SEPT. 8th
1928

Vol-13
No-25

FIFTEEN CENTS

RADIO WORLD

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WORLD

The First and Only National Radio Weekly

337th Consecutive Issue—Seventh Year

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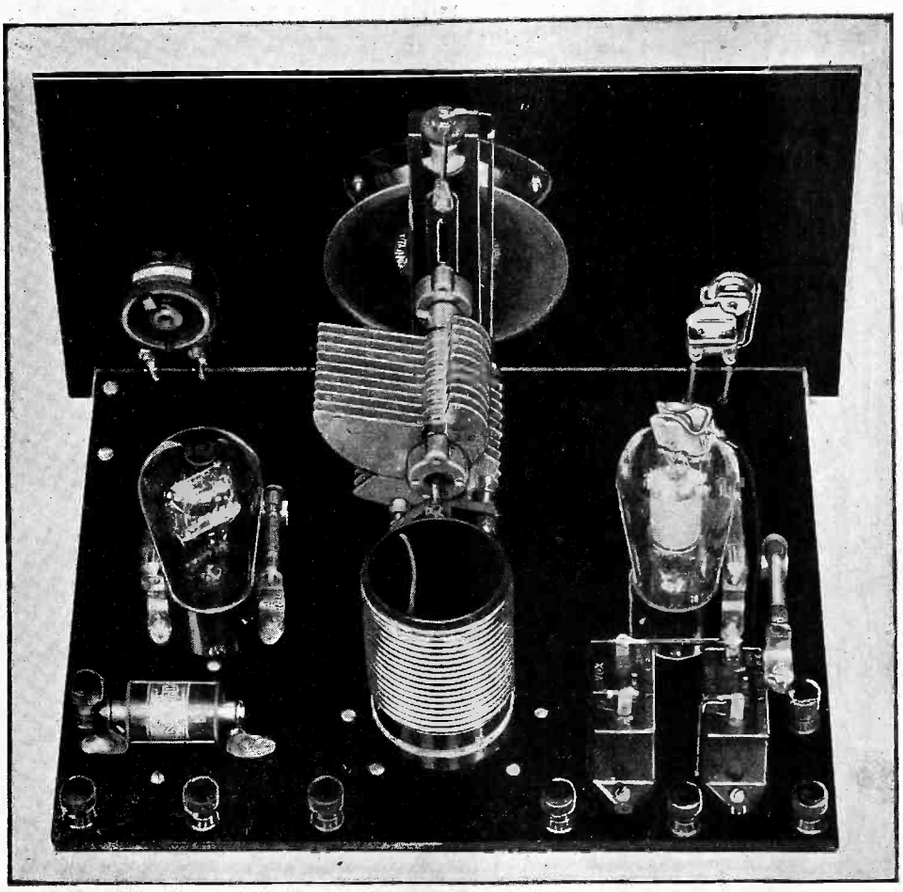
Quality with High Mu Tubes!

DC TUBE SETS MADE BATTERYLESS!

The Virtues of Wooden Horns!

SIMPLE MIXER FOR ALL WAVES!

SHORT-WAVE SET GETS TELEVISION!



With the National Screen Grid Short-Wave Receiver (above), plus an audio channel, television was received by James Millen. Constructional article begins on page 3. Complete in this issue.

S-M 720 TUNING

RADIO BOARD

—Frowns On Phonograph Programs
—Cancels Some Licenses
—Defines Equalization Law

AC CIRCUIT NEWS

"UNINTERRUPTED READER INTEREST"
EVERY WEEK — EVERY YEAR

RADIO WORLD

SEPTEMBER 8, 1928
Vol. XIII, No. 25. Whole No. 337
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

Television, Code, Music

WITH THE NATIONAL SG SHORT WAVE CIRCUIT

By James Millen

Holder of World's Record for Distance Reception of Televised Movies

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(Continued on next page)

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One National short-wave sub-panel containing two tube sockets, one coil receptacle and five resistor or coil clips.

One National .00125 mfd. tuning condenser.

One National vernier dial with built-in pilot light.

One Yaxley filament switch.

One 0-500,000 ohm Electrad variable resistor.

Two .5 Aerovox condensers, 200 volt test.

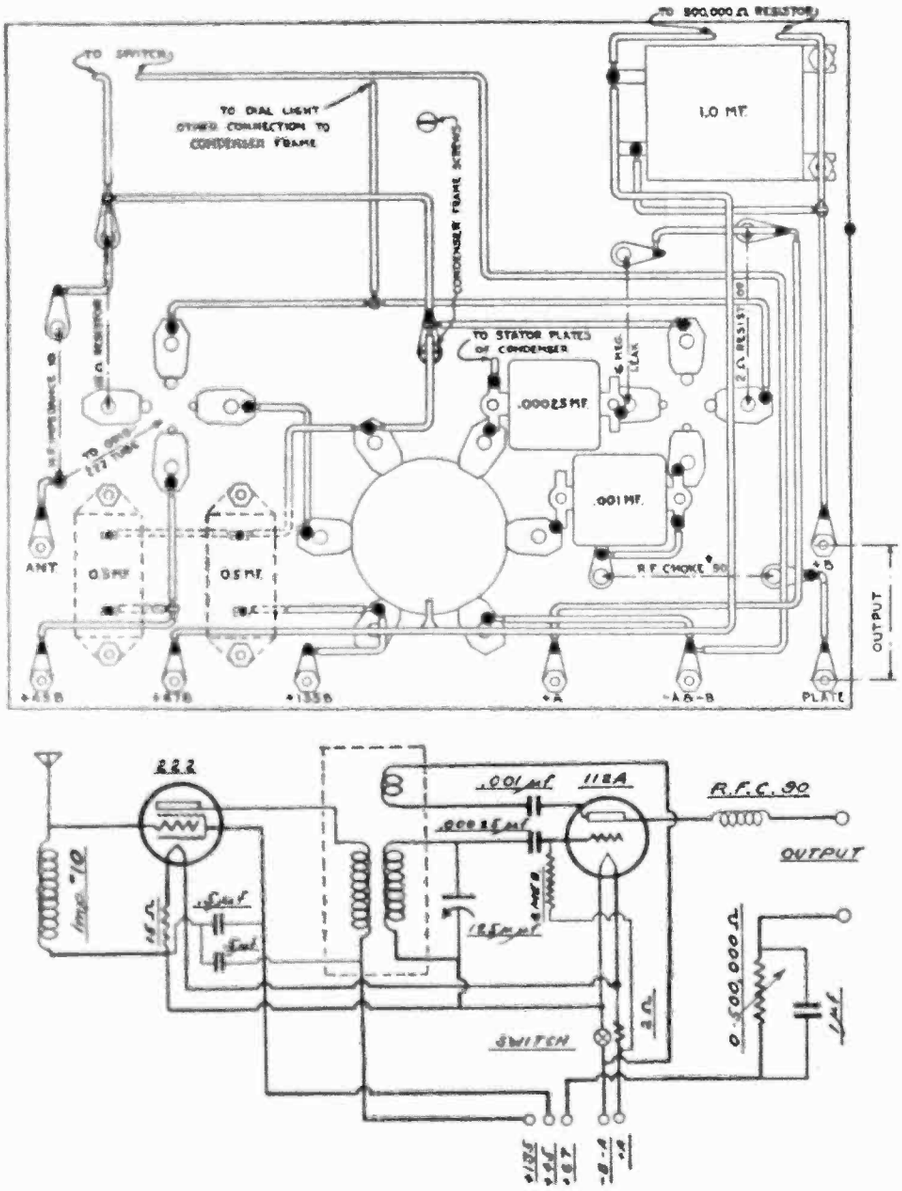
One 1 mfd. Aerovox condenser, 200 volt test.

One .00025 mfd. Aerovox condenser.

One .001 mfd. Aerovox condenser.

One 7x12x¼ inch panel.

Eight binding posts.



AT TOP IS A PICTURE DIAGRAM OF THE NATIONAL SHORT-WAVE CIRCUIT. BELOW IS THE SCHEMATIC DIAGRAM. THIS IS THE CIRCUIT USED BY JAMES MILLEN WHEN HE RECEIVED THE JENKINS TELEVISED MOVIES AND THE TELEVISION TRANSMISSION OF WLEX.

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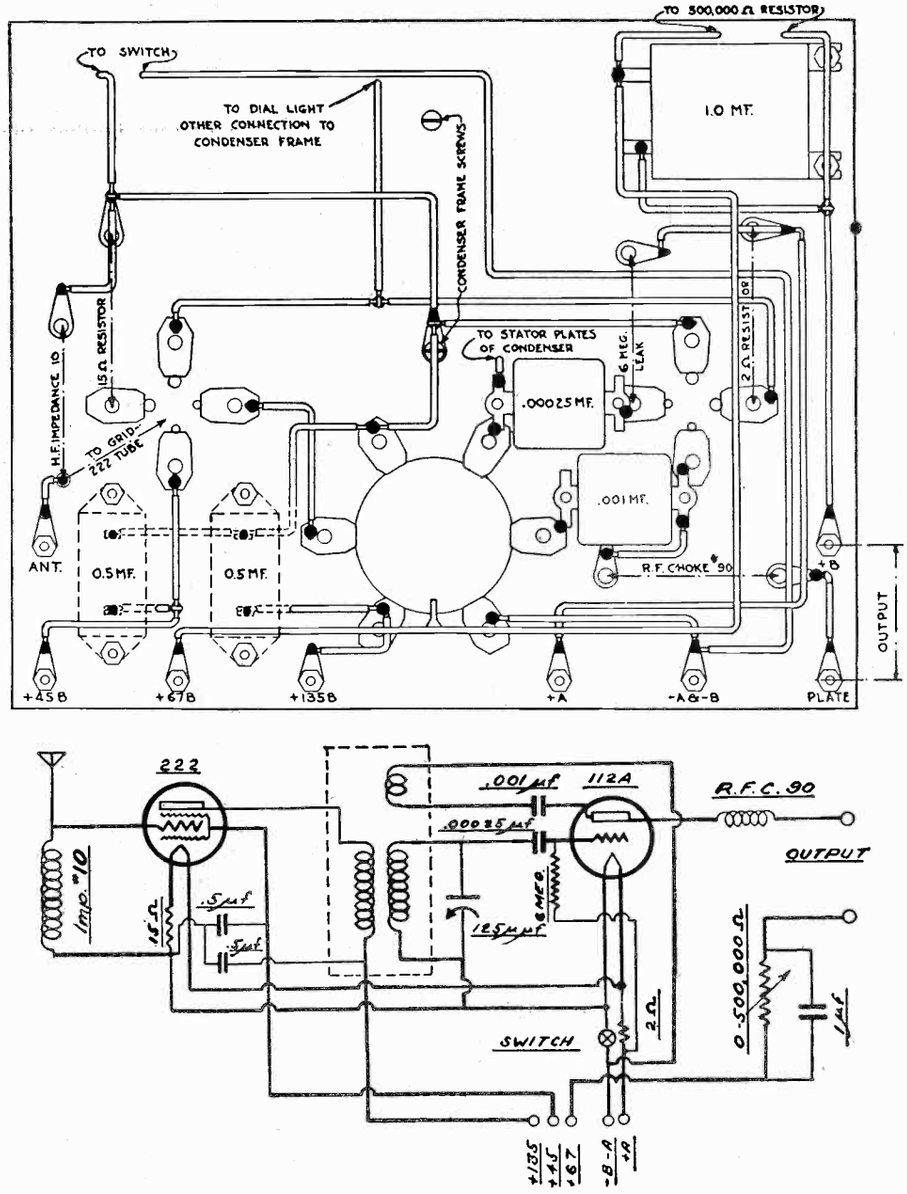

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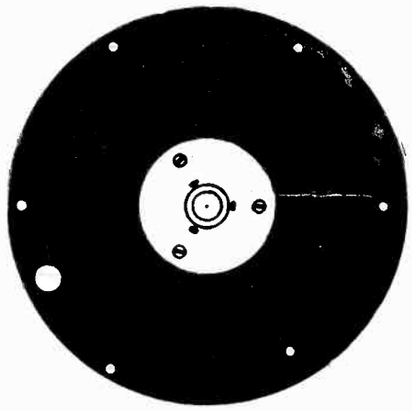
Learn About TELEVISION!



Expert articles in 16 issues give you a good understanding of this absorbing subject. Without such knowledge you may be up against it in trying to build a television receiver to tune in WGY, WLEX, WRNY, WCFL, 3XK (Jenkins) etc.

THESE ARTICLES TELL

HOW

to build a scanning disc to get WGY.
to build a receiver to get television.
to connect kino-lamp (neon)
to regulate motor speed to synchronize.

And Answer 500 Other Important Questions—These Sixteen Issues Sent FREE! (See Coupon Offer)

Titles of Articles on Television and Dates of Sixteen Issues of Radio World containing those articles.

1926

Eyes to Watch Scenes by Radio, by Conrad Nugent, Dec. 25. Illustrated by photograph of Dr. Alexanderson and his first television transmitter.

1927

The Advance Toward Television Told by Alexanderson in Absorbing Brief, by E. F. W. Alexanderson, Jan. 1.

Alexanderson in Address Explains Television Theory, Jan. 22, 1927. A Simple Explanation of Alexanderson Method of Television. Also, Television Set Being Planned by General Electric, by Herman Bernard. Both in Jan. 22 issue.

Baird Uses Infra-Red in His Television Tests, by Knollys Satterwhite, Jan. 29. A brief discussion on the use of infra-red light in television experiments and possible applications.

First Television Hookups Elucidate Alexanderson and Baird Plans, by Hector Wall, Feb. 26. Hookups illustrating the principles of transmission and reception of television.

New Television Advance Demonstrated, April 23. An account of the television demonstration between New York and Washington by wire and between New York and Whippany, N. J., by radio, conducted by the American Telephone & Telegraph Company.

1928

Television Quits Dream Road for Real Bumps. Also, The New Twist That Made Television Spurt, by Neal Fitzalan, an illustrated article comparing the Alexanderson seven-spot method of illuminating the picture to be sent, with the Gray innovation which overcame the chief difficulty in television transmission, that of adequate illumination without imposing dangerous light intensity on the subject. Also, Television Across the Ocean Claimed by Baird Company, Feb. 4. Also, Colored Television Due; Three Coils Suggested, Feb. 4. All four in Feb. 4 issue.

Movements of Woman in London Watched from New York by Television, by Neal Fitzalan, Feb. 25. An illustrated account of successful television experiments between New York and London by the Baird system.

Television in Five Years, Not Now, Says Trade, April 28.

Jenkins Demonstrates Silhouettes in Action. Also, Nakken to Broadcast Television from WRNY. Both in May 26.

How Television Is Tuned In, by Neal Fitzalan. June 9. A profusely illustrated article on the reception of television signals.

How to Connect Any Set's Output for Television Reception. An article with circuit diagrams showing how to connect the television receiving tube to the output of any radio receiver. Also, Automatic Television Synchronizing Apparatus, By Paul L. Clark. A richly illustrated article of a new system of automatically synchronizing a television receiver with the transmitter, invented by the author. Both in June 16.

The Effect of Wave and Frequency Distortion on Television Reception, by J. E. Anderson. June 23. The writer discusses the effect of wave form and frequency distortion in the transmission and reception apparatus on the received images. Illustrated with diagram showing the blurring effect of high frequency side band suppression.

Requirements for Television Reception, by J. E. Anderson, June 30. The author discusses the necessary conditions for retaining the high and the low frequencies in the side bands to prevent distortion of the received image and gives the design of a receiver which will not only give undistorted television images but which may be used as a high quality broadcast receiver.

Talking Television and How It Is Worked, by J. E. Anderson, July 7. A profusely illustrated article showing how talking television works.

Mechanical Problems in Television, by J. E. Anderson, July 14. Tells how to make disc for WGY reception, also how to avoid distortion due to mechanical conditions. Also schedule of WGY television broadcasts.

RADIO WORLD, 145 W. 45th St., N. Y. City:

Enclosed please find $6 for one year's mail subscription for RADIO WORLD, and you will please ship at once FREE the sixteen television issues as advertised and the Sept. 1st and 15th issues, 1928.

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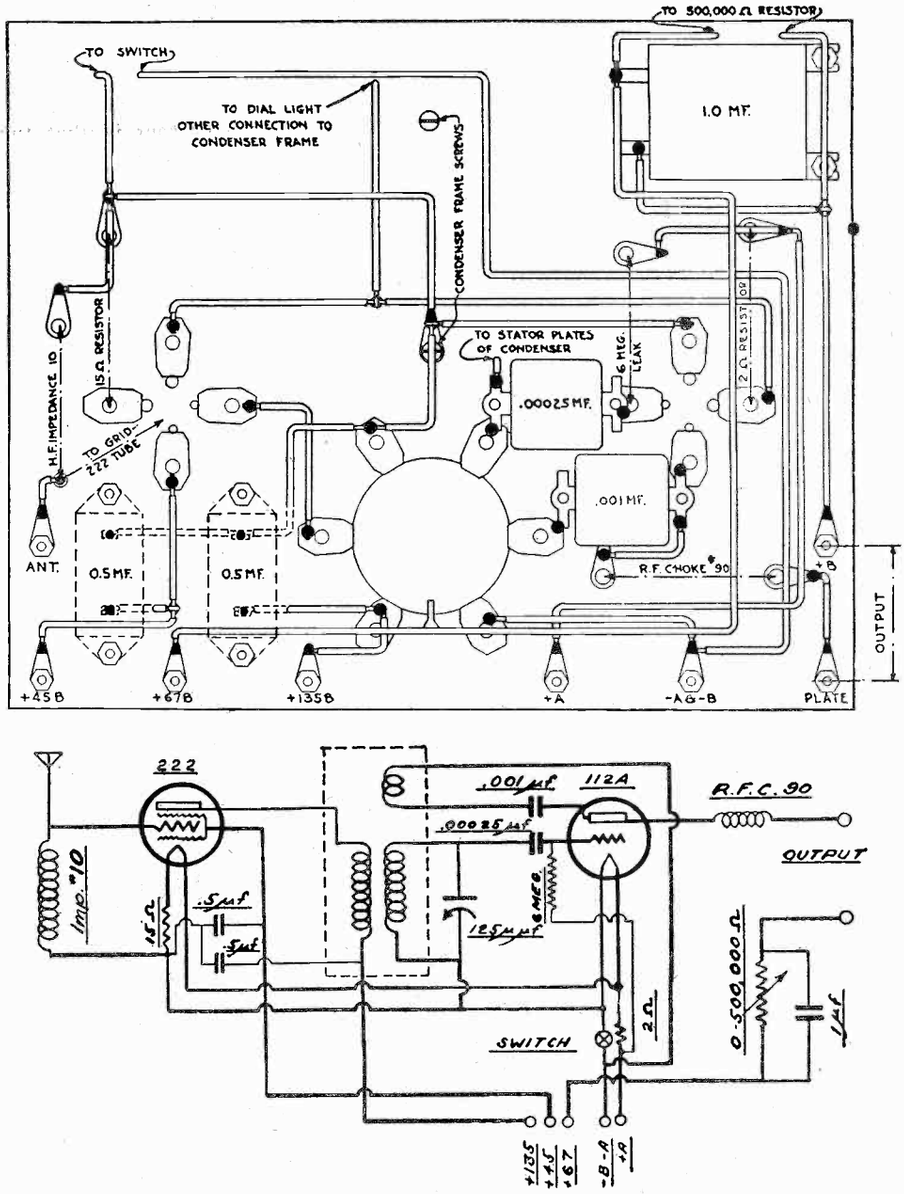

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Short Wave Circuit Easy Indeed to Tune

(*Continued from preceding page*)

And what a vast room the single tuning knob on the short-wave receiver opens up! It opens up the entire short wave field below 115 meters.

Impedance Input

One reason why a single tuning control can be used with a short-wave receiver is that a radio frequency choke coil of special design is put in the grid circuit of the screen grid tube. The high frequency current flowing in the antenna develops a high signal voltage across this coil. This voltage is amplified to a high degree by the screen grid tube and then delivered to the primary of the short-wave three-circuit tuner, specially designed to work efficiently with a screen grid tube.

The screen grid tube cannot go into oscillation for several reasons. The capacity between the plate and the control grid is so small that not even at the shortest wavelengths within the tuning range is there enough feed back to cause oscillations.

The aperiodic grid circuit in the screen grid tube still reduces the chance of oscillation in the first tube, and then the grid impedance coil and the grid lead of the tube have been placed so with respect to the three circuit tuner that there is not enough feed-back to cause any oscillations although no shielding is done.

The screen grid and plate supply leads have been by-passed by two .5 mfd. condenser placed so as to insure the shortest possible leads in which high frequency currents are flowing.

Regeneration in the detector is accomplished by the usual parallel feed circuit, that is by a condenser and tickler in series both connected across the output.

But the regeneration is not controlled by adjusting the condenser as is usual in short-wave sets nor by turning the tickler. Both are fixed, and that is one reason why the condenser may be logged. Any station comes in at the same dial setting every time. That is of utmost importance in a short-wave set where there is one or more stations for every division on the dial.

Control of Regeneration

The regeneration is controlled by adjusting the resistance in the plate circuit and thus by controlling the effective plate voltage. The variation is done by means of a 0-500,000 ohm resistor. Since this high resistance is in series with the output a one mfd. condenser is connected across it in order to prevent it from choking out the audio frequency output of the receiver.

A radio frequency choke R.F.C. 90 is put in series with the output to prevent the radio frequency currents from passing into the headset or audio transformer and to force them through the tickler. The adjustment of the tickler circuit and the variable resistance is such that about half of the total resistance is used for most of the frequency range when a good -12A tube is used.

The grid condenser is a .00025 mfd., which is shunted by a 6 megohm grid leak. The leak is connected from the grid to the negative end of the filament battery.

Micrometer Tuning

The tuning is done with a .000125 mfd., double spaced, National condenser, the capacity of which varies as the frequency. This makes the separation of stations at the short wave end as great as at the long wave end.

The tuning condenser is provided with a National, illuminated vernier dial which is micrometric in its motion.

A two ohm Equalizor is put in the positive lead to the battery. Through this the filament current of both the tubes flows. In addition to this ballast a 15 ohm Equalizor is put in the negative lead to the filiment of the screen grid tube. This not only limits the current in that tube to approximately the correct value but it also supplies the necessary grid bias to the tube.

A special six contact coil socket is used for the plug-in coils. This is so constructed that a coil can only be inserted in one way. The contacts formed are positive at all times. This is a very important feature because many coil receptacles do not make sure contact resulting in noisy operation or no operation.

Voltages Used

The voltage applied to the filament terminals is 6 volts. The voltage applied to the screen grid is 45 volts, that applied to the plate of the detector is 67½ and that applied to the plate of the screen grid tube is 135 volts.

The author has consented to furnish a complimentary blueprint of the screen grid short-wave receiver. Address James Millen, care of RADIO WORLD, 145 *West 45th street, N. Y. City. Also see his television construction article next week in the Show Number, dated September 15th.*

1,000 Watts in Face, Smith Is Televised

Governor Alfred E. Smith, candidate for President on the Democratic ticket, went to the electorate of the nation by voice and gesture on the day of his acceptance speech, when WGY, broadcasting an outside television pick-up for the first time, televised the Governor as he acknowledged the applause of the crowd before he began his speech.

Listeners tuned to WGY or to the short wave stations 2XAF and 2XAD, heard first a short explanation of what was to be expected and then followed a peculiar high-pitched tone, broken at varying intervals. This was the face of the Democratic candidate for President.

The peculiar tones heard on the loudspeaker were convertible into the moving image of Governor Smith by those properly equipped.

Transmission of the television signals on short wave permitted those at great distance to receive the signals unhampered and undisturbed by static.

The demonstration marked another advance in the fascinating art of television, and it was made possible by the simplification of the system of television transmission and reception by Dr. E. F. W. Alexanderson, consulting engineer of the General Electric Company and chief consulting engineer of the Radio Corporation of America.

The apparatus was erected at a short distance from the bank of microphones used by the National and Columbia broadcating chains for the transmission of the notification ceremonies. The set-up consisted of three pieces of apparatus, two tripod-mounted photo-electric cells housed in boxes little larger than a graflex camera, and the light source and scanning device in a box about half the size of a phonograph. This was also mounted on a tripod.

The photo-electric cells were placed at the left of Governor Smith, within three feet of his face and the light source was placed between the cells, face high.

The light from a 1,000-watt lamp, broken up by the scanning disc, played on the Governor's face. The photo-electric cells, which respond to the slightest changes in light intensity, caught the changing lights as the Governor moved his head, and these light changes, converted into electrical current by the photo-electric cells, were amplified and flashed to the transmitter of WGY, eighteen miles from the Capitol.

The electrical signals were then impressed on the antenna as in the case of speech and were flung out in all directions.

The loudspeaker converted these signals into sounds, but the experimenter with a television receiver equipped with a 24-hole scanning disc might have seen Governor Smith.

Six months ago in Schenectady, Dr. Alexanderson and his assistant, R. D. Kell, demonstrated their simplified home television receiver. Since that time they have been engaged on the other side of the problem, the simplification of the pick-up or transmitting apparatus, and the televising of Smith marked the first practical application of the equipment.

Much to Be Done

The General Electric Company said:

"The demonstration marked another step in the investigators' progress toward television for everyone. Much remains to be done, but the first appearance of television pick-up outside of the laboratory is a forerunner of the day when such apparatus will be as familiar as the present microphone, and it may sometimes be expected to find its place at all great public functions, at athletic events, etc., carrying not a verbal description of the event, but an actual picture.

"WGY is the pioneer station in the broadcasting of television programs. A regular television schedule has been maintained for the past few months.

"These programs, from fifteen minutes to a half hour in duration, are carried on primarily for the assistance of engineers in the development of a system of transmission and reception, but they are offered also to all experimenters who care to use them.

"Reports of reception of images have been received from Los Angeles, Detroit and several places in Pennsylvania."

Plea to Oust Stations Denied by Commission

Washington.

The Federal Radio Commission would not be justified in revoking the licenses of the radio stations controlled by the General Electric Company, Westinghouse Electric and Manufacturing Company, and the Radio Corporation of America, as demanded in resolutions adopted by the Radio Protective Association, it has informed the executive secretary of the association, Oswald F. Schutte.

The Radio Protective Association, representing a group of manufacturers, adopted the resolutions on August 3, making the charge of "disproportionate allotment to a few stations owned by the Radio Trust." The Radio Commission referred the matter to its general counsel, Louis G. Caldwell, and the denial of the request was the result.

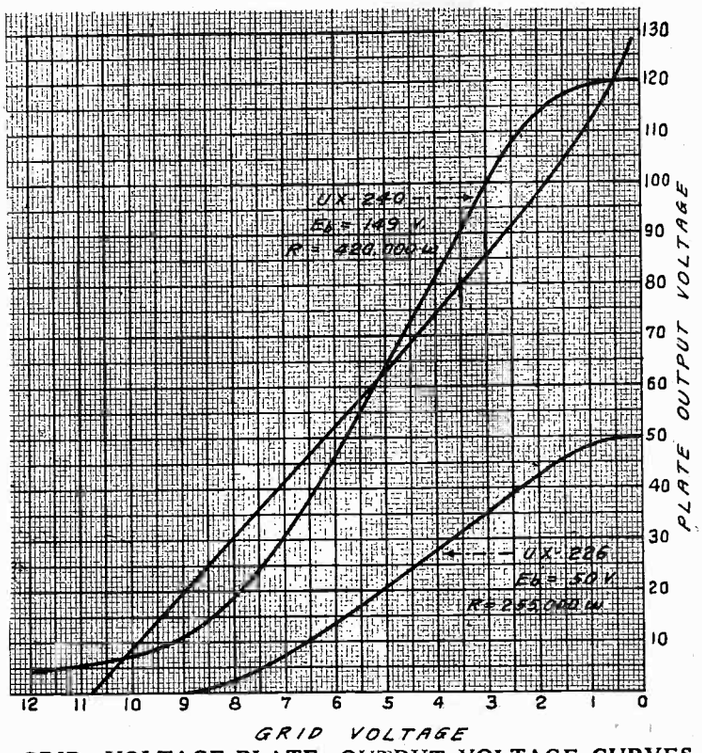
New Facts on AC

HIGHER PLATE AND GRID VOLTAGES AID QUALITY

By Capt. Peter V. O'Rourke

IN he course of development of a new amplifier it became necessary to obtain the characteristic curves of types —26 and —40 tubes with AC on the filaments, both tubes working into high resistance loads. The voltage required on the plate of the —26 tube was 50 volts and that on the —40 tube was 150 volts. Consequently grid voltage—plate output voltage curves were taken with these voltages applied to the plates, and these curves are reproduced in the accompanying graph.

Since the —26 tube has a comparatively low plate impedance a load resistance of .255 megohm was used for that tube. For the high mu tube a load resistance of .42 megohm was used, because that tube has a much higher internal resistance. These are actual values and not rated.



GRID VOLTAGE-PLATE OUTPUT VOLTAGE CURVES OF —26 AND —40 TYPE TUBES WITH AC ON THE FILAMENTS, HIGH RESISTANCE LOADS AND HIGH RESISTORS IN THE GRID CIRCUITS.

The shape of the curves obtained under these conditions is interesting, as it differs considerably from the shape of curves taken with DC on the filament. On page 12 in this issue curves taken on a high mu tube when the filament was heated with DC are shown. They are straight for low values of grid bias, whereas the curves obtained when the tubes were heated with AC have considerable curvature in the same region.

Effect of Grid Current

When DC is used on the filament the grid bias is measured from the negative end of the filament. As long as the grid bias with respect to the negative end of the filament is negative or zero no grid current can flow. Hence there will be no voltage drop in the grid resistor and the bias of the grid has the value applied. Hence the curve is straight up to the zero bias point.

When AC is used on the filament the bias is measured with respect to the midpoint on the filament. Hence one-half of the filament is negative when the grid bias is zero, and this is equivalent to a positive bias on the grid as far as the negative half of the filament is concerned. Grid current can therefore be expected.

If the effective voltage across the filament is 5 volts, the peak value is 7.07 volts, assuming regular wave form. Hence the peak value on either side of the midpoint is 3.535 volts. Hence it is to be expected that grid current will start to flow as soon as the grid bias is less than this value. The effect of this grid current can be seen at the upper end of the curve for the high mu tube in the graph, but there is no appreciable deviation from rectilinearity until the grid bias is 3 volts. For lower grid bias values the curvature due to the grid current is very pronounced. But the curve is such that the distortion introduced by the grid current is negligible down to 2 volts negative bias.

For high grid bias values the curve has the same shape as if DC had been used.

Higher Plate Voltages Necessary

In view of the curvature at the upper end of the characteristic, the straight portion of the curve is considerably contracted. To offset this it is necessary to use higher plate voltages when AC is used on the filament than when DC is used, to get the same range of undistorted output. It is also necessary to use high grid bias values for a given applied plate voltage, because the bias must be adjusted so that the operating point lies in the middle of the straight portion.

On the curve for the high mu tube given on the graph the optimum grid bias is 5 volts. This permits a grid voltage swing of 3 volts on either side of the operating point.

At 5 volts bias the voltage drop in the output resistor is 63.5 volts. At 2 volts it is 113.5 volts. At 8 volts is is 18.5 volts. Thus the amplitude of the positive half of the wave will be 50 volts and the amplitude of the negative will be 46 volts. Hence the distortion is about 8 per cent., which is not serious, particularly in the circuit in which the arrangement is to be used.

Curve for —26 Tube

The amplification indicated on the high mu tube curve is 18 in the neighborhood of the operating point, that is, at 5 volts.

The curve for the —26 tube is similar to that for the high mu tube, but it shows less curvature both at the lower and at the upper end. The effect of the grid current is noticeably less, which is to be expected, since the total effective filament voltage on that tube is only 1.5 volts. The peak voltage is 2.121 volts. Hence the effect of the grid current should begin at 1.06 volts. This agrees with the curve.

Just as it was necessary to use a higher bias on the high mu tube, so it is necessary on the —26 tube in order to keep away from the upper curvature. The optimum point on the curve seems to be at 4 volts. This permits a voltage swing of 2½ volts on either side of the operating point without appreciable distortion. The amplification at this point is about 7½ times.

The —26 tube is supposed to be the first in the amplifier, the high mu the second and a —71A the third. A voltage amplitude of 40.5 volts must be allowed for. From the higher curve it is seen that this will be obtained if the amplitude swing on the high mu tube is 2.25 volts, which is permissible without much distortion. To get a voltage amplitude of 2.25 volts on the grid of the high mu tube the input amplitude on the —26 should be .3 volt.

It is not at all certain that either the high mu or the —26 tube will work satisfactorily with AC on the filament in a resistance coupled amplifier. The percentage of hum in the output increases very rapidly as the plate current decreases. In the -26 tube the percentage of hum is least when the plate current is about 3 milliamperes. With 50 volts and 225,000 ohms in the plate circuit the plate current is only 211 microamperes, as indicated by the lower curve. The curve for the high mu tube indicates a current of only 151 microamperes. This tube will undoubtedly introduce more hum than the —26 tube.

The amplifier under consideration is such that hum is normally reduced. It is hoped that it will be negligible. If not, the —27 tube will be investigated for use in the first two stages.

The third curve in the graph is the voltage calibration curve.

New Handbook on Standards Issued

Nearly four hundred and fifty radio standards are defined in the fourth edition of the National Electrical Manufacturers' Association Handbook of the Radio Standards which has just been published. This is an increase of nearly fifty over the number of standards contained in the third edition of this handbook.

The fourth NEMA Radio Handbook contains 106 general standards, 97 transmitter standards, 121 receiver standards, 64 on power supply and 60 on vacuum tubes. There is also a listing or more than 700 subjects in a cross-referenced index. The handbook includes a number of tables and curves giving useful data on general purpose and audio output tubes.

The handbook is sold by the National Electrical Manufacturers' Association, 420 Lexington Avenue, New York City

A Series Filament

By Oscar

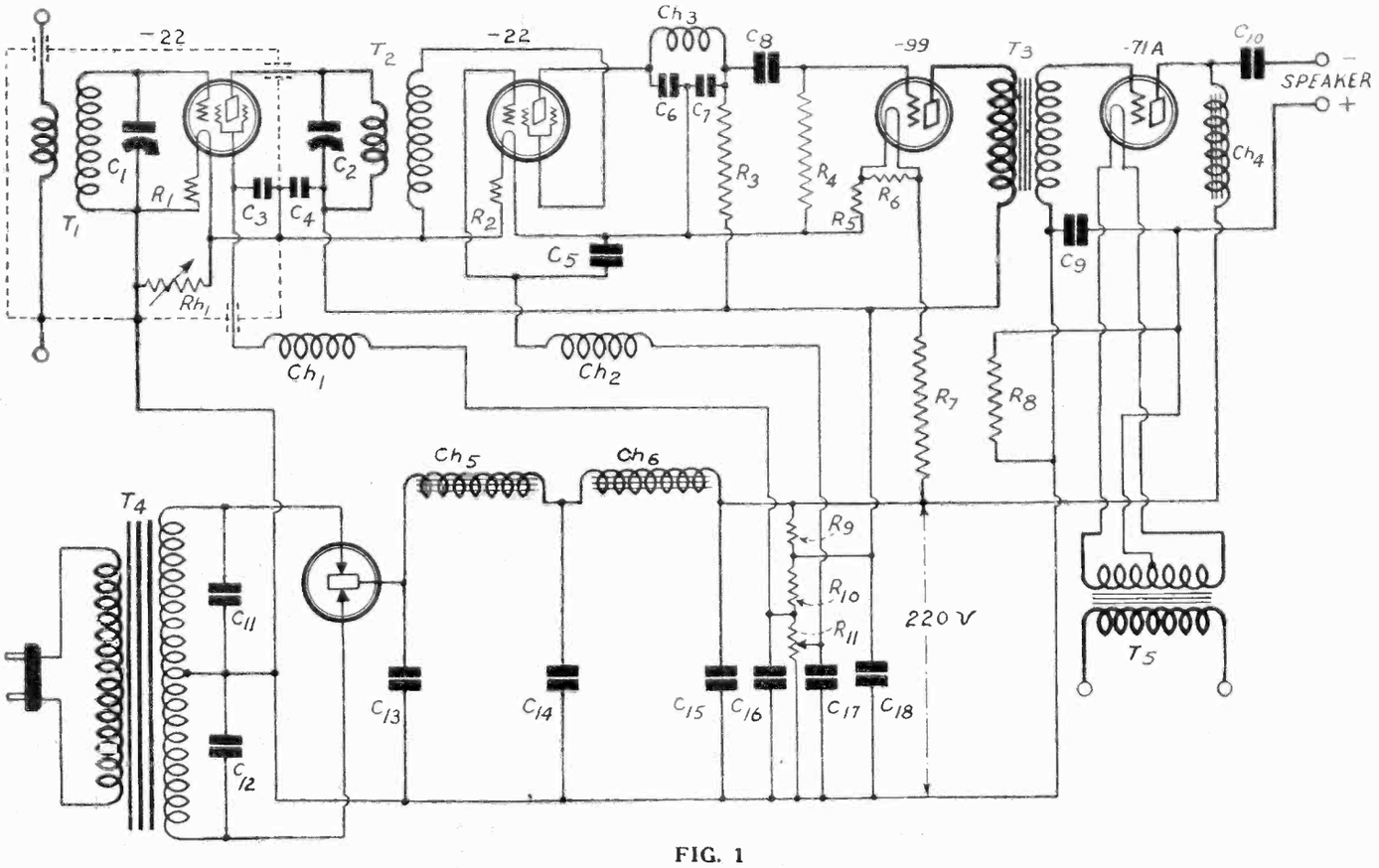


FIG. 1

THE CIRCUIT DIAGRAM OF A COMPLETELY ELECTRIFIED RECEIVER USING SERIES CONNECTED FILAMENTS.

THERE is a constant demand for electric receivers, sets in which no batteries whatsoever are used. The demand is for a receiver which can be plugged into a light socket and which can be controlled by a single switch, without any relays.

There is also a demand for screen grid tubes and of course the question is raised as to whether such tubes can be used in an electric set. The filament of this type tube is for direct current, although two or three manufacturers are making AC screen grid tubes.

An electric set incorporating the DC tubes may contain a rectifier and filter which is capable of delivering well-filtered direct current sufficient to heat the filament.

The best solution to the problem seems to be a circuit employing series connected filaments. Hence we shall discuss such a circuit.

Filament in Series

The screen grid tube takes 132 milliamperes on the filament and a terminal voltage of 3.3 volts. Hence if the rectifier and filter can supply about 175 milliamperes of ripple-free current there will be enough current for both the filaments and the plates.

Since grid bias is required on all the tubes and no batteries are to be used the bias must be obtained from voltage drops in external resistors, or in the filaments themselves.

The circuit under discussion is shown in Fig. 1, in which there are one screen grid amplifier, one space charge detector, one —99 type amplifier and one —71A amplifier. The filament current for the power tube is derived from a 5-volt filament transformer, and that for the other tubes is derived from the direct current delivered by the rectifier.

The filaments of the two screen grid tubes and the filament of the —99 are connected in series. Since the —99 tube only takes 60 milliamperes it is necessary to connect a suitable resistor R6 in shunt with the —99 tube filament. The value of this resistor can be determined easily. The voltage drop in it is to be 3 volts, since that is the filament terminal voltage of the —99 tube. The total current through the filament and the shunt resistor is to be 132 milliamperes. Hence the current through the shunt R6 is to be 132 minus 60, or 72 milliamperes. The value of R6 therefore must be 3 divided by .072, or 42 ohms. There is no commercial resistor of 42 ohms fixed resistance. The nearest size is 50 ohms, which may be used, because it increases the current in the —99 tube by only 10 per cent., 66 milliamperes going through the tube and the same amount through the shunt.

Grid Bias Resistors

R1 is put in the negative leg of the first filament to provide a bias for that tube. This bias should be 1½ volts. Since the normal current through this resistor is 132 milliamperes the value of R1 should be 11.4 ohms. A 10-ohm commercial resistor will do. To make use of the drop in this resistor for grid bias the grid return is connected to the negative end.

The space charge detector employs plate bend rectification and requires a bias of about 4 volts on the grid. This bias may be obtained in one of two ways. The grid return of the detector may be connected to the negative end of R1, or to the same point that the grid return of the first tube is connected. It may also be obtained by the use of a resistor R2 in the negative leg of the filament of the detector tube. In this case the grid return goes to the negative end of R2, as shown in the drawing. To get a drop of 4 volts in R2 the resistance should be 30 ohms. If a commercial resistor of this size cannot be obtained it may be built up by connecting suitable resistors in series, for example, one 25 ohm and one 5 ohm resistor. The value need not be exact, for there will be another control to adjust the detecting efficiency.

The bias on grid of —99 tube should be about 6 volts for the effective plate voltage used. This bias is obtained from the drop in R5. The value of R5 should therefore be 45 ohms. A 50-ohm commercial resistor may be used because the tube is not critical.

Adjustment of Filament Current

The source of voltage is 220 volts, which is many times too high to apply to the filament series directly. Hence a resistor R7 is connected in the series on the positive side. The value of this resistor is determined from the filament current and the difference between supply voltage and the drop in the filament series.

The current is 132 milliamperes. The total drop in the filaments and the grid bias resistors is 21.76 volts. Then if the supply voltage is 220 volts the difference is very nearly 200 volts. Thus R7 must have a resistance of slightly over 1,500 ohms. A variable resistance is preferable, one that will carry 132 milliamperes. The best way of adjusting it is to put a milliammeter in series and change the resistance until the current is 132 milliamperes.

The grid bias for the power tube is de-

Screen Grid Circuit

Hubert

LIST OF PARTS

T1—One antenna coupler for .0005 mfd. tuning.
T2—One RF transformer with primary wound for .0005 mfd. tuning.
Ch1, Ch2, Ch3—Three 85 millihenry choke coils.
Ch4—One 30 henry choke coil.
Ch5, Ch6—Two heavy-duty choke coils.
T3—One audio frequency transformer.
T4—One heavy duty power transformer.
T5—One 5-volt filament transformer, if T4 has no 5-volt winding.
C1, C2—Two .0005 mfd. tuning condensers.
C3, C4, C5, C8—Four .01 mfd. condensers.
C6, C7—Two .00025 mfd. condensers.
C9—One 4 mfd. condenser, 200 volt test.
C10, C13—Two 4 mfd. condensers, 1,000 volt test.
C11, C12—Two .1 buffer condensers, 1,000 volt test.
C14—One 8 mfd. condenser, 1,000 volt test.
C15—One 16 mfd. condenser, 1,000 volt test.
C16, C17, C18—Three mfd. condenser, 600 volt test.
R1—One 10-ohm resistor.
R2—One 30-ohm resistor.
R3—One 1-megohm resistor with clips.
R4—One 2-megohm resistor with clips.
R5, R6—Two 50-ohm resistors.
R7—One 1,500-ohm resistor to carry 175 milliamperes.
R8—One 2,000-ohm resistor.
R9—One 3,000-ohm resistor.
R10—One 3,600-ohm resistor.
R11—One 2,000-ohm potentiometer.
Rh1—One 200-ohm potentiometer used as rheostat.
One shield for first stage.
Five standard sockets.
Two screen grid tubes.
One —99 test tube.
One —77A type tube.
One BA Ralytheon tube.
Two vernier dials.

rived from the drop in R8, a resistor of 2,000 ohms. It should be noted that the 40-volt drop in this is subtracted from the 220 volt output so that effective voltage on the plate of the power tube is only 180 volts.

The plate of the first tube is returned to the 135-volt tap on the voltage divider composed of the three resistors R9, R10 and R11. The screen grid of the tube is returned to the 45-vole tap. The plate of the detector is returned also to the 135 volt tap, but this does not make the applied voltage 135 volts. It is less by the amount of drop in R2 and the detector filament.

That difference is of little importance, since a variable space charge voltage has been provided for. The cap grid is returned to a slider on resistance R11 so that the voltage applied to the cap grid can be varied from abont 9 volts minus to 36 volts plus. Normal voltage is 22 volts plus, measured from the positive end of R2. In practice it is adjusted for greatest detecting efficiency.

One Transformer Stage

The plate return of the —99 tube is also to the 135 volt tap. This gives the tube an effective plate voltage of 116 volts due to its position in the filament series. This voltage is somewhat higher than the maximum recommended, but it will stand up well with the grid bias provided for it.

Since a —99 tube is not designed for resistance coupling it is necessary to use a transformer between it and the power tube. The step-up ratio of the transformer insures that the signal voltage on the last tube is the maximum permissible before the —99 is overloaded.

The speaker is coupled to the power tube by means of the usual output filter. Note that the speaker is returned to the filament rather than to B minus. This connection has been found to give most volume, least distortion and at the same time least feedback through the power supply.

The screen grid and the plate supply leads are by-passed by condensers C_3 and C_4 each of .01 mfd. In series with the screen grid lead is an 85 millihenry coil Ch1. The object of C3 and Ch1 is to keep the voltage applied to the screen grid constant and free from radio frequency fluctuations, and hence to prevent feedback. C4 has a similar purpose in the plate circuit. No choke coil is used because the plate circuit is tuned, and itself offers a very effective impedance to feedback currents.

A similar filter, composed of a .01 mfd. condenser C5 and an 85 millihenry choke Ch2, is put in series with the cap grid lead in the detector. Its object is to keep the voltage applied to the cap grid constant with respect to radio frequency fluctuations.

In the plate circuit of the detector is a low pass, or high elimination filter composed of two .00025 mfd. condensers and an 85 millihenry choke coil Ch3.

These choke coils and by-pass condensers all serve to confine the radio frequency currents in their proper channels and to prevent feedback and oscillation. C9 across R8 has a similar purpose in the last tube. This condenser should have a capacity of at least 4 mfd.

The power supply circuit is designed around a 350 milliampere rectifier tube like the Raytheon BA. This calls for a large power transformer T4 and two heavy duty chokes Ch5 and Ch6. Also much larger filter condensers are necessary when the current drain is large than when it is small. In fact, the size of any one condenser should be proportional to the current drain for a given filtering action.

Recommended values for the various condensers in the filter are as follows: C13, 4 mfd.; C14, 8 mfd.; C15, 16 mfd.; C16, C17 and C18, each 1 mfd.; C11 and C12, each .1 mfd. Each of the two chokes should have an effective inductance of 15 henries or more at a drain of 175 milliamperes.

T5 is a 110—5 volt step-down transformer T4 has a five volt winding T5 is not of the power tube. If the power transformer T4 has five volt winding T5 is not necessary.

The 200-ohm rheostat across the filament of the first tube is used for two purposes. First, it by-passes the plate currents accumulated in the tubes above the first in the filament series and thus prevents excessive current on the screen grid tube filament. Second, it acts as a very effective volume control. This it does by reducing the heating current.

Six Sets to Be Taken on Byrd Expedition

The Byrd Antarctic Expedition is taking along three powerful transmitting and receiving sets, to be employed on ships at the base station of the party, together with a vast supply of tubes, accessories, parts and radio supplies in general, in an effort to insure communications with the outside world from the South Polar region.

The transmitters of the 500-watt, intermediate-frequency type have been supplied by the Radiomarine Corporation. One is installed aboard the S. S. "City of New York," another aboard the S. S. "Chelset." The third is intended for use at the base station of the expedition, which will be established on the ice. Three short-wave receivers have also been supplied, to accompany the transmitters.

Radio experts are of the opinion that the Byrd Expedition, by means of its three transmitters, will have little difficulty in maintaining communication with the outside world, at least with stations in South America and New Zealand and Australia, and quite likely with Radiomarine stations and U. S. Naval stations in this country. It is also expected that communication will be maintained between the base station and the planes of the expedition.

Washington.

The Federal Radio Commission assigned eight high frequencies, for temporary use, to the antarctic expedition of Commander Richard E. Byrd. The largest assignment of power was to the base operating ship of the expedition, the "City of New York," which is assigned the call letters of WFBT, and given power of 1,500 watts.

Four ship portable licenses to permit the parties to communicate with the base ship, and three licenses for the airplanes of the expedition also were assigned. Means also were provided for commercial communication. The assignments:

WFBT—Ship "City of New York"—General Public—600-705-800 meters, 1,500 watts. Also limited commercial license—750, 91.2, 68.1, 53.1, 45.59, 34.05, 26.55, 22.75, 17,945, 13,758 meters. Compass 800 meters. (Calling) 600, 53.57, 26.78, and 17,857 meters.

WFA—Ship portable—to operate in the vicinity of the vessel "City of New York," Byrd Antarctic Expedition. Limited commercial—same frequency as for WFBT limited commercial—500 watts.

WFD—Ship portable, same frequencies, 50 watts.

WFE—Ship portable, same frequencies, 7.5 watts.

KFK—Ship portable, same frequencies, 50 watts.

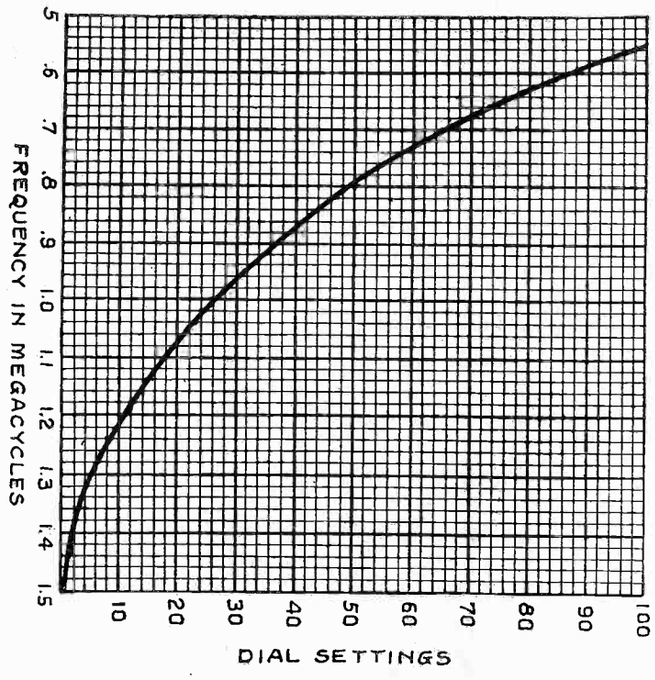
WFC—Aeroplane "Fairchild," same frequencies, 50 watts.

WFB—Aeroplane "Floyd Bennett," same frequencies, 50 watts.

WFF—Aeroplane "Fokker," same frequencies, 50 watts.

The 720 Screen Grid 6

By Miles Furness



THE CALIBRATION CURVE OF THE SECOND TUNING DIAL

[*The circuit theory and constructional details of the S-M 720 were described by McMurdo Silver himself in the August 18th and 25th issues. The permanent value of the receiver was discussed last week. Herewith is the final phase—the tuning of this super-sensitive receiver.*]

A VERY convenient aid in tuning in distant stations with the S-M 720 six-tube screen grid receiver is a calibration graph of the second dial. This is a graphic log of all stations received and a potential log of all stations not yet received. Such a graphic record of the stations received with the circuit in Chicago is shown in Fig. 1. In this graph the frequency in megacycles is plotted against dial degrees.

It is not to be expected that all points observed should fall exactly on the smooth calibration curve, for the frequencies of broadcast stations often deviate from the assigned frequencies and the dial setting for any one station tuned in is not always accurately done. But the curve gives the most probable dial setting for any station.

Suppose such a graphic log has been prepared and it is desired to make use of it for picking up distant stations not previously received. For example, it is desired to tune in WJZ, 660 k.c., from a point in the Middle West where this station is not easily received. The frequency of this station is always held constant to a high degree and it should be tuned in exactly as indicated by the log.

Entering the graph with the known frequency of .66 megacycles we find that this line crosses the curve at a horizontal line corresponding to 72.5 degrees on the dial. Hence the second dial should be set at the mark and the first dial should be adjusted until the first tuned circuit is in exact resonance with the second. WJZ should come in, provided that the volume control has been turned up to that required for the station.

It may be necessary to retouch the second dial to bring up the volume to the highest value. The graph can be read to the nearest half dial degree and for a distant station half a degree may mean the difference between a just barely audible signal and full loudspeaker volume.

The calibration curve of the second condenser in the S-M 720 receiver can be used as a means of identifying broadcast stations and thus save time often wasted waiting for announcements. DX hunters well know that many of the stations continue for an hour at a time without a single announcement. The annoyance of waiting is done away with if use is made of the graphic log.

Suppose the mid-Westerner tunes in a station at 77 on the dial. He knows that it is a distant station from the strength of the signal and the general noise level. What station should come in at 77 on the dial? Entering the log we find that the 77 degree horizontal line cross the curve at the .64 vertical line. Hence the station is operating on a frequency of 640 k.c. Now we have to consult a list of broadcasting stations to find that it is KFI, Los Angeles, which operates on that frequency.

Where many stations operate on the same wave the station received is not uniquely determined. To fix the station it may be necessary to consult a time schedule to find out which of two or more stations is supposed to be on the air at the time in question, and on the frequency found in the log. If two stations are operating on the same frequency simultaneously it will be necessary to determine by means of a loop from which direction the signal is coming. By that means it is possible to determine which one of several is being received.

Permanency of Calibration

If the dial is carelessly installed the calibration curves will not be constant. The dial may slip on the shaft.

While a calibration curve can be taken on any receiver, it is only on a well-constructed receiver that it would have any meaning the second time it was tested. If the receiver is made of well-constructed parts, both electrically and mechanically, and firmly held together the calibration curve will last indefinitely. The S-M 720 fufills requirements, because the chassis has holes drilled for the specified parts, and the whole assembly is easily done well.

In the S-M 720 the second dial controls three separate tuned circuits, all of which are accurately tuned to the same frequency, no matter what that frequency may be, so long as it lies in the broadcast band. And the accurate and rigid construction makes the adjustment permanent.

The first tuned circuit is separately tuned because of the effect of the antenna. The adjustment is such, however, that for most of the tuning range the dial for the first tuned circuit trails along with the dial controlling the three subsequent tuners. Thus it is a simple matter to tune in a distant station by means of the graphic log, for the exact setting for any station is found from the log for the second dial and a close approximation to the setting of the first.

The log can be constructed in a few minutes after a few dial settings have been obtained for stations of known frequencies. Most of these stations can be local or semi-distant. As soon as the frequency and the corresponding dial setting have been found for a number of stations the points are entered on a piece of cross section paper and a smooth line is drawn through all the points. If a point lies so that it requires a kink or sudden bend in the curve, the point is very likely inaccurate. Not until the point has been checked by another observation should it be allowed to put a kink in the curve.

Amateur Licenses Extended to November 1

Washington.

The licenses of all coastal, point-to-point, technical, and training, experimental, ship and amateur radio transmitting stations were extended until November 1, under a general order (No. 39) issued by the Federal Radio Commission. The order followed one made public extending the licenses of all stations in the broadcasting band, excepting those involved in the Commission's public service merit order, until October 1.

WBAL Women Soloists Are Mostly Blondes

Baltimore.

It may be true that "gentlemen prefer blondes" but the majority of women radio soloists at WBAL are brunettes.

Of 143 women musicians, including singers and instrumentalists, who have appeared on the air from this station within the past year, approximately 58 per cent have been brunettes.

Very few and far between are the women musicians who are really blondes—that is with the traditional golden hair. Indeed, Roberta Glanville, staff soprano, and Lady Baltimore, who conducts the WBAL Sandman Circle, are the only two of this station's regular broadcasting artists who are decided blondes.

This is an interesting observation.

The All-Wave Super

By Herman Bernard

A SHORT-WAVE mixer that worked very well in a Super-Heterodyne with a low intermediate frequency (about 70,000 cycles) is shown herewith. It is, indeed, the mixer for an all-wave Super, and represents an advanced stage of development reached in a series of experiments discussed from other angles in previous articles.

The short-wave coils used were those made by Pilot Electric Company. They are designed for tuning with a .00014 mfd. condenser across the secondary. However, in that fashion they reach only a little beyond WEAF, and as it is desired to obtain the full broadcast range, .00025 mfd. tuning condensers were used. These tuned from 600 meters to about 150 meters. By turning a switch, C6 and C7, both .00025 mfd. fixed condensers, were cut in. They are series connected with the tuning condensers and reduce the tuning capacity maximum from .00025 mfd. to .000125 mfd. Then you go down to the 150-meter level. Hence, you need not change the plug-in coils for the entire broadcast band, but merely by turning a switch can tune from 600 to 150 meters.

For higher frequencies the series connection is left intact, and the other coils are plugged in. There are four coils to a set.

Help Smallest Coil

The entire range was tuned in, as stated, except that the smallest coil did not always provide oscillation. The fixed condensers C2 and C3 were added, for their bypassing help, and oscillation was easier to produce when the smallest coils were used.

As shown in the diagram, two sets of coils are necessary. One set is for the modulator (first detector), the other for the oscillator. When you change coils in one you must change them in the other.

Each coil consists of a primary, a secondary and a tertiary. The primary and the secondary are self-interconnected, at a point numbered 2 on the base of the coil. This base has prongs that fit into a five spring socket of the Y type. This is the socket otherwise used for the AC detector tube, type 27. The interconnected terminals are represented by one H on the socket, and which may be distinguished as HC, where H stands for heater and C for cathode, HC being arbitrarily combined to denote the heater terminal nearer the C or cathode terminal on the socket.

Similarly, the other heater terminal could be HP, being nearer the P post of the socket.

As the socket is used as a coil receptacle, the terms "heater," "cathode," etc., have no relationship to any AC tube, but only to coil terminals, some of which go to the modulator and oscillator tubes of the mixer.

Tuning Keeps In Step

The tuning of both dials should "track." Especially as on the short waves you will want the readings to be about the same. This is accomplished by introducing a series condenser C5 in the oscillator's tuned grit circuit.

Assuming that each of the two circuits is independently tuned, set the modulator and the oscillator to bring in a broadcasting station. The oscillator should be at the higher frequency (usually lower dial setting). The readings will be off about ten degrees. Then make the oscillator dial read the same as the other, although you lose the signal. Turn the series condenser C5 with a wooden dowel, since this condenser is of the pressure type, until the station comes in as before.

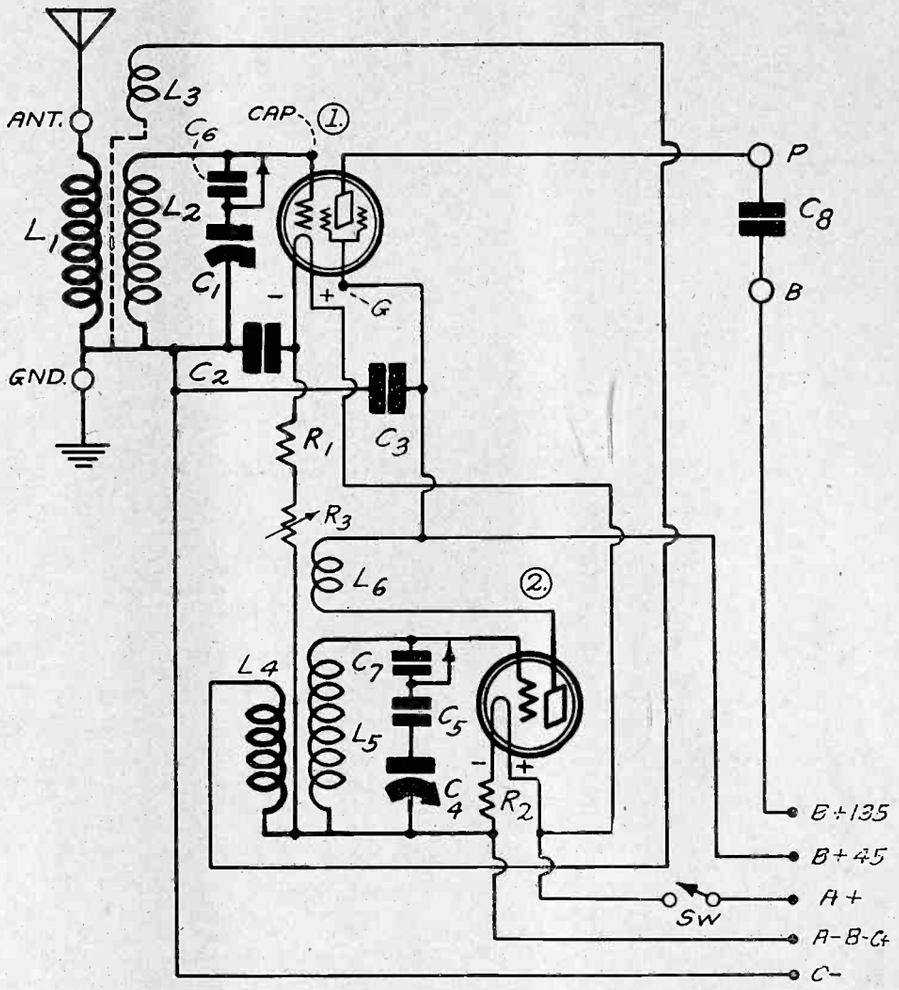


DIAGRAM OF AN ALL-WAVE MIXER FOR A SUPER-HETERODYNE WHICH WORKED VERY WELL IN CONJUNCTION WITH AN INTERMEDIATE CHANNEL OF LOW FREQUENCY (ABOUT 70,000 CYCLES.) SEVERAL INGENIOUS METHODS OF GETTING AROUND DIFFICULTIES ARE SOLVED IN THIS DIAGRAM, AND THE AUTHOR DISCUSSES THESE NOVELTIES, AS WELL AS TELLING OF EXPERIMENTAL RESULTS, IN THE ACCOMPANYING TEXT. THE TEXT GIVES SEVERAL CONSTANTS, EXCEPTING C2 AND C3, WHICH ARE .006 MFD. EACH, AND C8, WHICH IS .00025 MFD.

The modulator or first detector dial has not been touched, but the oscillator dial has been made to read the same as the other, and the series capacity used to make the frequency difference between the two equal to the intermediate frequency.

Focus on a High Frequency

The effect on the broadcast band is the same as on the higher frequencies, but it is advisable to make the adjustment all over again, when a short wave station is tuned in, because synchronous dial readings are most desired in that spectrum, and the dials may read a trifle off at high frequencies, although they read fairly well together in the broadcast band. It must not be supposed, however, even when the correction is made at a short wave length, that the dials will track absolutely through 150 to 600 meters. The effect of the antenna capacity upon the tuned secondary L2 makes this impossible. But the readings are near enough together.

If you make them alike at a reading of about 50 on some short wave the oscillator will have a slight tendency to run away from the other a trifle in opposite directions at opposite ends of the dial scale. But it is a great improvement over having them constantly apart.

As has been said, good results were obtained. That led to an experiment with single dial tuning, a trimmer being put across the oscillator tentatively, then removed from that position and put across the modulator. In the broadcast band that worked fairly, but not well. At short waves it failed. Therefore do not try to gang condensers for an all-wave Super. If you are going to use the cut-in series fixed condenser method, then by all means avoid ganging, because fixed condensers of the same marked capacity differ enough, though slightly, in actual capacity to ruin the whole plan.

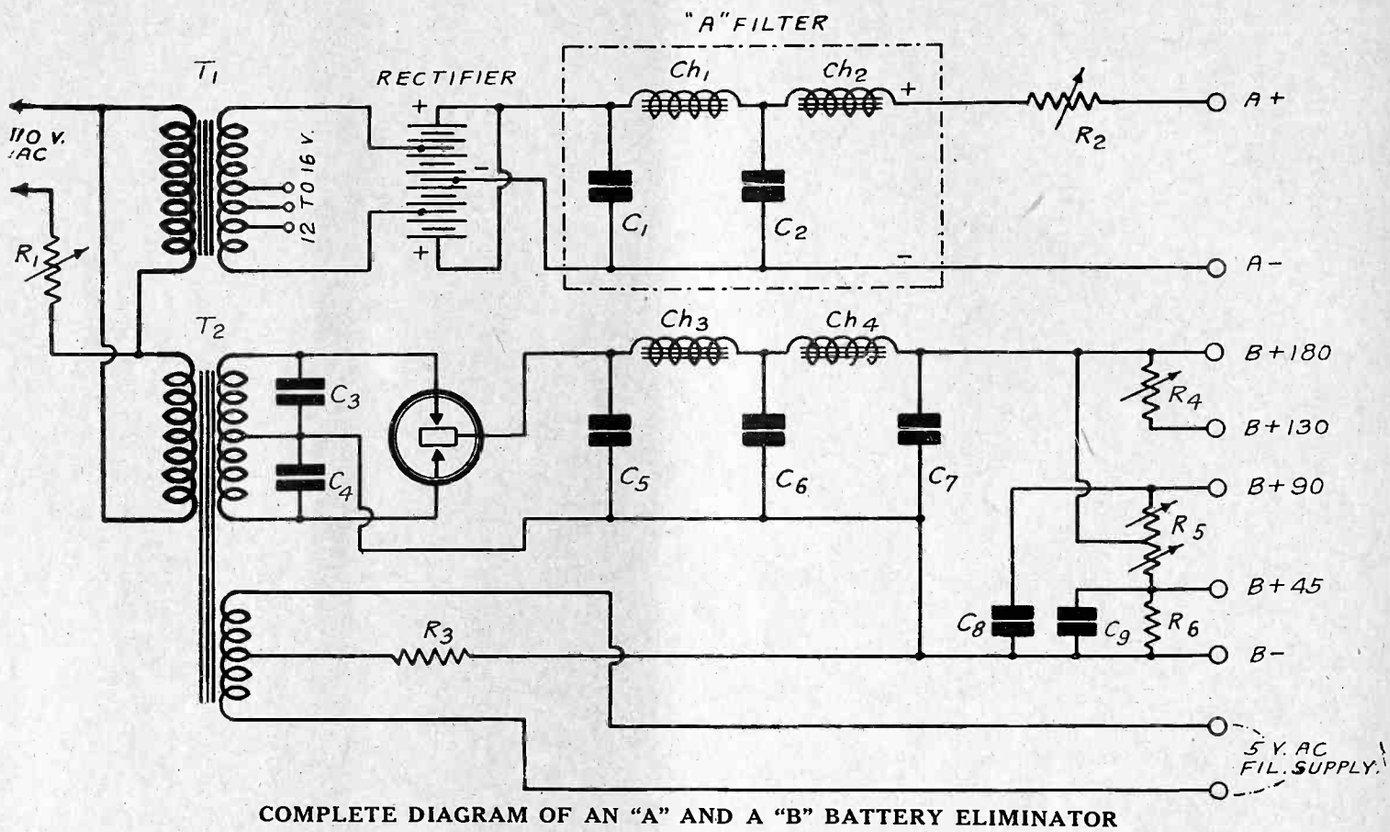
With a radio frequency transformer enough, though slightly in actual capacity, coil in the oscillator circuit, it was assumed that the two coils could be placed side by side, and the mutual inductive coupling would be all-sufficient for operation of the mixer. It was, on the broad-

(*Continued on page* 15)

Batteryless Opera

"A" Filter, Rectifier and

By Perry S.



COMPLETE DIAGRAM OF AN "A" AND A "B" BATTERY ELIMINATOR

IN the rush for the latest AC set developments it would seem that the millions of owners of battery operated receivers have become a "lost battalion," cut off and forgotten in the heat of battle.

Visitors to the annual trade show in Chicago were impressed with the fact that the only marked development over last year were the AC tube operated receivers and dynamic speakers. Now, both of these things were available in a limited way last year, so that this year it merely means that they have come into more general use.

Electrically and mechanically the better class of battery operated reecivers sold during the last two years are every bit as good as the new AC ones. The fan who wants to be relieved of the care of batteries is faced with junking his DC set or selling it for a song to get AC operation—unless he is shown the other and, indeed, brighter side of the picture.

A Filter Is Solution

The B end of the battery question has long been solved with satisfactory eliminators. The A end has just been solved, for this year sees a perfected A eliminator possible through research work of the Tobe Deutschmann Company, resulting in a first-class condenser and choke filter system for A current.

This unit combined with a good B unit gives the owner of the battery operated set complete dry AC operation, with all the advantages of his present set.

The saving in money is considerable and there are many who feel that this operation is quite superior to any AC tube operation.

This sort of a unit can be easily assembled. Since buying the parts and assembling the unit saves considerable money, and the use of the device is primarily an economical arrangement, the details of the building and construction of a combined A and B unit are presented herewith.

Ripple Is Removed

The diagram shows the parts and wiring of this supply unit. The upper part is the A end and the lower the B. Taking the A end, we have a transformer which steps down the incoming 110 volts AC to 12 to 16 volts. This in turn is fed into a metallic rectifier which converts it into direct current.

This current, however, still has a bad ripple in it, which would cause a loud hum in the set, so it is filtered through the Tobe A filter, consisting of a special condenser of 8,000 mfd. C1, C2 and two large chokes, Ch1, Ch2, which will permit the passage of the heavy current drawn for A work.

The actual voltage to the set is controlled by a 10-ohm power clarostat R2. It is advisable to connect a voltmeter across this line to insure against putting too great a voltage into the receiver.

The B eliminator is a particularly compact outfit and since the A eliminator is equally compact the whole affair is but little larger than several B batteries.

Just Turn the Switch!

Once this combination is completed and attached to your receiver your current troubles are over. No more batteries. Just turn the switch and your set will play indefinitely, as long as the house current is connected. You have perfect AC operation. When you replace a tube in this set it costs from one-half to one-third as much as an AC tube. The DC tubes have also been developed so many years that their life is long and uninterrupted service to the listener is assured.

Two input transformers are required. One is to be associated with the Tobe A Filter and the other is a part of the power compact.

The first operation is to mount all the parts on a wood sub-base, using a similar arrangement to that shown in photograph.

The input transformer for the A supply is mounted adjacent to the A Filter. Mount the Elkon dry rectifier on top of this transformer. Connect the rectifier as shown. Only four connections are required. If any other make is used, such as the Benwood-Linze, the instructions which accompany the unit should be followed. Not all dry rectifiers have the middle lug for the negative post.

Respect the Markings

As the A Filter will allow the current to flow only in the proper direction, care should be taken to observe these markings.

If you have a good two-ampere charger, such as a Tungar or Rectigon, you may substitute it for the transformer and rectifier specified in this article. In this case only two connections are necessary. Connect the red lead from the charger to the A plus and the black lead to A minus post of the rectifier side of the A Filter. You will not have full-wave rectification. This, however, is not necessary, as the charger and A Filter will supply humless A current.

Having completed the A supply, the B supply should now be wired. This is also very simple. The circuit diagram shows all connection points.

With arrangement as shown no C battery is required. If your set is not wired for this arrangement you can make the change very easily. Disconnect the wires on the filament lugs of your power tube socket and place insulation around the wires so they will not come in contact with any others. Connect these two lugs on the socket now vacant to two additional bind-

ion of DC Tubes

B Supply Solve Problem

Graffam

LIST OF PARTS

Ch1, Ch2, C1, C2—One Tobe A filter.
T2, Ch3, Ch4—One Thordarson 171 power compact.
T1—One Tobe step-down transformer 110 to 12 or 16 volts.
R1—One power Clarostat, 0 to 500 ohms.
R2—One power Clarostat, 0 to 10 ohms.
R3—One 2,000 ohm Tobe Veritas resistor.
R4—One standard Clarostat.
R5—One Duplex Clarostat.
R6—One 10,000 ohm Tobe Veritas resistor.
C3, C4—One Tobe buffer condenser.
C5, C6, C7, C8, C9—One Tobe 171 type condenser block.
One full-wave Elkon rectifier.
One Standard type socket.
One Raytheon BH tube.
Nine Elby binding posts.

ing posts for easy connections to the corresponding posts on the A and B supply. If your set is not wired for a C battery no other changes are required. If it is wired for a C battery connect the C minus binding post to the A minus post of your set.

Line Voltage Adjustment

A Duplex Clarostat R5 is used to divide and regulate the voltage for the B plus detector and B plus 60. Also a standard Clarostat R4 is shown for those who require three B plus leads beside the B plus 180 volts. If this is not required in your set, you may omit R4 and its associated wiring (two leads).

Two Power Clarostats are shown, one a low range R1, not more than 500 ohms being required, to regulate the 110 volts to the supply.

Voltage May Vary

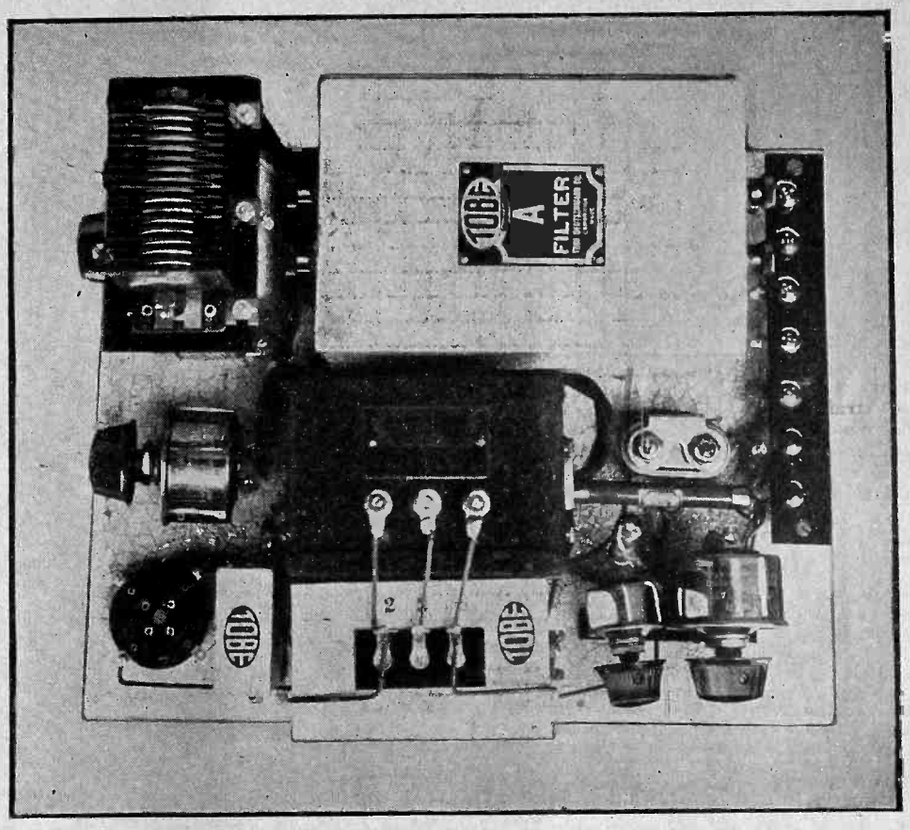
By test in various cities in has been found that this incoming voltage may vary from 100 volts to 125 volts, depending upon the time of day the readings are taken and local conditions. For this reason you should adjust your incoming voltage to as near 110 volts as possible. A good AC voltmeter should be used. If, however, you have a DC voltmeter you may regulate the AC supply by connecting your voltmeter on the DC side of your A and B supply and make adjustments to suit. If you are measuring between B minus and B plus 180, you can adjust until you are obtaining this voltage.

Limited to Two Amperes

The 10-ohm power Clarostat is connected in the A plus lead to your set, to regulate the A voltage to no more than 6 volts, depending upon the number of tubes in your set.

The total filament current of your tubes should not exceed 2 amperes. You can have eight 1-4 ampere tubes or fewer in your set. However, should you be using some of the very old types of tubes which draw one ampere or more of current, you must replace them with new tubes which draw less current.

You will also gain in the operation of your set with better signal strength and lower cost of operation.



ASSEMBLY VIEW OF TOBE "A" AND "B" ELIMINATOR

Line Control Needs Greater Resistance

By Charles Golenpaul

Clarostat Manufacturing Co., Inc.

The layman is often at a loss to understand why a line-voltage control fails to control. Such a device has variable resistance, yet it often makes little difference how much or how little of its resistance is employed. Why?

The answer is that voltage control depends on two factors, first the amount of resistance in the circuit, secondly, the current drain. The latter factor explains the mystery. Many line-voltage controls of the wire-wound type have a total resistance of 60 ohms or less, which, with the relatively low current drain of most radio power devices and electrified receivers, affords very little reduction of applied voltage.

The Wire-Wound Type

With the usual run of radio socket-power devices, a resistance range of from 25 to 500 ohms affords the necessary control of line voltage.

Unfortunately, such a high resistance cannot be obtained in a device of reasonable size and cost unless fine wire is used, and such wire does not provide a sufficient current-carrying capacity.

Hence the wire-wound line-voltage controls are generally suited to radio socket-power devices consuming 100 watts or more, and consequently have little or no effect when employed with the usual run of devices.

Compression Type

In compromising between high resistance and high current-handling capacity, it has been necessary to go to non-wire devices.

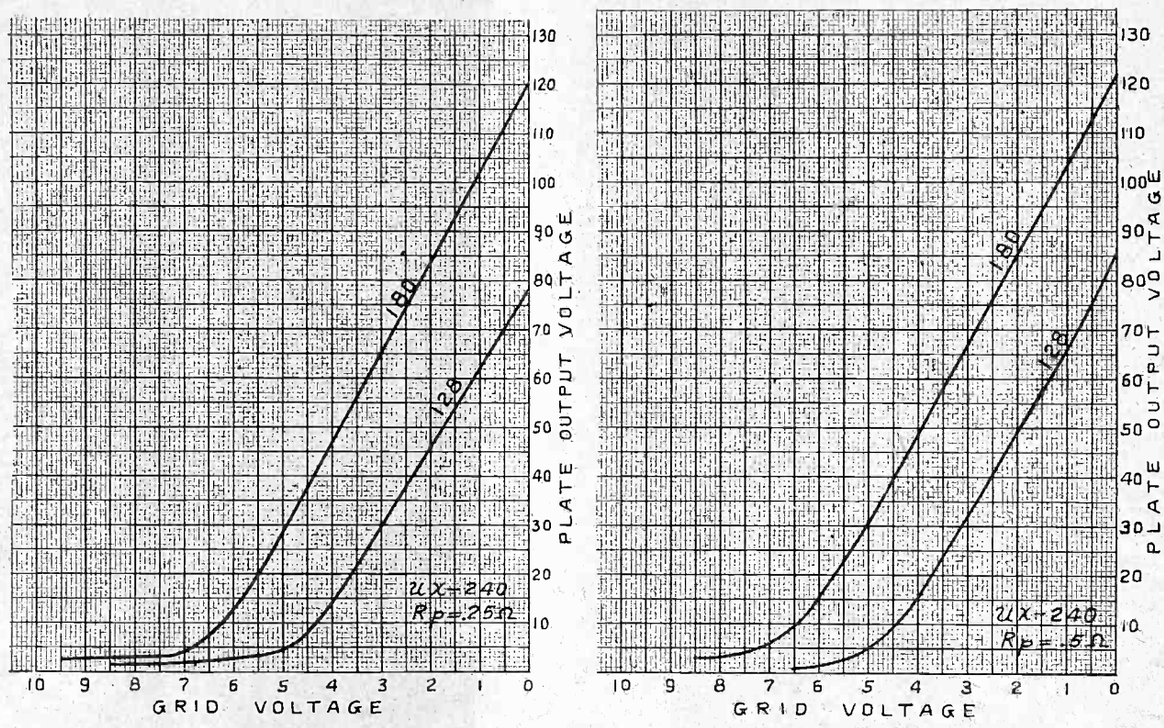
The power clarostat, with a resistance range of 25 to 500 ohms, and a current-handling capacity of 100 watts in the latest type provided with mica washers and asbestos packing ring, demonstrates the possibilities of the compression type of variable resistor. This device provides the necessary range of line-voltage control from 25 watts to 100 watts.

This range covers most receivers.

Quality with a High Mu

By J. E. Anderson

Technical Editor



Grid voltage, plate output voltage curves of a high mu tube into load resistors of .25 and .5 megohm for two different applied plate voltages. The curves are straight over the operating range, showing a high voltage amplification without any distortion.

ONE of the best methods of showing the performance of a high mu tube working into a high resistance is to take the grid voltage, plate output voltage curve under specific conditions and to study its shape. This curve shows whether there is any wave form distortion and it shows directly the voltage amplification that can be expected from the tube under the conditions specified.

If the curve is straight over the operating range there is no wave form distortion. If it is steep the voltage amplification is high. If the curve is bent there is considerable wave form distortion.

Four such curves taken on a UX-240 tube with 5 volts on the filament are shown in Fig. 1. The two curves at the left are for .25 megohm in the plate circuit and the two to the right are for .5 megohm in the plate circuit. One curve for each load was taken with 180 volts applied at the low end of the load resistor and one for each load with 128 volts applied.

Curves Almost Straight

A notable characteristic of these curves is that they are practically straight over a considerable grid voltage range. This indicates that there is practically no wave form distortion. Another fact is that for the higher plate voltage the curves are both steeper and more nearly straight than for the lower plate voltage. Thus for the higher voltage the amplification is greater and the distortion less.

For the 180-volt curves the amplification is slightly more than 18 and for the 128 curves it is between 17 and 18.

An unexpected feature is that the curves for the .25 and the .5 megohm loads are practically identical. It is true that theory predicts only a small difference in the amplification, but the difference is much smaller than the predicted value. This might be accounted for by the fact that the resistors used were of commercial rating, and that the actual value of the .25 megohm resistor was slightly higher, and that the .5 megohm was slightly lower than rated value.

The resistors used had been previously chosen because they were nearly as rated but they had been used in the meantime and they might have changed. But that is not as important as the fact that the curves are straight.

The only material advantage of using the higher voltage in the plate circuit is that the curves are more nearly straight over a greater grid voltage range. A much higher signal level may be used before overloading sets in when the higher plate voltage is used. Thus on the .25 megohm, 180-volt curve is a signal amplitude of about 3 volts is permitted, with a corresponding grid bias of 3 volts. On the .25 megohm, 128 volt curve the signal amplitude cannot exceed 2.25 volts, with the grid bias the same as the amplitude. About the same applies to the .5 megohm curves at the right in Fig. 1.

Drop in Plate Resistor

The ordinates in the curves are the voltage drops in the plate resistor. When the tube is coupled directly, without any stopping condenser between the plate of one tube and the grid of the next, the voltage drop in the resistor is the grid bias on the next tube, provided that separate plate voltage supplies are used for the two tubes, or an arrangement which amounts to the same thing. At this time it seems that this is an unimportant case, but it is not. Circuits of this type were published in the July 21st and July 28th issues of RADIO WORLD, and others and more practical circuits of the same type will be published in the near future.

Circuits of this type will receive much more attention in the future than in the past because of the special requirements of television amplifiers. In these it is necessary to amplify currents of frequencies as low as 16 or 18 per second to the same extent that currents of higher frequencies are amplified. A truly direct coupled amplifier is capable of doing this. If there is a stopping condenser in the lead between the plate of one tube and the grid of the next the low frequencies will be suppressed to a degree depending on the capacity of the condenser and the resistance of the leak.

If the condenser is used its capacity must be 1 mfd. or larger and the grid leak must be one megohm or more. Such a combination usually gives rise to a great deal of trouble on account of leakage through the condenser and the insulation and insufficient leakage through the grid resistor .

Weil and Zatulove New Sales Agents

A combination that should achieve great success in the radio field is that of the newly organized Martwel Sales Company with offices in the Paramount Building, New York City. Paul S. Weil, formerly sales and promotion manager of the Charles Freshman Company and who has been successful in putting over many other big operations, and Martin Zatulove, former supervisor of sales for the Freshman Company, comprise the firm.

This new sales organization, with sound merchandising plans and a vast experience, will act as exclusive representatives for a select list of radio and musical instrument manufacturers in obtaining resultful nationwide distribution of their products. Among the lines to be handled exclusively are the well-known Magnatron, a fine line of radio cabinets by a prominent Western Manufacturer, a high-grade dynamic speaker and an AC chassis. Several other lines are being considered.—J. H. C.

BOSTON SHOW IN OCTOBER

From October 1st to 6th the Eighth Annual Radio Exposition will be held at Mechanics Building, Boston.

Wood Horns—and Why

By James H. Carroll

Contributing Editor

THERE is something to be said in favor of each type of present-day reproducer and each has its sincere following. The exponential type, recently developed to its fullest efficiency, leaped at once into favor but lately not so much is heard of it. However, there are thousands in use today and the owners thereof consider them the finest.

The horn speaker of a non-exponential type is the earliest form of radio reproducer, the pioneer in loudspeakers. The earliest horns were crude productions, to say the least, but were better than nothing and their deficiencies were overlooked in the joy of hearing any kind of sound.

Low notes were not thought of at that time, and their lack passed unnoticed. It was sufficient to obtain a blare from the tall trumpet. The horn that produced the loudest noise was rated the best.

The Queen Flood

A weird crop of assorted sizes and shapes flooded the market and were as quickly snapped up by eager buyers. Some were tall and some were squat; some had narrow throats and wide bells while others had wide throats, albeit somewhat throttled, and skimpy bells. Some resembled the neck of a giraffe swallowing a cocoanut. Others resembled goose necks, partly goitred. Tone chambers were not considered in the scheme of things and tone travel was an unknown quantity. Some of these horns responded to low frequencies very poorly or not at all—mostly not at all—Others brought out the middle frequencies fairly, but all of them brought out the high frequencies best.

Although many may believe otherwise, no horn in itself is capable of amplification. Any horn, no matter of what type, shape or capacity, simply functions as a help to the diaphragm of the actuating unit, aiding it to obtain a grip on the air, which, in turn, enables a more efficient transfer of energy from the vibrating diaphragm to the atmosphere and thence to the listening ear via the long air column within the horn. This long air column, overlooked in design in the early horn, performs a most important function in evolving tone quality, in fact, it is the secret of success.

Amplifier Must be Good

The perfected horn should radiate uniformly over a wide range of frequencies. The entire range which perhaps is as yet, impossible of accomplishment. The perfect horn will respond equally to all sounds it is required to produce.

The true exponential horn, correctly designed and built, reproduces all frequencies uniformly down to a certain frequency called the cut-off point, below which no radiation takes place. Of course, if the transformers, audio systems or output tubes of the receiver do not supply the low frequencies to the reproducing unit—the soul of the horn—the horn, no matter how truly exponential, no matter how far the nicely balanced tone travel, how accurately calculated the air column, will not bring them forth.

Fine Results from Wood

A horn doubles in area every foot will respond well at 64 cycles per second, if long enough, while one expanding at twice the rate (hence half the length of the other) will reproduce well only down to 128 cycles. The higher the cut-off point will be in proportion, the greater the rate of taper.

The material used in making the horn is of great importance as the horn must be absolutely free from resonance. Horn resonance within the working frequency range, no matter how limited or great the range the horn may cover, works havoc with true tone reproduction. Certain pitches, those governed by the resonance cause, will be accentuated. Distortion results. This undesirable resonance may be due to incorrect design, but also is often due to the material used in the construction of the horn.

Therefore, the choice of proper material is highly desirable and it should be such that it cannot readily be set into vibration to give false or phantom overtones or undesirable harmonics.

Tin was once widely used and then rejected in favor of composition materials. Cloth and pressed fabrics and shredded fibres mixed with cement were among the materials used later. Paper mache and many of the fibres and composition yielded good results.

Of late, however, leading authorities in acoustics have gone on record for wood as the best tone producing material, and the author is inclined to agree with them according to his experiments along this line. Wood is used by the leading phonograph manufacturers for their orthophonic tone chambers which give such pleasing results. The organ, harp, piano, violin and the cello (the master instruments) owe their supremacy in the service of Orpheus to Nature's own material—wood.

Requires Length

The most efficient exponential horn should be extended until the bell has a diameter of about one-quarter of the wavelength corresponding to the low frequency cut-off point. In a horn constructed with the mouth having such a calculated diameter, the amount of resonance, if any, will be reduced to the unnoticeable minimum.

If the horn constructed is to be designed to reproduce as low as 64 cycles as the cut-off point, to determine the diameter of the mouth the velocity of sound in feet per second, viz, 1120, should be divided by 64, the frequency in cycles per second, and the result divided by four, which gives us about four feet four inches as the bell diameter. In case the cross-section of the horn is square or oblong, the bell area should be the same as that of a circular horn having this diameter.

The longer the path of the tone travel, providing good dimensional construction has been followed, the better the tone reproduction. The force exerted in vibrating the diaphragm of the reproducing unit will in part be used to overcome the radiation pressure of the air column within the horn and will be partly spent to overcome the inertia and stiffness of the diaphragm.

Comparison of Tone Travel

The highest effiicency is attained when the greater part of the energy going to the diaphragm is used in overcoming the radiation pressure. This result is attained if the horn was a high radiation pressure, which it has if the throat is relatively small in the proper proportion to the other dimensions.

In the average size horn for home use the throat may vary from three-eighths inches in diameter.

For the fan and experimenter to show off to the best advantage the fine quality of their sets a large horn with eight-foot chamber and about 100 inch tone travel with oblong bell measuring about 18x20 inches will answer the purpose well. Where space is limited, however, and lack of facilities for mounting exist, a medium size horn with a square or oblong bell, measuring about 12x15 inches and with a six foot tone travel, with a good, sensitive reproducing unit, may be used with good results. Where, for space reasons, the travel is shorter than would be desired, a baffle board helps atone for the shorter travel. The board favors low notes.

Good Results

The best horn should be exponential in shape and principle, but would take up to much room for most persons, hence a baffle board, housing a long tone-trave horn, meets general requirements excellently.

The efficient horn must also be designed with a slowly increasing cross section area in order to radiate the lower frequencies otherwise lost. The horn should have a large mouth to minimize horn resonance and conversely it should have a small throat so that the diaphragm will be given a high radiation pressure to overcome.

Compound Interest Law Is Followed

An exponental horn is one in which the cross-sectional area increases according to the compound interest law. The principal in the case is the area of the small end opening, that is the area of the hole just above the actuating unit. The diameter of this opening may be 5/8-inch, for example. The area of the circle would be .307 square inches.

The interest is the rate of expansion. The amount at any distance from the small end is the area of the cross-section at that point.

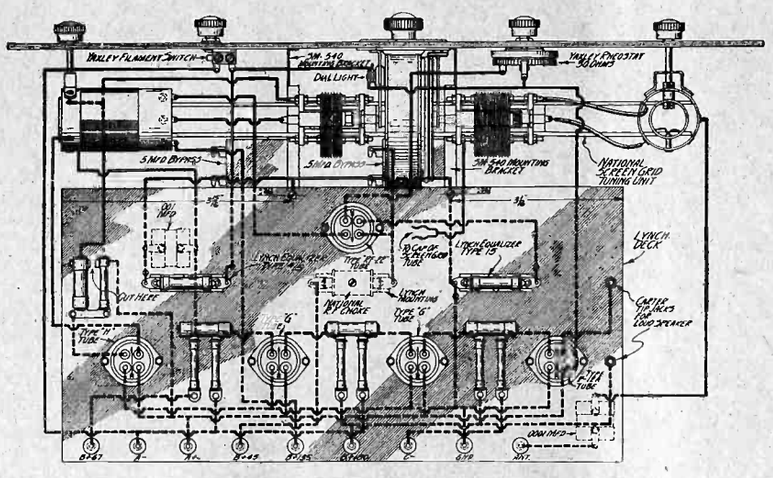
The cross-sectional area at any point from the small end is obtained by multiplying the initial area by an exponential involving the rate of expansion and the distance, just as the amount at any time is obtained by multiplying the principal by an exponential involving the rate of interest and the time elapsed.

The base of exponentials may be any number desired. The natural base **e** is about 2.72. The common base is 10, and the base used in the musical sale is 2. And this is a very convenient base. Using this the area A at any distance from the small end may be expressed $A=a\ 2^{rx}$, where **a** is the area of the small end, **r** is the rate of expansion and **x** is the distance. Suppose the area is to double at every foot of length. In that case **r** is unity. Then at one foot A is 2**a**, at two feet A is 4**a**, at three feet A is 8**a** and so on. If the horn is 6 feet long the area at the large end is 2 to the sixth power times **a**, or 64**a**.

Since the value of **a** for a 5/8-inch diameter was .307 square inches the area at 6 feet is 19.65 square inches. This is too small, and to make a practical horn six feet long the rate of expansion has to be greater. Suppose the rate is such that the area doubles every six inches. In that case the value of r is 2, the foot being taken as the unit of length. Then the area six feet from the small end is **a** times twelfth power of 2, or 4096**a**. This is the area of a circle having a diameter of 64 inches, which makes a practical horn.

The Greater N. Y.

By M. J.



THE GREATER NEW YORK SCREEN GRID FIVE, BUILT ON A LYNCH DECK, AND COMPRISING THE NATIONAL SCREEN GRID TUNING UNIT AND A THREE-STAGE RESISTANCE-COUPLED AMPLIFIER

LIST OF PARTS

One National Type 222 Tuning Unit.
One National Type 90 Radio Frequency Choke Coil.
One Lynch RF Choke Mount.
One Lynch Five-Tube Deck.
One Lynch Type 15 Equalizor with Mount.
One Lynch Type 4/5 Equalizor with Mount.
One Yaxley Filament Switch.
One Yaxley 30-ohm Rheostat.
Two Carter Tip Jacks.
Nine Binding Posts.
One Sangamo .001 mfd. Mica Condenser.
One Sangamo .0001 mfd. Mica Condenser.
Two Tobe .5 mfd. By-pass Condensers.
One Acme 8-Wire Cable.
One Pair Silver-Marshall Type 540 Brackets.
One Front Panel, 7 x 18 Inches.

FOR a receiver to function satisfactorily in New York, and I assume the same is true in nearly all other large centres, consideration must be given to the fact that most of the homes in centres of this character are within easy range of from fifty to sixty broadcasting stations. The receiver must therefore be very selective.

The majority of residents in large cities lives in apartment houses and the difficulty of erecting an antenna on the roof of the average apartment house is one which most folk find it difficult to overcome. The best solution of this problem is the use of a receiver requiring for its satisfactory operation an antenna which does not have to be on the roof but which may be laid around the picture moulding of the living-room or in some other way be completely hidden from view.

The receiver we consider here will perform in a very satisfactory manner with such an antenna of a total length of between thirty and fifty feet.

In a great many sections we find that alternating current is not available and the most satisfactory manner in which a receiver may be operated is by the use of a storage A battery, a direct current trickle charger and a group of heavy duty B batteries. The receiver described here performs in a very satisfactory manner where an arrangement of this character is employed. Where alternating current is available, a satisfactory storage battery and trickle charger with a good B eliminator form a good combination.

Uses Short Antenna

Another point in connection with the building of a receiver for use in urban territories is having the receiver small enough to be conveniently placed in the living-room without making it necessary to crowd the room by the addition of an extra piece of furniture.

The receiver we are considering is not very deep and the front panel measures only 7 x 18 inches. It is equipped with a very attractive illuminated dial and the entire assembly should improve the appearance of any room. The receiver lends itself admirably to installation in a book-case, high-boy, spinnet desk or one of the popular secretaries.

If one will look over the parts included in this receiver as they appear in the accompanying list, it will be observed that very few parts are necessary, that they are all of standard design and of a type easily procurable in almost any radio store. The total list price of everything necessary for the construction of the receiver is very modest. In view of the performance of which this receiver is capable, this low cost is a particularly attractive item.

Because the total filament current required by this receiver is slightly less than 1¼ amperes, it may be used with a very small storage battery and a trickle charger, such as a battery having 40-ampere-hour capacity. Where the receiver is operated on dry B batteries the author recommends the use of 135 volts in conjunction with a -12A power tube.

With this combination the total plate current drain of the receiver is approximately nine milliamperes. This means that the average life of a set of three heavy-duty B batteries would be between nine months and about a year and a half, depending upon how much the receiver was used.

If You Have AC

Where the receiver is to be used with an alternating current supply, it has been found to give greatest satisfaction in conjunction with a B eliminator of low interval resistance, such as the National type 7080, which is provided with the necessary voltage taps. Each is adjustable, so that the range of voltage covered by each tap is enough to take care of any variations that may be necessary to get the most satisfactory performance.

Where a high voltage eliminator such as the National, is employed, it is advisable to use a tone filter in the output circuit of the last tube, with a -71A tube instead of a -12A.

The accompanying picture diagram reveals the simplicity of the design, and construction of this receiver.

Some of the more important panel manufacturing companies, including the Lignole Manufacturing Company and the Cortlandt Panel and Engraving Company, are now providing front panels for this receiver already drilled and engraved, ready for assembly.

Selective Enough

The set was operated within 2,500 feet of WNYC, 526 meters, in the heart of the steel skyscraper section of New York City. The antenna used for demonstration purposes is approximately thirty feet long. WEAF, 492 meters, is some thirty miles distance.

We have no trouble whatever in eliminating WNYC completely and hearing WEAF, which is not an easy station to receive in this territory.

It is also possible to receive WJZ, 455 meters, 25 miles distant, with quite a blank space on the dial between WNYC and WJZ. The same is also true of WMCA, 370 meters, and WHN, 395 meters, both of which are approximately five miles from the point of reception.

Volume

For battery operation with a type -12A power tube with 135 volts on the plate enough volume is obtained from this receiver to fill a large living-room.

Where a B eliminator and type -71A power tube are used it is possible to procure more volume than is comfortable in an average sized living-room.

The tone quality is quite superior. Although the receiver is very sharp, it is not sharp enough to cut sidebands and thereby impair the tone quality.

The audio frequency amplifier is resistance coupled, which has a flat characteristic.

To obtain satisfactory sensitivity without many stages of tuned radio frequency and without the added difficulty brought about by shielding each stage in a metal container, advantage has been taken of the high amplification factor of the new screen grid tube. One such tube is used as the radio frequency amplifier. The amplification obtained from the antenna circuit in conjunction with the use of a tube of this character is so high, that if an ordinary -01A type or more specially if a -00A were used as detector there would be a tendancy for the detector overload on local stations. For this reason for local reception the use of a semi-power tube such as the -12A is recommended for use as a detector. The amplification factor of this tube is slightly higher than that of the -01A. If this receiver is to be used in a section far from a broadcasting station, it may be desirable to use high mu tube as the detector.

Assembly Is Easy

The audio frequency amplifier channel in this receiver is provided with two high mu tubes and one power tube.

In connection with the audio amplifier, it will be noted that all of the plates of the three audio tubes are supplied from

Screen Grid 5

eidman

the highest voltage on the batteries or the highest voltage on the B eliminator. The proper C bias for the first two audio tubes is provided by the drop across the filament Equalizors.

As nearly all of the necessary elements for the receiver, including the vacuum tube socket and the coupling units for the resistance coupled amplifier, are already made a part of the Lynch Five Tube Deck, the work of assembly has been reduced to an absolute minimum.

Then, too, the National Company's Screen Grid Tuning Unit includes the necessary coils for the Screen Grid radio frequency amplifier tube and the necessary condensers for tuning both the antenna and the detector circuit simultaneously with a single drum dial.

This tuning unit is used to hold the panel and the deck together by the proper placing of two machine screws and the S-M mounting brackets.

First Step in Assembly

The first step in the assembly is to place the rheostat in the hole provided for it on the front panel. Next the filament switch and the rheostat are mounted on the front panel and following this the National Tuning Unit is attached to the front panel by following the directions provided with the Tuning Unit.

Two holes will be found in the Lynch Deck, one on either side of the radio frequency tube socket. By placing a large enough washer on the bottom of each one of these holes to prevent the screw from going through, a machine screw may be passed through the hole and through the Lynch Equalizor Mount and thus employed to hold the latter in place. One mount is therefore mounted on each side of the radio frequency tube socket as shown in the accompanying illustrations.

The Lynch Deck is provided with a combination grid leak and condenser mounting which connects the two external ends of the two units to be held in place together. In the particular type of circuit employed in this receiver, as may be seen from the accompanying diagram, the grid leak is connected directly back to filament instead of across the grid condenser.

This means that the metal clips holding the condenser and grid leak in place, must be cut. This may be done with a file, a pair of tin snips or any of the simple means commonly employed by ingenious home constructors. The position of this cut is illustrated in the accompanying photographs.

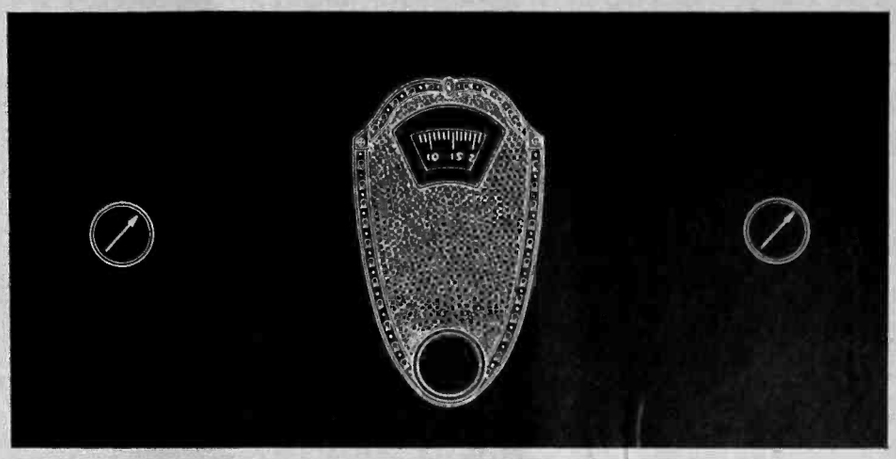
The next operation is to measure off and drill two additional holes in the SM type 540 mounting brackets as indicated in the general drawing. These holes may be drilled with a number 19 drill.

A Bracket Convenience

The Silver-Marshall type 450 brackets may be used without drilling of any kind if the holes already provided in the bracket are used to pass machine screws which held the bracket directly to the bases of the National condensers which form a part of the National Tuning Unit. A lock washer, nut and screw are then placed through the front end of each bracket and screwed up until bearing tightly against the front panel.

The eight binding posts may now be applied to the Lynch Deck.

Measure off and drill two holes for mounting Deck to the S-M type 540 bracket. If 8/32 machine screws are used, the holes should be drilled with a No. 19 twist drill. If 6/32 machine screws are to be used the holes should be drilled with a No. 27 drill.



THE FRONT VIEW OF THE RECEIVER BEFORE THE RHEOSTAT AND SWITCH ARE MOUNTED. THERE IS ONLY ONE MAIN TUNING CONTROL, THE DIAL. AT LEFT IS THE TRIMMER KNOB, AT RIGHT THE TICKLER KNOB.

The brackets are now attached to the Deck.

A small hole is drilled through the Deck for mounting the Lynch Mount used to carry the National RF choke coil. The directions given above for the drilling of the holes may be followed in this instance.

The entire Deck assembly may now be joined to the front panel assembly by two machine screws which go directly into the lower portion of the Screen Grid Tuning Unit condenser frame.

It is always best to finish the wiring of the filament circuit first and then it is well to test the work done before going on with the wiring of the plate and grid circuits. The wiring of the dial light is considered to be part of the filament circuit. Once the filament circuit has been completed the remaining wiring will be found equally simple.

Since the antenna circuit of the National Screen Grid Tuning Unit is provided with an inductive trimmer, any variation between the tuning in the antenna circuit and the detector circuit is counteracted by a simple movement of this trimmer.

Fits Screen Grid Tube

This unit is also provided with a special high impedance transformer designed particularly for use with a screen grid tube.

About 45 volts are applied to the screen grid of the radio frequency tube, 67½ volts to the plate of the detector tube, 135 volts on the plate of the screen grid and high mu tubes, and 135 or 180 on the last three audio tubes. Slight variations in these voltages may be found to be advantageous for the particular tubes employed in your receiver, as each tube is likely to vary slightly from any other tube of the same general character.

THE ALL-WAVE MIXER

(*Continued from page* 9)

cast band. But troubles enough developed at higher freqencies, and this system likewise is recommended for strict avoidance.

Keep the two coils at least 5 inches apart, and couple them as shown.

This coupling consists of connecting the free end of L4 to the end of L3. You have your choice of leaving the other terminal of L3 open, or connecting through a fixed condenser. But quietest, smoothest and slickest operation was obtained with the second terminal of L3 unconnected conductively. There is, of course, a coupling between L5, L4, L3 and L2, and it is mainly through the distributed capacity of the windings of these coils. It is all-sufficient for the wide broadcast and short wave range covered by the tuning system.

A screen grid tube negatively biased is used as the first detector. This improves selectivity. A high mu tube (type —40) may be used here, instead, if you have one on hand, but if you're going to buy a tube you might as well make it a screen grid, as the results were just a trifle better.

The volume control is a rheostat in series with the 622 Amperite R1. This also gets rid of any oscillation that may creep into the modulator at the very high frequencies, although no trouble of this sort was encountered in the two laboratory models contructed.

The intermediate frequency must be low for high frequency Super-Heterodyne work, otherwise the intermediate frequency will be one of the frequencies to which the mixer is tuned. When that occurs there's trouble aplenty—no reception or frightful squealing or strangely dissimilar tuning or large surges of plate current or—well isn't that enough? With a low intermediate frequency, say 70,000 cycles (4,300 meters), no such trouble is experienced.

This mixer has been tested carefully and the diagram herewith is recommended to advanced Super-Heterodyne students and specialists, although obviously it is too difficult for the run of fans to tackle without the aid of a blueprint. At present there is no blueprint, but an announcement concerning one will be published soon, and any who desire advance information may obtain it by addressing the author.

[Questions concerning an all-wave mixer for a Super, together with types of intermediate channels, tuning condensers, coils, tubes, etc., to use, will be answered by the author. Address him: Herman Bernard, c/o Radio World, 145 West 45th Street, New York City.]

Radio University

A QUESTION and Answer Department conducted by RADIO WORLD, by its staff of experts, for University members only.

When writing for information give your Radio University subscription number.

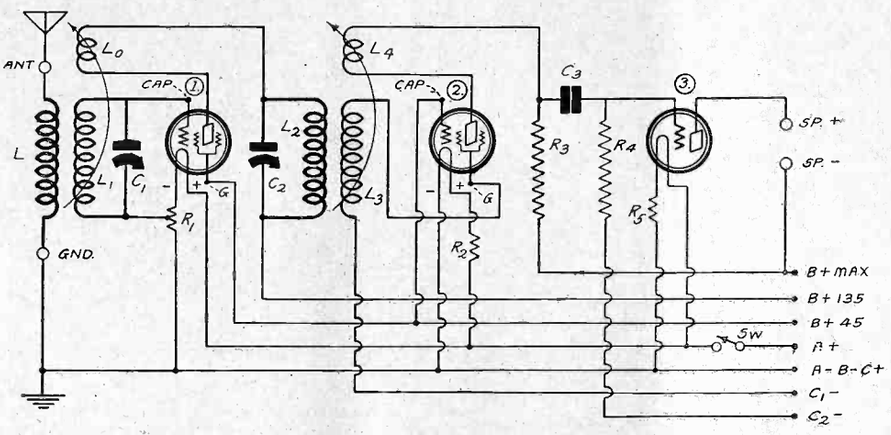


FIG. 713

A THREE-TUBE RECEIVER WHICH HAS BEEN FOUND TO BE EXCEPTIONALLY SENSITIVE. REGENERATION IS USED IN BOTH THE SCREEN GRID AMPLIFIER AND SPACE CHARGE DETECTOR. CIRCUIT REQUESTED BY WILLIAM H. BURTON.

PLEASE PUBLISH a circuit diagram of a three-tube receiver using a screen grid amplifier, a space charge detector and one stage of resistance coupled audio amplification.

(2)—If there is any advantage in regenerating in the first tube as well as in the second please show how it can be done.

WILLIAM H. BURTON,
Chattanooga, Tenn.

(1)—Fig. 713 shows this circuit. The primary of the inter-tube coupler is tuned in order to get a high impedance in the plate circuit of the screen grid amplifier.

(2)—Some advantage is gained by regenerating in the first tube as well as the second. The tickler Lo should be a small coil of a few turns. It may be adjusted once and then left fixed in position, as may the other tickler.

* * *

I WISH TO CONSTRUCT a low pass filter for taking the needle scratch out of the output. Please give the required data. I wish to make the cut-off at 8,000 cycle per second, and it is to work between a pick-up unit and the grid circuit of a tube.

FOLKE SODERMAN,
Duluth, Minn.

You need one radio frequency choke coil of 85 millihenries and two condensers of .01 mfd. each. The connection was shown in lower right corner of Fig. 1, page 6, RADIO WORLD for Aug. 25.

* * *

WHEN I MEASURE the voltage of my A battery eliminator it measures the correct value but as soon as I turn on the filament switch it drops to zero. What causes this?

(2)—Can an A battery eliminator be used satisfactorily without any filter chokes?

(3)—What capacities should be used in the A battery eliminator?

(4)—Are electrolytic condensers satisfactory for this purpose?

SAMUEL LUTZ,
Cleveland, Ohio

(1)—It is possible that you have grounded the negative side of the filament circuit in the set and the positive side in the A battery eliminator. When you close the filament circuit you short-circuit the eliminator, hence there is no voltage across the meter. This is likely to damage the eliminator in a short time. Try to reverse the connections or else remove one of the grounds.

(2)—No. Some inductance is necessary to choke out the ripples.

(3)—Two condensers of a total capacity of 8,000 microfarads should be used, or more.

(4)—They are the only condensers we have of such high capacities.

* * *

WHICH IS THE BETTER method of coupling the loudspeaker to the receiver, by transformer or choke and condenser?

(2)—I have noticed that in some cases the loudspeaker and condenser are connected across the choke coil and in other cases from the plate to the filament of the tube. Which is better?

(3)—When a push-pull output stage is used, which is the better way to connect the speaker, from plate to plate or to the secondary of the transformer?

(4)—Can a dynamic speaker be connected in the same way as a magnetic speaker?

RUDOLPH BANNERMAN,
Laredo, Texas

(1)—That depends on the tube and the speaker. If the tube has approximately the same impedance as the speaker it is better to connect the two by condenser and choke. If the impedances differ considerably it is better to use a transformer to match impedances.

(2)—It is better to connect the condenser and speaker from the plate to the filament, but when this connection is used a higher voltage test condenser must be used.

(3)—This also depends on the impedances of the tubes and the speaker. If the impedance of the speaker is twice that of each tube it is better to connect from plate to plate. If the impedance of the speaker is considerably less it is better to use a step-down transformer.

(4)—Usually not, for the impedance of a dynamic speaker is very low. A step-down transformer is necessary. If this is built into the speaker assembly the speaker may be connected directly to the tube in the ordinary fashion.

* * *

I HAVE NOTICED on listening to very high pitched sounds that my head must be in a certain position to hear it. If I move a few inches one way or the other the sound disappears. Why is that?

FRANK COWLEY,
Lincoln, Neb.

To hear a sound the ear drum must be at a position of high sound pressure. If it is at a pressure node maximum, or velocity maximum, no sound is heard. When the ear drum is at a pressure maximum the sound is loudest. The distance between a node and a maximum is one-half wavelength. At 10,000 cycles the wavelength is about 1½ inches.

* * *

THE HOLES in some scanning discs are round, in others square, in still others they are oval and in some they are radial. Which type of hole is the best?

(2)—What is the best size for a scanning disc?

(3)—Can a transformer coupled amplifier be used for receiving television?

MAURICE FLINT,
Chicago, Ill.

(1)—Radial holes are best for a disc scanning device.

(2)—There is no best size for a scanning disc. The size of the disc to use depends on the size of neon lamp that is used for reception.

(3)—Yes, if good transformers are used good signals may be received. James Millen used transformers in his television, with which he received Washington, D. C., at Malden, Mass., a distance of 500 miles.

THE SHOW NUMBER of Radio World, dated September 15th, will be outstanding. Out next week! Get it "for sure!"

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 .....

C. F. Searle, Box 525, Hallandale, Florida
L. A. Miller, 988 Bergen Street, Brooklyn, N. Y.
Geo. W. Weaver Saxton, Penna.
F. W. Herrman, Jr., 128 Colidge Hill Road, Watertown, Mass.
Richard W. Vogeley, 100-26 92nd Avenue, Richmond Hill, N. Y.
A. D. Muldoon, 1028 Oliver Bldg., Pittsburgh, Penna.
Robert Jones, 904 Taylor Street, Ft. Worth, Texas
Sgt. H. A. Tunks, c/o Air Corps Technical School Chanute Field, Ill.
F. E. Danforth, 1658 10th Ave., San Francisco, Calif.
F. I. Cadon, c/o Kansas Power Co., Topeka, Kansas
Adolph Elfers, 31-10 35th St., Astoria, N. Y.
J. H. Stehn, 6413 Funston Pl., Middle Village, N. Y.
Harold Clift, 6721 8th Ave., Brooklyn, N. Y.
Dr. J. W. P. Smithwick, LaGrange, North Carolina
F. Flores, 1527 Baker St., San Francisco, Calif.
Herman Felscher, 1085 Simpson St., Bronx, N. Y.
E. L. Martin, 222 So. 2nd St., E. Cedar Rapids, Iowa
John Calabrisi, 10 Auburn St., Lawrence, Mass.
Al. Nordin, 96 Main St., Wellsville, N. Y.
E. Gardner, 460 Washington St., Springdale, Penna.
R. D. Scanlin, 114 Hospital Pl., Sayre, Penna.
Robert Wurlitzer, R. R. 2, Box 108, Little River, Miami, Fla.
I. V. Roger, Woolrich, Penna.
K. O. Peterson, Mine, Anyox, B. C., Canada
A. Pache, Radio Service, 252 W. 22nd St., N. Y. C.
W. Murray, 725 W. Tioga St., Philadelphia, Penna.
B. T. Baggott, 1015 Monroe St., Baltimore, Md.
Robert Barber, 817 W. Oak St., Fort Collins, Colo.
John Feiker, 701 E. Franklin St., Raleigh, No. Carolina
Fred Allard, c/o Kansas Theatre, 612 Kansas Ave., Kansas City, Kansas
Arthur H. Miller, Rt. 1, Box 13, Robbinsdale, Minn.
Paul Serre, 178 Pennsylvania Ave., Emsworth, Pa.
Frank Zabawa (9BGP), 46 Center St., Peely, Penna.
A. C. Avery, 226 Maynard St., San Francisco, Calif.
Wm. D. Smith, P. O. Box 1057, Mexico City, D. F., Mexico.
A. W. Yetter, 1047 Emerick St., Philadelphia, Penna.
F. W. Post, Bellflower, California.
Wm. M. Wiggins, 7403 Elm Ave., Maplewood, Missouri.
Chas. Waldhauser, 3322 Tileet St., Baltimore, Md.
John W. Woodards, 2 Chapel Ave., Merchantville, N. J.
R. L. Mathias, 2100 Finance Bldg., Philadelphia, Penna.
R. M. Strickland, 102 Clifford St., New Haven, Conn.
Carl E. Chambers, 2305 N. Mansfield Ave., Chicago, Ill.
A. Pache, 252 W. 22nd St., N. Y. City.
Joseph Dreyer, Merchantville, N. J.
Thomas Stewart, 91 Albany St., Buffalo, N. Y.
J. W. Carvey, c/o Gillsy Hotel, Cleveland, Ohio.
Harry Eichler, 890 University Ave., Rochester, N. Y.
A. La Ferriere, 46 William St., Waterbury, Conn.
L. M. Rile, 1532 Roselyn St., Logan, Philadelphia, Penna.
H. B. Pomeroy, 147 E. Goepp St., Bethlehem, Penna.
D. E. Federici, 94 Shrewsbury St., Worcester, Mass.

Third Trade Show Set for the Spring

The Fifth Annual Convention and Third Annual Trade Show of the Radio Manufacturers Association will be held in the late spring of 1929, said Major Herbert H. Frost, the association's president.

The Fourth Annual Convention and Trade Show, at Chicago, last June, drew 24,657 of the country's radio dealers, jobbers and manufacturers, and thereby set a record.

WHK JOINS COLUMBIA

WHK, Cleveland, has become a regular member of the Columbia chain. The station is operated by the Radio Air Service Corporation.

Farmers' Preferences Cited by Specialist

Allan B. Pontius, farm specialist for the Radio Corporation of America, said:

"Radio serves many definite purposes in farm life. The farmer values radio for its entertainment and religious and educational benefits first of all, and then for its utilitarian benefits, weather forecasts, news items and market reports.

"The weather forecasts are vital. In the Spring an early forecast of frost may save millions of dollars worth of fruit.

"Market reports are equally vital. Many farmers and orchardists sell through their own organizations, but the independents find radio of great assistance.

"Many of the farmers would like to have the evening programs earlier. This is mostly to give the children a chance to listen before bedtime, but it is also on the farmers' own account, for the farmer rises early and does not care for late hours.

"Musical performances run about 50-50 for jazz and the classics.

"Plays enjoy some popularity, but the farmers complain that the loss of a few words makes a whole play of doubtful value. Religious services are much appreciated. Noted speakers are sure of a hearing, no matter what their subject, and educational talks are a favorite.

"The radio book reviews have taken on an added flavor. The chats about books by Joseph Henry Jackson over KGO are a religion with many of them. Books on psychology, religion, philosophy and scientific subjects fill their book shelves."

Flechtheim Catalogue

Listing their full line of condensers, rated at from 250 volts to 3,000 volts DC, A. M. Flechtheim & Co., Inc., of 136 Liberty St., New York City, has issued a new catalog containing information on by-pass, filter, high voltage and transmitting condensers.

One of the new types of condensers is the so-called Midget, available in consecutive sizes from .0001 to .05 mfd. A perfected paper dielectric is used of low power factor radio frequency resistance and direct current leakage.

A contrasting item is the new 3,000 volts DC type HP transmitting condenser (test 8,000 volts DC). A copy of the catalogue may be obtained by addressing the company and mentioning RADIO WORLD.

THE SHOW NUMBER of Radio World, dated September 15th, will be on sale while the Fourth Annual Radio World's Fair is in progress. It will be a specially fine number. Out next Thursday.

RADIO WORLD

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)
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SUBSCRIPTION RATES

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Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address; also state whether subscription is new or a renewal.

ADVERTISING RATES

General Advertising

1 Page, 7¼"x11"	462 lines	$300.00
½ Page, 7¼"x5⅛"	231 lines	150.00
½ Page, 3¼" D. C.	231 lines	150.00
¼ Page, 4⅛" D. C.	115 lines	75.00
⅛ Page, 4⅛" S. C.	57 lines	37.50
1 Column, 2¼"x11"	154 lines	100.00
1 Inch		10.00
Per Agate Line		.75

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26 times consecutively or E. O. W. one year	15%
13 times consecutively or E. O. W.	12½%
4 consecutive issues	10%

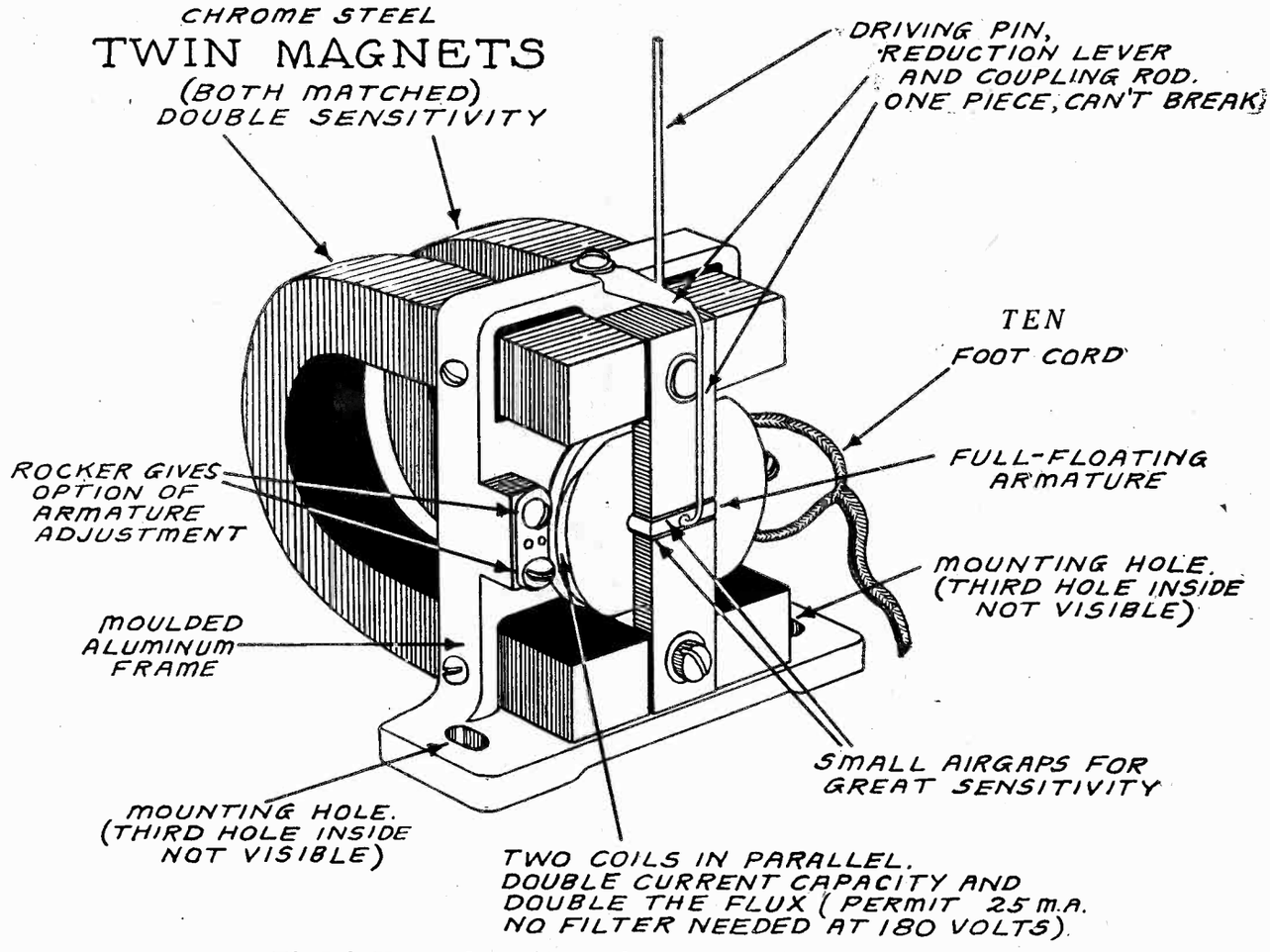
WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

CLASSIFIED ADVERTISEMENTS

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.

BY STORM!



The Polo Unit is shown ¾ actual size. It weighs three full pounds.

SO obviously superior are its advantages that the New Polo Duo-Magnetic Unit has taken the country *by storm.* Such enthusiastic success has immediately greeted few radio devices as attended the recent introduction of the Polo Unit.

Everybody who has the slightest knowledge of what a unit should be could see at a glance that expert design at last realized what others vainly sought for years.

If you want a unit to improve your present speaker, or to make the speaker you are about to build do more than you could reasonably expect, a unit giving you the *utmost* in volume, the *finest* in tone, capable of handling even the output of two —50 tubes in push-pull, and, of course, any smaller output, then use the Polo Duo-Magnetic Unit.

POLO ENGINEERING LABORATORIES, 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 ten-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.

NAME .....

ADDRESS .....

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

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

Scientific minds combined their ingenuity and skill to produce the finest—and the popular verdict proves the boundless measure of their success.

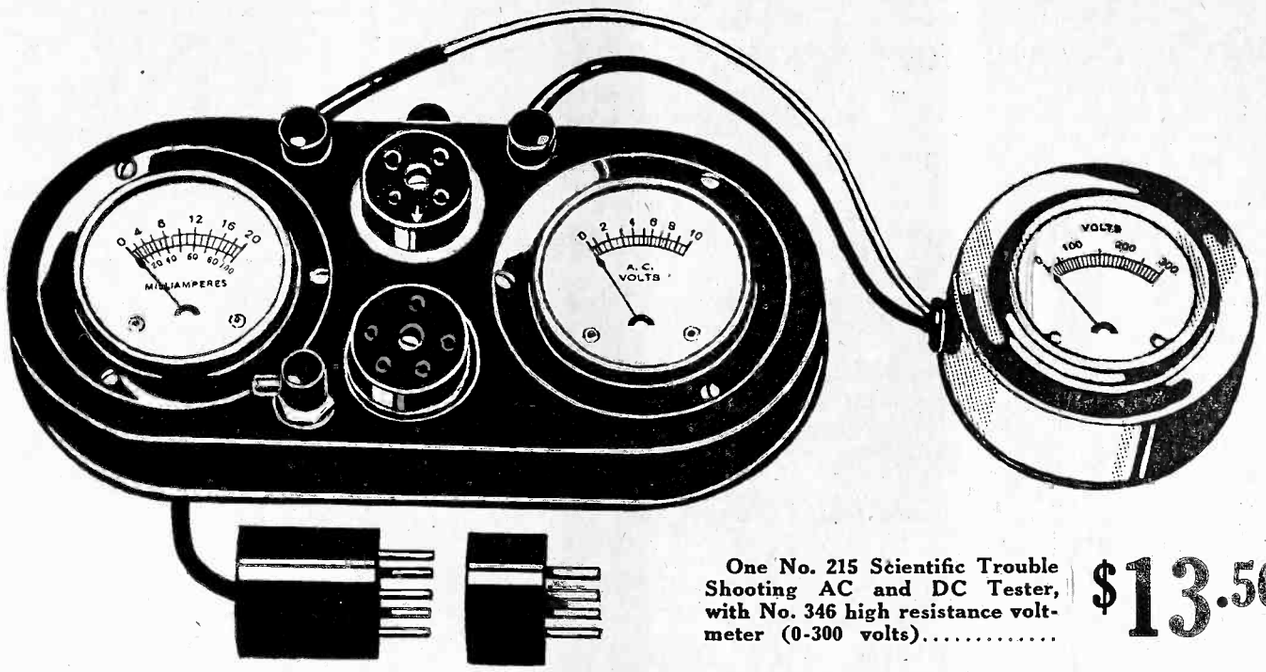
POLO ENGINEERING LABORATORIES

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

All in a Jiffy!

Tube Any Good?
Set Getting Proper Voltages?
Any Shorts or Open Circuits?
Universal Tester Answers 12 Questions in a Jiffy!

You are lost without meters when you shoot trouble and seek remedies. The Universal Tester is your reliable diagnostician for both AC and DC.



One No. 215 Scientific Trouble Shooting AC and DC Tester, with No. 346 high resistance voltmeter (0-300 volts)..... **$13.50**

The Scientific Trouble Shooting AC and DC Tester (at left) and high resistance meter (at right) Make Twelve Vital Tests in 4½ Minutes. The instruments are exactly TWICE the size pictured. They are handy and handsome.

Amply Accurate, Even for Service Men!

SERVICE men, going out on calls, must have a reliable test set. The Universal Tester and separate Voltmeter are reliable and versatile. The readings are accurate to 5% plus or minus, which is ample. Twice as great accuracy as this costs four to five times as much money, and isn't really necessary, except for engineering work in laboratories.

The Universal Tester and Separate Voltmeter can be used to make ALL the following twelve tests in 4½ minutes:

(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 a 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.

Fits Your Needs, As Well As Your Purse!

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

☐ Please send me at once, by parcel post, 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 and one No. 346, with two adapters for UV199 tubes $14.50
☐ One No. 215 and one No. 347, with two adapters for UV199 tubes $15.50
☐ One No. 215 alone, $10.00.
☐ One No. 346 alone, $4.50.
☐ One No. 347 alone, $5.50.

NAME .....

ADDRESS .....

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

FIVE-DAY MONEY-BACK ABSOLUTE GUARANTY!

Try out the combination tester and high resistance voltmeter, if you are a service man, custom set builder, home constructor, experimenter, teacher or student. You run no risk. These instruments are guaranteed. Money back if you're not satisfied after a five-day test.
High value and low price combine to give these instruments a field all to themselves, because they meet your needs fully in quality as well as in economy.

HERE'S WHAT YOU GET FOR ONLY $13.50:

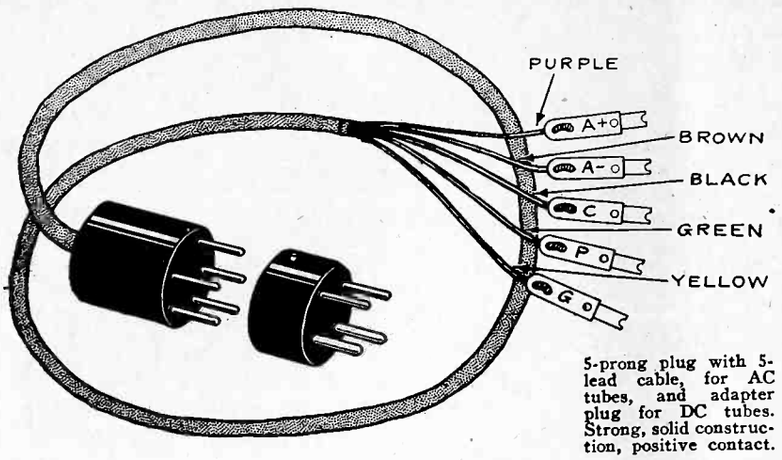
(1) One two-in-one 0 to 10 voltmeter for AC and DC. Same meter reads both. Scale specially legible at 1½ to 7½ volts. This meter reads the AC and DC filament voltages.
(2) One DOUBLE reading DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with changeover switch. This reads plate current, which is 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.

[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

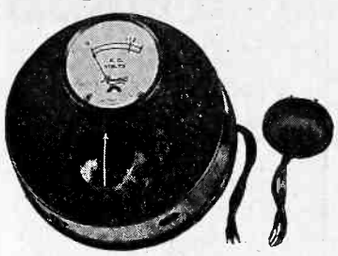
GUARANTY RADIO GOODS CO.
145 West 45th Street
New York City Just East of Broadway

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**

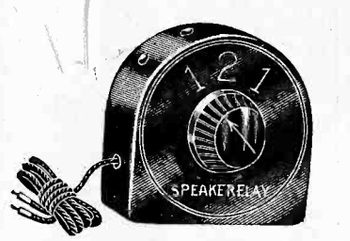
HIGH RESISTANCE VOLTMETERS

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**

Strong, Rugged Loud Unit

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.....

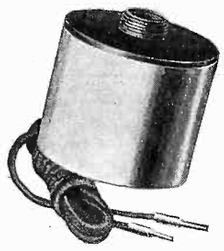
SEND NO MONEY!

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.

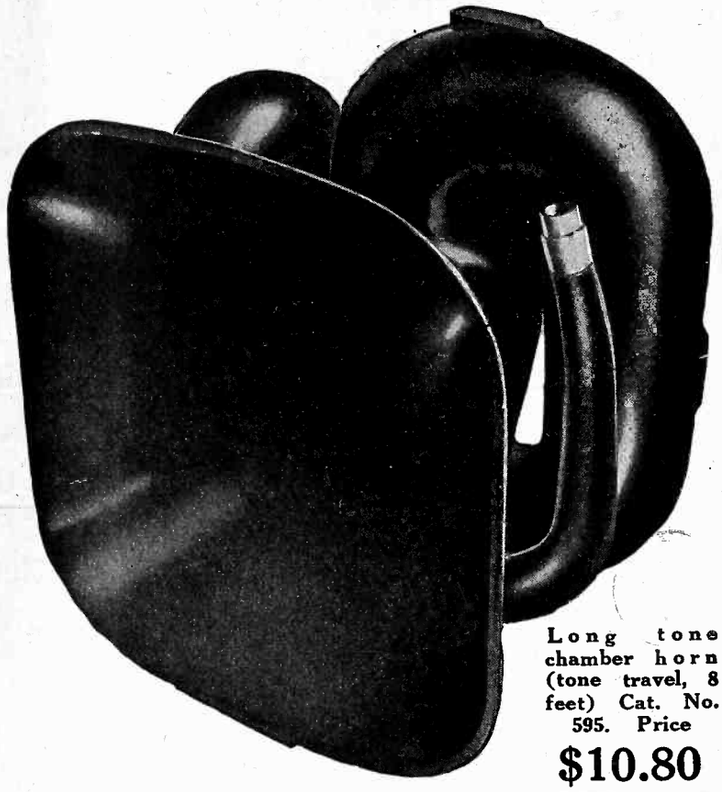
With fine quality moulded wood formed into a long tone chamber you hear the orchestral instruments stand out individually,—sounds from the boom of the bass drum, the zoom of the 'cello, to the sweet, high notes of piccolo and clarinet. And the human voice is natural, real. The hissing sounds of speech—high 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, 21¼" 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

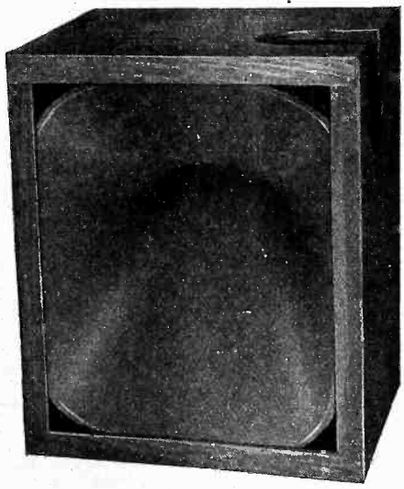
WHERE space requirements limit you to a smaller size horn, use Cat. No. 570, illustrated below. The tone quality of this medium-sized model far surpasses that of the usual cones, but does not quite come up to that of the No. 595 on the extremely low register (40 cycles and less). However, it is a very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

Name .....

Address .....

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

5-Day Guarantee of Money Right Back if Not Delighted— No Stalling—No Questions!