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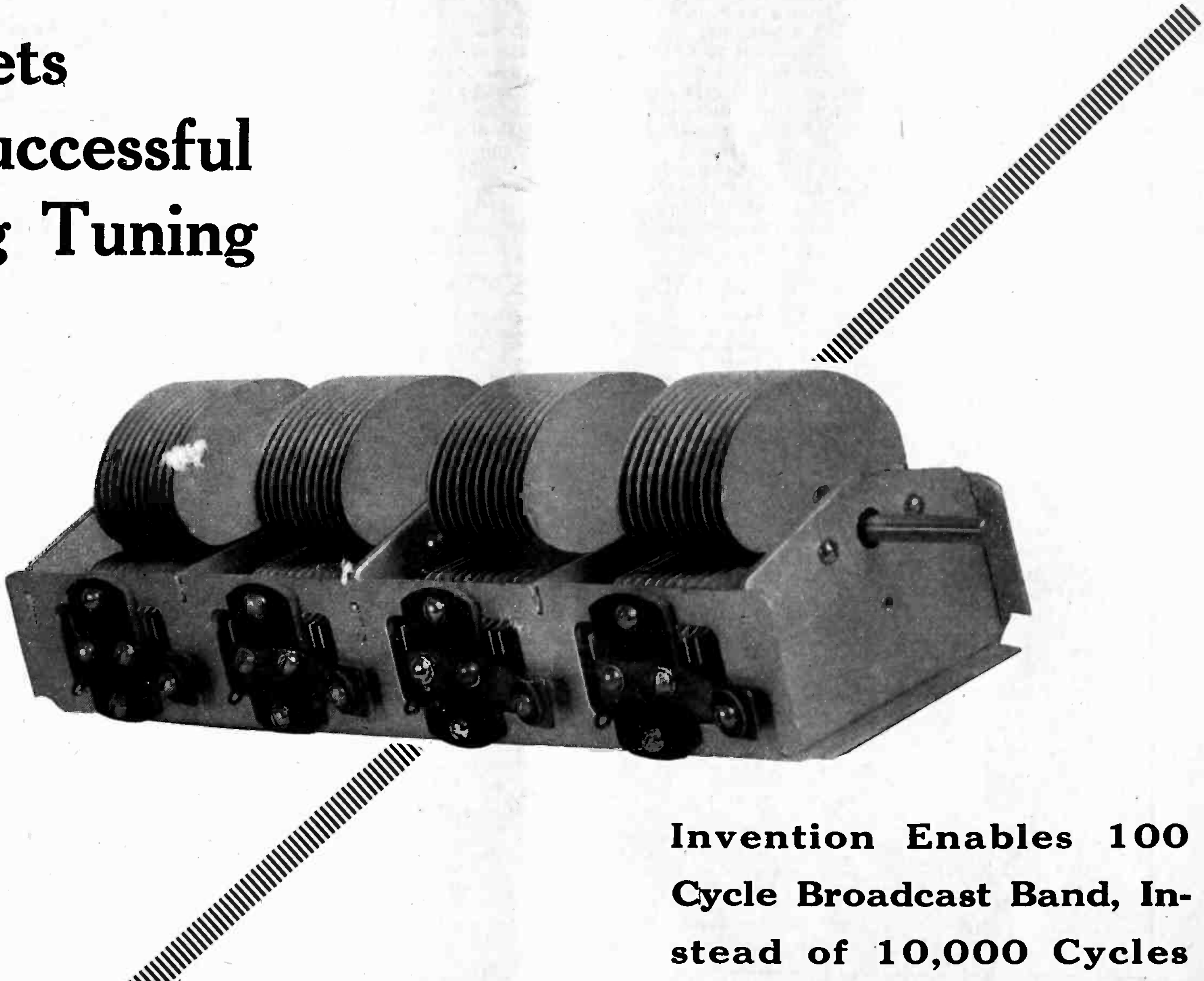

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**Units of Measurement and How to Use Them**


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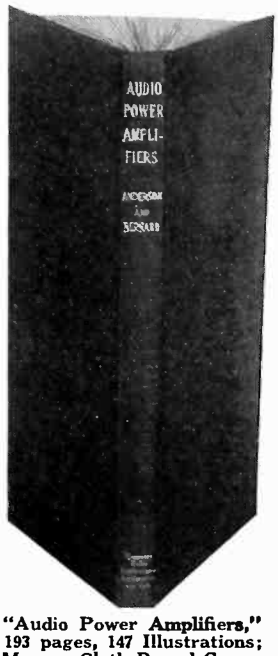


"Audio Power Amplifiers," 193 pages, 147 Illustrations; Maroon Cloth Bound Cover, Lettering in gold. Price, $3.50.

# "AUDIO POWER AMPLIFIERS"

## By J. E. ANDERSON and HERMAN BERNARD

### *The First and Only Book on This Important Subject—Just Out*

IN radio receivers, separate audio amplifiers, talking movies, public address systems and the like, the power amplifier stands out as of predominating importance, therefore a full and authentic knowledge of these systems is imperative to every technician. "Audio Power Amplifiers" is the book that presents this subject thoroughly. The authors are

J. E. Anderson, M.A., former instructor in physics, University of Wisconsin, former Western Electric engineer, and for the last three years technical editor of "Radio World."

Herman Bernard, LL.B., managing editor of "Radio World."

They have gathered together the far-flung branches of their chosen subject, treated them judiciously and authoritatively, and produced a volume that will clear up the mysteries that have perplexed many.

What are the essentials to the reproduction of true tone values?

What coupling media should be used? What tubes? How should voltages be adjusted?

These are only four out of 1,400 questions raised and solved in "Audio Power Amplifiers."

The book begins with an elementary exposition of the historical development and circuit constitution of audio amplifiers and sources of powering them. From this simple start it quickly proceeds to a well-considered exposition of circuit laws, including Ohm's laws and Kirchhoff's laws. The determination of resistance values to produce required voltages is carefully expounded. All types of power amplifiers are used as examples: AC, DC, battery operated and composite. But the book treats of AC power amplifiers most generously, due to the superior importance of such power amplifiers commercially.

Rectification theory and practice in all the applied branches, grid bias methods and effects, push-pull principles, power detection, reproduction of recordings and methods of measurements and testing are set forth. And besides there is a chapter on the subject of motorboating, with which one of the authors is probably better familiar than any other textbook author. Then, too, there is a chapter on tubes, with essential curves and a full list of tables of tube data. Every tube that will be used in an audio amplifier—therefore virtually all tubes—is clearly diagnosed, classified and tabulated! These data on tubes should be at every radio engineer's hand.

"Audio Power Amplifiers" is a book for those who know something about radio. It is not for novices—not by a mile. But the engineers of manufacturers of radio receivers, power amplifiers, sound installations in theatres, public address systems and phonograph pickups will welcome this book. Engineers—even chief engineers—of the Bell Telephone Laboratories, Radio Corporation of America, Westinghouse Electric & Mfg. Co., Western Electric, Photophone, Vitaphone and the like needn't be afraid they won't learn something from this little book.

The book consists of 193 pages in type the size used in printing these words, known as 8 point, and therefore a great deal of text is contained in these 193 pages, and the book is small enough to be carried conveniently in the side pocket of a sack coat. It was purposely printed that way because busy engineers and other experimenters will want to consult this precious volume while riding in conveyances, as well as when in the laboratory, and compactness was therefore desirable.

The edition is strictly limited to 1,000, and the publishers recognize that the field of distribution is necessarily small, hence the price is $3.50. Those to whom such a volume is of any value would not be without it at any price.

The device of presenting no more information or greater number of illustrations, but of using larger type, and thicker and often cheaper paper, to present a bulkier appearance, was purposely avoided. The paper is finest super stock and the size of the page is 5 x 8".

## Table of Contents



## What Is Not As Well As What Is

*SOMETIMES it is more important to expose a fallacy than merely to state the fact. A crop of technical weeds has grown into the garden of audio amplification, and the authors have gone to the pains of exposing these.*

*The book "Audio Power Amplifiers" is free from traditional errors, except in citing them as fallacious conclusions. Each attack on a fallacy is abundantly supported by proof of the REAL facts.*

*As an example, take the theory that motorboating is due to grid blocking. The authors say: "Many explanations for this oscillatory condition (motorboating) have been made, some of which are wholly untenable. One of these is that the oscillation is due to blocking of the grids of the amplifiers . . . If blocking of the grid were the cause of the phenomenon, the wave form of the oscillation would be very irregular, but an oscillograph shows that it is very nearly of a sinusoidal form."*

*Then follows an exposition of motorboating, and oscillation at other frequencies, with expressions for predetermining the instability or stability of audio circuits.*

## Detailed Exposition of Chapter Contents

**Chapter I.** General Principles, analyzes the four types of power amplifiers, AC, DC, battery-operated and composite, illustrates them in functional blocks and schematic diagrams, and treats each branch in clear textual exposition. Audio coupling media are illustrated and discussed as to form and performance: transformer, resistance-resistance, impedance-impedance, impedance-resistance, resistance-autotransformer, autotransformer-resistance and non-reactive. Push-pull forms are illustrated, also speaker coupling devices. Simple audio ampifiers are illustrated and analyzed. Methods of connection for best results are stressed.

**Chapter II.** Circuit Laws, expounds and applies Ohm's laws and their special form known as Kirchhoff's laws. Direction of current flow in tube circuits is revealed in connection with the application of these laws to several circuits, including a DC 110-volt A, B and C supply, and series and parallel filaments in general. Special diagrams are published for Ohm's and Kirchhoff's laws.

**Chapter III.** Principles of Rectification, expounds the vacuum tube, both filament and gaseous types, electrolytic and contact rectifiers, and explains why and how they work. Full-wave and half-wave rectification are treated, with current flow and voltage derivation analysis. Regulation curves for the 280 tube are given. Voltage division, filtration and stabilization are fully illustrated and dissected.

**Chapter IV.** Practical Voltage Adjustments, gives the experimental use of the theoretical knowledge previously imparted. Determination of resistance values is carefully revealed.

**Chapter V.** Methods of Obtaining Grid Bias, enumerates, shows and compares them.

**Chapter VI.** Principles of Push-Pull Amplifier, defines the push-pull relationship, with keys to the attainment of desired electrical symmetry.

**Chapter VII,** Oscillation in Audio Amplifiers, deals with motorboating and oscillation at higher audio frequencies, explaining why it is present, stating remedies and giving expressions for predetermination of regions of instability. The trouble is definitely assigned to the feedback through common impedance of load reactors and B supply, and in some special instances to the load's relationship to the C bias derivation as well. The feedback is shown as negative or positive and the results stated.

**Chapter VIII,** Characteristics of Tubes, tells how to run curves on tubes, how to build and use a vacuum tube voltmeter, discusses hum in tubes with AC on the filament or heater, and presents families of curves, plate voltage—plate current, for the 240, 220, 201A, 112A, 171A, 227 and 245, with load lines. Also, plate-screen current characteristics of the 224, at five different control grid biases, at plate voltages 0-250. Then Table I gives the Average Characteristics of Amplifier and Detector Tubes 220, 200A, 201A, 112A, 171A, 222, 240, 226, 227, 224, 245, 210 and 250, stating use, filament voltage, current, and resistance, Det. B volts, Amplifier B volts, grid bias for amplification and detector, plate current, plate AC resistance, mutual conductance, mu, maximum undistorted power output, physical size. There is a composite table (II) of characteristics of Rectifier and Voltage Regulator Tubes, and individual tables, giving grid voltage, plate current characteristics over full useful voltage ranges for the 220, 201A, 112A, 171A, 222, 240, 227, 245 and 224.

**Chapter IX,** Reproduction of Recordings, states coupling methods and shows circuits for best connections.

**Chapter X,** Power Detection, explains what it is, when it should be used, and how to use it. A rectifying detector, designed by one of the authors, is expounded also.

**Chapter XI,** Practical Power Amplifier, gives AC circuits and shows the design of a sound reproduction system for theatres. A page is devoted to power amplifier symbols.

**Chapter XII,** Measurements and Testing, discloses methods of qualitative and quantitative analysis of power amplifier performance. A scale illustrates the audio frequencies in comparison with the ranges of voice and musical instruments. A beat note oscillator is described. Thirteen causes of hum, with remedies, are stated, also the estimation of power required for output and preliminary tubes.

You may safely order "Audio Power Amplifiers," either enclosing your remittance or ordering the book mailed C.O.D. Examine it for five days. If you are not completely satisfied with it for any reason, or for no reason, send it back in five days with a letter asking for a refund. A check refunding the purchase price will be sent to you immediately. We can not send the book on approval, without payment before receipt, so please do not ask us to do so.

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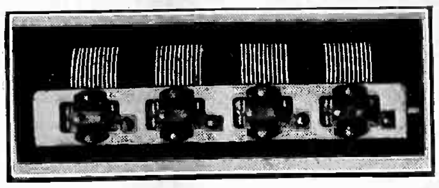

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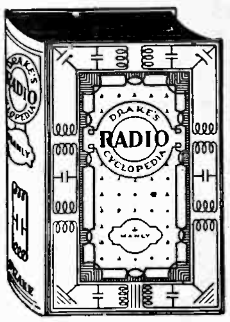


Each rule, fact, method, plan, layout and diagram is instantly picked out and separated from everything else by placing all subjects in alphabetical order with cross references for every imaginable name under which the information might be classed.

This alphabetical arrangement lets the experienced worker refer directly to the one thing in which he is interested at the moment without hunting through non-essentials. The needs of the beginner are cared for.

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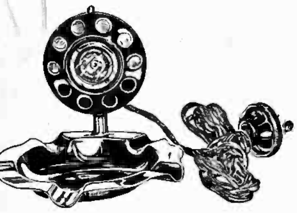

Model B lighter, microphone design, on tray, with 5-ft AC cable and plug. Works on 110 volt AC, any frequency, and on direct current. Exactly the same lighter as the other, only tray is added.
Price...............$1.50

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

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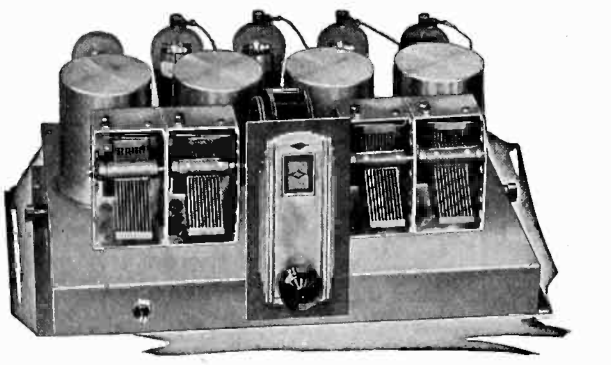
# NATIONAL SCREEN GRID TUNER

# MB-29



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

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## Push-Pull Amplifier

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

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

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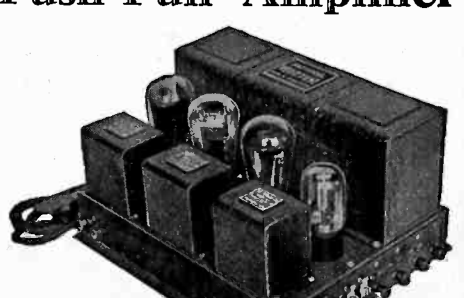

View of National Velvetone Push-Pull Power Amplifier, an expertly made A, B and C supply and audio amplifier, producing marvelous tone quality.

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143 WEST 45TH STREET NEW YORK CITY

RADIO WORLD, a weekly paper published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y. Vol. XVI, No. 18. Whole No. 408. January 18th, 1930. 15c per copy, $6.00 per year. [Entered as second-class matter, March. 1922, at the Post Office at New York, N. Y., under act of March, 1879.] Roland Burke Hennessy, president and treasurer; M. B. Hennessy, vice-president; Herman Bernard, business manager and managing editor; J. E. Anderson, technical editor.

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# NEW J-245-X TROUBLE-SHOOTING JIFFY TESTER

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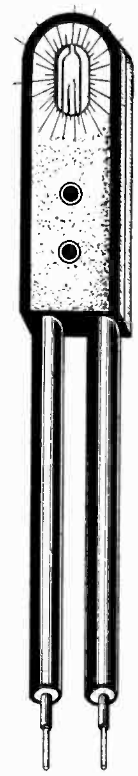
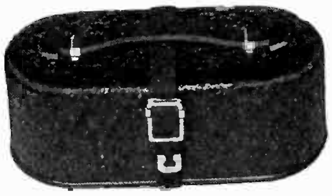


**Illumination Tester, Vest Pocket Size, Shows Shorts and Opens Visually, also polarity of DC line. A Neon lamp is built in.**



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

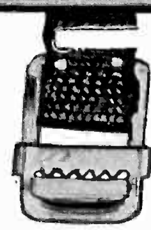
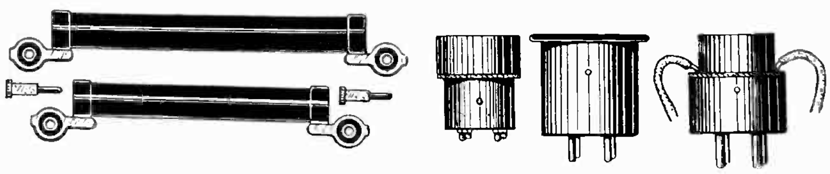


**Illustration above is 2/3 scale.**



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

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

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

With this outfit you plug the cable into a vacated socket of a receiver, putting the removed tube in the tester, and using the receiver's power for making these tests: plate current, up to 100 milliamperes; plate voltage up to 300 volts; filament or heater voltage (AC or DC), up to 10 volts.

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

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

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

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

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

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**5-DAY MONEY-BACK GUARANTY**

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

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

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

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

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

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

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

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

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# Loftin-White Circuits

## Non-Reactive Audio Amplifiers Improved

*By J. E. Anderson*
**Technical Editor**

EVERY once in a while there is much interest in non-reactive amplifiers, that is, amplifiers in which the tubes are coupled with non-reactive resistors and without the use of any stopping condensers or choke coils. The interest aroused from time to time has never been lasting, as far as the fans are concerned, because these amplifiers are relatively unstable and difficult to get into operating condition.

Just now, however, there is keen interest in a non-reactive amplifier sponsored by Loftin and White and popularized by well-known writers on radio.

Because of the expressed interest of many of our readers in this system we herewith describe two of the circuits proposed.

Those among our readers who remember the series of articles in RADIO WORLD in the Fall of 1928 will realize there is now nothing essentially new in these circuits, since the principles involved were fully discussed more than a year ago. Special reference is made to articles in the September 15th, September 29th and October 6th, 1928, issues of RADIO WORLD, where the principles involved were discussed in conjunction with push-pull amplification.

### WHERE CREDIT IS DUE

At that time credit was given for the ideas presented in these circuits to G. H. Paris, of Duluth, Minn., and to an English writer named Johnston.

Lack of novelty at this time in no way detracts from the credit that is due to Loftin and White for having devised and constructed simple and stable amplifiers on this principle.

There is one feature of the Loftin-White application which deserves special mention, and that is the hum-bucking arrangement by which they balance out hum from the amplifier and thereby make it possible to use a plate current supply that is exceedingly simple and inexpensive. It is so simple that one might say that the filtering is only nominal, yet complete. This is an achievement of no small magnitude and may be the thing needed to transform this theoretically excellent circuit into one which is equally excellent practically.

There are many advantages of this system of amplification which tempt one to be exceedingly patient with its shortcomings. These are unexcelled quality, simplicity of circuit, and low cost of operation and assembly. The main disadvantage has been instability. We are assured that Loftin and White have overcome this difficulty.

### DETAILS OF THE CIRCUIT

Fig. 1 herewith shows the schematic of the two-tube Loftin-White amplifier together with its plate voltage supply. The first tube is a 224 screen grid tube and the second a 245 power tube. These two tubes give adequate amplification and volume, the amplification, of course, being mainly contributed by the screen grid tube.

A discussion of this circuit is mainly a discussion of the manner in which the proper voltages are obtained on the various elements on the two tubes, both AC and DC voltages.

The input voltage on the circuit is obtained from a portion of the signal voltage drop across the potentiometer P1. The portion of the total drop impressed on the tube depends on the setting of the slider, and the voltage may be varied from zero to the full drop across P1. The input signal voltage to the second tube is the signal voltage drop in the coupling resistor R2.

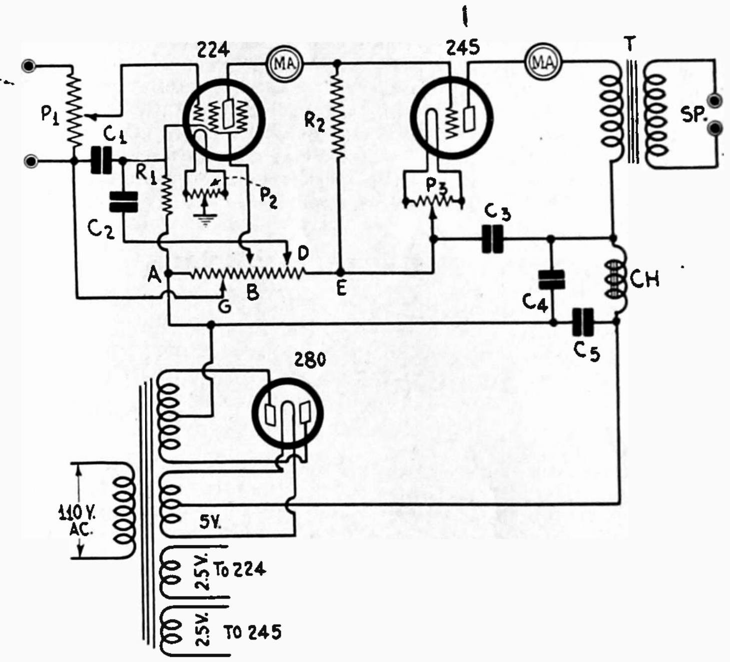



FIG. 1
THE TWO-TUBE, LOFTIN-WHITE NON-REACTIVE AMPLIFIER IN WHICH NO STOPPING CONDENSER IS USED BETWEEN THE PLATE OF THE FIRST AND THE GRID OF THE SECOND TUBE

The recommended value of this coupling resistor is 1.0 meg. The steady voltage drop in this resistor is the bias on the succeeding tube, as the resistor is connected between the grid and the center of the filament of the power tube. This bias should be 50 volts for a 245, and therefore the steady current through R2 should be 50 microamperes. The screen grid tube voltages should be adjusted until this current flows in the plate circuit, and is read on the 0-1 milliammeter, or microammeter, connected in the plate lead of the first tube.

### PLATE VOLTAGE ON SCREEN GRID TUBE

The plate voltage on the screen grid tube is the voltage drop in the resistance between points A and E, less the steady drop in R1. The drop in R1 can be neglected in comparison with the drop in the resistance between A and E so we need only consider the main drop. The current through the resistance AE is practically equal to the plate current of the power tube. The currents diverted by the plate and screen of the first tube can be neglected in comparison with the 32 milliamperes required by the power tube.

The recommended values for the two main sections of the resistor between A and E are A to B, 600 ohms and B to E, 2,900 ohms. Thus the total resistance is 3,500 ohms, and through

# Reverse Brake on Hum

## Out-of-Phase Equal Voltage Used in New Way

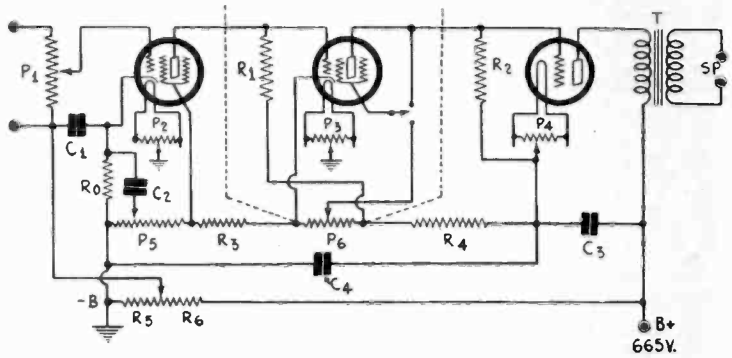


FIG. 2
THE THREE-TUBE, LOFTIN-WHITE NON-REACTIVE AMPLIFIER. A SWITCH IS PROVIDED FOR CONVERTING TH MIDDLE TUBE FROM A SCREEN GRID TUBE TO A THREE-ELEMENT TUBE, IN EFFECT, FOR ALTERING THE VOLUME. THIS FIRST TUBE IN THIS CIRCUIT IS ALSO SUPPOSED TO WORK AS A DETECTOR.

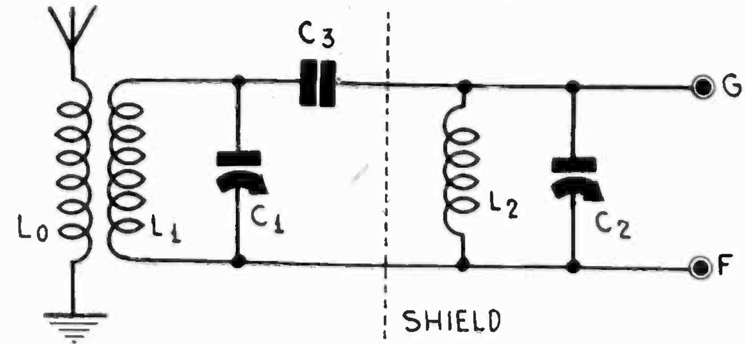



FIG. 3
A SUGGESTED TUNER TO BE USED AHEAD OF THE CIRCUIT IN FIG. 2 TO COMPLETE THE RECEIVER. EXCEPTIONAL SELECTIVITY IS CLAIMED FOR THE COMBINATION, AS WELL AS HIGH SENSITIVITY.

this 32 milliamperes flow. Therefore the drop is 112 volts. This is a rather low voltage to apply to a screen grid tube when one megohm is used in its plate circuit, but this is all right provided the screen voltage is lower than the usual rated value.

R1 is 100,000 ohms. Through this resistance both the plate and the screen currents flow, and the plate current alone would establish a steady drop of 5 volts. If the screen current is of the same order of magnitude as the plate current the total drop in R1 would be 10 volts. This would be too high bias for a screen grid tube, and therefore the grid return is connected to a point on the resistance AE which is at a suitably higher voltage so that the grid bias has the proper value for amplification. This adjustment is brought about experimentally by moving the point G.

### GETTING THE SCREEN VOLTAGE

The screen voltage on the tube is also adjusted by trial by sliding the return lead over the resistance, that is, by moving the point B. The resistance value given above, namely, 600 ohms, gives a voltage of 18 volts on the screen, which was the correct adjustment in one instance. This low screen voltage is consistent with the low plate voltage and the high resistance load on the tube.

The first section of the resistance between A and E, next to A, is a 200 ohm potentiometer, and the grid return of the first tube is connected to the slider of this potentiometer. That is to say, G is the slider. Next comes a 400 ohm fixed resistance, which ends at B. Next is a 400 ohms potentiometer with the slider at D. Then follows a 2,500 ohm resistor terminating at D. This really provides only a variation for the grid bias since the slider D is used for another purpose to be discussed later. In other words, although B appears as a slider for the screen grid voltage the screen is really returned to a fixed point. If the screen voltage is to be adjusted independently it will be necessary to provide another potentiometer, still keeping the total resistance between A and E at 3,500 ohms. But the values given above are those recommended by the sponsors of the circuit after much experimenting.

### HUM-BUCKING DEVICE

A condenser C2, of 0.1 mfd., is connected between the cathode of the screen grid tube and a point D on the voltage divider. The object of this condenser is to introduce a hum component into the grid circuit of the tube in opposite phase to the hum introduced by the ripple in the supply current. The amount of hum thus introduced is varied by slider point D. A point can be found where the hum introduced in one direction is just equal to that introduced in the other, when no hum appears in the signal. This is a noteworthy contribution by Loftin and White.

It is recommended that separate filament transformers be used for the two tubes, or at least separate windings on the same transformer. It will be noted that on each one is a potentiometer the mid-point of which is connected to ground in the case of the first tube and to N in the case of the second. A potentiometer is superior to a center tap on the transformer winding because you can get a closer centering. Since the voltages involved are low it is not necessary to use potentiometers higher than 10 ohms.

It will be observed that the by-pass condensers used in the B supply are only 1.0 mfd. each, and only four of them are used. One of these, C1, by-passes the grid bias supply of the first tube and another, C3, by-passes the plate supply of the second tube. The remaining two condensers, C4 and C5, are the regular by-pass condensers in the B supply. A single choke Ch is used in the filter, and this should not have a direct current resistance higher than 500 ohms because of the heavy current and the need of high voltage.

### HIGH VOLTAGE NEEDED

The total voltage needed for this type of circuit is equal to the sum of the plate voltages of the two tubes. Thus if the power tube is to get 250 volts and the screen grid tube 112 volts, the total voltage should be 362 volts. There are many plate voltage supply units which will give this voltage, since the current drawn is only 32 milliamperes.

There is a milliammeter in the plate lead of the power tube as well as one in the plate lead of the screen grid tube. The second meter indicates the plate current of the last tube and hence also the current flowing through the resistance AE. It is important that the current be about 32 milliamperes if the resistance values recommended are to give the correct voltages on the plate and the screen of the first tube. However, small variations in the current do not matter so much because there will be corresponding variations in the voltages, and if the balance should be upset it is a simple matter to readjust with the potentiometers.

### THE THREE TUBE CIRCUIT

A three-tube circuit working on the same principle is shown in Fig. 2. The first two tubes are of the screen grid type and the last is a 250 power tube. The arrangement in this circuit is slightly different, but the principle is the same.

The total voltage required for this circuit is 650 volts. The first screen grid tube gets a voltage of about 15 volts, the second about 75 volts and the power tube the remaining available voltage. The voltage on the screen of the first tube is about 2.5 volts and that on the second about 15 volts.

The coupling resistors are 1.0 meg., as in the two-tube circuit. The second coupling resistor is connected from the grid to the cathode, or mid-point of the filament circuit, and therefore the drop in this resistor is the bias on the power tube. The other coupling resistor is connected from the grid of the middle tube to a point on the voltage divider which insures that the bias on the second tube has the proper value.

It will be noted that the return is made to a point which is positive with respect to the cathode. This means that the steady drop in the first coupling resistor is greater than the bias required.

### RESISTOR VALUES RECOMMENDED

The recommended values of the various voltage divider resistors are as follows: Ro, 100,000 ohms; P5, 320 ohms; R3, 180 ohms; P6, 500 ohms; R4, 2,500 ohms; R5, 400 ohms, and R6, 60,000 ohms. These are for the particular combination of tubes and voltages given in Fig. 2 and in no other.

The condensers in Fig 2 have the same values as those in Fig. 1. C1, C3, and C4 are 1.0 mfd. condensers and C2 is a 0.1 mfd. condenser. It will be noted that condensers C3 and C4 are across high voltages. For this reason they should be of a high voltage rating, say 1,000 volts.

The hum-bucking condenser is connected differently in the three-tube circuit. Note that in Fig. 1 the condenser is returned to a point on the positive side of the screen return to the voltage divider, whereas in Fig. 2 it is connected to a point on the negative side. The differences are due mainly to the distribution of the voltages.

(*Continued next week*)

# Soldering As An Art

## Cleanliness the First Essential of Success in Wiring a Circuit

*By Capt. Peter V. O'Rourke*

**Contributing Editor**

MAKING neatly soldered joints while building radio receivers is an art that must be acquired. Many fans have been told that they should use a hot iron, and indeed that is one of the necessary conditions. But fans have also found that using a hot "iron" it has required so much time to complete a joint, to make the solder flow and take hold, that during the process insulators such as hard rubber, wax, wire covering, and others have melted or burned. There was no lack of heat in the "iron," but there was actually too much of it. A neat soldered joint must be made quickly when there is any danger of burning insulation and damaging certain parts by the heat that flows from the "iron."

What is the reason the solder will not flux when the iron is hot enough not only to melt the solder but to make the joints to be soldered so hot that when the solder comes in contact with them it melts? There are several reasons, but all may possibly be summed up by saying lack of preparation of the joint, or possibly by saying lack of cleanliness of the joint.

### IRON MUST BE PREPARED

One of the essential conditions for good soldering is that the "iron" be properly prepared. It must not only be hot but it must be clean and well tinned. When starting out on a job of soldering the "iron" should first be filed down so that the copper is everywhere exposed. There must be no dirt on the tip of the "iron" nor any pits due to corrosion. After the filing the copper should be covered with a layer of solder. If the filed surfaces are clean and the "iron" hot enough it is only necessary to apply rosin core solder to the surfaces and spread it out. If they are not so clean it may be necessary to employ a more effective flux than rosin, such as soldering paste or even acid. If acid core solder is used it is essential that every speck of acid be removed from every part of the "iron" after the tinning process, for if ever so little is left on, it will attack the copper and make deep pits in the surfaces, requiring much filing before the "iron" again can be restored to good working condition.

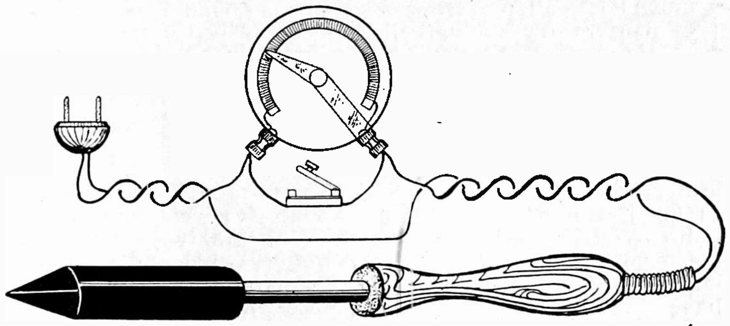
After a good layer of tin has been applied to the copper it is in good condition for soldering. But it must be kept in that condition. If the "iron" overheats, the tin, or solder, will be burned off, and a layer of oxide of tin will replace the metal. While this oxide is on the copper good soldering cannot be effected. Possibly that is responsible more than anything else for bad soldered joints and burned insulation. Then there is the dirt that gathers on the copper during operation, such as burned rosin. This must be removed occasionally, and the best way to remove it is to wipe the copper with a dry cloth. This also removes any oxide which may have formed. Whenever the copper has been wiped, a little clean solder should be applied. It is easier to keep the copper in a good working condition by occasional wiping and retinning than to restore it after all the solder has been burned off.

### AVOIDING OVERHEAT

Overheating of the copper does not occur while the "iron" is actually in use, but during moments of idleness, when heat is supplied to it by the electric current and no heat is taken away by the work. One way of preventing overheating is to turn off the current the moment the "iron" is put aside for the pliers or the diagonals. But if that is done it is cold by the time it is needed again, and a delay will result while the "iron" is heating up again.

Another method of preventing the "iron" from getting too hot while not in use, yet permitting it to keep sufficiently hot for good soldering, is illustrated in the accompanying sketch. A rheostat of suitable resistance is connected in series with the heating circuit and its resistance adjusted so that the current that flows is just sufficient to supply the heat losses of radiation. If the current is adjusted so that the copper remains at a good soldering temperature while not in use, it will not be hot enough for soldering, especially if the copper comes in contact frequently with extensive metals or heavy copper leads. Hence a switch is provided whereby the rheostat can be short out of the circuit, allowing the full current to flow while the "iron" is in use.

In the sketch this switch is indicated under the rheostat and is manually operated. It is possible to arrange the switch so that when the "iron" is laid aside the switch automatically opens and so that when it is picked up again the switch closes. The weight of the "iron" being used to open and close the switch. Any ingenious set builder can devise such an automatic switch. If he does a good deal of soldering he will find that this device will save a great deal of time and at the same time will result in better soldering and a longer life of the iron.



TO PREVENT A SOLDERING COPPER FROM GETTING TOO HOT DURING MOMENTS IT IS NOT ACTUALLY IN USE A RESISTANCE CAN BE PUT IN SERIES WITH THE HEATER TO LIMIT THE CURRENT TO A VALUE SUCH THAT WILL JUST KEEP THE COPPER AT A SOLDERING HEAT.

### PREPARING THE WORK

Just as the "iron" must be clean, so must the work be clean before a good soldered joint can be made. If the conductors to be soldered together are tinned there is no difficulty at all. It is only necessary to apply the "iron" until the conductors are hot, and then apply the solder until it fluxes.

If the conductors are bare copper or brass greater care must be exercised to make the solder flux and stick to the metals. It is advisable to tin the conductors first, individually, and then solder them together. However, if the surfaces are thoroughly cleaned so that the metals are bright, and if a good flux is used, such as rosin or paste, there will be no difficulty, provided the "iron" is hot, clean, and tinned.

There are certain types of wire which are difficult to solder because it is difficult to get the surfaces clean. One example is Litz, in which the strands are fine and enameled. The enamel must first be scraped off before the solder will stick, and the removal is not easy. If, however, the bared strands are dipped into alcohol and ignited, the strands will come clean and bright. Another wire which must be cleaned carefully is that which has a layer of rubber over it. Very often this wire is also stranded, which makes cleaning more difficult because of the fineness of the strands. One way of cleaning the strands is to spread them out on a flat surface and rubbing them with fine sand paper.

### SOLDERING NICKEL AND IRON

Sometimes it becomes necessary to solder iron or nickel, or alloys containing these metals. Solder will stick to iron without much trouble provided the surface is well cleaned, but to make solder stick to nickel is more difficult. But even with this metal the secret is thorough cleaning of the surfaces. However, where nickel, or nickel plate iron, forms one of two conductors that are to be joined, it is usually best to join them mechanically with screws or rivets. Fortunately, it is not often that it is necessary to join nickel conductors. It is more frequent that it is necessary to join aluminum conductors. This cannot be done with ordinary soldering methods and the simplest way is to make pressure junctions.

Where contact is made by pressure and screws it is safest to put a lock washer under the nut so that no matter what happens the nut will not work loose.

### CONDENSER TURNS WITHOUT TUNING

I have a receiver with which I cannot get down to the 200 meter limit. In fact I cannot get below 220 meters. I turn the condensers but they do not seem to have any effect. It seems to me that as long as it is possible to turn the tuning condensers there should be a decrease in the wavelength to which the circuit tunes. If you can explain the behavior of the condensers I shall appreciate it very much.—I. W.

It is possible that as the condenser rotors are turned they move toward conductors which are connected to the stator plates in some way. The capacity of the condenser proper decreases but the capacity between the rotor plates and the conductor connected to the stator increases. If these two effects just balance each other there would be no change in the tuning. There have been cases in which the capacity actually increased as the condenser plates were opened. You can bring in the short wave stations by removing a turn or two of wire from the tuned coil, and it may be that you can do this without at the same time throwing the high wave stations off the dial.

# Secret of Gang Tuning

## Equality of Inductance and Capacity Is Essential

*By Edward Fitch Burroughs*

NEARLY all modern radio receivers employ ganged condensers for tuning, all condensers being coupled to a single control knob. Any receiver that does not incorporate this form of tuning stands little chance of being accepted by the fans. For that reason even those fans who like to build their own receivers to satisfy their whims as to quality and sensitivity demand gang-controlled tuning units.

These fans frequently buy ganged condensers and put them into receivers, and they find to their disappointment that not as good results are obtained as with receivers having fewer radio frequency amplifiers in which all the tuned circuits are independently controlled. They wonder why, and quite often believe that they have picked on the wrong circuit or that they have obtained defective parts. Those who have given the subject of gang-control a thorough study wonder why they get as good results as they do. Gang tuning of several tuned circuits is the acme of simplicity when it comes to operation but it is one of the most complex of subjects when it comes to making it work electrically. And the complexity mounts much more rapidly than the number of tuned circuits on the same control.

### REQUIREMENTS OF CONDENSERS

The first essential of success with gang-controlled receivers is that all the condenser sections in the gang have the same rate of capacity change at all settings, that is, over the entire tuning range of the circuit. All the condensers do not have to have the same maximum capacity, for any differences in this respect can be compensated in the inductances. But it is better that all the sections be equal for if they are there is a better chance that all the sections will have the same rate of capacity change at every setting.

There are many reasons why the rate of change of the capacities of the sections of a gang condenser may be different. One of them, and the most difficult to control in the manufacture of condensers, is the variation in the thickness of the plates. If all the plates are cut out of one sheet of metal there will be little variation from this effect, but it is obviously impossible to make condensers in this necessarily practical way and in quantity production. Even if they are cut out of the same sheet there will be some variation because the sheet may be thicker at one side than at the other.

Another cause of variation is differences in the shape of the condenser plates. Such differences will be small, to be sure, since all are cut with the same tool, but small differences are of importance in gang-controlled condensers. As an example of differences in shape one might mention those due to wear on the tools. One plate may have been cut after the tool has been in use for some time, another may have been cut when the tool was new. That plate which was cut with an old tool may not be cut so cleanly and may have a rougher edge and even burrs. Small though the burrs may be they will have a considerable effect on the capacity.

### VARIATION DUE TO SPACING

Another source of variation is differences in spacing of the plates. The spacers may have different thicknesses for the same reason that the plates may have different thicknesses. These will inevitably have an effect on the rate of change of capacity.

It is true that in a well constructed gang condenser all these variations are minute and may be negligible if other sources of differences are eliminated. Suppose every section in a gang condenser has a capacity at every setting which is equal to that of any other section, within tolerable limits. Is there any certainty that these condensers will be the same when connected into a circuit? There is a certainty, to be sure, but in the adverse direction. There is every chance that the condensers will not be the same when mounted and connected. Hence the circuits will not tune right. The receiver will not be selective and its sensitivity will be comparatively low.

What can be done to prevent this change? One thing that can be done is to mount all the sections in similar position with respect to other conductors as far as this is possible. If the condenser is surrounded by shielding, all the sections should have the same space relation to this shielding. Likewise, every section should be placed similarly with respect to coils and tubes.

If all the sections cannot be placed similarly, the same condition should be brought about artificially by means of trimming condensers. But not all differences can be compensated for by trimming condensers, although a great deal can be done in this respect with them.

The condenser is not always to blame for differences that may exist in a circuit. That they are is merely jumping at conclusions because the condensers show up the differences. Suppose, for example, that by the aid of trimmers the condensers are all brought into step at 550 kc. Then the condenser gang is turned to 1,500 kc and the balance is all upset, requiring an entirely different adjustment of the trimming condensers. Are the condensers to blame? Perhaps partly, but most of the trouble is due to the inequalities of the tuning inductances. One coil may not have had enough inductance, thereby making it necessary to use more of the trimming condenser capacity. Another coil may not have had enough inductance, thereby making it necessary to adjust the trimming condenser to have very little capacity. The thing to do in this case is to attack the coils and make them equal.

And how can that be done? The first suggestion usually is to add or remove turns. But there is more to the effective inductance than turns. The shielding also affects the inductance, as does any conductor which may be in the field of the coil. The windings not tuned affect the inductance if the coupling is appreciable. The fact that the surroundings of a coil affects the inductance indicates the necessity of putting all the coils in similar settings as well as the condensers. Not only is the inductance of a coil changed by the presence of other conductors in the field by the distributed capacity is changed. However, this change in the distributed capacity is constant as long as the coil is fixed in position, and therefore the distributed capacity adds to the zero setting capacity of the condenser and can be compensated for by the trimming condensers.

### DUAL TRIMMING

It may be that the correct amount of inductance cannot be obtained in any case by adjusting the number of turns. It may be necessary, for example, to employ a fractional turn. This is rarely necessary when the coil is wound on a small form and contains many turns.

In view of the fact that in order to make the tuned circuits equal at every setting over the scale it is necessary not only to make the capacity rate of change the same but also the inductances, it would seem best to use both an inductive and a capacitative trimmer. The use of capacity trimming is universal but the use of inductive trimming is very rare. Yet one is as important as the other. The only reason a capacity trimmer is used exclusively is that it is easier to provide a small adjustable condenser than a small variometer. If both were used in a circuit it would be possible to adjust inductance and the capacity so that if the adjustment were made at any setting it would be equally good at every other setting. Then there would be no lack of either sensitivity or selectivity.

In selecting a gang condenser the safest thing to do is to pick one that has been made by a manufacturer that makes all the condensers for the better grade of receivers. These condensers are made to rigid specifications out of stock that has been selected for uniformity. Equality of capacity change of all the sections is thus assured. The exact value of the maximum capacity of each condenser is not of much importance because the coil to go with it can always be selected to match. However, it is important that the capacity be not too small, for if it is the broadcast band cannot be covered. The minimum should be not less than .00035 mfd.

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## Smallest Number of Lines for Use in Television

WHAT IS THE smallest number of lines that can be used in a satisfactory system of television? I have heard of systems using as few as 20 and as many as 60 lines per frame. Is there any number of lines which gives better results than any other?—V. O. K.

There is no limit one way or the other, nor is there any one number which gives the best results. Fine pictures have been obtained by Baird on 30 lines per frame. Bell Laboratories have shown good pictures with 50 lines, and RCA have demonstrated good pictures on 60 lines. The more lines that are used the finer will be the definition of the image, and conversely, the fewer lines, the poorer the definition. As the number of lines increases the difficulty of transmission increases rapidly and requires a wider frequency band. In the Baird system 30 lines are used because in Great Britain and in Germany the signal must stay within a 10 kilocycle band.

# Piezo Oscillators

## How They Control or Establish Carrier Frequency

Washington.

THE Bureau of Standards, Department of Commerce, described the testing of oscillators used at stations, in the following text:

Piezo oscillators are the most satisfactory frequency standards yet devised for use in radio broadcasting stations.

A piezo oscillator may be used either to check or to control the frequency of a radio station.

Most of the piezo oscillators tested by the Bureau of Standards are used to check the frequency of a station, because there is considerable difficulty in submitting a complete piezo oscillator intended to control the station frequency. A description of the apparatus and methods used at the Bureau in testing piezo oscillators will be given in the Bureau of Standards Journal of Research for January.

A piezo oscillator is a generator of radio-frequency current, the frequency of which is determined primarily by the dimensions of the quartz plate used.

If another radio-frequency generator is operated at approximately the same frequency, a beat note will be produced, the frequency of which can be measured with considerable precision. The measurement of the frequency of a piezo oscillator can therefore be made with high precision although the device may not maintain its frequency as accurately as may be desired.

The complete piezo oscillator must be submitted for test. Preliminary tests are first made to determine that the quartz plate operates readily and does not have one or more extra frequencies near the desired frequency. The piezo oscillator is then kept in a constant temperature room for at least two days during which the frequency is measured.

The method of measurement may be briefly stated as follows: All measurements on piezo oscillators for broadcasting stations are made by reference to a 200-kc. temperature-controlled piezo oscillator.

In accomplishing this result, harmonics of a 10-kilocycle generator accurately adjusted in terms of the standard, are used in the setting of another radio-frequency generator to the frequency assigned to the station submitting the piezo oscillator for test. Special indicating circuits are employed to make the required settings of the apparatus. After these settings are made, a beat note usually is heard in the telephone receivers connected to the test piezo oscillator.

The frequency of the beat note is matched by comparison with a similar note produced by a calibrated audio-frequency generator. The frequency of the audio generator represents the correction to be applied to the piezo oscillator under test. At the same time that this measurement is made, a check measurement is made on the radio-frequency generator using a frequency meter. The radio-frequency generator is next readjusted to zero beat with the test piezo oscillator and another reading taken with the frequency meter.

The difference between the two readings of the frequency meter should give the same frequency as the audio generator. Under certain conditions one of the radio-frequency generators is set 400 cycles off of the required harmonic by matching the beat note with the note produced by a tuning fork.

While the method and apparatus were developed chiefly for piezo oscillator testing, they have also proved to be useful in frequency meter calibration and station frequency measurement. The system has the following advantages: Great accuracy, high precision, usefulness of a given frequency standard over a wide range, large number of calibration points available, flexibility of system and ready operation.

# Right or Wrong?

(1)—Synchronization in television can be achieved simply by sending a synchronizing impulse in the picture signal once every scanning line.

(2)—Satisfactory television images cannot be obtained with as few as 30 scanning lines per image and a speed as slow as 12.5 repetitions per second.

(3)—The trouble with television transmission at this time is that it is necessary to use a light so intense that it is uncomfortable to those who are being televised.

(4)—One of the best methods of obtaining correct grid bias for power detection is to connect a 25,000 ohm potentiometer from B plus to B minus, with the grid return of the detector to B minus and the cathode of this tube to the slider of the potentiometer. To vary the bias it is then only necessary to move the slider until best detection results.

(5)—Ganging of condensers in a superheterodyne can be done successfully by selecting the proper value of oscillator inductance and by using a small trimmer condenser across the main oscillator condenser.

(6)—Ganging of the condensers in a superheterodyne is also possible by using an inductive trimmer in the oscillator circuit.

(7)—When a 30-ohm rheostat is put in the filament circuit of two 222 tubes the current through the filaments is so small that the circuit is virtually inoperable. It is assumed that there is a ballast in addition to the rheostat and that this ballast is just right for normal filament voltage.

### ANSWERS

(1)—Right. Automatic synchronism can be achieved in this way by a very simple and ingenious arrangement devised by Baird and is used in the latest of the Baird television systems.

(2)—Wrong. In the latest Baird system the number of scanning lines per frame is 30 and the speed of repetition is 12.5 per second, and the resulting images are exceptionally good. This is due in part to the accuracy of the scanning and in part to the close synchronism and the steadiness of the reproduced images.

(3)—Wrong. The intensity of the light now used is so weak that it is not at all uncomfortable. Looking into the source of the light it appears no stronger than a moderately bright incandescent electric lamp. Of course, the brightness of the scanning spot is many times greater than the apparent brightness of the source. The weak light used is possible because of the development of more sensitive photo-electric cells.

(4)—Right. The advantages of using a resistor from the B plus terminal to the cathode has been expounded many times, and this is just one way of applying the method. Moreover, it is the simplest way of using it in a detector.

(5)—Right. It can be done easily provided that only the higher frequency of the oscillator is used for beating with the signal. The oscillator coil is made smaller than the other coils and a small variable condenser is used to take up the differences that necessarily exist.

(6)—Right. When an inductive trimmer is used both the higher and the lower oscillator settings can be utilized provided that the oscillator inductance is made equal to the inductances of the other tuned circuits.

(7)—Wrong. If a 30-ohm rheostat is used in addition to the regular ballast it can be set at zero so as to operate the tubes under normal conditions. If all the resistance of the rheostat is used the amplification will be practically nil, but that is just what the rheostat is for, that is, to control the volume.

# Winding of Coils for .000375 mfd.

I HAVE CONDENSERS of .000375 mfd. capacity and bakelite tubing 1.75 inches in diameter on which I wish to wind coils to fit the condensers and the broadcast band. How many turns should I put on and what size and type of wire are most suitable?—M. N. P.

The distributed capacity in each circuit will probably amount to 25 micromicrofarads so that the total capacity will be .0004 mfd. when the variable condensers are fully meshed. A suitable wire for the small diameter coil is No. 28 enamel copper. This will require 69 turns for the tuned winding. Since there may be some variation in the distributed capacity it is safest to put on a few more turns and then remove one at a time until the coil and the condenser cover the broadcast band satisfactorily. If there is a shield around the coil the distributed capacity will be considerably higher than if the coil is in the open. Hence more turns would have to be removed when there is a shield around the coil.

The 69 turn winding is the one across which the condenser is connected, whether that is the primary or the secondary. For the other winding of the transformer the number of turns depends on the position and the kind of tube with which it is to work. If the transformer is to follow a screen grid tube and the secondary is tuned, the primary may consist of 30 or 40 turns of wire on a form which fits snugly into the main winding form. If the secondary is the untuned winding it may contain as many turns as the tuned winding, or more turns, also put on a form that fits inside the tuned winding. The untuned winding may be of fine wire. If the transformer is to follow a three-element tube the primary should be untuned and it may contain 15 to 20 turns on the same form as secondary.

# Units of Measurement

## Resistance, Capacity, Inductance, Current, Voltage, Frequency

*By J. E. Anderson and Herman Bernard*

RESISTANCE is measured in ohms, capacity in farads, current in amperes, and voltage in volts. Wide ranges of these values are used in radio receivers, hence multiple and decimal quantities are employed to express values.

Resistance in ohms is common, as, for instance, a rheostat of 20 ohms, or a voltage divider of 25,000 ohms. Values of less than one ohm are seldom used in radio. But values in hundreds of thousands or even millions of ohms are frequent, for instance, a grid leak of 2,000,000 ohms. A million ohms are a megohm, so 2,000,000 ohms would be written as 2 meg.

A farad is a large quantity of capacity, and one millionth of a farad, called a microfarad, is a common denomination. For bypassing and filtration capacities are almost always used in units of microfarads. So the condenser next to a rectifier tube may be one microfarad, written 1 mfd. Smaller values than 1 mfd. are expressed decimally. Thus one-tenth of one microfarad would be written as .1 mfd., sometimes with a cipher preceding the decimal point, to avert typographical error, e. g., 0.1 mfd. For the same reason 2 meg. may be written 2.0 meg.

Small values of microfarads are used for tuning condensers. A common value is five ten-thousandths of a microfarad, written .0005 mfd., and spoken as triple-oh-five mfd.

### "MICRO MIKES"

A micro-microfarad (mmfd.) is one one millionth of a microfarad, hence a millionth millionth a farad. A capacity of .0005 mfd. therefore might be stated as 500 mmfd. Compensating, equalizing or trimming condensers are of such low capacity that it is usual to define the capacity in micro-microfarads. Also, the minimum capacity of a tuning condenser, representing the capacity when the rotor plates are totally unmeshed from the rotor plates, is expressed in micro-microfarads (colloquially called "micro-mikes"). A frequent value of this minimum is 50 mmfd. (also expressible as .00005 mfd.). Therefore the so-called "zero capacity is a misnomer, as the minimum is always in excess of zero.

If the rotor plates of a tuning condenser are semi-circular and the stator plates are likewise, the variation in capacity is proportional to the number of degrees of rotation, called the angle of displacement. When dial settings of 0 to 100 are calibrated against capacity the "curve" is a straight line, and the variation is therefore called straight capacity line. This type of tuning condenser is not used in modern receivers, but was the type predominating in early receivers. However, capacity measurement devices often use the straight capacity line type of condenser.

### MODIFIED TUNING CONDENSERS

Three types of variable condensers have specially cut plates, so that when the condenser is connected across a coil a given type of preferred tuning results: straight wavelength, straight frequency or midline, which strikes a medium between straight wavelength and straight frequency lines.

The reason for special shaping of plates is to spread out the stations as to dial readings, particularly at lower capacity settings. The straight capacity type of condenser causes low wavelength stations to be crowded into a short stretch of the dial, with an awkwardly large spreadout at high wavelengths. Straight wavelength line condensers make the dial readings proportionate to the wavelength. Straight frequency line condensers cause the dial readings to be proportionate to the frequency.

While the straight capacity type condenser makes tuning in of low wavelength stations inconvenient, hence is not desirable, the selection of a remedial condenser is a matter of personal preference. The straight wavelength, straight frequency and midline condensers all offer good solutions in different ways. All three remedial types uncrowd the lower end of the dial at the expense of the upper end.

The wavelength and the frequency types have the advantage of enabling an approximate calibration of a quantity production dial in meters or kilocycles, respectively, instead of requiring resort to arbitrary numbers from 0 to 100 or 100 to 0. Hence dials calibrated from 1,500 to 550 kilocycles, or 200 to 545 meters, become practical. If you know a station's wavelength or frequency, and the station is within reception range, you can tune in the station by turning the dial to the stated wavelength or frequency.

### INDUCTANCE

The henry is the unit of inductance. Only at audio frequencies, or for B supply filtration, is this large unit used. A common audio choke coil is one of 30 henrys. In tuning coils at radio frequencies the measurement is given in millionths of a henry, called microhenries. Hence a coil for .0005 mfd. tuning, consisting of 55 turns of No. 21 wire on a 2½-in. diameter tubing, would have an inductance of about 170 microhenries (170 mh.). Radio frequency choke coils have an inductance measured in thousandths of a henry, called millihenries. A standard value is 85 millihenries (85 mh.).

THE INDUCTANCE OF TUNING COILS IS MEASURED IN MICROHENRIES. THE INDUCTANCE DEPENDS ON THE SIZE OF THE TUBING, THE SIZE AND INSULATION OF THE WIRE AND, PRINCIPALLY, THE NUMBER OF TURNS OF WIRE.

### CURRENT

An ampere is a high amount of current in radio receiver circuits. Only the filament or heater will require as much as an ampere. Plate current will be in milliamperes, which are thousandths of an ampere, except that a detector tube may draw less than one milliampere (1 ma.) plate current if the plate load is a resistor or if negative bias detection is used with any type load. One one-thousandth of a milliampere, or millionth of an ampere, is a microampere. Hence 20 milliamperes would be written .02 ampere, while two-tenths of a milliampere would be written .0002 ampere or 200 mca. (200 microamperes).

The current values are expressed in these ways for alternating and direct current.

### VOLTS

Multiples of volts are used in radio receivers. Seldom is less than a volt used. The low voltages are present on filaments or heaters, or for biasing purposes, the high voltages for the plates of tubes. Power tubes, however, particularly those of high undistorted power output, require high negative bias. For instance, the 250 tube, the largest power tube found in radio receivers and power amplifiers for home use, at 450 volts on the plate requires 84 volts negative bias. This 84 volt negative bias voltage may be higher than the voltage on the plates of radio frequency amplifier tubes in the same receiver.

### FREQUENCY

Frequency is measured in cycles. A thousand cycles are a kilocycle (kc), and a million cycles, a megacycle (mgc.). Wavelength is distance, measured in meters. A meter is about 39.37 inches. A thousand meters are a kilometer (kilo.).

Since the speed of a radio wave is 186,000 miles a second, equalling 300,000,000 meters, if we know the wavelength we can compute the frequency, or if we know the frequency we can compute the wavelength.

Suppose a man is firing a pistol, two bullets each second. Assume he shoots several bullets. We know the frequency is 2. Suppose the speed or velocity of the bullet is 100 feet a second. We now have the frequency of discharge and the velocity. If two bullets are fired each second, and the speed of the bullets is 100 feet a second, the distance between successive bullets is the velocity per second divided by the number of bullets per second, that is, 100 divided by 2, or 50 feet.

In radio the determination of the distance between crests of successive waves (wavelength) is by the same formula: wavelength equals the velocity divided by the frequency. Wavelength is symbolized λ (the Greek letter lambda), so the formula is written:

$$\lambda = V/f$$

where λ is the wavelength, V the velocity and f the frequency.

Suppose the speed of the bullet, its velocity, were not known, but that the distance between bullets (50 feet) and the frequency of discharge (2) were known. What would the velocity be? It would be the number of discharges per second multiplied by the distance between bullets, or the velocity equals 2×50 or 100 feet per second. So

$$V = f\lambda$$

# Channels Multiplied

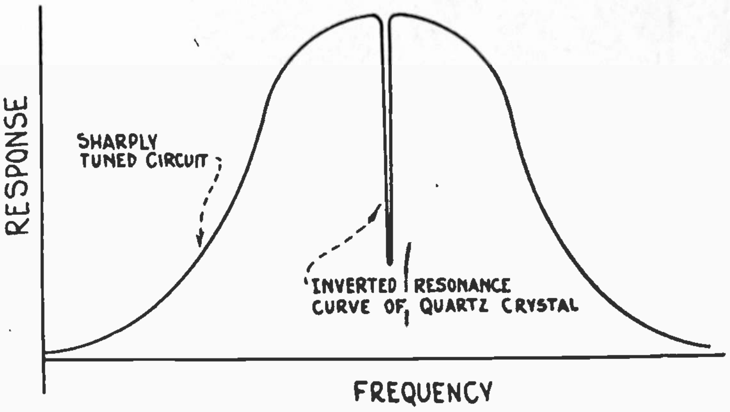
## Stenode Radiostat Said to Permit Super-Selectivity

*By Neal Fitzalan*

A NEW system of radio reception whereby a broadcast channel can be reduced to a width of only 100 cycles per second is said to have been invented in London by Dr. James Robinson, former chief of wireless research to His Majesty's Royal Air Force. The new system has been named "Stenode Radiostat," the first part of which is derived from the Greek and meaning "narrow path."

In reading the description of the system one is reminded of the old super-regenerative receiver invented by Major Edwin H. Armstrong several years ago and which stirred up considerable interest in the early days of broadcasting.

It will be recalled that in theory the super-regenerative receiver worked on the principle of continuous stopping of oscillation in a detector circuit adjusted so that if left alone would oscillate vigorously. The regeneration made the circuit extremely receptive to weak radio signals due to the great reduction in the resistance in the tuned circuit. It is well known that when a circuit oscillates clear signals cannot be received. For this reason a device was introduced into the circuit which stopped the oscillation some 10,000 times every second, or at a rate which corresponded to a super-audible frequency. The regeneration in the circuit started the oscillations as many times a second. The result, in theory at least, was that full advantage was taken of the enormous sensitivity which super-regeneration afforded without at the same time suffering from continuous oscillation.




QUALITATIVE COMPARISON BETWEEN THE SELECTIVITY OF A SHARPLY TUNED ELECTRICAL CIRCUIT AND THAT OF A QUARTZ CRYSTAL. THE RESONANCE CURVE OF THE CRYSTAL IS SUPERIMPOSED ON THAT OF THE ELECTRICAL CIRCUIT AND IS THAT OBTAINED WHEN THE CRYSTAL ABSORBS ENERGY FROM THE ELECTRICAL CIRCUIT.

### PRINCIPLE OF STENODE RADIOSTAT

The principle of the Stenode Radiostat is somewhat similar. But before we attempt to explain it let us discuss briefly the requirements of clear broadcast reception.

The width of a channel for broadcast purposes is 10,000 cycles. It should be at least 20,000 cycles wide for the very best quality. But the limited space in the broadcast spectrum and the great demand for channels impose the 10,000 cycle condition. Good quality then calls for wider space and the demand for channel room demands a narrower space for each channel. Any device which will permit the use of a very narrow channel without any sacrifice in the quality will therefore be a welcome addition to radio.

Much has been said of sideband cutting, meaning the suppression of the higher audio frequencies contained in a modulated wave as a result of too high selectivity. It is quite possible to obtain such high selectivity that only the bass notes would be reproduced. Indeed, many Superheterodynes and some regenerative receivers have been constructed in which the selectivity was much too great for good quality. If we were to limit the space occupied by each broadcast station to 100 cycles an enormously selective receiver would be required to separate the signal of one station from the signals of other stations. And after the separation had been effected only tones of less than 100 cycles could be heard. That is, if we use the established method of reception.

### PROLONGED RESPONSE

A resonant circuit has the property of continuing its vibration for a considerable period after the exciting force has ceased to exist. The same is true of every resonant system. For example, a bell is struck once and it keeps ringing for a considerable period, and the more resonant it is the longer it will keep on ringing. The same applies to a piano string, a pendulum, a bar of steel, a tuning fork, a piece of quartz.

Difficulties arise at times when highly resonant systems are excited so rapidly that the vibration caused by one excitation has not time to die down before the system is again excited. Take a bell, for example. It is struck once and it keeps ringing. If it is struck again before the ringing has died down the ringing due to the second excitation will mingle with the ringing due to the first. There will be interference between the two, although they are of the same frequency, and the resulting noise will be a continuous din. To avoid this large resonant bells are struck at considerable times apart, or else the vibrations are intentionally killed before the bell is struck again. This is done in a piano by the damper, which is used to avoid a confusion of sounds. Doing this is more important when there are several resonant systems of different pitch to be excited at intervals.

### TUNED CIRCUIT A RESONANT SYSTEM

The disagreeable effects due to prolonged ringing of the resonant systems are very evident in carrillon playing. Here the prolongation of the vibrations are in part due to the resonance of the room in which the carrillon is and in part to the resonance of the mechanical vibrators. So-called poor acoustics of auditoriums is also due to the prolongation of the vibrations by resonance, in this instance the resonance in the room.

A tuned circuit in a radio receiver is one form of resonant system. If this system is "struck" by an incoming wave it keeps on vibrating for some time, and the less resistance in the circuit, that is, the less damping, the longer it will vibrate. This continued vibration is the cause of the boominess of many selective receivers. It vibrates by resonance only at the frequency to which it is tuned, or to frequencies very close to this frequency. It is tuned to the carrier frequency but not to any of the side frequencies. It is, however, nearly tuned to the side frequencies representing the low audio notes, and only roughly tuned to those side frequencies which represent high audio notes. Hence the low notes are prolonged and intensified more than the high.

A high resonant system does not respond as quickly as a non-resonant system, although the final response of the resonant system is enormously greater than the final response of the non-resonant system. This has a direct bearing on the speed of signalling with systems involving resonant circuits. With a non-resonant system the possible speed is practically unlimited, but it requires a very great force to conduct the signalling. With a highly resonant system the possible speed is slow, but it does not require much force to conduct the communication. It is necessary to wait for the response to build up and down before another impulse can be transmitted. In a non-resonant system it is not necessary to wait at all.

Voice communication requires a fairly high speed of signalling, say 5,000 impulses per second. Broadcast communication involving true realism of speech and music requires a still higher speed, say 10,000 or 20,000 impulses per second. Television of good quality requires a still higher speed, say 50,000 to 100,000 impulses per second. For this reason non-resonant circuits, as far as possible, are used for television. Of course, it is not practical to dispense with all resonance in the receiver.

### SUPER-SELECTIVE SYSTEMS

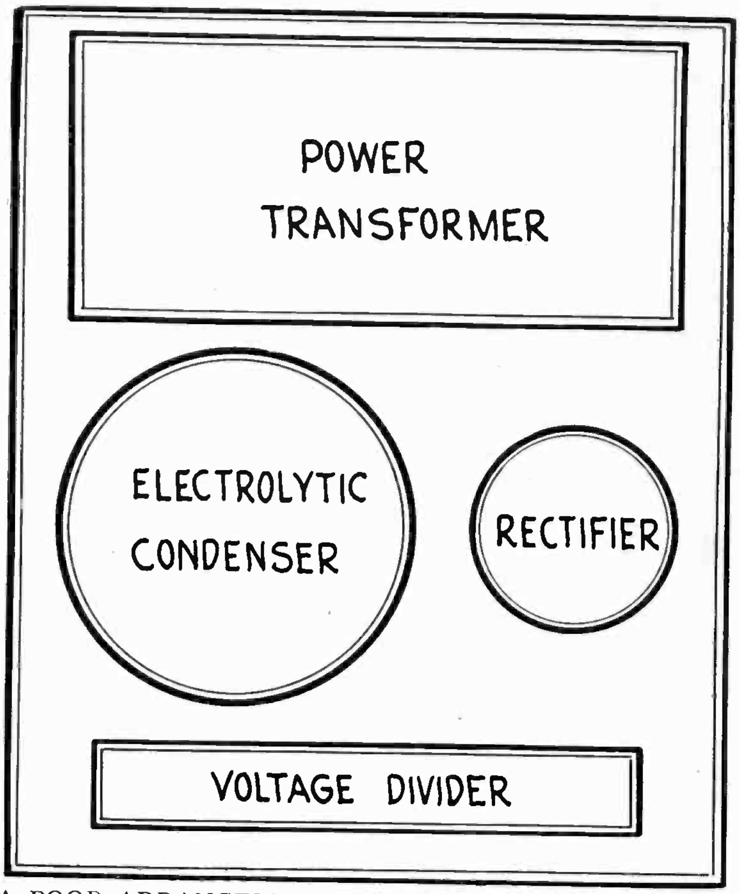
There are many systems which are extremely selective. Perhaps the most resonant system yet discovered is the quartz crystal used as frequency control in most modern transmitters. In getting an idea how resonant a good quartz crystal is, a comparison is useful. Suppose we take the best possible tuned circuit and plot its resonance curve, spreading out the frequency scale so that the top of it is sensibly flat over a considerable region. Then if we superimpose the resonance curve of a quartz crystal on this it will look like a straight vertical line, with scarcely any separation between its two branches. A steel bar is another highly resonant system but it does not compare favorably with a quartz crystal.

The idea back of the invention of Dr. Robinson is the use of extremely resonant circuits, intentionally producing the prolongation of the response which we discussed in conjunction with the bells, and then introduce a periodic stopping of the vibration, that is, to introduce a device which does electrically just what the hand does in stopping the bell from continuing ringing, or what the damper does in the piano. The details of this device are not available at this time, pending patent applications throughout the world.

# Heat Causes Crackles

## Condensers Break Down Due to Poor Ventilation

*By Herbert E. Hayden*




A POOR ARRANGEMENT OF THE PARTS IN A B SUPPLY UNIT. THE ELECTROLYTIC CONDENSER IS HEMMED IN BY THE POWER TRANSFORMER, RECTIFIER TUBE, AND THE VOLTAGE DIVIDER. IT IS SURE TO OVERHEAT.

QUITE often owners of home-built receivers, and at times those of factory make, find that a severe crackle develops in the output after the receiver has been in operation for half an hour or so. What is the cause of this trouble?

Undoubtedly there are many causes which could account for the crackling, but there is one that is to blame more than any other, and that is excessive heat. The heat in the receiver gets so intense that the wax in by-pass condensers and transformers softens or even melts and so that the electrolyte in electrolytic condensers boils.

When the receiver is first turned on the parts are all cool and the operation is as it should be. The output sound is pure and free from any crackling. But as the receiver functions the parts heat up and the crackling develops. Usually the trouble is in the B voltage supply where most of the heat is developed.

### PREVENTING CRACKLES

In order to prevent the occurrence of crackling it is essential that the circuit be built so that any part that contains insulators which may melt is far away from the heat-generating parts, or so that there is ample ventilation.

Perhaps the greatest source of heat in the receiver is the power transformer. Frequently it gets so hot that it is impossible to put a hand on it and leave it there for more than a second. Such heat is great enough to melt many waxes used as insulators in condensers. Hence condensers should be kept away from the power transformer.

Another prolific source of heat is the rectifier tube. This is always so hot that it will burn the hand that touches it. However, this does not mean that more heat is generated in the tube than in the transformer. It means that it does not radiate the heat so well because it has less radiating surface, and usually poorer radiating surface, too. The heat generated in the filament of the 280 rectifier tube is equivalent to that of a 10-watt electric light, since the filament requires this power. There is additional heat generated on the plates of the rectifier tube, which may be as high as 5 watts. Thus the total would be about 15 watts. This is small in comparison with the power required by the average light in a house, but it is large when one considers that all the heat generated is often kept in a confined space.

Considerable heat is also generated by the amplifier tubes in the receiver, both on the filaments and on the plates. That this is true can be verified by touching any one of the tubes in the receiver. The power tube, particularly, is much too hot to touch.

The total power required by a modern receiver is probably in the neighborhood of 75 watts. Many sets are so rated. Now a 75-watt light in the house generates a good deal of heat. It is not noticed because it is usually far away from any observer and is well ventilated. Hence it does no harm. But when the same amount of heat is generated inside a small radio cabinet with inadequate ventilation it is enough to do a considerable damage to the more fusible substances such as rubber, sealing wax, insulating wax and varnish.

In a half hour a 75-watt light, or a radio receiver of equivalent rating, will generate 32,400 calories, which is sufficient heat to raise the temperature of a third of a quart of water from 32 to 112 degrees Fahrenheit, that is, to raise the temperature from freezing to boiling. It is also sufficient to melt, or at least to soften, a considerable amount of wax used in by-pass condensers, and that is just what it does in many radio receivers.

Suppose a wax-filled or an electrolytic condenser is placed in actual contact with the case of the power transformer or in very close proximity with the rectifier tube in the power supply. Much of the heat generated in the transformer or in the tube will then be transferred to the condenser. If it is a wax-filled condenser the wax will soften and the insulation will not be as good as when it is solid. The filtering will be imperfect. Likewise if the condenser is of the electrolytic type the electrolyte will become hot and the performance of the condenser will be less satisfactory.

One thing that frequently occurs is that the electrolyte expands and exudes through the crack between the copper can and the insulator on top. The electrolyte forced out will dry and leave the salt on the top. This is the cause of the accumulation of white substance on top of these condensers. Fans whose condensers have formed such accumulations of salt have assumed that the condensers were defective, whereas the fact is that the layout of the power supply instead has been defective, or the ventilation of the device has been inadequate.

### HEAT IN VOLTAGE DIVIDER

Another source of heat in the B supply is the voltage divider. There have been cases in which this device has become so hot as to char woodwork. It is a wonder that fires have not been started in this manner. This condition was recognized a long time ago and it was rectified. Voltage dividers were made larger so that there was a greater radiating surface from which the heat could escape, and at the same time the resistance strip was mounted so that the heat could escape by convection, that is to say, by a draught of air. The chimney effect was brought into play. Moreover, asbestos was placed between any material which would be damaged by excess heat and the voltage divider.

It is not enough, however, to treat the voltage divider alone in this manner. Every part in which considerable amounts of heat are produced should be treated in the same manner. But putting asbestos protectors in strategic positions in no way eliminates the heat. It still remains in the cabinet unless it is carried away by radiation from the external surfaces of the cabinet or by convection through holes cut in the cabinet for that purpose. The amount of heat that can be carried away by radiation from the external surfaces is negligible in the case of wood cabinets, for the heat must first get to these surfaces by conduction through the wood, and wood is a very poor heat conductor. In metal cabinets a little more heat is carried away in that manner because heat travels easily in metal, just as electricity does. The radiation is further enhanced if the external surfaces of the metal are painted black.

Most of the heat that is produced inside the cabinet must necessarily be carried away by ventilation. Hence the cabinet should be provided with air vents both at the bottom and at the top, the bottom holes for cold air to enter and the top holes for hot air to escape. If this is not done the condensers inside will get overheated whether or not they are protected locally by asbestos or other stuff.

And if the condensers get overheated the receiver will crackle half an hour or so after it has been turned on.

When a condenser is called on to carry a heavy alternating current, such as a strong signal current, there will be internal heating which will have the same effect as if the heat comes from the outside of the condenser. There are two condensers which often break down from this effect, and they are the condenser in series with the loudspeaker and the large condenser across the voltage divider. This is another reason why the receiver should be well ventilated to prevent condenser breakdown and crackles.

# HB 44 Efficiency Data

## Trouble-Shooting in Screen Grid Receiver Is Explained

SELECTIVITY and sensitivity are like a see-saw. When one goes up, for a given number of similarly tuned circuits, the other goes down. Therefore, the HB44 was so designed that the selectivity was abundant.

The sensitivity is most marked below 400 meters, and it is in this range that most of the distant stations come in, plenty of them, with clear-cut separation among them.

On the higher wavelengths there is less sensitivity but more selectivity, because the amplification is less the higher the wavelength, a condition known as the rising characteristic of tuned radio frequency, since the higher the frequency the higher the amplification.

At higher wavelengths selectivity is higher, another natural characteristic, unless altered by regenerative effects on lower wavelengths, an intrusion, by the way, which often works in a most favorable direction.

### MAY DOUBLE ANTENNA TURNS

Since there is selectivity to spare, any who desire to build up the volume on the higher wavelengths may do so by winding more turns on the primary of the antenna coupler. The number of turns is not critical at all. Even if there are around 40 turns now on the 1¾-inch diameter tubing used, you may safely double the number of turns.

This will bring in the highest wavelength stations with suitable volume in those locations where this special treatment is necessary, due to weak field strength of some high wavelength stations.

For instance, in many parts of New York City and its suburbs, WEAF comes in very weakly, also WNYC and WMCA, but the location difficulty may be circumvented this way.

### USE PICTURE DIAGRAM FOR WIRING

The design as published in picture form on the following two pages should be followed, but for reading the circuit in conjunction with text, the schematic diagram is preferable, because better subject to glance reading. It takes time to follow the connections of a picture diagram, while a schematic reveals itself at sight. Yet in building any receiver, of course the picture diagram is the thing. It shows you where each part is and where each lead is connected.

It will be found that the negative bias applied to the radio frequency amplifying tubes 1, 2 and 3, is rather critical, so the Clarostat Humdinger should be adjusted for maximum volume, even though the moving arm has to be placed at one extreme end. At worst, you can not fail to use at least 12 ohms of resistance, as the device is built that way, and at the current flowing in the section of the voltage divider of which the adjustable resistor is a part, the resultant minimum bias is about 1 volt. This would be enough, although the rated voltage is 1.5 volts. The object is to attain the best sensitivity level, let the bias be what it may, since it is confined to authentic limits by the constants of the parts.

### HIGHER SCREEN GRID VOLTAGE

There need be no hesitancy in using a higher voltage on the screen grids than that shown. The potentiometer's side that goes to plus 50 volts, equal to the midtap of the power tubes' filament winding, may be connected to the next highest lug. But do not move the bias for the power tubes to this lug. If any experiments are to be made with biasing, moving the filament center connection on the voltage divider down, rather than up, one lug.

The voltages obtained should come near to the rating. As for the filaments, there will be no trouble here, since all filaments, save the 280 filament, take 2.5 volts and the power transformer windings have ample current capacity. The 280 filament voltage is 5 volts, and should be tested with all tubes out of the receiver, even the 280 out of its socket, and a plug-in tester put into the 280 socket. The only reading you will get this on most testers is the filament voltage, but having determined this to be 5, you need investigate this point no further.

The screen grid, plate and bias voltages may be measured, using a high resistance voltmeter. The total voltage across the divider will be around 300 volts, but if it is even 10 per cent more or less, it is not important.

### BIAS COMPUTED

The drop between the power tube filament winding's center tap and ground should be around 50 volts. If you get a reading much different from this, measure the plate current of one of the power tubes under existing voltage conditions. Since this tube is a 245, the total voltage across the divider being 300, the bias voltage will be 50 if the plate current is 32 milliamperes in the single power tube tested. The other power tube, since this is push-pull, must be in circuit while this test is being made, and so must every other tube in the receiver.

The reason for a wrong reading of bias voltage likely would be too low a resistance voltmeter, so the computed bias on the basis of known overall B voltage, and plate current in one power tube, is an ample substitute for use of a poor meter. But if you have a high-class meter use it, since you will get an accurate reading, and it will jibe with the computed value, unless there is something the matter with the tube.

### HUM ERADICATION

A small amount of hum has to be tolerated, because the circuit amplifies the low notes well, and hum is in the low-note region. But when the program is being received the hum becomes inaudible by comparison. Nobody would notice it while anything was being played, sung or spoken. Even when the carrier alone is on for a moment or so, while an announcer or a program halts, the hum isn't more than feeble, because the filtration is particularly good.

So if you are troubled with excessive hum, first look to the filter condenser, the one next to the rectifier, and be sure that it is not of large capacity. In this circuit 1 mfd. was recommended and this should be used.

Test the power tubes under equal conditions, that is, work both, measure the plate current of one, then, turning off the set, interchange tubes in the push-pull sockets, so that the other tube is now in the same socket used previously for testing. The plate current should be approximately the same, and the deviation should not exceed 1.5 milliamperes. Unbalance of this sort is provocative of hum, so use two 245 tubes that draw the same plate current under the same operating conditions, even though the difference may be due only to one tube having a little better emission than the other.

Sometimes a .00025 mfd. condenser connected across a half-section of the secondary of the push-pull input transformer will reduce hum. Try one section, then the other. The one on which the trick works is the one on which the condenser should be left.

### OPEN GRIDS

The most frequent cause of hum in home-constructed receivers, it is sad to relate, is not anything wrong with a diagram or the parts used, but with the wiring, whereby a grid circuit is left open.

Either in the radio, detector or audio circuits, if there is an open grid there is an open season for humming. It is hum of the worst type, in that it is always objectionable, and further it starts loud and gets louder and louder, then less, or starts low and gets louder and louder and then recedes again, behaving thus all the while the circuit is operated. Close up the grid circuits properly and your hum will disappear if due to this cause.

### RESONANT HUM

Resonant hum is often due to detection in radio frequency amplifiers, remedied by lowering the bias on these tubes, as may be done with the Humdinger, or by introducing an extra audio frequency filter in the B plus lead going to the plates of the RF tubes. A 30 henry choke intercepts this lead, for RF only, and a 1 mfd. or higher condenser is connected from the end of the plate coils of the receiver to ground. Resonant hum is the type that appears only when you tune in a station.

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## How Can Voltage Leak Over Insulator's Surface?

I READ IN a book on radio about leakage of voltage over the surface of an insulator. Could you tell me what that means? I understand how current can leak through an insulator, but how voltage can leak is beyond my comprehension.—A. A. J.

It is also beyond our comprehension. The one who made the statement probably did not have a clear conception of voltage or he would have confined himself to current leakage. If a condenser is charged to a certain potential difference between the plates, that is to say, to a certain voltage, and if that condenser leaks, a small current will flow from one plate to the other through the insulation, and this flow will continue as long as there is a voltage difference. At any time the current leakage is proportional to the voltage difference. As the current flows the voltage difference decreases, and perhaps it is because of this fact that the idea of voltage leakage is entertained by some.

# Picture Diagram of the W

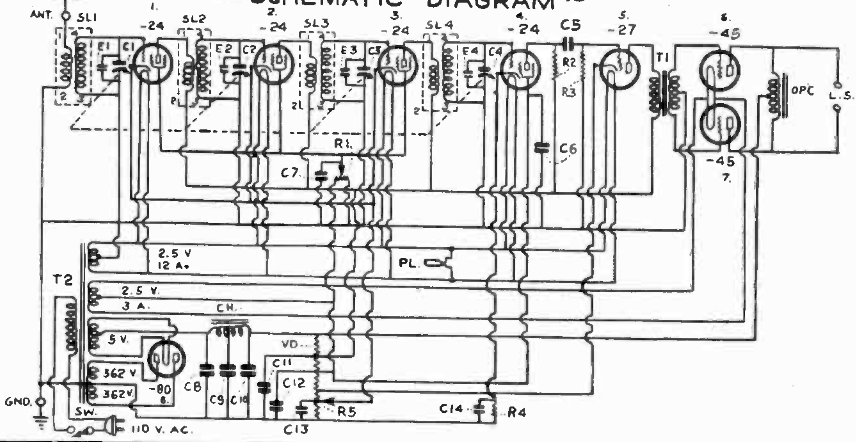
## Three Stages of Screen Grid RF, Screen Grid

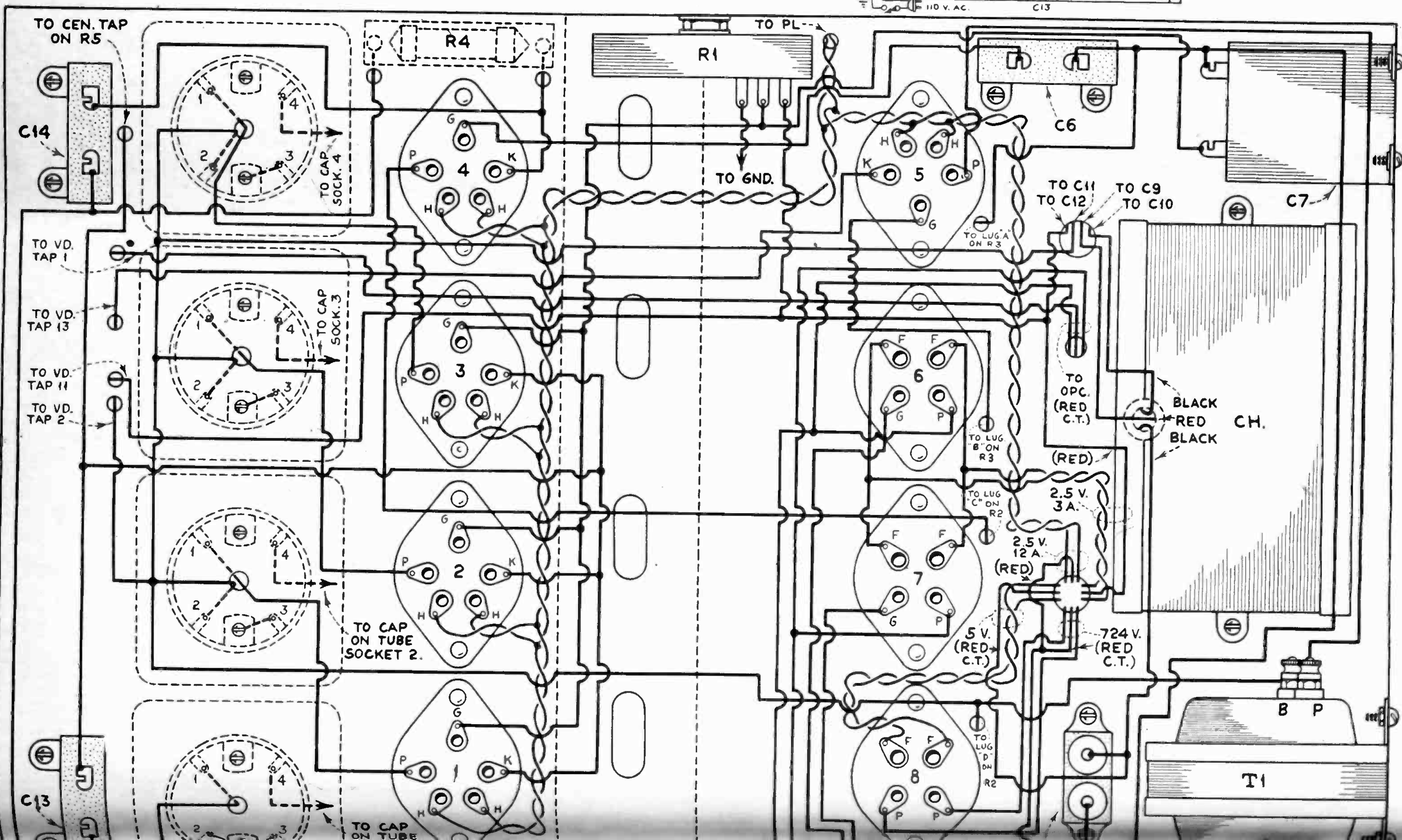
# HB 44

### ~ LIST OF PARTS ~

SL1, SL2, SL3, SL4 - FOUR STAGES OF INDIVIDUALLY SHIELDED COILS FOR .00035 MFD. (SCREEN GRID COIL CO. SH-3)
C1, C2, C3, C4 - ONE FOUR GANG COND. .00035 MFD. WITH EQUALIZERS E1, E2, E3, E4 BUILT IN.
C5 - ONE .01 MFD. MICA COND.
C6, C7, C13, C14 - FOUR 1 MFD. 200 V. DC. BY-PASS COND.
C8 - ONE 1 MFD. 550 V. AC. FILTER COND.
C9, C10, C11, C12 - ONE MERSHON COND. CONSISTING OF TWO 8 MFD. AND TWO 18 MFD. WITH BRACKET (CAT. NO. Q 2-8, 2-18 B)
R1 - ONE ELECTRAD 25,000 OHM POTENTIOMETER, KNOB & INSULATORS.
R2 - ONE LYNCH 50,000 OHM RESISTOR (.05 MEG.) WITH MOUNT.
R3 - ONE LYNCH 5 MEG. GRID LEAK AND MOUNTING.
R4 - ONE 5,000 OHM RESISTOR
VD - ONE MULTI-TAP VOLTAGE DIVIDER OF 13,850 OHMS, 14 TAPS.
T1 - ONE PUSH-PULL INPUT TRANSF.
OPC - ONE CEN. TAP. OUTPUT CHOKE
T2 - ONE POLO FIL.-PLATE SUPPLY CAT. PFPS (NOTE: FOR 40 CY. USE PFPS-40; FOR 25 CY. USE PFPS-25).
CH - ONE DOUBLE FILTER CHOKE COIL, EACH SECTION 30 HENRIES AT 100 MA.
SW - ONE PENDANT TYPE AC. LINE SWITCH, WITH 12 FOOT CABLE.
PL - ONE 2.5 VOLT PILOT LAMP AND BRACKET.
ANT., GND., - TWO BINDING POSTS AND INSULATORS.
ONE PAIR OF TIP JACKS FOR SPEAKER OUTPUT.
R5 - ONE 30 OHM CLAROSTAT HUMDINGER.
FOUR NATIONAL CO. GRID CLIPS.
ONE SUBPANEL 17-1/2" X 11-1/2" WITH FIVE UY AND THREE UX TYPE SOCKETS BUILT IN.
ONE DRILLED STEEL CABINET WITH CRACKLED BROWN OUTSIDE FINISH.
ONE VERNIER DIAL.

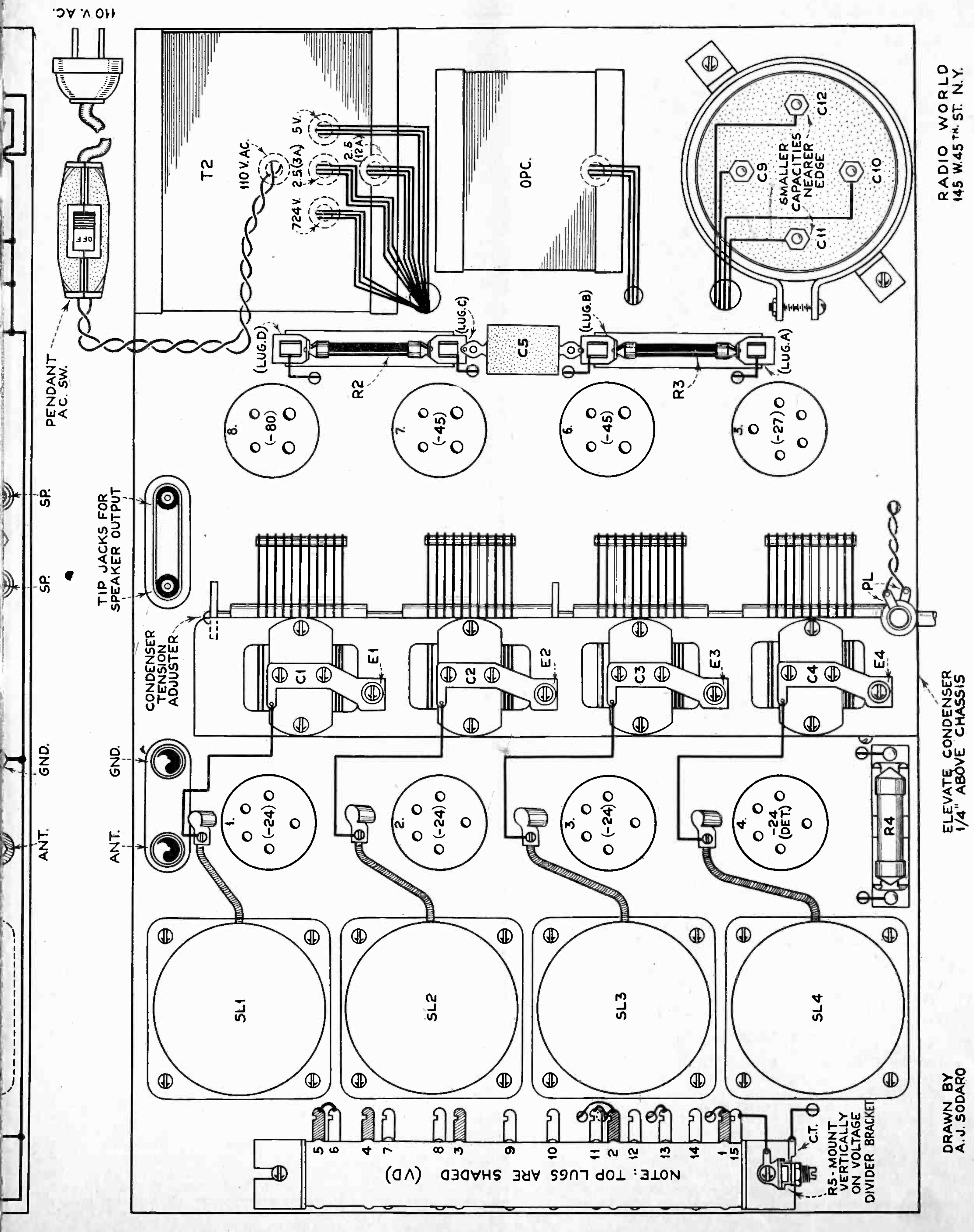
~ SCHEMATIC DIAGRAM ~



# ring of the HB 44 Circuit

## ector and First AF Precede Push-Pull Output



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

# RADIO UNIVERSITY

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

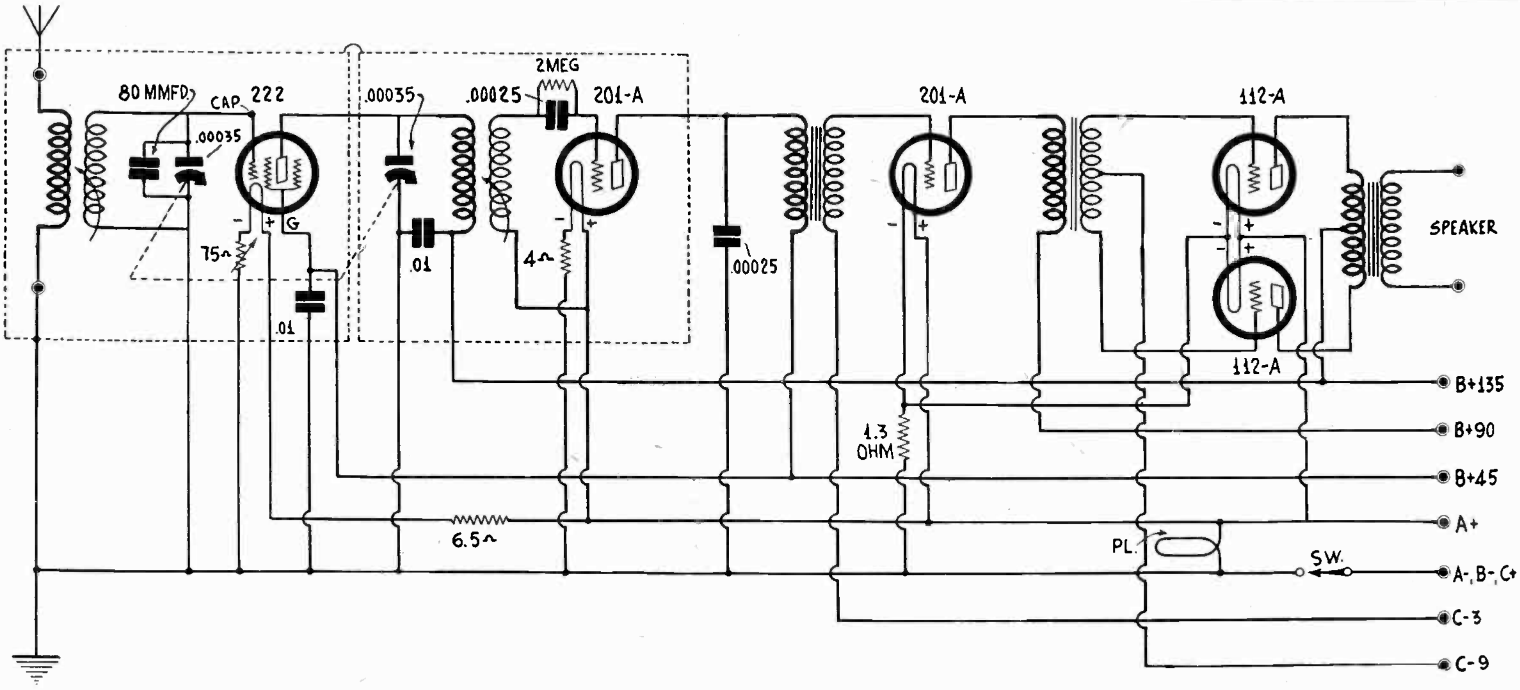



FIG. 822
A SCREEN GRID TUBE FOR HIGH SENSITIVITY AND PUSH-PULL FOR A HIGH UNDISTORTED OUTPUT ARE INCORPORATED IN THIS BATTERY-OPERATED RECEIVER.

## DC PUSH-PULL RECEIVER

KINDLY PUBLISH a diagram of a four-stage, push-pull receiver with one screen grid tube and two 112A tubes in the push-pull. The set is to be operated with storage battery and a B supply unit.—J. B. K.

You will find such a receiver in Fig. 822 above. All the components are specified except the tuning coils. They are the Bernard dynamic tuning coils for the condensers specified. Of course, the circuit can also be built with ordinary tuning coils provided that they fit the condensers used. Note that the primary of the interstage coil is tuned.

## SET HAS LOST ITS SENSITIVITY

SOME TIME ago I built the Diamond of the Air, one stage of resistance coupling and one stage of transformer. At first this set worked very well and gave good quality. Recently it has failed to work at all. When I first turn on the power there is a peep and then the set dies entirely. I have tested all the tubes, measured the voltages, and tried different values of grid leak without results. What do you think is the matter with the set?—K. W. J.

It sounds like a case of defective leakage in one of the grid circuits. It may be in any stage but most likely in one of the audio, possibly the one that is preceded by a resistance coupler. The trouble may be due to insufficient leakage through the grid leak or to too much leakage from the plates to the grid. One of the grid circuits may actually be open. To test this condition measure the plate currents in all the tubes. You may find that while the peep is heard the plate current is normal in all the tubes and that when the set is dead the plate current in one of the tubes is either zero or very much too high This condition is often met in resistance coupled amplifiers.

## ENERGY LOSS IN SHIELDS

IS IT NOT A fact that the shields used in modern receivers reduce the sensitivity and the selectivity? If it is a fact, why are shields used?—A. W. S.

Yes, it is a fact. The reduction in the sensitivity and the selectivity is greater the smaller the shields are with respect to the size of the coils inside them. They are used despite this reduction because the receiver would not work without them. The feed back from one stage to preceding stages would be so great that the circuit would oscillate uncontrollably, and when it does it is of no use in receiving signals. So the shields introduce losses which result in overall gain. Of course, if the shields are too small the losses may be greater than the gain, in which case it would be better to remove one stage so that more room can be given to the remaining stages, especially more to the coils in the shields. It is because the relative sizes of the coils and the shields count that small coils are used in shields of given size. Better overall results are obtained with coils of small size than with coils of large size, although by themselves the larger coils are superior to the smaller.

## RECEIVER HUMS ON SUNDAYS

ON HOLIDAYS, Sundays, and late at night my radio set hums with such intensity as to ruin a program that is received with ordinary volume. At other times while there is a hum present it is not too objectionable. This type of hum has been received on several other sets I have built. On an all battery set I could eliminate it by pulling the service switch on the house current. This is obviously impossible on a AC set. All sets have been regenerative, and it seems to make no difference whether the audio is transformer, impedance, or resistance coupled. Apparently the hum occurs only when the load is lessened on the city current. What is the cause and is there any remedy for this condition?—H. A. G.

Undoubtedly this trouble is due to oscillation or excessive regeneration. The hum from the line is picked up by the receiver and is intermodulated with the radio frequency current in the receiver, and then amplified together with the desired signal. This happens in nearly all regenerative receivers or in receivers in which there are parasitic oscillations. The remedy is to prevent regeneration. The reason it hums more when the load on the line is partially cut off is that the voltage rises to a point where oscillation begins.

## USING BATTERY FOR FIELD CURRENT

I HAVE a dynamic speaker operated with AC and a built-in rectifier. Is it possible to connect a 90 volt battery across the field winding in place of the rectifier?—A. C. Q.

Dynamic speakers operated with AC usually have fields of low resistance because the rectifier used supplies power at low voltage and heavy current. If you were to connect a 90 volt battery across the low resistance field winding the current would be very high and both the battery and the field winding would be ruined in a few minutes. Probably the speaker would start to burn. However, if the rectifier used with the speaker is of the high voltage type, whether it is a tube or a dry rectifier, the field winding would be of high resistance and it would be safe enough to connect a 90 volt battery across it. But the battery would not last very long.

## RECEIVER WEAK ON STRONG STATIONS

IN MY LOCALITY the long wave broadcast stations are much stronger than the short wave stations, yet with my receiver I can get the weak stations much better than the strong. What is the cause of this peculiarity of my set?—J. E. W.

That is not a peculiarity of your set at all. It is a property of all radio receivers unless special design has been done to equalize the sensitivity. Radio frequency transformers are much more effective at the short wave stations. If you want to bring up the sensitivity of the receiver at the long wave stations you can do so by adding turns to the primaries of the RF transformers, if they are untuned, or to the secondaries, if they are untuned. The greater the number of turns the greater will be the sensitivity at all frequencies, until the number is so high that the distributed capacity of the untuned winding reduces the response at the high frequencies. The coil form will be full long before this happens. The number of turns can also be increased on the antenna coil so as to increase the pick-up. If this results in too great sensitivity on the high waves it is a simple matter to put a small condenser in series with the antenna. This condenser may be as small as .0001 mfd.

## INTERESTED IN SUPERHETERODYNES

I AM INTERESTED in superheterodynes and should like to know how it is possible to determine where the repeat points can be expected on the dial. I realize that in every superheterodyne such repeats are present and that they cannot easily be avoided. What relation is there between the intermediate frequency and the points on the dial where the repeats appear?—P. W. A.

The repeats come in on the oscillator dial at points representing a frequency separation equal to twice the intermediate frequency. For example, suppose that the intermediate frequency is 50 kc and a station operating on 600 kc is tuned in. This will come at a point on the dial representing 550 kc and again at a point representing 650 kc. The difference between these two points is 100 kc, which is twice the intermediate frequency. It will be noted that one of those points falls on the end of the tuning range of the receiver, assuming that it just covers the broadcast band. Any station operating on a frequency lower than 600 kc can only be received at one setting since all the others would be outside the tuning range.

If the intermediate frequency is 50 kc as assumed above it is clear that a station operating on 700 kc will come in at 650 kc as well as the station operating on 600 kc. There would be image interference between these two stations if they should happen to be within reception range of the receiver. Any other two stations operating 100 kc apart would be subject to image interference, except those operating on frequencies below 600 kc.

The higher the intermediate frequency of the superheterodyne the wider is the region in which there is no interference of broadcasting stations. For example, if the intermediate frequency is 200 kc the repeat points come in 400 kc apart and there cannot be any image interference below 750 kc. Thus there would be 20 channels which would be free from image interference. When the intermediate frequency is only 50 kc there are only five channels which are free.

## RECEIVES WITHOUT AERIAL

WHAT IS THE USE of having an aerial on a receiver when I can get all the stations I want without any aerial at all and no ground? The only thing that an aerial seems to do to my set is to make it less selective.—F. R. C.

There is no use at all in your case of having either an aerial or a ground. You are fortunate in having such a good receiver. There are not many sets that can be operated satisfactorily without either an antenna or ground, or both. As a matter of fact you are not really operating your set without antenna and ground because some of the wiring of the set acts as an antenna and some other part acts as ground or counterpoise.

## SIZE OF BAFFLE BOARD

WHAT IS THE VERY BEST size of baffle board to use with a push-pull radio receiver and a dynamic type loudspeaker? Upon what does the size depend, that is, what factors enters into the determination of the size?—W. H. D.

The very best size in any case is a baffle board of infinite extent. Naturally, this is not the most practical size since it is not possible to realize it. The next best thing to an infinite plane baffle board is a large wall with the speaker placed in the middle. When it comes down to baffle boards of reasonable and practical dimensions there is no definite rule to go by in selecting the size. There is one quite definite rule and that is that the side of a square baffle board, or the diameter of a circular baffle, should be at least equal to one quarter of the wavelength of the lowest tone it is desired to receive with full intensity. But even that is not very definite because there is no agreement as to what the lowest frequency should be. Some may put this at 30 cycles, and they would require a very large baffle board; others may put the lowest note at 60 cycles, and they would only need a baffle board one-half as large in linear dimensions as those who demand full volume on 30 cycles. For a 60 cycle lower limit the board should be 4 feet 7 inches square, or its

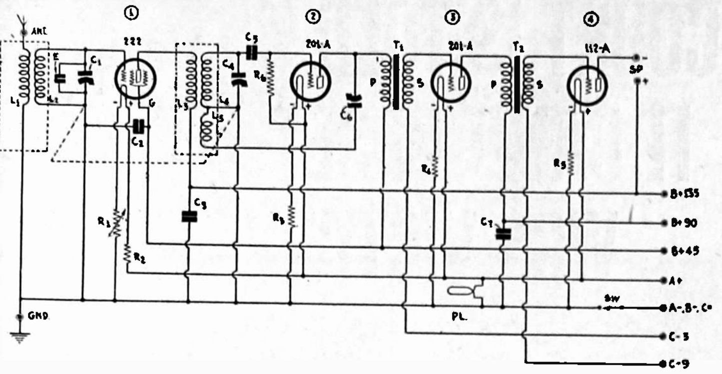



FIG. 823
THOSE WHO WANT A SIMPLE RECEIVER THAT COMBINES SENSITIVITY AND ECONOMY OF OPERATION WILL FIND THIS CIRCUIT SUITABLE FOR BUILDING.

diameter should be that. For a 30-cycle lower limit the corresponding dimension should be 9 feet 2 inches. These dimensions are based on the supposition that the velocity of sound in air is 1,100 feet per second, which is about right at ordinary room temperatures.

When the lower frequency limit is set at 60 cycles it does not mean that 30-cycle tones cannot be heard if they are impressed on the speaker. It means that they will be much weaker than if the larger baffle board were used.

## SIMPLE BATTERY RECEIVER

WILL YOU PLEASE publish a simple four-tube, battery-operated receiver using one screen grid tube as radio frequency amplifier. I prefer a regenerative circuit with transformer coupling. Please specify the tubes to be used.—K. W. J.

Fig. 823 is a good circuit which fits your description of what you want.

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# COURT IS TOLD IT CAN'T UPSET WGY VICTORY

Washington.

The Supreme Court of the United States is powerless to upset the victory gained by WGY, Schenectady, N. Y., in the Court of Appeals of the District of Columbia, which victory granted full time to the station, although the Federal Radio Commission had allowed only part time under the November 11th, 1928, reallocation.

**New York's Contention**

This contention was made in a brief filed by the People of the State of New York, through Hamilton Ward, Attorney General of that State.

The case is before the Supreme Court on a writ of review obtained by the Commission in an attempt to have the lower court's decision overthrown. This remedy is known as certiorari.

The station is owned by the General Electric Company and operates on 790 kilocycles.

In the brief New York contends that although the United States Supreme Court has granted the petition for a writ of certiorari, that the Supreme Court has no jurisdiction to review the case, since the judgment of the court of appeals was an administrative judgment and not subject to review.

**Cites Deprivation**

The contention also is set forth that the people of the State are parties in interest. In support of this contention it is argued that the Federal radio act conceives of a State as a party interested in radio licensing.

Supporting the contention that the limited license issued to WGY would not give the broadcasting service which public convenience, interest or necessity require, the brief argues that New York has the greatest system of hospitals in the country, most of which are located at or near Schenectady and depend on WGY for their radio programs.

# *Vatican to Erect Message Station*

Washington.

A radio station is to be erected by the Holy See in a part of the Vatican territory previously intended to be used as a Vatican airport, according to a report from Vice Consul Donald C. Wilcox, Rome, made public by the Department of Commerce.

Apparently the Vatican State has not abandoned the idea of having its own landing field, but at present it is considered more important to set up a wireless station for the prompt transmission and reception of official communications.

# FEAT IGNORED, INVENTOR DIES

Vienna, Austria.

Otto Nussbaumer, according to the Austrians, the inventor of wireless telephony as well as the first person to discover the detecting properties of crystals, died at Salzburg. He was 54 years old.

Twenty-five years ago he was doing research work in Graz University when he discovered a method of transmitting speech and music by electrical waves over short distances. While the received signals were quite audible they were not clear.

The system devised by Nussbaumer is quite unlike the system invented later and which now is basis of all broadcasting throughout the world. The university authorities decided that he had performed an interesting scientific trick of no practical value and experiments had to be suspended for lack of funds.

Nothing was known of Nussbaumer's pioneer work until the occasion of the Austrian broadcasting jubilee last year, when Profesosr Ettenreich of Graz told the story which the inventor himself had been too modest to publish.

During the years of broadcasting's growth Nussbaumer watched that growth with quiet delight, but he never even uttered a singe word suggesting that he and his confidantes had let a precious invention slip through their fingers.

# STOP PROFANITY ON AIR, DEMAND OF LAWMAKERS

Washington.

The use of profanity on the air is growing, and laws to prohibit it should be enacted, said Representative Lankford, (Dem.), of Douglas, Ga.

Steps against profanity over the radio were advocated by Senator Dill (Dem.), of Washington, in calling the attention of the Senate to a telegram sent by L. K. Watrous, of Minneapolis, Minn., to the Federal Radio Commission, containing allegations against KWKH, of Shreveport, La.

The telegram to the Commission, follows in full text:

"Henderson Shreveport station KWKH quotes you as saying you have no right to censure his talk or inclination to do so. Certain it is public decency and respect of society in general, as well as best interests of child welfare, should at least move you to stop his constant cursing over air. If you cannot at least protect the radio public and the welfare of child life in preventing his soiling the air with filthy, unnecessary words and expressions, you should step aside and let more active men protect the inspiring standards of American life and so perpetuate the high standards set by all other radio stations on the air. Do you intend to let this one exception prove definite Governmental weakness as quoted by Henderson last night?"

**Dill's Reply**

In the Senate Senator Dill said:

"I have inquired of the members of the Radio Commission in order to learn whether or not the statement to the effect that the Radio Commission considers it has no power to stop the use of profanity and obscene language over the air is correct, and I am told that that is the attitude of the majority of the Commission.

"Public interest alone would be sufficient to justify the Radio Commission in putting a stop to the use on the air of terms and phrases of profanity, but the law specifically makes it a crime for anybody to use profanity over the air from a radio station."

**Quotes Law**

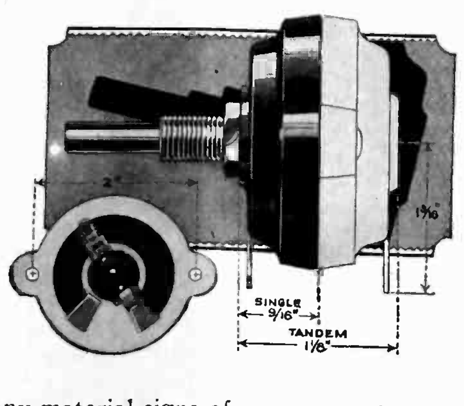
Senator Dill then read from section 29 of the law of 1927 relative to radio, which states that "no person within the jurisdiction of the United States shall utter any obscene, indecent, or profane language by means of radio communication." He stated that a penal provision is attached to this law.

"The Radio Commission, if it feels it cannot take action by revoking or suspending a station's license, ought to call upon the district attorney of the community to enforce the penal provision of the law," Senator Dill said.

## New Volume Control Announced by Electrad

A new high voltage volume control was announced by Electrad, Inc., of 175 Varick Street, New York City. It is the Model B Super Tonatrol, particularly adapted for use by manufacturers on account of its compact size and clever arrangement whereby, if desired, two completely isolated circuits may be controlled by one shaft. Single control units are also supplied.

Model B Super Tonatrol (illustrated) has the same general construction and operating characteristics as Model A announced six months ago. The contact is a pure silver multiple type which floats over the resistance element with smoothness and which grows smoother with use, owing to a microscopic deposit of silver from the contact on the resistance element. The specially developed resistance element itself is fused at high temperature to the surface o fa vitreous enameled metal plate. The result is greater permanence and accuracy of resistance values and more rapid heat dissipation. Laboratory tests equivalent to more than ten years' average use failed to produce any material signs of wear or variation in resistance value and showed a practical immunity to changes in temperature and humidity.




An advantage offered by the dual or tandem type Super Tonatrol is that a tapered resistance can be used in the antenna circuit, while a uniform resistance, operated for the same shaft, can control the grid circuits.

## Improving, Anyway!

PLEASE accept this note to mean that I really think RADIO WORLD is improving and has some helpful articles of late.

I appreciate your efforts.

Earl Walrod,
Tulsa, Oklahoma.

# BILL CALLS FOR STATIONS' SALE TO GOVERNMENT

Washington.

Representative Lankford of Georgia introduced a bill for government ownership and control of all radio communications under a proposed Department of General Welfare. Concerning the bill he said:

"My bill is to create a department of general welfare with authority and funds to control all radio communications within the United States for the use of the three great branches of our Government and for the use and benefit of the public schools, churches, and all other legitimate assemblies, groups and organizations of American people.

"The department would also be authorized and required to prepare, secure and provide such movie films as may from time to time be needed and requested by the Departments of Government and the organizations just mentioned.

**Means Much to Schools**

"The bill carries provision for the Federal Government paying 50 per cent of the cost of free school books for the children of the Nation.

"The bill would enable the Government by and through the radio and motion picture to do much more effectively and cheaply what is now attempted in hundreds of ways.

"There is nothing that would mean so much to the public schools and to all the people. The general welfare of everyone would be greatly promoted.

"Under the scheme of the bill, the Government would own and control all radio communications. Why not? What about the freedom of the air? Why not the radio, with all its miraculous possibilities, be owned and operated by all the people for all the people?

**Wonderful Possibilities**

"In the movie field the department would only furnish whatever high class films might be required for the schools, churches, lodges, and various organizations of the country. Private enterprise could operate wherever there is demand for their activities.

"The Government would only attempt to furnish clean, high class, instructive, beneficial entertainment to the people.

"I feel that there are wonderful possibilities in the operation of a department of general welfare as here proposed."

## Universal is Sued By RCA on Patents

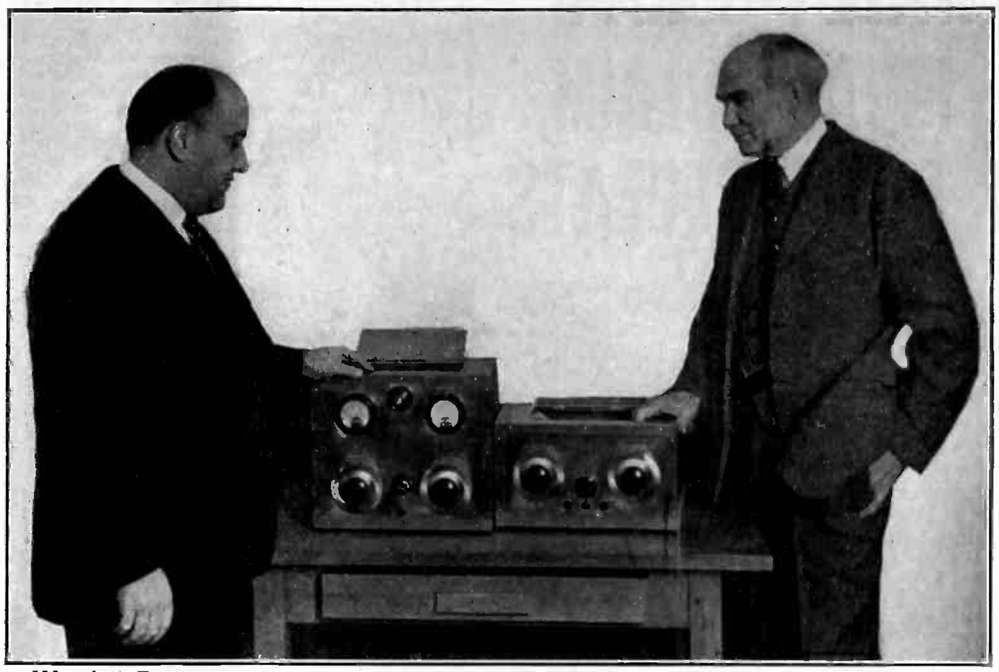
Buffalo, N. Y.

Suits charging infringement of patents used in radio communications apparatus have been filed in Buffalo, and Newark, N. J., by the Radio Corporation of America against the Universal Wireless Communication Co.

In the Buffalo case three bills of complaint were filed in the United States district court, alleging infringement of six patents relating to vacuum tubes, crystals, and their circuits. The New Jersey case is based upon the De Forest feed-back patents, and was filed with the United States District Court for the District of New Jersey.

District Judge William N. Runyon, of the New Jersey court, signed an order to show cause.

# DE FOREST ELECTED HEAD OF I. R. E.



Wendell Buck

DR. LEE DE FOREST (RIGHT) AND LOUIS GERARD PACENT, PIONEERS IN THE RADIO FIELD. DR. DE FOREST WAS ELECTED RECENTLY AS PRESIDENT OF THE INSTITUTE OF RADIO ENGINEERS, WHILE MR. PACENT WAS NOMINATED AS PRESIDENT OF THE RADIO CLUB OF AMERICA. THEY ARE SEEN DISCUSSING A NEW DEVELOPMENT IN SHORT WAVE RECEIVERS. DR. DE FOREST AND MR. PACENT HAVE BEEN FRIENDS FOR TWENTY-THREE YEARS. DR. DE FOREST DEFEATED RAYMOND HEISING, OF THE BELL TELEPHONE LABORATORIES, FOR THE PRESIDENCY

# RADIO TALKIES ON AIR NIGHTLY BY 2 STATIONS

Every evening, from 7 to 9 P. M., Eastern Standard Time, the experimental transmitter W2XCD of the DeForest Radio Company at Passaic, N. J., is on the air with test programs. The frequency of this transmitter is 1604 kilocycles, or 187 meters, and the signals can be tuned in by many broadcast receivers.

**Increasing Power**

The power of W2XCD is being steadily increased. The transmitter went on the air several weeks ago with 50 watts. At the beginning of the year, the power had been increased to 500 watts, and is to be further increased up to 5000 watts. A 100-kilowatt short-wave transmitter is now being constructed by the DeForest engineering staff, employing new water-cooled transmitting tubes, for long-distance broadcasting to overseas countries.

W2XCD is located on the second floor of the DeForest experimental laboratory building adjoining the radio tube plant at Passaic. The installation is entirely experimental and is intended mainly to test tubes under actual operating conditions, as well as to conduct certain studies in radio transmission. Many reports are being received from all parts of the United States and Canada regarding successful reception of the signals.

**Received Over Wide Range**

Radio talkies or combined and synchronized sight and sound broadcast programs are available in the New York metropolitan area and over a considerable portion of the country. Every week-day evening, at 8:15 and again at 9:00 P. M., Eastern Standard Time, W2XCD, Passaic, N. J., W2XCR, Jersey City, N. J. (Jenkins Television Corp.), are on the air with synchronized pictures and sound.

W2XCR operates on 2800 kilocycles, or 107 meters, and may be tuned in on a short-wave receiver for television purposes.

**Composition of Talkies**

The Jenkins radio talkies consist of half-tone pictures, scanned in 48 lines at a speed of 15 pictures per second. The radiovision pick-up is by means of special film in the Jenkins studio at Jersey City, while the synchronized sound pick-up is by means of disk recordings mechanically coupled with the film pick-up. The sound signals are amplified and transmitted over direct wire to the DeForest transmitter at Passaic.

The first public demonstration of the Jenkins radio talkies will be given in Newark, N. J., within the next few weeks, say the promoters.

## The Passing of Jimmie

*Readers of* RADIO WORLD *and members of the radio trade will be sorry to know that James H. Carroll, connected with this publication for several years, passed away at his home in Brooklyn on January 4th.*

*Jimmie Carroll endeared himself to the staff of* RADIO WORLD *and to his many other friends in radio, because of his loyalty and his smiling helpfulness whenever he could do a good turn for the other fellow. He was straightforwardness itself, possessed of a wonderful character. He was clean in all his relations of life.*

*His friends will miss his cheery greeting, his willingness at all times to do good deeds, and his warm, ever-present smile that helped to light up many a shadow of the day.*

*Jimmie Carroll loved radio, and radio loved Jimmie Carroll.*

# WAVE PRIORITY INVALID CLAIM, COURT REPEATS

Washington.

WENR, Chicago, was allotted half time on 870 kilocycles by the Court of Appeals of the District of Columbia, which required WLS, Chicago, to relinquish enough hours on this channel to make the readjustment possible. WLS had contended it used this channel first and was entitled to priority rights. The court overruled this argument, in line with its denial of priority rights in the WGY case, where the station won on other points.

The Federal Radio Commission had denied half time to WENR, operated by the Insull interests, but had given it two-sevenths time. WENR appealed to the court and the decision is the result.

The court affirmed the action of the Commission in denying WLS's application for full time on 870 kilocycles, and denying the application of WCBD, Zion City, Ill., which formerly operated on the frequency for restoration to the frequency on limited time.

### WLS Priority Cited

Commission counsel, arguing the case, had contended with WLS that WLS, because of its prior use of the 870 kilocycle channel and its unquestioned good service in the interest of farmer-listeners in the Middle West, was entitled to preference on the frequency. The court stated that, although it is true that WLS began broadcasting earlier than WENR, and that it was the first assigned to the channel, "these facts, however, are not controlling, for neither station has any fixed right in the frequency as against the reasonable regulatory power of the United States."

"We are of the opinion," said the court, "that the operating time upon this channel should be shared equally by WLS and WENR.

### Economic Considerations

"We base this opinion upon a consideration of the excellent service heretofore rendered to the public by WENR, and its capacity for increased service; also its large expenditures for meritorious programs for public instruction and entertainment, and the popularity of the station; also its ability by means of its 50,000 watt transmitter to cover a large area; and the assured financial responsibility behind it.

"It is manifest also that an allowance of only two-sevenths time for broadcasting is totally inadequate for the economical operation of such a station."

WLS, established in 1924 by Sears, Roebuck & Company, was taken over in November, 1928, by the Prairie Farmer, with 51 per cent of the station owned by the latter company and the remaining 49 per cent by Sears-Roebuck. It now operates with 5,000 watt power, but holds a construction permit for a 50,000 watt transmitter.

## Westinghouse Tests Plane Communication

Springfield, Mass.

The Westinghouse Electric and Manufacturing Company has made arrangements for the use of the Springfield Airport for conducting experiments in two-way radio communication between ground and airplanes.

## Literature Wanted

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

RADIO WORLD,
145 West 45th St., N. Y. City.
I desire to receive radio literature.

Name ..........................................

Address ..........................................

City or town ..........................................

State ..........................................

Adolph Hoppe, 31 Walfert Terrace, Rochester, N. Y.
Elmer Ogle, 215 Avenue "E," Crowley, La.
Nolan Uhls, 1712 Fairfax Ave., W. H., Cincinnati, Ohio.
S. S. Rank, 310 First Ave., Johnsonburg, Pa.
Elmer Wutzler, 1215 E. 6th St., Alton, Ill.
William Brown, 495 St. Pauls Pl., Bronx, N. Y. City.
Russell Coutant, Box 310, Western Ave., Marlboro, N. Y.
B. DeMeis, 6515 11th Ave., Brooklyn, N. Y.
Y. Pchek, 773 Forest Ave., Bronx, N. Y. City.
B. L. Lehle, 514 Park Ave., Wilmette, Ill.
A. E. Sparling, 507 N. 104th St., Seattle, Wash.
Court Cisler, 10 Lockwood St., Geneva, Ohio.
Efren Gil, Ave. 13 Poniente 509, Puebla, Pue., Mex.
M. F. Michaels, 42 Canedy St., Fall River, Mass.
Herbert S. Wyer, 55 Bond St., Hartford, Conn.
Thos. S. Hughes, Fort Ogden, Fla.
F. N. Watters, 5766 Vicente St., Oakland, Calif.
Geo. L. Gardner, 24 Coomes Ave., Springfield, Mass.
Tom Harrington, 3601 E. 10th St., Long Beach, Calif.
Jos. V. Stracuzza, 431 Tenth St., New Kensington, Pa.
Little Star Radio Shop, South Bend, Ind.
E. J. Erickson, 504 S. Union St., Aurora, Ill.
J. Lohman, 4 113th St., Troy, N. Y.
J. R. McNicholas, 151 W. 14th St., N. Y. City.
R. Wildman, 20 W. Atlantic Ave., Haddon Hgts., N. J.
John Z. Pay, 2043 Robin St., Lakewood, Ohio.
Bartlett Auto Supply, Bartlett, Cook Co., Ill.
James Payne, Fries, Va.
Ralph H. Bellinger, 2823 Scioto St., Cincinnati, Ohio.
D. A. Mawell, Elec. Dept., Public Schools, Braddock, Pa.
Arthur Langraf, 42 Market St., Brantford, Canada.
P. V. Apple, 62 2nd St., Erlanger, No. Car.
E. M. Atwood, W. U. Tel. Co., No. Platte, Neb.
David Allan, 64 Epping St., Lowell, Mass.

## *Forum*

### Advises More News

I WISH to say a word in behalf of your good radio magazine. I believe it is the best magazine of the kind on the market. I believe though you are making a mistake in not printing more radio news, as you have lots of subscribers who know nothing and care nothing about technicalities, but are only interested in the news. So please let me suggest that you include more news and I feel sure the public at large will be better satisfied.

Arthur Day,
Sergent, Kentucky.

* * *

### Sick!

I AM sick of reading schoolboy stuff and the same stuff about three and four-tube circuits rehashed. I can't see where it is doing me any good to be reading RADIO WORLD.

John Harris,
Detroit, Mich.



# $450,000,000 IN SETS SOLD IN YEAR 1929

Washington.

Despite temporary recession in the sale of radio receiving sets, caused largely by the stock market collapse in the latter months of 1929, the radio industry looks forward to 1930 as another record-breaking year, said Federal Radio Commissioner Harold A. Lafount. He was formerly a manufacturer of radio accessories. He said that the natural development in radio programs and improved methods of regulating broadcasting, made possible by experience, will contribute to the expected development. Although there admittedly was overproduction of receiving sets in 1929, he said, the industry does not expect this to be a burden.

### Absolescence Reduced

Whereas in past years the industry has offered something radically new in radio receiving sets, which tended to render obsolete the sets of the preceding year, Mr. Lafount stated to "The United States Daily" that no sweeping changes are now being considered. Moreover, he said, there apparently are no radical changes contemplated that will disturb existing reception conditions.

On the whole, said Commissioner Lafount, the broadcasting situation should improve. Stations are offering better programs. Listeners generally are afforded improved reception through the station installation of modern equipment, automatically controlled, to keep them on their assigned frequencies, and thus eliminating to a great extent, at least, interference with other stations. There is much room for improvement in the broadcasting set-up, he stated, but the terrific congestion of stations on the limited number of channels is responsible for the condition.

### $450,000,000 for Sets

"The industrial situation gradually will work itself out," said Commissioner Lafount, "with no unfavorable reaction upon the public. It is not unlikely that some manufacturers will retire and that there will be consolidations, but the readjustment period should not be drastic or revolutionary."

Preliminary statistics from the industry, said Mr. Lafount, indicate that, in spite of the disappointing fourth quarter, sales of receiving sets in 1929 established a new annual record. Preliminary figures, he said, are that sales of receivers amounted to more than 3,500,000 units for the year, as against some 2,500,000 for 1928. The gross revenue, in round figures, he said, was estimated at $450,000,000, or about 40 per cent above the total for 1928.

## Use of Damped Waves Discouraged by Board

Washington.

To reduce to a minimum interference caused by transmitters employing damped waves, the Federal Radio Commission has just adopted a new general order specifying frequencies upon which such transmitters will be allowed to operate. The order states also that no license will be issued hereafter for the operation of any station using, or proposing to use, transmitters employing damped wave emissions.

# $10,000,000 AIR UNIVERSITY PLAN BLOCKED

Washington.

A fact finding subcommittee of the Advisory Committee on Education by Radio recommended the establishment of a national air university, endowed privately at $10,000,000. This was opposed by Secretary Wilbur of the Department of Interior. The Advisory Committee therefore is expected to kill the proposal of the fact-finding subcommittee. It failed to act on the proposal when it came up for consideration.

Dr. William John Cooper, United States Commissioner of Education, said that the recommnedations made by the fact-finding committee were too far-reaching at the present experimental stage of radio as a factor in education. He pointed out, however, that in spite of the failure to act favorably upon the proposed university by radio and the reaching of any agreement with respect to the other recommendations, distinct progress has been made.

### Opposition by Wilbur

Secretary Wilbur, it was stated at the Department of the Interior, said the magnitude of the proposals require further experiments in the use of radio as a branch of education before so large an undertaking can be considered. For this reason a new subcommittee was appointed.

A statement issued by the Department of Interior said:

The advisory committee on education by radio has given its subcommittee instructions as to the principles upon which its recommendations are to be based. It wants to recommend, in the first place, that an agency be set up in the Federal Office of Education for the study of education by radio. It wants, in the second place, to provide for an advisory committee made up of individuals from educational institutions and agencies, from broadcasting organizations, and from the general public to work with this agency within the Government.

### More Research Asked

It wants to recommend that the funds for carrying on this work be provided by congressional appropriation. In defining the work that this is to be a part of the Office of Education, the advisory committee believes that it should study the development and encouragement of programs and make researches into the important problems in this field; that it should disseminate information; that it should stimulate local and national interest in radio education; that it should prepare plans for the integration of effort among broadcasting agencies; that it should suggest programs upon request; that it should scientifically evaluate programs and producers.

This action on the part of the advisory committee on education by radio came after it had given extended consideration to a recommendation made by its fact-finding subcommittee that a campaign be put on the purpose of which was to raise, outside of the Government, the sum of $10,000,000 to endow a national radio university. The committee failed to act favorably upon that recommendation after having heard Secretary Wilbur who warned against too great haste in establishing final agencies in a field which was so experimental.

# *Physicians Oppose Wynne on Quacks*

Washington.

Letters supporting and opposing the request of Health Commissioner Shirley W. Wynne, of New York City, that steps be taken to prevent medical quacks from advertising over radio stations have been received by the Federal Radio Commission.

Some physicians and other medical workers oppose the movement of the New York official. In each case the Commission is responding that, under the radio law, it has no power of censorship, but that if there is any evidence of obscene or indecent language being used in such advertising programs, the Commission may consider it when the licenses of the stations broadcasting the programs are before it for renewal.

# MIXUP ON TWO WJSV STUDIOS

Washington.

A subpoena—the first subpoena ever issued by the Federal Radio Commission—for the attendance of a witness, and calling for production of documents or written data concerning a broadcasting station, was served on J S. Vance, president of the Independent Publishing Company, operating WJSV, at Mount Vernon Hills, Va.

Mr. Vance was subpoenaed to appear at a hearing involving the application of WMBG at Richmond, Va., for a change in status from a local to a regional station. The subpoena was requested by Wilbur M. Havens, president of Havens & Martin, Inc., operating the Richmond station.

The application was made "to ascertain the main studio location of WJSV," said Mr. Havens. WJSV maintains a studio at Mount Vernon Hills and another in Washington, D. C. The radio act specifies that a station shall be considered in the radio zone in which its main studio is located.

The subpoena demands that Mr. Vance bring books, papers, and radio logs or schedules showing the number of hours broadcast daily from the studio of WJSV at Mount Vernon Hills, and from the studio in Washington.

WMBG now operates on the 1,210-kilocycle channel with 100 watts. It seeks assignment on the 1,240-kilocycle channel with 500 watts, and proposes to show that WJSV is a Washington station, and that consequently its assignment should not be charged against the Virginia quota.

WJSV operates on the 1,460 kilocycle full time, with KSTP, at St. Paul, Minn., both stations using 10,000 watts. The channel is known as a "heterodyne" channel.



# 2ND SELECTION FOR WABC SITE ALSO OPPOSED

WABC, New York City, key station of the Columbia Broadcasting System, which was diverted from erecting a transmitter in New Jersey because of opposition to "an invader," and which then sought a site on Long Island, is meeting opposition in its new efforts, also.

George V. Harvey, president of Queens, one of the borough of New York City, discussed the project of WABC to erect a plant at or near the Raunt in that borough. He said:

"It is believed that this powerful equipment would blanket the dial of thousands of radio receiving sets in Brooklyn and Queens, and I oppose it. If New Jersey does not want it, certainly Queens does not. I will take the matter up with my building department immediately.

### Must Protect Listeners

"We are glad to have the present home of WABC in Queens. Its present power output is 5,000 watts and that is sufficient to overspread the Long Island and Greater New York area with a very strong signal.

"Some set owners tell me that even at the present power rating the waves are so strong that they overspread more space on the dial than one station should occupy. There are too many radio set owners in the thickly populated sections of Queens and Brooklyn to have a 50,000-watt station in their midst to spray the aerials with powerful electric waves. The radio listeners must be protected and afforded good reception. In turn that helps the radio industry."

President Harvey's stand follows a protest registered by the radio dealers in Brooklyn and Queens.

* * *

### Board Gets Complaints

Washington.

The proposal of the Columbia Broadcasting System to install the new high-powered transmitter of WABC on Long Island, close to its present site, is being opposed by civic and radio trade groups in the surrounding territory, it was declared at the Federal Radio Commission.

The new complaints, it was declared, are on the ground that a high powered transmitter will prevent reception of other stations by listeners residing in the area close to the station. Radio dealers contend that this will react unfavorably for sales of sets.

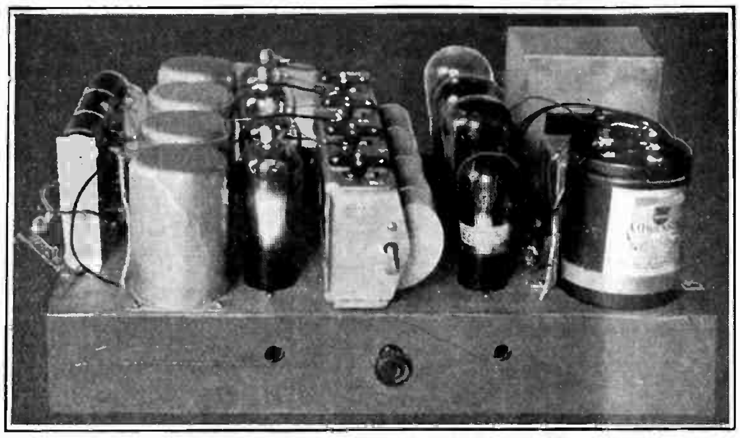
Columbia recently was given a construction permit to install a 50,000-watt station for WABC, which now uses 5,000 watts. After protracted hearings before the Commission, at which the New Jersey interests combated the construction permit, the system announced its plan to withdraw that construction permit, and subsequently filed the application for the New York location. The plan, as explained to the Commission, is to install the new transmitters in "steps" of 5,000 watts each, rather than the 50,000-watt outfit.

### A THOUGHT FOR THE WEEK

*Radio gives us music, classic and popular; tragedy, comedy, grand opera, minstrelsy, recitation, oratory—and jazz! And to those of the under-twenty millions the greatest of these is jazz! But who wouldn't be under twenty, in spite of Atwater Kent.*

# High Gain at Low Cost

# HB44 - - - $45.59



The HB44, assembled, presents in compact form, on a 17½ x 11½" steel chassis, a completely AC operated shielded receiver, using four 224 screen grid tubes, one 227, two 245s in push-pull, and a 280 rectifier, eight tubes all told. Here is the circuit that will bring 'em in from all over the country—and at a price you can afford—$45.59. This price includes EVERYTHING except speaker, cabinet and tubes.

## It's the Real Thing!

(a) Three stages of tuned R.F., using 224 screen grid tubes.
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(d) Four totally shielded R.F. coils.
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(f) A four gang condenser, guaranteed accurate, with equalizing condensers built in.
(g) 61 mfd. of filter and bypass capacity.
(h) Thirteen different fixed voltages available from the output.
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| ☐ C1, C2, C3, C4—One four gang .00035 mfd. condenser with equalizers E1, E2, E3, E4 built in | 3.95 |
| ☐ C5—One .01 mfd. mica condenser | .35 |
| ☐ C6, C7, C13, C14—Four 1 mfd. 200 volt DC bypass condensers | 2.00 |
| ☐ C8—One 1 mfd. 550 volt AC filter condenser | .85 |
| ☐ C9, C10, C11, C12—One Mershon, consisting of four condensers, two of 8 mfd. and two of 18 mfd. with bracket (Cat. Q-2-8, 2-18-B) | 5.15 |
| ☐ R1—One Electrad 25,000 ohm potentiometer with knob and two insulators | 1.60 |
| ☐ R2—One 50,000 ohm Lynch metallized resistor (.05 meg.), with mounting | .45 |
| ☐ R3—One Lynch 5.0 meg. metallized grid leak, with mounting | .40 |
| ☐ R4—One 5,000 ohm resistor with mounting | .50 |
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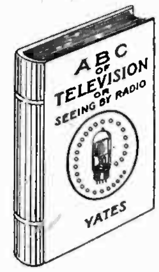


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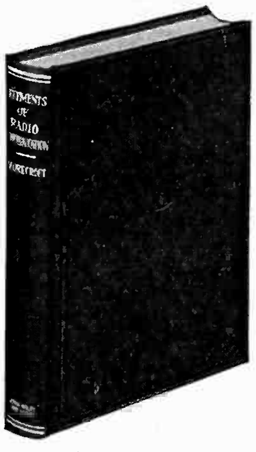

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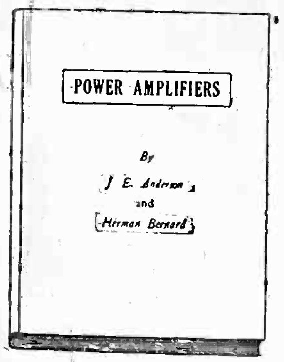


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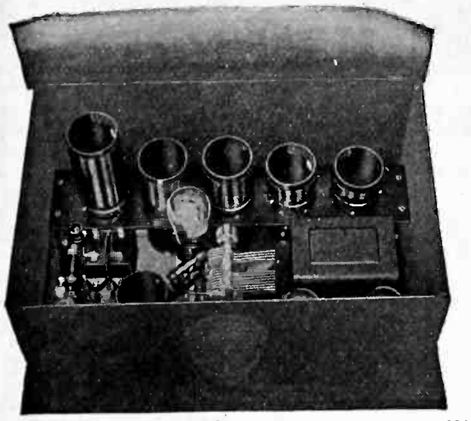

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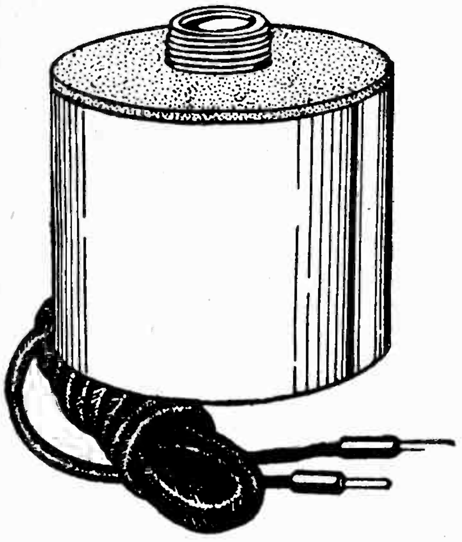

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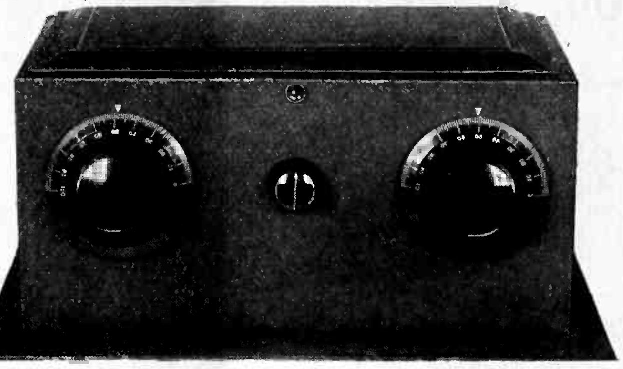
FIVE-DAY MONEY-BACK GUARANTEE

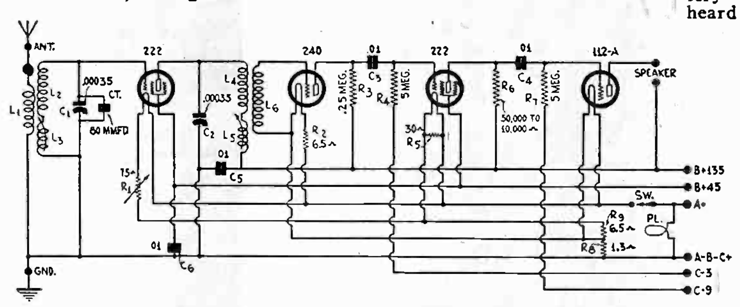
# Tone That Thrills!



**Build the HB Compact (Battery model)**

**$18.55**

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




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

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

## LIST OF PARTS

[*Check off what parts you want*]

| | |
|---|---|
| ☐ L1L2L3—Antenna coil, BT3A | 1.35 |
| ☐ L4L5L6—Interstage coil, BT3B | 1.35 |
| ☐ C1, C2—Two .00035 mfd., brackets | 2.00 |
| ☐ CT—Hammarlund 80 mmfd. | .35 |
| ☐ C3, C4, C5, C6—Four .01 mfd. mica fixed | 1.40 |
| ☐ R1, SW—75 ohm switch rheostat | '.80 |
| ☐ R2, R9—Two 6.5 ohm filament resistors | .50 |
| ☐ R3, R4, R6, R7—0.25, 5.0, 0.05 and 5.0 meg. with 4 mounts | 1.65 |
| ☐ R5—30 ohm filament resistor | .45 |
| ☐ R8—1.3 ohm filament resistor | .20 |
| ☐ Ant., gnd., Sp. (+), Sp. (—)—Four posts | .40 |
| ☐ PL—Pilot lamp 6v. and bracket | .70 |
| ☐ Drilled, socketed steel subpanel 9½x14¼" | 2.00 |
| ☐ Crinkle brown steel cabinet, 7x9½x15" | 3.50 |
| ☐ Two metal links | .20 |
| ☐ Seven leads for battery cable | .70 |
| ☐ Two Dials | 1.00 |
| ☐ All parts | $18.55 |
| ☐ Tubes: two 222., one 240, one 112A | $ 5.79 |

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

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- ☐ R2—One 6.5 ohm. filament resistor ........ .25
- ☐ R3—One 5 meg. grid leak ........ .30
- ☐ R4—One 4 ohm. filament resistor ........ .20
- ☐ C3, C4—Two .01 mfd. mica dielectric fixed condensers ........ .70
- ☐ C5—One .00025 mfd. mica dielectric fixed condenser with clips ........ .25
- ☐ C6—One .00025 mfd. mica dielectric fixed condensers ........ .20
- ☐ SW—One A battery switch ........ .40
- ☐ Ant., Gnd., A minus, A plus, B plus 45, B plus 135 and P, seven binding posts ........ .70
- ☐ One National Velvet Vernier Modernistic dial, with rainbow feature and pilot light and bracket. 3.13
  One drilled front panel, 7x18", black bakelite. 1.80

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- ☐ All parts for AC Tuner, including fil. trans. ........ $22.10

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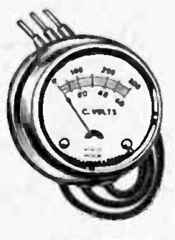
**With three 28" tipped leads built in**



J-246 Voltmeter, for measuring all direct current voltages, including B eliminators. 0-60, 0-300 (double range).

A portable type, high resistance meter, 2⅛" outside diameter, for close reading of direct current voltages up to 60 volts, and for reading DC voltages up to 300 volts. Three vari-colored 28" insulated leads, with jack tips, are built in. Black is minus, yellow is 60 volts maximum and red is 300 volts maximum. These voltages are marked at the meter outlets. Cat. J-246. Net price, $2.28.

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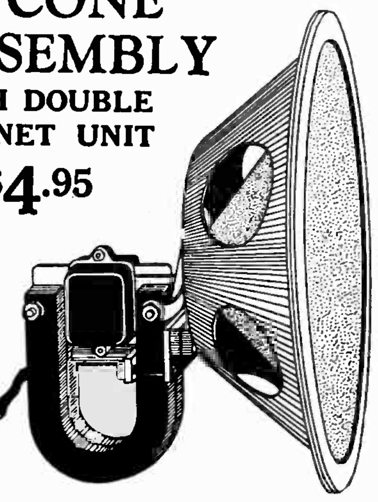

An excellent magnetic type speaker for installation in any cabinet. The unit is a double-magnet Paratone, with two magnet coils, for utmost sensitivity. Each horseshoe magnet is ¾" thick. The magnet coils are forever protected against dust and other foreign, injurious substances, by special bakelite housings. The pin is reverse drive. The cone frame is metal. The 9" cone is specially treated buckram.

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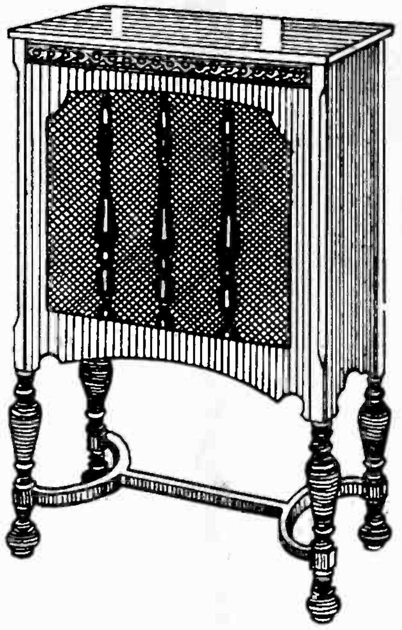
With Molded Wood Horn of 8 ft. tone travel (exponential type) with baffle and horn motor built in. Extraordinary bargain. **$12.00**



The speaker cabinet is walnut finish, 33" high, 24½" wide, 17½" deep, with carved legs. Golden cloth grille covers front opening. Built inside is No. 595 molded wood horn with baffle and No. 203 driving motor unit that stands 250 volts without filtration. Horn and motor removable. Table alone is worth price asked.

Shipped C.O.D. if desired.

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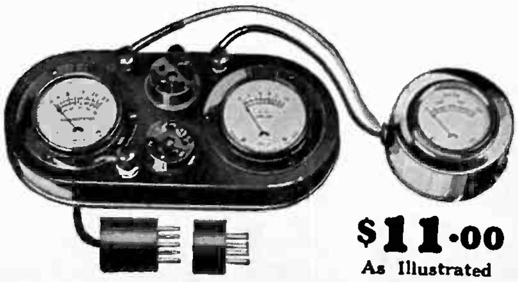

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