An antenna coil dispenses with the loop in the Magnaformer 9-8. Other changes are suggested in article on page 14.

WHAT ABOUT PUSH-PULL RESISTANCE AF?

HB55, AC Circuit for a 180 Volt B Eliminator MICROVOLT PER METER—WHAT’S THAT?
Highest Grade Speakers at Lowest Prices!

**TEMPLE FAR-RAN-D**

Temple AC Dynamic Model 10, in a beautiful cabinet. The speaker chassis is one of the finest made. There are an output transformer and dry rectifier built in. The cabinet has decorated walnut front and back, with carved grille ornament. An AC switch is accessible underneath cabinet. Rear is removable for adjustment of resistor knob to match the impedance of your receiver's output tube. Connect plugged AC cable to 110 volts AC, 50 to 60 cycles, and connect tipped cords to speaker post of receiver. This remarkable speaker Cat. TEM-10 at only $1.34.

$15.34

**R-O-L-A**

Rola Model D-10 dynamic chassis, less cabinet, for 110 volts 50-60 cycles AC. Dry rectifier and output transformer built in. The fine workmanship of this chassis is shown in the illustrations of the front and rear views. Extreme diameter of rim 9 inches but baffles with cutouts down to 7 inches may be used. This is the biggest dynamic chassis bargain we have ever offered and enables you at low price to obtain one of the best chassis made. Tone is most excellent.

Order Cat. No. RO-10 at $11.34

Farrand Inductor Chassis, consisting of the unit, cone, spider, bracket, assembled, but not in a cabinet.

- Model 6-G, 10" extreme diameter of cone front rim $9.00
- Model 10-G, 12" extreme diameter of cone front rim $10.00
- Model 10-G-PP for connection to push-pull, requiring no output device, because unit is constructed as a center tapped output impedance. Center tap is yellow and goes to B+. Tipped cords go direct to plates. Outside diameter 12" $11.00

Brookfield cabinet, No. 10 or No. 6 for these speakers. $6.50

The Temple, Rola and Farrand speakers are highly recommended by us for true tone and high volume. They are extremely sensitive as well. The chasses (Farrand and Rola) will work without a baffle, but it is preferable to provide one. The Temple requires no extra baffle, as the cabinet is itself a baffle box. All three speakers are sold in factory-sealed cartons. Immediate delivery.

Model 10-G-PP Farrand may be used in push-pull without any output device. Connect yellow lead to B+, tipped leads to power tube plates. May be used on single output by ignoring yellow lead.
High Gain at Low Cost

HB44 -- $45.59
HB33 -- $23.28

Now Get All the DX You Want!

Every one at some time feels the urge to possess an ultra-sensitive receiver, one so sensitive that at night stations can be tuned in from all over the United States and Canada, and without objectionable interference.

A screen grid circuit, properly designed, using good parts that need not be expensive, will give you these results in full. The HB44, for AC operation, will cost you only $45.59, including power apparatus; has:

(a) Three stages of tuned R.F., using 224 screen grid tubes.
(b) Tuned input to 224 power detector.
(c) Audio, consisting of first stage resistance coupled, second stage 245s in push-pull.
(d) Four totally shielded R.F. coils.
(e) A chassis all drilled for necessary parts.
(f) A four gang condenser, guaranteed accurate, with equalizing condensers built in.
(g) A 4.6 mfd. filter and bypass capacity.
(h) Thirteen different fixed voltages available from the output.
(i) Single dial control.

LIST OF PARTS FOR THE HB44

<table>
<thead>
<tr>
<th>Part</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL1, SL2, SL3, SL4</td>
<td>4</td>
<td>Four stage individually shielded coil cascade for 4.0003 mfd. (Four Cat. SH-3 of Screen Grid Co.)</td>
</tr>
<tr>
<td>C1, C2, C3, C4</td>
<td>4</td>
<td>One gang .0005 mfd. condenser with equalizers E1, E2, E3, E4 built in.</td>
</tr>
<tr>
<td>CS</td>
<td>1</td>
<td>One 40 mfd. mica condenser.</td>
</tr>
<tr>
<td>C6</td>
<td>1</td>
<td>One 1.60 mfd. 200 volt DC bypass condenser.</td>
</tr>
<tr>
<td>C8</td>
<td>1</td>
<td>One 5.0 meg. Lynch metallized resistor.</td>
</tr>
<tr>
<td>R2, R3</td>
<td>2</td>
<td>Two 6.5 ohm fixed filament resistors.</td>
</tr>
<tr>
<td>CS, C6</td>
<td>2</td>
<td>Two .01 mfd. mica fixed condensers.</td>
</tr>
<tr>
<td>C8, C9, C10, C11, C12</td>
<td>4</td>
<td>Four 1 mfd. 200 volt DC bypass condensers.</td>
</tr>
<tr>
<td>C13</td>
<td>1</td>
<td>One .01 mfd. mica condenser.</td>
</tr>
<tr>
<td>CS, C13, C14</td>
<td>3</td>
<td>Three .01 mfd. mica fixed condensers.</td>
</tr>
<tr>
<td>SL1, SL2, SL3, SL4</td>
<td>4</td>
<td>Four stage individually shielded coil cascade for 4.0003 mfd. (Four Cat. SH-3 of Screen Grid Co.)</td>
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<td>One 40 mfd. mica condenser.</td>
</tr>
<tr>
<td>C6</td>
<td>2</td>
<td>Two 4.6 mfd. filter and bypass capacity.</td>
</tr>
<tr>
<td>Hardware</td>
<td>24</td>
<td></td>
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LIST OF PARTS FOR THE HB33

<table>
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<tr>
<th>Part</th>
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</tr>
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<td>C1, C2, C3, C4</td>
<td>4</td>
<td>One gang .0005 mfd. condenser with equalizers E1, E2, E3, E4 built in.</td>
</tr>
<tr>
<td>CS, C6</td>
<td>2</td>
<td>Two .01 mfd. mica fixed condensers.</td>
</tr>
<tr>
<td>C8</td>
<td>1</td>
<td>One 1.25 amperes.</td>
</tr>
<tr>
<td>R2, R3</td>
<td>2</td>
<td>Two 6.5 ohm bypass condensers.</td>
</tr>
<tr>
<td>CS, C6</td>
<td>2</td>
<td>Two .01 mfd. mica fixed condensers.</td>
</tr>
<tr>
<td>C8, C9, C10, C11, C12</td>
<td>4</td>
<td>Four 1 mfd. 200 volt DC bypass condensers.</td>
</tr>
<tr>
<td>C13</td>
<td>1</td>
<td>One .01 mfd. mica condenser.</td>
</tr>
<tr>
<td>CS, C13, C14</td>
<td>3</td>
<td>Three .01 mfd. mica fixed condensers.</td>
</tr>
</tbody>
</table>

It's the Real Thing!

Do not make the mistake of assuming that simply because the prices of the parts of the HB44 and HB33 are low that performance is not of the very highest. As quantity production of parts results in low price passed on to the consumer for his benefit. You can take it for granted that these circuits, designed by Herman Bernard, are all they are cracked up to be. The claims made are conservative, and not bombastic. It stands to reason that four tuned stages, working into screen grid tubes, must give superlative results, if the design is expert and the parts are good.

Take the HB44, for example, Parts used include those of Electrolyte, Inc., National Company, Amrad Corporation (Merchant Division), Clarostat Mfg. Co., Lynch Manufacturing Corp., Spalding, Pollo Engineering Laboratories, and Martin Copeland. These are manufacturers with indeed high reputations.

The parts for the HB33 are on the same high plane of quality.

You are assured of most excellent tone quality when you build either of these receivers, as the audio coupling media are the same in both, and negative bias detection is used in both. Choose either one—it's the real thing, rest assured!

GUARANTY RADIO GOODS CO.,
141 West 35th Street, New York, N. Y.

Please ship all parts for HB44 $45.59
Please ship all parts for HB33 $23.28

NOTE: If only some (not all) parts are desired, check off on list at left and tear out and send in this entire page.

GUARANTY RADIO GOODS CO.,
141 West 35th Street, New York, N. Y.

Please ship all parts for HB44 $45.59
Please ship all parts for HB33 $23.28

NOTE: If only some (not all) parts are desired, check off on list at left and tear out and send in this entire page.

FIVE DAY MONEY-BACK GUARANTY
The Latest in Tuning Equipment

**Shielded Coil**

RF transformer in aluminum shield 2¾". The primary of fine turns is used with extra base. Coils have 600 mfd. All metal case panel is used. Enclosed parts consist of shielded tube, primary, and input terminals to built-in lugs. For all circuits and stages, including screened grid tubes.

Cat. No. RS3 for .0005 mfd. $0.35
Cat. No. MS1 for .0005 mfd. $0.30
Cat. No. extra base $0.10

**Antenna Coupler**

Merges primary and fixed secondary, for antenna coupling. Screen as volume control.

Cat. No. VAS-$0.85

**SG Transformer**

Screen Grid Coil Company, 33 West 44th Street, New York, N. Y. (East of Broadway.)

Enroled glass and lead for which please specify at time of ordering parts:

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS63</td>
<td>$0.85</td>
</tr>
</tbody>
</table>

**BERNARD TWO-TUBE TUNER ASSEMBLY**

BERNARD TUNER BT3 for .0005 mfd. for antenna coupling, the primary being fixed and the secondary being adjusted to bring antenna coupling. Screen as volume control.

Cat. No. BT3A-$1.35
Cat. No. BT5A-$1.35

**BERNARD TUNERS**

BERNARD Tuner BT3A for .0005 mfd. for antenna coupling, the primary being fixed and the secondary being adjusted to bring antenna coupling. Screen as volume control.

Cat. No. BT5A-$1.35
Cat. No. BT5B-$1.35

**DIAMOND PAIR**

Antenna coupling for any standard circuit, and one of the two coils constituting the Diamond Pair.

Cat. No. RF5-$0.60
Cat. No. SGT5-$0.85
Cat. No. BT5-$0.60

**STANDARD TUNER**

The standard three-circuit tuner is used with primary in the plate circuit of any RF tube. AC or battery type, not containing only screen grid stage.

For .0005 mfd. order TL at $0.85
For .0005 mfd. order FL at $0.80
All coils have 2½" diameter, except the shielded tube.

Cat. No. TL-$0.85
Cat. No. FL-$0.80

**FLA $0.30**

Flexible insulated coupling for uniting cell or condenser with chokes.

Equalizing condenser 80 mfd. for connecting across any tuning condenser where range is required, or for connecting separate equally tuned circuits to make dial track.

Order Cat. No. FLA at $0.30

The Latest in Tuning Equipment
Tone That Thrills!

Build the
HB Compact
(Battery model)

$18.55

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 RF amplifier, 222 first audio and 112A power tube. Draws only 75 anode filament, 18 milliamperes plate current. Very economical to run. B batteries last 6 months or more. Pleasurably selective and sensitive.

Send in your order for parts today to Guaranty Radio Goods Co., 143 West 45th Street, New York, N. Y., just E. of B'way. Use Cousin. Name

Address

City State


MORECROFT

New second edition of "Principles of Radio Communication," by Prof. John H. Morecroft, of the Electrical Engineering Department of Columbia University and past president of the Institute of Electrical Engineers. This is an outstanding and authoritative book on the subject. This large book on radio principles and practice is something that you must not be without. Every set builder, every designer, every engineer, every service man, simply must have this book. Ready reference to all intricate problems makes this volume invaluable. Set builders, experimenters, distributors, dealers, salesmen and teachers, students and operators, all find Morecroft their standby, and now the new second edition awaits you. 1,001 pages and 67 illustrations in this cloth-bound volume.

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145 West 45th Street
New York City
(Just East of Broadway)

TWO FOR PRICE OF ONE!


A GREAT ADVERTISING MEDIUM

A Two Tube AC Tuner
Works Splendidly Into a Power Pack—Uses Bernard Tuners

By James H. Carroll
Contributing Editor

A TWO-TUBE A C tuner, fundamentally the same as the one for battery operation published last week, uses substantially the same parts, except that the sockets are of the five-prong type, and the filament transformer is added, besides resistors and by-pass condensers. This makes a dandy tuner to go with an AC power amplifier, and besides renders available 2.5 volts for operation of one or two 245 output tubes, or 5 volts for 112, 112A, 171 or 171A, singly or in matched pairs, and besides permits heating three other heater type tubes—224, 227 or 228—from the high current 2.5 volt winding. The B voltages must be supplied by the power amplifier.

The Bernard tuner assemblies, left and right types, are used, and in addition two extension shafts are employed. These provide a ¼-inch shaft at one end and take a ¼-inch shaft in the receptacle at the other end. The object of introducing these is to permit sufficient separation to enable the filament transformer to be moved close to the National modernistic color wheel drum dial.

A 7”x21” front panel is required, and this is obtainable all ready drilled. The tuner assemblies have aluminum bases, so no subpanel is necessary, the bases being elevated from the bottom of a table model cabinet to provide clearance for the socket lugs.

The Bernard tuners have a tuned inductance consisting of a fixed coil and a moving coil, an important object of this combination being to insure coverage of the complete band of broadcast wavelengths when resorting to the high-gain method of tuning the screen grid plate circuit. To obtain the fine results that this combination assures it is necessary to have the moving coils in proper position.

You may correct the wiring and then pay attention to the position of the moving coils. Turn the dial to read 100 and have both moving coils parallel with the fixed winding, using only your eye as your guide. They may not be electrically parallel, for one may be bucking the fixed winding and the other aiding it, but this you will correct.

As an extra precaution, turn only one of the coils around half way now. Should selectivity and volume improve, note whether you have a first stage of transformer coupled audio or a high impedance plate resistor is used. If the readings are much higher than this, you may complete the wiring and then pay attention to the position of the moving coils. Take the dial to read 100 and have both moving coils parallel with the fixed winding, using only your eye as your guide. They may not be electrically parallel, for one may be bucking the fixed winding and the other aiding it, but this you will correct.

Tune in a station. Tune in several other stations. Notice whether they come in with a snap and provide good selectivity. Then see that if the entire wave band is tuned in. If the low wavelength stations come in with too much capacity of the tuning condensers in use, you will not be able to tune in the highest wavelength station. You should tune in 200 meters at 15 or lower and 500 meters at about 80. If the readings are much higher than this, you may complete the wiring and then pay attention to the position of the moving coils.

As an extra precaution, turn only one of the coils around half way now. Should selectivity and volume improve, note whether you have a first stage of transformer coupled audio or a high impedance plate resistor is used. If the readings are much higher than this, you may complete the wiring and then pay attention to the position of the moving coils.

By making these tests you will have both moving coils aid the fixed windings at the high wavelengths and buck them at the low wavelengths.

The P lead from the detector goes to the first audio coupling unit, in the power pack, which should be a .1 meg. resistor. If you are using a first stage of transformer coupled audio you may introduce the resistor between the P lead from the tuner and the P post of the first audio transformer primary, placing an .01 mfd. condenser from the P lead of tuner to G of the first audio socket. The screen grid detector tube works best with a high impedance load, and this is a good way to provide it if you have a first stage transformer. If your first stage is resistance coupled, be sure the plate resistor is .1 meg.

[More details next week.]
Good Regulation Needed
It Improves Quality and Avoids Motorboating

By Brunsten Brunn

THERE are many power amplifiers in which 250 type tubes are used in push-pull in the last stage. Such a circuit requires both high plate and heavy current for operation. Moreover, it requires a steady plate voltage if good quality is to be obtained from it. This is particularly necessary when the same B supply is used to supply the plates of several other stages in the same amplifier. If the voltage is not kept to a high degree of constancy, as a rule, that the regulation is poor and that there is not sufficient by-pass capacity across the voltage taps on the filter and voltage divider.

To supply adequately such an amplifier it is necessary to use at least two 281 tubes in the rectifier. While the same current could be obtained with two or more 280 type rectifier tubes these do not withstand the high voltage and therefore they are not suitable for the high voltage supply. The 281 tubes have been designed especially for heavy duty service and they can be depended on.

VOLTAGE CONSTANCY

One method of improving the regulation, and hence the voltage constancy, is to connect the plate return of the two 250 power tubes so that the plate current from these flows only through one of the chokes in the filter. This choke may be especially designed to carry a heavy current without appreciable voltage drop and without much saturation of the core. The inductance of this coil, L1 in Fig. 1, need not be more than 10 or 20 henries because in a well-balanced push-pull circuit there is practically no change in the demand of current on the rectifier tube. When one tube in the stage relinquishes its demand for current the other tube takes it up. It is advisable to use a separate power transformer and by-pass condensers for each plate circuit. One method of doing this is illustrated in the Fig. 1. Here we have four terminals with a resistance between each and ground. Each one of these should be connected to a separate circuit in a resistance coupled amplifier or to radio frequency amplifiers. Of course, if the circuit contains fewer than four plate circuits that should be treated in the manner indicated it is not necessary to use all of them.

The resistances shown in this circuit are not coupling resistors at all. Their sole purpose is to prevent feedback. The coupling resistors are connected between the points shown and the plates of the tubes.

Many will no doubt ask what the values of the filter resistors should be to drop the voltage by a stated amount. The answer is based on the current that flows. It is of no use to specify the voltage drop desired without also specifying the current flowing, for if both are not given the value of the resistance cannot be given. However, in a resistance coupled amplifier in which the coupling resistors are 100,000 ohms or higher let the value of each of these resistors be 20,000 ohms and let the current be whatever it will. If there is too high a voltage drop in the resistors boost the applied voltage to make up for it.

It is of no value to use condensers across the resistors less than 2 mfd. if the circuits involved carry audio frequency current.

The voltage on the various tubes is raised or lowered by moving the potentiometer slider P up or down. When it is at point 6 the voltage is as high as the B supply can maintain.
HB 55, to Work from AC
Two Stages of Shielded Screen Grid RF, Negative Bias, by Herman
Managing Editor

"I have a B eliminator." So say many radioists. They want AC operation, but they would like to omit the expense of a new B supply, as they deem their B eliminator all right. Also they want push-pull audio. They can have these advantages. Fig. 1 shows the circuit.

It is understood that the current drain will be greater than what they have been accustomed to take from the B eliminator, hence the filtration will not be adequate, unless extra capacity is provided. That capacity is easily obtained compactly, and in large capacity, by the use of a type of condenser. C10, C11, C12 and C13 are the anodes of a Q 2-8, 2-18 Mershon, C12 and C13 are 18 mfd. each, in parallel at the output, where they reduce hum and improve quality, especially on low notes, and C10 and C11 being 8 mfd. each. The smaller capacities are nearer the edge of the case.

EXCELLENT TUNER SECTION

The push-pull output consists of two 171A tubes. The undistorted power output is ample for any home. It is a fact that even a single 112A gives a large enough undistorted power output for home use, overloading being preventable by by-passing of a volume control that governs the signal amplitude ahead of the detector. Such a control is used in this circuit, even though 171As are used as output, since the proper location of a volume control would be in any event ahead of the detector.

By using two stages of screen grid radio frequency amplification and a screen grid detector, the sensitivity and selectivity are greatly increased. The audio amplification is high, due to the shielded grid tube used as detector, the resistance-coupled first stage coupled thereto, and the transformer-coupled push-pull output. The two 224 tubes are then 227 and 222, and two filament windings are used. A filament transformer heats the screen grid tubes, and the first audio tube, as well as the filaments of the output pair.

Since the transformer has three secondary windings of the, two of 2.5 volts at high current, one of 2.5 volts at low current, and the other at 5 volts low current, the first audio winding and pilot lamp may be heated from the low current 2.5 volt winding. The other 2.5 volt winding serves the first three tubes, and the 5 volt winding, rated at 2 amperes, heats the filaments properly of the output pair.

BYPASS CONDENSER VALUES

Each stage has an individual biasing resistor, bypassed by a condenser of a capacity sufficient for the purpose. In the radio frequency level, the two biasing resistor bypass condensers may be .01 mfd., for the detector and first audio they should be 1 mfd., while for the power tube stage no less than 4 mfd. should be used. The capacity used in the power tubes' stage is 8 mfd., as previously stated.

It will be noted that all plates receive the same applied voltage. But the effective plate voltages are different. The voltage on the radio frequency amplifiers is highest, since the voltages dropped in the primary of the RF transformers is least, due to their small DC resistance.

The greatest use of the plate in the detector circuit plate resistor. The plate current will be about .2 milliampere, or too low to give a reading on most milliammeters of a 0-20 or higher scale. This current at 180 volt total drop, shows that the total DC resistance of the load resistor, plate-to-cathode resistance and the biasing resistor R3 is 900,000 ohms. This gibes with the rated resistance values of 800,000 ohms for the plate-to-cathode circuit, and .1 meg. for the load resistor A4.

The value of the biasing resistor is 5,000 ohms, negligible in comparison to the other values.

INTERESTING DETECTOR CIRCUIT

The detector circuit is highly interesting. The 224 tube is worked as a negative bias detector, with medium value of bias about 1 volt. The plate current flows through this biasing resistor, R3, but is not ahead of the coupling resistor.

The screen grid current preponderates, indeed is about four times as great as the plate current. Also the screen current is about 100 times as great as the plate voltage, hence regardless of changes in plate current that are introduced by the modulation.

The radioist is particularly fortunate to have some steady and relatively high value of current, as this acts as a bleeder to the biasing resistor. Instead of being a bleeder current in the strict sense, serving no other purpose, it is here, of course, the necessary screen grid current, flowing from B plus to screen grid (G post of socket) and to ground.

So it serves a purpose.

The first is its necessary purpose in connection with voltagting the screen grid, the second is in permitting the use of a smaller value of biasing resistor than otherwise. Whatever the circuit affords or permits, the biasing voltage, once selected, is a fixed quantity, and it may be provided in any of several ways. To produce the desired value, the higher the current through the biasing resistor, the lower the resistance value, in the famous inverse ratio according to Ohm's law. So here we are able to use a lower resistor, hence present a lower impedance. This in turn makes a by-pass condenser of any given value much more effective than if the same value were used across a higher resistance. Also, the lower impedance is an attribute in the quality performance of the detector, not to mention its sensitivity. This type of detector has good sensitivity and fine stability, a combination not too common, by the way.

SHIELDED COILS USED

To feed the detector two shielded stages of screen grid radio frequency amplifications are used. The third shielded coil is to couple the second RF stage to the detector. A three-gang condenser may be used, and trimmers adjusted at a low-wattage, then left thus.

In building the circuit, the condenser is placed facing the left, as the front panel is toward you, while behind the condenser are the three shielded coils and three sockets. A drum dial is used—the new National modernistic dial with color wheel—and to the right of this go the filament transformer and the Mershon. Behind these are the three remaining sockets and in good receivers is input and output equipment is provided.

Illustrations of the layout are expected to be published next week, issue of January 11th.

One of the reasons why trouble is experienced on motor-boat receiving is that the equipment is too small, that is, that coils have too low inductance and too high resistance and that by-pass condensers have too low capacity.

The .005 mfd. value of socket) and to ground. So it serves a purpose. The other 2.5 volt winding serves the first three tubes, and the 5 volt winding, rated at 2 amperes, heats the filaments properly of the output pair.

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With 180 Volt B Eliminator
ive Bias Detector and 171 A Push-Pull Output

Bernard

FIG. 1

AN ATTRACTIVE CIRCUIT FOR THOSE WHO HAVE A 180-VOLT B ELIMINATOR, AND DESIRE AN AC RECEIVER. PLUG THE B ELIMINATOR IN THE CONVENIENCE OUTLET CO.

as of the primaries will be staggered, and the tuned circuits at many settings will be slightly off resonance.

The effect of a larger number of primary turns, in respect to a fixed number of secondary turns, is to reduce the effective inductance of the secondary while of course increasing the effective inductance of the primaries. The decrease is due to the inductance loss through mutual coupling.

For .0005 mfd. the primaries may be as stated, the secondaries having 75 turns.

In connecting up to the B eliminator, note that the ground lead of the receiver is B minus, hence B minus of the eliminator must be connected to ground, which may be done simply by running B minus up to the set. Incidentally, B minus goes to no other point. It is actually C minus, of different values, all through this circuit.

The telling points of this circuit, to sum up, are:

1. Screen grid radio frequency amplification, using shielded coils.
2. Negative grid biased 224 detector.
4. AC operation.
5. Good tone, sensitivity and selectivity.
7. Compactness.

LIST OF PARTS

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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1L2, L3L4, L5L6</td>
<td>Three shielded radio frequency transformers .0005 mfd. (Three Cat. SH-3)</td>
</tr>
<tr>
<td>C1, C2, C3</td>
<td>One three-gang .0005 mfd. tuning condenser</td>
</tr>
<tr>
<td>E1, E2, E3</td>
<td>Three Hammarlund 80 mfd. equalizing condensers</td>
</tr>
<tr>
<td>C4</td>
<td>One .0022 mfd. fixed condenser</td>
</tr>
<tr>
<td>C5, C6, C8</td>
<td>Three .01 mfd. condensers</td>
</tr>
<tr>
<td>C7, C9</td>
<td>Two 1 mfd. bypass condensers</td>
</tr>
<tr>
<td>C10, C11, C12, C13</td>
<td>Four Mershon condensers in one copper case, 8, 8, 18, and 18 mfd. respectively, with bracket (Cat. Q 2-8, 2-18 B)</td>
</tr>
<tr>
<td>R1, R2</td>
<td>Two electrad grid resistor strips, 400 ohms each</td>
</tr>
<tr>
<td>R3</td>
<td>One 5,000 ohm tubular resistor with mount</td>
</tr>
<tr>
<td>R4</td>
<td>One 0.1 Lynch metallized resistor, with mount</td>
</tr>
<tr>
<td>R5</td>
<td>One 5 meg. Lynch metallized grid leak, with mount</td>
</tr>
<tr>
<td>R6</td>
<td>2,000 ohm Electrad wire-wound resistor, type B</td>
</tr>
<tr>
<td>R7</td>
<td>One 1,000 ohm Electrad wire wound resistor, type B</td>
</tr>
<tr>
<td>R8</td>
<td>One Electrad 25,000 ohm Super tonatrol, potentiometer type, with knob</td>
</tr>
<tr>
<td>Ant., Gnd., Speaker Minus, Speaker Plus</td>
<td>Four binding posts</td>
</tr>
<tr>
<td>T1</td>
<td>One push-pull input transformer</td>
</tr>
<tr>
<td>T2</td>
<td>One push-pull output transformer</td>
</tr>
<tr>
<td>T3</td>
<td>One filament transformer (Polo Cat. PFT)</td>
</tr>
<tr>
<td>P1</td>
<td>One National modernistic dial with 2.5 volt AC pilot lamp</td>
</tr>
<tr>
<td>F1</td>
<td>One 2 ampere fuse with fuse clips</td>
</tr>
<tr>
<td>CO</td>
<td>One convenience outlet</td>
</tr>
<tr>
<td>SW</td>
<td>One AC pendant switch, with AC cable and male and female plug</td>
</tr>
<tr>
<td>Three leads for B voltage cable</td>
<td>One drilled front panel, 7&quot;x21&quot;</td>
</tr>
<tr>
<td>One subpanel, with four UY sockets and two UX sockets</td>
<td>One dummy shaft, knob and bushing</td>
</tr>
</tbody>
</table>

Wrong?

(2)-Right. The reason for this is that screen and the plate currents are nearly complementary. They always vary in opposite directions. Of course, there is some variation in the sum of the two.

(3)-Wrong. The inductance depends on the number of turns, the diameter of each turn, the size of the wire, and on the length of the coil. That is, the inductance depends on the relative positions of the turns.

(4)-Wrong. It does not amplify at all. The voltages must be adjusted to the proper values on all the elements or the tube will not work.

(5)-Wrong. The plate is at a lower potential than the battery end of the coupling device by the amount of drop in the coupler. If the coupler is resistance there is a very great difference of potential.

(6)-Wrong. While the answer in the preceding question would seem to indicate that the statement is true, it is obvious that the signal potential at the plate is actually higher in value than the signal potential at the battery end of the coupler. The battery end of the coupler is effectively grounded and so the signal potential there is zero.

(7)-Wrong. It is the negative which is grounded and the case of the condenser is the negative.

(8)-Right. The surest way of getting into this trouble is to use a cheap, inadequately by-passed B supply for a good receiver. The better the receiver the greater the trouble that is sure to follow. Likewise, the poorer the B supply the more trouble.

(9)-Wrong. The width of the pass band is directly proportional to the frequency when the coupling is inductive and it is inversely proportional when the coupling is capacitive. Hence, even with band-pass filters of the simple type, ten kilocycle selectivity throughout the scale of the tuner is not a reality.

(10)-Right. For low degrees of coupling the width of the band is practically proportional to the coupling.
What About Push-P-P
Some Fancy Schemes Prove Fallac
By Driblek

The problem of coupling a detector tube to a push-pull amplifier by means of resistance is still unsolved. Various circuits purporting to solve the problem have been published in popular articles in radio magazines from time to time, but so far not one has been a complete and satisfactory solution, and some have not approached it.

The only suggestion offered which had any sound theoretic basis was published in Radio World, October 5th, 1929, and had previously been suggested in an English technical journal. That circuit made use of a phase inverter tube which took the output of the detector and reversed the phase by an angle of about 180 degrees before the voltage was impressed on one side of the resistance coupled push-pull amplifier. The other side of the push-pull amplifier was coupled directly to the detector in the usual way.

If the output of the phase inverter tube is adjusted so that its absolute value is equal to the direct output of the detector, the signal in the push-pull amplifier will be balanced as far as magnitude is concerned but not necessarily in respect to phase. The phase shift by the tube is not exactly 180 degrees for all frequencies. And, of course, if the phases in the two sides of the push-pull amplifier are not exactly 180 degrees apart much of the benefit of the push-pull action is lost.

Adjusting the Output

Since the direct output of the detector in this circuit must be exactly equal in magnitude to the output of the phase inverter tube, it is clear that there must be no amplification whatsoever in the phase inverter tube. Neither should there be any distortion. The adjustment of the output to equality with that of the detector is a relatively simple matter, for it can be adjusted both by adjusting the input voltage to that tube and by adjusting the output coupling devices. But the adjustment must be effected so that there is no other phase shift than that introduced by the normal action of the tube. If there are condensers in the circuit, as there usually must be, there will be other phase shifts which will alter the phase relationship between the two sides of the push-pull amplifier from that of 180 degrees difference.

There are two ways in which phase shift is introduced. First, there are shunt capacities in the circuit, mostly those between the elements of the tube. These introduce lags in the high frequencies which may be sufficient to alter the 180 degree relationship greatly. Hence the circuit will not function well at the high audio frequencies. Second, there will be series condensers, used for blocking purposes, which will introduce shifts of phase at the very low frequencies. The lower the frequencies the greater this shift. Therefore the amplifier will not function well at the very low frequencies. There will, however, be a considerable frequency range in the middle register in which the shifts of phase will be negligible, and in this most important region the operation of the amplifier will be satisfactory.

Possibility with Non-Reactive Circuit

Amplifiers in which there are no stopping condensers have been devised which are quite satisfactory. If the principle of these can be applied to this phase inverter circuit it would be possible to achieve true 180 degree phase difference for all except the very high audio frequencies at which the effect of the inter-electrode capacities becomes appreciable. The gain in such circuit would be substantial and it is hoped that it will be worked out soon by some one.

Another circuit has been suggested for solving the problem, one based on the difference between the grid bias detector and the leak-condenser detector. This idea is illustrated in the accompanying diagram.

It is well known that a grid bias detector modulates upward, that is, the plate current increases as the radio frequency signal voltage increases. The audio frequency signal is therefore in phase with the modulation in the radio frequency signal.

It is equally well known that the leak-condenser detector modulates downward, that is, the plate current decreases as the radio frequency signal voltages increases. Therefore the audio frequency signal is in opposite phase with the modulation of the radio frequency signal voltage.

Now, then, if one side of the push-pull resistance coupled amplifier is preceded by one type of detector and the other side of the amplifier by the other type of detector, the signals in the two sides...
Wokanda

ious, But Real Solution is Awaited

Hokanda

of the amplifier will be 180 degrees out of phase. At least one necessary condition for coupling a push-pull amplifier by means of resistance to a detector is then satisfied.

MAKING SIGNALS EQUAL

It remains to insure that the signals applied to the two sides of the amplifier are equal in magnitude. Suppose the input voltage to the two detector tubes be the same, as they will be when connected as in the diagram herewith. The equality of the outputs of the detectors then depends on the two detectors being alike, which is well known that the leak-condenser detector is more sensitive than the other. Hence the outputs will not be the same unless something is done to compensate for the difference in detecting efficiency.

One way would be to reduce the input to the more sensitive detector until the output voltages of the two tubes are equal, which might be done with a potentiometer to the slider of which the grid of the more sensitive detector is connected. By adjusting the position of the slider any desired signal voltage could be impressed on the more sensitive tube. The potentiometer is not shown in the figure, but it could well be R2 if this is connected from C11 to the cathode instead of to the grid of the upper. The grid of the lower detector was then removed from its connection to C11 and connected to the slider. By moving the slider down toward the cathode any desired reduction in the signal input to the lower detector could be obtained.

Another method of equating the output voltages of the two detector tubes would be to manipulate the output coupling resistances. For while the upper portion of R4 could be made larger than the lower section. This would put a higher load on the less sensitive detector than on the other and consequently the input voltage on the upper side of the amplifier would be increased relatively to that of the other side.

USING DIFFERENT TUBES

Still another method of equating the outputs of the two detectors would be to use different detector tubes, making the grid bias detector more sensitive than the other. For example, the grid bias detector tube could be one of a high amplification constant and the other a general purpose tube. In the figure both detectors are screen grid tubes, but if this method of equating the outputs were used, only the upper would be a screen grid tube. The use of a high mu tube, either the screened type or the three-element type tube, the load impedance method could well be used in addition as an equalizer, since the high mu tube normally takes a higher load impedance.

If it is necessary to equalize the voltages in the two sides of the amplifier more than is possible in the detector it is still not too late at the input of the first audio stage. The resistance R5, for example, may be a high resistance potentiometer with a slider for the grid bias connection. If this is moved toward the lower tube the greater part of the drop in the potentiometer will be impressed on the upper 2a7 tubes.

During the process of adjustment it is necessary to have some means of determining when the outputs of the two sides of the amplifier are equal. Possibly the best way is to use a vacuum tube voltmeter for measuring the input to the power tubes, that is, for measuring the signal voltages across the two sections of R7. In the absence of such a meter a headset or other sound producer can be put into the common plate lead of the output tube. When the signal voltages in this lead is minimum the amplifier is most nearly balanced.

MORE PHASE SHIFTS

Now suppose that the two detector circuits and the coupler following them have been adjusted so that the magnitudes of the input voltages to the two sides of the amplifier are equal, what is the assurance that the circuit will be truly push-pull? There is every assurance that it will not be exactly push-pull, but only approximately so.

There is practically no phase shift in the grid bias detector, for only the small input capacity between the grid and the cathode enters. This also enters in approximately the same way in the other circuit, but not quite. Any difference, however, due to this cause would be very small and negligible for all essential audio frequencies. But there will be a small grid condenser and a leak across it in the other detector. This will introduce differences and these differences will change the relative phases of the two signals so that the output voltages will not be exactly 180 degrees out of phase.

Part of the phase shift at the higher frequencies can be compensated for by manipulating the sizes of the by-pass condensers CD1 and CD2, but the adjustment must be made experimentally for there is no other way of determining just what the proper values of the two condensers should be. While adjusting them one should listen to the highest audio notes present in the signal while the headset is coupled to the common plate lead in the power amplifier.

ANOTHER PUSH-PULL DETECTOR

There is another possibility for achieving push-pull detection in resistance coupling. Suppose one of the tubes is adjusted to detect on the lower bend of the grid voltage plate current curve. As the radio frequency signal increases the plate current is decreased. Hence the two tubes will operate in opposite phase although the same signal is impressed on both simultaneously.

There are many objections to this scheme. One is that the detecting efficiency of the two tubes is not quite the same, the detecting efficiency of the two tubes will not be the same. Also, the tube operating at the upper bend will be positive part of every cycle and therefore it will draw grid current. This will place a load on the tuned circuit which will lower the selectivity. This fact, however, does not upset any phase relationship, except in so far as the inter-electrode capacities are changed by the changed operating conditions.

It is clear that many of the suggestions offered above are only applicable to tubes of the heater type except by the use of separate grid batteries.

RADIO FREQUENCY TUNER

The radio frequency amplifier in the diagram is shown in conjunction with the proposed push-pull detector to show the essential connections. This amplifier is exceptionally sensitive as well as selective so that a very strong signal is available for the detector and the audio amplifier.

Questions

(1)—State the two types of current. Give an example of each.
(2)—How does the input high frequency voltage get past the "barrier" of direct voltage in the plate circuit?
(3)—Does the detector output consist of audio or radio frequencies or both?
(4)—Does a tube function differently at audio than at radio frequencies?
(5)—Is a magnetic field set up in a resistor across which a pulsating direct voltage exists?

Answers

(1)—Alternating and direct. The carrier frequency of the broadcasting station is alternating current. The current in a flashed bead by a dry cell is direct.
(2)—The radio frequency input to a tube is an alternating voltage of which the tube produces an enlarged copy in the form of pulsating direct plate current. When this pulsating current, which is of the same frequency as the alternating current, is passed through a coil, the electro-magnetic action restores the alternating condition.
(3)—Both. The radio frequency is usually detoured to ground, as only the audio frequency is desired.
(4)—The principle of operation is the same.
(5)—No.

Broadcast Sermon
Brings $25,000 Bequest

Her receiving set gave Mrs. Virginia J. Kent, widow, her first contact with the Church of the Nazarene while she was staying at a hotel at Long Beach, Cal. After hearing the Rev. L. A. Reed's broadcast sermon, she discussed spiritual matters with the pastor.

When she died recently in Chicago she left $25,000 to the church at Long Beach.
Methods of Using Scr
Either Leak-Condenser, Low Negative
By Herbert

ANY circuits for detection by means of screen grid tubes have been published, as the advantage of this tube as a detector are in. There are two different screen grid tubes, the battery type and the AC type, and each can be used in two ways, first as a screen grid tube and second as a space charge tube. Then again, either tube may be operated as a grid bias detector or as a leak-condenser detector. And again either may be used as a detector of weak signals or of strong signals. Therefore there is a large variety of circuit arrangements for obtaining detection by means of these tubes.

As a power, or strong signal detector, it is possible to get such a high output that it is not necessary to use a two-stage audio frequency amplifier in order to get a sufficient signal voltage to load up a power tube. With the weak signal arrangement, however, the output of the detector is not sufficient to load up the power tube without an extra audio amplifier, and one audio stage will not suffice.

USUAL CONSTANTS

When the screen grid tube is used as a weak-signal, leak-condenser detector the usual circuit constants and connections are employed, because as far as the grid circuit is concerned it behaves exactly like a three-element tube. The advantage of the screen grid tube over the three-element tubes comes from the fact that the screen grid tube is a better audio frequency amplifier. Detection occurs in the grid circuit, and the audio frequency voltage fluctuations are amplified in the plate circuit just as if the tube were only used as an amplifier at audio frequency.

Referring to Fig. 1, which represents a 222 screen grid detector circuit, the value of R1 should be from 1 to 1.5 megohms and the condenser C1 should be .00025 mfd. for weak signals. The grid return, as shown, is made to the positive end of the filament. The values of the grid leak and grid condenser capacity are usually recommended for an AC screen grid tube in the same manner as shown in Fig. 3. The values of the grid leak and grid condenser are the same as in Fig. 3, that is, .25 megohm and .0001 mfd. The grid return, however, is made to minus one volt.

Power Detection

A strong signal detector using a 222 screen grid tube and grid leak and condenser is shown in Fig. 3. In this case the grid return is made to the negative end of the filament, the ballast resistor being placed in the positive leg. The value of the grid leak in this instance is only .25 megohm and the grid condenser capacity is only .0001 mfd. Thus both the condenser and the leak have been reduced in value.

The use of the AC screen grid tube in the same manner is shown in Fig. 4. The values of the grid leak and grid condenser are the same as in Fig. 3, that is, .25 megohm and .0001 mfd. The grid return, however, is made to minus one volt.

Questions

WHICH TUBE SHOULD BE USED?

IN AN AMPLIFIER using battery tubes and transformer coupling what tube should be used ahead of the 171A push-pull amplifier? — P. W. C.

Either a 201A or a 112A. The 112A gives a little better results than the other because it has a lower plate resistance.

HOW DISCLESS TELEVISION WORKS

READ recently about a television receiver in which no scanning disc was used. How does it work? — J. J. K.

There are several television systems which work without a scanning disc but perhaps you have in mind the cathode ray system. This works on the same principle as the Braun cathode ray oscillograph, exemplified by the Western Electric cathode ray oscillograph. This device is a modified form of vacuum tube. A narrow beam of electrons from a heated filament inside a large pear-shaped, evacuated tube is made to impinge on a phosphorescent screen. The intensity of this beam is modulated by the television signal. It only remains to distribute this beam over the phosphorescent screen so as to "paint" the picture. The distribution is done by voltages across electrodes between which the beam has to pass on its way from the filament to the screen. One set of electrodes causes the beam up and down across the screen and the other to move it back and forth. If the frequencies of the two voltages are adjusted properly, the beam will cover the entire screen in an orderly manner and will trace the picture. The light on the phosphorescent screen is feeble, which is a disadvantage of the system. The advantages are compactness and high speed without lag.

EFFECT OF LARGE ZERO CAPACITY

WHAT is the effect of a large zero setting capacity on the range of a radio frequency tuner? Does it narrow the band or does it widen it? For a given variable portion of the tuning condenser can the inductance in the circuit be reduced to make up for a large zero setting capacity? — Wm. H. J.

The tuning range of a tuner depends on the ratio of the variable portion of the condenser to the minimum capacity. The greater this ratio the wider the tuning range. Hence if the variable portion has a given value the range will be smaller the larger the minimum capacity. It is for this reason that .0005 mfd. tuning condensers are usually recommended in preference to .00035 mfd. condensers.
Tube as Detector
Bias or Power Detector May Be Employed

E. Hayden

**FIG. 7, FIG. 8**
The screen grid tubes can also be used as space charge tubes for detection purposes. These diagrams show the connections when a grid leak and grid condenser are used.

Instead of to the cathode. Therefore a grid bias battery B is indicated, but this is merely to emphasize the need of a bias. There is no convenient battery of one volt. In an actual circuit the one volt bias would be obtained from a drop in a resistor.

Naturally, when power detection is used a much higher radio frequency signal voltage must be used to load up the detector to the overload limit. That is the principal difference between power and weak signal detection. Since the power detector is not so sensitive as the weak signal detector it can be operated very close to the overload of the device. As to the total number of tubes in the receiver it makes no difference, because the weak signal detector requires an extra audio stage. The actual power comes from the fact that there is less distortion in a radio frequency amplifier and tuner than there is in an audio amplifier.

**FIG. 9, FIG. 10**
If grid bias detection with the space charge connection is desired, these two diagrams show how the tubes should be connected.

**GRID BIAS DETECTION**

Grid bias detection is more popular now than it has been previously. This is largely because more amplification is available in radio frequency amplifiers so that a high signal voltage may be impressed on the detector. When grid bias is used the grid condenser is omitted or else it is made large as in audio frequency amplifiers. If a condenser is used a grid leak is used and this has about the same resistance as in audio frequency amplifiers.

The grid bias is much higher than in audio frequency amplifiers and depends on both the screen grid voltage and on the plate voltage. Usually the bias is about equal to the plate voltage. If a rectifier tube is used the current is less than one millampere and often as low as one-tenth millampere. The best bias for power detection is not necessarily the bias which gives greatest detecting efficiency.

In Fig. 5 is shown the circuit for a DC screen grid tube. In this the bias is supplied by the drop in R1 and the voltage of the battery. It is clear that the circuit is identical with that of an amplifier except that the bias is higher.

Fig. 6 shows the same circuit for an AC screen grid tube. This also is hooked up as an amplifier with the exception of the higher bias.

No by-pass condenser is shown in the plate circuit of any of the diagrams given above, but it is understood that it is used. When a transformer is used for coupling the detector to the first amplifier there is usually sufficient distributed capacity in the primary to detour the radio frequency component in the plate current to make detection efficient, when the tube is followed by a resistance coupling or a condenser of not more than .0005 mfd. should be connected between the plate and the filament or the cathode. It is also understood that the high voltage leads are well by-passed.

**SPACE CHARGE DETECTION**

When the space charge connection is used the screen grid is used as control grid and the inner grid is connected to a positive voltage from 22.5 to 45 volts. Otherwise the circuits are the same as for screen grid uses of the tube. Figs. 7 and 8 show the DC and the AC screen grid tubes, respectively, connected in space charge fashion in grid leak and grid condenser detector circuits. The tube can be used in this fashion as a grid bias detector also, and if the grid bias is high enough it will stand a very high signal voltage.

Figs. 9 and 10 show the two tubes used as grid bias detectors with the space charge connection of the grids.

The space charge detector is very sensitive when used in this manner provided that the critical voltages are adjusted properly.

In every one of the preceding diagrams there is a condenser marked C2. Each works primarily at audio frequency and therefore should be large to be effective. A point to bear in mind in connection with the 224 medium negative used as grid bias or high grid bias (power) detector, with a residual biasing resistor, is that the screen and plate currents flow through the resistor. Hence the bias may be 5,000 to 6,000 ohms or thereabouts, a relatively low value. The screen current is steady, and so the bias is relatively steady despite the variations in signal amplitude. This improves quality.

January 4, 1930

RADIO WORLD

**FIGS. 7, 8**

The screen grid tubes can also be used as space charge tubes for detection purposes. These diagrams show the connections when a grid leak and grid condenser are used.

**FIGS. 9, 10**

If grid bias detection with the space charge connection is desired, these two diagrams show how the tubes should be connected.
Magnaformer Modernized

Negative Bias Modulation and Detection Improve Operation

By Hood Workman

THE Magnaformer 9-8 was one of the most popular receivers for kit construction in 1927 and a great number of these are in use. The circuit as originally presented required a loop for operation, but it is quite practical, and indeed advantageous, to use an antenna coupler. Also some other changes may be made to advantage, including the introduction of negatively biased grid circuits for the modulator and the detector.

The circuit has a switch which cuts in or out the fourth intermediate frequency stage. The coupler that feeds the detector should be removed, and likewise the socket whose plate circuit fed this coupler. Therefore the preceding coupler is made to feed into the detector.

At the place where the coupler was situated on the subpanel the new antenna coupler is placed. This may be any suitable coil, for instance, if a 25/2 diameter tubing is handy, wind 14 turns, leave 1/4 space, and wind 15 turns, using No. 24 wire. For 15/2 diameter the turns may be 20 primary, 1/4 space, 07 secondary. Use No. 28 enamel wire. The first winding is for the aerial-ground circuit, the other for the input to the first tube, the modulator. Antenna and ground posts may be established where the loop jacks were.

CHANGED GRID RETURNS

All grid returns of the tuner, exclusive of the oscillator, are to be changed. The modulator and the detector grid returns go to minus 4.5 volts of C battery. The intermediate stages are returned to negative A. Hence the potentiometer that was at left on the front panel is not used. Remove it, and in its place put a 20 ohm rheostat, which will be used as volume control.

The modulator and oscillator formerly were on one rheostat, but this is changed, so that this rheostat serves only the oscillator. A 6-ohm rheostat is used for giving the intermediate frequency tubes their best operating voltage. This is well under 5 volts for these tubes, even though they are 201A.

A 4 to 10 ohm fixed resistor is used to drop the A battery voltage for the detector. This resistor is shown in the negative leg, not designated by any constant, however, as it may be anything from 4 to 10 ohms.

The switch rheostat at right on the front panel is removed, and may be used in place of the 6 ohm rheostat shown in the diagram herewith. A toggle switch is placed in the vacated position, and a knob placed on the switch shaft to match the knob on the volume control rheostat at left.

In the position formerly occupied by the 9-8 switch, which would cut in and out the extra intermediate stage, a pilot bracket is put, with a 6 volt lamp. Connect this lamp across the oscillator filament.

Remove the connections to the pickup winding of the oscillatorcoil. Formery the loop circuit was completed to A plus through this pickup winding, which coupled modulator and oscillator. We have dispensed with the grid leaks, and closed the clips of the two grid condensers, to short these condensers out of circuit, because we are using negative bias modulation and detection.

HOW TWO ARE COUPLED

We do not need the pickup winding of the oscillator, because the antenna coil is near enough to the oscillator, even when six inches up as, or a little more, to provide adequate coupling between modulator and oscillator circuits. The coupling in any instance should be small, as the smaller it is the less the whistling when tuning in, and the better are the two circuits in independence of tuning.

The diagram does not show the audio channel, as this is not changed. The tubes, from left to right, as shown, are the modulator, oscillator, first, second and third intermediate frequency amplifiers, and detector. The three stages of intermediate are entirely sufficient, as is proved by the fact the tubes of these stages must be worked well under 5 volts.

Under the new system the intermediate frequency amplifier will not oscillate, as the rheostat controlling the tubes in this channel is turned until there is no oscillation. Hence there is no necessity for swinging these grids positive to stop oscillation, a method that works all right, but which is not the wisest.

The sensitivity will be greater this way, because an aerial is used and because the intermediate frequency amplifier is always somewhat negatively biased. The negative bias modulator and detector work excellently but the voltage must be 4% for about 45 volts on the plates, represented by B plus in the diagram.

In the receiver itself the tubes do not run in the order shown, since the oscillator is alone, near the front panel, but otherwise the schematic order is duplicated physically.

USE 240 AS MODULATOR

The modulator tube should be a high mu 240 instead of a 201A, as better sensitivity obtains. This holds true no matter which type of modulator hook up is used, even leak-condenser. The oscillator may be a 201A or a 112A, the 112A giving a steadier oscillation, with less whistling attending the tuning.

No filament voltage except that of the modulator for volume control need be touched after the settings are once made. Nor will the circuit be tricky in tuning. Repeat points will be diminished, due to lessened distortion. Tone quality will be improved, because the detector will not be overloaded, except on strongest locals, when the volume control can be adjusted to keep down the terrific volume to what a human ear can stand in a standard sized room.

LITTLE NEEDED FOR AERIAL

Only a small aerial is necessary. About 15 feet of wire under the carpet or around the moulding will give at least as great pick up as was obtained with the loop. If desired, an outdoor aerial may be used, but should not exceed 50 feet in most locations. Many who don't want to use an orthodox aerial may connect a ground lead to the antenna post and leave the ground post blank.

DIAGRAM OF THE TUNER CIRCUIT, INCLUDING INTERMEDIATE AMPLIFIER, OF A MAGNAFORMER 9-8, WHEN THAT RECEIVER IS SUBJECT TO CERTAIN CHANGES FOR EASE OF OPERATION, IMPROVED STABILITY AND BETTER TONE QUALITY, WITHOUT ANY SACRIFICE OF SENSITIVITY.

RADIO WORLD

January 4, 1930
Watch Condenser Mounting

When Building the HB33 or HB44, High-Gain Circuit

The HB33, a high gain screen grid receiver, using three stages of frequency amplification, tuned screen grid detector, first stage of resistance-coupled audio working into a 112A, and second stage transformer coupled audio working into 112A in push-pull, should be constructed from the pictorial diagram of the wiring published last week. The diagram shows the view of the top of the steel chassis, on which there is no wiring, and then the bottom view of the chassis is presented, turned "backward," as it were, the front becoming the rear, so as to preserve the same relative right and left directions. This greatly simplifies the reading of the diagram, as leads take the same course in the diagram as in your receiver.

The large schematic diagram was published the previous week, issue of December 21st, and constructional details were given, principally in regard to mechanical rather than wiring problems, as it was stated the pictorial diagram would be published. This diagram last week dispose of the wiring problems at once.

HOW TO MOUNT CONDENSER

On the score of the mechanical problems, the details previously published are sufficient, except that a few words more should be stated concerning the mounting of the four gang tuning condenser. This has a capacity of 0.00035 mfd., in any metal tank used without any metal tight against it, but if the condenser is mounted right to the subpanel the capacity mounts to 0.00042 mfd., and the rotation incidental to tuning, and adjust for that purpose, realign the moving blades at center between stator blades.

The subpanel or chassis has a row of holes down the center, consisting of four large holes and eight small ones. The large ones are intended to avoid any possibility of the any section contacting with the subpanel and thus grounding the grid, hence shortening the input to the particular staged tuning. These will be repeated now with additions. The subpanel or chassis has a row of holes down the center, consisting of four large holes and eight small ones. The large ones are intended to avoid any possibility of the any section contacting with the subpanel and thus grounding the grid, hence shortening the input to the particular staged tuning. These will be repeated now with additions.

One 5-lead connector cable.
One vernier full-vision dial.
One drilled steel cabinet, brown crinkle finish.
Ant., Gnd. Speaker—Four binding posts.
PL—Pilot lamp and bracelet.
C5, C6—Two 0.01 mfd. mica fixed condenser.
C7, C8—Two 1.0 mfd. bypass condensers 200 volt DC working voltage.
R1—150-ohm rheostat with switch, knob, insulators.
R2, R3—Two 6.0-ohm fixed filament resistors.
R4—One 0.5 meg. Lynch metallized resistor.
R5—One 1.0 meg. Lynch metallized resistor.
R6—One 1.0-ohm fixed filament resistor.
T1—One push-pull input transformer.
T2—One push-pull output transformer.
P1—Pilot lamp and bracelet.

LIST OF PARTS

SL1, SL2, SL3, SL4—Four stage individually shielded coil cascades for 0.0035 mfd. (Cat. S1-3 of Screen Grid Coil Co.).
C1, C2, C3, C4—Four gang 0.00035 mfd. condenser with equalizers.
E1, E2, E3, E4.
C5, C6—Two 0.01 mfd. mica fixed condenser.
C7, C8—Two 0.001 mfd. bypass condensers 200 volt DC working voltage.
R1—150-ohm rheostat with switch, knob, insulators.
R2, R3—Two 6.0-ohm fixed filament resistors.
R4—One 0.5 meg. Lynch metallized resistor.
R5—One 1.0 meg. Lynch metallized resistor.
R6—One 1.0-ohm fixed filament resistor.
T1—One push-pull input transformer.
T2—One push-pull output transformer.
P1—Pilot lamp and bracelet.

As previously stated, the receiver may be operated outside the cabinet. But when you remove the blades of these condensers by loosening the set screws and pulling out the shaft. It is really the shaft you want to remove, but the blades must come out, too.

Notice that there is an adjusting screw, for tension, at rear of the condenser.

When the receiver is in the cabinet, replace the condenser blades and put the shaft back in place, also the round metal washer between the first section and the front of the frame. Now you should carefully center the assembly, so that by the method of equalizing, it will be exactly equi-distant from the stator blades between which they rotate.

If you tighten the tension adjustment screw at the rear of the condenser you push all the blades forward, toward the front, so that if you want more frictional resistance during the rotation incidental to tuning, and adjust for that purpose, realign the moving blades at center between stator blades.

Otherwise you will not gain full value from the equalizing capacities built into the condenser.

So, in equalizing, it should not be necessary to drive the screw all the way down for any stage, but only part of the way, and if you find the opposite is required to achieve resonance, then the moving blades are not correctly centered in respect to the stator blades on either side of them, and correct this.

STATIONS FROM ALL OVER U. S.

Any lack of sensitivity or selectivity in the receiver may be ascribed to you misjudgement of the four gang tuning condenser, and so be certain that you get this right. It is easy enough, but unless you are forewarned you might make a mistake that would cause baffling lack of results, whereas you must know that from a well-designed receiver of this type, using four screen grid tubes in the tuner, you have a right to expect abnormal results, and if directions are carefully followed you certainly should be able to tune in quite easily stations from all over the country, including stations on high wavelengths that are not brought in, or not brought in well, on most receivers, since the sensitivity of the run of receivers falls off sharply at the higher wavelengths.
Radio wave field strengths are measured in the same manner as steady field strengths, although the voltage varies rapidly as time goes on. The ground may be taken as zero potential all the time. Then as a wave passes the voltage at a point above the ground varies through a certain range, measured with respect to ground. Whether the voltage at that point is positive or negative does not matter. At any instant the field strength at that point may be 500 millivolts. At another instant it may be zero. If the 500 millivolt potential is the maximum during a cycle this value is twice the amplitude of the wave and the amplitude of course is 250 millivolts. The effective value is .707 times 250, or 146.75 millivolts.

This, however, is the field strength of the wave unless it happens that the chosen point was unit distance above the ground. Suppose the point is ten meters above the ground.

Then the field strength is approximately 15 millivolts per meter. If the point is only one meter above the ground then the field strength is 146.75 millivolts per meter, but if that is the case a point ten meters up would have an effective voltage of nearly 1.5 volts. The field strength is always the number of voltage units difference in potential per unit vertical distance. When the voltage varies like that of a radio wave the effective voltage counts and this is .707 times the amplitude of the wave.

**Sensitivity of Receivers**

The sensitivity of receivers is usually expressed by the number of microvolts per meter required to produce a standard audio signal when the set has been adjusted to its greatest sensitivity. Thus the more sensitive a receiver is the smaller the number of microvolts per meter will be required to express it. A very sensitive receiver might have a sensitivity of one microvolt per meter and a less sensitive set 10 microvolts per meter.

Since there are many variable factors affecting the output of a receiver it is not necessary to use a standard input, which must be provided by a local oscillator. The wave emitted by this oscillator should be free from harmonics and it should be modulated 30 per cent. There must be a means of measuring the output of this oscillator, which is usually a thermocouple and a sensitive microammeter.

The output of this oscillator must be coupled to the receiver under test through an artificial antenna having standard characteristics. The standard antenna has an inductance of 20 microhenries, capacity in series with the inductance of 200 mmfd., and a total series resistance of 23 ohms. These are the average characteristics of an antenna four meters high, and this height is taken as standard.
transferred to the artificial antenna circuit by means of mutual inductance between the coils L1 and L2. The field intensity is obtained by the formula \( E = \frac{6.28hI}{h} \), in which \( E \) is the field strength in microvolts per meter, \( I \) the frequency of the current in kilocycles per second, and \( h \) is the mutual inductance in microhenries between coils L1 and L2. I is the current through L1 in microamperes and \( h \) the height of the antenna.

There are two methods for calculating the mutual inductance. First, values of L, R and C were given above for the standard artificial antenna. R is the total resistance and therefore includes that of the coil L1.

In the circuit in Fig. 1 the signal intensity impressed on the receiver can be varied either by varying the coupling between L1 and L2, that is, \( M \) or by varying the current through the primary coil.

Another arrangement for measuring the sensitivity is shown in Fig. 2. This differs from the arrangement in Fig. 1 in that the signal strength is measured in the coil inside the other, or even outside. The mutual inductance between the coils is measured in the same way by means of the thermocouple TC1 and the galvanometer. The voltage across the input terminals of the attenuator is measured by a similar thermocouple TC2 and another galvanometer. The attenuator is usually of the resistor type, and it has certain constant resistances which may be altered in number and value to reduce the voltage across Z to any desired proportion of the measured voltage across the corresponding input impedance.

**FORMULA FOR INPUT SIGNAL**

The values of L, C and R in this circuit are the same as the values of L2, C and R in Fig. 1, namely, 20 microhenries, 200 \( \mu \)mfd. and 25 ohms, respectively. However, \( R \) includes the resistance of the coil. The formula for the field intensity in this instance is \( E = \frac{KZ}{h} \), in which \( E \) is the field strength in microvolts per meter, \( K \) the attenuation factor of the thermocouple, and \( h \) the height of the antenna (4 meters).

It will be noticed that the input voltage to the receiver is the open circuit drop in \( Z \). If the attenuator is calibrated in volts, the formula takes the form \( E = KV/h \), in which \( K \) is the attenuation factor and \( V \) is the voltage across the input impedance as measured by the thermocouple TC2 and the second galvanometer. This input voltage is the product of the input impedance and the current in the thermocouple TC2. Since \( K \) is the attenuation factor, and \( V \) the voltage, the current in the thermocouple is not measured directly in \( Z \), and this is the reason why the voltage is not measured accurately with any available thermocouples. Accurate attenuators can be constructed out of non-inductive resistances or they can be purchased already calibrated.

**LOOP RECEIVERS**

When the receiving device is made for loop reception the measuring device takes a simple form, as shown in Fig. 3. The same modulated oscillator is used and the same current measuring device is placed so that its center line passes through the center line of the receiver loop in the manner indicated. The two coils may or may not be parallel, but if they are not, the angle between them must be measured as this enters into the calculation.

With this arrangement the field intensity can be calculated with the formula \( E = \frac{\text{KSONA} \cos B}{(A^2 + X^2)} \), in which \( E \) is the field intensity, \( N \) the number of turns on the coupling coil, \( A \) the radius of this coil in centimeters, \( I \) the current through the coupling coil, \( B \) the angle of the coil when the two coils are parallel, and \( X \) the distance in centimeters between L and the receiver loop, the center line on which the loop is being taken.

The value of \( E \) is obtained from a chart or table, but the angle \( B \) has been found if the coils are parallel. In this case the value of \( E \) is given in microvolts per meter.

**ASSUMED VALUES**

It will be realized that these devices, particularly those in Figs. 1 and 2, do not give the actual values of the field strength because of the assumed height of the antenna. But they do provide convenient and standardized methods for comparing commercial receivers. The loop method gives more definite indication of the field strength because there is no assumption of height.

It is clear that the circuit in Fig. 1 is the simpler of the two which are suitable for the ordinary receiver using an open antenna because the coil L1 is simpler and cheaper than the attenuator in Fig. 2. The only difficulty in Fig. 1 is that it must be determined what the mutual inductance is between the two coils. This, however, can be calculated without much labor when the two turns are regular and placed with their centers on the same line. It can also be measured with simple means.

One way of varying the coupling is to rotate the smaller coil inside the other, or even outside. The mutual inductance for any setting of the rotor can then be calculated from measured inductance values of the two coils separately and the inductance when they are in series. For example, if the measured inductances of the two coils L1 and L2 and the measured inductance of the two in series adding is \( L3 \), the mutual inductance between them is \( L3 - (L1 + L2)/2 \). If a dial is attached to the rotor coil L3 can be measured at several different settings of the dial, and the mutual inductance determined from a formula. But it is only necessary that the scale cover more than ninety degrees because the mutual inductance varies from zero to maximum while the rotor turns through this angle. Negative values of mutual inductance are of no interest in this case.

The values of L1 and L2 can be calculated with simple formulas because coil forms for which simple formulas are available can be selected.

**STANDARD SIGNAL**

The standard signal is one modulated 30 per cent with an audio frequency of 400 cycles per second which is free from harmonic content. The standard output is 0.05 watt in a resistance equal to the plate resistance of the tube used as power tube. That is, the product of the signal current squared and the resistance supposed to be 0.05 watt.

If the power tube is followed by an output transformer the resistance to be connected to the secondary is to be equal to the reflected resistance of the tube as seen from the secondary of the transformer. The tube is to be operated so that the second harmonic in the signal does not exceed 5 per cent. It is assumed that the tube is large enough to put out the standard signal before it becomes overloaded.

**VOLUME CONTROLS IN SCREEN GRID RECEIVERS**

In nearly all up-to-date screen grid receivers using the 224 type tube, I have noticed that the volume is controlled by varying the screen grid voltage with a potentiometer. Is there not a better volume control that could be used? I have tried it and have not had much luck with it. It seems to me that when the screen grid voltage is changed the efficiency of the tubes changes greatly.—W. H. S.

This method of controlling the volume is used almost exclusively because there is no other satisfactory way of controlling the receivers. Yes, the efficiency of the screen grid tubes change when the screen grid voltage is varied, and that is just exactly the reason for changing it. The volume could be changed by changing the heater current in the tubes, just as is done in receivers using DC screen grid tubes, but the volume does not respond quickly enough to make the scheme satisfactory. If changing the screen grid voltage were not the most satisfactory method of controlling the volume it would not be used by all those who have designed outstanding receivers.
A TWO-STAGE RESISTANCE COUPLING AMPLIFIER WHICH CAN BE USED WITH A RADIO RECEIVER FOR GETTING SPEAKER VOLUME ALTHOUGH NO AUDIO TRANSFORMER IS USED IN THE CIRCUIT.

LOUDSPEAKER VOLUME WITHOUT TRANSFORMERS

I HAVE been told that loudspeaker operation is impossible without the use of audio frequency transformers for coupling the audio stages. Is that correct? If not, please show circuits which will give loudspeaker volume without transformers—D. J. D.

You have been misinformed. The best audio frequency amplifiers do not contain any audio transformers at all. Have you not heard of resistance coupled amplifiers? In Fig. 817 is a typical audio frequency, resistance coupled amplifier of two stages which, when connected to a moderately sensitive receiver, will give you enough volume to operate the average loudspeaker. There is no limit to the volume that you can get from a resistance coupled circuit if you use large enough output tube and employ sufficient amplification. Fig. 818 shows you a complete radio receiver in which no audio transformer is used, yet it will give sufficient volume to operate almost any loudspeaker. For battery operation that is about as good a receiver as you can get without going into a great deal of expense.

AUTOMATIC VOLUME CONTROL

ISAN automatic volume control in a receiver really practical? If you think it is, please publish a circuit diagram of one or tell me where I can find such a diagram. I mean the type which controls the amplification by the signal strength in the audio frequency level.—J. K.

There is a circuit diagram of the RCA 64 in Trouble Shooter's Manual by John F. Rider. This receiver has an automatic volume control of the type you ask for.

GREAT IMPROVEMENT IN SET

I BUILT a screen grid receiver the way you described it, but it did not work out as well as it was supposed to do. It was very selective, but it would only bring in local stations. Substitution of general purpose tubes cleared up the trouble. With 20A tubes the circuit is wonderful. Why does not receiver work with screen grid tubes?—A. C. C.

Either the tubes were defective or you did not use them right. If the circuit worked by merely substituting 20A tubes the connections were surely wrong before because the screen grid tubes require a different hookup. Then again your voltages may not have been right. In most instances of failure the voltages are at fault.

MULTIPLE CONNECTION OF SPEAKERS

I WISH to connect several speakers to my push-pull, 250 tube power amplifier. Should I connect them in series or in parallel or in some other combination? The speakers are of different make.—O. G. H.

It is not an easy matter to connect speakers of different constants to the same output circuit. If they are connected in parallel the low impedance speakers will partly short-circuit the high impedance speakers; if they are connected in series the high impedance speakers will take most of the output power. In either case the impedances are not right for best transfer of energy from the tubes to the speakers. If the speakers are in series the load impedance is likely to be too high, and if they are in parallel it is likely to be too low.

Now if the speakers are connected in series parallel the resulting impedances is somewhat difficult to predict. If all the speakers are the same two in series and two in parallel will give the same impedance as a single speaker and all will get the same amount of power. But if they are different one branch may have a much higher impedance than the other and the situation becomes about the same as if two speakers, one of low impedance and one of high, were connected in parallel. If two speakers are of a type which has one-half the impedance each to another speaker, the two low impedance speakers should be connected in series and then connected in parallel with the high impedance speaker. The total impedance of the three speakers will then be equal to that of one of the low impedance speakers. If the total impedance of the amplifier is such as to match this impedance all is well.

VACUUM TUBE VOLTOMETER

WHAT type of indicating meter would you recommend for use with a vacuum tube voltmeter?—J. B. K.

That depends entirely upon what kind of vacuum tube voltmeter and for what purpose it is to be used. For measuring alternating voltages with accuracy, a sensitive microammeter is recommended, one having a sensitivity of at least 0-100 microamperes. Such a meter is desirable because the current required is so small that the tube need will last indefinitely without recalibration. For less accurate work a 0-1 milliammeter will do. If the instrument is not to be direct-reading it is possible to use any kind of indicating current meter. For different types of vacuum tube voltmeters, in the back issues of Radio World where complete descriptions have been given of different types.

WINDING DATA ON SMALL COIL

PLEASE let me know how many turns of No. 28 enamelled wire I should put on a 1.25 inch diameter to give an inductance which will cover the broadcast band with a .0005 mfd. tuning condenser.—F. D.

Use 84 turns and wind them without other spacing than that afforded by the insulation. The coil will be about 1.35 inches long on the average. The thickness of the wire will vary a little.

BIAS RESISTOR FOR 245

I HAVE a voltage divider having a large number of taps and a total resistance of nearly 14,000 ohms. Would it be possible to use part of this resistance for grid bias resistor to serve a 245 power tube?—P. C. A.

If the taps are located at the right points it is possible. It is only necessary to connect B minus to a point 1,500 ohms from one end of the resistor and then connect the end of the 1,500 ohm section to the center tap of the filament for the 245 tube.

SCREENS USED AS BAFFLE

I HAVE in mind of building a receiver on a high panel and treat it somewhat like a highboy. The loudspeaker would be placed in the center. Then I plan to have swinging doors the length of the height of the panel, the width of each being equal to one-half of the width of the panel. The speakers will be swung open and placed so that they will act as a baffle board. The panel will be about five feet high and the total width with doors open will be about 36 inches. Would this arrangement work satisfactorily?—J. O. P.
SUPPLY CURRENT FOR DYNAMIC FIELD

WILL YOU kindly publish a circuit diagram of a current supply for a dynamic speaker requiring 90 volts for the field?—R. H.

Fig. 819 is the circuit diagram of a simple B supply unit. This might be used, or part of it. Cut off everything to the right of C2 and connect the field winding across the condenser. This will work all right provided that the voltage is not too high. Of course, the voltage depends on the secondary of the power transformer. If the voltage across each half is 110 volts you will have ample current and voltage for your dynamic field. It is difficult, though, to get a transformer of such low voltage, unless it is especially wound for the purpose. You might use the commercial transformer of lower voltage which is then connected in the field by a resistance in series with the field. To determine the value of resistance you need you must know the voltage at the end of the transformer and the current required by the field. Suppose the voltage is across a resistance placed across C2 when a current of 40 milliamperes flow, and suppose further that the rated current of the speaker is 40 milliamperes and the voltage 90 volts. You must then put a resistance in series with the speaker to cut the voltage from 220 to 50 when a current of 40 milliamperes flow. That is, you must have a resistance equal to 130/84, or 1,520 ohms. Hence, in this case get a variable resistance of 3,000 ohms, capable of carrying more than 40 milliamperes, and connected in series with the field. Then adjust it until the current in the speaker is 40 milliamperes or until the voltage across the field is 90 volts. Either arrangement should work very well. Undoubtedly, something very attractive could be worked up along this line, as well as something very effective acoustically. If you build such an outfit you may be interested in this paper by a phonograph, with record compartments and all. Not only that, but you might find room in it for a home movie outfit. The upper part of the panel might be used for the screen.

USE OF ELECTROLYTIC CONDENSER

YOU are always recommending the use of a large condenser across the grid bias resistor in the power stage, and I have found that it is a good idea to use an electrolytic condenser. Now I am wondering whether it would be possible to use a section of the electrolytic condenser used in the power pack. I realize that the copper can is negative and that this is common for all the sections. It seems to me that some arrangement would be possible which would allow this use of the condenser.—A. D.

The way most receivers are connected it is possible to use one of the sections of the electrolytic condenser without any special arrangement. Connect the can to B minus and one of the sections to the mid tap of the filament transformer serving the power tube. The center tap is positive with respect to B minus by the drop in the grid bias resistor. One of the high capacity sections cannot be used for any better purpose.

CONNECTION OF PHONOGRAPH

I NOTICE in the AC model HIQ-30, described in the December 21 issue of Radio World that the phonograph pick-up unit is connected between the grid of the detector and ground, and that there is no provision made for opening the radio input circuit. Does this circuit short-circuit the phonograph input?—A. B. W.

As was clearly explained in the article to which you refer, the short-circuit is prevented by a high resistance grid leak and the high impedance of the grid condenser. There is only a slight short-circuiting effect at the highest audio frequencies, but this is desirable to equalize the high and the low frequencies and to eliminate some of the scratch noises.

COMPARISON OF OUTPUT

WHICH will give the more output, a single 245 tube or two 112As in push-pull?—M. N. W.

With maximum recommended plate voltages on the tubes one 112A will give a maximum undistorted output of 310 milliwatts and two in push-pull would give about 1,000 milliwatts. A single 245 will give a maximum undistorted output of 1,600 milliwatts. It will require much greater amplification ahead of the 245 than ahead of the 112A to get this maximum undistorted output.

DOES CARRIER FREQUENCY VARY?

IS IT a fact that the carrier frequency of a broadcast station varies when the signal is modulated, and that the degree of variation is greater the greater the degree of modulation?—W. H. H.

That is more or less the case. However, it depends on the kind of broadcasting station. It is the frequency of the master oscillator which is practically no variation in the frequency. Likewise where a master oscillator is used there is practically no variation, provided that there is no reaction between the modulator and the oscillator. In the old type broadcaster where the oscillator and the modulator were coupled directly together in the Heising circuit there was considerable frequency variation accompanying modulation.

EQUIPMENT FOR 25 CYCLE POWER

WHAT are the principal differences between power transformers intended for 60 cycle and 25 cycle work? If a transformer has been designed for 25 cycles can it be used on 60 cycles satisfactorily?—T. P. R.

The transformer made for 25-cycle work is usually built on a larger scale, and therefore it costs more than one made for 60-cycle work. The 25-cycle transformer has a larger core and more turns on the windings. If a transformer has been built for 25 cycles it can be used for 60-cycle work but one built for 60 cycles cannot be used for 25-cycle work.

MODULATION OF DIRECT CURRENT

COULD it be said correctly that the plate current in a vacuum tube is modulated by the radio or audio frequency current?—M. Q.

Yes, it may be looked on in this manner. Modulation is a variation in the amplitude of a radio frequency current, but it could also be regarded as a variation in the "amplitude" of a steady current.

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INEQUALITIES OF POWER AND TIME PERSIST

Washington.

The Senate has been informed by the Radio Commission that while the desired equality of power required by the Davis amendment of the radio law has been achieved as far as possible in the allocation of frequencies and time of station operation, there still exist inequalities in radio facies.

"This was due," the Commission said, "first, to the fact that States have not availed themselves of the opportunity of obtaining their proportion of power, through lack of applications, and second, to the fact that some applications for power could not be approved. Had the necessary number of applications been received from stations located at suitable points or applications received for increases of power at existing stations at suitable points, this equality of power would have been accomplished."

N. Y. and N. J. Situations

The report stated that "in New York State, on March 28th, 1928, there were forty-eight stations operating day or night or on November 28th, 1929, there were fifty-three, of which ten were national, twenty-eight regional and fifteen local stations. In New Jersey, in March, 1928, there were twenty-six stations, compared with fourteen in November, 1929, of which three were national, ten regional and one local."

"In March, 1928, New York State had thirty-four frequencies, which were reduced to twenty in 1929, to twenty-eight of which ten were national, twelve regional and six local. In New Jersey, in March, 1928, there were eighteen frequencies, which were reduced in November, 1929, to seven, of which three were national, three regional and one local."

Watertown Comparison

"In March, 1928, New York State had 127,200 watts power, which was increased in November, 1929, to 162,765 watts, of which 145,000 watts were used on national frequencies, 16,750 on regional and 1,015 on local channels."

"In New Jersey, in March, 1928, had 54,175 watts power, which was reduced to ten in 1929, to twenty-eight of which ten were national, twelve regional and six local."

Webster and Segal Resign Legal Posts

Washington.

The resignation of Bethune M. Webster, Jr., and Paul M. Segal, as general counsel and assistant general counsel, respectively, of the Federal Radio Commission, have become effective. They will enter private practice of law in Washington. Mr. Webster joining a prominent law firm while Mr. Segal will specialize individually in the practice of radio law. Appointment of Thad, H. Brown, of Ohio, chief counsel of the Federal Power Commission, as special assistant counsel of the Federal Radio Commission, to succeed Mr. Webster, was announced. He was president of the Cleveland Broadcasting Corporation, operating WJAY in Cleveland for seven months in 1927. He served in the World War.

MANY STATIONS SHOW A PROFIT; SENATE IS TOLD

Washington.

A report to the Senate by Paul M. Segal, assistant general counsel of the Radio Commission, shows that many broadcasting stations are making $10,000 or more, some are breaking even, while others are showing losses. A report, based on a questionnaire, is to be used by the Senate on a method of assessing license fees upon users of the air to defray the administrative cost of radio. The following are extracts from the report:

"Only 340 of the approximately 610 stations thus far have answered that portion of the questionnaire relating to profits and losses over a given twelve-month period. At this point, it is impossible to tell what proportion of this breakdown represents stations which are profit and twenty-three lost in the grade of $2,500 to $5,000, while $2,500 profits are shown by twenty-six stations, while thirty-five lost stations up to that amount."

"In the matter of broadcasting time the report showed that of the total of 802 hours consumed by all stations, the total time sold, exclusive of chain programs, is 410,425 hours, whereas 291.5 hours were lost. The total time used for station programs and the promotion of good will for the broad cast of station business is placed at 51 per cent. The average figures for the individual stations, of course, amount to identically the same in percentages."

School of Air to Start Soon

A new plan of educational instruction by radio has been offered to Secretary of the Interior, Ray Lyman Wilbur, by the Columbia Broadcasting System of New York. The plan, by the Grigsby-Grunow Co., of Chicago, manufacturers of radio receivers. The tentative plan provides for a series of educational broadcasts to be given for the school term beginning the first week in February. The practical use of radio in the public schools of the country is a matter now under investigation by the Advisory Committee on Education by Radio, appointed by the Secretary. The proposed experiment is a practical step in attempting to use the radio as a direct method of education. This educational feature will be called "The American School of the Air" and will be broadcast one-half an hour, twice a week, Tuesday and Thursday afternoons, at 2:30 p.m., to junior high school pupils.

Upkeep Costs Differ

"Statistics on the annual average gross operating costs of stations disclose strange trends. For example, the average cost of superpowered 50,000 watt stations is placed at $265,707.83, while stations using just half that power, spent $265,707.83, while $268,266.41. Similarly, the average expenditure of a 350 watt station was $190,000, whereas a 250 watt station cost only $265,707.83."

"Stations of 100 watts and under spent an average of $9,118.46 a year; 200 watts, $26,702.17, and a 500 watt station $27,907.52. Similarly, the average amount to identically the same in percentages."

Aerovox Asks $500,000 for Dubilier Threats

The use of mineral oil as a cooling agent in the manufacture of electrical condensers forms the basis of a suit the Aerovox Wireless Corporation filed against the Dubilier Condenser Corporation on the recent patent No. 1,736,764, granted to Dubilier.

Aerovox is filing a countersuit against the Dubilier in another action for $500,000 damages, charging Dubilier intimidated Aerovox by alleging infringements of Dubilier patents.
Musicians Assured
Radio Aids Them

Washington.

Peter W. Dykoma, Professor of Musical Education at Teachers College, Columbia University, said that he had been told by many of those who see aid to musical education in radio and sound devices. He believes the increasing demand for music teachers will provide employment for many musicians now out of work. Among other statements made by Mr. Dykoma were:

"Even if it were possible to put a stop to the widespread use of 'canned music,' I seriously question whether it would be a wise move. It seems to me that it is immensely better for the great masses of people to have some music that is passably good than to have none at all. The music that we get from the phonograph, the radio, and the talking movies certainly is better than to have note at all."

Depositions Ordered
In Television Suit

Washington.

Justice Jennings Bailey in District of Columbia Supreme Court has issued an order that the Federal Radio Commission take depositions of twenty-two New Yorkers in the suit brought against Charles F. Jenkins, prominent television inventor, by Arthur D. Pickard, vice-president of the Columbia Broadcasting System, owners of the key station WABC, has announced that the company has filed its application to the Radio Commission for authority to locate a 50,000-watt transmitter for WABC at Columbia Bridge, N. J. The application had been granted by the Commission. This is in answer to the complaint of the State of New Jersey that "foreign" stations were "invading" the State.

"The transmitter will not be located in New Jersey," Mr. Jenkins, declared, "because our company does not want to arouse the ill-will of the people of the State. We want to give the best service we can, and if the New Jersey site would suit our purposes. If the people of the State do not want it located there, we will go elsewhere."

The transmitter of WABC is now located west of Cross Bay Boulevard in Queens County, New York City, and uses 5,000 watts power. Mr. Pickard denied a report that the 50,000-watt transmitter would be located within 300 miles of each other. The order was issued last September, but its effective date was postponed several times. The Commission gave the following reasons for rescheduling the order:

"To assure the uninterrupted broadcasting of high-class chain programs for the benefit of the general public and 'to afford adequate time to the Commission to investigate whether high-class chain programs are being unnecessarily duplicated, and to enable the Commission to determine whether the program has been made toward the successful operation of two or more stations on the same frequency in synchronization, either by wire connection or otherwise."

The commission also said that it wanted "opportunity to determine whether chain broadcasting may be successfully carried on in the future with more economic use of frequencies than now employed."

WORTH THINKING OVER
Enters that lusty youngster, Master 1930, and introduces with all the other arts, sciences and activities of the times. Give him a hearty welcome. Be not afraid of him. Do not despair of him. Do not go adventuring with him and let the world see that radio, though ages old in principle, still has far to go in practice and that there are better worlds to conquer and greater things to be done for the eternal glory of the craft.

A THOUGHT FOR THE WEEK
"Beethoven or Handel were of this age we might expect from either a radio-inspired composition that would go home, somberly down the corridors of time. However, so far as America is concerned, we can always fall back on that good old 'Rhapsody in Blue.'"

BLAN ISSUES A CHALLENGE
Bian, the Radio Man, 89 Cortlandt Street, New York City, challenges any other dealer in the country to match his stock of Hammarlund parts. This does not cover the Hammarlund-Roberts Hi-Q 30, but includes only the 1930 line of Hammarlund Mfg. Co.

At last perfect symphonic transmission over the radio has been accomplished, according to Walter Damrosch, maestro. Mr. Damrosch expresses the following opinion after three years of intensive experimentation:

"We have had some of the greatest engineering minds of the country at work. They have accomplished a great deal. In fact, I can say that hardly any technical difficulties remain. If under the new conditions the results of broadcasting a symphonic program are not satisfactory, the conductor himself is to blame."

"I understand Mr. Stokowski has not been completely satisfied with what he has been getting over the air. He must not forget that while he is a distinguished veteran as a symphonic conductor, he is still in a new field of broadcasting. A knowledge of radio acoustics and the proper placement of the orchestra in relation to the microphone solves many of the seemingly insurmountable difficulties that beset a conductor during his broadcasting novitiate."

Handicaps Eliminated
"Many of the old handicaps have been eliminated through the recent invention of the condenser microphone. It is no longer necessary to have several microphones placed in front of and above the orchestra. Instead we have one single microphone, so delicately constructed that it is able to transmit the softest pianissimo and withstand the loudest crescendo.

"In former years radio engineers did not dare let the full force of a crescendo hit their instruments for fear they would be shattered. A conductor would work up to a grand climax—and then there would be no climax. When the man at the controls in the operating room now gives the word all the masters can be heard just as they were intended by the composers."

Placement Solved
During the past three years I have experimented a great deal in the placement of the orchestra so that the tone color and properties of the different choirs be transmitted properly. With the help of my assistant, Ernest La Prade, is in the operating room, noting every effect and suggesting changes when necessary. Someone else, when a delicate nuance is being worked upon, I myself go to the operating room and listen to the effect.

"We now know exactly where every instrument should be in relation to the microphone in order to produce the right effect. It has been like learning to move chess-men about, but we now know the secret of every move."
## 1930 List of Stations by Call Letters

With Location, Power, Frequency and Wavelength

<table>
<thead>
<tr>
<th>Call Letters</th>
<th>Station</th>
<th>Power (kw)</th>
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<th>Wavelength</th>
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**New Corporations**

- Radio Dial—filed by the company, 101 West 42nd St.
- New York, N. Y.
- National Broadcasting—Atty. H. Rosenblatt, 66 Court St., Brooklyn, N. Y.
- American Broadcasting Co. of America, Wilmington, Del.
- National Broadcasting—Atty. H. L. Jenson, 205 West 42nd St., New York, N. Y.
- Columbia Broadcasting—Great Neck—Atty. J. F. Soviere, Jamaica, N. Y.
- Vic's Radio Store—Atty. M. Davidson, 1,463 Broadway, New York, N. Y.
- Friedman, Bresser & Schubert, radios—Atty. C. Wood, 66 Court St., Brooklyn, N. Y.
Parts for the
HB 55

[Two 224 AF, 224 power detector, 227 first AF, 17A push-pull output, all to work with 180-volt B eliminator.
L1, L2, L3—Three pulsed radio frequency transformer for 0.0083 mid-frequency stage.
C1, C2, C3—One electrolytic condenser 4.5 mm.
R1, R2, R3—Three 100,000 and 200 microfarad electrolytic condensers.
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ABC of Television

By Raymond Francis Yates, Editor and Publisher of the Popular Periodical known as the " father of all Popular Electronics Magazines."
January 4, 1930

RADIO AND OTHER TECHNICAL BOOKS

At a Glance

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"Audio Power Amplifiers," by Anderson and Bernard $3.50

"Elements of Radio Communication," by Morecroft 3.00

"Footpath on Radio," by Rider 1.00

Mathematics of Radio, by Rider 2.00

"Practical Radio," by Moody & Wostrel 2.50

"Principles of Radio Communication," by Morecroft 7.50

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"Superheterodyne Construction and Operation," by Moyer & Wostrel 2.50

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"Trouble Shooter's Manual," by Rider 2.50

TELEVISION

"A B C of Television," by Yates 3.00

AVIATION

"A B C of Aviation," by Maj. Page 1.00

"Aerial Navigation and Meteorology," by Capt. Yancy 4.00

"Ford Model 'A' Car," Its Construction, Operation and Repair - by Maj. Page 2.00

"Modern Aircraft," by Maj. Page 5.00

"Modern Aviation Engines," by Maj. Page 9.00

NEW Morecroft

"Principles of Radio Communication," by Morecroft 1.00

for the late last year are procurable at

Radio Cyclopedia," by Drake 5.00

"Radio Blueprint Library" - AC Hook-ups 2.50

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MB-29 Push-Pull Amplifier

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

The new Power Amplifier has been developed and built to get the very most out of the MB-29. It is a combination power supply and audio amplifier, using a 25-volt tube for a rectifier, one stage of transformer audio and a 25-volt and a stage of push pull amplification with two 245s. It furnishes all power for its own and for the MB-29, as well as that of the audio channel. Price $55.00. Order catalog FP-66, list price, completely wired and equipped with phonograph jack, (less tubes) $95.00. Your price.

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January 4, 1930

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Power Amplifier Equipment

At left is illustrated a push-pull power amplifier, using a first stage of resistance-coupled audio, and two 245s in push-pull, as described in the November issue of the Radio World. Abounding volume and faithful reproduction are assured by the Mershon Filament-Plate Supply, two Polo center-tapped audio chokes and a Multi-Tap Voltage Divider. The following parts, including cadmium-plated steel sub-plate, come to $45.35 net, for the best power amplifier for that modest amount. Provision is made for phonograph pickup plug insertion. Thirteen filter condensers are provided, including 300, 600, 75, 90 and an assortment of nine different voltages up to 500 available for bias. All A, B and C voltages are provided for the power amplifier and for a tuner to be used simultaneously. The price is $143 West 45th St., New York, N.Y.

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Model

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For high voltages two 25 cycles

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A conservative rating of the Multi-Tap Voltage Divider is 30 watts, continuous use. The unit is serviceable in all installations where the total current drain does not exceed 15 milliamperes.

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Besides 22 chapters covering thoroughly the field of trouble shooting, this volume contains the wiring diagrams of models, as obtained direct from the factory, a wealth of hitherto confidential wiring information released for the first time in the interest of producing better results from receivers. You will find these diagrams are of new and old models, of receivers and accessories and as well as of some of the set manufacturers.

The Three Books by John F. Rider constitute an outstanding asset to all possessors!

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7) A J-111 Multiplier, upper left, with tip; below it, J-110 Multiplier with tips, leads, left to right, J-42, J-41, J-12, J-10, J-9; 4-prong plug J-30, centerless UX tester socket to UV109 tube; J-35, to test Kelloggs and all style Autotrons tubes.

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14) A J-111 Multiplier, upper left, with tip; below it, J-110 Multiplier with tips, leads, left to right, J-42, J-41, J-12, J-10, J-9; 4-prong plug J-30, centerless UX tester socket to UV109 tube; J-35, to test Kelloggs and all style Autotrons tubes.

15) A J-111 Multiplier, upper left, with tip; below it, J-110 Multiplier with tips, leads, left to right, J-42, J-41, J-12, J-10, J-9; 4-prong plug J-30, centerless UX tester socket to UV109 tube; J-35, to test Kelloggs and all style Autotrons tubes.

16) A J-111 Multiplier, upper left, with tip; below it, J-110 Multiplier with tips, leads, left to right, J-42, J-41, J-12, J-10, J-9; 4-prong plug J-30, centerless UX tester socket to UV109 tube; J-35, to test Kelloggs and all style Autotrons tubes.

17) A J-111 Multiplier, upper left, with tip; below it, J-110 Multiplier with tips, leads, left to right, J-42, J-41, J-12, J-10, J-9; 4-prong plug J-30, centerless UX tester socket to UV109 tube; J-35, to test Kelloggs and all style Autotrons tubes.

18) A J-111 Multiplier, upper left, with tip; below it, J-110 Multiplier with tips, leads, left to right, J-42, J-41, J-12, J-10, J-9; 4-prong plug J-30, centerless UX tester socket to UV109 tube; J-35, to test Kelloggs and all style Autotrons tubes.

19) A J-111 Multiplier, upper left, with tip; below it, J-110 Multiplier with tips, leads, left to right, J-42, J-41, J-12, J-10, J-9; 4-prong plug J-30, centerless UX tester socket to UV109 tube; J-35, to test Kelloggs and all style Autotrons tubes.

20) A J-111 Multiplier, upper left, with tip; below it, J-110 Multiplier with tips, leads, left to right, J-42, J-41, J-12, J-10, J-9; 4-prong plug J-30, centerless UX tester socket to UV109 tube; J-35, to test Kelloggs and all style Autotrons tubes.

21) A J-111 Multiplier, upper left, with tip; below it, J-110 Multiplier with tips, leads, left to right, J-42, J-41, J-12, J-10, J-9; 4-prong plug J-30, centerless UX tester socket to UV109 tube; J-35, to test Kelloggs and all style Autotrons tubes.