# RADIO WORLD

REG. U.S. PAT. OFF.

*407th Consecutive Issue—EIGHTH YEAR*

JAN. 11th 1930 15¢


**Coils, Condensers, Resistors Explained for Novices**

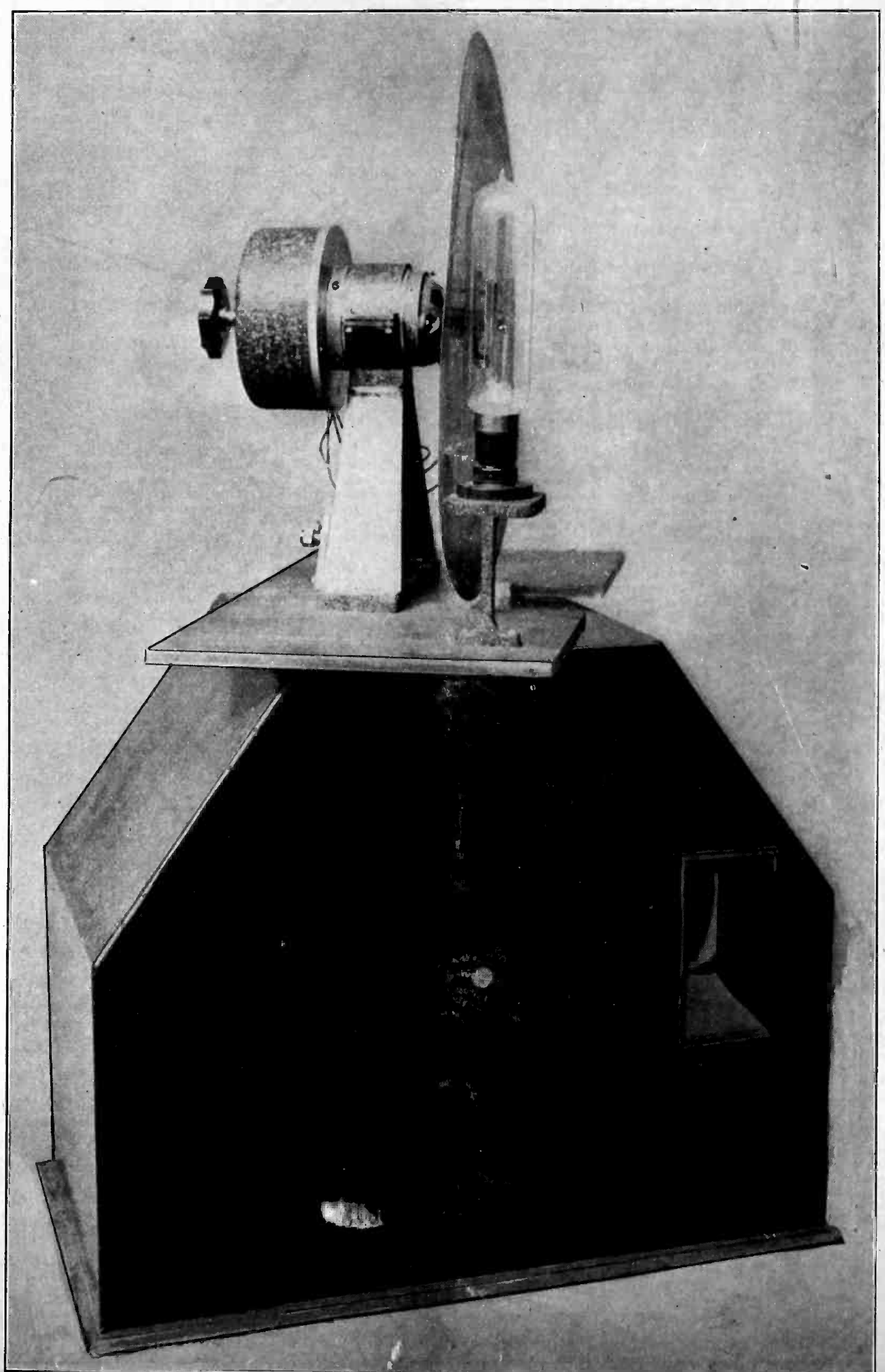
**RF Filter Uses**

**Superheterodyne Single Control**

**HB33 Trouble Shooting**

# BAIRD DEMONSTRATES FINE TELEVISION RESULTS

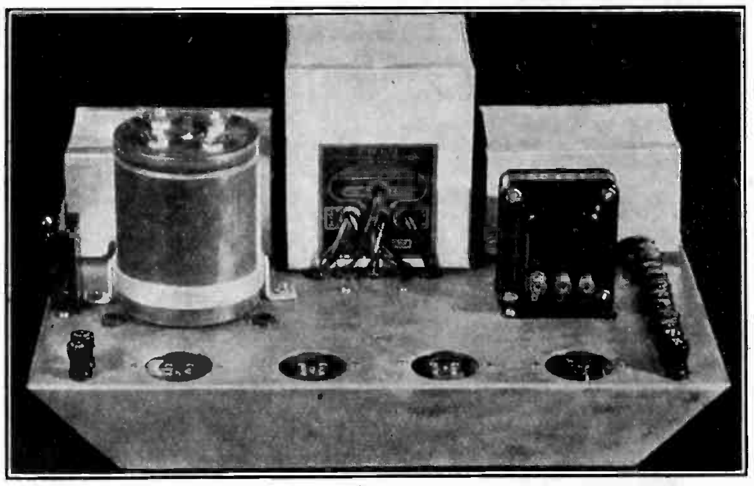
See Article on Page 7



The Baird scanning disc and motor shown removed from the cabinet which is underneath. (Wide World)

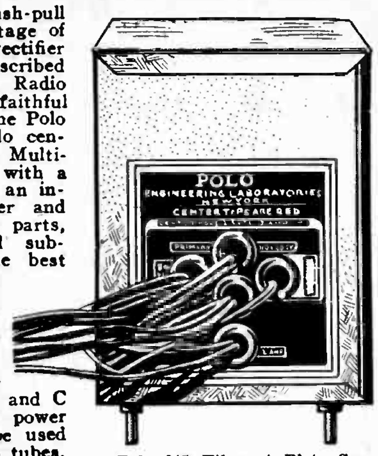
RADIO WORLD, published by Hennessy Radio Publications Corporation. Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager, all of 145 West 45th Street, New York, N. Y.

# Power Amplifier Equipment

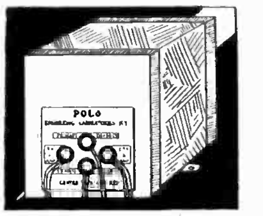


At left is illustrated a push-pull power amplifier, using a first stage of resistance coupled audio, 280 rectifier and two 245s in push-pull, as described in the November 2d issue of Radio World. Abounding volume and faithful tone reproduction are assured. The Polo Filament-Plate Supply, two Polo center-tapped 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 4½" 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**

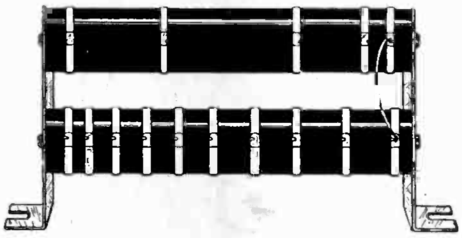
For by-passing B+ leads to ground or C minus from 200 v. post or less, where current is less than 10 m.a., 1 mfd. paper dielectric condensers are useful. Order LV-1 @ ................$0.50 ea.

**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.

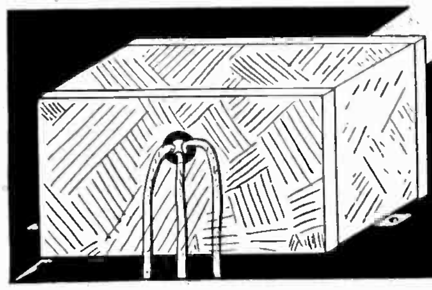
The Multi-Tap Voltage Divider is useful in all circuits, including push-pull and single-sided ones, where the current rating of 125 milliamperes is not seriously exceeded and the maximum voltage is not more than 400 volts. If good ventilation is provided, this rating may be exceeded 15 per cent.

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

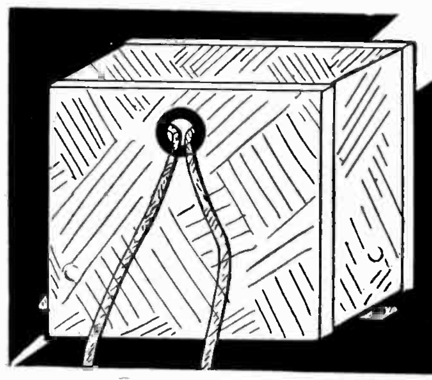
When the Multi-Tap Voltage Divider is placed across the filtered output of a B supply which serves a receiver, the voltages are in proportion to the current flowing through the various resistances. If a B supply feeds a receiver with two-stage audio amplifier, the last stage a single-sided 245, then 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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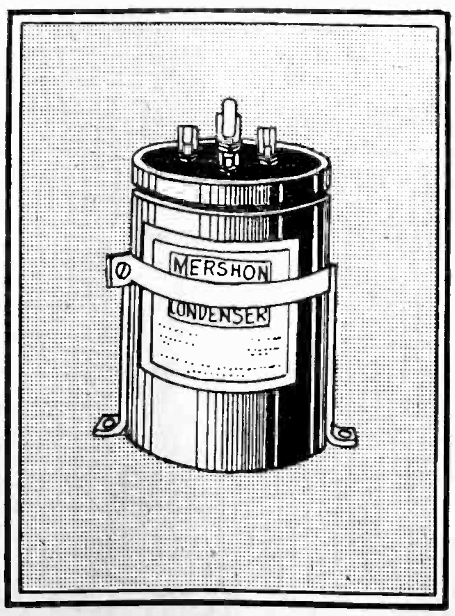
5-DAY MONEY-BACK GUARANTEE!




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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"UNINTERRUPTED READER INTEREST"
EVERY WEEK — EVERY YEAR
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Technical Accuracy Second to None
Latest Circuits and News
EIGHTH YEAR

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# Baird Television Scores

## Highly Successful Demonstration in New York City

*By J. E. Anderson*

**Technical Editor**

SURPRISING advance in the art of television was demonstrated recently in New York City by the American representatives of Baird interests. Judging by the simplicity of the apparatus used and the quality of the reproduced images the art is well on the road toward commercial practicability.

In the latest Baird system the scanning disc contains only 30 holes and is driven at the rate of 750 revolutions per minute, or 12.5 per second. This is considerably coarser scanning than any that has been considered necessary heretofore and a speed of repetition much slower than has been considered necessary to eliminate flicker. The surprising things about the demonstration were that there was no marked flicker and that the image contained detail in a remarkable degree.

In the transmitter the spot light system of illumination was employed, that first suggested by Dr. Gray of the Bell Laboratories and usually called indirect illumination. The object to be transmitted is scanned by a bright spot of light and the light reflected from the object is intercepted by a number of exceptionally sensitive photo-electric cells placed in front of the object.

### BRIGHTNESS NOT INTENSE

The source of light used was comparatively weak, a 900 watt incandescent light being used. The intensity of the light as seen by the living object was not so great as to be uncomfortable in the least. The possibility of using such weak illumination is due to the increased sensitivity of the photo-electric cells. It might be thought that in order to secure a high sensitivity enormously large cells must be used, but that is not the case, for the cells used are really very small. The increased light-sensitivity has been effected by increasing the electron emission per unit of luminous flux rather than by enlarging the light gathering capability of the cells.

Possibly the most interesting and important feature of the latest television system of Baird is the method of synchronization. A synchronizing signal is sent on the carrier of the visual signal, a part of the picture frame being masked to light for this purpose. The signal is determined by the motor driving the transmitter scanning disc and is about 375 cycles per second. This 375 cycle tone frequency is picked up by the receiver and is used to speed up or slow down the receiver scanning disc as may be required.

### DRIVING THE RECEIVING DISC

The receiver scanning disc is driven by a non-synchronous motor the speed of which can be varied manually with a rheostat. To effect synchronism it is only necessary to adjust this rheostat until the picture is clear, although at first it may be somewhat unsteady. As soon as synchronism has been achieved the synchronizing signal mantains the speed of the receiver disc the same as that of the transmitter disc. The arrangement is ingenious because of its simplicity and effectiveness.

As the synchronizing signal necessarily must be weak there must not be much inertia in the receiving scanning disc. For that reason the scanning disc is no dsc at all but a wheel with a suitably wide rim in which the scanning holes are punched. Moreover, the thickness of the disc, or wheel, is not much greater than an ordinary sheet of paper. It is so thin that it will not hold itself flat while it is standing still, but of course it flattens out as the speed increases. The lightness of the disc permits the feeble synchronizing signal to hold the disc in proper speed.

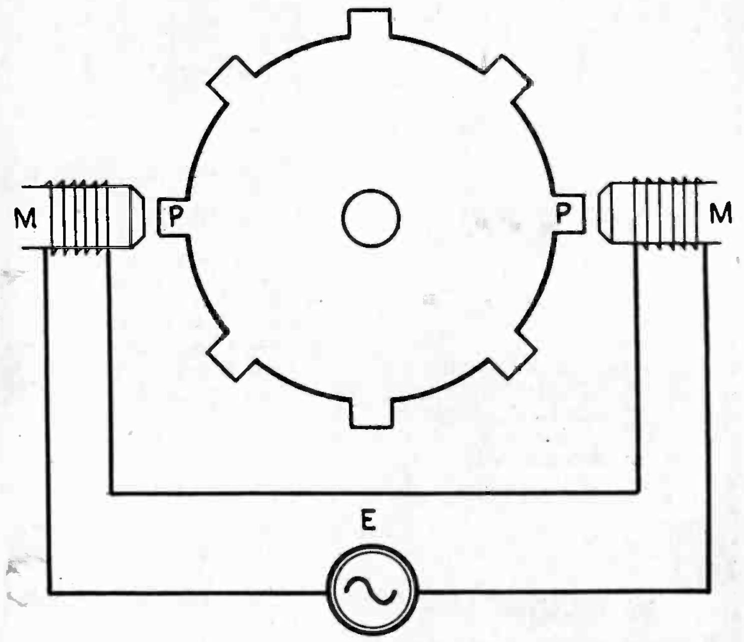



FIG. 1
A DRAWING WHICH SHOWS THE PRINCIPLE OF THE AUTOMATIC TELEVISION SYNCHRONIZER USED IN BAIRD'S LATEST TELEVISION RECEIVER

### DETAILS OF SYNCHRONIZING DEVICE

To give an idea how the automatic synchronizing device works Fig. 1 has been appended. The toothed iron wheel is mounted on the shaft of the motor driving the disc and spins at the same rate. It is mounted between two electro-magnets MM in the manner indicated. The synchronizing signal is passed through the coils of these magnets. For simplicity the source of the synchronizing signal is represented as an alternator E. Actually the alternator is at the transmitter and the 375 cycle tone is picked up from the radio carrier and sent through the magnets after detection and amplification in the usual manner.

If a current pulse is sent through the magnet windings the instant the pole pieces, or teeth on the wheel, are opposite the poles of the magnet, there is neither a tendency to accelerate the disc nor to retard it. The two discs, the one at the transmitter and the one at the receiver, are in exact synchronism. But suppose that the receiver disc slows down a little bit. The signal pulse will arrive before the teeth are opposite the poles and there will be a slight acceleration. Conversely, if the re-

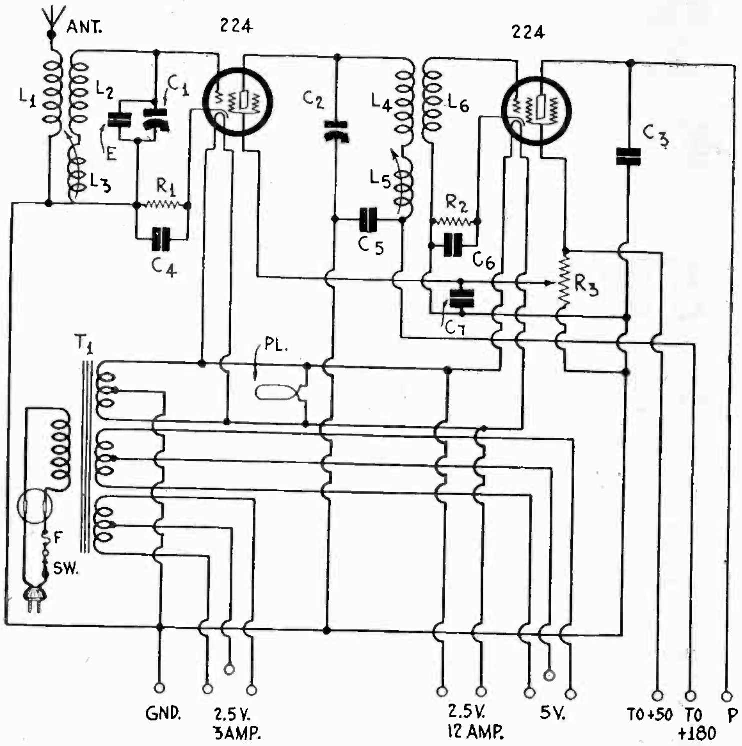
**(Concluded on pages 16 and 17)**

# Bernard AC Tuner

## Directions for Achieving the Maximum Results from Two Tuber

*By Herman Bernard*

**Managing Editor**




BERNARD TUNER FOR AC OPERATION

THE Bernard tuner for AC is to be worked with a power pack, uses the screen grid tube, 224, as detector, and in that way permits the employment of a relatively low value of biasing resistor for detection, about 5,000 or 6,000 ohms being suitable. Both screen grid and plate currents flow through this resistor, which accounts for the relatively small ohmage. The detector is thereby maintained at a steady value of negative bias of about 5 or 6 volts, depending on which value of resistor is chosen, since about 1 milliampere will flow through the resistor, if the plate load is a resistor of about .1 meg. It is best to use a resistive plate load with the screen grid detector.

This value of bias does not necessarily give the loudest signals, but it usually gives the loudest signals consistent with best quality. If you have a 2,000 ohm resistor you may try this for R2, and you will find the volume goes up somewhat, although the quality probably will not be improved.

The amplification from the single radio frequency tube is so great, due to tuning the plate circuit, that you should favor the higher bias.

The audio amplifier in the power pack should be sufficient to provide speaker volume on all receivable stations. One stage of resistance audio and one stage of transformer audio, single or push-pull, will accomplish this nicely.

The two circuits have to tune together for single control. A diagram published last week, issue of January 4th, suggested a layout of parts for single control. The equalizing condenser E was shown at left, across the first tuned circuit, as that is where it is usually needed. In few instances conditions will compel the placement of this condenser across the second tuned circuit instead.

There is always a high capacity across opposite potentials when there is high amplification. This capacity shows up in the plate circuit of the screen grid tube, particularly because this circuit is tuned and the pickup coil that feeds the detector has a large number of turns. Hence there is also distributed capacity to reckon with, and the theoretical side of the case compels the placement of the equalizing condenser across the first tuned circuit, as does general practical application.

The exception arises when the antenna-ground capacity is so high that the capacity it reflects in the first tuned circuit is even greater than that which arises in the second tuned circuit because of high amplification and the distributed capacity of the pickup coil added to the distributed capacity of the tuned plate winding. However, you can quickly determine on which side the equalizer is to be placed, because you will get only low volume and poor selectivity when it is on the wrong side. When the circuits are properly balanced you will get good selectivity and high gain. Also, when the equalizer is set for some low wavelength you will tune truly throughout the broadcast band of wavelengths, and cover the entire band nicely.

### DATA ON ASSEMBLIES

Those who prefer separately tuned circuits in a two tube design of course may build the AC tuner that way. If the Bernard assemblies, (BT-L-AC and BT-R-AC) are used, then the condenser should be put against the front panel, in one instance, and the coil mounted on the front panel in the other instance. Select which one to put in each individual place on the basis of the direction of dial readings, so that highest number corresponds to highest wavelength and lowest number to lowest wavelength.

This divergence of assembly for separate tuning is necessary because in the assemblies these tuning arrangements are in opposite directions for corresponding rotation of dials. If, however, you have condensers of your own, and desire only to incorporate the coils, BT3A and BT3B for .00035 mfd., and BT5A and BT5B for .0005 mfd., then you may mount both condensers on hte front panel, but condensers of your own then should have shafts protruding at rear. Or, if your condensers do not have rear extension of their shafts, put both coils on the front panel. This is easily done because of the single hole mounting feature of the coils. However, the condensers would have to be supported on the baseboard with brackets.

The antenna assembly (left-hand for single control) consists of a BT3A coil, a .00035 mfd. tuning condenser, a coupling link, a UY socket and an aluminum base on which these are mounted. The assemblies are completely mounted but you must wire them yourself.

The right-hand interstage assembly, BT-R-AC, is the same as the one previously mentioned, except that the direction of shaft rotation is opposite, when shafts are considered side by side, and the coil is a BT3B, for interstage coupling.

The coils are the Bernard tuners, with a moving coil inside a form that contains a fixed winding. The moving coil and the fixed winding are connected together at the factory and constitute the tuned circuit with the tuning condenser across it, adding variometer tuning to capacity tuning, to insure wave band coverage and efficient operation by large step-up ratio.

The antenna coil has two fixed windings on the single outside form. The other coil has three forms, as the pickup coil L6 is on a separate form inside the largest form, but of course smaller than the winding that holds the moving coil.

### FILAMENT TRANSFORMER

The volume control, R3, is a potentiometer of 25,000 ohms that should be connected to B plus 50 volts or thereabouts. You may use up to 75 or 80 volts here if that voltage is independently available. If your power pack has a 250, 210 or 245 tube, or two of any of these in push-pull, the lead marked B plus 50 may be connected to the positive side of the resistor biasing the power tube stage. This is usually the center tap of the power tube filament winding of the power transformer in your pack.

A filament transformer included in the tuner permits the heating of 5 volt and 2.5 volt tube tubes. There is one winding at 2 amperes for 5 volts, which may heat the filaments of 112, 112A, 171 or 171A, also one at 2.5 volts 3 amperes for 245 tubes, also another 2.5 volt winding, this one 12 amperes, which is used on the heaters of the two tubes in the tuner, but which may be used on three additional tubes of the same type, 227, 224 or 228, in the audio amplifier.

## *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 AC screen grid tube 224 (Cat. BT-L-AC).**

**L4 L5 L6, C2, socket, link, base, .00035 tuning condenser—One Bernard tuner assembly for right-hand position, when using drum dial, socket for 224 or 227 or 228 (Cat. BT-R-AC).**

**R1—One 300 ohm resistor strip (Electrad).**

**R2—One 5,000 ohm resistor with mounting.**

**R3—One Electrad 25,000 ohm Super Tonatrol (potentiometer).**

**C3—One .00025 mfd. mica dielectric fixed condenser.**

**C4, C5, C7—Three .01 mfd. mica dielectric fixed condensers.**

**C6—One 1 mfd. 200 volts mica dielectric fixed condenser.**

**T1—One Polo filament transformer, PFT.**

**Fourteen binding posts.**

**F—One 2 ampere fuse with clips.**

**SW—One pendant AC switch and 12 ft. AC cable.**

**One National Velvet Vernier Modernistic dial, with rainbow feature and pilot light PL and bracket.**

**One drilled front panel, 7 x 18', bakelite.**

# What Size Wire?

## Diameter Choice Easily Remembered—Safe Current Given

*By James A. Dowie*

**Chief Instructor, National Radio Institute**

A WIRE table showing the size, resistance and weight is very useful to the radiotrician and service man.

Although most are familiar with such a table, there are perhaps a good many who do not thoroughly understand the relation between the various sizes and also how it is possible to memorize the table well enough so that they can tell off-hand about almost any wire which is mentioned.

The main thing about a wire table is its regularity in that every three sizes doubles the area and weight of the wire. When you double the area, of course, it halves the resistance and so every three numbers will cut the resistance in two. Of course, when the diameter is doubled, the area is four times as great. From this follows that three numbers double the area, and three numbers more double it again, to a total of four times. Four times the area is twice the diameter and so the rule: every six numbers doubles or halves the diameter, according to whether the area increases or decreases in the table.

To check this rule, start with No. 10. Notice the diameter and also the resistance of the wire. Three sizes smaller will be No. 13. The resistance then will be double. Three sizes smaller than this will be No. 16. Hence, the resistance is again doubled or four times that of No. 10.

### EXAMPLES CITED

Suppose you want to compare the sizes ten numbers apart. The first three will double the resistance, the second three will double it again to four times, and the third three (nine in all) will double it again to eight times. We now have one more size to go, from 9 to 10. One size increases the resistance by 25%, or one-quarter. A quarter of eight (which we found is the increase for 9 numbers) is 2, which added to the 8 makes 10. In other words, every ten numbers multiplies the resistance by 10. This is quite interesting and makes the wire table so easy to remember.

Knowing the relation between the sizes of wire, you want to remember some starting point from which to work. Number 10 wire is easiest to remember, since it has a resistance of .0010 of an ohm per foot, or 1 ohm per thousand feet, and a diameter of 102 mils or 1/10 of an inch. With this as a foundation, you can build up the whole wire table in your head. For instance, what is the diameter of No. 16 wire? Six sizes has doubled the diameter of .2, (two-tenths of an inch).

What is the resistance of No. 17 wire? Going up three sizes to 17 has doubled, and three more to 16 has quadrupled the resistance. Four times 1 ohm is 4 ohms per thousand feet. Going 1 more size from 16 to 17 increases the resistance 25%. 25% more than 4 is 5. This you will see is the correct answer from the wire table.

### HABIT FOLLOWED

The first column of the wire table gives the wire size in American gauge. This is often called B & S after Brown & Sharpe who originated it. It would be much more convenient and scientific simpy to set down the diameter of the wire in thousandths of an inch, but years ago engineers got into the habit of specifying the sizes of wire by the particuar slot or hole in a gauge plate into which the wire would fit. The habit has persisted. The slots or holes were numbered, hence the present numbers used to designate the sizes of wire.

In the second column the diameter of the bare wire is given in thousandths of an inch. Rather than make every one of these read as a decimal, it is more convenient to put the answer down directly in thousandths, which are called mils. Thus, size 8 is 128 mils (128 divided by a thousand) or .128 inch. The next column shows the weight of bare copper wire per foot, or in other words how many feet of a certain size wire in a pound. The fourth column shows the resistance of various size bare copper wire in ohms per foot.

In some tables these values are given per thousand feet. This eliminated the small decimal point. Naturally, if you want the value per thousand feet, you multiply the figures given by 1,000. Of course, the resistance of copper wire changes quite a bit with temperature. The values here are correct for ordinary room temperature in Summer. In Winter the resistance is slightly less owing to the cold.

The current to be carried is also a factor in selecting wire sizes. The answer may be found for general purposes from Table II, which gives safe current carrying capacities for different sizes.

**TABLE I**

| Size B.&S. Gauge | Diam. bare Wire in in. | Area Cir. Mills | Ohms per 1000 ft. | Ohms per. lb. |
|---|---|---|---|---|
| 1 | .2893 | 83690 | .1237 | .00049 |
| 3 | .2294 | 52630 | .1967 | .00124 |
| 2 | .2576 | 66370 | .1560 | .00078 |
| 4 | .2043 | 41740 | .2480 | .00196 |
| 5 | .1819 | 33100 | .3128 | .00312 |
| 6 | .1620 | 26250 | .3944 | .00496 |
| 7 | .1443 | 20820 | .4973 | .00789 |
| 8 | .1285 | 16510 | .6271 | .01255 |
| 9 | .1144 | 13090 | .7908 | .01995 |
| 10 | .1019 | 10380 | .9972 | .03173 |
| 11 | .0907 | 8234 | 1.257 | .05045 |
| 12 | .0808 | 6530 | 1.586 | .08022 |
| 13 | .0720 | 5178 | 1.999 | .1276 |
| 14 | .0641 | 4107 | 2.521 | .2028 |
| 15 | .0571 | 3257 | 3.179 | .3225 |
| 16 | .0508 | 2583 | 4.009 | .5128 |
| 17 | .0453 | 2048 | 5.055 | .8153 |
| 18 | .0403 | 1624 | 6.374 | 1.296 |
| 19 | .0359 | 1288 | 8.038 | 2.061 |
| 20 | .0320 | 1022 | 10.14 | 3.278 |
| 21 | .0285 | 810.1 | 12.78 | 5.212 |
| 22 | .0253 | 642.4 | 16.12 | 8.287 |
| 23 | .0226 | 509.5 | 20.32 | 13.18 |
| 24 | .0201 | 404.0 | 25.63 | 20.95 |
| 25 | .0179 | 320.4 | 32.31 | 33.23 |
| 26 | .0159 | 254.1 | 40.75 | 52.97 |
| 27 | .0142 | 201.5 | 51.38 | 84.23 |
| 28 | .0126 | 159.8 | 64.79 | 133.9 |
| 29 | .0113 | 126.7 | 81.70 | 213.0 |
| 30 | .0100 | 100.5 | 103.0 | 338.6 |
| 31 | .0089 | 79.70 | 129.9 | 538.4 |
| 32 | .0080 | 63.21 | 163.8 | 856.2 |
| 33 | .0071 | 50.13 | 206.6 | 1361 |
| 34 | .0063 | 39.75 | 260.5 | 2165 |
| 35 | .0056 | 31.52 | 328.4 | 3441 |
| 36 | .0050 | 25.00 | 414.2 | 5473 |
| 37 | .0045 | 19.83 | 522.2 | 8702 |
| 38 | .0040 | 15.72 | 658.5 | 13870 |
| 39 | .0035 | 12.47 | 830.4 | 22000 |
| 40 | .0031 | 9.888 | 1047 | 34980 |

**TABLE II**

| Size (B & S) | Amperes | Size (B & S) | Amperes |
|---|---|---|---|
| 14 | 12 | 26 | 0.5 |
| 16 | 6 | 27 | 0.4 |
| 18 | 3 | 28 | 0.3 |
| 19 | 2.25 | 30 | 0.2 |
| 20 | 2 | 32 | 0.12 |
| 22 | 1.2 | 34 | 0.08 |
| 24 | .08 | 38 | .025 |

# Weather Spoils Plan for Foreign Programs

Abnormal static prevented a surprise rebroadcast of European programs New Year's Eve. The stage was all set, and the National Broadcasting Company was ready to treat American listeners to programs from five European countries, but the weather made the general plan a fizzle.

The midnight tolling of Big Ben on the House of Parliament and a London chorus singing "Auld Lang Syne" were as far as the project got. The rest of the receiving attempts proved hopeless. A Broadway dance orchestra played "On the Road to Mandalay" as an exchange greeting, without knowing if its efforts were getting over in a trans-Atlantic sense.

The whole plan pivoted about the New Year's Eve programs of stations in the five foreign countries. One midnight signal after another were to be received from three countries, which was theoretically possible because of time difference among these countries.

The London midnight toll was heard in New York at 7 p m. E. S. T. All day long engineers on the American side listened on short waves and it seemed that the project would succeed if only the static would subside a little. As night drew near on this side static became worse, and finally, just before the earliest European midnight toll, it was just terrible, and stayed that way until the attempt had to be abandoned.

"Another "surprise" may be tried soon.

# Detector Bi

## Low Value Impedan

*By James*

**Contributin**

IT IS NOW well understood that when a grid bias resistor is used to maintain the grid negative with respect to the cathode there is signal feedback as well as steady voltage feedback. The bias resistor must necessarily be in the plate circuit and since it is placed between the cathode and the grid return it is also in the grid circuit.

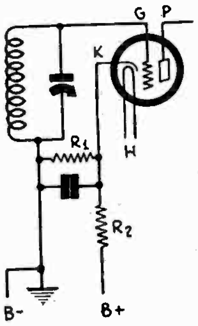
The steady voltage feedback is the grid bias and is equal to the steady current flowing through the resistance multiplied by the resistance value in ohms. This voltage can be made to assume almost any desired value provided that the total steady voltage available in the circuit is high enough.

The signal feedback, in the absence of a by-pass condenser across the resistance, is equal to the effective value of the signal current flowing in the plate circuit multiplied by the resistance in ohms. The direction of this feedback is such as to oppose the input voltage, consequently it reduces the amplification in the tube. This reduction is considerable when the bias is adjusted to a suitably high value. In some instances it is so great that the tube does not amplify at all but actually causes a decrease in the signal. This is likely to be the case in the power tube where the amplification constant of the tube is low.

In a 227 tube circuit with a load resistance of 100,000 ohms the reduction may be as great as 50 per cent. In a transformer coupled circuit it may be nearly as great because in that case the voltage drop in the bias resistor is entirely lost to the next tube.

### EFFECT OF BY-PASS CONDENSER

When there is a condenser across the bias resistor the situation is different. The signal feedback is equal to the signal current through the bias resistor multiplied by the resistance in ohms, as it was before, but now only a very small signal current flows through the resistor and therefore the signal voltage drop in it is much smaller. Most of the signal current flows through the by-pass condenser, which has a low impedance to signal frequencies, provided the condenser is large.



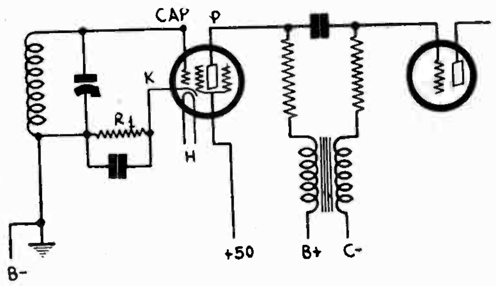




FIG. 1A FIG. 1B

AT LEFT IS SHOWN HOW TO AUGMENT THE CURRENT THROUGH THE GRID BIAS RESISTOR BY CONNECTING A RESISTANCE BETWEEN THE CATHODE AND ONE OF THE B PLUS TAPS IN ORDER TO DECREASE FEEDBACK. AT RIGHT A SCREEN GRID TUBE IS BIASED BY MEANS OF A DROP IN A RESISTOR. THE PLATE AND THE SCREEN CURRENTS COMBINE, MAKING THE EXTRA RESISTOR UNNECESSARY, THOUGH STILL DESIRABLE.

Since the impedance of the by-pass condenser is greater for the lower audio frequencies than for the high, there will be more feedback at the low frequencies than at the high. The effect of this is that the amplification will be less at the low frequencies and the output from the receiver is likely to be lacking in the low notes.

There is one advantage of this in some instances. Suppose the plate supply is such as to cause a considerable feedback in such a manner as to maintain motorboating or cause blasting on the low notes. The reduction by the bias resistor would tend to minimize this effect by reducing the amplification at the low notes where it occurs. Any method which reduces the amplification on the low notes will tend to stabilize the circuit on these notes.

### IT'S A POOR ARRANGEMENT

But to stop motorboating in this manner is not a good policy, and the circuit arrangement requiring it is not a good one. It is much better to have the low notes with stability than to eliminate them completely just to be able to hear something without the stuttering noise. The usual remedy is to employ condensers without stint, both across the grid bias resistors and across the taps on the voltage divider. The effect of low note suppression by grid bias resistors that are not by-passed can be appreciated well by observation. It is akin to the effect of using a baffle board for the speaker. Probably every one has tried the experiment of putting the speaker up against a large baffle board and taking it away again. The effect of connecting a large condenser across the bias resistor is about the same. A large condenser produces the same effect as a large baffle board. Without the baffle board or the by-pass condenser the reproduction is thin and tinny and lacks all depth. With either or both it becomes sonorous and pleasant.

### AN ALTERNATIVE

In certain circuits, such as resistance coupled amplifiers and grid bias detectors, the plate current is so small that the required grid bias resistance for a given value of bias must be very high. In these cases it is difficult to obtain the proper bias without feedback and with good amplification or effective detection. Therefore in such circuits it is advantageous to use the second resistor R2 in Fig. 1A. This is connected between the B plus post on the voltage divider and the cathode of the tube it is to serve. Since the current that flows through R2 also flows through R1, the current in R1 is augmented, thus allowing the use of a proportionately smaller grid bias resistor to obtain the necessary bias. The introduction of this second resistor has made many receivers highly efficient at the cost of only a few milliamperes of current from the B supply.

The question as to where on the voltage divider resistance R2 should be connected is of little importance. If it is connected to a high voltage point the resistance value of R2 should be high and, conversely, if it is connected to a low voltage tap the resistance should be low. In almost any circuit in which it can be used advantageously the current through R2 may be taken arbitrarily as 5 milliamperes. Suppose that the positive end of R2 be connected to a point 45 volts higher than the cathode. The resistance value of R2 should be 9,000 ohms. If, on the other hand, it is connected to a point which is 180 volts higher than the cathode, the resistance of R2 should be 36,000 ohms.

### REDUCTION OF BIAS RESISTOR

If the current through R2 is 5 milliamperes how much is R1 reduced? Suppose the bias required on the tube is 13.5 volts and the current through the tube is one milliampere. Then without R2 the value of R1 would have to be 13,500 ohms, an excessively large value. Now if R2 is used the total current through R1 will be 6 milliamperes, one contributed by the tube and 5 by the second resistor. In this case the value of R1 need only be 2,250 ohms. The feedback through this resistor will be only 1/6 as great as that through the 13,500 ohms resistor, yet the bias will be the same in the two instances.

The bias resistor could be reduced still more if necessary by reducing the value of R2, or by increasing the voltage across R2. But to do so would require a higher current from the B supply, and it may be there is little to spare since it may be needed for plate current in the various tubes in the amplifier.

The resistor R2 makes it clear that the grid resistor takes the voltage used for bias from the total available plate voltage. Suppose the positive end of the R2 be connected to the highest voltage tap on the B supply. The grid return is connected to B minus, the lowest potential point. Then the total available voltage is equal to the sum of the drops in R1 and R2. The drop in R1 is the bias and the drop in R2 is equal to the plate voltage actually on the tube. Therefore the greater the drop in R1 the lower the effective voltage on the plate. This division of the voltage should be taken into account when calculating the value of R2, or the value of voltage drop in it. If the voltage drop in R1 is to be 13.5 volts, for example, this should be subtracted from the voltage on the tap to which R2 is connected, if that voltage is measured from the B minus terminal. It is only the voltage measured from the cathode that is effective on the plate.

### BIASING A SCREEN GRID TUBE

When the tube in question is of the screen grid type, as shown in Fig. 1B, the screen current enters the problem of determining the grid bias resistor. When the tube is used as a detector and followed by a transformer of comparatively low resistance, and the normal screen, plate and grid voltages are used, the sum of the plate and the screen current is about 2 milliamperes. Since the bias in this case should be 5 to 6 volts, the bias resistance R1 should be 1,200 ohms for 6 volts. This looks small in comparison with the resistors used for some other detector tubes. Also in this case we need a condenser across the bias resistor. In view of the fact a condenser of given size is less effective across a low resistance than across a high one, the size of the condenser should be large.

When the screen grid detector tube is resistance-coupled to the succeeding tube the plate current is very low and the screen current is larger. In that case it is the screen current mainly

# as Resistors

## Insures Best Tone

. *Carroll*

itor

which establishes the drop across the grid bias resistor. This current is of the order of .8 milliampere, while the plate current is about .2 milliamperes, so that to get a bias of 5 to 6 volts the resistance would have to be 5,000 or 6,000 ohms.

### USE HIGH PLATE VOLTAGE

It is well to call attention to the fact that when a screen grid tube is used in a resistance coupled circuit the applied plate voltage should be much greater than when it is used in transformer coupled circuits, and the screen voltage should be less. The higher the resistance in the plate circuit the greater should be the disparity between the applied plate voltage and the screen voltage. If this is not observed the screen grid tube will behave in a very erratic manner and is like to be a distorting device rather than an amplifier.

Fig. 1B illustrates both resistance and transformer coupling. If the coupling is to be solely resistance, short-circuit the primary and secondary of the transformer or remove the transformer connecting the resistors to the suitable voltages. If the coupling is to be transformer, short-circuit the resistors and remove the stopping condenser.

Those experimentally inclined can try the circuit just as it is, combining resistance and transformer coupling. Try both connections of the secondary and note which gives the better result.

The method of augmenting the current through the grid bias resistor in Fig. 1A can be applied also to the circuit in Fig. 1B. The second resistor can be connected either between the cathode and the screen grid or between the cathode and the plate return. Suppose the voltage on the screen is 50 volts as indicated on the drawing and we desire a current of 5 milliamperes through the resistor to be added. How many ohms should be used?

Let the total voltage between the screen and B minus be 50 volts and let us disregard the plate current. The drop in the added resistor should therefore be 48.5 volts. Hence the resistor should be 9,500 ohms. The bias resistor should be about 1,200 ohms for 6 volts bias. Hence if we take a 10,000 ohm potentiometer and connect the extreme terminals to B minus and plus 50 volts and then connect the cathode of the tube to the slider a very simple arrangement is obtained for securing the proper bias. It is only necessary to move the slider until the best results are obtained.

### A GOOD METHOD OF COMPENSATION

If the plate voltage should be insufficient for the screen voltage used, this can be compensated for by increasing the grid bias. Here again the potentiometer is useful. Moving the slider away from the negative end increases the grid bias and decreases the screen voltage. The optimum position can be found by trial very easily no matter what the plate voltage may be, assuming a reasonable value.

It must not be assumed that the amplification of the screen grid tube remains high when the grid bias is increased and the screen voltage is reduced to compensate for lack of plate voltage. The amplification decreases rapidly. And this fact suggests that the same arrangement can be used as a volume control in resistance coupled radio frequency and intermediate frequency circuits.

#### 50,000 Ohms for Bias

Fig. 2 shows the essential circuit of a six tube AC design wherein each bias is independently obtained through an individual resistor. The bias for the radio frequency tubes is 3 volts negative, due to the voltage drop in 600 ohms when 5 milliamperes are flowing. The bypass condensers of .01 mfd. each are sufficient here, as radio frequencies alone are concerned, and the resistanc value is small.

But note the detector stage. Here a 227 tube is used, and no bleeder current flows through the biasing resistor. Hence to attain a bias of 10 volts negative, at .2 milliampere of plate current, the resistor is 50,000 ohms, a high value indeed, and 1 mfd. would be the barest minimum of capacity to use across the 50,000 ohms, values of the order of 4 mfd. being more suitable. The low detector plate current is due largely to a first stage of resistance coupling.

It is the object of bleeder current passed through a biasing resistor to make possible a reduced value of resistance to attain the ame bias, since the goal is always to obtain the tated bias, and the different resistance values merely denote that the current through the brased is different.

#### Economical Aspect

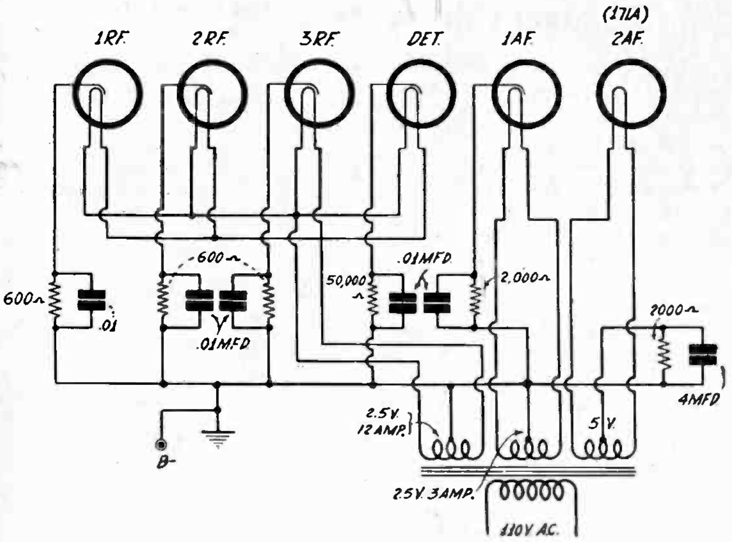
Since condensers of higher value are considerably more expensive than an extra resistor for bleeder current, ther is an conomical reason for using a bleeder in conjunction with a 227 tube, beside a qualitative consideration. With the 224 tube, due to the screen grid current acting as a substitute for the bleeder current introduced externally for 227 bias, the resistance value is low enough, but any who desire to make it still lower may do so by introducing the bleeder in connection with the 224 also.

It should be borne in mind, however, that sometimes when such experiments are made one seems to stumble into an impossible ituation, namely that where detection was obtained previously, now none results, hence the much-wanted reception is sadly lacking. What is the cause and what is the remedy?

The cause is the appliation of a bia that is so high that it almost cuts off the plate current, or the attainment of a bias hat provides amplification instead of detection.

It is true that all tubes used as amplifier detect a little, this being called stray detection, but it may be so litle ha here is no audibiliy worth mentioning, and what is desired is excellent detection.

Simply alter the value of the bleeder resistor until good detection results. If you desire to adhere to a demonstrated set of valus, for a 227, apply 135 volts to the plate and use an 1,800 ohm biasing resistor, connecting a bleeder resistor of 25,000 ohms from B plus 135 volts to cathode. Bypass the biasing resistor for a certainty, 1 mfd. being suitable, and if you have an extra 1 mfd. condenser handy, bypass the bleeder resistor as well.




CATHODE, HEATER AND FILAMENT CIRCUITS OF A SIX TUBE AC RECEIVER, WHERE THE DETECTOR BIASING RESISTOR IS AS HIGH AS 50,000 OHMS, DUE TO RESISTANCE COUPLED AUDIO PROVIDING A PLATE CURRENT OF .2 MILLIAMPERE WHEN THE INTERCEPTING RESISTOR IS USED.

### FUSE RECOMMENDED

IS IT NECESSARY to install a fuse in a radio receiver to protect it from possible short circuit, or will the fuse protecting the house be safe enough?—J. L. F.

It is not necessary to use a fuse any more than it is necessary to have one for each light in the house. If the house fuse protects the entire electrical circuit in the house it protects the radio receiver as well. Nevertheless, it is desirable to have a small fuse in the receiver, particularly if there is much experimenting with the set while the power is on. This is often done, although it is a bad practice. If a small fuse is installed in the set that fuse alone will blow in case of a short-circuit in the set. It will not be necessary to grope around in the darkness to replace the fuse in the fuse box. Neither will it be necessary to call up the electric company to replace a fuse in the electrical meter. But the fuse in the set should be rated at a lower current than any of the more general fuses. If not, it will not serve any purpose at all.

### NEED FOR RADIO FREQUENCY FILTERS

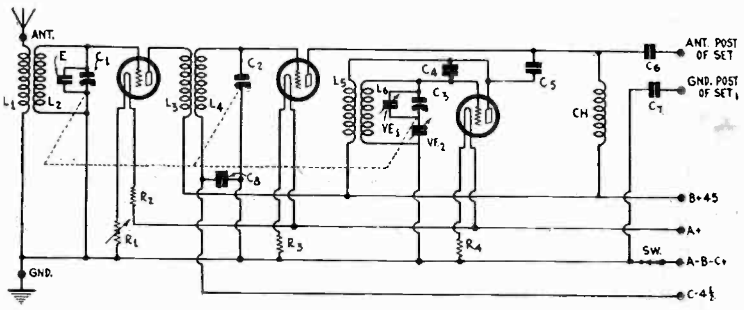
IN MANY radio receivers described individual grid bias resistors, by-pass condensers and radio frequency chokes are recommended. Now, I have assembled many of these receivers without using separate filter devices and bias resistors and still the circuits work. In some instances I have omitted the filter entirely, and still the circuits work. If you can give any reason why separate devices should be used when the circuits work just as well without them, I should like to have them.—N. R. W.

There is no reason at all for using grid bias resistors at all, let alone one for each tube, if the circuits work just as well without them. The same holds for by-pass condensers and radio frequency chokes wherever they are called for in a drawing. The object of the circuit is to work well. But there are few receivers that work just as well if half the parts are omitted as if all are used that are called for in the schematic. Whether the circuits work well or not depends on the amplification and the common coupling between two or more stages.

# Superheterodyne Ganging

## Single Control Provides "One-Spot" Tuning

*By Knollys Satterwhite*




ANY RADIO RECEIVER MAY BE CONVERTED INTO A SHORT-WAVE SUPERHETERODYNE WITH A TUNER AND FREQUENCY CHANGER OF THIS KIND IF THE OSCILLATOR IS ADJUSTED SO THAT THE BEAT FREQUENCY IS EQUAL TO THE LOWEST FREQUENCY TO WHICH THE RADIO RECEIVER WILL TUNE.

GANG tuning of all the tuned circuits in a Superheterodyne, including the oscillator, is the goal of all Superheterodyne fans. Usually this requires an oscillator condenser of specially cut plates or else strictly straight line frequency condensers. But condensers of specially and properly cut plates are not available to the home-set builder. Indeed, they have not available to anybody except to those who can have them constructed and can give the exact shape of the condenser plates for a particular job. Neither are straight line frequency condensers available, although many that approximate straight frequency condensers have been sold.

The difficulty with the straight line frequency condensers usually is that they are straight line when they are by themselves but not when they are in any circuit. In some cases the so-called straight line frequency condensers have been designed with an allowance for a certain distributed capacity, but it is not a simple matter to get just this value of distributed capacity in a practical circuit.

### TRIMMERS AN ALTERNATIVE

In the absence of truly straight line frequency condensers and specially cut condensers the only alternative is to have trimmers, either of the inductive or the condenser types. The condenser trimmers are by far the simpler both to use and to install, and for that reason they have been inserted in the circuit diagram shown herewith.

Condenser E in the first tuned circuit is shown to be constant, but it may be desirable to use a trimmer in this position because the effect of the antenna is different for different frequencies, since a Superheterodyne is normally very sensitive not much pick-up is needed to get a satisfactory signal. Hence in such a circuit very loose coupling can be used between the antenna and the first tuner, and it is possible to do away with the trimmer condenser entirely.

In the second tuner of the circuit there is a condenser C8 across the grid bias battery. This condenser is used to complete the tuned circuit with a condenser, the resistance of which is low, rather than completing it through the battery, which may be of high resistance. It should be noted that if the rotors of the condensers are insulated from each other it is possible to connect the coil and the condenser so that C8 may be omitted. The rotor is then simply connected to the coil instead of to the ground. But if the condenser is of the usual gang type the connection shown should be used. If C8 is large it has no appreciable effect on the tuning characteristic of the tuned circuit.

### THE OSCILLATOR CIRCUIT

We now come to the oscillator circuit, which causes most of the trouble in ganging the condensers in a Superheterodyne. The reason is that it does not cover the same tuning range as the other circuits. It covers neither the same absolute range nor the same relative range.

Suppose the intermediate frequency is 200 kilocycles Let the circuit be designed so as to use the upper oscillator setting only. Then the oscillator must cover the band between 750 and 1700 kc. To get this range we can use the same capacity as in the other tuners and a smaller inductive, or the same inductance and a smaller capacity. Or, again, we can combine these two methods, reducing both the inductance and the capacity relatively to the values used in the other circuits.

Suppose we select an inductance equal to that in either of the other tuners, which is approximately 160 microhenries when the tuning condenser has a maximum capacity of .0005 mfd. When, then, should be the maximum capacity in the oscillator circuit to tune down to 750 kilocycles. It figures out to be 281 mmfd. And what should the minimum capacity be to make the highest frequency equal to 1,700 kilocycles? The computation yields 55 mmfds. This capacity is approximately the value of the minimum capacity in many tuned circuits. If the minimum capacity is not quite large enough it can be made so with a trimmer condenser. The total capacity range is therefore 226 mmfd. (.00026 mfd.). There is no such condenser available, and one would have to bemade up from a condenser of the 250 mmfd. But if such a condenser is made by cutting down the number of plates the rate of change of capacity as the common shaft is turned will not be that required in the oscillator. So a variable trimmer should be used rather than a fixed one. If this has a maximum capacity of 90 mmfd. it will have enough capacity to supply the necessary zero setting capacity as well as to take up any differences that may exist. In the figure this condenser is marked VE1.

### SERIES VARIABLE CONDENSER

In place of varying the capacity of the main condenser by means of changing the number of plates, it might be varied by connecting another variable condenser in series with the main condenser. This is marked VE2. Suppose that this condenser has the same value as C3 and that each is a 500 mmfd. condenser. When C3 is set at 500 capacity of C3 and VE2 in series should be 281 mmfd., forgetting for the moment that VE1 is in the circuit. This calls for a value of 641 mmfd. for VE2. Hence a 500 mmfd. condenser is not sufficient and a small fixed condenser will have to be connected across it.

It is also possible to reduce the inductance and keep the tuning capacity the same as in the radio frequency tuners. Let us see how that works out. Let us assume that the zero setting capacity is 25 mmfd. and the variable portion of the capacity is 500 mmfd. This will require an inductance of 85.6 microhenries to reach the 750 kc limit. With this inductance the minimum capacity required is 102 mmfd. This is much larger than the capacity of the 500 mmfd. tuning condenser will be when set at minimum, and it is so large that a trimmer can be used very well to supply it. Hence this arrangement is not satisfactory.

### USING SMALLER VARIABLE CONDENSER

Let us see how it works using a smaller tuning condenser in the oscillator circuit and at the same time a somewhat smaller coil. Let the maximum capacity be 275 mmfd. The required inductance is 147 microhenries, and with this inductance the minimum capacity to tune up to 1,700 kc must be 53.5 mmfd. This falls well within practical values and a trimmer of 90 mmfd. will serve well. Then if a 250 mmfd. variable condenser be used with a 147 microhenry coil in the oscillator it is only necessary to use a 90 mmfd. trimmer across the 250 mmfd. condenser which is on the sommon shaft.

There is a condenser C4 connected between the grid and the plate of the oscillator tube. This sometimes aids in producing oscillation on the high frequencies. If, however, the circuit oscillates well without it, it is not necessary to use it. At any event it should be a condenser not larger than .0001 mfd.

Condenser C5 couples the oscillator and the modulator tubes, since there is no other connection betfeen the two circuits, assuming that the B supply is well by-passed. The larger C5 is the closer the coupling and the louder the volume. But it will be found that a small condenser, say one of 50 mmfd., will prove more satisfactory than a larger one, because loose coupling between the two circuits is necessary if repeat tuning and squealing are to be avoided.

### OUTPUT CIRCUIT

The output of the modulator is delivered to the intermediate amplifier through two condensers C6 and C7. To the binding posts connected to these condensers any intermediate frequency amplifier can be connected just so it fits the oscillator range provided for.

The circuit has been drawn thus in order that it may be used to convert any radio receiver into a superheterodyne by merely connecting the output of the modulator to the antenna and ground posts of the receiver. When it is used in this manner the radio frequency tuner of the receiver becomes the intermediate frequency filter, which should be tuned to the lowest frequncy to which it will respond, say 550 kc.

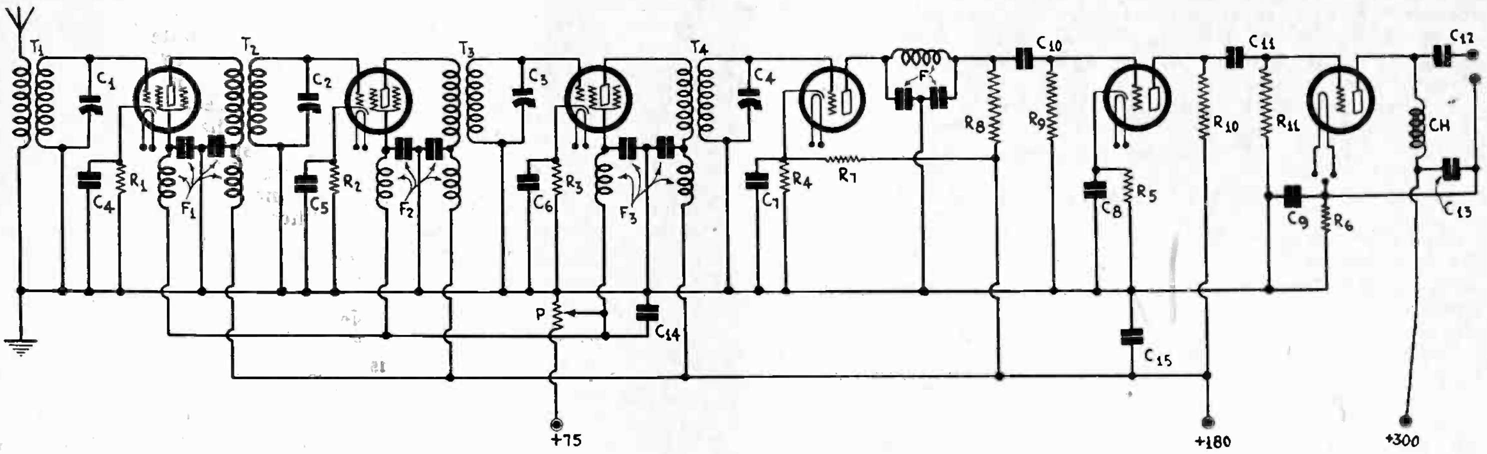
This is a high intermediate frequency and in order that the circuit may work it is necessary to readjust the oscillator to cover the new band, which now is 1,100 to 2,050 kc. This band is so narrow that it is almost necessary to use a small variable condenser as well as a small inductance coil for the oscillator. If the condenser has a maximum capacity of 250 mmfd. the inductance of the coil should be 83.6 microhenries. The minimum capacity to reach the 2,050 kc limit with this inductance is 72 mmfd. This comes within the range of a 90 mmfd. trimmer condenser. Not all the broadcast stations can be received with this circuit but only those of higher frequency, so it is a good short-wave design.

# Radio Frequency Filters

## Independence of Circuits Enhances Performance

*By Capt. Peter V. O'Rourke*

**Contributing Editor**




COMPLETE FILTERING OF THE PLATE AND SCREEN CIRCUITS AND PROVISION FOR NDIVIDUAL GRID BIAS

IN THE circuit diagram above there are twenty-four condensers. Are all these necessary for proper operation of a properly designed radio reeceiver of the type shown? It will be observed that all these condensers are used in the receiver proper and do not include the condensers in the B supply.

There are also seven radio frequency choke coils in the circuit. Are all these necessary for proper operation? Again, there are six grid bias resistors, one for each tube. Are they all necessary?

All these parts are necessary if the receiver is to be a finished job. It is true that many of them can be omitted and still leave the receiver operative, but it will work much better if they are all used.

There is no question about the necessity for using the tuning condensers C1 to C4, or of using the stopping condensers C10 and C11. Neither can there be any quarrel about using the speaker filter condenser C12 nor the choke Ch.

But there are four filter units F, F1, F2 and F3. Do they perform such important functions that they cannot be omitted without making the receiver inferior? Most assuredly they do. Take F1, for example, and analyze it. There is a radio frequency choke coil in the screen circuit, and this choke might well be one of 85 millihenries. It keeps the screen grid voltage from fluctuating at radio frequency due to any feed back from the other tubes. It also prevents any fluctuations in the voltage from entering the common supply. The similar coil in the plate circuit serves the same purpose in the plate circuit. And the two condensers connected in T fashion with the common side grounded serve to by-pass any signal fluctuations to ground. As far as the signal fluctuations in the first tube go, this filter prevents them from reaching the common supply. Moreover, they prevent any fluctuations of radio frequency that may exist in the common supply from reaching the elements of the tube. So F1 is a stabilizer and feed back preventer.

F2 and F3 serve the same purpose in the second and third tubes respectively as F1 serves the first. The values of the chokes and condensers are the same in all, but they are not critical. Any condenser from .001 to .1 mfd. is suitable.

While the common sides of the by-pass condensers are grounded they may be connected instead to the cathode since it is with respect to this point that the voltages should be maintained constant.

### CONDENSER PLATE FILTER

The filter F in the plate circuit of the detector is often omitted from circuits. Sometimes only a large choke is used, sometimes only one by-pass condenser. The first condenser next to the detector tube makes detection more efficient. The choke coil prevents radio frequency currents from reaching the audio amplifier and the second condenser aids the coil in this task. If both condensers and the choke are used, each condenser need not be higher than .00025 mfd. and the choke need not be greater than 5 or 10 millihenries. These small values are used in order to prevent attenuation of the high frequencies in the audio signal, the absence of which makes speech difficult to understand.

Let us say a word about grid bias resistors. Each of the first three should have a value of 300 ohms to give the tube a bias of 1.5 volts. There would be considerable reverse feed back through this resistor were it not by-passed with a large condenser, and for that reason there is a .1 mfd. condenser from the cathode of each of these tubes to ground. It is assumed that ground is B minus. A .1 mfd. condenser is recommended across the grid bias resistor in the radio frequency stages because it is desirable that the by-passing be as thorough as practical although from .01 mfd. up will work well.

### AUDIO FILTERING

When we come to the detector we have to treat the bias resistor somewhat differently because audio frequency current passes through it as well as radio frequency current. R4 in the figure above is the bias resistor and C8 its by-pass condenser. It can be said without qualification that the larger C8 is the better the circuit will function. And if it is less than 2 mfd. detection may not be satisfactory. Of course, any condenser which is large enough to by-pass all audio frequencies satisfactorily is large enough to by-pass the radio frequency currents.

The resistor R7 is very valuable in rendering the detector efficient. It is recommended in building a receiver like that in the digram to make R4 and R7 a 25,000 ohm potentiometer, which can be obtained in wire wound type, and to connect the cathode of the tube to slider of this potentiometer. Moving this slider changes the bias and the plate voltage at the same time, and the best setting for greatest detection efficiency can be found experimentally in a few minutes. After the setting has once been found it is not necessary to touch it again. Therefore there is no danger of wearing out the fine wire on the potentiometer. It will last as long as the set and when the receiver has outlived its usefulness it can be taken out and put into another.

It will be observed that if power detection is desired it is only necessary to move the slider so as to give the tube the proper bias. This, in general, requires a somewhat greater bias than that which gives greatest efficiency.

R5 should be a 2,000 ohm resistor, by-passed with a condenser not smaller than 2 mfd. A 25,000 ohm resistor, not shown, should be connected between the 180 volt tap and the cathode of the first audio amplifier. The purpose of this resistance is the same as that of R7. While the amplifier will work without it, it is really well worth while to use it.

### POWER TUBE TREATMENT

Assuming that the power tube is of the 245 type, the bias resistor R6 should be 1,500 ohms and the condenser across it, C9, should not be smaller than 4 mfd. If the winding of the loudspeaker used with this receiver has a high impedance condenser C12 may be as small as 2 mfd. That would be the case, for example, if a magnetic or inductor speaker is used. But, as always, it is preferable to use a much larger condenser. C13 serves merely as a refinement but a useful one in preventing motorboating. Two microfarads should be large enough.

With a few more statements regarding the parts the description of this receiver is complete, and it is a receiver correctly designed for the tubes used. The radio frequency transformers T1 to T4 should be wound for .0005 mfd. condensers and screen grid tubes, and therefore the condensers used across their secondaries should have the values just stated. They may be ganged provided the coupling between the antenna and the first tuned winding is very loose. The RF transformers should be placed inside roomy shields.

The stopping condensers C10 and C11 should be of the mica dielectric type and be not less than .01 mfd. The plate resistors may be as high as .25 megohm and the grid leaks 2 and 1 megohm, in the order of their appearance in the circuit.

# HB 33 Trou

## How to Obtain Maximum Perform

*By Herber*

EXCELLENT PERFORMANCE is obtainable from the HB33, a seven tube receiver, using four screen grid tubes and three 112A, the last two in push-pull. The circuit is for battery operation of filaments, and with B batteries or B eliminator as the plate voltage and current supply.

Any who build the receiver and who obtain indifferent results or no results at all should heed the directions herewith for remedying the trouble.

In the December 21st issue a pictorial diagram of the wiring was published. R2 was shown going to the wrong place. This upset the filament voltages a little. Make the filament resistor and filament connections as shown in the schematic diagram herewith. R2, please note, intercepts the positive lead of the first two screen grid tubes only. The pictorial diagram had it effective instead on the second pair of screen grid tubes. The official blueprint of the circuit, full scale, which should be obtained by all builders of the HB33, will show the correct filament connections.

This mistake in the pictorial diagram published December 21st would be enough to produce poor results instead of excellent results, so check up on this point.

### HOW TO ASSURE SIGNALS

The other trouble-shooting considerations have to do with the functioning of the receiver when all the wiring is correct. As the connections are easily made, and the wiring is a simple piece of work, it is assumed everybody will get the connections straight.

Suppose the receiver has been built and no speaker reception is obtainable or no signals at all, even if phones are connected at the output intended for speaker.

In such an instance remove the shields and work the receiver without any shields. The screen grid voltage, marked 22 to 45, should be somewhere in that region, but when the shields are removed it is barely possible that a smaller voltage than 22 will be required for best stability.

The battery type screen grid tubes are not as uniform or as good as the AC type, but if the tubes are perfect the amplification is sufficient to support the losses introduced by the shields. All must understand that shielding introduces losses, and that the main object is to utilize these losses gainfully, so that an otherwise unmanageable receiver is stable. If the receiver is stable without shields, then there is no occasion for use of the shields, in fact, no basis on which they may be used.

These remarks apply only to the HB33, and not to its AC counterpart, the HB44, as shields must be used in the HB44, and the amplification is easily high enough to sustain the use of shields.

### ALTERNATE STRAY COUPLING

Because the coils are connected in a given way, as given on the blueprint, and as explained in previous issues of RADIO WORLD, the stray inductive coupling between stages is between every other coil, so that good separation between coils is electrically maintained, and the RF cascade is operatable when unshielded.

Now suppose the removal of the shields brings in stations where none were received before, but the volume is not high enough. There are three points to consider: first, the tuning condenser, second, the voltages, and third, the detector plate resistor R4.

The four-gang condenser is mounted ¼" up from the steel subpanel. The condenser has built-in trimmers. While the price of the condenser is low, the accuracy of the condenser sections is good, but can be destroyed by poor adjustment or mounting. How to avoid this trouble will be explained now.

Suppose the circuit is built simply on the chassis. That means the set is not in a cabinet. Then a knob would be used on the condenser shaft, for tuning in of stations, the accuracy being sufficient for experimental purposes of the moment. Adjust the trimming condenser until volume is loudest on some low wavelength station, say, around 250 meters. If it is found necessary to turn any trimming condenser all the way down to establish resonance, then loosen the set-screw on the moving main section of this condenser, and relocate the rotor so that the moving blades are exactly in center of the stator blades. Any time any such adjustment is made be sure that all rotors are flush when the knob is turned to maximum capacity setting of the condenser, which would be 100 if the dial were on.

### VOLTAGE SUGGESTIONS

At the rear of the condenser is a set-screw. It is sometimes necessary to adjust this. If the adjustment is to be made, loosen the locknut first. This nut is inside the frame. If you try to turn the set-screw from the outside without loosening the nut you may break the screw. While this set-screw is primarily a tension adjuster, it can be used also for relocating the relative position of the rotor of the first tuned circuit.

After the condenser is adjusted properly, and trimmers set, tune in some stations again.

If volume is not as high as expected, instead of using 135 volts where that is marked, use 180 volts, and changing the detector bias to 3 volts negative as an experiment, but definitely increasing the bias on the first audio and push-pull pair to 12 to 16 volts. No change need be made in the tubes. It is all right to use 180 volts on the 112A's and also on the 222's, although this is a little higher voltage than usually recommended in tube data.

If the receiver oscillates a little, the rheostat may be used as an oscillation control. It works well for this purpose.

The third consideration is the detector plate resistor. It may be 50,000 ohms, or any higher value up to the point where motorboating sets in. Higher values give more volume.

Any other trouble would be due to defective parts, bad tubes, wrong wiring, or shorts occasioned perhaps by passing poorly insulated wire through a hole in the subpanel so that the edge of the hole cuts into the insulation. Such shorts may not be complete, but only modified, resulting in leakage and in wrong bias, both of which reduce amplification severely.

### SENSITIVE RECEIVER

In the locality where this receiver was given several complete tests in the heart of New York City, WTAM, Cleveland, is used as the test station. Any receiver that brings in WTAM at night at that location is sensitive. The HB33 did that consistently.

The next consideration, after the receiver is working properly, is to pay attention to the wave band coverage. It may be found that the set does not tune down low enough, since the coils commercially produced, and the directions for winding your own coils, purposely provide a little too much inductance. This is due to the effect of the elevation of the condenser from the subpanel, as no elevation contributes considerable capacity, ¼" elevation reduces the minimum capacity by about .00004 mfd., and higher elevation reduces it still further.

### HOW TO REMOVE TURNS

It is easy enough to reduce the number of secondary turns,

## Right or

(1)—Voltage regulator tubes used in conjunction with the voltage divider of a B supply unit steady the operation of any receiver operated with the supply and have a tendency to stop motorboating.

(2)—If the plate return of the power tube be connected to the point of junction between the two chokes in the filter of the B supply feed back from the power tube to the preceding stages is prevented by the second choke coil.

(3)—Individual filters in the plate circuits of an audio amplifier serve no good purpose in stabilizing the set.

(4)—A power amplifier tube of the three element type cannot be put on the same heater winding as the filament of a heater tube if different grid bias values are to be applied on the two tubes.

(5)—Push-pull detection with push-pull resistance coupled amplification is a practical success.

(6)—If the filter type output is used the size of the condenser that should be used in series with the speaker does not in any way depend on the impedance of that speaker.

(7)—The success of a push-pull amplifier depends on making the signals in the two sides of the amplifier equal in magnitude and exactly opposite in phase.

(8)—In every television scheme there is a scanning disc at the receiver and another similar disc at the transmitter.

(9)—A standard output signal is .05 watts at 400 cycles in a resistance equal to the plate resistance of the output tube.

(10)—The detection efficiency of a screen grid tube is superior to that of a three element tube mainly because the screen grid tube amplifies the detected signal more than does the three element tube.

### ANSWERS

(1)—Right. In a sense the regulator tube acts the same way as a large condenser across the section of the voltage divider where it is connected, and any condenser steadies the operation. The regulator tube does it more effectively, however.

(2)—Right. Any signal current which may be present in the plate return of the power stage must back up through the second choke before it can get into the plate circuits of the other tubes, and the choke effectively stops this feed back.

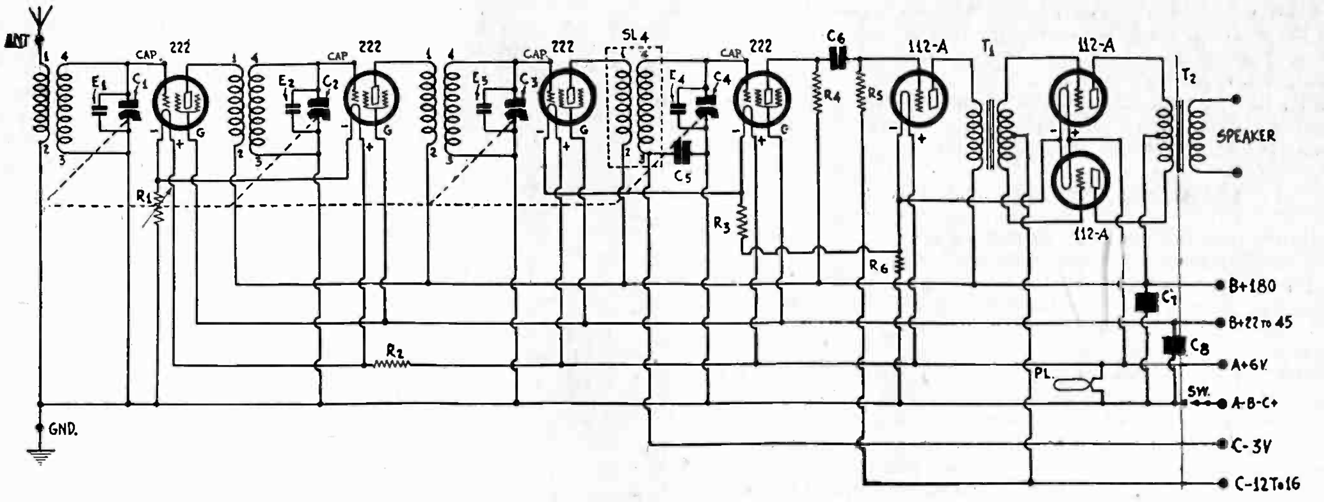
(3)—Wrong. Individual filters are very effective in preventing coupling between any two tubes in the receiver and often this arrangement is the only one that will stop the oscillation that is called motorboating.

(4)—Wrong. It is usually done and is possible because the

# le Shooting

## ce From This High-Gain Receiver

*Hayden*




DESIGN OF THE HB44 WITH 180 VOLTS ON THE PLATES OF THE THREE 112K TUBES, AND A NEGATIVE BIAS OF FROM 12 TO 16 VOLTS. USE THE HIGHEST BIAS IN THIS RANGE THAT AFFORDS STABILITY. TRY 3 VOLTS NEGATIVE DETECTION GRID.

hard to put on turns, so remove the first two RF tubes, connect the antenna temporarily to the plate lead on the third coil (second from front), which is the front left-hand lug as you face the front of the set, and remove turns from the secondaries of the first and second coils counting from front until the tuning is such as to bring in 860 kc at 45 on the dial, just a little more than half of the total disengagement of the rotors from the stators. Instead, any of these data may be used: 1,500 kc should come in at about 10, 550 kc at about 97. Or, WNYC should come in at about 90, WEAF at about 80, WOR at about 65, WJZ at about 60, WABC at about 45. Note the number of turns removed to attain these results, and take off the same number of turns from the secondaries of the two other coils. The removal of turns is easy, since the windings adhere to the forms in the commercial models, and will not spring apart. Even if you wind your own coils, you will have no trouble with the wire springing off if you hold it tight when pulling upward, and when you stop at the given number of turns, scrape off the enamel at the lug contact position and anchor the wire to the mounting screw of the bracket on the coil form. This lug is the grid lug at right front on each coil.

### PUTTING CHASSIS IN CABINET

If you use a steel cabinet you will not be able to put the assembly directly into the cabinet, because of the condenser shaft sticking out too far, so remove the rotors from the condenser and pull out the shaft. A round metal washer will be found between the front of the condenser frame and the first rotor, so don't lose this. Note that there is a "bite" in the shaft, to take one of the set-screws. This is your key later in replacing the plates. It requires that the overlapping plate of the rotor be toward the front. See that all the other rotors are that way when replacement is made of the removed sections.

Slip the installation into the steel cabinet by pointing the rheostat shaft toward its intended hole. Then the condenser shaft hole will be in line with its receiving end. Restore the shaft. Put the washer between the first rotor and the front of the condenser frame. Be sure that the "bitten" end of the shaft goes in last. Slip the shaft through each rotor section, with the bulge of the cutaway part of rotor at left bottom, all sections going on alike. Temporarily tighten set-screws. Align the condensers so that the rotors are exactly at center of stator separation spaces. Some slight readjustment of trimmers may be needed, because of the new position of rotors. Then the receiver is all set to go, and give you first-class performance.

### LIST OF PARTS

**SL1, SL2, SL3, SL4—Four coils for .00035 mfd. (Cat. SH-3 of Screen Grid Coil Co.).**
**C1, C2, C3, C4—Four gang .00035 mfd. condenser with equalizers E1, E2, E3, E4.**
**C5, C6—Two .01 mfd. mica condenser.**
**C7, C8—Two 1.0 mfd. bypass condensers 200 volt DC working voltage.**
**R1, Sw—30-ohm rheostat with switch, knob, insulators.**
**R2, R3—Two 6.0-ohm fixed filament resistors.**
**R4—One .05 meg. Lynch metallized resistor, or higher.**
**R5—One 5.0 meg. Lynch metallized resistor.**
**R6—One 1-ohm fixed filament resistor.**
**T1—One push-pull input transformer.**
**T2—One push-pull output transformer.**
**PL—Pilot lamp and bracket.**
**Ant., Gnd. Speaker—Four binding posts.**
**One drilled steel cabinet.**
**One vernier full-vision dial.**
**One flanged subpanel with seven UX sockets and one UY socket.**
**Four National grid clips.**
**One 5-lead connector cable. (A+=A+, A—=A—, G=G posts of tubes 1, 2, 3, 4; C=C— 3 to 4½; P=C— power. (9 for 135 v., 12 to 16 for 180 v.)**

# Vrong?

heater and the cathode are electrically connected together except at some point which may be chosen so that the connection spoken of is possible.

(5)—Wrong. No practical way has yet been developed for coupling a detector to a push-pull amplifier by means of resistances. There are several ways in which the problem can be solved partly.

(6)—Wrong. The size of the condenser that should be used in series with the speaker depends on the impedance of the speaker. If the impedance is high a relatively small condenser will do, say one of 2 mfd. capacity. If the impedance of the speaker is small a very large capacity must be used in order to get the low frequencies into the speaker. In any case, however, the larger the condenser is the better the low notes will get through.

(7)—Right. The advantage of a push-pull amplifier is that it balances out the even harmonics generated in the power tubes. If the magnitudes of the signals in the two sides are not equal the elimination of the harmonics is only partial. Likewise if the two signals are not exactly opposite in phase the elimination will not be complete.

(8)—Wrong. There is a scanning device at each end but there are many such devices which are not discs. In one case the scanner is an endless belt in which the scanning holes are punched. There are also scanning devices operating with prisms, lenses, or mirrors.

(9)—Right. This has been taken as standard output for the purpose of comparing the performances of different receivers. The wattage is the product of the voltage across the load resistance and the current through that resistance, the effective values of the signal current and voltage being used. Since the voltage across the resistance is equal to the product of the current and the resistance, the power is also equal to the resistance and the current squared. Suppose the tube is such that the required load resistance is 2,000 ohms. Then to get a standard output power it is necessary that the effective value of the signal be 5 milliamperes.

(10)—Right. As far as straight detection efficiency is concerned there is little difference between a three-element tube and a screen grid tube, but the amplification of the detected signal is much greater in the screen grid tube than in the three-element tube and therefore the screen grid tube shows up to better advantage, provided that it is loaded up properly to force the tube to amplify.

# Coils, Resistors

## How They Are Rated an

*By J. E. Anderso*

THE coils used in radio are of four principal types: radio frequency, audio frequency and power transformers, and choke coils.

The radio frequency transformers usually have an air core, that is, are wound on a form with no laminations. The audio frequency and power transformers always have laminations. Radio frequency choke coils have an air core, while audio frequency choke coils have an iron or other metal core.

The radio frequency transformer is fairly well standardized now as one wound on a circular tubing. This form of coil is called a solenoid. There are usually two windings, a primary and a secondary. The primary consists of the winding designated 1 and 2 in Fig. 30A, the secondary as 3 and 4. It is usual to connect antenna to 1, ground to 2, grid return to 3 and grid to 4 if the coil is used in the antenna circuit for input to the first tube. If used as an interstage coil, then the primary is in the plate circuit, connected from plate to B plus, and the secondary is in the grid circuit of the succeeding tube.

Sometimes a center tap is provided on primary or secondary for connection of a neutralizing condenser, or other taps are put on, to enable use of only part of the winding. This multi-tap method of obtaining various values of inductance is not a good one, as the unused part of the coil adds resistance, hence inflicts a loss. The unused part of the winding is called the dead end.

### THIRD WINDING

Also, some coils have a third winding, either fixed or movable, usually for connection in the plate circuit of the same tube as the grid winding is connected to, and this third winding, if used that way for regenerative purposes, is called a tickler. If it is connected in reverse phase, to produce damping instead of regeneration, than it is called a reverse feedback winding.

Besides, there are several special forms of solenoid windings, including one in which a moving coil inside is connected in series with a fixed winding on a separate outside form, the total constituting the tuned circuit when a condenser is placed across the extreme terminals. The condenser shaft and the moving coil shaft are linked by a coupling device, so that the same motion turns both. The moving coil acts as a variometer, or varying inductance, because at one extreme position it fully aids the fixed part of the secondary, at right angles it acts as if it were a fixed coil, whereas when moved past the middle position it starts to buck the secondary, hence the effective inductance of the secondary is varied in the same direction as the capacity is varied. When lower capacity is used there is lower effective inductance in use.

### AUDIO TRANSFORMER CONNECTIONS

The audio transformer consists of two windings, also, and the terminals are usually marked P and B for primary, G and F or G and C for secondary. As a given method of connection produces better results, this method is usually followed by manufacturers in designating the terminals. The audio transformer is usually encased.

An audio choke coil is represented symbolically as in Fig. 30E, the parallel lines representing the core, whereas a radio frequency transformer would be shown by the same diagram without the core.

A special type of transformer is one in which a capacity is placed across the plate and grid connections, so that the coupling is largely of the impedance type, with incidental transformer couping.

A power transformer is one useful for alternating current lines as where the house wiring affords 110 volts, 50-60 cycles, which is standard. Besides, a transformer may be made for other voltages and frequencies, but special construction is necessary to meet these special needs. For 40 cycles, for instance, the wire should be larger and the core larger and more substantial as well, while for 25 cycles, further increase in the same direction is necessary, assuming the voltage is 110 volts in each instance. Also, where filtration is introduced, as in an AC B supply, it is necessary to use substantial choke coils and suitable capacity condensers, as ripple and hum are harder to filter out at the lower frequencies. Often, however, choke coils and condensers used for 50-60 cycles are sufficiently comprehensive in performance to be useful at 40 cycles, although for 25 cycles special construction commonly is necessary.

The power transformer may have only two windings, as a

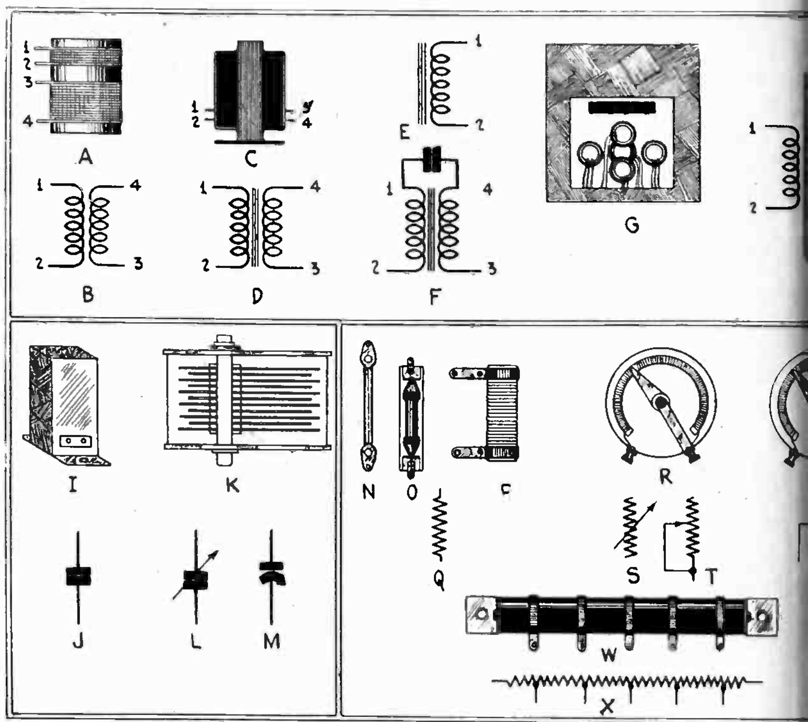



FIG. 30
A, B, RADIO FREQUENCY TRANSFORMER.
C, D, AUDIO FREQUENCY TRANSFORMER.
E, AUDIO CHOKE COIL.
F, DOUBLE IMPEDANCE.
G, H, POWER TRANSFORMER.
I, J, K, L, M, CONDENSERS.
N, O, P, Q, WX, FIXED RESISTORS.
R, S, T, U, V, ADJUSTABLE RESISTORS.

# Baird Television

(*Continued from page 7*)

ceiver disc speeds up, the teeth will have passed the magnet poles when the synchronizing impulse arrives. Hence the impulse will retard the disc. The result is that the receiver disc is forced to rotate at the same rate as the transmitter disc as long as it does not require a greater force than is afforded by the synchronizing impulses.

While the wheel in Fig. 1 only shows eight teeth on the synchronizing wheel, there should be one for every scanning line on the picture, that is, 30 teeth for a 30-line system. Therefore there is a synchronizing impulse at the beginning or end of every scanning line. It is the frequency of the scanning impulses which makes it easy to effect perfect synchronization with the weak impulses that are available.

Perfect synchronism has been maintained in this way for one hour and a half without any manual readjustment of the speed of the motor. If the voltage of the line on which the receiver motor should vary considerably, or if the resistance in the circuit should vary, it may be that a readjustment of the rheostat will become necessary, but no one will object to doing so once every hour when it takes only a fraction of a minute to do so.

This synchronzing device seems to be the simplest that has yet been suggested, and at the same time it is very effective.

### FRAMING OF IMAGE

When synchronism has first been achieved it may be that the image is out of frame. It may be too high or too low in the field of view. Here, too, the synchronizing device comes into play. By means of a small knob, similar to the one used for adjusting the rheostat, the magnets may be rotated through a small angle. This rotation either raises or lowers the image, depending on the direction of rotation, and it is a simple matter to move the image until it is in the center of the field.

A large neon type tube is used at the receiver in the usual manner. The visual signal varies the intensity of the light emitted by the glowing surface of the tube. In order to in-

# nd Condensers

## ed and How They Behave

*Herman Bernard*

primary to be connected to the source of power, and a high-voltage secondary to be connected to a rectifying device. If the rectifier is a filament type tube, the power transformer will have at least three windings, the third being for the filament of the rectifier tube. Where other tubes are to be heated, the power transformer will have windings for these purposes, too. Hence the secondaries will have both step-up and step-down ratios in respect to the primary, as the filament and heater voltages will be less than the input voltage, while the plate winding for the rectifier tube always will be of larger voltage than the input.

The behavior of coils toward alternating current, and so far in this chapter alternating current has been under discussion almost exclusively, is different than the behavior of simple resistors. In all coils the resistance to alternating current increases with frequency. This AC resistance is called the impedance of the coil, and it is always mentioned in connection with a particular frequency, otherwise it might be meaningless, since the impedance changes with frequency. However, in audio devices if the frequency is not stated it is understood to be 1,000 cycles.

Whereas a resistor, assuming a pure resistor, has the same resistance to direct current as to alternating current, a coil has a given impedance only at a given frequency.

A condenser likewise behaves differently to alternating current than does a pure resistor, in fact, it is only on alternating current that a condenser is effective.

The impedance of a condenser decreases with frequency.

### CONDENSER RATINGS

Condensers are fixed or variable. If fixed, they have a rated capacity, and if for use at 100 volts or more, they are rated as to both their capacity and their maximum continuous working voltage. This voltage differs for alternating and direct current. For exclusively alternating current the steady working voltage at which a given condenser may be worked is about half as great as the voltage at which it may be worked continuously on direct current.

A condenser is said to be used on "direct current" if used in a circuit that carries direct current that has been rectified from alternating current, but still has an alternating current component, such as a ripple voltage, which it is desired to eliminate. It is still true that the condenser is effective on the alternating current component, despite the term "direct current" use.

Fixed condensers are used for filtration at low voltages, in which instance they are called by-pass condensers, and for filtration at high voltages when they are called filter condensers. So a filter condenser and a by-pass condenser are the same thing, the different terms simply distinguishing roughly the voltages at which the devices are used.

Fixed condensers for low voltages usually have low capacity, and if not more than .02 mfd. is required, the dielectric, or medium separating the two plates of the condenser, is mica. This stands a high voltage and is an excellent dielectric, but it is too expensive to use in high capacities. So paper is used instead as the dielectric where high capacity is required, even from .1 mfd. up.

### WETS AND DRYS

Low voltage fixed condensers of the electrolytic type are used in large capacities for filtration of filament current used to heat battery-type tubes, in A eliminators. These condensers have a paste inside and are called dry condensers. Other fixed condensers for high voltage and relatively high capacity have a liquid inside, and are called wet. Hence one type has a moist electrolyte, although called a dry condenser, and the other has a liquid electrolyte.

The fixed condenser is represented by two parallel lines, the variable condenser by two parallel lines with an arrow through them, or one simple line with a parallel or nearly tangent line constituting an arrow. When the arrow constitutes a line as one of the integral lines the diagram is more informative, since the identity of the moving plates is disclosed. The moving plates, called the rotor, are always connected to the return, that is, the end of a coil other than the terminal that goes to grid or, if the plate circuit is tuned, to plate. The stationary plates are called the stator.

### DATA ON RESISTORS

Resistors are fixed or variable. The voltage drop across a given resistor is proportional to the current flowing through the resistor, therefore the rating of the resistor depends essentially on the current. Once the current is known, since the resistance value is known, the voltage is computable: it is the product of the current in amperes and the resistance in ohms.

The usual way of rating resistors is in watts. A watt is the product of the current in amperes and the voltage. It is good practice to use resistors at values not exceeding one-half of their commercial wattage rating.

The resistor family likewise is segregated as to its working strength.

The adjustable types of resistors are the rheostat, which has two effective terminals, and provides a different voltage across those terminals as the arm is moved, or a potentiometer, which has the same voltage across its terminals all the time but permits taking off as much of the total drop as desired, by rotation of the arm.

The rheostat arm is connected to one of its two terminals as part of the construction of the device at the factory. The arm is connected to the center terminal of a potentiometer.

A resistor may have several taps for affording fixed values of different voltages, or there may be sliders to permit variation of the voltages derived from the taps. Such a resistor, of either type, is most frequently found at the output of a B supply or eliminator, and is called a voltage divider.

# es Good Showing

crease the apparent size of the image a large aperture lens is interposed between the disc and the observer, which makes the image apparently life-size when a human face covers the entire field. The reddish glow of the tube seems to increase the life-likeness of the image.

An audio signal s transmitted simultaneously with the visual and the synchronizing signals and the voice and accompanying sounds are reproduced by a loudspeaker. Hence the image not only looks natural but it talks naturally.

### REASON FOR 30-LINE PICTURE

The reason for using 30-line scanning is that in Great Britain and in Germany, where the system is being exploited, the signal must stay within the 10 kc band allotted to broadcast stations without any interference with neighboring channels. If television is to be banned permanently from the broadcast band in this country, and if the allowed band is to be 100 kc, as at present, it is probable that a greater number of lines will be used here. But the system is as well suited to 60 lines per picture as to 30 lines.

Heretofore most amateurs who have experimented with television receivers have become discouraged because of the difficulty in effecting synchronism. This should no longer be an obstacle because with the automatic system of synchronizing it is easier to tune in a television signal than to tune in an ordinary radio signal, or at least it is no more difficult, because there are the same number of controls in the television set as in the up-to-date radio receiver. There is a line switch for turning on the power that drives the motor, another control for effecting initial synchronism, and a third for framing the picture. Of course, these controls are in addition to the controls which are on the radio receiver used in conjunction with the television signals. But there is no difficulty in tuning in two radio sets, so why should there be in tuning in one radio set and one television receiver?

### NEW CORPORATIONS

Radio King Tube Corp., Newark—Atty. Theodore D. Gottlieb, Newark, N. J.

Herbst's Radio Shop—Attys. Lubit & Geschelin, 303 West 42nd St., New York.

Brunswick Panatrope and Radio Corp., Lynbrook, L. I.—Corp. Trust Co. of America, Wilmington, Del.

Brunswick Radio Corp., Lynbrook, L. I.—Corp. Trust Co. of America, Wilmington, Del.

Reburn Radio Stores, Inc., Wilmington, Del.—Atty. John S. Reburn, Wilmington, Del.

Newark Plate Laboratories, Newark, N. J., radio supplies—Atty. William Greenbaum, Newark, N. J.

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

Annual subscriptions are accepted at $6 for 52 numbers, with the privilege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

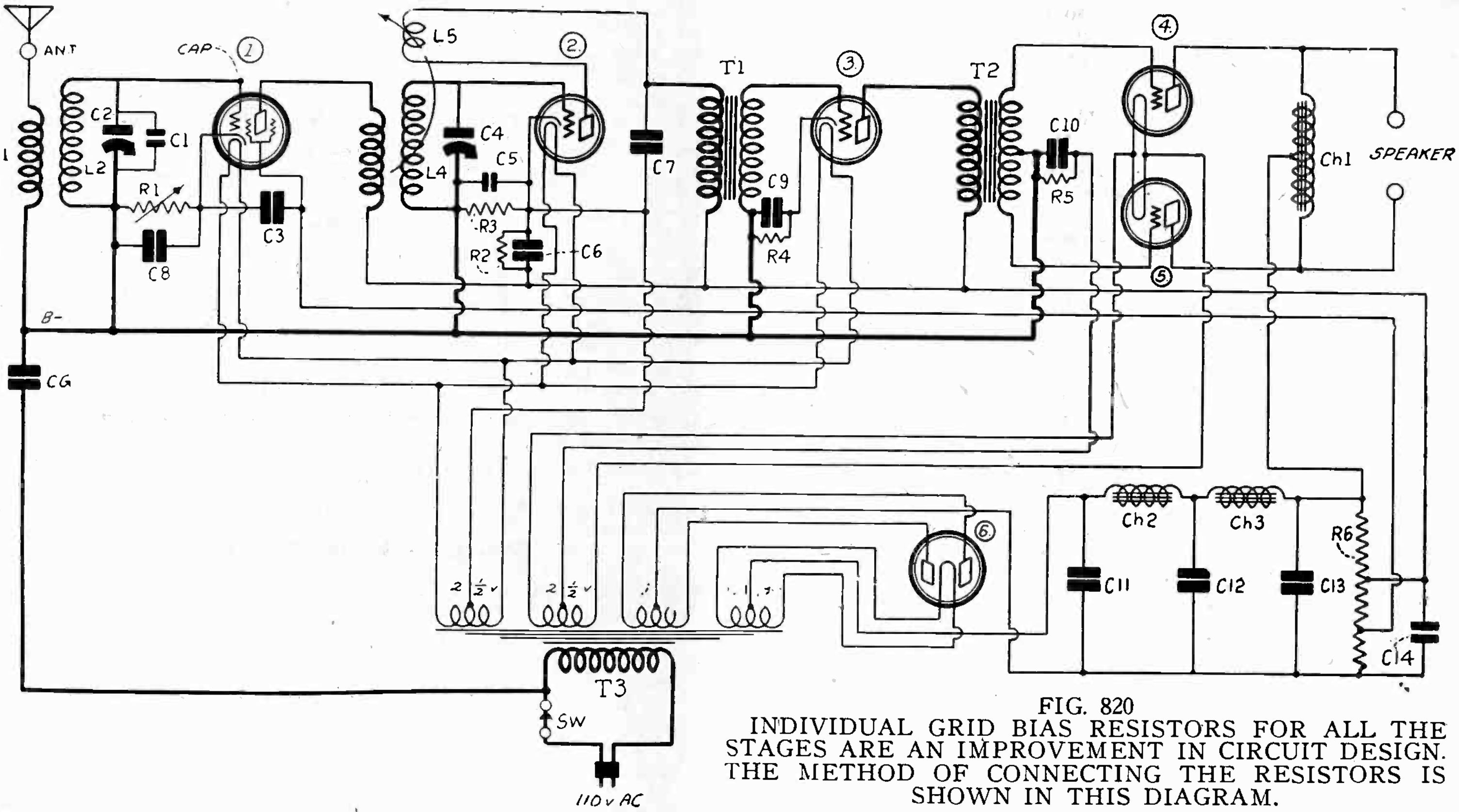



FIG. 820
INDIVIDUAL GRID BIAS RESISTORS FOR ALL THE STAGES ARE AN IMPROVEMENT IN CIRCUIT DESIGN. THE METHOD OF CONNECTING THE RESISTORS IS SHOWN IN THIS DIAGRAM.

## BIAS FROM INDIVIDUAL RESISTORS

WILL YOU KINDLY explain with a circuit diagram how individual grid bias resistors can be used in a circuit for providing the grid voltage? Please explain how the value of the resistance in any case can be computed.—E. S.

Fig. 820 is well adapted for explaining this point. First note that the grid return leads of all the tubes are connected to B minus, the lowest potential point in the circuit. If any resistor be placed between the lowest potential point and the cathode of any tube so that the plate current, and the screen current also for screen grid tubes, the cathode will be at a higher potential than the grid return, and therefore the grid will be negative with respect to the cathode. It is only necessary to choose a resistor of such value that the drop in it has the value necessary for grid bias.

In the first tube the variable resistance R1 is connected between B minus and the cathode. The combined plate and screen current in this tube can be assumed to be 5 milliamperes if normal plate and screen voltages are used. The required bias on the grid is 1.5 volts. Hence R1 should have such value that when 5 milliamperes flow through it the drop will be 1.5 volts. Therefore R1 should be 300 ohms, obtained by dividing 1.5 by .005. The resistor in this case is variable because it is supposed to be a volume control. In order to be effective as such the resistance should have a range from 300 to about 5,000 ohms. In the detector, the second tube, the situation is different. The plate current may not be more than one milliampere. To boost this current in the grid bias resistor another resistor R2 is connected between the cathode and the B plus lead. We can make the current through R2 anything we like. Let the voltage across it be 180 volts and let the current be 5 milliamperes. Therefore R2 should be 36,000 ohms. Now the current in R3, the grid bias resistor will be 6 milliamperes. The drop in it in this case should be about 18 volts. Hence R3 should be 3,000 ohms. R4 can be determined on the supposition that the current in it will be 6 milliamperes and the drop 13.5 volts. This makes R4 2,250 ohms. R5 is similarly determined on the supposition that the total current through it will be 64 milliamperes and that the voltage drop is 50 volts, which makes R5 781 ohms, that is, 50 divided by .064.

## VOLUME DIED OUT

MY AC RECEIVER, using mostly heater type tubes, worked fine for several days and then it became noisy, the volume fluctuating. After this had lasted about an hour the signals disappeared entirely. Now I cannot receive a single station. Kindly suggest a cause and a remedy.—M.J.C.

You have not given sufficient data to determine the cause of the trouble because many things could go wrong with a receiver in this manner. It is quite possible that one of the heater tubes is defective. Sometimes when the heater comes in contact with the cathode the tube behaves in this manner. Ultimately the heater burns out and the receiver ceases to work entirely. The reason the volume does not die out the instant the heater comes in contact with the cathode is that the cathode remains hot a few moments after the mishap, and as along as the cathode is hot the tube functions.

## BEST SHIELDING MATERIAL

WHAT IS THE best shielding material for tuners in radio receivers? Does the thoroughness of the shielding depend in any way on the thickness of the material used? What determines the value of a shielding material, that is, what property of the metal?—W. M. G.

The best electrical conductor is the best shielding material. Silver comes first in the scale, copper second, and aluminum third. Brass is also a good conductor. Of these conductors silver is not practical because of its high cost but the other three are satisfactory. Aluminum has the advantage of lightness. Copper and brass can be soldered easily and for this reason they are often used where complete shields are required. Their disadvantage is that they are heavy.

The effectiveness of a shielding material depends first on the specific electric conductivity. The higher this is the better the material. In terms of resistance, this means that the lower the resistance of the material the better the shielding. Secondly, the shielding depends on the thickness. The thicker the material used the better the shield.

## NON-INDUCTIVE RESISTANCES

PLEASE DESCRIBE how non-inductive resistances can be wound. The resistances are to be used for coupling in resistance coupled circuits. Does a little inductance in a resistance to be used for this purpose in audio frequency amplifiers make much difference?—J. H. K.

One way of winding a non-inductive resistance is to wind the wire on a flat form such as a slab of bakelite. The inductance is low because the cross-sectional area is small. To reduce the inductance still further half the turns can be wound in one direction and the other in the opposite. This method of making practically non-inductive resistances can also be employed for circular forms. For example, the wire may be doubled and two turns wound on at the same time. This, however, makes the distributed capacity of the resistance unit high. In most circuits a little inductance makes no difference. If it did, fine quality would not be possible with inductance coupled amplifiers. When winding resistance coils in the manner described above it is necessary to use well insulated wire.

### LEAKAGE CURRENT IN MERSHON CONDENSERS

HOW MUCH should the reverse current in a Mershon electrolytic condenser be when a voltage of about 300 volts is across the terminals?—J. K. P.

In a well constructed condenser the reverse current should not be more than 2 milliamperes. But the current depends not only on the voltage across the condenser but also on the capacity. The larger the capacity the greater the leakage current that can be expected, and also the higher the voltage the greater the reverse current. When the voltage goes much over 400 volts the condenser breaks down and passes current in both directions.

### GRID CIRCUIT MODULATION

WHAT IS MEANT by grid circuit modulation in a transmitter? Is that the same as grid circuit detection?—T. P. R.

In grid circuit modulation transmitters the audio frequency signal is impressed on the grid of the oscillator tube, usually in series with the radio frequency coil of the oscillator coupler. While the grid circuit modulator and the grid circuit detector do not function the same way, they both work because of distortion in the tube. One circuit impresses audio frequency variations on the amplitude of the generated radio frequency current and the other extracts an audio frequency current from a modulated radio frequency current. One undoes what the other has done.

### SIGNALS BECOME HARSH

AS LONG AS the volume of my set is low the quality is excellent, but when I turn it up so that the loudspeaker speaks up the signals become very harsh and disagreeable to listen to. The plate and grid voltages are as recommended by the designer of the circuit and the output tube is large enough to handle all that the speaker will stand. In fact, the last tube is a 245 with 300 volts on the plate and grid combined. What do you think is the cause of the distortion on loud signals?—W. H. H.

No doubt the trouble is due to overloading of some kind. This may be in the detector circuit. Perhaps the voltages are not what they should be on the detector tube. If you have the grid bias type of detector, the bias may be too high. If you have the grid condenser type of detector, the grid leak may be too high. The bias on the audio amplifiers also may be incorrect. Just because the correct voltages are applied to the binding posts there is no assurance that the actual voltages are correct. Then, again, a tube may be defective, or the filament voltage may not be high enough.

There is also a possibility that the distortion takes place in the radio frequency amplifier, which could happen if the circuit oscillates. There is still another possibility that the B supply is not able to support heavy draughts of current. The regulation may be poor or the by-pass condensers across the sections of the voltage divider may be too small.

### SET HOWLS IN ONE PLACE

I HOOKED UP a radio receiver in my shop and it worked fine. I immediately took it over to a neighbor and installed it in his cabinet. But there it developed a terrific squawk. I am sure it is not motorboating because it does not sound that way, and if it motorboated in one place I can see no reason why it should not do so in another. Neither is it the fault of the tubes, because the same tubes were used in both places and there was no tube which showed any tendency toward microphonism. Neither was it acoustic feedback, because the loudspeaker at the time was a long way from the receiver, and moving the speaker had no effect whatsoever. Now, what do you think is the matter? Kindly suggest a remedy.—J. F. S.

It may be there is electric feedback from the output lead from the power tube to the grid of the detector. Look over the wire and see if these leads are not quite close together. If the layout is such that you cannot separate these leads you might put a static shield, grounded, between the leads, or if the circuit is transformer coupled, reverse one pair of leads.

### DISSIPATION OF ELECTRICAL ENERGY

I HAVE A DC circuit in which I want to drop about 200 volts in a resistor which is to carry 1.75 amperes. I realize that this will require a dissipation of 350 watts, which will cause a good deal of heating. Is there any practical way of reducing the amount of heat that is generated in the resistor and still dissipate the 350 watts?—B. B. S.

There is no way of reducing the dissipation and still maintain it. No matter in what way you dissipate the 350 watts the same amount of heat will be generated. There are different ways, however, in getting rid of what is generated, that is, getting it away from the resistor in which the heat is generated. First, you might paint the resistor dull black. Second, you should provide plenty of radiating surface, all painted black. But to provide a large radiating surface for the resistor may be a difficult task unless the resistor is made specially for the job. A very good way of getting the heat away from the resistor is to provide plenty of ventilation. A draft of air past the resistor will keep it cool. If there are air holes both above and below the resistor the heat from the resistor will keep the draft going.

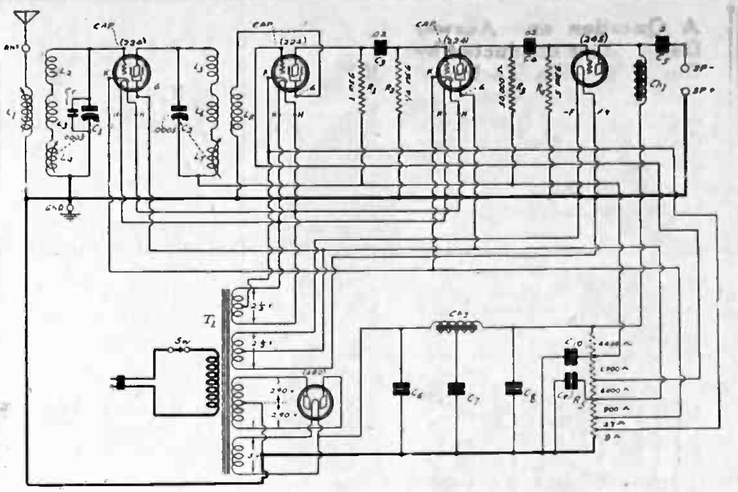


FIG. 821

THE AC SCREEN GRID TUBE CAN BE USED EFFECTIVELY IN RESISTANCE COUPLED AMPLIFIERS PROVIDED THAT THE VARIOUS VOLTAGES ARE ADJUSTED PROPERLY. IN THIS CIRCUIT THE DETECTOR IS CONNECTED IN THE SPACE CHARGE MANNER.

### SPACE CHARGE DETECTOR

WILL YOU please publish a receiver diagram in which a screen grid tube is used for detection in the space charge hook-up? I would prefer a receiver in which the screen grid tube is used for amplification both in the RF and the AF stages.—W. O. A.

Fig. 821 is such a circuit. It is resistance coupled in the audio amplifier and for that reason a screen grid tube can be used effectively. It is advisable to vary the voltage on the screen of this tube between 22.5 and 45 volts.

# *Verse-Reading Test to Be Held in Spring*

A verse-reading contest is to be held in the Spring by the National Association of Teachers of Speech, to promote better standards of pronunciation and enunciation. Broadcasts of final contests are planned.

There will be two groups of contestants: one of high school age, the other of college age. But the contest will be open to all, whether enrolled in schools or not.

A resolution suggested to Secretary of Commerce Wilbur's advisory committee on education by radio that its program include "efforts for the promotion of better standards of speech.

# LONG HUNT FOR MUSEUM GIFTS

WASHINGTON.

It will take three years before the project for the establishment of a radio museum, housing notable exhibits of pre-broadcasting developements, actually will have assumed definition, said C. W Mitman. He is curator of mechanical technology of the Smithsonian Institution. Space has been allotted at the Institution for the museum

A survey of available material is being made by Governmental agencies, radio corporations and an unofficial committee.

As a nucleus for the collection, the Radio Corporation of America has offered its comprehensive collection of apparatus which it now displays at radio shows throughout the country. George H. Clark, historian of the RCA., is actively cooperating with the governmental committee, and will be a member of the official committee, the membership of which has not yet been completed.

Large amounts of this radio material, considered obsolete, and unfit for service, are stored in Government warehouses and will be disposed of as "junk" unless reclaimed by Federal action. In all parts of the Nation and in other countries, similar conditions exist, and expeditious action is required to preserve these materials before they are disposed of.

Moreover, declared Mr. Mitman, it is of utmost importance to obtain authentic records of radio developments while the individuals who participated in them are alive. Marconi, De Forest, Fassenden and others who actually introduced radio, are still active in the art, he said, and must be consulted in connection with the enterprise

Mr. Mitman said several years will be required before the enterprise shapes up. "By 1933 we hight have an indication of what we are driving for," he asserted.

In England a thorough search and investigation must be made if the collection is to be comprehensive, Mr. Mitman declared Radio actually had its inception there under Senator Marconi. Thus the "real, original material" should be in England.

The conferees decided to limit the collection up to the end of the World War period to exclude broadcasting.



# BOARD IS TOLD IT HAS RUINED WTMJ SERVICE

WASHINGTON.

How a station with an average service area comprising two States and parts of four other States, was reduced to serving to listeners 14 miles to the East, and about 20 miles in other directions, was recited by WTMJ, Milwaukee, Wis., in a report to the Commission. H. J. Grant, publisher of the Milwaukee "Journal," operator of WTMJ, submitted the report. The assignment of other stations to the same frequency, 620 kilocycles, was given as the reason for the service range reduction.

Criticizing the Commission for assigning additional stations to the channel, the report urges that this frequency be converted from a regional into a cleared channel, and assigned to the Milwaukee station.

If this is not possible, then WTMJ insists that 620 kilocycles be restored to a condition at least as good as that in which the allocation of November 11th, 1928, originally established it.

"The Commission has failed to keep its engagement with WTMJ and with the State of Wisconsin, and the channel of 620 kilocycles has been ruined," declares the report.

The report is submitted to show the "destruction of service area" of the Milwaukee station "by recent actions of the Commission."

**Three Reasons Cited**

The destruction of WTMJ's service area is due entirely to recent actions of the Commission, as follows, says the report:

"1.—The Commission's action in placing WFLA-WSUN, of Clearwater, Fla., on the same channel, 620 kilycycles, to operate simultaneousely with WTMJ;

"2.—The Commission's actions in increasing the evening power of WLBZ, at Dover-Foxcroft, Me. (whch station was already on the same channel), from 250 watts to 500 watts; and

"3.—The Commission's action in placng WJAY, of Cleveland, Ohio, on the same channel to operate simultaneously with WTMJ until sunset."

"Prior to these actions," continues the report, "WTMJ enjoyed a very satisfactory area, reasonably free from interference, which, on evenings of average good reception, comprised virtually the entire States of Wisconsin and Michigan and considerable portons of the States of Minnesota, Iowa, Illinois, and Indiana.

**Often Heard Far Away**

"The station was frequently heard in many more distant States, including Ohio, Pennsylvania, New York and New Jersey, and occasional letters were received from listeners in practically every State in the United States; although, of course, this varied with reception conditions as well as with the actual hours of operation of other stations on the same channel.

"Recent actions of the Commission have virtually destroyed this large service area and have caused it to shrink to a ridiculously small region extending only about 14 miles to the east of the transmitter and about 20 miles in other directions." continues the report. "Even the eastern part of the City of Milwaukee itself has been subjected to noticeable heterodyne interferences."

# ARMY 'PLANES IN LONG FLIGHT TO TEST RADIO

WASHINGTON.

The War Department will sponsor this month tests of long-distance short wave radio communication between aircraft and permanent ground stations, in cooperation with the American Radio Relay League.

The tests will be made in connection with winter maneuvers of the First Pursuit Group, which will bring into play an extremely realistic combat with King Boreas and his shock troops—snow, ice and subzero temperature—over a 3,000-mile "battle front" stretching from Detroit to Spokane and back.

**Purposes of Flight**

The flight has two principal purposes:

1. To measure the endurance and efficiency of Army Air Corps personnel, planes and equipment in a section of the country where the mercury in the thermometer hibernates at 40 below zero and lower during the early part of the year.
2. To test the value of short-wave radio as a means of contact between Army air units operating in isolated regions and remote posts of command.

The flight will consist of eighteen pursuit planes and two Army transports under command of Maj. Royce.

**Will Have Portable**

One of the transports will be equipped with portable short wave receiving and transmitting sets. The transmitter will operate on either 32 or 54 meters. This brings the flying radio station within adequate reach of the wave bands on which some 50,000 short wave amateurs operate. The call signal for the plane has not as yet been determined, but the receiver will tune in at from 5 to 150 meters.

The planes, equipped with skis instead of landing wheels, will start their 3,500-mile flight by way of Duluth, Grand Forks, Glasgow and other intermediate points to Spokane. Their return route will take them to Helena, Butte, Miles City, Bismarck, Fargo, Minneapolis and other stops. This program is, however, subject to change.

## *Colombia Station Aids Jobless In Crisis*

Bogota, Colombia.

The Government is using its radio station in an effort to find work for 25,000 unemployed. Help wanted advertisements, broadcast free, tell the time and place of appearance of applicants, nature of work, pay and hours, number of men required, and offer free transportation to the application point on Government conveyances.

Hence some of the hungry jobless ride to their hopeful destination in fine American automobiles, with uniformed chauffeurs.



## *One Cast Sings, Other Acts Opera*

A novelty was presented recently over a network of forty-five stations, WEAF as the key station, when Verdi's opera "Aida" was sung in dramatic form, while unsung parts of the condensed version were acted by a separate cast. The program was sponsored by RCA-Victor. Metropolitan Opera House artsts sang the leading operatic parts.

Giacomo Lauri-Volpi, tenor, sang the role of Rhadames, Marion Telva, contralto, Amneris and Elisabeth Rethberg, soprano, Aida. The occasion marked the radio debuts of Miss Telva and Mr. Lauri-Volpi.

The action of the opera was conveyed to the audience in lines spoken by the following cast: Virginia Gardiner as Aida; Rosaline Greene, as Amneris; Fred Forrester, as the King of Ethiopia; Allyn Joselyn, as Rhadames; Charles Webster, as High Priest.

# BOARD ATTACKS WMAK ON WRIT

WASHINGTON.

Although a station construction permit has been issued to an applicant, for use of a particular frequency, no station using that frequency may complain that it will be injured, because the Federal Radio Commission may change its mind, and assign a different frequency to the applicant.

This argument was presented to the Court of Appeals of the District of Columbia by Paul D. P. Spearman, acting chief counsel of the Commission, opposing the application of WMAK, Buffalo, N. Y., for an injunction against the assignment of 900 kilocycles to the proposed station of the Buffalo "Evening News." WMAK is on 900 kilocycles and the "Evening News" construction permit calls for the same frequency.

A license to use the channel full-time has not been given the newspaper, Spearman said, and, furthermore, the Commission has not yet denied WMAK the right to use the channel

Until January 31st, says the answer, filed by Spearman, WMAK is licensed to operate one-half time and has no rights beyond the terms of the license

"A construction permit confers no authority to operate," says the answer. "And in this case the Commission specifically ordered that no license to operate a new staton should become effective prior to January 31st, 1030, the date upon which appallant's license expires."

The petition for a stay and an appeal were filed by former Representative Frank D. Scott, of Michigan, one day after the Commission granted the construction permit to the Buffalo "News."

WMAK seeks to have the court issue a stay preventing the Commission from taking any further steps whatever with respect to the 900 kilocycle channel until after the court had reviewed the Commission's decision and taken action.

The Buffalo "News" was awarded the construction permit for the new station after several days of hearings before the Commission at which it was charged that a local broadcasting monopoly exists in Buffalo under the Buffalo Broadcasting Corporation. WMAK is one of four stations in that city operated by this corporation

# FIGHT STARTED TO RID THE AIR OF ITS QUACKS

The use of radio by medical quacks excluded from the columns of reputable newspapers and periodicals, to advertise their devices and treatment, has led Dr. Shirley W. Wynne, Commissioner of Health of New York, to take steps also to bar them from radio. He has written to the Federal Radio Commission asking if any existing law could be invoked against the fakirs. This letter follows in full:

"In the ordinary course of our work, we have uncovered what we believe a serious situation which seems to indicate that the radio is being fairly widely used by companies alleging to cure diseases through the sale of various products and services. These claims are, in many of the cases we have investigated, completely unfounded, fraudulent and inimical to the public health.

### A New Haven

"It seems that many of the charlatans who have been driven from the newspapers, have found a haven to activity in the radio broadcast. These commercial concerns engage the facilities, not of the larger reputable radio stations, but of the smaller stations.

"The use of radio by fake doctors and unscrupulous commercial organizations is a more serious menace to the health than the use of advertisements in the press, because such radio programs are listened to by larger audiences. New York being one of the largest centres of population, these programs pour into us from nests of smaller radio stations in surrounding communities outside of our own city and state.

"I write to ask whether there is anything in the existing laws yhich you might invoke to stop this practice. If there is not, is there any kind of voluntary scrutiny which can be set up to weed out these quacks and clear the air of their poisonous commercial propaganda?

### Wants Check on Quacks

"While we are constitutionally opposed to the principle of censorship, we feel that the practice which has been adopted by the leading radio stations of submitting their sponsors' health products and services for the approval of local health departments, might be an effective way of handling this among the other stations.

"We are convinced from the information that we have that this is a national problem of importance, and will be glad to place any material that we have at your disposal looking toward some constructive remedy."

## A THOUGHT FOR THE WEEK

*WHEN the player-piano attained the voque some years ago there was a notable dropping off in the sale of sheet music. Especially did the demand for the music of the masters fall off. Radio has had a different effect. The beauties of the compositions of the geniuses in the classic field of music have appealed to many among radio listeners-in, with the result that the sales of the really worth-while numbers have largely increased and the values of copyright reissues have steadily grown to immense totals. Thus does radio continue in its educational work among the millions.*



# Radio on Auto Opens Garage Door

WASHINGTON.

A system for opening and closing garage doors automatically by radio waves has been invented in Switzerland, according to an announcement of the chief engineer of the electrical plants of Neufchatel appearing in the Swiss press and transmitted to the Department of Commerce by its office at Berne.

The manner of operation is explained by the inventor as follows:

A few yards in front of the garage, the driver presses a button fixed near his seat in the car which causes waves to be sent out. These waves are picked up by an aerial fixed on top of the garage and serve to start a motor which automatically opens or closes the doors. The wavelength of the receiving apparatus would be so adjusted to the sending that a car having a different wavelength could not open the doors.

# BOARD CAN'T STOP QUACKS

WASHINGTON.

The Federal Radio Commission does not have the authority to act in connection with the protest received from Health Commissioner Wynne of New York against the broadcasting of alleged fraudulent medicine advertising by radio. Judge Eugene O'Sykes, vice chairman of the commission, said that it had no jurisdiction and that Commissioner Wynne would be so advised. Congress has repeatedly refused to give the commission any power of censorship over radio programs.

Harold A. La Fount alone of the commissioners thinks that the commission does have power to control objectionable broadcasting on "the public interest, convenience, or necessity" clause in the Radio Act. He believes that the offending station should be notified, and if they persist in broadcasting offensive programs they should be taken off the air by the commission on the ground they are not operating "in the public interest." The stations could then appeal to the courts.

Health Commissioner Wynne stated that he had referred the question of "radio quacks" to the Federal Radio Commission because the Health Department had no legal power to combat the nuisance.

"All the Department of Health can do," he said, "when medical claims are made for a certain device which we are convinced is harmful, is to report the matter to the State Department of Education in the hope that a means can be found to prosecute the offenders under the medical practice act. The Department of Health is not empowered to prosecute."

"Unless there should be a case," he added, "in which the purchaser of one of the devices or treatments offered should be seriously or fatally injured and civil or criminal action should be brought, there now seems to be no way by which the promotion of the sale of such commodities over the radio can be stopped."



# WAYS SOUGHT FOR IMPROVING STATION PLANT

WASHINGTON.

At the final 1929 meeting the Federal Radio Commission authorized the calling of a conference on January 17th of radio engineers to find means of improving the operation of broadcast stations in the United States.

Engineers of the Westinghouse Electric & Manufacturing Co., General Electric Co., Western Electric Co., Columbia Broadcasting System, Bell Laboratories, Broadcasting System, National Broadcasting Company, Bell Laboratories, and other companies engaged in radio research from the broadcasting angle, have been invited to the conference.

The acting chief engineer of the Commission, Capt. Guy Hill, said that the purpose of the conference "is to see if the most competent and experienced engineers on broadcasting are able to suggest any methods to the Commission that might be worked out to eliminate some of the present troubles encountered."

### Too Many Stations

Capt. Hill said that under present technical conditions, the number of stations now operating, approximately 600, greatly overtaxes the 90 available channels. "Very little can be done unless some definite improvement in technique is developel, or unless some of the existing stations are eliminated," he said.

The main subjects on which information and discussion are desired are recited by the Commission as follows:

"The possibility of developing an antenna system which will increase the service range near the transmitter and decrease the interference at a distance; that is, an antenna system that will reduce the 'sky wave' and strengthen the 'ground wave.'

### Synchronism to Be Discussed

"Discussion of synchronism of broadcasting stations. Information on this subject desired as a reliability and advantages and disadvantages of the various methods of synchronism.

"Any other engineering principles to be discussed that would aid broadcasting stations to render better service."

It is emphasized that the conference will be devoted entirely to engineering considerations and that it is desired that those interested send engineers who will be qualified to discuss the specified questions.

# "b" Suggested as Unit of Hum Measurement

The "b" has been suggested as the unit of hum in radio receivers operated by alternating current by George Lewis, vice-president of Arcturus Radio Tube Company of Newark, N. J. The magnitude of the produced unit is one microwatt of energy in the output of the receiver.

The name for the unit was taken from the bee, one of the insects known for its hum production. It is interesting to note that the power in the hum emitted by a bee in flight is nearly the same as the power suggested for the unit of hum in a radio receiver, namely, one millionth of a watt.

# ANNOUNCER HIT BY SPECTATOR IN FIGHT ARENA

CHICAGO.

Although he told the radio audience it was merely a slap, a blow Pat Flanagan, WBBM sports announcer, received in trying to keep ringside profanity out of hearthside loudspeakers, was severe enough to cause his absence from duty for several days.

Flanagan was injured during the short but hectic broadcast by WBBM of the fight between Art Shires, White Sox first baseman, and George Trafton, Chicago bears center, at the White City arena, in Chicago.

### Hits Announcer

Interest ran high in the fight, a "natural," scheduled for five rounds. Both boxers had hundreds of supporters near the ring and some of those near the WBBM microphone were rather profane in their cheering.

Flanagan politely asked that they tone down their language, as there was danger of it going on the air in violation of the federal law governing radio.

One spectator answered the announcer's request by leaning over towards the microphone and loosening a flow of exceedingly distasteful language. Flanagan pushed him away, whereupon the spectator hit the announcer in the left eye.

The blow was audible to the listeners in spite of the volume level being cut to a minimum to exclude the crowd noises. There was a moment's pause and Flanagan resumed his broadcast, stating that an over-enthusiastic spectator had slapped him with his open hand.

### Bone Broken

Before the close of the fight the "slapped eye" had closed. Next morning it was swollen to the size of a baseball and a doctor's examination revealed a broken bone beneath the eye.

Although Flanagan was reluctant to seek redress for the injury, he finally consented to the swearing out of a warrant for his assailant after WBBM officials pointed out that he owed this to the radio audience.

The fact that radio goes into the very heart of the family circle, they said, makes it imperative that broadcasts of all kinds be kept free from taint. If broadcasts of sporting events are to continue, they point out, the announcers who protect the audience must be protected and to let Flanagan's assailant go free would be setting a very bad precedent.

**PLEASE GIVE US TWO WEEKS**

**for changing your address, showing new renewal expiration date, etc. Subscription orders are arriving in such large numbers that it takes two weeks to effectuate the change. RADIO WORLD, 145 West 45th St., N. Y. City.**

## Literature Wanted

THE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank at bottom may be used, or a post card or letter will do instead.

RADIO WORLD,
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# SET NOT "MUSIC INSTRUMENT"

MONTGOMERY, ALA.

A radio receiver is not a musical instrument, according to an opinion given by Assistant Attorney General Luther Patrick to License Inspector J. B. Powers of Jefferson County and retailers who sell radios in Alabama cannot be required to pay a retail musical dealer's license tax. Patrick said:

"A musical instrument has been judicially defined as 'a contrivance by which musical sounds are produced.' There could, in my opinion, be no serious contention that a radio is such a contrivance."

A radio, the opinion set forth, consists of two parts—the sound wave producing part called a sending set and a receiving set, which reproduces sounds sent out by the sender.

"Such sounds may be conversation, information, music, or otherwise."

"The sound," the opinion says, "issues from a source so remote that it must pass through another agency, the sending set, before it is capable of being heard by aid of the receiving set or radio. It is quite as likely to be any other sound as that of music."

The Assistant Attorney General concluded his opinion stating: "It is my opinion that a radio is not a musical instrument and cannot come under the schedule suggested in your inquiry."

# RADIO WORLD BOOK SERVICE

AS the first and only national radio weekly, now in its eighth year, RADIO WORLD publishes the most timely, up-to-date news of radio circuits and events in the set-building and broadcasting fields. Technical accuracy second to none. Get a copy at your news-stand today, 15c. RADIO WORLD advises impartially on all radio topics, including what text books to buy, and helps you to read the books properly. Every book advertised on this page is essential to your radio library.

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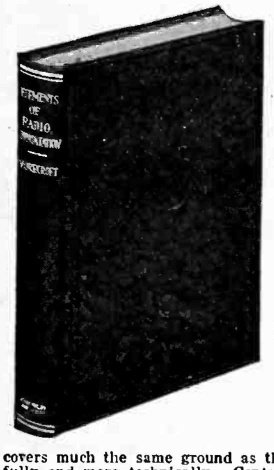
**"Elements of Radio Communication"**




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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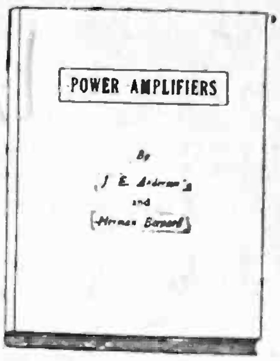
More than 200 pages and more than 100 illustrations are devoted to an analysis of this outstanding radio subject. "Power Amplifiers" is authoritative, original and comprehensive. It is free from the traditional errors that have crept into this subject. The theoretical part of the book can be understood 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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**"Service Man's Manual"**

Two new books by John F. Rider, R. E., Member, Institute of Radio Engineers, constitute the series grouped by him under the heading "Service Man's Manual." Part I is "Mathematics of Radio." Part II is "Trouble Shooter's Manual."

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*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. The home experimenter, the radio engineer, the custom set-builder, the teacher, the student—all will find this new book immensely informative and absolutely authoritative.*

MORE THAN 100 WIRING DIAGRAMS OF RECEIVERS MADE BY MORE THAN FORTY DIFFERENT SET MANUFACTURERS ARE PUBLISHED IN THIS BOOK, INCLUDING OLD MODELS AND LATEST MODELS! RCA, ATWATER KENT, CROSLEY, MAJESTIC, ZENITH, STROMBERG CARLSON, KOLSTER, FEDERAL, FADA, Etc. 240 pages, size 8½x11"; 200 illustrations. Imitation leather cover. Order Cat. TSM @..........................................$3.50


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Radio World has been receiving so many subscriptions of late that the Subscription Department is somewhat behind in its work. Please give us time to enter your subscription. We will enter all subscriptions as fast as we possibly can.

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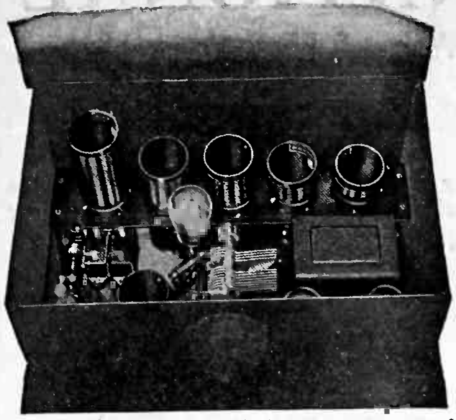
## Short Wave Circuit



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.

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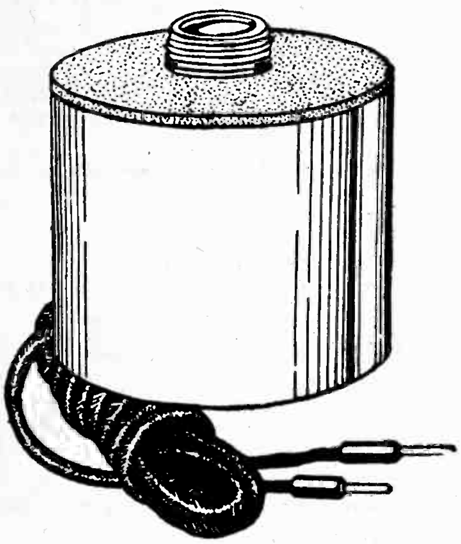
**143 West 45th Street New York City**

## 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.

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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

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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.

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Please ship C. O. D.
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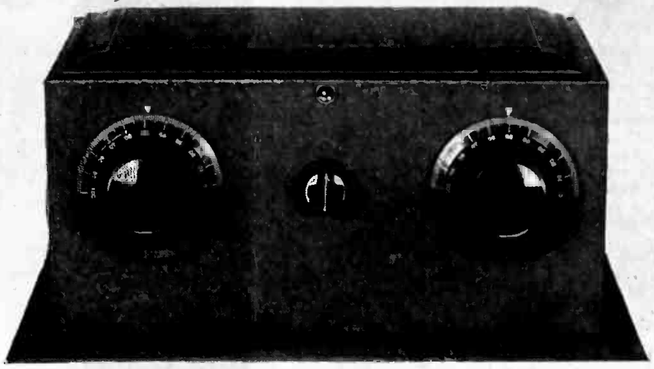
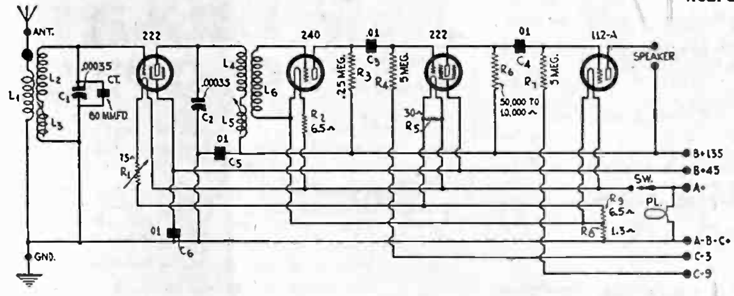
**Build the HB Compact (Battery model)**

**$18.55**



Front view of the HB Compact, battery model, the simple 4-tube receiver that works a speaker at high volume and produces tone that is of the very purest kind. Cabinet is only 15" wide, 9½" front to back, 7" high.




Follow this diagram of the HB Compact, battery model, when building this tone-marvelous receiver.

Everybody is delighted with the exquisite tone of the HB Compact, battery model. "Never heard anything like it," is the usual comment. The receiver uses a 222 screen grid tube for RF, 240 bias detector, 222 first audio and 112A power tube. Draws only .75 ampere filament, 18 milliampere plate current. Very economical to run. B batteries last 6 months or more. Plentifully selective and sensitive. Build it now!

## LIST OF PARTS

*[Check off what parts you want]*

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| ☐ L1L2L3—Antenna coil, BT3A | 1.35 |
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| ☐ R2, R9—Two 6.5 ohm filament resistors | .50 |
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| ☐ R5—30 ohm filament resistor | .45 |
| ☐ R8—1.3 ohm filament resistor | .20 |
| ☐ Ant., gnd., Sp. (+), Sp. (—)—Four posts | .40 |
| ☐ PL—Pilot lamp 6v. and bracket | .70 |
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| ☐ Crinkle brown steel cabinet, 7x9½x15" | 3.50 |
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| ☐ Seven leads for battery cable | .70 |
| ☐ Two Dials | 1.00 |
| ☐ All parts | $18.55 |
| ☐ Tubes: two 222., one 240, one 112A | $ 5.79 |

The HB Compact, battery model, designed by Herman Bernard, has tone quality second to none. All who appreciate music will revel in the delightful tone of this amazing circuit.

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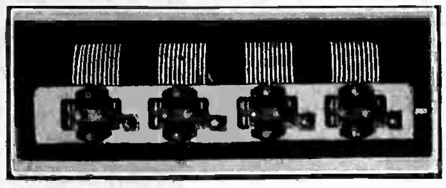

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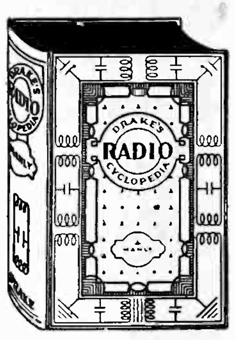


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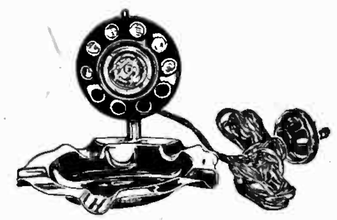

Model B lighter, microphone design, on tray, with 5-ft AC cable and plug. Works on 110 volt AC, any frequency, and on direct current. Exactly the same lighter as the other, only tray is added.
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This lighter is instantaneous. Hold button down only long 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.

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☐ Please send me Model A Microphone Lighter at $1.00.
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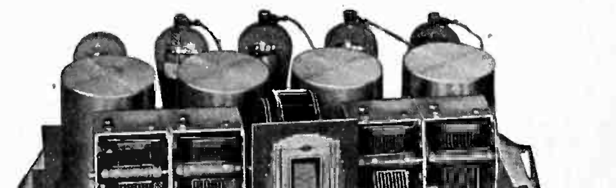
# NATIONAL SCREEN GRID TUNER

# MB-29



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