interest before we continue because some extensions of ideas involved in the former circuit are contained in the latter, namely, the current flow in the primary coil, AC induced flow in the secondary coil and the value of the maximum average induced current in the secondary as modified by the effect of the proximity of a shield can.

Inspection shows that the previous circuit test could have been provided with a shield, but even so, the physical dimensions of such a shield might have been most impractical; as a final consideration, therefore, it was purposely not included.

Before setting forth the details of Fig. 4, something should be said about shields, what they are, why shielding helps, and also why it does not, and what materials are commonly used for shields.

A shield, or shield can, as it usually is known, is a device whose principal function is to limit the stray magnetic field of a coil or radio frequency transformer which carries high frequency alternating current. The use of shielding cans is indicated wherever the physical condensation of component parts of a radio receiver to reasonable area results in a degree of instability which is uncontrollable by any other means.

Proper and helpful use of shielding denotes care in design, whereas lack of sensitivity, a poor tuning characteristic, and perhaps a woody tone, may be traced to excessive shielding. Shield cans become lossers to an excessive degree usually when they are too close to the secondary tuned winding. They may also appear to be contributing to some general deficiency when the value of M is incorrect (usually too small). A shield can is regarded as a single turn coil of very low impedance, which dissipates the current induced in it by the external field of the radio frequency transformer in the form of heat. But actual confirmation of this fact with the usual emfs used in ordinary radio frequency amplifiers (shielded) would be very difficult as the exciting power is of the order of a few milliwatts.

Shield Materials

Nevertheless, the fact that the energy is dissipated by heat can be conclusively proved by winding a coil of No. 18 magnet wire, of 10 layers and 3 inches long with a hollow core of 1-inch inside diameter. Connect this coil to a source of 110 volts AC and then hold the shield can over it as long as posible. The heat you will notice is caused by induced currents and it represents loss.

Shield materials are mostly divided into two classes, magnetic and non-magnetic conductors—that is, ferrous or non-ferrous substances. Shield cans used commercially in the better grade radio sets are of copper, next in favor is brass, and finally aluminum. Copper is expensive, and very tough, but its specific resistance is the lowest of all (next to pure silver). Next comes brass, considerably cheaper, though not so ductile, and very slightly higher in specific resistance, and finally aluminum, very ductile, easily formed, and having a specific resistance low enough to enable it to compete with the other two substances easily.

Iron shield cans or boxes provide the advantages of the above, and in addition a path of extremely low reluctance that effectively shorts the weakest stray field to "ground," especially where the chassis is made of the same material. But a disadvantage lies in the fact that magnetically the latter is very different in its reaction to an external field, as compared to the former, but they may be used if they are very carefully designed and coordinated with the intended coils they are to shield.

Fig. 4 is a circuit whose objective is to determine the degree of similarity of tuning of Lx and LSTD and in addition the effect upon this tuning and similarity produced by the use of shield cans (dotted lines) that completely surround the coils under test. Two shield cans of similar size and gauge thickness are used. Also, with and without the effect of shield cans it is possible to make rapid comparisons of the output "punch" of the two radio frequency transformers under test.

The two tuned systems must first of all tune similarly over the entire broadcast frequency scale, without the use of shield cans. Then with shield cans in place the difference in response should be no greater than about three scale divisions.

Final Comparison

This means that you will have to try more than one shield can for a given set of coils, but in no case should the coils be tampered with once the result of tests preceding is decided upon.

The final comparison with and without shields is that of comparing the output at similar resonance, and for this purpose the Lx and LSTD coils (RF transformers) are shown operating into an amplifier tube that is operating under "standard" conditions of plate voltage, grid bias and heater current and voltage. A new tube is assumed and a screen grid tube may be used if desired. "Standard" conditions for the above are those that are to obtain in the set you are about to build or are checking up on.

All you have to do here is to work for the largest average induced current in the resonance frequency meter with and without the shields and you will have the most accurate indicated result that a test circuit devoid of complication can give.

The extension of the above tests to short-wave coils could be described now if transformer effect was still the principal controlling phenomenon, but the effect of capacitive coupling gets troublesome in so far as the previous test circuits are concerned and hence some different circuit arrangements are indicated which will have to be treated at a later date.

Resonance Indicator

I have shown two forms of resonant frequency meter hook up, a series circuit (Fig. 2) and a shunt arrangement (Fig. 3). Either one of these may be used depending upon whether or not you have a very sensitive indicator. In the former case the circuit of Fig. 3 applies and in the latter, that of Fig. 2 will prove the better.

The indicator is a thermo-galvanometer with a built-in thermo-couple, and this is supplied with a graph or curve by means of which the meters deflection may be readily translated into terms of milliamperes, and the range is usually from zero to 115 milliamperes for a full scale deflection. The safe current carrying capacity of the thermo-couple is greatly in excess of this. Hence accidental burn-out is ordinarily avoidable.

Suppose, though, that it becomes very difficult to find a coupling condition that enables this best response to be found, a condition that might be expected if the set constructor made his own coils, however excellent they might be.

Here a different condition presents itself because the whole band of frequencies can not be tuned in, and investigation in numbers of cases reveals that the high frequency end of the band is missed. The usual limit is 1,400 kc and in some cases it's 1,300 kc. The substitution of another tuning condenser of the larger capacity and larger ratio minimum to maximum,

adio Frequency Coils

Chadwick

would cure the condition, but that might require .0075 mfd., and only .0005 mfd. is commercially obtainable.

Alternative Remedies

An alternative remedy is to re-wind the coil form with wire that has heavier insulation so that the turns are separated more than previously. This may necessitate perhaps three more turns, but the net result is a higher natural period for the coil, and may result in the desired frequency range being covered. If not, at least there has been some improvement. Another method is to use larger shields, as if the coil is too close to the shield. The inductance is reduced and a capacity effect built up, both defeating coverage.

It is not impossible for the builder to realize, that the impedance of the primary or inducing coil may be a little scant, and therefore subject to increase without changing the number of turns, or changing the DC resistance to any serious degree.

Use of Ohmmeter

A method whereby an ohmmeter may be made to read resistance values far beyond its immediate scale range is one that employs a simple equation written out below. While the equation applies to any direct reading ohmmeter, generally this particular one was a 3,000 ohms maximum scale reading (in ohms) instrument, which was provided with two scale ranges that were sub-multiples of the largest range, namely 100 ohms and 1,500 ohms.

The scheme is to plug in the maximum scale range and then adjust the value of a sub-standard resistance so that it is adjusted exactly to 3,000 ohms, and then when this is achieved the sub-standard fixed resistor is left connected across the ohmmeter and the circuit is all set up ready to measure any resistance value in excess of 3,000 ohms.

As previously mentioned, the contact plug connects the desired scale range resistor into that of the bridge.

Extending the Scale of an Ohmmeter

The indicating meter is so calibrated, and of such design, that it reads the resistance value of X directly in ohms when the key is depressed. The sensitivity of the meter is such that a very small current is drawn, resulting in accuracy and extended battery life.

For those who may be dubious of the extent of the useful range of a bridge type ohmmeter the condensed table below gives values for indicated and actual values for unknowns from 1,500 ohms to 8 megohms.

Error possibility is present if your standard resistor is not constant, but if you make it of manganin resistance wire that danger is not very great.

The tabulated values furnish all the necessary data for plotting a quickly-read resistance curve, and the reader can fill in any gaps in the table given by use of the formula given below:—

$$\frac{1}{\dfrac{1}{\text{Meter Reading in Ohms}} - \dfrac{1}{\text{Standard Resistor Ohms}}} = \text{Unknown Ohms}$$

Meter Reads in Ohms	Meter Reads in Ohms
1500	3000
1700	3846.1
1800	4833.3
2000	6000
2200	8250
2400	12000
2500	15000
2600	19500
2650	22714
2800	42000
2850	57000
2900	87000
2950	177000
2960	222000
2970	297000
2980	447000
2990	897000
2996	2247000
2997	2997000
2998	4497000
2999	8997000

Choke Rectifier Input

WHICH is better, to put a choke coil next to the rectifier tube in a B supply or a condenser?—D. C. M.

Opinions differ on that point. Some think that a choke coil next to the rectifier is better and others that a small condenser should be used. As a rule, when a choke coil follows the output voltage will not be quite so high as when a condenser is used next to the rectifier tube. The filtering may be slightly superior when the choke is followed. It is said by those who favor a choke coil next to the rectifier that the tube lasts longer, but it is doubtful that sufficient life tests have been made to determine this point definitely.

* * *

Screen Current Variation

IT IS usually stated that the screen current in a screen grid tube should be less than one-third the plate current. I have measured the screen and plate currents at the same time and frequently the screen current is much larger. Is there something wrong with my tube?—L. A. S.

What the plate and screen currents are depends on the effective grid, screen and plate voltages. When the effective plate voltage is less than the screen voltage the screen current may be many times larger than the plate current. The tube should be operated with such voltages that the screen current is not more than one-third as large as the plate current. This is a matter of choosing plate and screen voltages, and in the case of resistance coupling of choosing the grid bias to suit the load resistance.

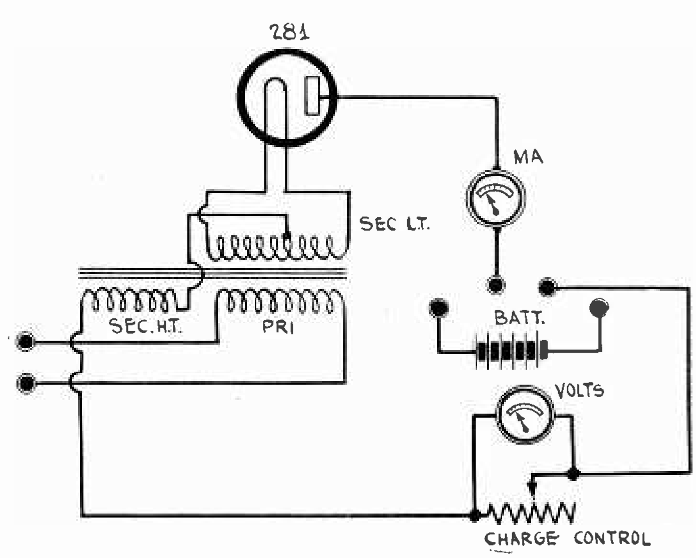
* * *

Coupling Between Condensers

WHEN TWO or more condensers are put in the same case close together is there not coupling between each two units, and is it not possible that this coupling will cause regeneration so that the stability is less with the condensers than without them?—S. T. C.

It is not possible to answer these questions in the negative without reservation because in some instances coupling enters where it is least expected. However, it is not likely that there is appreciable coupling or enough coupling to cause any trouble. Certainly, if the condensers have large capacity the intended advantages are greater than any possible disadvantages. In the case of tuning condensers placed close together without any shielding between the stators, there is undoubtedly a great deal of coupling. This may be such as to cause either regeneration or degeneration. That is, the coupling may cause either an increase or a decrease in the sensitivity of the set.

A condition under which leakage might be mistaken for coupling loss is one where a high potential difference at high frequency would result in a current ow that might be equivalent to a dead short-circuit, especially if the voltage source were one of relatively high resistance. But if the source were one of low resistance, and the voltage remained constant, the intervening insulating material would break down.



A CONVENIENT WAY OF CHARGING A PLATE POTENTIAL TYPE OF STORAGE BATTERY. THE EFFECTIVE DC PLATE VOLTAGE WILL BE THE DC COMPONENT OF THE SUPPLY VOLTAGE MINUS THE BACK EMF OF THE BATTERY.

Tone and Automatic Supert

By Herm.

IN choosing a tone control, one may select the continuously variable type, as where a variable resistor is in series with a fixed condenser of large capacity, or one may use the switch type, which produces different, distinct tonal settings by "jumps." Which one to choose is a matter of taste. Most of the commercial receivers have the switch type.

How the switch type of tone control may be used in the Supertone 801, the six-circuit tuner that uses AC tubes and has power supply built it, is shown in Fig. 1.

The detector plate circuit has a small fixed condenser from plate to ground, then a series radio frequency choke in the B lead, then a three-section fixed condenser 0.1, 0.1 and 0.1 bfd. so arranged that the switch cuts in about .00035 mfd., due to a series connection, then 0.1, then 0.2 mfd., due to a parallel connection. The tonal change from .00035 mfd. at the left-hand switch position, to 0.1 mfd. to 0.2 mfd. is considerable, particularly from .00035 mfd. to 0.1 mfd.

Works on Any Receiver

This device may be worked on any receiver. The capacities to be selected need not be the specific onces stated. If you have 0.2 or even 0.5 mfd., and some small capacity, like .0005 mfd., you may arrange these so that the smallest capacity will be cut in first, then the second largest one, then the largest one. Thus you would have three control positions and three types of tone, which might be termed brilliant, deep and mellow.

If desired, you may use a larger number of taps, due to extra capacities, and if four are to be used, a good combination would be from .00025 mfd. to .001 mfd. for the first 0.01 mfd. for the second, 0.1 mfd. for the third and 0.5 mfd. for the fourth. Then you may refer to the respective tonal values as brilliant, crisp, deep and mellow.

What you are doing as you include more and more capacity in this shunt position is to reduce the amplification of the high frequencies. For speech you would not want to reduce this at all, and only the smallest condenser would be out in, and it should not be more than .001 mfd. under any circumstances. Around .00025 or .00035 mfd. would be better. In the present instance .00035 mfd. was chosen. This was formerly an unusual capacity for a fixed condenser, but is available from several manufacturers now.

First One is RF By-pass

There is some high audio frequency attenuation even with .00035 mfd., but it is comparatively little, and moreover is unavoidable. The condenser is not there for tone control, but rather to present a low impedance to radio frequencies, while maintaining a high impedance to audio frequencies. The low impedance to RF accounts for the by-passing effect on RF currents. The RF choke coil likewise helps to keep radio frequencies out of the audio amplifier.

So the first condenser to be cut in by the switch may be accounted as an RF by-pass condenser solely, without effect on the tone, as the desire is to maintain the tone at a strong value of high audio frequency response. The next stages of capacity cut in very seriously reduces the high audio frequency response. It is therefore a fact, and you may as well realize it now as later, that all tone controls are distorting devices, and if a receiver or amplifier is a faithful reproducer, the tone control, if used, renders it unfaithful.

Some inquiry therefore may be made as to why a tone control should be included, aside from the fact that it seems to be a popular novelty this season. Its sole purpose is to appease a special tone taste of the listener. This may call for distortion and there is no good reason why it should not, since many forms of distortion are pleasing to individual ears, especially as auditory defects are thus atoned for in part, for instance, a person partly deaf to low notes may gain great low-note emphasis by the control method outlined, with resultant high enjoyment.

Helps When You Dance

Low-note accentuation, by the process of high-note suppression, also comes in handy when dancing to radio music. The

(*Continued on page* 13)

LIST OF PARTS

One center-tapped voltage divider, 10,000 ohms or more; 20 watts.
One 10,000-ohm resistor; 10 watts.
One 4 mfd. 200 volt nocdenser.

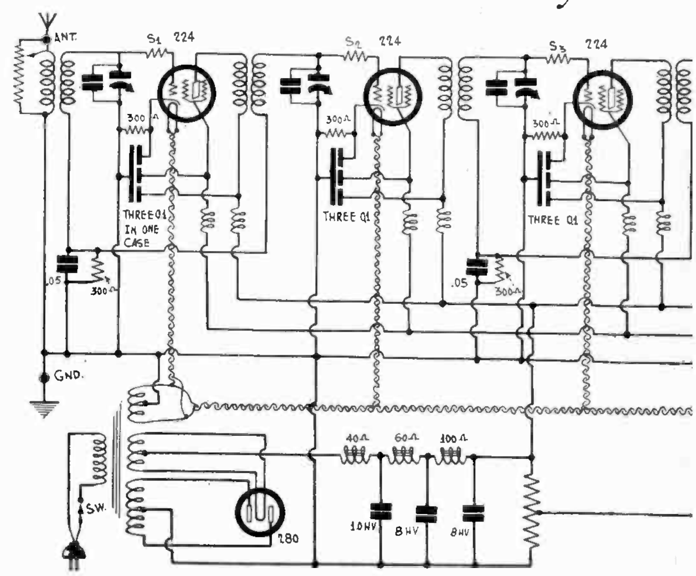


DIAGRAM OF THE SUPERTONE 801, WITH SWITCH

Right o1

QUESTIONS

(1)—The closer the coupling between the primary and the secondary of a radio frequency transformer in which the secondary is tuned, the greater is the amplification.

(2)—In a coupling transformer, a large current flows in the secondary even when it is connected to the grid of a vacuum tube. This holds for audio frequency transformers and for radio frequency transformers in which the primary is tuned.

(3)—In a heater type tube it is necessary to connect the midpoint of the heater transformer to ground or B minus in order to insure a complete plate circuit for the electrons constituting the plate current come from the heater.

(4)—A 227 amplifier tube is quite adequate as a rectifier in a B supply for a receiver drawing as much as 20 milliamperes.

(5)—If a short-wave receiver fails to get European stations of high power at any hour of the day and on any day of the year, it is indicative that that receiver is not as sensitive as it should be.

(6)—Enormously increased sensitivity can be obtained from a short-wave set if the antenna circuit is tuned to the incoming signal frequency.

(7)—All short-wave signals are reflected from the Heaviside-Kennelly layer and therefore all such waves are subject to skip-distance and fading.

(8)—A higher voltage gain per tube can be obtained from 224 screen grid tubes than 240 battery tubes when they are in resistance coupled circuits.

(9)—A loudspeaker designed for operation directly in the plate circuit of a power tube can be connected directly between the plates of the two tubes in a push-pull amplifier and the matching will be good.

(10)—A heater type tube like the 227 or the 224 cannot be operated with direct current on the heater because it has been designed especially for AC.

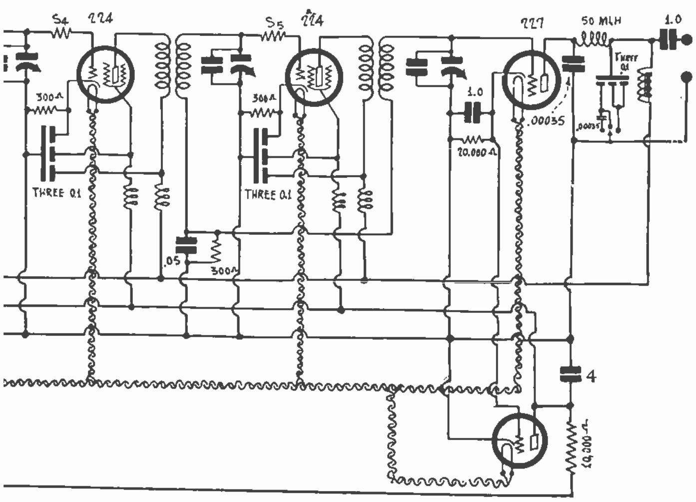
ANSWERS

(1)—Wrong. The statement is true up to a certain value of coupling, which is called the critical coupling. As the coupling is increased beyond that point the amplification decreases and the response characteristic becomes double-humped.

(2)—Wrong. No current flows in an open winding, and when

Volume Control in the
me 801

: Bernard



'PE TONE CONTROL, AND AN AUTOMATIC VOLUME
'ONTROL.

Wrong?

it is connected to the grid circuit of a vacuum tube it is open. Only the voltage across the terminals varies.

(3)—Wrong. While it is desirable to connect the center point of the heater to ground it is not necessary because the heater circuit has nothing directly to do with the flow of plate current. The electrons originate in the cathode, which is heated by the filament, and they never flow into the heater circuit. The tube would function just as well if the heater circuit were replaced by a gas flame.

(4)—Wrong. If 20 milliamperes were taken from the 227 tube connected up as a rectifier it would not last more than a few hours. There is no good reason for using this tube as a rectifier in a B supply. It costs more to operate than the 280 tube and it costs about the same to buy.

(5)—Wrong. To expect that of any receiver is entirely too much. There are times when the signals from a given station cannot be received with any receiver no matter how sensitive the circuit. Moreover, there are times when the stations are not operating, and then, of course, the receiver is useless no matter how good it may be.

(6)—Right. Just as much can be done by tuning the antenna when receiving short waves as when receiving broadcast waves. The antenna can be adjusted to a quarter wavelength of the waves being received, which may be done in effect by means of a condenser in series.

(7)—Wrong. Some waves go through the layer and never return. There is a certain limiting wave in the short-wave band below which the waves are not reflected. This limit varies with the nature and altitude of the layer.

(8)—Right. It is quite feasible to arrange the circuit so that a voltage gain of 60 per stage may be obtained with a 224 while the limit with the 240 is 30 per stage. In fact, 30 cannot be reached although 27 can be without much trouble.

(9)—Right. The matching will not be the best possible but it will be quite good. It will be better than that obtained when certain output transformers are used. A loudspeaker so used should have a high impedance because the impedance of the two tubes combined is twice that of one tube and hence the load on each tube will be only one half of the impedance of the speaker.

(10)—Wrong. Although the tube has been designed especially AC it will work just as well on direct current. In fact, it will work better, for there will be no danger of hum at all.

(Continued from page 12)

thump of the drums and toot of the tubas come in stronger, and this condition accentuates the rhythm. This is especially valuable when quite a few couples are dancing, since the noise of their shuffling feet will tend to make the rhythm less pronounced.

So there is reason aplenty for a tone control, and still, if you don't think much of the idea, it is just as well to have a control on your set, as you don't have to introduce any of this distortion if you don't want to, and also you may find yourself wanting to, in time.

The continuously variable type of volume control was illustrated last week, in the September 20th issue, where the variable resistor may be around 30,000 ohms if the condenser in series is 0.5 mfd. or 1 mfd., but if a smaller capacity is used then a larger value of variable resistor is necessary, otherwise the degree of control will be small.

Alternative Capacities

The capacities for the switch type tone control illustrated herewith are large enough to afford a good degree of variation, but if still greater tonal range is desired, the two parallel 0.1 mfd. may be increased by another paralleled capacity of 0.2 or 0.5 mfd. This will give you high audio cutoff with a vengeance.

The automatic valume control is one that uses a 227 tube, taking as its input the biasing voltage of the detector. This is around 16 volts. The connection is so made to the control tube's grid is positive all the time, hence the increase in carrier intensity in the negatively biased detector will increase the plate current, hence increase the bias. This is positive or upward modulation. The large by-pass capacities used remove the effect of the audio modulation from the control tube, leaving as the governing factor the carrier intensity.

Up and Down

As the plate current increases and bias increases on the detector, due to carrier intensity increase, the control tube's grid become more positive, the plate current in the control tube goes up, and the voltage drop in the 10,000-ohm resistor increases, hence the voltage on the screens of the RF tubes decreases, since these screens get their voltage from the plate of the control tube. Thus, increased signal intensity decreases the screen voltage, and decreases volume, and the idea is that the volume should decrease uniformly to the increase in the carrier intensity. Such is indeed an idea, never accomplished. The control is automatic, all right, but it is of relative effect, not absolute. It does not do all that we would wish it to do, for it does not take waves of unequal carrier intensities, but of equal percentage modulation, and turn them into reproduced outputs of the exactly the same uniform level. It does not do that, because of saturation effects and because of the use of a tube as a variable resistance, as in the volume control circuit, presupposes the operation of the tube at different points on its characteristic, hence different results, not uniform throughout, must be expected.

This statement of the truth of the case is no argument whatsoever against the use or utility of the automatic volume control, which tends to check fading, limits the volume of the strongest stations, so that you don't suffer ear blasts when tuning through locals, and tends to stabilize the receiver, since the greater the disparity of volume the harder it is to check oscillation.

Screen Currents Assist

It will be noticed that the screen currents flow through the resistor in the plate circuit of the volume control tube. These currents are out of phase from the plate current and modulate upward, which is in the right direction, since they thus tend to decrease the screen voltage as the carrier intensity increases.

The plate current of the control tube itself predominates over the combined screen currents of the RF tubes, hence the effect of the control tube on volume is a leading one.

The circuit as shown this week is complete, except for a resonance indicator. A meter could be used, but since the current measured would be small, the meter would have to be sensitive, and that means an expensive meter. A way can be worked out to use a lamp, either the pilot light itself, if of sufficiently low power consumption, or instead a neon lamp, so that the degree of illumination will indicate resonance. Work on this problem is now being done, and as soon as particulars are ready, which may be next week, they will be published.

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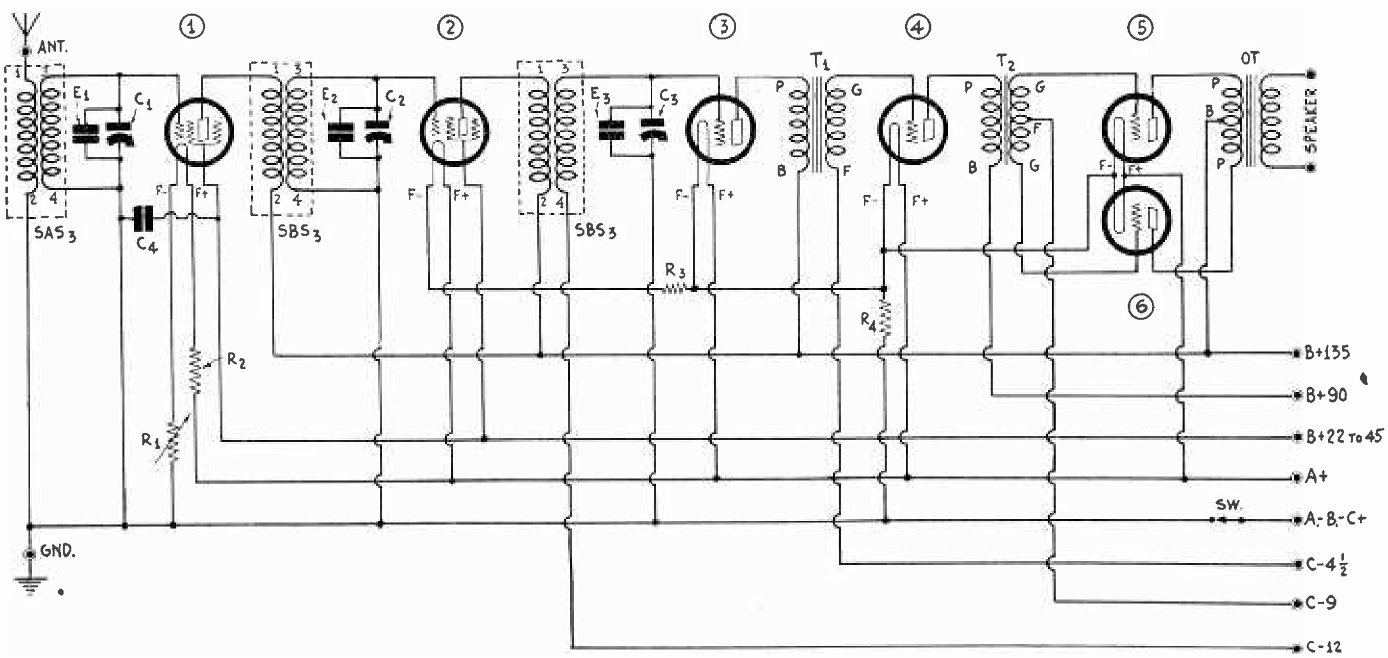

FIG. 850
THIS SIX TUBE RECEIVER HAS BEEN DESIGNED FOR BATTERY OPERATION. THIS IS CAPABLE OF HIGH SENSITIVITY IF THE COILS ARE PLACED INSIDE LARGE SHIELDS AND IF ALL THE TUNED CIRCUITS ARE ACCURATELY LINED UP.

New Radio Words

RECENTLY you have been using such words as "transduce," "transduction" and "transductor" There are no such words in the dictionary. Will you please tell what they mean and why they are not in the dictionary?—C. W. J.

The words were created by a committee of the Institute of Radio Engineers to denote general energy transformations from one form to another. They are not yet in the dictionary because no complete dictionary has been published since they were created. Whether they will get into future editions depends on whether they are accepted and used by radio engineers.

To transduce means the transformation of energy from one form into another form, such as from electrical to acoustic, electrical to mechanical, chemical to mechanical, radiant to acoustic. Energy may exist in many forms, such as luminous, acoustic, chemical, mechanical, and thermal. It is changed from one to another by transduction by means of a transducer or a transductor. A loudspeaker is a transducer that transduces electrical energy into acoustic energy. A microphone is a transducer that reverses this process. A phonograph is a transducer that transduces mechanical energy into acoustic. A gasoline engine is a transducer that changes chemical energy into mechanical, although in this case there are really two steps in the transduction, first from chemical to thermal and then to mechanical.

* * *

Hum in Heater Type Tubes

THE heater type tubes are supposed to be free from hum provided that the B supply current does not contain any. But my experience has been that even when B batteries are used there is a certain amount of hum in the output of the heater type tubes, such as the 227. In what way does this hum get into the signal?—S. H. V.

The cathode, which surrounds the filament, is heated by radiation and by conduction by the heater. Twice every cycle the filament current is maximum, and that means that the temperature is maximum twice every cycle. Due to the lag in the heating and cooling of the filament the variation in the temperature is not great, yet it is there. Since the cathode is heated by the filament, this also goes through certain temperature variations, attaining maximum values twice every cycle. There is also a lag between the temperature of the cathode and the heating so that changes in the cathode temperature are even smaller than the changes in temperature of the filament. Small though they are, they are finite and may give rise to appreciable hum. There are other effects also which will cause hum. The cathode is supposed to be a unipotential surface, but it is not exactly at the same potential at all points. This fact introduces a certain amount of hum, but this can be minimized by grounding the mid-point of the filament just as it is minimized by grounding the mid-point of the filament in a directly heated tube, such as the 226.

* * *

Plate Voltage on Screen Grid Tubes

IF I build a resistance coupled amplifier with 232 screen grid tubes with a resistance in the plate circuit of 250,000 ohms, how high plate battery voltage can be used safely? I understand that the highest plate voltage that should be used is 135 volts. Am I right when I assume that this is the effective plate voltage measured at the plate?—A. R. S.

Yes, you are right when you assume that the maximum effective plate voltage should be 135 volts. The plate battery voltage may be much higher. A battery voltage as high as 200 volts could be used if applied through 0.25 megohm resistor, provided that the brid bias be chosen properly. A good combination of voltages is 200 volts in the plate circuit, 15 volts in the screen circuit, and about 1.5 volts on the control grid. Since the effective plate voltage varies with the signal, it is necessary to limit the signal swing as well as the plate battery voltage. But if the signal amplitude is less than 1.5 volts, there is no danger. The signal amplitude must be kept down to this value anyway in order to prevent distortion of the signal.

* * *

Tube Voltmeter Draws No Current

RECENTLY you described a vacuum tube voltmeter for measuring DC potentials and you emphasized the necessity of putting a permanent negative grid bias on the tube in order to prevent grid current I can't see why it is so important to prevent grid current since a 1,000 ohm per volt meter measures voltages quite accurately and that meter takes as much as one milliampere from the source. Hence what is the use of rigging up a complex instrument when a simple one will do the work just as well?—R. E. F.

If the 1,000 ohm per volt instrument measured DC potentials just as well as the vacuum tube voltmeter in question there would not be any need of rigging it up. But the point is that no current drawing voltmeters will do the work as well as the vacuum tube voltmeter. For example, try to measure the effective plate voltage on a tube when the plate coupling resistance is one megohm. The 1,000 ohm per volt instrument might give a value one-tenth as high as the actual voltage. Obviously, the measurement does not mean a thing. Even if the maximum current drawn by the instrument were only one microampere there would be a considerable error in the measurement. And an instrument having a sensitivity of one megohm per volt would cost many times more than the vacuum tube voltmeter. It is true that the grid current drawn by a vacuum tube when the bias is zero is very small, but it may well exceed one microampere. In fact, it may be ten times as high. Hence, if the vacuum tube voltmeter tube were allowed to take current, even a little bit, this instrument would be no better than any other current drawing instrument which drew the same current. A grid bias resistor prevents current draw and it costs so little that it would be foolish to leave it out.

* * *

Best Short-wave Intermediate Frequency

YOU have described many short-wave converters but as far as I know you have never stated definitely what intermediate frequency is the best to use in such circuits. Perhaps there is no best frequency. Please discuss it?—W. H. H.

You are right; there is no best intermediate frequency, at least not one that is applicable in all cases. In any particular case, the best intermediate frequency is probably that at which the broadcast receiver is most sensitive. But this is not certain, for there may be other considerations beside sensitivity. For example, it may be that there will be interference at the frequency where the broadcast receiver is most sensitive. In that case, another frequency would be preferable. If extremely short waves are to be received with the converter it is advantageous to use the highest broadcast frequency to which the receiver will tune, even if the sensitivity is not greatest at this frequency. The reason for this is that if the intermediate frequency is low the high frequency oscillator will be influenced by the high frequency tuner and the two may not work independently. In fact, the converter may not work at all. Hence, when frequencies of the order of 20,000 kc are to be received it is best to set the broadcast tuner to 1,500 kc or higher if it can be set higher.

* * *

Low Plate and Screen Voltages

IN MOST of your short-wave converters in which you impressed the local oscillation on the screen grid modulator you use low plate and screen voltages. Would it not be better to use the ordinary, recommended voltages? What is your reason for using such low voltages?—B. B. W.

The choice of a low plate voltage and a correspondingly low screen voltage is largely a matter of convenience. It is not necessary nor desirable to use more than 45 volts on the plate of the oscillator and for simplicity this voltage was also applied on the plate of the modulator. There is no particular reason why the higher voltages should not be used, except that when the oscillator is coupled closely to the screen circuit it is desirable to choose such voltages that make the screen circuit resistance low. This subject is now being investigated experimentally to determine whether certain voltage combinations give better modulating efficiency, with certainty of oscillation.

* * *

Tone Controls

WHAT ARE the simplest ways of controlling the tone of a radio set, that is, to cut out the high notes when they are not desired and the low notes when they are not wanted?—H. V. M.

All tone controls work by virtue of the properties of choke coils and condensers. If a condenser is put across the line it cuts the higher frequencies by an amount depending on the capacity of the condenser and on the frequency. A choke coil connected in series with the line works the same way, the suppression being proportional to the inductance of the choke. To cut the low notes the condenser must be put in series or the choke must be put in shunt with the line. The smaller the series condenser the more the low notes are cut and the smaller the inductance across the line the more the low notes are suppressed. A variable resistance in series with a shunt condenser will provide a means of varying the tone without changing the size of the condenser.

Many believe that the best tone control is one that leaves the choice to the experts in the broadcasting station.

* * *

Regulation of Voltage

WHY IS IT that the voltage output of a B battery eliminator changes when the radio receiver is connected to it? I have a B supply in which the taps on the voltage divider are adjustable. With the aid of a high resistance voltmeter I can adjust the voltages at all the taps to any desired value. But when I connect the radio receiver to the taps and then measure the voltages they are no longer the same as they were before. Can you suggest a way to adjust the voltages so that they will remain fixed?—P.H.C.

The change in the voltages is partly due to the internal resistance of the B supply, that is, the tube and the filter coils, and partly to the change in the current distribution in the voltage divider. When you put the load on the B supply the current increases greatly and this in turn increases the voltage drop in the resistance of the tube and the choke. Hence the voltages at all the taps are lowered when the load is put on. Also, the current distribution in the voltage divider will change the voltage drops in the various sections so that the voltages will change due to this effect.

The only way to get the correct voltages is to adjust the positions of the taps on the voltages divider when the load is on. And since the currents to the various tubes change as the voltages are changed, it will require several adjustments to get the right values. In this connection it should be remembered that no plate voltage is critical, so that if a given adjustment gives approximately correct values there is no point trying to get them more accurate.

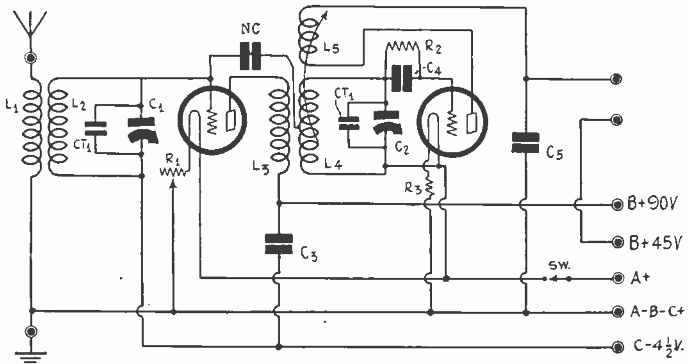

FIG. 851

THIS RADIO FREQUENCY AMPLIFIER AND DETECTOR IS SUITABLE FOR USE WITH A GOOD AUDIO FREQUENCY AMPLIFIER. A GOOD ANTENNA SHOULD BE USED WITH IT AND THE TWO TUNING CONDENSERS SHOULD PREFERABLY BE ADJUSTED SEPARATELY.

Battery Tube Set

YOU HAVE been very stingy with battery operated circuits lately. Why don't you give us some circuits of this type to work on? You know there are many of us who live in the country, where there is no alternating current available, and we have to rely on battery operated sets. If you cannot publish descriptions of such sets you could put something in the Question and Answer Department.—B. O. C.

It is true that not many battery operated circuits are published these days and the reason is that the demand is for electric sets. But in Fig. 850 is a six tube battery operated circuit diagram which should give good results with an antenna such as can be erected in the country. The coils and tuning condensers in this circuit are standard and the capacity of each condenser should be .005 mfd. If they are ganged there should be a trimmer for a least two of them. The circuit shows three trimmers. R1 is a 30 ohm rheostat mainly used for volume control. R2 is a ballast of 40 to 50 ohms, R3 is a resistor of 15 ohms, and R4 is one of 1.3 ohms.

* * *

Two Tube RF Amplifier

I HAVE a good audio frequency amplifier, and I desire a two tube radio frequency amplifier and detector. I want regeneration but no screen grid tube. Please publish a diagram of such a circuit. I believe I have all the necessary parts, including two .0005 mfd. condensers.—D. B. C.

Fig. 851 is a circuit which seems to meet your requirements. If you are to tune the two condensers separately it is not necessary to use the two trmimer condensers across the .0005 mfd. tuning condensers. The volume control rheostat R1 should have a value of 20 ohms and the ballast resistor R3 should be 4 ohms. C5 should not be more than .0005 mfd., C3 may be as large as you please. R2 and C4 have the usual values of 2 megohms and .00025 mfd., respectively.

Air-Plane Radio Direction Guide Improved

The Aeronautics branch of the Department of Commerce has announced some standardization improvements relative to aerial navigation recently by means of which changes in the intensity of radio-beacon signals are so controlled as to enable pilots who are flying "blind" easily to determine whether they are approaching or leaving the airport. Former radio-beacon signal receivers could only be depended upon for straight signaling purposes regardless of the plane's direction of motion.

These improvements consist essentially of an automatic signal intensity control circuit which operates to produce constant output signal voltage from the receiver, but at the same time registering the signal input received. Its operation depends upon the rectification of the output voltage, part of which is employed as negative bias to control grids of the radio-frequency amplifying tubes of the signal receiver.

Effect of Increased Signal Voltage

The increase in the signal output voltage as regulated by changes in the value of the input signal voltage operates to vary the negative bias of the control-grids, relative to some predetermined ratio of change of input signal voltage, whereby the ultimate result attained is an increase in negative bias when the input signal voltage increases, and a corresponding decrease when the signal decreases. Thus when the plane is flying toward the airport the increasing signal strength will result in grid voltage changes in one direction, and when the plane is flying away from the airport, it changes in the opposite direction.

Calibrated as a Distance Meter

This characteristic behavior of the newly developed automatic signal voltage-intensity meter has opened up the possibility of designing an air-distance measuring indicator which, it is hoped, may be so calibrated that it reads directly in miles or kilometers.

New Photo-Electric Cell Developed

Greatly increased sensitivity is claimed as the outstanding feature of the new DeForest caesium type-photo-electric cell, aside from extreme compactness. This cell, in a -99 size glass bulb, with the standard four-prong base, has an output of 35 to 75 micro-amperes per lumen, or several times the output of the larger potassium photo-electric cells heretofore extensively employed. As an example of its sensitivity, an automobile headlight bulb a foot away from the cell, shining through a ½-inch hole, will result in an output of 4 to 7 micro-amperes. To obtain a corresponding output from the potassium type cell, a large-sized incandescent lamp of many times as much candle-power would have to be employed as the light source. The new caesium photo-electric cell has been employed for several months past in the radiovision pick-up equipment of the DeForest experimental transmitting station, W2XCD, maintained by the DeForest Radio Company at Passaic, N. J.

De Forest Television Service to Begin

The De Forest engineering laboratory, Passaic, New Jersey, has announced that it will soon be ready to go "on the air" with experimental television programs. The schedule made up is not yet ready for publication but will be announced shortly, it was stated.

A construction permit was granted recently by the Federal Radio Commission for the installation and operation of a 5 KW transmitter to be installed at the laboratories at Passaic. The call letters of the station will be WXCD, which are the same as those of the experimental radiophone station that operated recently in conjunction with WXCR, the Jenkins television station at Jersey City, N. J.

At first, the standard 48-line pictures will be transmitted by W2XCD. Due to numerous refinements in the pick-up, the amplifier and the transmitting equipment, the quality will be of the best. As an instance of the refinement attained in 48-line work, the DeForest engineers are using an amplifier with a gain of 3,000,000, from 15 to 60,000 cycles, with practically no drop. In fact, the gain rises slightly at the higher frequencies, followed by a short drop at 70,000 cycles. This amplifier accounts for remarkable detail in the 48-line pictures demonstrated by the De-Forest engineers. However, when the practical limits of 48-line pictures have been attained, the engineers plan to go on the air with more lines, probably 72-line pictures, in furthering the radiovision art.

Television "Chains" Considered

The National and the Columbia Broadcasting Systems have applied for authority to conduct experiments in television broadcasting, according to a statement by Dr. C. B. Joliffe, Chief Engineer of the Federal Radio Commission. Definite progress is being made in the various laboratories, but many technical, practical, and economic factors must be carefully considered before all the present obstacles to its enjoyment in the home and theatre will be passible.

Dr. Joliffe has recommended that broadcasters adopt and use a standard scanning system, pointing out that its use will speed the development of the art, because it will influence experimentation by all interested, thus tending to shorten the elapsed time to the day when commercially practical television service will be a reality.

The adoption of standards of transmission such as those recently recommended by the Radio Manufacturers Association, which provide for the scanning from left to right, and from top to bottom, with 48 lines per frame and 15 pictures per second, was pointed out as being a practical step, although the difficulty of maintaining synchronous operation of sending and receiving apparatus is recognized to be one of the chief problems to be surmounted, especially where transmitting and receiving synchronization apparatus is operated by independent AC power supply sources.

"Short-Wave Commercial Programs Proposed"

The Westinghouse Electric and Manufacturing Co. has petitioned the Federal Radio Commission for permission to broadcast directly to Europe on a commercial basis regular sponsored American radio programs on short waves, probably from its East Pittsburgh station where KDKA is located.

This type of broadcasting service is now prohibited under present Federal regulations, but it is felt that the time has arrived when it would be in the interests of commerce to remove the present restrictions so that advertising time "on the air" might be sold to sponsors of programs originating at key or independent stations.

The field in which several American manufacturers are interested is Latin America, where short-wave transmission is particularly reliable. One commercial aspect of regular short-wave communication with Latin America is the market for short-wave receiving sets, the present demand for which is being largely supplied by German and English manufacturers.

Would Improve Business

Relay broadcasting was initially developed by the Westinghouse Company during 1922, and developmental work has been progressing ever since. It is now believed that more widespread use of these facilities for international broadcasting will result in an improved tone of American business and in its general expansion. American manufacturers can build up markets for their wares by sponsoring these relay broadcasts, it is contended.

Frequencies Requested

The new application is for the modification of the present license of W8XK, of East Pittsburgh, now using 40KW on an experimental basis, and assigned relay broadcasting channels of 6,140, 15,210, 11,880, 17,1780 and 21,540 KC. A hearing has been granted on this application and will take place on October 17th. The Westinghouse Co. now operates seven regularly assigned relay short-wave transmitters.

Competition Keen for High Power

Washington.

The Federal Radio Commission recently ruled that only four 50,000-watt stations will be permitted to operate in each of the five zones, and twenty-eight stations have already applied for the high power. In the First Zone three stations are already using this power, namely, WTIC, WEAF, and WGY, and four other stations have made application. These are WHAM, Wochester, N. Y.; WBZ, Boston, Mass.; WOR, Newark, N. J.; and WJZ, New York, N. Y.

Hearings on the twenty-eight applications were begun Sept. 15th, 1930, and will be continued until the twenty-eight applications have been heard, after which nine of the applicants will receive the coveted high power assignment.

Improvement In Radio Business Seen

Chicago.

"The radio industry is rapidly assuming its normal stride. The business tide has decidedly turned, and the flood of liquidations that began last fall has about run its course. With the seasonal upward trend, both of employment and of the public payroll, now under way, the purchasing power of the public will be greatly increased, and there will be money available for radio expenditure which would not have been spent while thoughts of lessened incomes were in the people's minds.

There has been a decided improvement in the design and operation of the new 1930 model radio sets and the radio public may purchase such merchandise without fear of its early obsolescence," says Mr. Harold J. Wrape, Chairman of the Advisory Council of the National Federation of Radio Associations. Mr. Wrape is one of the most outstanding leaders of the radio industry, having been connected with it since its earliest inception. He has been a leader both in the manufacturing and distributing branches of the industry and speaks with authority on broadcasting problems as well.

Regarding broadcasting, Mr. Wrape states, "Broadcasting programs have reached a pinnacle of perfection never heretofore dreamed of. At all times, there is now available some splendid form of radio entertainment to every home in America, some form of broadcasting program that will be pleasing to the most exacting radio listener.

National Radio Week, September 22-28, sponsored by the National Federation of Radio Associations, the Radio Manufacturers Associations, and the National Association of Broadcasters, will feature many programs of unusual value and interest that are available to every owner of a modern radio set. Many of these programs have been especially prepared by the sponsors of chain broadcasts and will bring the highest type of entertainment possible to the home. Many of the broadcasts listened to during the week will be created by the station for the express purpose of bringing to the public the latest and best in home entertainment."

The home without a modern radio set is missing the greatest opportunity available for splendid, wholesome, worth-while entertainment and an opportunity to secure the latest and best information on sports, finances and education."

New Corporations

Acoustic Telephone Corp.—Attys. Beekman, Brogue & Clark, 15 Broad St., New York, N. Y.

Sound Projectors, operate motion pictures—Atty. L. Day, 38 Park Row, New York, N. Y.

Personal Radio Stores—Attys. Rubinton & Coleman, 32 Court St., Brooklyn, N. Y.

Faulkner Brothers Motorphone Service Stations, Inc., Waukegan, Ill.; distribute auto radio and establish motorphone service stations—American Guaranty and Trust Co., Wilmington, Del.

Radio Sales Co., Inc., Dover, Del.—First Mutual Corp. Co., Inc., Dover, Del.

Norden Hauck Electric and Mfg. Co., Philadelphia, Pa., radio television sets—The Capital Trust Co. of Delaware, Dover, Del.

Fordham Radio Repair Co.—Atty. M. H. Plump, 349 East 149th St., Bronx, N. Y.

Bletcher Radio Service—Atty. M. Levy, 66 Court St., Brooklyn, N. Y.

The Billion Mark Reached in Radio

Washington

"The $1,000,000,000 mark" should be reached this year by the turnover in all branches of the radio industry, according to an oral statement to the United States Daily by Federal Radio Commissioner Harold A. Lafount, who recalled that the business "started from scratch less than a decade back."

Particular emphasis is being placed on the export field, said Mr. Lafount. In the past, he said, manufacturers have been kept busy meeting domestic demand, and now for the first time have the opportunity to exploit foreign markets on a large scale.

The opinion that the political unrest in certain of the South American countries will not have a bad effect on radio exports was expressed by the Commissioner. Pointing out that the South American market is one of the foremost in radio exports, partly because of the proximity of the continent, Mr. Lafount asserted that htere has been a steady rise in radio exports to these nations.

New Sensitive Tube Used In Astronomy

Schenectady.

A new type of vacuum tube, so sensitive that it will measure a hundredth of a millionth of a billionth of an ampere, has been developed by the General Electric Company, it was announced by Ellis L. Manning, of the company's research laboratory, in a talk over WGY.

The new tube is so sensitive to infinitesimal flows of current that astronomers can use it with photoelectric tubes in determining the amount of heat radiated by stars countless light years away—bodies so far away in space that, in spite of their enormous size, they remain simply as points of light, however powerful the telescope through which they are viewed. The current is measured in fractions of quadrillionths of an ampere and the stellar distances in multiples of quadrillions of miles.

One of the major applications will be in the laboratory measurement of currents in ionization chambers which are used to indicate the intensities of X-ray and ultraviolet light beams.

Another important application of the tube will be in the photoelectric measurement of stellar intensities. At the Washburn Observatory in Madison, Wisc., work is now being done on apparatus for the giant reflecting telescope for California, the 200-inch fused quartz mirror for which is now being constructed at the Thomson Research Laboratory of the General Electric Company at Lynn, Mass. Professor Joel Stebbins, director of the Washburn Observatory, is using two of the low grid current tubes in connection with a quartz photoelectric tube to indicate the position, intensity and spectrum of even very faint stars. It is possible, according to Professor Stebbins, to make nearly all astronomical observations photoelectrically rather than visually or photographically, as has been done in the past, with decided advantages in rapidity and sensitivity.

Argentine Aviator Talks to Australia

Washington.

An aviator 5,000 feet above the City of Buenos Aires, Argentina, recently conversed with the general post office in Sydney, Australia, over a 14,000-mile circuit, a feat believed to have set a world record in radio telephony, the Department of Commerce has been informed in a dispatch from the Assistant Trade Commissioner at Sydney, H. P. Van Blarcom.

An engineer of the radio-telephone service between Sydney and London was conversing with London when he was switched over by land line to Madrid. As the radio connection was good at the time, Madrid switched through to Buenos Aires. An airplane was making a test flight over that city in a radio-equipped plane, so the circuit was extended and a long conversation was held. The length of this radio-telephone circuit was approximately 14,000 miles.

Sound-Cartoon Device Facilitates Production

A German artist working in connection with the production of sound cartoons in the Fischerkosenfilm-Studio, Leipzig, Germany, is reported to have made an invention which will permit the production of sound cartoons with much greater facility than has hitherto been possible, according to a report to the Department of Commerce.

The new machine, called tonograph, system Fischerkosen, is reported to be a great improvement on all existing equipments, inasmuch as it permits of the simultaneous production and registering of sound and images, whereas up to the present this had to be done separately, the photographic record being later synchronized with the musical score.

The machine is supposed also to have other advantages. Patents have been applied for both in Germany and abroad.

DON'T ABUSE CONDENSERS

Electrolytic condensers are subject to rapid fatigue and deterioration if they are abused. If a condenser of this type is rated at 250 volts working voltage it should not be subjected to voltages of 350 volts. It does not pay.

LITERATURE WANTED

Mike Tisler, New Kensington, Pa.
M. Schafer, 254 Lockwood St., Providence, R. I.
R. L. Johnson, 6631 68th St., Portland, Ore.
George Pollio, 918 Metropolitan Ave., Brooklyn, N. Y.

A THOUGHT FOR THE WEEK

WE haven't heard much lately about the wondrous things radio has done for the shut-ins—the lame, the halt and the blind and those otherwise stricken. But the good work goes on day by day all over the world and continues to add one of the most glorious chapters to the history of radio's work for mankind.

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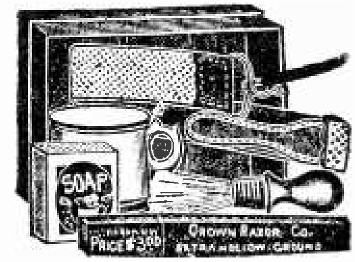

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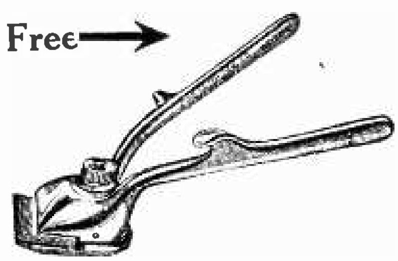

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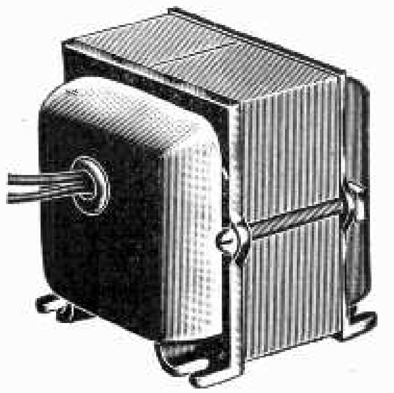


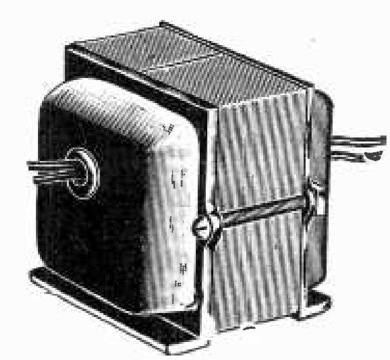
Shielded single choke, 200 ohms D.C. resistance, non-saturable at 100 milliamperes, with two black outleads each 6 inches long. For filtration of B supplies. Inductance, 30 henrys.
Cat. SH-S-CH. price..............................$5.00

The shielded single choke will pass 100 ma. One will suffice if the current is 100 ma. or less, for filtration of B supplies, provided the capacity at the filter output is 8 mfd. or more. Use two such shielded chokes if less than 8 mfd. is used at the filter output. Also, the shielded single choke may be used as in the power tube circuit for an output filter. In this connection use at least 2 mfd. for the capacity section of the filtered speaker output. Order Cat. SH-S-CH @ $5.00

The shielded double choke may be used for filtration where the B current is 60 ma. or less, with relatively small filter capacities, no less than 4 mfd. at the output, however. This choke consists of one winding, center-tapped. Its use is especially recommended for 171, 171A, 245 or 210 push-pull output. Connect the black leads (extremes of windings) to plates of the push-pull tubes, red center tap to B plus, and the speaker may be connected directly to plates without any direct current, but only signal current, flowing through the speaker. This system is applicable only to push-pull. Order Cat. SH-D-CH @ $6.00

In the same type of case a 20-volt secondary filament transformer, for 110 volts, 50-133 cycle, may be obtained for use in conjunction with dry rectifiers, such as Kuprox, Westinghouse, Benwood-Linze and Elkon, in dynamic speakers or A battery eliminators. Not made for 25 or 40 cycles. Order Cat. SH-F-20 @....................$2.50

245 Power Transformer for use with 280 rectifier, to deliver 300 volts D.C. at 100 milliamperes, slightly higher voltage at lower drain, and supply filament voltages.
Cat. 245-PT price $8.50

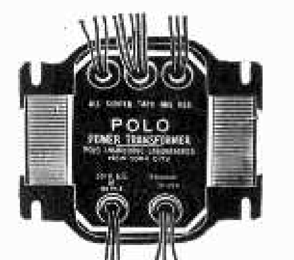


Twenty-volt filament transformer, 110 v. 50-133 cycle input, for use in conjunction with dry rectifiers. It will pass 2.25 amperes.

In a different type case, square, of cadmium plated steel with four mounting screws built in, size 4½ inches wide by 8¾ inches high by 4 inches front to back, a 50-60 cycle filament transformer is obtainable with the same windings as the 245 power transformer, except that the high voltage secondary is omitted. Order Cat. 245-FIL @ $4.50
For 40 cycles order Cat. 245-FIL-40 @.......... 7.00
For 25 cycles order Cat. 245-FIL-25 @.............8.50
[Any of the above three in the same case as the 245 power transformer, © $1.00 extra. Add PTC after the Cat. number.]

A single choke, unshielded, 65 ma rating, 30 henrys inductance, for B filtration or single output filter of speaker, is our Cat. US-S-CH @..................$1.25

The Polo 245 power transformer is expertly designed and constructed, wire, silicon grade A steel core and air gap large enough to stand the full rated load. The primary is for 110v A.C., 50-60 cycles, tapped for 82.5 volts in case a voltage regulator, such as a Clarostat or Amperite, is used. The black primary lead is common. If no voltage regulator is used, connect black lead to one side of the A.C. line, green lead to the other side of the line, and ignore red lead, except to tape the end. For use with a voltage regulator (82.5-volt primary) use red lead and ignore the green except to tape the end. The secondaries are: high voltage for 280 plates, with red center tap to ground; 2.5 volts, 3 amperes, red center tap to C plus, for 245 output, single or pushpull; 5 volts, 2 amperes, red center tap, as positive B lead, for filament of 280 tube; 2.5 volts, 16 amperes, red center tap to ground, for 224, 227 and pentode tubes, up to nine heater type tubes. Hence there are five windings.



Bottom view of the 245 power transformer. All leads are plainly marked on the nameplate, including the top row.

A special filament transformer, 110 v., 50-60 cycles, with two secondaries, one of 2.5 v. 3 amp. for 245s, single or push-pull, other 2.5 v. 12 amperes for 224, 227, etc., both secondaries center-tapped. Shielded case. 6 ft. AC cable, with plug. Order Cat. F-2.5-D @.......$3.75

The conservative rating of the Polo 245 power transformer insures superb results even at maximum rated draw, working up to twelve tubes, including rectifier, without saturation, or overheating due to any other cause. This ability to stand the gaff requires adequate size wire, core and air gap, all of which are carefully provided. At less than maximum draw the voltages will be slightly greater, including the filament voltages, hence the 16 ampere winding will give 2.25 volts at maximum draw, which is an entirely satisfactory operating voltage, increasing to 2.5 volts maximum as fewer than a total of nine RF, detector and preliminary audio tubes are used.

The avoidance of excessive heat aids in the efficient operation of the transformer and in the maintenance of good regulation, for excessive heat increases the resistance of the windings.

The transformer is equipped with four slotted mounting feet and a nameplate with all leads identified. It is one of the very finest instruments on the radio market.

Highest Capacity of Filament Secondary

SPECIAL pains were taken in the design and manufacture of the Polo 245 power transformer to meet the needs of experimenters. For instance, excellent regulation was provided, to effect minimum change of voltage with given change in current used. Also, the 2.5 volt winding for RF, detector and preliminary audio tubes, was specially designed for high current, to stand 16 amperes, the highest capacity of any 245 power transformer on the market. Hence you have the option of using nine heater type tubes. The shielded case is crinkle brown finished steel, and the assembly is perfectly tight, preventing mechanical vibration.

The power transformer weighs 11½ lbs., is 7 inches high, 4⅞ inches wide, and 4¼" front to back, overall.

Elevating washers may be used at the mounting feet to clear the outleads, or holes may be drilled in a chassis to pass these leads, and the transformer mounted flush.

Advice in Use of Chokes and Condensers in Filter

With the 245 power transformer either one or two single chokes should be used, or a shielded double choke, depending on the current drain and the capacity of filter condenser used. Where the capacity at the output is 8 mfd. or more for a drain of 65 to 100 ma., a single choke will suffice (Cat. SH-S-CH), but where smaller output capacity than 8 mfd. is used on such drain, two such chokes should be used in series. Next to the rectifier, in either instance, use a 1 or 2 mfd., 550 A.C. working voltage rating condenser (D.C. rating, 1,000 volts). You may use your choice of capacity at the midsection.

If the drain is to be 65 milliamperes or less, the double choke, Cat. SH-D-CH, may be used for filtration, instead of two single shielded chokes.

The Polo 245 power transformer may be obtained for 25 cycles or 40 cycles on special order, as these are not stocked regularly, and remittance must accompany order. The same guaranty attaches to them as to all other Polo apparatus—money back if not satisfied after trial of five days. In these the primary and secondary voltages and taps are the same, only the case is deeper (front to back) because of larger core and wire for lower frequency.
For 40 cycles order Cat. 245-PT-40...@ $9.50
For 25 cycles order Cat. 245-PT-25...@ $12.50
[Note: The filter for 40 cycles should consist of two shielded single chokes, Cat. SH-S-CH, with 2 mfd. next to the rectifier and 4 mfd. minimum at the joint of the two chokes and at the end of the filter. For 25 cycles the same holds true, except that the output capacity at end of chokes should be 8 mfd. minimum.]

We Make Special Transformers to Order

Polo Engineering Laboratories, 143 West 45th St., New York, N. Y.

Enclosed please find $———— for which ship at once:

☐ Cat. 245-PT @...$8.50 ☐ Cat. 245-FIL @..$4.50
☐ Cat. 245-PT-40 @ 9.50 ☐ Cat. 245-FIL-40 @ 7.00
☐ Cat. 245-PT-25 @ 12.00 ☐ Cat. 245-FIL-25 @ 8.50
☐ Cat. SH-S-CH @ 5.00 ☐ Cat. SH-F-20 @. 2.50
☐ Cat. SH-D-CH- @ 6.00 ☐ Cat. UN-S-CH @. 1.25
☐ F-2.5-D @ 3.75

Note: Canadian remittance must be by post office or express money order.

☐ If C.O.D. shipment is desired, put cross here. No C.O.D. on 25 and 40 cycle apparatus. For these full remittance must accompany order. The 25 and 40 cycle apparatus bears the 50-60-cycle label, but you will get actually what you order.

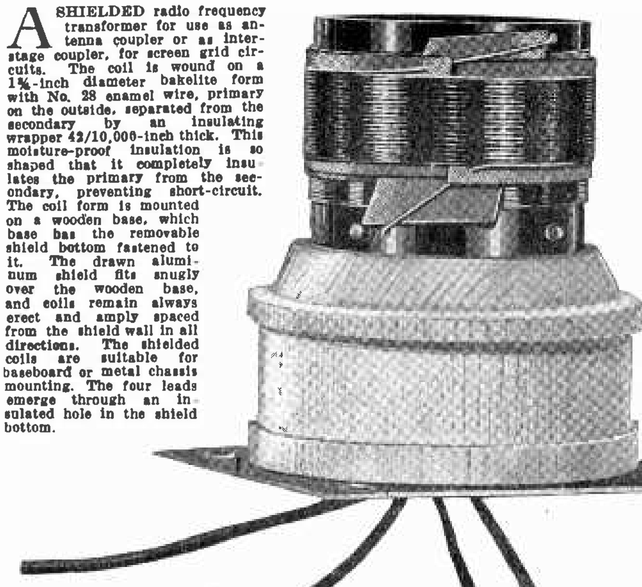
Name ....

Address ....

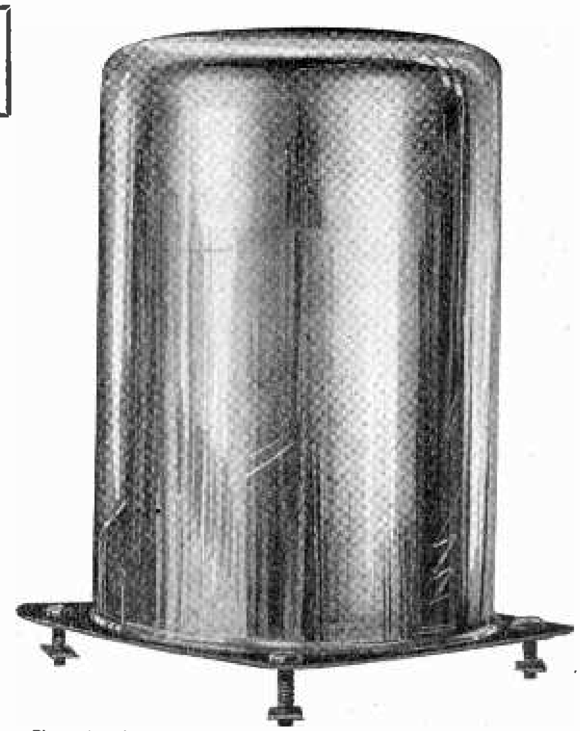
City.............................. State..............

High-Gain Shielded Coils

A SHIELDED radio frequency transformer for use as antenna coupler or as interstage coupler, for screen grid circuits. The coil is wound on a 1¾-inch diameter bakelite form with No. 28 enamel wire, primary on the outside, separated from the secondary by an insulating wrapper 42/10,000-inch thick. This moisture-proof insulation is so shaped that it completely insulates the primary from the secondary, preventing short-circuit. The coil form is mounted on a wooden base, which base has the removable shield bottom fastened to it. The drawn aluminum shield fits snugly over the wooden base, and coils remain always erect and amply spaced from the shield wall in all directions. The shielded coils are suitable for baseboard or metal chassis mounting. The four leads emerge through an insulated hole in the shield bottom.



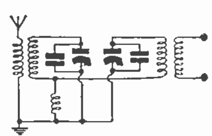
The coil comes already mounted on a shellacked wooden base, which is fastened at the factory to the shield bottom. Series A coil is illustrated.



The external appearance of the shield, with four 6/32 machine screws and nuts, which are supplied with each coil assembly.

Precisely Matched for Gang Tuning

ONE primary lead-out wire from the coil, for antenna or plate connection, has a braided tinned alloy covering over the insulation. This alloy braid shields the lead against stray pick-up when the braid alone is soldered to a ground connection. The outleads are 6 inches long and are color identified. The wire terminals of the windings themselves, and the outleads, are soldered to copper rivets. Each coil comes completely assembled inside the shield, which is 2¾ inches square at bottom (size of shield bottom) and 3¾ inches high. High impedance primaries of 40 turns are used. Secondaries have 80 turns for .00035 mfd. and 70 turns for .0005 mfd.



BP-6 is the coil at bottom.

EXTREME accuracy in winding and spacing is essential for coils used in gang tuning. These coils are specially suited for gang condensers, because the inductances of all are identical for the stated size condenser. The coils are matched by a radio frequency oscillator. The color scheme is as follows: shielded wire outlead is for antenna or plate; red is for ground or B plus. (These options are due to use of the same coil for antenna coupling or interstage coupling.) Blue is for grid and yellow is for grid return. For .00035 mfd. the Cat. No. is A-40-80-S. For .0005 mfd. the Cat. No. is A-40-70-S.

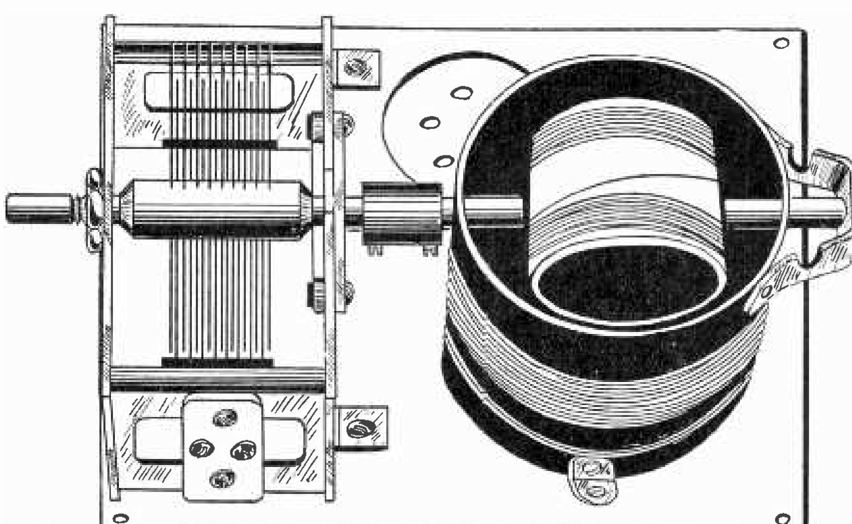
Where a band pass filter circuit is used the small coupling coil to unite circuits is Cat. BP-6. The connection is illustrated herewith.

Junior Model Inductances

The Series B coils have the same inductance and the same shields as the series A coils, but the primary, instead of being wound over the secondary, with special insulation between, is wound adjoining the secondary, on the form, with ¼-inch separation, resulting in looser coupling. No wooden base is provided, as the bakelite coil form is longer, and is fastened to the shield bottom piece by means of two brackets. No outleads. Wire terminals are not soldered. Order Cat. B-SH-3 for .00035 mfd. and Cat. B-SH-5 for .0005 mfd.

Coils for Six-Circuit Tuner

Series C coils for use with six tuned circuits, as in Herman Bernard's six-circuit tuner, are wound the same as type A shielded coils, but the shields are a little larger (3 1/16-inch diameter, 3¾ inches high), and there are no shield bottoms, as a metal chassis must be used with such highly sensitive cricuits. Fasten the brackets to the shield and then, from underneath the chassis, fasten the other arm of the two brackets to the chassis. Order Cat. C-6-CT-5 for .0005 mfd. and Cat. C-6-CT-5 for .00035 mfd. Five needed for Bernard's circuit. If band pass filter coupling coil is desired order Cat. BP-6 extra



For a stage of screen grid RF, either for battery type tube, 222, or AC, 224, followed by a grid-leak-condenser detector, no shielding is needed, and higher per-stage amplification is attainable and useful. This extra-high per-stage gain, not practical where more than one RF stage is used, is easily obtained by using dynamic tuners. Two assemblies are needed. These are furnished with condensers erected on a socketed aluminum base. Each coil has its tuned winding divided into a fixed and a moving segment. The moving coil, actuated by the condenser shaft itself, acts as a variometer, which bucks the fixed winding at the low wavelengths and aids it at the high wavelengths, thus being self-neutralizing and maintaining an even degree of extra-high amplification throughout the broadcast scale.

Two assemblies are needed. For AC operation (224 RF and 224 or 227 detector), use Cat. BT-L-AC and BT-R-AC. For battery or A eliminator operation (222 RF and any tube as detector), use Cat. BT-L-DC and BT-R-DC.

BT-L for the antenna stage and BT-R for the detector input. BT-L consists of a small primary, with suitable secondary for the .00035 mfd. condenser supplied. BT-R has two effective coils: the tuned combination winding in the RF plate circuit, the inside fixed winding in the detector grid circuit.

The moving coils must be "matched." This is done as follows: Turn the condensers until plates are fully enmeshed, and have the moving coils parallel with the fixed winding. Tune in the highest wavelength station receivable—above 450 meters surely. Now turn the moving coils half way round and retune to bring in the station. The setting that represents the use of lesser capacity of the condenser to bring in that station is the correct one. If gang tuning is used, put a 20-100 mmfd. equalizing condenser across the secondary in the antenna circuit and adjust the equalizer for a low wavelength (300 meters or less).

Screen Grid Coil Co., 143 West 45th Street, New York (Just East of Broadway):

Enclosed please find $............ (Canadian must be express or P. O. Money Order), for which send me prepaid the following:

☐ A-40-80-S, each $2.25
☐ Matched set, 4 A-40-80-S, $1 matching 10.00
☐ A-40-70-S, each 2.25
☐ Matched set of four A-40-70-S........ 10.00
☐ B-SH-3, each $1.00
☐ Matched set of four B-SH-3........... 4.00
☐ B-SH-5, each 1.00
☐ Matched set of four B-SH-5........... 4.00
☐ BT-L-AC and BT-R-AC, assembled, with condenser, link, socket and base, per pair....... 6.00
☐ BT-L-DC and BT-R-DC, assembled, with condenser, link, socket, base, per pair.......... 6.00
☐ C-6-CT-5, .0005 mfd. shielded coil for six-circuit tuner..........each $2.25
☐ C-6-CT-3, .00035 mfd. shielded coil for six-circuit tuner..........each $2.25
☐ BP-6 .... .25
☐ EQ-100, equalizer of 20-100 mfd. capacity, made by Hammarlund.......... .35

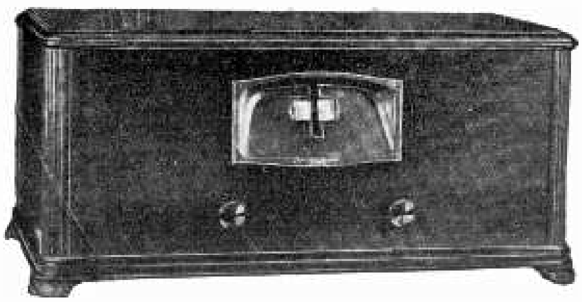
(Note: All coils come with shields, except BP-6 and BT-L.)

NAME.................................... ADDRESS....................................

CITY.................................... STATE....................................

☐ If ordering C.O.D. put cross here. Post office fee will be added to prices quoted.

Balkite Push-Pull Receiver



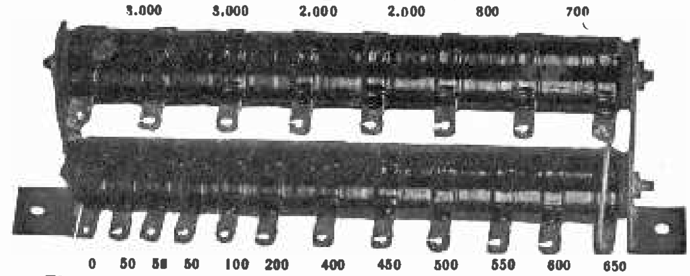
The Balkite A-5 Neutrodyne, one of the most sensitive commercial receivers ever developed; 8 tubes, including 280 rectifier. Wholly AC operated, 105-120 v. 50-60 cycles; in a table model cabinet, genuine walnut, made by Berkey & Gay.

Three stages of tuned RF, neutralized, so there's no squealing; easy tuning; operation on short piece of wire indoors perfectly satisfactory; no repeat tuning points; no hum; phonograph pickup jack built in; excellent tone quality; good selectivity. Two posts are accessible for connecting the field coil of a DC dynamic speaker.

The parts of which this receiver is made are all ace-high and the wiring is done with extreme expertness, by Gilfillan. The power supply is exceptionally fine, the set being worked at 50% less than the rated capacity of the power transformer and chokes, assuring long life. There is no hum, as filtration is remarkably good.

The illuminated drum dial, at center, reads 0-100 at left, and at right has a blank space in which to write call letters. The little knob at left is the volume control, and the one at right is the AC switch. Each RF stage is filtered and bypassed individually, and the RF coils, tuning condenser and power transformer are separately and totally shielded. The lead from antenna binding post to antenna winding of the first coil is of shielded wire that is grounded. Also, the receiver as a whole is totally shielded, with metal chassis and metal undercover, so there is no stray pickup. Complete with walnut magnetic speaker and tubes..... **$56.57**

New Multi-Tap Voltage Divider



The resistance values between the twenty taps of the new Multi-Tap Voltage Divider are given above. The total is 17,100 ohms and affords nineteen different voltages.

The Multi-Tap Voltage Divider is useful in all circuits, including push-pull and single-sided ones, in which the current rating of 100 milliamperes is not seriously exceeded and the maximum voltage is not more than 400 volts. Higher voltages may be used at lesser drain.

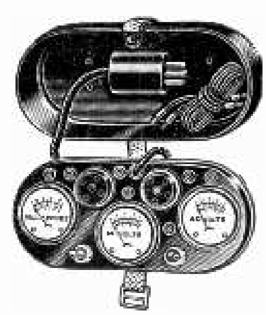
The expertness of design and construction will be appreciated by those whose knowledge teaches them to appreciate parts finely made.

When the Multi-Tap Voltage Divider is placed across the filtered output of a B supply which serves a receiver, the voltages are in proportion to the current flowing through the various resistances. By making connection of grid returns to ground, the lower voltages may be used for negative bias by connecting filament center, or, in 227 and 224 tubes, cathode to a higher voltage.

If push-pull is used, the current in the biasing section is almost doubled, so the midtap of the power tubes' filament winding would go to a lug about half way down on the lower bank.

Order Cat. MTVD, list price $6.50, net price.................... **$3.90**

R-245 Set and Tube Tester



With the R-245 Tube and Set Tester you plug the cable into a vacated socket of a receiver, putting the removed tube in the tester, and using the receiver's power for making these tests: Plate current, on 0-20 or 0-100 ma. scale, changed by throwing a built-in switch; 0-60, 0-300 v. DC, changed by moving one of the tipped cables to another jack; filament or heater voltage (AC or DC), up to 10 volts, or any other AC voltage source, measured independently, up to 140 volts, including AC line voltage. Also screen grid voltage and screen grid current may be read by following connections specified in the new 8-page instruction sheet.

Each meter may be used independently. The two test leads, one red, the other black, with tip jack terminals, enable quick connections to meters for independent use.

With this outfit you can shoot trouble in receivers and test circuits using the following tubes: 201A, 200A, UX199, UX120, 210, 171, 171A, 112, 112A, 245, 224, 222, 226, 227, and pentodes.

When the R-245 is plugged into the vacated socket of a set and the removed tube is placed in the proper socket of the Tester, the receiver's power supplies all the voltages and currents. You see the vital tests made right before your eyes, all three maters registering immediately, all three reading at the same time.

Here are some of the questions answered by the Tester when plugged into the receiver:

What is the filament or heater voltage (no matter if DC or AC)? What is the plate voltage at the plate itself? What is the plate current drawn by the tube? Is the tube in good condition or does it require replacement? What is the grid bias voltage? What is the cathode voltage? What is the screen grid voltage? Besides, when meters are used independently, you can answer these questions: What is the screen grid current? What is the line voltage (no mater if AC or DC)? Is the circuit continuous or is it open? What is the total plate current drawn in the receiver? What are the respective B voltages at the B batteries or voltage divider?

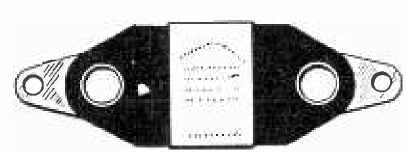
Order Cat. R-245. List price, $20; net price........... **$11.40**

Silver-Plated Coils

Wound with non-insulated wire plated with genuine silver, on grooved forms, these coils afford high efficiency because of the low resistance that silver has to radio frequencies. The grooves in the moulded bakelite forms insure accurate space winding, thus reducing the distributed capacity, and keep the number of turns and separation constant. Hence the secondary reactances are identical and ideal for gang tuning.

The radio frequency transformer may be perpendicularly or horizontally mounted, and has braced holes for that purpose. It has a center-tapped primary, so that it may be used as antenna coil with half or all the primary in circuit, or as interstage coupler, with all the primary on a screen grid plate circuit, or half the primary for any other type tubes, including pentodes. The three-circuit tuner has a center-tapped primary, also. This tuner is of the single hole panel mount, but may be mounted on a chassis, if preferred, by using the braced holes. Pair consists of RF transformer and three-circuit tuner, both for .0005 mfd. only. Order Cat., G-RF-3CT, list price $5.00; net price......................... **$2.48**

Fixed Condensers

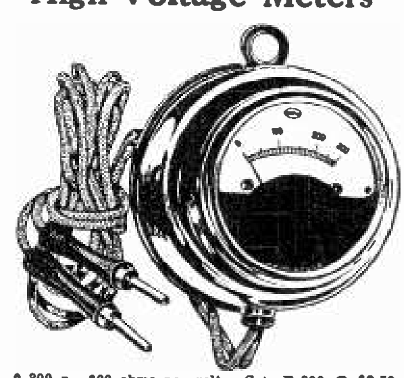


Dubilier Micon fixed condensers, type 642, are available at following capacities and prices:

.0001 mfd.	10c	.006	20c
.00025 mfd.	10c	.00025 with clips.	20c
.0003 mfd.	10c	All are guaranteed electrically perfect and money back if not satisfied within five days.	
.00035 mfd.	15c		
.001	17c		
.0015	17c		
.002	18c		

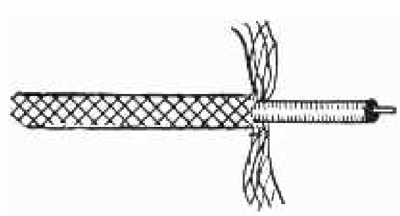
Order Cat. MICON .0001 etc. at prices stated.

High-Voltage Meters



0-300 v., 200 ohms per volt. Cat. F-300 @ $2.59
0-500 v., 233 o.p.v. Cat. F-500 @...... 3.73
0-600 v., AC and DC (same meter reads both); 100 ohms p.v. Order Cat. M-600 @ 4.95

Shielded Lead-in Wire



No 18 solid wire, surrounded by a solid rubber insulation covering, and above that a covering of braided copper mesh wire, which braid is to be grounded, to prevent stray pick-up. This wire is exceptionally good for antenna lead-in, to avoid pick-up of man-made static, such as from electrical machines. Also used to advantage in the wiring of receivers, as from antenna post of set to antenna coil, or for plate leads, or any leads, if long. This method of wiring a set improves selectivity and reduces hum. This wire is now appearing on the general market for the first time although long used in the best grade of commercial receivers. Order Cat. SH-LW. List price 9c per ft.; net price per foot **5c**

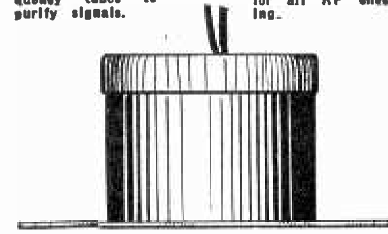
Double Drum Dial

Hammarlund double drum dial, each section individually tunable. Order Cat. H-DDD. List price $6.00; net price **$3.00**

Shielded RF Choke

Excellent in detector plate circuit or in B-plus RF leads of radio frequency tubes to purify signals.

An efficient radio frequency choke in a shielded case. Inductance, 50 millihenries. Useful for all RF choking.



In some instances one outlead is connected to case, so use this lead for B-plus or for ground, otherwise ground the case additionally. Order Cat. SH-RFC. List price, $1.00; net price **50c**

Guaranty Radio Goods Co., 143 West 45th St., New York, N. Y.
(Just East of Broadway)

Enclosed please find $.................................. (Canadian must be express or post office money order, for which please ship:

☐ Balkite comp. $56.57 ☐ Ft. of SH-LW @.......5c p. f. ☐ M-600 @.... $4.95
☐ MTVD @ ... 3.90 ☐ F-300 @..... $2.59
☐ G-RF-3CT @ 2.48 ☐ H-DDD @... $3.00 ☐ F-500 @..... 3.73
☐ R-245 @..... 11.40 ☐ SH-RFC @... 50c ☐ MICON.... @ ....
☐ MICON.... @ ....
☐ If C.O.D. shipment is desired put cross here.

Your Name ....

Address ....

City.. State.........................