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RADIO WORLD

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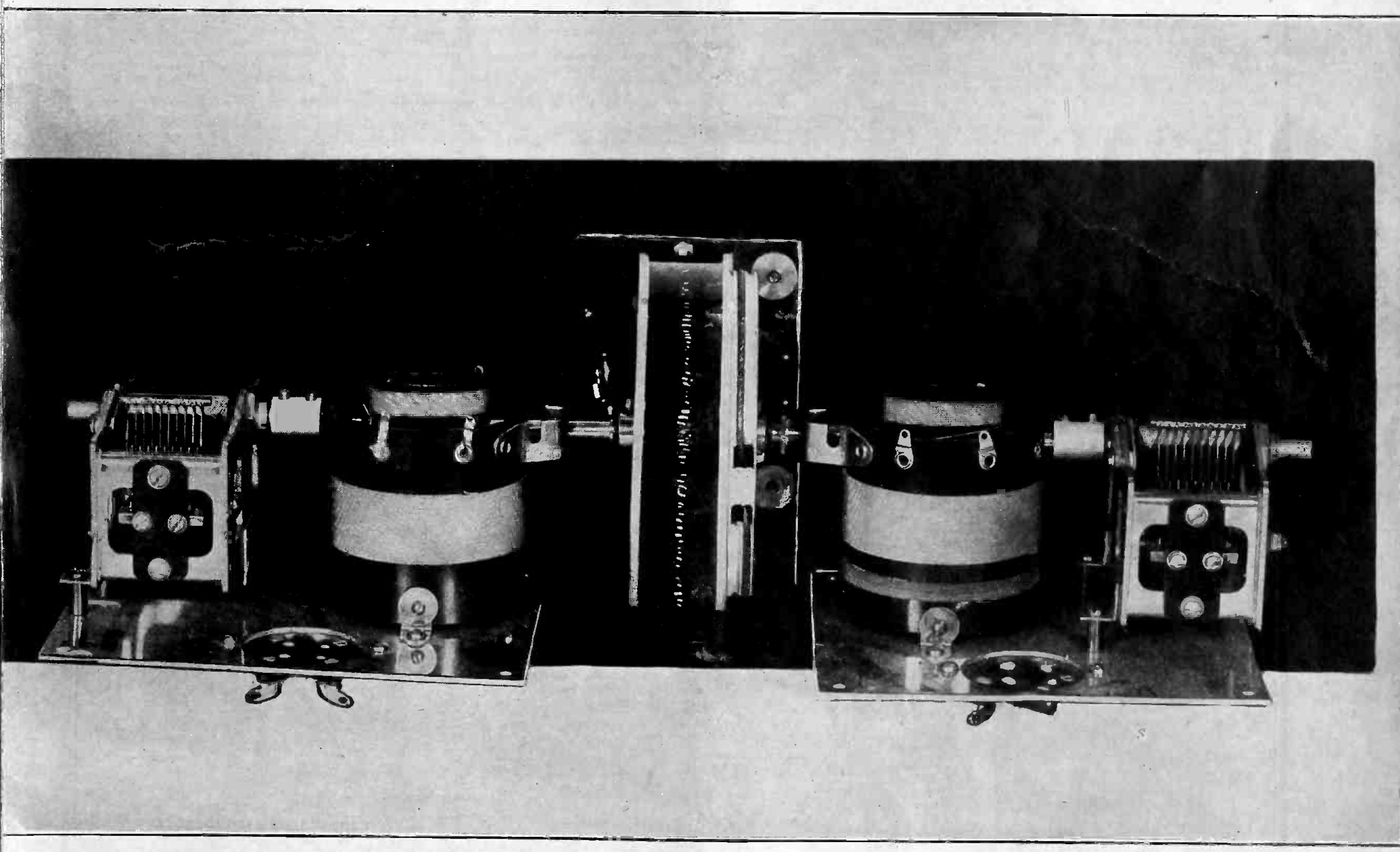
405th Consecutive Issue—EIGHTH YEAR

PICTURE DIAGRAM OF HB33 WIRING

BAND PASS FILTER METHODS

TWO TUBE BATTERY TUNER!



See pages 5, 6 and 7 for Construction of this Tuner

COMPACTNESS AS QUALITY-KILLER

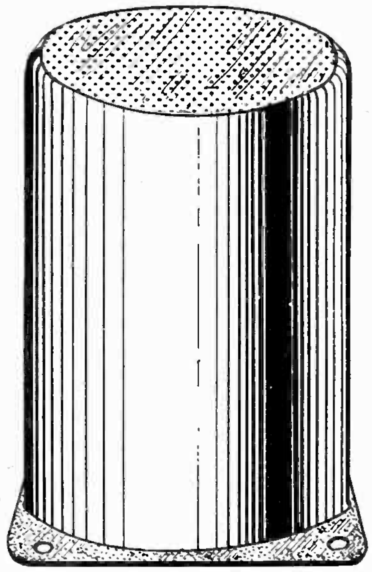
Plate Current's Fascinating Study

Foreign City Names Get DX Hounds' Goat

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.

The Latest in Tuning Equipment

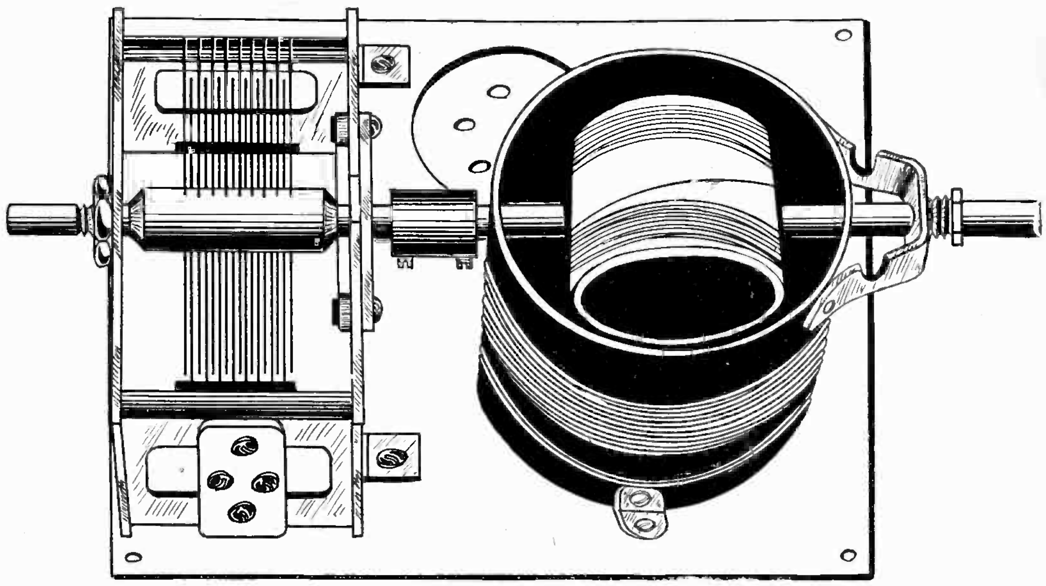
SHIELDED COIL



RF transformer in aluminum shield 2¾" square at bottom, 3¾" high. If metal subpanel is used no extra base is needed.
Coils have brackets on. You must assemble in shield yourself and solder winding terminals to built-in lugs. For all circuits and stages, including screen grid tubes.

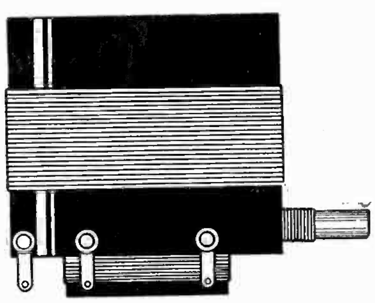
Cat. No. SH3 for .00035 mfd. $0.95
Cat. No. SH5 for .0005 mfd. $1.00
Cat. SHB (extra base) $0.10

BERNARD TWO-TUBE TUNER ASSEMBLY



For building a tuner consisting of a stage of screen grid radio frequency amplification and a detector, AC or battery-operated, use the Bernard two-tube tuner assembly. Suitable for single control with one drum dial or separately tuned stages with two flat-type dials. The assembly consists of antenna stage (BTL-AC or BTL-DC), having Bernard Tuner BT3A, a .00035 mfd. condenser, socket, link and aluminum base. The detector input stage (BTR-AC or BTR-DC) consists of the same parts, but the coil has a tuned primary with untuned input to detector. Assemblies are unwired but are erected.
The condenser has shaft protruding at rear, so if two dials are used coil is put at front panel in either instance and condenser at front panel for the other.
For AC operation, 224 RF and 224, 227 or 228 detector, order Cat. No. BTL-AC and BTR-AC at $6.00.
For battery operation of filaments, 222 RF and 222, 240, 201A or 112A detector, order Cat. No. BTL-DC and BTR-DC at $6.00.
[Note: for drum dial single control an 80 mmfd. equalizing condenser is necessary. This is extra at $0.35. Order Cat. EQ-80.]

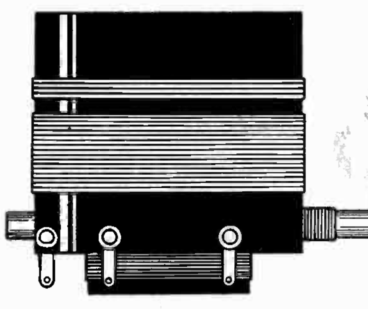
ANTENNA COUPLER



Cat. No. VA5—$0.85
FOR .0005 MFD. CONDENSER

Moving primary and fixed secondary, for antenna coupling. Serves as volume control.
Cat. No. VA3 for .00035 mfd. $0.90

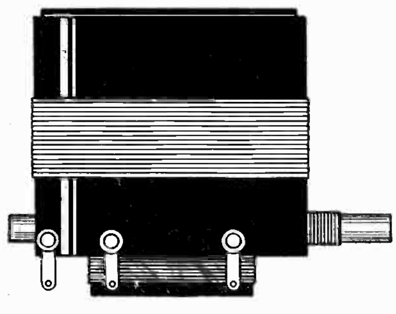
BERNARD TUNERS



Cat. No. BT5A—$1.35
FOR .0005 MFD. CONDENSERS

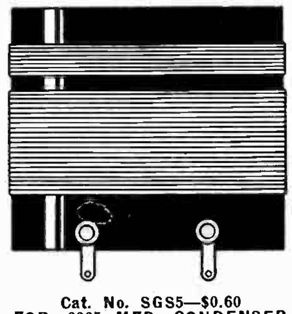
Bernard Tuner BT5A for .0005 mfd. for antenna coupling, the primary being fixed and the secondary tuned. This coil is used as input to the first screen grid radio frequency tube. Secondary has moving coil.
Cat. No. BT3A for .00035 mfd. ..$1.35

Bernard Tuner BT5B for .0005 mfd. for working out of a screen grid tube, tuned primary, untuned secondary. Primary has moving coil.
Cat. BT3B for .00035 mfd. ..$1.35



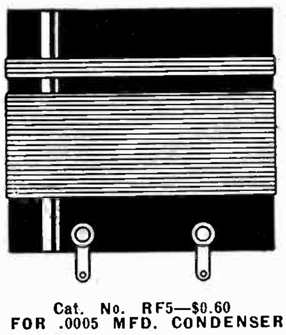
Cat. No. BT5B—$1.35
FOR .0005 MFD. CONDENSER

SG TRANSFORMER



Cat. No. SGS5—$0.60
FOR .0005 MFD. CONDENSER

Interstage radio frequency transformer, to work out of a screen grid tube, primary untuned.
Cat. No. SGS3 for .00035 mfd. $0.65



Cat. No. RF5—$0.60
FOR .0005 MFD. CONDENSER

DIAMOND PAIR

Cat. No. RF5—$0.60
FOR .0005 MFD. CONDENSER

Antenna coil for any standard circuit, and one of the two coils constituting the Diamond Pair.
Cat. No. RF3 for .00035..$0.65

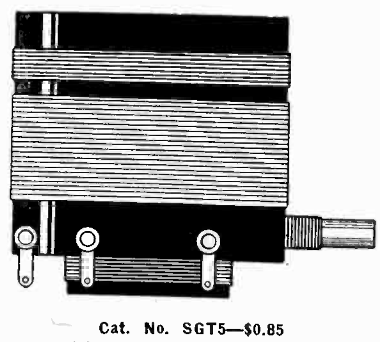
Cat. No. SGT5—$0.85
FOR .0005 MFD. CONDENSER

Interstage 3-circuit coil for any hookup where an untuned primary is in the plate circuit of a screen grid tube.
SGT3 for .00035 mfd...$0.90

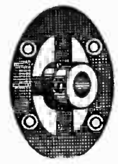
Order the Diamond Pair, Cat. DP5 for .0005 mfd. at $1.45

Order the Diamond Pair, Cat. DP3 for .00035 mfd. at $1.55

[Note: These same coils are for AC or battery circuit.]



Cat. No. SGT5—$0.85
FOR .0005 MFD. CONDENSER

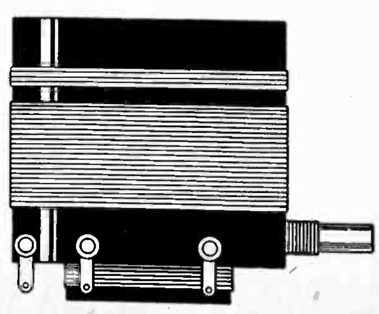


FL4 $0.30

Flexible insulated coupler for uniting coil or condenser shafts
Order Cat. FL4 at $0.30
Equalizing condenser, 80 mmfd., for connection across any tuning condenser where ganging is resorted to, or for equalizing independently tuned circuits to make dials track.
Order Cat. EQ80 at $0.35

STANDARD TUNER

The standard three-circuit tuner is used with primary in the plate circuit of any RF tube, AC or battery type, excepting only screen grid tube.
For .0005 mfd. order T5 at $0.85
For .00035 order Cat. T3 at $0.90
All coils have 2½" diameter, except the shielded coil, which is wound on 1¾".
The coils are wound by machine on a bakelite form, and the tuned windings have identical inductance for a given capacity condenser, i. e., .0005 mfd. or .00035 mfd. Full coverage of the wave band is assured.
All coils with a moving coil have single hole panel mounting fixture. All others have base mounting provision. The coils should be used with connection lugs at bottom, to shorten leads.
Only the Bernard Tuners have a shaft extending from rear. This feature is necesary so that physical coupling to tuning condenser shaft may be accomplished by the insulated link.



Screen Grid Coil Company,
143 West 45th Street,
New York, N. Y. (Just East of Broadway.)

Enclosed please find $........... for which please send at once the following parts:

☐ Cat. No. .... at $ ....
☐ Cat. No. .... at $ ....
☐ Cat. No. .... at $ ....

☐Please ship C. O. D.

Name ....

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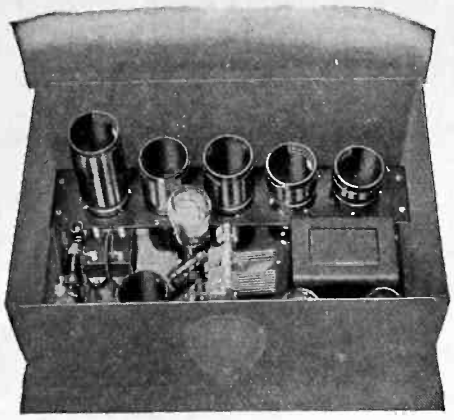
Short Wave Circuit



National Thrill Box, 4-tube short wave circuit, 15 to 535 meters, battery-operation of filaments; B supply, either batteries or eliminator.

Get a real kick out of listening to foreign stations on a real short-wave circuit, the National Thrill Box. Uses one 222 screen grid RF amplifier, one 200A detector, one 240 first audio and one 171A or 112A output. Single control. Buy the parts and build the circuit in two hours. Data sheet shows dial settings where foreign stations come in. Cat. SW4EF, all parts, including decorative brown steel cabinet, all six plug-in coils, list price $51.90 (less tubes). Your price $31.00.

Guaranty Radio Goods Co.
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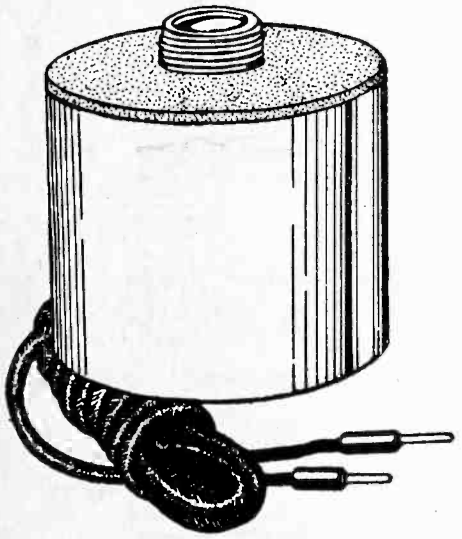
Horn Unit $2.25



This unit is pre-eminent for horn-type speakers, such as the exponential horns or other long tone-travel horns. The faintest word from a "whispering tenor" or the tumultuous shout of the crowd or highest crescendo of the band is brought out clearly, distinctly. Stands up to 450 volts without filtering. Works right out of your set's power tube, requiring no extra voltage source. Standard size nozzle and cap are die-cast aluminum, one piece, with milled platinum-like finish. The casing is full nickel, of highest possible polish. Works great from AC set, battery set or any other set, push-pull or otherwise.

For Portable Use

This unit can be used in a portable without any horn attached and will give loud reproduction. Order Cat. 225, with 4½ ft. cord attached . . . . (Shipping weight, 2 lbs.) $2.25

Air-Column Horn

8-ft. tone travel molded wood horn (less unit No. 225) is obtainable already mounted in a baffle box. Outside overall dimensions of baffle box, 21¼" high, 18" wide, 15" front to back. Shipping weight, 27 lbs. Order Cat. 596 @ $8.00.

Acoustical Engineering Associates,
145 W. 45th St., N. Y. City (Just E. of Bway).
Please ship C. O. D.
☐ Cat. No. 225 @ $2.25 ☐ Cat. No. 596 @ $8.00

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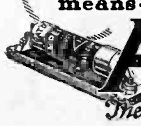

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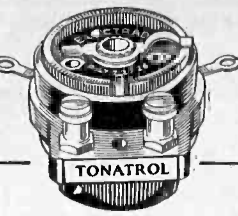

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HB44-$46.44

THE HB33 is a three-stage screen grid radio frequency amplifier, with screen grid power detector, all shielded, 112A first audio and 112A push-pull output. Single dial control, seven-tube circuit. Price includes all parts and crinkle brown finish drilled cabinet. Order Cat. HB33 at $28.33 (less tubes).

THE HB44 is the same fundamental circuit as the HB33 but is for AC operation. Three stages of screen grid RF, with screen grid power detector, all shielded, 227 first audio and 245 push-pull output. Single dial control 7-tube circuit and 280 rectifier, 8 all told. Price includes all parts, including power equipment, socketed subpanel (8 sockets, including one for 280 rectifier) and crinkle brown finish drilled cabinet. Order Cat. HB44 at $46.44 (less tubes).

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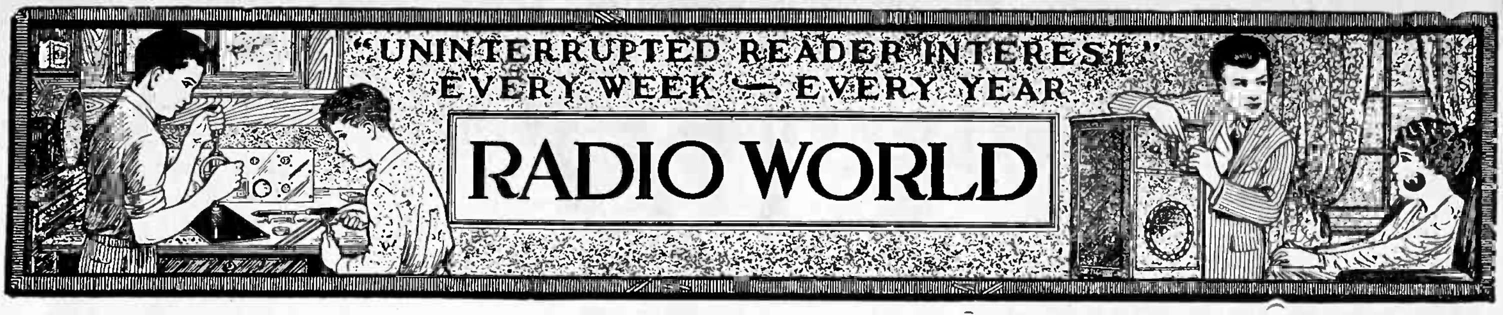

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EIGHTH YEAR

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The Bernard Tuner

Fine for Earphones or to Precede Power Amplifier

By Herman Bernard

WITH some persons the problem is, What type of a power amplifier shall I use with my tuner? With others it is, What type of tuner shall I use with my power amplifier? For those confronted by the second problem, a battery-operated tuner is shown. It consists of only two tubes, but it represents about as high a degree of efficiency as is obtainable from two tubes, and results are far beyond what you would expect from so modest an arrangement.

Since the possession of a power amplifier is assumed, a device possibly bring AC operated, the plate voltage for the tuner may be derived therefrom, or any B eliminator will do, if B batteries are not desirable.

Also, of course, for earphone reception this two-tube design is splendid. The second phone tip would go to B plus, 45 volts. No detector plate voltage connection is shown in the diagram because if an audio amplifier is used the plate lead P, of the tuner, is connected to the P post of the primary of the first audio transformer, and the B voltage is applied to the other terminal of the audio transformer primary. Also the pilot light is not diagramed. If used, connect between A minus and A plus to left of switch.

TUNED PLATE CIRCUIT

The unusual sensitivity of this design, as compared with most other two-tube hookups, arises from the use of a 222 screen grid tube with tuned primary. Therefore the Bernard tuner is used, as when the primary circuit is tuned the broadcast wavelength spectrum would not be fully coverable without the wavelength tuning extension provided by these exclusive tuners. A moving coil is in series with a fixed winding, the total being tuned, the moving coil acting as a variometer to accomplish the wavelength range extension. Also the amplification is maintained high at all frequencies, due to the compound variation of the degree of coupling, automatically established.

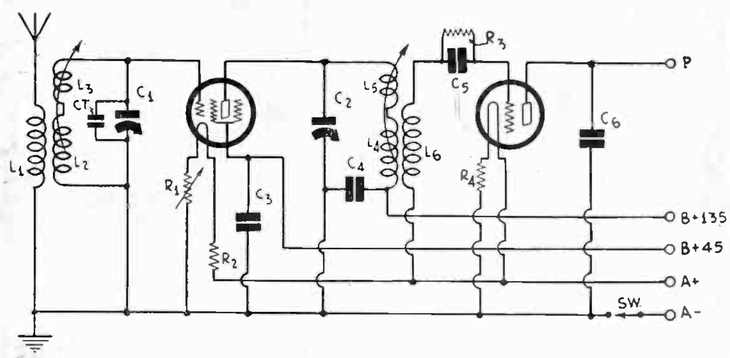
The moving coils are connected physically to the tuning condensers and the same motion turns both. This motion is provided in the present instance by the new National drum dial, and the Bernard tuner assemblies, with sockets, coils, tuning condensers, links and base erected, are designed to facilitate drum dial use. However, they may be employed as individual tuned circuits with two flat type dials. In the present instance a drum should be used.

The dial is mounted on the front panel, with rheostat at left and switch at right. A drilled panel takes care of the placement of these parts. No subpanel is necessary, because the tuner assemblies have aluminum bases with holes in them, and after the circuit is wired the bases may be tightened down against the bottom of whatever cabinet is used. A 7 x 18" front panel is the minimum, although a wider panel may be used, if you have one.

HARMFUL INTERACTION PREVENTED

The assemblies are so placed that the coils shafts are engaged by the drum dial. The metal drum is a sufficient shield to prevent troublesome interaction between stages. The drum is automatically grounded because of the coil shaft connection thereto. This shaft is metallically connected to the tuning condensers' stators or frames, which are grounded in the wiring.

Two Bernard tuners are necessary, because the circuits must tune alike. Even so, a small extra capacity, represented by CT, must be adjusted until it contributes as much capacity as does the screen grid tube between plate and filament, when the plate circuit is tuned and good step-up ratio established in the detector grid circuit. An equalizing condenser of 80 mmfd. takes care of this abundantly.



BERNARD TWO TUBE TUNER. THIS DESIGN MAY BE USED FOR EARPHONE RECEPTION OR AS THE "FRONT END" TO FEED A POWER AMPLIFIER. B MINUS SHOULD BE CONNECTED TO A MINUS IF EARPHONES ARE USED, BUT IN A POWER AMPLIFIER THIS IS USUALLY DONE THERE.

This tuner, from New York City, regularly brings in Cleveland, Canada, Wheeling, Schenectady, Pittsburgh and other stations, some farther away and hard to get. When a two-stage transformer-coupled audio amplifier is used, the reproduction is strong on the loud speaker. In fact, the volume of this tuner is exceptionally large, hence the volume control should have a good range, e. g., 75 ohms.

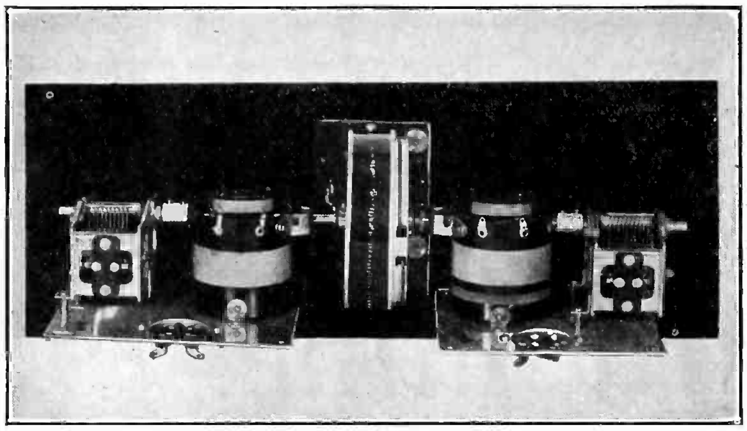
The construction is next to nothing at all, so far as work goes, since the main task in a two-tube assembly is the drilling

LIST OF PARTS

L1 L2 L3, C1, socket, link, base .00035 tuning condenser—One Bernard tuner assembly for left-hand position when using a drum dial, socket for DC screen grid tube 222 (Cat. BT-L-DC).
L4 L5 L6, C2, socket, link, base, .00035 tuning condenser—One Bernard tuner assembly for right-hand position, when using drum dial, socket for four-prong DC tube, 201A, 240, 112A, etc. (Cat. BT-R-DC).
R1—One 75 ohm rheostat.
R2—One 6.5 ohm filament resistor.
R3—One Lynch 5 megohm metallized grid leak.
R4—One 4 ohm filament resistor.
C3, C4—Two .01 mfd. mica dielectric fixed condensers.
C5—One .00025 mfd. mica dielectric fixed condenser with clips.
C6—One .00025 mfd. mica dielectric fixed condenser.
SW—One A battery switch.
Ant., Gnd., A minus, A plus, B plus 45, B plus 135 and P—Seven binding posts.
One National Velvet Vernier Modernistic dial, with rainbow feature and pilot light and bracket.
One drilled front panel, 7 x 18", bakelite.

A 'Big Time' Tuner That

High Sensitivity Attained Even at



VIEW OF THE SIMPLE ASSEMBLY OF THE BERNARD TUNER.

and mounting. Here the front panel is drilled, and only the rheostat, switch and dial need be mounted thereon, the rest of the mounting consisting simply of attaching the bases of the assemblies to the floor of the table model cabinet used. For console installation, a board 7 x 12" will do, but it should be thin, not more than 3/8" thick, and should have a 1¼ x ½" slot cut at front center to pass the part of the National dial frame.

TUNING EXPLAINED

The four corner holes in the bases of the assembly require that some method be used for elevating these bases to a height slightly exceeding the protrusion of the socket lugs below the bases. A distance of 3/8" to ½" will be ample, and may be provided by bushings or oversized nuts. If wood screws are used, 8/32 machine nuts may be used for elevation, and of course need not be fastened to the screws at all. If machine screws are used, a few extra nuts, of the same size as the screws, affixed to the screws between the bottom of the assembly base and the bottom of the cabinet, will serve the purpose.

In the input circuit the primary is connected to the aerial. This is the small winding on the outside of the antenna stage assembly, BT-L-DC. The secondary consists, as explained, of two series-connected coils, one winding, the fixed one, being on the same form as the primary, the other winding, the moving one, being on a separate rotatable form inside. They are interconnected at the factory. With these coils it makes no difference which end connects to grid—the end of the moving coil or the end of the fixed coil—but the precaution should be taken to connect both the first and second stage coils in the same way, whichever way you select.

One end of the primary L1 and one end of the second L2 L3 may be interconnected between the lugs of the coils themselves.

The BT-R-DC assembly, with its coil, should be connected with the tuned circuit in the plate of the 222 tube. Note that exactly the opposite condition prevails compared with the previous situation, since here the primary is tuned, whereas previously the secondary was tuned. This divergence of tuning in part accounts for high sensitivity retained at the higher broadcast wavelengths. In the antenna stage the effective inductance of the secondary is decreased as the wavelength is decreasd, hence the step-up is decreased in the same direction, whereas in the next stage the effective primary inductance is less, the lower the wavelength; therefore, the step-up ratio to the untuned secondary L6 becomes relatively greater. Hence equalization is established in one of the most efficient two-tube assemblies ever devised.

BOTH FRAMES GROUNDED

It is convenient to have the tuning condenser frames returned to the same potential, and while this is easy enough where grid circuits alone are tuned, it is necessary to complete the second tuned circuit through an extra capacity, C4, when the plate circuit is tuned, as one end of the plate coil goes to a high positive B potential. So the tuning condenser C2 has its frame connected to ground—done automatically, as previously explained—while one end of the plate coil itself goes to B plus. Then a condenser, C4, not only serves to bypass B supply resistance, but unites C2 to L4 L5 for tuning purposes. If this uniting condenser is large in respect to the tuning capacity then there will be virtually no effect on the tuning characteristics of C2. A uniting condenser of .006 mfd. would be entirely adequate even if the tuning capacity were .0005 mfd., but as an extra margin of absolute safety, the tuning capacity chosen was .00035 mfd. and the uniting condenser .01 mfd. This combination makes it absolutely certain that, with the aid of the trimming condenser, the tuning of the two circuits will be made exactly alike, hence drum dial single control is wholly effective.

HIGH SENSITIVITY

The grid condenser C5 should be .00025 mfd. and have clips for receiving the grid lead, R3, which is 4 meg. This value of resistance yields extreme sensitivity. The detector tube is assumed to be a 201A, if worked into a transformer. But if a resistance or impedance coupled first-stage audio is used, then the detector tube may be a 240, with no change in the wiring whatsoever, or in any constant. The plate coupling resistor for a 240 should be .25 meg and a higher plate voltage may be tried.

Right or

How Well Can You A

Based on Pre

(1)—Superaudible sound waves cannot be generated by driving a headset unit with a current of frequency above audibility because the diaphragm will not vibrate at high frequencies.

(2)—Sound waves of higher than audible frequencies can be generated with a piezo crystal by driving it with a current having a frequency equal to its natural frequency of vibration.

(3)—An arc light can be made to speak by superimposing a strong voice frequency current on the current maintaining the arc.

(4)—A screen grid tube is not a good detector because it is impossible to bring about the proper combination of grid bias, screen voltage, and plate voltage.

(5)—DX is impossible in daytime, no matter how sensitive the receiver may be, because daylight stops the signals a short distance from the transmitting station.

(6)—When the plate circuit of a tube is tuned and there is another tuned circuit in which the tuning condenser is grounded it is not possible to connect the circuit so as to gang the condensers unless an insulating coupler be used between the two condensers.

(7)—The tuned circuits in the intermediate frequency amplifier are very critical as to frequency, that is, if the frequency is not predetermined and the intermediate frequency tuners adjusted to this frequency the receiver will not work.

8)—The simplest way of adjusting the intermediate frequency tuners is to rig up an oscillator of the intermediate frequency and then adjust each circuit to have a natural frequency equal to that.

(9)—When DC screen grid tubes are used in a receiver one of the best volume controls is a rheostat in the filament circuit of these tubes.

(10)—In a screen grid tube connected to a resistance coupler the plate current is very nearly constant, that is, it does not depend much on the grid bias on the tube.

ANSWERS

(1)—Wrong. While the diaphragm will not vibrate widely, it will vibrate some even if the frequency of the driving current is much above the natural frequency of the diaphragm. It will vibrate in what is called forced vibrations. The amplitude of this vibration is very small if the driving current frequency is much off resonance.

(2)—Right. A piezo crystal can be made to vibrate at any frequency and for that reason a crystal has been used for loudspeaking purposes. It will, however, vibrate much more easily if it is driven with a current the frequency of which is equal to one of the natural frequencies of the crystal. A crystal can be ground so that its fundamental natural frequency has any value desired.

(3)—Right. The direct current flowing through the circuit maintains the arc at a certain temperature and intensity. If a voice frequency current of considerable intensity is superimposed on the direct current the intensity of the light and that of the heat will vary in accordance with the voice current. The varying temperature will cause the gases in the arc to expand

Uses Only Two Tubes

the Higher Broadcast Wavelengths

The selectivity of the two-tube assembly is in excess of that ordinarily obtained with a stage of radio frequency amplification and a regenerative detector. The circuit is not regenerative, and the high amplification is derived from tuning the plate circuit and having a pickup coil, L6, of sufficient inductance so there is a step-up ratio between the tuned plate circuit and the untuned detector grid circuit, no matter if the lowest broadcast wavelength is tuned in.

COIL DATA

Those who desire to wind their own coils, instead of using the commercial products of the Screen Grid Coil Company, may do so by reconverting a pair of three-circuit tuners to the present use.

The primary of the three-circuit tuner converted to use as the antenna coil L1 may be left as it is. About 14 turns of No. 24 insulated wire will suffice. A little more or less makes no appreciable difference. The secondary should be spaced ¼" away from the primary and wound on the same form with the same kind of wire. If you have a three-circuit tuner for .0005 mfd. tuning you may leave it as it is, but connect the ticker coil in series with the primary. For conversion, therefore, you do not need to do more than to connect the secondary in series with the tickler, providing the coil was originally intended for .0005 mfd., and even though now it is to be used for .00035 mfd. The reason is that the tickler will provide the extra inductance. Hence you do not have to regard the diameter for conversion.

But for winding a new coil, use 2½" diameter, put on 14 turns for the primary, 45 turns for the secondary, and upwards of 28 turns on the tickler. You may use a tickler that has even a larger number of turns, as the greater the inductance of the tickler the greater the wavelength coverage. There is no special object in exceeding the broadcast band of wavelengths. These directions are for the antenna coil.

For the interstage coil three forms are necessary. To convert an existing three-circuit tuner intended for .0005 mfd. originally, remove the small primary winding and leave the former secondary (now to be used as primary) as it is. Connect one end of the tickler to one end of the remaining fixed winding. Make the same relative connection as you did in the previous instance. Then get a form about ¼" smaller diameter, and wind 60 turns on it. Insert this form inside the other.

If you are to wind this interstage coil anew, use 2½" diameter tubing, put on 45 turns for the fixed outside winding, and 28 (or whatever other higher number was used for the previous tickler) on the moving form, and wind 60 turns on 2¼" diameter, inserting the smaller fixed diameter inside the larger.

All wire is No. 24 insulated.

The polarity of connection of the pickup coil L6 is not important in this circuit. Connect either terminal to grid of the detector tube, the other terminal to A plus.

Some special precautions: If you use a reconverted three-circuit tuner you will not have any shaft protruding from rear, therefore mount the condensers with their shafts in the drum, and couple the coil shafts to the rear shaft extensions of the condensers. Only condensers with extended shafts can be used in any instance. Another point: Both fixed coils must have the same number of turns on the same diameters, so must both moving coils, but of course the fixed inductance is larger than the moving coil's inductance. Also, you must have the moving coils in circuit with correct polarity. The test is, tune in a station. Turn one moving coil alone half way round. Does volume go 'way up? If so, O.K. If not, replace position. Finally, the correct method alone insures wave band coverage.

EXCELLENT QUALITY

This tuner produces a signal free from distortion, therefore the quality you get will depend on the audio amplifier. Of course, with ear phones the quality will be superb, and it will be the same with a fine audio amplifier, despite the much greater volume required for speaker operation.

The selectivity being excellent, it need not be increased for any ordinary purpose. It is of no advantage to shield such a circuit as this; in fact, it may be a disadvantage. Shielded models in the laboratory did not prove as sensitive or as selective as unshielded models.

However, any who are hard pressed for selectivity, because of proximity to a strong local, provided they have a first stage of resistance or impedance audio, may use a 240 tube with detector grid returned to F minus of the detector filament, instead of to A plus, and the grid leak and condenser shorted out, or the coil connected directly to grid, at one terminal, without the use of the leak and condenser. This provides a slightly negatively biased detector, as the action of the tube is such as to produce a small negative bias even when the grid is returned to what looks like a zero bias (negative filament).

The detector bypass condenser, C6, may be included in either instance. Its value is .00025 mfd. Its purpose is to counteract feedback and to keep radio frequencies out of the audio amplifier or phones.

The bypass condenser, C3, from screen grid (G post of socket) to A minus of the first tube, should be included, even though the ear may not be able to detect much difference with that condenser in or out. On feeble signals, however, the effect of the condenser is noticeable. The capacity is .01 mfd., but if desired any larger capacity may be used. C3 never can be too large, whereas C6 should never be larger than .001 mfd., because C6, if large, would bypass too much of the upper audio frequencies in the modulation.

[Next week, the AC Model.]

Wrong?

nswer These Questions

vious Articles?

and contract in unison with the speech current and the expansion and contraction will be communicated to the surrounding air as sound waves.

(4)—Wrong. A screen grid tube is a good detector when the various voltages applied are adjusted properly, and it is easy to make the adjustment. Usually two of the voltages can be left at given normal values and the adjustment made by adjusting the third. The adjustment is best made by operating on the grid bias.

(5)—Wrong. Radio signals don't stop anywhere; they merely attenuate or grow weaker and weaker as the distance from the transmitting station increases. The attenuation is much greater in day light, it is true; but no matter how weak they become they can be received if the receiver has sufficient sensitivity. It is also true that in the day time the sensitivity needed is sometimes so great that when the signal is brought in with audible intensity incidental noises may be louder than the signal. But the presence of various forms of interference has nothing to do with the bringing in of the signals.

(6)—Wrong. It is only necessary to complete the tuned circuit in the plate with a condenser across the plate voltage supply and ground to rotor of the variable condenser. This arrangement is often used in the oscillator in superheterodynes.

(7)—Wrong. The only conditions for having a good intermediate filter is that all the tuned circuits in it be adjusted to the same frequency, whatever that may be. Good superheterodynes have been constructed with intermediate frequencies ranging from 30 to 450 kilocycles. There are complications which make it desirable to select frequencies around 200 kilocycles, but that is not necessary.

(8)—Wrong. This is not at all the simplest way, although it is a very good way. The simplest way is to tune each tuner in the intermediate frequency filter for loudest volume just as if it were a radio frequency tuner, using for the purpose either variable condensers or variable inductances, or both.

(9)—Right. There is no simpler way and none more effective than to use a rheostat in the filament circuit of one or more tubes. Usually it is not necessary to put more than two tubes on the rheostat.

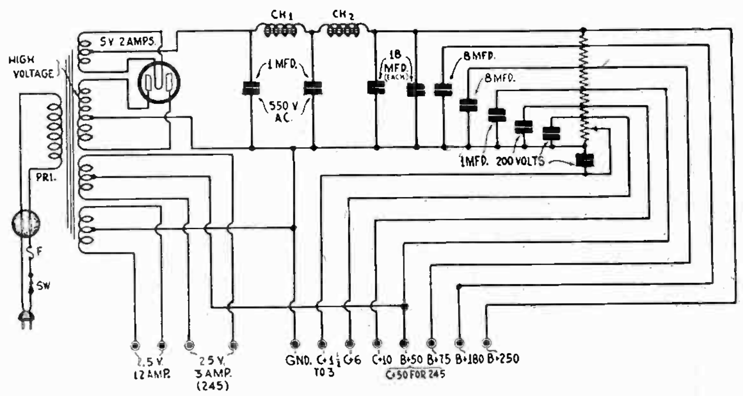
(10)—Wrong. It varies proportionately just as much when there is a high resistance in the plate circuit as when there is a low DC resistance in it. But the current is very small in comparison with the screen current so that if the total current is measured in the return from the cathode, or from the filament the current appears to be constant as the bias is changed. The change in the plate current does not appreciably alter the reading on the meter. It is also true that the screen and plate currents are complementary. That is, when one increases the other decreases. This also tends to keep the total current, as measured in the grid bias resistor, for example, constant in value. This has an important bearing on feedback through the grid bias resistor. Since there is no change in the total current through the grid bias resistor when the bias is changed, there is no change when the grid voltage changes due to an impressed signal. Hence, there is no feedback through the grid bias resistor.

The Carroll ABC Sup

Provides All Filament, Plate and Bias Voltages for

By James

Contributing



WIRING DIAGRAM OF THE ABC SUPPLY, AN EXCELLENT B ELIMINATOR FOR ANY TUBES, WHERE NOT MORE THAN 250 PLATE VOLTS ARE REQUIRED WITH NOT MORE THAN 50 VOLTS NEGATIVE BIAS FOR THE POWER TUBE, AS FOR A 245. SIX TUBES MAY BE WORKED FROM THE HIGH CURRENT 2.5 VOLT WINDING. THE TOTAL PLATE AND BLEEDER DRAIN SHOULD NOT EXCEED 100 MILLIAMPERES, ALTHOUGH THE VOLTAGES ARE RECKONED ON THE BASIS OF 80 MILLIAMPERES.

"PEASE let me have a B eliminator that supplies 250 volts for a 245 tube, or two 245 tubes in push-pull, and the filament voltages and B voltages for the rest of the set, as well as all other necessary biasing voltages."

Imagine a radio enthusiast asking a dealer to supply anything like that! It would be a rather large order, although perhaps not impossible of fulfilment. At least one who shopped around at fourteen stores in the largest retail radio market in the United States could not procure for love nor money just such a built-up device. Therefore the alternative was to build it himself, and your humble servant did just that. Having spent at least enough time on the design and its execution, he felt that other builders should be given the advantage of the time thus spent. So here are the results.

CAN CHANGE YOUR SET TO 245s

The ABC eliminator involves nothing new, remarkable or sensational, as no such extremities were desired, just excellent service. There is B voltage for the 245 tube, single or push-pull, heater voltage for amplifier or detector tubes, up to six, you might use, providing they are of the 2.5 volt heater type, besides C biasing voltages from 1½ volts to 50 volts, and B voltages of 50, 75 and 180 and 250 volts.

LIST OF PARTS

One Polo power transformer, providing 2.5 volts 12 amperes, 2.5 volts 3 amperes, 5 volts 2 amperes, 724 volts no load, 110 v. 56-60 cycle primary* all windings except primary center tapped (red); two chokes built in.
One 11½ x 6½ x 6½" cadmium plated punched steel chassis with 280 socket built in.
One 2 ampere fuse with mounting clips.
One convenience outlet.
One pendant switch with 12 ft. AC cable.
Twelve binding posts.
Two 1 mfd. filter condensers, 550 volts AC continuous working voltage.
One Mershon electrolytic condenser, two anodes 8 mfd., two anodes 18 mfd., with bracket, 415 volts DC continuous duty. (Cat. Q 2-8, 2-18 B).
Five 1 mfd. 200 volt DC bypass condensers.
One Multi-tap voltage divider, with 15 taps, brackets.
One Clarostat Humdinger, 30 ohms.
One 280 tube.
** This block is obtainable also for 25 or 40 cycles.*

So if you have a receiver now, for which you want a B eliminator, and you desire to incorporate the 245 tube, you may do so by building this ABC Supply in compact and good-looking form. If you do not want to use the filament voltages of this supply for the receiver itself you need not use them. No harm will come of working these secondaries at no load.

The total voltage from negative to positive is about 300 volts, but as the bias is to be provided for the power tube that takes 250 volts, the other 50 volts are used for negative biasing of the output.

All grid returns are made to grounded negative B, which is effectively C minus, of different values of bias, depending on the method of connection. However, if you have a receiver that obtains negative bias through drops in independent resistors, or otherwise, you may ignore the bias possibilities of the present design, still without harm or injury.

CAPACITIES EXPLAINED

The supply is built on a cadmium-plated steel chassis, with power transformer-choke block on top, with socket and Mershon condenser case, and a row of binding posts, although these posts are not shown in the photograph. Underneath are placed the Multi-Tap Voltage divider and two filter and several bypass condensers. The so-called filter condensers are 1 mfd. capacity, 550 volts AC steady working voltage, one next to the rectifier, as this capacity is adequate for the purpose. Too high a capacity next to the rectifier not only might put too great a starting strain on the rectifier tube but might bring up the hum component, which is purposely kept low enough not to be objectionable. Also below are the fuse and its clips.

It is assumed that the reader knows how to connect a B eliminator. Negative of B should go to negative of A of a battery-operated receiver, or the negative of the B supply should go to the grid returns of an AC receiver. But a few words will be said about introducing 245 output to replace 171A, 112A, 210 and the like.

The wiring of the filament leads to the present output tube or tubes of the existing receiver must be removed. The 2.5 volt 3 ampere of the power transformer should be connected to the vacated filament posts of the output socket or sockets of the receiver. The center tap of this winding is brought out to a binding post of the ABC supply, and is to be run to the fourth lug from the low end of the Voltage Divider if push-pull is used, or if single 245 is used, to the fifth lug from the bottom. The "low end" has the multitude of taps.

WATCH THE WINDINGS

Do not confuse the two 2.5 volt windings. The one of large current capacity, intended for not more than six 227, 224 or 228 tubes or combinations thereof, is not for the power tube, and the fact that it is not is disclosed by the high current rating, 12 amperes. The power tube filament winding, also 2.5 volts, is rated as 3 amperes. The windings are worked on the block.

The changes stated are the only ones necessary when connecting this ABC supply to an existing receiver into which 245 output is introduced.

On the subject of C bias, however, the situation is a little deeper. If the receiver is battery-operated you must use batteries for biasing other than the output tube or tubes. The reason is that the filament is common and a part of the radio circuit proper, so connection of A minus to B minus, for instance, leaves no possibility of providing bias by resort to the voltage divider or to independent resistors in each tube circuit. Indeed, no independent resistors could be used, as any bias thus obtained for one tube would be the same bias for all tubes. If the first audio tube were given 6 volts negative bias, so would the radio frequency amplifier tubes and the detector. Result: no results! So for a receiver with battery-operated filaments you must adhere to battery-operated bias of all save the output tube or tubes.

For any AC receiver, however, the bias may be obtained by using independent resistors or by resort to the voltage divider. Any directly heated AC tubes, e.g., the 226, if given any bias provide the same bias for all tubes served by that filament winding (1.5 volts, provided independently, and not through the

Easy to Change Your S

ply to Work 245 Output

AC Receiver, and is B Eliminator for Other Sets

I. Carroll

Editor

present supply, which has no 1.5 volt winding, as 226 tubes are not in vogue). But the situation in respect to the 226 tube resulting in the same bias for all is satisfactory, since the 226 is never anything save an amplifier, never is a detector and never is an output tube. So an amplifier bias of 3 volts would be satisfactory.

BIAS FOR AC RECEIVERS

It has been stated that biases from 1½ volts to 50 volts are obtainable and the reason is that an extra resistor is used as at the low end of the voltage divider to afford from 1½ to 3 volts. This is a 30-ohm Clarostat humdinger. By connection of the center tap of a 226 filament winding to the center lug of the Humdinger, the bias may be varied with a screwdriver, by turning the resistor arm, until highest sensitivity, or best stability consistent with best receptivity, is obtained.

Hence the rule of one for all and all for one is not only satisfactory in respect to the 226 bias but is commendable.

The center tap of the 226 filament winding externally obtained, already in the receiver proper, would be connected to the projecting lug at center of the Humdinger, while the grid return would be made to ground, and a bypass condenser of 1 mfd. 200 volts DC working voltage connected from this lug to grounded negative.

BIAS FOR HEATER TUBES

Where the heater type tube is used, any bias may be obtained for any tube, and all biases may be different, or some different and others common, or all common, as you desire. The method of obtaining any desired bias for such tube is to connect grid return to ground and select any point on the voltage divider intended to give the desired voltage drop for bias, joining the cathode to this higher point. Various biases, high and low, are provided, in the event you desire to obtain detection on the negative grid bias or power detector principle. It is not recommended, however, that the detector bias be obtained in this way, as it is preferable, especially with a screen grid tube (224) used as detector, to employ an independent resistor from cathode of detector to ground, independently bypassed by 1 mfd. capacity. The value of such a resistor may be 5,000 ohms when the plate voltage applied is about 180 volts and the screen grid voltage is whatever stability requires, usually 50 to 75 volts, 50 being all-sufficient in very sensitive receivers.

The reason for the comparatively low value of resistance, 5,000 ohms, is that despite the low plate current (for first stage resistance audio it would be only about .2 milliampere in the detector) the screen grid current flows through the resistor. This is advantageous and dispenses with the necessity of bleeder current for permitting lesser resistance value, hence lower impedance to the plate current. The screen grid current, therefore, under the above circumstances would be about .9 milliampere, so the negative bias on a screen grid detector tube thus used would be a little more than 5 volts. This is a good operating point indeed.

45 VOLTS USED TWO WAYS

The same positive voltage of 45 volts used for connection to the midtap of the power tube filament winding serves as a B voltage for other tubes, or a screen grid voltage, because the positive of no other biased tubes is connected that high up. Therefore actually the positive B voltage for screen grid or other purpose would be the difference betwen th bias voltage of that tube and the bias voltage of the output tube. For a 224 detector biased 5 volts negative, the screen voltage would be 45 volts effective, when obtained from the rated 50 volt tap.

The independence of the filament circuit and the connection of the filament or cathode for biasing permits the use of the same 45 volts in one direction for the power tube and in the other direction for any other tubes.

As for methods of assembly and wiring. the subpanel or chassis is specially made to receive the specified parts, although if any deviation from specifications is to be made, holes may be drilled in the chassis without much trouble. The steel is scarcely much harder to drill than bakelite. In factory-made products, however, the holes are punched instead of being drilled, hence have a clean edge.

The wiring is orthodox. It is well to remember that the 5 volt winding is only for the filament of the 280 rectifier tube. It must not be used for any other purpose, not even to light a pilot lamp. The reason is that the filament of the rectifier is extreme positive B voltage and you don't want that close to hand. Light any 2.5 volt pilot light from the 2.5 volt 12 ampere winding, or you may light even a 5 volt bulb from the 2.5 volt winding and get all the illumination necessary for piloting or for reading a dial.

SIDE VIEW OF THE ABC SUPPLY, BUILT ON A CADMIUM-PLATED STEEL CHASSIS, WITH POWER-CHOKE BLOCK, MERSHON CONDENSER AND SOCKET ON TOP, AND ALSO BINDING POSTS (NOT-SHOWN). THE OTHER PARTS ARE UNDERNEATH. THE LEADS FROM THE POWER TRANSFORMER-CHOKE BLOCK ARE BROUGHT FROM TOP TO BOTTOM THROUGH HOLES THAT ARE PROTECTED BY RUBBER GROMMETS.

NOTE ON GROUNDING

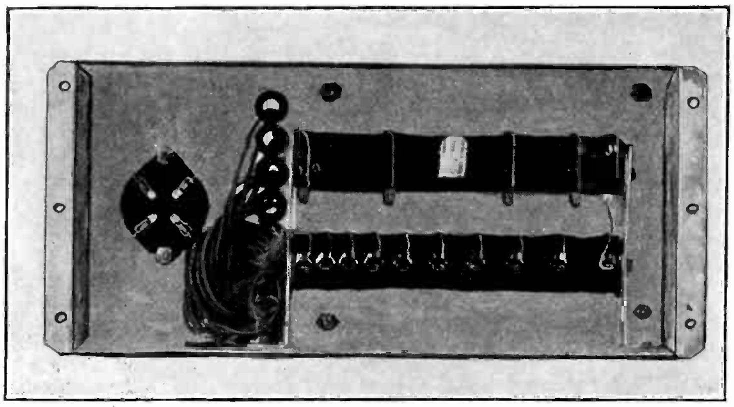
The center tap of the high voltage winding is negative of the B supply which, in some instances, as stated, will be C minus. This should be grounded. In some special instances hum is produced when the ground wire is connected to this post, so then use the ground lead as aerial and connect the aerial to the ground post. What you are doing, in fact, is grounding the negative of the B supply, and the reason for the quirk is that the ground lead is at a higher radio frequency potential that the aerial. This sometimes happens to dwellers in the upper stories of tall buildings, or even six-story apartment houses, in particular where the radiator is used as ground.

The chassis being metal, any leads taken from top to bottom

et to Have a 245 Output

Good Filtration Needed

Large Capacity in "Reservoir" is Advisable



BOTTOM VIEW OF THE ABC SUPPLY THAT ENABLES ONE TO OBTAIN ALL FILAMENT VOLTAGES FOR 280 RECTIFIER, 245 OUTPUT AND ANY OTHER 2.5 VOLT AMPLIFIER AND DETECTOR TUBES (224, 227 OR 228) UP TO A TOTAL OF SIX SUCH AMPLIFIERS OR DETECTORS.

(*Continued from preceding page*)

through drilled or even punched holes might endanger the insulation of the wire used for connection, due to severance of insulation if any strain is put on the wire at the sharp point of passage from top to bottom. To avoid any such cutting, the leads from the power transformer-choke block are brought through rubber grommets, so all danger on this score is averted.

The power transformer has the filament and high-voltage secondaries, the primary and the two chokes built in. The diagram shows what seems to be a single choke, center-tapped perhaps. The block has two equal chokes and there are two leads for each choke, these four leads being marked "chokes." Everything is properly marked, by the way. Connect either terminal or one choke to either terminal of the other choke, to establish a midtap. Then either remaining extreme may be used next to the rectifier and the other extreme at the "top" of the voltage divider.

This whole ABC Supply can be wired in one hour. It will produce excellent results: required voltages, well-filtered current, steadiness of voltage.

The required voltages arise from the voltage across the high voltage secondary, when the resistance of the rectifier tube, the choke coils and the voltage divider is considered.

The actual output voltage will not be the same in all instances, as it will be higher at less than 80 milliamperes total drain, and less at more than 80 milliamperes drain, but it is safe to drain up to 100 milliamperes or to use as low as 30 milliamperes external drain. The voltage divider total resistance is low enough (13,850 ohms) to supply an adequate drain for steadiness of voltage and to insure an adequate minimum. About 30 milliamperes will flow through the divider alone. Hence you can not turn on the juice and encounter "no load." The voltage divider load is always there and the rectifier tube is therefore safe, likewise are the condensers.

If there is any difference from the rated voltages, the same percentage of difference is taken up at the intermediate taps, so that proper bias results, and no concern need be felt, therefore, if you get a total reading of 325 volts, instead of 300, just as an example, or 290 volts instead of 300.

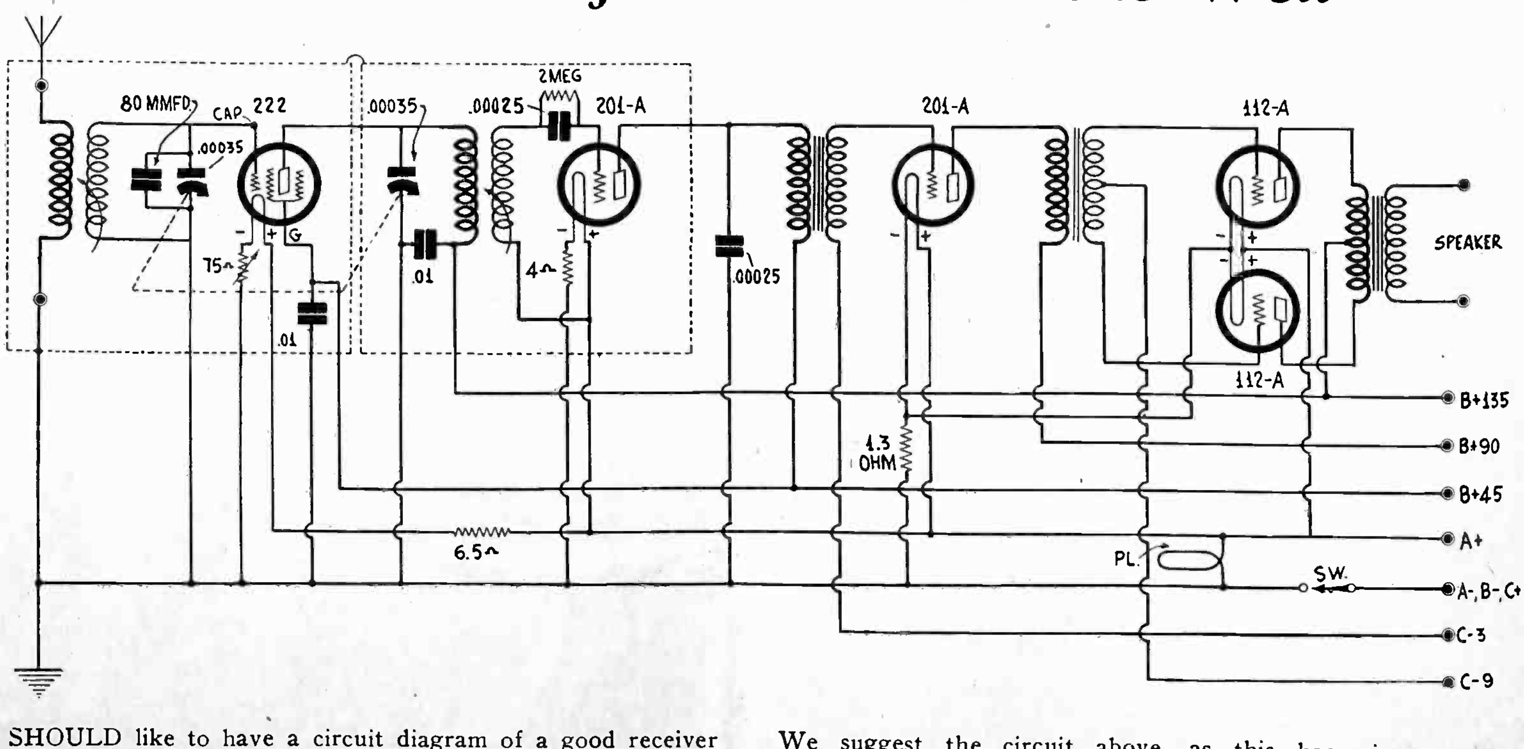
The voltage will be high enough, and the total difference will not exceed 25 volts, especially as the capacities are such as to help maintain the voltages.

Filtration is well aided by the capacities of the Mershon, since the end of the choke chain has 36 mfd., consisting of two 18 mfd. anodes of a Q 2-8, 2-18 interconnected. The 8 mfd. anodes are nearer the edge of the copper case. The case itself is negative, and goes to ground by connection to the mounting bracket. Do not rely on the connection of the case to the subpanel as sufficient. It usually is, but you shouldn't assume it will be in your case.

Across the 180-volt tap one of the 8 mfd. sections is connected, while the other 8 mfd. anode goes across the biasing section. Wherever you connect this bias, the positive of the power tube filament, see that the bypass condenser for the power tube bias goes to the same place. Do not leave the 8 mfd. at one tap and connect the midtap of the power tube filament winding to some different tap. Unless this precaution is taken the bypassing is next to nothing, and tone quality is ruined.

At least 4 mfd. always is necessary across the biasing section of any power tube, as all the plate current of the output tube or tubes flows through this section, and in the present instance also the bleeder current of the voltage divider and the plate current of any other tubes served by the supply.

Circuit That Gets Local Stations Well



I SHOULD like to have a circuit diagram of a good receiver with which I can get all the local stations with a short indoor antenna and stations up to a thousand miles with an outdoor antenna. Please publish a circuit diagram of a receiver which you would recommend. Quality is a requisite.—A. B.

We suggest the circuit above, as this has given many builders satisfaction. The quality you get depends on the grade of audio transformers you use. The screen grid tube working between two tuned circuits insures a high gain and good selectivity.

AC to DC and Back

Plate Current Gap Explained for Schoolboys

By J. E. Anderson and Herman Bernard

THE two types of current are alternating and direct, and both are used in all receivers. If the current is alternating the voltage is alternating. If the current is direct the voltage is direct. We speak of 110 volts AC, although our principal concern is the voltage, since the current will depend on the load placed upon this voltage.

An example of alternating current present in every receiver is the input radio frequency wave. It is alternating because it changes its polarity at a given number of times a second, the number of times expressing the frequency. Since the frequency of a carrier is high, it is a radio frequency. There is no definite limit to where audio frequency stops and radio frequency begins, or where radio frequency stops and heat frequency begins. Beyond heat frequencies lie light frequencies.

An example of direct voltage is the plate voltage. Only in a few amateur transmitters and receivers is alternating voltage used on the plate, and even this practice is discouraged by the Governmental agencies controlling radio. So it may be said that only direct voltage may be used for the plates. Alternating voltage produces abnormal hum there.

A FASCINATING PHENOMENON

Plate voltage and plate current being direct, it might seem strange that the signal frequency, with its astonishing rapidity of polarity reversal, could be duplicated. Less strange perhaps would be the fact that the audio frequencies present after detection also are present in the plate current.

How these conditions come about is one of the most interesting subjects in connection with radio and the vacuum tube in particular.

Suppose that a station is transmitting on 300 meters, 1,000 kilocycles. The radio frequency is tuned in, let us say, through two stages of tuned radio frequency amplification, and passed onto the detector through another tuned stage.

In the antenna winding the fluctuating voltage and current are active independent of plate current, since here electromagnetism alone is functioning. The input is to the grid-to-filament circuit of the tube. This, too, is independent of plate current. We can understand now that this input is isolated from plate current action.

But how about the output of the first tube?

The output is taken through a winding that duplicates the antenna winding. There is a fluctuating voltage across this winding. There is no magnetic coupling between the antenna coil and the first inter-stage coil we are now considering. There is no capacity coupling, no resistance coupling. Any coupling of any such type is stray or accidental, and small. If large enough to cause trouble it is eradicated by neutralization or shielding or by both methods.

WHAT THE TUBE DOES

Now we encounter the first example of the phenomenal action of a radio tube. If you heat the filament to the proper temperature, which is automatically established by using the rated voltage across the filament terminals, electrons are copiously emitted, and these flow through the grid to the plate. The plate current is said to flow from the plate to the filament hence against the stream of electrons, a handy fiction, since all direct current flows in one direction only.

If there is a suitable load on the plate circuit, with a positive voltage applied to one terminal of this load, and the grid is returned to some point preferably slightly negative in respect to the negative filament, and the signal is impressed on the grid circuit, the voltage changes taking place in the grid circuit are duplicated in the plate circuit, only on a magnified scale, magnified because the tube is used as a magnifier, or, in the more usual term, as an amplifier.

This action takes place by virtue of comparatively small changes in voltage in the grid circuit producing the same changes in the plate current, but on an enlarged scale. The signal voltage in the plate circuit changes at the same pace, likewise enlarged.

PLATE CURRENT IS DISTURBED

The positive battery or plate voltage applied to the plate of the tube through its load impedance—coil or resistor—causes plate current to flow, and this plate current is direct. It is called unidirectional, because it flows in only one direction, positive to negative. That is only another way of stating it is direct current.

But instead of being a steady direct current, as when a flashlight is illuminated by a dry cell, it is an unsteady or changing direct current, the unsteadiness or rate of change being determined by the changes in alternating voltage values as received at the grid-to-filament circuit of the tube.

If there is a frequency of 1,000 kc fluctuating in the grid-to-filament circuit, the plate current rises and falls 1,000,000 times a second. It never changes its polarity. It rises from zero to maximum and back to zero. Always positive, never reversing. So, to distinguish it from steady direct current, it is called pulsating direct current. It is still unidirectional, since it never changes its direction of flow, but only rises and falls in enlarged sympathy with the grid input voltage.

In amplification we are concerned almost exclusively with voltage, not with current. There is current, to be sure, but elevation of potential is the achievement accomplished by amplifiers.

The plate current changes, unaltered in frequency from the alternating grid voltage, pass through the primary of an interstage radio frequency transformer, and since passing current through a coil of wire sets up an electro-magnetic field, and since the current thus passing is direct current pulsating at a frequency of 1,000,000 cycles per second, the coil is made to behave just like the antenna coil, in that it now handles alternating current and voltage of that very frequency.

LOST CHARACTER REGAINED

It will be seen, therefore, that in the chain of events leading to the final accomplishment of loudspeaker reproduction, that the alternating voltage loses its character as such in the plate voltage itself, but that the phenomenon of electro-magnetism enables the passage of a fluctuating direct current through a coil to restore the condition of alternating current.

The same process is repeated in subsequent stages, until the

(*Continued on page* 15)

Questions

(1)—In a voltage divider connected across the output of the rectifier in a B supply, does any current flow, and if so why and in what direction?

(2)—If we know the resistance of a voltage divider and the voltage across it, can we compute the current? If so, how?

(3)—If we know the current and the resistance, can we compute the voltage? If so, how?

(4)—If we know the current and the voltage can we compute the resistance? If so, how?

(5)—If the voltage across a divider is 300 volts and the plate of a receiving tube is connected to an intermediate tap of 180 volts, does the plate current flow through the entire resistor?

(6)—How is negative bias for an AC receiver obtained from the voltage divider?

(7)—State two reasons why a rated 180 volt tap may give less voltage.

(8)—Does current flow differently in a B supply of the AC type than in B batteries?

(9)—What is one advantage of an adjustable or multi-tap voltage divider?

(10)—Does plate current flow in the filament of a receiving tube? In the cathode of a heater type tube?

Answers

(1)—Current flows in a voltage divider across a rectifier output because of the potential difference across the extremities, and the direction is from positive to negative.

(2)—Yes. The current in amperes equals the voltage divided by the resistance in ohms.

(3)—Yes. The voltage equals the product of the current in amperes, and the resistance in ohms.

(4)—Yes. The resistance in ohms equals the voltage divided by the current in amperes.

(5)—No. The plate current flows from the 180 volt tap to plate of tube and to filament of tube to negative B, skipping the distance on the voltage divider between 180 volts and negative.

(6)—By connecting the filament winding center tap, or in the case of heater type tubes, by connecting the cathode to a potential higher up on the voltage divider than the grid return.

(7)—The rated 180 volts may be less in practice due to heavier current than intended. This heavier current causes a higher drop in the resistor and also reduces the voltage from the rectifier tube itself.

(8)—No.

(9)—Desired voltages may be obtained by direct reading of a high resistance voltmeter without requiring extensive or in fact any computations.

(10)—Yes, plate current flows in both.

Compactness Often S

Minimizing By-Pass Condensers is Poor

By Herbert

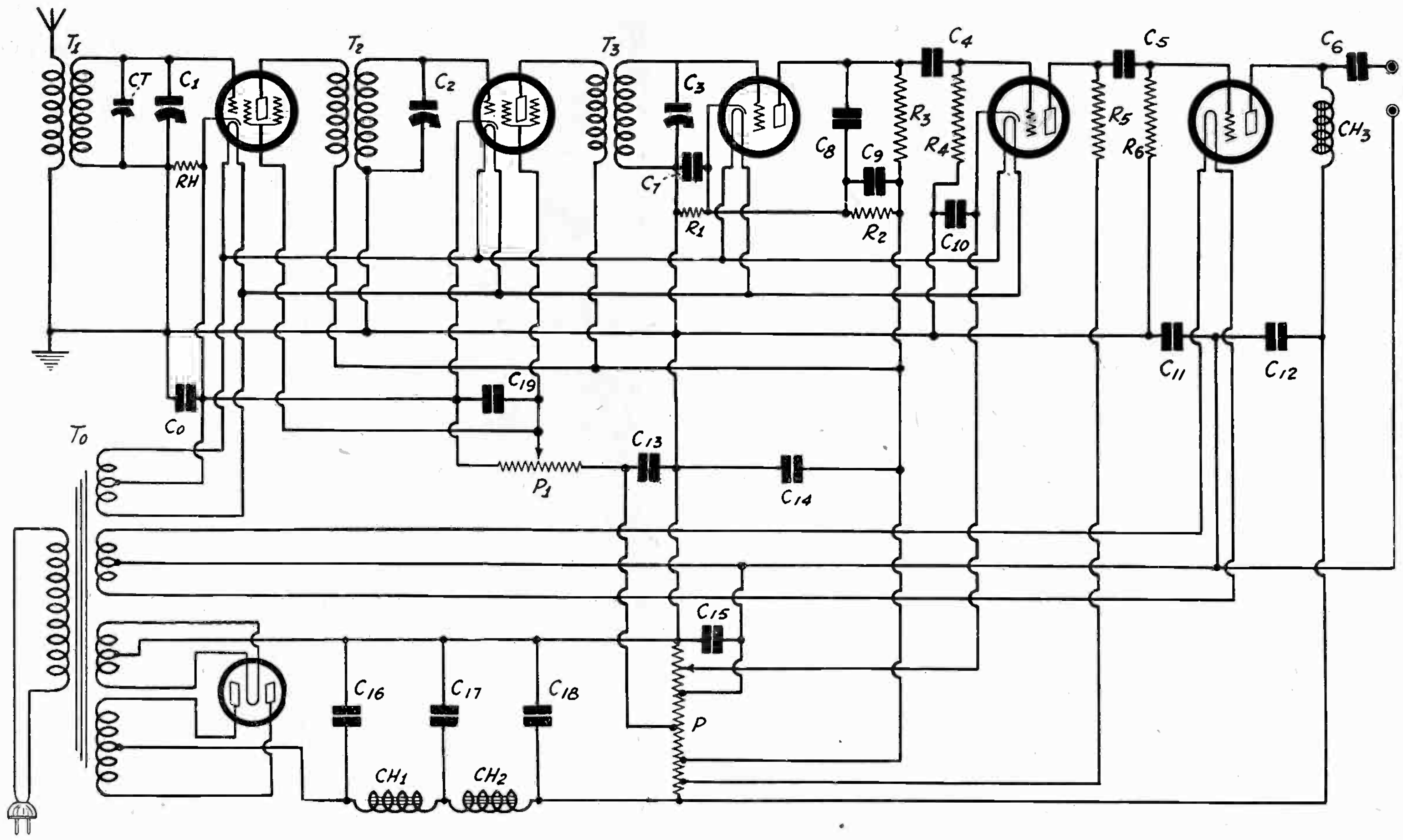


FIG. 1
THE DIAGRAM OF A COMPLETE AC OPERATED SCREEN GRID RECEIVER USING THREE TUNED CIRCUITS, GRID BIAS DETECTION AND RESISTANCE COUPLED AMPLIFICATION WITH ONE PURPOSEFUL MISTAKE. WHAT'S WRONG?

WHEN set builder starts assembling a high quality receiver one of the first things he discovers is that he needs lots of room. He wonders how it is that manufacturers can make such compact receivers as they do and still keep the quality up. What is the answer to this wonderment?

There are, of course, many factors which enter into the answer. Manufacturers have a staff of engineers whose duty it is to make everything as compact as is consistent with passable quality of performance in the finished product. Some of this entails sacrifice of many things which others consider essential to the highest order of performance. Others simply indicate that the parts have been designed so that they will dovetail into each other and so occupy the least possible amount of space.

One way of saving space is to make the radio frequency coils small. This is now permissible since many tuned stages are used in receivers and selectivity is obtained by the cumulative effect of many circuits rather than by the superior excellence of a single circuit. Still another factor which accounts for a certain saving of space is the use of gang condensers. Often as many as four tuning condensers can be put in a smaller space than formerly occupied by two condensers.

Then, again, space is saved by using sockets which are not much thicker than a postage stamp and which are directly mounted on the metal subpanel. That this is a saving in space is immediately evident on comparing a receiver using the old type socket and the new type. This change is not one in which any sacrifice was made for the new type is superior to the old.

CONSTRUCTION OF AUDIO AMPLIFIER

Perhaps the greatest saving in space is effected in the audio amplifier, and this saving is often effected by sacrificing quality, although not always. As a rule, if an audio transformer is to be good it must be of large size. But small transformers cost much less to make and require much less room, and therefore many manufacturers prefer to put in small transformers and trust to the ability of the advertising writer to supply what quality there is associated with them. Fortunately, some of the very best audio transformers that can be obtained are not excessively large, so that the amateur and professional set assembler can get the best there is without requiring a trunk in which to build the receiver.

One way of saving space in a receiver and still retain the best of quality is to use resistance coupling in the audio amplifier. Manufacturers generally have avoided this form of coupling, although the first cost of the receiver would be much less than when transformer or impedance coupling is used. Of course, there is a reason. A manufacturer operates on the basis of selling receivers and making them stay sold. There has been so much trouble with resistance coupled audio amplifiers that circuits incorporating them have not stayed sold, even if the engineering department of the manufacturer was able to put them out in a satisfactorily operating condition.

SKIMPING ON POWER EQUIPMENT

One reason why much trouble has been experienced with resistance coupled audio is that there has been too much skimping in the power equipment. B supply units capable of operating resistance coupled audio amplifiers must have good regulation and they must be thoroughly by-passed. This means high cost of power transformers, filter chokes and condensers. The cheaper way is to use small power equipment inadequately by-passed and then using rather cheap audio transformers in order to make the circuit perform. There is an overall saving in space requirements. The resulting quality has been passable in competition with that of other receivers designed on the same basis.

Power supply devices for complete radio receivers have been built so small that one of these units occupied no more room than a by-pass condenser block or a power transformer in some other receiver designed primarily for high quality and ample power. These small units are now frequently obtainable for less than the original cost and many of them are placed in receivers intended for high quality reception. These units account for a large proportion of complaints from amateur set builders whose technical knowledge is insufficient to appreciate the value of the Biblical injunction against putting new wine into old bottles.

SPACE-SAVING SPEAKER

Another point where manufacturers save space is in the loudspeaker. If the receiver must fit into a small cabinet it is

queezes Out Quality

Economy When Realism is the Goal

E. Hayden

usually not possible to use as large and powerful speaker as ought to be used. For example, where it is desirable to use a speaker with a cone diameter of 10 or 12 inches one of a 6-inch diameter may be used. Further, when a baffle board of 36 inches square is desirable none at all may be used. There simply is no room for one. Also in conjunction with the loudspeaker, an output filter or output transformer may be omitted when performance would dictate its use.

It is not difficult to build a DC receiver into a small space, if by the receiver we mean the tuner and the audio amplifier. But if we include the filament supply source and the B supply this problem is no less difficult than that of designing an AC receiver. Indeed it may be more difficult because a storage battery, or an A battery eliminator, usually takes more room than a filament transformer large enough to handle all the tubes in any receiver. If then we use a storage battery and provide a charger of some kind, the DC receiver will take more room than the most elaborate AC receiver. In drawing up DC or battery receivers it is customary to omit all power sources, but this omission in no way simplifies the circuit as a whole.

If the well-constructed AC receiver occupies more room than an equally well-constructed battery type receiver it may be due to the use of more and larger by-pass condensers. The AC receiver is characterized by the number and size of condensers used. They must be employed as a rule to eliminate hum and to make the circuit perform without any indication of the manner in which it is powered.

Just to illustrate this point we include the circuit in Fig. 1, which is a complete receiver designed for AC operation and for high quality and sensitivity. There are no less than 21 condensers. If we should desire to reduce the number of condensers, which of these should be left out? It is difficult to say for every one serves a definite purpose, and a very useful one at that. Remove one of the condensers and the receiver will not be as good as it was before. Decrease one of the by-pass condensers, with the sole exception of C8, and the receiver will be less satisfactory. Although 21 condensers are used, some have been made to perform double duty. For example, Co and C19 both serve the two first tubes.

FUNCTIONS OF CONDENSERS

Let us see what the function of each of the by-pass condensers is. Starting with Co, it by-passes the grid bias resistor Rh which serves the two screen grid amplifiers. It works at radio frequency and at low voltage, so it does neither have a large capacity nor a high voltage rating. About .5 mfd. is plenty large enough and the voltage across it will never exceed five volts. It will not even reach it.

Next comes C19, which serves the screen grids of the same amplifiers. The same size is large enough since only radio frequency is involved. But the voltage across it will be high, so it should be rated at least 200 volts. Next we jump to C7, which is connected across the bias resistor of the detector. This works at both radio and audio frequencies, but since if it is large enough for the low audio frequencies it will be large enough for all frequencies. A condenser less than 2 mfd. is of little use in this position, so that should be the minimum. The voltage across it might rise to 50 volts, although the normal value will not be more than about 20 volts. The rating should be higher than the highest voltage that may occur across it.

Going on to C8 we find that this is connected across the line, which means that if it is too large the high frequency notes will be by-passed. And if it is made too small the detecting efficiency of the tube will not be good. So we have to compromise. The writer prefers a .0005 mfd. condenser in this position, but many others prefer a .001 mfd. Any mica dielectric condenser having either of these values is all right.

C9 and C12, respectively, by-pass the plate supply voltages to the detector and the power tube. They work at audio frequency and therefore should not be smaller than 2 mfd. and the highest voltage will normally be 250 volts. A condenser rated at 400 volts will work safely in both cases. C10 by-passes the grid bias resistor for the first audio tube. A low voltage rating condenser will do but it should not be smaller than 2 mfd. and a 4 mfd. will work much better. C11 by-passes the 50-volt bias for the power tube and its position is rather critical. One way of getting poor results is to make this condenser less than 4 mfd. and a way of getting very poor quality as well as as low output is to omit this condenser entirely.

B SUPPLY CONDENSERS

The remaining condensers used for by-passing, namely, C13, C14, C15, C16, C17, and C18, are the usual condensers in the B supply. C10 really falls in this group too. All of these condensers might well have a value of 2 mfd. with the exception of C18, which should be much larger. Indeed all but C16 might well be much larger. It is recommended that condensers C14, C15, and C18 be electrolytic of large value.

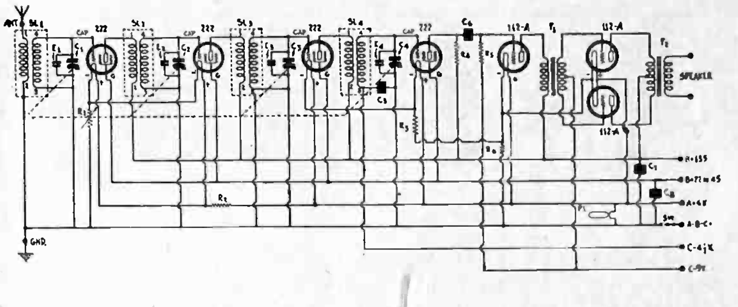


FIG. 2

A BATTERY OPERATED RECEIVER USING FOUR TUNED CIRCUITS, RESISTANCE AND PUSH-PULL COUPLED AUDIO. IN THIS CIRCUIT FEW BY-PASS CONDENSERS ARE USED BECAUSE EITHER B BATTERIES ARE SUPPOSED TO BE USED OR THE BY-PASS CONDENSERS ARE TO BE BUILT INTO THE B SUPPLY UNIT.

The first three condensers in the filter, namely, C16, C17 and C18 will be subjected to heavy stresses and they should have a high rating. C18, contrary to usual opinion, will be the most severely used and is the one that usually breaks down first. Since an electrolytic condenser does not stand much in excess of 400 volts, the other condensers need not have a much higher rating either. A momentary break-down of C18 will do no harm except that it will ruin the signal for a moment. But if the break-down is persistent the rectifier tube might blow up.

The three series line condensers should have the following values: C4 and C5, .01 mfd. each and C6 from 2 to 4 mfd.

P is an ordinary voltage divider provided with plenty of taps and of a total resistance of about 13,000 ohms. P1 is a 25,000 ohm wire-wound potentiometer. The grid bias resistors should have the following values: Rh, 150 ohms; R1, 1,800 ohms; R2, 25,000 ohms, classed as grid bias resistor because it aids R1. R3 and R5 may have values from 100,0000 to 250,000 ohms and the grid leaks R4 and R6, one megohm each.

To, Ch1, Ch2 is a Polo block which contains high voltage and filament windings as well as choke coils. T1, T2, and T3 are radio frequency transformers designed for compact construction and screen grid tubes. They should, of course, also be wound for the tuning condensers connected across their secondaries. Ch3 is any good 30-henry output filter choke. If the inductance is higher than 30 henries, so much the better.

Why Small Condensers?

NOT so long ago it was recommended that the condensers in the B supply be as large as possible, not excluding the condenser next to the rectifier tube. But now a small condenser, usually one or two microfarads, are recommended in the first position. Why this change? If large condensers are useful in other positions, why is not a large one next to the rectifier also desirable?—T. P. R.

It has been found that when the first condenser is very large there may be more hum in the output than when a comparatively small one is used. This is particularly true when the first condenser is of the electrolytic type. Then, again, if the first condenser is large the rectifier tube is subjected to heavy current pulses which shorten the life of the tube. Manufacturers of tubes have even recommended that the first condenser be omitted entirely. There is one thing in favor of using a large condenser, and that is that it increases the output voltage a little. In fact, the output voltage with a condenser is nearly twice as great as that when no condenser at all is used. However, the difference between the output voltages when a condenser of one microfarad and a condenser of 50 microfarads is only a few per cent. There is no practical advantage in making the condenser larger than two microfarads. This does not apply to the condensers across the voltage divider and across sections of the voltage divider. These should be as large as space will permit, and it is well to provide plenty of space.

Principles of Operatio

Circuits Mutually Coupled But Indep

By J. E.

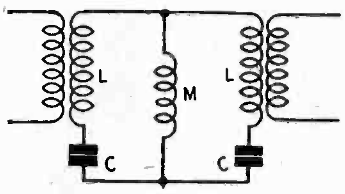


FIG 1

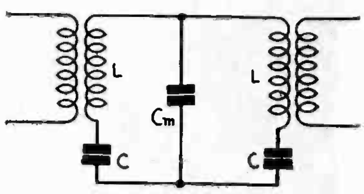


FIG. 2

A SIMPLE BAND PASS FILTER IN WHICH TWO EQUAL RESONANT CIRCUITS ARE COUPLED BY MEANS OF A SMALL INDUCTANCE COIL M, WHICH IS NOT IN INDUCTIVE RELATION WITH EITHER OF THE OTHER COILS. THE BAND WIDTH IN THIS IS DIRECTLY PROPORTIONAL TO THE FREQUENCY.

A SIMPLE BAND PASS FILTER SIMILAR TO THE ONE IN FIG. 1 BUT IN WHICH THE TWO EQUAL TUNED CIRCUITS ARE COUPLED BY MEANS OF A CONDENSER CM. THE WIDTH OF THE BAND IN THIS IS INVERSELY PROPORTIONAL TO THE FREQUENCY.

THE DESIRE for ten kilocycle selectivity is rapidly approaching the stage of an epidemic. Everybody, it seems, has caught it in some form or another, and some of the cases are quite virulent. Ten kilocycle selectivity now stands where "low loss" stood about four years ago. It is uppermost in the minds of the fans and no receiver is complete or acceptable unless it can boast of such selectivity.

Will ten kilocycle selectivity go the way of "low loss' tuners or will it still be with us four years hence? The answer depends on whether or not it can be realized practically, and if when realized it is really a desirable attribute in a receiver.

The idea of having a receiver which accepts every frequency within a 10 kilocycle band with equal facility and accepts nothing at all of frequencies lying outside that band is indeed enticing. It is easy "to fall for," and judging by the extent of the epidemic, many are those who have tumbled.

NOT DISAPPEARING

These statements are not meant to be disparaging, for ten kilocycle selectivity as outlined seems just as desirable to the writer as it does to any other radio fan. But there are difficulties in the way of achieving such selectivity. It cannot be done with any radio circuits or parts now known, and there is no indication that anything will be developed in the near future which will bring it about. The main difficulty is in the absoluteness of the demand. If we are willing to make a few concessions and accept relative values instead of absolute the problem is not insuperable. In fact, already quite a bit of success has attended development work along band pass filters which will approach the desired selectivity. But with the best band pass filters now available we must be satisfied with something less than ideal selectivity. We must tolerate a certain amount of discrimination of frequencies in the acceptance band, and we must also tolerate a certain amount of acceptance in the attenuation band. That is, we cannot now obtain a selectivity curve out of any practical band pass filter which is absolutely square topped with vertical slopes. Curves insist on being curves with rounded corners and gentle bends.

So long as we deal with inductance coils, condensers and resistances we cannot attain the ideal by quite a margin. There will be some sideband cutting or broadness of tuning, one or the other. Could we design inductance coils without any resistance and condensers without any losses, then we could hope of approaching band pass pass acceptance of the desired form by making the filter complex enough. But we cannot get away from losses and resistance in any practical circuit so we have to put up with something less than perfection. Even if the "low loss" coils of four years ago are resurrected we shall not get the desired selectivity.

PRACTICAL CIRCUITS

If we work with the condensers and coils which we now have we can construct fairly good band pass filters which will have characteristics which are much superior to filters consisting of simple tuned circuits which are used in all but one in every million receivers. We may have to use several band pass filters in tandem and make every one the same, that is, tune them so that they accept the same frequency band.

But when we have done that we still have on problem to contend with, and that is to maintain the width of the accepted band the same over the entire range of the tuner. Possibly that can be done by making two different kinds of filter, which are in a sense complementary to each other.

Let us explain what we mean. In Fig. 1 we have a simple band pass filter which has been used in many radio receivers and is therefore well known. In Fig. 2 we have a similar circuit but a condenser Cm is used in place of the coil M in Fig. 1. While these two filters look very much alike and both are band pass filters, their characteristics are quite different.

We can treat both mathematically at the same time. Let Z be the impedance of L and C in series in any one of the legs and let Zm be the impedance of either the coil M or of the condenser Cm. The condition for maximum reception with either circuit is then $Z(Z+2Zm)=0$. This equation is satisfied by either $Z=0$ or by $Z+2Zm=0$, and these two equations give the frequencies at which the acceptance is maximum.

INTERPRETING RESULTS

The condition $Z=0$ is the same for both circuits, and it gives the frequency at which L and C resonate. The condition $Z+2Zm=0$ is not the same for both circuits because it contains the coupling impedance Zm, which is different in the two cases.

Let w equal 6.28 times the frequency. Then we have for the square of the two frequencies at which the current is maximum in Fig 1 $w_1^2=1/(LC)$ and $w_2^2=1/(L+2M)C$ and in the other case we have the two frequencies $w_1^2=1/(LC)$ and $w_2^2=(1/C+2/Cm)/L$.

In Fig. 1 the second frequency of maximum current is lower than the first frequency of maximum. In Fig. 2 the second frequency is higher. If the two filters are made with the same constants, then the transmission bands will not coincide except at one maximum. This fact might be made use of in making a filter having a band twice as wide as the band of either one. To make the total band ten kilocycles it would only be necessary to make each band 5,000 cycles wide.

If the bands of the two are to coincide the constants must be made different so as to allow for the displacement of the maxima. This is easily done.

Band Widths

The width of the transmission band in either case is simply the difference between the two frequencies at which the current is maximum. The difference can be found by a simple computation for any values of L, C and M or Cm. It will be found that in Fig. 1 the difference is directly proportional to the frequency so that 2.72 times as wide at 1,500 kc as at 550 kc. It will also be found that in Fig. 2 the width of the band is inversely proportional to the frequency so that it is 2.72 times as wide at 550 kc as at 1,500 kc. This is the main difference between the two types of filter.

The reason for the change in the widths of the bands is that the degree of coupling between the two equal circuits changes as the frequencies changes. In Fig. 1 the impedance of M is directly proportional to the frequency also. In Fig. 2 the impedance of the coupling condenser Cm is inversely proportional and therefore the band width changes in the same manner.

If the two filters be used in conjunction, for example one type between the first and the second tube and the other type between the second and the the third tubes, the band width would remain approximately constant for the band of one would vary in one direction and that of the other in the opposite. The tuning of the filters could be made so that the LC maximum of one coincided with that of the other.

RECEIVER WITH BAND PASS FILTERS

Those wishing to experiment with receivers incorporating band pass filters can well do so with standard equipment such as tuning condensers and tuning coils. In Fig. 3 is such a tuner using no less than four band pass filters of the type shown in Fig. 1. All the condensers are supposed to be operated with one shaft, with the exception of the trimmers, which are used to compensate for any differences in the capacities.

The coils are ordinary tuning coils used for tuning in any circuit. They should, of course, be wound for the condensers used, and those following a screen grid tube should have primaries suitable for this tube. While the second coil in each filter is coupled directly to the grid circuit of the tube that follows, this too may be of the transformer type. If it is, the

n of Band Pass Filters

ndently Tuned Provide Quality Tuner

Anderson

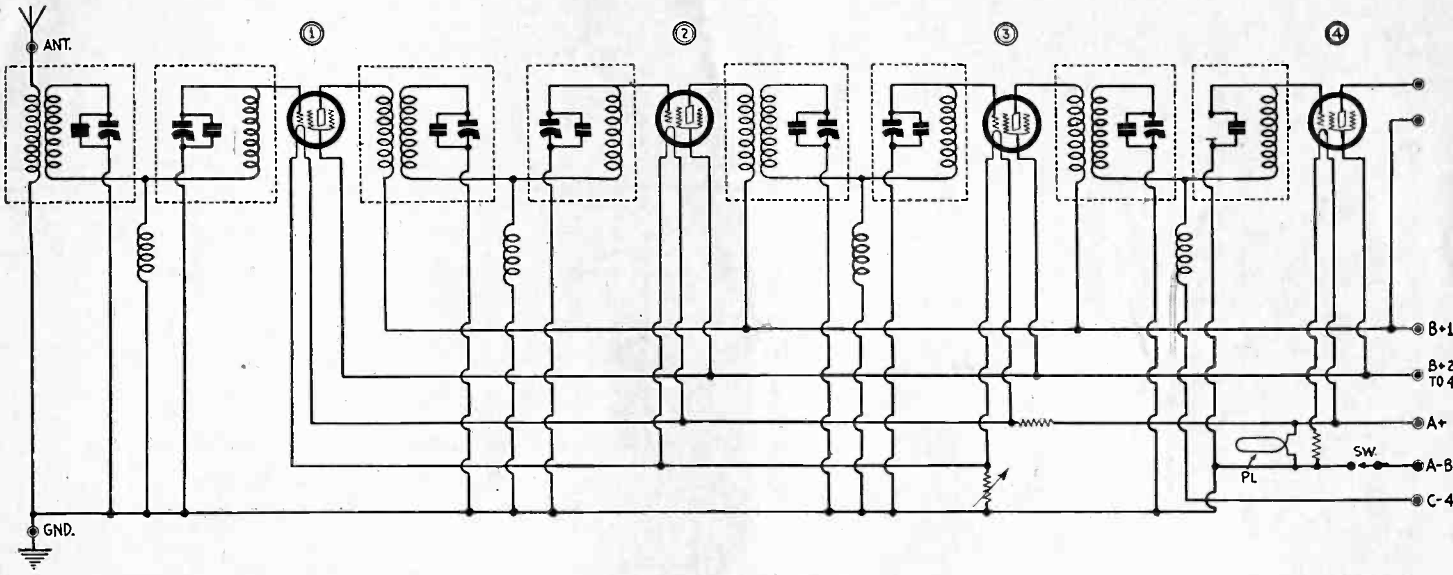


FIG. 3

AN EXPERIMENTAL RADIO FREQUENCY AMPLIFIER IN WHICH THE TUBES ARE COUPLED WITH BAND PASS FILTERS OF THE TYPE SHOWN IN FIG. 1. THE FILTERS CAN BE CONVERTED TO THE TYPE SHOWN IN FIG. 2 BY REPLACING THE SMALL COILS WITH CONDENSERS OF SUITABLE VALUE.

secondary coil should have at least as many turns as the primary.

The only part of one of these filters which is not in an ordinary tuner is the small coil connected between the junction of the other two coils and ground. This coil should contain 10 turns on a one-inch diameter for a band width of about 10 kilocycles. If this coil contains more turns the band width will be greater, and if it contains fewer turns the band will be less wide. In terms of inductance, this little coupling coil should have a value of 20 microhenries for a band width of 10 kilocycles.

CONDENSER COUPLING

In case the condenser type coupling is used in the filters in Fig. 3, or in any one of them, the impedance of the condenser should be the same as the impedance of the coil, that is, for the same degree of coupling. Suppose the frequency is one million cycles. The impedance of the 20 michrohenry coil is then 126 ohms. An equal impedance at the same frequency is given by a condenser of .001267 microfarad, a value which can be obtained with a .001 mfd. fixed condenser and a small variable condenser.

It will be noted on Fig. 3 that a shield surrounds each of the coils and that the coupling coil in each filter is outside the shields. This arrangement is to insure that there is no other inductive coupling than that afforded by the coil. If there were additional coupling between the two equal coils in a filter the width of the transmission band would not be the same, and just what it would be would be as indefinite as the coupling.

In order to make the shielding more definite each shield should be connected to ground. The rotors of the condensers, of course, should also be grounded.

Although it was previously stated that all the condensers in Fig. 3 are supposed to be controlled by one shaft, it is not necessary to do so if such an arrangement becomes cumbersome, which it is likely to do. They might be placed on two gangs. Also, it is not necessary to use as many as shown because the circuit may be no more selective with four filters in tandem than with three or even two. The circuit is mainly shown for those who want to experiment with super-selectivity without sideband cutting.

The band pass filter is particularly desirable in a superheterodyne because in this circuit the frequency remains constant and the width of the transmission band does not change. Another reason why it is desirable in a superheterodyne is that in this type of circuit the sideband cutting with ordinary tuners is very great.

Since the frequency is fixed very accurate adjustment of the filters can be obtained and it is only necessary to make the adjustment once. Hence a little extra time in bringing about close tuning is well spent.

What is the assurance that the response from a band pass filter circuit is that predicted by theory? If all the constants involved are equal to the assumed, or to those determined by the computation based on theory, there is every assurance. But there is some uncertainty about getting the values called for. The effective values of the inductance coils may be different from those required and the effective values of condensers may be different. Then, again, resistances, which are usually neglected in determining the constants, may change the circuits. Therefore, the only way of being sure that the circuit has the desired characteristics is to take a curve on the circuit. That is, measure the output for certain known frequencies about the pass band frequencies, for a constant input.

To measure the output certain auxiliary equipment is necessary. First, an oscillator covering the range of the filter to be studied, and this oscillator must be calibrated so that the frequencies are known. The simplest oscillator circuit is that built around the well-known three-circuit tuner. Connect the tuned winding in the grid circuit of a tube and the tickler in the plate circuit. The small winding can be used for taking off the oscillation and impressing it on the imput of the circuit to be measured.

The output of the circuit under study can be measured with a vacuum tube voltmeter, which should be connected across the grid of the last tube in the circuit, or it may replace the last tube. The vacuum tube voltmeter has been described so often, and in so many different forms, that it is not necessary to repeat the description.

(*Continued from page* 11)

detector is reached, when the only voltage we are interested in retaining is that represented by the audio frequency component, that is, the modulation. The function of the detector being to get rid of the carrier, and leave only the modulation, we even use bypass adjuncts to detour radio frequencies from the audio channel.

Hence, although the detector output has both radio and audio frequencies, the audio frequencies predominate, and the radio frequencies are sidetracked as well as possible.

The tube action is no different in principle at audio frequencies than at radio frequencies. The plate current and voltage behavior is the same, only the frequency is lower.

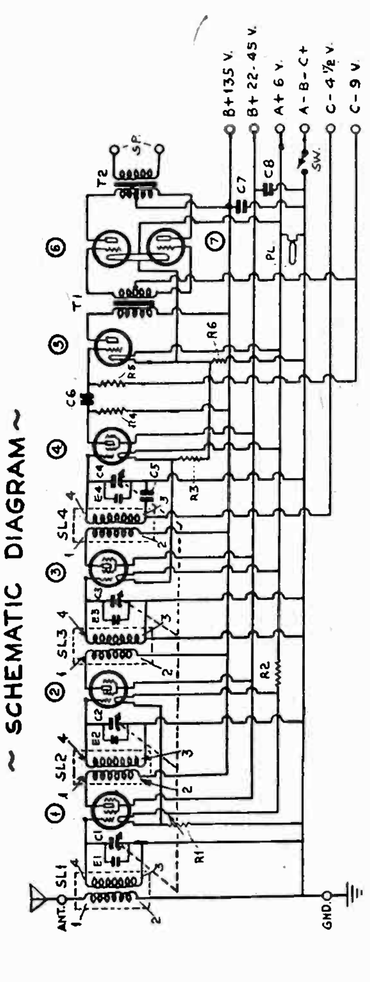
Coils are used almost exclusively for radio frequency coupling, but in audio frequency coupling the media may be resistors. Hence no magnetic field is set up, no electro-magnetism is present, but the voltage drop in the plate circuit resistor is utilized for input to the next tube, a condenser being used for preserving independence of biasing and plate voltages.

Suppose a note of 1,000 cycles is the modulation, the detector has gotten rid of the carrier, and a resistor is in the plate circuit of the detector tube. How does the 1,000 cycle note carry on to the next stage?

Pictorial Diagram of the H

Full Wave Coverage and Plenty of DX Assu

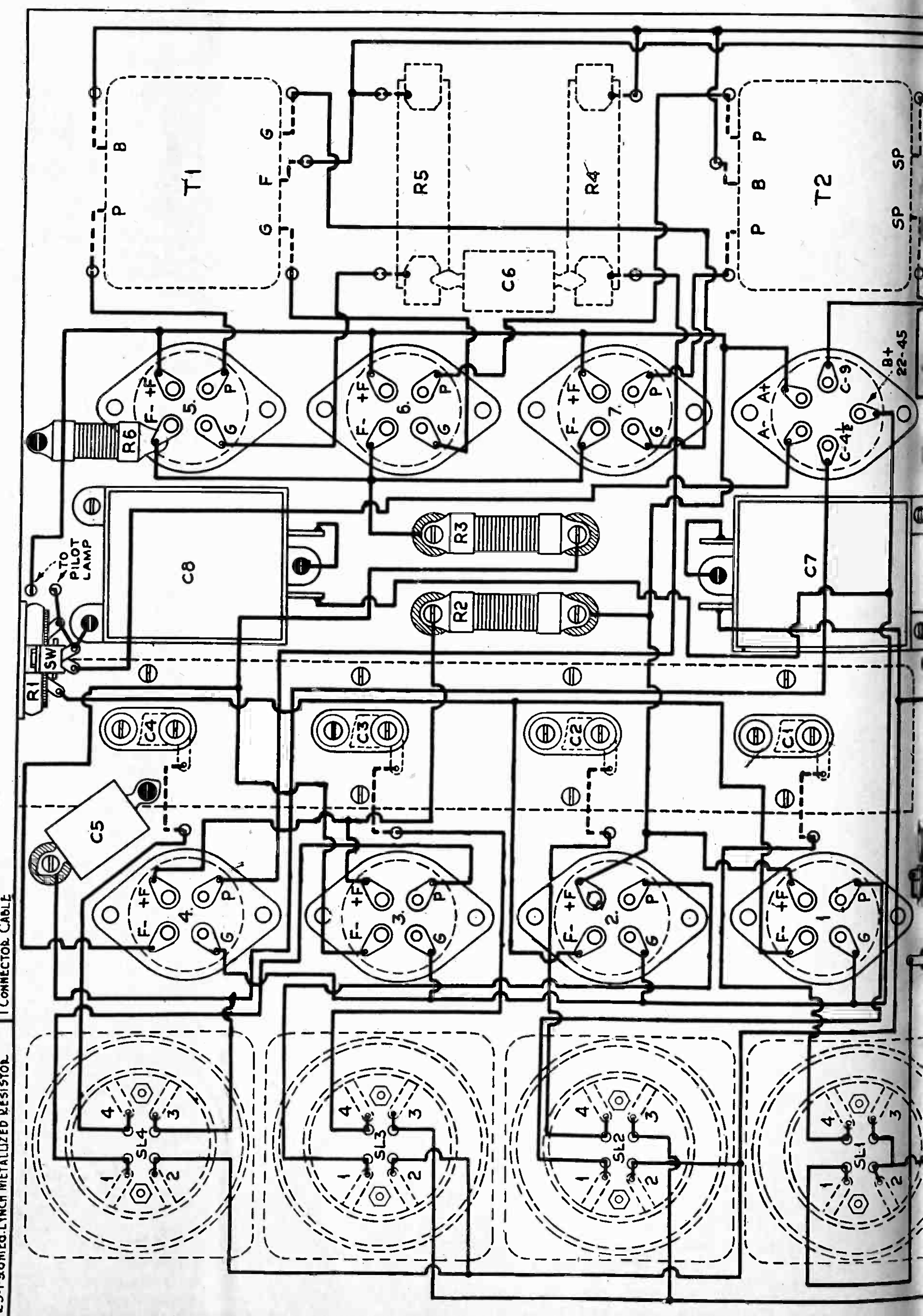
~ SCHEMATIC DIAGRAM ~



LIST OF PARTS

HB 33

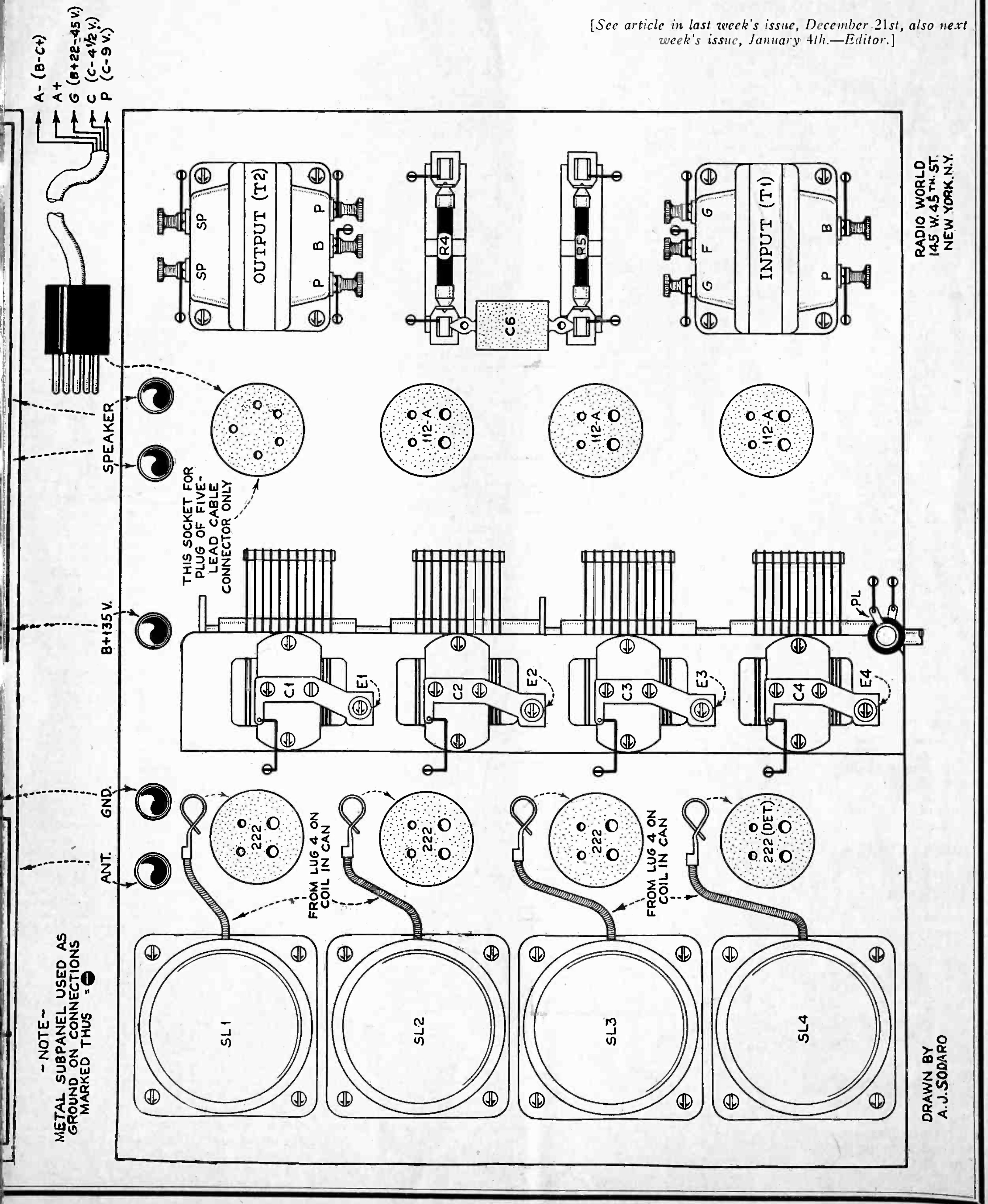
SL1, SL2, SL3, SL4 - 4 Stage Shielded Coil Cascade C1, C2, C3, C4 - 4 Gang .00035 M.F.D. Cond. With Equalizers E1, E2, E3, E4 Built In C5, C6 - 2 .01 M.F.D. Mica Fixed Cond. C7, C8 - 2 1.0 M.F.D. Bypass Cond. 200 V. D.C. Work Volt. R1, SW - 50-Ohm Rheo With Switch, Knob, Insulators R2, R3 - 2 6.5-Ohm Fixed Filament Resistors R4 - 1 .05 Meg. Lynch Metallized Resistor R5 - 1 5.0 Meg. Lynch Metallized Resistor	R6 - 1 Ohm Fixed Filament Resistor T1 - 1 Push-Pull Input Transf. T2 - 1 Push-Pull Output Transf. Ant, Gnd, Speaker - 4 Binding Posts 1 Vernier Full Vison Dial Mounting Bracket, Lamp And Bracket. 1 Metal Sub-Panel With 7 UX Sockets And [1-UY Socket Built In] 4 Grid Clips 1 Connector Cable



B 33 Screen Grid Receiver

d if the Condenser is Mounted As Directed

[See article in last week's issue, December 21st, also next week's issue, January 4th.—Editor.]



A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Those not answered in these columns are answered by mail.

RADIO UNIVERSITY

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BAFFLE BOARD HORIZONTAL

A TABLE is being sold in radio stores in which the bottom is used as a baffle board. This, of course, is horizontal and directs the sound toward the floor, which is about 30 inches below. Is this as good an arrangement as when the baffle board is vertical and directs the sound outward into the room? If there are any detrimental effects will you kindly point them out?—M. S. A.

There might be a tendency to resonance at a frequency determined by the distance between the baffle board and the floor but not a very strong one. The frequency of this resonance would be approximately 110 cycles per second. Due to the fact that the space is open on at least three sides any resonance effect would be very small. The arrangement is very good in view of the fact that it disposes of the speaker in a manner that does not leave an eyesore. Certainly it is better than using a small speaker in a box.

THERE IS A THUMPING SOUND IN THIS SET

MY receiver used to give very good service and does so yet except that once in a while there is a peculiar thumping sound. This did not occur until I moved into a new neighborhood. What do you think is the cause of it?—W. H. J.

The first thing that comes to mind is the thumping due to the key in an amateur radio transmitter. There may be such a transmitter close to your present location. Look around, and maybe you will discover a fancy antenna nearby. If you do, call on the owner and inform him that possibly he is the cause of the thumping. He will know what to do and will be glad to remedy the trouble if he is a typical amateur. If he is not to blame for the trouble he may even be willing to help you solve the trouble.

CURRENT SUPPLY TUBES

MY receiver consists of three screen-grid radio frequency amplifiers, a detector and one audio amplifier of the 227 type and one stage of push-pull using 250 tubes. Can such a receiver be operated successfully with a power pack in which a single 280 type rectifier tube is used, or would it be necessary to use one of the 281 type tubes?—A. F.

Neither is recommended because the 280 will not stand the voltage and it will not deliver enough current. The 281 is a half-wave rectifier which will only deliver currents up to 85 milliamperes. This is not enough. It is better to use two 281 tubes in a full-wave rectifier. Chokes used in the filter must be able to carry at least 125 milliamperes and the condensers should be rated conservatively at 1,000 volts.

FREQUENCY MODULATION

WHAT is the meaning of frequency modulation? Is this type of modulation ever employed in broadcasting station?—J. J. W.

In frequency modulation the frequency of the carrier is varied in accordance with the fluctuations of the speech or music amplitude. As far as this writer knows, it is not used in any broadcasting station because receivers are not suitable for reception of this type of signals.

CURRENT IN ANTENNA GREATEST AT GROUND

WHY is it that the current in an antenna is greatest near the ground? Why is it not the same in the entire antenna? Also, why is the voltage least at the ground and greatest at the far end of the antenna? Why is not the voltage the same all over the antenna? Maybe I am asking foolish questions, but I want to know.—L. H. M.

Voltage is being induced in the antenna by the incoming wave, so many microvolts per unit length. The voltage is measured from the ground. Hence, it is zero at the ground and higher the points higher up. At the farthest point naturally the voltage is the highest. There are exceptions when the antenna is oscillaing in sections. Under these conditions the voltage may be zero at other points besides the ground. But it is never zero at the far end.

To explain why the current is greatest at the ground and least at the far end let us take an analogy. Let the antenna wire be a pipe closed at the upper end and dipping into a gas tank at the lower end. Gas can flow into the pipe from the tank if the pressure increases. But it cannot flow in and out of the upper end because this is closed. Hence, at the closed end the motion of the gas is zero, that is, the gas current is zero. At the tank end the gas can flow in and out of the pipe in large quantities because the gas is compressed in the pipe. The amount of gas flow at any point in the pipe depends on how much more gas can be forced into the space above that point. At the tank the entire pipe is above the point in question and therefore more gas can be forced past this point than past any point higher up. The capacity of the antenna corresponds to the volume of the pipe and the ground corresponds to the tank. Even the gas pipe can vibrate in sections if the pressure of the gas is varying and if the frequency of the variation bears the correct relationship to the length of the pipe. An organ pipe is an example of a vibrating pipe of gas.

RECEPTION FLUCTUATES

THE radio signals come in and go out periodically on my set. The receiver is of a well known commercial make and I cannot tamper much with it. But I have tried fresh B batteries without any change. Can you suggest what can be done to clear up the trouble?—M. J. N.

Possibly the trouble you are experiencing is ordinary fading, in which case there is nothing to be done except to listen to stations the signals of which do not fade. But the trouble may also be due to a loose connection in the set. If that is the case take the set to a good service man, preferably one who is specializing in servicing that particular make. If the trouble is due fading the set will be all right on local stations, but if it is due to loose contacts the fluctuations will occur on all stations. You might watch the filaments while the fading is taking place. It may be that the brightness fluctuates at the same time as the signal. In that case the trouble is due to poor connection in the filament circuit. Maybe there is only one tube which acts that way. Then the contacts at the socket should be attended to.

WORKING THE SCREEN GRID TUBE

I HAVE been experimenting a great deal with screen grid tubes in resistance coupled circuits but so far my efforts have not been attended with any encouraging success. Surely there must be some way in which these tubes can be used for resistance coupled audio amplification so as to take advantage of the high potential gain. If you have any suggestions to offer on the subject I should be pleased to have them. —R. W. H.

The first necessary condition for getting a high amplification out of a screen grid tube in resistance coupling is to have a high value load resistance. However, as soon as this condition is satisfied complications arise in respect to voltages. The voltages on the control grid, on the screen grid, and on the plate must bear a definite relation. The plate voltage in question is the actual voltage on the plate, not the voltage applied in the circuit. In this respect the screen grid tube differs from three-element tubes. In order to make the tube operate properly it is necessary to boost the applied plate voltage until the effective voltage is high enough to meet the requirements of the grid and screen voltages. Leaving the grid bias voltage at 1.5 volts the screen grid and the plate voltages should be varied until the proper adjustment is obtained. With a plate load resistance of about 200,000 ohms and an AC screen grid tube, the screen voltage should be about 30 volts and the applied plate voltage 300 volts. This will permit a signal amplitude on the control grid of about 1.5 volts without overloading the tube. If the applied plate voltage is the usual 180 volts and the screen grid voltage the usual 75 volts, the tube will not function right, because there will not be enough voltage on the plate to support the signal. The voltage on the screen grid will be higher than the voltage on the plate for a large part of the signal wave.

COMPARISON OF SPEEDS OF SOUND AND RADIO

I HAVE heard it said that persons listening in by radio can hear the sounds sooner than some of those actually present at the original performance even if the radio listener is thousands of miles away. Is there any truth in the statement? If so, please explain how it is possible.—D. A. S.

It is quite possible. Radio waves travel at the rate of 186,000 miles per second and sound waves in air travel 1,100 feet per second. Suppose a listener is 55 feet from the source of the sound. He will hear the sound .05 second after it was created. Now suppose a radio listener sits close to the loudspeaker at a distance of 1,800 miles. The signal will reach the listener in .01 second. Thus the radio listener will hear the sound .04 second sooner than the listener who is 55 feet away. This neglects the time it takes the sound to travel from the source to the microphone and from the loudspeaker to the radio listener. But this time is usually very small. It also neglects any delay which may be introduced by the electrical devices. But these,

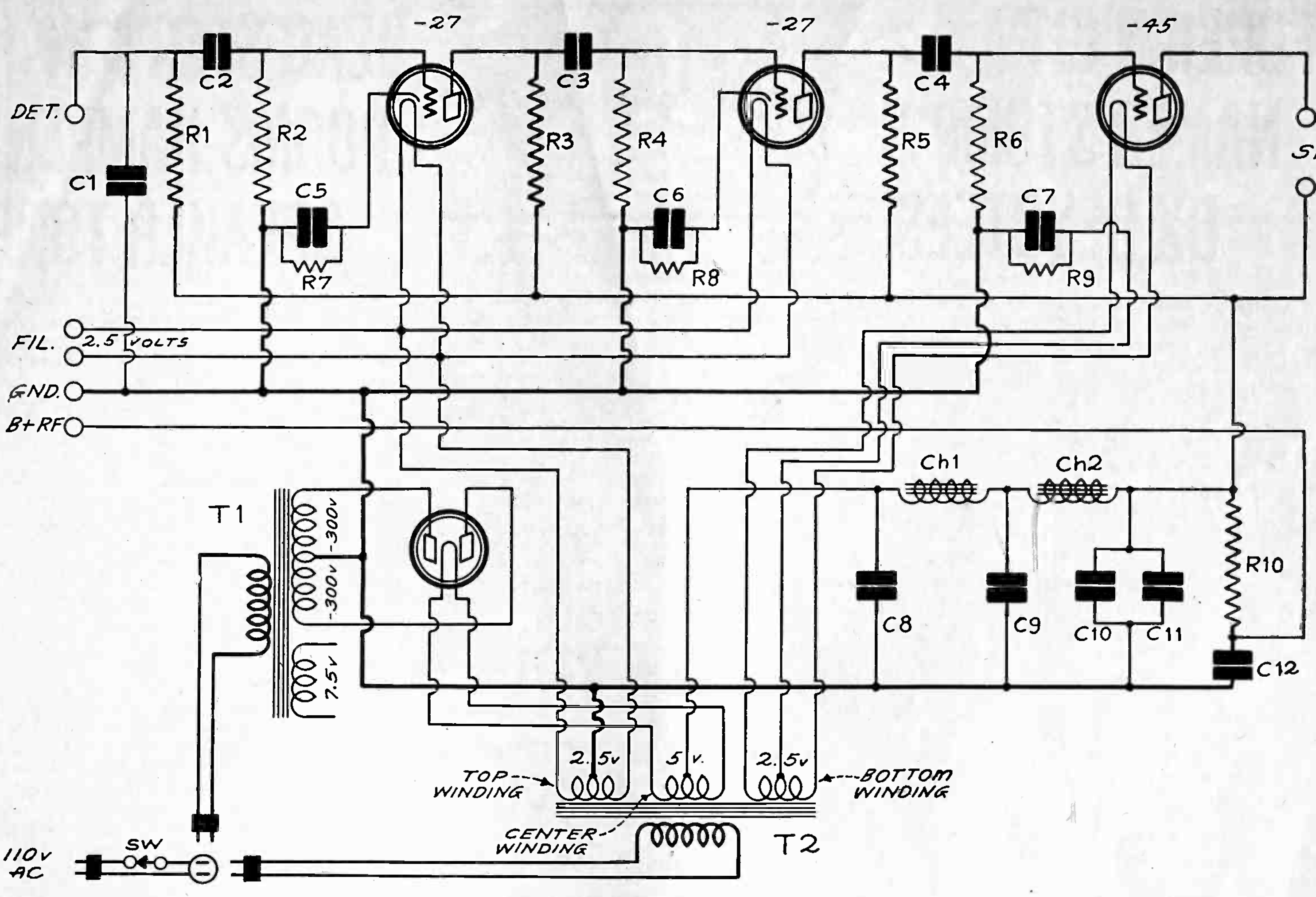

FIG. 816

A RESISTANCE COUPLED AMPLIFIER WITH B SUPPLY SUITABLE FOR HIGH QUALITY AUDIO AMPLIFICATION

too, are small so that actually the radio listener hears the sound before the listener present. A radio wave can travel around the world while a sound wave travels 148 feet.

SUBSTITUTE FOR PHOTO-ELECTRIC CELL

CAN you suggest a good substitute for a photo-electric cell for talking motion pictures and the like? I want to experiment a little along this line but I do not want to expend any more money than necessary.—P. P. W.

There is a light sensitive cell made of metal electrodes immersed in an acid solution which has been tried successfully for such purposes. It can be obtained at a much lower price than a good photo-electric cell, and when it is used it is not necessary to employ so high amplification as when photo-electric cells are used. There will be more said of this cell and its applications in the future.

LOOKING FOR AN AMPLIFIER

I AM looking for a resistance coupled amplifier and power supply. The circuit will not be used in conjunction with a radio receiver, but only for the amplification of audio frequency signals from microphones, pick-up units, and photo-electric cells. If you have such a circuit please publish it. You need not give the values of constants because I like to use my own ideas in that respect.—W. W. A.

Fig. 816 may be just what you are looking for. It employs two 227 tubes and one 245. Since you don't intend using this circuit in connection with a detector, the resistance coupler ahead of the first tube should not be used. That is, C1, C2, R1 and R2 should be left out and the signal to be amplified impressed across the terminals where R2 is now connected. A resistance should be connected across C12 in order to complete the voltage divider and establish a bleeder current. The value of this resistance you can figure out from the total bleeder current you want.

HIS RECEIVER HUMS

I BUILT one of the MB-29 receivers after I had heard a demonstration of one. Mine, however, does not work so well as the one I heard demonstrated. Whenever I turn up the volume it breaks into a terrific squawk. Can you suggest a possible cause for this trouble and a remedy?—H. A. P.

It is possible that one of the grid circuits is open, as any receiver will behave that way with an open grid. If the open is on the ground side signals usually come through, provided they are not too strong. Test all the grid circuits for this condition. The idea is to determine whether or not there is a continuous circuit between the grid clip and ground. This can easily be tested with a headset and a battery or with a voltmeter and a battery. The ground in this case is the framework of the set, or the subpanel. When you get all the connections right the circuit will work as well as the one heard demonstrated, or possibly better.

FOREIGN CITY NAMES STUMP DX DEVOTEES

American radio fans who have sensitive short wave receivers with which they can pick up the signals of European broadcast stations frequently hear names of cities which they have never heard before, according to the National Geographic Society. Programs from the Continent are announced to come from places which are not found on maps published in the English language. Of course, the places are not new, nor have they been given new names. They are the native forms of the names of old places.

Suppose, for example, that the fan is listening to the station at Huizen, in Holland. At first he may hear a speech that is coming from Amsterdam, a name familiar enough to Americans.

What's Gravenhage?

But shortly a concert may come from Gravenhage, and the fan is on unfamiliar ground. There is no such name on maps of the Netherlands printed in the English language. He may not find the place unless he happens to know that Gravenhage is the Dutch name for The Hague.

If he is listening to the German station at Langenberg he may hear announcements of programs coming from Berlin, Aachen, Koln, München. The first of these is familiar but the others are not, for on English language maps they appear as Aix-la-Chapelle, Cologne, and Munich.

Possibly he may be able to get stations announcing Moskva, Beogran, Torino, Milano, and Wien. Of these perhaps he can guess that Milano is Milan but he may not be able to guess the English names for the others, and certainly he will not find them on maps.

Other Names Translated

Moskva is Moscow in English, Beogram is Belgrade, Torino is Turin, and Wien is Vienna.

Because of this discrepancy between the Continental and the English names, and because of the wider use of radio, the National Geographic Society has issued maps of European countries with the native form of the names for all important places.

Denies Organizing Of Radio Artists

Reports that have been current recently in theatrical and radio circles that due to the closely forming affiliations between legitimate and musical comedy performers and the microphone, that the Actors Equity Association would soon seek to organize the actors and performers in radio, as they recently sought to do in the moving picture field. These reports were denied by Frank Gilmore, president of the Association. Mr. Gilmore said:

"Because of the various types of radio contracts now prevalent, the talk of the organization has been revived recently. It is reported among radio entertainers from the legitimate theater that an organization that would protect the performers is badly needed to check some of the abuses now rampant in the field.

"These performers, who for the most part hold contracts that do not permit appearances except before the microphone, have on occasions brought their troubles to the officials of Equity. But Equity is powerless to aid them."

New Music Firm Opposes ro-de-o-do

That a new radio music company, recently formed by the National Broadcasting Company, Carl Fischer, Inc., and Leo Feist, Inc., will not seek the upper hand in the music tax fight, nor to break down royalty barriers is the assurance given to the music trade and composers of music by E. C. Mills, president of the new organization.

"Jazz is an outgrowth of the World War, and represents the hectic reaction of an age that went mad its effort to divert attention from the awful maelstrom of blood and strife," asserted Mr. Mills. "It is not our aim to reform the world, nor is our cause garbed in the reformer's frock coat and white necktie. We merely seek to restore sanity and harmony to contemporary musical compositions, and to strike a death blow at the tedious and inane ro-de-o-do school of music.

"There is a decided trend already toward the public appreciation of more harmonious orchestration."

BOARD VEXED BY TELEVISION

Washington.

Concerning the problem of television, the Radio Commission, in its annual report to Congress, forecasts great difficulty in fitting television into the present radio system.

Television and visual broadcasting present one of the future problems of radio regulation, the Commission states. Even in its present experimental stage, states the report, television requires frequency bands at least 100 kilocycles in width, or ten times the width of the broadcast channel. The report continues:

"Some scientists estimate that a band in excess of 1,000 kilocycles in width may be necessary to give satisfactory detail in a moving picture transmitted by radio. Very serious problems will soon confront the Commission if frequency bands are to be made available for regular television services."

WLW Stops Patron's Aired Offer to Insure

Columbus, Ohio.

Powel Crosley, Jr., president of the Crosley Radio Corporation of Cincinnati, has telegraphed C. S. Younger, State superintendent of insurance, that WLW, operated by his company, no longer will broadcast an invitation to its listeners to take out "penny-a-day" insurance policies issued by the Sterling Casualty Insurance Co., of Chicago.

Mr. Younger had requested the company to cease broadcasting the offer to insure any listener who would apply at the rate of one cent a day. The request was based on the grounds that the company issuing the policies is not licensed in Ohio, that the representation that everyone applying would be insured was untrue and that no mention of the fact that the company operates on the assessment plan was made.

ECONOMY WITH SCREEN GRID

The filament current requirements of multi-tube Superheterodynes can be reduced materially by the use of screen grid-tubes of the 222 types, each of which takes only .132 ampere. As many as five of these tubes could be used economically in an eight-tube super.

DEAD SPOTS IN ROOMS HAMPER SPEAKER TONE

The acoustic properties of a room in which a loudspeaker is operating play an important role in the performance of that speaker or in the result obtained with any radio receiver. The results from a good receiver placed in a poor acoustic position in the room may be very poor when in another position it may be good.

In any room there may be dead spots or places where the direct and the reflected sound waves meet and cancel each other and these should be avoided, if possible. Reverberation, or the continued bouncing back and forth of the sound waves between the walls or between the ceiling and the floor, often causes unpleasant effects and is in fact the cause of the so-called poor acoustics of large auditoriums and empty rooms.

To prevent echoes of all kinds the room should be treated so that all reflecting surfaces absorb the sound waves that fall on them. Rugs, draperies, clothing, curtains and similar substances are good absorbers. A great improvement can be effected in any room by little such material judiciously placed. Open windows are a good deterrent to sound reflection, not by absorption but by lack of any reflecting surface.

Plain, hard walls and uncovered furniture present good reflecting surfaces and therefore they will contribute largely to reverberation. A piano in the same room as the loudspeaker is often a source of interference because the strings will vibrate freely whenever a sound of a frequency to which the strings are tuned comes from the loudspeaker.

The radio manufacturer cannot cater to the individual home so that it devolves on the individual owner of the receiver to learn about the acoustic peculiarities of his home and try to correct any faults which may develop.

Hart & Hegeman Seek Receiver for Sonora

A petition filed with Federal Judge Coxe in the United States District Court of New York, asks for the appointment of an equity receiver for the Sonora Products Company of America of 50 West 57th Street, New York City, controlling the Sonora Phonograph Company, Inc., the Sonora Corporation of Canada, Ltd., and other concerns.

The petitioning creditor was the Hart & Hegeman Electric Corporation, of Hartford, Conn. The claim is for $3,698, due and unpaid, and Judge Coxe was requested by the petitioner's attorneys to sign an order requiring the Sonora Products Company to show cause why a receiver should not be appointed.

Dr. Rogers Dead

Hyattsville, Md.

Dr. James Harris Rogers, inventor of multiplex telegraph printing machines and pioneer in underground and underwater radio communication, died of heart disease, at 79.

In addition to many other inventions, he won recognition during the World War by devising means of successful communication with submariens. For a time he occupied a front-line dug-out in France, in which high government officials heard messages.

HARBORD ASKS CABINET OFFICE CONTROL RADIO

Washington.

General James G. Harbord, president of the Radio Corporation of America favors a unified communications control, namely radio, wires and cables, by a single authority, preferably a new member of the President's Cabinet. This opinion he expressed at a hearing held by the Senate Committee on Interstate Commerce.

"Communications, as we would have it, deserves a place in the cabinet," he said. "Their administration and control I regard as important enough to be made a cabinet office."

Licensing practices, patent holdings and the relationship between the Radio Corporation and other manufacturers, both licensed and unlicensed, were discussed in detail by David Sarnoff, vice-president of RCA. Many manufacturers competing against the Radio Corporation and paying the regular license fee of 7½ per cent were making a greater profit on radio receiving sets than the Radio Corporation was making on its own sets, he declared. Referring to the license charge of 7½ per cent, he said there would be nothing illegal in requiring a fee of 15 per cent on the radio chassis alone and nothing on the cabinet that houses the chassis, but that the corporation regarded it as more equitable to charge the lower rate on a complete instrument rather than the higher rate on a part of it.

"The man who puts that chassis into a $150 cabinet is in that business because we have given him a license to use our patents," Mr. Sarnoff testified. "He is selling eye value as well as ear value to the customer. The cabinet often determines the purchase altogether, particularly with women. It is entirely up to the manufacturer to decide what kind of a cabinet he wants to put around the chassis. But if he is operating on a basis of, say, 10 per cent profit and sells the set for $50, he is getting 10 per cent and he is still earning the same rate of profit when he sells the set for $150."

WABC Won't Try To Override Jersey

In contradistinction to the beliefs of the residents of New Jersey, who have protested against the proposed erection there of the new 50,000 watt station of the Columbia Broadcasting System, the officials of this chain believe that the stage will benefit by the removal of WABC thereto, rather than suffer, and believe that fifty sets are the maximum that might suffer from interference. William S. Paley, president of the Columbia chain, gives his opinion of the installation in the following statement:

"In the event the Federal Radio Commission sustains the expediency of building a 50,000-watt station in New Jersey, unless the State Law Officers of New Jersey acquiesce in that expediency, we will immediately seek to locate elsewhere."

District Attorney Minard, of New Jersey, threatened not only to go the limit to prevent the proposed "incursion" of WABC but also to try to rush the nine New York stations now broadcasting there out of the State. A vigorous campaign is being waged by municipal, civic and broadcasting interests against any "invasion" by the powerful key station.

Mother Listens in 106 Sleepless Hours

Louisville, Ky.

A radio listeners' endurance contest just concluded here was won by Mrs. Mildred Daniel, 22 year old mother of two children, who was declared the winner after she had listened 106 hours without sleep. The contest was held in a downtown window with a $200 radio as the prize. More than sixty persons entered.

KENT WINNERS RECEIVE PRIZES

Five young men and five young women were selected as the winners in the finals of the Third National Radio Audition sponsored by the Atwater Kent Foundation, held over a coast-to-coast hookup, from the WEAF studio of the National Broadcasting Company. The winners of the first two prizes were:

Edward A. Kane, 22 years old, tenor, of Atlanta, Ga.

Miss Genevieve A. Rowe, daughter of Neill O. Rowe, dean of music at Wooster College, Ohio.

Mr. Kane sang "Celeste Aida" from the opera by Verdi; and Miss Rowe sang the "Shadow Song" from "Dinorah," by Meyerbeer. Each received $5,000; a two years' musical scholarship at a recognized conservatory or from an instructor, choice of which is left to them, and a gold decoration.

Second prizes of $3,000 each and one year's scholarship were won by:

Calvin Hendricks, 24 years old, baritone, of Los Angeles.

Miss Floy Hamlin, 22 years old, soprano, also of Los Angeles.

Mr. Hendricks has been blind from birth and learned music by means of the Braille method.

Third prizes of $2,000 each and one year's schooling went to John Jameson, a tenor, of Denver, Colorado, and Miss Josephine Antoine, colaratura soprano, of Boulder Colo. Charles E. Carlile, 25 years old, a tenor of Central Falls, Rhode Island, and Miss Frances Tortorich, 23 years old, a lyric soprano of New Orleans, La., won fourth prizes of $1,500 each and one year's scholarship. Fifth prizes of $1,000 each and one year's scholarship went to Carlyle B. Bennett, 22 years old, a tenor, of Chicago, and Miss Agnes Skillen, 23 years old, a soprano, of Springvale, Me.

Jersey Blanketing Aired Before Senators

Washington.

At a hearing on the Couzens general communications commission bill, during the examination of William D. Terrell, chief of the Radio Division of the Department of Commerce, Senator Kean of New Jersey brought up the New Jersey broadcasting situation. He asked why most of the New York City broadcasting stations were shifting their transmitters to New Jersey, while retaining their New York City studios.

He asserted that the presence of these high-powered transmitters in New Jersey is blanketing that State and that smaller stations there cannot be heard. When asked by Senator Wagner of New York what small stations he had in mind, Mr. Kean could not precisely recall the exact stations.

SALES BLURBS TOO COMMON, BOARD STATES

Washington.

The Radio Commission still believes that many broadcasting programs remain of "doubtful value," as declared in its annual report to Congress. While admitting that broadcasting had made progress, the Commission said, "much remains to be desired."

"Offensive sales talks are too common," the Commission continued. "The attitude of the listening public will tend ultimately to cause the correction of such defects.

"The radio act specifies that the Commission shall exercise no censorship over programs. Nevertheless, the kind of service rendered by the station must be a means of appraising its relative standing and must be considered by the Commission in making assignments."

Principal Efforts

The Commission declared that its principal efforts during the year had been in the fields of eliminating erroneous or impractical features of the general broadcasting allocation, designating frequencies for general communication purposes and providing a proper regulatory basis for the radio development of the radio art.

"In these efforts," the report said, "basic policies have been outlined as clearly as the state of radio technique has permitted, and future develepoments may be expected upon a sound regulatory background.

"While many channels are still much overloaded and there is considerable congestion in some sections, the commission has gradually been reducing the number of stations on the air. When the commission was organized, March 15, 1927, there were 732 stations licensed in the broadcast band. The number had been reduced to 677 on July 1, 1928.

28 New Stations, 121 Deleted

"During the past year twenty-eight new stations were added and 121 deleted, leaving the number 584 licensed, as of Nov. 1, 1929. On that date, however, the licenses of twenty stations were withheld because no applications for renewals had been received. New stations have been authorized only in sections of the country lacking radio facilities. During the year the commission has made fifty-four changes in frequency assignments, 162 changes in power assignments, thirty-one in the time of operation."

Concerning the synchronizing of broadcasting stations the board said:

"The commission has no knowledge of any synchronizing that has proved of real value except where it has been accomplished by direct wire circuits between stations. The commission has authorized two stations sharing time on a cleared channel to conduct synchronizing tests. The results of these tests have been unsatisfactory."

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LACAULT'S BOOK

GIVES YOU A FINE UNDERSTANDING OF the SUPER-HETERODYNE

R. E. LACAULT, E.E., I.R.E., who died recently, was one of the outstanding authorities on the Super-Heterodyne. He wrote a book, "Super-Heterodyne Construction and Operation," that explains in a non-technical manner the phenomena associated with a Super-Heterodyne. More, it gives a clear outline of the way such a receiver functions, and naturally gives the clues to solving virtually all the troubles that may arise in a Super.

So thoroughly did Lacault do his wrok that he covered associated topics, thus making his book a sidelight on radio in general, including advice on trouble-shooting

Therefore the service man, the home experimenter, the custom set builder and the student will welcome this book.

It consists of 103 pages and includes 68 illustrations It is bound in maroon buckram.

There are three valuable tables in the book, also. One classifies harmonics into groups, e.g., sound, radio, short waves, heat, light, chemical rays, X-rays and "unknown." Another is a trouble-shooting chart, classifying "trouble experienced" and "causes" and referring to the text for specific solutions. The third is a table for converting broadcast frequencies to wavelengths (accurate to .1 of a meter) or for converting the wavelength into frequency.

THE book begins with a comparison of alternating and direct current and proceeds to a discussion of the relation of wavelength to frequency. Then tuning is explained.

Condensers, coils, induction, vacuum tube operation and testing, earphones and speakers, rectification, oscillation, grid condenser action, modulation, grid bias detection, regeneration, beat notes, frequency changing, audio amplification, batteries, aerials, loops, wiring, sockets, and shielding are only some of the other important topics covered.

Besides, there is an entire chapter on the construction of a Super-Heterodyne receiver, with list of parts, front, top and rear views of set, front panel layout, shield dimensional drawings, schematic diagram of wiring and picture diagrams of the top and bottom views of the subpanel.

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- ☐ R1, Sw—One 75 ohm switched rheostat.. .80
- ☐ R2, C4—2 meg. Lynch leak, grid clip condenser .... .51
- ☐ R3—One .25 meg. .... .30
- ☐ R4—One 5.0 meg. .... .30
- ☐ R5—One 1.3 ohm filament resistor......... .20
- ☐ Ant., Gnd., Sp. (+) Sp. (—)—Four posts @ .10 .... .40
- ☐ One drilled front panel 7x18" 1.85
- ☐ One socketed, self-bracketing metal subpanel, all holes drilled..................... 3.50
- ☐ One National new modernistic drum dial with color wheel, pilot bracket, 6v. lamp, hardware, knob 3.13
- ☐ Two matched knobs for rheo. and tickler @ .18 .... .36
- ☐ Five vari-colored cable leads @ .07...... .35
- ☐ Metal link and insulated shaft.............. .22
- ☐ One screen grid clip......................... .06

☐ All parts (including blueprint).............$21.89

- - - - - - - - - - - - - - - -

GUARANTY RADIO GOODS CO., 143 W. 45th St., N.Y.C.
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Enclosed please find $.............. for which please mail at once the parts for the Push-Pull Battery Model Diamond of the Air as checked off above.

☐ If ordering C.O.D. put check mark here.

Name ....

Address ....

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

TRIAL SUBSCRIPTION, 8 WEEKS, $1.00. Send $1 and we will send you Radio World for 8 weeks, postpaid. RADIO WORLD, 145 West 45th St., N. Y. City.

"AERIAL NAVIGATION and METEOROLOGY." By Capt. Yancey. $4.00 postpaid. Radio World, 145 W. 45th St., N. Y. City.

Component Parts for 245 Push-Pull Power Amplifier

(as described and specified by Herman Bernard)
Check off which parts you desire. All parts sold separately.

- ☐ C1—One .00025 mfd. mica condenser............ .21
- ☐ C2—One .01 mfd. mica fixed condenser.......... .35
- ☐ C3—One Flechtheim 1 mfd. filter condenser, 1,000 volts DC continuous working voltage rating, 550 volts AC (root mean square) continuous voltage rating 1.76
- ☐ C4, C5, C6, C7—Four Mershon condensers in one copper casing, two of 8 mfd. and two of 18 mfd. with low bracket. Cat. Q2-8, 2-18B............ 5.15
- ☐ C8, C9, C10, C11, C12, C13, C14, 15, C16—Nine 1 mfd. bypass condensers, 200 volts DC continuous working voltage rating...................... 4.50
- ☐ T1—One Polo Filament-Plate Supply transformer: 110 volt 50-60 cycle primary, 724 volt secondary center-tapped, 5 volt 2 amp. secondary center-tapped; 2.5 volt 3 ampere secondary center-tapped. and 2.5 volt 12 ampere secondary center-tapped. Cat. PFPS 7.50
- ☐ FC, PPOC—Two center-tapped chokes for high current one used as filter choke, other as push-pull output choke 7.42
- ☐ PPIT—One push-pull input transformer......... 3.41
- ☐ SW—One AC pendant through-switch, with 12-ft. AC cable and male plug........................ 1.10
- ☐ F—One 2 ampere fuse, with holder............ .50
- ☐ CO—One convenience outlet (for dynamic speaker AC cable) .... .50
- ☐ PJ, PJS—Phonograph Jack with automatic switch and plug 1.42
- ☐ R1—One resistor, 0.1 meg...................... .30
- ☐ R2—One grid leak, 5.0 meg..................... .30
- ☐ R3—One multi-tap voltage divider, 50 watt rating; fourteen taps affording thirteen different voltages; 13,350 ohms 3.95
- ☐ Two resistor mountings.
- ☐ Roll of heavy insulated hookup wire for power work.
- ☐ Fifteen binding posts 1.50
- ☐ One 15x9 ½" cadmium plated steel subpanel, with self-bracketing flanges, one five-prong and three four-prong sockets built in; sockets marked to identify tubes that go in them; subpanel drilled and insulated where necessary; flat insulating washers; hardware 4.00

☐ All parts $43.57

Ferranti AF5CC push-pull input instead of above input transformer 9.60

[Note: For 40 cycles 110v. order Polo P40 FPS at $10; for 25 cycles 110v. order Polo P25 FPS at $11.]

Guaranty Radio Goods Co.
143 West 45th Street,
Just East of Broadway
NEW YORK CITY

Blueprint of the New One-Dial Push-Pull Battery Model SG DIAMOND

Full-sized picture diagram of the wiring, with list of parts. This 5-tube receiver is really superlative. It gives you screen grid radio frequency amplification and push-pull output, most economically.

Send $1.00 today for this blueprint or order it shipped C. O. D.

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Just East of Broadway New York City

One Tube? Two Tubes? Three Tubes? Four Tubes?

Circuits for Schoolboys—Easy to Build, Very, Very Inexpensive!

A One Tube Receiver, parts costing $4.28!
A Two Tube Audio Amplifier, parts costing $5.23!
A Three Tube Speaker—Operating Circuit, parts costing $11.10!
A Four Tube Speaker—Operating Circuit, parts costing $12.72!

The construction of these circuits, with a pictorial diagram as one of the illustrations, was described by Jack Tully, himself a schoolboy, in RADIO WORLD. See list below.

- ☐ Sept. 21st and 28th issues, One-Tube DX Set, by Jack Tully; two-part article.
- ☐ Oct. 5th, Three-Tube Single Dial Speaker Set, by Jack Tully.
- ☐ Oct. 12th, Two Stage Transformer, Coupled Audio Amplifier, by Jack Tully.
- ☐ Oct. 19th, Four-Tube DX Speaker Set, by Jack Tully.

15 cents a copy. Order at once while these copies are available.

RADIO WORLD, 145 W. 45th St., New York

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At a Glance

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"Audio Power Amplifiers," by Anderson and Bernard $3.50
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"Foothold on Radio, A," by Anderson and Bernard 1.00
"Mathematics of Radio," by Rider....... 2.00
"Practical Radio," by Moyer & Wostrel....... 2.50
"Practical Radio Construction and Repairing," by Moyer & Wostrel....... 2.00
"Principles of Radio Communication," by Morecroft 7.50
"Radio Blueprint Library"—AC Hook-ups.... .35
"Radio Cyclopedia," by Drake....... 6.00
"Radio Receiving Tubes," by Moyer & Wostrel 2.50
"Superheterodyne Construction and Operation," by Lacault .... .25
"Thermionic Vacuum Tube, The," by Van der Bijl 5.00
"Trouble Shooter's Manual," by Rider....... 3.50

TELEVISION

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"Everybody's Aviation Guide," by Maj. Page 4.00
"Ford Model 'A' Car," Its Construction, Operation and Repair—by Maj. Page....... 2.00
"Modern Aircraft," by Maj. Page....... 5.00
"Modern Aviation Engines," by Maj. Page... 9.00

RADIO WORLD
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"Elements of Radio Communication," by Prof. John H. Morecroft, of the Engineering Department of Columbia University, is the latest book on radio by this outstanding authority.

This book is entirely new and contains matter which never before has been published. It is written in plain language so that every radio novice can understand it, yet it is a complete course in the elements of radio.

It contains 266 pages, 170 illustrations and a complete index. Price $3.00.
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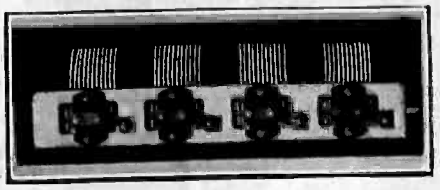

Capacity of each of the four sections is .00035 mfd. Overall length 11". Accurate capacity and precise alignment. Used in HB33 and HB44.

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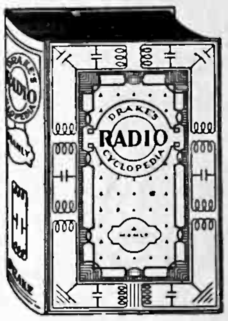
A reference work that has subjects classified in alphabetical order.



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The important articles deal primarily with receivers and reception. They do not stop with the electrical end, but go also into the mechanics of construction.

Every new thing in radio is covered in detail.

1,680 Alphabetical Headings from A-battery to Zero Beat
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OF THE PRINCIPAL ARTICLES

159 Concern service men, 129 help the set builder, 162 help the experimenter, 155 interest the student 75 assist in sales work, 73 interest set owners.

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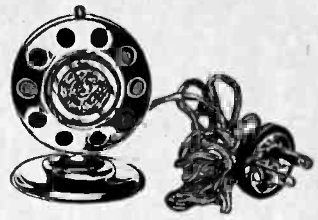
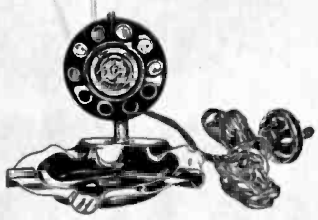
MICROPHONE LIGHTERS

for cigars or cigarettes, with button switch at top. Press the switch and light up!



Model A lighter, microphone design, with 5-ft. AC cable and plug. Works on 110 volts, AC any frequency and on direct current. ....Price $1.00



Model B lighter, microphone design, on tray, with 5-ft AC cable and plug. Works on 110 volt AC, any frequency, and on direct current. Exactly the same lighter as the other, only tray is added. Price..............$1.50

This lighter is instantaneous. Hold button down only long enough to light a cigar or cigarette. The two models are furnished in attractive sprayed finish. Both are very compact! For instance, the tray is only 4½" in diameter. Use these lighters in your home and for holiday gifts.

The heater element is renewable.

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

☐ Please send me Model A Microphone Lighter at $1.00
☐ Please send me Model B at $1.50.
☐ Enclosed is remittance [Canadian must be P.O. or express money order.]
☐ Ship C. O. D.

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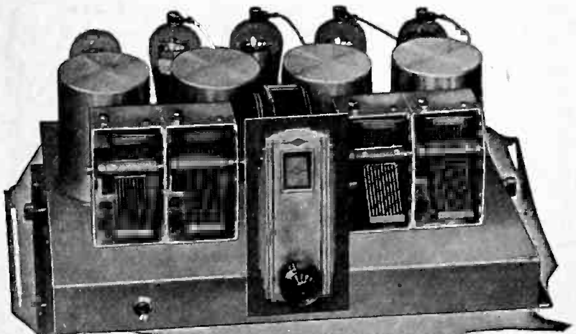
NATIONAL SCREEN GRID TUNER



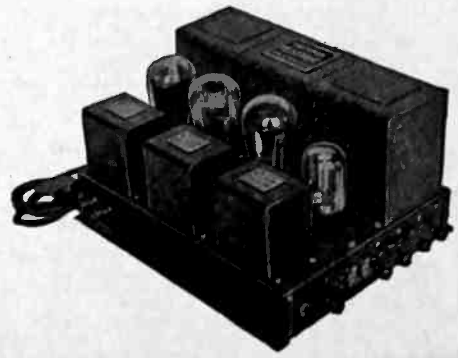
The most sensitive tuned radio frequency tuner so far developed, the MB-29 is long on distant reception, and penetrates seemingly unsurmountable barriers to reception. On the MB-29 the stations come in no matter where you are. The MB-29, designed by James Millen and Prof. Glen H. Browning, is the choice of the most discriminating. It is designed only for AC operation, uses four stages of screen grid RF and a power detector (227). Use 135 to 180 volts on the detector. Testimonials from radio's hardest-boiled experts prove this is the circuit of circuits. Buy the parts and find fullest radio delight. You will be sure nobody else has a tuner as good as yours, unless he too has an MB-29. Complete component parts for National Screen Grid Tuner MB-29, mounted on frosted aluminum chassis, including rainbow modernistic drum dial HC. Order catalog No. MB-29-K, list price, less tubes, $69.50. Your price **$40.00**

MB-29

Push-Pull Amplifier

The National Velvetone Push-Pull Power Amplifier (shown at right) consists of an AC-operated filament-plate supply, with two stage transformer audio amplifier and output transformer built in. Made only for 110-V., 50-60 cycles. Sold only in completely wired form, licensed under RCA patents.

The new Power Amplifier has been developed and built to get the very most out of the MB-29. It is a combination power supply and audio amplifier, using a 280 tube for a rectifier, one stage of transformer audio with a 227 tube and a stage of push pull amplification with two 245s. It furnishes all power for itself and for the MB-29, as well as the audio channel. Order catalog PPPA, list price, completely wired and equipped with phonograph jack, (less tubes) $97.50. Your price. **$55.00**

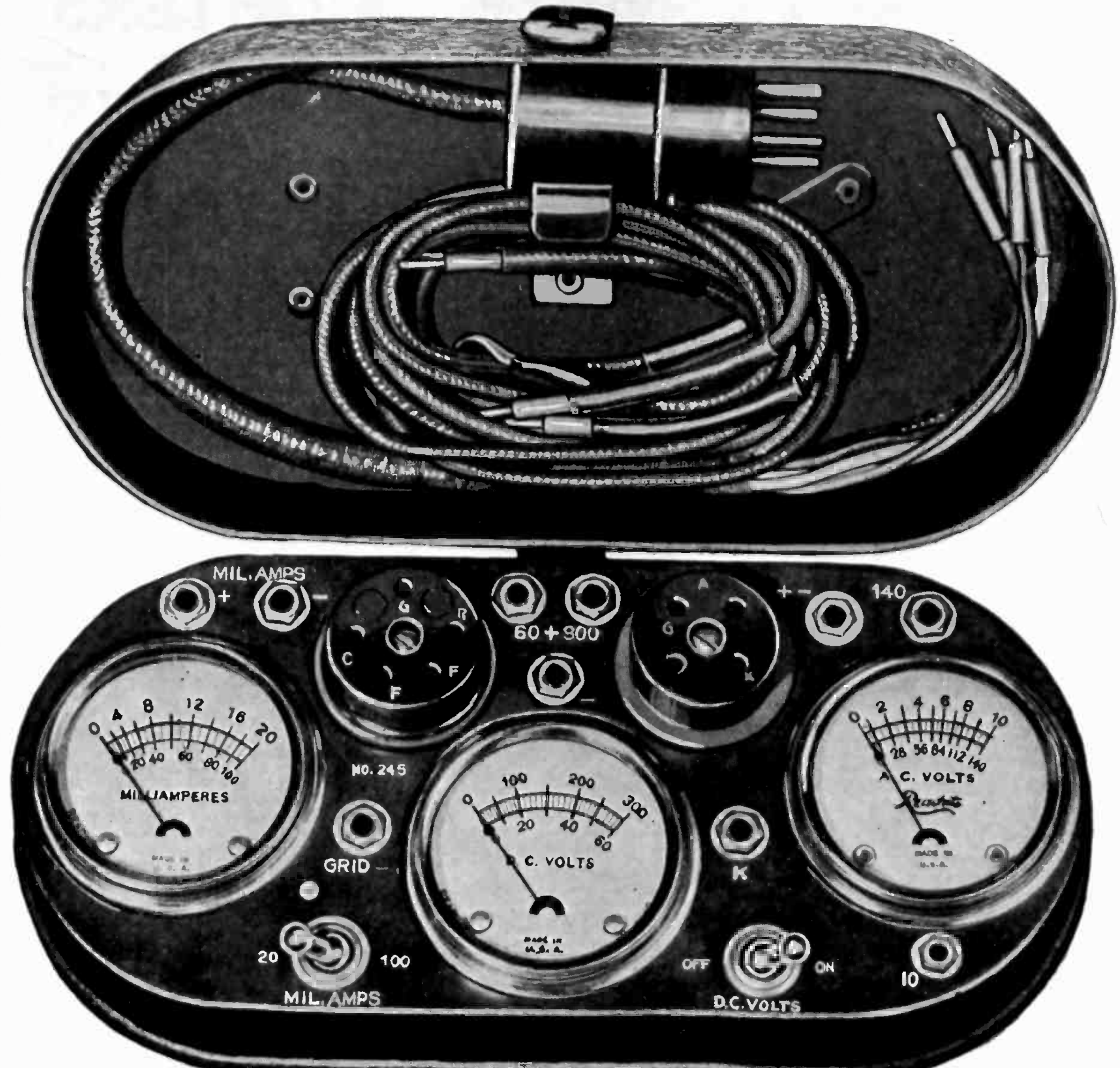


View of National Velvetone Push-Pull Power Amplifier, an expertly made A, B and C supply and audio amplifier, producing marvelous tone quality.

GUARANTY RADIO GOODS CO.
143 WEST 45TH STREET NEW YORK CITY

NEW J-245-X TROUBLE-SHOOTING JIFFY TESTER

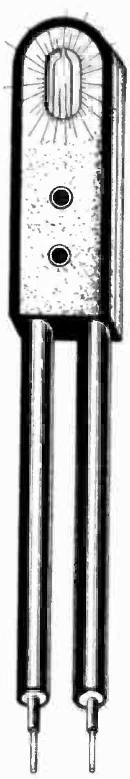
Illumination Continuity and Polarity Tester FREE with Each Outfit!



Your Price

$15.82

Complete



Illumination Tester, Vest Pocket Size, Shows Shorts and Opens Visually, also polarity of DC line. A Neon lamp is built in.

The three-meter assembly, in the crackle-brown finish carrying case, with slip-on cover in place. The handle is genuine leather. The buckled strap holds the cover on.

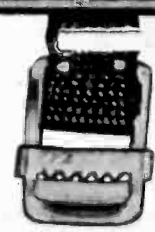
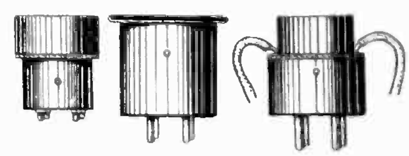


Illustration above is 2/3 scale.



J-111 Multiplier, upper left, with tip; below it, J-106 Multiplier with tip; plugs, left to right, J-19, conforms UV socket to UX plug; J-20, conforms UX tester socket to UV199 tube; J-24, to test Kellogg and old style Arcturus tubes.

Makes All Necessary Tests in a Jiffy and Simplifies Service Work!

THE new Jiffy Tester, J-245-X, is a complete servicing outfit. It consists of a three-meter assembly in a metal case, with slip-on cover and a cable plug. There are ten adapters. It is vital to have the complete outfit so you can meet any emergency.

With this outfit 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, up to 100 milliamperes; plate voltage up to 300 volts; filament or heater voltage (AC or DC), up to 10 volts.

Each meter may be used independently. One of the adapters—a pair of test leads, one red, the other black, with tip jack terminals—serves this purpose. Multiplier J-106 extends the range of the DC voltmeter to 600 volts, but this reading must be obtained independently, as must readings on the 0-60 scale of the DC voltmeter. Independent reading of the AC voltmeter for line of voltage is necessary; also to use 0-140 scale while Multiplier J-111 extends the AC scale to 560 volts for reading power transformer secondaries.

The other adapters permit the testing of special receiver tubes, so that tests may be made, in all, of 22 different tubes: 201A, 200A, UX199, UV199, 120, 240, 171, 171A, 112, 112A, 245, 224, 222, 228, 280, 281, 227, 226, 210, 250, Kellogg tubes and old style Arcturus tubes.

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

☐ Please send me on 5-day money-back guaranty your J-245-X Jiffy Tester, complete, with all 10 adapters, and with illuminated Tester FREE with each order. Also send instruction sheet, tube data sheet and rectifier tube testing information.

☐ Enclosed please find $15.82 remittance. Ship at your expense. [Canadian must be P.O. or Express M.O.]

☐ Please ship C. O. D. @ $15.82 plus cartage and P.O. fee.

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5-DAY MONEY-BACK GUARANTY

WHEN servicing a radio set, power amplifier, speech amplifier or sound reproduction or recording equipment, the circuits and voltages are almost inaccessible, unless a plug-in tester is used.

The Jiffy 245-X plugs in and does everything you want done. It consists of:

(1)—The encased three-meter assembly, with 4-prong (UX) and 5-prong (UY) sockets built in; changeover switch built in, from 0-20 to 0-100 ma.; ten vari-colored jacks, five of them to receive the vari-colored tipped ends of the plug cable; grid push-button, that when pushed in connects grid direct to the cathode for 224 and 227 tubes, to note change in plate current, and thus shorts the signal input.

(2)—4-prong adapter for 5-prong plug of cable.
(3)—Screen grid cable for testing screen grid tubes.
(4)—Pair of Test Leads for individual use of meters.
(5)—J-106 Multiplier, to make 0-300 DC read 0-600.
(6)—J-111 Multiplier, to make 0-140 AC read 0-560.
(7)—Two jack tips to facilitate connection of multipliers to jacks in tester.
(8), (9), (10)—Three adapters so UV199 and Kellogg tubes may be tested.
(11)—Illumination Tester.

The illumination tester will disclose continuities and opens and also the polarity of DC house mains. It is as handy as a pencil and fits in your vest pocket. It works on voltages from 100 to 400. There are two electrodes in a Neon lamp in the top of the instrument. On AC both electrodes light. On DC only one lights, and that one is negative of the line, the light being on the same side as the lead. Hence the illuminator shows whether tested source is AC or DC, and if DC, which side is negative.

Even the output of the speaker cord will show a light.

Also, the device will test which fuses are blown in fused house lines, AC or DC. Besides it tests ignition of spark plugs of automobiles, boats and airplanes, also faulty or weak spark plugs.

Just flash on the illumination tester momentarily. It will last about 4,000 flashes.

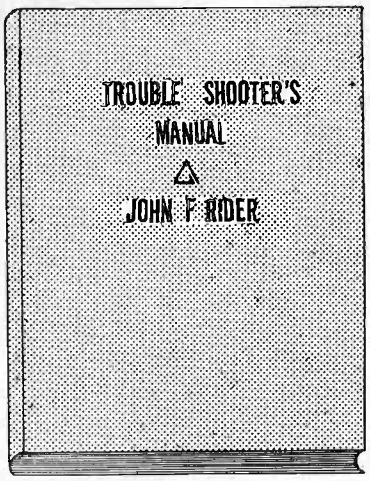
THREE SPLENDID GIFT BOOKS FOR SERVICE MEN!

"Trouble Shooter's Manual" *The most popular and fastest-selling book in radio today. Wiring diagrams of commercial receivers are contained in this outstanding book.*

"Mathematics of Radio" *A sure route to a good grasp on radio technique. Radio theory outlined so that anybody can understand it.*

"Testing Units for Service Men" *Circuits and Methods of Testing Equipment, particularly use of individual meters and of meters united in combination testers.*

These Three Books by John F. Rider Constitute an Outstanding Asset to All Possessors!

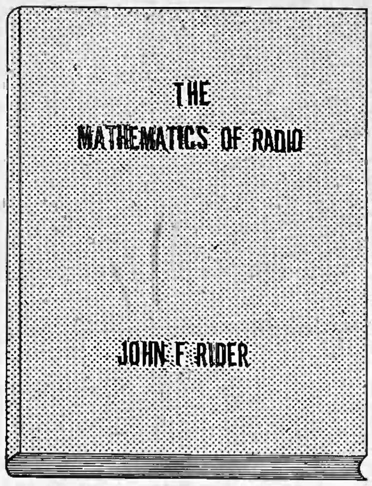


"Trouble Shooter's Manual"

is the first comprehensive volume devoted exclusively to the topic. The 240 pages include 200 illustrations devoted to wiring diagrams of factory-made receivers, besides other illustrations. It is not only a treatise for service men, telling them how to overcome their most serious problems, and fully diagramming the solutions, but is a course in how to become a service man.

This book is worth hundreds of dollars to any one who shoots trouble in receivers—whether they be factory-made, custom-built or home-made receivers.

Besides 22 chapters covering thoroughly the field of trouble shooting, this volume contains the wiring diagrams of models, as obtained dirrect from the factory, a wealth of hitherto confidential wiring information released for the first time in the interest of producing better results from receivers. You will find these diagrams alone well worth the price of the book. The wiring diagrams are of new and old models, of receivers and accessories and as to some of the set manufacturers, all the models they ever produced are shown in wiring diagrams! Here is the list of receivers, etc., diagrams of which are published in this important and valuable book:



Wiring Diagrams of All These Receivers

R. C. A.
60, 62, 20, 64, 30, 105, 51, 16, 32, 50, 25 A.C., 28 A.C., 41, Receptor S.P.U., 17, 18, 33.

FEDERAL
Type E series filament, Type E series filament, Type D series filament, Model K, Model H.

ATWATER-KENT
10B, 12, 20, 30, 35, 48, 32, 33, 40, 38, 36, 37, 40, 42, 52, 50, 44, 43, 41 power units for 37, 38, 44, 43, 41.

CROSLEY
XJ, Trirdyn 3R3, 601, 401, 401A, 608, 704, B and C supply for 704, 704A, 704B, 705, 706.

STEWART-WARNER
300, 305, 310, 315, 320, 325, 500, 520, 525, 700, 705, 710, 715 720, 530, 535, 750, 801, 802, 806.

GREBE
MU1, MU2, synchrophase 5, synchrophase AC6, synchrophase AC7, Deluxe 428.

PHILCO
Philco-electric, 82, 86.

KOLSTER
4-tube chassis used in 6 tube sets, tuning chassis for 7 tube sets, power amplifier, 7 tube power pack and amplifier, 6 tube power pack and amplifier, 6 tube power pack and amplifier, rectifier unit K-23.

ZENITH
39, 39A, 392, 392A, 40A, 35PX, 35APX, 352X, 352APX, 37A, 35P, 35AP, 352P, 352AP, 34P, 342P, 33, 34, 35, 35A, 342, 352, 352A, 362, 31, 333, 353A, power supply ZE17, power supply ZE12.

MAJESTIC
70, 70B, 180, power pack 7BP3, 7P6, 7P3 (old wiring) 8P3, 8P6,7BP6.

FRESHMAN
Masterpiece, equaphase, G, G-60-S power supply, L and LS, Q15, Q, K60-S power supply.

STROMBERG-CARLSON
1A, 2B, 501, 502, 523, 524, 635, 638, 403AA power plant, 404 RA power plant.

All-AMERICAN
6 tube electric, 8 tube 80, 83, 84, 85, 86, 88, 6 tube 60, 61, 62, 65, 66, u and 8 tube A.C. power pack.

DAY FAN
OEM7, 4 tube, 5-5 tube 1925 model, Day Fan 8 A.C., power supply for 6 tube A.C., B power supply 5524 and 5525, motor generator and filetr, 6 tube motor generator set, 6 tube 110 volt D.C. set, 6 tube 32 volt D.C. set.

FADA
50/80A receivers, 460A, Fada 10, 11, 30, 31, 10Z, 11Z, 30Z, 31Z, 16, 17, 32, 16Z, 32Z, 18, 18, special, 192A-192S and 192BS units, R80A, 480A, and SF 50/80A receivers, 460A receiver and R60 unit, 7 A.C. receiver, 475 UA or CA and SF45-75 UA or CA, 50, 70, 71, 72, C electric unit for special and 7 A.C. receivers, ABC 6 volt tube supply, 86V and 82W, E180Z power plant and E 420 power plant.

FREED EISEMANN
NR5, FE18, NR70, 470, NR57, 457, NR11, NR80 D.C.

COLONIAL
26, 31 A.C., 31 D.C.

WORKRITE
8 tube chassis, 6 tube chassis.

AMRAD
70, 7100, 7191 power unit.

SPARTON
A.C. 89.

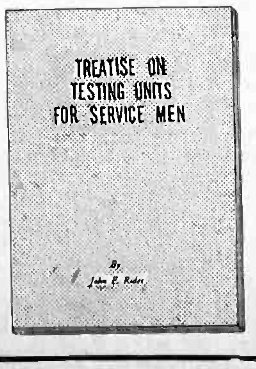
MISCELLANEOUS
DeForest F5, D10, D17. Super Zenith Magnavox dial, Thermiodyne, Grimes 4DL inverse duplex, Garod neutrodyne, Garod EA, Ware 7 tube, Ware type T. Federal 102 special, Federal 59, Kennedy 220, Operadio portable, Sleeper RX1, Amrad inductrol.

HERE ARE THE 22 CHAPTER HEADINGS

"Mathematics of Radio"

TABLE OF CONTENTS:

"Testing Units for Service Men."



A 43-page, liberally illustrated book on testing units and circuits. Tells what equipment a service man should have and how to use it most effectively and quickly. Rapidity of operation is one of the points stressed throughout this valuable book, as a service man's time is his chief stock in trade.

CONTENTS

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(Just East of Broadway)

Enclosed please find:

- ☐ $3.50 for which please send me postpaid "Trouble Shooter's Manual" (Cat. TSM), by John F. Rider, 240 pages, 8½x11", more than 200 illustrations, including wiring diagrams of commercial receivers as advertised; imitation leather cover, gold lettering.
- ☐ $2.00 for which please send me postpaid "Mathematics of Radio" (Cat. MOR), by John F. Rider, 128 pages, 8½x11", 119 illustrations, flexible cover.
- ☐ $1.00 for which please send me postpaid "Treatise on Testing Units for Service Men" (Cat. TU), by John F. Rider, 43 pages, 6¼x9⅛".
- ☐ If ordering C.O.D., put cross in this square.

NAME...

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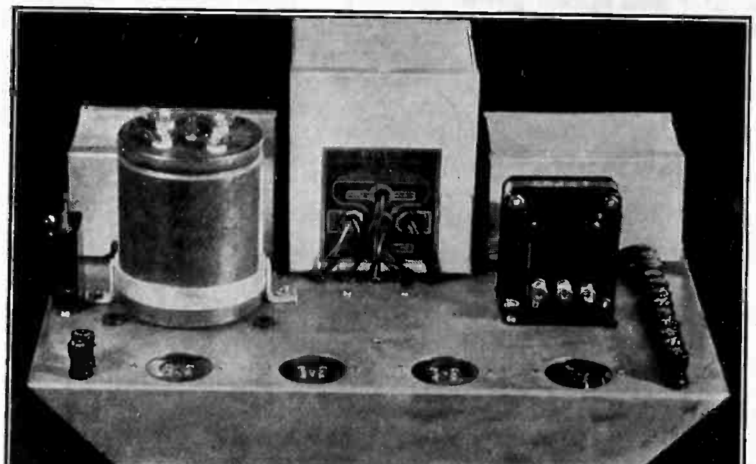
CITY.. STATE..........................

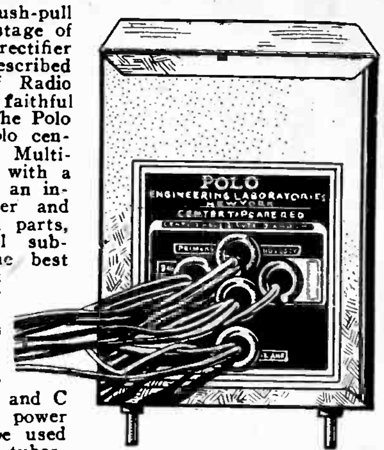
[Canadian remittances must be made by postal or express money order.]

Power Amplifier Equipment

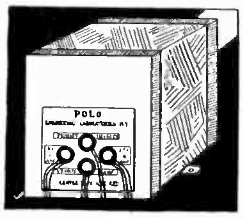


At left is illustrated a push-pull power amplifier, using a first stage of resistance coupled audio, 280 rectifier and two 245s in push-pull, as described in the November 2d issue of Radio World. Abounding volume and faithful tone reproduction are assured. The Polo Filament-Plate Supply, two Polo center-tapped audio chokes and a Multi-Tap Voltage Divider are used, with a Q 2-8, 2-18 Mershon condenser, an input push-pull audio transformer and auxiliary equipment. The total parts, including cadmium-plated steel subpanel, come to $43.57 net, the best power amplifier for that modest amount. Provision is made for phonograph pickup plug insertion. Thirteen output voltages are provided, including 300, 180, 75, 50 and an assortment of nine different voltages under 50 available for bias. All A, B and C voltages are provided for the power amplifier and for a tuner to be used with it employing 227, 224 or 228 tubes. Order Cat. **PO-245-PA @ $43.57 net,** for 50-60 cycles, 110 volts. [For 25 cycles order PO-245-PA-25 @ $48.57. For 40 cycles order PO-245-PA-40 @ $46.07.]

Subpanel alone, cat. SPO @ $3.50



Polo 245 Filament Plate Supply (less chokes) has four windings, all save primary center-tapped (red), is 4⅛" wide, 5" high, 4" front to back. Weight, 9 lbs. Filament windings, 2.5 v. at 12 amps., 2.5 v. at 3 amps. (for 245 filaments), 5 v. at 2 amps. for 280 rectifier, and 724 v. @ 80 m.a., center-tapped. Order Cat. PFPS @ $7.50.
[For 25 cycles order Cat. PFPS-25 @ $12.00.]
[For 40 cycles order Cat. PFPS-40 @ $10.00.]



Polo Filament Transformer Only, four windings, consists of 50-60 cycles 110 v. winding, 2½ v. at 12 amps., 2½ v. at 3 amps., 5 v. at 2 amps. All windings, save primary, are center-tapped (red). Size, 4⅝" high x 3¾" wide x 3" front to back. Weight, 6 lbs. Order Cat. PFT @ $4.25.
[For 25 cycles order PFT-25 @ $7.00; for 40 cycles order PFT-40 @ $6.25.]

By-pass Condensers

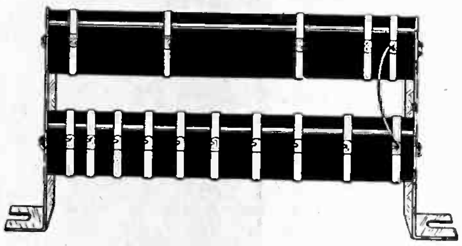
For by-passing B+ leads to ground or C minus from 200 v. post or less, where current is less than 10 m.a., 1 mfd. paper dielectric condensers are useful. Order LV-1 @ ....$0.50 ea.

Filter Condensers

For high voltage filtration next to the rectifier, use 1 or 2 mfd. The 2 mfd. makes the output voltage a little higher.
Order Cat. HV-1 (1,000 v. DC, 550 v. AC)..........$1.76
Order Cat. HV-2 (1,000 v. DC, 550 v. AC)..........$3.52

Filament-Plate-Choke Block

Same as Filament-Plate Supply, except that two 50 henry chokes are built in. Six windings: primary, 110 v., 50-60 cycles; 2.5 v. at 12 amps.; 2.5 v. at 3 amps.; 5 v. at 2 amps.; 724 v. at 80 m.a.; choke All AC windings center-tapped (red), except primary. Connect either end of a choke to one end of other choke for midsection. Order Cat. P-245-FPCH @ ..$10.00
[For 40 cycles order P-245-FPCH-40 @ $13.50.]
[For 25 cycles order P-245-FPCH-25 @ $14.50.]



Two rugged, expertly engineered wire-wound, enamelled resistors, mounted in series, one atop the other, with fourteen useful lugs, providing all necessary choice of voltages without the uncertainty of adjustable variable resistance.

The Multi-Tap Voltage Divider has a total resistance value of 13,850 ohms, in the following steps: 3,000, 4,500, 2,000, 800, 700, 600, 550, 500, 450, 400, 200, 100 and 50 ohms. With the zero voltage lug (at lower left) the total number of useful lugs is fourteen. The resistance stated are those between respective lugs and are to be added together to constitute 13,850 ohms total.

A conservative rating of the Multi-Tap Voltage Divider is 50 watts, continuous use. The unit is serviceable in all installations where the total current drain does not exceed 125 milliamperes.

Extreme care has been exercised in the manufacture of the Multi-Tap Voltage Divider. It is mounted on brackets insulated from the resistance wire that afford horizontal mounting of the unit on baseboards and subpanels.

There long has been a need for obtaining any necessary intermediate voltage, including all biasing voltages, from a Multi-Tap Voltage Divider, but each lug has to be put on individually by hand, and soldered, so that manufacturing difficulties have left the market barren of such a device until now.

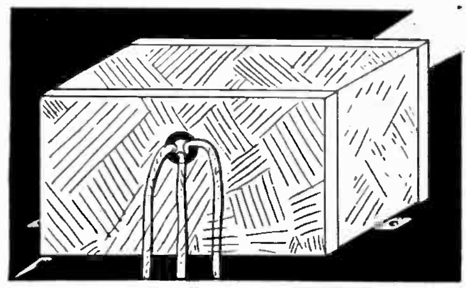
The Multi-Tap Voltage Divider is useful in all circuits, including push-pull and single-sided ones, where the current rating of 125 milliamperes is not seriously exceeded and the maximum voltage is not more than 400 volts. If good ventilation is provided, this rating may be exceeded 15 per cent.

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

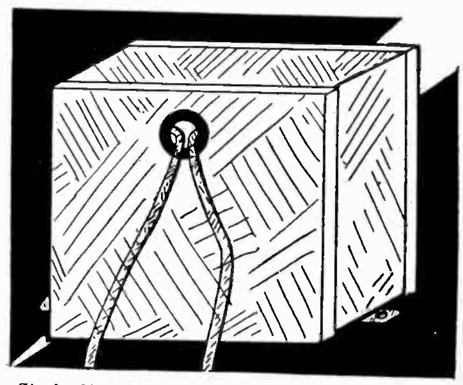
When the Multi-Tap Voltage Divider is placed across the filtered output of a B supply which serves a receiver, the voltages are in proportion to the current flowing through the various resistances. If a B supply feeds a receiver with two-stage audio amplifier, the last stage a single-sided 245, then the voltages would be 250 maximum for the power tube, 180, 135, 75, 50, 40, 35, 30, 25, 16, 10, 6 and 3. By making suitable connection of grid returns the lower voltages may be used for negative bias or even for positive voltage on the plates.

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.

Order Cat. MTVD at $3.95.



Center-tapped double choke, 125 m.a. rating, 30 henrys in each section. Used for filtering B supply or for a push-pull output impedance, where speaker cords go directly to plates of tubes. Center tap is red. Order Cat. PDC @ $3.71.



Single 30 henry 100 m.a. choke for filtered output (where condenser is used additionally) or for added filtration of a B supply. Order Cat. PSC @ $2.50.

ACOUSTICAL ENGINEERING ASSOCIATES,
143 West 45th St., N. Y. City.
(Just East of Broadway.)

Please ship at once the following:

Quantity	Cat. No.	Product	Price
☐	PO-245-PA	Power amp. parts, 50-60 c.	$43.57
☐	PO-245-PA-40	Same, 40 cycles	46.07
☐	PO-245-PA-25	Same, 25 cycles	48.57
☐	PFPS	Fil. plate supply, 50-60 c.	7.50
☐	PFPS-40	Same, 40 cycles	10.00
☐	PFPS-25	Same, 25 cycles	12.00
☐	PFT	Fil. trans., 50-60 c.	4.25
☐	PFT-40	Same, 40 cycles	6.25
☐	PFT-25	Same, 25 cycles	7.00
☐	P-245-FPCH	Power-filter block	10.00
☐	P-245-FPCH-40	Same for 40 cycles	13.50
☐	P-245-FPCH-25	Same for 25 cycles	14.50
☐	PDC	Single choke	2.50
☐	PSC	Multi-tap volt. div.	3.95
☐	MTVD	Double c.-t. choke	3.71
☐	Q2-8, 2-18B	Mershon with bracket	5.15
☐	LV-1	200 v., 1 mfd. by-pass cond.	.50
☐	HV-1	1,000 v., 1 mfd. filter cond.	1.76
☐	HV-2	1,000 v., 2 mfd. filter cond.	3.52
☐	SPO	Subpanel	3.50

☐ Enclosed please find check—money order—for the above. [Note: Canadian remittance must be by postal or express money order.]

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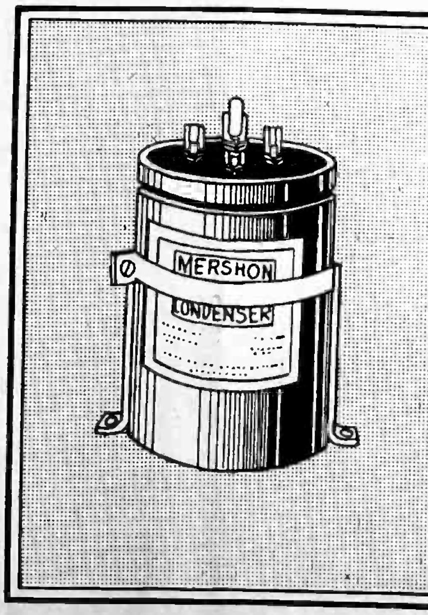

The Mershon electrolytic condenser, 415 volts DC, for filtering circuits of B supplies. Q 2-8, 2-18 has four capacities in one copper casing: two of 8 mfd. and two of 18 mfd. The copper case is negative. The smaller capacities are nearer the edge of the case. The vent cap should not be disturbed, and the electrolyte needs no refilling or replacement.

Mershon electrolytic condensers are instantly self-healing. Momentary voltages as high as 1,000 volts will cause no particular harm to the condenser unless the current is high enough to cause heating, or the high voltage is applied constantly over a long period.

High capacity is valuable especially for the last condenser of a filter section, and in by-passing, from intermediate B+ to ground or C+ to C—, for enabling a good audio amplifier to deliver true reproduction of low notes. Suitably large capacities also stop motor-boating.

Recent improvements in Mershons have reduced the leakage current to only 1.5 to 2 mils total per 10 mfd. at 300 volts, and less at lower voltages. This indicates a life of 20 years or more, barring heavy abuse.

In B supplies Mershons are always used "after" the rectifier tube or tubes, hence where the current is direct. They cannot be used on alternating current. Rated 415 v. DC.

The Mershon comes supplied with special mounting bracket. Order Q 2-8, 2-18 B @ **$5.15**

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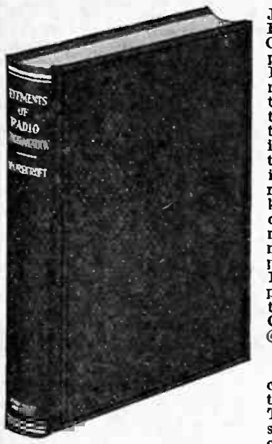

The latest book by Prof. John H. Morecroft, of the Engineering Department of Columbia University, and past president of the Institute of Radio Engineers, is his "Elements of Radio Communication," a book for the novice to enjoy. We regard this as the best elementary book to inform you authoritatively on the technical phases of radio in plain language, without requirement of mathematical knowledge. The book is a complete course on the elements of radio, containing much material never before published. It has 226 pages, 170 illustrations and a complete index. Just out, it is the book of the year in radio. Cloth bound. Order Cat. ME @ $3.00

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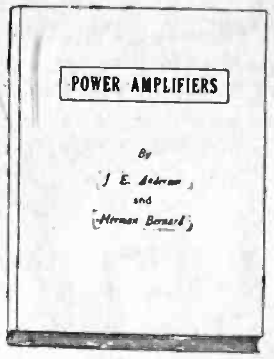
ANDERSON and BERNARD
"Power Amplifiers"



Here is the *first* book to be published on the subject of "Power Amplifiers." Now printing, it is certain to fill a void in radio literature. The whole subject is fully covered in a masterful theoretical discussion of audio amplifiers and power supplies, supplemented by constructional chapters, with complete wiring diagrams and specification of parts. Learn while you build! J. E. Anderson, M. A., technical editor of RADIO WORLD, and Herman Bernard, LL. B., managing editor of RADIO WORLD, both of the Institute of Radio Engineers, have explained fully the phenomena of power amplifiers. Learn all about motorboating and its cures, push-pull theory and practice, grid bias methods and effects, vacuum tubes in audio circuits, AC and battery type AF amplifiers, phase relationships, common impedance, filter systems, by-pass condenser effects, necessities for tone quality, values of coupling constants, and a host of other topics associated with power amplification, including speech amplifiers and "talkie" installations.

More than 200 pages and more than 100 illustrations are devoted to an analysis of this outstanding radio subject. "Power Amplifiers" is authoritative, original and comprehensive. It is free from the traditional errors that have crept into this subject. The theoretical part of the book can be understood by most novices, while the constructional part, that capitalizes the previously imparted knowledge, is thoroughly understandable by anybody. There is virtually no mathematics in the book. Cloth bound. Order Cat. PAM @..$3.50

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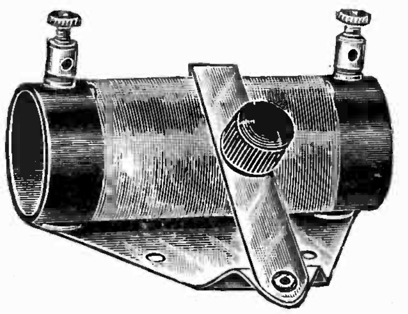

Remove aerial lead from set. Connect aerial instead to one of the binding posts of the Aerial Tuner. Connect the other binding post of the Aerial Tuner to antenna post of your set. Then move the lever of the Aerial Tuner until any weak station comes in loudest. The lever need not be moved for every different frequency tuned in. The Aerial Tuner acts as an antenna loading coil and puts the antenna's frequency at any frequency in the broadcast band that you desire to build up. Price, 85c.

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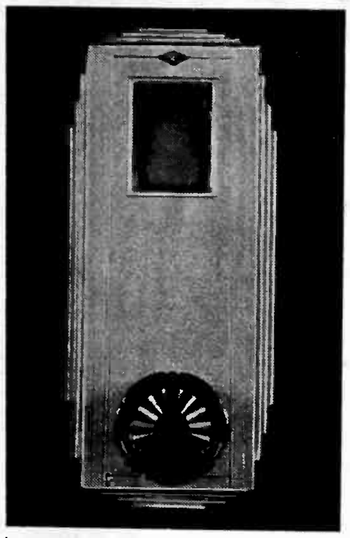

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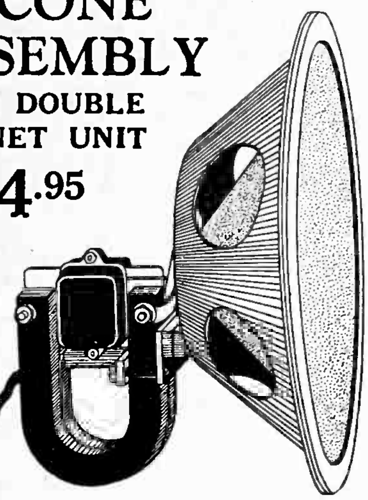

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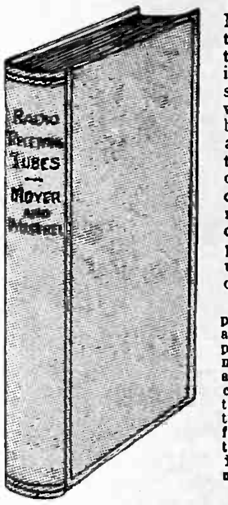

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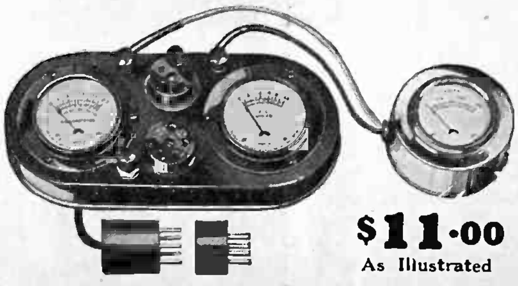

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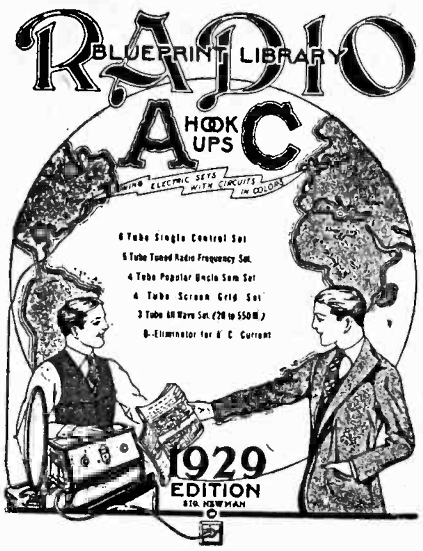

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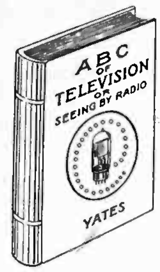

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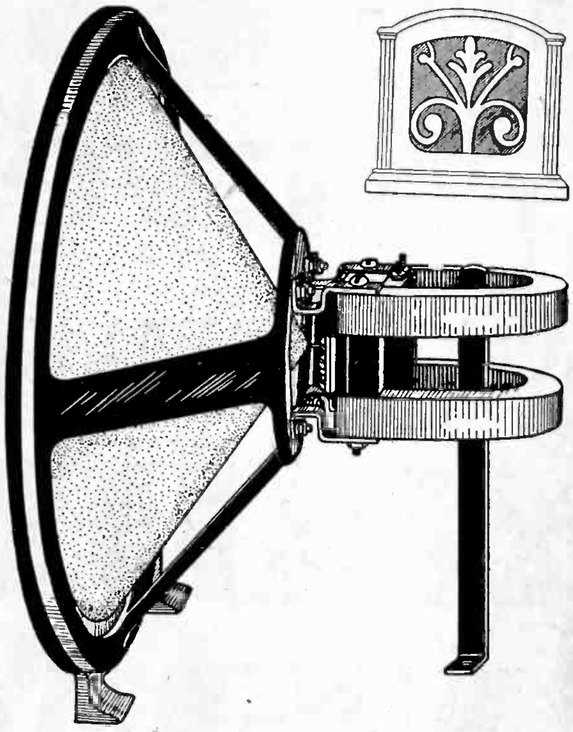

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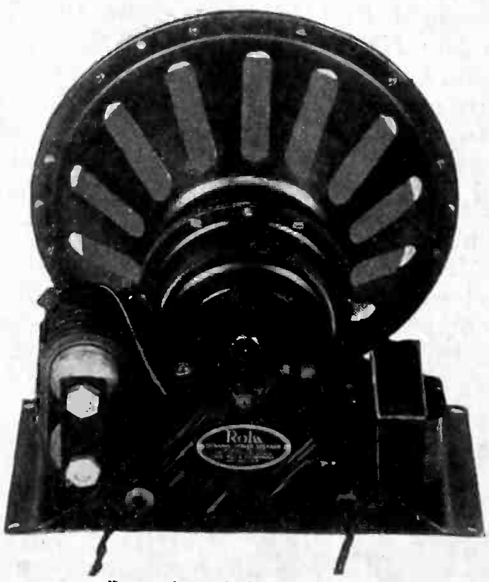
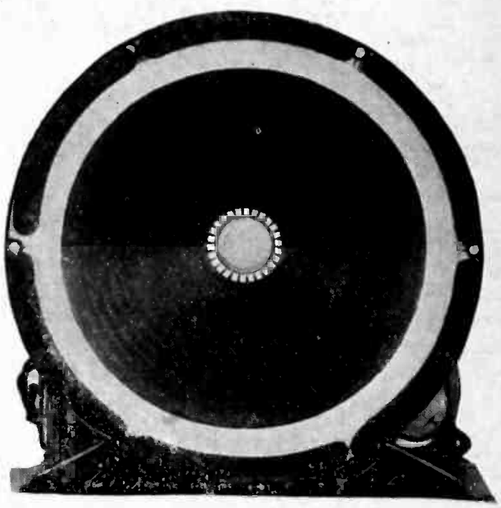


Rear view of the Rola chassis



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