AUG. 11
1928

FIFTEEN CENTS

RADIO WORLD

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The First and Only National Radio Weekly

333d Consecutive Issue—Seventh Year

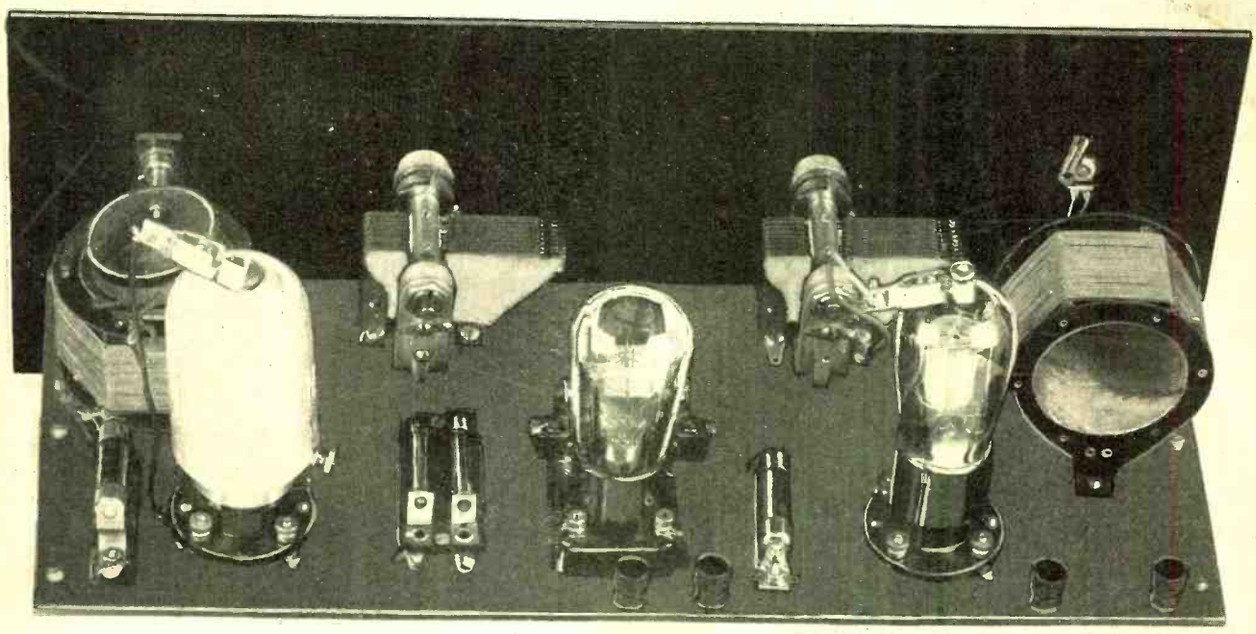
WHAT WIRE TO USE!

The Custom Set Builder!

MIXER FOR SUPER!

DC "A" Eliminator!

'WAY UP GOES THE VOLUME!



Just a little change in applied voltage and the volume of this 3-tube screen grid set went 'way up. See page 5 for reasons why.

FIRST SCREEN GRID TUBE CURVES!

NEW TYPE OF UNIT IS DEVELOPED!

Real MUSICAL Instruments Are Made of Wood!

THE SWEET MELLOWNESS OF WOOD GIVES REAL MUSIC!

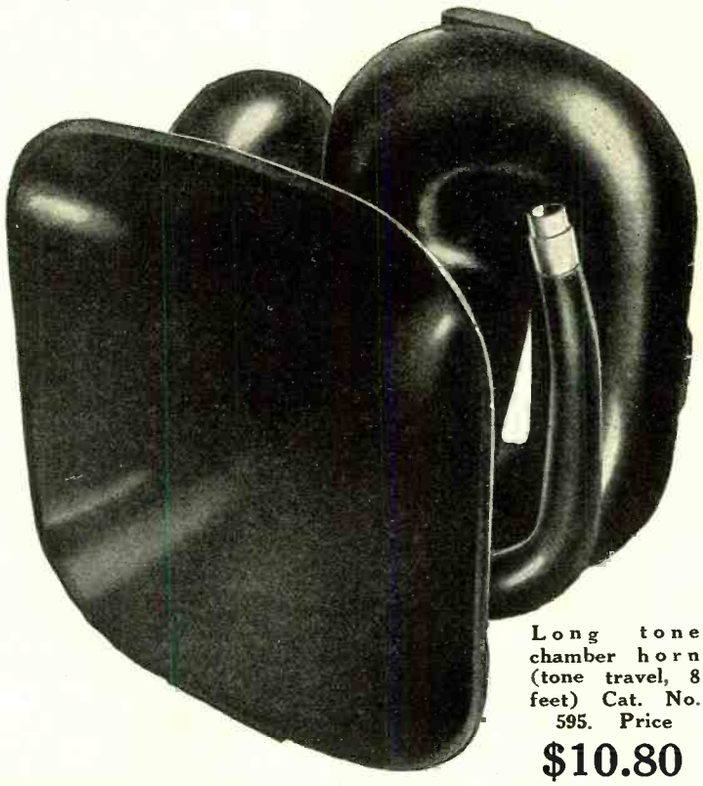
THE finest reproduction is made possible by the long tone chamber horn loudspeaker, for then you hear the *true* sounds, without over-emphasis or under-emphasis, in other words, without distortion. Violins, pianos, flutes, 'cellos and the like are not made out of paper or cloth, but out of wood. Nature chose wood as the unsurpassed vehicle of sound. Man utilized the long tone chamber to make the sound supremacy of wood available for radio reproducers.

With fine quality moulded wood formed into a long tone chamber you hear the orchestral instruments stand out individually,—sounds from the boom of the bass drum, the zoom of the 'cello, to the sweet, high notes of piccolo and clarinet. And the human voice is natural, real. The hissing sounds of speech—high audio frequencies—come through as realistically as the guttural.

Horn Motor, Cat. No. 112. Price $4.20.

Use a long tone chamber horn, like the No. 595 illustrated at right, with a specially sensitive and faithful motor, (Cat. No. 112), shown at left and enjoy the best. Cat. No. 595, horn loudspeaker, tone travel 8 feet; over-all dimensions, 21¾" high, 18" wide, 13" or 15" deep. Nozzle takes standard size unit. Price $10.80.

Felt-padded Baffle Board FREE with each order for a No. 595. The baffle is used as the inside shipping box. No need to remove the horn from the box. Use the outfit as you receive it, inside a cabinet, or in any other place you desire.



Long tone chamber horn (tone travel, 8 feet) Cat. No. 595. Price

$10.80

Smaller Model Meets Space Economy Needs

WHERE space requirements limit you to a smaller size horn, use Cat. No. 570, illustrated below. The tone quality of this medium-sized model far surpasses that of the usual cones, but does not quite come up to that of the No. 595 on the extremely low register (40 cycles and less). However, it is a very satisfactory horn, as good as can be made for the smaller space.

Your mounting problems are solved completely with this model, as with the other, due to the inclusion of a FREE baffle board with each order.

No one need hesitate ordering the smaller model if space limitations compel such choice, for the result will be charming beyond expectations.

Cat. No. 570 horn loudspeaker, tone travel 6 feet; over-all dimensions 15" high, 12" wide, 12" deep. Nozzle takes standard size unit. Price $7.80.

Felt padded baffle board FREE with each order for a No. 570.

Baffle Board FREE with each horn order!

FREE Baffle Board with Each Order

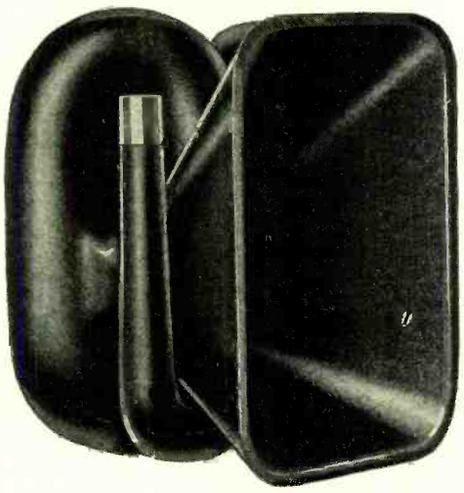
THE long tone chamber moulded wood horns are sold with an offer of a FREE baffle board that is felt-padded so that the horn is felt-suspended and doubly protected against possibility of rattles. This is the final point of protection and perfection.

What DeForest Says:

"I do not consider any of the cones now on the market come anywhere near the perfect loudspeaker. Cones invariably favor some frequencies at the expense of others and most of the cones, while over-emphasizing the bass, put a mask of paper rustle over the higher frequencies. There are certain types of non-metallic horns now on the market which, with proper loudspeaker units, give far better reproduction than any 18-inch cone. I strongly advocate a radio set built into a large console cabinet with sufficient room to take in one of the larger exponential horns."

—Dr. Lee DeForest in "Radio News" for April, 1928.

Why saddle a good set to a poor speaker? Travel 8 feet and get somewhere! Travel 6 feet and outstrip the others, anyway!



Medium sized tone chamber horn (tone travel, 6 feet) Cat. No. 570. Price $7.80.

SEND NO MONEY!

ACOUSTICAL ENGINEERING ASSOCIATES, 143 West 45th Street, N. Y. City

Please ship me at once the following (check off):

☐ **One No. 595 at $10.80 plus a little extra to defray shipping costs; also send FREE baffle board. 15" width will be sent unless 13" is specified by a cross in this square ☐**

☐ One No. 570 at $7.80 plus a little extra to defray shipping costs; also send FREE baffle board.

☐ One No. 112 horn motor (universal nozzle) at $4.20 plus a little extra for shipping.

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RADIO WORLD

AUGUST 11, 1928
Vol. XIII, No. 21. Whole No. 333
15c Per Copy
[Entered as second-class matter, March 1922, at the post office at New York, N. Y., under Act of March, 1879.]

Technical Accuracy Second to None

A Weekly Paper published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y.
(Just East of Broadway)
Phone: BRYant 0558 and 0559

Curves Reveal Secrets of Screen Grid Tube

Remarkable detection efficiency obtained with 5 volts negative bias and 127 applied plate volts, with resistive load—Grid bias critical indeed for amplification—First presentation of plate voltage, grid voltage curve of this wonder tube.

By J. E. Anderson

Technical Editor

CURVES of the screen grid tube were taken with a circuit identical to that shown in Fig. 1. Eg is a battery which supplied the grid voltage. P is a 400-ohm potentiometer connected across two cells of the battery. By means of this potentiometer the voltage applied to the grid could be varied continuously and set at any desired value. The voltage applied was measured by voltmeter V. Note that the voltage was measured with respect to the negative terminal of the filament of the tube and not with respect to the negative of the filament battery.

R1 is a 622 amperite which dropped the voltage of the filament battery A to the required 3.3 volts. R2 is the load resistance, the voltage drop in which is to be measured. It was a commercial resistor rated at one megohm. It measured close to its rated values for the small plate currents involved.

Ec is a battery which maintained the screen grid at a positive potential. Various values were used for this. Eb is a battery which supplied the plate voltage to the tube under measurement. It was kept at 127 volts throughout.

The Vacuum Tube Voltmeter

The vacuum tube voltmeter was of the —71A type. Its filament was heated with alternating current from a 5-volt transformer. The plate current in this tube was cut down by a high variable resistor R3 and it was measured with a 0-1 milliammeter M. A grid battery Eg2 of 45 volts was put in the grid lead, with positive terminal toward the grid, to prevent the reduction of the plate current to zero for large voltage drops in R2. The vacuum tube voltmeter was calibrated immediately before and after a run by noting the plate current in M for various settings of the lead S on the battery Eb.

Fig. 2 shows four of the curves obtained. The lower curve marked O was taken for Ec zero. Another curve was taken with Ec equal to 22 volts, another with Ec 44 and still another with Ec equal to 66.

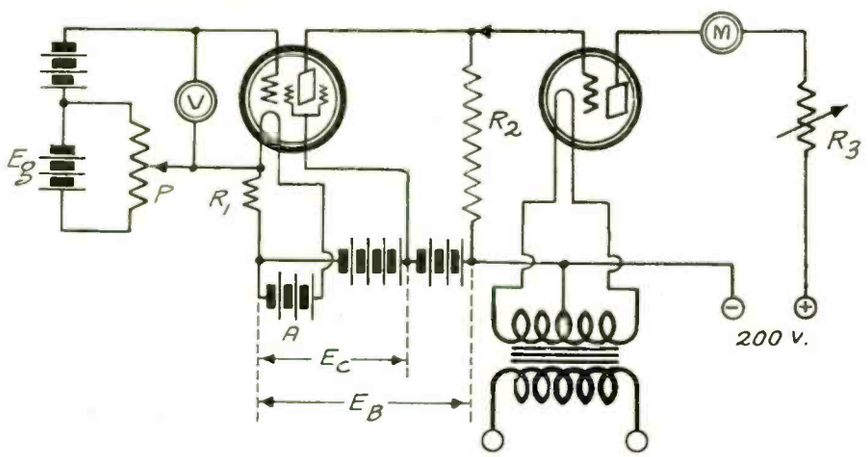


FIG. 1
CIRCUIT ILLUSTRATING HOW CHARACTERISTIC CURVES OF A SCREEN GRID TUBE ARE TAKEN WITH A VACUUM TUBE VOLTMETER.

The upper and lower limits of the curves are interesting. The curve for Ec equal zero has only one limit within the range shown. Each of the other three has two limits. Each of these curves rises rapidly to a value slightly over 125 volts, and beyond that there is appreciable rise. The highest voltage attained is 127 volts, toward which all the curves approach.

Reason for Limitation

The reason they approach 127 volts as a limit is that the total voltage in the plate circuit is 127 volts and the voltage drop in the resistance R2 cannot exceed that value.

The sudden rise of the curves to this value produces very sharp bends in the curves. This indicates that the tube can be used as a grid bias detector very effectively by adjusting the bias to the points of greatest curvature. This was verified for the Ec equal 44 curve. Greatest detecting efficiency was found at 5 volts bias.

Similar upper bends are obtained with other tubes also when they are working into a high resistance. But the sharp upper bend occurs on the positive side, that is, with positive grid bias, and this makes the sharp curvature useless for detecting purposes, for in that case a very high grid current flows and the tuned circuit is practically short-circuited.

With the screen grid tube the bends occur on the negative side where no grid current flows. Hence the selectivity of the tuned circuit is not cut down and a high voltage can be impressed on the grid.

Bias Becomes Zero

The lower limit of the curves is not due to the screen grid tube but to the

Strong Effects of Bias

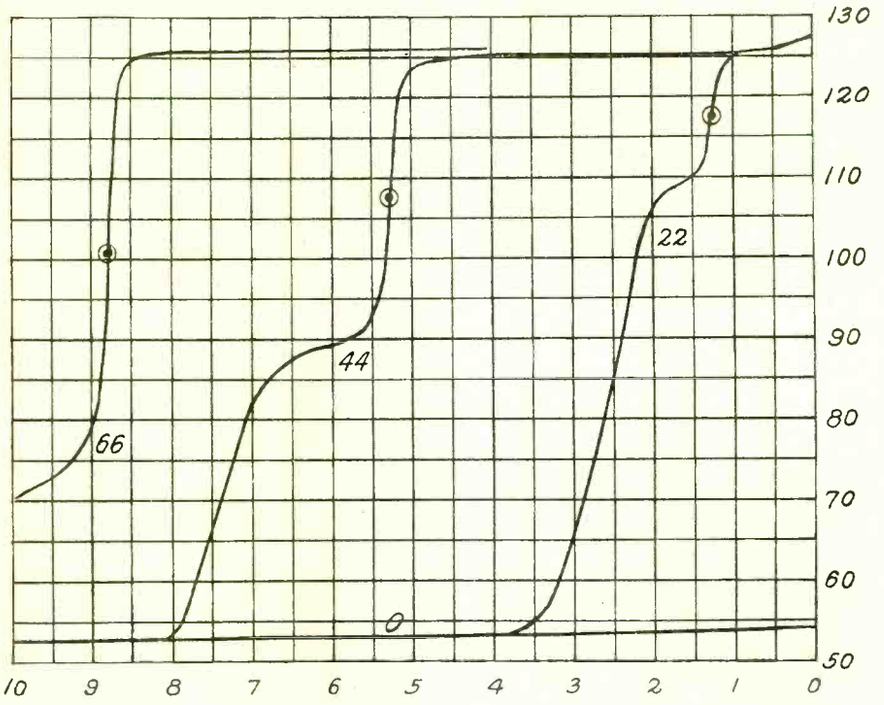


FIG. 2

GRID VOLTAGE, PLATE VOLTAGE CURVES TAKEN ON A SCREEN GRID TUBE WITH A VACUUM TUBE VOLTMETER. ABSCISSAS ARE GRID VOLTS AND ORDINATES ARE OUTPUT VOLTAGE DROP IN LOAD RESISTOR.

(*Continued from preceding page*)

vacuum tube voltmeter. When the voltage drop in the plate resistor R2 became 46.5 volts it was equal to the voltage of the battery Eg2 and thus the bias on the vacuum tube voltmeter became zero. As the drop in R2 becomes less than 46.5 volts the bias on the vacuum tube voltmeter grid is positive, and grid current begins to flow. Due to the high grid resistance, R2, the actual voltage on the vacuum tube voltmeter grid cannot be made positive, and hence the plate current will not change as the applied bias changes. The highest value obtained in this run was 1.07 milliamperes.

This limitation could have been avoided by removing the battery Eg2 and by allowing for the changes in the grid voltage and the plate current. Also it could have been avoided by using a —50 type tube for voltmeter, with high voltage on the plate. In that case it would not have been necessary to use Eg2 at all.

Other Detecting Bends in Curve

There are several other bends in the curves in Fig. 2. In fact each curve contains four bends, two with rising slope and two with falling. The tube detects well at all these bends. The detecting efficiency was tested on the middle curve and it was found that between 5.5 and 6 volts bias the detection was very good. Between 6 and 7 it was fair. Between 7 and 8 it was practically nil, and beyond that point it was also fair but not so good as it was between 6 and 7 volts. It was best of all at 5 volts, that is at the upper sharp bend, for the given plate voltage.

The upper bend on the Ec equals 66 curve is very abrupt, indicating that the tube would be an excellent detector at that point, that is at a bias of 8.5 volts. This was not verified.

Each of the three curves has a relatively straight portion at which the slope is very steep. If the bias is adjusted to these values the tube is an excellent amplifier. The point on each curve where the slope is steepest has been indicated by a dot surrounded by a circle. On the first curve to the right this occurs at 1.25 volts bias. At this point the amplification, or the slope of the curve, is about 50.

On the middle curve the steepest point occurs at 5.26 volts bias. At this point the amplification is between 60 and 70. On the third curve the steepest point occurs at 8.8 volts, at which the amplification is approximately 110.

It is clear that the grid bias adjustment is very critical in each case if the amplification is to be the greatest.

The amplification obtained from these curves is valid only for low frequencies at which the by-pass and stray capacities are negligible. Strictly it holds only for direct current.

In view of the steepness of the characteristic curves of the screen grid tube when working into a high resistance, and the sharpness of the bends, it is advisable to install a device in the circuit by means of which the grid bias can be varied continuously. In no other way can the exact grid bias required for maximum detection or amplification efficiency be obtained.

A 400 or a 2,000-ohm potentiometer connected across two dry cells will provide this continuous variable. This will vary the voltage from zero to 3 volts. Additional bias can be obtained by the use of other cells connected in series with the potentiometer circuit.

In some instances the bias is obtained from a voltage drop in a resistance. Then the voltage may be varied continuously by making the resistor variable continuously. There are many types of such resistors on the market. In fact, most variable resistors are suitable, although the resistance is not quite continuously variable. The variation is in very small steps in wire wound resistors. Resistors of the clarostat type are continuous.

Other Methods

If a potentiometer is connected across a dry cell battery, provision must be included for breaking the circuit when the set is not in use. If this is not done the C battery will deliver current all the time and it will not last long.

One way of obtaining a variable bias is to connect the potentiometer across the A battery, or across one of the filaments in the circuit. This will provide a continuously variable grid bias source of a 5 or 6 volt range. When this is done more cells must be used in the grid battery because the A battery reduces the bias.

Still another way of obtaining a variable grid bias is to connect a 400-ohm potentiometer across the ballast resistor in the negative end of the screen grid tube filament. This will increase the filament current by a small amount but not enough to endanger the tube. In fact the current will increase only 5 per cent.

Ranges Compared

The voltage drop in the filament ballast resistor is normally 2.7 ohms. Thus if the potentiometer is connected across it almost the same voltage range is obtained as if it were connected across a 3 volt battery. This is probably the best arrangement.

When this is used the grid return is to the slider on the potentiometer and additional grid bias cells are connected in series with the lead to the slider, with the positive terminal toward it and the negative toward the grid.

New Books

Storage Batteries Simplified, new enlarged edition, 1928, by Victor W. Page, M. S. A. E., published by The Norman W. Henley Publishing Company, 2 West 45th Street, New York. Price $2.00.

This book discusses the principles, construction, use and care of all types of storage batteries from a thoroughly practical point of view. The principles are explained in an elementary manner in terms easily understandable. Numerous historical references to the pioneers in storage cell development make this phase of the book especially interesting.

The construction of various types of storage batteries is discussed in great detail and is profusely illustrated with drawings and photographs. Many uses to which storage batteries have been put are enumerated and explained in detail. These include submarine operation, automobile ignition, propulsion, lighting, starting, radio A and B batteries, farm lighting equipment, locomotive and street car propulsion, and power house stand-by and emergency service.

The discussion on troubles in and care of batteries is exhaustive and a study of it will enable the student not only to extricate himself from any battery trouble he may encounter but to so care for the battery that a minimum of trouble will be met.

The section on radio batteries and chargers, which is of particular interest to radio fans, contains 50 pages and is one of the most instructive sections in the entire book.

A complete glossary of all technical terms used is appended and the book is fully indexed so that any subject contained in the book can be located instantly.

Up Goes the Volume!

An Account of Some Interesting Experiments with the Economy Three

By Herman Bernard

THE screen grid tube used as a grid bias detector in screen grid fashion, that is, with G post of socket connected to B plus, is shown in the accompanying schematic diagram of the Economy Three.

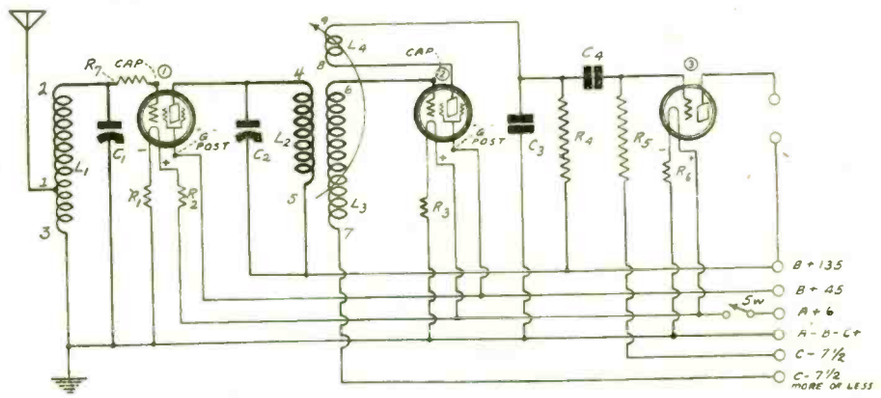
The circuit, with space charge detector, was published in the July 28th issue, and is otherwise the same, except also that now a grid suppressor is shown. This suppressor should be used only if self-oscillation is encountered in the radio frequency amplifier. No specific value of resistance can be recommended, but for the voltages shown in the diagram, no more than 2,500 ohms, probably less, should be used.

The screen grid hookup for grid bias detection affords greater selectivity, while the space charge detector affords greater volume. Both methods should be tried, to determine which one suits you better. It is easy to make the change by switching two leads, so that the G post is used as screen grid and the cap as the control grid.

Voltages Critical

It is necessary to get the voltages correct, and no hesitancy should mark the experiments, for the voltages should be changed until you get the results you are after. These voltages may be regarded as critical, in the light of most recent experiments, for you will notice that the grid bias must be just right, and the correspondingly greater plate voltage likewise.

You will reach a certain point where the amplification goes away up, whereas above and below that point it is just average. The immense difference in volume will startle you, and you will simply experiment until you establish yourself firmly at the highest amplification point. This refers particularly to the radio frequency amplifier, since the tube detects well over a greater margin than it amplifies well.



THE ECONOMY THREE, A NEW RECEIVER WITH ONE STAGE OF SCREEN GRID RADIO FREQUENCY AMPLIFICATION, A GRID BIASED SCREEN GRID DETECTOR AND A SINGLE STAGE OF AUDIO, THAT OPERATES A SPEAKER WITH GOOD VOLUME AND REMARKABLE QUALITY. THE SAME DIAGRAM WAS PUBLISHED IN THE JULY 28TH ISSUE, EXCEPT THAT NOW A SCREEN GRID HOOK-UP IS USED FOR DETECTOR, FOR GREATER SELECTIVITY, RATHER THAN THE SPACE CHARGE DETECTOR THAT GIVES GREATER VOLUME; ALSO A SUPPRESSOR IS SHOWN IN THE GRID CIRCUIT OF THE RF AMPLIFIER, TO KILL OFF ANY SELF-OSCILLATION.

One way of proving the fact that voltages are critical is to use a rheostat experimentally on the radio frequency amplifier. Put this rheostat in the negative leg. You may reduce the filament current to this tube very gradually, and come upon one point where the volume increases enormously. This would seem contrary to expectations. Filament rheostats frequently are used as volume controls. The more resistance cut in, the less volume. But here is a tube that at some point where subnormal resistance is used gives greatly increased volume.

Pointers on Volume

It is not because the filament works better at any point of underheating, but because as the used resistance of the rheostat is increased the voltage drop across it increases, hence increases the negative grid bias, and it is the criticalness of the bias that accounts for the sudden volume spurt.

Obviously you should duplicate that bias with batteries, or with a potentiometer across C batteries, with midpoint connected to grid return, for the potentiometer gives you a gradual range, instead of the set minimum jumps of 1½ volts obtainable from batteries. Another plan is to vary the plate and screen grid voltages gradually, but these voltages preferably should not be far from the values given.

The three-tube set, the result of long experiments with screen grid tubes, is very satisfactory in operation, especially as the step-up ratio of the coils increases the voltage. It will be remembered that an antenna coil of familiar pattern was suggested, but that the three-circuit coil was a special one, with tuned primary, a secondary with about twice the inductance of the primary, and a usual tickler coil of the rotating type. Thus the plate load on the screen grid tube is of high impedance, while the coupling to detector is accomplished with a 100 per cent. gain. This is due to the use of the new Screen Grid Three Circuit Coil. Its equivalent can be made by converting an existing three-circuit tuner, using the secondary of that coil as the primary, ignoring the small primary on that coil, and winding a large secondary on a separate tubing to be placed inside or outside of the other large form. The tickler remains as is.

Distributed Capacity

One point well worth considering is that the large secondary will have some distributed capacity, and this is effectively in parallel with the distributed capacity of the tuned primary and the tuning capacity. For that reason it is well to favor a primary inductance for .0005 mfd. tuning, as the coil will be smaller, also the distributed capacity will be at a minimum, and you can not then escape covering the entire broadcast band, which otherwise might be the result with a home-made coil, where no special precautions are taken to keep the distributed capacity low. This capacity is tantamount to a small condenser across the terminals of the coil. It adds to the minimum or so-called zero capacity of the tuning condenser just when the smallest capacity is desired.

When the voltages are right the set works without any possibility of motor-

(*Continued on next page*)

LIST OF PARTS

L1—One antenna coil for .0005 mfd. tuning.
L2, L3, L4—One three-circuit tuner for .0005 mfd. tuning, with special secondary winding (six connections, Nos. 4, 5, 6, 7, 8 and 9.)
C1, C2——Two .0005 mfd. tuning condensers.
C3—One .0005 mfd. fixed condenser, mica dielectric (optional).
C4—One .5 mfd. by-pass condenser.
R1, R2—Two 10-ohm resistors.
R3—One 20-ohm resistor.
R4—One .5 meg. or higher.
R5—One 5 to 10 meg.
SW—One switch.
One grid suppressor, 2,500 ohms or less.
Three standard sockets.
Two dials.
Two one-inch knobs.
Four binding posts (Ant., gnd., speaker +, speaker —).
One 7x21-inch front panel.
One 8x20-inch subpanel.
One six-lead battery cable.
Two No. 45 Universal Peewee clips.
135 volts of B supply.
One 7½-volt C battery.
Two screen grid tubes and one 112A tube.
One pair brackets, 1" high.

A Double

By Harrison

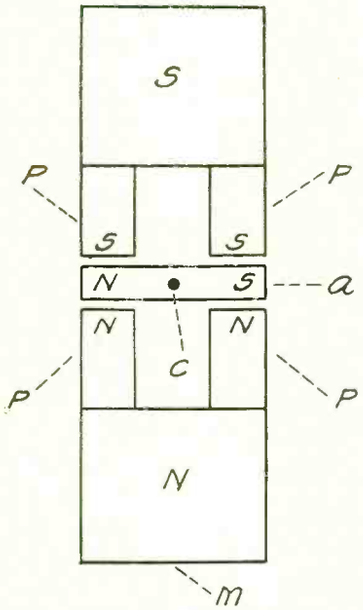


FIG. 1
DIAGRAM SHOWING THE PRINCIPLE OF THE BALANCED, PUSH-PULL LOUDSPEAKER UNIT. THE MAGNETIC FLUX DISTRIBUTION IS MORE EVENLY MADE UNDER THIS SYSTEM OF OPERATION.

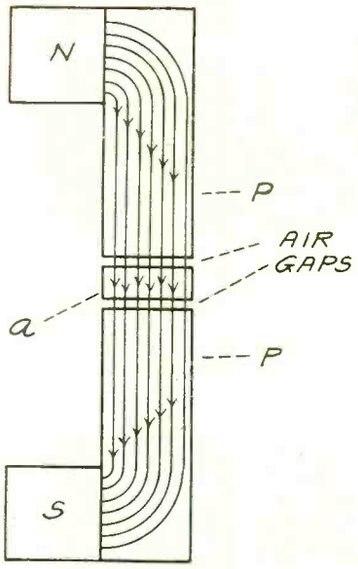


FIG. 2
THIS DIAGRAM SHOWS THE UNSYMMETRICAL DISTRIBUTION OF THE MAGNETIC FLUX IN THE POLE PIECES AND ACROSS THE AIR GAPS WHEN A SINGLE POLARIZING TYPE OF MAGNET IS USED.

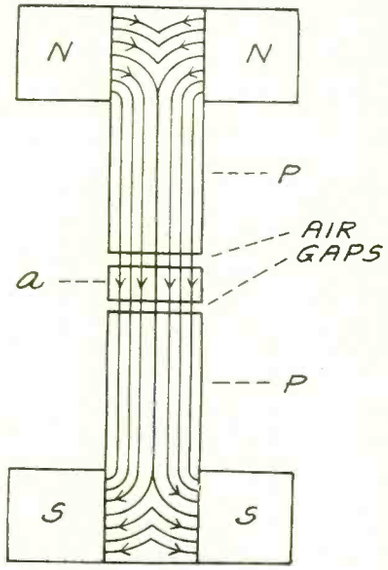


FIG. 3
THIS SHOWS THE SYMMETRICAL DISTRIBUTION OF THE MAGNETIC FLUX IN THE POLE PIECES AND ACROSS THE AIR GAPS WHEN TWO MAGNETS ARE USED, SUCH AS IN A DUO-MAGNETIC UNIT.

Economy Three-Tuber Has Remarkable Tone

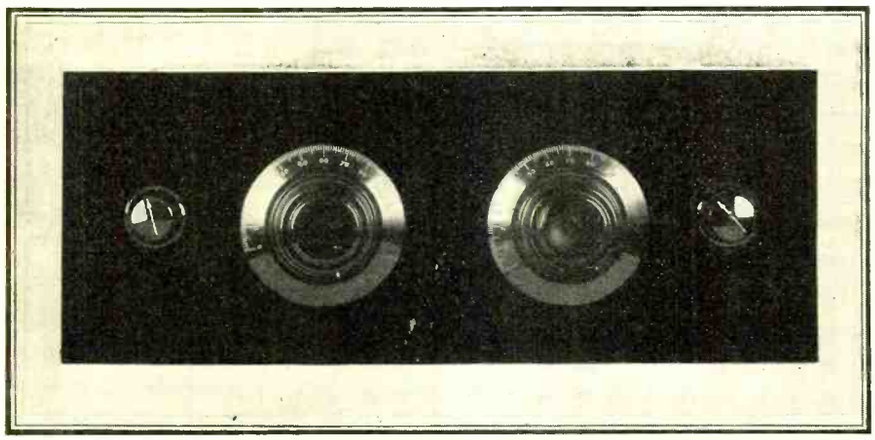
(*Continued from preceding page*)

boating. Some self-oscillation may be present in the radio amplifier, and the resulting sound may be like the put-put of a motorboat engine, but despite the similarity this is not motorboating, but radio frequency oscillation. Proof is found in the fact that a grid suppressor in the input to the RF tube will kill off this oscillation. Motorboating is audio-frequency oscillation, and a suppressor at this point would have no effect upon it.

Results Are Delightful

The experiments with the receiver were interesting indeed, especially as only one audio tube was used, and that the last one. Moreover, the single audio stage was resistance-coupled, which isn't usually counted on to produce enough volume to operate a speaker from two stages, much less from one. But here is the circuit and you are at liberty to try it yourself. You will be delighted not only with the volume, which is ample, but with the quality, which is perhaps a superior feature, for distortion due to audio coupling is avoided, and enough volume is developed to work a 112-A output tube to the limit of its undistorted power output. It is not recommended that the —71A be used as the output tube in this circuit.

Since the 112A is favored, and since a high mu tube may be operated as a grid bias detector at 3½ volts negative, with 1 meg. plate resistor and 135 to 180 volts feeding the resistor, many wonder why such a tube is not recommended. Well, it is. One has been used very successfully, but the screen grid tube as a detector permits somewhat more volume.



FRONT PANEL OF AN EXPERIMENTAL MODEL OF THE ECONOMY THREE. THE PANEL IS 7 x 21 INCHES. THE CONDENSER AND OTHER SHAFTS SHOULD BE 3 INCHES UP, INSTEAD OF THE USUAL 3½ INCHES, IF THE SUBPANEL IS TO HELP SUPPORT THE CONDENSERS AND THREE-CIRCUIT COIL, OTHERWISE THE CABINET LID WILL HIT THE SCREEN GRID TUBE CAPS. IF YOU USE BRACKETS ONLY 1 INCH HIGH YOU MAY CENTER ALIGN THE SHAFTS.

Choice Limited to Two Tubes

Any who have a type —40 tube, however, or who prefer to use one because of the price difference, well may do so without hesitancy. But either a screen grid tube or a mu 30 tube, as described, should be used, for no other tube will give nearly so satisfactory results. Do not use —01A or a special detector tube, but only a high mu tube. Of course it is understood the screen grid tube is a very high mu tube and the type —40 tube a much lower mu tube.

The circuit is being developed into blueprint form, and in a few weeks an announcement is expected. Meanwhile any one interested in the circuit may build it from instructions in this article and in the one published in the July 28th issue, where coil data and other details were given in full.

Magnet Unit

Brown Phelps

IT is generally admitted that the push-pull, balanced type of polarized loudspeaker unit is the most sensitive. Because of its acknowledged sensitivity it is used in most loudspeakers.

What makes this unit more sensitive than other types of polarized units? The complete answer to this question is somewhat involved but one reason is that the construction permits more effective use of the magnetic forces. Another is that the reluctance of the magnetic circuit to alternating magnetomotive forces is low, so that for a given value of signal input a high magnetic flux is set up. Still another reason is that very strong polarizing magnets may be used. The importance of this will be taken up in detail.

Fig. 1 shows the principle of the push-pull type of unit. N and S are the ends of a strong permanent magnet which establishes a strong, steady magnetic field. P are pole pieces, or extensions of the permanent magnet used for the purpose of directing the magnetic flux so as to be most effective in transforming electric and magnetic energy into mechanical energy. An armature is mounted on a spring support indicated by C is mounted between the four pole piece P.

The stiffness of the spring is such that the armature is held exactly in the midway position between the pole piece extensions. If the spring is too weak the armature will be pulled over to one diagonally placed pair of pole pieces. If the spring is too stiff the armature will be held too rigidly in the center and it will not respond readily to the signal. The proper adjustment of the rigidity of the spring relative to the intensity of the magnetic field is such that the armature will just pull away from a pair of pole pieces after it has been forcibly pulled over. Then the unit is most sensitive and least subject to resonance effects. It will respond particularly well to low notes.

Action of Unit

The signal current is passed through a coil surrounding the armature *a*, which becomes magnetized according to the signal, that is *a* becomes a magnet variable polarity.

At some instant the polarity of the armature is as indicated by n and s, that is the left end is a north pole and the right end is a south pole. The pole piece extensions at the ends of the armature always have the polarities indicated by ss and nn on these members.

Now there is a general rule that two unlike poles attract and two like poles repel. Therefore at nn the armature is pushed upward and at ss it is pushed downward. At sn on the left it is pulled upward and at sn on the right it is pulled downward. Therefore the interaction of the permanent magnet and the armature at four different places is such as to cause the armature to turn about C in a clockwise direction.

At some other instant the armature is polarized in the opposite direction, that is so that its north pole is at the right and its south pole at the left. All the four forces acting on the armature are then reversed and the rotation is counter clockwise.

Elementary View

This is a rather elementary view of looking at the action of the unit. As a matter of fact there is no pushing, only relatively so. There is attraction at all the four active points. The magnetized armature is attracted both toward the south pair of pole pieces and toward the north pair. But the attraction is greater than normal at the gaps where unlike polarities occur and smaller than normal where like polarities occur.

A mathematical analysis of the action of the unit will show that the torque, or the force tending to produce rotation of the armature about C, is proportional to the flux produced by the permanent magnet as well as to that produced by the signal current. If the permanent flux is B and the varying flux is b and k is a suitable constant then the torque T equals kBb. This holds for small displacements of the armature only but as the maximum displacement of the armature during normal reception is small it may be regarded as true for all displacements which may occur.

The fact that the force is proportional to the flux produced by the signal current shows that there is no harmonic distortion. This is one of the advantages of balanced construction.

The formula for the force producing rotation of the armature is also proportional to the permanent flux B. Thus the greater the permanent flux the greater the force, and hence the greater is the sensitivity of the the unit. For this reason the design of a permanent magnet loudspeaker unit should be designed with as large permanent flux as possible within practical limitations.

There is still another advantage in making the permanent flux large as compared with the flux produced in the armature by the signal current. For large displacements of the armature some harmonic distortion will be introduced. The larger the permanent flux, the smaller is this distortion for a given displacement of the armature. Hence for good quality on loud signals it is important that the permanent flux be very large. This means that the magnets used should be large.

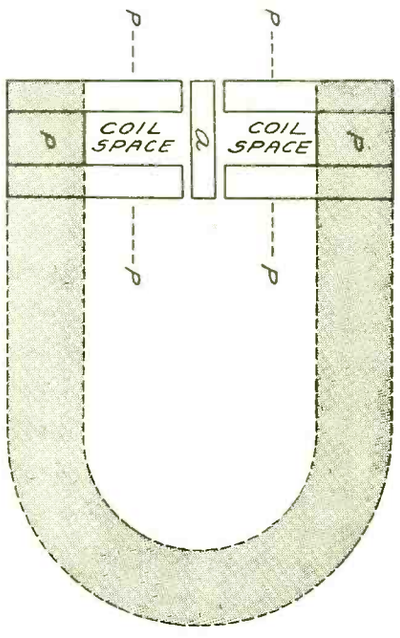
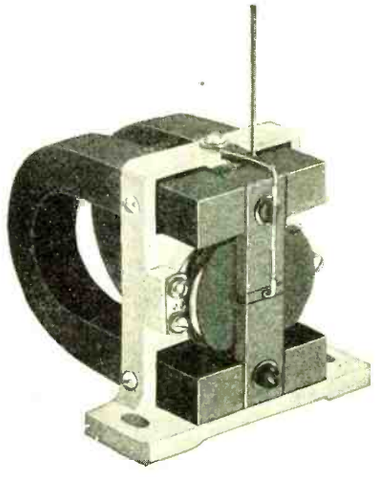


FIG. 4

THIS SHOWS A SIDE VIEW IN SECTION OF THE DUO-MAGNETIC LOUDSPEAKER UNIT. THE POSITIONS OF THE TWO MAGNETS ARE SHOWN IN SHADED OUTLINES.



VIEW OF THE ASSEMBLED DUO-MAGNETIC LOUDSPEAKER UNIT, SHOWING THE LARGE POLE PIECES AND ARMATURE. THE ALUMINUM FRAME HOLDS THE UNIT TOGETHER WITHOUT ANY HOLES IN THE MAGNETS.

Large Flux Produced

The amount of flux produced by a permanent magnet depends on the length of the magnet, on its cross section, and on the strength of the magnetic material. Properly tempered chrome steel is a suitable material for permanent magnets. It will produce a large flux and will retain its magnetization provided that the magnet is much longer than its cross sectional dimensions.

The cross section of the magnet should also be large in order that the reluctance be low, for the lower the reluctance the greater is the flux. This is one reason why a two magnet unit is better than one which has a single magnet, assuming that each of the magnets has the same cross-section as the single.

But it is not enough to have strong magnets to have large useful flux. It is the flux across the armature air gaps which counts. Hence the pole pieces used should have a large cross section also. The same applies to the armature across which the flux passes. A short and chubby armature gives better results than a long narrow one.

The use of two magnets symmetrically placed with respect to the pole pieces permits the more uniform distribution of the flux in the pole pieces and thus decreases the reluctance since no part of the pole pieces will be saturated before others.

Flux Distribution

Fig. 2 shows the distribution of the flux when a single magnet is used. In the corners of the pole pieces away from the magnet there is very little flux. Even across the air gaps on the side away from the magnet there is not as much flux as on the side next the magnet. Fig. 3 shows the distribution of the flux when two magnets are used. While there is little flux at the ends of the pole pieces away from the air gaps, the distribution is uniform at the gaps.

Fig. 3 shows partially the end construction of the duo-magnetic unit. The two magnets are indicated by squares marked NN and SS. The coils and the armature support spring have been omitted.

Fig. 4 shows a side view, or rather section, of the unit. The position of one of the magnets is shown in shaded outlines. Again the coils and the armature spring have been omitted but the coil space is indicated.

The advantages of using two magnets are:

Stronger polarizing flux and hence greater sensitivity.

Symmetrical construction and uniform distribution of the flux.

Less harmonic distortion than for single magnet unit for same volume.

Greater ease of mounting the unit.

DC "A" Eliminator

By Walter J. McCord

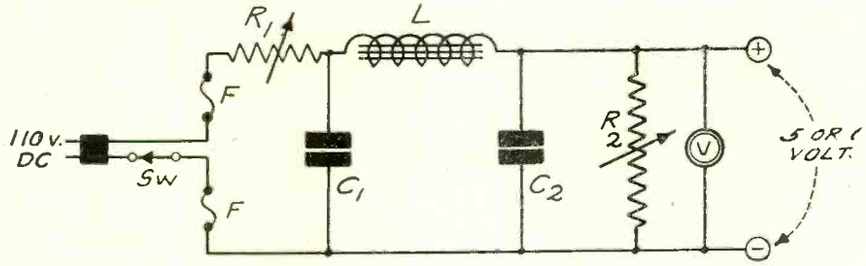


FIG. 1
THE CIRCUIT DIAGRAM OF AN A BATTERY ELIMINATOR WHICH WORKS DIRECTLY FROM A 110 VOLT DC POWER LINE.

RADIO listeners living in districts served with direct current are desirous of eliminating the storage A battery and substitute some device which takes the filament current directly from the line. What kind of device will do this?

The simplest form of such device is a rheostat put in the line for the purpose of dropping the voltage down to the required 6 or 5 volts. But this will admit the ripples to the filaments, and the set served with this unfiltered current will hum badly. Hence a filter is necessary.

There is no definite way of constructing this filter and no definite number of parts. A single large condenser connected across the line will do a great deal to cut down the hum. If a suitable inductance coil be placed in series with the line the hum will be reduced still further. And then if a second large condenser is connected across the line almost every trace of ripple is eliminated. Fig. 1 shows a complete A battery eliminator for use on a 110 volt DC line.

In this circuit FF are two line fuses placed in the supply leads of the device to protect the installation as well as the house against the possible consequences of a short circuit. These fuses should be as small as the current drawn by the set permits. For example, if the set contains six tubes and each tube draws ¼ ampere, the total current will be 1½ amperes. Hence the fuse should be rated at about 3 amperes.

Line Rheostat Used

The line rheostat R1 is used for cutting down the voltage to fit the tubes. Its value depends on the current taken from the line and on the voltage at the source. The value can be calculated easily by an application of Ohm's law.

Assume that the voltage across the filament terminals of the set is 6 volts. Also assume that there is a 15 volt drop in L when a current of 1½ amperes is flowing. The total drop in the filaments and the choke coil L is 21 volts. Now if the line voltage is 110 volts the drop in R1 must be 110-21, or 89 volts. The value of R1 then should be 89/1.5, or 59 ohms.

R1 should have a current carrying capacity of at least 2 amperes. Of course if the device is to be used for a receiver which draws more than 1½ amperes, R1 must be able to carry more and at the same time its resistance value should be smaller.

For a 1½ ampere receiver R1 may be a 60 ohm rheostat which will carry the required current. But if a rheostat of this type is not obtainable then R1 may be built up of other resistance devices. For example, two electric lamps, one 100 watts and one 50 watts, placed in parallel, have a resistance of 80 ohms. One 200 watt lamp has a resistance of 60.5 ohms, and it has adequate current carrying capacity. By the use of electric lamps and other electric appliances the proper resistance can be built up.

It is not always possible to find the proper resistance by using a simple combination of lamps or resistors. For that reason R2 is connected across the 6 volt line. The purpose of this is to increase or decrease the current that flows through the choke coil L and the resistance R1 and hence to change the voltage drop in them. R2 serves as a vernier voltage adjustor. A 10 ohm rheostat may be used here.

Voltmeter for Adjustment

The voltmeter V is connected across the filaments in order to facilitate voltage adjustments.

The choke coil L must be able to carry the heavy filament current without saturation of the core, as well as without overheating. This means that the core must be made of large section and that the wire be of a heavy gauge. The inductance of the coil need not be over .25 henry under full load, and it may be as low as .05 henry. Coils of this type may now be obtained.

The most effective portions of the filter are the two by-pass condensers C1 and C2. They should be of the electrolytic type in order that very large capacities may be obtained. It will be observed that the resistance R1 is on the line side of the first condenser. So is also the line switch Sw.

The object of placing these on the line side is to prevent any high voltage from reaching the condensers. If these condensers are formed at 25 volts they will be safe provided that the filament switch in the set is not opened while the power is on.

Electrolytic condensers formed at such a low voltage have enormously high capacities for a given size. They are available in units of 1,000, 2,000, 4,000 and 6,000 microfarads. A couple of 4,000 microfarad units should be sufficient to eliminate all trace of hum.

Precautions During Adjustment

When this A battery eliminator is first adjusted it is well to connect a resistor across the output terminals which is equal to the resistance of the filaments to be connected across them. Otherwise the filaments may be subjected to a dangerously high voltage. The correct resistance for any combination of tubes can be determined from the characteristics of the tubes to be used.

Let us assume that the voltage across the terminals is to be six ohms and also that there are six tubes in the circuit each drawing ¼ ampere. The total current is then 1½ amperes. Six volts divided by 1½ amperes gives 4 ohms. This is the resistance that should be connected across the filament terminals while the A battery eliminator is adjusted.

If there are no rheostats or ballast resistors in the filament circuit the voltage across the output terminals of the eliminator should be 5 volts. Five volts divided by 1½ amperes gives a resistance of 3.33 ohms, which in this case should be the value of the resistor connected across the terminals while adjusting.

If another combination of tubes is used the total filament current should be added up and this should be divided into the terminal voltage to obtain the resistance to be used for adjustment of the voltage.

If the receiver has a filament switch built in, which nearly all sets have, this must be kept closed at all times. In fact, to make sure of this it is well to short circuit it with a piece of wire and to solder the connections. If it is opened at any time the voltage across the by-pass condensers will rise to a value which may break them down. The voltage across R2 and across the voltmeter will rise also, and these two also may be damaged.

Cost of Operation

The cost of operating the A battery eliminator will be considerable. But it will be less than if a storage A battery were used if this were charged from the 110 volt line. Hence this circuit will not only save all battery troubles but it will actually save operating charges. It will be about 20 percent more efficient than a charger and A battery, and it will never run down. For a set drawing 1½ amperes the hourly cost will be 1.4 cents when power costs 8.5 cents per kilowatt hour.

LIST OF PARTS

FF—Two three ampere fuses and one fuse block.
Sw—One 110 volt switch.
R1—One heavy duty resistance, about 60 ohms and 200 watts.
R2—One 10 ohm rheostat.
C1, C2—Two 4,000 mfd. electrolytic condensers.
L—One heavy duty choke coil, from .05 to .25 henry.
V—One 0-10 voltmeter.
Two binding posts.
One plug and cord.

Aerovox Enlarges Again

Samuel I. Cole, head of the Aerovox Wireless Corporation, 70 to 72 Washington Street, Brooklyn, N. Y., announces that this concern has been forced to expand again. The increased demand from fans and manufacturers alike for the popular Aerovox brand of condensers and resistors has made necessary the addition of 10,000 square feet of floor space to the plant in the same building.

This is the third factory enlargement of Aerovox in a short time.

The line has been considerably augmented and those wishing to know the complete numbers manufactured may receive the information by addressing Mr. Cole. Mention RADIO WORLD.

—J. H. C.

The Way of the Wire

Personal Preferences Conflict, But Rule Decisions —Author Likes Flexible, Stranded, Insulated Kind, and Tells Why

By H. B. Herman

APPEARANCE, safety and convenience are the main considerations regarding the wire you use in building a set. You may want a particularly good-looking job, and therefore may prefer insulated bus, with its shiny black coat almost brilliant, the symmetry of right-angel bends in the wire heightening the architectural effect you cherish.

A little less good-looking perhaps, but easier to work with, is the flexible stranded wire, with the same glossy coat, black preferred, but colors being available. Then there is the solid, single-strand wire with insulation you can push back with your anger, after having cut the wire at the desired point.

The remaining type of stranded insulated wire used for connections in sets is annunciator or bell wire, with its cotton-wrapped insulation and wax finish.

Among the non-insulated types the round and square bus are popular, or have been popular, for the set-building public is taking to insulated wire more and more.

Not Cock-Sure

I have had some experiences with all these types of wire, and I would like to set forth what I think of them and their uses, just to express my own views, and not necessarily to insist that I must be right about them in all instances. I realize some must dissent from my findings. I grant them the same right to their opinions as I hope all will extend to me in regard to my own!

Must Stand Up

Stiff wire, round or square or octagonal, insulated or bare, I have no use for, because (1) it has no "give"; (2) it intensifies any tendency toward microphonism, especially in the grid lead; (3) it is harder to work.

Every set should be built so that it will stand handling. It should be strong enough to resist the wear and tear of shipment. It may be true indeed that the receiver you are engaged on is intended only for use in the very room where it is being transformed from a kit of parts into a working marvel of sensitivity and sound. But you may move. The set would have to stand the kindly treatment of the gentle hands of husky moving men. Or you may decide to make a gift to some friend or relative in another State, and honor him or her with the very circuit of your own design and construction. Under any of these circumstances the stiff wire may work loose, for all the points regarding wiring security revolve about soldering. Stiff wire, when a strain is placed upon it, ducks the responsibility nine times out of ten, and obligingly confers it upon the solder.

Grid Modulation of "Gong"

Vibration of a long solid, stiff grid wire will modulate the grid circuit and accentuate any tendency toward microphonic effects. While microphonism usually is a form of mechanical coupling, this grid-modulation of a gong-like sound, due to any motion striking the wire, makes matters so much worse that I long ago forewent the use of stiff wire.

Compared with stiff bare bus, round, square or otherwise, the insulated stiff wire is harder to work, because the insulation has to be peeled off at the connecting point, and when worked does not lend itself to so much neatness, as the corners have a tendency to be rounded. This is a mere matter of personal taste and I am merely expressing my own, you will remember. Personally I care not about your finely rounded or neatly squared corners, for I am a staunch disciple of the school of flexible wire and use point-to-point connections, not long, architectural effects. Factory-made receivers, many fine custom-made sets, innumerable home-constructed receivers, are made with flexible wire, preferably insulated. I could no more consider absence of insulation a virtue than I could denounce anybody's personal taste in wiring as a vice!

Too Much Confidence

Bare wire implies in every instance a blind confidence in the continued existence of things as they are. All experience should lead one to the inevitable conclusion that things may change—usually do. A quarter of an inch separating two right-angle bus leads, one carrying the B current the other the filament current, are a constant menace to all the tubes in your receiver. One wire may drop on or be pushed against another. The short may be disastrous to tubes—and more.

Besides, when you're working over a set wired with bare bus you may cause a short with an accidental connection completed through a screwdriver, or somebody may drop a conductor into the set and cause the short that way. Some conductors I've met ought to be dropped into a set!

Against this argument is a strong one: popular taste in some quarters runs specifically to bare, squared-off bus wiring.

What One Dealer Said

I was talking to a radio dealer on Greenwich Street, New York City, the other day. He buys many second-hand, factory-made and home-made sets, from time to time, as the market makes possible, and services them for resale, rewiring nearly all of them, and certainly all that have flexible wire connections.

"Why don't you let well enough alone?" I inquired idly, for I know him very well.

"I do whatever is necessary to sell the set," he replied. "My customers don't want sets that are wired with flexible, insulated wire. They want shiny bus-bar wiring, square bus preferred, not insulated, and I simply give them what they want. It costs me $6 labor charges to rewire a set, and about $5 average in parts replacements. The set loses its dusty appearance and I can sell it. I'd rather sell the set as is, if I could, but I can't, so I don't try any more. I've been in this business seven years."

Cheap Insurance

There was no doubting him, for he has always been truthful, and I ascertained from subsequent personal observation that he was quite right—in his particular location and with his own clientele, at least.

There is no reason to suppose his statement does not cover the general situation, yet it can not be said that any public preference is necessarily correct. The sets, I am convinced, would give less trouble if flexible wire were used, for the flexible wire will take up any unexpected or intentional strain, while insulation is cheap insurance, and everybody should have it.

I prefer the stranded flexible insulated wire, and use black exclusively, since with leads properly brought to binding posts or a terminal strip or connecting jack and cable plug, there is no particular need for an informed radioist needing protective coloration like an insect!

A kind of flexible wire I do not like is bell wire, because the wax with which the insulation is impregnated makes the wire too "greasy" for me to work with conveniently. Sometimes it is hard to make solder stick, the wire itself, when the insulation is pared off for connecting purposes, preventing the solder from adhering, unless the bared protrusion is filed or otherwise treated. Benzine will clear it nicely, if rubbed on with a rag, but one does not like to use benzine or its companion solution, naphtha, since these are inflammable. Carbona will do the trick nicely, without any possibility of ignition.

Price Question

Bell wire also is popular in some quarters, particularly with the Bell Telephone Company, but I suppose the price question enters considerably in that instance, because so many, many miles of wire are used. In a radio receiver, however, the type of wire used makes so little price difference that one well may indulge his tastes. A fact not to be ignored, however, is that bell wire is insulated, and none but the very brave seem to want bare wire. The big companies will have none of it, nor will the set constructors who have an eye to safety and long life of anything they produce.

Custom set builders greatly prefer insulated wire, although they, too, have to bow to public demand, against their better discretion. As a custom set builder usually is a service man, to boot, and as he will most likely be the one to service the sets he makes, his choice is for insulation.

His Preference

Yet he has to make a living, he has to work as fast as is consistently possible, and he will not naturally prefer the stranded wire from which the insulation is not so easy to remove.

He wants to snip a piece of wire at a desired point and push back the insulation with his fingers. That saves him forty minutes on every set he wires, and his time means money.

Those of us who are not professional set builders, but simply build a few sets a year for ourselves and our friends, don't mind the extra time it takes to pare off bits of insulation, for the wire we use looks ever so much better than the more convenient push-back type.

DURHAM APPOINTS KILLAM

Killam, Inc., of Portland and Seattle, has been named Oregon and Washington representative for Durham products. Francis R. Ehle, president of the International Resistance Co., made the announcement.

Literature Wanted

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

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

I desire to receive radio literature.

Name .....

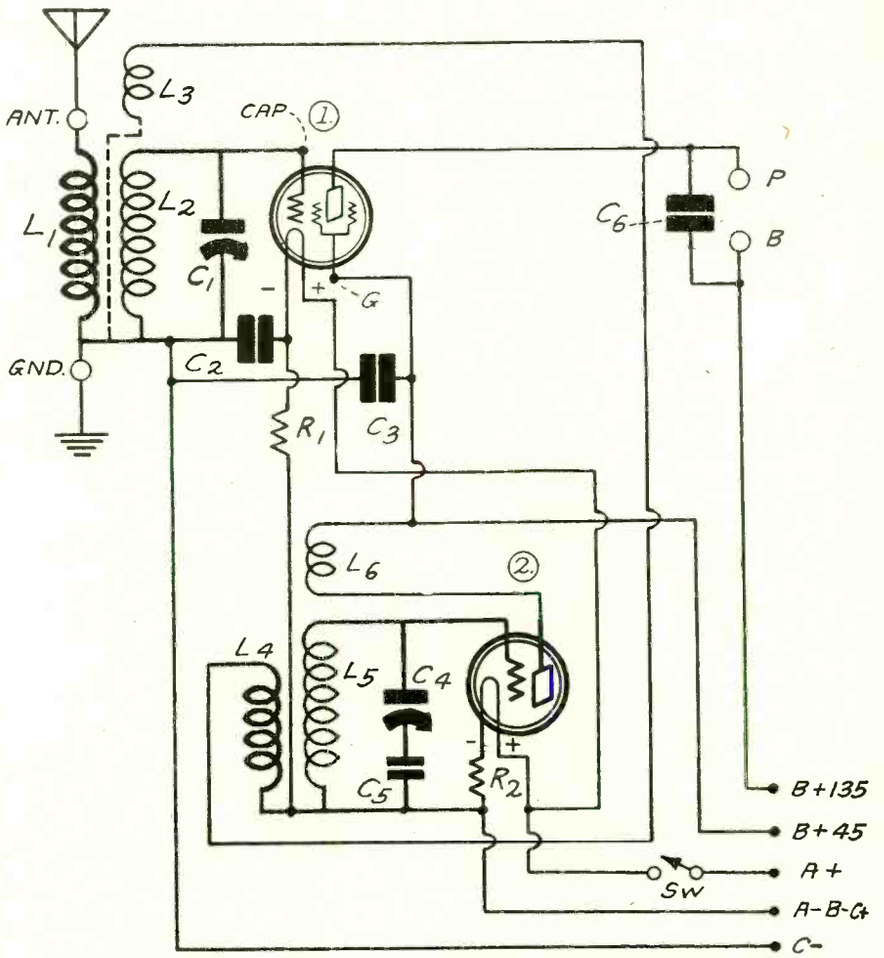
Address .....

City or town .....

State .....

A. J. Bost, 405 W. Main St., Burlington, N. Carolina.
H. E. Blackman, Glenview, Illinois.
R. O. Lindblad, Box No. 2, Newport, Minnesota.
Star Radio Mfg., 4130 Ruckle St., Indianapolis, Ind.
Dwight M. Lag, 521 Roosevelt Ave., Kewanee, Illinois.
Carlisle Horning, 20 Park Avenue, Casitle, N. Y.
Wm. Vallese, 181 Julian St., Providence, R. I.
Frank Reynolds, Box 1496, Pittsburfh, Penna.
Frank Murray, 511 W. 44th St., New York City.
I. S. Evans, 1215 Sixth Ave., (Rear), Altoona, Pa.
L. W. Baab. 2510 California St., Berkeley, Calif.
H. H. Collins, Campbellsville, Kentucky.
Frank Castek, 15 So. Grant St., Hinsdale, Illinois.
Harry A. Ely, 540 Third St., Brockenridge, Pa.
A & K Service Sta., T. C. Bobil, Denver, N. Carolina.
B. B. Gray, Fruithurst, Alabama.
Carl J. Haussman, 67-47 Cooper Ave., Glendale, L. I., N. Y.
Edw. Barrown, 76 St. Nicholas pl., New York City.
E. F. Carrington, 3509 Hartford Ave., Baltimore, Md.
W. Wm. Hunt, Box 213, Point Richmond, California.
Frank van Gilluwe Jr., 1517 Poppy Peak Drive, Pasadena, Calif.
E. Grassman, 754 E. 152nd St., New York City.
H. E. Reighard Oil Co., 847 24th St., Altoona, Pa.
S. Grundy, 8 Vivian Ave., St. Vital, Winnipeg, Manitoba, Canada.
Dominican Trading Co., Dept. of Radio, Apartado 726, Santo Domingo. RD
Dr. C. B. Moffett, Dixon, Missouri
Russell E. Haggith, 15 Furlong St., Rochester, N. Y.
Wallace Abern Athie, Box 65, Cobden, Illinois.
Jack H. Smith, 108 East 15th Street, Oklahoma City, Okla.
G. Ryan, Ryan's Radio Shop, 315 E. Grand, Hastings, Mich.
Ernest Lord, 2303 Collinwood Sta., Cleveland, Ohio.
F. J. Menzel, 8815 Birch St., Oakland, Calif.
William J. Riley, 21 Cohasset St., Roslindale, Mass.
S. R. Criswell, 2415 1-2 Cheremoya Ave., Hollywood, Calif.
L. W. Baab, 2510 California St., Berkeley, California.
J. Champagne, Box 740, Moosup, Connecticut.
Oran Cantwell, Floydada, Texas.
H. A. Heffelfinger, 44 Parker Street, Carlisle,
H. L. Hinderer, 367 S. Schuyler Ave., Kankakee, Illinois.
Milton H. Murray, 6427 Mount Ave., St. Louis, Missouri.
Edward A. Mitchell, Essex Theatre, Broadway & 103rd St., N. Y. C.
L. P. Graner, 421 Canal Street, New York City.
C. H. Ostermeier, 1506 Chelton Ave., Pittsburgh, Penna.
R. Arthur Heiser, 1517 Olivewood Ave., Cleveland, Ohio.
Thomas F. McGrath, 420 East 138th St., New York City.
E. D. Acton, Bell Merc. Bldg. Oak Creek, Colorado.
C. D. Lowenstein, Savannah Sugar Refining Corp., Port Wentworth, Savannah, Georgia.
A. J. Conroy, 625 Market Street, Youngstown, Ohio.
Kay Radio Service, 680 Bedford Ave., Brooklyn, N. Y.
E. H. Paston, 2043 East 4th Street, Cleveland, Ohio.
A. N. Moore, 67 Granite Street, Brooklyn, N. Y.
George B. Perrive, 549 Avenue E., Bayonne, N. J.

The Solution of in an All-



A MIXER FOR SHORT AND LONG WAVES, WHICH RENDERS POSSIBLE A RANGE FROM 15 TO 500 METERS WITH A PARTICULAR MAKE OF SHORT WAVE COILS. THE NOVELTIES OF THE CIRCUIT, BESIDES THE ALL-RANGE FEATURE AND SCREEN GRID USE, ARE A NEW FORM OF LOOSE COUPLING BETWEEN OSCILLATOR AND MODULATOR, SYNCHRONIZED TUNING OF OSCILLATOR AND MODULATOR REGARDLESS OF THE FREQUENCY OF THE INTERMEDIATE CHANNEL, AND DETECTION BY GRID BIAS, WHICH MAY BE AROUND 22½ VOLTS.

WHEN commercial short wave coils are used in a mixer for a Super-Heterodyne, particularly for a receiver that will bring in broadcast as well as higher frequency programs, if the coupling is made through the usual primary of the oscillator inductance, as is common practice in broadcast receivers, it will be too strong. It results in self-oscillation of the modulator tube, tricky tuning of the oscillator, compensating tuning between the two circuits, and diminished selectivity. It therefore becomes necessary to utilize some different form of coupling.

As the result of months of experimenting a coupling form is presented here for the first time anywhere that solves the problem nicely.

To understand the diagram readily, assume that the coils have the low potential ends of primary and secondary terminating at a common lug. This happened to be true of the coils used, and it is true of some other short wave inductances. The line joining the bottoms of the primaries and secondaries in the diagram denotes this interconnection.

The Coupling Solution

Except for grid bias detection, using a screen grid tube, and for the coil L3, which is ordinarily the plate coil in short wave tuners, the modulator has a standard input at the received frequency. The oscillator is standard as to plate coil L6 and secondary L5, the oscillation being produced by a fixed tickler coil, without condenser aid.

The coupling novelty consists of taking the free end of the primary of the oscillator coil, which is the high radio frequency potential point of that inductance, and connecting it to the corresponding terminal of the tertiary of the modulator coil, which would be the plate post in other hookups. The other end of the third coil L3 in the modulator circuit is connected to minus A, as shown by the dotted line, or left unconnected.

Which course to resort to will depend on the intensity of your aerial pickup, because the stronger the pickup the greater the ten-

Five Problems Wave Mixer

dency to produce unwanted oscillation in the modulator circuit. This is contrary to the general rule, whereby the tighter the antenna coupling or stronger the input, the less the tendency toward self-oscillation.

Improved Results

Much better results were obtained in the experiments by leaving the low end of L3 unconnected. This was particularly true on short waves, although also true in the broadcast band. Besides, the antenna input could be used at full strength without self-oscillation. The short wave stations came in smoothly, with scarcely even a rushing sound in the speaker. Almost perfect quiet—denoting freedom from extraneous noises of any sort—and then in came the station, full and clear.

Of course an intermediate channel was used. Next came a single stage of audio, made possible by a grid biased screen grid second detector. The diagram of the intermediate channel and the audio stage was published in the July 21st issue of RADIO WORLD.

Experimenters too deeply doctrinated have come to regard an unconnected coil end as anathema. The phrase "dead end loss" comes to mind prohibitively. But nothing is a loss that produces a gain. A damper on free oscillation is a virtue and not a vice. The coupling is reduced about 60 per cent. by the open-end method, and loose coupling between oscillator and modulator is a requisite even on the broadcast band, while on short waves it is an imperative, inflexible, essential, supreme necessity—and more. Half the troubles in Super-Heterodynes are due to excessive coupling between these circuits. The tighter the coupling, the more these supposedly independent circuits are united, and their separate functions and identities should be preserved with fervid zeal.

Automatic Provision

The thought will occur to many that the coupling will be too tight for the short waves, since the inductive field is larger, and a system to suit all needs must necessarily have looser coupling as the frequency is increased. However, the coils themselves provide the remedy. The primary of a coil intended for broadcast use is larger by far than the primary of any coil intended for short waves. Also the tickler coils are smaller for short waves, that is, likewise have fewer turns.

Within the working range of any particular coil the primary or tickler coil is all right as it is.

Therefore when you change coils to change bands of reception, you automatically reduce the coupling, or rather the inductance used for coupling. Since the pickup is through what would be the primary of the oscillator and the standard tickler coil of the modulator, coil changing for different bands changes the coupling in the right direction, and in the right degree.

Only three other novel points arise. One is the grounding of C minus detector. This is made necessary by the fact that the antenna coil is grounded. Since the end of that coil is connected to the end of the secondary in the coils used, the secondary, at the point of grid return, is grounded. As the grid return is to C minus, this is grounded. There is no good reason why C minus should not be grounded, instead of A minus.

To make the average potential of negative filament, C minus and screen grid (G post) about the same, the bypass condensers C2 and C3 are used. These may be .006 mfd. mica fixed condensers, although if you have two condensers of different capacities, use the higher for C3.

High Strays Eliminated

The second remaining novelty is the fixed condenser C6, which may be used across the primary of the first intermediate transformer, as shown, or may be connected from plate of the modulator to C minus. It is the usual radio frequency shorting condenser, which aids detection. But as it bypasses strongly above 10,000 cycles, it clears out virtually all high-pitched interference. High audio frequently strays are killed.

In some instances your intermediate frequency coils in days to come may have high impedance primaries, with a condenser put across the primary to provide the desired intermediate frequency, and in such instances you will not need C6, because the built-in condenser will have high enough capacity.

When such coils do arrive, and it is confidently expected that some enterprising manufacturers will produce them, you will have a primary tuned to the intermediate frequency, and a secondary with, say, twice as many turns, but without condenser across it, representing a much higher frequency, and one sufficiently apart from the intermediate frequency to prevent any possibility of having two intermediate frequencies in one coil which would respond to the oscillator tuning at one predetermined point and at one unexpected point. The secondary, having twice as many turns as the primary, would double the voltage, so that from an economical intermediate channel using screen grid tubes you would get, free, the gain ordinarily obtained from a -01A tube stage simply by the step-up ratio of the transformers, or even greater gain than that, while of course the high impedance load on the screen grid tubes would give you a sensitivity beyond your greatest expectations, and with few tubes, at that. The diagram published July 21st points the way.

Equalized Tuning

The small fixed condenser C5, in series with the oscillator tuning condenser, is a physically small variable, adjusted to one point and left thus, so that the oscillator tunes in at the same dial numbers as does the modulator. It constitutes the third remaining new development. This keeping in step holds good even on the short waves. The higher frequency dial setting of the oscillator, where two points are possible due to the intermediate frequency permitting repeat tuning, is to be preferred, because more stable and dependable. Simply tune in a broadcast station with the small condenser shorted out, then remove the shorting bus and turn the setscrew of the little adjustable condenser until the station can be brought back by having the oscillator dial read exactly the same as does the undisturbed modulator dial.

This little solution of an old difficulty has never been presented before, and may be adopted for almost any Super-Heterodyne.

—HERMAN BERNARD.

[The author's discussion of mixers for Super-Heterodynes, affording short wave as well as broadcast band reception, began in the July 7th issue, was continued in the July 21st and 28th issues, and will cover still more fascinating phases in issues soon to be published. All Super-Heterodyne enthusiasts will find the subject immensely attractive, especially as a circuit is gradually developed to blueprint form. At present only advanced Super Heterodyne students are asked to follow the author's laboratory experiments, and on the basis of their findings and his own the concensus circuit will be founded.]

Four Different Voltages Perplex Swiss Buyers

Washington.

Switzerland has been relatively slow in radio development compared with surrounding European countries, Assistant Trade Commissioner Kenneth M. Hill, Berne, advises the Department of Commerce. The full text of the report follows:

"There are only five broadcasting stations in Switzerland and 62,000 licensed radio receiving sets, of which more than one-half are crystal sets, according to statistics issued in January, 1928.

"In Switzerland different voltage is used in different parts of the country. In the Canton of Berne, for example, 110 volt, 125 volt, 140 volt and 220 volt current is used although 125 volt current is most common.

"There is a movement on foot, however, to standardize at 220 volts, and for this reason the Swiss are reported loath to invest in an expensive set when there is a possibility of a change in voltage within a year or two.

"A few German manufacturers are now marketing transformers in Switzerland which permit the adaptation to different voltage in case a purchaser is obliged to adjust his set to another voltage. One large Swedish manufacturer has a similar system built into cabinet."

New Japanese Station Is Answer to Mountain

Washington.

A new station at Kumanoto, Japan, call letters JOGK, commenced operating this month, Consul Henry D. Hitchcock, Nagasaki, says in a report to the Department of Commerce. The full text of the report follows:

"The new station, of ten kilowatt power, broadcasts on a wavelength of 380 meters. It is expected that inauguration of the new station will increase the Japanese demand for radio sets. Up to the present but few sets had been sold, owing, it is said, to the poor reception from stations over the mountains in central and eastern Japan."

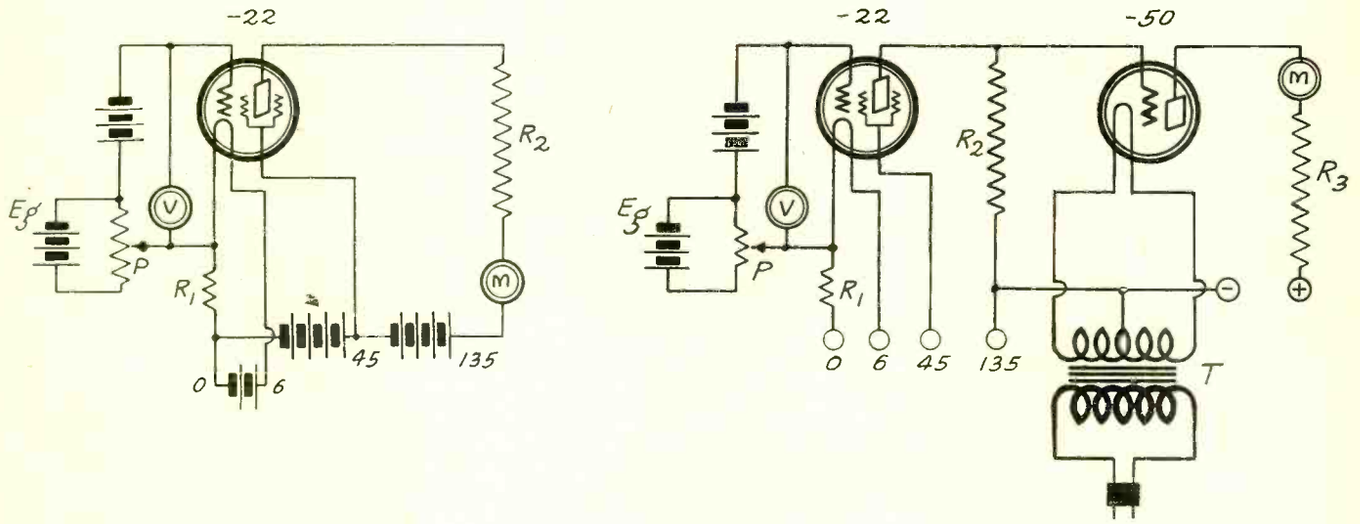
LIST OF PARTS

L1L2L3, L4L5L6—Two sets of short wave coils, with a home-made coil, if necessary, to bring in the broadcast waves, although some coil kits do both in commercial form.
C1, C4—Two .00014 mfd. tuning condensers.
C5—One .0001 to .00005 mfd. adjustable condenser of the set-screw type.
C2—One .006 mfd. fixed mica condenser.
C3—One .006 mfd. or larger capacity fixed condenser.
R1—One 20-ohm resistor.
R2—One 4-ohm resistor.
C6—One. 001 mfd. fixed mica condenser.
One switch.
Four binding posts (Ant., Gnd., P and B).
Two sockets (1) and (2).
Two dials.
One 7x12 inch front panel.
One 7x10 inch subpanel.
One set of 2 inch high brackets.
One 5-lead battery cable.
One screen grid tube (1) and one 112A tube (2).

How to Run Curves on

By J. E.

Technical



CURVES showing the relationship between the grid voltage and the plate current in screen grid tubes working into high resistances are not generally available. Yet such curves are very important if intelligent design of screen grid tube circuits is to be done.

One reason for the lack of these curves is that they cannot be taken with instruments ordinarily available in amateur laboratories. If the curves are to be taken by the same method as is used for taking the curves of general purpose tubes it is necessary to use a sensitive microammeter for measuring the plate current, and it is also necessary to have a low range voltmeter for measuring the known grid potentials applied to the control grid.

But microammeters of adequate sensitivity are not to be found in many radio laboratories, for they are expensive and are not adapted to many routine measurements of receivers. Hence if amateurs as well as many professional radio experimenters wish to take such curves on screen grid tubes another method is necessary, one utilizing the apparatus already at hand.

The simple circuit shown in Fig. 1 is that ordinarily employed in taking grid voltage plate current curves. In this Eg is a battery which supplies the grid voltage required to take the curves. P is a high resistance potentiometer by means of which fine adjustment of the voltage is obtained. R1 is the usual filament ballast by means of which the filament current is adjusted. This may also be a rheostat.

The usual filament, screen grid and plate voltages of 3.3, 45 and 135 volts are indicated. R2 is the load on the tube, which may have any value from zero up, and it may be resistance, inductance, capacity, or a combination of two or more of these. M is a meter which is capable of accurately measuring the plate current for any grid voltage that may be applied, which is measured by the voltmeter V.

Voltage Measurement Possible

Now if R2 is a resistance of about 1 megohm the current in the plate circuit will probably never exceed 100 microamperes. Most of the readings will be much less than this. Hence a microammeter having a range of 0-100 microamperes would have to be used. A 0-1 milliameter would not be nearly enough sensitive, and not many radio experimenters have even a meter of this sensitivity.

It is doubtful whether the experimenter could borrow a microammeter, for these meters are extremely delicate as well as expensive and any one having such a meter would be extremely reluctant about trusting it to some one else.

It is not the current in the plate circuit of a screen grid tube which is of prime interest when the load is resistive, but it is the voltage drop across the resistance in the plate circuit. If the voltage is

The Four Horsemen of Fidelity Apocalypse

By Roger M. Wise

Engineering Department, E. T. Cunningham, Inc.

The paramount qualities that contribute most to quality performance in a radio receiver may be listed as follows:

1. The fidelity of reproduction and the efficiency of the loud speaker.
2. The circuit design of the receiver, which requires proper tone frequency characteristics of the audio frequency circuits and proper circuit constants for the particular tubes for which the receiver was designed.
3. Correct battery voltages.
4. The correct tubes of satisfactory quality.

Needs Good Speaker

Failure to meet properly and fully the requirements of each one of the above factors will result in impaired performance.

If, for instance, the speaker is of inferior quality it may be deficient in response to the bass range, and if so, no amount of care in the selection of the tube supplying energy to the speaker can adequately compensate for this fault. As well try to get good music by having a master pianist play on a decrepit and untuned piano.

The "input" is all that could be expected but the "output" would be far from satisfying.

One respect in which receivers of early design have been lacking is in the audio amplifier circuit design, inadequate transformers being used, which overamplified some portions of the audio band and at the same time entirely failed to amplify the bass notes.

Voltages Vital

With such a handicap the use of a power tube in the last stage is of comparatively little value from the point of quality reproduction, although it will permit much greater volume to be obtained.

In such a case we have the parallel of a fine instrument capable of exquisite tone and melody being played by a rank novice, who plays merely a melody without the finer shadings of bass notes which give character to a musical composition.

The use of correct voltages is a matter of vital importance which may be likened to that of proper adjustment of the keys, pedals and other vital parts of the piano or other instrument.

Tube Choice

The fourth major factor, that of the selection of correct tubes of satisfactory quality, is the final link in the chain which make for satisfactory radio performance.

Without high quality tubes, properly used, deterioration soons set in, and all advantage of careful selection of the remaining equipment is set at naught.

Screen Grid Tubes

Anderson

Editor

known the performance of the tube under specific operating conditions is known, and if the value of the resistance is also known then the current is known. Hence one way out of the difficulty is to measure the voltage developed across R2. But how?

Here another difficulty present itself. No ordinary voltmeter capable of measuring the voltage developed across a resistance of the order of one megohm exists. A much more delicate and sensitive voltmeter than a microammeter would be required, for the current required to operate the voltmeter would be greater than the current through the load resistance.

The only voltmeter suitable for the purpose is a vacuum tube voltmeter, and this must be adjusted so that it never takes any current at all. Fig. 2 shows the circuit diagram in which such a meter has been connected across the load resistance R2. This voltmeter may employ any vacuum tube which will handle all the voltages which are likely to develop across R2 as Eg is varied from zero to about 3 volts. A -50 type tube is suggested, though a -71A may serve the purpose.

A -50 Recommended

If the -50 tube is selected T should be a filament transformer having a secondary voltage of 7½ volts. The plate voltage may be 450 volts as suggested in the drawing, or it may be lower, depending on what is available. The plate voltage supplied to the tube under test and that applied to the voltmeter tube should be entirely independent. Preferably batteries should be used for the screen grid tube while under test, while a B battery eliminator may be used for the voltmeter. Precautions should be taken to insure the filament voltage and the plate voltage on the voltmeter tube remain constant both during the test run and during calibration, and that they remain the same in both instances.

The milliameter M in the plate circuit of the voltmeter tube may be any instrument which is available. R3 is a resistance connected in the plate circuit in series with the meter to limit the plate current and to adapt the plate current to the range of the milliammeter used. It should be a variable resistor having a range of 500 to 100,000 ohms, such a power clarostat. Once adjusted, the value of R3 must not be changed.

When Eg is set at zero, that is, so that the reading on V is zero, the current through R2 will be the greatest, for it is assumed that no readings on the screen grid tube will be taken for positive values of Eg. It will never be used with positive bias. When the current in R2 is greatest the voltage drop in it will also be greatest.

The drop in R2 constitutes a negative bias on the voltmeter tube. Hence when the current in R2 is greatest the current in M will be least.

Calibrating the Voltmeter

The first observation is taken with the reading on V adjusted to zero. The corresponding reading on M is taken and recorded in a table opposite the value of Eg, or the reading on V. Then the Eg is adjusted until the reading on V is a quarter volt. The corresponding reading on M is taken and recorded. The grid battery is then adjusted until V reads ½ volt and so on until the entire battery Eg has been used.

For large readings of V the current in R2 is very small. Indeed it may be zero. When no current flows in R2 there is no bias on the grid of the voltmeter tube and hence the current in the milliammeter is very large.

It is now necessary to calibrate the voltmeter tube. This is done by taking the grid lead to that tube and connecting it to various positions on the plate battery for the screen grid tube. It is not necessary to change the circuit in any other way. When the grid lead is moved to the negative end of the plate battery or to the filament battery the bias on the voltmeter tube is 135 volts. This is likely to reduce the current in the plate circuit of that tube to zero, or at least to a very low value.

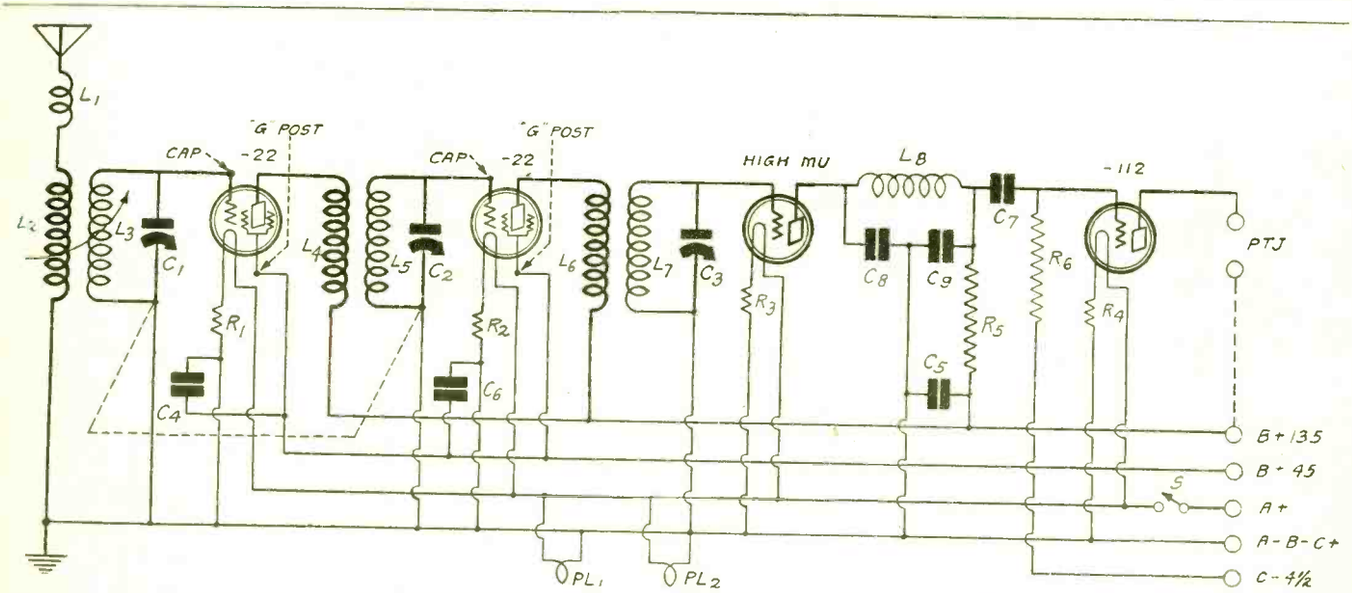
This reading is taken whatever it may be. Then the grid lead is moved to 22½ volts, that is to the middle tap on the 45 volt section. The current in M is observed and recorded opposite the 22½ volts. Then the grid lead is moved up to 45 volts and so on up to 135 volts.

When readings on M have been taken every 22½ volts from zero to 135 volts a curve of grid bias against plate current is plotted. This curve is the calibration curve of the vacuum tube voltmeter and from it the voltage drops in R2 for given currents in M may be obtained. Hence a known relation between Eg and the voltage drop in R2 has been obtained and the grid voltage, output voltage curve for the screen grid tube may be obtained. The grid voltage plate current curve also may be obtained by dividing the voltage drop in R2 by the resistance.

The Useful Range of Curve

It should be observed that the voltage drop in R2 is more useful for it gives the voltage input to the next tube while the current does not. The value of the resistance R2 varies as the current through it varies and this variation is automatically taken care of when the voltage drop is obtained.

It is only the straight portion of the curve between the grid voltage on the screen grid tube and the voltage drop in R2 which is useful. The grid bias on the screen grid tube should be adjusted to that value which gives a voltage drop in R2 which lies in the middle part of the straight portion of the curve. Then a maximum signal voltage swing may be impressed on the screen grid tube with a minimum of second harmonic distortion.



SURPRISING RESULTS CAN BE ACHIEVED WITH A CIRCUIT EMPLOYING GANG CONTROL IF THE COUPLING BETWEEN THE ANTENNA AND THE FIRST TUNED CIRCUIT AND BY INSERTING A VARIOMETER L1 IN THE ANTENNA CIRCUIT. NOT ONLY WILL THIS ARRANGEMENT SERVE AS A TRIMMER OF THE TUNED CIRCUITS BUT IT WILL TUNE THE ANTENNA CIRCUIT, THEREBY BOOSTING THE VOLUME SEVERAL TIMES. THIS CIRCUIT IS INTENDED FOR USE IN CONNECTION WITH A POWER AMPLIFIER AND BOOSTER. IT EMPLOYS TWO SCREEN GRID TUBES WITH A HIGH MU DETECTOR. THUS IT IS CAPABLE OF HIGH SENSITIVITY AS WELL AS HIGH SELECTIVITY

The Custom Set Builder

Why and How He Prospers in His Work

By James H. Carroll

Contributing Editor

A COMPOSITE photograph of the greatest presidents of the United States shows a countenance typically American, shaded with the lines of character and etched with the lights and shadows of genius. A composite photograph of the custom set-builders of the nation would show a physiognomy just as American, with character, ability, skill and mechanical genius limned thereon.

One of the most startling growths in the history of radio, apart from the development of radio itself as an art and an industry, is the healthy growth of the custom set builder, both individually and as a class. Starting by the roadside in a small way, in the early phase of the industry, with humble beginning in most every instance, the custom set builder has grown from a Colossus of "Roads" to the Colossus of Radio. A gigantic, outstanding figure, much of the future trend, growth and swing of radio depends upon his guidance.

Few people, in or out of the industry, realize the importance, standing and influence wielded by this self-same custom set builder.

Knows His Business

The custom set builder has much to offer his clients beyond his mere set building facility. He cheerfully gives them advice on the best circuits to suit their needs and location. He knows how to select the best of these circuits to give them the most satisfaction. He is unhampered by restrictions and gives them advancement in design, refinements and improvements that are about a year ahead of the market. He does not charge them for waste, because he has no waste. He does not charge them interest on large stocks of parts because he does not carry them but he buys mostly as he needs. In many cases, if the circuit selected is on the market in kit form, he merely has to order the kit and buy the minor parts to complete the job.

He eliminates guesswork and the element of worry for his customers as in the instance of the screen-grid tube. He knows the best uses of this tube and advises the circuit accordingly. If a National Screen Grid Five is the best thing for his customer rather than a seven tuber with three straight RF stages, he will so advise him although his profit may be less. Also with AC tubes, he instructs in their use and care and his installation avoids all destructive losses so that the upkeep is kept at a minimum.

His job is skillfully constructed by his master hand throughout. It is not the product of many hands, practiced to varying degrees of skill and when it is completed it stays put until scrapped or otherwise disposed of.

Good Reason for Good Work

It is to his interest to turn out a job that will stay sold, with the least service that will eat into his modest profits and he therefore builds accordingly.

It pays him to turn out work that will satisfy his customers, merit their sincere recommendations and thus bring him new orders. He is, therefore, an asset to his community in general and to the radio industry as a whole. After he has completed the installation he thereafter maintains a friendly interest in his clients and is always ready with advice and service.

Every good job put out by the custom set builder is another advertisement in a long series of ads, beginning at the inception of his business. However, our custom set builder is keenly perceptive and fully realizes the value of advertising, using it to good advantage in his business. He runs copy in whatever mediums will best help him and uses literature and follow-ups logically and intensively. He does not rely alone on goodwill to keep his business going, and he has, perhaps, a better idea of the value of advertising and a clearer sense of the best mediums to place it in than many of the large manufacturers. He knows, too, the value of consistent advertising and that more loss than gain is entailed by "splash" campaigns where copy is placed spasmodically, the product boomed meantime dying a natural death from lack of follow-up to keep interest alive.

Will Not Be the Goat

While he is willing to do all he can to back manufacturer campaigns he is unwilling to finance the fame of new parts or circuits entirely at his own expense, his own campaign being based upon the amount of money he can afford to spend during the year.

To tube manufacturers, the custom set-builders are invaluable customers being insatiable consumers of all kinds of tubes, for their own uses and for their installations. To the parts and kit manufacturers they open a vast field of sales, the combined custom set business amounting to yearly volume far beyond the demand for parts of set manufacturers from parts manufacturers.

The Colossus is gradually awakening and beginning to figure his field and look to his own interests as is evidenced by the movement toward a National Association. If this were once started with decisive aims and benefits in view for its members, radio would be well on the way toward stability and the influence for good wielded by the Colossus would be decisively felt and participated in by all of us.

Some Examples

In New York City the customer set builder is strong. There are many of them in New York and vicinity and they are all shining examples of skill, ability and character. They are all doing well, notwithstanding that their field is more limited by competition than their country brothers. To cite a few examples, Paul R. Fernald, of H. & F. Radio Laboratories, 168 Washington Street, is one of the pioneers. Established since the inception of radio, he has a fine and growing clientele of high-class fans who always seek the newest and best and who keep up-to-date every year by having their receivers and installations modernized. Many of them order the newest circuit built as soon as it is announced.

Another pioneer is Walter J. McCord, of the Jaynxon Laboratories, 57 Dey Street, established for many years and doing a fine business. He builds and repairs sets, eliminators and speakers. He also has a good following built up by giving honest service and good work. He is held in high respect by all his customers and new business comes to him daily from their recommendations.

Radio Construction Laboratories, 142 Liberty Street, specialize in high power power packs, developing the best in modern quality reproduction with dynamic speakers to match. They also do expert testing and give advice on radio problems.

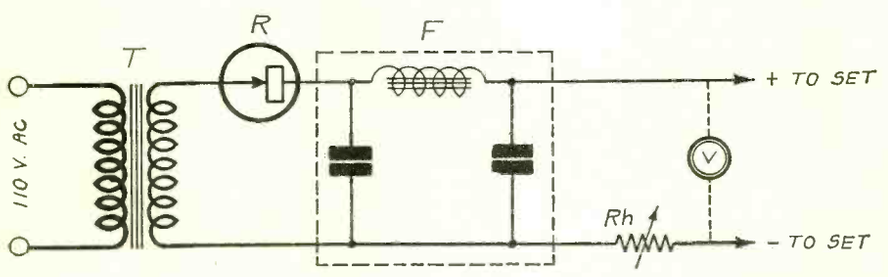
Satisfy Customers

R. D. Montgomery, 63 Cortlandt Street, is also an old-timer in the ranks of custom set-builders. He knows radio thoroughly through study and practice and always satisfies his customers.

Rossiter, Tyler & McDonnell, 136 Liberty Street, is another house that is built upon satisfaction and the reputation of prescribing the best for their clientele.

Rudy Siemens, one of the trail-blazers in the radio field, runs the Central Radio Service Bureau at 72 Cortlandt Street, and is one of the successful custom set-builders in Manhattan. He also has a fine testing equipment at the service of his following.

S. Hammer, on Liberty Street, is another live wire.



A BATTERY ELIMINATORS WILL UNDOUBTEDLY FIND GREATER APPLICATION THE COMING RADIO SEASON THAN EVER BEFORE. SUITABLE ELECTROLYTIC CONDENSERS AND HEAVY DUTY FILTER COILS HAVE BEEN DEVELOPED FOR THIS SERVICE. RECTIFICATION IS OBTAINED BY THE USE OF ORDINARY STORAGE BATTERY CHARGERS, EITHER OF THE TWO AMPERE RATING OR TRICKLE CHARGERS, DEPENDING ON THE DRAIN THAT IS EXPECTED.

Poor Hearing's Problem

How to Make Ringing of Phone and Door Bells Audible in Headset While Program is Being Received

By C. G. M. Brabant

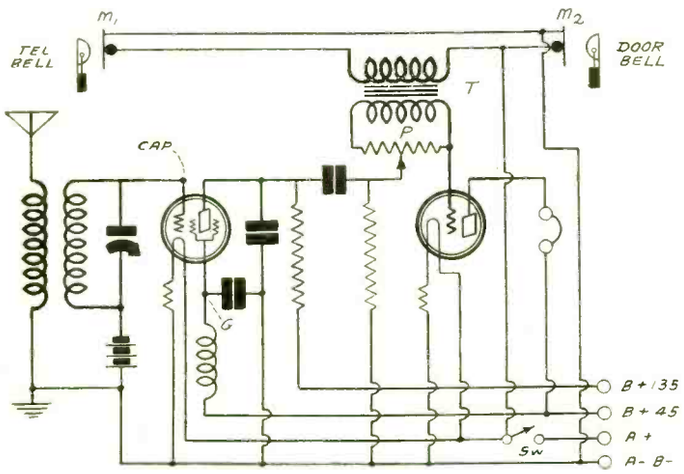


FIG. 1

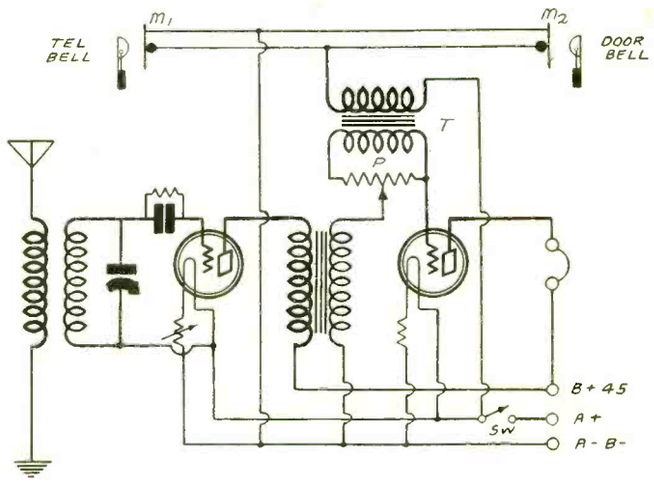


FIG. 2

A DIAGRAM SHOWING HOW TO CONNECT TWO MICROPHONES TO A RADIO SET SO THAT THE SOUNDS OF THE TELEPHONE AND DOOR BELLS WILL BE HEARD IN THE HEADSET (FIG. 1). THE TUNER SHOWN IS SIMPLY ILLUSTRATIVE OF THAT OF ANY RECEIVER, WHILE THE AUDIO STAGE IS THE LAST ONE OF ANY SET. RESISTANCE COUPLED AUDIO IS ILLUSTRATED FIG. 2 IS A CIRCUIT SHOWING HOW TO CONNECT THE MICROPHONE CIRCUIT INTO THE RADIO SET WHEN TRANSFORMER COUPLING IS USED.

A MAN of defective hearing liked to listen to radio, but he could not use a loudspeaker, for when the volume was loud enough for him to hear it was unbearably loud for those around him whose hearing was normal. He preferred to use a headset so that he could listen in whenever he wanted without disturbing anyone else.

But listening with the headset raised a problem when he was alone. He could not hear either the door bell or the telephone bell, and it was important that he should hear both.

Some kind of indicator which would show him when either bell was ringing was needed, and this indicator could either be optical or acoustic. For example, the ringing of the door bell might turn on a red pilot light placed on the panel of the radio set, and the ringing of the telephone bell might turn on a green pilot light. The problem also might be solved acoustically by coupling the bells to the radio receiver in such a manner that the sound of the bells could be heard in the headset.

Simple Arrangement Desired

To make the ringing of the bells turn on lights, relays would be necessary. The current in one of the bell circuits could be made to close a switch in a circuit containing the pilot light Or the sound of a bell could be made to actuate a microphone which in turn would actuate a relay switch for closing the pilot light circuit. But either of these schemes is rather complex, and the simplest possible arrangement was desired. Furthermore a visual indicator is not the best kind of alarm, for it requires constant watching. And a person who is enjoying radio reception is not as a rule very watchful, or he would not be enjoying the reception.

An acoustic indicator is by far the better, and it is easier to combine this with the radio set so that the sound from the bell will crash in on the music. This interference is not very pleasant but it is no more unpleasant when it crashes in on the headset than when it crashes in on the loudspeaker through the air. The more unpleasant the crashing the more effective is the alarm.

Various simple arrangements could be devised for coupling the bells to the radio receiver. In some instances no special arrangement at all is necessary, for the radio receiver picks up the disturbance in the bell circuit. But this pick-up is not dependable.

Microphones Installed

A more definite arrangement is to place a microphone near the bell and then couple the microphone circuit to the audio amplifier in the receiver. The input from the bell to the radio receiver may be adjusted either by adjusting the distance between the microphone and the bell or by adjusting the voltage input by means of a potentiometer.

If the telephone and the door bells are close together a single microphone will be enough. It is mounted half way between the two bells so that the sound from either will actuate the microphone with equal intensity.

If the two bells are far apart two microphones will be necessary, for if a single pick-up were used it would have to be so far from either bell that the sound received from either would not actuate it. Whether one or two microphones are used, the sound of both bells will be heard in the headset. But this should not cause any confusion, for the sounds of the two bells are different and it will be just as easy to recognize the characteristics of the two bells when heard through the headset as when heard through the air.

Suggested Circuit

Fig. 1 shows a suggested circuit for hooking up two microphones, M1 and M2, so that the sound of both will be heard in the headset. One microphone is placed near each bell and then the two are connected in parallel across the primary of the microphone transformer T. Across the secondary of this transformer is connected a 500,000-ohm potentiometer P by means of which the intensity of the signal from the bells is adjusted to suit the amplifier and the listener.

One side of the secondary and the potentiometer is connected to the grid of the amplifier tube. The slider on the potentiometer is connected to the top of the grid leak resistor. This case is for a resistance coupled amplifier.

In case the detector and the audio amplifier are connected by means of a transformer the secondary of the microphone transformer is connected between the grid of the amplifier and the grid terminal on the coupling transformer in the manner shown in Fig. 2.

Many types of microphones are available on the market which are suitable for this purpose, some of which are inexpensive. For example, a microphone button such as is used in dictaphones will serve the purpose nicely.

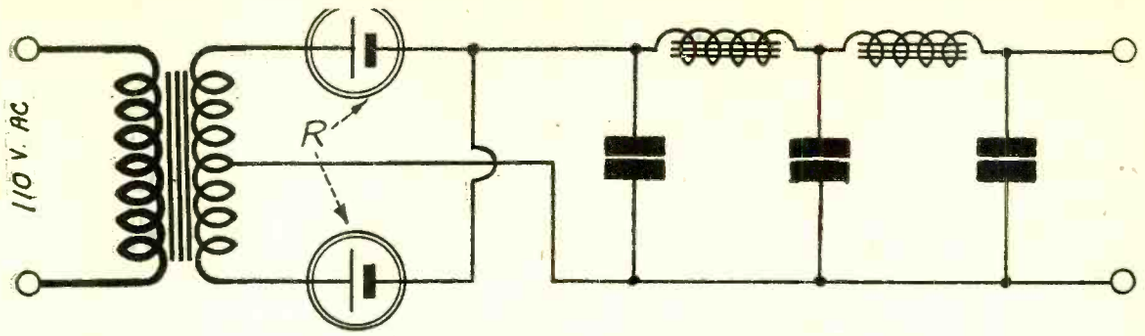


FIG. 703
The circuit diagram of a full wave rectifier and filter in which the rectifier elements are of the electrolytic type. Circuit requested by Rudolph Zimmerman

Radio University

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When writing for information give your Radio University subscription number.

PLEASE PUBLISH a circuit diagram of a full wave rectifier and filter in which the rectifier elements are of the electrolytic type.

(2) Also please publish a diagram of a half-wave rectifier and filter suitable for filament current supply.

RUDOLPH ZIMMERMAN,
St. Louis, Mo.

(1) Fig. 703 shows the circuit of a full-wave rectifier using two electrolytic rectifiers R.

(2) See Fig. 704 for a single wave rectifier. T and R may be an ordinary battery charger capable of supplying the necessary current. F is a filter which will handle the filament current which is to be drawn. The two inductance coils must have a large current carrying capacity and the condenser should be of the electrolytic type. Its capacity should be about 4,000 mfd.

* * *

HOW CAN a vacuum tube with negative bias on the grid rectify current when no grid current flows? What does it rectify?

(2) Please explain the action of a vacuum tube when used with grid bias for detection.

(3) How is it possible for the grid voltage to be negative half of the cycle and positive the other half when the grid is made so much negative that it never goes positive?

EDWIN E. BURTON,
Fall River, Mass.

(1) It can't rectify and it does not rectify anything. It detects.

(2) The fluctuating signal voltage on the grid changes the plate current in the tube. During half of the signal wave the signal voltage decreases the actual voltage on the grid and thus decreases the plate current. During the other half the signal voltage increases the actual voltage on the grid and thus increases the plate current. The decrease is always less than the increase when the grid is sufficiently negative and therefore an effect similar to rectification appears in the plate circuit.

(3) It is not possible. The grid is always negative if the grid bias is greater than the amplitude of the greatest radio signal. What is meant by negative half of the wave is that part of the wave which increases the normal bias on the grid. By positive half is meant that part of the wave which decreases the normal bias on the grid. The signal voltage is measured from the normal bias, not from the point from which the bias itself is measured, that is, the negative end of the filament.

* * *

DOES THE SHIELD around a tuning coil change the constants of that coil, that is, its inductance and resistance?

(2) Will more tuning capacity be required when the coil is shielded than when it is not?

(3) If the condenser also is enclosed in the shield will more or less capacity be needed to tune the coil to a given frequency?

(4) What effects will the shielding have on the constants of the condenser, that is, its capacity and resistance?

GUSTAVE HILMAN,
Tallahassee, Florida.

(1) The shielding increases the resistance of the coil and decreases its inductance.

(2) Since the inductance is decreased by the shielding one would expect that more capacity would be needed to tune the coil to a given frequency, but this increase in capacity is not always apparent on the tuning condenser. In fact, less capacity may be necessary. The shielding increases the distributed capacity of the coil and this may be more than enough to offset the decrease in the inductance.

(3) When the condenser also is included in the shield the distributed capacity is still greater, and in this case it is usually necessary to decrease the setting of the condenser to tune the circuit to the given frequency.

(4) There is a slight increase in the resistance of the condenser but this increase is negligible for the total resistance in the condenser is a very small portion of the total resistance in the tuned circuit. There is a considerable increase in the minimum setting capacity of the condenser.

* * *

SOMETIMES when listening to a strong local station the signal suddenly fades out. It always seems to happen when the programs are most interesting. What may be the cause?

JACOB BERNSTEIN,
Bronx, New York

One of your nearest neighbors has a higher and better antenna than yours and it is very close. When he tunes in on the signal you have, he takes it away from you. Install a better antenna.

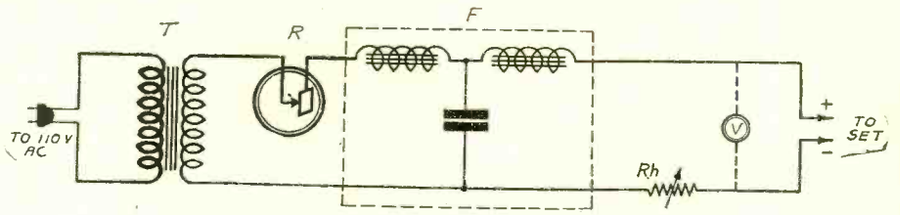

FIG. 704

THE CIRCUIT DIAGRAM OF A SINGLE WAVE RECTIFIER AND FILTER SUITABLE FOR FILAMENT CURRENT SUPPLY. THE CONDENSER IS OF THE ELECTROLYTIC TYPE AND THE TRANSFORMER AND RECTIFIER ARE THOSE OF A STORAGE BATTERY CHARGER. CIRCUIT REQUESTED BY RUDOLPH ZIMMERMAN

122 Excluded Stations Win License to Sept. 1

Washington.

Licenses of 122 broadcasting stations included among the 164 cited for failure to serve the public interest, were extended until September 1 by the Federal Radio Commission under a General Order. The old licences of these stations expired August 1.

The Commission announced that the action was taken because it had been impressed by the arguments presented by some of the stations regarding their public service, and that the extension of time was made to permit the Commission to "determine definitely that no injustice will be done any broadcaster, and that no community will be unjustly denied the radio service it prefers."

Two additional stations, KFVG, Independence, Kans., and WLBY, Iron Mountain, Mich., have been denied their application for renewal of licenses, making a total of 42 of the 164 stations to be eliminated thus far. These stations, it was found had defaulted their rights for relicensing by failure to offer testimony to show their public service.

Situation Recounted

The Commission had previously announced that 36 stations had defaulted, and four others had voluntarily retired from the broadcast spectrum. The text of the statement follows:

"The Federal Radio Commission extended to September 1, 1927, the licenses of 122 radio broadcasting stations whose cases were heard subject to General Order No. 32, issued May 25, 1928, which order provided that unless those stations made a showing at hearings set originally for July 9, 1928, that public interest, convenience or necessity would be served by granting their applications for renewal they would be denied renewal as of August 1, 1928.

"The Commission has been impressed at the public hearings with the cases made by quite a number of these stations regarding the local and community service they are rendering, and in order to determine definitely that no injustice will be done any broadcaster, and that no community will be unjustly denied the radio service it prefers, the Commission desires ample time to study the voluminous documentary evidence before it, affecting these cases."

Extension Order

The General Order of the Commission regarding the extension follows:

"General Order No. 36.—At a session of the Federal Radio Commission held at its office in Washington, D. C., on July 26, 1928:

"This order is issued with reference to all broadcasting stations listed in, or later made subject to, General Order No. 32 of this Commission, issued on May 25, 1928, excepting the following:

"1. Those stations with respect to which pending applications for renewal of license have been denied by the Commission, such stations having in each case been so notified by order dated July 25, 1928.

"2. Those stations that have heretofore surrendered their licenses.

"3. Those stations with respect to which there have not been heretofore duly filed with this Commission applications for renewal of their existing licenses.

Thirty-one Days Extension

"It is ordered that all existing licenses to broadcast of all broadcasting stations listed in, or later made subject to General Order No. 32 (other than those above excepted) be, and the same are hereby, further extended for a period of thirty-one days to terminate at 3 o'clock a.m., Eastern Standard Time, September 1, 1928, subject, however:

"1. To such modifications as may heretofore have been appended thereto, and

"2. To the condition that this order shall not be deemed or construed as a finding or decision by the Commission, or as any evidence whatsoever, that the continued use or operation of any of said broadcasting stations serves, or will serve, public interest, convenience or necessity, or that public interest, convenience or necessity would be served by the granting of any pending application for renewal of license to broadcast with respect to such station, and any licensee subject to this order who shall continue to use or operate a broadcasting station during the period covered by this order shall be deemed to have assented to said condition."

Manufacturers Sales Opens Boston Office

The Manufacturers Sales Co., 377 Fourth Avenue, New York City, representing several lines, has opened offices at 552 Massachusetts Avenue, Cambridge, Mass. This branch will be under the supervision of Herbert H. Buck, formerly of "Popular Radio," a trained radio man widely known in the field.

Among the lines carried here are the full line of Corbett cabinets and console, including the new console de luxe with built-in phonograph pickup; Lignole panels, the new, complete 1929 inlays in beautiful tones; Kenneth Harkness Screen Grid and AC kits and the new H. F. L. Isotone.

The chassis of this new H. F. L. will be ready in a few days and will be on display there and at the New York office. Full information on all these lines will be sent to those interested upon application to either of above addresses. Mention RADIO WORLD. —J. H. C.

New B Rectifier Uses Chemical that is Dry

An interesting device is the Pow-R-Driver just placed on the market. This unit is the result of three years of exhaustive research work and experimentation on the part of F. A. Rojas, head of the Rojas Chemical Works, and he regards it as his greatest product in this line. The Pow-R-Driver is a high-powered rectifier for use in all types of B eliminators, power packs and amplifying units, introducing also a condenser capacity into the circuit of hundreds of microfarads, greatly improving the filtering, giving greater energy and reserve power. It is claimed that low notes are perfected by this huge capacity and general tone production greatly improved. No extra filament winding is needed on the transformer and a center tap is not required. Full-wave rectification is delivered up to 750 volts at a current flow of 100 milliamperes.

Another claim for it is that there is no exhaustion process from the moment that it is placed in use, but that the elements and composition improve with use.

It is a small, compact unit, made in two sizes, the eight-cell for —12 type power tubes, the 16-cell for —71, —10 and —50 types. It is simply plugged into the rectifying tube socket of the B eliminator or socket-power amplifier and left to run without further attention.

It was designed to work efficiently with all the modern electric sets, power phonographs and all types of eliminators. The electrolyte is solid, non-acid and non-creeping and the device can be turned upside down safely, as there is nothing to spill.

The large anode surface affords ample heat dissipation, reduces hum to a minimum, working the power tubes at capacity potential and with a minimum of plate current drain consequently increasing life of the tubes and giving greater volume without distortion together with improved tone quality. Tests are now being made and further technical data will be given later on. In the meantime, those desirous of complete data will obtain them upon addressing Universal Electro Chemical Corp., 30 West 15th Street, New York City. Mention RADIO WORLD.—J. H. C.

Dellinger Selected to Allocate Waves

Washington, D. C.

The Federal Radio Commission has appointed Dr. J. H. Dellinger of the Bureau of Standards as Chief Engineer to assist the Commission in working out the new allocation plan necessitated by the amended radio act which makes mandatory the distribution of stations and powers equally among the five radio zones.

The appointment is for three months and Dr. Dellinger will accept provided he gets the approval of the Secretary of Commerce for a leave of absence for that period.

Dr. Dellinger is now chief of the radio laboratory of the Bureau of Standards. He is an outstanding authority on radio, a fellow and past president of the Institute of Radio Engineers and holder of degrees in physics from Western Reserve, George Washington and Princeton Universities. He has been with the Bureau of Standards since 1907 and he now holds the rank of physicist. He is the author of many articles on radio and other electrical subjects and he collaborated in the preparation of "Principles Underlying Radio Communication," a Government publication.

Dr. Dellinger's salary while with the Radio Commission will be at the rate of $7,000 per annum.

The position was first offered to John V. L. Hogan, a consulting engineer of New York and a leading member of the Institute of Radio Engineers. But Mr. Hogan declined the position because of pressure of private business. He will assist the Commission in an advisory capacity, nevertheless.

A THOUGHT FOR THE WEEK

THE interest in a broadcast program used to be directly proportional to the square of the distance between the sender and receiver but now it is directly proportional to the square root of what-have-you.

RADIO WORLD

Trade Mark U. S. Pat. Off.

The First and Only National Radio Weekly

Radio World's Slogan: "A radio set for every home."

TELEPHONES: BRYANT 0558, 0559
PUBLISHED EVERY WEDNESDAY
(Dated Saturday of same week)
FROM PUBLICATION OFFICE
HENNESSY RADIO PUBLICATIONS CORPORATION
145 WEST 45TH STREET, NEW YORK, N. Y.
(Just East of Broadway)
ROLAND BURKE HENNESSY, President
M. B. HENNESSY, Vice-President
HERMAN BERNARD, Secretary
Kansas City, Mo.: E. A. Samuelson, 300 Coca Cola Bldg.
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Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities, 10 cents per word. $1.00 minimum.

Entered as second-class matter March 23, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

Tex Rickard's Lament

POOR Tex Rickard! He'll have to take a part of those millions he has made out of exploiting the flat-nosed gentry and apply it to his losses on the dolorous "World's Championship" fight recently put on at the New York Stadium. And the distraught Tex blames it mostly on radio!

Let us all burst into tears at the sight of this poor inexperienced boy trying to put it up to anything except the one thing that possibly turned the dirty card for him—the fact that a lot of folk just naturally rebelled at the idea of paying forty dollars or so for the doubtful pleasure of seeing a first rate fighter iron out the proboscis of a second-rater.

Poor Tex, indeed! It's tough when the well-trained fight fans finally wake up and refuse to jump through the ring any more. No wonder the doughty Gene wants to retire from the ring!

Divider Takes Guess Out of B Voltages

In nearly all B battery eliminators taps are brought out on the voltage divider and the corresponding binding posts are marked by definite voltages, such as 45, 90, 135 and 180 volts, yet no provision is made for adjusting the voltages at these binding posts. Some users suppose that the actual voltages are those that are marked, regardless of what circuit is used with the B battery eliminator or what the input voltage may be.

It is well known that the voltages at these points depend not only on the input voltage on the rectifier but also on the current that is drawn from the device as a whole as well as from the various voltage taps. For example, the voltage at the so-called 45-volt tap has one value when one tube is connected to it, another value when two tubes are connected to the point, and still another when three tubes are connected, and so on. This applies also to all the other voltage taps. Not even the taps provided for grid bias remain fixed in voltage when the current changes. In fact the entire voltage distributor is one uncertainty.

Affect Quality

This state of affairs is not conducive to the best results, for there is no assurance that any tube in the circuit will be operated at the proper plate and grid voltages, and therefore the output from a set served with such an eliminator is quite uncertain both as to quality and as to volume.

A few resistor manufacturers have realized the need for adjustable voltage taps so that the voltage at any one of the taps could be adjusted to the proper value for any circuit and for any combination of tubes and have provided resistors with such taps.

But in order to make use of the adjustable taps and to obtain correct voltages it is necessary to have a high grade voltmeter with which to measure the voltages obtained for various settings of the taps. Such meters are not available in the home or in the amateur laboratory. They are not even available in many radio stores or in the tool kits of many service men. Hence in most cases the voltage can only be adjusted by guess, the result of which may be even worse than no adjustment at all.

A Step in Advance

One of the resistor manufacturers (Electrad, Inc.) has provided an output voltage divider not only with adjustable but with calibrated taps. With this device it is only necessary to connect the terminals according to directions and to set the knobs according to the number and type of tubes used in the receiver to be served. The proper voltage is assured at every tap.

A 28-page booklet accompanies the device, in which the calibrations for eight different combinations of tubes are given with the proper settings of the various taps for each combination. This practically covers all the sets which are operated by B battery eliminators. The calibration presumes a total voltage across the voltage divider of 220 volts, which is the most common output voltage of B battery eliminators.

Other Useful Data

Besides the knob settings for the eight conventional sets there is a great deal of other data in the book which help in obtaining the proper voltages. For example, in the event the output voltage of the rectifier and filter is higher than 220 volts a table of series multiplier resistance is given by means of which the voltage across the divider can be brought down to the 220 volts. These resistances are given for five different voltages higher than 220 volts and for five different totals plate currents. For example, if the voltage available is 450 volts and the current through the series resistor will be 30 milliamperes, the value of that resistor should be 7,500 ohms. This is just one of the 25 different combinations listed.

Another table gives the plate current characteristics of all the standard tubes used in receivers from the —99 to the —50.

Numerous circuit diagrams showing the connections of the voltage divider and the series multiplier are also given as well as many calibration curves for both plate voltage and grid bias.

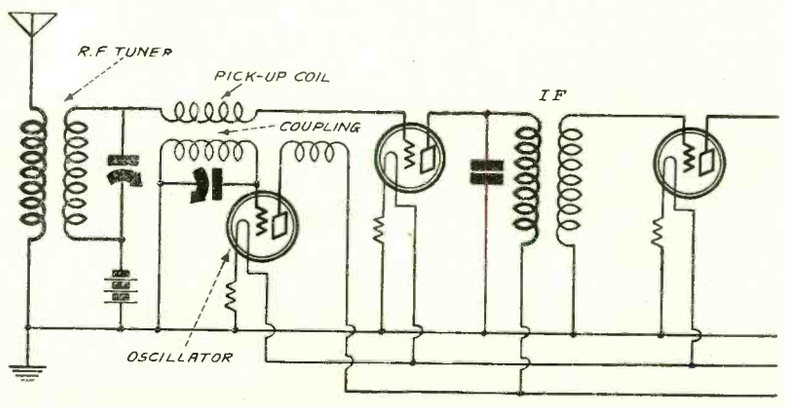
Shows Much Research

The booklet contains the results of a great amount of research work and measurements on all types of receiver as related to the voltage divider.

The voltage divider is enclosed in an attractive molded bakelite case and is provided with soldering lugs as well as binding posts. The bottom of the unit is of solid sheet metal and the sides are of perforated sheet metal, thus giving adequate ventilation to the resistors.

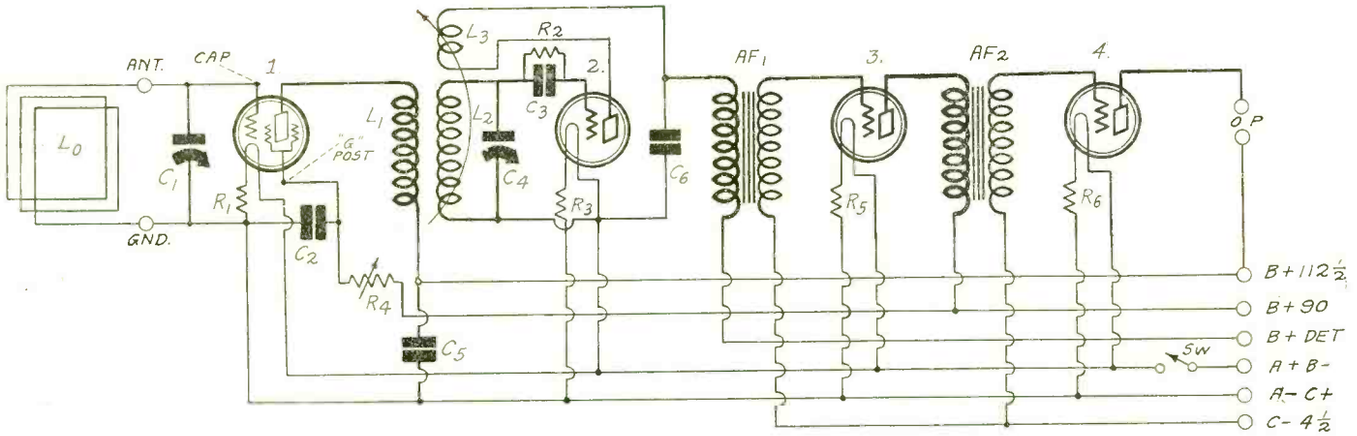
Any one interested in the divider or booklet should write to Arthur Moss, c/o Electrad, Inc., 175 Varick Street, New York City, and mention RADIO WORLD.

COUPLING AFFECTS BEAT FREQUENCY

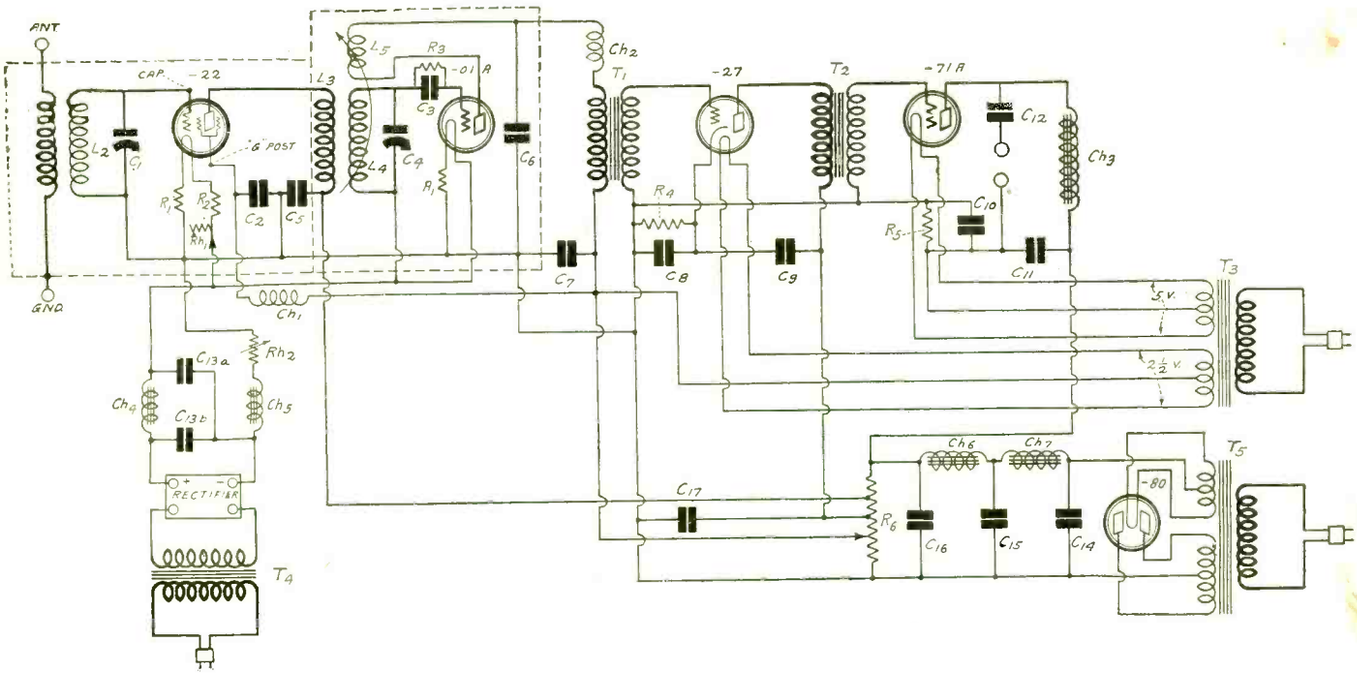


THE CIRCUIT OF A SUPER-HETERODYNE MIXER IN WHICH THE BEAT OR INTERMEDIATE FREQUENCY IS AFFECTED BY THE DEGREE OF COUPLING BETWEEN THE PICK-UP COIL AND THE OSCILLATOR.

Screen Grid Circuits



THERE IS A CONSTANT DEMAND FOR CIRCUIT DIAGRAMS OF RECEIVERS SUITABLE FOR PORTABLE SETS. HERE IS SUCH A CIRCUIT COMPRISING ONE SCREEN RF AMPLIFIER WITH LOOP INPUT, A REGENERATIVE DETECTOR, AND TWO STAGES OF TRANSFORMER COUPLED AUDIO FREQUENCY AMPLIFICATION. SINCE THE CIRCUIT IS INTENDED FOR PORTABILITY THE DETECTOR AND THE FIRST AUDIO SHOULD BE OF THE —99 TYPE AND THE LAST TUBE MAY BE EITHER A —99 OR A 120, DEPENDING ON THE AMBITION OF THE BUILDER. A RECEIVER SUCH AS THIS CAN BE USED FOR HOME RECEPTION AS WELL. AN OUTDOOR ANTENNA MAY BE SUBSTITUTED FOR THE LOOP BY USING A TUNED RF COUPLER IN PLACE OF THE COIL ANTENNA.



THIS IS THE CIRCUIT DIAGRAM OF A COMPLETE RADIO INSTALLATION IN WHICH THE FILAMENTS OF THE RADIO FREQUENCY TUBES ARE HEATED BY AN A BATTERY ELIMINATOR MADE OF A LOW CURRENT CHARGER AND HEAVY HIGH CURRENT FILTER CHOKES AND ELECTROLYTIC CONDENSERS. THE AUDIO TUBES ARE HEATED WITH ALTERNATING CURRENT. THE PLATE VOLTAGES ARE SUPPLIED BY A FULL WAVE RECTIFIER AND FILTER WHILE THE GRID POTENTIALS ARE OBTAINED THROUGH VOLTAGE DROPS IN INDIVIDUAL RESISTORS. SUCH A COMBINATION CAN BE USED INDEFINITELY WITHOUT FEAR OF RUNNING DOWN ANY BATTERIES, FOR THERE IS NONE. THE POWER SUPPLY WILL HAVE ABOUT THE SAME LIFE AS THE AMPLIFIER TUBES.

Intimate Facts Given On Television Tube

Raytheon Technical Bulletin, Vol. 1, No. 3, published by the Raytheon Manufacturing Company, Cambridge, Mass., contains a very interesting article entiled "Useful Facts About the Raytheon Kino Lamp," by D. E. Replogle.

Numerous curves are given showing the characteristics of the Raytheon Kino Lamp. Some of these curves are: Relation of Light Output and Brightness to Direct Current through Raytheon Kino Lamp, Visual Contrast Curve, Brightness Variation with Alternating Current Change, and Relation of Current Output to Power Input. In fact it contains all the characteristics of the tube which are useful in designing television receiving equipment.

WHEN THE RUSH STARTS

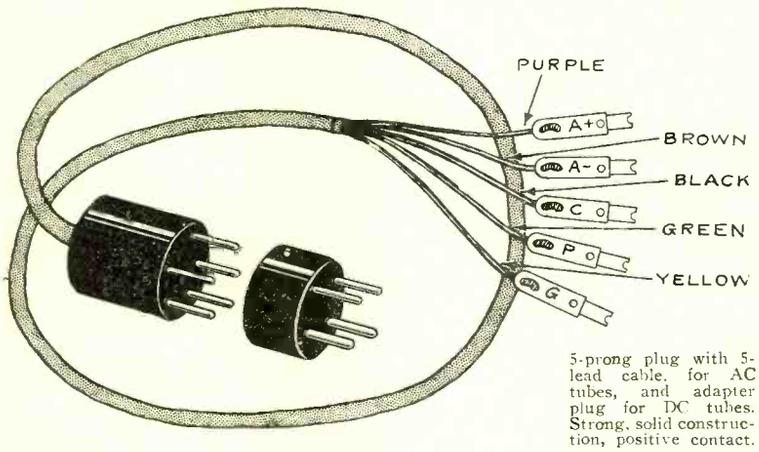
If two or more tubes in your set become inefficient all of a sudden, your voltages may be too high.

WABC Becomes a Key Station for Columbia

WABC of the Atlantic Broadcasting Company, Richmond Hill, New York, has joined the Columbia Broadcasting system, J. Andrew White, president of the Columbia System, and Alfred H. Grebe, president of the Atlantic Broadcasting Company, announced.

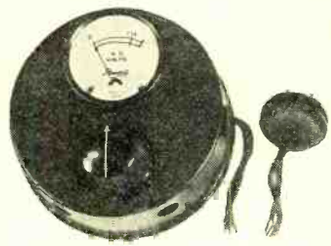
WABC will act as alternate 'key" station with WOR. The new arrangement is to become effective Sept. 2.

Universal AC and DC Short-Wave Adapter Plugs! Voltage Regulator!



5-prong plug with 5-lead cable, for AC tubes, and adapter plug for DC tubes. Strong, solid construction, positive contact.

Handiest thing in the world for any short-wave adapter. Put detector tube of your present set in socket of any short-wave adapter you build, put plug in detector socket of your broadcast receiver. Cable, 34". Leads identified both by color scheme and tags. May be used as 5-lead battery cable plug with UY socket. 5-prong plug with 5-lead cable (Cat. No. 21AC) **$1.50**
4-prong extra plug only, for DC short-wave adapter (Cat. No. 21DC) **$0.50**
Cat. No. 21AC and 21DC ordered together **$1.75**
Cat. No. 21AC and 21DC with 99 adapter **$2.25**



Line voltage regulator for AC sets has an AC meter showing line voltage, and a power adjustable resistance so that the line voltage may be reduced until it reads 110 volts. Wall plug and socket for connection to AC cord from the set also built-in (Cat. No. 218) **$5.00**

Accurate Meters for Exacting Radio Uses! Speaker Switch!

Cat. No. 390, reading 0-100 milliamperes. Price ..**$1.65**

Cat. No. 326, reading 0-6 volts DC, price **$1.65**

Two of the most popular meters are Cat. No. 390, reading 0-100 milliamperes, and Cat. No. 326, reading 0-6 volts DC. Both are panel mount types (2 5/64" hole). See illustrations above. No. 390 is recommended for sets having six tubes or more, particularly if a —71, —10 or —50 tube is used as the output. May be kept permanently in circuit. For DC measurements 0-100 milliamperes. Cat. No. 390 .....**$1.65**
The 0-6 panel voltmeter may be kept permanently in circuit (Cat. No. 326) **$1.65**

PANEL AC VOLTMETER

Cat. No. 351 For reading 0-15 volts AC **$2.25**

PANEL MILLIAMMETERS

Cat. No. 311 For reading 0-10 milliamperes DC **$1.95**
Cat. No. 325 For reading 0-25 milliamperes DC **$1.85**
Cat. No. 350 For reading 0-50 milliamperes DC **$1.65**
Cat. No. 399 For reading 0-300 milliamperes DC **$1.65**

PANEL AMMETER

Cat. No. 338 For reading amperage, 0-10 amperes DC **$1.65**

6-VOLT A BATTERY CHARGE TESTER

Cat. No. 23 For showing when 6-volt A battery needs charging and when to stop charging; shows condition of battery at all times **$1.85**

VOLTAMMETER

Cat. No. 35 For testing amperage of dry cell A batteries and voltage of B batteries (not B eliminators); double reading, 0-50 volts, 0-40 amperes DC **$2.00**

HIGH RESISTANCE VOLTMETERS

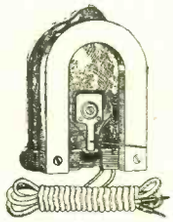
A 0-300 DC voltmeter with a very high resistance. Specially made that way so it will test the output voltages, from maximum to any intermediate voltage, of any B eliminator or grid biasing resistor. Cat. No. 346 ..... **$4.50**

[Note: 0-500 volts, instead of 0-300 volts, is No. 347. Tests ALL power packs—Price $5.50.]

PANEL VOLTMETERS

Cat. No. 335 For reading DC voltages, 0-8 volts **$1.65**
Cat. No. 310 For reading DC voltages, 0-10 volts **$1.65**
Cat. No. 337 For reading DC voltages, 0-50 volts **1.65**
Cat. No. 339 For reading DC voltages, 0-100 volts **$1.75**
Cat. No. 40 For testing A and B batteries, dry or storage, but not for B eliminators: double reading, 0-8 volts and 0-100 volts DC scale.....**$2.25**
Cat. No. 42 For testing B batteries, dry or storage, but not for B eliminators; 0-150 volts DC scale.....**$2.00**
Cat. No. 348 For testing AC current supply line, portable, 0-150 volts.....**$4.50**

In home or store you often want to operate two speakers together, or each separately, and this speaker switch, the Speakerelay, does the trick! Connect the cord to the set and the speakers to the jacks in the switch. Turn knob at No. 1 at left to operate one speaker alone, to No. 2 to operate both speakers together, and to No. 1 at right to operate the other speaker alone. Enclosed in moulded Bakelite case. (Cat. No. 121)..... **$2.00**



Powerful unit, excellent for any cone or similar type of speaker. Stands up to 150 volts unfiltered. Very loud. Adjustable armature. Well packed. Won't get damaged in shipment. Supplied with apex, chuck and nut. Unit easily mounted. **$3.75**

Build yourself a very fine large cone speaker and get the fullest enjoyment of the quality your receiver offers. Nothing but praise has been heaped on these 36" and 24" speakers. Also, their appearance is so entrancing that they fit nicely into the surroundings of the finest living rooms and parlors. Expert radio and acoustical engineers indorse them. Nobody need be without a really fine speaker of 36" or 24" diameter, now that all have a choice of these two sizes at the same price. Remember, a five-day money-back guaranty attaches to each of these speaker kits!
Take your choice of a 24" or 36" diameter cone speaker kit, with Unit No. 1098 (see description at left). Either size at same price. Tri-foot pedestal FREE with each kit order. Front sheet of designed Phonotex, rear sheet of plain Phonotex. Radio cement furnished with each kit. Also mounting bracket, apex, chuck and nut, with instruction sheet. Fine tone quality reproduced at large volume. Ornamental and efficient cone easily built by anybody. Novices find not the slightest difficulty. As the unit is adjustable you can adjust the impedance until best results are obtained. These speakers are used as demonstrators in stores in New York City at full volume without rattling. Low notes are reproduced particularly well, because of the large radiating surface. Apex is at center for highest efficiency. (Cat. No. 36 for 36" or Cat. No. 24 for 24") **$6.00**
Kit is complete, including unit, apex, bracket, chuck, nut, paper, pedestal, cement and instruction sheet.

If bothered by interference between stations or living near a station that comes in all over the dials and prevents you from getting other stations, use a wave trap and trap out the offender at will. Turn of the knob covers entire broadcast band. Trap is encased in moulded Bakelite (Cat. No. 22WT).... **$1.50**

Guaranty Radio Goods Co.
141 W. 45th Street, N. Y. City

Please mail at once C.O.D. on a five-day money-back absolute guaranty, your catalogue numbers as follows, for which I will pay the advertised prices, plus a few cents extra for postage:

Cat. No. ..... Cat. No. ..... Cat. No. .....

Name .....

Address .....

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

SEND NO MONEY!

Acceptance Speeches to be Sent by Chains

The acceptance speeches of the Presidential candidates of both the Republican and Democratic parties will be broadcast over nation-wide hook-ups.

Herbert C. Hoover's address will be broadcast from his home in Palo Alto, California, Saturday, Aug. 11, at 4 p. m., Pacific Standard Time. This is 5 o'clock Mountain Standard Time, 6 o'clock Central Standard Time and 7 p. m. Eastern Standard Time. Daylight Saving Time is an hour later in each instance.

Alfred E. Smith will deliver his acceptance speech from the Capitol steps in Albany, N. Y., on Wednesday, Aug. 22, at 7:30 p. m., Eastern Daylight Saving Time.

Thus Mr. Smith will speak eleven days after the Hoover acceptance speech, but half an hour earlier in the day.

According to word from the offices of the National Broadcasting Company the same hook-up will be used for the acceptance speeches of both candidates.

The Columbia Broadcasting chain also is to broadcast both events.

Let Radio World Follow You on Your Vacation

If you are a subscriber and are going away this summer, send us your name and change of address and we will see that the paper reaches you every week.

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BLUEPRINTS of National Screen Grid Five, 4-tube Screen Grid Diamond and Karas 3-tube Short Wave Set—three blueprints—one dollar. Guaranty Radio Goods Co., 145 W. 45th St., N. Y. C.

KARAS SHORT WAVE SET, three tubes, 13 to 750 meters, described in the March 31, April 7, 14, 21 and 28 issues. Send 60 cents for these five issues and get blueprint free. **RADIO WORLD, 145 W. 45th St., N. Y. City.**

USED MOTORCYCLES. Low terms. Also Parts. Accessories. Catalog Free. Western Motorcycle Co. 947 East 15th St., Kansas City, Mo.
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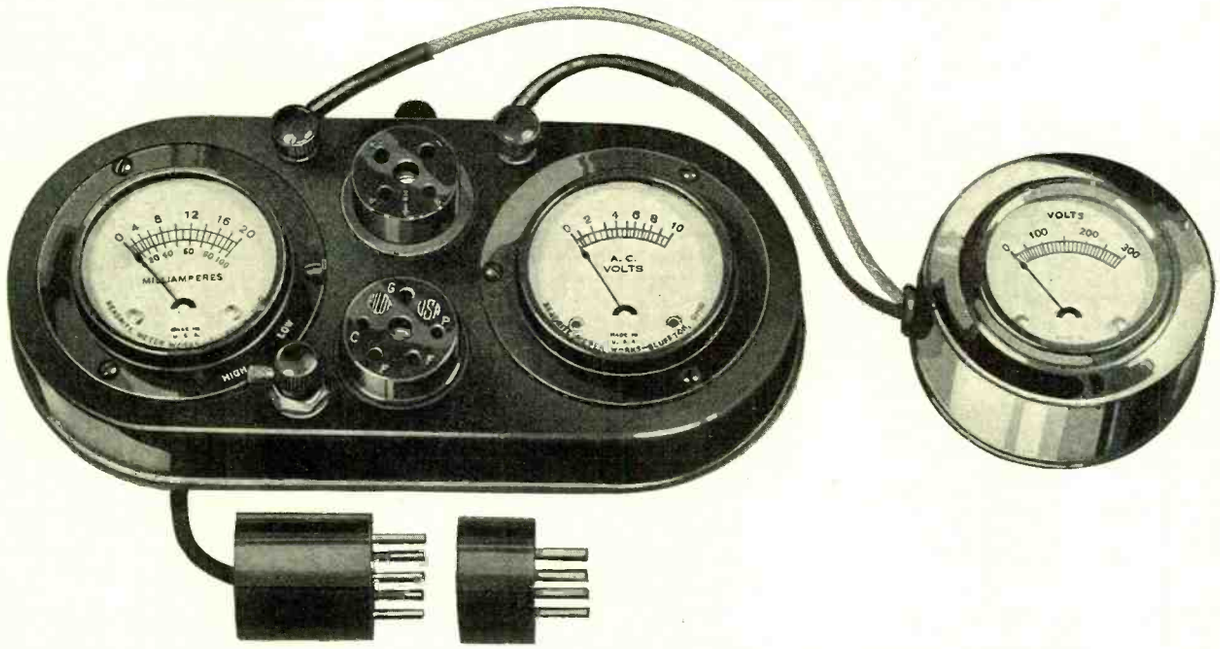
SCREEN GRID TUBES, famous standard manufacturers, no bootleg, $4.50 each. Special three circuit tuner, high primary impedance for screen grid tuned plate, $2.50. Antenna coil for screen grid circuits, adjustable primary, $2.00. Aluminum shield caps fit over entire screen grid tube, $1 each, C.O.D. only.—Philip Cohen, 236 Varet Street, Brooklyn, N. Y.

12 VITAL TESTS
In Only 4½ Minutes!



The Handsome Outfit, Shown One-Half Scale

With this Scientific Trouble Shooting Combination AC and DC Tester (at left) and the high resistance voltmeter (at right) twelve vital tests were made of tubes and receivers, in 4½ minutes, because the combination can be used quickly for the following purposes:

(1) to measure the filament voltage, up to 10 volts, of AC and DC tubes.

(2) to measure the plate current of any one tube, including any power tube, from less than 1 milliampere up to 100 milliamperes;

(3) to measure the total plate current of a receiver or amplifier, up to 100 milliamperes. (Hardly any set draws more). Open common A and B of set and connect to P of tester socket and to P prong under adapter plug;

(4) to measure the B voltage applied to the plate of tube; the voltage across B batteries or B eliminators, up to 300 volts.

(5) To determine the condition of a tube, by use of the grid bias switch.

(6) To measure any tube's electronic emission (tester cuts in at no load, hence plate current equals filament emission).

(7) To regulate AC line, with the aid of a power rheostat, using a 27 tube as guide, turning rheostat until filament voltage is 2.5 or 2.25 volts.

(8) To test continuity of resistors, windings of chokes, transformers and circuits generally.

(9) To find shorts in bypass and other condensers, as well as in inductances, resistors and circuits generally.

(10) To read grid bias voltages, including those obtained through drops in resistors (bias read by noting plate current and voltage and consulting chart).

(11) to determine the presence of distortion and overloading, by noting if milliammeter needle fluctuates.

(12) to determine starting and stopping of oscillation, as milliammeter needle reads higher current for oscillation and lower for no oscillation.

GUARANTY RADIO GOODS CO.,
145 West 45th Street, New York City.

Please send me at once, on a five-day money-back guaranty, one complete Two-in-One (AC and DC) scientific trouble-shooting test set, consisting of one No. 215 and one No 346, for which I will pay the postman $13.50, plus a few cents extra for postage.

☐ If 0-500 v. high resistance voltmeter No. 347 is preferred, put cross in square and pay $14.50, plus postage, instead of $13.50, plus postage.

☐ One No. 215 alone, $10.00.
☐ One No. 346 alone, $4.50.
☐ One No. 347 alone, $5.50.
☐ Two adapters for UV-199 tubes, $1.00.

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Service Men, Custom Set Builders, Home Constructors, Experimenters, Teachers, Students, Laboratories

Order one of these combination 215 AC-DC testers and 346 meter 0-300 volts. Send no money. Just fill out coupon. If after five-day test you're not delighted, return and purchase price will be promptly refunded! Here's what you get for only $13.50.

(1) One newly-designed Two-in-One 0 to 10 voltmeter for AC and DC. Same meter reads both. Scale especially legible at 1½ to 7½ volts. This meter reads the AC and DC filament voltages.

(2) One DOUBLE reading DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with changeover switch. This reads plate current, which is always DC in all sets.

(3) One 0-300 volts high resistance voltmeter, No. 346, with tipped 30" cord to measure B voltages.

(4) One 5-prong plug with 30-inch cord for AC detector tubes, etc., and one 4-prong adapter for other tubes.
(5) One grid switch to change bias.
(6) One 5-prong socket.
(7) One 4-prong socket.
(8) Two binding posts.
(9) One handsome noire metal case.
(10) One instruction sheet.

$13.50
SEND NO MONEY

[If 0-500 voltmeter No. 347 is desired instead of No. 346, price of combination is $14.50.]

No. 215 Universal AC-DC Tester Alone.....$10.00
No. 346 high resistance 0-300 voltmeter alone..... $4.50
No. 347 high resistance 0-500 voltmeter alone..... $5.50

Flechtheim Power Block

The latest addition to the line of by-pass, high-voltage and filter condensers of the A. M. Flechtheim Company of 136 Liberty Street, New York City, is a new condenser block designed for use with the new —50 type power tube. This condenser pack is designated in the line as the type DX-250.

EVERY FRIDAY at 5.40 P. M. (Eastern Daylight Time) Herman Bernard, managing editor of **Radio World**, broadcasts from WGBS, the Gimbel Bros. station in New York, discussing radio topics, mostly television.

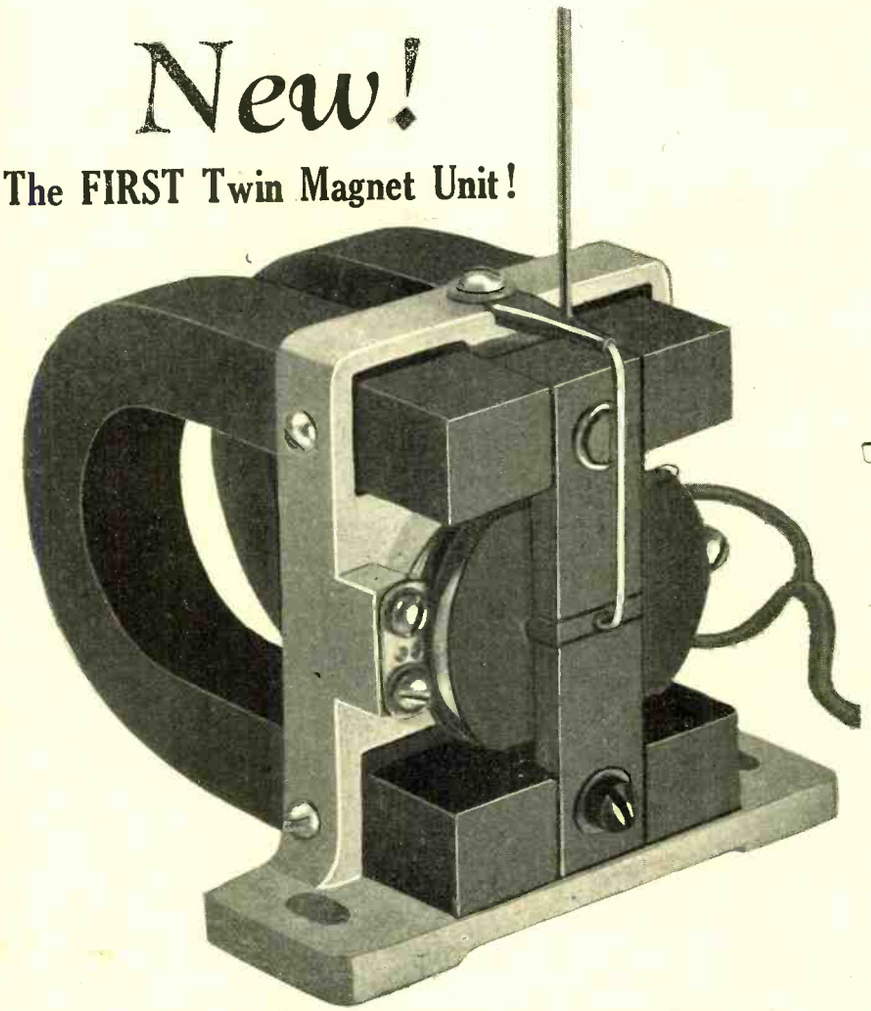
POLO

DUO-MAGNETIC UNIT

TWIN MAGNETS
DOUBLE SENSITIVITY

New!

The FIRST Twin Magnet Unit!



Polo Duo-Magnetic Unit, shown actual size. Weight three full pounds. Supplied complete with five-foot cord, apex, chuck, nut and moulded metal mounting bracket (Senior model) **$10.00**

No Filtering at 180 Volts!

THE magnet coil of the unit consists of two separate windings, connected in parallel, so that the current divides between them. This enables you to put TWICE AS MUCH current through the coil without danger of harming it!

Use 180 volts on a —71A or —10 tube, with proper negative grid bias, and you do not need an output filter, the usual list price of which is around $10.00. The coil of the unit safely carries 25 milliamperes!

Enormous Volume, No Rattling!

THE volume obtainable from a set depends to a large extent on the efficiency of the unit. The Polo Duo-Magnetic Unit is incredibly loud—enormously loud—yet without rattling! The SENSITIVITY IS DOUBLED by the use of two magnets —the first time two have been used in a commercial unit. The magnets are genuine, efficient, costly chrome steel, and there are no holes in them. Holes weaken a magnet and shorten its life.

POLO ENGINEERING LABORATORIES

57 Dey Street (Suite 6), Corner Greenwich Street Tel. CORtland 5112 **New York, N. Y.**

ASTOUNDING

Performance—And Why!

THE new and startling Polo Duo-Magnetic Unit is of the balanced armature type, needing no adjustment and no servicing. It is exceptionally efficient, long-lived and mechanically rugged. Here is a summary of its superiority:

(1) Twin magnets double sensitivity.

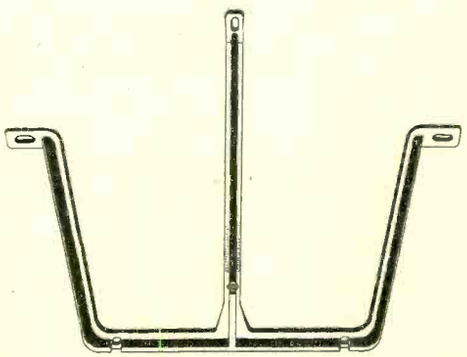
(2) Magnets are of chrome steel.

(3) Magnet coil consists of two windings in parallel, doubling the flux and the current handling capacity.

(4) Volume is extraordinary, and without rattling, due to twin-magnets, great flux density, short air gaps, balanced silicon steel armature and single-piece coupling rod and pin. The pin WON'T BREAK OFF!

(5) Die cast aluminum frame fits assembly to 1/1000 of an inch, enhancing rigidity.

(6) Large, solid machined pole pieces.



Moulded bracket FREE with each unit order; also cord, apex, chuck and nut.

Every unit undergoes seventeen careful tests and is guaranteed against all mechanical or electrical imperfections. This unit needs no after-servicing, but will last indefinitely. It works superbly any cone, cloth, Balsa or skin speaker and is one of the most remarkable units ever produced. Make Polo your choice and you'll rejoice!

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57 Dey St. (Suite 6), corner Greenwich St., New York, N. Y.

Enclosed please find ten dollars for which send me one Polo Duo-Magnetic Unit, with five-foot cord, moulded metal bracket, apex, chuck and nut. YOU ARE TO PAY SHIPPING CHARGES. If after a 10-day trial I return the unit YOU WILL QUICKLY REFUND THE TEN DOLLARS.

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[Note: Shipments Begin on August 25. Orders Filled in Sequence of Their Receipt]