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1930

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RADIO WORLD

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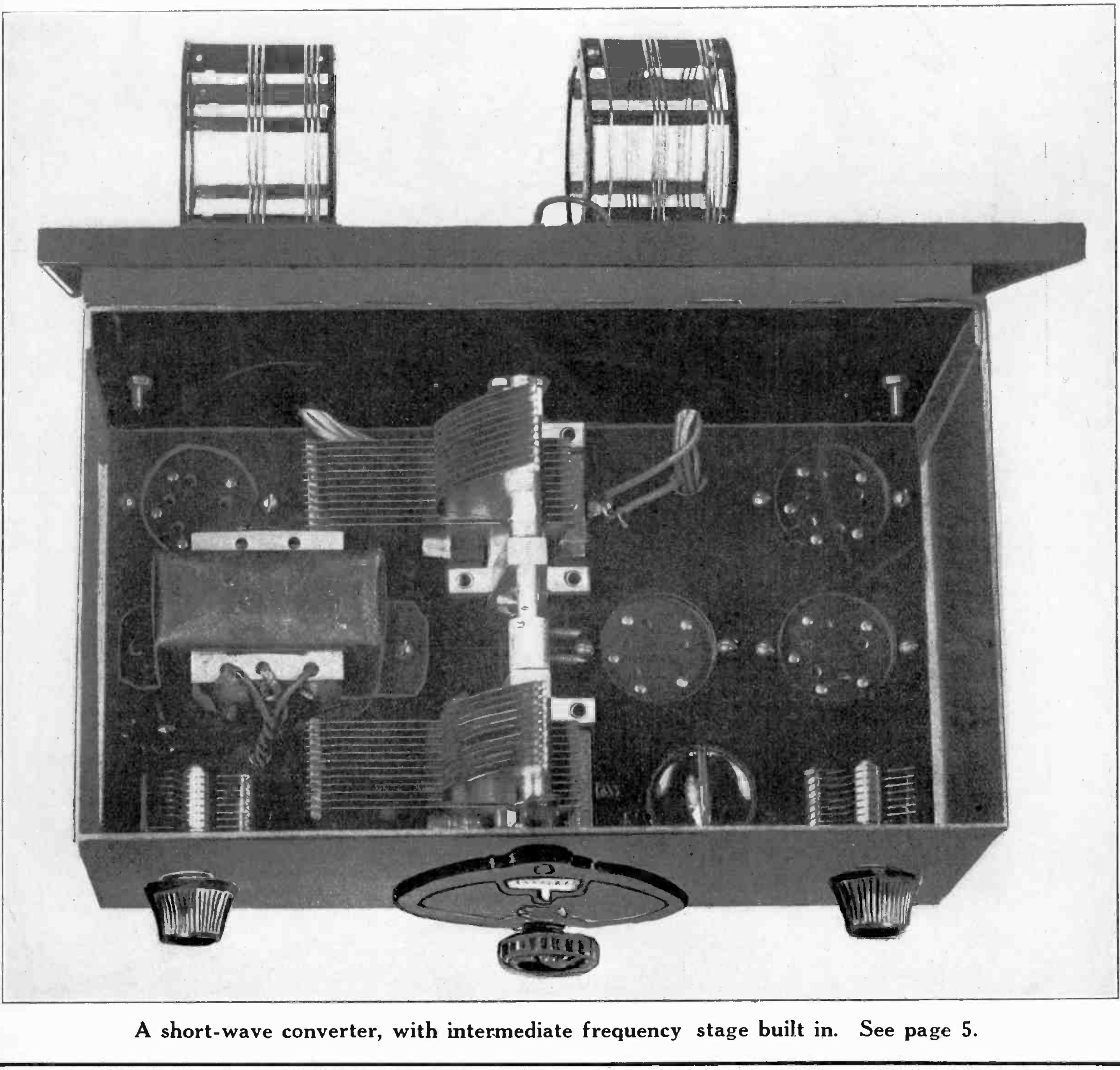
The First and Only National Radio Weekly

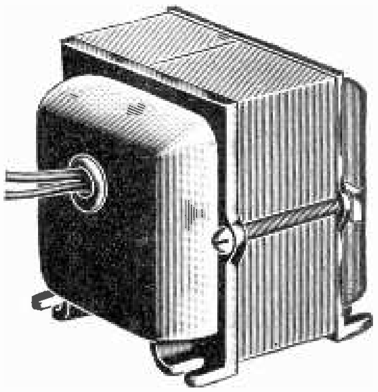
439th Consecutive Issue—NINTH YEAR



A short-wave converter, with intermediate frequency stage built in. **See page 5.**

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.

New Polo Power Transformers and Chokes

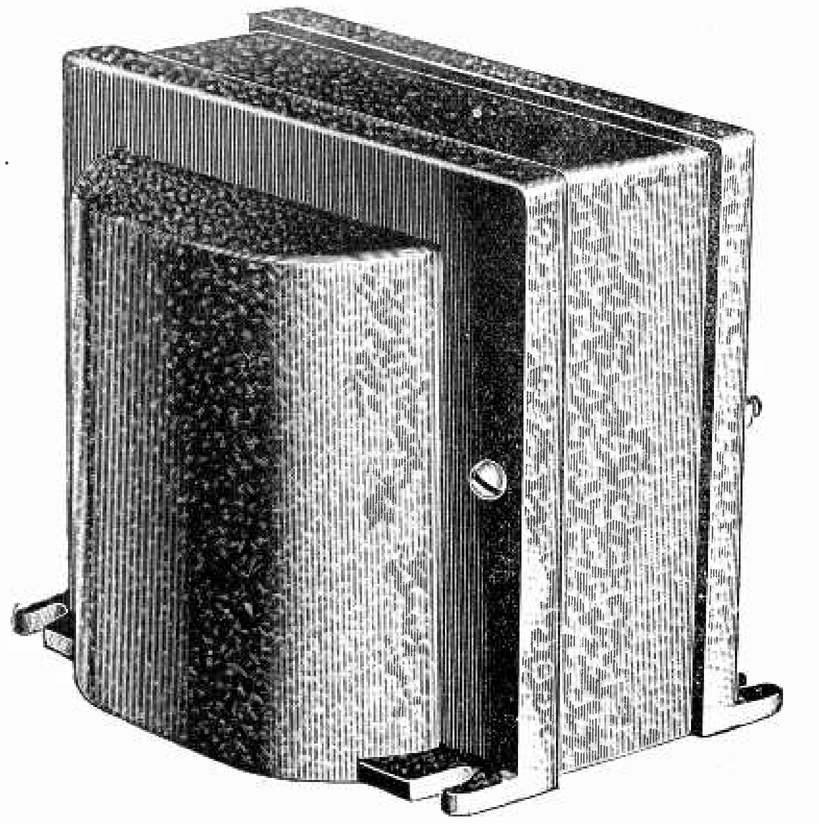


Shielded single choke, 200 ohms D.C. resistance, non-saturable at 100 milliamperes, with two black outleads, each 6 inches long. For filtration of B supplies. Inductance, 30 henrys.
Cat. SH-S-CH, price..............................$5.00

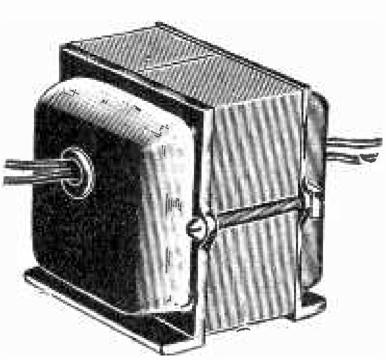
The shielded single choke will pass 100 ma. One will suffice if the current is 100 ma. or less, for filtration of B supplies, provided the capacity at the filter output is 8 mfd. or more. Use two such shielded chokes if less than 8 mfd. is used at the filter output. Also, the shielded single choke may 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



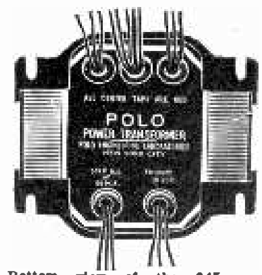
Twenty-volt filament transformer, 110 v. 50-133 cycle input, for use in conjunction with dry rectifiers. It will pass 2.25 amperes.

In a different type case, square, of cadmium plated steel with four mounting screws built in, size 4½ inches wide by 3⅝ 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.

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..............

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

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NINTH YEAR

Latest Circuits and News

Technical Accuracy Second to None

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A Short-Open-OK Tester

By Herman Bernard

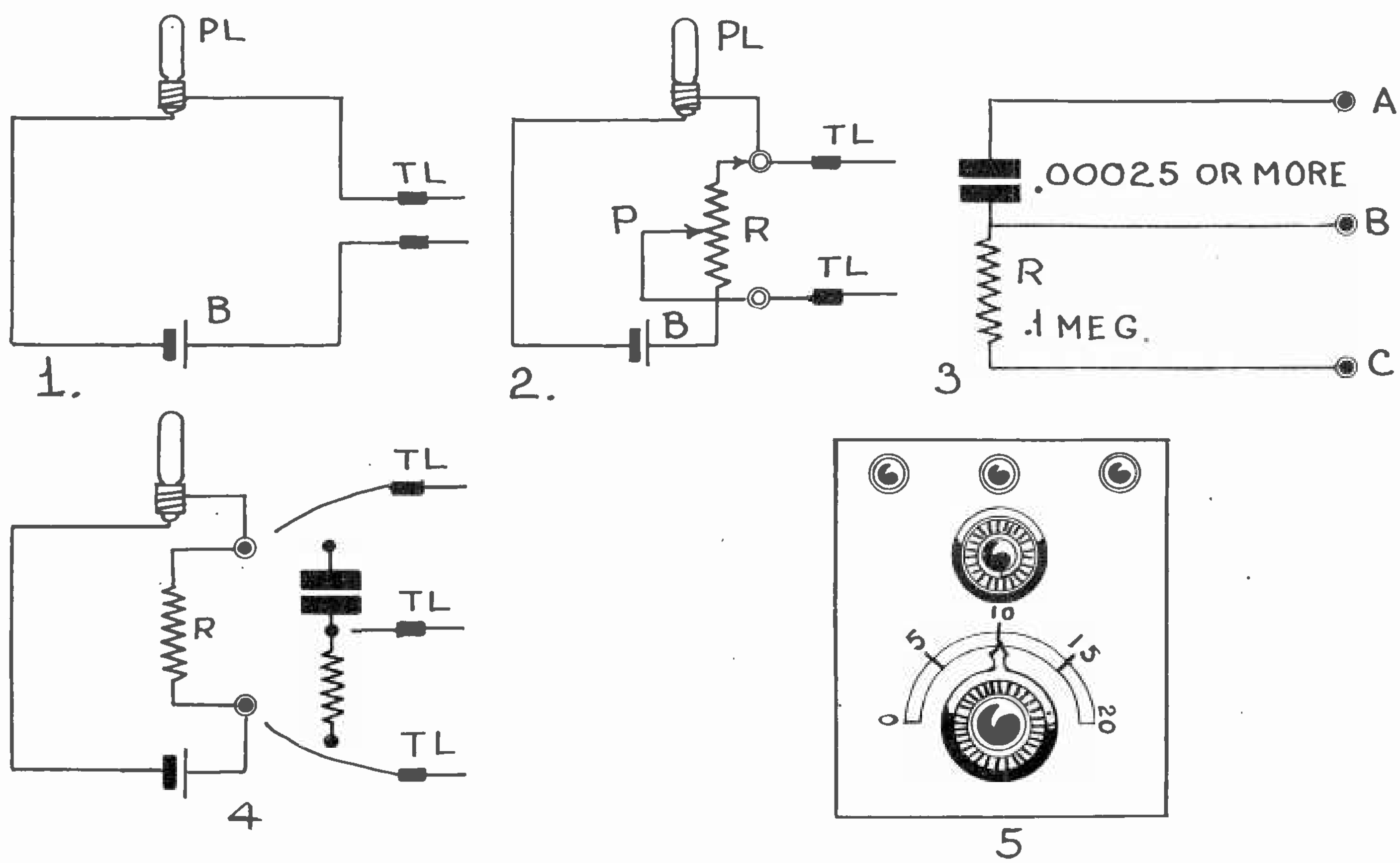


FIG. 1 SHOWS A CONVENTIONAL CONTINUITY TESTER, WHICH DISCLOSES WHETHER THERE IS A CONTINUOUS OR DISCONTINUOUS CIRCUIT.

IN FIG. 2 A RHEOSTAT IS USED SO THAT AT A LOW VALUE IT WILL BE IN PARALLEL WITH THE TESTED CIRCUIT. BRILLIANCY INCREASE DENOTES THE TEST CIRCUIT HAS A LOAD NOT SHORTED.

FIG. 3 SHOWS A RESISTOR AND A CONDENSER, TO CONSTITUTE AN ADJUNCT SERVICEABLE IN DISCOVERING WHETHER AUDIO PLATE OR GRID LOADS ARE OPEN.

FIG. 4 IS A COMPOSITE OF FIGS. 2 AND 3. TL ARE TEST LEADS. THREE ARE REQUIRED BECAUSE OF THE LEAD FROM B IN FIG. 3. THE TWO OTHER LEADS ARE CONNECTED AS NEEDED, TO LAMP SIDE AND BATTERY SIDE, OR TO A AND B OF FIG. 3.

FIG. 5 IS THE PANEL VIEW.

A CONTINUITY tester is a tester that will show whether a circuit is continuous or discontinuous. (Fig. 1) It is commonly believed that such a tester will show whether there is a short circuit or an open circuit, but this is not a fact.

Suppose you are shooting trouble in a receiver and want to ascertain whether the secondary of radio frequency transformer is open or shorted. With an indicating device in series with a voltage source you will get no indication if there is an open, but suppose there is a short, what will you get? Exactly the same result as if there were no short. The lamp in Fig. 1 will light. Apply the Fig. 1 circuit in the grid circuit. All you can learn is that the circuit is continuous (lamp lights) or it is discontinuous (lamp does not light). Yet you must know whether the grid circuit has a load on it or not, but can't find out by the conventional continuity test, because the resistance of the secondary is small.

However, see Fig. 2. Besides the dry cell B and pilot lamp PL there is a rheostat R, with pointer P and switch SW, that can be cut in or out at will. You can set the rheostat pointer P so that the lamp lights with extreme dimness. If this circuit as ad-

(*Continued on next page*)

LIST OF PARTS

One 1.5 wet pilot lamp.
One 20-ohm rheostat.
Three binding posts.
Three test leads.
One 0.1 meg. resistor with mounting.
One .00035 mfd. fixed condenser.
One panel with calibration for rheostat drilled.
One pointer knob.
One 1.5-volt dry cell.
One pilot lamp socket.
One switch.

(Continued from preceding page)

justed is applied to the coil in an RF grid circuit, the lower resistance of the secondary winding will be in parallel with the resistance of R, and the total resistance will be even less than that of the coil. Hence the lesser resistance will enable more current to pass, and the lamp will light much more brightly. Therefore, the increased illumination proves that the coil is not only continuous, but is not shorted.

No. 24 covered wire, as an example, has a direct current resistance of 1 ohm for about each 40 feet, and the secondary will consist of almost 40 feet, whereas R may be a 20-ohm rheostat, so that the difference in illumination will be great.

The condition described, as affecting the secondary, is even more effective as to the primary, because the primary has a lower DC resistance, except in tuned plate circuits.

Hence the tester as shown in Fig. 2 is useful in radio frequency circuits, or any other circuits having tuning coils, although the same tests can not be carried on so fully in audio circuits, because of the high DC resistance of both the plate and grid loads. As these resistances would be in series with the test circuit, the lamp would not light, since current is virtually stopped, and normal operating current for brilliant illumination is around 200 milliamperes.

Shorts Always Show a Light

In radio frequency circuits the lamp does not light on open circuits only. It does light on shorts and on properly loaded circuits.

In audio frequency circuits the lamp does not light on open circuits either, but neither does it light on properly loaded circuits, but only on shorts.

Hence as to both RF and AF, a short always will show a light. In RF the problem is whether the light means a short or a proper load, solved by Fig. 2. In AF the condition of no-light may mean either an open or a proper load, and that distinction can not be made with the tester shown in Figs. 1 or 2.

The previous discussion was based on a receiver not being powered when the tests are made, but as to audio load tests, having remedied any bad conditions discovered in the RF circuit, the set may be worked to discover whether the no-light condition denotes an open, or a proper load. If there is an open in the plate circuit there will be no reception. An open in the grid circuit will result in reception in some instances, particularly where an audio transformer's secondary or an audio choke coil is in the grid circuit, while an open in a resistor load may afford weak signals or no signals. However, an easy checkup is to use a condenser and a resistor, as in Fig. 3, connecting the resistor from plate to B plus, and the open side of the condenser to the next grid. If the plate circuit was open, now it will be closed, and signals will come through. B goes to plate, C to B+, while A is the "open side."

If no material change results, put the resistor instead in the grid circuit and the open side of the condenser to plate. If signals did not formerly come through, but come through now, then the secondary was open.

Previous tests have proven there was no short, or that if there was one it is assumed to have been remedied, so now with Fig. 3 we can test for opens, shorts and proper loads in both RF and AF circuits, and have an open-short-OK tester.

Calibration of Rheostat

The resistor R, Fig. 2, is a rheostat, and its resistance is directly proportionate to the angle of rotation of its knob. A pointer knob used in conjunction with a scale graduated from zero to maximum resistance, the number of divisions equal to the number of ohms, and evenly divided, will constitute a workable calibration of the rheostat. Then with the test tips interconnected, the brilliance or dimness of the light for any resistance value in the range may be noted, and when the same degree of illumination appears when you test a circuit, you can determine thereby the resistance of the tested circuit, not with scientific precision, but with reasonable accuracy. It is surprising how easy it is to memorize the resistance in terms of the illumination.

The maximum resistance limitation is governed by the rheostat and the amount of current necessary to show some illumination in the lamp. Normally the lamp will draw about 200 milliamperes, i.e., 0.2 ampere, so the 1.5-volt lamp would have filament resistance of 7½ ohms. A 20-ohm rheostat would stop the illumination, at maximum resistance setting, the current being only 1.5/27.5, or 65 milliamperes (.065 ampere). Therefore, the resistance values to be judged by the illumination test must be less than 20 ohms. The lamp's resistance remains in circuit always.

11 New Station Requests to be Heard

Recent applications for construction permits, whereby new stations seeking the air will get a hearing, follow:

550 KC

Merchants Radio Station, Vicksburg, Miss. .... 100 watts

570 KC

Radio Service Co., Russellville, Ala. .... 10 watts

580 KC

Radio Service Laboratories, Negaunce, Mich. .... 1 kw

590 KC

R. S. and D. W. Gavin, Marion, Miss. .... 250 watts

1150 KC

Forrest H. Bayne, Trenton, Mo., ... 100 watts

1210 KC

R. P. Denman Music Stores, Paris, Texas .... 100 watts

1260 KC

D. Estes, Vernon, Texas...... 100 watts

1310 KC

G. B. Bairey, Valley City, North Dakota .... 50 watts

1380 KC

Radio Advertising Co., Pittsburgh, Pa., ... 500 watts

A. P. Stark, Pampa, Texas.... 500 watts (Seven hours daily)

1500 KC

J. E. Bennett Music Co., Cordell, Okla. .... 100 watts (Six hours daily, day and night)

Broadcasting Changes

WMAY, St. Louis, Mo., operating on 1,200 kc, has petitioned the Federal Radio Commission for authority to change its frequency to 1,500 kc, and change its present operating hours from sharing with WIL and WFWF to unlimited time with 250 watts day and 100 watts night transmission power.

WQBC of Vicksburg, Miss., also has an application pending whereby it seeks to increase its transmission power from 300 watts to 500 watts, and also requests unlimited time, instead of the present day time hours' schedule.

WLOE, of Boston, Mass., has suspended transmission until Labor Day in order to facilitate reorganization.

W3XAL, of Bound Brook, N. J., will use 6,100 kc for communication purposes with members of Bartlett-Greenland Expedition.

WBZ, of Boston, Mass., will increase power from 15 kw to 50 kw shortly.

WHAS, of Louisville, Ky., will increase power from 10 to 50 kw.

WBT, of Charlotte, N. C., will increase power from 5 to 50 kw.

WMAQ, of Chicago, Ill., will increase power from 5 to 50 kw.

KYW, of Chicago, Ill., will increase power from 10 to 50 kw.

WORTH THINKING OVER

AN official of a certain big baking company was asked the other day how much money his concern intended to spend for radio advertising during the coming year. "Oh, between two hundred fifty and three hundred thousand," was the reply—just like that!

Fire on Marconi's Yacht Spares Lab

Civitavecchia, Italy.

Guglielmo Marconi's yacht, Electra, which has figured recently in some important short-wave radiophone and beam transmission experiments, narrowly escaped destruction by fire while at anchor in the harbor here.

The principal damage occurred near the crew's sleeping quarters, but the fire was checked before it could reach the laboratory, which is located amidships.

This floating laboratory has been the scene of innumerable successful and historic radio experiments, including the recent two-way short wave phone conversations between the Mediterranean and America, and also Australia. The yacht has also figured recently in some "beam wireless" transmissions, a system which concentrates radiated electric waves in the form of a strongly directional "beam," as a searchlight's optical system concentrates the radiations of a powerful carbon arclight.

The fire was the result of a backfire in the engine room, and was put out promptly. The damage, restricted to the poop deck, was estimated at $5,000.

NEW WMSG TRANSMITTER

WMSG, New York City, will install a new 250-watt transmitter, employing direct crystal control.

WEMC OFF AIR AWHILE

WEMC, of Berrien Springs, Mich., has discontinued transmission until September 30th.

An Extra-Stage Converter

By H. B. Herman

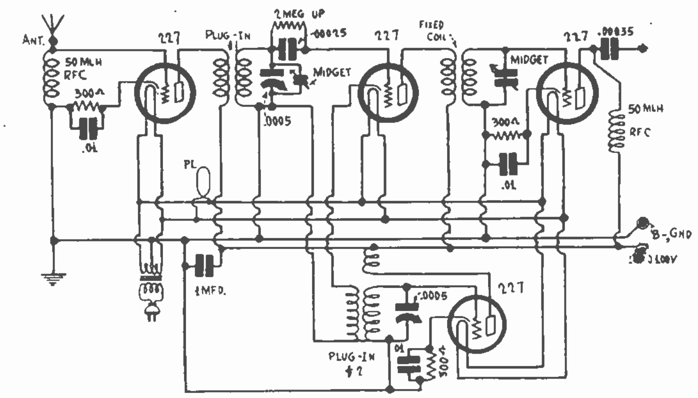


FIG. 1
A SHORT-WAVE CONVERTER WITH AN INTERMEDIATE FREQUENCY STAGE BUILT IN, TO INCREASE THE AMPLIFICATION AND LIMIT THE INTERMEDIATE FREQUENCY TO BETWEEN 1,500 AND 1,200 KC.

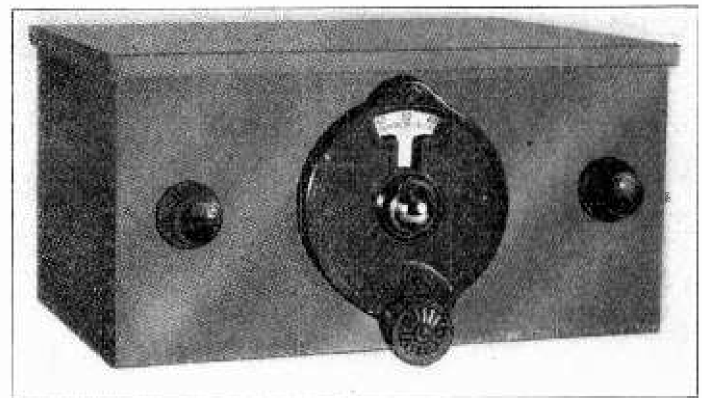


FIG. 2
THE SHORT-WAVE CONVERTER FRONT PANEL VIEW.

THE effect of an intermediate frequency stage built into a short-wave converter is to increase the amplification and also to limit the receiver's intermediate frequency to not less than 1,200 kc.

The converter brings in the short waves, changes them to a longer wave, an intermediate frequency within the frequency range of the broadcast receiver, and the principal amplification is obtained from the receiver. Therefore the entire broadcast receiver is used. The input thereto is a new transmission frequency established by the conjunctive operation of the short-wave modulator and oscillator. A single dial will serve all right if a two-section condenser is used, with a trimmer across the modulator tuning capacity. Or, two condensers of the individual type, united by a flexible or other coupler, may be used. The uniting of separate condensers was found satisfactory in the laboratory model of this converter, shown as to the interior detail and coil position on the front cover this week, and as to front panel appearance herewith as Fig. 2.

Intermediate Working Range

The diagram, Fig. 1, is republished from page 4 of the August 2nd issue, in which issue the theoretical side was presented. Coil data and list of parts were given then.

The converters that have been most numerously described in these pages in the past four months have used three tubes, but this one uses an extra tube, due to the intermediate stage added to the former models. Since a small condenser, of the trimming variety, say, 50 mmfd., is used across a broadcast radio frequency transformer in the built-in intermediate stage, the intermediate frequency will run down to about 1,200 kc. The working range therefore is between 1500 kc., and 1,200 kc.

To tune in, set your broadcast receiver at some frequency above 1200 kc., pick up a signal by tuning the converter, as to its two main tuned sections and also the trimmer across the longer-wave coil in the converter, and once having established reception, see if you can get louder signals by resorting to a still higher frequency. This will require retuning of oscillator, trimmer across the built-in broadcast coil, and the receiver itself. However, once the intermediate frequency of best sensitivity is established, you will not have to change the setting of the trimmer across the built-in broadcast coil, nor resort to any other receiver dial setting than the one now noted finally for its best setting.

The heater voltages is supplied by a filament transformer in the converter. All four tubes used are 227s.

Some source of B voltage is necessary, which may be a separate battery or may be the voltage in the receiver. The voltage at the screen grids, with volume control advanced to maximum, as it should be whenever the converter is worked, will be sufficient. This may be obtained by soldering a lug to an insulated wire lead, so that the insulation is snugly against the lug, and inserting the screen grid prong of the receiver's first RF tube through the lug aperture before inserting the tube in the socket. This device is open to all who have screen grid receivers, whether AC type or not.

Rectifier Type

At a little extra expense, regardless of whether an intermediate stage is built into the converter or not, a rectifier may be included, using either a small tube commonly employed as detector or amplifier, or even using a 280. Whether short-wave enthusiasts are willing to spend the little extra money to dispense with the external B connection has not been proved. However, it has been pointed out that the converter offers such a simple, easy way of getting short waves, by affording a double utility of the broadcast receiver, and all power is built in save the B voltage, so a total power independence of the converter from the receiver or any other voltage source save the 110 volts AC input and the signal transmission, would constitute a valuable convenience.

The coming season will see several short-wave converters on the market, and the question of which type will prove the most popular will be decided by experience only. It is my opinion that the rectifier type of short-wave converter will be the most popular, particularly as the public comes to realize that the short-wave converter is the far ahead in performance of the dubious short-wave adapters that plug into the detector socket and all too often furnish no signals whatsoever.

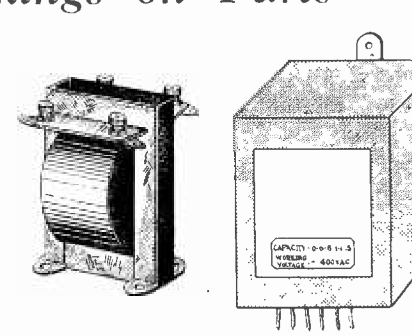
Owners of battery-operated sets will not be interested in rectifier type converters, perhaps, because they have the B voltage readily accessible, and indeed may prefer, or be compelled, to omit the filament transformer, not having AC at all, so models catering to the non-electric household may be expected, also.

New Developments

A rectifier type of converter, using screen grid tubes and a 280, is being developed in RADIO WORLD'S laboratories, and is scheduled for publication in these columns in September. However, prior to that a totally AC operated five-tube short-wave receiver of extreme compactness and moderate cost will be described. Both the rectifier type coverter and the AC receiver use the same general layout, in fact, the same model cabinet, which is chromium plated steel. The metal first is copper plated, then nicked plated, then chromium plated. The foundation platings make the final chromium finish non-peeling and also rustproof.

(Other Illustration on Front Cover.)

Markings on Parts



THE AUDIO TRANSFORMER IS MARKED P. B. G AND F. ALTHOUGH F NEARLY ALWAYS GOES TO C MINUS. AT RIGHT THE FILTER CONDENSER BLOCK HAS CAPACITIES DESIGNATED ON THE LABEL.

An audio transformer has its terminals marked or color-identified. Markings would be P for beginning of primary, B for end of primary, G for end of secondary and F for beginning of secondary, these representing plate, B plus, grid and C bias. F used to be connected to filament, in the days when battery sets were the rule and C bias the exception. If howling results, reversal of the connections on either primary or secondary may cure it.

The illustrated transformer is unshielded. A mere steel case would be no shield. Cast iron casings are shields to audio magnetic waves. They are also static shields.

If a filter condenser block has a capacity label in sequence, and unmarked out-leads, the capacities are in the order of the leads, the black one (or one at left) being common.

Screen Grid Debate

Resolved, That the 224 Is Superior

AFFIRMATIVE

By Godfrey Gibson

THE advent of the modern radio receiving tubes is the result of careful and exhaustive research by experts. The successful mass production of a tube of more complicated structure is really not to be compared with the relatively simpler production problems associated with the three-electrode tube.

To begin with, the last five years of research and practice have resulted in enormously improved exhaustive processes, both mechanical and chemical, the tipless tube and a "sealing off" production problem of no mean proportions that have helped to bring the latest product of our scientific laboratories well within the financial reach of all.

As to the tube defects, it must be remembered that it takes some time to circumvent design defects, and also once it is decided to put a given design "through," that tube goes to the production department "as is" and Mister Fan has to take what's offered and let it go at that. He needn't fear he fares badly under such circumstances these days.

Uninformed persons naturally assume that design faults should be remedied, and very well informed engineers agree, but the user usually fails to recognize that big manufacturing enterprises have considerable inertia, or stay-as-it-is-ness, and due to this one factor alone it would be ruinously expensive to scrap several million dollars worth of dies, jigs and other mechanical equipment, which unfortunately is more or less a "fixed" investment, as it is very difficult to transform steel machinery from one guise into another by merely giving the order to do so.

New Tubes High in Standard

The new tubes have been made to very exacting laboratory standards, despite the arguments to the contrary, and if one finds that there is so little practical advantage to be gained from the use of the screen-grid tube, I would suggest that he examine it considerably more critically, because there must be very valid reasons for its conception in the designer's mind, aside from merely furnishing something new for the radio-minded public.

I also wish to take issue with derogatory statements made concerning the comparative amplification efficiency of the screen grid tube and the old three-electrode type.

Feedback, and the unwanted oscillatory effects due to it, are not at all necessarily due to stray magnetic field, but are more likely to be due to interelectrode tube capacity, a very undesirable property of tubes generally, when they are employed as radio frequency amplifiers in condenser tuned circuits, and as the interelectrode capacity of the new tubes is lower, and also a fourth element, the screen grid, is present to help neutralize the evil tendencies that were so characteristic of the old style tubes, it is seen that the new design has at least one cardinal feature that the old tube certainly did not have.

The new tubes are also vastly better than the old ones in circuits that are inherently more sensitive, despite the argument to the contrary, tests having proved this point many times. If anyone who takes the negative view would take the trouble to make more careful observational as well as electrical tests, I am sure that he would have found that in some manner the full advantage of the screen grid design was not being employed.

Seven Advantages Listed

Screen grid tubes have the following advantages over others as radio frequency amplifiers:

(1) Higher gain by far, even in practice.

(2) Low interelectrode capacity and consequent minimum feedback conditions.

(3) Higher plate voltage, offering greater relative amplification and freedom from cross-modulation.

(4) Low energy consumption, considering the performance.

(5) Sturdiness of construction, considering the difficulty of manufacture, and comparing favorably in ruggedness to previous tubes.

(6) Low cost, due to great popularity and consequent quantity production.

(7) Option of greater selectivity at the same gain per stage as previously enjoyed, or greater amplification at the same selectivity as previously.

NEGATIVE

By Austin Frauenhofer

THE advent of the screen grid tube has been hailed by fans, radio periodicals and all others interested as the latest achievements in radio, and is depicted as open sesame to the cure of oscillation and other unwanted troubles. These new tubes don't appear by either test or use to possess any special virtue that distinguishes them from the three-electrode type, as anyone can quickly determine if he makes ordinary static measurements on these new tubes.

Screen-grid tubes for radio receiving sets as now designed don't appear to contribute one iota to sensitivity, stability or volume, which can't be easily obtained with the old style tube and furthermore considerably greater room for improvement resides in the design of shields, coils and the capacity change, that is, angular displacement factor of variable condensers.

Milliwattage Compared

The old style three-element tubes that were intended for use in tuned radio frequency circuits, especially those tubes that were oxide coated, had a milliwatt output capacity in excess of 2,700 at 90 volts, whereas the present screen grid tubes don't rate much over 4 milliamperes at 180 volts applied on the plate, or a total of 720 milliwatts, which is immediately seen to be very much below the old time standard for an oxide coated tube.

And furthermore if a comparison be made between the old oxide coated three-electrode tube and the new screen grid "wonders," using standard recommended applied plate voltages, it will be found that an equal change of grid voltage in each case will produce an alarmingly different change in plate current. If the amplifying power of a tube is a function of the recorded change in plate current due to a comparison of grid voltage then the superiority of the old style tube is again re-established.

I have two receivers, both of which I have built up from bought parts. One is an old-style Superheterodyne, and the other is a modern screen grid set, employing gang condenser tuning, and having four screen-grid tubes, which are operated at the manufacturer's rated applied voltages.

The old-style receiver, operated by batteries, uses two independent old-style condensers with uniformly semicircular plates, and the tubes are the old oxide-coated three-electrode warriors, veterans of five years of constant service.

A recent test on these tubes revealed that they have suffered about 10% depreciation, compared to the results of a test made when they were new.

How to Repair 224s

Whereas, since I have had the screen grid set in operation, I have had to change screen grid tubes at least four times! And a recent test showed the four recently-removed tubes to have suffered a drop in emission current of more than 80%. In other words, at 180 volts the plate current was only eight-tenths of a milliampere, and of course I received weak signals. Of course after I replaced the poor tubes with new ones the trouble was cleared up.

My own experience with screen grid tubes has been corroborated by the observed results of friends who report that their new electric set requires regular attention from the visiting sevice man, and he usually has to insert a new tube.

It is also stated by certain engineers (in advertising matter, no doubt) that the new tubes enable one to utilize the higher amplification gain with more than the usual circuit stability, because a shielded coil with a high impedance primary may be employed. It is pointed out that in general the higher the plate load impedance, the greater is the efficiency of the tube, that is, the greater the energy of signal transfer through the amplifier system.

There is no valid reason that I can see why the old three-electrode tube isn't just as good, because in the old days no sets were made that employed cup-type coil shields, and if these had been used there is no doubt that no excuse for the design of the screen grid tube would have cropped up.

These same worthy men solemnly state that the new tube is a cure for self-oscillation, or oscillation due to feedback, and I beg to dissent again, because observation has shown that this is not in accordance with known facts.

The July "Proceedings"

By Brunsten Brunn

IN "Ultra-Short Waves for Limited Range Communication," W. J. Brown, Uxbridge, England, describes experiments with transmitters and receivers operating on 2-meter waves, in the July issue of "Proceedings of the Institute of Radio Engineers." A communication range of over 12 miles was obtained using a super-regenerative receiver and reflectors at both the transmitter and the receiver.

One transmitting circuit used consisted of straight parallel wires connected in a balanced oscillator. The tubes, from which the bases had been removed, were connected at the ends of the wires and the leads supplying the energy were connected to the mid-points of the wires. With proper phasing this circuit produced short-wave oscillations, the frequency of which was determined by the length of the conductors, between the tubes and the inter-electrode capacities of the tubes.

In another circuit the wires were bent into the shape of a U with the tubes connected to the terminals as in the previous circuit. The energy supply leads, as before, were connected to the middle of the oscillatory conductors, which in this case was at the bottom of the U-shaped circuit. A straight wire half-wave antenna was coupled to the oscillating circuit by connecting the antenna wires, the antenna proper and an equal counterpoise, a short distance up from the bottom of the U. Sliding contacts were provided for both wires to vary the degree of coupling and to secure symmetry.

Length of Antenna

The total length of the oscillatory circuit was 50 centimeters and the total length of the antenna was 100 centiemters. The total length of the common coupling was 5 centimeters and the distance between the two branches of the U was 1.25 centimeters. The generated wavelength was 2 meters, that is, 200 centimeters. The voltage applied to the plates of the tubes was 500 volts r.m.s., 500 cycles. The average plate current, with Marconi LS5 tubes, was 50 milliamperes and the antenna current was 0.3 amperes.

The receiver employed was similar in design to the U-type transmitter with a single metal rod for antenna, coupled to the U a short distance above the bend. The receiver was of the super-regenerative type with a quench frequency of 300,000 cycles per second. The receiver employed five tubes, two for the short-wave oscillating detector, one for the quench frequency generator, and two audio frequency amplifiers.

Reception tests with the 2-meter system demonstrated that waves of two meters are quite useful for certain purposes both over land and over sea.

With the transmitter set up at ground level in an open courtyard in the center of the city, signal could be picked in city streets with a portable receiver carried on an automobile up to distances of one mile. The intensity of the signals received varied greatly at this distance according to the direction of the streets with respect to the signal path, the reception being much better when the signals could follow the streets than when they were forced to cross buildings.

When the transmitter was set up on top of a 50-foot building reception could be picked up without much interruption up to two miles.

Radio-Frequency Modulation

Mr. Brown points out the possibility of communication with radio-frequency modulation of the two-meter wave and thereby gain secrecy as well as many additional communication channels. If a super-regenerative receiver is used the signals can be received only if the quenching frequency is adjusted so as to give an audible beat note with the modulation frequency. Hence anyone attempting to intercept the transmission has to adjust his receiver to two independent frequencies at the same time. If several modulation frequencies are used on the same short wave, such as 150, 175, 200, etc., kc. each modulation frequency becomes an independent channel.

A Radio-Frequency Potentiometer

William W. Macalpine, International Communications Laboratories, Inc., New York, describes a potentiometer with which the amplitude and phase of voltages up to 1,000,000 cycles per second can be measured. The theory of the device is explained in detail and methods of standardization and use are given. A bibliography to other papers on the subject is appended. An accuracy of one per cent. plus or minus is claimed for the instrument regarding potential measurements and of plus or minus 0.5 degree for the phase angle.

Service Area of Broadcast Stations

P. P. Eckersley, formerly chief engineer of the Brtiish Broadcasting Corporation, contributes a paper on "The Calculation of the Service Area of Broadcast Staitons," which is a comprehensive study of the practical considerations in the determination of the field strength laid down at any distance by a given radio station at any given location. All factors entering into such calculations are considered and practical means of their determination or estimation set forth.

Many attenuation curves are given by means of which the field strength at any distance from the transmitter on any wavelength within certain limits may be determined. The radiated power in each instance is one kilowatt.

Mr. Eckersley's conclusions regarding the suitaiblity of the waves used at present for broadcasting is interesting.

"It will be obvious to those who take the trouble to observe closely the quantitative implications involved that the shorter wavelengths are most unsuitable for regionable broadcasting. A striking case has already been cited where a station of 800-kw. power (drawing about 6,000 kw. from the power-supply mains), only gives true service over an area bounded by a fifteen- to twenty-mile circle around the station. A more striking example can be added. The author has calculated that, whatever the power of the stations involved, 24 stations in Canada using waves spaced equally in frequency between 545 and 200 meters could not cover more than 7 per cent. of the total area of that country with true service broadcasting. With the same number of stations using waves spaced equally in frequency between 2,000 and 280 meters, 83 per cent. of the area of Canada could be covered by true service broadcasting. Long-wave broadcasting will be the only means by which such programs (so interesting as to suffer by their irregular disappearance as coherent sound!) can be universally and reliably diffused.

"At present moment we waste power for an incommensurate gain and to the detriment of other broadcasters and listeners.

"The two main reasons cited against the use of long-wave broadcast concern dislocation to other users of the ether who are at present using waves between 600 and 2,000 meters, and the added difficulty in designing receiving sets to cover the full-wave range.

"As to the former point, the problem is only insoluble as it is left to be discussed by non-technical persons anxious only to preserve a status quo and afraid to spend money for progress. The latter problem cannot be insoluble because it is solved in Europe today."

Frequency Modulation

Balth. van der Pol, Eindhoven, Holland, contributes an interesting mathematical paper on the subject of frequency modulation, that is, modulation characterized by a change in the frequency of the carrier rather than a change in the amplitude. He derives the fundamental differential equation and solves it for two cases, telephony and telegraphy. He shows that the important thing is the ratio of the change in the carrier frequency to the modulating frequency, both assumed to be small in comparison with the carrier frequency.

The solution in either case contains many frequencies such as the carrier, the side frequencies obtained by combining the carrier and the fundamental of the modulation frequency, and many side frequencies obtained by combining the carrier with the harmonies of the modulation frequency.

Spectra for different values of the ratio referred to above have been calculated as to amplitude and location for both types of communication. They have also been calculated for constant value of the change in the carrier frequency and variable modulation frequency and for variable change in the carrier and constant modulation frequency. Exceedingly interesting spectra are the results.

Locating Interference with Oscillograph

J. K. McNeely and P. J. Konkle suggest a method of locating interference with radio reception by taking oscillograph records of disturbances and then comparing them with records of noises produced by different electrical apparatus. This seems not only to be new but one that leads quickly to desired results. It is in effect similar to the identification of criminals by fingerprints. Every noise gives a characteristic oscillograph print and to identify it, it is only necessary to find its counterpart in the files.

Resistance of an Air Condenser

R. R. Ramsay, Department of Physics, University of Indiana, reports on experiments "The Variation of the Resistance of a Radio Condenser with Capacity and Frequency." He also reports on the results obtained by other investigators, reducing all measurements of "standard conditions."

It is shown that the resistance of a condenser may be as high as one ohm. It is ordinarily assumed that the resistance is so small that no appreciable error is committed if it is considered to be zero. These experiments show, however, that the resistance is high enough to affect the result, since a resistance of one ohm in a circuit the total resistance of which may be only 5 ohms is certainly not negligible.

The 200A and the 112A

By J. E. Anderson

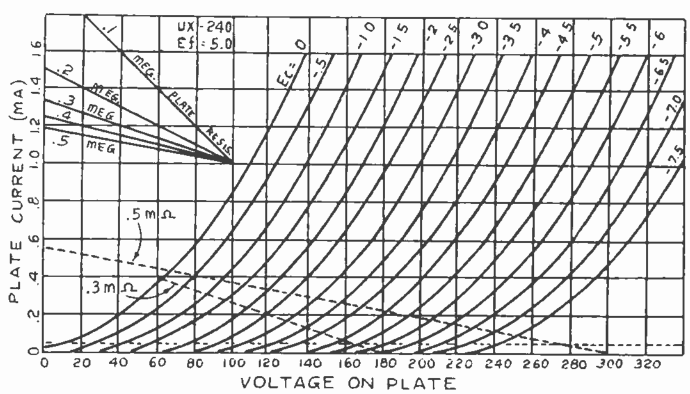


FIG. 22

A FAMILY OF PLATE VOLTAGE, PLATE CURRENT CURVES OVER THE OPERATING RANGE OF GRID VOLTAGES FOR THE 240 TUBE, WITH TWO LOAD LINES, ONE FOR 0.5 MEGOHM AND 300 VOLTS AND THE OTHER FOR 0.3 MEGOHM AND 180 VOLTS.

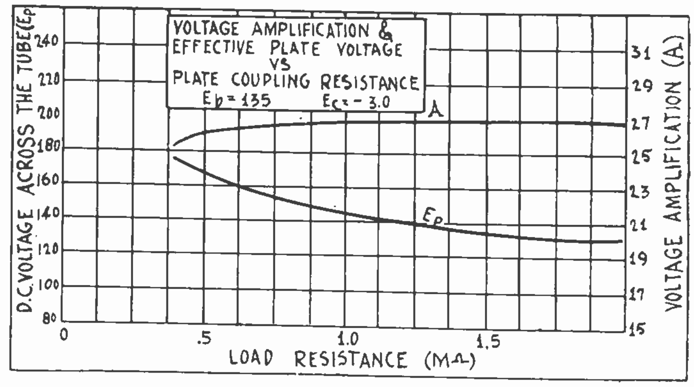


FIG. 24

CURVES SIMILAR TO THOSE IN FIG. 23 BUT FOR 425 VOLTS IN THE PLATE CIRCUIT AND 3 VOLTS ON THE GRID

[Herewith is the third instalment of "Modern Radio Tubes." The first instalment, in the August 9th issue, contained a discussion of the WD11, WD12, UV199 and UX199. Last week, issue of August 16th, the tubes were 120, 201A and 240. Next week, issue August 30th, the tubes will be the 230, 231 and 232, all new tubes.—Editor.]

The low note amplification is largely determined by the stopping condenser and grid leak resistance. If either is made small the low notes will be suppressed, and, of course, if both are made small the low note cut-off will be still greater. A good guide in choosing a combination is to make the product of the grid leak resistance, in ohms, and the grid condenser capacity in farads, equal to .02 second. That is, the time constant of the circuit should be .02 second. This may be obtained by using a small condenser and a high leak resistance or by using a large stopping condenser and a small leak. There are certain limitations to the choice which will be discussed later.

Calculation of Amplification

The voltage amplification can be computed readily with the aid of a family of plate voltage, plate current curves for various grid bias voltages in the working range, such as is shown in Fig. 22. Two load lines, representing load resistances of .3 and .5 megohms, are drawn across the curves, and a number of guide lines are drawn in the upper left corner of the figure. Other load lines may be drawn across the curves by making them parallel to these guides and through the voltage on the plate axis equal to the voltage in the plate circuit. For example, suppose the applied voltage is 250 volts and the load resistance is 100,000 ohms. The corresponding load line would be drawn through the point on the voltage axis corresponding to 250 volts

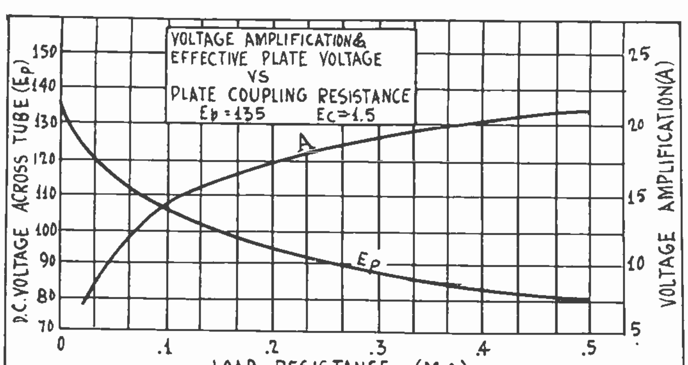


FIG. 23

CURVES SHOWING THE VARIATION IN THE VOLTAGE AMPLIFICATION AND THE EFFECTIVE PLATE VOLTAGE WITH VARIATION IN THE PLATE LOAD RESISTANCE FOR THE 240 HIGH MU TUBE UNDER THE CONDITIONS GIVEN

and parallel to the upper guide line, that is, the line for .1 megohm plate resistor.

In the figure the .3 megohm load line is drawn through the point representing 180 volts in the plate circuit and the .5 megohm load line through the point representing 300 volts in the plate circuit. The dotted line parallel to the voltage axis is drawn at .05 milliampere, which is the lowest current permissible without distortion.

Let us see what the voltage amplification is in the two cases, first considering the load line for .3 megohm load. We note that it crosses the zero bias line at 60 volts on the plate and again that it crosses the .05 milliampere line at 165 volts on the plate. At this point the bias is 5 volts. Therefore a change in the grid bias of 5 volts causes a change in the actual plate voltage of 105 volts. This is the voltage change in the load and hence it is the output voltage. Since by definition the amplification is the ratio of the output voltage to the input voltage the amplification is 105/5, or 21. This is just .7 of the amplification constant of the tube and it compares very favorably with the amplification obtainable with a 201A tube and a good transformer.

The amplitude of the output voltage is 52.5 volts, which is more than is required to load up a 245 power tube. The grid bias required on the grid of the 240 is 2.5 volts, which may be made up by a one-volt drop in the filament ballast and 1.5 volts from a dry cell battery.

Now let us examine the case when the load is .5 megohm and the voltage in the plate circuit is 300 volts.

We note that the load line crosses the zero bias curve at 68 volts on the plate and the minimum current line at 276 volts. The difference is 208 volts. We also estimate that the bias at the lower crossing is 8.5 volts. Thus a change of 8.5 volts on the grid produces a change of 276 volts in the output voltage. Hence the voltage amplification is 208/8.5, or 24.5. This compares with 21 when the load resistance was .3 megohm.

The needed bias is one-half of 8.5 volts, or 4.25 volts, and the amplitude of the output voltage is 104 volts, which is more than is needed to load up a 250 power tube. Even with 300 volts in the plate circuit, the steady plate current will not be higher than about .2 milliampere.

If the power tube following the 240 and the resistance coupler is a 171A it is clear that it is not necessary to use a voltage higher than about 180 volts in the plate circuit and a load coupling resistance of 250,000 ohms. But if the tube is a 245 or 250, higher voltages and higher coupling resistances are necessary.

Variation of Voltage Amplification

In Fig. 23 the change in the voltage amplification A with changes in the plate coupling resistance is given for the conditions that the voltage in the plate circuit is 135 volts and the grid bias is 1.5 volts. From this curve we estimate the amplification to be 18.2 when the load resistance is 250,000 ohms.

The second curve in Fig. 23 shows the variation in the DC voltage across the tube, that is, the effective plate voltage as the plate load resistance varies. At 250,000 ohms the effective voltage is about 92 volts.

Fig. 24 gives the same functions when the voltage in the plate circuit is 425 volts and the grid bias is 3 volts. The curves terminate on the left where the effective net voltage on the plate is 180 volts, the highest effective voltage that it is safe to

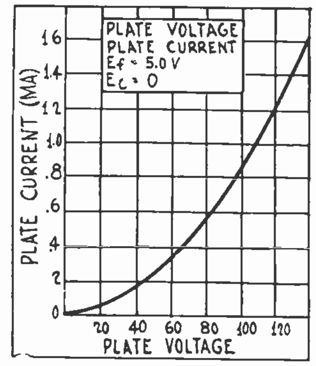


FIG. 25
PLATE VOLTAGE, PLATE CURRENT CURVE FOR ZERO GRID BIAS FOR THE 240 HIGH MU TUBE.

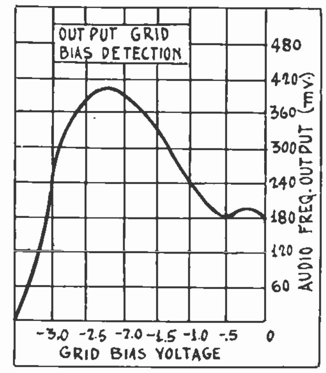


FIG. 27
RELATION BETWEEN THE GRID BIAS AND AUDIO OUTPUT VOLTAGE OF A 200A TUBE WITH PLATE VOLTAGE OF 45 VOLTS.

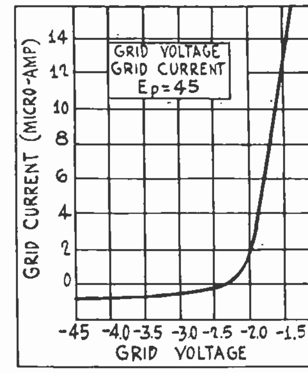


FIG. 28
VARIATION OF GRID CURRENT WITH GRID BIAS FOR THE 200A TUBE. THE CURRENT IS ZERO WHEN THE BIAS IS 2.25 VOLTS.

use. When the load resistance is one megohm the voltage amplification is about 26.5 times, and the effective voltage on the plate is nearly 150 volts. It is not recommended that a voltage as high as 425 volts be used in the plate circuit for ordinary applications of the tube, for we found previously that even 300 volts in the plate circuit with one-half megohm load resistance was sufficient to load up the largest available receiving power tube.

Stability and Amplification

In a resistance coupled amplifier having three or four stages and designed so that it will amplify the low notes well there is likely to be oscillation at a low frequency, known as motorboating. The cause of this trouble is the common impedance that enters because the tubes are all served by the same voltage supply. If the plate supply is a storage battery the trouble rarely occurs. Also, if the supply is a dry cell battery the trouble does not occur as long as the battery is fresh, but develops as soon as the internal resistance of the battery becomes appreciable. In extreme cases the resistance need only be 5 ohms but ordinarily it does not occur until the resistance is about 500 ohms.

When the plate voltage supply is a B battery eliminator there is always a possibility of oscillation.

The straightforward remedy in any case is to use more and larger by-pass condensers across the B supply, but in some instances the oscillation is so violent and so low in frequency that no reasonable capacity will suffice to stop the trouble. An electrolytic condenser of over 50 microfarads has failed in some instances, but these cases are extreme.

Individual filters in the plate leads to the tubes, including that of the detector, are quite effective when by-pass condensers alone fail. The series part of one of these filters may be either an audio choke coil or a resistance of 25,000 or 50,000 ohms, each by-passed directly to ground with a 2 mfd. or larger condenser. The live terminal of the condenser should be connected to the junction of the plate coupling resistor and the choke or resistance used for filtering.

When the frequency of the oscillation is so low that condensers are quite ineffective, the best way of stopping the oscillation is to lower the value of the time constant of the stopping condenser and the grid leak, and the simplest way to do this is to try lower values of grid leak resistances. The amplification on the low notes is sacrificed for stability.

There is another reason for using a low value of grid resistance in some instances. If there is considerable leakage from the positively charge elements to the grid, the actual grid voltage is not determined by the potential of the grid return for the leakage from the positive elements may be greater than the leakage through the leak resistance. When this is the case the grid gradually asumes a positive potential and the tube fails to function. When the power is first turned on the operation is normal but after a few seconds or a few minutes distortion sets in and finally the circuit fails to function. A lower value of grid leak resistance usually cures this condition, but in some instances it becomes necessary to improve the insulation of the grid. This may require a new stopping condenser, a new tube, a new tube socket, new resistance mountings, or it may only require the cleaning of the insulators around the grid.

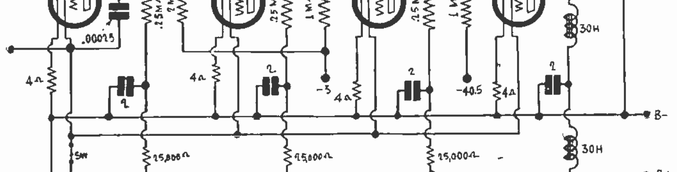


FIG. 26
A RESISTANCE COUPLED AMPLIFIER USING 240 TUBES AS VOLTAGE AMPLIFIERS AND 171A AS POWER TUBE. THE SUPPLY LEADS HAVE BEEN FILTERED SO AS TO PREVENT MOTORBOATING.

200A

THE 200A is a special supersensitive, alkali vapor detector tube that may be used with either resistance or transformer coupling. Its sensitivity is partly due to the alkali vapor and partly to its high amplification constant, which is 20.

In external appearance it is like the 201A and it has the same filament rating and the same type of base.

CHARACTERISTICS OF 200A

Filament voltage	5.0
Filament supply voltage	6.0
Filament current, amperes	.25
Amplification factor	20.0
Plate voltage, maximum	45.
Grid bias, at 22.5 volts on plate	—1.0
Grid bias, at 45 volts on plate	—2.2
Grid resistance, megohms	2.0 or 3.0
Grid condenser, mfd	.00025

The tube is sensitive both as a grid bias detector and as a grid leak and condenser detector. When bias detection is used maximum detection efficiency is quite critical with grid bias, as may be seen from Fig. 27, which shows the change in the audio frequency output voltage with variation in the grid bias for a given modulated radio frequency voltage. The peak of the curve falls at 2.25 volts on the grid. As the bias increases above this value the detecting efficiency falls rapidly to zero at about 3.5 volts. It also falls, although less rapidly, as the bias is decreased below 2.25 volts, but it does not fall to zero for any negative bias. The curve in this figure is for 45 volts on the plate.

A peculiarity of this tube is that it takes considerable grid current even for negative values of grid bias. The variation in the grid current with bias voltages is shown in Fig. 28. It will be noted that the current is zero when the grid bias is about 2.25 volts negative. For lower negative values of bias the grid current is positive and increases very rapidly as the bias is reduced. Thus at minus 1.5 volts the current is 13 microamperes. As the bias is increased above 2.25 volts the grid current flows in the other direction, but the variation in the current with bias change is not great.

Most Sensitive Detecting Point

A comparison of Figs. 27 and 28 shows that the greatest detecting efficiency occurs at the point where the grid current is zero, or where the bias is 2.5 volts. This is to be expected since the point in question is at the knee of the curve where the grid rectification is greatest.

The relation between the plate voltage and the plate current, at three different grid bias voltages, is given in Fig. 29. By interpolating between the 1.5 and 3.0 volt curves at 45 volts on the plate we find that the plate current at 2.25 volts on the grid is 0.8 milliampere. This assumes, of course, that the effective plate voltage is 45 volts, and not the applied voltage in the plate circuit. However, if a transformer follows the tube we may assume that the effective voltage is the same as the applied voltage, so that the plate current is 0.8 milliampere.

The relationship between the modulated radio frequency input and the audio frequency voltage across the primary of the coupling transformer is shown in Fig. 30 for plate voltages of 22.5 and 45 volts. Complete modulation of the radio fre-

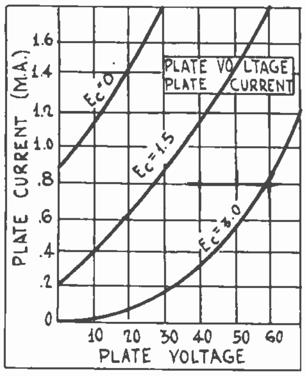


FIG. 29
PLATE VOLTAGE, PLATE CURRENT CURVES FOR THE 200A FOR THREE BIAS VOLTAGES.

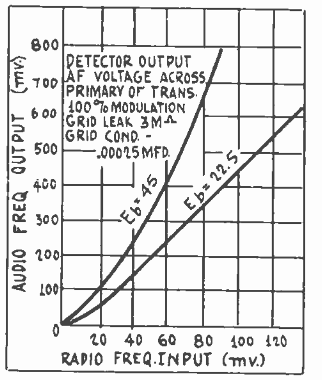


FIG. 30
RELATION BETWEEN THE RF INPUT VOLTAGE AND THE AF OUTPUT VOLTAGE WHEN THE GRID CONDENSER AND LEAK METHOD OF DETECTION IS USED.

quency voltage is assumed. Both the output voltage and the input voltage are measured in millivolts.

The curves were taken with a grid condenser of .00025 mfd. in the circuit, a grid leak resistance of 3 megohms, and a grid return to the negative end of the filament. This return should always be used for this tube, whereas for high vacuum tubes the return should always be made to the positive end of the filament.

A practically linear relationship between the input and output voltages when the plate voltage is 22.5 volts is noted, and only a slight curvature when the plate voltage is 45 volts.

Tube Noises

When this tube is first turned on there is a hissing sound in the signal, but this stops after about two minutes. It is due to the formation of alkali vapor while the tube is warming up.

Some tubes of this type may be microphonic and for that reason it is recommended that the tube be put in a cushioned socket, and in extreme cases that it be loaded down with a lead cap. If the amplification after the tube is not too great, these precautions are not necessary but they are always desirable.

Due to the flow of grid current the selectivity of a receiver is slightly less when this tube is used than when a high vacuum tube is used in the same circuit. This reduction in the selectivity can be offset by loosening the coupling between the antenna and the first tuned circuit, or by using a shorter antenna, and this compensation may be effected without a reduction in the sensitivity because of the greater sensitivity of the tube as a detector.

The tube works well as a regenerative detector, sliding in and out of oscillation smoothly, thus permitting use of maximum regeneration without troublesome "spilling over." The ordinary three-circuit tuner may be used but due to the high plate resistance of the tube it is usually necessary to advance the tickler a little farther than if a high vacuum tube of low amplification factor were used for detection.

Since the amplification factor of the tube is high, it will work efficiently in a resistance coupled circuit. A plate coupling resistance of about 100,000 ohms should be used. When this coupling is used, especially in a regenerative circuit, it is necessary to increase the applied plate voltage until the net plate voltage is at least 22.5 volts. This means that the voltage in

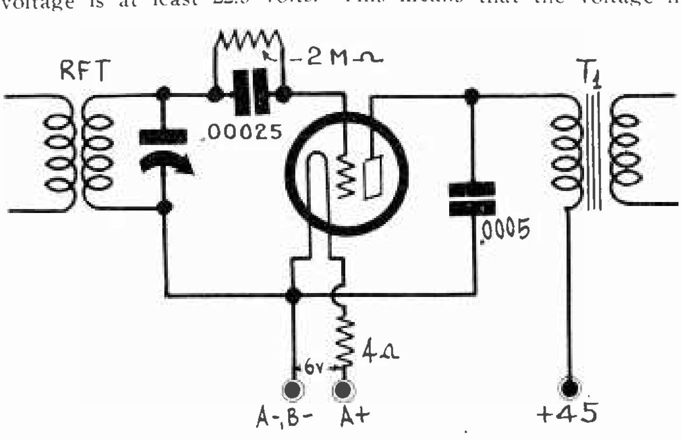


FIG. 31
THE CIRCUIT OF A GRID LEAK AND CONDENSER DETECTOR USING A 200A TUBE. THE GRID RETURN IS MADE TO THE NEGATIVE END OF THE FILAMENT.

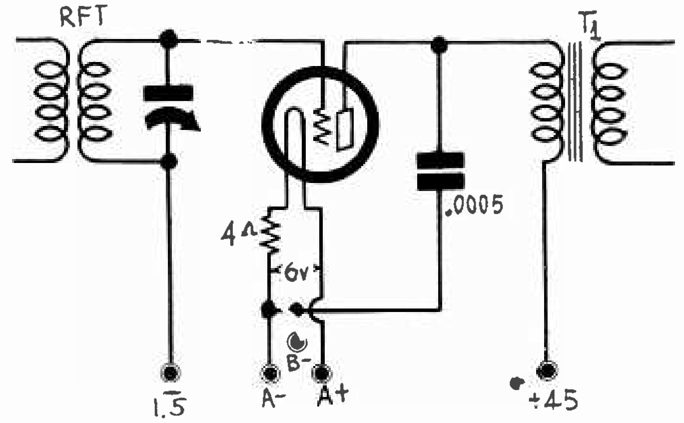


FIG. 32
THE CIRCUIT OF A GRID BIAS DETECTOR USING A 200A TUBE. THE APPLIED PLATE VOLTAGE IS 45 VOLTS AND THE TOTAL EFFECTIVE BIAS IS 2.5 VOLTS.

the plate circuit should be from 90 to 135 volts when the plate coupling resistor is around 100,000 ohms.

The superiority of this tube as a detector is not noticed on strong signals and for that reason it should not be compared with other detectors on such signals. It shows up to greatest advantage on very weak signals.

How to Obtain Bias

The one volt grid bias required when 22.5 volts are used on the plate of this tube can be obtained from the 4 ohm ballast resistor in the filament circuit. The 2.25 volts needed for bias when 45 volts are used on the plate can be obtained in part from this ballast and in part from a 1.5 volt dry cell. This combination gives a slightly higher bias than that which is required for maximum detecting efficiency, but the reduction in the sensitivity is negligible. The grid bias method of detection gives better quality on strong signals. Hence when there is a great deal of radio frequency amplification and when best quality is desired, this method should be used.

112-A

THE 112A tube is useful as radio frequency amplifier, detector, oscillator, audio frequency amplifier, and as power output tube. As detector it may be used with either grid condenser and leak or with grid bias and may be followed by either resistance or transformer coupling. It works excellently as a regenerative detector and oscillates more freely than the 201A due to its high mutual conductance. As an oscillator it is particularly useful in Superheterodyne receivers and in short-wave converters. As audio frequency amplifier it may be used with any of the standard types of coupling, such as resistance, transformer, and impedance, with less distortion than when a 201A tube is used in the same setting.

As an output tube it will give a maximum undistorted power of 300 milliwatts when the plate voltage is 180 volts and the grid bias is 13.5 volts, the load resistance being twice the value of the internal plate resistance of 4,700 ohms. The power output when the plate voltage is 157 volts and the grid bias is 10.5 volts is 195 milliwatts.

The filament is of the oxide coated type and is rated at 5 volts and 0.25 ampere. When the tube is used as power amplifier the filament current may be either direct or alternating, but when it is used for any other purposes in a receiver the filament current should be direct only.

CHARACTERISTICS OF 112A TUBE

Filament voltage	5.0
Filament supply voltage	6.0 DC or 5.0 AC
Filament current, amperes	0.25
Amplification factor	8.0
Plate voltage, maximum	180
Grid voltage, with 180 on plate	13.5
Grid to plate capacity, mmfd	10.5
Grid to filament capacity, mmfd	6.0
Plate to filament capacity, mmfd	5.5

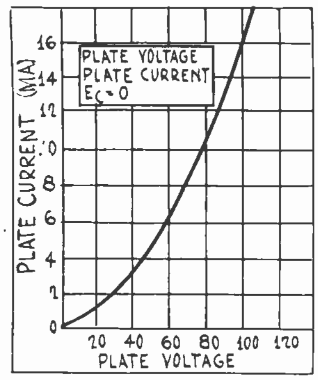
In external appearance the 112A is identical with the 201A and has a standard UX base fitting into either the old bayonet or the new push-in sockets.

The tube is relatively free from microphonic disturbances, due to the rugged internal construction. Thus there is little need of mounting the tube in a cushion socket or of taking any other special precautions against troubles of this kind. This applies both when the tube is used as detector and as amplifier.

Use as Detector

When the tube is used as a detector with grid leak and con-

FIG. 33
A PLATE VOLTAGE, PLATE CURRENT CURVE FOR THE 112A TUBE WITH ZERO BIAS ON THE GRID.



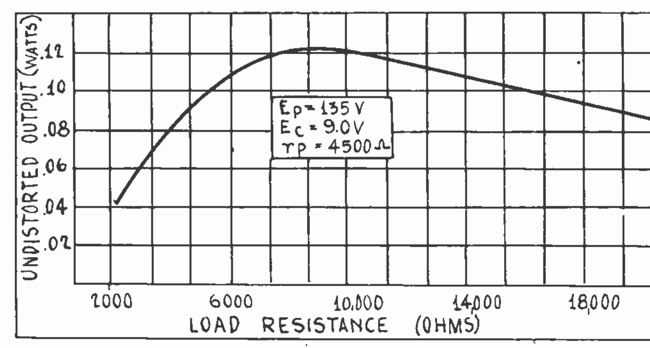


FIG. 35
LOAD RESISTANCE, OUTPUT POWER CURVE FOR THE 112A TUBE WITH 135 VOLTS ON THE PLATE AND 9 VOLTS ON THE GRID.

denser, the capacity of the grid condenser should be .00025 mfd. and the grid leak's resistance should be 2 or 3 megohms. The grid return should be made to the positive end of the filament. An effective plate voltage of 45 volts is recommended when the tube is used in this manner.

When the grid bias method of detection is used, higher plate voltage may be used, but whatever voltage that is applied it should be accompanied by the recommended grid bias. When the applied plate voltage is 180 volts and the appropriate grid bias is used, the detected output will be so high that in many instances it is unnecessary to use more than one stage of audio frequency amplification, provided that the radio frequency voltage applied on the grid of the detector is suitably high.

BIAS VOLTAGES FOR THE 112A

Plate Voltage	Detector Bias Voltage	Amplifier Grid Voltage
45	3.0	0
67.5	6.0	3.0
90	7.5	4.5
135	13.5	9.0
157	16.5	10.5
180	18.0	13.5

When the tube is used as power amplifier with alternating current on the filament, the proper grid bias for amplification can be obtained by using a bias resistor of 1,350 ohms in the lead to the mid-tap of the 5-volt filament winding. This value, however, is not easily obtainable and therefore either 1,250 or 1,500 ohms may be used. In a push-pull stage with two tubes the resistance should be half as great.

When the tube is used as an oscillator it is operated essentially as an amplifier and the same grid bias and plate voltage combinations should be used. However, it may also be connected up as a regenerative detector with grid leak and condenser. The grid leak resistance may be considerably lower when the tube is used as oscillator than when it is used as detector.

Use as Audio Frequency Amplifier

As audio frequency voltage amplifier the tube should be used in the same manner as the 201A tube in resistance, impedance or transformer coupled circuits. The plate and grid voltages should be as recommended in the table. Coupling impedances may have the same values as those specified for the 201A tube. If a transformer has been designed for a 201A tube it will work better with a 112A tube, because the mutual conductance of this tube is higher and the internal resistance is lower.

Therefore the amplification will be higher and the quality will be better.

Because of these characteristics the 112A tube is especially valuable in the stage preceding a power output tube of the types 171A, 245 and 250, which require a high signal voltage. Of course, it is also valuable as a voltage amplifier to feed a push-pull stage of these tubes.

Fig. 33 gives the relationship between the plate voltage and the plate current for the 112A tube for plate voltages less than 100 volts. The usefulness of the curves is mainly to determine the effective plate voltage when the plate current is known and the grid bias is zero.

In Fig. 34 we have a family of plate voltage, plate current curves over the operating range of grid voltages. Two load lines, both for 10,000 ohms, are drawn across the curves. One of these lines, the lower, is for an applied plate voltage of 180 volts and the other is for an applied voltage of 225 volts.

The minimum permissible plate current is taken at one milliampere and is indicated by the dotted line parallel to the voltage axis.

Let us calculate the output power of this tube when the applied voltage is 180 volts. We note that the 180 volt load line crosses the minimum current line at 170 volts on the plate and 17.5 on the grid. If the signal amplitude is such that the grid swings between zero bias and 17.5 volts, the double amplitude of the plate voltage change is 95 volts and the double amplitude of the plate current change is 9.4 milliamperes. Therefore the maximum undistorted output power is 112 milliwatts, which is obtained by taking one-eighth of the product of 95 volts and 9.4 milliamperes. This requires a grid bias of 8.75 volts. At this bias the steady plate current is 5.8 milliamperes and the effective plate voltage is 130 volts.

A Greater Output

If we take the upper load line the power output is 197 milliwatts and the required bias is about 12 volts, and this makes the effective voltage on the plate approximately 160 volts.

These output powers are based on the supposition that the load on the tube is 10,000 ohms and purely resistive.

In Fig. 35 is shown the relation between the load resistance on the tube and the undistorted output power when the effective plate voltage is 135 volts and the grid bias is 9 volts. The maximum occurs when the load resistance is about 9,000 ohms. Since the quality improves as the load resistance increases and the reduction in the output power is small as the load increases, it is clearly advantageous to use a higher load resistance than twice the value of the internal resistance of the tube. According to the curve in Fig. 35 the output power is 120 milliwatts when the load resistance is 10,000 ohms.

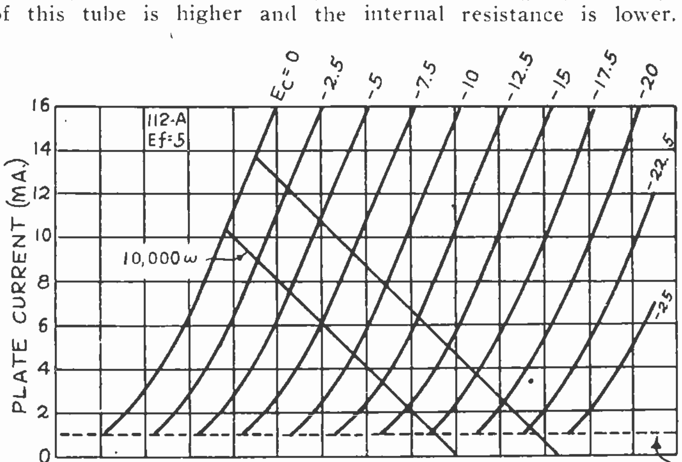


FIG. 34
A FAMILY OF PLATE VOLTAGE, PLATE CURRENT CURVES FOR THE USUAL OPERATING GRID VOLTAGES OF THE 112A TUBE, AND TWO 10,000-OHM LOAD LINES.

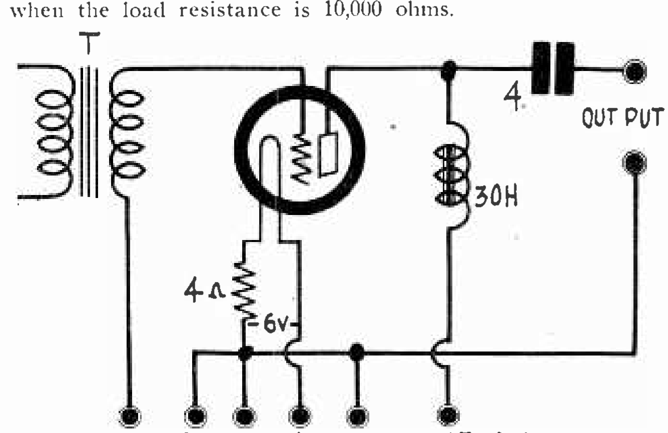


FIG. 36
A POWER BATTERY OPERATED AMPLIFIER WITH A SINGLE 112A AND AN OUTPUT FILTER.

Trouble-Shooting w

By John

TROUBLE shooting in radio receivers is not the haphazard practice it once was.

In the early days here and there someone with a one-tube receiver, probably using a WD-11 tube for which he paid $9, wondered why the music stopped. Having no means of knowing, he probably carried the "treasure box" into town where the local electrician succeeded in burning out the filament of the tube only to find that the main cause of interrupted reception was a broken tickler lead through the insulation was intact.

Before the advent of the AC receiver, batteries were the only source of power both for filament and plate circuits, with the result that there was keen competition among the fans for the type and arrangement of battery and cell grouping that would provide the most continuous and trouble-free service.

This "competition" was especially lively among the amateurs, who assiduously operated transmitters, and to this class of enthusiast the advent of commercially practicable transformer designs was a boon.

Cast from the Matrix of Amateur Effort

The amateur radio operator fostered and encouraged the combined study and practice of the radio art, and because he received little or no outside help, he had to lean on fellow amateurs, although frequently each man had to depend on his own initiative to solve the intricacies of the behavior of a particular circuit.

Therefore the radio amateur of years gone by was equipped by sheer necessity with keen perception, ability to reason and the determination to win out, no matter how difficult were the obstacles.

Of course time then was relatively valuable and no doubt those pioneer workers realized the disadvantages they worked under. The more foresighted ones visioned the greater degree of progress attainable with improved apparatus.

Many of these former amateurs, now grown up with the art, look back upon the old days and doubtless see now that the present secure status of the radio industry as a whole is cast from the matrix of amateur effort and accomplishment.

Today there is a wholly changed attitude pervading the technical field. A new type of radio interest and activity known as "trouble shooting" has developed and the type of individual that is engaged in this new calling is called a "service man."

The duties of the service man are standard, yet on occasion even an experienced service man finds himself face to face with a problem that stumps him.

Sixth Sense, or Meters, Found Necessary

Here we find the real division between the service man, on the one side, and the expert trouble shooter on the other. The trouble shooter is technically trained to a degree resulting in his being capable of locating electrical faults by a system of rational procedure that is due to a combination of study (perhaps in spare time) and work-a-day practice. Formerly trouble was traced down, as well as could be under the circumstances, with the five senses. Today all realize that to be a real trouble shooter you need meters.

As recently as six years ago the necessity for the understanding of meter indicated values, as applied even to tube measurements, was not widely appreciated, and one of the accepted ways of "testing" a tube was to substitute for it a similar tube under operation in a set. Now compact "testers" are used, frequently those equipped with a cable with plug attached, to plugged into the "live" set socket, and put the tube in the tester socket, thus furnishing instantly the main information about the condition of the circuit: plate current, plate voltage and filament voltage.

Some radio sets, however, do not develop what would be termed a standard trouble, hence it is often necessary to carry out some tests that are of an interpolative rather than directly deductable character.

Inaccessibility Factor Overcome

An instance of this is when it is desired to read the rectifier tube output current when this tube is a two-element rectifier (or full wave). Most set testers are arranged to read the plate current of the 224, 227, 222 and other types of tubes, but when it becomes necessary to find out what the total load current of a 280 tube is, or two 281s arranged for full-wave rectification, without getting at the "works," it will be appreciated that something out of the ordinary will have to be done.

The usual connections to the 280 tube consist of two high tension secondary leads that go to the two plates and two heavy leads that supply the filaments.

The filament supply secondary winding is provided with a center tap that is not very accessible, in fact often is most inacessible. Some sets have provision for a dynamic speaker field coil to be operative when placed in series with the filter network, or in parallel with a bleeder resistor, no opportunity is likely for an accurate test because of the presence of an unknown bleeder current through a resistor.

The procedure is as follows: Provide yourself with a small portable filament transformer with which you can light the filament of the 280 tube and place this transformer so that it does not come in contact with the receiver chassis. It could be mid-tapped.

Then provide a four-prong socket with the plate prong extended so that the socket is somewhat elevated. Also provide two heavy flexible filament leads that will attach to the short filament prongs and will lead over to the auxiliary transformer. Then you may run a lighter weight conductor from the mid-tap of the auxiliary transformer to a single (or double) filament prong assembly that plugs in to the regular 280 socket in the receiver.

If the filament current is two amperes at five volts, the set

Right o

QUESTIONS

(1)—There can be no true push-pull action in a direct coupled circuit built in the form of push-pull amplifier, because the junctions of two grid leaks are grounded so that each one works independently.

(2)—If it were possible to couple a push-pull output stage to a push-pull resistance coupled amplifier so that the junction of the two grid leaks is ungrounded, true push-pull action would be obtained.

(3)—If there is an impedance common to the plate circuits of the tubes of a direct coupled amplifier the effect of this impedance can practically be nullified by building the circuit in symmetrical form.

(4)—If the proper value of the grid bias resistor of a tube is 2R ohms, the proper value of the bias resistor in a push-pull stage using the same tubes, or in a stage of two parallel tubes of the same kind, is R ohms. That is, the proper value is one half for two tubes.

(5)—If a push-pull circuit is accurately balanced there is no signal current in the leads common to the two. For example, there is no signal current in the grid bias resistor. For this reason it is unnecessary to by-pass the grid bias resistor, or any other common impedance.

(6)—A 201A tube can be used as a low-voltage rectifier for the purpose of supplying a grid bias or a low rectified current.

(7)—The voltage amplification of a 240 tube in a resistance coupled circuit increases without limit as the plate coupling resistor is increased.

(8)—When the plate of a tube is connected to a tap on a voltage divider the effect is equivalent to connecting a resistance in shunt with that part of the voltage divider which is between the tap and B minus, and the connection alters the current and voltage distribution in the voltage divider.

(9)—A vacuum tube the plate circuit of which is connected in parallel with a fixed resistor and in the grid circuit of which is impressed a signal voltage, or any variable voltage, may be regarded as a variable resistance, the variation depending on the variation of the voltage in the grid circuit.

(10)—The variable resistance in the plate circuit of a vacuum tube can be utilized as an automatic volume control.

ANSWERS

(1)—Right. The criterion as to whether a circuit is push-pull or not is that the even order harmonics are balanced out, that is, those harmonics generated in the stage ahead of the coupler. They cannot be balanced out if the junction of the grid leaks are grounded for the plate signal current of each tube can flow to ground without affecting the other. Hence the even harmonics set up voltages across both leaks and these voltages are transmitted to the grids of the following stage.

(2)—Right. If it were possible to couple the second stage to the first in such manner that the grid leaks were not grounded at the junction the even order harmonics could not flow through

rsus Mere Servicing

Williams

will play. Now you merely insert a milliammeter in series with the light weight conductor and the result will be the indication of the total B current drain. The milliammeter selected should have a range of at least 0-200 milliamperes to be capable of indicating any overload.

Apportionment of Current

The simplest way to find out what portion of the total current is true plate current and the balance bleeder current (where a voltage divider is used) is to measure the plate current of each tube separately and there deduct the sum of these currents from the previous total.

For instance, suppose the set contains the following:

Four	224 @	4	milliamperes
One	227 @	1	milliamperes
One	227 @	10	milliamperes
Two	245 @	34	milliamperes
Total		49	

The total current indicated before was 89 milliamperes, say, therefore the bleeder current must be the difference, or 40 milliamperes.

From these data you can compute the voltage total supplied to the plates by merely multiplying the applied plate voltage by the observed plate current in each case, and you can also make a similar measurement on the voltage divided and in this case the voltage drop across it is obtained between the chassis and the plugged-in filament prong.

It will be seen that this description of a test method does not involve even withdrawing the set from its cabinet.

Don't Guess What the Trouble Is

This same isolation test is one of the simplest means of finding a defective buffer condenser, because you merely include a 25 watt 110 volt lamp in series with the milliammeter and if there is execessive current the lamp merely lights up. The milliammeter of course will deflect off scale but not dangerously so, since the lamp protects it.

A point in connection with trouble shooting is that it is always best to try to find out what's the indicated trouble before you start to look for surface indications.

When you are asked to fix up a set it isn't necessary to begin to tell the owner what's "likely wrong," even if he invites an opinion, for the truth is that until you have tested out the various circuits you don't really know.

A power transformer may have been correctly wired but carelessly connected with the result that a short developed on the high-tension secondary. This short created a voltage surge that punctured the secondary insulation, but after the short is cleared the transformer operates all right.

But in another similar case the same thing happens and the same cure is applied but the insulation puncture is permanent, necessitating a new transformer, if the puncture is really bad and not merely leakage through a layer of surface carbon that was formed when the breakdown occurred.

Thus are the hard-to-get-at-facts, at first sight obscure, brought to light and the problem is solved.

But these are not the only problems that confuse. There are others, such as what's wrong when the plate voltage is excessive and the grid bias voltage is too high, or there is no plate current.

Has the voltage distribution gone west or is the tube on the rocks?

Also what's the best way to get at the trouble, if possible without, removal of the set from the chassis?

Instance of an Open Bias Resistor

Most of us are aware by this time that 227 tubes function via a resistor that is placed in series between the cathode and ground (chassis) and that the tube's plate current flows along a circuit formed by a path that can be traced from the cathode in the tube down the tube prong to the resistor then through the resistor to the chassis to the low end of the voltage divider. The resistor furnishes grid bias to the extent of the voltage drop due to plate current flow.

In any case the path of the plate current is traced from the voltage divider tap to the plate of the tube to cathode.

Imagine a type of test socket on "stilts" that is so arranged that the cathode prong instead of leading straight down, as it usually does, is cut off short, and a suitable small clamp terminal is attached. Insert the original tube in the stilt socket and connect, say, a 2,000 ohm resistor between this short clamp terminal and the chassis (being careful to make a clean connection) and also shunt this resistor with a .01 microfarod fixed condenser.

If the set be now turned on and it will play, the extra resistor supplied was all that was required, hence a new regular 2,000 ohm resistor must be supplied to make the temporary repair permanent.

If a 227 tube employed as an audio tube should suddenly begin to glow excessively blue you may be sure that if a meter test shows nothing wrong, that the tube in question has "gone west" and the only remedy is to replace a new tube.

Test for failure of first audio transformer by inserting ear phone tips on first audio grid in tube socket, and touch the chassis with the other (being sure you make good contact) phone cord tip, failure to hear music, etc., means that the transformer is defective, and if there is plate voltage on the detector plate it is obvious that the secondary of this first audio transformer is open.

Wrong?

the grid leaks but would be balanced out. Each grid of the second stage would then get one-half of the signal voltage drop in the two leaks, and this voltage would not contain the even order harmonics.

(3)—Right. The fundamental signal currents flow in opposite directions at every instant through the common impedance and since they are equal in magnitude there is no net current of fundamental frequency in the common impedance.

(4)—Right. The steady plate current is doubled and therefore in order to maintain the voltage drop the same, it is necessary to cut the resistance in half. This is true for both push-pull and parallel operation.

(5)—Right. This follows from (3). Since there is no net current of the signal frequency in the bias resistor there is nothing to by-pass and hence there is no need for a by-pass condenser. Unfortunately there is rarely a perfectly balanced circuit and therefore it is well to use a condenser. The transformers may be accurately balanced but the tubes are usually different.

(6)—Right. The grid and the plate are tied together to form the anode. If a resistance and a filter are placed in the output the voltage drop in this resistor can be used for bias. If the resistance is high it does not require much capacity in shunt or inductance in series to take out of ripple.

(7)—Wrong. It increases to a definite limit and that limit is the amplification constant of the tube. For example, if the amplification constant is 30, the voltage amplification can never exceed this value no matter how high the coupling resistance is. Indeed, it can never be reached. But it is practical to get a gain factor of 25.

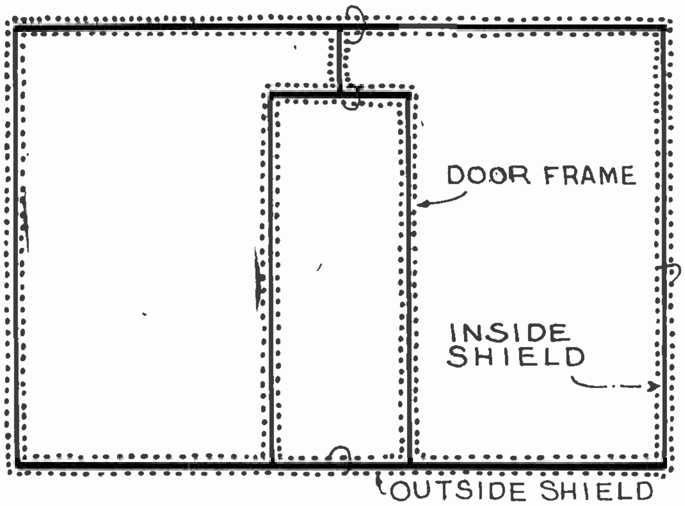
(8)—Right. The tube takes current of a definite amount. The equivalent resistance of the plate circuit to direct current is the ratio of the voltage applied across the plate and filament to the current. For example, if the voltage is 180 volts and the current is 6 milliamperes, the equivalent DC resistance is 180/.006, or 30,000 ohms. The value of this equivalent resistance also depends on the grid bias of the tube.

(9)—Right. This follows from (8). Since the effective DC resistance of the plate circuit of the tube depends on the grid bias the resistance varies with the bias. It makes no difference how the bias varies, slowly or rapidly, or according to some definite law. However, it is not necessary that a fixed resistor be connected in parallel with the tube.

(10)—Right. Suppose the screens of the tubes in a radio frequency amplifier be fed through a resistance. There will be a definite voltage drop in this resistance and hence a definite voltage on the screens. The amplification has a certain value. Now if the plate circuit of a tube be connected across this resistance and a signal voltage be put on the grid of the tube. The resistance of the tube will vary and hence the resistance of the combination of tube and fixed resistance. Therefore, the voltage drop will vary and so will the voltage on the screens. Hence the amplification will change in accordance with the signal voltage impressed on the tube. It is only necessary to arrange the circuit so that the amplification is decreased as the signal voltage increases.

A Test Cage

By Jackson Woodrow



SHOWS THE FORM OF CONSTRUCTION USED. NOTE COMPLETE ENCLOSURE OF FRAME.

DISTRIBUTION of parts in a set influenced many properties of the set and while coil design does not account for everything still it is an important item. Changes in coil designs are easy to make and whenever a new tube appears on the market, and especially if it should prove to be a radio frequency amplifier, you'll see a batch of new coils almost over night.

From 1922 to 1924 we had a spell of "low-loss" merchandise, a lot of which was anything but low-loss, electrically speaking. After a while popular demand for this stuff was less pronounced and finally it fell to zero.

Technically, however, the aspect of the demise of the low-loss part, and particularly the low-loss coil, is one that shows that some of the early "coil makers" were striving for something else besides the greatest possible reduction of distributed capacity. The words "low-loss" had the magic effect upon the mind of the radio set fan.

The tubes then available were the triode type and most circuits made up with them had a tendency to oscillate uncontrollably, unless some damping means were provided.

The Neutrodyne's Entry

The most notable contribution here was Prof. Hazeltine's neutrodyne, which was developed at Stevens Institute of Technology at Hoboken, N. J., and presented publicly during 1923.

Subsequently some designers who realized the far-reaching importance of this improvement tried to find various ways of achieving the same effect, and two general types of "neutralized field" coils appeared.

One of these was the "astatic" coil and the other was the "toroid." The principal excuse for their use is found in the fact that their external magnetic field is very limited in effective radius, and for this reason their use in radio frequency circuits as a means to help to suppress undesirable feed back due to stray magnetic flux effects was advised. But they were not likely to retain the degree of electrical constancy over a period of time, as was retained by single-layer solenoids, and furthermore the use of some kind of binder, applied in liquid form that subsequently dried out, resulted in the development of excess distributed capacity. And last, but most important, the measure of a coil's efficiency is its magnetic field, and if a coil has a low field it is a high-loss coil!

The most efficient coil is the solenoid or single-layer coil.

Some designers have found it necessary to have a coil of high inductance, but have very limited space in which to locate this coil—therefore they employ a style of winding that is known as the self-supporting weave type.

This coil is a multilayer winding, but its distributed capacity is much lower than the end to end wound coil and the coil is used frequently as an oscillator inductance in Superheterodyne circuits.

A Test Cage

Fans who have the time and inclination can set up a simple test, to determine for themselves the effectiveness of some particular coil or other. The test is best performed in a wire enclosure called a test cage.

The frame work is 2-inch square soft lumber and you construct a framework and provide for a door, say 5 feet by 30 inches wide—some cages employ a double sheathing of light gauge copper sheet, but these are too expensive.

The fan likely to construct his own cage throughout would be just as well provided for if he used ordinary half inch mesh chicken fence wire, well galvanized, and which comes in 30 and 36 inch widths.

There are to be two layers of this wire and they are to be attached to the finished skeleton framework, one on the outside and the other to the inside. The selvage edges of the wire are to be butted together and may be laced with copper wire, and then to be soldered well.

After you have finished you will have two insulated metallic surfaces with the exception of the door opening.

The door frame is covered now and when you have soldered up the seams the door is to be fitted.

The outside metal covering is to be grounded thoroughly from several points along its exterior surface and the inside layer is to be connected to it at six equally spaced points—i.e., top and bottom and all four sides, right in the center of the panel.

You now have an embryo shielded radio laboratory within which you can do almost anything you want without causing anyone else the slightest radio set interference.

Shielding the Power Input

If the cage is open you won't require any special lighting arrangement, but if it is finally covered with wall board you'll require some lights.

If the power line enters the cage the advantage of shielding is partly lost. Hence the correct procedure is to place radio frequency chokes in both sides of the power line and locate these chokes in a shielded box outside the cage and arrange a mid tap by-pass condenser to ground. These are not commercial RF chokes but special ones, about 100 turns of No. 18 wire on 3-inch diameter.

Or you could use a transformer and simply mount it in a shielded and grounded box mounted on the cage and run the secondary wires inside right from the shielded box.

With the cage all completed place a Superheterodyne or any other sensitive radio receiver in the cage and with the door open tune in a powerful station, and then close the door.

The signal should cease, or at least be of very low intensity. You will find that if you connect the door frame's outside layer to the cage's outside layer of wire mesh, that the signal will fade out to inaudibility.

Generally speaking, the tighter the cage is made against outside interference, the higher is the grade of work that you can do.

Assuming then that the cage is tight, the next step is to install the worktable and arrange your instrument layout.

Equipment Suggested

Here is some equipment useful generally:

A 24-volt storage battery
A 5-ampere tungar charger
A good A eliminator
A good B eliminator, using 280 tube
Another high voltage source, preferably a copper oxide rectifier capable of furnishing 300 volts at around 1 ampere.
A wave meter, or a resonance indicator.
An oscillator, covering the broadcast range.
An oscillator, tunable over a 10 to 100 KC range.
A modulation device for use with the broadcast oscillator.

This is only a partial list, and any who are interested can write in for further suggestions.

Regarding the general coil test, suppose that you have two coils that are similar, and that these are the only coupling media between an exciting and a responsive circuit.

If, therefore, you will compare similar coils under conditions of similar transmission frequency and similar coupling or vary the coupling according to the degree of response of the pick up circuit in a shielded room you will be able as a result of such tests to evolve comparisons of coils and determine the degree of coupling necessary to provide the best average response over the selected frequency band you may intend to use, or even the regular broadcast band of 1,000 kc in width.

It is a good plan to make a second test in a case like the above, employing some modulation.

Meter Range Extension

By Hollis Fairbanks

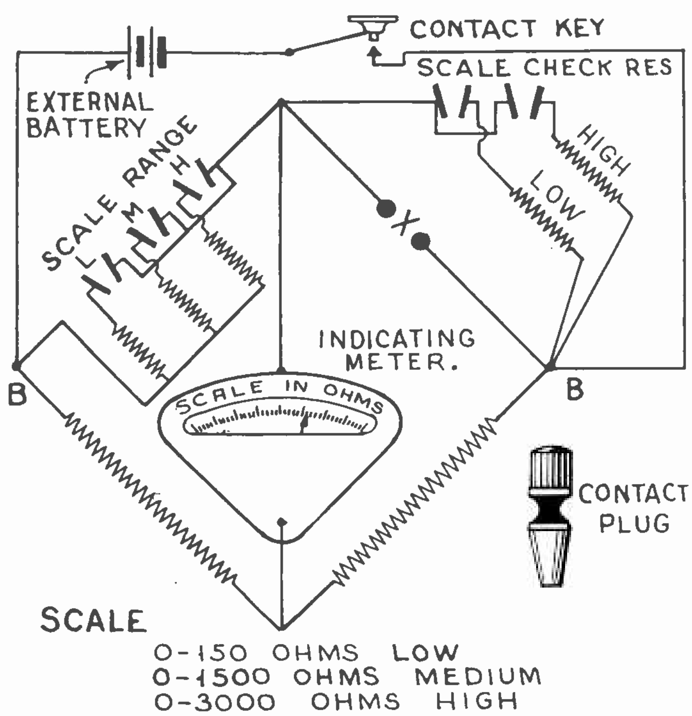


FIG. 1

SCHEMATIC DIAGRAM OF A DIRECT READING WHEATSTONE BRIDGE OR OHMMETER.

THE acquisition of high-range electrical measuring instruments is not always a simple matter financially and it is thought that some fans would like to know of some simple general procedure by means of which they can increase the readable range of their present ammeter, voltmeter or milliammeter without the strict necessity of applying to the meter's maker.

If you have reasonably good instruments in the first place, and they check reasonably well, and care is taken to avoid temperature changes of any consequence, (less than a degree or so above room temperature) the percentage of error will not be very serious.

A voltmeter, if it is of the moving coil or d'Arsonval type, is usually a very low range milliammeter placed in series with a very high resistance, and since in these moving coil systems deflections are proportional (an evenly graduated scale is assumed) to the deflecting forces, the instrument's range may be extended by merely increasing the series resistance. The sensitivity is not affected.

Etending the Range

Assume that the fan has no way of knowing in advance what his present voltmeter resistance value is, but he must extend the range to some desired value.

Suppose he has a 0—200 volt instrument and he wishes to extend the range to 800 volts. Suppose further that there are 40 scale divisions. It is apparent then that under the present condition the indicated voltage per scale division is 5 volts. Now two courses are open. Either impress a constant voltage on the meter terminals of exactly 20 indicated volts, and add sufficient resistance to reduce the indicated deflection to one division, or else impress the full scale indicated voltage of 200 volts, and add sufficient resistance to reduce the deflection to ten scale divisions.

It is obvious that the instruction applies to any voltmeter at all, and just as long as the added resistor stays "cold" you are safe and need not be interested in the absolute value of the added resistance. The need often arises to make such an indicated voltage extension and it may be safely done as outlined above.

The ammeter, if it is of the d'Arsonval type, consists of a moving coil suspension that constitutes a millivoltmeter, and it measures "amperes" by virtue of the potential difference across a resistor of very low ohmic value called a shunt. This "shunt," or current by-pass, is usually located within the instrument case, if the ammeter is a small one, and there is as before no serious temperature change involved when the instrument is in use.

Let us suppose again that the fan has a 0—10 ampere instrument and that there are 40 scale divisions all told. Then each scale division indicates ¼ of an ampere. It is desired to raise the indicated scale reading to 40 amperes.

Here, as before, we don't know anything about the instrument at all, except that it is uniformly graduated and that there is an inaccessible internal shunt.

But there are usually two extra hexagon nuts on each terminal post and we may as well use them to hold an external shunt which we are going to make.

Select two pieces of copper say ¾ inch by 1 inch, of 3/32 inch stock.

Drill these so that they will fit over the terminal posts snugly and remove any burrs due to drilling, and cut a slot in either copper piece so that the shunt strip will fit in say to a depth of ¼ inch. Theoretically the resistance of this strip is ¼ of the self-contained shunt resistance, but as we cannot remove the component parts to ascertain this, provide a shunt strip that can be easily pared down. The adjustment of the meter reading by this means will be accurate finally even if it's a tedious process.

This strip is made of 1/32-inch copper strip ¾ inch wide and of sufficient length to span the intervening distance which in the case of a small meter under the conditions above prescribed will not exceed 1¼ inches.

The strip is preferably silver soldered to the contact lugs. Upon cooling, clean the soldered joint

From a source of constant current adjust the indicated current (without using the extra shunt) to 10 amperes and then add the outside shunt, clamping it securely in place, and you will find that the meter reading will be considerably below what it was previously.

But the source of current is constant, so all you have to do is to pare the shunt down with a sharp knife until the scale deflection is one scale division. Therefore, as there are 40 scale divisions the instruments scale has been extended to 40 amperes.

Watch the Contact

If the milliammeter is of the d'Arsonval type and of low range the general instructions outlined above may be followed, only it will be necessary to observe extreme care in the manufacture of a shunt. There must be positive and uniform contact at the shunt terminals and this means that the copper blocks must be very flat and clean at the points where they are clamped to the meter's terminal posts.

Those who have a direct reading ohmmeter and may desire to extend the scale reading may do so by providing a "standard" resistance that causes the ohmmeter to indicate its maximum resistance value.

Then if the unknown resistance is found by measurement to exceed the resistance indicating capacity of the ohmmeter, it is only necessary to place the "standard" in parallel with it, and read the deflection.

Then, recollecting that the resultant parallel resistance is the reciprocal of the sum of the reciprocals of individual resistances, it is a simple matter for the fan to multiply the usefulness of the maximum range.

Illustrating the above let us assume the following:—

Indicated reading = 2,500 ohms.
"Standard" resistor value = 3,000 ohms

Parallel Resistance Formula

The formula for resistance in parallel is

$$R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

where R is the unknown, and R1 and R2 are two parallel resistors. Since the requirement is to find an unknown resistance value that is greater than either of the two values shown, it is obvious that the value indicated in the meter is greater than the standard.

Solving we find:

$$\frac{1}{\text{Indicated ohms}} - \frac{1}{3{,}000 \text{ ohms}} = \frac{1}{\text{Unknown}}$$

and substituting values we have,

$$\frac{1}{2{,}500} - \frac{1}{3{,}000} = \frac{3{,}000 - 2{,}500}{7{,}500{,}000} = \frac{500}{7{,}500{,}000}$$

= 15,000 ohms, the value of the unknown.

Therefore, a calculation plus a carefully measured standard have provided the desired results.

Fig. 1 shows an ohmmeter circuit in schematic form, and shows the principal components involved.

The external battery, a source of constant voltage, is connected to two instrument terminals, B and B1, in series with a self-contained contact key.

There are two standard resistor arms that are fixed. The two other arms are the "scale range" and X, the unknown.

For the instrument shown the ranges, L, M and H, correspond to the table shown, and there is a scale correction circuit, consisting of two standard resistors that take the place of X when the accuracy of the instrument is to be checked up.

RADIO UNIVERSITY

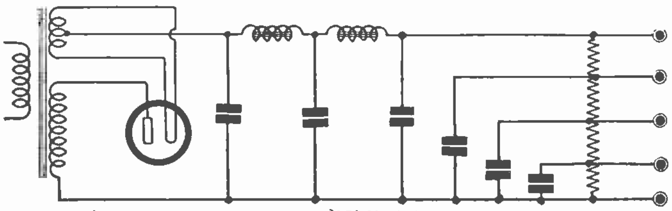


FIG. 840

THE CIRCUIT OF A HALF-WAVE RECTIFIER AND FILTER WHICH MAY BE USED WITH A 280 TUBE BY CONNECTING THE TWO PLATES TOGETHER.

Variation of Condenser Resistance

DOES THE alternating current resistance of a condenser increase or decrease with frequency? What is the approximate resistance of a good condenser in the broadcast frequency range?—A. R. E.

The resistance decreases as the frequency goes up. At 1,000 cycles it may be of the order of 1,000 ohms while at million cycles it may be only a small fraction of an ohm.

* * *

Necessity of Stopping Condensers

IS IT REALLY necessary to use stopping condensers in series with the loudspeaker when it is coupled to a push-pull stage by means of two chokes or a center tapped choke?—W. H. H.

It is not. No direct current can flow through the loudspeaker when it is connected from plate to plate and hence it is not necessary to use stopping condensers. However, condensers are sometimes used because they protect the speaker from the high plate voltage. The excuse given for this use is that there is no danger handling the speaker when it is insulated from the plate voltage source.

* * *

When Resistance Is Zero

IS IT A fact that the resistance of a conductor, such as a copper wire, decreases continually as the temperature of the copper decreases and that the resistance is zero when the temperature is absolute zero?—C. N. T.

Theoretically the specific resistance of a metal is zero at the absolute zero of temperature, for the decrease in resistance is proportional to the temperature. If the "curve" is extended to absolute zero the resistance at the absolute zero is zero. Of course, the absolute zero has never been reached so that direct observation of the resistance is impossible, or has been impossible so far. Hence it is not known whether or not the relation that holds at ordinary temperatures holds all the way to the absolute zero. However, the great Dutch physicist Onnes made a series of experiments on the specific resistance of certain metals within one degree centigrade of absolute zero and he got values which agreed with the law. Hence we are reasonably certain that a metal at absolute zero has zero specific resistance.

* * *

What Bolometer Is

RECENTLY I saw a reference to a bolometer as an instrument for measuring radio frequency currents. What is a bolometer and if it is a current meter in what respect does it differ from any other current meter?—T. T. A.

A bolometer is an instrument for measuring current by the change in the resistance of a wire through which the current flows. The heated resistance is usually put in the arm of a Wheatstone bridge. The instrument can also be used for measuring radiant heat.

* * *

Merits of Shielding Material

WHICH IS the better shielding material, iron or aluminum? How thick should a shield be to be effective?—M. J.

Iron is a better magnetic shield for low frequencies. Both are about equally good electric shields. The thicker the shielding the better. A thickness of about 1/16 of an inch should be sufficient in any case.

* * *

Impedance and Resistance of Tubes

WHY IS IT that the plate impedance, or AC resistance, of a tube is different from the DC plate resistance? Is there any definite relationship between the two values?—J. E. H.

The plate impedance, or AC resistance, is the resistance of the plate circuit to an alternating current and it is also the reciprocal of the slope of the plate voltage, plate current characteristic. Since the slope of the curve varies the plate impedance varies also. The DC resistance is the ratio of the voltage applied in the plate circuit to the plate current. This ratio also varies. There is no definite relationship between the two except that at the usual operating point the DC resistance is roughly twice as great as the AC resistance.

* * *

Removing Hum from Set

I AM BUILDING a B supply for a six-tube radio frequency tuner and a two-stage, push-pull audio frequency amplifier. I plan to use the regular filter and a 280 rectifier tube. Would you recommend the use of a condenser across the circuit next to the rectifier tube, and if so, how large a capacity? How much capacity should I use across the filter at the other places, such as from the junction of the two chokes to ground and across the taps of the voltage divider?—N. A. V.

The tendency now is to omit the condenser next to the rectifier tube. If it is used, it should not be larger than two microfarads. The larger the other condensers are the better. Some have used as much as 100 microfarads, distributed among the different positions. Such capacities are not practical unless they are electrolytics. From the junction of the two chokes to ground a condenser of 36 mfd. could well be used. Another condenser of equal capacity might be used across the voltage divider. The remaining 28 mfd. may be distributed among the voltage taps that are used, reserving a rather large one for the supply to the detector.

* * *

Cost of Receiver Operation

I HAVE a receiver using five 224 tubes, two 227, two 245, and two 280 tubes. About how much power does it take to operate this receiver? What would be the cost per hour if electrical energy costs 7 cents per kilowatt hour? What is the primary current in the supply transformer, the line voltage being 110 volts?—K. Y.

The power is approximately 100 watts, or 0.1 kilowatt. At 7 cents per kilowatt hour the cost of operation would be 0.7 cent per hour. The current in the primary of the supply transformer is 100/110 ampere. The current will probably be a little higher than this so that we may say one ampere.

* * *

Speaker Field as Filter Choke

IS THERE any reason why a DC speaker field should not be used as one of the chokes in the B supply filter? Is the field coil a good choke? Is there any chance of introducing hum into the speaker?—T. H. O.

There are reasons why it should not be done and other reasons why it should. If the field coil is used as one of the chokes in the filter there is likely to be hum introduced. Sometimes the use of the field coil as one of the filter chokes entails long and awkward leads. The field coil is not the best choke. If the field coil is connected in series with the supply line it takes a good deal of voltage, 90 volts usually. If it is connected in parallel it takes a lot of current and may cause saturation of the first choke and hence cause hum. The advantage of using the field coil as a filter choke is that one less piece of apparatus is needed.

* * *

Voltage Amplification

IN A TRANSFORMER coupled audio frequency amplifier is the voltage amplification in a given stage equal to the product of the amplification constant of the tube and the ratio of turns of the transformer following the tube? If not, how can the amplification be estimated?—J. C. L.

The voltage amplification is always less than this amount because the impedance of the primary of the transformer is finite. If it were infinitely large the gain would be the product of the two constants. If the primary impedance is equal to twice the plate impedance of the tube, the voltage amplification would be 2/3 of the product of the amplification constant and the ratio of turns. Thus if the ratio of turns is 1-to-3 and the amplification constant is 8, the voltage amplification is 16. This is a good estimate. The amplification, of course, varies with frequency since the impedance of the transformer primary varies with frequency.

* * *

What Is Thermo-Junction

IN A RECENT issue you referred to a thermo-junction as a means of measuring alternating currents. Just what is a thermo-junction?—F. W. K.

A thermo-junction is another name for a thermo-couple. Two wires of different metals are joined together. If the two wires are crossed and an alternating current is sent through the junction from one kind of metal to the other a DC electromotive force will be generated in the junction and if a milliammeter is connected between the two terminals not used for the alternating current, a direct current will flow through the meter. The amount of direct current that will flow depends on the temperature of the junction. Since the temperature depends on the amount of alternating current flowing through the junction, the direct current is a measure of the alternating current. It is not necessary to send an alternating current through the junction in order to get a direct current through the meter. A lighted match held under the junction will also cause a direct current to flow. It is easy to try. Take a piece of copper wire and a piece of resistance wire from an old rheostat. Connect them to the terminals of a 0-1 milliammeter and twist the free ends together. Heat the junction with a match and note the deflection on the meter, indicating that a current is flowing.

* * *

Audio Tuning

IN RECEIVING code signals would it be possible to tune the audio frequency amplifier to the frequency of the signal, that is, to say 1,000 cycles, and in that manner increase the sensitivity of the circuit and especially to reduce the interfering effects of static?—A. D. O.

This is very often done and a very high sensitivity can be achieved in that manner. One method is to tune the audio frequency transformers and another is to tune the acoustic system. Audio frequency tuning in the circuit makes the set sensitive as well as less receptive to static. An effective acoustic method of discriminating among frequencies is to interpose an acoustic band pass filter between the reproducing diaphragm and the ear. If this filter is adjusted right a very pure audio tone comes out even if the input contains much extraneous noise.

* * *

Voltage Distribution

IN A VOLTAGE divider the currents in all the resistance sections between utilized taps are different. In view of this fact how is it possible to determine the amount of resistance between two adjacent taps to get the correct voltage difference?—G. N. E.

It is necessary to estimate the currents that will flow in the different sections of the voltage divider and then divide the desired voltage difference by the estimate current. The current in one section may be taken arbitrarily and that section is between the lowest voltage tap and B minus. The current taken determines not only the amount of resistance in this section, but to a large extent the resistance of the other sections also. This current is the so-called bleeder current. Suppose we assume the bleeder current to be 15 milliamperes and that the voltage across the lowest section of the voltage divider is 45 volts. Then the resistance should be 45/.015, or 3,000 ohms. In the resistance section just above this a larger current flows, and the increase is that which flows into the 45 volt tap. To estimate the amount of this current it is necessary to take into account the number of tubes connected to this tap and the current taken by each tube. It may be one milliampere or it may be ten. Suppose we estimate it to be 5 milliamperes. Then the total current in the second section of the voltage divider is 20 milliamperes. The required voltage drop in this section may be 45 volts, which is the case if the voltage at the second tap is to be 90 volts. Then we have for the second resistance section 45/.020, or 2,250 ohms. In the third section still more current flows, the increase being that which flows into the 90 volt tap. The voltage drop in the third section may be 90 volts, which is the case if the third tap is to have a voltage of 180 volts. The process is continued until all the resistance sections have been determined.

* * *

Using 280 in Half-wave Rectifier

I WANT to hook up a B supply circuit out of parts that I have, namely, two 30-henry chokes, three one microfarad condensers, e 2 mfd. condenser, two 4 mfd. condensers, a voltage divider with sliding taps, and one 300-volt transformer, single high voltage winding, and one 280 rectifier tube. Will you kindly publish a diagram? How can a 280 tube be used in a half-wave rectifier advantageously?—C. N. N.

The circuit is given in Fig. 840. Connect the two plates of the 280 tube together. The condenser next to the rectifier tube should be the 2 mfd. unit, the next two should be the 4 mfd. units, and those across the voltage divider sections should be the ones.

* * *

A Loftin-White Amplifier

I HAVE THE PARTS for a Loftin-White direct coupled amplifier but I have misplaced the drawing of the circuit. Will you kindly publish one for the two-tube circuit?—D. T. B.

Fig. 841 is a diagram of this kind. R1 should be about 50,000 ohms and R2 half megohm. The voltage divider should have sliding taps so that the proper voltages may be obtained for the plates, the screen, and the grids.

* * *

Static Elimination

CAN YOU SUGGEST any way of eliminating static disturbances from the output of a receiver? I have tried various devices purporting to be static eliminators but most of them were either signal eliminators or nothing at all.—T. A. G.

We can suggest nothing practical along this line, at least not for broadcast reception. Static is a signal coming in on nearly all frequencies, and no practical way of increasing the signal to static ratio has been found. Indeed, there is theoretical evidence pointing to the impossibility of finding such a device. Some relief may be found in a loop pick-up, because this is directional and static usually

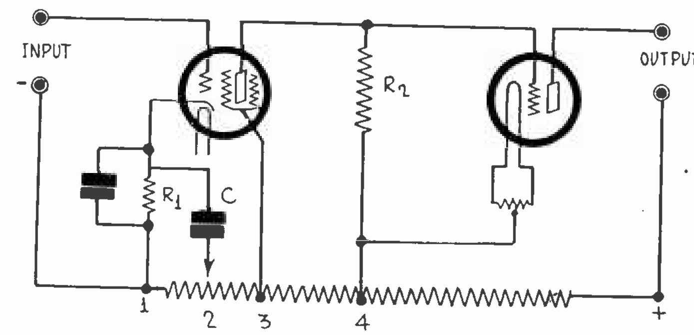


FIG. 841

THE CIRCUIT OF A LOFTIN-WHITE TYPE AMPLIFIER

comes from certain directions. But if the desired signal should come from the same direction as the static disturbances, or from the opposite direction, a loop does not help either. It has been found that static is relatively absent on the short waves, say below 35 meters. So the thing to do when static is bad is to turn to the short-wave stations.

Pre-Installation Test Makes Coils Get DX

Some experimenters have found that coils that are coated with a thin application of varnish, or collodion, are better performers. The writer has also found that a similar "effect" can be obtained by shunting the primaries of the radio frequency transformers of a cascade radio frequency amplifier with a few micro-microfarads, with better performance of the radio frequency stage or stages involved.

The writer has frequently traced bad, unwanted radio frequency oscillation in receivers to poor tubing and has found it possible to "match" coil forms by the simple expedient of placing them in the radio frequency fields of successive stages of a cascade amplifier and running modulated radio frequency current through them, the source being a carefully adjusted local transmitter arranged to simulate average reception conditions.

A feature of this test is that the operator can obtain "distant" signals at will and make a very careful check on the condition of the test circuit before the coils involved are a part of the regular receiver.

WABC MAKES NEW PLEA FOR SITE IN JERSEY

Trenton, N. J.

Having made an unsuccessful attempt to find a location for its proposed 50 kw transmitter in New Jersey, and then in two places on Long Island, in New York, WABC has returned to the possibilities of locating in New Jersey. This station, in the New York quota, is located near Crossbay Boulevard, Queens County, N. Y., and is the key station of the Columbia Broadcasting System.

Wayne Township, Passaic County, is the new proposed site. WABC has a 50 kw construction permit, but the permit requires that a more suitable site be found, before the high-power operating license will be issued.

Governor Morgan F. Larson, of New Jersey, has written to William A. Stevens, State Attorney General, to study the effect of the proposed location of the transmitter in Wayne Township, and to oppose it if it would cause serious inconvenience and annoyance to residents of the locality. The Governor said that a permit actually had been granted.

Reason for Previous Opposition

WABC's prior effort to locate in New Jersey was opposed on the ground of blanketing of locals and "invasion" of New Jersey by an "alien station," since WABC is a New York station. Other New York stations have their transmitters in New Jersey.

The Governor's letter to the Attorney General follows:

"Supplementing my secretary's letter to you, expressing my wish that you take whatever steps you deem necessary to protect the interests of New Jersey regarding the proposed installation of a 50 kw transmitter for WOR in New Jersey, I have just ascertained that the Columbia Broadcasting Co., operating WABC in New York, has been granted a permit to erect and operate a 50 kw transmitter in Wayne Township, Passaic County.

Issues Order

"I have also ascertained that an application has been made by the Columbia Broadcasting Co. to the Board of Public Utility Commissioners of New Jersey for a certificate of public convenience and necessity for the Wayne Township transmitter, and that a hearing thereon will be held before the Commission, in accordance with the law enacted at the last session of the Legislature.

"I hereby authorize and direct you to investigate both proposals forthwith, and if either or both proposals would affect the best interests of the State and cause serious inconvenience and annoyance in the immediate neighborhoods, oppose the carrying out thereof."

A THOUGHT ON TELEVISION

TELEVISION is, of course, on the way. Until it arrives, however, keep your old radio set going merrily and perhaps in five years—maybe less—you will be able to turn it in for the latest thing in the see-while-you-hear contraption. In the meantime the technicians will give their best thoughts to the idea and the big radio companies will be spending their millions in trying to evolve something that will stand the acid test. That's the best the public can expect for a long time to come.

Forum

Satisfied

RECENTLY I have noticed in Forum quite a bit of criticism of your magazine, which you have had the courage to pass on to your readers.

I have been a fairly regular newsstand patron of RADIO WORLD since the first number, but recently became a regular subscriber. In all the years that I have been reading your magazine I have not observed serious deviation from what appeared to be a fixed policy to furnish a well-balanced periodical which appealed to all classes of readers who are interested in the many aspects of radio.

There are too many angles of interest for any one feature to monopolize space in such a magazine. It seems that the greatest number of complaints come from those of an experimental turn who are interested in circuits and hookups. Countless editions of text books and strictly technical data are available to those who wish to pursue their own experiments in detail. It would seem that you publish enough of that kind of material to stimulate further research in those who care to follow it up. Such critics probably are not inclined to put out the necessary energy, but wish someone else to do their experimenting.

Personally I lean to the "tailor-made" laboratory equipment and have obtained a great deal of help from the articles which have appeared in the past. Although a man may not "roll his own" there is still a lot of room for suggestion when it comes to assembling the high-grade kit sets.

I am also interested in the subject of commercial broadcasting's influence in molding public thought. Your discussion of everything from the mad scramble for 50 kw to infractions of the radio law, and rulings of the Federal Radio Commission, appeals to me. I do not begrudge the hook-up devotee the space given to his subject, nor any other reader those features in which I do not find absorbing interest.

So long as you continue to give your readers a well-rounded, well-balanced magazine, of interest to the greatest possible number of readers, you will continue to be the only radio publication which, to my knowledge, has continued in business "at the same stand" from the date of its appearance.

SIDNEY ADAMS,
Rock Hill, S. C.

* * *

Dissatisfied

REFERRING to your August 9th issue, under head of "WABC and WHK Synchronize in Morning Tests," you state the synchronization of WOC, Davenport, Ia., and WHO, Des Moines, has been one of the most successful ever attempted.

While this statement is probably true I would like you to know that since said synchronization the best broadcast we had formerly received is now a failure. The words are not plain spoken and fading is terrible. If I want to sell a radio set I must refrain from tuning in Des Moines and Davenport as the average customer will blame the radio.

What Iowa needs is to have Des Moines put back where it was three years ago, then I would not give thirty cents for all the other stations.

RALPH BOLLINGER,
116 N. Market St., Oskaloosa, Ia.

* * *

Pardon

IN RADIO WORLD, in the news item on Synchronizing, it states two stations owned by the same company have been synchronized for several weeks. They are WOC, Davenport, Ia., and WHO (not WHT as you have printed), Des Moines, Iowa.

R. C. JONES,

ASKS LAW BAN ON AVOIDABLE INTERFERENCE

Tallahassee, Fla.

The subject of radio reception interference has at last come to the attention of the legal fraternity.

The Attorney General of Florida, in a recent letter to the assistant vice-president of the Georgia Power Company, just made public, has expressed the opinion that "electrical interference with radio reception should be covered by a comprehensive and intelligently constructed statute," with a view to clearly defining the causes of the undesirable noises that tend to mar reception, and particularly to indicate in an understandable manner the difference between avoidable disturbances and unavoidable ones.

Quotes a Maxim

"There is a legal maxim to the effect that one must so use his own property as to not injure his neighbor," said the Attorney General. "Where a person has a choice of the use of personal property he must select the usage that will be of the least harm to his neighbor."

Mr. Wills, speaking for the Georgia Power Company, stated that he was convinced that the various factors entering into radio interference were not fully cognizant to members of the bench and bar, some of whom have an incorrect view of the duties that devolve upon the users of electrically operated devices, and those that maintain radio receivers.

It would be unfair, Mr. Wills continued, to award exclusive use of electric power to one class of user (the radioist) free from disturbing effects, at the expense and inconvenience of another class (the general user of electric energy), who would have to restrict or abandon the use of the power which is fundamentally of the same character initially and is supplied by a common source.

Favors Filter in Appliance

Mr. Wills then quoted in part from a paper read by him at a joint meeting of the Institute of Radio Engineers and the American Radio Relay League in Atlanta last Winter on the subject of the rights and duties of the radio listener, in suggesting a solution to the problem.

In this paper it was pointed out that the average receiving set is capable of being operated successfully at power levels for below those impressed from operation of commercial electrical apparatus, which causes complaints against users of electrical equipment.

Likes Parallel Rectifiers

FOREWARNED is forearmed. A good saying indeed but seldom heeded. That parallel rectifier idea by Edison Farrell in your June 14th issue sure would mean a lot in a case like mine. I have an electric set. Since January I replaced four 280 rectifier tubes that just couldn't stand the load. If two horses can easily do twice the work of a single horse then the same can be said of two rectifier tubes. Why shouldn't parallel rectifier installation be stressed by others. Another rectifier on the Fritz like those I've been experiencing then I'll resort to an experimental parallel rectifier system.

The single 280 just can't stand delivering the goods to more than five tubes without being taxed to the limit. Besides two rectifiers would cost less in the long run.

FRANK DE MARCO,
New York City.

QUACKS DODGE INTENT OF LAW BY AIR BLURBS

Washington.

The Food and Drugs Law forbids misrepresentation on the labels of containers, but does not prohibit misrepresentative advertising, so that unfounded claims are frequent in certain branches of the antiseptic business, including broadcast blurbs. This was the burden of a talk given by Dr. J. J. Durrett, chief of the Division of Drug Control, of the Food, Drug and Insecticide Administration, over WRC, and carried by the National Broadcasting Company's network in the National Farm and Home Radio Hour.

Dr. Durrett said in part:

"During the last four years samples of over 1,000 preparations described as antiseptics have been collected, tested, and the label claims reviewed. As a result of this activity on our part the labels of widely distributed antiseptics are at this time comparatively accurate in their claims.

"Unfortunately for the consumer, this cannot be said about the extensive antiseptic mouth wash and gargle advertisements appearing in papers and magazines which are not subject to regulation by the Food and Drugs Law.

O. K. for Test Tube Use

"Many preparations of this class are modestly labeled as deodorant, cleansing, antiseptic mouth washes and gargles. The only reason why they are labeled antiseptic at all is because they possess the ability to kill bacteria in a test tube under favorable conditions.

Some "Antiseptics" Did Harm

"After exhaustive experiments on rabbits, using eight or ten different varieties of the best and most accredited antiseptics, one group of outstanding workers concluded that antiseptic mouth washes and gargles when dropped into the noses of rabbits, are devoid of beneficial influences in removing disease-producing germs; that in some instances an actual increase in disease-producing germs occurs; that there is no possibility of freeing the upper respiratory passage of disease-producing germs by treatment with antiseptic solutions; and that great harm can be done by putting irritating solutions into the nasal passage.

"Meaningless jargon, purporting to be scientific facts, is used in many advertisements to impress those who are seeking an antiseptic mouth wash and gargle to kill the germs which they have been led to believe are about to attack them. A recent statement said that the preparation referred to had such strong effect that it would destroy 1,400,000,000 germs in 15 seconds, and went on to explain that the law in the United States required such a preparation to kill only 200,000,000 germs in 300 seconds.

Reason for Big Figures

"Such a statement is incorrect and means absolutely nothing. These big figures are used solely for the purpose of impressing the unsuspecting public with the great power of the preparation, when, as a matter of fact, any antiseptic mouth wash and gargle meeting only the minimum requirements, easily accomplishes such results. These statements are loosely based on test-tube experiments and the" only have to use a bigger tube, more antiseptic and more germs, and the figures can be raised to any desired size."

Revoke KTNT's License, State Health Board Asks

Washington.

The Kansas State Board of Health has petitioned the Federal Radio Commission to revoke the license of KTNT, Muscatine, Ia., because the medical profession has been "maligned and abused" in talks over the station, which is operated by Norman Baker.

Talks "derogatory to the best interests of public health" are given over the station, says the complaint. Dr. C. H. Kinnaman, epidemiologist of the Kansas State Board, said he frequently heard a speaker claim to be able "to cure cancer in any stage," and heard him warn listeners "to keep away from the Slaughter House, the State University Hospital, at Iowa City, Ia."

Tirades against diptheria, typhoid fever and smallpox immunization were heard over the station, the Commission was told, although these methods have been well established for ten years and have produced excellent results in death reduction and disease prevention.

The station is operating under a provisional license that expires October 31st, but meanwhile it must show cause why its license should be renewed after that date, due to previous complaints of strong talk over the station.

KDKA BUILDING 400 KW PLANT

Success of the new transmitting station of KDKA, which is being built near Saxonburg, Pa., will depend largely upon innovations in broadcast set design which have been developed by the radio engineering and research departments of the Westinghouse Electric and Manufacturing Company.

Of these innovations, one of the most important is the new 200-kilowatt tube which will be used. This tube, is not merely an enlarged edition of a smaller tube, but is thoroughly engineered as a tube of larger size and of a distinctly novel design. The mere building of a larger tube following the style of the smaller type would not produce the results desired. The quantity of output and the life of such a tube would not be up to the desired standard.

The new tube, called the AW-220, is 72 inches in height, has a diameter of eight inches and weighs 60 pounds.

In its design engineers found one of their greatest problems to be that of cooling the grid. This difficulty has been overcome by I. E. Mourmomtseff, Westinghouse research engineer, who has produced a tube of mechanical strength and sturdiness through a double end construction.

An idea of the cooling problem which was overcome may be obtained from the statement that approximately five tons of cooling water must be passed through the water jacket of the tube each hour it is in operation. This water cools the tube in the same manner as water in an automobile cools the motor. One hour's operation of the tube would heat enough water to supply the domestic requirements of the average home for several weeks.

The application for a construction permit to use 400,000 watts experimentally has been filed with the Federal Radio Commission, and it is expected the permit will be issued before the new transmitter is completed.

A THOUGHT FOR THE WEEK

This is entirely a business thought for the week: A certain radio merchandising concern, and its affiliates, sold radio goods to the amount of $115,679.25 through the advertising columns of RADIO WORLD *during the year starting June 1st, 1929, and ending May 31st, 1930.*

RADIO WORLD *can do the same for other advertisers. (As this little boost for ourselves sounds like an adv. we shall close the lesson with—adv.)*

GROUP HEARING ON 50 KW PLEA

Washington.

Nearly 400 hearings already have been scheduled by the Federal Radio Commission for September, October and November, when applicants for various types of radio facilities will be heard.

Calculating that hearings will be held at the rate of five a day on "hearing days," the Commission has docketed cases on the basis of applications received up to July 1st. Applications received after that date have not yet been docketed.

The ever-increasing duties of the commission are reflected in the number of applications now being received, members of the Commission pointed out. Under the law, hearings must be held before the commission can take negative action on applications of other than a purely routine nature.

Among the applications pending and designated for hearing are about a score from stations seeking the maximum allowable power of 50,000 watts. All of these applications either have been or will be designated for hearing at the same time, to cover a week's period in September. Because these requests are interlocking, the Commission decided it would be advisable to hear them consecutively.

The most recent check of the Commission shows that there are fifty unlicensed or "pirate" stations on the air, creating disturbances by what the Commission characterizes as "bootleg" operations.

Definite evidence obtained on ten of these unlicensed stations has been transferred to the Department of Justice for prosecution.

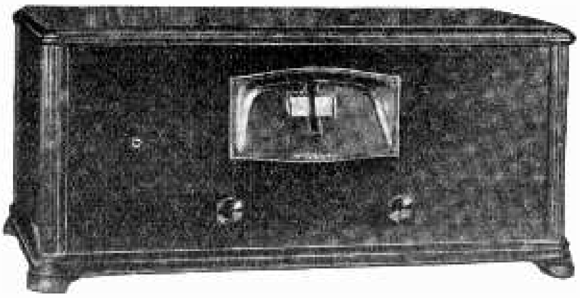
New Incorporations

Tischler Radio Corp., Newark, N. J., manufacture radio parts—Atty. Joseph Seiben, Newark, N. J.
Audio Projector Co., Wilmington, Del., talking motion picture projectors—Corporation Service Co.
Hohfeler & Hohfeler, radios—Atty. J. Danziger, 276 5th Ave., New York, N. Y.
Birhcfield Television Corp.,—Attys. Eppstein & Hirschfield, 521 5th Ave., New York, N. Y.

Literature Wanted

Marvin Allion, 607 Maumee St., Angola, Indiana.
C. Bakker, 162 Borgess Pl., Passaic, N. J.
R. W. Connor, 6 Division St., Toronto, Ont., Canada.
Del Mar Doyle, 3720 No. 13th St., Tacoma, Wash.
Miller Radio Service, 1615 - 1st Ave., So., Minneapolis, Minn.
D. A. Ross, 11512 - 72nd St., Edmonton, Alberta, Canada.
Alfred H. Haner, 3004 Euclid, Cincinnati, Ohio.

Balkite Push-Pull Receiver



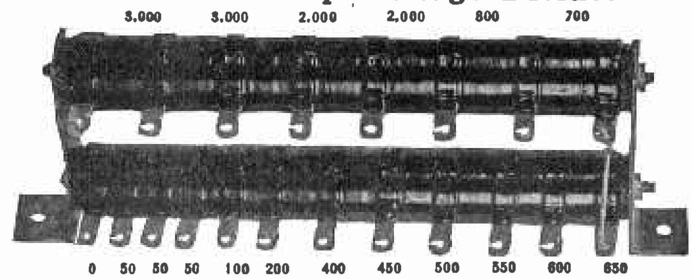
The Balkite A-5 Neutrodyne, one of the most sensitive commercial receivers ever developed; 8 tubes, including 280 rectifier. Wholly AC operated, 105-120 v. 50-60 cycles; in a table model cabinet, genuine walnut, made by Berkey & Gay.

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. Cat. BAL-A5, list price $135; net price......... **$44.00**

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.

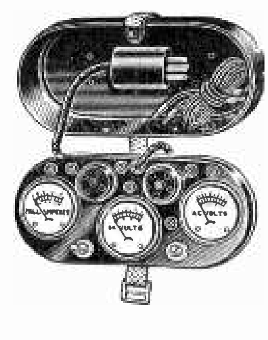
The expertness of design and construction will be appreciated by those whose knowledge teaches them to appreciate parts finely made.

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 meters 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?

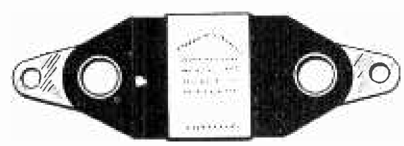
Order Cat. R-245. List price, $20; net price........... **$11.40**

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



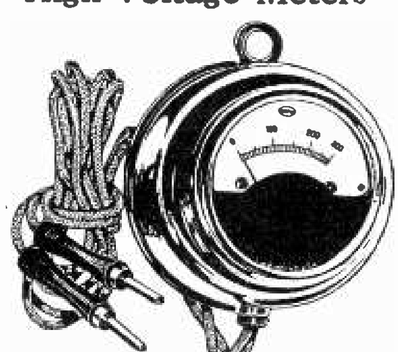
Dubilier Micon fixed condensers, type 642, are available at following capacities and prices:

.0001 mfd.	10c	.006	20c
.00025 mfd.	10c	.00025 with clips.	20c
.0003 mfd.	10c		
.00035 mfd.	15c		
.001	17c		
.0015	17c		
.002	18c		

All are guaranteed electrically perfect and money back if not satisfied within five days.

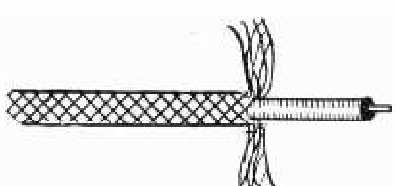
Order Cat. MICON .0001 etc. at prices stated.

High-Voltage Meters



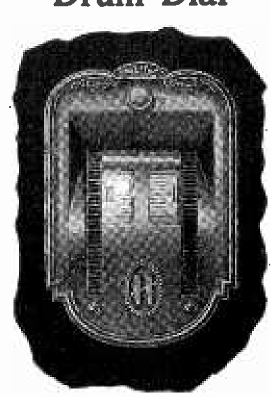
0-300 v., 200 ohms per volt. Cat. F-300 @ $2.59
0-500 v., 233 o.p.v. Cat. F-500 @...... 3.73
0-600 v., AC and DC (same meter reads both); 100 ohms p.v. Order Cat. M-600 @ 4.95

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

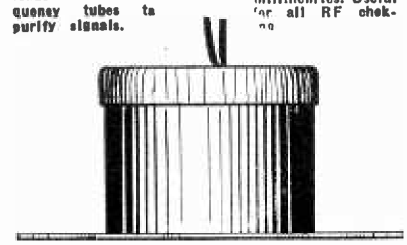


Hammarlund double drum dial, each section individually tunable. Order Cat. H-DDD. List price $6.00; net price **$3.00**

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:

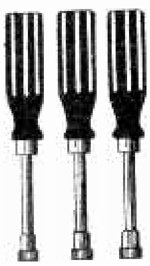
☐ BAL-A5 @. $44.00
☐ MTVD @... 3.90
☐ G-RF-3CT @ 2.48
☐ R-245 @..... 11.40
☐ Ft. of SH-LW @.......5c p. f.
☐ H-DDD @... $3.00
☐ SH-RFC @... 50c
☐ M-600 @.... $4.95
☐ F-300 @..... $2.59
☐ F-500 @..... 3.73
☐ MICON.... @ ....
☐ MICON.... @ ....
☒ If C.O.D. shipment is desired put cross here.

Your Name ....

Address ....

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

Set of SOCKET WRENCHES *FREE*



FOR turning nuts down or up there is nothing as efficient and handy as a socket wrench. Here is a set of three wrenches for hexagonal nuts, enabling use with 5/32, 6/32, 8/32 and 10/32 nuts. Fit the nut into the proper socket and turn down or up. The three different size sockets, one size on each wrench, enables use of three different outside diameters of nuts, but at least ten different sizes of threads. Send 50 cents for four weeks subscription for RADIO WORLD and get this set of three wrenches FREE!

RADIO WORLD, 145 W. 45th St., New York, N.Y.
50 cents enclosed for 4 weeks' subscription for RADIO WORLD. Send socket wrenches free!

Name ....

Address ....

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

☐ Cross here if extending existing subscription.

KEY TUBES

Quality First

The following constitute the thirteen most popular tubes used in radio today. Despite the severely low prices the Key tubes are firsts of the very first quality. The tubes are manufactured under licenses granted by the RCA and its affiliated companies.

All prices are net and represent extreme discount already deducted.

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

Enclosed please find $.............. for which ship at once tubes marked below:

☐ 224 AC screen grid $1.43
☐ 245 AC power tube $1.10
☐ 226 AC amplifier .... .68
☐ 227 AC det.-amp. .... .85
☐ 222 battery SG $1.68
☐ 112A power tube .... .78
☐ 171A power tube .... .78
☐ 201A battery tube .... .53
☐ 240 hi mu tube $1.60
☐ 250 power tube $4.95
☐ 210 power tube $3.25
☐ 280 AC rectifier $1.00
☐ 281 AC rectifier $2.95

Name ....

Address ....

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

☐ Put cross here if C. O. D. shipment is desired. Canadian remittance must be by postal or express money order.

DOUBLE RANGE POTENTIOMETER; made by Centralab, designed for volume control. In dust-proof bakelite case. Price, $1.05. Guaranty Radio Goods Co., 143 W. 45th St., New York.

SOLDERING IRON FREE!

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

RADIO WORLD
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RADIO WORLD and "RADIO NEWS"

BOTH FOR ONE YEAR @ **$7.00**

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

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

ERLA-DYNAMIC CHASSIS, WESTINGHOUSE RECTIFIER. Sensitive and efficient dynamic speaker chassis. List price, $25; our net price, $12.50. Guaranty Radio Goods Co., 143 W. 45th St., New York.

"SECONDS"

TUBES that fall a trifle below the most exacting laboratory specifications may be obtained at prices that seem incredible. They are called "seconds" and they are "seconds," but they are not "thirds." Note the prices. Remit with order.

201A	50c	224	70c
UV199	70c	245	75c
UX199	70c	280	75c
200A	70c	281	85c
240	70c	210	90c
227	70c	250	$1.00

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Room 504
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"MATHEMATICS OF RADIO."—A great help to everybody interested in radio. $2 postpaid. Radio World, 145 W. 45th St., N. Y. City.

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Get a FREE one-year subscription for any ONE of these magazines:

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☐ RADIO (monthly, 12 issues; exclusively trade magazine).
☐ RADIO ENGINEERING (monthly, 12 issues; technical and trade magazine).
☐ RADIO INDEX ((monthly, 12 issues) Stations, programs, etc.
☐ SCIENCE & INVENTION (monthly, 12 issues; scientific magazine, with some radio technical articles).
☐ AMERICAN BOY—YOUTH'S COMPANION (monthly, 12 issues; popular magazine).
☐ BOYS' LIFE (monthly, 12 issues; popular magazine).

Select any one of these magazines and get it FREE for an entire year by sending in a year's subscription for RADIO WORLD at the regular price, $6.00. Cash in now on this opportunity to get RADIO WORLD WEEKLY, 52 weeks, at the standard price for such subscription, plus a full year's subscription for any ONE of the other enumerated magazines FREE! Put a cross in the square next to the magazine of your choice, in the above list, fill out the coupon below, and mail $6 check, money order or stamps to RADIO WORLD, 145 West 45th Street, New York, N. Y. (Just East of Broadway).

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TESTED TUBES—201A, .43; 226, 227, 171A, 224, 245, 280, .48. Unshielded 85 milliampere filter chokes, .49. Waterman Radio, 2140 Kirby West, Detroit, Mich.

COLOSSAL BARGAIN—A 4-tube AC 105-120 Volt, 50-60 cycle, custom made receiver, in table model cabinet, with Mayolian B eliminator, A battery, Westinghouse trickle charger, C bias batteries, Relay switch, 5 tubes (includes Raytheon rectifier). One dial finger tuning, 171 output. Operates dynamic. Humless, sturdy performer. Can be heard by appointment. Will install free in residence if in or around New York City. A. Basbein, 1116-56 Street, Brooklyn, N. Y.

SONGWRITERS

WRITERS—Poems, Melodies—opportunity. Tommie Malie, RW4215 North Ave., Chicago.

MALE HELP WANTED

RELIABLE WHITE MEN EVERYWHERE, interested in distributing advertisers circulars. No selling. Spare or full time. Experience unnecessary. Enclose stamps. Consolidated, 1608RW Milwaukee Ave., Chicago.

400 QUESTIONS Radio Course $2.00. Stephen Plavetich. 1597 East 47th Street, Cleveland, Ohio.

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"CITY OF CHICAGO" WORLD'S DURATION PLANE—30" Plan 10c. Model Aviator, Dept. RW, 605 Washington, Chicago.

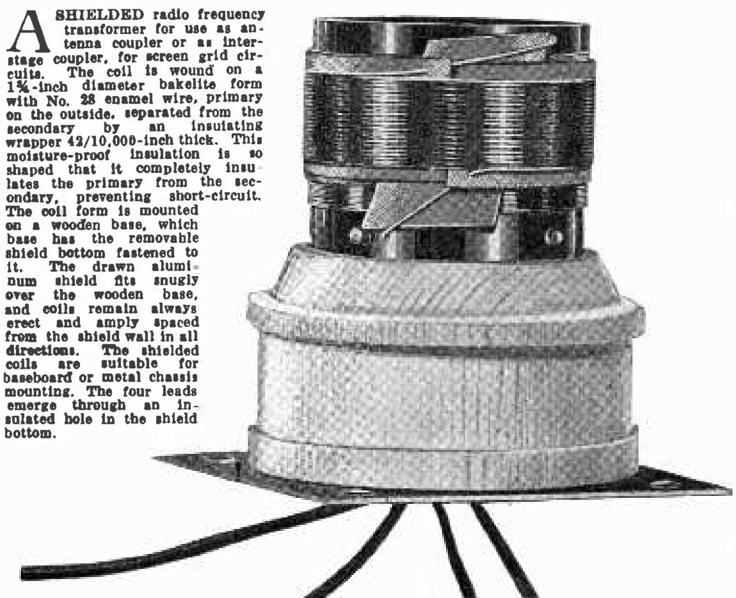
BARGAINS in first-class, highest grade merchandise. B-B-L phonograph pick-up, theatre type, suitable for home, with vol. control, $6.57; phono-link pick-up with vol. control and adapter, $3.50; steel cabinet for HB Compact, $3.00; four-gang .00035 mfd. with trimmers built in, $1.95; .00025 mfd. Dubilier grid condenser with clips, 18c. P. Cohen, Room 1214, at 143 West 45th Street, N. Y. City.

Subscribers! Important!

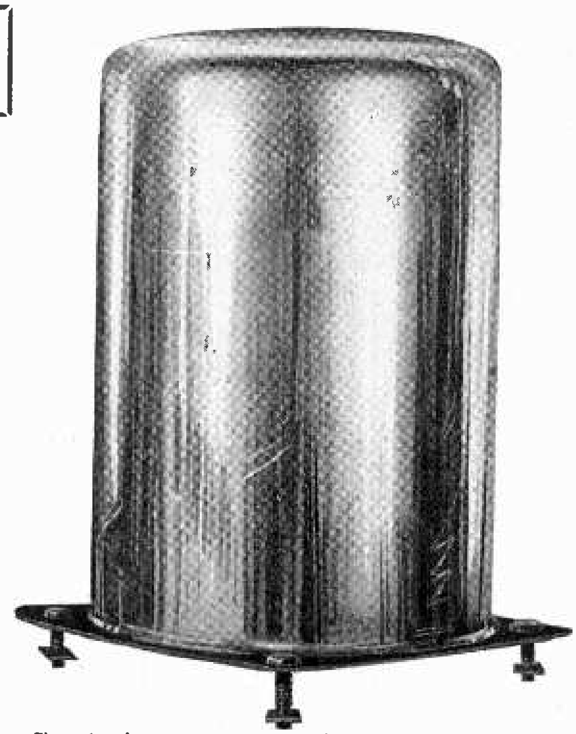
Note subscription expiration date on wrapper containing your copy of RADIO WORLD. If nearing expiration date, please send in renewal so that you will not miss any copies. Subscription Dept., RADIO WORLD, 145 W. 45th St., New York City.

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.



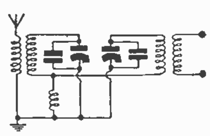
The coil comes already mounted on a shellacked wooden base, which is fastened at the factory to the shield bottom. Series A coil is illustrated.



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.

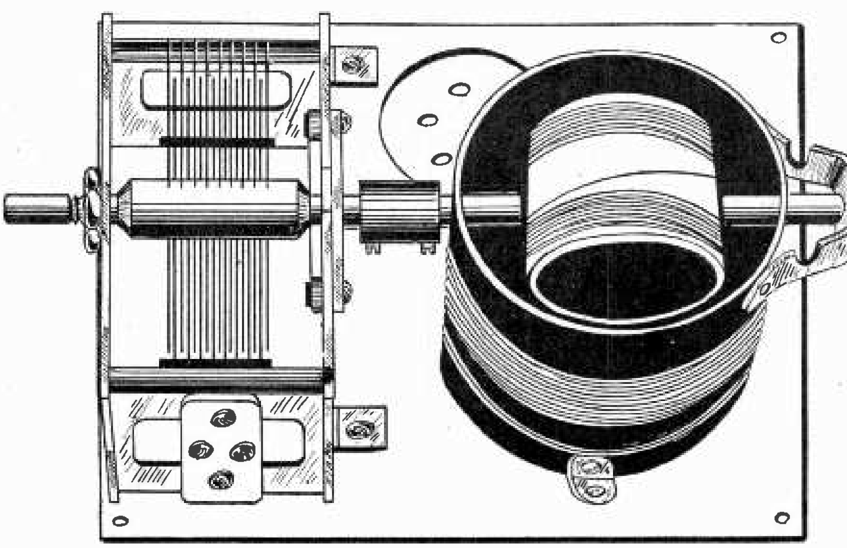
EXTREME accuracy in winding and spacing is essential for coils used in gang tuning. These coils are specially suited for gang condensers, because the inductances of all are identical for the stated size condenser. The coils are matched by a radio frequency oscillator. The color scheme is as follows: 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	☐ B-SH-3, each	$1.00
☐ Matched set, 4 A-40-80-S, $1 matching	10.00	☐ Matched set of four B-SH-3	4.00
☐ A-40-70-S, each	2.25	☐ B-SH-5, each	1.00
☐ Matched set of four A-40-70-S	10.00	☐ 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.