NOV. 23 RD 1929

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RADIO WORLD

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The First and Only National Radio Weekly

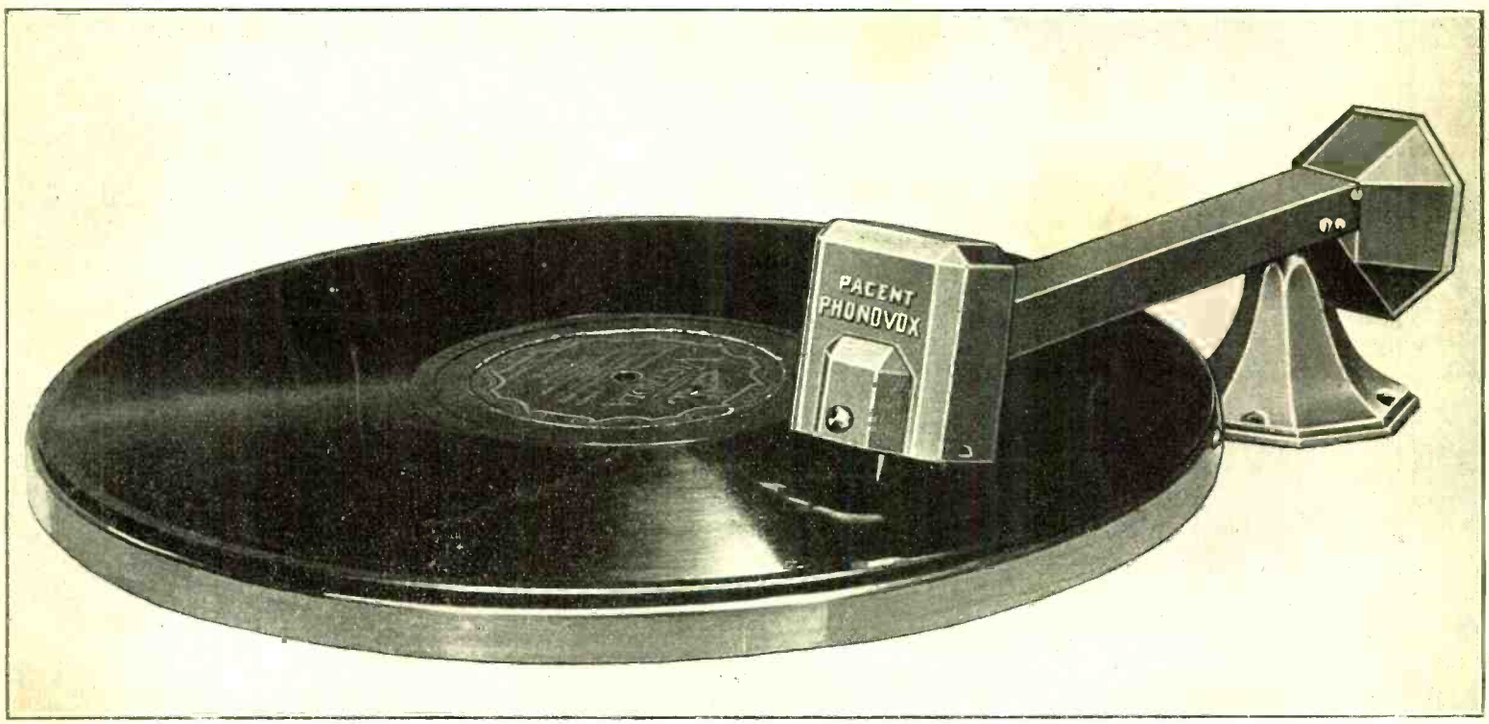
400th Consecutive Issue—EIGHTH YEAR

How to Use New J-245-X Tester

COIL DESIGNS FOR SUPERS

Elementary Circuits for Schoolboys

NEW ADVANCE IN PICK-UP QUALITY



The latest model of a popular phonograph pick-up, designed for results with all types of modern output. Of low impedance, it comes with adapters for use with all tubes, including screen grid.

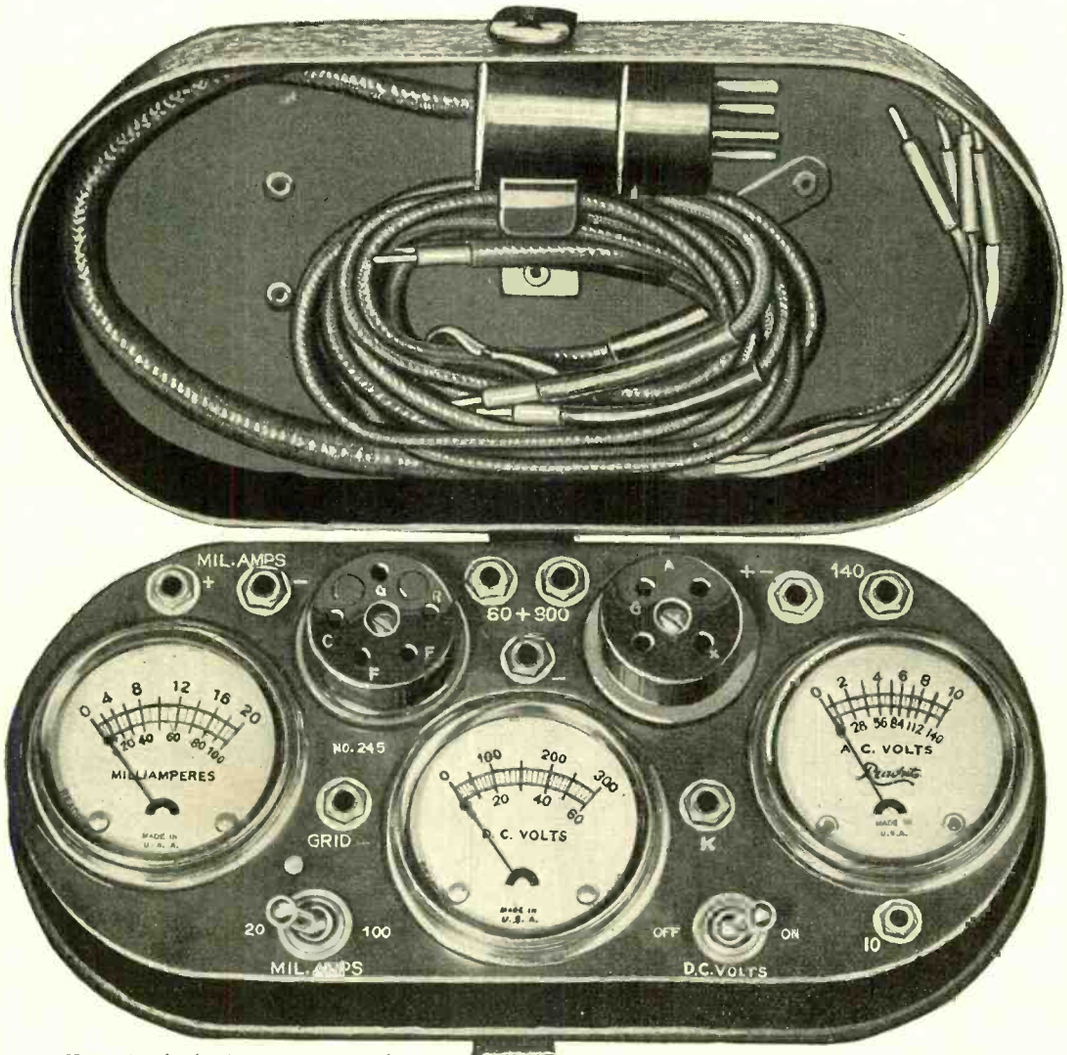
LAWS ASKED TO STOP SPEAKER DIN

Open Type Tuning Units for HB 22

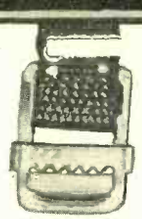
FEE FOR STATION LICENSE FAVORED

New Jiffy Tester, J-245-x, Analy

Plate Voltmeter Range Enlarged to 600 volts, AC



Note the fascinating appearance of the new J-245-X Jiffy Tester, with connector plugs and cable tucked beside the screen grid tube testing cable and the color-identified pair of test leads for using each of the three meters individually. As each meter is double range, you get six-meter service from this splendid outfit. This is the most popular type of Jiffy Tester and the most desirable in the low price range. It is entirely sufficient in accuracy.



Three meters built into a case, 3¼" high, 4" front to back, 8½" long, with slip-on cover, both brown crackle-finished steel. Makes all tests of filament voltages, AC or DC, with AC voltage readings up to 140, plate voltages up to 300, plate current up to 100 ma. Tests 4-prong and 5-prong tubes, including screen grid tubes. Makes all tests to 600 volts DC, 560 volts AC, of all tubes, in conjunction with five accessories included at $15,82.

The New J-245 Jiffy Tester, shown two-thirds scale.

What Test is Needed? J-245-x Makes It!

INSTRUCTIONS FOR J-245-X

A very complete three-meter tester. Polarity cords—red positive and black negative—with tips, are furnished for using meters individually. Also a special cord with clips is supplied for connecting to the control grid of screen grid tubes. No extra adapter is required for screen grid testing. A four-prong adapter is a part of the equipment, used with the five-prong plug on cable for connecting set socket with tester. These parts are held in the cover which makes a very compact and convenient outfit.

Service Procedure

Check line voltage by connecting red and black tipped cords at (+) (—) and 140. The other end of tipped cord insert in a divided plug which is screwed into outlet of line supply. If necessary adjust compensating device on set when set is not supplied with automatic voltage regulator. Start with the first RF tube and test straight through to the power tubes. Leave all tubes in set except tube under test. Put plug into emptied set socket and tube into proper Jiffy Tester socket. Do not insert tester plug in rectifier socket which is fed by AC. See instructions for comparative testing of rectifier tubes. Place cable tips in tester jacks according to colors. Always do this before plugging into set socket.

Filament Volts

Place brown tip of cable in 10 jack and white tip of cable in (+) (—) jack. Read directly upper scale of AC Voltmeter, which will indicate equally accurately DC volts.

Grid Volts

By noting the plate and filament voltage for a corresponding plate current in milliamperes a grid bias voltage will be determined from the tube chart furnished with instruction sheet with all J-245-X.

To test grid volts at tester socket: Set DC volt switch OFF.

Place red tipped wire in 60 jack and touch to K jack.

Place black tipped wire in B— jack and touch to grid jack.

Reverse leads if DC voltmeter reads below zero.

Grid Condition

Push button to note grid condition indicating change in the plate current reading. The extent of plate current change estimates the tube's liveliness.

Plate Voltage

Connect all cable tips in their respective colored jacks, except YELLOW, which place in B— jack.

Have DC volt switch ON. Read 0-300 upper scale of DC Voltmeter.

Plate Current

With cable tips in their respective colored jacks set MIL-AMPS switch at 100. If milliammeter shows less than 20 set switch at 20. Read upper scale on milliammeter with switch at 20 and lower scale with switch at 100. Use 100 for power tubes.

Cathode Volts

Set DC volt switch OFF. Place black tipped wire in B— jack and touch to 10 jack.

Place red tipped wire in 60 jack and touch to K jack.

Screen Grid Volts

(G post of socket)

Set DC volt switch OFF. Put yellow tipped cable wire in B— jack. Insert a tipped wire lead in 60 or 300 jack and touch to grid jack.

Control Grid Volts

(cap of tube)

Set DC volt switch OFF. Attach wire with clips to pig tail in receiving set and to top of tube in tester.

Place the red and black tipped wire leads in 60 and B— jacks. Touch B— wire to top of tube, and B+ or 60 wire to YELLOW jack.

When testing AC power supply circuits use the tipped cords and attach them to the tester jacks connected with the filament AC voltmeter. If higher voltages than 140 are to be measured the proper multiplier should be used. This is one of the five pieces of auxiliary equipment furnished with the outfit.

GENERAL

For individual and independent use of meters, remove tester plug from set socket, and remove from jacks all cable tips used for connecting set with tester.

To test 0-10 AC, DC volts plug one tipped cord into jack marked (+) (—) and other tipped cord in jack marked 10 v. Read directly on upper scale of voltmeter.

To test line voltage plug into jacks marked (+) (—) and 140 v. Read lower scale on voltmeter.

To test milliamperes plug black tipped cord in jack marked —MA, and red cord in jack marked +MA. Set MIL-AMPS switch to 20 or 100, according to measurement taken.

To measure the total plate current set MIL-AMPS switch to 100. Open the B—lead to set operated with batteries or eliminator and connect the end from set to jack marked +MIL-AMPS on tester. Connect the other lead from eliminator to jack on tester marked MIL-AMPS. If current is below 20 set switch to the lower reading.

To make continuity or open circuit tests. With plug in receiver socket and tube in tester socket the deflection of the milliammeter shows circuit is continuous in the primary load. Testing transformers, chokes, etc., may be done by disconnecting them and connecting each winding between the plate voltage source and the B voltmeter. The voltmeter should show a lower reading if the circuit is continuous with the added resistance of a transformer, etc., between one of the connections to the voltmeter and the B voltage supply. Usually a 22½ volt battery is used for this purpose.

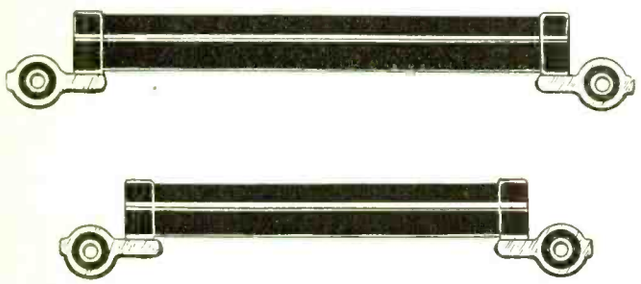
To test for shorts in condensers, resistors, etc. With tube in tester connect condenser under test to jacks —MA and +MIL-AMPS. If milliammeter shows change in reading the part tested is shortened. Resistors, etc., may be tested by the same method as noted above for continuity tests, or by disconnecting tester plug from set socket and connecting part to be tested between an external source of current and individual meter.

Testing Rectifier Tubes

Usually this testing is done after all other tubes and circuits are checked. If the proper voltages are furnished to the plates at the different sockets then the rectifying tube would not require testing. The comparative method of testing is done by substituting a tube of known value for the one in the rectifier socket. Then, with the tester plugged into another of the set sockets. after removing the tube and placing in the tester, the readings of the instruments will show any difference in output of the two rectifier tubes as supplied to the tube in the tester. This test is most emphatic when made on the power tube or tubes.

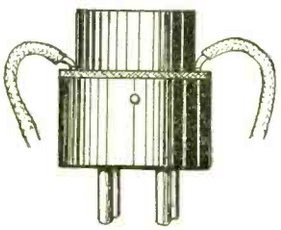
zes All Tubes, Sets and Circuits

Voltmeter Range Extended to 560 volts—Dandy Outfit!

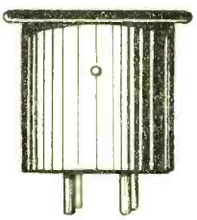


J-560 multiplier increases 140 volt AC range to 560 volts. Supplied with jack terminals (top illustration). J-106 multiplier increases 300 volts maximum of plate voltmeter to 600 volts, with jack terminals.

J-19 changes UV socket of UV-199 tube receiver to take UX plug of Tester.



J-24 permits tests of Kellogg and old style Arcturus tubes as filament is on top.



J-20 changes UX socket of Tester to receive the odd base of the UV-199 tube.

List Price, $26.10, Your Price $15.82, Complete!

THE very exacting demands of service men, experimenters, teachers and students for an analyzer of sets, circuits and tubes, whereby great versatility is required with accuracy, are met by the brand-new Push-Switch Jiffy Tester, J—245—X. It is scarcely possible you will ever encounter a testing requirement that the new J-245-X will not fulfill.

The J-245 is housed in a steel carrying case, finished in crackle brown, and contains everything except the five accessories that give the new Jiffy Tester its high mark of utility and distinction.

The basic device is the J-245, consisting of three meters mounted on a panel, with sockets, jacks, and two switches, and including test leads and 5-prong plug with 4-prong adapter. The DC volts switch and cathode tester are new features of this.

There are five accessories, represented by the "X" in the catalogue number. These accessories greatly extend the range and usefulness of the basic device.

Therefore the new Jiffy Tester with ALL accessories (and you should have ALL of them) gives you close readings on low voltages and currents, yet reads all high values as well. Now you'll never be stumped.

J-245-X is especially designed to test up-to-date receivers, particularly those using screen grid tubes and 245 single or push-pull, testing out-of-date receivers just as well. It has an extensive usefulness and brilliant eye appeal. It tests sets with 201A, 200A, UX199, UV199, 120, 240, 171, 171A, 112, 112A, 245, 224, 222, 228, 280, 281, 227, 226, Kellogg tubes and old style Arcturus tubes. The two multipliers extend the ranges of two meters.

Into the case of the basic J-245 are built the following meters: one reading 0-20 ma. and 0-100 ma. for plate current, change-over switch included; one reading 0-60, 0-300 volts DC for plate voltages and DC house line voltages; and one reading 0-10, 0-140 volts AC and DC (though the meter is marked AC), thus 0-140 may be used for DC line voltage.

The two plated switches and nine tip jacks are on the panel. The jacks are marked to receive the five-tipped leads which emerge from the plugged cable connector. These leads are colored red, blue, brown, white and yellow, and so are little rings around the tip jacks that the leads connect to. All nine jacks are marked besides.

One switch is for change-over on the milliammeter, and the other is for the grid return to note a tube's "liveliness." How this is noted is explained in the instruction sheet.

Two sockets are on the panel, one 5-prong, the other 4-prong, for holding the UX and UY tubes, including screen grid tubes, both AC and battery types. To enable full test of screen grid tubes, including AC 224 and DC 222, a screen grid cable is supplied with the basic J-245.

The compact J-245-X (meaning including accessories), therefore, tests all plate voltages up to 600 volts, including B eliminators, all filament voltages, DC or AC, up to 10 volts; all plate current up to 100 ma. Besides, it provides close readings for plate current of 20 ma. or less and for B voltages of 60 volts or less, and AC voltage readings up to 560, including AC line voltage. Besides, it reads screen grid voltage and control grid bias voltage.

The base that contains the meters has four feet on it, is only 1¼" high, and snugly receives the cover. Inside the cover is a spring clip to hold the plugged cable, with a 4-prong adapter, as well as the red and black separate test leads for use of each meter independently, and the screen grid cable. You have three separate double-range meters independently accessible, in other words, six meter service, besides the plug-in feature for joint use of all meters in testing receivers, tubes, continuity, shorts, opens, etc. Used as a unit, the J-245 gives simultaneous readings on all meters. Use of individual meters gives one, two or three readings at a time.

This outfit has a genuine leather handle on the top for carrying, and a braided strap for keeping the cover from coming off accidentally. It is the very thing that the service man, experimenter, student and teacher have been looking for.

Order Cat. J-245-X and you will be surely overjoyed at the possession of such a handy, dandy, reliable and rugged Jiffy Tester, the neatest one you ever saw, and one that abundantly answers the purposes of service work. A tube data sheet tells how to determine if tubes are O. K.

IF YOU are a service man you are lost without meters. You may carry individual meters around with you and still remain perplexed, for lack of any means of obtaining access to the voltages or currents you desire to test. Therefore, an analyzer like the J-245-X is just the thing, and it is much more neatly made than you could possibly make a tester yourself, since, besides the engineering talent required to design such a device, thousands and thousands of dollars must be invested in dies. You reap the benefit of expert engineering, quantity production and careful instruction as to use when you buy a J-245-X. It is unqualifiedly recommended as superior to any tester that is anywhere near so low in price. You could pay twice as much and get half as much value!

Order a J-245-X today. It is sold on a 5-day money-back guaranty, which nobody else offers. Try it out for five days after receipt. If not fully satisfied for any reason, or for no reason at all, send it back with a letter asking for refund of the money you paid. The refund will be made promptly. There are no strings to this guaranty!

Remit $15.82 with order and we pay the cartage to any place in the world. We positively guarantee speedy service as well.

BESIDES fetching appearance, sturdiness, compactness and low cost, the J-245-X affords versatility by rendering individual access to each meter. Use the red and black test leads for this purpose. Suppose you want to know the total plate current drain of all tubes of a receiver. Use the milliammeter at its "0-100" setting, connect the test leads to "milliamps +,—" and the other ends of the leads in the negative B line.

This accessibility of each meter—six meter service, remember—heightens the value of the J-245-X more than 100 per cent, and is a new feature.

You are all set to go when you possess the J-245-X. You will not even experience limitations when desiring to test the B voltages on 210 and 250 tubes or desire to test UV 199 or Kellogg tubes which have filament emerging from a cap at top.

The plate voltage on a 210 is usually 350 volts while that on a 250 is usually 450 volts, and the B voltmeter, by use of multiplier, reads up to 600 volts.

Also, you may desire to test high AC voltages. In some places the line voltage is 220 volts AC. You may want to measure power transformer high voltage secondaries. The use of the other multiplier (for the 140 volt AC meter) permits readings to 560 volts, so center-tapped secondaries up to 1,120 volts may be measured. Multiply the reading on half the secondary by two.

Extension of the serviceability of the Jiffy Tester to a final form of remarkable completeness, enabling as many tests as analyzers make that cost more than $100, is an important achievement. Push-switch service is one feature. Extension of meter ranges is another, as the accessories permit voltages as high as 560 AC and 600 DC to be measured directly, and 1,120 volts AC indirectly.

The J-245-X (consisting of the new J-245 and five accessories) is packed in a strong carton and safe delivery is guaranteed. You run no risk whatever. Our 5-day money-back guaranty is absolute.

How the J-245 looks when the cover is slipped on and the strap is tightened. The handle is genuine leather

PLEASE USE THIS COUPON!

Guaranty Radio Goods Co., 143 W. 45th St., New York City, just East of Broadway.

Enclosed please find $15.82 M. O. ☐ for which please send at once, at your check ☐ expense, the J-245-X, as advertised, with the five accessories, instruction sheet, carrying case.

☐ Please send C. O. D. I will pay $15.82, plus cartage.

Name.....

Address.....

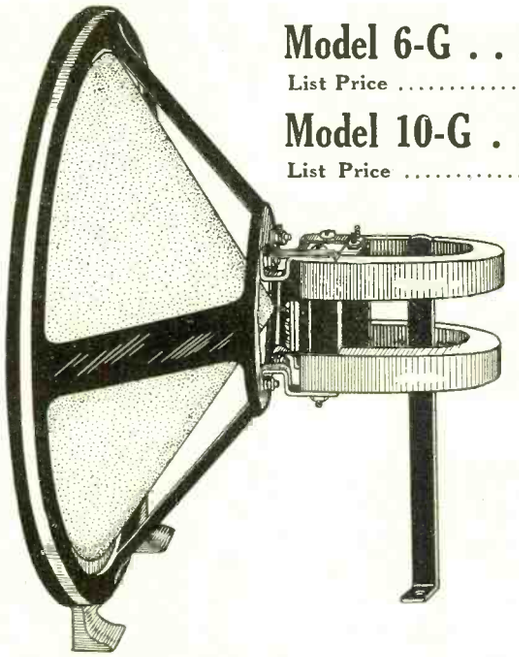
City.....State.....

5-DAY MONEY-BACK ABSOLUTE GUARANTY!
SHIPMENT 24 HOURS AFTER RECEIPT OF ORDER!

New

Farrand Inductor

Extremely Sensitive, Faithful Speaker at 50% off List Price!



Model 6-G . . . $10.00
List Price $20.00

Model 10-G . . $11.00
List Price $22.00

The New Farrand Inductor Chassis, the inductor unit on a spider assembly, with cone and supporting brackets. Chassis comes completely assembled, ready to play.

How the New Inductor Excels!

THE new Farrand Inductor Chassis is all the rage now because it affords extremely high sensitivity with faithful reproduction of all the notes of the audible scale. Here is a speaker that will support the good low-note reproduction of the most modern and most excellent audio amplifiers, without discriminating against middle or upper frequencies. If you do not have a speaker that will respond faithfully to the audible scale of frequencies, then the value of any good audio amplifier is largely lost.

An entirely new principle is involved in the Inductor Unit. The armature, instead of moving from side to side in the direction of the pole pieces, as happens in ordinary magnetic units, moves like a piston along the length of the air gap and maintains a steady distance from the pole pieces. As the sensitivity is extraordinarily high, the gap is made wide, and the armature will not strike the pole pieces.

The Inductor Chassis comes completely assembled, ready for operation. All you need do is connect the speaker cords to the output posts of your receiver or power amplifier. No energizing field is necessary.

Treat yourself to one of these exceptional chasses, and put it in a cabinet, or use some other form of baffle if you prefer. The chassis works well just as you get it, but works still better when aided by a cabinet or baffle.

These models, No. 6-G and No. 10-G, work exceptionally well with any of the following as single output tube: 171, 171A, 245 or 250. Also the same models are meant for ***any*** type of tubes in push-pull.

Model No. 6-G is 10" extreme outside diameter of cone, and Model 10-G is 12" extreme outside diameter of cone. The larger size, Model 10-G, gives a little better reproduction of low notes. Both types stand the same exceedingly high volume and output and use exactly the same unit.

Brookfield Cabinet
Model 10 for 10-G Inductor
Model 6 for 6-G Inductor
Either cabinet $6.50

A highly suitable cabinet for the Farrand Inductor Chassis is the Brookfield, made in two models, one for each size Inductor cone. The finish is genuine ply walnut. The baffle effect is particularly fine. These cabinets are specially made for these speakers and are beautiful in appearance, as well as sturdy, because of extreme expertness and care in manufacture.

Acoustical Engineering Associates
143 West 45th Street, New York City.
(Just East of Broadway)

Gentlemen: Enclosed please find ☐ money order ☐ check for $ ..... for which please send me at once

☐ One Model 6-G Farrand Inductor Speaker Chassis, ... $10.00
☐ One Model 10-G Farrand Inductor Speaker Chassis, ... 11.00
☐ One Model 10 Brookfield cabinet 6.50
☐ One Model 6 Brookfield cabinet 6.50
☐ For C. O. D. shipment put cross here

Name .....

Address .....

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

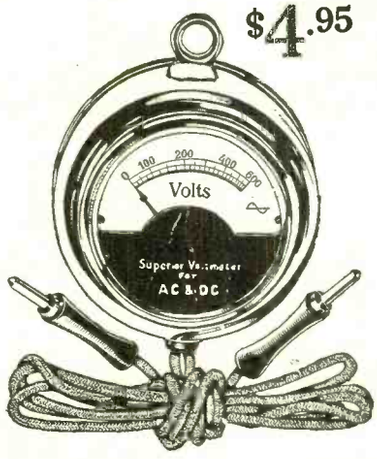
[Prepaid orders shipped same day as received. Canadian remittance must be by postal or express money order.]

O-600v, AC & DC

High Resistance Meter

ACCURATE TO 1%!

$4.95



O-600 AC and DC Voltmeter—same meter reads both —with 32" long flexible cords built in, and equipped with hanger. Extreme diameter (less hanger) 2¾".

MOST USEFUL!

Here is a meter that serves an abundance of uses, because it has a wide voltage range, 0 to 600 volts, and measures voltage of alternating current and direct current, and is accurate to 1%. In a meter it's accuracy that counts.

You can measure not only the DC voltages of B eliminators, power packs and B batteries, with easily legible readings of 20 volts per division of the scale, with wide divisions between 100 and 400 volts, so that you can easily see to within 5 volts, but you can also measure the AC voltage across high-voltage power transformer secondaries. If full-wave rectification is used, you measure each of the two sections of the transformer secondary and add the voltages. Thus up to 1,200 total volts across the secondary may be read. For half-wave rectification, a secondary up to 600 volts is read across the total winding. You find out at once whether this winding is open or shorted, since no reading then would be obtained, or find out whether the voltage is right, or too high or too low. In all instances the AC voltage across the secondary should read higher than the desired DC output, due to the voltage drop in the tube and to the current in the entire voltage divider and its sections. The normal deduction from the AC voltage, to obtain the DC voltage, is at least 10%.

A REQUISITE FOR SERVICING!

Often service men, experimenters and students must know not only the transformer high voltage, but also whether the AC line voltage is the rated 110 volts or not. This meter tells you. Connect it across the 110-volt line. By reading this voltage and the voltage of the high-voltage secondary you can also determine the step-up ratio, by dividing the smaller reading into the larger.

Because this is a high-resistance meter you can rely on the accuracy of the readings.

Only a high-resistance meter can accurately measure the DC voltage of a B eliminator. Other meters draw so much current that the reading may be 50 volts less than what it should be, or still more inaccurate, and you could almost guess the voltage more accurately than a low-resistance meter would read.

MONEY-BACK GUARANTY!

This meter is sold on a 5-day money-back guaranty. Buy one, try it, test it thoroughly, compare it with other meters in performance and appearance. If not fully satisfied, send it back and your money will be promptly refunded.

The meter is full nickel plated, highest possible polish, has green cords, with red (positive) and black (negative) moulded bakelite tip-holders, and sturdy tips. The positive and negative indications are for DC measurements. For AC the meter may be connected at random.

This meter, which is of the moving vane type, is made in Germany and represents finest workmanship.

Cat. M600 AC-DC $4.95

SEND NO MONEY!

GUARANTY RADIO GOODS COMPANY,
143 West 45th Street, New York, N. Y
(Just East of Broadway).

Please ship at once C.O.D. one 0-600 voltmeter, reading both AC and DC, on 5-day money-back guaranty. This meter must be exactly as advertised in Radio World. Cat. M600, price $4.95

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5-DAY MONEY-BACK GUARANTY

400TH CONSECUTIVE WEEKLY ISSUE!

"UNINTERRUPTED READER INTEREST"
EVERY WEEK — EVERY YEAR

RADIO WORLD

Vol. XVI, No. 10 Whole No. 400
November 23d, 1929
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.]

Technical Accuracy Second to None
Latest Circuits and News
EIGHTH YEAR

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

RADIO WORLD, owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, editor; Herman Bernard, business manager and managing editor; J. E. Anderson, technical editor.

Fallacies Gain High Favor

Popular but Wrong Roads Lead to Trouble

By James H. Carroll

Contributing Editor

THE misconceptions regarding radio technique could be codified and would make an interesting volume. Some of them are of such popular acceptance as to make the fallacy counterbalance the fact in numerical credence. It would be a fascinating study in psychology to ascertain how these misbeliefs originated, or, rather, how they come to win greater popularity than the truth. Notions are notorious for their lack of authenticity. A man may regret he does not know what the fact is, but is proud nevertheless to assert that he knows what he believes. In mere academic discussion this would be harmless, but radio is a practical science, and it is disastrous to follow the miscues. An audience of tubes will hiss a man for his gauche efforts.

In general, the chief mistake is in ascribing untenable causes to effects. To select one example, a receiver works well on a certain eliminator, another receiver, when served by the same eliminator, will make motorboating audible. The customary inference is that the second receiver is at fault. If the receiver must be separated from the B eliminator for the assignment of cause, then certainly the B eliminator is to blame. The reason there was motorboating when the second receiver was used was that this receiver had a good audio amplifier, one that carried on high amplification even at low audio frequencies, hence the oscillation at low frequency (motorboating) was audible. You could filter out the low-note response and stop motorboating, but that would be nothing other than sabotage to a good audio amplifier. A better remedy by far would be to reduce the impedance of the B supply by putting in filter and bypass condensers of large capacity, as across the output, and from intermediate B positive voltages to negative of the B supply. Electrolytic condensers afford such large capacity compactly.

HARD PUT TO IT SOMETIMES

It is true that sometimes motorboating is so bad that even an expert is put to it for a remedy. Sufficiently large capacity always will turn the trick, but it is not always possible to obtain large enough capacity. Some conditions would require 50 to 100 mfd. across the output, with 8 or 18 or some other such capacities for bypassing intermediate positive voltages.

Oscillation at audio or radio frequencies is often an encouraging sign. At radio frequencies it proves that the circuit is keen, and that it requires only balancing or shielding to make large gain stable and effective. Of course uncontrolled oscillation is a gain-killer, for instead of pure signals you have impure interference. But always something can be done about it.

At audio frequencies the oscillation may be anywhere in the audible scale, or even may be super-audible, in which instance we usually are unaware of its presence, hence happily do nothing about it.

GAINFUL LOSS BY SHIELDING

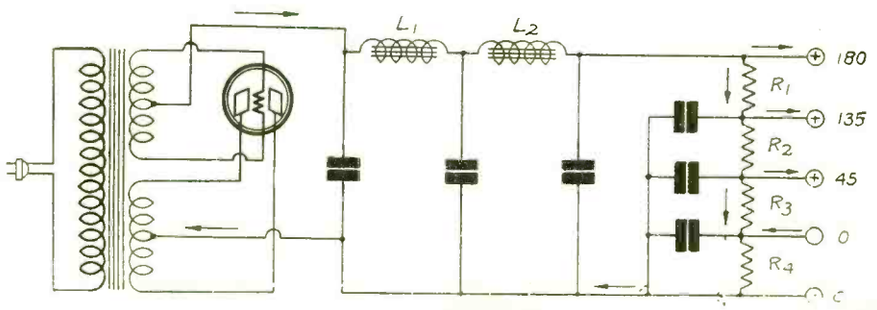
The subject of shielding is surrounding with a maze of misconception. What shielding effectuates, in general, is the manageable operation of a high-gain radio frequency amplifier. Gain is produced by establishing a loss of a peculiarly protective type, a loss that has its compensatory features.

Take, as an example, a stage of radio frequency amplification and a detector. That is a simple two-tube receiver. Omit consideration of the audio amplifier for the moment. Little, if anything, can be gained by shielding such a receiver, first, because the oscillation nuisance is otherwise easily made tractable, and, second, because the shields themselves usually produce enough losses to deprive the circuit of selectivity.

But take several stages of radio frequency amplification, and there is so much excess amplification that some means must be introduced of reducing the gain, and that means may well be shielding, which becomes a double advantage, because (a) it tends to eliminate stray pickup by the coils used for coupling, hence confines the input to the detector to the tuned frequency, and (b) the gain is confined to practical limits. The circuit must be long past that state when introduction of losses is necessary for stability or workability before shielding can be recommended. There are some exceptions, as where extremely high gain is artfully produced in a simple two-tube circuit, but as a rule shielding should be reserved for two stages or more of radio frequency amplification.

POINTERS ON SCREEN GRID TUBES

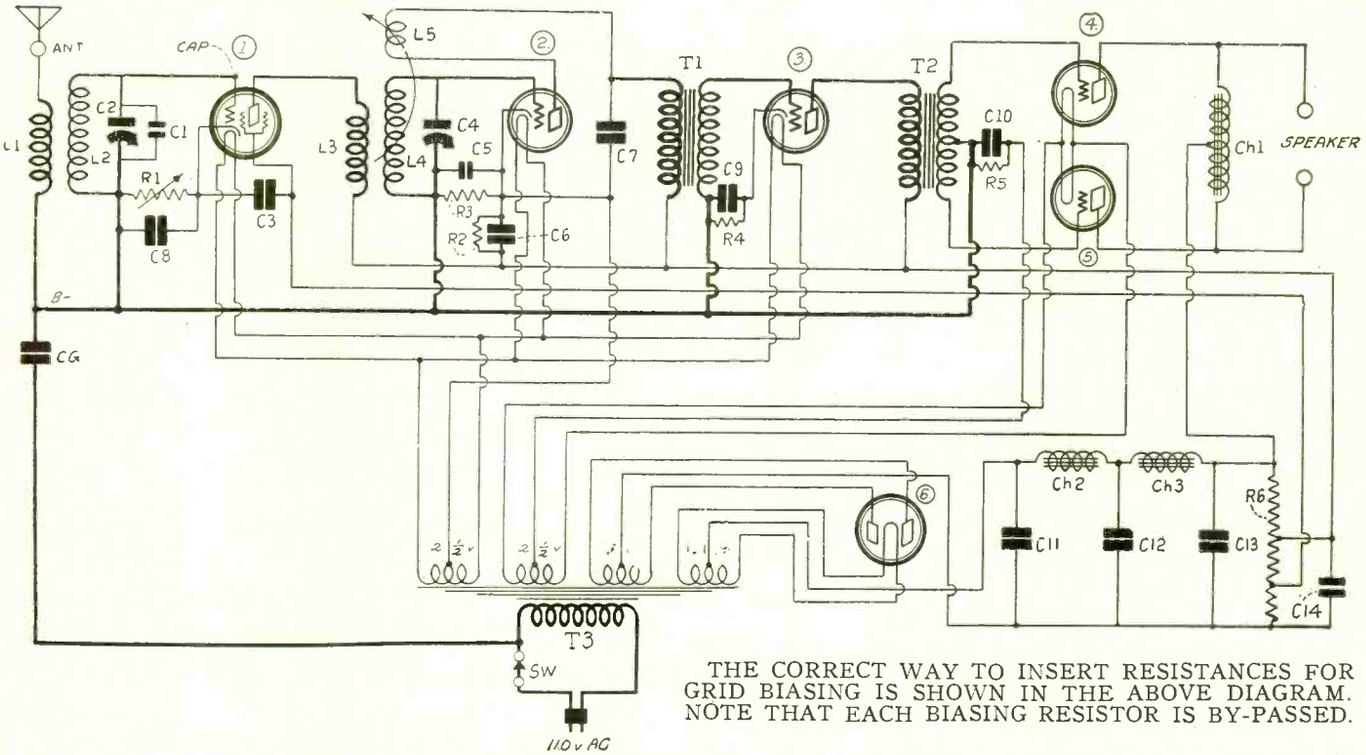
Since the higher the amplification the greater the advisability or necessity of shielding, it follows that high-gain tubes are first to require stage shielding, and even the tubes may be shielded



THE USE OF LARGE FILTER AND BY-PASS CONDENSERS IN THE FILTER CIRCUIT AND BETWEEN EACH OF THE INTERMEDIATE VOLTAGES, AS SHOWN IN THIS DIAGRAM, CURBS MOTOR-BOATING.

Pointed Misconceptions

Deeply Rooted Ideas Often Run Counter to Science



THE CORRECT WAY TO INSERT RESISTANCES FOR GRID BIASING IS SHOWN IN THE ABOVE DIAGRAM. NOTE THAT EACH BIASING RESISTOR IS BY-PASSED.

as well, to advantage. An example is the screen grid tube worked in multi-stages.

Screen grid tubes, like some wives, are misunderstood. It is not a good suggestion to revamp an existing receiver to include screen grid radio frequency tubes, although if only one stage of RF is used, a screen grid tube may replace a general purpose tube. In that event the number of turns on the primary of the interstage coil would have to be increased, usually doubled. This is the winding in the plate circuit, assuming that the succeeding grid circuit is tuned. Substitution made in this manner improves volume and sensitivity, but does not work miracles.

All tubes biased by a voltage drop in a resistor, where the current through the resistor is low, require that the resistor be bypassed by a condenser of suitable capacity. At radio frequencies this capacity may be small, say .006 or more, but for audio frequencies it should be at least 1 mfd. for intermediate stages and 4 mfd. for the output stage bias.

The current through individual resistors in AC circuit stages is plate current, and the signal voltage across the resistor is out of phase with the grid circuit voltage, hence there is negative feedback or de-amplification, besides an injury to tone. That this condenser may be safely omitted is a common fallacy.

CONDENSER NEXT TO RECTIFIER

Next to the rectifier tube in a B supply, it is often assumed, a large capacity must be placed. In point of fact, 2 mfd. is sufficient. The larger the capacity at this point, the greater the strain on the rectifier tube at the moment of starting, since a high capacity subjects the filament of the rectifier to a high drain for charging up the condenser. The higher this capacity, the higher the final voltage output, but that voltage should be determined by proper design of the high-voltage winding of the power transformer and the amount of current drawn by the receiver and amplifier, plus the bleeder current which is the current independent of that drawn by the receiver.

The lower the total resistance of the voltage divider, the higher the bleeder current, and this current should be maintained at a fairly good level, and the rectifier circuit so designed and chosen to permit this, as when the current is higher the resistance values necessary to produce required voltage drops are less, and the relative effect of the bypass condensers is greater. Therefore, a fairly good amount of bleeder current, say 20 milliamperes or more, tends toward stability, the bleeder method being one way of enhancing the effect of the condensers and reducing also the impedance in two ways, both in the same favorable direction. Hence, it is not necessary to have 15,000, 20,000 and 30,000 ohm voltage dividers. About 14,000 ohms would be plenty for a 245 power amplifier to work a receiver.

Where the current is high in battery-operated circuits the resistance is so small that it is not imperative to bypass it, as, for instance, the biasing of a tube that has a battery heating its filament, where the bias is obtained through the voltage drop in a filament resistor. If the resistor is in the negative filament leg, and the negative filament (F minus) is taken as the reference point, a grid return to negative A (at the battery or equivalent) will provide a bias equal to the voltage drop in the resistor.

Whatever the bypass condenser recommended or specified (except the filter condenser next to a rectifier), nothing but good can result from using a higher capacity. If 8 mfd. is recommended for across the output of the filter chokes, 18 mfd. may be used beneficially. Capacity in these positions is like money: you can't have too much of it.

THE CASE OF METERS

Meters have not escaped the notice of the bad guessers. It is assumed by many that something can be done to a meter to make it more sensitive. But the sensitivity is built into the meter and in general can not be changed. If a series resistor is used with a 0-300 voltmeter to increase the range to 600 volts, the amount of current required to make the needle read full-scale deflection is not doubled, but remains constant, and the sensitivity of the meter remains unchanged. The multiplier simply requires that 600 volts be applied to produce the same current. So 150 volts could not be read more accurately with the multiplier in or out.

Nevertheless, many believe that a 0-10 milliammeter somehow, by attaching something to it, could be turned into a 0-1 milliammeter. Under all circumstances the 0-10 milliammeter will require 10 milliamperes flowing through the meter for full-scale deflection. This is true even if a shunt resistor is used to multiply the range. The current in excess of 10 milliamperes would flow through the shunt. So a 0-1 milliammeter has its sensitivity built into it, and requires 1 milliampere for full-scale deflection. The resistance of this metter when the meter is used this way may be small, say 100 ohms. This is usually the resistance of the coil in the moving coil type of meter.

HOW TO FIND RESISTANCE PER VOLT

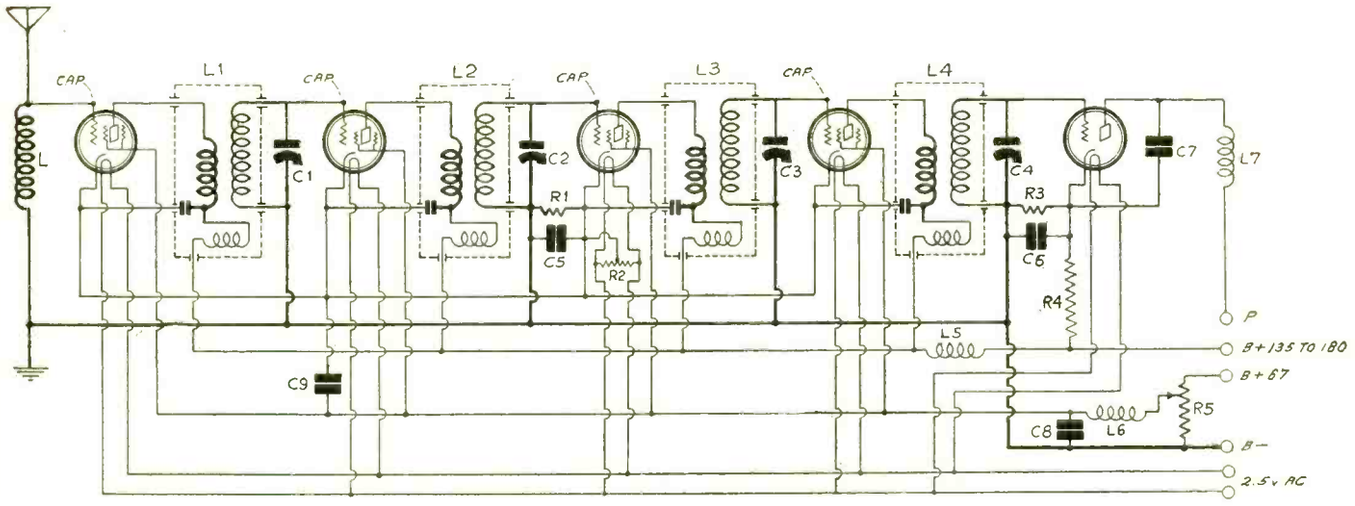
If a resistor is put in series with the 0-1 millammeter, so that when 600 volts are applied the full scale will be read, then you have a 0-600 voltmeter, of 1,000 ohms per volt resistance. Whatever the value of the series resistor, the meter will have 1,000 ohms per volt resistance, because the resistance per volt of a voltmeter is the number 1 divided by the total current required for full-scale deflection. This total current always is 1 milliampere in the given instance.

Nevertheless, many believe that a 0-1 milliammeter is simply a 0-10 or 0-100 or other higher range meter that has had something done to it. And the assumption is that a dollar that buys a 0-10 milliammeter of sorts will buy a 0-1 milliammeter, although a meter that draws only 1 milliampere at full-scale deflection is a sensitive instrument, something expertly and carefully made, and the price usually runs into two figures.

Sensitivity Galore!

MB-29 Sets New High Mark for Delighted Users

By Harvey Sampson



THE CIRCUIT OF THE MB-29, A SCREEN GRID AMPLIFIER WHICH IS ONE OF THE MOST SENSITIVE TUNED RADIO FREQUENCY TUNERS EVER DESIGNED.

THE MB-29 has brought about an unusual situation in radio. The stock question by fans used to be: "How can I make my set more sensitive?" Now many fans who have given this circuit a good trial ask the opposite: "How can I cut down the sensitivity of my receiver?"

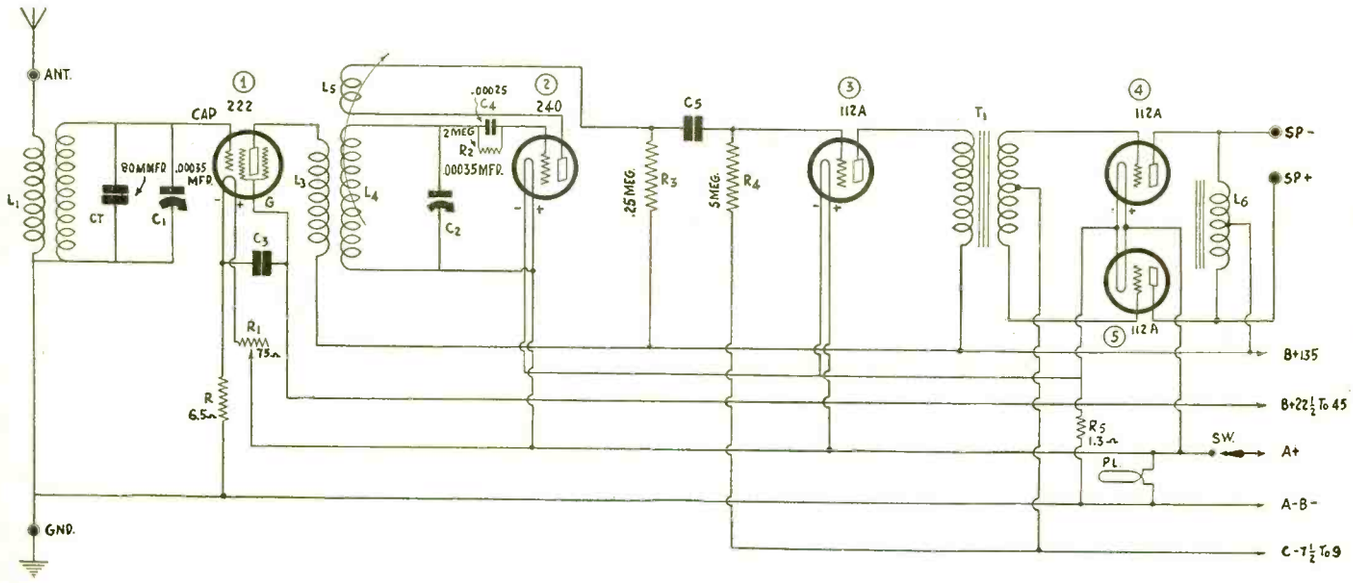
Of course they do not mean that they are anxious to have a less sensitive receiver permanently, but only while they are listening to local stations. They don't want to sit on the loudspeaker to keep it from jumping out of the nearest window when a local station is tuned in. They want plenty of volume on all stations but not too much of it on any one.

There is a wide-range volume control in the circuit to take care of just this situation, and in most instances it is only necessary to hand it out to those fans who think they are getting too much for their money. But in some cases the complaints have not been formulated until after the volume control has been explored. It seems that local stations of high power are too strong. In these cases a simple remedy is to put a small condenser in the antenna circuit. It's magical.

Another thing this condenser is good for is to cut out reception on the second harmonics. If a local station should come in at two or more points on the dial, try the condenser. It's effective.

There have been some complaints that the tuner hums too much. Those who complain know it is the tuner because the audio amplifier did not hum before it was connected to this particular. One of these cases was investigated and it was found that the hum was due to an open grid in the audio frequency amplifier. The "C" battery has simply been left out. In another the hum was found to be due to a badly overloaded B supply unit.

The MB-29 brings in an almost unbelievable number of distant stations with local volume. It has a steady daylight range of 1,500 miles and will "cross the continent" at night.



SPLENDID RESULTS HAVE BEEN OBTAINED WITH THIS SCREEN GRID, PUSH-PULL RECEIVER. THERE IS VOLUME APLENTY. IT IS THE NEW PUSH-PULL BATTERY MODEL SCREEN GRID DIAMOND OF THE AIR.

"Television Soon"-Lafount

Federal Radio Commissioner Calls Present Success Fair

By Harold A. Lafount

Federal Radio Commissioner

NINE years ago an amazed world awoke to read that on the night before instrumental and vocal music had been broadcast through a strange electrical apparatus and received many miles away from the sender by persons in various parts of the country. Radio broadcasting was hailed as the miracle of the century—a scientific discovery, infinitely more wonderful to the popular imagination than the transmission of the crude wireless telegraphy of Marconi, accomplished in 1896.

Since that time, the art has developed with astounding rapidity until today its importance in the industrial world can only be appreciated when we realize that $650,000,000 worth of receiving sets and accessories was manufactured and sold last year. This does not include the enormous sum which went for transmitting sets, studio equipment and other facilities for production of programs. And neither does it include the millions of dollars paid to artists and musicians.

$3,000,000,000 INVESTED

Today nearly every family in the United States owns a receiving set. I am told that the investment of the American people in receiving sets alone amounts to more than $3,000,000,000.

This certainly indicates your interest in radio programs. It is positive proof that radio is an indispensable necessity.

Naturally this stupendous investment must be safeguarded. And so it was with a view to protection that a sympathetic President, Cabinet and Congress exercised the foresight to pass the radio act of 1927. And by so doing, they anticipated the universal use of this new and undeveloped discovery of science. The Federal Radio Commission was by the same act created to regulate and limit the use of radio in the best interest of the American public.

The act provided that this country be divided into five radio zones and for the appointment of a commissioner from each—not to represent the zone, but to act with his four associate Commissioners—as a part of a National Commission. The new Commission was charged with the responsibility of issuing all licenses for radio transmission.

EQUALIZATION AMENDMENT

Some months later, the law was amended providing that the radio facilities of the United States be divided equally among the five zones and equitably among the several States in each zone according to the distribution of the population in the States.

By this you can readily see that a sincere effort has been made by the Government to impartially divide the benefits of this great natural resource between all the citizens of the Nation because they share equally in its ownership.

To make and maintain such a division, or such equality, was found to be no easy task. In other words upon 90 wavelengths available for the purpose we must place the 615 broadcasting stations in such a way as to maintain equality and reduce interference.

This proved to be somewhat of a Chinese puzzle but after working day and night for several months the Commission decided upon a plan of allocating a definite number of cleared, regional and local channels to each zone and to each State based upon its population.

An additional requisite of the law and a very wise one, is that every station must be operated in the public interest, convenience and necessity. Although a just requirement, it is a difficult one for the Government to enforce. It means that the Commission must determine which applicant or broadcaster can best serve you.

Naturally all of them believe they can render or that they actually are rendering the highest possible public service, commensurate, of course, with the size of their respective cities. It is, however, a matter for the Commission to decide, and in so doing the public's interests, likes and dislikes, and local conditions, are all-important. Naturally mistakes are made, it being rather difficult always to anticipate public desire. Likewise there may be violations of the Government's confidence expressed by its granting a radio license, but generally speaking broadcasters are making a sincere effort to comply with all rules and regulations of the Commission and to operate in the public interest.

BLURBS GETTING FEWER

Yes, indeed, they sometimes talk too much about the commodities they advertise, but that practice is being discontinued by many stations. Certainly, their only available income is from advertising but this generally is in the form of a sponsored program, which is not so objectionable to the listeners, in fact, I believe this method of support or maintenance is preferable to the taxing of receiving sets. Under the present method of broadcasting in the United States it is leading every other nation on earth.

I do not believe we have reached perfection. Many changes will have to be made and some programs improved. But the programs now being broadcast in this country cost millions of dollars annually. It requires a substantial army of men and women. A still larger throng, including many of the world's greatest artists, carries out the carefully planned details in order that the public may be entertained and educated. Thousands appear before the microphone each year, all seeking public approbation.

TELEVISION "WON'T BE LONG"

It is inconceivable that we all enjoy the same program, consequently broadcasters are continually striving to diversify them in an effort to please all their listeners some of the time, and perhaps that is all we can expect since our likes and dislikes vary so much.

It won't be long until you are going to see as well as hear by radio. Experiments in television are being conducted now with fair success.

It is my belief that the day is imminent when you may witness not only moving pictures, scenes and spectacles but even football games or a world series. I believe you will be able to follow the progress of a trans-Atlantic flight and I believe also that planes may be flown without a pilot just as battleships may be controlled by radio signals.

At every hand we have indications that these and other wonderful developments are on the threshold. Such a growing and such a changing scientific art requires the eternal vigilance of your Government, that it may be qualified to allocate these precious wave lengths to the proper service consistent with their characters and public necessity.

Unceasing study and research must underlie every decision of the Commission. This rapidly growing industry must be maintained in paths of public interest. Your right as citizens of this great country must be and I am sure are being safeguarded, and under no circumstance should we permit a subversion of your interests to the profit-taking interests of private or commercial enterprises.

How Important Is Artist's Confrontation?

The radio is not yet a refuge to which the under-educated repair for the replenishment of their brain. An author estimates the annual cost of radio at $750,000,000 in the United States, listing it under "play impossible without machinery," its financial predecessors being (1), pleasure motoring; (2), vacations and travel; (3), moving pictures; and (4), newspapers, tabloids and light fiction.

There is indeed an advantage in directly seeing a singer or watching an orchestra, and this adds to the enjoyment. but does not deprive other forms of listening of their enjoyment and play factor. Due to radio, ten thousands times as many persons have heard the great living musicians than would have heard them by confrontation.

The assumption that the artist performing before a phonograph recorder must be necessarily "a more or less bored singer," is opinionative, not factual. One could not have meant Al Jolson, Sophie Tucker, Irene Franklin, Rudy Vallee, Harry Lauder, Reinald Werrenrath, Emilio de Gogorzo, but he may have had in mind the two records Jenny Lind made, long after her retirement and very shortly before her death. If anything, most of the living phonograph singers, and they are the radio singers also, have too much wild enthusiasm for their musical and histrionic weight, straining like a fat man at a picnic trying to climb a rope hand over hand.

A fact lost to sight in the discussion of radio and its relation to play is that although the physical personality of the performer can not yet be envisaged, the faithfulness of the copy makes up for that. There is no need to argue that the gap is wide, but the bridge of television is being built to span it. Radio is not and never can be original rendition, but always is a copy of an original, or a copy of a copy. There is no possible argument against transmitting specially recorded broadcasts, and even now extensive plans are afoot to send out chain programs by the recorded method.

The Value of Recordings

Phonograph a Great Auxiliary—Pickup Must Be Excellent

By Neal Fitzalan

SO MANY eminent artists are now performing over radio almost nightly that it would seem there is no need to supplement the splendid music with phonograph recordings, but that is not so. The better the programs received over the radio set, the more good records are being played, and they are played over a part of the radio receiver, the amplifier and the loudspeaker.

There are many reasons, of course, why the popularity of the electrically played phonograph is gaining. In the first place the public is getting used to first-class music and only the best will now be accepted. When there is a decline in the quality of the radio program fans turn instinctively to the phonograph to keep up the good entertainment until the time that a really first-class program is being rendered.

Another important reason for the increasing popularity of electrically recorded and played phonograph music is the desire to make direct comparisons between performances of different artists of the same selection and between radio and phonograph renditions of the same music by the same performer at different times. For example, Chaliapin sings a certain well-known and well-liked song over the radio. As soon as he has signed off and while the memory of his rendition is fresh in the mind, the listener turns on a phonograph record of the same song by the same artist. Or, again, Tibbett may sing a song over the radio, a song made famous by Chaliapin, and as soon as Tibbett's turn at the microphone is over, the phonograph is turned to Chaliapin's record of the same song, which is enjoyed a second time.

PHONOGRAPH GOES ON

The phonograph is not turned off after the first record but it is kept playing for some time. Perhaps it is not stopped until several of Chaliapin's records have been played, and several of Tibbett's, and several of some other recording artist. After all, the phonograph record represents a best performance of every artist, a performance selected out of many trials, while the radio performance is only one rendition. The artist may not be at his best at the radio moment.

The ponograph is by no means limited to comparisons after the radio performance of a certain artist, but is often used as a preparation for a radio program that is known to go on the air at a certain hour. Perhaps Bunchuk is scheduled to play some cello solos on the radio at a certain hour and as a preparation records of Casals are played just before the hour. The enjoyment of the music is sure to be keener because of the familiarity that timely repetitions engender.

The greatest argument for the use of phonograph records has always been that any music can be had when it is wanted. And it can be had as played under conditions that approach very closely to the ideal.

IDEAL CONDITIONS

There is no denying that phonograph music electrically recorded and electrically played is reproduced under the most favorable conditions. The technique of recording by electric means is well-nigh perfect from the acoustic, the electric and the artistic points of view. There is little more to be desired with respect to quality of the music stored in the record.

However, that music stored in the disc must be reproduced under conditions as nearly ideal as possible if full benefit is to be derived from the artistic and scientific achievements which it represents. There are four devices used in playing, all of which must be of exceptional quality possibilities. These devices are: (a), the motor driving the record; (b), the pick-up unit that converts the mechanical vibrations into equivalent electrical vibrations; (c), the audio frequency amplifier that increases the minute electrical vibrations into true and magnified electrical copies of the vibrations generated in the pick-up unit, and (d), a loudspeaker which can convert these magnified electrical vibrations into equivalent sound vibrations with greatest fidelity.

The driving motor must meet certain definite conditions if it is to be suitable for driving a phonograph record. In the first place it must have sufficient power not only to start up quickly but to maintain the speed at a constant value. This means that the motor should have a high starting torque and reserve power. It must also operate satisfactorily on commercial current frequencies, and it must have a positive micrometric speed control so that the turntable can be driven at the proper rate without the slightest variation

Moreover, the motor must run noiselessly and without any vibrations. Mechanical vibrations easily get into the music and are reproduced as interfering sounds and they also shorten the useful life of a record. Electric sparking must be completely absent from the motor, and this means that it must be of the induction type in which no commutator brushes of any kind are used.

THE PICK-UP UNIT

One of the most important parts of an electric phonograph is the pick-up unit, and it must have certain mechanical and electrical features without which the best system is incapable of reproducing true music. It must have a well counterbalanced tone arm of suitable length and of suitable weight. If the arm is too short, the needle will not trace the record groove at the correct angle throughout the run. If it is not counterbalanced the unit will bear too heavily on the record and rapidly wear it out. If the entire unit and tone arm assembly are not heavy enough the low notes will not be reproduced because the unit as a whole will move instead of the needle and armature alone.

The armature must be properly mounted in the unit so that it is free to move without noisy friction. Further, it must be so mounted that there will be no undue stiffness to limit its excursions as demanded by the low note undulations in the record. Neither must the armature be so heavy that it cannot follow the rapid undulations corresponding to the high notes. If there is too much mass in the armature the needle will rapidly ruin the high frequency portions of the record. Naturally, it requires a great deal of research to secure a unit of the best possible design both with respect to low and high frequencies. But such designs are now available and one is represented by the latest model Phonovox.

A distinct advance was made in phonograph pick-ups when cobalt steel magnets were introduced. With this steel a unit of comparatively light weight can be constructed without in the least sacrificing its magnetic efficiency. Indeed, the chief advantage of this steel is that a greater magnetic strength can be obtained and vastly greater permanence. With respect to permanence of the magnetism, this steel is in a class by itself, and pick-up units made of this material should have marked advantages over those which employ ordinary steel.

The armature coil in the pick-up unit in which the signal voltage is induced by motion of the armature is another element of the unit which must receive careful attention if proper reproduction is to be achieved. In this respect, Pacent engineers, designers of the Phonovox pick-up units, have found that a low impedance coil gives the best results, and can be used advantageously when working into a screen grid tube.

Since the armature must be mounted so that it will swing freely in the magnetic field without being permanently attracted to one pole or the other, there must be a restoring force, which is usually supplied by springs. There is danger in this of getting resonance peaks at which excessively high voltages will be generated. It is customary to introduce filters of some kind to overcome this difficulty. Sometimes the filters are electrical and sometimes mechanical. In the latest Phonovox units mechanical filters are used to level the generated voltage, and it is said that there is practically no change in the generated voltage amplitude within the band of frequencies from 40 to 8,000 cycles. With such a range the low notes obviously will be brought out full strength and the high will not be overemphasized to necessitate a scratch filter.

POINTS OF CONVENIENCE

A desirable feature in any pick-up unit, found in the latest Phonovox, is the "fold-back hinge" by means of which the pick-up can be folded back on the tone arm for easy insertion or removal of the needle. This removes the necessity of swinging the tone arm off the record while making the change. However, the tone arm can be swung around easily to get it out of the way while changing records.

The remaining two sections of the electric phonograph, namely, the power amplifier and the loudspeaker, need no special discussion. There are many excellent amplifiers and speakers available. However, when possible the amplifier should be of the push-pull type, at least in the last stage. Also, the loudspeaker should preferably be of the inductor or dynamic types. Two stages of amplification usually are sufficient, although three can be used if there is a suitable volume control.

The Pacent Wafer Adapters are a great convenience in making the correct connection between the output of the pick-up unit and the amplifier circuit. These adapters fit over the prongs of the tube and contain tip jacks for the terminals. The connection made is in the grid circuit of the tube, which is the only way that connections should be made.

A complete electric phonograph, with the exception of the amplifier and the loudspeaker, is available in one unit. It contains the motor, turntable and the pick-up unit, together with necessary accessories, and is called the Pacen Electrovox.

How to Make 19 Tests in 5

Plate Current, Filament, Plate and Line Voltages, Continuity,

By Homer

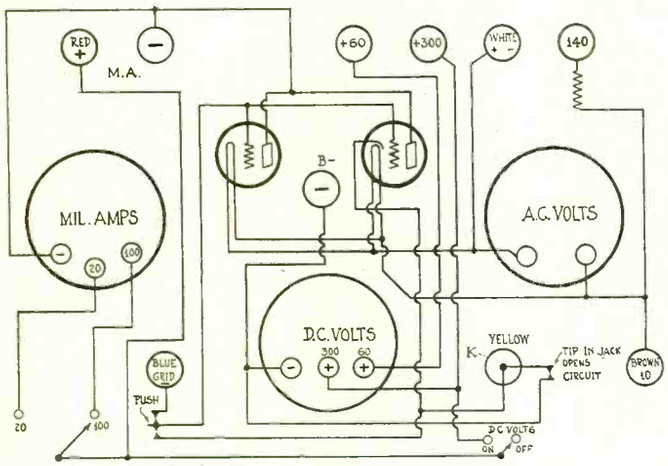


FIG. 1
THE CIRCUIT DIAGRAM OF THE J-245-X TUBE AND SET TESTER.

The J-245-X tube and set tester, the diagram of which is shown above, has been primarily designed for making various tests on receivers and tubes, such as voltage, current, emission tests, as well as continuity tests on the various units that are used for coupling tubes. Thus it uses the receiver's power. However, the tester is equally valuable in making tests on tubes independently of any receiver and a large number of measurements can be made with the unit in this manner. A feature of the unit is that each of the meters can be used independently for external measurements, such as AC and DC line voltages, low voltages both AC and DC, direct currents up to 100 milliamperes, and indirectly, resistances. Nineteen of the possible tests that can be performed quickly are outlined below.

TEST NO. 1—FILAMENT VOLTAGE, AC OR DC.

Connect the four-lead cable terminals to the tester, color for color. Keep right snap switch on off position. Remove tube from set and put in tester. Plug cable into socket just vacated. Read the filament voltage on the 0-10 scale of AC voltmeter. Repeat for other tubes.

The filament voltage alone on any tube can be measured by using the voltmeter separately. Use the red and black leads only on the tester, using brown and white sockets. Touch the other two terminals to the filament terminals the voltage of which is to be measured. Read on the 0-10 scale.

TEST NO. 2—PLATE CURRENT OF ANY TUBE.

Proceed as in test No. 1. Set left snap switch on 100. Read the corresponding scale. If the current is less than 20 milliamperes throw switch over to 20 and read the upper scale of the milliammeter for a more accurate reading.

TEST NO. 3—TOTAL PLATE CURRENT OF A RECEIVER.

Use the milliammeter of the tester as a separate meter. Open the B minus lead of the receiver at a point where it is known all the current flows. Set the milliammeter on 100. Connect the opened B minus leads to (—) and red jacks marked milamps. If needle of the milliammeter goes backward reverse the leads. For this purpose use red and black leads furnished with the instrument. If the current is less than 20 milliamperes, which is not likely, throw switch to 20 and read the upper scale of the milliammeter.

TEST NO. 4—PLATE VOLTAGE, ANY RECEIVER TUBE.

Proceed as in Test No. 1. Put right snap switch on the "on" position. Read the voltage on the 0-300 scale.

TEST NO. 5—CONDITION OF TUBE.

Proceed as in test No. 2. Note the plate current. For filament tube connect a lead between Blue and White momentarily while reading current. For a good tube the current should be about doubled. For a heater tube push down small brown push-button to connect grids with cathode. Again the current should about double. For normal values of current see the table plate currents for various tubes that accompanies the tester.

TEST NO. 6—FILAMENT EMISSION.

Plug in all the tip jacks except the blue. Join the blue and the (—) M.A. jacks with a lead. Otherwise proceed as in test No. 2. Read current on the milliammeter set on 100 or on 20 according to the value of the current. The total is the emission current because the filament and the grid are connected together.. Short-circuit load on the tube in the receiver to get the current when there is no load.

TEST NO. 7—AC LINE VOLTAGE.

Tap the AC at any convenient point, taking precautions against short circuit of the line. Bring one side of the line to jack 140 and the other to the white jack. Read voltage on the 0-140 scale of the AC voltmeter.

TEST NO. 8—CONTINUITY.

Apply tests Nos. 1, 2 and 4. If the circuit shows filament voltages, plate current, and voltage the circuits involved are continuous. If there is no indication there is an open somewhere. To locate the open use DC voltmeter and an external voltage source, such as a 7.5 volt battery. Plug the black into (—) in the center of the tester and the red into plus 60 jack. Connect the red to the plus side of the external battery and another lead to the negative. Use the black and the new lead for exploring the suspected circuit. If the two leads are touched on opposite sides of the open no indication will be obtained on the meter, or at least very much less than when the two exploring leads are touched together. By this method the open can be bracketed in until its location is found.

TEST NO. 9—SHORTS IN CONDENSERS, RESISTORS AND COILS.

Proceed as in test No. 8. Preferably remove the part to be tested from the circuit. Connect the exploring leads to the two terminals of the part and note the voltage reading. If it is shorted the reading should be the same as when the two exploring points are touched together. If the condenser is good there should be no reading. If the resistor is good there should be a reduction in the voltage reading by an amount depending on the value of the resistance. A coil is tested the same way as a resistor if its resistance is high. If its resistance is low this is no test and the coil should be traced out when that is possible. This is easy on open radio frequency coils.

TEST NO. 10—WHAT BIAS IS APPLIED.

This can be done on any tube by using the DC voltmeter separately. Use the red and the black leads and plug into 60 and (—) jacks, respectively. Connect the red to the filament or cathode in the set and the black to the grid or the F minus terminal of the coupling transformer ahead of the tube, or to the corresponding point on the grid leak. If the lead is connected to the grid inaccurate readings will be obtained, if any at all.

A better way of obtaining the grid bias is by noting the plate current as in Test No. 3 and then applying a grid bias battery, varying it until the plate current is the same as when the regular bias is applied. The bias is thus measured by its effect on the plate current and by comparing it against a known voltage. This method works in all cases whereas the first method works only under certain conditions.

TEST NO. 11—OVERLOAD AND DISTORTION ,

Proceed as for measuring current, plugging into the socket of the power tube. Note the needle of the milliammeter. If the needle remains stationary, or if it fluctuates only a little. on loud signals, the tube is not overloaded. The violence with which the needle jumps around on loud signals is a measure of the degree of distortion or overloading. If the overloading is severe, the tube ahead of the power tube might be tested in the same way, provided that the coupling between the two tubes is not resistance.

TEST NO. 12—WHAT BIAS SHOULD BE APPLIED.

Proceed as in test No. 11 and note the needle on the milliameter. If it kicks upward on loud signals the bias is too high; if it kicks downward, the bias is too low. If the needle stands still, the bias is correct. If the tube is overloaded the needle will never stand still, but if the bias is right it will kick up as much as down from the position it holds when no signal is impressed on the tube.

TEST NO. 13—STARTING AND STOPPING OF OCCILATION.

Proceed as for obtaining the plate current, plugging into the

Minutes With the J-245-X

Shorts Ascertained—Rectifier Tubes Tested Comparatively

J. Andrews

oscillator tube. The starting of oscillation is indicated by a sudden drop in the plate current.

TEST NO. 14—SCREEN GRID TUBES.

Proceed as for other tubes, leaving the grid switch on the "off" position. Connect one end of the special cord with clips to the control grid at top of the tube in the tester and the other end of the cord to the clip in the receiver, that is, to the clip which goes on the cap of the tube normally. Read plate current on the milliammeter. The control grid test may be made by removing the end of the special cord from the receiver and touching this end to the 10 (brown jack). The plate current should increase.

TEST NO. 15—SCREEN GRID VOLTAGE.

Use DC voltmeter separately. Plug in red lead into plus 300 jack and black lead into (—) jack. Connect other end of red lead to screen grid (G on socket) and the other end of the black lead to the filament or the cathode. Read voltage on DC meter. If less than 60 move red lead on tester to plus 60 jack and read on lower scale.

TEST NO. 16—DC VOLTAGES UP TO 600 VOLTS.

Use the DC voltmeter separately and connect one J-106 multiplier in series with one of the leads to the meter. Read the 0-300 scale and multiply reading by two. This multiplier is extra equipment.

TEST NO. 17—UV TYPE TUBES (UV99).

Use adapters J-19 and J-20 as required and proceed as for other tubes. These are extra equipment.

TEST NO. 18—KELLOGG AND OLD ARCTURUS TUBES.

Use adapter J-24 in tester and connect the red leads to the heater clips. Proceed as for other tubes. This adapter is extra equipment.

TEST NO. 19—RECTIFIER TUBES.

It is best to test the rectifier tube by a comparative method. The tester is set up to test a tube in the receiver for plate current and plate voltage. When this has been done the rectifier tube to be tested is inserted into its socket in the rectifier and the plate voltage and plate current of the receiver tube are measured. Then a rectifier tube known to be good is inserted and another reading made of the plate voltage and plate current. If a rectifier tube is not good the plate current and plate voltage will be low, or there will not be any. This method is not only applicable to filament tube rectifiers, but to gaseous and dry type rectifiers as well.

These nineteen tests can be made in five minutes.

EACH METER INDEPENDENTLY USEFUL

The circuit diagram of the improved set and tube tester is shown in Fig. 1 herewith. It will be noted that all the meters are separately available so that any meter can be used for making external measurements. For example, if AC voltages up to 140 volts are to be measured the voltmeter is available by plugging into jacks 140 and White. If AC voltages up to 10 volts are to be measured the lower range of the AC voltmeter is available by plugging into jacks Brown and White.

The negative terminal of the DC voltmeter is available at (—) jack in the center of the tester. The two positive terminals for the two ranges of this meter are available at the 300 and the 60 jacks at the rear of the tester.

The milliammeter is available at the two terminals marked M.A., the polarity being marked. To select the desired range the switch marked Mil.Amps is turned to the appropriate side.

The tester therefore contains, in effect, six different instruments capable of measuring AC voltages up to 140 volts DC voltages up to 300 volts, and current up to 100 milliamperes.

MEASURING RESISTANCE

Measuring of resistance is one useful thing that can be done with the tester instruments. For this purpose the DC voltmeter and the milliammeter are employed. The first thing necessary is a voltage source, which should preferably be a battery. In some instances it is possible to use the voltage of the battery without measurement. For example, a storage battery which is fully charged has a voltage of about 6.2 volts. A dry cell battery has a voltage of 1.5 volts per cell. When the voltage is known and when it is sufficient to get an approximate value of the resistance it is only necessary to connect the known voltage in series with the milliammeter and unknown resistance in series and note the current. The voltage used divided by the current in amperes is the resistance in ohms.

When the voltage is not known beforehand it is necessary to measure it, and this can be done with the DC voltmeter in the tester. The battery is first connected across the voltmeter, using the suitable range, and then the voltage obtained is used in computing the resistance.

Let us take an example to illustrate the procedure. We have a resistance intended for grid bias in a 245 push-pull amplifier and we wish to find whether or not it has a suitable value. We take a dry cell battery having a nominal voltage of 45 volts. But we are not sure about its voltage. Hence we connect it across the DC voltmeter using the plus 60 and the (—) jacks, that is, the minus jack in the center of the tester. We get a reading of 46 volts. Now we connect the battery and the unknown resistor in series with each other and also in series with the milliammeter. Suppose the milliammeter reads 45 milliamperes, or .045 ampere. Therefore the resistance is 46/.045 ohms. Dividing out we get 1,022 ohms, which is suitable for a grid bias resistor in the type of amplifier mentioned.

PRECAUTIONS ON MEASUREMENT

When using the milliammeter for measuring resistance, or for making any measurement of current as well, it should always be set on the higher scale as a matter of precaution. If the current is less than 20 milliamperes the switch should be turned to 20 to get a more accurate reading.

Another point that should never be forgotten is that when measuring the resistance of any device there is a possibility that it is short-circuited, so that even if the 100 milliampere range is used there is danger of burning out the meter. To prevent any damage in case of a short circuit the lowest possible voltage should be used at first. For example, instead of using 45 volts only 1.5 volts should be used. When it is found that this is safe the voltage should be increased cautiously, say in steps of 22.5 volts, or even in smaller steps, until the final voltage is attained. It should be remembered in this connection that most accurate measurements are obtained when the milliammeter reading is very nearly full scale.

MEASURING HIGH AC VOLTAGES

While the AC voltmeter in the tester is limited to 140 volts, it is possible to measure even higher voltages with the instrument, for example, those occurring across the secondary of the power transformer. In order to do this it is only necessary to put a voltage multiplier resistance in series with the meter. It is put in series with the 140 volt lead. The value of this voltage multiplier resistance depends on the value of the voltage to be measured, as well as on the resistance of the meter. It is easier to calibrate the voltmeter than to determine the exact value of the multiplier resistance.

The calibration can be carried out very simply in the following manner: A variable resistor, such as a volume control clarostat, is connected in series with the 140 volt lead, and a short circuit for this resistor is provided. Now the voltmeter is connected across a 110 volt AC line and the voltage reading carefully noted while the short circuit strap is across the voltage multiplier resistance. Next remove the short circuit and increase, or decrease, the resistance until the reading on the meter is one-half, one-third, one-fourth, or one-fifth of its former reading. Then the meter with the external resistance in series can be connected across the higher unknown voltage.

Suppose, for example, that the voltage to be measured is around 600 volts. If the range of the meter is multiplied by five, the new range of the meter will be 0-700 volts, and this is suitable for the voltage in question. To get this range we have to increase the series resistance until the reading with the resistance in series is one-fifth what it is when the resistance is short-circuited.

This calibration is so simple that it can be done each time a high voltage is to be measured and therefore it is not necessary to use a separate, expensive voltage multiplier for the purpose.

When necessary, the range of the DC voltmeter can be extended exactly in the same way.

USING TESTER FOR MEASURING TUBES

It is clear that the tester can be used for testing tubes alone without any reference to the receiver. They are plugged into the suitable socket and then the various voltages are applied directly to the jacks. The jack marked White is the negative terminal for the filament circuit and that marked Brown is the positive when DC voltages are applied. When AC voltages are applied these terminals can be used interchangeably. The one marked Red is for the plate voltage, the one marked Blue for the grid voltage, and the one marked White for the positive of the grid bias and the negative of the plate battery. For heater type tubes White should only be used for the heater current and K should be used for the common point for the grid and plate batteries.

Coil Designs for

Modulator and Oscillator Windings as

By Knollys

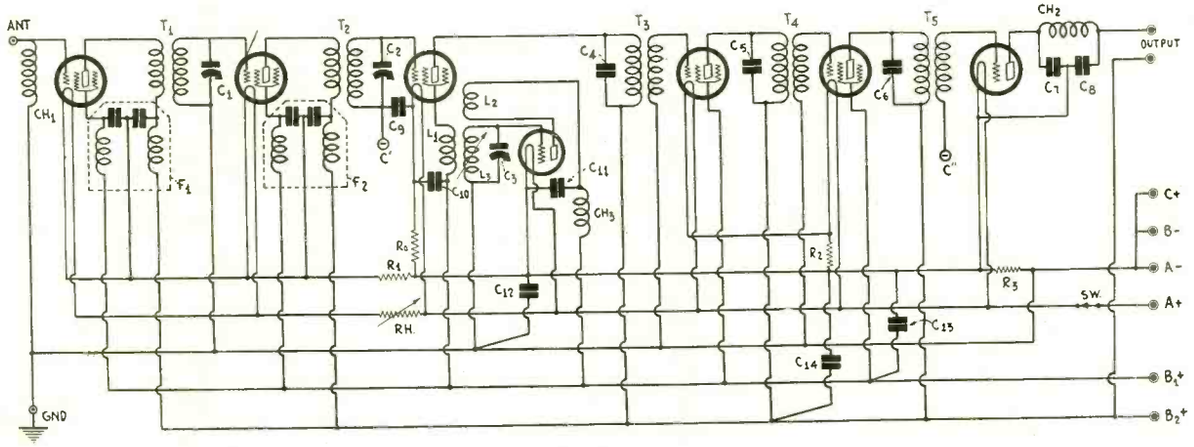


FIG. 36
THE CIRCUIT DIAGRAM OF A SUPERHETERODYNE FOR BATTERY TYPE SCREEN GRID TUBES. THE OSCILLATOR COIL CONTAINS A SMALL VARIOMETER WHICH CAN BE USED AS A VERNIER.

[*The following is another instalment of the series on the Super-Heterodyne. Next week another article.—Editor.*]

WE have discussed the various essential components of a Superheterodyne, such as oscillators, modulators, radio and intermediate frequency tuners and amplifiers, and filters. We shall now show two circuits coordinating these components into receivers, complete up to the audio frequency amplifier. One of these circuits is for direct current and the other for alternating current, but otherwise they are essentially the same.

Those parts in these circuits which have the same designations have the same electrical values and therefore it is only necessary to describe in detail one of the circuits and to explain the differences between them.

Fig. 36 depicts the direct current, or battery, model, which is the simpler to build. It contains five 222 type screen grid tubes and two 201A type tubes. The first two screen grid tubes are radio frequency amplifiers, the third is the modulator, and the next two are intermediate frequency amplifiers. The first 201A tube is the oscillator and the second is the detector.

The input circuit is untuned and contains a radio frequency choke coil Ch1, which may be any one of a number of commercial coils varying in inductance between 5 and 250 millihenries. There is no particular choice among the coils available in different inductances, all working about equally well. The reason for using an untuned input is to enable ganging of the tuning condensers C1 and C2, which can only be done when the coils T1 and T2 are alike and are placed in exactly similar positions.

SUGGESTED VOLUME CONTROL

Before passing from the antenna circuit it is well to say a word about the control of the input voltage. On certain local stations the input voltage will be so great as to cause appreciable overloading, not only of the final tube, but even of the first in the circuit. There will be detection in this circuit, which manifests itself in a type of double tuning. For example, a strong station may be received not only on its carrier frequency but also on its second harmonic. If the tuner reaches down below 200 meters several higher wave stations may be received at the lower end of the scale as well as higher up. In some instances this will even result in interference between a strong local station and another station. This would be the case, for example, when the receiver is operated close to a transmitter working on a frequency in the 550 to 750 kc band because the second harmonics of these stations fall within the broadcast band.

The remedy for this possible interference is to limit the input voltage to the receiver, and this can best be done by means of a small condenser connected in series with the antenna. Such a condenser will be much more effective in reducing the input of a low frequency carrier as that of a high. In fact, the reduction on 550 kc, for example, will be twice as great as that on 1,100 kc. Therefore the condenser can be used advantageously in cutting out the interference due to second harmonics, provided the harmonics are generated in the receiver, as they usually are. The smaller the condenser in series with the antenna the more effective it is in reducing the input on all frequencies, and for this reason it is useful as a volume control. It is easy to arrange the antenna so that the condenser can be inserted or cut out according to requirements. Indeed, it is a simple matter to arrange it so that several condensers of different values can be selected. However, it is not recommended that any condenser be used except where reception conditions are such that it may seem desirable. Whether or not it is worth while in any particular instance can be determined very quickly by connecting a variable condenser in series with the antenna and observing the effect at different settings of it.

DESIGN OF THE TUNERS

We now come to the radio frequency tuning coils T1 and T2. Countless times amateur builders of receivers have asked what kind of coil should be used in a given circuit to produce the best possible results from every conceivable point of view. If such a general question could be answered there would be nothing to do in radio but to get the coil and be satisfied. Unfortunately, there is more to a tuner than size of form, kind of wire, and number of turns. A coil may be designed to have superlative qualities, yet when that coil is put in a circuit it may be as poor as the worst. An example is when a good coil is put next to a shield or near any conductor which effectively short-circuits the turns. Another example is when a good coil is put in a circuit which effectively puts a low resistance across it. In either case the selectivity of any coil, good enough by itself, may be practically nil.

There are many good coils available, any one of which may be selected for the tuners in this Superheterodyne. This is stated with the proviso that the coil must have been designed for use with a screen grid tube, which means that the primary should have more turns than ordinarily, and that these turns should be coupled very close with the turns on the secondary. The number of turns to use on either winding depends on the size of tuning condenser and the size of form used for the coil. And the size of the form depends to some extent on the space that can be allowed for the tuners. Where shielding is used, usually better results are obtained with smaller coils than with larger, even if the smaller coils by themselves are not as good as the larger, because the smaller coils can be placed farther away from the walls of shields of given size, and therefore the effects of the shields on the selectivity will be considerably less.

USE .0005 CONDENSERS

If a tuning condenser of .0005 mfd. be used, which is recommended, a suitable coil can be made by winding 48 turns of No. 24 double cotton covered wire on a diameter of 2.5 inches, the turns being wound as closely as the covering of the wire permits. This is for the secondary of either T1 or T2 in Fig. 36. The primary should be wound on a form which fits snugly into the other. For example, if the thickness of the wall of the outer form is 1/16 inch the diameter of the inside form can be 2.25 inches. The inside coil can be wound with any size wire

Super-Heterodynes

Well as Data on Intermediate Inductance

Satterwhite

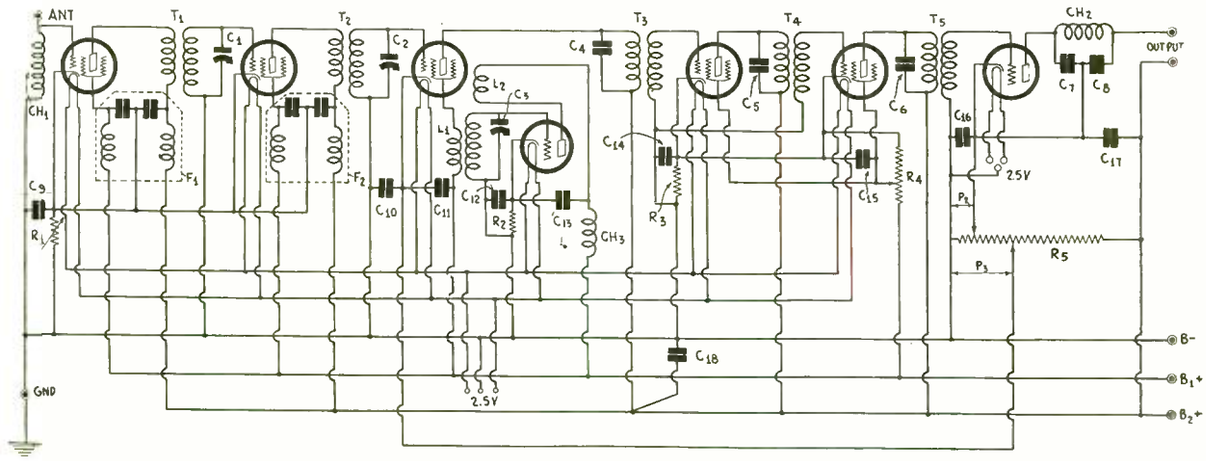


FIG. 37
THIS CIRCUIT IS ESSENTIALLY THE SAME AS THAT IN FIG. 36 EXCEPT THAT IT IS DESIGNED FOR HEATER TYPE TUBES THROUGHOUT.

which will not make the winding too bulky but it is better to use fine wire, as small as No. 40 being large enough. Any insulation ordinarily found will do. But this winding should be put on the inside form so that it can be mounted in the center of the outside winding, that is to say, the inside winding should be placed symmetrically with the outside. The purpose of this is to get close coupling.

The number of turns on the primary may be about 30, although this number can be increased or decreased without much change in the results if the coupling is close. The larger the number of turns and the closer the coupling, the greater the sensitivity but the less the selectivity. Since the amplification in the circuit will be very high, and since selectivity is needed in the radio frequency level, it may be best not to use more than 30 turns.

The reason for not tuning the primaries in these radio frequency tuners is that ganging of the condensers can be done more easily. The sensitivity of the amplifier may be slightly less with tuned secondaries but this is offset by a somewhat higher selectivity. This loss of sensitivity is not a disadvantage for the amplification in the receiver is so high that in many instances it will not be a question of getting more sensitivity but rather less. A very good volume control is needed.

DESIGN OF OSCILLATOR COIL

The theory of the oscillator has been given already, but we shall give the design of a suitable oscillator coil more explicitly, especially in reference to the radio frequency coils given above. We shall give this design on the assumptions that the intermediate frequency is 200 kc. and that both the upper and the lower oscillator settings are desired.

The tuning condenser has a maximum value of 500 micromicrofarads and has the same shape of plates as the condensers in the radio frequency tuners. The particular shape used is not of great importance, although that approximating straight line frequency is recommended.

For coil forms we can select the same size used for the radio frequency tuners, namely, 2.5 inches for L3 and 2.25 inches for L2. L1 can be wound on either of these forms but should be placed as far away from L2 as is consistent with the construction. For example, if L1 and L2 are wound on the same form L2 might be placed near one end of the form and L1 at the other.

Now L3 is really made up of two coils in series, as illustrated in Figs. 18 and 19, one part being a small rotor inside the other forms. This small coil should be mounted so that it can be turned through an angle of 180 degrees, or as nearly that as practical. It might be mounted near that end of the inner form which contains L1.

THE PICK-UP WINDING

L1 is the pick-up winding which couples the oscillator to the modulator. The number of turns that should be used is somewhat arbitrary, as has been pointed out already. It depends largely on the degree of coupling desired or on the degree of coupling that can be used in a given locality. To be on the safe side regarding squealing and image interference it is best to use a small coil and thus to sacrifice a little of the sensitivity which a large coil would insure. Ten turns on the 2.25-inch should be sufficient and yet not so large as to result in interference. A little experimentation with the number of turns on this coil will do no harm, for a larger or a smaller number of turns than that given might prove more suitable in some instances.

The kind of wire to use on this coil is of little consequence. As small as No. 40 is suitable and the only objection against it is that it is difficult to handle. Heavier wire is more easily applied, but certainly the wire should not be heavier than that used for L3. Any of the standard insulations may be used on the wire.

What has been said about the pick-up coil with respect to wire applies equally to the plate coil L2, but there should be about 30 turns on this coil. That is sufficient to cause oscillation at all settings of the oscillator provided that the oscillator tube is reasonably good. Note that the plate coil is fixed and is not like the tickler in a three-circuit tuner. However, the plate coil may be the tickler in a standard three-circuit tuner if it is desired to use such a coil as the basis of construction. It is better, though, to use a fixed coil, in view of the fact that another rotatable coil is to be mounted on the form.

DESIGN OF THE THIRD INDUCTANCE

If the tuning condenser in the oscillator has the same value as the tuning condensers in the radio frequency tuners the inductances across the condensers should also be the same. But the third winding L3 in the oscillator is composed of two parts and therefore the sum of the inductances of these parts should be equal to the inductance in either of the radio frequency transformers. The exact values of the two portions of the inductance cannot be predetermined and it is best to obtain it experimentally. In the radio frequency coils 48 turns were specified; in the oscillator the larger portion of L3 may contain 42 turns and the smaller a number of turns depending on the size of form closeness of coupling. It is easily possible to make the diameter of the smaller form 1.5 inches and about 1.25 inches long. At first this form should be filled with the same kind of wire as was used for the main portion and the two connected in series after suitable mounting.

It may be that this coil is too large to match well with the other tuners in the circuit, but it will not be so much too large that stations cannot be tuned in with the condenser and the rotatable coil. If the rotor is too large inductively stations will be crowded too closely near the neutral position of the two coils, that is, the position in which the mutual inductance between the two is zero. This is all right at first.

But it may be that the inductance of the two in series is so large that the neutral position does not correspond at all with the point on the oscillator where the carrier tunes in. To determine this point it is best to listen for the beat between the oscillator and the carrier frequencies and to note where

Wave Resonance Sending

Moving Plate's Position Governs the Carrier Frequency

By J. E. Anderson

Technical Editor

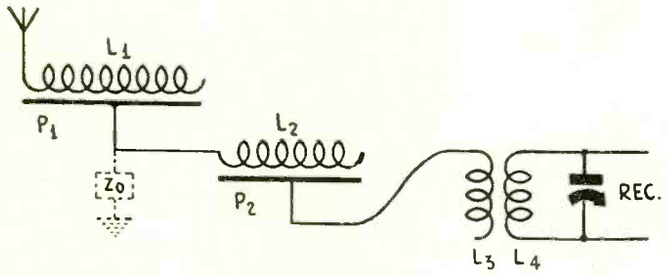


FIG. 2
TANDEM CONNECTION OF WAVE RESONANCE COILS.

When two wave conductors are connected in tandem as in Fig. 2, the junction point between the plate of the first conductor and the coil of the second may be grounded directly or preferably through an impedance Zo.

The fact that an antenna and a wave conductor connected in series can be made to resonate suggests the possibilty of utilizing the wave conductor as an eliminator of interference, or a kind of wave trap. Its utility for this purpose has been demonstrated experimentally. One practical way ot securing results is to have a coil connected to the antenna above the receiver and the metal plate under the coil is grounded directly.

Suppose there exists a signal voltage in the antenna which interferes in the receiver with another. That voltage causes a current to flow, and this current produces a voltage drop across the input impedance in the receiver. Now, if some means could be found for reducing this voltage to zero for the interfering frequency without at the same time reducing the voltage across the receiver at the desired frequency, then the interference will have been eliminated.

By tuning the wave conductor it is possible to establish a very low voltage between ground and that end of the coil which is connected to the antenna, and hence to tune out an interfering signal. If there are more than one station which cause interference a wave conductor can be rigged up for each one, tuning one of the wave conductors to each interference frequency. Several of these resonant wave conductors can be connected between the antenna and the ground without reducing appreciably the signal intensity, except when one of the wave conductors is tuned to a frequency very near that to which the receiver is tuned.

The resonant wave conductor is exceptionally well suited to multiplex reception from a single antenna, a fact which will undoubtedly lead to its adoption in apartment houses. The method of connection of several receivers to an antenna by means of wave

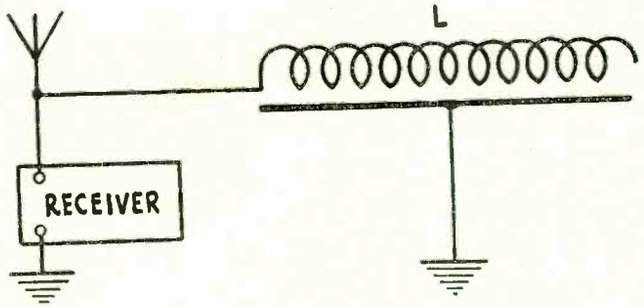


FIG. 3
METHOD OF CONNECTING A WAVE RESONANCE COIL TO ELIMINATE AN INTERFERING SIGNAL.

conductors is such that all the receivers are connected in parallel as are all the wave conductors.

A large number of receivers may be operated from the same antenna in this manner, and there will be a negligible amount of interaction among them. This is not only possible when the separate wave conductors are tuned to different frequencies but when all are tuned to the same frequency. There is some reduction in the intensity of the received signals in this case, but it is so small that it requires 50 receivers, all tuned to the same frequency, before the voltage is reduced to one-half the value it would have if there were only one receiver connected to the antenna. Of course, the number 50 is based on certain assumption as to values of constants, but the values assumed are those normally encountered.

The wave conductor has also been applied to transmission of radio signals, including multiplex, in the laboratory of the Signal Corps, and the results have been very satisfactory.

One of the advantages gained by using wave resonance is the elimination of harmonics from the radiated wave. This is accomplished by interposing a wave conductor between the antenna and the transmitter. The antenna is connected to the metal plate and the coil to the tuned circuit carrying the power to be transmitted. The radiated wave from the device is very nearly a pure sine wave.

Just as multiplex reception was possible, so multiplex transmission can be carried out with the wave conductor. The plates of the wave conductors are connected to the transmitting antenna and the coils to the different tuned circuits in the transmitters.

Wave resonance is a fruitful and interesting field for the radio experimenter, and there is no doubt that in the near future many developments will be announced and many applications offered.

Adjusting Coils for Zero Beat

(*Continued from preceding page*)

on the dial of the rotatable coil this is heard. It should be heard at the center of the dial. If it is not heard near the center the inductance of the circuit should be adjusted so that it will be heard there. This is done by reducing the number of turns on the fixed coil when the inductance is too high. It must be remembered that the setting of the condensers influences the position of the point where the squeal is heard and that it is necessary that the condensers be set every time so that the radio frequency circuits are in exact tune with the carrier frequency.

This method is of little help if the receiver is such that the direct heterodyne squeal cannot be heard, and it should not be audible in a well-designed circuit. If such is the happy result of the design and the construction, a headset should be inserted in series with the plate circuit of the oscillator, putting a rather large condenser across it to minimize coupling and changes in distributed capacity. One suitable place for the headset is just below choke coil Ch3. The point to locate, of course, is that of zero beat between the carrier and the oscillator.

When the condensers are set accurately for the carrier frequency and the inductance of the oscillator is correct, this beat should be heard when the rotatable coil is set at right angles to the main section of L3, and the dial attached to the rotatable coil should be set so that the indicator points to the center of the dial.

If now the rotatable coil is too large, the stations will come in near the central position, on either side. If the rotor coil is too small, they will be spread out, and it may well be that some of them will be off the dial so that they cannot be brought in at all. If that is the case the rotor coil turns can be increased by a few.

If, on the other hand, the stations are crowded too much near the center of the rotor coil dial turns may be removed from the rotor coil, but this decrease in the inductance should be accompanied by an equivalent increase in the main coil, not turn for turn but microhenry for microhenry.

The design of an oscillator having a rotor coil and designed for the reception of signals on the higher oscillator setting only will be given in detail in a later section.

FILTERS IN THE CIRCUIT

Following the first and second tubes in the receiver are two units designated as F1 and F2. These are radio frequency filters, the object of which is to prevent the high frequencies from entering the power supply, as well as to prevent any radio frequency disturbance existing in the power supply from entering the plate and the screen circuits. The two units are exactly the same and each one consists of two 85 millihenry coils and two .01 mfd. condensers, or condensers of larger values if space for them is available. The dotted lines indicate shielding. They may be assembled in very compact units. One precaution is necessary in their construction, and that is to place the fields of the two coils at right angles. This permits greater compactness without any detrimental effects.

Theory of Receivers

How and Why the Work Told for Schoolboy

By J. E. Anderson and Herman Bernard

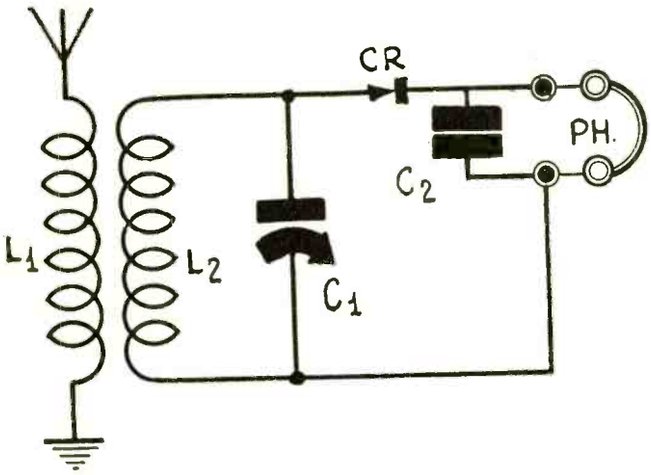


FIG. 19
A CRYSTAL RECEIVER. THE LOW END OF THE SECONDARY MAY BE GROUNDED OR MAY BE LEFT AS SHOWN.

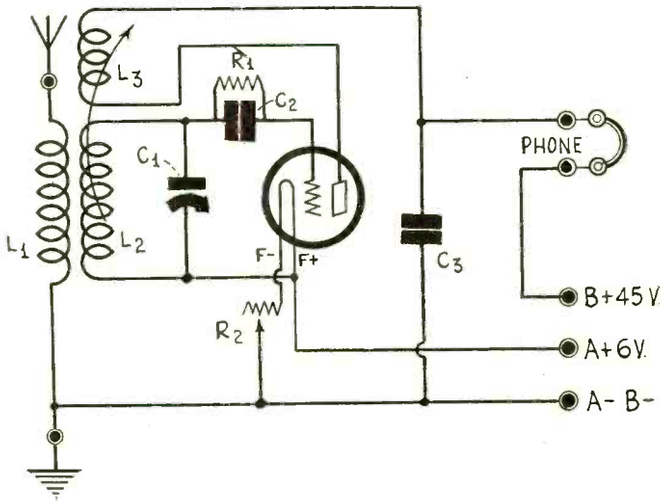


FIG. 20
A ONE TUBE RECEIVER USING REGENERATION.

[*The following article is one of a series entitled, "Radio for Schoolboys." Another instalment will be published next week, issue of November 30th.—Editor.*]

THE simplest circuit is a crystal receiver. Fig. 19 illustrates such a circuit, with antenna and ground connected to the primary, L1, while the secondary, L2, is tuned. The crystal is placed between one terminal of the secondary and one terminal of the earphones. The other side of the earphones goes to the remaining terminal of the secondary. The side of the secondary connected to rotor may be grounded. A bypass condenser of .001 mfd. is connected across the phones.

Such a circuit is out of favor nowadays, nor is it considered practical to use a crystal receiver, due to the necessity for good selectivity which this type of circuit does not afford. Various methods of improving selectivity result in reduction of volume, so that the crystal receiver may be forgotten for any practical value it may possess, although its theory still remains interesting.

The fundamental theory of the operation of the circuit is the phenomenal action of certain types of minerals, such as galena and iron pyrite, and also some synthetic compounds, of passing current in one direction only. This action constitutes the crystal a detector, since the alterating current which constitutes the radio frequency does not seriously get by the crystal, but the pulsations representing the audio frequency component do pass on. That is, the carrier is eliminated, but the impression on the carrier, being voltage of an audio frequency, is retained. Actually a little radio frequency does get by the crystal, so the crystal is unindirectional only to a modified extent.

REPUTATION FOR FINE TONE

The object of the bypass condenser C2 is to cause any such stray radio frequencies to pass through the condenser and thus be detoured from the earphones. Even this bypassing is not complete, since the capacity is not high enough, but can not be made much higher without cutting down on the intensity of the higher audio frequencies.

The crystal receiver was long associated with wonderful tonal qualities, but these claims were largely unfounded, in that a tube as a rectifier gives as good tone quality, especially when worked without grid leak and condenser, but with grid returned to a point substantially more negative than the one used for negative biasing of tubes serving as amplifiers. Crystal receivers always were used with earphones, and the quality of tone produced from earphones was much better, with any circuit gaited for earphone reception, than from circuits using the early efforts at audio frequency amplification and the crude speakers of those days. In modern receivers, even where radio frequency amplification is obtained ahead of the detector by use of tubes, the crystal does not serve well as a detector, for if the signal voltage is large at the detector input the crystal will overload, hence distort, while a properly employed tube detector will stand an enormously greater signal voltage without overload.

Instead of a crystal receiver being the first one that a beginner is likely to construct, the simple one tube receiver is the choice. This must be regenerative if the selectivity and sensitivity are to be at least fair. Such a circuit is shown in Fig. 20.

Here, too, an untuned primary is used, the term aperiodic being applied to such a primary by custom. The secondary is tuned and constitutes the input to the tube. The input circuit is from grid to positive filament. The positive connection makes for greater sensitivity in all battery-operated tubes that use the grid-leak-condenser method of detection, as here. The leak and condenser are in series with the "high" or "hot" side of the secondary. Customary values for these are .00025 mfd. for the condenser and 2 to 10 meg. for the leak. The grid condenser has clips on it to receive the leak.

The third winding, L3, is introduced to afford regeneration, as is physically close to the secondary. The radio frequency voltage in the plate circuit is fed back to the grid circuit in this way, and the signal voltage is reinforced. It is necessary to adjust the tickler for almost every different radio frequency received, hence a knob on the front panel is required, and the coil shaft is engaged by this knob.

C3 is the bypass condenser shunting the phones and the batteries, as it is well to detour the radio frequencies past the batteries, also.

FACTS ON OSCILLATION

Tuning is accomplished by rotating a dial attached to the rotor of the tuning condenser, C1, while the ticker is used as a sensitivity control. The circuit will break into oscillation if regeneration is pressed too far. This oscillation evidences itself as an audible squeal. As the circuit is oscillatory, in the sense of generating radio frequency voltage and current, and is connected to an antenna, it is a small radio frequency transmitter, and the squeal may be picked up by any one within range who is operating a receiver. Often this squeal is present over a large band of radio frequencies, as well as being receivable over a large area, sometimes miles. So it is no more than decent to operate a regenerative receiver of this type so that oscillation is avoided and thereby others are not molested in the enjoyment of their own receivers.

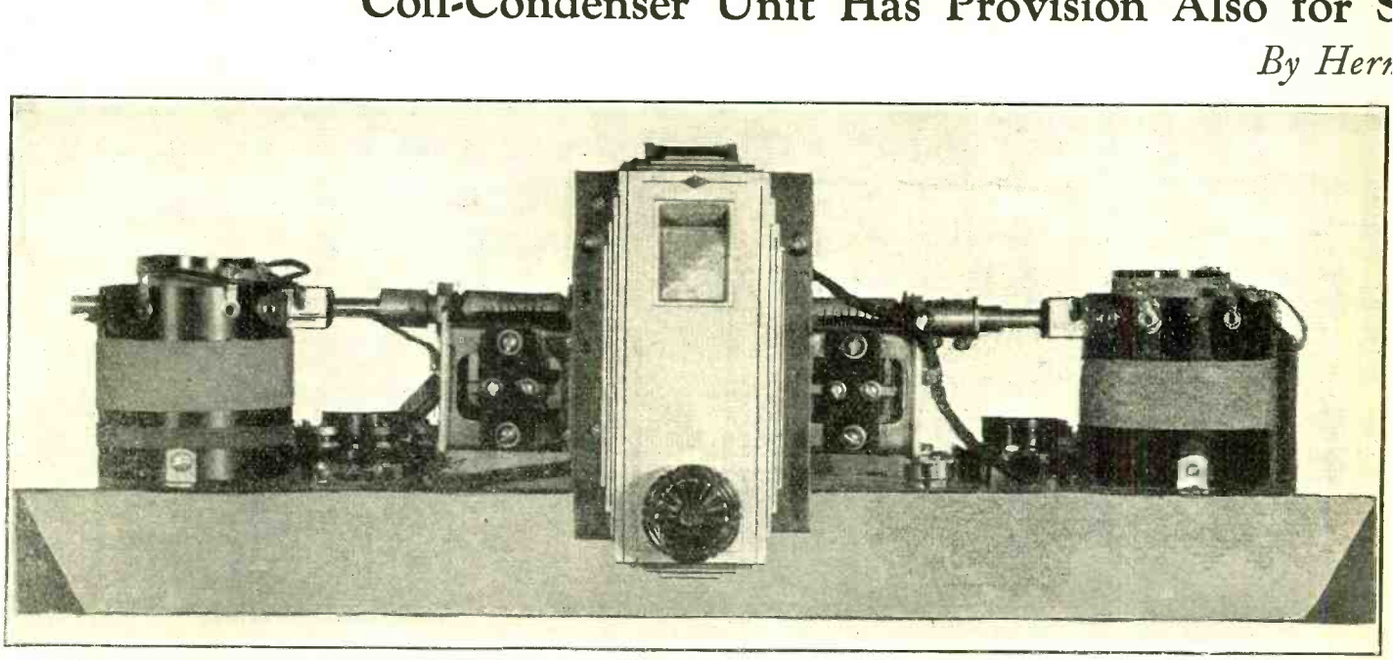
In Fig. 20 is shown a rheostat. This makes it possible to use several different types of tubes, requiring different filament voltages, and also the rheostat serves as a switch. Were it not for these reasons a fixed resistor could be used. If the A voltage source is 6 volts, and a 201A tube is used, a fixed resistor to replace R2 would require a resistance of 4 ohms.

A great deal of enjoyment and experience may be obtained from the construction of a one-tube receiver like this. Different values of grid condenser capacities and grid leak resistances may be tried in combinations, and the effects noted. It will be found in general that with a given value of grid leak, the smaller the capacity of the grid condenser, the less the sensitivity, assuming that no greater capacity than .0005 mfd. is used. When large capacities are tried for this purpose the signal becomes not only weak but distorted.

Open Type Tuners for th

Coil-Condenser Unit Has Provision Also for S

By Herr



FRONT VIEW, SHOWS THE NATIONAL MODERNIST IC DIAL, WITH PEARL-LIKE SCREEN ON WHICH TH NUMBERS ARE READ. AT LEFT IS THE ANTENNA STAGE TUNING ARRANGEMENT, AT RIGHT THE INTER STAGE TUNING CIRCUIT. THE COILS USED ARE THE BERNARD TUNERS.

[*This is the third article on the HB22. Another will be published next week.*]

AN open assembly of the HB22 tuner is shown in the two reproductions of photographs. The antenna stage coil and tuning condenser are mounted on a small subpanel of their own, and so are the interstage coil and its tuning condenser. The shaft of each coil is connected to the shaft of each condenser by a link. Then the two condenser shafts at the other end are engaged by the new National rainbow drum dial.

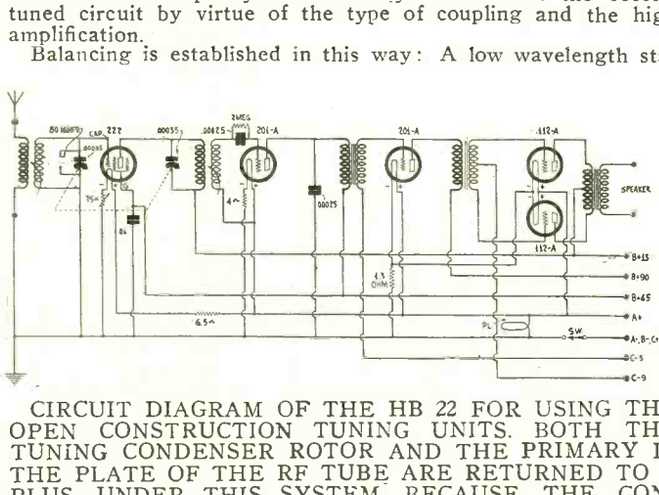
This arrangement works out very well indeed. It is obvious that the coils are far enough apart to prevent any harmful coupling. Oscillation is well under control and the receiver functions selectively and sensitively.

The arrangement pictured was laboratory-tested and as a result of these tests the coil-condenser assemblies were manufactured as units, and these are available to the public.

This circuit is for battery operation of the filaments and for B batteries or B supply for the plates, as you prefer. Hence there are five tubes: screen grid radio frequency amplifier, detector, first audio and 112A push-pull output pair.

The two tuned circuits being operated by a single control, it is necessary to get them to work accurately together. This is accomplished by adding capacity to the first tuned circuit to balance extra capacity automatically included in the second tuned circuit by virtue of the type of coupling and the high amplification.

Balancing is established in this way: A low wavelength station is tuned in, preferably one that comes in with pretty good volume. The wavelength chosen should be the lowest one receivable at this volume level. Turn the setscrew of the equalizing condenser across the first tuning condenser so that the moving plate of the equalizer is as far out as possible, without disengagement of the screw. (*Continued on 4th column.*)



CIRCUIT DIAGRAM OF THE HB 22 FOR USING THE OPEN CONSTRUCTION TUNING UNITS. BOTH THE TUNING CONDENSER ROTOR AND THE PRIMARY IN THE PLATE OF THE RF TUBE ARE RETURNED TO B PLUS, UNDER THIS SYSTEM, BECAUSE THE CONDENSER ROTOR IS INSULATED FROM THE GROUNDED POTENTIAL BY USE OF A SMALL INSULATED SHAFT.

Right a

(1)—If the loudspeaker is connected directly from plate t plate in a push-pull amplifier no sound is heard because th two plates are at a difference of potential, being connected t the same plate voltage source.

(2)—An inductor speaker does not discriminate among fre quencies as much as an ordinary magnetic speaker because th armature suspension has a greater compliance, that is, it is hel in place by weaker springs.

(3)—Box resonance in a loudspeaker is due to the same phe nomenon as the sound heard in a conch shell or a barrel.

(4)—A condenser speaker works because there is a variabl electric force between the two plates of the condenser. Thi variable force is composed of a steady polarizing force and force due to the signal voltage superimposed on it.

(5)—An audio transformer is a sort of lever in which th core might be considered as the fulcrum. The number of turn on the primary corresponds to the length of the lever on th side the force is applied and the number of turns on the second ary corresponds to the length of the lever on the side wher the work is done. The ratio of turns corresponds with the rati of the lengths of the lever. If the two windings are not per fectly coupled there is some leakage inductance and this cor responds to a fulcrum which is not rigid but which moves bac and forth as the force is applied in one direction or the other.

(6)—Short waves cannot be received with the Superhetero dyne principle because the intermediate frequency is too lo compared with either the signal or oscillator frequencies.

(7)—Interrupted continuous waves cannot be received audibl without the use of an auxiliary oscillator the frequency of whic differs by an audible amount from the frequency of the signal.

(8)—Standing radio waves similar to the standing waves o a stretched wire suitably agitated can exist on an electrical con ductor such as an antenna or a long coil.

(9)—Standing waves in any medium can occur only whe there is reflection of the wave.

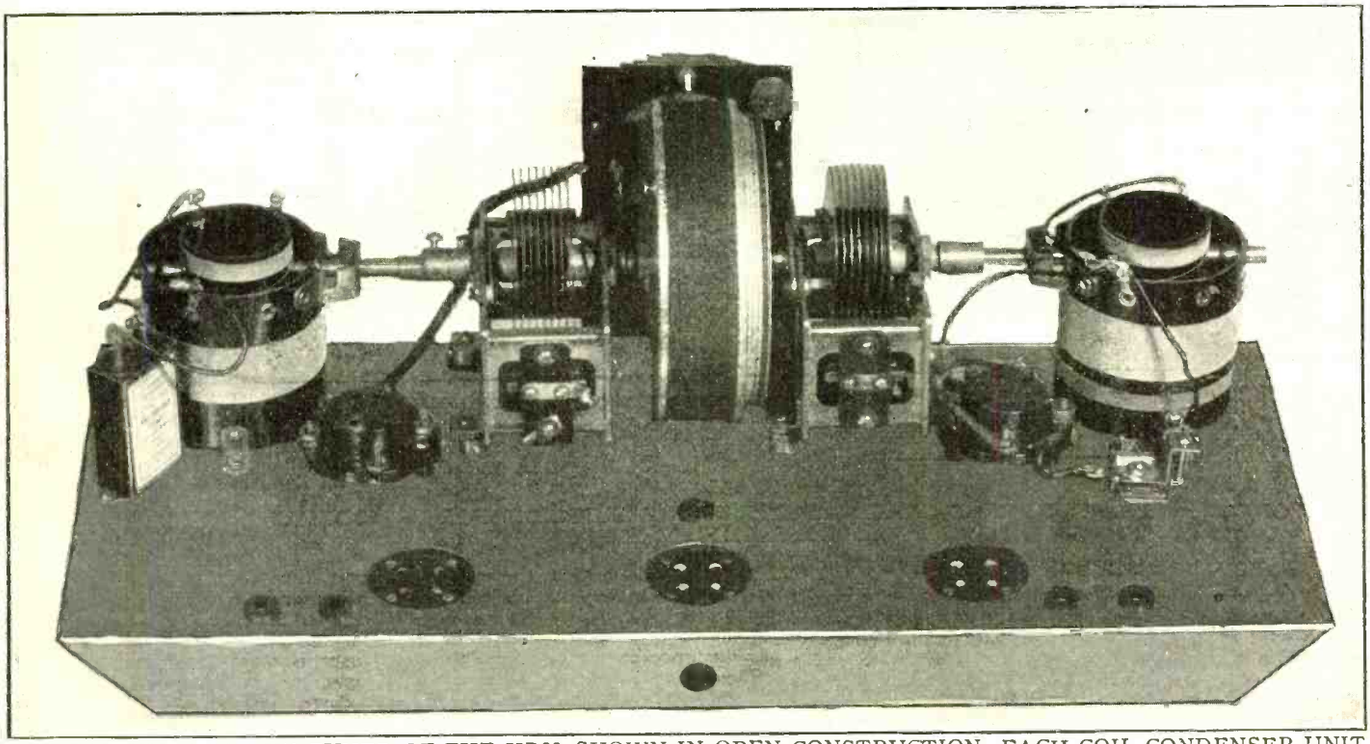
ANSWERS

(1)—Wrong. It is true that the plates are normally at th same steady or average potential but they are not at the sam signal potential. Because they are at the same steady potentia no direct current flows through the loudspeaker, but the A voltage difference produces sound.

...e HB22 Push-Pull Circuit

...ocket, While Second Tuned Circuit Is Insulated

...an Bernard



REAR VIEW OF THE TUNER OF THE HB22, SHOWN IN OPEN CONSTRUCTION. EACH COIL-CONDENSER UNIT HAS A SMALL SUBPANEL OF ITS OWN, WITH HOLE DRILLED IN IT TO ACCOMMODATE A SOCKET.

...r Wrong?

(2)—Right. Most of the frequency discrimination in magnetic speakers is due to the necessity of mounting the armature on springs sufficiently stiff to balance the magnetic pull. In the inductor, as well as in the dynamic, it is not necessary to balance the armature in this manner, at least not in the direction of motion. The compliance of the mounting springs in the direction of motion is very great, and for that reason the low notes are produced strongly. To produce the higher notes it is only necessary to make the armature and other moving parts as light as possible or practicable.

(3)—Right. A box is a resonance cavity which responds to a certain frequency when sounds of many different frequencies are produced near it in inside it. A barrel does the same, as does a conch shell. The frequency at which the cavity responds depends on the size of the cavity, particularly its length.

(4)—Right. The pull between the plates is directly proportional to the square of the voltage between the plates. The motion of one of the plates, the other being rigid, is proportional to the product of the signal voltage and the steady polarizing voltage.

(5)—Right. The analogy applies even when the secondary is open. In this case the end of the lever where work is done must be fixed so that it cannot move in order to make the analogy good. The force exerted by the end of the lever against the device holding it in place corresponds to the voltage developed in the open secondary.

(6)—Wrong. The Superheterodyne principle can be applied very well and the intermediate frequency is no limitation because that frequency can be chosen at will to suit the particular case.

(7)—Right. Continuous waves do not detect in the same way as damped or modulated waves and must be received audibly by employing an audible beat note between itself and the signal waves.

(8)—Right. These waves are made use of in the wave resonance method of tuning.

(9)—Right. The wave that travels down the conductor must be reflected at the end and return to the starting point at the right instant to be reinforced by a new impulse. An organ pipe works in the same manner.

Now turn the rheostat up nearly all the way, and with a wooden dowel sharpened in screwdriver fashion, turn the equalizing condenser's setscrew to make the moving plate come closer and closer to the fixed plate. At some one point, with maximum equalizing capacity never more than half in use, the volume will increase considerably, and there may be some oscillation. Get rid of this oscillation by adjustment of the rheostat. Now turn the drum dial, using the front panel knob, ever so slightly one way, then another, as a test of whether you can increase the volume that way without molesting the equalizing condenser for the moment. If you can increase the volume that way, reduce the effective capacity of the equalizing condenser and turn the drum knob again, just a trifle. By turning the tuning condensers themselves while the equalizer is being adjusted, you will reach the correct relationship, so that volume is highest.

As a final test, turn the drum a little one way and then another to ascertain if the station has two "humps," that is, comes in with good volume at one dial setting, decreases in volume as the dial is turned, then comes in with a little more volume, although less than the first volume, at another setting. If this is true, readjust the equalizing condenser, and test for greatest volume at a given position of the dial without bringing in the station at two points. When this work is completed the circuit is properly balanced capacitatively and the single control will be very effective.

Balancing should be done on a low wavelength because the trimming capacity is then a much greater percentage of the total capacity in the circuit, due to the tuning condenser plates being almost totally out of mesh. Therefore greater accuracy can be achieved, and for higher capacity setting of the tuning condenser the previous equalized capacity will be found excellent. Worked the other way round—tested on a high wavelength—poor results might be obtained on low waves.

In wiring the second tuned circuit, the rotor may be returned to B plus,the same as the coil, by using a 1¼" long piece of fibre, hard rubber or bakelite, ¼" diameter. This would connect to the drum at one end and to the tuning condenser shaft through a link at the other end. As the condenser and coil would return to the same point, B plus, the little subpanel on which the interstage tuner is mounted should not be grounded in that instance.

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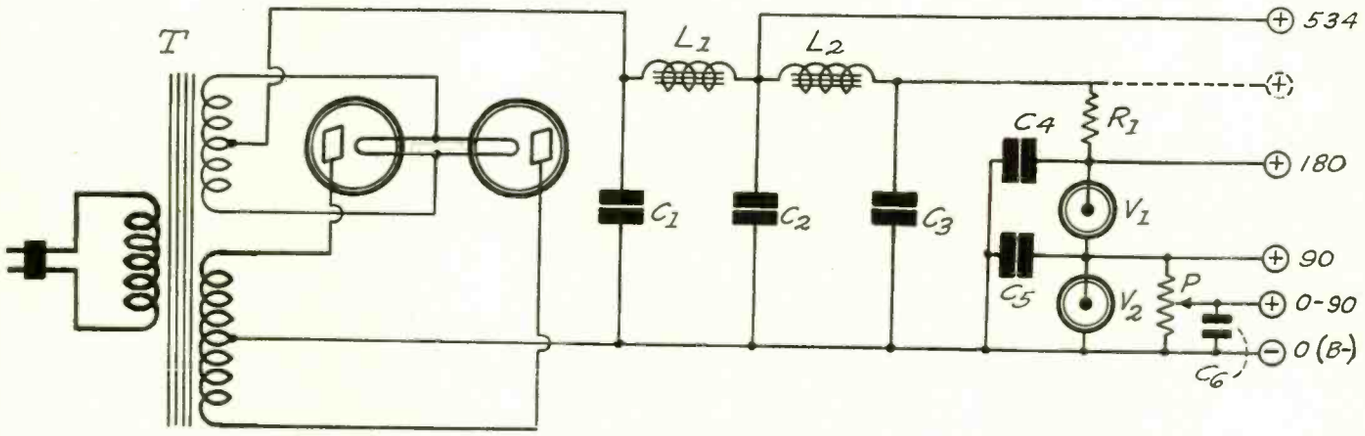


FIG. 807

A HIGH VOLTAGE, HEAVY DUTY B POWER SUPPLY UNIT SUITABLE FOR A MODERATE SIZE PUBLIC ADDRESS AMPLIFIER

HIGH VOLTAGE POWER SUPPLY

IF YOU have a diagram of a B voltage supply using two 281 tubes and suitable for a push-pull amplifier using 250 tubes I would appreciate your publishing it. The supply is also supposed to handle several other tubes with plate voltages of 180 and 90 volts, and a very good regulation is necessary since the amplifier is to be used with a high quality public address amplifier. I desired to use voltage regulator tubes, so if you have a diagram incorporating such tubes, I should like to see it. If not, please describe the necessary connections.—J.S.

You will find the diagram of such a circuit in Fig. 807 herewith. You will need a power transformer having one 7.5-volt winding for heating the filaments and one high voltage, center-tapped winding with about 600 volts, root mean square, on each side of the center tap. The first choke coil, L1, should be heavy duty capable of carrying about 150 milliamperes. Its inductance can be as low as 10 henries. The second choke should have a much higher inductance but need not carry so much current. The first three condensers should be rated at 1,000 volts or higher. The remaining condensers need not be rated at more than 400 volts. Condensers C2 and C4 should be of 4 mfd. or more. The others need not be larger than 2 mfd.

* * *

EFFECT OF SHIELDING

WHY IS it that the tuning and selectivity characteristics of a tuner change radically when a shield is put around it? I have experimented a good deal and have found that the selectivity is greatly decreased by the shield and that the stations come in lower down on the tuning condenser dials when the shield is used. Please explain.—A. McD.

The selectivity goes down considerably because of losses by induced currents in the shielding. The stations come at lower dial settings because there is more distributed capacity between the coil and ground when the shields surround the coil than when it is in the open. Both these efforts depend on the size of the shield with respect to the size of the coil and to some extent the size of the condenser. The larger the shield, the smaller the effects. It is assumed that the inductance coil is placed in the center of the shielding. The material of the shield also has some effect on the selectivity. The better the conductivity of the shielding material the less the losses. When there are many tuned circuits in a receiver, the overall selectivity may be considerably better when the shielding is thorough than when no shielding is used. This is due to the elimination of mutual inductance between the tuned coils and hence to the elimination of the double resonance characteristic of coupled tuned circuits.

* * *

WHICH END GOES WHERE

I HAVE a Bernard dynamic tuner and I am doubtful about the correction connections of the terminals. Which end of the secondary should go to the grid and which to the filament? Which end of the primary should go to the plate and which to the plate battery?—J. J. O'B.

It makes no practical difference in either case. Connect one of the secondary terminals to the grid and the other to the filament. In the primary the rotor and stator coils might be connected so that the rotor is nearer the plate battery, but practically it makes little difference whether it is on the battery or the plate side. The essential thing is that the rotor and the stator coils be connected in series in such a way that the inductance increases when the condenser is turned so that the capacity increases. If the first connection made is wrong in this respect just reverse the two leads to the rotor coil. The circuit will not work unless the connection is correct so there can be no doubt.

* * *

SENSITIVITY VERSUS VOLUME

IT SEEMS to me that sensitivity and volume at times are used interchangeably for the same thing and at other times the terms are used to express different conceptions. If there is any difference will you kindly point them out? I am sure that many others are mixed up on the two.—P. P. H.

It is true that the two terms are often used to express the same idea, although the connection between the two is only incidental. Sensitivity refers to the ability of a device to respond to very feeble impulses. If it is the sensitivity of a receiver that is in question it means the ability of that receiver to pick up very weak signals and amplify them to the point where they are appreciable. Volume refers to the intensity of the signals after they have been amplified. A receiver may be quite insensitive and yet be able to turn out a tremendous volume of sound from local stations. Conversely, a receiver may be enormously sensitive and yet not be able to turn out a sound, even from a local higher power station, strong enough to operate a headset. The sensitivity of a receiver depends on the degree of amplification, the detecting efficiency of the detector, on the type of pick-up system used or antenna, and on the transduction efficiency of the loudspeaker. The volume depends only on how much power the system can turn from electrical energy to sound energy, or on how much it is made to convert.

To measure the sensitivity of a receiver the input required to produce a given output is measured. The less input required, the more sensitive the receiver. The sensitivity can also be measured by measuring the output obtained from a fixed input. The greater the output under this condition, the greater the sensitivity. By volume of a receiver is usually meant the maximum undistorted sound output of which it is capable, and that is measured by measuring the sound power. What that power is has nothing to do with the sensitivity.

* * *

WHY SET IS ERRATIC

I HAVE built a screen grid receiver according to one of your circuit diagrams which gives enormous volume, but it does not give the greatest volume when I adjust the grid bias voltages according to specifications. What accounts for this trouble?—A. K.

The voltages specified in any circuit are for normal or average conditions. They are not necessarily the optimum in all instances. The only criterion for correctness is highest sensitivity, assuming that the voltages used are within the safe limits of the tubes. One should always try different voltages to find the

one that gives the best results in any particular instance. This is not only desirable when screen grid tubes are involved but it is necessary, for such tubes are more critical than others. When three-element tubes are used the adjustments are not near'y so critical.

* * *

IMPORTANCE OF FILAMENT EMISSION

LATELY there has been considerable interest in the filament emission of tubes. Is it really important to know what the filament emission of any tube is? I cannot see any particular value in knowing it since a tube is never used in the manner in which the filament emission is measured, that is, connecting the grid and the plate together. If there is any advantage in knowing what the emission is I should like to know what it is.—E. H.

There does not seem to be any good reason for filament emission tests on tubes intended for amplification since in an amplifier the grid and the plate are never tied together. There is one condition, however, which might call for a fi'ament emission test. If the tube has become gaseous the filament emission is usually excessive. Ordinary tests on the tube would indicate that it is an exceptionally good tube but when it is put in an amplifier circuit it does not function. A test on the emission on such a tube would show excessive current. But even this is of little use. The fact that the tube does not work as an amplifier is sufficient to condemn it. If the tube is gaseous this fact should show up in the form of a blue glow when a high voltage is impressed on it. It might a'so show by the color of the plate, for the plate current is usually so high that the plate turns red hot after a few minutes.

* * *

COBALT STEEL MAGNETS

I HAVE heard many claims to the effect that loudspeaker and phonograph pick-up units made with cobalt steel magnets are superior to those made of chrome or tungsten steel magnets. Is this a fact or simply advertising enthusiasm? If such units are superior what is the reason?—J. J. M.

The simple fact that the units are made of cobalt steel magnets is not sufficient to make them superior to units made of other magnet steels. It is true, however, that cobalt steel is far superior to any other known magnet steels. Such steel is being used more and more in fine electrical instruments where a strong permanent magnet is essential and where cost is no great consideration. Cobalt steel is comparatively expensive and it is very difficult to work on account of its hardness. One advantage of such steel is that less of it can be used to secure a given strength of magnetism, and this recommends it for use in pick-up units which must be light enough not to ruin the record and yet magnetically strong to be sensitive.

* * *

RHEOSTAT GETS HOT

I HAVE a charger which delivers too much current for the battery, or I should say that it charges the battery faster than I want it to charge. I have connected a rheostat in series with the battery to cut down the current but the rheostat gets too hot. What can be done to limit the current? Is not a rheostat the proper thing to use?—G. A. H.

Yes, the rheostat is the correct thing to use. But every rheostat will not carry the current without getting hot. You have to use a rheostat which has been designed to carry the current. Get a heavy duty one, and preferably one which can get very hot without burning anything.

* * *

BAND PASS FILTER TUNERS

I HAVE decided to build a receiver which is as selective as possible, but I don't want to get it so selective that it will cut sidebands. Many band pass filter tuners have been recommended and I wonder if one of these can be used to advantage. Is it rea'ly advisable to use such a filter in the radio frequency tuner, and can 10 kc selectivity be obtained throughout the broadcast band?—W. H. J.

There is no band pass filter which will give you 10 kc selectivity throughout the broadcast band. If you make the band 10 kc at the 550 kc end of the band it will be about 30 kc wide at 1,500 kc. And if you make it 10 kc wide at 1,500 kc it will be about 3.3 wide at the other end. Of course, such selectivity would be entirely too high. You have very little assurance that you will have any kind of selectivity with a band pass fi'ter unless you take great precaution in adjusting the circuit. There are many things in radio which seem more advantageous than they are.

* * *

LENGTH OF ANTENNA

I HAVE one of the sets which you described a few years ago, but I am not getting as good results with it as I think I should, or as good as I did at first. Do you think that a longer aerial would give me better results? I now have about 100 feet, about 30 of which is the lead-in.—D. Ll. E.

An antenna of 100 feet ought to be all right but it would be better if you could run it higher. For example, you might make the vertical portion 70 feet and the horizontal 30 instead of the reverse. It is the height of the antenna that counts and not the length of wire. Since your receiver worked all right at first the trouble now may be that your tubes are weak. Try new tubes. You may not need to change the antenna at all.

LEAKAGE IN CONDENSERS

I HAVE a resistance coupled amplifier which worked excellently for about two years, but recently it has been misbehaving. The quality is not good and the speaker seems to choke up. I have measured the plate current in the last tube. When I first turn the set on the current is normal but after a while it becomes excessively high. What do you think is wrong? —E. G. H.

This trouble is due to leakage from the plates to the grid either through the stopping condenser or through the socket of the output tube. The leakage may be through the bodies of these devices or over the surfaces. The resistor mounting may also be at fault. Clean all surfaces thoroughly of all dust and note if there is any improvement. If not, replace the grid leak resistor with one of lower value. If this will not stop the trouble until the grid leak is too low in value, about 100,000 ohms, you might replace the last stopping condenser. A mica dielectric condenser is the best.

* * *

CHOICE OF SUB-PANEL

WHICH is better, a wooden sub-panel or one of metal? If there is no difference I should like to use a metal sub-panel because it makes a better looking set and permits wiring to be placed underneath the sub-panel.—G. A. T.

There is practically no difference electrically. If you plan to build a permanent set use a metal sub-panel, but if you are only to assemble an experimental set, use wood for that is easier to work with and does not cost so much.

* * *

PLEASE point out how the Four Stage All Screen-Grid tuner described in the previous issue is adjusted for loudest signals. Also state if it is necessary to use the bypass condensers, C5, C7 and C9, which are connected between the screen grid terminal and the minus A.—P. S. L.

The four condensers are first turned until a station at about 300 meters is brought in and with maximum intensity. Then a dowel stick with one end sharpened like that of a screw driver is used to turn the small screw on the equalizers across each section of the condenser. Each screw is turned until the signal intensity increases. The hand must not be placed too near the equalizer, for the capacity of the hand will affect the setting. If it is found that the screw has a tendency to shift insert a couple of small washers between the screw and the spring plate. It is quite important that these small condensers be fastened down securely, for a slight shifting of them will also tend to vary the capacity and throw the previous setting off. The control grid connection should also be watched. That is it is very important that this connection be solid. Raspy signals will otherwise result. The variable resistance in series with the minus filament of the first radio frequency tube should also be carefully turned.

Yes, it is absolutely necessary to use these condensers.

POLL OF 4,000 FAVORS CUT IN STATION LIST

Washington.

Too many broadcasting stations and too much advertising are the leading complaints of radio listeners in the vicinity of San Francisco concerning the ills of radio today, according to a survey made by the Commonwealth Club of America in San Francisco, the results of which were transmitted to the Federal Radio Commission. It is one of the first such surveys to be made.

Approximately 4,000 responses to the questionnaire sent out by the club have been analyzed, the Commission was informed. Members of the club, employes of the Southern Pacific Railroad and employes of San Francisco's largest department stores were canvassed, it was explained, to obtain cross-section of opinion.

WANT MORE SUNDAY VARIETY

Sixty-six per cent of the returned questionnaires were to the effect there are "too many preachers," and a "lack of Sunday variety" over the radio, says "The United States Daily." Other complaints, of the same general percentage, were "too much jazz," "too many cigarette ads," and "women announcers."

The majority of the listeners favored orchestral selections over other types of musical programs. Eighty-five per cent preferred more semiclassical music, 68 per cent more classical music, 36 per cent more "jazz," 55 per cent more radio dramas, 34 per cent more spoken-word programs, and 68 per cent more educational talks.

Of outstanding significance, according to members of the Radio Commission, was the opinion of 94 per cent of the 4,000 listeners that local reception has improved as compared with two years ago. This, it was stated at the Commission's office, is interpreted as meaning that the general reallocation of broadcasting stations effected a year ago has accomplished its end, and unquestionably has improved reception conditions for the country as a whole.

DX IS BETTER

In the opinion of 69 per cent of the listeners distance reception has improved as compared with two years ago. Thirty-seven per cent reported that they still "try to get 'distance'," while 5 per cent said they were "tired of radio."

As to chain radio programs versus individual station programs, 71 per cent favored the former, with the remaining 29 per cent showing a preference for the programs of the independent stations. Eighty-one per cent responded that they "enjoy broadcasts of records," but they were not asked to state their preference as between mechanical reproductions and original programs.

In the controverted sphere of advertising via the radios, 85 per cent said they "feel grateful to advertisers," 12 per cent said they did not, and 2 per cent responded they were grateful to "some of them." But 53 per cent of the listeners declared they were "annoyed" by radio advertising, while 40 per cent said they were not, and 7 per cent replied that "some does" annoy them. The opinion that radio advertising leads to purchases of the commodities advertised was expressed by 47 per cent.

CENSORSHIP ASKED

Votes in favor of Government censorship of radio programs were registered by 47 per cent. Twenty-two per cent advocated outright Government control of programs, and 78 per cent believed that educational programs should be prepared and sponsored by governmental groups and State universities.

To the question: "Can you suggest a way of financing programs without advertising?" varied replies were received. The outstanding suggestions were as follows:

"Tax set owners. Tax radio manufacturers. Government subsidy. Radio clubs. Slot machine sets. Voluntary contributions. Free programs by educational groups. Philanthropic subsidy. Tax phone bills. Municipal subsidy. Tax railroad tickets and transfers, 1 cent each. Tax with seal on sets and notice posted at front door. Tax sport and amusement gate receipts."

NEW FEATURES WANTED

Many suggestions were received from the listeners for "something new in radio programs." The analysis cites a few samples as follows: Lessons in international language. Rebroadcast foreign programs. Eliminate cigarette ads. Diversified local programs. News items. Health and hygiene talks. Art, music, drama criticism. Better announcers. "Kill announcers." Daily Federal program subsidized by Government. Broadcast proceedings at the city hall, legislature and Congress. Unsponsored time signals. Monthly all-night programs. Education on voting. Early Sunday morning programs. More fights. University extension courses with credit for examinations. More call letter announcements. Reading books and short stories. Information on hunting and fishing districts in season. More rehearsals before programs.

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 .....

Godwin Williams, Jr., 829 Avery Avenue, Dyersburg, Tenn.
Community Radio Shop, 20507 Choolcraft Ave., Detroit, Michigan.
W. A. Horton, 110 Elizabeth Lane, East Point, Ga.
Samuel Gould, 952 Anchor, Philadelphia, Pa.
W. Hansen-Casanova, Altagracia-A-Salas 28, Caracas, Venezuela.
J. W. Kissick, 3521 Wilton Avenue, Chicago, Illinois.
G. S. Mandigo, 959 Main Street, Springfield, Mass.
Milton Meyer, 1821 S. Jennings St., Ft. Worth, Texas.
R. M. Howard, 1505 E. Amelia, Orlando, Florida.
C. J. Roosenberg, 37 W. Charlotte, Ecorse, Michigan.
H. T. Reeves, 444 Main Street, Biloxi, Miss.
Sidney Adams, 312 Oakland Avenue, Rock Hill, S. C.
Carl Hermansen, 828 Ocean Avenue, Jersey City, N. J.
R. C. Henre, 446 May Street, Hammond, Md.
Chester Mayers, 51 Bennett Avenue, New York City.
George A. Zwald, 425 Emery Street, Philadelphia, Pa.
C. W. Tanner, 2901 Long Street, Chattanooga, Tenn.
F. Marotta, 1234 So. Fraser Ave., Los Angeles, Calif.
B. A. McEntegart, 306 E. Mosholu Parkway, Bronx, N. Y. City.
R. Brown, Gen'l. Del'y., Davenport, Iowa.

ANNIVERSARY FINDS CLEARER AIR CONDITIONS

Washington.

The first anniversary of the broadcasting reallocation found reception conditions throughout the country vastly improved, with a minimum of complaints and with the industry itself thriving and prosperous, according to Federal officials identified with the regulation of radio, and responsible for the reallocation.

Reports reaching the Federal Radio Commission, according to "The United States Daily," show conclusively that the reallocation has served its primary purpose of reducing man-made interferences with reception, and of serving the remote listener. At the Commission it is stated that the broadcast set-up is not yet perfect, and probably never will be, since there must be a "fluid" arrangement with so many stations operating on so few available channels.

CONDITIONS IMPROVED

The chief engineer of the Commission, Capt. Guy Hill, declared orally that unquestionably there is a material betterment of broadcasting conditions directly attributable to the reallocation.

"Conditions seem to be improving every day," said Capt. Hill. "Better equipment, making possible higher percentages of modulation by stations, improved assignments, and higher power for stations on cleared channels, all have made toward these improvements. Moreover, on the receiving end, manufacturers are turning out improved and higher grade sets, which permit of sharper tuning and a greater fidelity of reception."

Radio's greatest trouble today, said Capt. Hill, is that of too many broadcasting stations.

"It is very difficult to improve conditions when the broadcasting spectrum is crammed full with stations," he said.

STATIONS SHUFFLED

Under the reallocation the assignments of 94 per cent of the 600-odd stations on the air was shuffled. To make possible improved reception for distant listeners, notably the farmer, the Commission set aside 40 cleared channels for the exclusive use of high powered stations. Thirty-four channels were designed for regional service, for stations ranging in power from 250 to 1,000 watts. The remaining 16 channels were designated for "local" stations ranging in power up to 250 watts.

The chief of the radio division of the Department of Commerce, William D. Terrell, commenting on the reallocation's first anniversary, said that the cleared channel has filled a definite need, and that there might well be more such channels if used properly. He emphasized that unless they are properly used, however, little benefit is derived for the listener.

"I support cleared channels because they make possible the distribution of programs without conflict for the listener. The farmer and the remote listener is more in need of radio service than any other class, and should be accorded it. The Commission might have set aside 50 instead of 40 cleared channels."

MANY CHANGES MADE

Federal Radio Commissioner Harold A. Lafount declared the reallocation has been eminently successful, and supports the clearing of at least 10 additional channels.

"This improvement has been most perceptible on the cleared channels, although reception of regional and local stations has materially improved," he declared.

LICENSE FEES AT 20¢ A WATT ARE PROPOSED

Washington.

Imposition of license fees upon all radio transmitting stations and licensed users of the ether, to defray the costs of administering radio, will be considered by Congress at the next regular session, Senator Dill (Dem.), Washington, declared orally.

The Federal Radio Commission, said Senator Dill, will submit to the Senate prior to the convening of the new Congress in December, a proposed schedule of license fees for all types of radio licenses. In March, he explained, the Senate passed a resolution requesting the Commission to formulate a schedule of fees to be recommended to Congress.

SUGGESTED RATE

Senator Dill said he did not know whether it would be possible to include in a bill to have the life of the Federal Radio Commission extended indefinitely, the schedule of license fees. It may be decided, he said, to hold the plan for consideration as a part of the Couzens bill, to create a Federal communications commission, with full authority over all modes of communication, as well as interstate power lines.

"Personally," said Senator Dill, "I think the time has come when license fees should be charged for use of the ether."

Several months ago, the Senator stated, the Commission discussed with him a tentative proposal for assessment of a tax of approximately 20 cents per watt for broadcasting stations, and of a flat license fee rates for commercial communications companies, together with a pro rata tax on their net incomes.

COSTS ARE MOUNTING

The chairman of the Commission, Ira E. Robinson, said Senator Dill, informed him that the proposed schedule of the Commission would be submitted in advance of the convening of Congress in regular session.

Chairman Robinson, in testimony before the Senate Committee on Interstate Commerce last year, endorsed a proposal for imposition of license fees, saying it would cause holders of franchises to the ether more thoroughly to realize their responsibility to the public. Moreover, he declared that the mounting costs of radio administration make it desirable to assess charges upon licenses.

The estimated cost of radio regulation is $750,000 annually, disbursed jointly by the Commission and the radio division of the Department of Commerce, it is stated. It is generally stated that these expenditures will exceed $1,000,000 because of the increased work entailed in administering radio with the technical development of the art.

STRICTER WAVE SUPERVISION

Washington.

In an order recently adopted by the Federal Radio Commission all automatic frequency control apparatus will have to be approved by the Commission in the form of a written authorization before it is installed. This is to reduce interference to as low a minimum as possible.

Proposes Community Aid Control of Air

Washington.

Oswald F. Schuette, executive secretary of the Radio Protective Association, in a letter to the Federal Radio Commission proposes that local communities receive a greater share in determining allocation of broadcasting wavelengths. The Federal Government's part under this plan would consist chiefly in allotment of the wavelengths to zones, while States and communities controlled the power of the stations and policing of the channels to prevent interference. Actual allotment of the wavelengths would be left to the joint decision of the Federal Radio Commission and the local communities.

In an address made by President Hoover to the Fourth National Radio Conference, when he was Secretary of Commerce, Mr. Schuette pointed out, the same opinion was voiced.

"The ideal situation," Mr. Hoover said at that time, "would be a traffic regulation by the Federal Government to the extent of an allotment of wavelengths and control of power and policing of interference, leaving to each community a large voice in determining who are to occupy the wavelengths assigned to that community.

"It is true, of course, that radio is not circumscribed by State lines and still less by city boundaries; but it is possible, nevertheless, to establish zones which will at least roughly approximate the service areas of stations and to a very considerable extent to entrust to them the settlement of their local problems."

COURT UPHOLDS WTRL OUSTER

Washington.

The order of the Federal Radio Commission refusing to renew the license of WTRL, Midland Park, N. J., with a wavelength of 206 meters and a maximum power of 15 watts, on the ground that the operation of the station was not in the public interest, has been affirmed by the reviewing court, the Court of Appeals of the District of Columbia.

The decision of the Commission, it was held, was amply sustained by the evidence adduced at the hearing on the application for renewal of the license.

In reaching this conclusion, the court also held that the proceedings before the Commission had been properly conducted, and overruled objections to the refusal of evidence of persons not called as witnesses, and to the fact that only four of the five Commissioners sat at the hearing.

It was further held that the authority of Congress to regulate radio communication as a species of interstate commerce necessarily implies the right of reasonable regulation to control in the public interest the number, location and activities of the broadcasting stations of the country as an integral system. Such control, it was further stated, must necessarily at times involve the right of reasonable restriction and pro tanto prohibition.

SYKES PLAN VOTED DOWN

Washington.

The plan of Commissioner E. O. Sykes to conduct experiments to find out the feasibility of simultaneous operation of more than one high-powered broadcasting station on the same channel was recently rejected by the Commission.

UNITED MOVE FOR 50 CLEAR AIR CHANNELS

Washington.

Represented by John V. L. Hogan, consulting engineer, and Louis G. Caldwell, former chief counsel of the Federal Radio Commission, ten of the broadcasting stations now sharing time on cleared channels recently presented a brief asking that the Commission increase the forty cleared channels to fifty.

More cleared channels could be obtained, according to Mr. Caldwell, by making the separations between regional and local stations seven and one-half instead of ten kilocycles. He went on further to say that in Europe separation between stations is only four and one-half kilocycles and it is working very satisfactory.

If the band from 550 to 1,190 kilocycles were allocated for cleared channels, except for Canadian stations, and the band from 1,200 to 1,500 kilocycles for local and regional stations, the plan would work out very well, he continued. He also said that Canada is not satisfied with its allocation of cleared channels and before long the United States would be called upon to give up more cleared channels, and this plan would help solve such a problem.

A station of 5,000 watts power on a cleared channel has a much greater range than one on a local or regional channel, he said. Also, he pointed out, cleared channels are a necessity for the rural fans.

Amateurs Get Band For Voice Overseas

Washington.

A recent ruling of the Federal Radio Commission authorizes amateur radio operators holding an "extra first class amateur operator license" and those not holding this license who are particularly qualified to engage in international radiotelephonic communication experiments, the band of 14,100 to 14,300 kilocycles being set aside for this work.

Amateurs have heretofore been restricted to the continental field for radio voice transmission, but have conducted international experiments with code.

The ruling was made as a result of a plea by K. B. Warner, secretary of the American Radio Relay League, which has a membership of over 17,000 amateurs.

STATIONS GET CHANGED TIME AND FREQUENCY

Washington.

The following changes have been made by the Federal Radio Commission:

WDAY, Fargo, N. Dak., to be changed from one-half time on 1,280 kilocycles, to full time on 940 kilocycles; the power of station remains the same.

KFXF and KFEL—Denver, Colo., sharing time on 940 kilocycles, to be changed to share time on 630 kilocycles; the power of stations to remain the same.

WEBC—Superior, Wis., to be changed from one-half time on 1,280 kilocycles, to full time on 1,290 kilocycles, unless station WHA, Madison, Wis., is assigned part time on this channel at a later date.

WCFL—Chicago, Ill., operating as a limited time station on 970 kilocycles, to be changed to regional station with full time on 1,280 kilocycles, the power of WCFL to be 1,000 watts after local sunset, and 1,500 watts until local sunset.

Local stations near Chicago, each having one-fifth time, WEHS, WKBI and WHFC, to be changed to 1,500 kilocycles, and operation limited to hours when the three 5,000-watt stations, WSOA, WJAZ, ond WORD are not operating. The high-powered stations just mentioned have a total of three-sevenths time.

WIBW—Topeka, Kans., to be changed from 1,300 kilocycles to 580 kilocycles and share time with KSAC, Manhattan, Kans. The power of station WYBW on 580 kilocycles to be 500 watts night and 1 kilowatt to local sunset.

WSUI — Iowa City, Iowa, to be changed from 580 kilocycles to 600 kilocycles, sharing with WMT, Waterloo, Iowa, and power of WSUI to remain unchanged.

WMT—Waterloo, Iowa, to be changed from 1,200 kilocycles to 600 kilocycles, sharing time with WSUI, Iowa City, Iowa. The power of WMT to be 250 watts, which is the maximum of its present equipment.

KXRO — KXRO, Inc., Aberdeen, Wash. freq. changed to 1,420 kilocycles to 1,310 kilocycles.

Alda Leaving Opera for Radio

At the end of this season, Mme. Frances Alda, noted operatic and concert soprano, will retire from the Metropolitan Opera Company, and devote her entire time to radio broadcasting.

"After twenty-one years on the operatic stage," said Mme. Alda," I am giving up work with the Metropolitan to devote my time entirely to broadcasting.

The first of six Puccini operas was recently broadcast. It was "Madame Butterfly." Mme. Alda san gthe role of Japanese sweetheart to the American naval officer.

PLEASE GIVE US TIME

New subscriptions have been coming to the Radio World office in such large numbers of late that the Subscription Department is worked to death, but everybody is doing all possible to keep up to date. Please give us time to enter your subscription. This will require two weeks in some cases. In the meantime, do not be unhappy about it. We will give you service just as fast as we possibly can.

Forum

NOT DIFFICULT FOR HIM

I NOTICED what you told Y. E. in the October 5th issue of Radio World as to revamping receivers. I differ with you greatly. You said that there was no simple, valuable way. I have converted to AC several battery radios, such as Crosley, Atwater Kent, Federal and others, with good results and I didn't rebuild any of them. I merely put a harness in the sets and supplied new tubes and power units. It took me only about three hours to have them in good working order. They had more volume, power and sensitivity. It looks to me as if you want to give some one a lot of work to do for nothing.

As to being far better satisfied as to results, you could not wish to have any better satisfied customers than I have.

I am a professional service man and I think I know. You may be a technician but your theory and my practical results don't go together. As to your standard advice, I think you would be better off if you didn't have to look up your standard advice every time you answered a question and put that time in on practical advice. I would like Radio World better if it would publish articles for the service man and articles on standard sets instead of some of those pages of no-good small stuff.

Lloyd Beths,
Norman, Okla.

SPEAKER NOISE IN FOR IT NOW

If the measure introduced in the Aldermanic branch of the Municipal Assembly of New York City, as an amendment to the Sanitary Code, is passed, the playing of speakers, unreasonably loud after hours, will be a misdemeanor. It will also put a stop to the use of unreasonably loud speakers by radio dealers at any time.

Recently a committee appointed by Commissioner Shirley Wynne, of the New York Health Department, found that the blare of loudspeakers was the cause of much of the noise disturbance of the city. They also reported that this noise was responsible for many cases of nervousness and general rundown conditions, due to lack of sleep.

Committees appointed in other cities are investigating the speaker situation throughout the country. Bills to curb the operation of offensive loudspeakers are being introduced.

Hoover Opens Circuit

Washington.

The new direct radio telegraph circuit between New York and Madrid recently was opened by the pressing of the key in the offices of the Radio Corporation of America in Washington by Senor Mariano Amoedo, Charge d'Affaires of the Spanish Embassy. The first message sent was that of President Hoover congratulating the King of Spain on the success of the international expositions at Seville and Barcelona.

RADIO IS HELD FINE IN ADULT INSTRUCTION

Washington.

According to the report of the subcommittee of the advisory committee on education appointed by Secretary of the Interior Wilbur, radio offers remarkable possibilities in educating adults, bringing worth-while political discussions to classrooms and promoting community spirit in outlying rural districts.

The report goes on to say that illiteracy among adults might be prevented by educational broadcasts and also that remote mountain districts might be placed in close contact with current events.

The report also brings out that in connection with school work several set manufacturers have provided free receivers for classrooms. Each of the classrooms in certain schools in Ohio and California are fully equipped, the report states, and more are being added daily.

State superintendents of schools and their subsidiary units that use radio for educational purposes, and 73 colleges and universities in the United States that broadcast educational programs, were the two chief contributors of the information contained in the report.

Four Ousted Stations Resume

Because o fthe offering of satisfactory explanations as to their failure to apply for license renewals upon the license expiration, four of twenty stations ordered off the air were given license renewals and permitted to go on the air immediately.

The stations granted renewals were WTNT, operated by the Tennessee Publishing Company, Nashville, Tenn., 1490 kilocycles. 5000 watts; KSEL, Pocatello, Idaho, 900 kilocycles, 250 watts; KGHX, Richmond, Texas, 1500 kilocycles, 50 watts, and KDB, Santa Barbara, California, 1500 kilocycles, 100 watts.

z

Construction Delay Is Held Excusable

Washington.

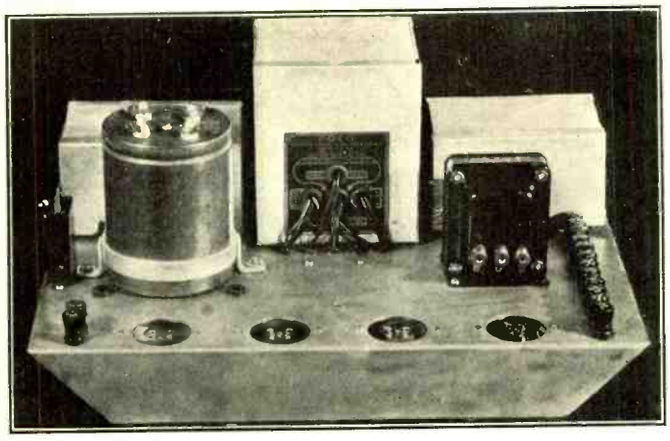
It is the duty of the Federal Radio Commission to grant a further extension a construction permit, when an applicant under permit for the construction of a radio broadcasting station has not been able to complete the construction of the station within the time allowed by the permit because of delays caused by engineering difficulties, contractors, and weather conditions, the Court of Appeals of the District of Columbia recently held.

The Richmond Development Corporation, building a 250 watt station at Roanoke, Virginia, the defendant in this test case, appealed the revocation and won.

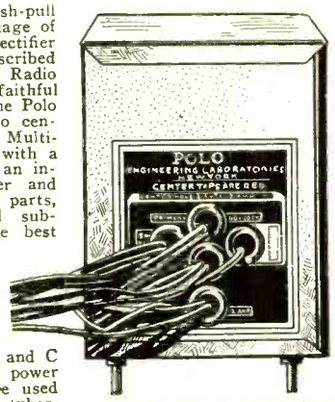
A THOUGHT FOR THE WEEK

Radio is
A science.
An entertainment.
A business.
A moving world force.
An art.
And the greatest of these is the first.

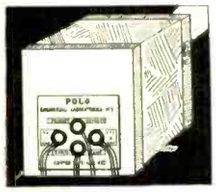
Power Amplifier Equipment



At left is illustrated a push-pull power amplifier, using a first stage of resistance coupled audio, 280 rectifier and two 245s in push-pull, as described in the November 2d issue of Radio World. Abounding volume and faithful tone reproduction are assured. The Polo Filament-Plate Supply, two Polo center-tapped audio chokes and a Multi-Tap Voltage Divider are used, with a Q 2-8, 2-18 Mershon condenser, an input push-pull audio transformer and auxiliary equipment. The total parts, including cadmium-plated steel subpanel, come to $43.57 net, the best power amplifier for that modest amount. Provision is made for phonograph pickup plug insertion. Thirteen output voltages are provided, including 300, 180, 75, 50 and an assortment of nine different voltages under 50 available for bias. All A, B and C voltages are provided for the power amplifier and for a tuner to be used with it employing 227, 224 or 228 tubes. Order Cat. PO-245-PA @ $43.57 net, for 50-60 cycles, 110 volts. [For 25 cycles order PO-245-PA-25 @ $48.57. For 40 cycles order PO-245 - PA - 40 @ $46.07.]



Polo 245 Filament Plate Supply (less chokes) has four windings, all save primary center-tapped (red), is 4½" wide, 5" high, 4" front to back. Weight, 9 lbs. Filament windings, 2.5 v. at 12 amps., 2.5 v. at 3 amps. (for 245 filaments), 5 v. at 2 amps. for 280 rectifier, and 724 v. @ 100 m.a., center-tapped. Order Cat. PFPS @ $7.50.
[For 25 cycles order Cat. PFPS-25 @ $12.00.]
[For 40 cycles order Cat. PFPS-40 @ $10.00.]



Polo Filament Transformer Only, four windings, consists of 50-60 cycles 110 v. winding, 2½ v. at 12 amps., 2½ v. at 3 amps., 5 v. at 2 amps. All windings, save primary, are center-tapped (red). Size, 4⅝" high x 3¾" wide x 3" front to back. Weight, 6 lbs. Order Cat. PFT @ $4.25.
[For 25 cycles order PFT-25 @ $7.00; for 40 cycles order PFT-40 @ $6.25.]

By-pass Condensers

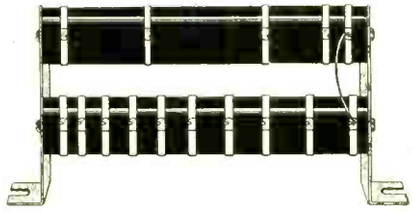
For by-passing B+ leads to ground or C minus from 200 v. post or less, where current is less than 10 m.a., 1 mfd. paper dielectric condensers are useful. Order LV-1 @ .....$0.50 ea.

Filter Condensers

For high voltage filtration next to the rectifier, use 1 or 2 mfd. The 2 mfd. makes the output voltage a little higher.
Order Cat. HV-1 (1,000 v. DC, 550 v. AC).....$1.76
Order Cat. HV-2 (1,000 v. DC, 550 v. AC).....$3.52

Filament-Plate-Choke Block

Same as Filament-Plate Supply, except that two 50 henry chokes are built in. Six windings: primary, 110 v., 50-60 cycles; 2.5 v. at 12 amps.; 2.5 v. at 3 amps.; 5 v. at 2 amps.; 724 v. at 100 m.a.; choice All AC windings center-tapped (red), except primary. Connect either end of a choke to one end of other choke for midsection. Order Cat. P-245-FPCH @..$10.00
[For 40 cycles order P-245-FPCH-40 @ $13.50.]
[For 25 cycles order P-245-FPCH-25 @ $14.50.]



Two rugged, expertly engineered wire-wound, enamelled resistors, mounted in series, one atop the other, with fourteen useful lugs, providing all necessary choice of voltages without the uncertainty of adjustable variable resistance.

The Multi-Tap Voltage Divider has a total resistance value of 13,850 ohms, in the following steps: 3,000, 4,500, 2,000, 800, 700, 600, 550, 500, 450, 400, 200, 100 and 50 ohms. With the zero voltage lug (at lower left) the total number of useful lugs is fourteen. The resistance stated are those between respective lugs and are to be added together to constitute 13,850 ohms total.

A conservative rating of the Multi-Tap Voltage Divider is 50 watts, continuous use. The unit is serviceable in all installations where the total current drain does not exceed 125 milliamperes.

Extreme care has been exercised in the manufacture of the Multi-Tap Voltage Divider. It is mounted on brackets insulated from the resistance wire that afford horizontal mounting of the unit on baseboards and subpanels.

There long has been a need for obtaining any necessary intermediate voltage, including all biasing voltages, from a Multi-Tap Voltage Divider, but each lug has to be put on individually by hand, and soldered, so that manufacturing difficulties have left the market barren of such a device until now.

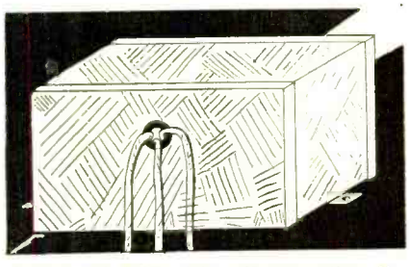
The Multi-Tap Voltage Divider is useful in all circuits, including push-pull and single-sided ones, where the current rating of 125 milliamperes is not seriously exceeded and the maximum voltage is not more than 400 volts. If good ventilation is provided, this rating may be exceeded 15 per cent.

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

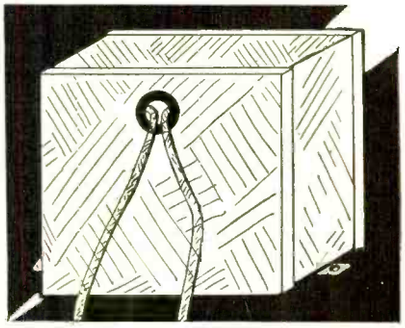
When the Multi-Tap Voltage Divider is placed across the filtered output of a B supply which serves a receiver, the voltages are in proportion to the current flowing through the various resistances. If a B supply feeds a receiver with two-stage audio amplifier, the last stage a single-sided 245, then the voltages would be 250 maximum for the power tube, 180, 135, 75, 50, 40, 35, 30, 25, 16, 10, 6 and 3. By making suitable connection of grid returns the lower voltages may be used for negative bias or even for positive voltage on the plates.

If push-pull is used, the current in the biasing section is almost doubled, so the midtap of the power tubes' filament winding would go to a lug about half way down.

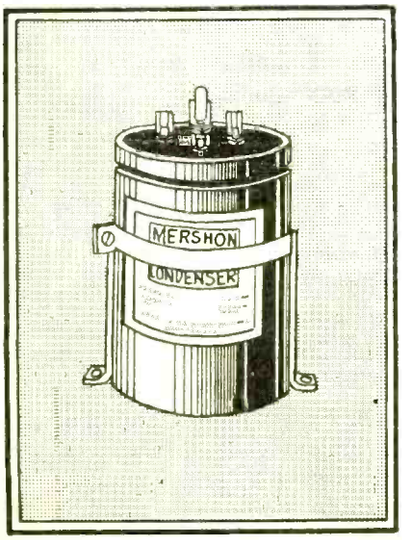
Order Cat. MTVD at $3.95.



Center-tapped double choke, 125 m.a. rating, 30 henrys in each section. Used for filtering B supply or for a push-pull output impedance, where speaker cords go directly to plates of tubes. Center tap is red. Order Cat. PDC @ $3.71.



Single 30 henry 100 m.a. choke for filtered output (where condenser is used additionally) or for added filtration of a B supply. Order Cat. PSC @ $2.50.



The Mershon electrolytic condenser, 415 volts DC, for filtering circuits of B supplies. Q 2-8, 2-18 has four capacities in one copper casing: two of 8 mfd. and two of 18 mfd. The copper case is negative. The smaller capacities are nearer the edge of the case. The vent cap should not be disturbed, and the electrolyte needs no refilling or replacement.

Mershon electrolytic condensers are instantly self-healing. Momentary voltages as high as 1,000 volts will cause no particular harm to the condenser unless the current is high enough to cause heating, or the high voltage is applied constantly over a long period.

High capacity is valuable especially for the last condenser of a filter section, and in by-passing, from intermediate B+ to ground or C+ to C—, for enabling a good audio amplifier to deliver true reproduction of low notes. Suitably large capacities also stop motorboating.

Recent improvements in Mershons have reduced the leakage current to only 1.5 to 2 mils total per 10 mfd. at 300 volts, and less at lower voltages. This indicates a life of 20 years or more, barring heavy abuse.

In B supplies Mershons are always used "after" the rectifier tube or tubes, hence where the current is direct. They cannot be used on alternating current.

The Mershon comes supplied with special mounting bracket. Order Q 2-8, 2-18 B @ **$5.15**

ACOUSTICAL ENGINEERING ASSOCIATES,
143 West 45th St., N. Y. City.
(Just East of Broadway.)

Please ship at once the following:

Quantity	Cat. No.	Product	Price
☐	PO-245-PA	Power amp. parts, 50-60 c.	$43.57
☐	PO-245-PA-40	Same, 40 cycles	46.07
☐	PO-245-PA-25	Same, 25 cycles	48.57
☐	PFPS	Fil. plate supply, 50-60 c.	7.50
☐	PFPS-40	Same, 40 cycles	10.00
☐	PFPS-25	Same, 25 cycles	12.00
☐	PFT	Fil. trans., 50-60 c.	4.25
☐	PFT-40	Same, 40 cycles	6.25
☐	PFT-25	Same, 25 cycles	7.00
☐	P-245-FPCH	Power-filter block	10.00
☐	P-245-FPCH-40	Same for 40 cycles	13.50
☐	P-245-FPCH-25	Same for 25 cycles	14.50
☐	PDC	Double c.-t. choke	3.71
☐	PSC	Single choke	2.50
☐	MTVD	Multi-tap volt. div.	3.95
☐	Q2-8, 2-18B	Mershon with bracket	5.15
☐	LV-1	200 v., 1 mfd. by-pass cond.	.50
☐	HV-1	1,000 v., 1 mfd. filter cond.	1.76
☐	HV-2	1,000 v., 2 mfd. filter cond.	3.52

☐ Enclosed please find check—money order—for the above. [Note: Canadian remittance must be by postal or express money order.]

☐ Please ship C.O.D.

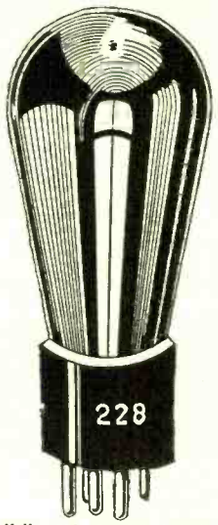
NAME.....

ADDRESS.....

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

5-DAY MONEY-BACK GUARANTEE!

New 228, High Gain Detector for AC Sets



Kelly 228 Special Detector for AC circuits has a high mu. (Amplificaion factor) and increases sensitivity.

INCREASE the sensitivity of modern AC-operated circuits by substituting the new Kelly 228 AC detector, a high mu tube (large amplification), for the 227 tube otherwise used. The result is immediately obvious in the greatly increased volume. Otherwise weak, distant stations come in stronger and tone quality is improved. Simply substitute the 228 for the 227. No wiring change of any kind is required.

If an AC receiver uses resistance-coupled or impedance-coupled first audio stage, where the resistor or coil is in the plate circuit of the first audio tube, the 228 may be used as audio amplifier, too. It is not suitable as a radio frequency amplifier.

CHARACTERISTICS OF THE KELLY 228

Heater voltage 2.5 volts AC.
Heater current 1.75 amperes.
Amplification factor 45.
Mutual conductance 1,000.
Plate voltage 180 volts.
Grid bias, detector —6 volts.
Grid bias, amplifier —2.5 volts.
Load resistance, 0.1 to 0.5 meg.
Internal plate resistance 45,000 ohms.

$2.50 NET PRICE

Screen Grid Tubes

THE Kelly screen grid tubes are of two types: the 222 for storage-battery operation of the filament, and the 224 for AC operation of the filament. The tubes are similar but not identical. Either type may be used as radio frequency amplifier, detector or, with resistor plate load, as audio amplifier.

The 222 has four prongs and fits into the regular UX socket. The 224 has five prongs and requires the special five-spring UY socket. The control grid is the cap of the tube.

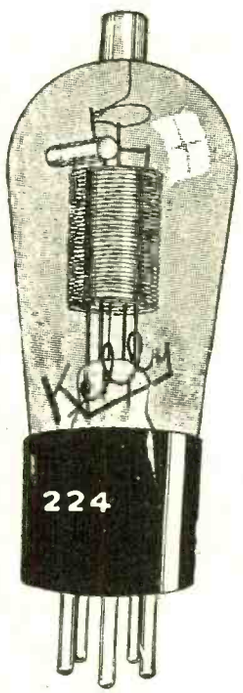
The filament voltage of the 222 is 3.3 volts, the plate voltage 135, the screen grid voltage 45 volts or less. The heater voltage of the 224 is 2.5 volts AC, the plate voltage 180, the screen grid voltage 75 volts or less.

The net price of the 222 is $3.50, while the net price of the 224 is $3.00.

Other Tubes

The line of Kelly tubes includes, besides the 228, 222 and 224, the following types: 245, 226, 227, 171A, 280, 240, 112A, 201A and UX199. The 240 is a high mu tube for battery operation of the filament. It is suitable as detector or audio amplifier where a resistor of .25 meg. or an impedance coil is in the plate circuit.

You run no risk whatever when you purchase Kelly tubes. Not only are they expertly made but they are sold on a 5-day money-back guarantee. This exclusive form of protection enables you to be the ultimate judge in your own laboratory or your own home, with no appeal from your decision on our part. If you are not delighted with the performance of Kelly tubes your money will be promptly refunded on the foregoing 5-day basis.



Kelly 224 Screen Grid Tube assures best tube performance in the most up-to-date AC circuits using screen grid tubes.

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Enclosed please find $....., for which ship at once Kelly tubes marked below:

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☐ Matched pair of 245s for push-pull (for both).....$4.50
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☐ Matched pair of 112As for push-pull (for both).....$1.90

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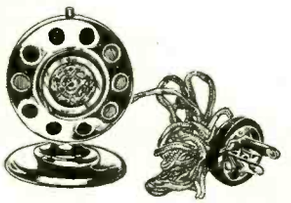
☐ Put cross here if C.O.D. shipment is desired.
Canadian remittance must be by postal or express money order.

MICROPHONE LIGHTERS

for cigars or cigarettes, with button switch at top. Press the switch and light up!



Model A lighter, microphone design, with 5-ft. AC cable and plug. Works on 110 volts, AC any frequency and on direct current. .....Price $1.00

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.

The heater element is renewable.

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☐ Please send me Model A Microphone Lighter at $1.00.
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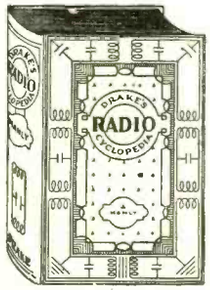
A reference work that has subjects classified in alphabetical order.



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NATIONAL SCREEN GRID TUNER—Read full advertisement on another page of this issue.

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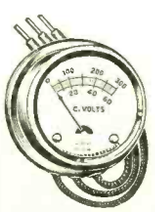

J-246 Voltmeter, for measuring all direct current voltages, including B eliminators. 0-60, 0-300 (double range).

A portable type, high resistance meter, 2½" 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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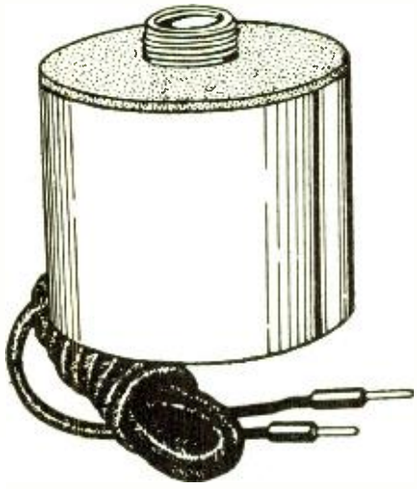

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Acoustical Engineering Associates,
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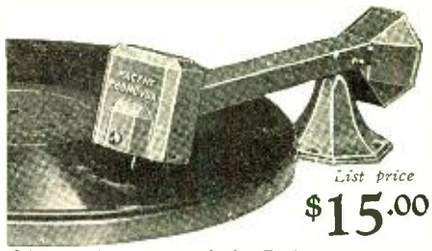
FIVE-DAY MONEY-BACK GUARANTEE



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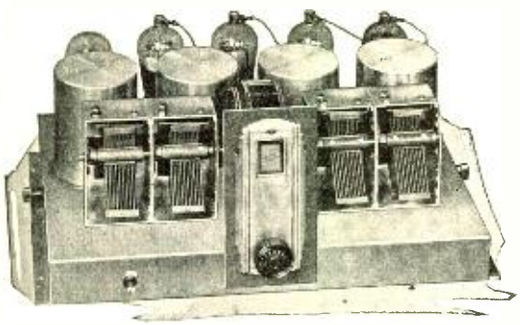
RADIO WORLD, 145 West 45th St., N. Y. City

NATIONAL SCREEN GRID TUNER



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, $89.50. Your price .....

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MB-29

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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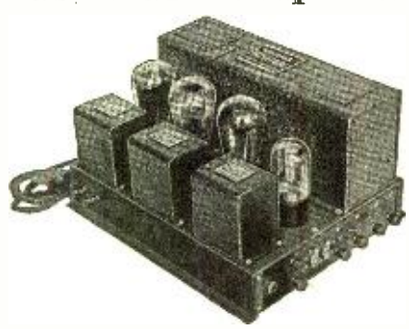

View of National Velvetone Push-Pull Power Amplifier. an expertly made A, B and C supply and audio amplifier, producing marvelous tone quality.

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Your Choice of These Nine Meters FREE!

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Equip Yourself Now With Necessary Meters!

To do your radio work properly you need meters. Here is your opportunity to get them at no extra cost. See the list of nine meters at left. Heretofore we have offered the choice of any one of these meters free with an 8-weeks subscription for RADIO WORLD at $1, the regular price for such subscription. Now we extend this offer. For the first time you are permitted to obtain any one or more or all of these meters free, by sending in $1 for 8-weeks subscription, entitling you to one meter; $2 for 16 weeks, entitling you to two meters; $3 for 28 weeks, entitling you to three meters $4 for 35 weeks, entitling you to four meters, $5 for 44 weeks, entitling you to 5 meters, $6 for 52 weeks, entitling you to six meters. Return this offer with remittance, and check off desired meters in squares at left.

RADIO WORLD will help you in your radio work, so you will be able to use the meters most valuably. Keep abreast of all the new circuits, intimate details on perfecting existing sets, and get inside track on sensitivity, distance reception, tonal quality, and news of radio technical and non-technical. Enjoy the writings of Dr. Lee De Forest, McMurdo Silver, J. E. Anderson, Herman Bernard and a host of other radio engineers who contribute their knowledge to you through the medium of RADIO WORLD, the first and only illustrated national radio weekly. You can find no magazine that better caters to your needs than RADIO WORLD. Short waves? RADIO WORLD will tell you all about them. Extremely sensitive broadcast receivers? Their construction and operation are fully discussed with confident regularity. Power supplies push-pull or otherwise? AC receivers? Screen grid tubes? Large receivers that give a super-abundance of performance—small, economical receivers that give performance out of all comparison to their size? Are you interested in these? Then you're interested in RADIO WORLD.

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LACAULT'S BOOK

GIVES YOU A FINE UNDERSTANDING OF the SUPER-HETERODYNE

R. E. LACAULT, E.E., I.R.E., who died recently, was one of the outstanding authorities on the Super-Heterodyne. He wrote a book, "Super-Heterodyne Construction and Operation," that explains in a non-technical manner the phenomena associated with a Super-Heterodyne. More, it gives a clear outline of the way such a receiver functions, and naturally gives the clues to solving virtually all the troubles that may arise in a Super.

So thoroughly did Lacault do his wrok that he covered associated topics, thus making his book a sidelight on radio in general, including advice on trouble-shooting.

Therefore the service man, the home experimenter, the custom set builder and the student will welcome this book.

It consists of 193 pages and includes 68 illustrations. It is bound in maroon buckram.

There are three valuable tables in the book, also. One classifies harmonics into groups, e.g., sound, radio, short waves, heat, light, chemical rays, X-rays and "unknown." Another is a trouble-shooting chart, classifying "trouble experienced" and "causes" and referring to the text for specific solutions. The third is a table for converting broadcast frequencies to wavelengths (accurate to .1 of a meter) or for converting the wavelength into frequency.

THE book begins with a comparison of alternating and direct current and proceeds to a discussion of the relation of wavelength to frequency. Then tuning is explained.

Condensers, coils, induction, vacuum tube operation and testing, earphones and speakers, rectification, oscillation, grid condenser action, modulation, grid bias detection, regeneration, beat notes, frequency changing, audio amplification, batteries, aerials, loops, wiring, sockets, and shielding are only some of the other important topics covered.

Besides, there is an entire chapter on the construction of a Super-Heterodyne receiver, with list of parts, front, top and rear views of set, front panel layout, shield dimensional drawings, schematic diagram of wiring, and picture diagrams of the top and bottom views of the subpanel.

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[Check off parts you want. Each part is sold separately.]

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☐ C1, C2—Two .00035 mfd. ext. shafts @ 98c	1.96
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☐ R—One 6.5 ohm filament resistor	.25
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Circuits for Schoolboys—Easy to Build, Very, Very Inexpensive!

A One Tube Receiver, parts costing $4.28!
A Two Tube Audio Amplifier, parts costing $5.23!
A Three Tube Speaker—Operating Circuit, parts costing $11.10!
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The construction of these circuits, with a pictorial diagram as one of the illustrations, was described by Jack Tully, himself a schoolboy, in RADIO WORLD. See list below.

- ☐ Sept. 21st and 28th issues, One-Tube DX Set, by Jack Tully; two-part article.
- ☐ Oct. 5th, Three-Tube Single Dial Speaker Set, by Jack Tully.
- ☐ Oct. 12th, Two Stage Transformer, Coupled Audio Amplifier, by Jack Tully.
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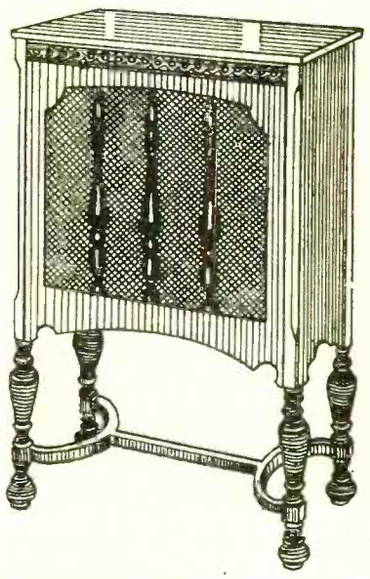
Aristocrat Floor Speaker

With Molded Wood Horn of 8 ft. tone travel (exponential type) with baffle and horn motor built in. Extraordinary bargain. **$14.00**



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.

Acoustical Engineering Associates
143 WEST 45th STREET NEW YORK CITY

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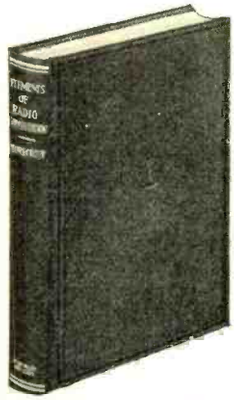
Five New Volumes Offer Short-Cut to Knowledge!

MORECROFT
"Elements of Radio Communication"



The latest book by Prof. John H. Morecroft, of the Engineering Department of Columbia University, and past president of the Institute of Radio Engineers, is his "Elements of Radio Communication," a book for the novice to enjoy. We regard this as the best elementary book to inform you authoritatively on the technical phases of radio in plain language, without requirement of mathematical knowledge. The book is a complete course on the elements of radio, containing much material never before published. It has 226 pages, 170 illustrations and a complete index. Just out, it is the book of the year in radio. Cloth bound. Order Cat. MEE @ $3.00

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The need for an elementary book on radio tubes that answers all the important questions has been filled by James A. Moyer, Director of University Extension, Massachusetts Department of Education, and John F. Wostrel, Instructor in Radio Engineering Division of University Extension, Massachusetts Department of Education.

This new book is a complete discussion of tube principles, functions and uses, thoroughly up-to-date. In this book the essential principles underlying the operation of vacuum tubes are explained in as non-technical a manner as is consistent with accuracy. The book covers the construction, action, reactivation, testing and use of vacuum tubes as well as specifications for vacuum tubes and applications for distant control of industrial processes and precision measurements. 297 pages, cloth bound. Order Cat. MWT @.....$2.50

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[NOTE: *The standard book on tubes for advanced students is "The Thermionic Vacuum Tube," by Hendrik Van der Bijl. Order Cat. VDB @*.....$5.00]

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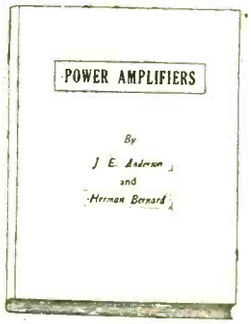
Here is the *first* book to be published on the subject of "Power Amplifiers." Now printing, it is certain to fill a void in radio literature. The whole subject is fully covered in a masterful theoretical discussion of audio amplifiers and power supplies, supplemented by constructional chapters, with complete wiring diagrams and specification of parts. Learn while you build! J. E. Anderson, M. A., technical editor of RADIO WORLD, and Herman Bernard, LL. B., managing editor of RADIO WORLD, both of the Institute of Radio Engineers, have explained fully the phenomena of power amplifiers. Learn all about motorboating and its cures, push-pull theory and practice, grid bias methods and effects, vacuum tubes in audio circuits, AC and battery type AF amplifiers, phase relationships, common impedance, filter systems, by-pass condenser effects, necessities for tone quality, values of coupling constants, and a host of other topics associated with power amplification, including speech amplifiers and "talkie" installations.



More than 200 pages and more than 100 illustrations are devoted to an analysis of this outstanding radio subject. "Power Amplifiers" is authoritative, original and comprehensive. It is free from the traditional errors that have crept into this subject. The theoretical part of the book can be understood by most novices, while the constructional part, that capitalizes the previously imparted knowledge, is thoroughly understandable by anybody. There is virtually no mathematics in the book. Cloth bound. Order Cat. PAM @.....$3.50

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60, 62, 20, 64, 30 105, 51, 16, 32, 50, 25 A.C., 28 A.C., 41, Receptor S.P.U., 17, 18, 33.

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Type F series filament, type E series filament, type D series filament, Model K, Model H.

ATWATER-KENT
10B, 12, 20, 30, 35, 48, 32, 38, 49, 38, 36, 37, 40 42, 52, 50, 44, 43, 41 power units for 37, 38, 44, 43, 41.

CROSLEY
XJ, Trirdyn SR3, 601, 401, 401A, 608, 704, B and C supply for 704, 704A, 704B, 705, 706.

ZENITH
39, 39A, 392, 392A, 40A, 35PX, 35APX, 352PX, 352APX, 37A, 35P, 35AP, 352P, 352AP, 34P, 342P, 33, 34, 35, 35A, 342, 353, 352A, 362, 31, 32, 333, 353A, power supply ZE17, Power supply ZE12.

MAJESTIC
70, 70B, 180, power pack 7BP3, 7P6, 7P3 (old wiring) 8P3, 8P6, 7BP6.

FRESHMAN
Masterpiece, equaphase, G, G-60-S power supply, L and LS, Q15, K, K-60-S power supply.

FADA
50/80A receivers, 460A Fada 10, 11, 30, 31, 10Z, 11Z, 30Z, 31Z, 16, 17, 32, 18Z, 32Z, 18, special, 192A-192S and 192BS units, R30A, 480A, and SF 50/80A receivers, 460A receiver and R60 unit, 7 A.C. receiver, 475 UA or CA and SF45-75 UA or CA, 50, 70, 71, 72, C electric unit for special and 7 A.C. receivers, ABC 6 volt tube supply, 86V and 82W, E180Z power plant and E 420 power plant.

FREED-EISEMANN
NR5, FE18, NR70, 470, N R 5 7, 457, NR11, NR80 DC.

STEWART-WARNER
300, 305, 310, 315, 320, 325, 500, 520, 525, 700, 705, 710, 715, 720, 530, 535, 750, 801, 802, 806.

GREBE
MU1, MU2, synchrophase 5, synchrophase A C 6 synchrophase AC7, Deluxe 428.

PHILCO
Philco-electric, 82, 86.

KOLSTER
4-tube chassis used in 6 tube sets, tuning chassis for 7 tube sets, power amplifier, 7 tube power pack and amplifier, 6 tube power pack and amplifier, rectifier unit K23.

STROMBERG-CARLSON
1A, 2B, 501, 502, 523, 524, 635, 636, 403AA power plant, 404 RA power plant.

ALL-AMERICAN
6 tube electric, 8 tube 80, 83, 84, 85, 86, 88, 6 tube 6C, 61, 62, 65, 66, 6 and 8 tube A.C. power pack.

DAY FAN
OEM7, 4 tube, 5-5 tube 1925 model, Day Fan 8 A.C., power supply for 6 tube A.C., B power supply 5524 and 5525, motor generator and filter, 6 tube motor generator set, 6 tube 110 volt D.C. set, 6 tube 32 volt D.C. set.

COLONIAL
26, 31 A.C., 31 D.C.

WORKRITE
8 tube chassis, 6 tube chassis.

AMRAD
70, 7100, 7191 power unit.

SPARTON
A.C. 89.

MISCELLANEOUS
DeForest F5, D10, D17, Super Zenith Magnavox dial, Thermyodyne, Grimes 4DL inverse duplex, Garod neutrodyne, Garod EA, Ware 7 tube, Ware type T, Federal 102 special, Federal 59, Kennedy 220, Operadio portable, Sleeper RX1, Armad inductrol.

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It would be far short of an accomplishment to hook indifferent audio onto a grid leak-condenser detector. So in both models he used a power detector, two resistance audio stages producing undistorted volume exceeding that of any ordinary two-stage audio amplifier, amplification sufficient to load up the power tube in each instance. And in the case of the AC model HB Compact it is a 245, with 1,600 milliwatts maximum undistorted power output, standing enough gaff for a small hall! And what tone realism! Breath-taking! Nothing in radio ever excelled this tone quality! Nothing! Absolutely nothing!

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As the prices quoted in the list of component parts show, these advantages may be obtained economically. The battery model draws only 21 milliamperes of plate current, .664 amperes of filament current. Large B batteries would last a year at that rate, for average use, and a small A battery require recharging only every two months to ten weeks!

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Selectivity

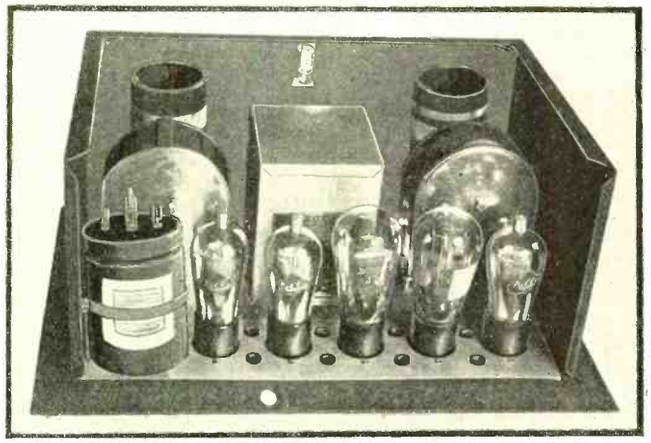
HB Compact, battery model, uses a 222 RF amplifier, a 240 (high mu) power detector, a 222 first audio and a 112A or 171A power tube. The RF tube's plate circuit is tuned by a new type coil that has a moving segment as part of the tuned inductance, with step-up ratio to untuned detector grid. The audio is resistance-coupled. A 7x14" front panel may be used, with baseboard, but the HB Compact Steel Cabinet, decorated brown, with satin aluminum subpanel, sockets affixed, is recommended.

HB Compact, AC model, uses a 224 RF amplifier, a 224 space charge power detector, a 224 first audio and a 245 output tube, with 280 rectifier. Except for the space charge feature, not suitable in the battery model, and the larger power tube, not economically powered by batteries, the two models are fundamentally the same. The AC model is still more sensitive, however.

The same steel cabinet is recommended for the AC model, while the aluminum subpanel has the five sockets affixed and the type of each tube (except detector) printed on each socket.

Order what individual parts you want.

Front view of the HB Compact. The view is the same for AC or battery model. For batteries the switch is built in the rheostat. For AC a pendant switch is used at rear, in the AC cable.



View of the HB Compact AC Model, the tubes being, left to right: 224 detector, 224 first AF, 245 power tube, 280 rectifier and 224 RF. The subpanel is only 9½x14¼", yet everything save the speaker is in this small space!

Component Parts for HB Compacts

AC MODEL

L1L2L3—Bernard Antenna Tuner BT5A	$2.50
L4L5L6—Bernard Interstage Tuner BT5B	2.50
CT—One 80 mmfd. equalizer	.35
C1, C2—Two .0005 Dustproof @ $2.50	5.00
C, C3, C4, C5—Four .01 mfd. @ .35	1.40
C7—One 1 mfd. 500V AC	.85
C8, C9, C10, C11—Mershon Q2-8, 2-18B	5.15
C12, C13—Two 1 mfd. 200 V. DC @ .50	1.00
R—One 25,000 ohm wire-wound pot	1.50
R1, R2, R3, R4—.5, 1.0, .05 5.0 meg. @ .35	1.40
T1—Polo 245 Power Supply Cat. P245PS	10.00
2500, 4400, 774, 50, 8 (20 watt) Voltage Divider	1.75
PL—Bracket and 2.5 v. AC lamp	.70
OC, C6—Output choke, 2 mfd. 500 v. AC cond.	3.85
SP—, SP+—Two binding posts @ .10	.20
Three National grid clips @ .06	.18
F—One 1 amp. cart. fuse with base	.50
Aluminum socketed subpanel, 9½x14¼", 8 brackets	3.25
Steel cabinet, crackled brown finish, 7x15x9½	4.00
3 Insulating washers @ .03	.09
Two full-vision dials with pointers @ 75c	1.50
One AC pendant switch, double opening	.40
One 12 ft. length AC cable	.72
Two rolls Corwico braidite @ .35	.70
Two flexible couplers (links) @ .35	.70
	$50.19

Kelly tubes: Three 224 @ $3, one 245 @ $2.25, one 280 @ $1.75 ..... $13.00

BATTERY MODEL

L1L2L3—One Bernard Tuner for antenna circuit, for .0005 mfd. tuning (BT5A of Screen Grid Coil Co.)	$2.50
L4L5L6—One Bernard Tuner for screen grid interstage coupling, for .0005 mfd. tuning (BT5B of Screen Grid Coil Co.)	2.50
C1, C2—Two .0005 mfd. Dustproof tuning condensers @ $2.50	5.00
CT—One Hammarlund 80 mmfd. equalizing condenser	.35
C3, C4, C5—Three .01 mfd. mica fixed condensers @ .35	1.05
R1—One .25 meg. metallized resistors	.30
R2, R4—Two 5.0 meg. metallized resistors @ .30	.60
R3—One .075 meg. metallized resistor	.40
R5, SW—One 75-ohm rheostat with switch attached	.80
R6—Two resistors, one 1.3 ohms, the other 6.5 ohms (both)	.45
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One pilot light bracket with 6-volt DC lamp	.70
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Two insulated links (flexible couplers) (both)	.70
One 7-lead battery cable	.50
	$23.75

Kelly tubes: Two 222, one 240, one 112A or 171A, total, $9.20.

[The HB Compacts were designed and built by Herman Bernard. The battery model was described in the August 24th, 31st, September 7th and 14th issues of Radio World.]

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80 Mmfd.	.35
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Dummy	.35
(4) front insulators	.20
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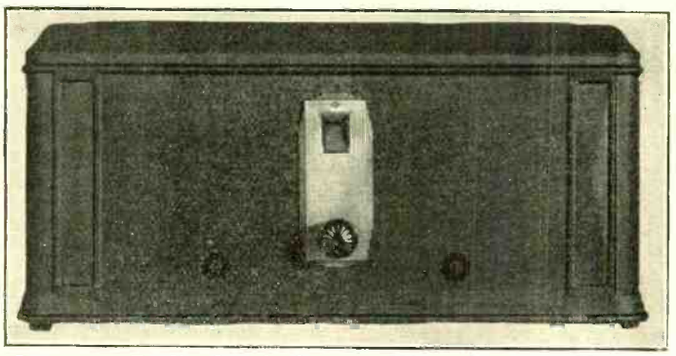

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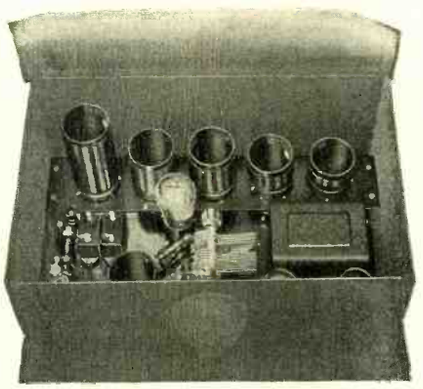

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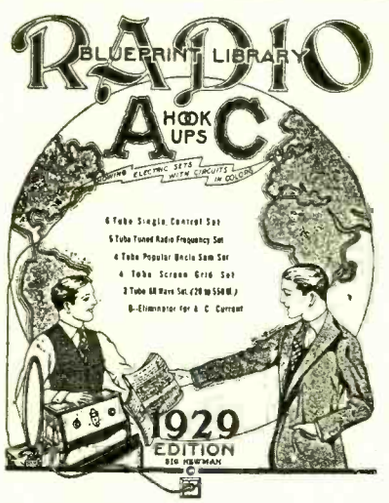

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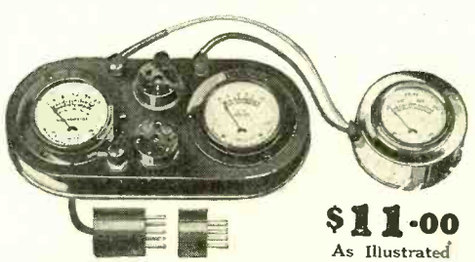

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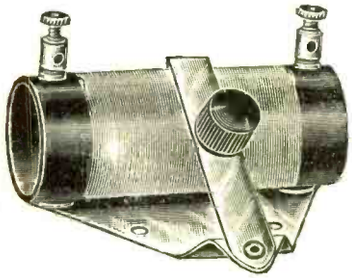

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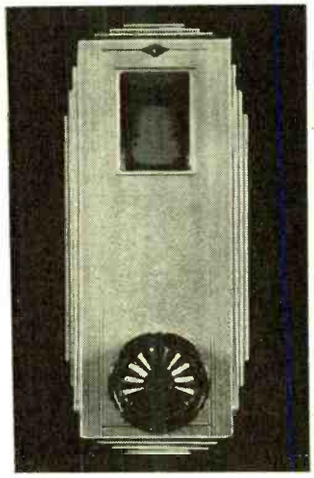

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