NOV. 30TH 1929

Plate Current's Ups and Downs

15¢ PER COPY

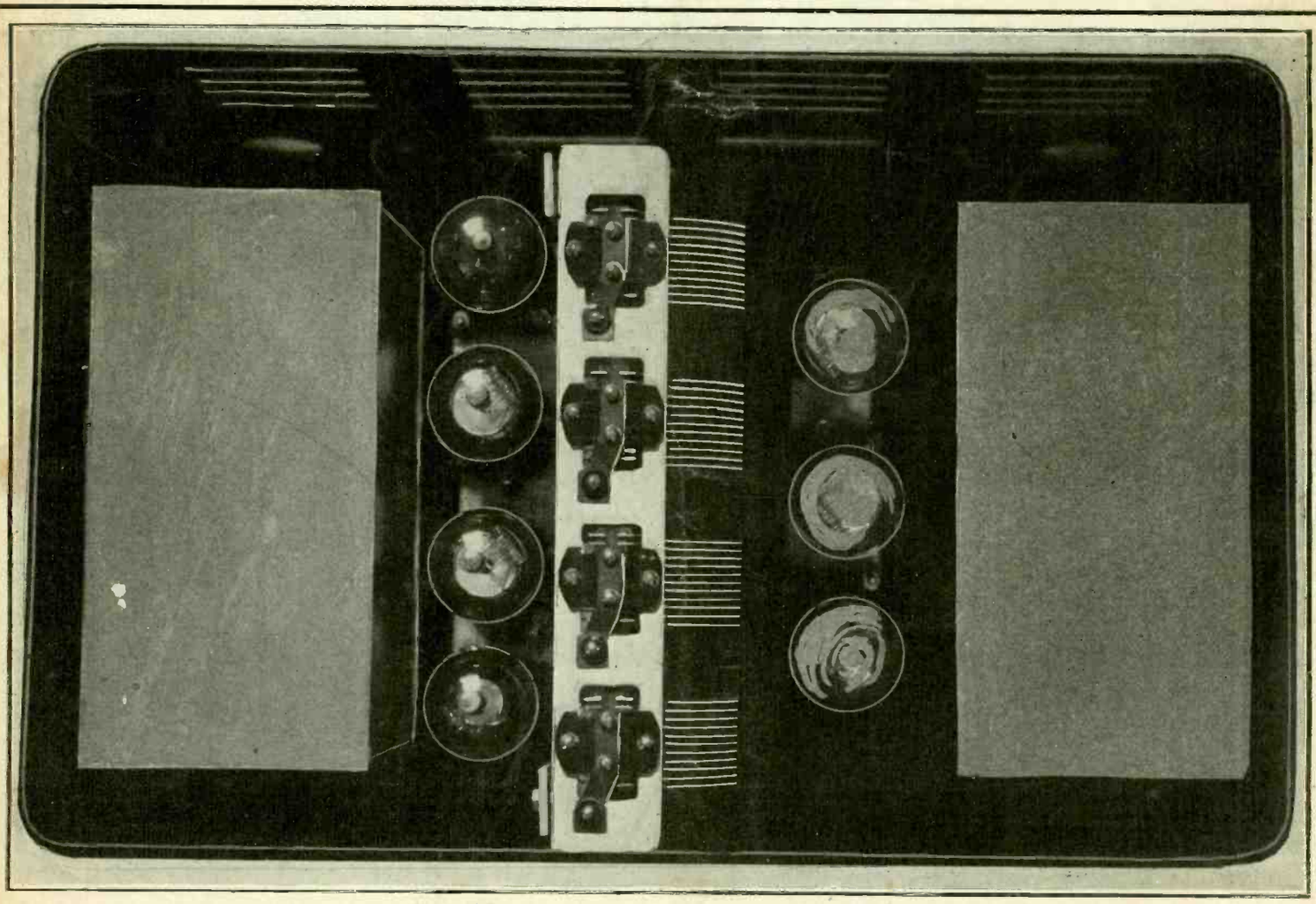
RADIO WORLD

REG. U.S. PAT. OFF.

The First and Only National Radio Weekly

401st Consecutive Issue—EIGHTH YEAR

HB33 HAS THREE SG RF AND POWER DETECTOR



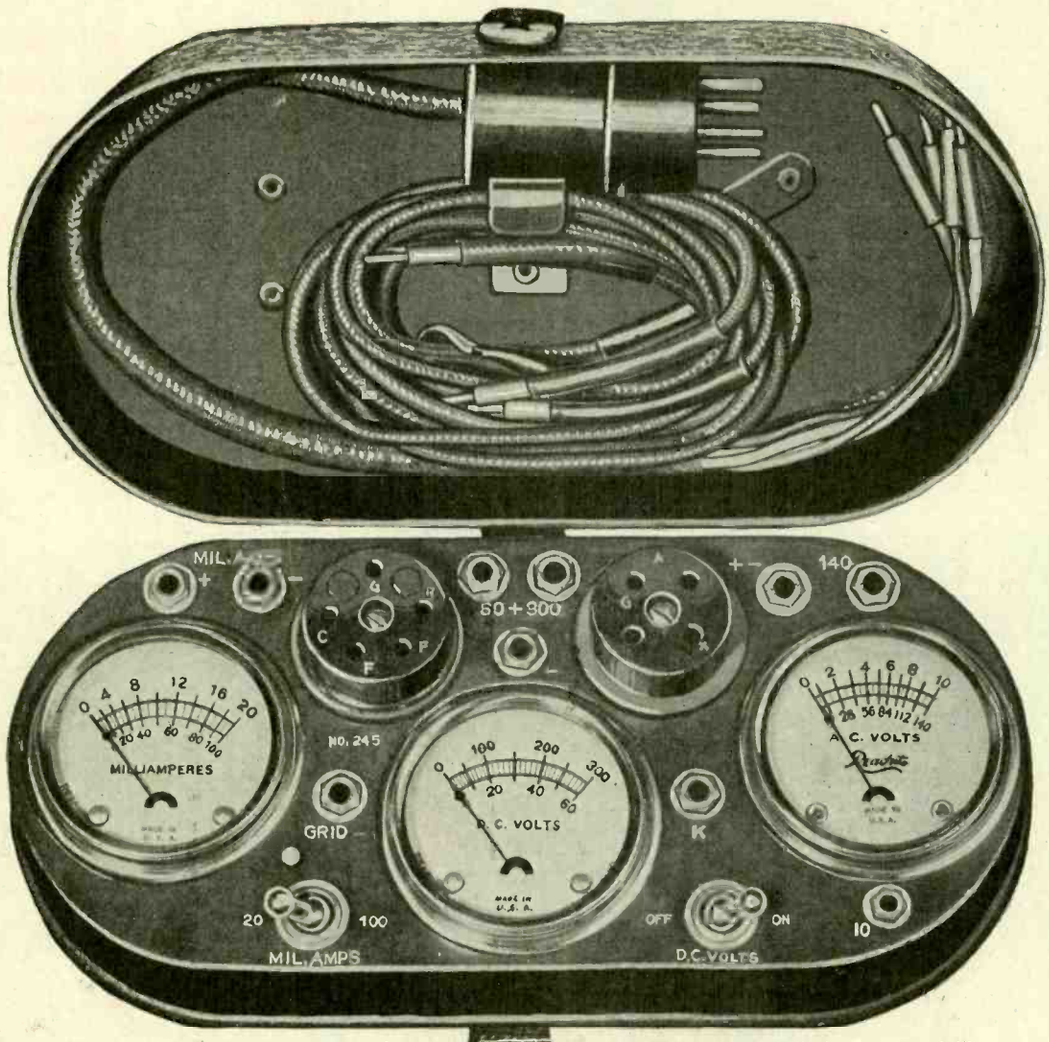
A Seven Tube Screen Grid Receiver the Parts For Which Cost Less Than $30.
See Pages 5, 6, 7, 8 and 9.

Fundamental Circuits Expounded for Schoolboys

Audio Amplifiers for Superheterodynes

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.

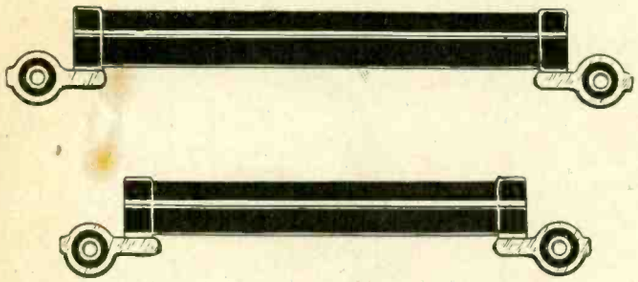
To test for shorts in condensers, resistors, etc. With tube in tester connect condenser under test to jacks —MA and +MIL-AMPS. If milliammeter shows change in reading the part tested is shortened. Resistors, etc., may be tested by the same method as noted above for continuity tests, or by disconnecting 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.

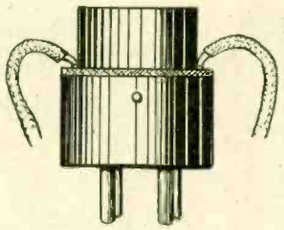
zes All Tubes, Sets and Circuits

Voltmeter Range Extended to 560 volts—Dandy Outfit!

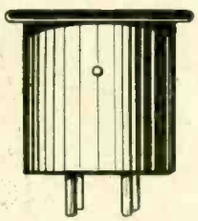


J-560 multiplier increases 140 volt AC range to 560 volts. Supplied with jack terminals (top illustration). J-106 multiplier increases 300 volts maximum of plate voltmeter to 600 volts, with jack terminals.

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.....

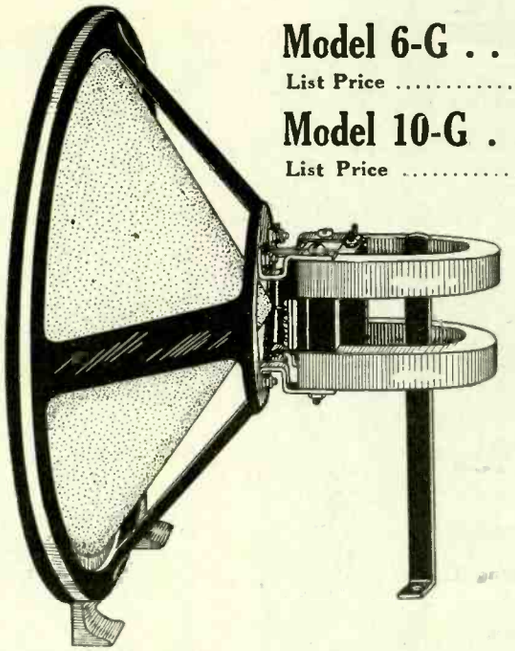
City.....State.....

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.

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.]

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

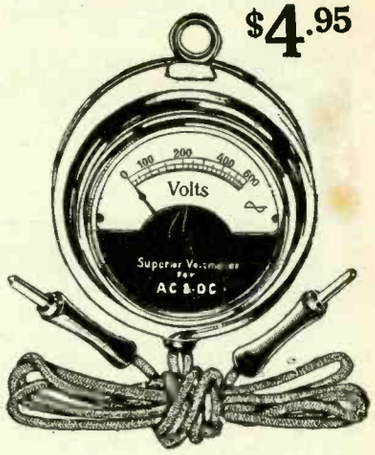
A highly suitable cabinet for the Farrand Inductor Chassis is the Brookfield, made in two models, one for each size Inductor cone. The finish is genuine ply walnut. The baffle effect is particularly fine. These cabinets are specially made for these speakers and are beautiful in appearance, as well as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

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 O-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

NAME .....

ADDRESS .....

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

5-DAY MONEY-BACK GUARANTY

"UNINTERRUPTED READER INTEREST"
EVERY WEEK — EVERY YEAR

RADIO WORLD

Vol. XVI, No. 11 Whole No. 401
November 30th, 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.

The HB33 for Sensitivity!

Four Screen Grid Tubes Ahead of Two Stages of Audio

By Herman Bernard

Managing Editor

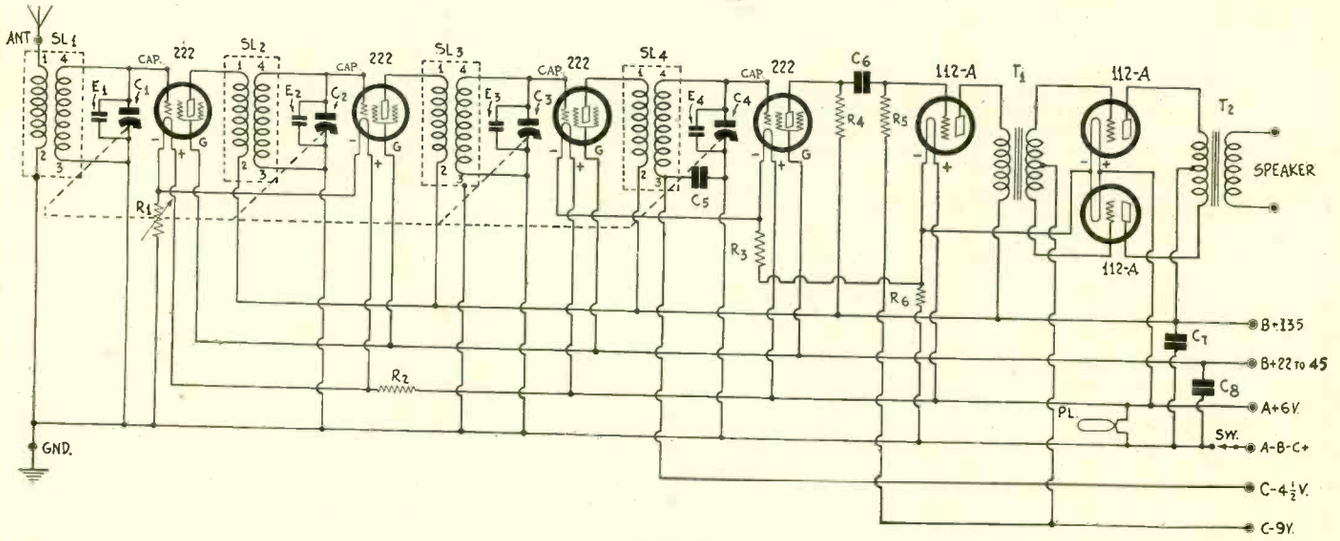


FIG. I.
CIRCUIT DIAGRAM OF THE HB33, A BATTERY-OPERATED RECEIVER OF EXTREME SENSITIVITY AND HIGH SELECTIVITY. THERE ARE THREE STAGES OF SCREEN GRID RF, A SCREEN GRID POWER DETECTOR AND AUDIO WITH A PUSH-PULL OUTPUT.

THREE stages of screen grid amplification afford all the gain at broadcast radio frequencies that it is practical to use, because any more would result in amplification to a high degree of the background noises and render reception objectionable on distant stations at least. The reason is that a distant station is not as strong as a local one, hence the background is a larger percentage of the total.

Some idea of the sensitivity of this receiver, with its four tuned stages, may be gleaned from the fact that stations within 800 miles of the point of reception are in the same class as locals. The adequateness of the volume control makes it easy to reduce the sensitivity on purely local stations, which is always necessary in a high-gain cascade of radio frequency amplification, while the gain may be worked at its stupendous maximum for signals of lesser intensity.

The sensitivity is rated at 9 microvolts per meter, and while that statement is not revealing to all, it will be easily understood how sensitive the circuit is when it is stated that it is more sensitive with one foot of wire hanging from the set's antenna post than the general run of receivers is with a 100-foot outdoor aerial, and of course much more selective. There will be no trouble from inter-station crosstalk arisng from lack of sufficient selectivity.

GOT A PEEP COAST TO COAST

To make such a circuit operable it is necessary to shield care-

LIST OF PARTS

SL1, SL2, SL3, SL4—Four stage shielded coil cascade.
C1, C2, C3, C4—Four gang .00035 mfd. condenser with equalizers E1, E2, E3, E4 built in.
C5, C6—Two .01 mfd. mica fixed condenser.
C7, C8—Two 1.0 mfd. bypass condensers 200 volt DC working voltage.
R1, Sw—30-ohm rheostat with switch, knob, insulators.
R2, R3—Two 6.5-ohm fixed filament resistors.
R4—One .05 meg. Lynch metallized resistor.
R5—One 5.0 meg. Lynch metallized resistor.
R6—One 1-ohm fixed filament resistor.
T1—One push-pull input transformer.
T2—One push-pull output transformer.
Ant., Gnd. Speaker—Four binding posts.
One drilled steel cabinet, crackle brown finish.
One vernier full-vision dial, mounting bracket, lamp bracket and lamp.
One subpanel with seven UX sockets and brackets.
Two drilled brackets for 4-gang condenser.
Four grid clips.
One connector cable, with UY socket.

The HB44, Same Circuit

Screen Grid RF and Detector, Two

By Herman

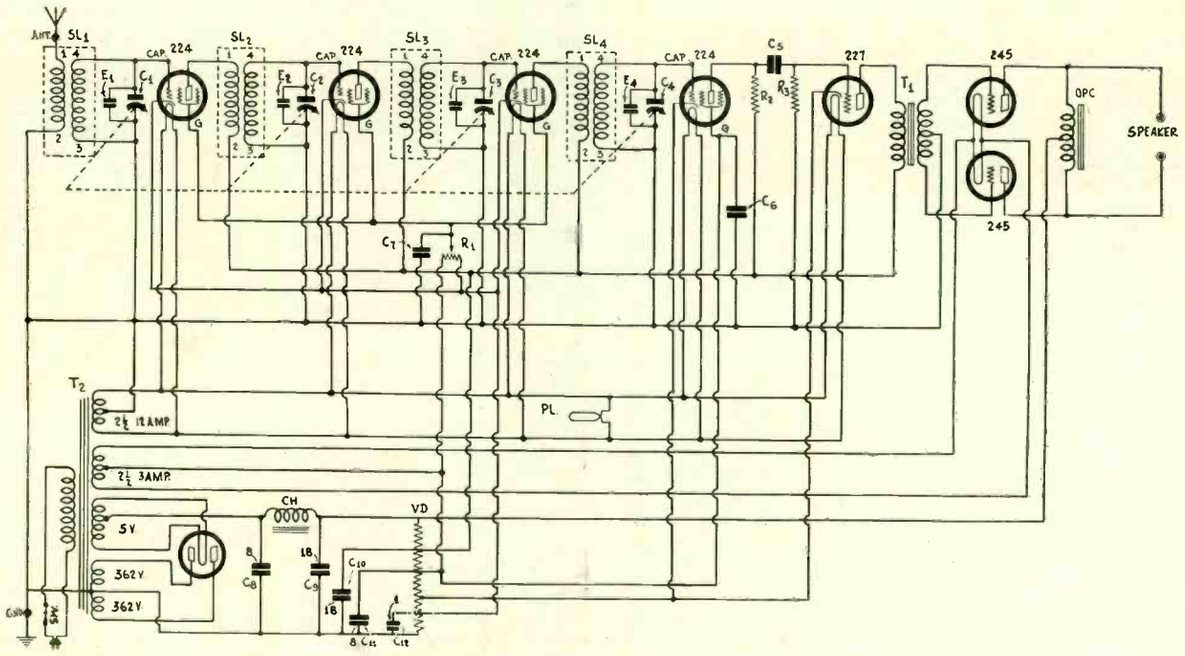


FIG. 1

DIAGRAM OF THE HB44, A COMPLETE RECEIVER FOR AC OPERATION, USING THREE STAGES OF SCREEN GRID TUNED RADIO FREQUENCY AMPLIFICATION, TUNED INPUT TO A SCREEN GRID POWER DETECTOR, A 227 AS FIRST AUDIO AMPLIFIER AND TWO 245's IN PUSH-PULL AS THE OUTPUT.

THE AC MODEL of the supersensitive receiver described on the foregoing pages maintains the same fundamental circuit, consisting of three stages of screen grid RF and a screen grid power detector, all shielded, a stage of resistance coupled first audio and a stage of push-pull final audio. The power supply is added, so that AC for the heaters and filaments, and DC for the bias, screen and plate voltages is automatically afforded.

However, the AC circuit is still more sensitive than the battery-operated model. The AC model is known as the HB44, to distinguish it from the battery model HB33.

The reason for the greater sensitivity lies principally in the fact that the AC screen grid tube provides a higher amplification under actual operating conditions, the geometrical structure of the 224 tube being similar to that of the battery model, 222, but not identical by any means, the allowable plate voltage for the 224 being 180 volts, or 45 volts higher than in the other instance. Also, the screen grid may take a higher voltage than for the 222.

HUSKY OUTPUT CHOKE OPC

In the present instance the same voltage of 50 used as negative bias for the push-pull pair, which pair consists of two 245's, is used as the positive voltage for the screen grids of three tubes. This is electrically practical because of the independence of the heater circuits of the 224 tubes from the filament circuit of the 245's.

As the plate current is high in the output, about 64 milliamperes for the two 245's, a husky center-tapped impedance coil is used. This has a rating of 100 milliamperes continuous use and an inductance of 35 henrys each side of the midtap, or 70 henrys across the total winding.

The same negative bias used on the detector serves for the first audio tube. The reason for this, despite the same plate voltage applied to both, is not the difference in effective voltage, because one load is a resistor and of high DC resistance and the other the primary of an audio transformer of relatively low DC resistance, but the characteristics of the tubes are different. Excellent power detection is obtained from the 224 when the negative bias is around 13 to 16 volts for a plate voltage of 180. Also, the average bias requirement of the 227 tube, for 180 plate volts, is 13 volts negative, without being at all critical, so the detector and the first audio may take the same bias at the same plate voltage to produce exactly diametric results: best detection in one instance and best amplification in the other.

VOLTAGE DIVIDER CONDENSER

How the voltages are obtained from the Multi-Tap Voltage Divider is shown in Fig. 2. The exact voltages obtained are not stated, because they will be slightly different in different locations, and some constructors believe that a small difference is important. It is of no importance, because the difference is distributed proportionately throughout the entire system. Even

LIST OF PARTS

SL1, SL2, SL3, SL4—Four stage shielded coil cascade for .00035 mfd.

C1, C2, C3, C4—One four gang .00035 mfd. condenser with equalizers E1, E2, E3, E4 built in; two brackets.

S5—One .01 mfd. mica condenser.

C6, C7, C12—Three 1 mfd. 200 volt DC bypass condensers.

C8, C9, C10, C11—One Mershon consisting of four condensers, two of 8 mfd. and two of 18 mfd. with bracket (Cat. Q 2-8, 2-18 B).

R1—One Electrad 25,000 ohm potentiometer with knob and two insulators.

R2—One 50,000 ohm Lynch metallized resistor (.05 meg.), with mounting.

R3—One Lynch 5.0 meg. metallized grid leak, with mounting.

VD—One Multi-Tap Voltage Divider, 13,850 ohms, 14 taps.

T1—One push-pull input transformer.

OPC—One center-tapped output choke.

T2—One Polo filament-plate supply, Cat. PFPS (Note: For 40 cycles use PFPS-40, for 25 cycles use PFPS-25).

Ch—One filter choke coil, 30 henrys, 100 ma.

SW—One pendant AC switch with 12 ft. cable.

Speaker (+), (—), Ant., Gnd.—Four binding posts.

PL—One pilot bracket with 2.5 volt lamp.

One subpanel 17½"x11½", with eight sockets.

One vernier dial.

One crackle brown finish drilled steel cabinet.

Four National grid clips.

as the HB33, But for AC

Audio with Push-Pull 245 Output

Bernard

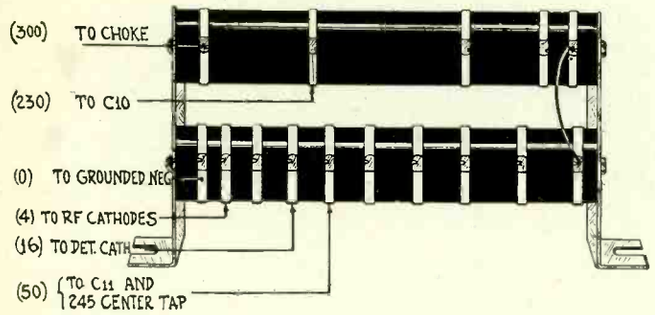


FIG. 2

DETAIL OF THE VOLTAGE DIVIDER AND THE TAPS TO USE TO OBTAIN THE REQUIRED VOLTAGES. THE DETECTOR CATHODE GOES TO A POINT ABOUT 16 VOLTS POSITIVE IN RESPECT TO NEGATIVE OF THE B SUPPLY, HENCE THE SCREEN GRID VOLTAGE ON THE DETECTOR WILL BE 50 LESS 16, OR 34 VOLTS. THE TUBE CHARACTERISTICS REQUIRE A LOWER VOLTAGE ON THE SCREEN FOR DETECTION THAN FOR AMPLIFICATION, AND THIS IS HOW THE LOWER VOLTAGE IS OBTAINED.

the resistance of the voltage divider, stated to be 13,850 ohms, may be 100 ohms more or less or 200 ohms more or less, and it is still of no consequence. The proportion is maintained throughout.

For instance, suppose that the voltage reading on a high resistance voltmeter, from one extreme of the voltage divider to the other, is 270 volts, instead of 300. This is a condition of undervoltage on the basis of 30 parts in 300, or ten per cent. But if the other voltages are proportionate, instead of 50 volts for negative bias of the push-pull pair and positive bias of the screen of three 224 tubes, the voltage would be 45, and instead of 180 volts on the plates of five tubes, 162 volts would be applied, but the screen grid voltage is lower in the same proportion, and it is the proportion that counts, even 10 per cent more or less not justifying any alarm whatsoever. The difference in performance between even a 10 per cent excess and a 10 per cent shortage scarcely could be noticed by any one by an ear test of the performance of the receiver.

SINGLE CHOKE SUFFICIENT

The power supply is standard, except that only a single choke coil is used, which is consistently done in factory-made receivers, but not so often prescribed in circuits for experimenters and home constructors. The reason why a single choke may be used is that an 8 mfd. capacity is placed next to the rectifier. This high capacity occasions a higher starting drain on the rectifier tube, for purposes of charging up the condenser, and may slightly shorten the rectifier tube life, but it is a small matter, and in fact some 280 tubes used in such circuits, with 8 mfd. next to them, gave satisfactory service without replacement or substitution for more than 18 months, where the receiver was used at least four hours nightly.

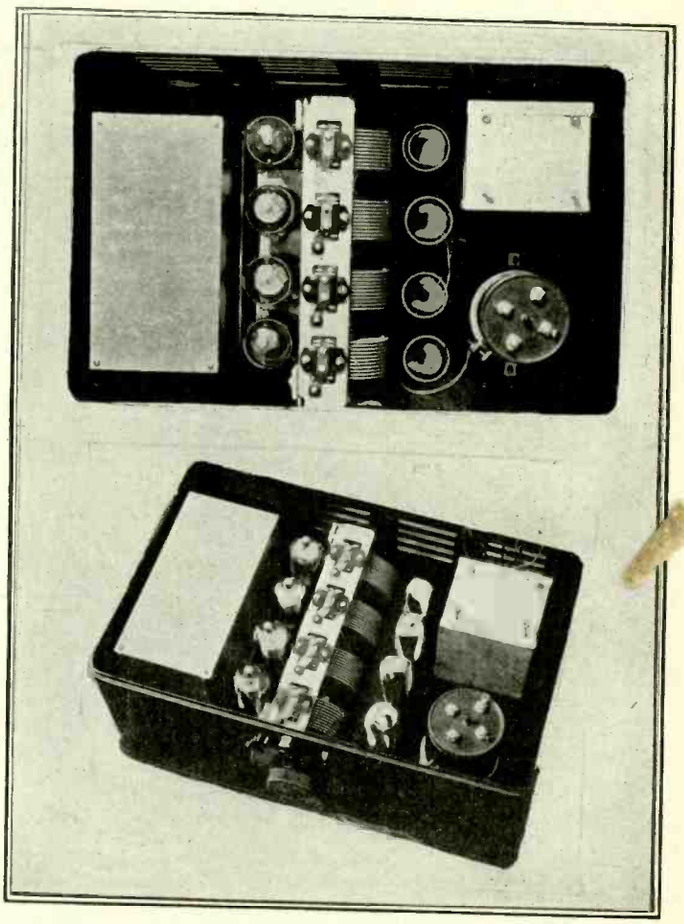
USE OF THE MERSHON

At the other side of the choke coil Ch an 18 mfd. capacity is placed. Since a Mershon condenser with four capacities, two of 8 mfd. and two of 18 mfd., is used, there are left one 18 mfd. and one 8 mfd. It is advisable to use the remaining 18 mfd. to bypass the 180 volt lead, especially because a stage of resistance coupled audio is used. This type of audio coupling gives the low notes good amplification, and for that reason the plate voltage supplied to a resistance coupled stage should be adequately bypassed. Also RF stability is aided because 180 volts go to the RF plates.

The other large capacity, 8 mfd., goes across the 50-volt biasing section, as tone quality requires a high capacity to reduce the impedance of the biasing resistance, otherwise low-note reproduction would suffer.

The other by-pass condensers are of low voltage type, 200 volts DC working voltage, and of 1 mfd. capacity.

The appearance of the receiver is the same externally as that



FIGS. 3 AND 4

TOP AND ANGULAR VIEWS OF THE HB44 IN A STEEL CABINET WITH CRACKLE BROWN FINISH. THE LID IS REMOVABLE, BUT THE REST OF THE CABINET IS ONE PIECE. THE BOTTOM IS SPOT-WELDED TO THE FRONT, REAR AND SIDES. A CHASSIS OR SUBPANEL IS TO BE ATTACHED TO THE METAL BOTTOM OF THE CABINET AND ENABLES ALL THE PARTS TO FIT IN COMFORTABLY.

of the battery model. The volume control is placed under the dial, but the switch is not on the front panel. It is a pendant switch, emerging from the rear of the receiver.

The choke coil CH and the output impedance OPC are placed underneath the subpanel, and help to support it at the center. Thus they are under the tuning condenser. The push-pull input transformer and the voltage divider likewise are underneath, being mounted by means of brackets.

The method of placing these parts affords adequate room for the filament-plate supply and for the Mershon condenser. Particularly does the filament-plate supply require a good position, as free as possible from surrounding objects. As the rear of the panel cabinet is cut out for suitable ventilation, another favorable point is gained.

Naturally, the rectifier tube, which gets hottest of all the tubes, is placed nearest the rear, also.

The chain of tubes, consisting of four 224's at left in Fig. 3, rear to front, is first RF, second RF, third RF and detector. The right-hand tubes are, front to rear, first audio, push-pull pair and 280 rectifier.

A wide-range sensitivity control is available in the form of a potentiometer R1 across a medium voltage section of the voltage divider. To the sliding contact of this potentiometer all the screen grids of the radio frequency amplifiers are connected so that to control the volume it is only necessary to turn the potentiometer knob.

[More details on the HB33 and HB44 will be published next week.—Editor.]

Control of Oscillato

Regenerator, Neutrodyne, TRF, Screen Grid and Su

By J. E. Anderson a

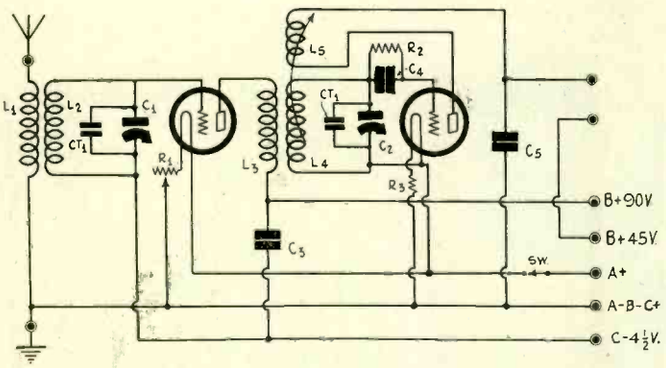


FIG. 21
THE TWO TUBE REGENERATOR, USING A STAGE OF TUNED RF AND A REGENERATIVE DETECTOR. IF 201A TUBES ARE USED, R1 IS 20 OHMS, R3 IS 4 OHMS, CT1 AND CT2 ARE MIDGET CONDENSERS. C5 IS .001 MFD. OR LESS. C3 IS 1 MFD. R2 AND C4 ARE 2 MEGOHMS AND .00025 MFD. RESPECTIVELY.

Questions

(1)—What are the five main types of speakers?
(2)—Describe the operation of each.
(3)—What is a baffle? Its purpose?
(4)—What is box resonance?
(5)—State two remedies for box resonance.
(6)—What is the flux of a magnet coil?
(7)—What are the two types of magnets?
(8)—What is an exponential horn?
(9)—Contrast the performance of the magnetic unit with the dynamic and inductor.
(10)—Which country was first in commercially producing condenser reproducers?

(*See answers on page* 12)

[*This article is one of a series entitled "Radio for Schoolboys."—Editor.*]

The most interesting thing about the one-tube circuit is the effect of regeneration. Omit that feature and the little set tunes broadly. Introduce regeneration and it is surprising what a great gain is established not only in volume but in selectivity. In fact, the selectivity is enhanced at a greater pace than the volume.

The tickler will not produce regeneration if the terminals are connected wrongly. The way the coil is wound and the method of making the connections to the circuit, plus the position in which the tickler is used, determine whether there will be regeneration, and if so, how much. An easy solution is to connect these terminals at random, then, if no regeneration is obtainable, remove the connections to plate and earphone, and connect to plate the lead that formerly went to earphone, and to earphone the lead that formerly went to plate. That is what is meant by reversing the leads. The electrical effect is to put the voltage of the plate circuit in phase with the voltage of the grid circuit. When voltages are out of phase there is, instead of regeneration, a condition called damping, sometimes referred to as degeneration.

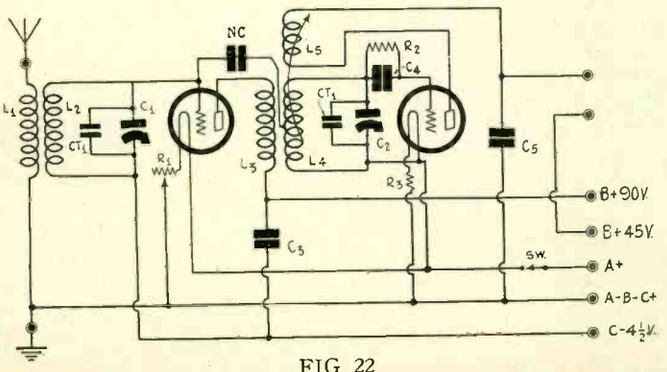


FIG. 22
THE NEUTRALIZATION PRINCIPLE APPLIED TO THE RF TUBE. NC IS THE NEUTRALIZING CONDENSER.

The higher the wavelength, the closer the coupling needed for good regeneration.

In a two-tube design the circuit for detection is used in the second tube, while the first tube is a tuned radio frequency amplifier.

The objects of using tuned radio frequency amplification are to increase the sensitivity and the selectivity. If only one stage of radio frequency amplification is used, then the increase in selectivity usually will not produce quite the desired result, since some interference will be suffered, due to inability to reject undesired frequencies near the frequency of the station that is tuned in. So in a two-tube design it is usual to introduce regeneration in the detector. This increases both selectivity and, principally on weak signals, sensitivity. The circuit diagram is shown in Fig. 21.

With the two-tube design, using or omitting regeneration, it matters not which, we encounter the tendency of the first tube to oscillate at the higher frequencies, due to capacity back-coupling inside the first tube. This vice is called oscillation in a radio frequency amplifier, to distinguish it from intentional controlled feedback which is called regeneration. And yet in another circuit, the Superheterodyne, when the oscillation is intentional the action is called oscillation nevertheless. This is common usage. All through radio such terms arise, but the actual meaning is usually clearly understood.

RHEOSTAT STOPS OSCILLATION

The two-tube design, with regeneration, is a good one, because if oscillation occurs turning the rheostat the right way will stop the oscillation. This rheostat is used principally as a volume control, but it serves the additional purpose of stabilization.

Within the last year it has become popular to use a screen grid tube as the first tube.

In one form or another the two-tube regenerative circuit has proved popular for several years. It enables the most attainment from two tubes, consistent with stable and clear results. Other circuits, such as reflexes, that used radio frequency amplifiers also as audio frequency amplifiers, established greater gain for the number of tubes used, but at the expense of stability and tone quality. The result is that the reflex has utterly lost all its former popularity and nowadays is heard of only in retrospection.

The first tube in the two-tube regenerative receiver may be prevented from breaking into self-oscillation by introducing a neutralizing system, such as a capacity that will feed the voltage back to the input, but out of phase with the advancing voltage. Thus the neutralizing capacity functions as a counter-capacity to the inter-element capacity of the first tube itself. The capacity between the grid and the plate is high enough to effectuate back coupling at the higher frequencies, but if an equal but opposite voltage is introduced, the two opposing forces cancel each other, and the circuit is said to be neutralized. This is the principle used in the Neutrodyne, hence the two-tube regenerative receiver treated in this manner may be classed as a regenerative Neutrodyne. However, the principal Neutrodyne circuits have consisted of multiple stages of tuned radio frequency amplification, without regeneration.

SEVEN TYPES OF CIRCUITS

So far, therefore, we have discussed the following circuits:
(1)—The crystal circuit.
(2)—The regenerator.
(3)—The Neutrodyne.
There are three other fundamental circuits:
(4)—The tuned radio frequency receiver.
(5)—The screen grid receiver.
(6)—The Superheterodyne.

The tuned radio frequency receiver is the same as the Neutrodyne, except for the omission of the neutralizing capacities. Hence the circuit will break into oscillation, unless some damping method is introduced. The most popular method now in use is the insertion of resistors in series with the grid of the tube, and the tuning circuit. These resistors are called suppressors, and while they function by introducing losses, these are gainful losses, because they render operative at the higher broadcast frequencies a receiver that would be uncontrollable in this region. Other methods of stopping the oscillation are to put resistors in the plate circuit, or to place the tuning coils so close to the tuning condensers that losses called eddy current losses are introduced.

r in RF Amplifiers

per-Heterodyne Receivers Explained for Schoolboys

nd Herman Bernard

SCREEN GRID CIRCUITS

The screen grid receiver is one of the tuned radio frequency type, using screen grid tubes. These tubes have four elements: filament, control grid, screen grid and plate. The control grid corresponds to the grid familiar in the general purpose types of tubes already discussed, while the screen grid is like an extra plate, and it surrounds the plate and takes a positive potential. The position of the screen grid makes it serve as a barrier against feedback within the tube itself, hence the necessity of introducing neutralizing capacities does not exist.

The screen grid tube, used as a radio frequency amplifier, is capable of much higher gain than any other tube. However, to use more than one stage of screen grid tuned radio frequency it is necessary to resort to shielding. The high amplification heightens the tendency toward feedback taking place inductively, from one coil to another. While the neutralizing condenser in the Neutrodyne was effective in getting rid of feedback that was due to inter-electrode tube capacity, it did not counterbalance the effect of inductive feedback, so coils were placed at non-coupling angles in the Neutrodyne, and such angles, which have been patented, sometimes are referred to as "the sacred angles."

In the screen grid receiver, the inductive feedback is prevented by the use of shielding. The shields consist of metal, usually aluminum, copper or steel, and completely isolate the coil from the rest of the circuit, except so far as connections are deliberately made from the coil terminals.

The screen grid tube requires a different type of coil than other tubes require. The winding in the plate circuit of the screen grid tube should have more turns than a winding used in the plate circuit of another tube, or it is even practical to tune the primary in the plate circuit, and use an untuned pickup secondary coil to feed the next tube. With other tubes the plate cannot be tuned, as oscillation occurs all over the dial.

THE SUPERHETERODYNE

The Superheterodyne is the sixth type of fundamental receiver. It is the most interesting of all radio frequency circuits, the most complicated theoretically, and is capable of enormous sensitivity consistent with stability.

In the Superheterodyne a tuning arrangement known as a mixer is used. The mixer is diagrammed in Fig. 24. The output is taken from the upper tube in the diagram, called the modulator tube, and is fed directly into a chain of stages using transformers with a large number of turns of wire on them, and permanently tuned to some frequency lower than the lowest broadcast frequency.

The two tubes in the mixer are the modulator and the oscillator. The incoming frequencies are picked up by the antenna winding L1, and L2 receives these frequencies by inductive coupling, communicating them also to L3, because the voltage drop in the inductance is not completed until the return of the L2 is made through L3 to A plus. The tuning condenser C1 is across the combined inductance of L2 and L3, and the tuned circuit accepts one particular frequency, at any setting, much more strongly than it accepts any other frequency. However, the selectivity of this tuned circuit alone is not high.

The incoming frequency, which we will assume is a tuned-in frequency of 1,000,000 cycles (1,000 kilocycles, or 300 meters wavelength), is introduced into the modulator tube, which is circuited like a detector, although its function is really somewhat different from that of detection. Nevertheless it is often called the first detector.

HOW CIRCUIT WORKS

The same frequency is introduced into the other tuned circuit, C3L4, through L3, and this second tuned circuit may be tuned to any frequency within its own range.

Notice the third coil L5 in the plate circuit of the oscillator. This coil is wound with enough turns of wire, and coupled sufficiently close to the secondary L4, so that oscillation is permanently present while the circuit is being operated. We therefore have a counterpart of what took place at the broadcasting station: a modulator and an oscillator mixing their frequencies. Now, the questions are: how is the tuning effected, where does the selectivity arise, and how is the output of the modulator utilized?

Since any two different frequencies may be combined to form a third frequency, we tune in a desired incoming radio frequency, tune the oscillator to some other frequency, different from the first by a predetermined frequency, and when we use subsequent stages permanently tuned to this difference frequency we have

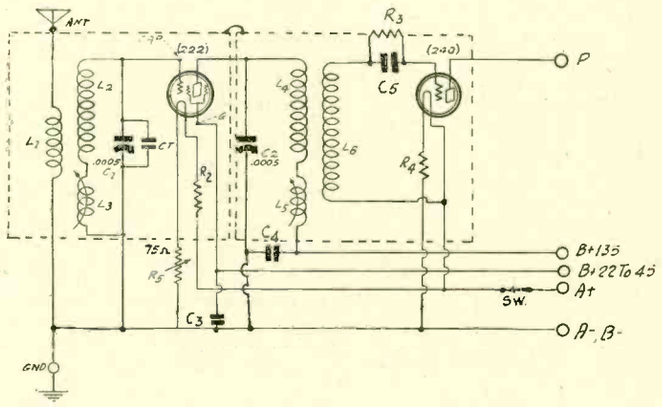


FIG. 23

A STAGE OF SCREEN GRID RF AND A DETECTOR, BOTH STAGES SHIELDED. THE DOTTED LINES REPRESENT THE SHIELDS, WHICH MUST BE GROUNDED.

a channel of a lower frequency that passes and amplifies the output of the modulator. By connecting a detector circuit to the end of this channel we produce detection, in what is sometimes called the second detector.

WHY CALLED "INTERMEDIATE"

The resultant-frequency amplifier is known as the intermediate frequency amplifier, because the frequency is intermediate in relation to the higher radio frequency and the lower audio frequency we shall finally obtain from the detector output. It is well to refer to the so-called first detector as the modulator, and the second detector simply as the detector, as that terminology is more accurate.

The intermediate amplifier may consist of several stages, the more stages, the greater the sensitivity and selectivity, and in general the greater the peril of oscillation at the intermediate frequency, and undesired condition.

EXPERTNESS OF DESIGN REQUIRED

Since tuned radio frequency amplification will be used in a Super-Heterodyne ahead of the mixer, and as there will be several stages of intermediate frequency amplification, there is double danger of oscillation in the one receiver of all that should be singularly free from this vice. Hence care in the design of a Superheterodyne is most essential.

So sensitive may the Superheterodyne be that it is possible to work the loudspeaker right from the detector. To date there are no tubes especially suitable for detection and output to the speaker at the same time, because the power handling capability will be low. The type of detection to use under such circumstances is negative grid bias detection where the bias is of a high order because the plate voltage itself is high. This is called power detection. But under such circumstances the plate current would be low, because the higher the negative bias, the smaller the plate current. In general, an output tube requires heavy plate current to support large fluctuations in signal voltage and current at greatly heightened amplitudes.

While use of the detector of a Superheterodyne as the output tube is rather a novelty than a recommended practice, and is still only a stunt, no doubt the day soon will arrive when receivers will build up such a large radio frequency amplification, either exclusively at the signal frequency, or at the signal frequency and at an intermediate or supermediate frequency, that special purpose tubes will have to be developed to meet the situation, in other words, tubes that function well as detectors but still can handle largely magnified voltage.

At least the use of only one stage of audio has gained some favor, and tuned radio frequency and Superheterodyne circuits have been produced commercially that use this system. The single stage of audio amplification is used to couple the detector output to a power tube input, that being mainly a means of introducing a power tube.

The action therefore may be summarized as follows:

(1)—A particular radio frequency is tuned in by the modulator input circuit and is imparted to the oscillator by virtue of some form of coupling between the first and second circuits.

(2)—The oscillator is tuned to a frequency differing from the

Is Oscillator Selective?

Authors Say it is not, Discussing Super-Heterodyne

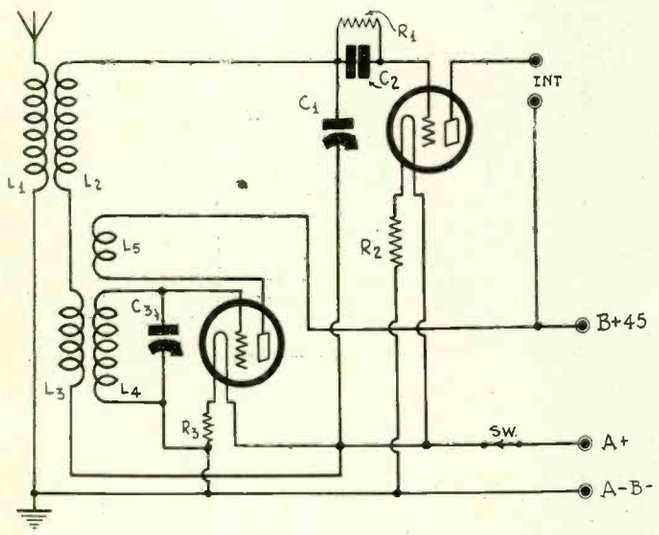


FIG. 24
THE MIXER OR FREQUENCY CHANGER OF A SUPER-HETERODYNE. THE UPPER TUBE IS THE MODULATOR AND THE LOWER ONE THE OSCILLATOR.

(*Continued from preceding page*)

modulator frequency by the frequency of the intermediate amplifier.

(3)—The modulator therefore entertains, among many frequencies present in it, a predominating frequency which is the intermediate frequency, and which it imparts to the intermediate amplifier for amplification at the second carrier frequency prior to detection.

Let us take a numerical example, based on tuning in a frequency of 1,000,000 cycles by the circuit C1, L1L2.

THE OSCILLATOR FREQUENCY

The intermediate frequency is always known first, since the intermediate amplifier is constructed to be particularly sensitive at a given intermediate frequency. So let us assume the intermediate frequency is 200,000 cycles (1,500 meters wavelength). The lowest broadcast frequency is 550,000 cycles, so the intermediate frequency is less than one-third the lowest broadcast frequency.

We can determine now to what frequency the oscillator must be tuned to bring in the station. It is the incoming frequency (1,000,000 cycles) less the intermediate frequency (200,000 cycles), or an oscillator frequency of 800,000 cycles.

Stated another way, when 800,000 cycles is mixed with 1,000,000 cycles, one of the resultant beat frequencies, and the principal one, is the difference between the two, or 200,000 cycles.

There are several forms of oscillators, the one diagrammed being the inductive tickler type, with tuned grid circuit. Also there are several ways, and combinations thereof, of coupling the modulator and the oscillator, besides the one shown. Usually the pickup coil, L3, is not a part of the tuned circuit, the end of L2 being connected to the condenser rotor, but the diagrammed method is a good one.

HOW SELECTIVITY ARISES

In practice it will be found that simply a modulator for radio frequency level selection will not suffice, hence some tuned radio frequency amplification is desirable for the enhanced selectivity prior to mixing.

The Superheterodyne gains its selectivity principally in the intermediate amplifier. The oscillator is not selective, of itself, but merely generates different frequencies, depending on the setting of the condenser C3 and the inductance of the coil L4, but if the intermediate amplifier is sharply tuned, then the oscillator tuning seems to be sharp.

The selectivity obtained from the intermediate amplifier is due to the close confinement of the amplification to the intermediate carrier emitted from the mixer.

The original carrier frequency has been lowered by the mixer, and the intermediate channel receives its own modulated special carrier, as produced by the mixing process, so if the intermediate channel were not sharply tuned the intermediate amplifier would be uselessly broad, and many stations would come in at any dial setting.

It is well therefore to use at least one stage of tuned radio frequency amplification ahead of the modulator so that the incoming frequency is freed from interfering frequencies.

If interfering frequencies ahead of the intermediate amplifier are even of low strength, squealing may result, and this may sound like the tweeting of young birds, or moans and howls, depending on the frequencies mixed unintentionally but inevitably. Even if an interfering frequency is weak, the resultant beat note, due to the frequency difference between the interferer and the oscillator, may be strong, because the oscillator is strong.

So it is accepted practice now to use tuned radio frequency ahead of the modulator. The circuit is still a Superheterodyne, since what makes a circuit a Superheterodyne is the fact that the desired incoming frequency is changed to a lower frequency for intermediate radio frequency amplification. So, too, if screen grid tubes are used in a Superheterodyne the circuit may be called a Screen Grid Superheterodyne.

THE SUM FREQUENCY

A form of circuit similar to the Superheterodyne, in that it uses a frequency changer or mixer, was described for the first time in 1924 in RADIO WORLD by Walt S. Thompson. The third frequency, or second carrier, instead of being intermediate was supermediate, that is, instead of the difference between two frequencies being used to produce a lower frequency for amplification, the sum of the two frequencies was used to obtain a higher frequency for amplification. Thus 1,000,000 cycles as the incoming frequency, and 800,000 cycles as the oscillator frequency, to borrow from a previous example, would require a supermediate frequency of 1,800,000 cycles, or higher than the highest broadcast frequency (1,500,000 cycles).

About two years later a circuit for home constructors, using this principle, was popularized by others under the name of the Infradyne.

Answers

To Questions appearing on page 10

(1)—Horn, dynamic, magnetic, inductor and condenser reproducers represent the main types.

(2)—The horn unit operates by the mechanical motion of a metal diaphragm, the sound radiation being aided by the horn. The dynamic speaker has an electro-magnet for balancing a voice coil that is moved by the signal current flowing through this moving coil, which is attached to a cone. The magnetic unit has a permanent (horseshoe) magnet, with magnet coils through which signal current is passed to actuate an armature that is attached to a radiating surface (cone). The inductor is a magnetic unit of special construction, whereby the motion of the armature is not toward the pole pieces, but in the direction of the length (instead of width) of the gap between poles. The condenser speaker has two oppositely polarized plates with insulating material (rubber) in between. It operates on the principle of electrostatic attraction. Differently polarized plates are pulled toward each other at varying rates, depending on the changing signal voltage.

(3)—A baffle is a board or other stiff substance with a hole in it the diameter of the cone attached to it, or may be a box, where the sides, top, bottom and rear are auxiliary to the front cut-out piece. The object of a baffle is to aid sound radiation and improve fidelity. It is acoustically an auxiliary sound-radiating or sound-directing medium.

(4)—Box resonance is the boominess or barrel-like reproduction resulting from the over-accentuation of low audio frequencies because the box acts as a resonant chamber to these frequencies and also stifles high audio frequencies.

(5)—Two remedies for box resonance are to leave the back, sides, top and bottom acoustically open, as by using lattice work or cane or equivalent, and to stuff the inside of the box with cotton batting.

(6)—Flux is the name given to the magnetic field of a coil.

(7)—Permanent (iron horseshoe) magnet and electro magnet (coil).

(8)—An exponential horn is one that has a flare increasing in the size of the opening at a certain predetermined mathematical ratio.

(9)—The magnetic unit is not so good on low-note reproduction as the dynamic and the inductor, and will not stand as heavy a strain or load, due to the armature striking the pole pieces.

(10)—Germany.

The Crux of Motorboating

Why It is Present and What Remedies to Apply

By Herbert E. Hayden

WE HAVE BEEN charged with gross negligence in not calling attention to the fact that motorboating may occur in amplifiers under certain conditions. We would gladly plead guilty if we had neglected this important subject, but the truth is that we say something about it nearly every week. This repetition may become monotonous to some, and it surely does to us, but the continuous stream of questions about oscillation in amplifiers is even more monotonous. Judging by the letters and calls we get on this subject, it would seem that every receiver is subject to this trouble except the one under immediate discussion. That has been tested so thoroughly that, although it oscillates viciously, it is not motorboating. No, in that particular instance the trouble is due to something entirely different, something that has never before happened in any receiver.

When that has been made perfectly clear the troubled fan wants to know why such receivers are designed, for did he not build it exactly as described. There is something inconsistent about the assurance that the trouble is entirely novel and individual and the question why such circuits are designed, and it is in that inconsistency where we seek our defense. One thousand receivers of a given design may be built and only one of them is a complete failure, complete from the builder's point of view. And also from his point of view he is entirely blameless. Now if he is entirely blameless the other 999 builders must have made some mistake which cancelled the mistake of the designer and which turned the failure into a wonderful success.

"Look, Pa, all the soldiers are out of step but our son John." He alone, indeed, marches exactly as prescribed in the school of the soldier.

SMALL SPOT ON HIS ESCUTCHEON

But even so, it may be only a small error for which he cannot be held accountable. Suppose he has not read any of the directions which apply to all the receivers, or if he has read them, perhaps he has no reason to assume that they apply to his particular set. For example, he knows that receivers motorboat as a rule when operated with B supply units and that they do not frequently do so when operated with batteries. What is he to believe, then, if his receiver works splendidly on a B supply and refuses to work at all when on a battery? At least he has a right to presume that his is an individual trouble. But is he justified in shutting his mind to any suggestions that the trouble after all falls into the general class? He is not. Although he asserts vehemently that he has built the receiver exactly as specified and that he has tried every known remedy for oscillation and motorboating, there may be something which somebody else has heard of, and which he has not yet tried.

We have in mind two similar cases. Two individuals had built two different receivers, both of which failed to work entirely on batteries but worked splendidly on B supply units. Both builders had tried every remedy known to them and both concluded that there was no hope. It could not possibly be motorboating in either case because the receivers worked on B supply units and not on batteries. Moreover, the noise in either case did not sound like motorboating. In one case it was a high pitch squeal, and in the other it sounded like the rat-a-tat of a machine gun.

A MACHINE GUN BARRAGE

The man whose receiver sounded like a machine gun was very militant in his complaint. Indeed, he turned a veritable machine gun barrage of words on the suspected culprit, the designer of the receiver. While he was getting his breath preparatory for a new burst of invectives the designer cautiously suggested that the trouble might be due to resistance in the B battery. The whole munitions dump exploded at that suggestion. He had measured the voltage of the battery and knew that it was all

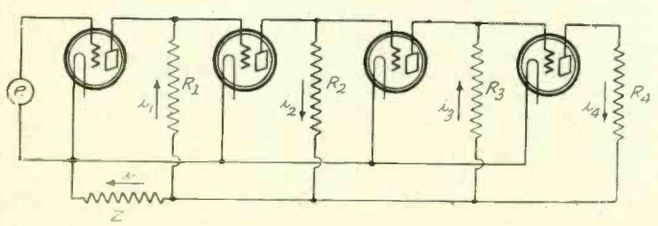


FIG. 1
THIS IS A FOUR-CIRCUIT AMPLIFIER ILLUSTRATING THE CAUSE OF MOTORBOATING, OR RATHER STABILITY IN THIS INSTANCE.

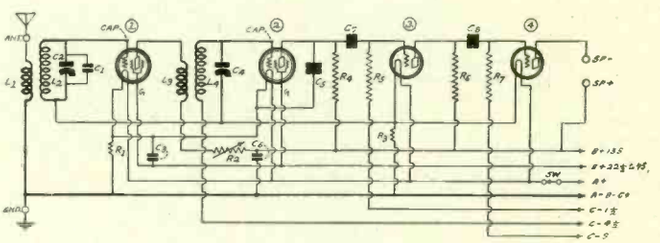


FIG. 2
THIS AMPLIFIER CONTAINS THREE PLATE CIRCUITS AND IS, THEREFORE RATHER UNSTABLE, BUT ITS INSTABILITY CAN BE REMEDIED VERY EASILY WITH CONDENSERS.

right. It was the set that was wrong in design and the B battery was all right.

When the detonation was over, the designer suggested that he might stop the noise by connecting condensers across the battery. Had he done so? Condensers across the batteries! Nobody ever suggested that before as a cure for motorboating. Of course, he had not tried it. Why should he, anyway, when he had good batteries and a receiver built **exactly** to specifications?

He should at least have tried condensers for they had been recommended as a cure for motorboating every time the subject had been discussed. Not only had they been recommended but they had been held up as the only remedy that is more than a makeshift, and the easiest to apply. Condensers are for motorboating what food is for hunger and water for thirst.

We have made similar statements so often that most readers must wonder if there is nothing else to discuss, and yet we are charged daily, and many times a day, that we never say anything about motorboating cures.

HOW LARGE THE CONDENSERS

When a troubled set-builder finally has been convinced that condensers may be advantageous as a cure of motorboating even when used in conjunction with batteries, his next question relates to the size of the condensers. The answer invariably is that the larger the condensers the better. "Why, you have never said that before," he counters. Now that is really an admission that he has seen something to the effect that condensers should be used, but the assertion is good defensive ammunition nevertheless.

This continual tussle with the set-builder who has never heard of the cures for motorboating has its compensations. He goes home, or he hangs up the receiver, and proceeds to connect all the condensers he has around—and they are usually both many and large—and he discovers their efficacy. He calls again, in person or by phone, or he may write a letter, and swears that the receiver now works wonderfully. "It is all that you claimed for it, and more," he enthuses. "But do publish something about it so that others who may have the same trouble don't have to go through all the misery that I have gone through," he entreats. "Perhaps they," he adds, "will read it more attentively than I have done in the past."

Three weeks later the same man, or possibly it is another man whose name is the same and who lives in the same place, writes a letter somewhat as follows: "I have built the XYZ receiver **exactly** as you described it and it works wonderfully. But there is a queer noise in it, something like the rat-a-tat of a machine gun. I have tried everything I can think of but cannot stop it. Can you suggest anything that might help?" We could suggest something very effective, but we don't, because there are many who may never have read anything on the subject at the time they had the trouble, and that is the only time that the discussion has much meaning. So all we do is to recount all the well-tried remedies for motorboating for their benefit, and one of these is that more and larger by-pass condensers be used across the voltage taps in the plate voltage supply, even if that supply be a battery thought to be in good condition.

ODDS AND EVENS

"How is it that you never tell your readers that a resistance-coupled amplifier having three plate circuits is more unstable than one having four plate circuits?" One reader upbraided us

(*Continued on page 22*)

Audio Amplifiers fo

Push-Pull Transformer Coupling for

By Knollys

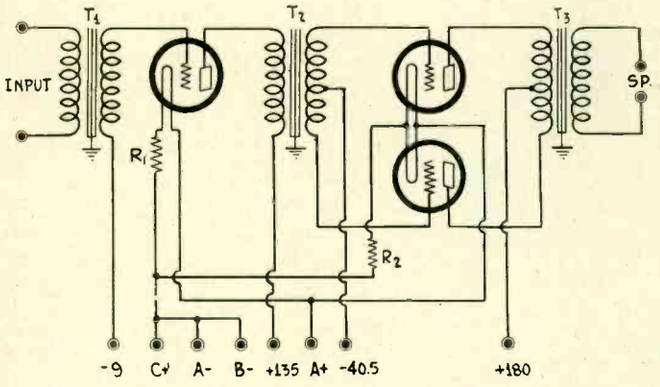


FIG. 38

A TWO-STAGE, BATTERY TYPE, PUSH-PULL AMPLIFIER SUITABLE FOR USE WITH THE BATTERY CIRCUIT IN FIG. 36.

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

Another radio frequency choke, Ch3, is put in the plate circuit of the oscillator, and this, too, can have an inductance of 85 millihenries. The condenser connected from the high side of this coil and the filament should have a capacity not less than .01 mfd. This condenser is indicated by C11 in Fig. 36 and by C13 in Fig. 37.

In each of the circuits is an output filter consisting of a choke coil, Ch2, and two condensers, C7 and C8. The values of this coil and these condensers are more restricted than those of the other filters because the coil is in series with the signal line and the condensers are across it. Each of the condensers should have a value of .0005 mfd. and the inductance of the coil should not be greater than 85 millihenries. If a coil of lower value is available it can be used to advantage, but the value should not be less than 10 millihenries. The effect of using too large condensers and a too high inductance in this filter is to cut down the intensity of the high audio notes. The values suggested, that is, .0005 mfd. for the condensers and 85 millihenries for the inductance, are large enough to suppress the intermediate frequency of 200 kc and yet not large enough to suppress appreciably audio frequencies below 10,000 cycles.

INTERMEDIATE FREQUENCY TUNERS

We have already suggested the design for 200 kc intermediate frequency tuners, but we repeat it here for the convenience of the reader. The tuning condensers C4, C5, and C6 should be of .0005 mfd. capacity and all should be as nearly equal as practical. A small variable midget condenser having a capacity of about 80 mmfd. should be connected in parallel with each of these fixed tuning condensers to allow for accurate adjustment. These variable condensers are not shown in the drawings but are understood to be electrically integral parts of the fixed condensers.

The primary winding of any one of the coils, T3, T4, and T5, is tuned and should be on the outside form. If this form is two inches in diameter the proper inductance is obtained by using 177 turns of No. 32 enameled wire, wound solenoid fashion without spacing. The secondary of each coil should be wound on tubing which fits snugly inside the primary form, and it should consist of 250 turns of No. 36 enameled wire, also wound solenoid fashion without spacing. The secondary should be centered with respect to the primary so as to get the closest practicable coupling.

GRID BIAS PROVIDED

Grid bias for the amplifier tubes in the battery circuit, Fig. 36, is provided by voltage drops in the filament circuits. Four different bias and ballast resistors are used for the seven tubes. R3 serves all the tubes and its value should be one ohm. This makes the drop in it a little more than one volt, which is the bias on the oscillator tube. R2 serves the two intermediate frequency tubes and its value should be 6 ohms. This makes the grid bias on the two screen grid tubes approximately 1.5 volts. R1, which serves the first two screen grid tubes, should have the same value because both the filament current and the grid bias on these amplifiers should be the same as those in the two intermediate tubes.

The modulator and the detector tubes require higher grid voltages than are available in the circuit and therefore two binding posts to which suitable voltages may be connected. C' is for the modulator and C" for the detector. Since the tubes are different, different voltages will in general have to be employed to give best results. The best way of determining the optimum voltages in any case is to try different values until the signals are the loudest. Approximately 3 volts will be needed for the modulator in addition to the drops in R0 and R3, and from 6 to 18 on the detector in addition to the drop in R3.

It is assumed that the voltage between B2 and A minus is 135 volts and that between B1 and A minus 45 volts.

There are several by-pass condensers in Fig. 36 not yet mentioned. C9, which bypasses the grid bias battery or bias resistor serving the modulator, should not be smaller than .01 mfd. The remaining condensers, C10, C12, C14, and C15, may well be as large as one microfarad.

Rh in this circuit is a volume control rheostat controlling the filament current in the two screen grid radio frequency amplifiers. In order to provide a wide-range control, a rheostat of 30 to 50 ohms is recommended. It must be able to carry about one-half ampere without undue heating.

DETAILS OF AC CIRCUIT

Rheostat R1 in Fig. 37 serves two purposes, namely, to provide a grid bias for the first two screen grid tubes and a volume control in the radio frequency level. The bias on the tubes should be 1.5 volts, and since both the plate and screen currents of the two tubes flow through R1, the total current is approximately 10 milliamperes. Therefore, the resistance value should be at least 150 ohms. This value, however, does not allow for any volume control, but if a 2,000 ohm variable resistor be used the volume control range will be considerable. It makes little difference just what variable resistor is used just so it can be set as low as 150 ohms. There are both wirewound and compression type variable resistors covering the range required.

The condenser C9 across this resistance should be used to prevent coupling between the tubes, and its value should not be less than .01 mfd. A much larger value would be preferable.

Resistor R2 serves to provide bias for the oscillator and a value of 1,500 ohms is recommended. It should be by-passed with condenser C12, which should not be smaller than 0.1 mfd.

R3 serves to provide bias for the two intermediate frequency screen grid amplifiers. Since these tubes are operated in the same manner as the two radio frequency amplifiers the bias should be the same, and, therefore, R3 should have a value of 150 ohms. The by-pass condenser C14 should be at least of one microfarad because it is necessary to make the coupling between the tube very low on account of the high amplification and also because the intermediate frequency is comparatively low, even though it is 200 kc.

INTERMEDIATE VOLUME CONTROL

The principal volume control in this circuit is the potentiometer R4 by means of which the voltage on the screen grids of the intermediate frequency amplifiers may be varied between zero and 75 volts. There are wirewound potentiometers of 25,000 ohms available and one of these is recommended. The portion of this potentiometer which is in use at any time is by-passed with condenser C15, the value of which should not be less than one microfarad. This capacity is necessary in order that the screen voltage may be kept constant with respect to signal variations. Of course, the larger the capacity is, the more effective the condenser is in maintaining the voltage constant.

The control of volume in a receiver employing AC tubes is always a problem, but the potentiometer method specified in this circuit is one which is not only very effective but which can be used without complications. Its effectiveness is due to the rapid change in the amplification as the screen grid voltage is changed. The volume control range is very great within the zero to 75-volt range of voltage.

A special arrangement is provided for obtaining proper bias on the detector. Resistance R5 is connected across the voltage source and the cathode of the detector is returned to a suitable point on this resistance. If it is connected to a slider any desired voltage can be obtained and that setting which gives best results should be sought experimentally. If the total voltage across R5 is 180 volts the drop in the portion marked P2 should be about 22 volts for power detection. The value of

r a Superheterodyne

AC and Battery Operation of Filaments

Satterwhite

this portion depends on the resistance value of R5. Suppose this is 25,000 ohms. P2, then, should be nearly 3,000 ohms.

BIAS ON MODULATOR

The bias on the modulator tube is also taken from a drop in this resistor and is that in the portion marked P3. This tube may need an entirely different bias from that needed by the detector, and, therefore, a second slider is provided so that this bias, too, can be obtained experimentally, and independently. While the cathode of the modulator is returned to a point on R5 to the right of the return of the detector cathode, thus indicating a greater bias, it should really be to the left, for the screen grid tube does not require as much bias as the other tube. Approximately, the bias should be one-half so that the return of the screen grid cathode should be to a point half way between B minus and the return of the detector cathode.

In order to provide two sliders on R5 it may be necessary to use two potentiometers in series, one of 2,000 ohms next to B—, to which the cathode of the modulator should be connected, and another of 25,000 ohms to the slider of which the cathode of the detector should be connected. That makes a total of 27,000 ohms for R5, but that is all right.

In Fig. 37 the lead from the cathode of the modulator to the potentiometer R5 is rather long, but this does not necessarily mean that the lead in the receiver is correspondingly long. The length depends entirely on the layout. However, it is desirable, necessary in fact, to by-pass P3 with a condenser C10, the value of which should not be less than .01 mfd. It should be placed as close to the modulator tube as practicable.

Another condenser, C16, should be used for by-passing P2, and this should not be smaller than 2 mfd., since this operates primarily at audio frequency. It would be preferable to make it 4 mfd. or even larger. Another condenser, C17, is connected across the major portion of R5, and it is well to make it at least 2 mfd. since it operates at audio frequency. C18 should also be large.

VOLTAGES REQUIRED

The voltages to be applied at B1 is 75 volts and that at B2, 180 volts. One 2.5-volt winding supplies the filament current for the first six tubes. Since each tube requires 1.75 amperes, the winding should be able to deliver at least 10.5 amperes. Another 2.5-volt winding supplies the detector tube. This winding need not be rated higher than about 2 amperes. If a winding that is able to carry up to 12 amperes is available it is possible to put all the tubes on it.

The plate current required for the battery circuit in Fig. 36 is about 13 milliamperes, a value based on the supposition that all the plate, screen, and grid voltages are normal. The value is so small that the circuit may be put on a B supply designed for about 85 milliamperes, even when a power amplifier using two 245 power tubes are put on the same supply.

The AC circuit in Fig. 37 takes considerably more current. Each screen grid amplifier takes about 5 milliamperes, and since there are four of them the current taken by them alone is 20 milliamperes. The oscillator takes an additional 3 milliamperes and the modulator and the detector one-half each. Then there are the 25,000-ohm potentiometer R4, which takes 3 milliamperes, and the 27,000-ohm potentiometer R5, which takes 6.7 milliamperes. Therefore, the total current is 33.7 milliamperes. This estimated value is undoubtedly a little higher than actual value will be in a practical case, but it is well to figure on at least 30 milliamperes.

AUDIO AMPLIFIER NEEDED

If transformer-coupled, push-pull amplification is desired for the circuits shown in Figs. 36 and 37, the amplifiers given in Figs. 38 and 39, respectively, can be used. The two circuits are essentially alike except that different tubes and voltages are used. The transformers are the same in both. The choice of transformers is mainly a matter of compromise between cost and quality.

Resistor R1 in Fig. 38 is a four-ohm ballast and resistor R2 is a two-ohm ballast. The tubes recommended are 112A type in the first stage and 171A in the output stage. The recommended voltages are given on the figure. The grid bias voltages indicated may be obtained either from batteries or from voltage drops in the voltage divider in the B supply.

No by-pass condensers are shown in the amplifier because these are supposed to be built into the B supply.

The amplifier in Fig. 39, which is especially suitable for the

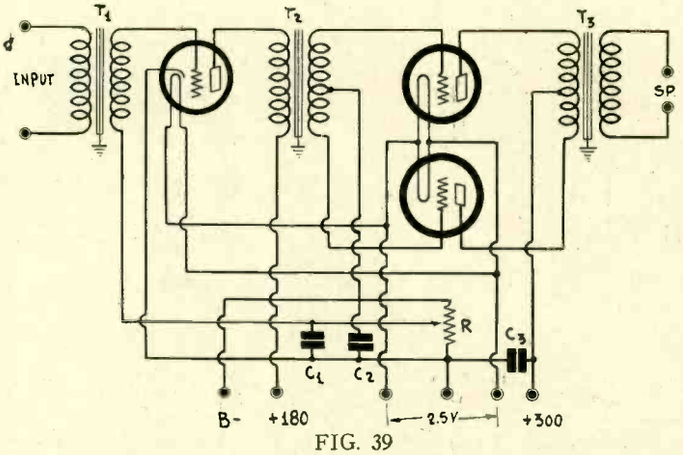


FIG. 39

A TWO-STAGE, AC TYPE, PUSH-PULL AMPLIFIER SUITABLE FOR USE WITH THE AC CIRCUIT IN FIG. 37.

circuit in Fig. 37, contains one 227 type tube and two 245 type tubes. The filament current for all the tubes is derived from a single 2.5-volt winding, which should be capable of delivering at least 4.75 amperes.

Bias for all the tubes is taken from a voltage drop in R, a potentiometer of 750 ohms. The slider is connected to the grid return of the first tube and it should be set so that the bias on the tube is 13.5 volts. This requires a resistance between the slider and the center-tap of approximately 200 ohms. Every part of resistance R must be able to carry 64 milliamperes without undue heating.

The resistor called for here is not standard but it can be made up by connecting smaller units in series. While the total resistance called for is 750 ohms it is all right to use 800 ohms because the value that should be used is really 780 ohms. A small deviation one way or the other does not make much difference.

It does make a great deal of difference whether or not the condensers C1, C2, and C3 are used. It is recommended that each one be not smaller than 4 mfd. C3 is across a voltage of 250 volts and it should have a rating high enough to withstand it. The others are across comparatively low voltages.

While Fig. 39 was designed to follow the circuit in Fig. 37, it can be used in conjunction with that in Fig. 36 as well, provided that alternating current is available. Indeed, the circuit in Fig. 39 is recommended whenever it can be used, because it is capable of both greater output and better quality.

The total plate current in the amplifier in Fig. 38 is approximately 45 milliamperes while that in Fig. 39 is about 70 milliamperes. Due to this heavy current in the second amplifier, it is necessary to use an extra heavy duty B supply if this is also to supply the radio frequency portion of the receiver, or else it is necessary to use two separate B supply units. This procedure is recommended because for equal results two will be the less expensive. B supply units will be given later.

SINGLE-SIDED AMPLIFIERS

It may be that some will prefer to use single-sided amplification in order to economize on plate current. They will find two suitable amplifiers in Figs. 40 and 41. Two good audio transformers, T1 and T2, are used in each one and also one heavy duty, 30-henry choke coil Ch. The tubes in the battery amplifier Fig. 40 are supposed to be 112A and 171A and those in the AC circuit 227 and 245. The condenser C4 in each circuit should have a capacity of at least 4 mfd. and be rated at 600 volts or more.

R1 and R2 in Fig. 40 are equal ballast resistors of 4 ohms each.

R1 in Fig. 41 should have a value of 2,250 ohms, which is a standard commercial value. This resistor should be by-passed with a condenser C1, which should be not smaller than 2 mfd. R2 is a resistor of 1,500 ohms to supply bias for the power tube. It should be by-passed with a condenser C2, which should be at least 4 mfd. C3 is desirable but not absolutely necessary in all instances. Its object is to aid in the elimination of feedback and possible motorboating. Two microfarads or more should be used, with a rating of about 600 volts.

The voltages applied to this circuit are indicated at the binding posts.

The Shielded Universa

Tuning Conditions Are Mounted on Front

By Capt. Peter

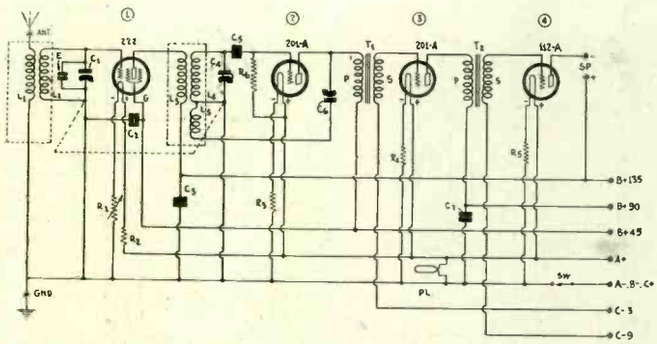


FIG. 1
CIRCUIT DIAGRAM OF THE NEW UNIVERSAL, IN SCHEMATIC FORM. THE TWO COILS ARE SHIELDED. A SCREEN GRID TUBE IS USED AS RADIO FREQUENCY AMPLIFIER. THE CIRCUIT IS DESIGNED FOR USE OF A STORAGE BATTERY FOR THE FILAMENTS, AND B BATTERIES OR A B ELIMINATOR FOR THE PLATES OF THE TUBES.

THE extremely sensitive four-tube circuit design that has become popular under the name of the Universal is shown herewith for the first time in shielded form, with a screen grid tube as radio frequency amplifier. The shielding is effected by a single unit, divided into two compartments by a partition. A novelty exists in the method of mounting the condensers, as they are bracketed directly onto the front of the shield.

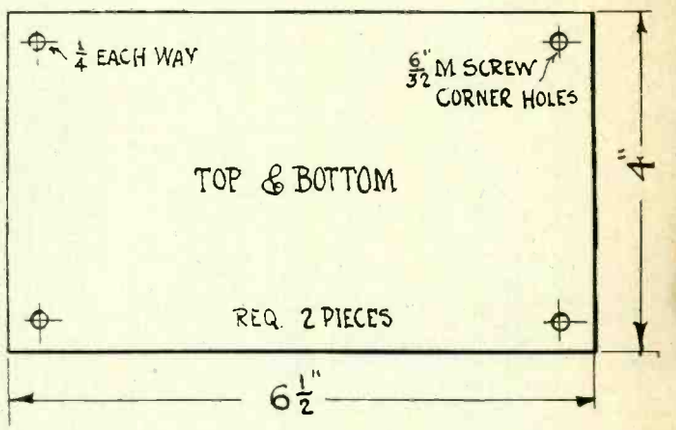
Use of shielding makes for a better stability, although it must be admitted that shielding is not absolutely essential in a circuit design that consists of one stage of tuned radio frequency amplification, even when using a screen grid tube.

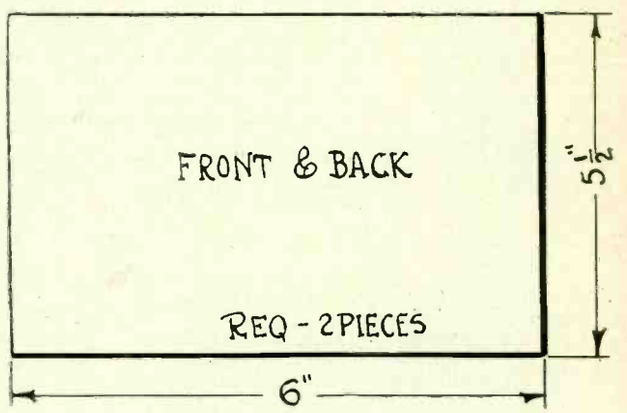
The resultant arrangement is decidedly good-looking. The shielded stages are at left, with the tubes between the shield and the front panel, while at right the two audio tubes are similarly arranged, with the transformers and two of the bypass condensers behind them.

The shield must be grounded to be effective, and the rotors or frames of the tuning condensers automatically take the same potential. Although a minus is grounded likewise, this does not interfere with a positive grid return for the detector stage, since the grid condenser C5 isolates the tuned secondary L4 from the direct voltage on the grid, while the conductive return for the grid is made directly through the leak to positive of the detector filament. This requires a mounting for the leak independent of any clips on the grid condenser, which clips would not be used in this instance.

LIST OF PARTS

L1L2—One shielded antenna stage, for .00035 mfd., SAS3.
L3L4L5—One shielded Universal detector input, for .00035 mfd., SU-3.
(Both of above one unit.)
C1, C4—Two .0035 mfd. tuning condensers, with shafts protruding front and rear; brackets affixed.
C2, C3, C7—Three 1 mfd. bypass condensers, 200 volt DC working voltage.
C5—One .00025 mfd. fixed condenser.
C6—One 50 mmfd. Hammarlund Junior condenser.
CE—One 80 mmfd. Hammarlund equalizing condenser.
T1, T2—Two audio frequency transformers.
R1, SW—One 75 ohm rheostat with switch built in.
R2—One 6.5 ohm fixed filament resistor.
R3, R4, R5—Three 4 ohm fixed filament resistors.
R6—One Lynch 5 meg. grid leak with mounting.
Ant., Gnd., Speaker (+), Speaker (—)—Four binding posts.
National modernistic dial with color wheel and 5 or 6 volt pilot lamp, PL.
Two coupling links and a 1¼ inch rod ¼ inch diameter.
One 7x18 inch drilled front panel.
One 17x8½ inch baseboard.
Four UX (four prong) sockets.
One grid National grid clip.
One 222, two 201A and one 112A tubes.





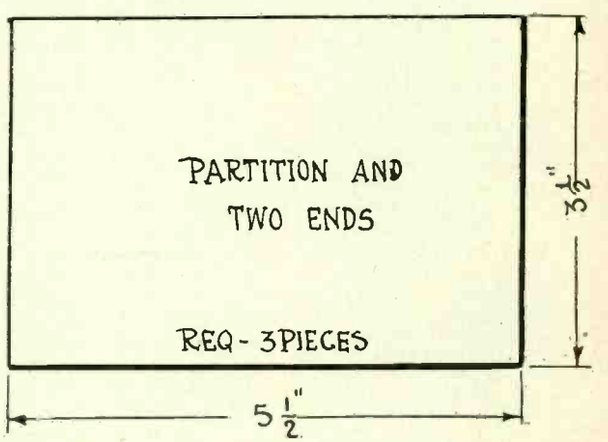


FIG. 2
DATA FOR CONSTRUCTING PARTITIONED SHIELD USED FOR HOUSING THE COILS INSIDE, AND SUPPORTING THE TWO TUNING CONDENSERS OUTSIDE THE FRONT UPRIGHT.

The two tuned circuits may be made identical in tuning characteristics by use of an equalizing condenser, EC, across the first tuning condenser, C1. None is needed across the second tuning capacity, C4.

If you desire to use condensers you now have, and they do not

l with Screen Grid RF

of Partitioned Shield in Neat Assembly

V. O'Rourke

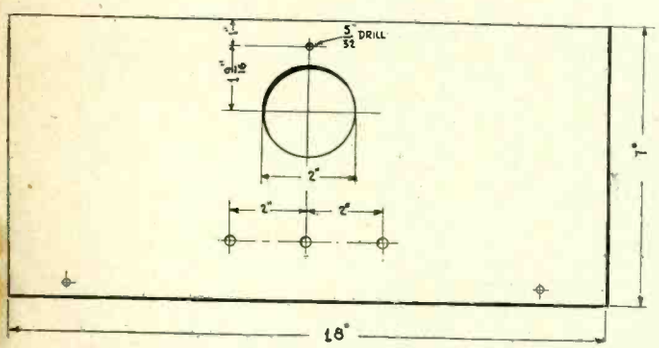


FIG. 3

DIMENSIONS FOR DRILLING A 7x18 INCH FRONT PANEL, TO ACCOMMODATE THE NEW NATIONAL MODERNISTIC DIAL, THE SWITCH-RHEOSTAT AT RIGHT AND THE REGENERATION CONDENSER AT LEFT.

come equipped with mounting brackets, you can fasten a bracket at the single hole mounting fixture and bend it at right angles at the desired distance, which is gauged by the height of the condenser frame. A single bracket for each condenser will suffice, but it is necessary to have condensers with shafts extending front and rear, to enable coupling by a link. If the arrangement used in the laboratory model of the receiver is duplicated, the shields are obtainable with holes already drilled to receive the brackets that are built into the particular condensers.

The circuit needs bypassing, so a capacity of 1 mfd. is used to ground in each of three instances: C2 from the G post, screen grid, of the first tube; C3 from the B plus terminal of the primary L3, and C7 from the 90-volt (B) post of the second audio transformer. Every point in the circuit that well could be grounded has been grounded. This gets rid of body capacity, an end served also by connection of the regeneration condenser, C6, of 50 mmfd., with rotor to detector plate and stator to the parallel feed coil, L5.

HOW REGENERATION IS OBTAINED

Regeneration is obtained by introducing as much capacity of C6 as required, the 50 mmfd. maximum being ample even for the highest broadcast wavelength.

The radio frequency voltage in the detector plate circuit, instead of being bypassed to ground, as is usually done in circuits where the immediate elimination of as much as possible of the RF is desired, is here fed to the parallel feed coil, L5, in which a varying voltage is set up, in the form of an electro-magnetic field. As the two windings L5 and L4 are really one tapped winding, the coupling is close, the field of L5 linking with the field of L4 to produce regeneration. The voltage must be fed back in phase to make regeneration possible, but the coil is shown in its proper phase relationship, established by the method of connection, the tap going to the grounded potential.

The customary rheostat for volume control of battery-operated circuits is used, but instead of being at left as you look at the front panel, it is at right, for the regeneration condenser should be as near as possible to the detector input coil, for shortness of leads and consequent stability. The placement of this condenser, C6, is about as close to the detector input coil as is practical. There is just enough room behind the front panel for the condenser to be mounted with freedom of motion for the rotor plates.

MODERN FRONT PANEL

A space between the detector tuning condenser and the National drum is used. The only requirement is that the coupling link near the drum engage a shaft ¼ inch diameter and 1¼ inches long. Thus about ½ inch extra distance prevails between the drum and the tuning condenser, and the regeneration capacity is accommodated.

The switch is built into the rheostat, so that the minor controls are reduced to two.

Extreme modernity is present in the front panel design, occasioned principally by the use of the new National dial, which has a modernistic escutcheon. The scale is a photographic film on which the numbered are developed. Instead of reading this scale directly,

(*Continued on next page*)

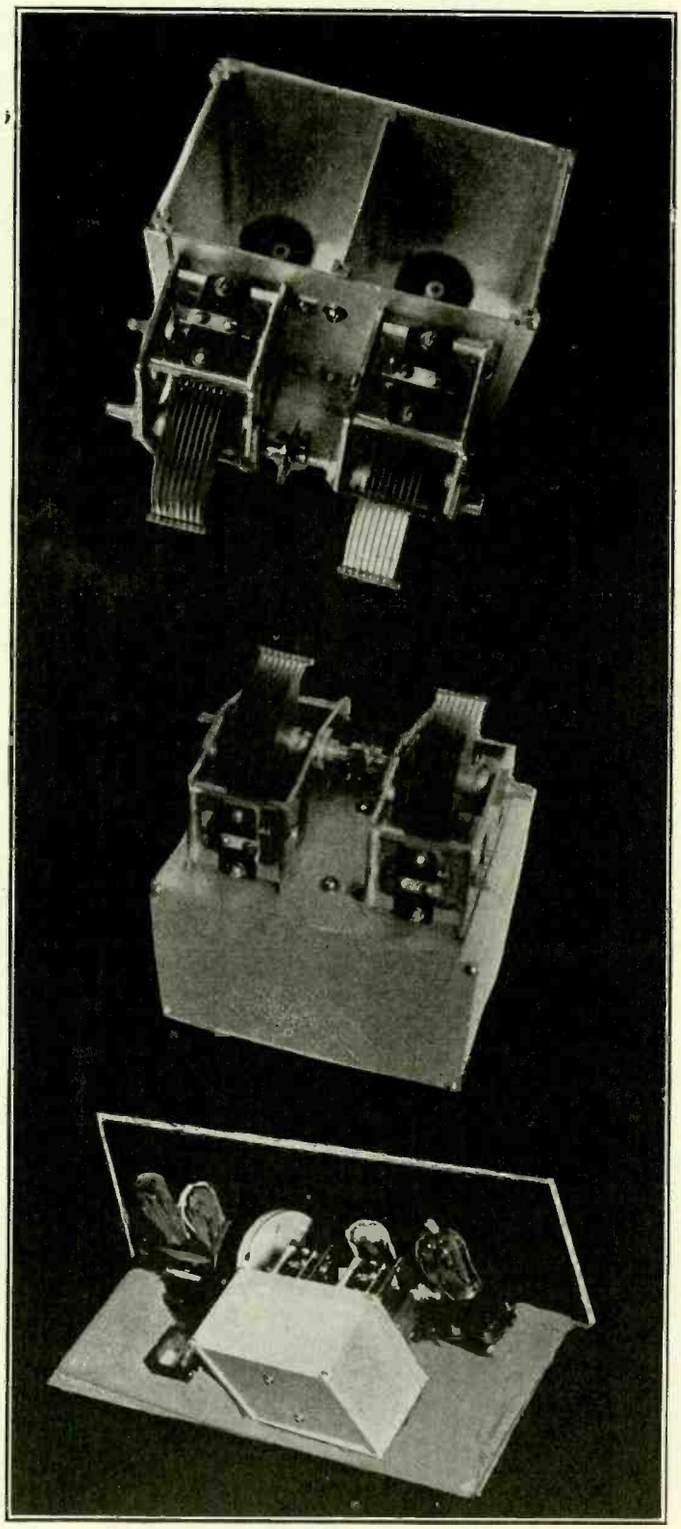


FIG. 4

A VIEW OF THE ASSEMBLY. THE TUNING CONDENSER SHAFTS ARE UNITED WITH A COUPLING LINK. THE JOINDER TO THE DRUM DIAL IS EFFECTUATED THROUGH ANOTHER LINK.

The Ups and Downs in the Pu

Behavior is Explained with Aid of

By James

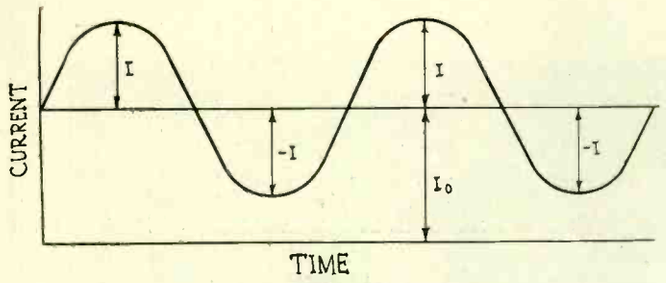


FIG. 1
A CURVE SHOWING THE VARIATION OF THE PLATE CURRENT AS TIME GOES ON WHEN A VOLTAGE REPRESENTING A PURE TONE IS BEING IMPRESSED ON THE GRID OF THE TUBE.

IS THE plate current in a vacuum tube direct or alternating? If it is alternating, how are the alternations produced when the plate voltage is direct? If it is direct, how can it give rise to any sound, which is alternating in nature?

The answer to these questions is that the plate current is neither alternating nor direct, or with equal truthfulness it is that the current is both alternating and direct. The current is pulsating.

Let us take an analogy to illustrate the nature of the current, and let us do this by asking another question. Is the water in the ocean alternating or direct when the waves are running high? Does the water mass as a whole move up and down in succession all the way to the bottom, no matter how deep the ocean may be? If the water were to move up and down as a whole it would have to flow through the bottom. Obviously, it cannot do that. The water is always at rest at the bottom, flowing neither up nor down, although it may flow this way and that along the bottom. But we are interested only in the up and down movement, so there is no motion at the bottom.

The water wave is a motion of the water up and down on the surface and it fluctuates about a mean level which is determined by the level when there is no wave disturbing the surface. The water oscillates about the mean level, and with respect to this level it is alternating, but it is not alternating with respect to the bottom. It merely rises and falls with respect to the bottom, always being in the same direction, above.

SOUND ANALOGY

Let us take another analogy. It is said that sound is an alternation in the air pressure, but really it is not. The total air pressure of the atmosphere near ocean level is about one million bars, which is equal to the weight of a column of mercury 76 centimeters high, one square centimeter in cross section. But a strong sound wave does not represent a pressure more than one bar.

If the air pressure were alternating there would have to be a negative pressure, but it is hard to conceive such a thing. All that we can conceive is a varying pressure about a mean value. So when a sound wave passes the pressure of the air varies up and down about the mean value by an amount which is only one millionth part of the total pressure. There is only a feeble ripple in the air even when the strongest sound wave passes. Just how small the sound ripple is can be appreciated by making a comparison. At the deepest part the ocean is about 5 miles and one millionth part of this is about one-third of an inch. That would be a very tiny ripple. Yet an equivalent ripple in the air gives rise to a very loud sound.

Let us draw still another analogy. There is a river in which the water, of course, always flows in the same direction. But the level of the river is not always the same. Sometimes it is high, sometimes low. In some instances it may even be dry part of the time. The rise and fall in the water level can be considered as a wave on top of the steady, unidirectional flow of water. Indeed, it is a wave.

FLUCTUATING PLATE CURRENT

Now refer to Fig. 1. That might well represent an instantaneous cross section of a body of water, such as would be seen through a glass wall. The actual water level is not the same at every point if the water is disturbed by a wave. At one point it is a distance *I* above the mean level, at another point it is the same distance below that level.

But the figure is not intended to represent a water wave, but rather the plate current in a vacuum tube when a signal is passing through. This intention is indicated by writing *current* along the vertical instead of *height*, and *time* along the horizontal instead of *distance*. So the wavy curve represents the manner in which the plate current varies as time goes on. *Io* represents the mean level of current, or the steady plate current when no signal wave is passing. *I* represents the amplitude of the signal current wave, the ripple on top of the steady current. Sometimes the amplitude is added to the steady current, sometimes it is subtracted from it, but the current as a whole never reverses direction. It is always flowing in the direction impelled by the plate battery, just as the water in a river never changes direction but always flows in the direction determined by the slope of the land.

The plate current always flows in the same direction, from the battery to the plate, but it does not flow at the same rate all the time. Now it is greater than the mean value, now equal to it, now less, and so on. It keeps on fluctuating just as long as there is a fluctuating voltage applied to the grid of the tube.

ANOTHER ANALOGY

And that reminds of another analogy. Suppose there is a dam in the river somewhere and that the height of this dam is changed periodically. When the dam is low the water will rush over in large quantities, when it is high less will flow. So the rate of flow of water below the dam will depend on the height of the dam at any instant. That is, the water will pulsate in the river just as the plate current pulsates when the grid voltage is raised and lowered periodically. Indeed, the grid is a kind of dam. When the grid bias is low, much current flows; when it is high little flow, and when the bias is very high, no current flows because the dam is too high.

Now the amplitude of the fluctuations in the plate current depends directly on the amplitude of the fluctuations in the grid voltage. If the grid voltage varies just a little the plate current will vary from the mean by a small amount, that is, the ripple in the steady plate current will be small. If the grid voltage fluctuates widely, the plate current will do the same, but its direction will never change, for the plate battery is always in the same direction.

If the grid voltage fluctuates too widely the plate current may be completely shut off part of the time, just as the water in the river could be cut off completely by raising the dam sufficiently. This case is illustrated in Fig. 2. Now the rise in the current above the mean level as the bias on the grid is low-

The Shielde

Circuit Uses Parallel Fee

(*Continued from preceding page*)

you see the numbers projected on a pearl-like screen. This projection feature is extremely handy, especially when tuning in distant stations, since close reading is required, and the same station must always come in at the same reading, which the projection improvement makes possible. No matter in what position you hold your head, high above the dial, far below it, or on a level with the screen, you still read the same number from all positions, an exclusive feature. Besides, the drum dial is equipped with a color wheel, called a rainbow, so that different colors progressively flood the screen as the dial is turned throughout its complete scale. This dial is unquestionably one of the smartest and best ones ever developed.

OUTPUT TUBE

Close to the dial knob, only 2 inches away on either side, are the shafts of the rheostat and the regeneration condenser. This intimacy of mechanical position of all the controls is one of the reigning features of up-to-the-minute receivers, factory-made or home-constructed.

The audio amplifier consists of two stages of transformer coupling. The output tube is shown as a 112A, requiring no other speaker filter, but if it is desired to use a 171A, then a filter, consisting of an audio choke and a 2 mfd. filter condenser, should be included, as the voltage on the plate of the last tube alone should be

lsating Life of Plate Current

Sound and Water Wave Analogies

H. Carroll

ered is very high. But when the grid bias is increased from its mean position by an amount equal to its previous decrease from that mean the plate current cannot decrease proportionately because the current is completely shut off for a time. Thus *I'* in Fig. 2 is not as great as *I*, but it is equal to *Io*. It can never be less than that value. This condition in the plate circuit is equivalent to the condition of the river when it is dry. The dam has been raised, momentarily, so high that no current can flow.

RAISING THE MEAN LEVEL

Of course, when the current is completely stopped for part of the cycle there is distortion. How can this be prevented? By raising the mean level of current, which is done by increasing the plate voltage. In some instances it can also be done by decreasing the grid bias, but if this is done it may be that the distortion will only be transferred from the negative to the positive side of the current. The grid bias cannot be reduced so that it is less than the amplitude of the voltage impressed on the grid. The plate voltage can always be increased if necessary, just so it is not increased beyond the safe operating limit. This limit is given by the manufacturers of the tubes as the maximum operating voltage.

The maximum voltage is the effective voltage on the plate of the tube, not the voltage of the battery. If the tube is loaded up with a transformer, loudspeaker, or low resistance choke, the voltage on the plate is not much less than the voltage of the battery; but if the tube is loaded up with a high resistance, the voltage on the plate is very much less than the voltage of the battery. In some instances it may be only a small fraction of it. In such cases the applied voltage can be increased greatly before any harm results to the tube.

PULSATING VOLTAGE

We have found that the plate current is pulsating and always in the same direction. But what about the voltage? Is that, too, pulsating? Surely. But we have to distinguish between two voltages, first the voltage on the plate and second the voltage drop in the plate load. The voltage on the plate at any instant is the same as the voltage drop in the internal resistance of the tube, and this pulsates because the resistance varies up and down. The voltage drop in the plate load is also pulsating because the impedance remains constant and the current pulsates. At any instance the voltage drop in the plate load is

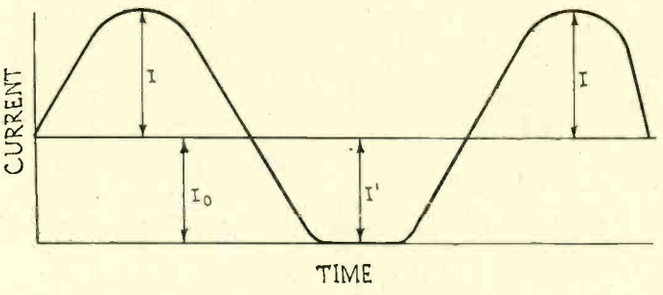


FIG. 2

THIS SHOWS THE VARIATION OF THE PLATE CURRENT WHEN THE GRID VOLTAGE SWINGS TO FAR NEGATIVE SO AS TO REDUCE THE PLATE CURRENT TO ZERO DURING A PART OF THE WAVE.

equal to the impedance of the load and the current flowing at that instant.

The voltage on the plate and the voltage drop in the plate load are so related that their sum is constant and equal to the applied battery voltage. Thus when the voltage drop in the load is high the voltage on the plate is low. When the plate current is zero the plate voltage is equal to the applied voltage for then there is no drop in the load impedance. When the current in the plate is high the voltage drop in the impedance is high and then the voltage on the plate is low.

It is the pulsating part of the plate current that is effective in inducing a voltage in the secondary of a coupling transformer. The direct current component of the plate current does not play directly any useful part. Still it must be present or there could be no pulsations, for the current cannot reverse in direction and become a true alternating current. The DC component does have a bad effect on the transformer for it tends to saturate the core and make the load impedance lower than it would be for pure AC equal to the pulsations. Transformers have been designed such that the effect of the direct current component is balanced out by another current through an auxiliary winding, but these transformers have not come into use to any great extent, possibly because of the necessity of making two extra connections to them and of providing a source of voltage.

VOLTAGE TRANSFER

In direct coupled circuits also it is the pulsating component of the plate current which is effective. It establishes a fluctuating voltage drop in the coupling impedance and this becomes the fluctuating grid voltage on the succeeding tube. The drop due to direct current is kept away from the grid by the stopping condenser. Because of this action of the stopping condenser there is a high, steady voltage drop across it, and this is equal to the combined values of the plate voltage of the tube ahead and the grid voltage on the tube following. This voltage drop plays no part in the signal transfer as long as the condenser does not leak. If it should become leaky the amplifier ceases to work.

The difference between the plate current when an audio and a radio frequency signal passes through the circuit is only one of time. That is, the pulsations in the current when a radio signal passes are very rapid and those when an audio signal passes are compartively slow, although they may occur several thousands times a second. Fig. 3 shows the difference between an audio current at left and a more rapid current at right. The horizontal is the time scale, supposed equal for both curves.

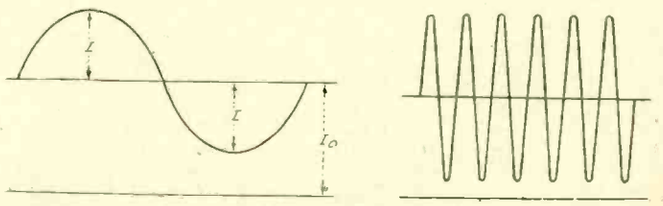


FIG. 3

TWO CURVES ILLUSTRATING THE DIFFERENCE BETWEEN A SLOWLY PULSATING PLATE CURRENT AND A RAPIDLY PULSATING CURRENT.

---

d Universal

d by Controlled Capacity

Holes are drilled in the shields to pass the wire leads to the coils. raised to 180 volts for a 171A and the negative bias increased to a total of 40 to 45 volts. The reason for the filter is that the 171A draws too much plate circuit to pass continuously through the windings of a magnetic speaker, although if a dynamic is used the filter is omitted, because an output transformer is built in the dynamic.

The 112A is adequate for the circuit, and the substitution of a 171A is simply a matter of individual choice. The substitution would raise the maximum undistorted power output, but would reduce the volume, as the 112A has a higher mu (amplification factor) than the 171A.

COIL DATA

The outside diameter of the bakelite tubing used for the coils is 1¾ inches and the height is 3 inches. Two small brackets are used to mount the coils to the bottom of the shield, one coil in the center of each compartment, the winding extremities equi-distant from top and bottom of the shields.

For the primary L1 wind 25 turns, leave ¼ inch space, and for the secondary L2 wind 100 turns.

For the primary L3 wind 40 turns. leave ¼ inch space, wind 140 turns, tapped at the 100th turn. The 100 turns are L4 and the extra 40 turns are L5.

The wire is No. 28 throughout. Usually enamelled wire is used when the wire is No. 28, but silk covered is just as good.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. The reply is mailed to the member. Join now!

RADIO UNIVERSITY

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

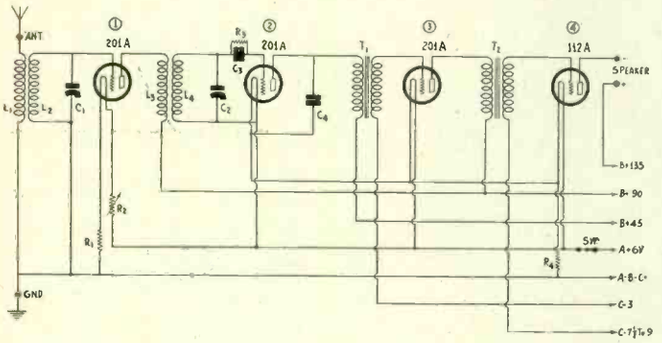


FIG. 808

THOSE WHO MUST USE BATTERY SETS AND DO NOT WANT TO GO INTO ANY GREAT EXPENSE WILL FIND THIS SIMPLE RECEIVER A GOOD ONE.

CAN'T UNDERSTAND SPEAKER

I HAVE a very good radio receiver. It is splendid on music but it is not easy to understand what the announcers and other speakers say. What is the reason? Do you think that the speaker is at fault, or is it the receiver as a whole that is not as good as it is supposed to be?—M. N. O.

It is most likely the receiver which is not so good as it is thought to be. Of course, the speaker may be a contributory factor. This condition is usually due to the absence of the high audio frequencies. It may be that the receiver is too selective, or that a special effort has been made in the design of it to eliminate noises, or again that too much emphasis has been placed on the low notes. Fans get what they demand, and during the last year or two they have demanded low notes.

* * *

VOLTMETER READS LOW

WHILE using my circuit tester I have discovered that the voltmeter does not read the same when plugged into different sockets, although plate returns go to the same point on the voltage divider. I have tested the voltmeter and that measures voltages all right. I am stumped as to the cause of the erratic behavior of the tester. Please explain.—R. O. C.

The plate load impedances in the various tubes have different resistance values, and what the tester measures is the voltage on the plates rather than the voltage applied at the B plus post on the voltage divider. The meter indicates the difference between the voltage applied and the voltage drop in the resistance of the plate load. In a radio frequency circuit the resistance is negligible and in these the voltmeter indicates practically the voltage applied. In a resistance coupled amplifier the voltage in the load is so high that the drop in the resistance is higher than the drop in the tube. Indeed, it is so high that the voltmeter indicates practically no reading. In a transformer or impedance coupled circuit the resistance may be so high that the voltage drop in it may be as high as 20 volts. Instead of assuming that the tester is erratic when different results are obtained, this irregularity should be expected and it should be used in interpreting the condition of the circuit. Some of the tests on a receiver are based on these differences, for example, a short circuit in the transformer primary.

* * *

WHERE IS TELEVISION?

ABOUT a year ago we heard a great deal about television, but lately we have had nothing except predictions by non-technical men. What is the present status and is anything being done?—B. L. C.

Continuous work is being done in many research laboratories on the subject and advances are being made all the time. However, due to the enormous difficulties involved the work is very slow. It is too early to make any definite predictions as to when it will be ready to be put on the air as a public service, but there is no doubt that it will come. Think of the length of time it took radio to develop. The principles of voice transmission have been known for 20 years or more, but broadcasting is only 9 years old. Television is in about the same position now that voice transmission by radio was before the invention of the vacuum tube, or possibly a little farther ahead.

* * *

RECTIFIER TUBES DON'T STAND UP

I HAVE a power amplifier and an MB-29 receiver which I use on the same B supply in which a single 280 tube is used. This tube does not stand up under this load and burns up very quickly. Do you suppose that the load on the tube is too high or might there be a short circuit somewhere that may cause the trouble?—C. W. S.

It depends entirely on how quickly the tube gives out. If it lasts only a few minutes there must be a short, but if so you would not get any signals while the tube does last. If the tube lasts some time and you do get signals during this time the trouble must be due to overloading of the tube. You know, this tube is not supposed to deliver more than 125 milliamperes. If it delivers more it may get red hot and burn out after a few hours of operation.

* * *

QUARTER WAVE ANTENNA

IN TECHNICAL articles on radio there often appear such terms as "quarter wave antenna," "half wave antenna" and "three-quarter wave antenna." What is the difference and what determines when an antenna is of one type or another?—S. L. C.

These terms arise from the fact that an antenna can oscillate, when suitably excited, in several different modes. If an antenna is grounded at one end it can oscillate resonantly in as many different modes as there are integral multiples of one-quarter wavelengths of the signal wave exciting it. Of course, that is an unlimited number. In the first mode the antenna oscillates so that it is one-quarter wave long. The current node is at the far end and the current loop near the ground. In the next mode the antenna is three-quarters wave long—not for the same carrier wave, of course. In this case, as always, the far end is a current node and the ground, as always, is a current loop. Between these points there is one node and one loop, the loop being one-quarter wavelength from the far end and the node one-quarter wavelength from the ground. In the first case the antenna is called a quarter wave antenna; in the second, a three-quarter wave antenna. If the antenna is not grounded at either end it can oscillate in one-half wavelength, or in any even multiple of a half wavelength. When it oscillates in the half-wave mode there is a current loop at the middle and a node at each end. A grounded antenna is analogous to an organ pipe which is open at one end, and an ungrounded antenna is analogous to an organ pipe closed at both ends. By current node is meant that the current is always zero at that point, and by current loop is meant that the current is always maximum at that point. Wherever there is a current node there is a voltage loop and wherever there is a current loop there is a voltage node. There can never be a voltage loop at the ground.

* * *

WISH TO INSTALL A TRANSMITTER

I AM desirous of building a transmitter both for code and voice. Can you show me a diagram of a small transmitter? What licenses will I have to get before I can proceed?—N. E. V.

Yes, we can give you a circuit diagram of a transmitter. You have to have an operator's license, which you can get from the Department of Commerce after you have passed the required examination of proficiency. You also have to have a license for the transmitter and you even have to get permission for building the transmitter. You might write to the Federal Radio Commission for details, or to the Radio Division of the Department of Commerce.

* * *

NOT ENOUGH SIMPLE SETS

HOW is it that you rarely publish any simple battery receivers with transformer coupling? I live in the country, where AC receivers are no good, and I for one should like to see more battery sets, and inexpensive ones that can be built by one who is not a millionaire. If you cannot publish one in an article please run one in your question and answer department. Just a circuit diagram will do for me.—A. R. N.

The reason why such receivers are not published often is that there is little demand for them. Everybody, it seems, has gone in for screen grid tubes and push-pull power amplification. But we are glad to accommodate you any time. Perhaps the circuit shown in Fig. 808 is just what you want. We hope so. It's really a good little receiver. The cost to build it is largely for you to decide, since the various parts can be had in all grades and at many different prices.

TESTING 250 TUBES

HOW can a 250 tube be tested with a tester in which the voltmeter reads only 300 volts and the voltage applied to the tube is 450 volts?—C. A. L.

If you plug into the 250 socket directly the voltmeter, of course, will jump off the scale, so you cannnot measure the voltage directly. The voltage, however, is only 50 per cent. high and that is not high enough to damage the meter. Hence you can plug in directly to get the plate current. To measure the plate voltage use an external voltage multiplier and measure the applied voltage.

* * *

WHY ARE SIGNALS RECEIVED ON HARMONICS?

ON my receiver I can tune in certain stations at two points on the dial. I understand why this can be done on a superheterodyne, but my circuit is a radio frequency type receiver. I have never seen an explanation why this type of receiver behaves like a superheterodyne in this respect.—M. O. N.

The explanation of this phenomenon has been given a number of times recently, but since everybody has not seen the articles in which the explanation appeared, we give it again. Repeat tuning on radio frequency amplifiers occurs only on strong local stations from which the signals are so strong as to overload appreciably the first tube. A strong signal is impressed on the first grid and this signal is doubled in frequnecy by the overloading. The subsequent tuners in the receiver select the double frequency signal and amplifies it just as if it were an original carrier. Since the original is modulated by an audible signal the double frequency signal, or the second harmonic is also modulated. Hence the second harmonic is detected after amplification just as any other signal. This kind of interference—for interference it is usually—occurs most frequently in circuit in which the input circuit is not tuned, that is, when the input is by means of a radio frequency choke coil or a high resistance. When the first input circuit is tuned all but one signal are tuned out so that the effect of the harmonic distortion is not noticeable. However, it occurs all the time in every receiver, and it occurs more in the first tube when the input is tuned than when it is not. But when it does not result in distortion no harm is done.

* * *

PLATE CURRENT IN MB-29

WHAT is the total current in the MB-29 receiver when it is working normally with recommended voltages? I have one and I have a suspicion that it takes a lot of current.—I. D. A.

There are four screen grid tubes in the circuit and each of these takes an average of 5 milliamperes, so that the total taken by the screen grid tubes is 20 milliamperes. The plate current in the detector is not more than one milliampere. So far we have 21 milliamperes. However, there is a potentiometer associated with the detector having a total resistance of 20,000 ohms, and this is connected across 180 volts. Hence the current is 9 milliamperes, and we have a total of 30 milliamperes. Then there is a 25,000-ohm potentiometer connected across the 67-volt portion of the voltage divider. The current through this is nearly 3 milliamperes. Hence the total current is approximately 33 milliamperes. If the circuit takes much more than that there is something wrong. The current just obtained is on the basis of 180 volts on the plates. If 135 volts are used a little less current can be expected.

* * *

DEAD BATTERIES CAUSE HOWLING

A REFLEX receiver consisting of only three tubes and two stages of transformer coupled amplification emits a terrific howl when I use it on B batteries. The only way I can stop it is to connect the plate return of one of the amplifiers, the reflexed, to A plus. This connection gives clear but weak signals. The batteries are new, so I do not believe that the howling is due to high resistance in them. Incidentally, the same circuit did not howl until I put in new and high grade transformers in the receiver. Do you suppose that the transformers are defective?—J. K. M.

It is possible, of course, that the transformers are defective, but it is not likely. Although the batteries are new to you they may not be fresh. Even if they are, they may still be the cause of the trouble. When reflex circuits were popular there was a great deal of trouble from howling, and this howling was ascribed to almost everything but the true cause, feedback through the batteries. At that time B supply units as we know them today had not been invented and motorboating in resistance coupled amplifiers had not been encountered. Much howling and squealing had, of course, been met, but that, too, was ascribed to things that had nothing to do with it. Also, in those days transformers were not as good as they are today and they were not capable of sustaining oscillation at the low frequencies we now call motorboating. But all the howling and stuttering in receivers of every kind were, and still are, due to feedback through the B battery or the B supply unit. There are two types of disturbance which are not due to the same cause. One is acoustic feedback, or mechanical feedback, and the other is due to periodic blocking of a grid circuit. But even most of the blocking, so-called, is due to feedback in the voltage supply.

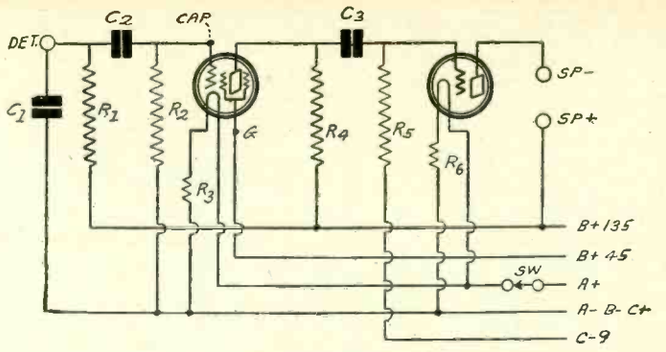


FIG. 809
AN AUDIO AMPLIFIER USING RESISTANCE COUPLING AND ONE SCREEN GRID TUBE WHICH IS CAPABLE OF FIRST RATE QUALITY PROVIDED THAT FRESH B BATTERIES ARE USED, OR PROVIDED THAT LARGE BY-PASS CONDENSERS ARE CONNECTED ACROSS THE BATTERY SECTIONS.

WANTS RESISTANCE AUDIO

I WISH to construct a resistance coupled amplifier to be used as a kind of standard for comparing the quality of other amplifiers. I should like to use one screen grid tube and one 112A and to connect the speaker directly in the plate circuit of the last tube, for I believe this to give the best quality. Kindly give a circuit and the values of the various parts.—J. D. A.

You will find the circuit in Fig. 809. Values are as follows: C1, .0005 mfd., used only if there is no equivalent condenser in the detector and not used if the signal is derived from a phonograph; C2 and C3, each .02 mfd., with mica dielectric; R1, 100,000 ohms; R2 and R5, each one megohm; R4, 250,000 ohms; R3, 20 ohms; R5, 4 ohms. While the screen grid voltage is indicated as 45 volts, lower values should be tried for better results. It may be that about 22.5 volts will prove to be best. To insure success with this amplifier the plate battery should be fresh, or else very large condensers should be connected across the plate and screen voltage sections of the battery. Electrolytic condensers are recommended. It is sometimes difficult to tell whether any given battery is sufficiently fresh to insure proper operation, for voltmeters don't tell the complete story of their condition.

RADIO WORLD

The First and Only National Radio Weekly

***Eighth* Year**

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.

More Sensitive Circuits

READERS have written to our Forum, stating their views on what should be published, and criticizing, favorably or otherwise, the general policy of what is being chosen for publication. The run of letters is not as uncomplimentary as an editor might expect. Some of them are quite biting, to be sure, but it is at least encouraging to find persons so deeply interested in this publication as to take the trouble to write us their opinions. Whether the letters are biting or soothing is not so important as the interest and the really friendly feeling behind them.

Of the tempered letters of criticism, quite a few have expressed disfavor of the publication of so many modest circuits, particularly of only four tubes. Not with the object of roiling these good friends at all, we are publishing this week still another four-tube circuit, the Shielded Universal, yet to meet the objections of those more deeply interested in larger endeavors, we are printing also the HB33, for battery operation, and the HB44, for AC operation, both being three-stage shielded screen grid radio amplifiers, with screen grid detector and two stages of audio. The performance of these receivers is described elsewhere in this issue, but special mention should be made of the fact that the aspirants for DX laurels have these splendid circuits to work with, and the total outlay for parts is incredibly low.

While we have not published as much as some of our readers would like to see published concerning receivers that are real go-getters, it is not because our laboratories have not been at work on them. Several months are often consumed in the design, execution and perfection of a circuit, so our big-circuit friends will realize that we have been interested in the same attainment as they, but that months have an uncanny habit of rolling around when multi-stage circuit experiments are under way. And besides, the laboratories are most exacting, which is as our readers would have them be.

It must not be forgotten that RADIO WORLD was the first magazine to publish the constructional details of the MB-29, an AC tuner using a stage of untuned screen grid RF, three stages of tuned screen grid RF and a tuned power detector.

At present exhaustive tests are under way on other receivers of large performance, and readers are assured there will be plenty of reading matter and illustrations to guide them in the construction of the receiver of their desire.

Cures for Motorboating

(*Concluded from page* 13)

in that manner recently, but the wording of the question is a tell-tale for it indicates that the questioner had read something about that very thing. The question contains a statement which we make periodically just to be sure that it is being made. It is made nearly every time that the subject of motorboating is discussed in more than one paragraph. And here it is again in a more general form. A direct coupled circuit having an odd number of plate circuits, counting the detector, is inherently unstable; and one having an even number of plate circuits is inherently stable, except at the very low frequencies when small stopping condensers are used in the circuit.

Now here is some good news: If the circuit contains only two plate circuits it is stable because it is even, and it does not oscillate even at the low frequencies. An odd circuit having three plate circuits is very unstable, but the instability is at frequencies where by-pass condensers of reasonable values are effective in stopping it. An even circuit of four plate circuits is unstable at the very low frequencies but the instability at these frequencies can be stopped by reducing the size of the stopping condensers and the resistance of the grid leaks.

"I have read several of your discussions on the causes and the cures for motorboating, but there is one thing that worries me. Where can I get the money with which to buy condensers large enough to stop the motorboating when it is so slow that it causes the loudspeaker to wheeze once every two minutes?" That is, indeed, a poser. One solution is to save every penny and not play the stock market on margin. Another solution is what we suggested above: use smaller condensers and put them in the grid circuits. Still another is to change the circuit to one which does not behave that way. And still another is to use electrolytic condensers. And if all these fail, there are still other methods which have been given in more complete discussion of the subject.

Right or Wrong?

(1)—When a new circuit component, such as a radio frequency amplifier, an audio frequency amplifier, a B supply or a loudspeaker is added to a receiver which has worked satisfactorily but fails to work all right after the addition, it is perfectly obvious that the new part added is at fault.

(2)—In all instances the addition of shielding to a receiver increases the losses in the radio frequency tuners.

(3)—In all instances the addition of shielding to a receiver makes the circuit less selective than at was before because of the losses that are introduced by the shielding.

(4)—When a receiver hums badly due to insufficient filtering in the B supply the surest way to stop the hum is to connect a large condenser across the filter next to the rectifier tube.

(5)—If a voltmeter or a milliammeter is not as sensitive as it should be for a certain application all that is necessary to make it more sensitive is to add resistance in series with it.

(6)—Sensitivity and volume mean the same thing. For example, if a set is not sensitive it is not capable of high output volume, and if it does deliver a great output it is very sensitive.

(7)—If high notes are to be reproduced by a phonograph pick-up unit the moving parts in the unit must be light so that the needle may follow the undulations in the record freely.

(8)—If the low notes are to be reproduced well from a phonograph record the electric pick-up unit as a whole must be heavy so that it will not move with the needle, but so that the relative motion between the needle and the pick-up unit is large.

(9)—Wave resonance coils can be connected in tandem and used as a pretuner of exceptional selectivity.

(10)—Multiplex transmission as well as reception is practical with wave resonance coils, that is, several transmitters or receivers can be put on the same antenna without appreciable interaction among them.

Answers.

(1)—Wrong. To make that assumption is jumping at conclusions. Most fans it seems make the error. All that can be said logically is that the new combination is at fault. It might well be that one of the old parts in the receiver is inadequate and that its inadequacy did not show up until the new part was added. Then, again, it may be that a mistake has been made in connecting up the circuit. It often happens that when a new set of audio transformers are put in place of an old set that the circuit will begin to motorboat. In this case it is the B supply which is inadequate. Sometimes in making a change a lead is left open or it is connected to the wrong place. In this case, of course, it is the one making the change who is inadequate.

(2)—Right. Whenever any piece of metal is put in the field of a tuning coil eddy currents are induced in the metal by the current circulating in the coil, and the energy required to keep these eddy currents flowing must come from the coil. This energy loss amounts to an increase in the resistance of the coil.

(3)—Wrong. It is true that the selectivity of each tuned circuit is decreased by the shielding but not necessarily of the complete tuner. Sometimes the selectivity is increased because the shielding eliminates double tuning characteristics. Whether or not this is a gain in the overall selectivity depends on how close together the tuning coils are and on how close to the shielding the coils are after the shielding has been put in.

(4)—Wrong. Often this itself is a potential cause of much hum. For example, when a large electrolytic condenser is put across the filter next to the line there is often a terrific hum which stops when the condenser is removed or when it is replaced with a much smaller one. When such a condenser is available it should be connected across the voltage divider, or across a portion of it.

(5)—Wrong. The sensitivity of a voltmeter or of a milliammeter depends on the construction of the meter and cannot be changed by any manipulation of resistors. The sensitivity, for example, of a D'Arsonval instrument depends on the number of turns of wire on the moving coil, on the strength of the permanent magnet, and on the compliance of the spring which restores the needle to zero when current stops flowing through the winding.

(6)—Wrong. There is only an incidental connection between the two. Sensitivity depends entirely on the amplification and on the effective pick-up and the volume depends on how much sound the receiver can put out.

(7)—Right. If the moving parts, that is, the armature and the needle, are not light the needle will ride over the undulations and will move in a nearly straight line. Very weak signals will result and the record will wear out rapidly.

(8)—Right. If the unit as a whole is light it will move with the needle and there will be little relative motion between the two. It is only the relative motion between the armature and the field magnet which is effective, and this relative motion is large only when the unit is heavy.

(9)—Right. Exceptionally high selectivity can be obtained by connecting wave resonance coils in tandem and tuning each one separately to the same frequency.

(10—Right. Multiplex transmission and reception will undoubtedly be the biggest field of application for the wave resonance coil. There is practically no mutual effect and as many as fifty receivers can be put on one antenna, and all tuned to the same frequency, before the signal in each one is reduced to one-half what it would be were only one receiver connected to the antenna.

BOARD ALTERS FREQUENCY AND POWER RATINGS

The Detroit "Evening News," which operates WWJ in that city, has requested the Federal Radio Commission to grant authority to construct a broadcasting station using the maximum power of 50,000 watts. In its application the newspaper also seeks permission to move its transmitter, install new equipment and change its frequency of 920 kc to 1,020 kilocycles. The exact location for the new station was not announced.

Text of the Commission's announcement of favorable decisions made on applications follows:

WNAX—Gurney Seed & Nursery Co., Yankton, S. Dak., to be assigned full time on 570 kc. with 1,000 w. power, day and night.

WEBW—Beloit College, Beloit, Wis., assigned to 560 kc., sharing time with WIBO and WPCC in Chicago; WEBW to be assigned the following time: Sunday, 4:30 to 6 p .m.; Monday, 5 to 7 p. m.; Tuesday, 5 to 6 p. m.; Wednesday, 5 to 6:30 p. m.; Thursday, 5 to 6 p. m.; Friday, 5 to 6 p. m.; Saturday, 5 to 7 p. m. (All of the above times to be Central Standard Time, except during the period when Chicago is on daylight saving time, when daylight saving time will govern except the Sunday time will be Central Standard Time.)

WIBO and WPCC, Chicago, to be assigned to 560 kc. with no change in power. The time divisions between these stations to be as follows: WPCC, to operate on Sunday from 10 a. m. to 11:30 p. m., except for the hours of 4:30 to 6 p. m. assigned to WEBW; WIBO, may operate on hours not specified for WEBW and WPCC. The hours for WIBO and WPCC will relate to Chicago time except hours of 4:30 to 6 p. m. on Sunday assigned to WEBW. The power of WEBW to be 500 w. (All of above changes to be effective Nov. 30.)

WABCYDOO — Atlantic Broadcasting Co. granted construction permit for change in location from west of Cross Bay Blvd., New York, to Columbia Bridge, N. J., approximately 20 miles west of Manhattan, N. Y. C.

Chamber of Commerce of Savannah, Savannah, Ga., WTOC, frequency change from 1,410 kc. with 500 w. power and unlimited time to 1,260 kc. using 500 w.

A. F. Tittsworth, trading as Tittsworth's Radio & Music Shop, Union City, Tenn., WOBT. license to cover construction permit, 1,310 kc. 100 w. night, 250 w. day on an experimental basis. Unlimited time.

The Toledo Broadcasting Co., Toledo, Ohio, WSPD, modification of license. To increase daylight power from 500 w. to 1 kw.

KXRO, Inc., Aberdeen, Wash., KXRO modification of license. To change frequency from 1,420 kc. to 1,310 kc.

KSEI Broadcasting Assn., Inc., Pocatello, Ida., KSEI, renewal of liense. 900 kc. 250 w. Unlimited time.

The Commercial Radio Service Co., Columbus, Ohio, WCAH, license to cover construction permit. 1,430 kc. 500 w. Divide with WHP and WRAK.

WAVES PERMEATE SOLID STONE

Scientists from the Bureau of Standards have conducted radio experiments in Mammoth Cave, Ky., and have proved that radio waves travel through hundreds of feet of solid stone. A transmitting antenna was placed on the ground and signals from this antenna were picked up by a commercial superheterodyne hundreds of feet directly below.

Forum

DETECTOR VOLTAGE FOR MB-29

HERE'S A SUGGESTION for those who put up the MB-29 tuner, especially those who have a B supply and amplifier already and hook onto it.

When adjusting the equalizing condensers in each circuit, it is all right to make a coarse adjustment while listening from speaker, but after that is accomplished, disconnect tuner and hook a pair of head phones onto detector and make final and very delicate adjustment in this way.

I cannot agree with the statement of Capt. O'Rourke in the October 19th issue regarding detector voltage for this circuit when he states "The working range, however, is 135 to 180 volts, and these voltages are specified in the diagram." These voltages are specified but not for the detector. The lead in question plainly goes to R4 and plate returns of the first four tubes, cut the plate lead from detector just as plainly hangs loose in the air and the constructor is left to use his own imagination as to what voltage to use. There has not been one word printed in any magazine nor instruction about this tuner that would give the constructor any idea of detector voltage until Capt. O'Rourke told us, and the man who was "careful to be wrong" was perfectly justified.

My MB-29 was built exactly in accordance with instructions. I am using resistance for first audio, Ferranti transformers with 245s in push-pull, and Thordarson power transformer. I can hear no difference in output, either volume or quality, with detector voltages ranging all the way from 20 to 200. I have a Clarostat in this lead so voltages can be produced of any value. If there is any difference at all it is slightly in favor of 20 to 40. And I would be very glad to be shown what's wrong here.

A. B. GARDNER,
Dowagiac, Mich.

* * *

MERGERS INTEREST YOUTH OF 16

I LIKE your news columns. I think it is very interesting to know all about the latest mergers and lawsuits through these columns.

I am 16 years old and have been interested in radio since 1922.

I certainly enjoy reading the excellent articles explaining the many questions that constantly arise in my mind. I think the series entitled "Radio for Schoolboys" is great.

I am a member of the University Club. My questions always have been accurately and promptly answered. This question and answer department certainly is worth many times the cost of a subscription.

JERRY MINTER,
Fort Worth, Tex.

* * *

LITERATURE WANTED

R. J. Hentschel, 10757 Ventura Blvd., North Hollywood, Calif.

E. G. Swanberg, Orchard Homes, Missoula, Mont.

Thomas Beck, 1017 N. 10th Court, Birmingham, A'a.

WIOD APPEALS ITS DEMOTION

Washington.

The operator of WIOD, Miami Beach, Florida, the Isle of Dreams Broadcasting Company, filed an appeal to revoke the order of the Federal Radio Commission shifting this station's channel assignment and reducing the power and hours of operation. Along with its appeal to the Court of Appeals of the District of Columbia, WIOD filed a petition for a stay, seeking to have the court command the Commission to authorize the station to continue to operate under the terms of its existing license.

The company contends that its application for renewal of license, which it states was made according to law, was denied without the hearing specifically required by law.

The station operated with unlimited time on 560 kilocycles, using 1000 watts. Under the reassignment the station was assigned to 1120 kilocycles with only 500 watts power night operation and 1000 until local sunset, to divide time with station WDBO, Orlando, Florida.

The station represents an investment of $180,000 in equipment. Including property valuation, the value is held to be about $235,000.

TELEVISION FOR HOME CONSTRUCTORS

Full explanation of the theory and practice of television is contained in the new 210-page book (5¾ x 8⅝"), with 100 illustrations.

A B C of Television

By Raymond Francis Yates,

Students and Experimenters alike will glory in the possession of this masterful volume. Popularly written, easily understood.

TABLE OF CONTENTS

CHAPTER I—TELEVISION—THE NEW CONQUEST OF SPACE
How the Principles of Television were Invented in 1884 and what the Future Holds for this Promising New Child of Science—A Description, in Narrative Form, of the Television of the Future.

CHAPTER II—TELEVISION SYSTEMS
Complete and Elementary Explanation of the Fundamental Principles of Television As They Are Applied Today in Both Transmitting and Receiving—Methods of Synchronization, Scanning and the Function of Photoelectric Cells.

CHAPTER III—TELEGRAPHING PICTURES
An Outline of the Various Successful Methods Employed Today in the Transmission of Facsimiles and Photographs by Wire and Wireless Systems—Practical Description of Telephotographic Receivers for Home Use With Practical Instruction Concerning Their Operation.

CHAPTER IV—PHOTOELECTRIC CELLS
How Photoelectric Cells Serve as "Light Microphones" in Modulating Radio Waves With Light Impulses—Elementary Outline of the Theory of Photo electric Phenomena.

CHAPTER V—AMPLIFYING PICTURES
Theory and Practice of the Amplification of Picture Signals Together With Data for the Construction of Television Amplifiers That Will Function With a Minimum of Picture Distortion.

CHAPTER VI—THE AGILE NEON LAMP
Theory, Operation and Practical Application of Neon Tubes in Television Reception—How the Neon Tube Functions as a "Light Loud Speaker" in Television Reception.

CHAPTER VII—SELENIUM CELLS
Theory of Selenium Cells Together With a Description of the Popular Types of Cells and Practical Data Concerning Their Construction by Home Experimenters.

CHAPTER VIII—THE PROBLEM OF SCANNING
The Function of the Scanning Disc With Complete Instructions for the Design and Construction of Different Types of Scanning Devices Including Drums and Moving Belts.

CHAPTER IX—SYNCHRONIZING TELEVISION
An A B C Outline of the Synchronizing Methods Now Employed by the Television Broadcasters of Today—Problems of Synchronizing Television Scanning Discs Treated in a Popular Way.

CHAPTER X—TRANSMITTING TELEVISION AT HOME
How the Experimenter Can Construct and Operate Both a Television Transmitter and Receiver for Home Use—This Equipment Makes Possible the Transmission of the Outline of Simple Objects From One Room to Another.

CHAPTER XI—HOW TO MAKE A TELEVISION RECEIVER
Practical Application of the Principles of Television in the Construction of a Television Receiver Involving a Special, Highly Efficient Short-Wave Receiver.

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

Enclosed please find $3.00 for which send at once at your expense one copy of "A B C of Television, or, Seeing by Radio," by Raymond Francis Yates, as advertised.

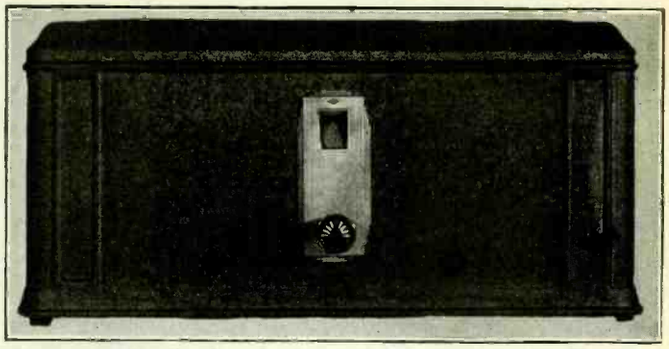
NAME .....

ADDRESS .....

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

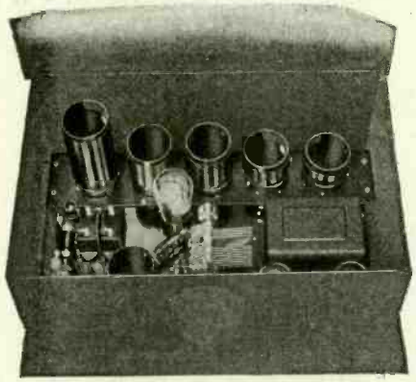
PARTS FOR HB22

Ant. Unit (coil, condenser, base, socket, link)	$4.00
Interstage Unit (coil, condenser, base, socket, 2 links, insul. rod.	4.25
2 meg. and .00025	.51
Subpanel, 3 sock.	3.25
.01 mfd.	.35
6.5, 4, 1.3 ohm...	.65
.00025 mfd. fix...	.21
80 Mmfd.	.35
Audio trans.	1.25
P.P. input	3.41
P.P. output	3.41
(4) Bind. posts..	.40
Nat'l new dial....	3.13
75 ohm Sw. rh..	.80
Dummy	.35
(4) front insulators	.20
All parts	$26.52
Drill. steel Cab...	$5.00



Guaranty Radio Goods Co., 143 W. 45th St., N. Y. City

Short Wave Circuit



National Thrill Box, 4-tube short wave circuit, 15 to 535 meters, battery-operation of filaments; B supply, either batteries or eliminator.

Get a real kick out of listening to foreign stations on a real short-wave circuit, the National Thrill Box. Uses one 222 screen grid RF amplifier, one 200A detector, one 240 first audio and one 171A or 112A output. Single control. Buy the parts and build the circuit in two hours. Data sheet shows dial settings where foreign stations come in. Cat. SW4EF, all parts, including decorative brown steel cabinet, all six plug-in coils, list price $51.90 (less tubes). Your price $31.00.

Guaranty Radio Goods Co.
143 West 45th Street New York City

LOOK AT YOUR WRAPPER

You will see by the date thereon when your subscription for Radio World expires. If the subscription is about to run out, please send us renewal so that you will not miss any copies. Subscription Department, RADIO WORLD, 145 West 45th St., N. Y. City.

PLEASE GIVE US TWO WEEKS

for changing your address, showing new renewal expiration date, etc. Subscription orders are arriving in such large numbers that it takes two weeks to effectuate the change. RADIO WORLD, 145 West 45th St., N. Y. City.

Fourteen Circuits

Each Shown in Colored Picture Diagram, Colored Schematic Diagram and Front Panel Layout

Get This FREE Book!

Complete AC electric receivers, with B eliminators included, also AC receivers without B eliminators, also battery operated models, all easy-to-build circuits, using your own parts.

RADIO WORLD, 145 W. 45th St., N. Y. City.
(Just East of Broadway)

Gentlemen: Enclosed please find $1.00 for which please send me Radio World each week for eight weeks (regular price, $1.20) and besides send me a FREE copy of the 1929 edition of The Radio Blueprint Library of AC and Battery Hookups.

Name .....

Address .....

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

Note: Present mail subscribers may take advantage of this offer by putting a cross in this square. ☐ Your subscription will be extended eight weeks.

[Canadian remittance must be by postal or express money order, due to high discount rate on cashing Canadian checks in New York.]

Blueprint FREE!

Get a free blueprint of either circuit listed on the coupon below, by sending $1.00 for eight weeks' subscription for RADIO WORLD, or send $1.50 for 13 weeks' (quarter of a year) and get both blueprints free!

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

☐ $1 for which send RADIO WORLD for 8 weeks and send free blueprint of the battery model 4-tube Screen Grid Diamond of the Air.

☐ $1 for which send RADIO WORLD for 8 weeks and send free blueprint of the 4-tube AC Screen Grid Diamond of the Air.

☐ $1.50 for which send RADIO WORLD for 13 weeks and send both blueprints free.
(If renewing a subscription put cross here)

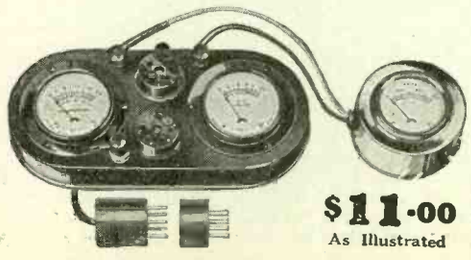
NAME .....

ADDRESS .....

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

SEPARATE TESTER COMBINATION

Consists of two-meter assembly in neat black metal case, with an external high resistance meter. The two meters in the case read (a) 0-20, 0-100 milliamperes; (b) 0-10 volts, AC or DC, same meter reads both. The external high resistance meter reads 0-600 volts, AC or DC (same meter reads both). Thus you can test any plate current up to 100 ma., any filament voltage, AC or DC, up to 10 V., and any plate voltage, or line voltage or other AC or DC voltage, up to 600 volts. Five-prong plug, screen grid cable, and 4-prong adapter included. Order Cat. ST-COMB @.....$11.00
2-meter assembly, cable plugs, Cat. 215 @ $7.06
0-600 AC-DC meter alone, Cat. M600 @ $4.95



$11.00
As Illustrated

Guaranty Radio Goods Co., 143 West 45th St., N. Y. City

RECENT NUMBERS

for the current year are procurable at the rate of 15c a copy, or 8 copies for $1.00. RADIO WORLD, 145 West 45th St., N. Y. City.

FREE!

Your Choice of These Nine Meters FREE!

- ☐ 0-8 Voltmeter D.C. ..... No. 326
- ☐ 0-50 Voltmeter D.C. ..... No. 337
- ☐ 0-Volt Charge Tester D.C. ..... No. 23
- ☐ 0-10 Amperes D.C. ..... No. 338
- ☐ 0-25 Milliamperes D.C. ..... No. 325
- ☐ 0-50 Milliamperes D.C. ..... No. 350
- ☐ 0-100 Milliamperes D.C. ..... No. 390
- ☐ 0-300 Milliamperes D.C. ..... No. 399
- ☐ 0-400 Milliamperes D.C. ..... No. 394

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-week's 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.

Present mail subscribers may renew their subscription under this remarkably generous offer. Put a cross in square. ☐

RADIO WORLD
145 W. 45th St., N. Y. City—Published Weekly.
All Newsstands, 15c per copy—$3, six months—$6 a year

GUARANTY RADIO GOODS CO.
143 West 45th Street, New York, N. Y.

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 103 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.

You Can Get This Book At Once!

You will want this book not only for present reading but also for future reference. It is authoritative and highly informative. Send for it now! It's free with each order for an eight weeks' subscription for RADIO WORLD. Present subscribers may renew under this offer. Their subscriptions will be extended eight weeks. Please use coupon.

RADIO WORLD, 145 W. 45th St., N. Y. City
(Just East of Broadway)

Gentlemen: Enclosed find $1.00. Please enter my subscription for RADIO WORLD for eight weeks at $1.00 and send me at once one copy of R. E. Lacault's "Super-Heterodyne Construction and Operation," FREE!

☐ I am a subscriber at present. (Check off if true.)

Name .....

Address .....

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

5-DAY MONEY-BACK GUARANTEE
☐ If C. O. D. desired, put cross here.

Component Parts for PUSH-PULL BATTERY DIAMOND

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

- ☐ L1L2—Antenna coil RF3 @ ..... $ 0.80
- ☐ L3L4L5—3-circuit SG coil SGT3 @..... 1.30
- ☐ L6—Push-pull output transformer..... 2.83
- ☐ T1—Push-pull input transformer 3.41
- ☐ CT—.80 mfd. equalizer ..... .35
- ☐ C1, C2—Two .00035 mfd. ext. shafts @ 98c 1.96
- ☐ C3, C5—Two .01 mfd. mica condensers.... .70
- ☐ R—One 6.5 ohm filament resistor..... .25
- ☐ R1, Sw—One 75 ohm switched rheostat.. .80
- ☐ R2, C4—2 meg. Lynch leak, grid clip condenser ..... .51
- ☐ R3—One .25 meg. ..... .30
- ☐ R4—One 5.0 meg. ..... .30
- ☐ R5—One 1.3 ohm filament resistor..... .20
- ☐ Ant., Gnd., Sp. (+) Sp. (—)—Four posts @ .10 ..... .40
- ☐ One drilled front panel 7x18" 1.85
- ☐ One socketed, self-bracketing metal subpanel, all holes drilled..... 3.50
- ☐ One National new modernistic drum dial with color wheel, pilot bracket, 6v. lamp, hardware, knob 3.13
- ☐ Two matched knobs for rheo. and tickler @ .18 ..... .36
- ☐ Five vari-colored cable leads @ .07..... .35
- ☐ Flexible link and insulated shaft..... .55
- ☐ One screen grid clip..... .06

☐ All parts $23.91

GUARANTY RADIO GOODS CO., 143 W. 45th St., N.Y.C.
(Just East of Broadway)

Enclosed please find $..... for which please mail at once the parts for the Push-Pull Battery Model Dismond of the Air as checked off above.

☐ If ordering C.O.D. put check mark here.

Name .....

Address .....

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

TRIAL SUBSCRIPTION, 8 WEEKS, $1.00. Send $1 and we will send you Radio World for 8 weeks, postpaid. RADIO WORLD, 145 West 45th St., N. Y. City.

"AERIAL NAVIGATION and METEOROLOGY." By Capt. Yancey. $4.00 postpaid. Radio World 145 W. 45th St., N. Y. City.

One Tube?
Two Tubes?
Three Tubes?
Four Tubes?

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!
A Four Tube Speaker—Operating Circuit, parts costing $12.72!

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.
- ☐ Oct. 19th, Four-Tube DX Speaker Set, by Jack Tully.

15 cents a copy. Order at once while these copies are available.

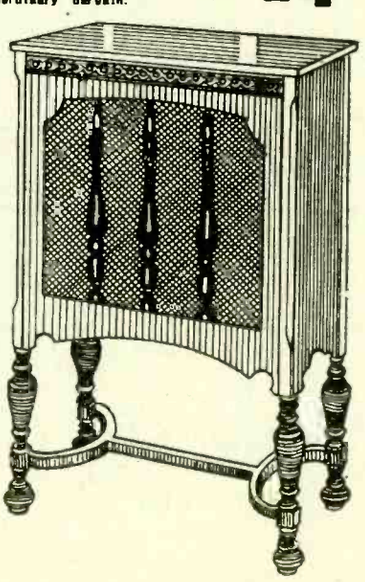
RADIO WORLD, 145 W. 45th St., New York

LOOK AT YOUR WRAPPER

You will see by the date thereon when your subscription for Radio World expires. If the subscription is about to run out, please send us renewal so that you will not miss any copies. Subscription Department, RADIO WORLD, 145 West 45th St., N. Y. City.

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

Shipped C.O.D. if desired.

Acoustical Engineering Associates
143 WEST 45th STREET NEW YORK CITY

Rider Lifts a BIG *Load Off the Service Man's Chest!*

In New Book Noted Radio Engineer Devotes 240 Pages to Trouble Shooting in All Receivers and Gives the Wiring Diagrams of Factory-Made Sets in 200 Illustrations—You Can Carry This Book Around With You—No More Torture Tracing Out Circuits.

JOHN F. RIDER
Member, Institute of Radio Engineers

"Trouble Shooter's Manual" *By John F. Rider*

JUST OUT!

The first comprehensive volume devoted exclusively to the topic uppermost in every service man's mind is "Trouble Shooter's Manual," just published. It is not only a treatise for service men, telling them how to overcome their most serious problems, and fully diagramming the solutions, but it is a course in how to become a service man. It gives all the details of servicing as they have never been given before. Finding the right mode of attack, applying the remedy promptly and obtaining the actual factory-drawn diagrams of receivers always have been a load on the service man's chest. But no more. Rider, expert on trouble shooting, has produced the outstanding volume on servicing, and has taken the load off the service man's chest!

This book is worth hundreds of dollars to any one who shoots trouble in receivers—whether they be factory-made, custom-built or home-made receivers. The home experimenter, the radio engineer, the custom set-builder, the teacher, the student,—all will find this new book immensely informative and absolutely authoritative.

Wiring Diagrams of *All* These Receivers!

Besides 22 chapters covering thoroughly the field of trouble shooting, this volume contains the wiring diagrams of models, as obtained direct from the factory, a wealth of hitherto confidential wiring information released for the first time in the interest of producing better results from receivers. **You will find these diagrams alone well worth the price of the book.** The wiring diagrams are of new and old models of receivers and accessories, and as to some of the set manufacturers, all the models they ever produced are shown in wiring diagrams! Here is the list of receivers, etc., diagrams of which are published in this most important and valuable book:

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

FEDERAL
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, 33, 49, 38, 86, 37, 40, 42, 52, 50, 44, 43, 41 power units for 37, 38, 44, 43, 41.

CROSLEY
XJ, Trirdyn 3R3, 601, 401, 401A, 608, 704, B and C supply for 704, 704A, 704B, 705, 706.

ZENITH
39, 39A, 392, 892A, 40A, 35PX, 35APX, 352PX, 352APX, 37A, 35P, 35AP, 352P, 352AP, 34P, 342P, 33, 34, 35, 35A, 342, 352, 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, 16Z, 32Z, 18, special, 192A-192S and 192BS units, R80A, 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 F6, D10, D17, Super Zenith Magnavox dial, Thermodyne, 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.

Here are the 22 chapter headings;

SERVICE PROCEDURE
PRACTICAL APPLICATION OF ANALYSIS
VACUUM TUBES
OPERATING SYSTEMS
AERIAL SYSTEMS
"A" BATTERY ELIMINATORS
TROUBLES IN "A" ELIMINATORS
TROUBLE SHOOTING IN "A" ELIMINATORS
"B" BATTERY ELIMINATORS
TROUBLES IN "B" BATTERY ELIMINATORS
TROUBLE SHOOTING IN "B" BATTERY ELIMINATORS
SPEAKERS AND TYPES
AUDIO AMPLIFIERS
TROUBLE SHOOTING IN AUDIO AMPLIFIERS
TROUBLES IN DETECTOR SYSTEMS
RADIO FREQUENCY AMPLIFIERS
TROUBLE SHOOTING IN RF AMPLIFIERS
SERIES FILAMENT RECEIVERS
TESTING, AND TESTING DEVICES
TROUBLES IN DC SETS
TROUBLES IN AC SETS

Some of the Questions Settled in Book:

Securing information from the receiver owner, list of questions, practical chart system of repairs, circuits and operating conditions.

Repairs in the home, method of operation, spare tubes, the process of elimination, recognizing symptoms, examples of practical application, tracing distortion, tracing electrical disturbances; vacuum tube tests; neutralizing systems, filament circuits, grid circuits, methods of securing grid bias, plate circuits; long aerials, short aerials selectivity, imperfect contact, directional qualities, grounds; "A" battery eliminator types, design, operating limitations, requirements for perfect operation, AC eliminators, DC eliminators; "A" eliminator hum, reasons, voltage, reasons, noise; full wave, half wave, B battery eliminators, filament rectifiers, gaseous rectifier, dry disc rectifier, wiring, parts used, design, voltage regulation, operating limitations, requirements for perfect operation, combination filament and plate voltage eliminators, AC and DC types; B battery eliminator output current and voltage, excessive hum, dead eliminator, poor design, reasons for defects, motorboating, punctured condensers, shorted chokes, voltage regulator tubes, function of filter system, C bias voltages, voltage divider systems, filter condensers, by-pass condensers, voltages in the system; determining voltages in B eliminators, AC, DC, voltage drop, effect of shorted filter system, defective rectifiers, defective transformer, defective chokes, defective by-pass condenser, design of filter system, defective voltage divider network, relation between hum and output voltage, isolation of troubles, external filters, noise filters; cone, dynamic, exponential speakers, troubles, dead, weak output, distorted output, rattle, continuity testing, windings, magnets, frequency filters, testing, chokes, condensers, hum elimination; audio amplifier types, transformer, resistance, impedance, auto-transformer, combinations, requirements for perfect operation, operating limitations, tubes, forms of coupling, plate voltage, grid voltage, filament voltage, isolating condensers, voltage reducing resistances, noises, analysis of trouble, plate current, grid current.

RADIO WORLD, 145 West 45th St., New York, N. Y.
(Just East of Broadway)

Enclosed please find:

☐ $3.50 for which please send me postpaid "Trouble Shooter's Manual," by John F. Rider, being Part II of "Service Man's Manual." 240 pages, 8½x11", more than 200 illustrations, including wiring diagrams of commercial receivers as advertised; imitation leather cover, gold lettering.

☐ $2.00 for which please send me postpaid "Mathematics of Radio," by John F. Rider, 128 pages, 8½x11", 119 illustrations, flexible cover, this being Part I of "Service Man's Manual."

NAME .....

ADDRESS .....

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

"The Mathematics of Radio"

John F. Rider wrote two companion books grouped under the title "Service Man's Manual." The first was "Mathematics of Radio," the second "Trouble Shooter's Manual." The value of one of these books is more than doubled by the possession of the other.

"The Mathematics of Radio," 128 pages, 8½x11", 119 illustrations, bridges the gap between the novice and the college professor. It gives a theoretical background so necessary for a proper understanding of radio and audio circuits and their servicing.

RADIO WORLD BOOK SERVICE

AS the first and only national radio weekly, now in its eighth year, RADIO WORLD publishes the most timely, up-to-date news of radio circuits and events in the set-building and broadcasting fields. Technical accuracy second to none. Get a copy at your news-stand today, 15c. RADIO WORLD advises impartially on all radio topics, including what text books to buy, and helps you to read the books properly. Every book advertised on this page is essential to your radio library.

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. ME @ $3.00

By the same author: "Principles of Radio Communication," second (new) edition. This book is for advanced students. It is the standard of excellence in its field. It covers much the same ground as the later book, only much more fully and more technically. Contains 1,001 pages. 831 illustrations. Cloth bound. Order Cat. MP @..... $7.50

MOYER and WOSTREL
"Radio Receiving Tubes"

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

By the same authors:

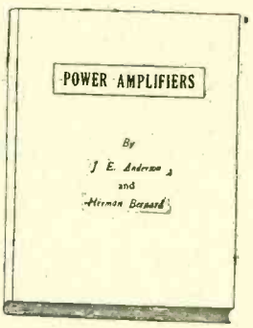
"Practical Radio," including the testing of radio receiving sets. 378 pages, 223 illustrations. Cloth bound. Order Cat. MWPR @ $2.50

"Practical Radio Construction and Repairing," 319 pages, a companion volume. Order Cat. MWPRC @.....$2.00

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

ANDERSON and BERNARD
"Power Amplifiers"

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

RIDER
"Service Man's Manual"

Two new books by John F. Rider, R. E., Member, Institute of Radio Engineers, constitute the series grouped by him under the heading "Service Man's Manual." Part I is "Mathematics of Radio." Part II is "Trouble Shooter's Manual."

The value of one of these books is more than doubled by the possession of the other.

"The Mathematics of Radio," 128 pages, 8½x11", 119 illustrations, bridges the gap between the novice and the college professor. It gives a theoretical background so necessary for a proper understanding of radio and audio circuits and their servicing. Flexible cover. Order Cat. MOR @....$2.00

The first comprehensive volume devoted exclusively to the topic uppermost in every service man's mind is "Trouble Shooter's Manual," just published. It is not only a treatise for service men, telling them how to overcome their most serious problems, and fully diagramming the solutions, but it is a course in how to become a service man. It gives all the details of servicing as they have never been given before. Finding the right mode of attack, applying the remedy promptly and obtaining the actual factory-drawn diagrams of receivers always have been a big load on the service man's chest. But no more. Rider, expert on trouble shooting, has produced the outstanding volume on servicing, and has taken the load off the service man's chest!

This book is worth hundreds of dollars to any one who shoots trouble in receivers—whether they be factory-made, custom-built or home-made receivers. The home experimenter, the radio engineer, the custom set-builder, the teacher, the student—all will find this new book immensely informative and absolutely authoritative.

MORE THAN 100 WIRING DIAGRAMS OF RECEIVERS MADE BY MORE THAN FORTY DIFFERENT SET MANUFACTURERS ARE PUBLISHED IN THIS BOOK, INCLUDING OLD MODELS AND LATEST MODELS! RCA, ATWATER KENT, CROSLEY, MAJESTIC, ZENITH, STROMBERG CARLSON, KOLSTER, FEDERAL, FADA, Etc. 240 pages, size 8½x11"; 200 illustrations. Imitation leather cover. Order Cat. TSM @.....$3.50

Read Radio World Every Week

RADIO WORLD will help you in your radio work, so you will be able to use meters most valuably. Keep abreast of new circuits, intimate details on perfecting existing sets, get inside track on sensitivity, distance reception, tonal quality, and news of radio, technical and non-technical. Enjoy the writings of McMurdo Silver, J. E. Anderson, Herman Bernard, John F. Rider and a host of other radio engineers in RADIO WORLD. 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 interestd in RADIO WORLD.

See the list of nine meters at left. Obtain one or more 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 26 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.

Present RADIO WORLD mail subscribers may renew their subscription under this remarkably generous offer. Put a cross in square. ☐

☐ 0-6 Voltmeter D.C.....Cat. 326
☐ 0-50 Voltmeter D.C.....Cat. 337
☐ 6-Volt Charge Tester D.C.....Cat. 23
☐ 0-10 Amperes D.C.....Cat. 338
☐ 0-25 Milliamperes D.C.....Cat. 325
☐ 0-50 Milliamperes D.C.....Cat. 350
☐ 0-100 Milliamperes D.C.....Cat. 390
☐ 0-300 Milliamperes D.C.....Cat. 399
☐ 0-400 Milliamperes D.C.....Cat. 394

RADIO WORLD

145 W. 45th St., N. Y. City—Published Weekly.
All Newsstands, 15c per copy—$3, six months—$6 a year

Gentlemen: Enclosed find $..... for which please send items checked on coupon..

(R -10)

☐ CAT. ME @.....	$3.00	☐ CAT.....326	Name .....
☐ CAT. MP @.....	$7.50	☐ CAT.....337	
☐ CAT. PAM @.....	$3.50	☐ CAT..... 23	
☐ CAT. MWT @.....	$2.50	☐ CAT.....338	
☐ CAT. MWPR @.....	$2.50	☐ CAT.....325	Address .....
☐ CAT. MWPRC @...	$2.00	☐ CAT.....350	
☐ CAT. MOR @.....	$2.00	☐ CAT.....390	
☐ CAT. TSM @.....	$3.50	☐ CAT.....399	
☐ CAT. VDB @.....	$5.00	☐ CAT.....394	City..... State.....

RADIO WORLD'S BOOK SERVICE

has been found of great value not only by radio fans, constructors, etc., but also by radio and other technical schools throughout the country. See the radio books advertisements in this issue.

TRIAL SUBSCRIPTION

Send $1 for trial subscription for 8 weeks, starting with current issue, or of any recent issue. Radio World, 145 W. 45th St., N. Y. City.

A GREAT ADVERTISING MEDIUM!

That describes Radio World. Rates on application. Radio World, 145 W. 45th St., N. Y. City.

Blueprint of the New One-Dial Push-Pull Battery Model

SG DIAMOND

Full-sized picture diagram of the wiring, with list of parts. This 5-tube receiver is really superlative. It gives you screen grid radio frequency amplification and push-pull output, most economically.

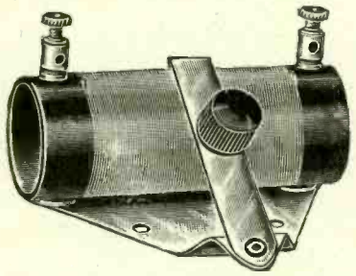
Send $1.00 today for this blueprint or order it shipped C. O. D.

RADIO WORLD
145 West 45th Street
Just East of Broadway New York City

EVERY WEEK in RADIO WORLD appears a feature article of intense interest to schoolboys. Parents and other relatives will bring great delight to youngsters by sending $3 for a 6 months' subscription for RADIO WORLD (26 issues) in the youngster's name.—RADIO WORLD, 145 West 45th Street, New York City.

AERIAL TUNER

Improves Your Reception



Remove aerial lead from set. Connect aerial instead to one of the binding posts of the Aerial Tuner Connect the other binding post of the Aerial Tuner to antenna post of your set. Then move the lever of the Aerial Tuner until any weak station comes in loudest. The lever need not be moved for every different frequency tuned in. The Aerial Tuner acts as an antenna loading coil and puts the antenna's frequency at any frequency in the broadcast band that you desire to build up. It makes high wavelengths come in loud as low wavelengths. It helps separate stations and clear up reception. Makes great improvement in Summer reception. Price, $1.00.

GUARANTY RADIO GOODS CO.

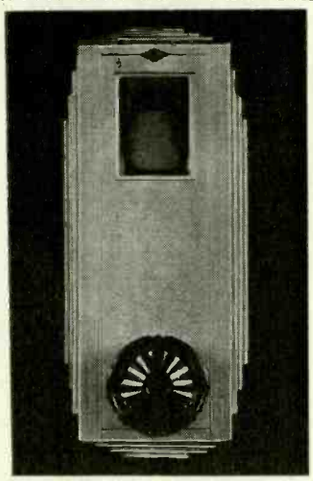
143 West 45th Street
New York City

(Just East of Broadway)

BRILLIANT, NEW

NATIONAL

MODERNISTIC PROJECTION DIAL WITH RAINBOW FEATURE



Modernize the appearance of your receiver by installing the brilliant new National dial, with color wheel built in, so that as you turn the dial knob one color after another floods the screen on which the dial numbers are read. On this screen the numbers are projected, so that you get the same dial reading from any position of the eye. This is just what DX hunters want—laboratory precision of dial reading.

The escutcheon is of modernistic design. The Velvet Vernier mechanism drives the drum superbly.

Order today. Remit with order and we pay cartage. Shipments day following receipt of order.

GUARANTY RADIO GOODS CO.,
143 W. 45th St., N. Y. City (Just E. of B'way)

Enclosed please find $3.13 for which please send me dial marked below:

☐ Cat. HC6, National modernistic drum dial, with color wheel built in, pilot bracket, 6-volt pilot lamp for storage battery or A eliminator sets; hardware; instructions $3.13

☐ Cat. HC2½, same as above, but with 2½-volt AC pilot lamp 3.13

☐ Order C.O.D. and I pay cartage.

NAME .....

ADDRESS .....

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

RADIO WORLD'S BOOK SERVICE has been found of great value not only by radio fans, constructors, etc., but also by radio and other technical schools throughout the country. See the radio books advertisements in this issue.

LACAULT'S BOOK

"Super-Heterodyne Construction and Operation," giving the master's most masterful exposition of the theory, performance and construction of this fascinating type of circuit. is a necessity to every serious radio experimenter. More than 100 pages and more than 50 illustrations. Buckram cover. This book by R. E. Lacault, FREE if you send $1.00 for an 8-weeks subscription for Radio World. Present subscribers may accept this offer. Subscription will be extended.

RADIO WORLD 145 W. 45th St., N.Y. City Just East of B'way

NATIONAL

Velvet B Eliminator **$16.13**
180 Volts (280 Tube Free)

Latest Model National Velvet-B, Type 8580, in handsome crackle finish black metal casing, for use with sets up to and including six tubes. Input 105-120 volts AC, 50 to 60 cycles. Output, 180 volts maximum at 35 milliamperes. Three variable output intermediate voltages. (Det., RF, AF). Eliminator has excellent filter system to eliminate hum, including 30 henry choke and 18 mfd. Mershon condenser. No motorboating! (Eliminator Licensed under patents of the Radio Corporation of America and associated companies.)

Guaranty Radio Goods Co.
143 W. 45TH STREET
(Just East of Broadway)
NEW YORK CITY

New Junior Model

POLO UNIT $4

The famous twin magnet principle for double sensitivity, large magnets for great flux, permanently adjusted armature, all are in the new junior model Polo Unit. Weight, 2¾ lbs. Stands 150 volts unfiltered. Stands up to 250 push-pull filtered. Works any output tube, power or otherwise. Supplied with 10-ft. cord. Order unit now. Five-day money-back guarantee. Shipped C. O. D. if desired.

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

RADIO WORLD and "RADIO NEWS"

BOTH FOR ONE YEAR @ **$7.00**

You can obtain the two leading radio technical magazines that cater to experimenters, service men and students, the first and only national radio weekly and the leading monthly, for one year each, at a saving of $1.50. The regular mail subscription rate for Radio World for one year, a new and fascinating copy each week for 52 weeks, is $6.00. Send in $1.00 extra, get "Radio News" also for a year—a new issue each month for twelve months. Total, 64 issues for $7.00.

☐ If renewing Radio World subscription, put cross square.

RADIO WORLD, 145 West 45th Street, New York, N. Y.

Quick Action Classified Ads

Radio World's Speedy Medium for Enterprise and Sales

10 cents a word — 10 words minimum — Cash with Order

EDISON STORAGE BATTERIES—100 volts $6.50; ¼ Horsepower Alternating Motors $7.00. Hoffmann Electrical Shops, 904 North Fifth, Philadelphia, Pa.

"MATHEMATICS OF RADIO."—A great help to everybody interested in radio. $2 postpaid. Radio World, 145 W. 45th St., N. Y. City.

RECENT NUMBERS OF RADIO WORLD, for 1929, 15c per copy. Any 7 copies for $1. Radio World, 145 W. 45th St., N. Y. City.

TELEVISION and all about it in "A B C of Television," by Raymond Francis Yates. $3 postpaid. Radio World, 145 W. 45th St., N. Y. City.

"EVERYBODY'S AVIATION GUIDE." By Maj. Pagé. $2 postpaid. Also "Modern Aircraft" by same author. $5. postpaid. Radio World, 145 W. 45th St., N. Y. City.

A. C. TUBES—Manufactured by licensed R.C.A. manufacturer. UX250—.95 UX224—.85 UX245—.85 UX227—.80 UX280—. 75 UX226—.65 Charles Blackmore, Windsor, Missouri

"AUDIO POWER AMPLIFIERS," by J. E. Anderson and Herman Bernard, the first and only book on the subject. $3.50. Hennessy Radio Publications Corporation, 145 West 45th St., N. Y. City.

HELP FOR SERVICE MEN.—Nothing better than John F. Rider's "Trouble Shooter's Manual." $3.50 postpaid. Radio World, 145 W. 45th St., N. Y. City.

BE SURE TO READ the advertisement on another page of this issue about the HB Compact. Guaranty Radio Goods Co., 143 W. 45th St., N. Y. City.

EVERYTHING IN RADIO
At attractive Prices **Sets or parts**
Orders shipped exactly as ordered. Prompt service. Write for prices. Inquiries invited. Send your address.
ALL RADIO CO., 417 North Clark St., Chicago

"A B C OF AVIATION." By Maj. Pagé. $1.00 postpaid. Radio World, 145 W. 45th St., N. Y. City.

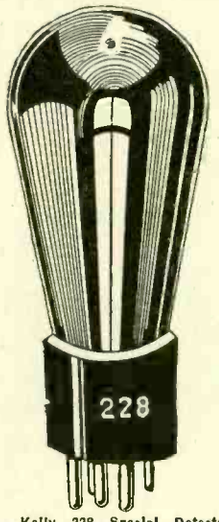
TWO FOR ONE. Radio World for 52 weeks and Radio News twelve months at the combination rate of $7. Radio World, 145 W. 45th St., N. Y. City.

"MODERN AIRCRAFT," By Maj. Pagé. $5. postpaid; and "Everybody's Aviation Guide," By Maj. Pagé, price $2. postpaid. Latest and best up-to-date aviation books. Radio World. 145 W. 45th St., N. Y. City.

RECENT NUMBERS

for the current year are procurable at the rate of 15c a copy, or 8 copies for $1.00. RADIO WORLD, 145 West 45th St., N. Y. City.

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.

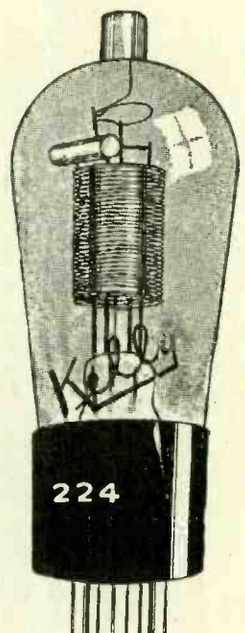
The filament voltage of the 222 is 3.3 volts, the plate voltage 135, the screen grid voltage 45 volts or less. The heater voltage of the 224 is 2.5 volts AC, the plate voltage 180, the screen grid voltage 75 volts or less.

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.

GUARANTY RADIO GOODS CO., 143 West 45th St., N. Y. City.
Enclosed please find $....., for which ship at once Kelly tubes marked below:

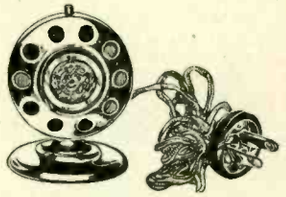
☐ 228 AC high mu. $2.50
☐ 224 AC screen grid $3.00
☐ 245 AC power tube $2.25
☐ 226 AC amplifier $0.95
☐ 227 AC det.-amp. $1.50
☐ 280 AC rectifier $1.75
☐ 222 battery screen grid.....$3.50
☐ 240 battery high mu.....$1.25
☐ 112A power tube $0.95
☐ 171A power tube $0.95
☐ 201A battery tube $0.65
☐ UX199 battery tube.....$1.25
☐ Matched pair of 245s for push-pull (for both).....$4.50
☐ Matched pair 171As for AC push-pull (for both).....$1.90
☐ Matched pair of 112As for push-pull (for both).....$1.90

ALL PRICES QUOTED ARE SELLING PRICES AND ARE NET.

Name.....
Address.....
City..... State.....
☐ 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.

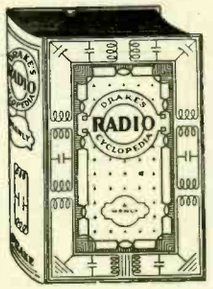
The heater element is renewable.

RADIO WORLD, 145 West 45th St., N. Y. City
☐ Please send me Model A Microphone Lighter at $1.00.
☐ Please send me Model B at $1.50.
☐ Enclosed is remittance [Canadian must be P.O. or express money order.]
☐ Ship C. O. D.

Name .....
Address .....
City..... State.....

New DRAKE'S ENCYCLOPEDIA

A reference work that has subjects classified in alphabetical order.



BOOK IS 2½" THICK, WEIGHS 3¾ LBS., 1,025 ILLUSTRATIONS.

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

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

The important articles deal primarily with receivers and reception. They do not stop with the electrical end, but go also into the mechanics of construction.

Every new thing in radio is covered in detail.

1,680 Alphabetical Headings from A-battery to Zero Beat
1,025 Illustrations, Diagrams, Layouts and Graphs
920 Pages, Each 6 by 9 Inches
240 Combinations for Receiver Layouts

OF THE PRINCIPAL ARTICLES

159 Concern service men, 129 help the set builder. 162 help the experimenter. 155 interest the student. 75 assist in sales work. 73 interest set owners.

PRICE, $6.00

Remit with order and we pay cartage. Canadian remittance must be by postal or express money order. Order C. O. D. and you pay cartage.

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

SUBSCRIBERS!

Look at the Expiration Date on Your Wrapper

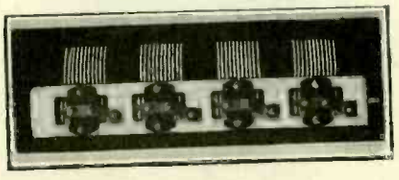
Please look at the subscription date stamped on your last wrapper, and if that date indicates that your subscription is about to expire, please send remittance to cover your renewal.

In this way you will get your copies without interruption and keep your file complete.

SUBSCRIPTION DEPARTMENT
RADIO WORLD
145 WEST 45TH ST., N. Y. CITY

4-GANG CONDENSER

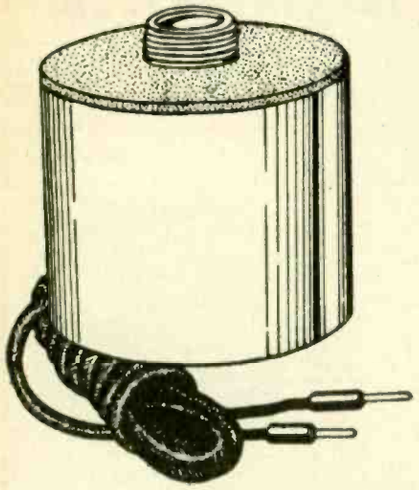
With Trimmers Built in **$3.95**



Capacity of each of the four sections is .00035 mfd. Overall length 11". Accurate capacity and precise alignment.

Guaranty Radio Goods Co.
143 West 45th Street,
New York City
[Just east of Broadway.]

Horn Unit $2.25



This unit is pre-eminent for horn-type speakers such as the exponential horns or other long tone travel horns. The faintest word from a "whispering tenor" or the tumultuous shout of the crowd or highest crescendo of the band is brought out clearly, distinctly. Stands up to 450 volts without filtering. Works right out of your set's power tube, requiring no extra voltage source. Standard size nozzle and cap are die-cast aluminum, one piece, with milled platinum-like finish. The casing is full nickel, of highest possible polish. Works great from AC set, battery set or any other set, push-pull or otherwise.

For Portable Use

This unit can be used in a portable without any horn attached and will give loud reproduction. Order Cat. 225, with 4½ ft. cord attached. (Shipping weight, 2 lbs.) $2.25

Air-Column Horn

8-ft. tone travel molded wood horn (less unit No. 225) is obtainable already mounted in a baffle box. Outside overall dimensions of baffle box, 21¼" high, 18" wide, 15" front to back. Shipping weight, 27 lbs. Order Cat. 596 @ $8.00

Acoustical Engineering Associates,
145 W. 45th St., N. Y. City (Just E. of Bway).

Please ship C. O. D.
☐ Cat. No. 225 @ $2.25 ☐ Cat. No. 596 @ $8.00

Name .....

Address .....

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

FIVE-DAY MONEY-BACK GUARANTEE

List price $15.00
Slightly higher west of the Rockies

PHONOGRAPH MUSIC is at its best *with the* Super Phonovox

Plays records electrically through your radio with amazing tone realism and volume. New combination switch and volume control (with special adapter for screen grid tubes) switches instantly from radio to records without changing any connection. **English 36% Cobalt Magnets** provide extreme sensitivity. Hear it at your dealers. Two new low impedance models now available.

PACENT ELECTRIC CO., INC., 91 SEVENTH AVE., N. Y.

Pioneers in Radio and Electric Reproduction for over 20 years

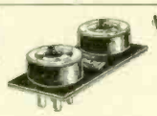
Manufacturing Licensee for Great Britain and Ireland: Igranic Electric Co., Ltd., Bedford, Eng.
Licensee for Canada: White Radio Limited, Hamilton, Ont.

CLAROSTAT

Not just the name of a product, but the name of a service dedicated to better radio results. CLAROSTAT stands for variable and fixed resistors, volume controls, automatic line voltage ballasts, socket antennas, etc.

CLAROSTAT MFG. CO.,
291 North 6th Street Brooklyn, N. Y.

LYNCH



TUBADAPTA
For Better TONE
List Price..$2.50
Improves reception and prolongs life of expensive power tubes. Used in last audio stage. Write for descriptive circular and complete catalogue Lynch Guaranteed Radio Products.
LYNCH MFG. CO., Inc., 1775 B'way, N. Y.

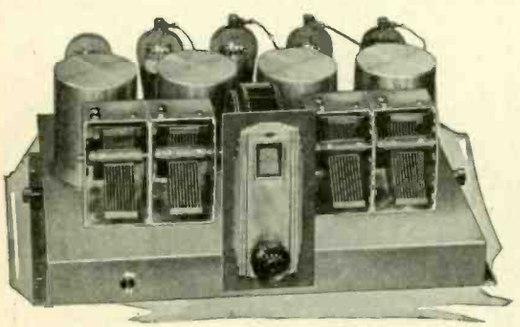
SUBSCRIBERS! Look at the Expiration Date on Your Wrapper

Please look at the subscription date stamped on your last wrapper, and if that date indicates that your subscription is about to expire, please send remittance to cover your renewal. Please give our subscription department two weeks to make changes in expiration dates, street addresses, etc.

In this way you will get your copies without interruption, and keep your file complete.

SUBSCRIPTION DEPARTMENT
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, $69.50. Your price .....

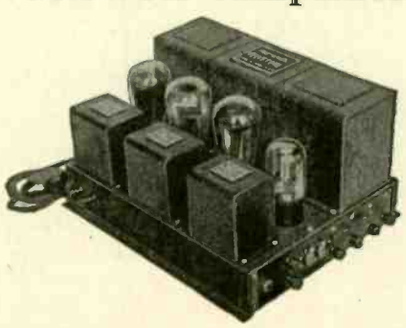
$40.00

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.

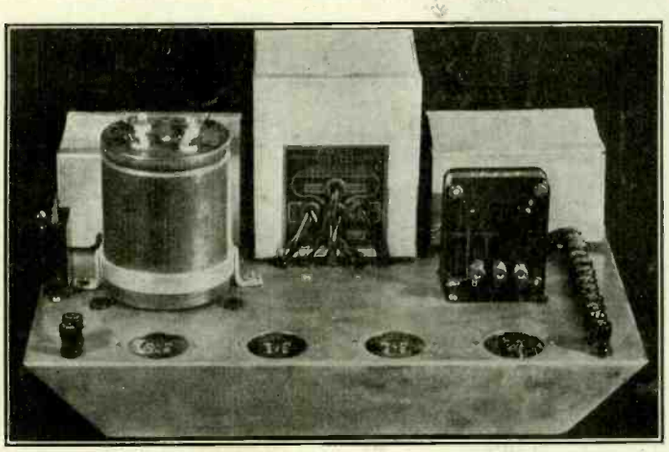
$55.00



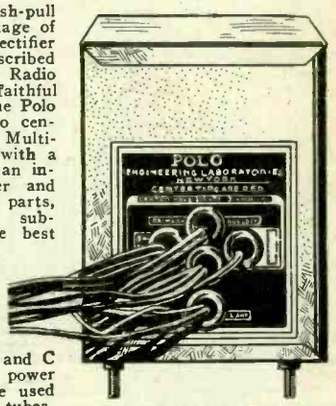
View of National Velvetone Push-Pull Power Amplifier, an expertly made A, B and C supply and audio amplifier, producing marvelous tone quality.

GUARANTY RADIO GOODS CO.
143 WEST 45TH STREET NEW YORK CITY

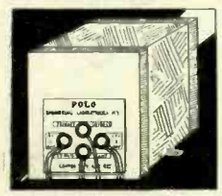
Power Amplifier Equipment



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 2¾" 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.

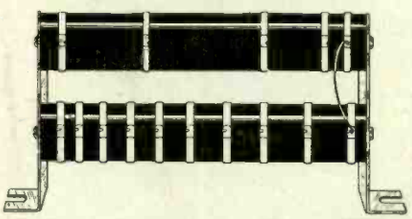
Filter Condensers

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.; choke 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.

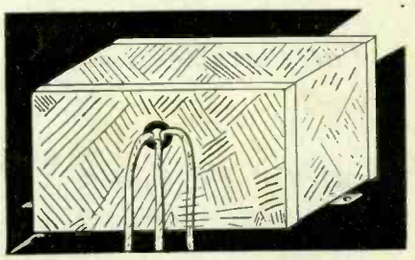
The Multi-Tap Voltage Divider is useful in all circuits, including push-pull and single-sided ones, where the current rating of 125 milliamperes is not seriously exceeded and the maximum voltage is not more than 400 volts. If good ventilation is provided, this rating may be exceeded 15 per cent.

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

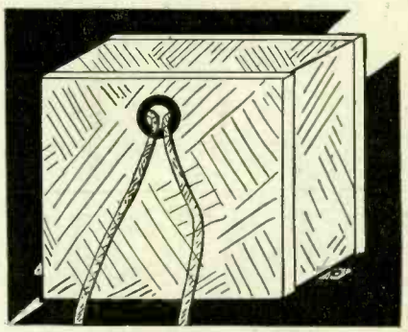
When the Multi-Tap Voltage Divider is placed across the filtered output of a B supply which serves a receiver, the voltages are in proportion to the current flowing through the various resistances. If a B supply feeds a receiver with two-stage audio amplifier, the last stage a single-sided 245, then 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 180 m.a. choke for filtered output (where condenser is used additionally) or for added filtration of a B supply. Order Cat. PSC @ $2.50.

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.]

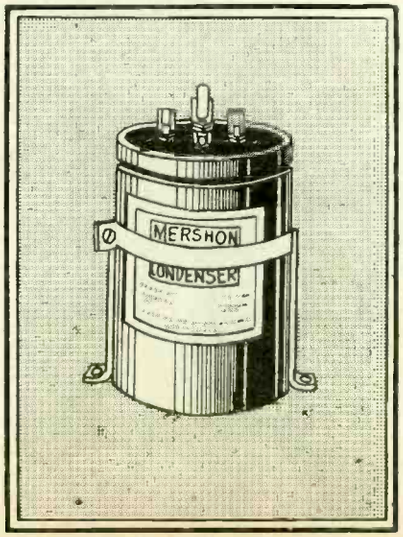
☐ Please ship C.O.D.

NAME.....

ADDRESS.....

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

5-DAY MONEY-BACK GUARANTEE!



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 motor-boating.

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**