NOV. 2ND 1929

# NEW RECEIVER SYSTEM!

15 CENTS

RADIO WORLD

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The First and Only National Radio Weekly

*397th Consecutive Issue—EIGHTH YEAR*

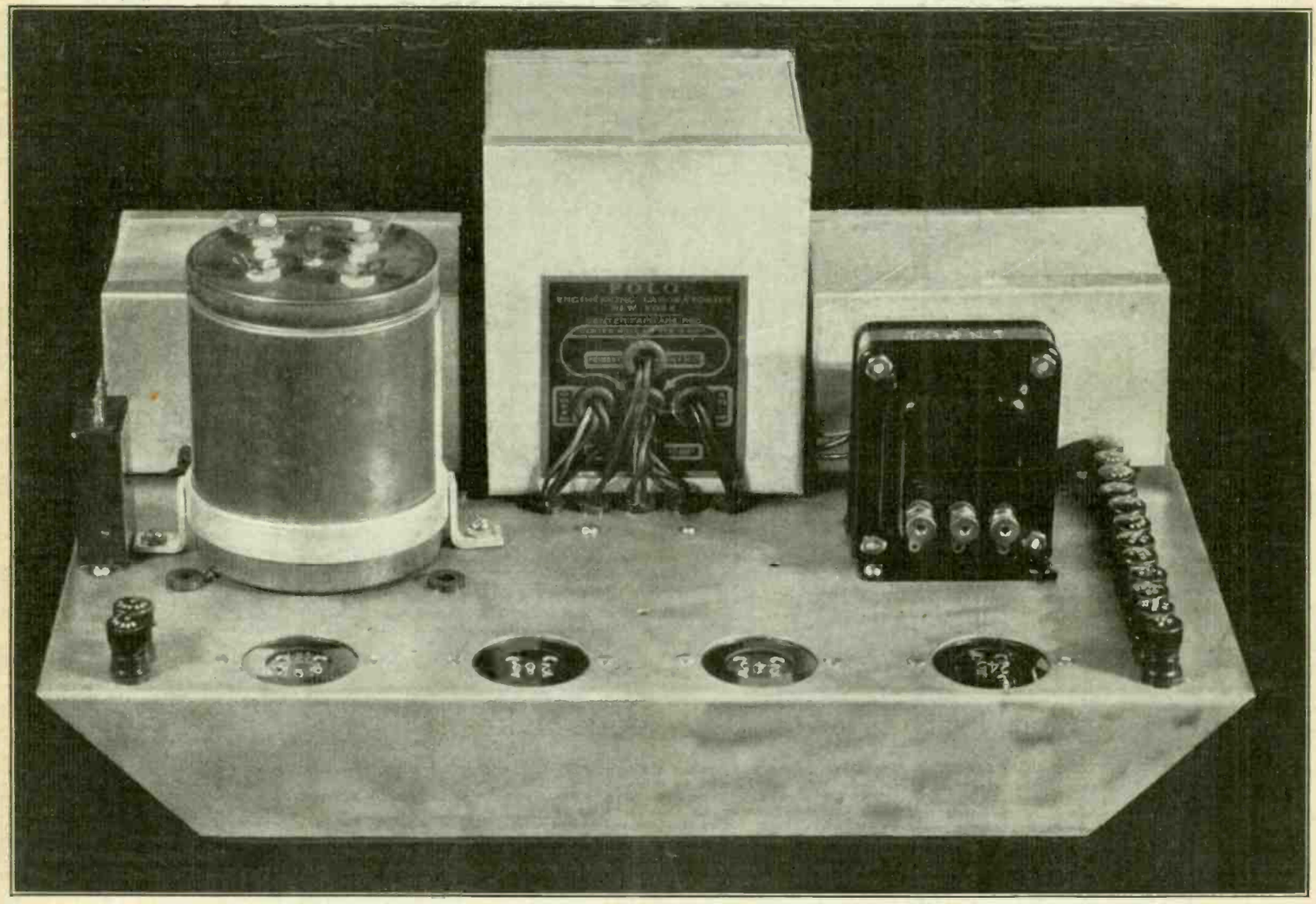
SUPERHETERODYNE SELECTIVITY AT THE RF LEVEL

3-TUBE MIDGET

NOVEL SHIELDED TUNER

NEW AC DIAMOND

# 245 PUSH-PULL POWER AMPLIFIER!

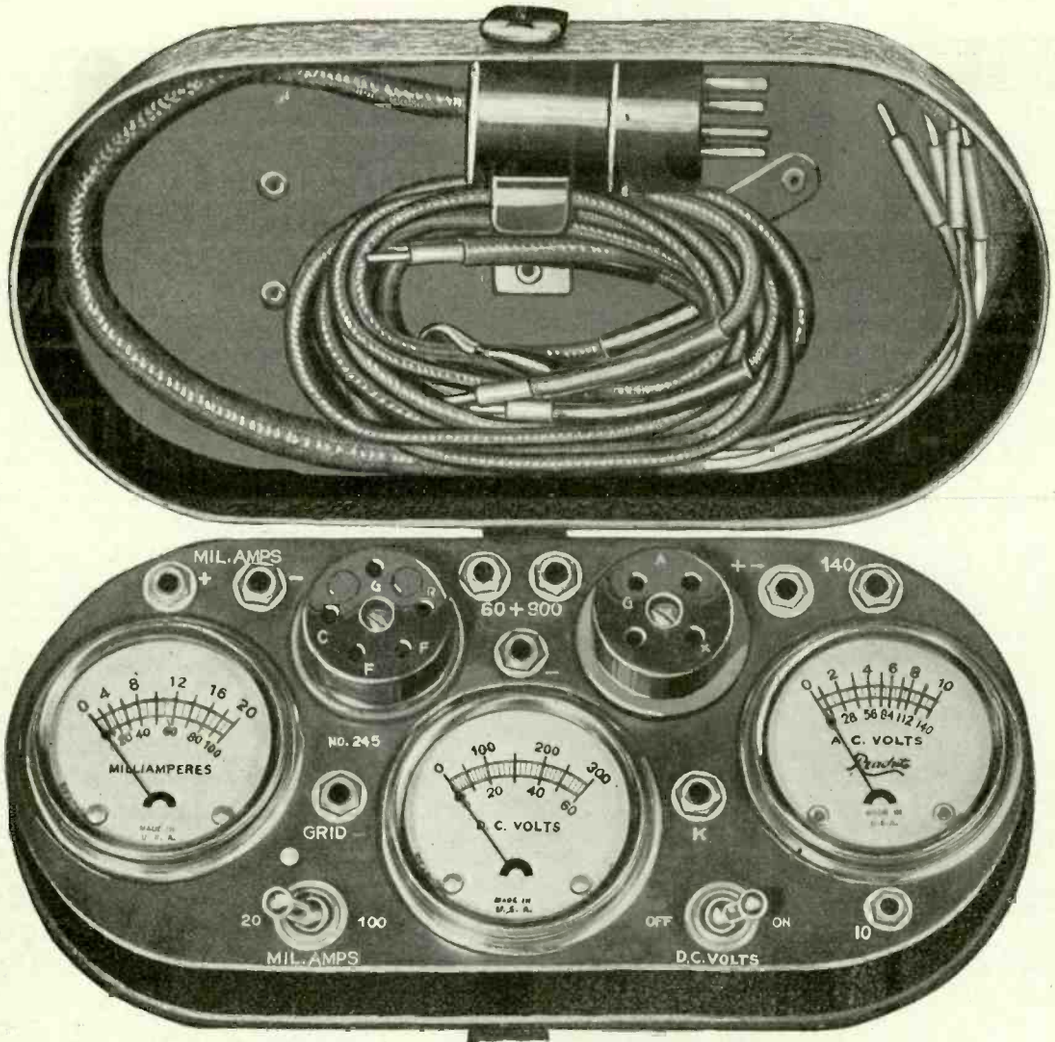


An audio amplifier with A, B and C voltages for its own operation and for powering a tuner, is assembled on a cadmium-plated steel subpanel. See particulars on pages 5, 6 and 7.

## TUNING PHENOMENON EXPOUNDED FOR SCHOOLBOYS

# 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 500 volts DC, 560 volts AC, 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.

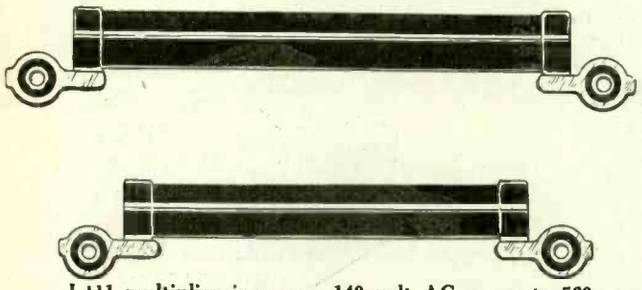
**To test for shorts in condensers, resistors, etc.** With tube in tester connect condenser under test to jacks —MA and +MIL-AMPS. If milliammeter shows change in reading the part tested is shortened. Resistors, etc., may be tested by the same method as noted above for continuity tests, or by disconnecting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

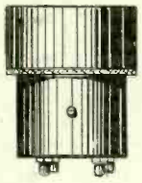
# zes All Tubes, Sets and Circuits

## Voltmeter Range Extended to 560 volts—Dandy Outfit!

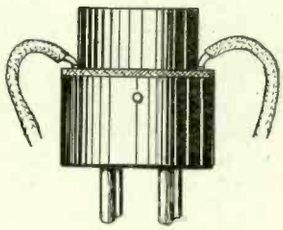


**J-111 multiplier increases 140 volt AC range to 560 volts.**

**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, UX120, 240, 171, 171A, 112, 112A, 245, 224, 222, 228, 280, 281, 227, 228, 226, while accessories permit testing of UV199 tubes, Kellogg tubes and old style Arcturus tubes. The two other accessories 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 possible 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.

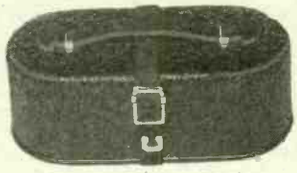
You are all set to go when you possess the J-245-X. You will not even experience limitations when desiring to test the B voltages on 210 and 250 tubes or desire to test UV 199 or Kellogg tubes which have filament emerging from a cap at top.

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.....

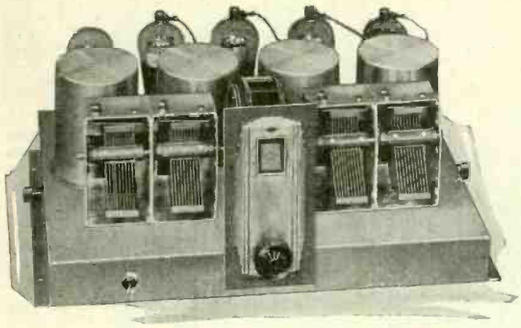
Address.....

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

**5-DAY MONEY-BACK ABSOLUTE GUARNTY!**

**SHIPMENT 24 HOURS AFTER RECEIPT OF ORDER!**

# NATIONAL SCREEN GRID TUNER MB-29



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

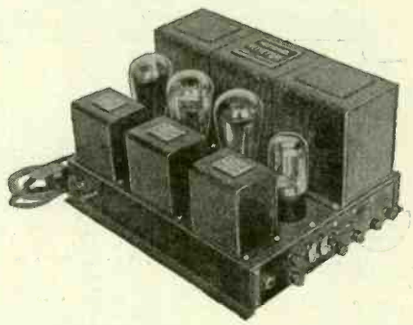
**$40.00**

## 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.

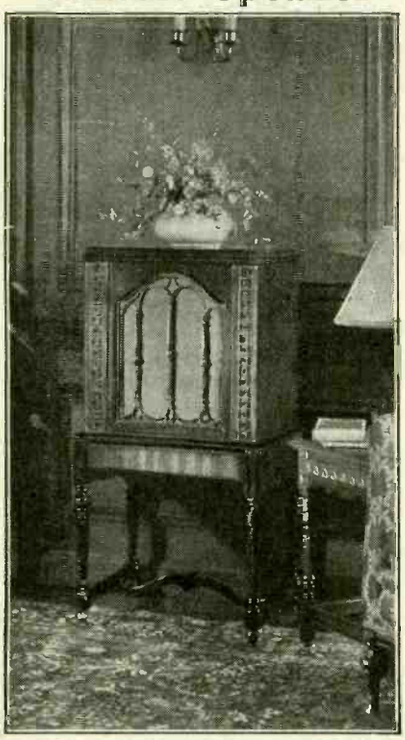
The new Power Amplifier has been developed and built to get the very most out of the MB-29. It is a combination power supply and audio amplifier, using a 280 tube for a rectifier, one stage of transformer audio with a 227 tube and a stage of push pull amlification with two 245s. It furnishes all power 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.

## PEERLESS Super Dynamic Console Speaker



Peerless Super Dynamic 12" AC-operated speaker, built into a Sonora console, with 2,000 mfd. filter condenser to kill hum; equipped with special rectifier and switch. Speaker by United Rep. Corp. List, $155.00. Your price.....

**$37.50**

The famous Peerless AC dynamic speaker, with Kuprox rectifier and 2,000 mfd. hum-killing condenser built-in, all housed in this 40" high Sonora cabinet of fascinating ply-walnut. The cabinet is all one piece—carved legs, marqueterie panel and grille pilars. Sliding back is made of caned steel, acoustically open to present boominess. This imposing floor model speaker, exactly as illustrated, in original factory packing case, shipping weight 100 lbs. Never in your life did you hear of such an amazing bargain—highest class, perfect, guaranteed merchandise at more than 75% off list price! Look at that beautiful console cabinet, its graceful legs, with archer's bow tiepiece; its rosetted side panels at front, its shapely grille pillars, all in two-tone effect, with high-polish surface of ply-walnut. The speaker sets against a golden grille, with ample baffle board concealed. Order catalog PSHB @ $37.50. The console, which has removable back, is 40" high, 19" wide, 16" front to back. Speaker only, with 2,000 mfd. and Kuprox rectifier, all built up at factory. Order Cat. SO @ $23.50. Cabinet only, Order Cat. CO @ $15.00.

## Farrand Inductor

Absolutely unexcelled tone quality, with amazing sensitivity, is assured when you use Farrand Inductor Speaker and a fine audio amplifier. The chassis is sold completely erected with unit and supporting brace mounted. The unit, cone spider, and ring are sturdily put together. Use a baffle board or box of your own choice.

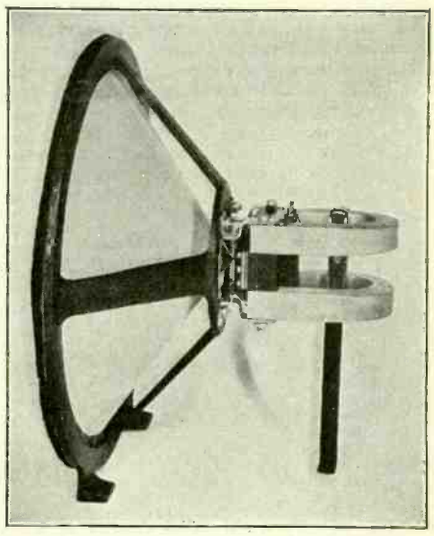
A new principle is involved in the Inductor Chassis. The armature moves up and down, in a wide gap, instead of from side to side in a tiny gap. Hence the armature does not strike the pole pieces.

The chassis is offered at professional discounts, the prices quoted being net. The outside diameters of the two different sized models are 9" and 12" respectively. The speaker should be selected, no matter what size, that matches the impedance of the output tube or tubes. See list below. The larger size gives better low-note response.

For single 112, 112A or 210 output tube, 9" diameter, order Cat. N9R @ $11.95.

For 171, 171A, 245 or 250 single output, or ANY push-pull output where you have an output transformer or midtapped impedance, order Cat. N9G @ $11.95.

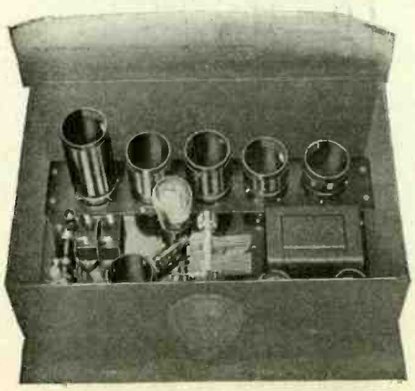
Same as above, only 12" outside diameter, order N12R for single 112, 112A, or 210 tube, @ $12.95. For single 171, 171A, 245, 250, or for ANY push-pull, order Cat. N12G for 12" size, @ $12.95.



Farrand Inductor Speaker (12" size illusirated), list price, $22.50. Your price $12.95.

Consult information at left as to suitable type speaker for your output tube. The 12" is preferable if you have room.

## 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, N. Y.

☐ Please ship at once on 5-day money-back guaranty the parts checked off below for which $.....is enclosed.

☐ Please ship C. O. D.

| | |
|---|---|
| Cat. MB29K @ $40 net | Cat. N12R @ $11.95 net |
| Cat. PS HB @ $37.50 net | Cat. PPPA @ $55 net |
| Cat. SO @ $23.50 net | Cat. SW4EF @ $31 net |
| Cat. CO @ $15 net | Cat. N9G @ $12.95 net |
| Cat. N9R @ $11.95 net | Cat. N12G @ $12.95 net |

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EVERY WEEK — EVERY YEAR

RADIO WORLD

Vol. XVI, No. 7 Whole No. 397
November 2d, 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.

# A Power Amplifier

## Using 245 Push-Pull on a Special Steel Subpanel

*By Herman Bernard*

**Managing Editor**

SO much attention has been paid to circuit formation, power transformers, chokes and tubes for power amplifiers that one of the most desirable mechanical conveniences has been overlooked. That is a steel subpanel, one that will amply support the necessarily heavy parts, and that will make a good impression on the eye.

It is only natural that a manufacturer of audio transformers should confine himself to his own field, that a condenser manufacturer should not worry about audio transformers, and a socket manufacturer should disregard chokes, power transformers and condensers. Nevertheless every constructor who has in mind building a power amplifier desires a good-looking and substantial subpanel for his choice layout. Therefore extreme pains were taken to design one that was attractive and sturdy, and it will appear from a view of the illustrations and a reading of this text, that a gratifying result has been attained.

### FILLS THE NEED WELL

Here is a subpanel, with sockets built in, and with the code number of the required tube imprinted on each socket; a subpanel that has turned-down flanges, 2" high, to afford plenty of room for parts underneath, including a husky voltage divider; a subpanel with all holes drilled in it for the specified parts, and with insulated openings to carry through the "hot" leads.

The placement of parts is such that the casing containing the filament transformer and high voltage for the plates of the rectifier tube is at rear center, while on either side is a mid-tapped choke coil, a dozen binding posts being in a row at right, three in a row at left. Behind this left-hand group are the condensers used for filtration. In the exact center are the low voltage bypass condensers of 1 mfd. each. Next to the right row of binding posts is the push-pull input audio transformer.

The subpanel is designed for a standard circuit, which comprises a 280 rectifier tube, a 227 first audio tube and a pair of 245 output tubes in push-pull. This season the 245 push-pull power amplifier is by far the most popular. Besides being popular it is also most excellent. The present circuit design capitalizes the excellence of this circuit.

Besides the two-stage audio amplifier and filament-plate power supply that runs it while automatically furnishing grid biases, there are available filament, plate and grid voltages for a tuner using 224, 227 or 228 tubes in any combination, with the sole provision that not more than six tubes be used in the tuner. In other words the total number of tubes (including four in the power amplifier itself) must not exceed ten.

### SUBPANEL IS 15X9½"

A phonograph pick-up may be used by connecting it between the ground post and the grid post, to constitute an input from the pickup to the grid circuit of the first audio tube. The connection is made by plugging into a switching jack.

All the parts are arranged neatly on the 15x9½" subpanel. The height of the subpanel top, as stated, is 2". The highest part is the filament-plate supply transformer, which is 4¼" high, so that the maximum height overall is 6¼". So anyone desiring a compact power amplifier that is also a good one, and most up-to-date, can readily fit this one into a console or radio table or other compartment which he has been desiring to fill with such a device.

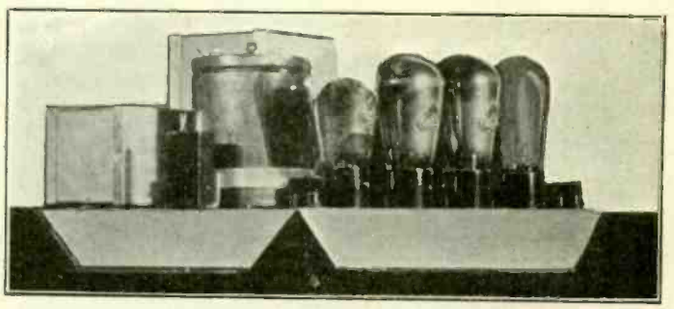


FIG. 1.
CORNR VIEW OF THE PUSH-PULL POWER AMPLIFIER. AT LEFT FOREGROUND ARE THE DETECTOR PLATE AND GROUND BINDING POSTS.

Every necessary part has been included, and nothing has been omitted that was deemed advisable in such a circuit. There is even a convenience outlet, into which a dynamic speaker's AC cable may be plugged, so that the switch used on the power amplifier will control the speaker. Also a fuse protects the entire installation.

The filter system is a good one, using a paper dielectric condenser of 1,000 volts DC continuous working voltage rating, 550 volts AC, root mean square, next to the rectifier. This condenser has an effect on the output voltage, and only 1 mfd. is used here because the voltages are satisfactory under the circumstances. Anyone desiring to increase the voltage applied to the push-pull pair may put another 1 mfd. condenser in parallel with the prescribed capacity, making certain, however, that it is of the same high voltage rating. Do not put a 200-volt DC bypass condenser in this position, as it will break down at once. All who build this push-pull power amplifier for 25 or 40 cycle current should include the extra 1 mfd. filter condenser.

The filter choke, a single winding center-tapped, is at left, and either one of its black insulated wire leads is connected to 5 volt midtap and to one side of the 1 mfd. high voltage filter condenser. The other side of this condenser goes to ground. As the subpanel should be grounded, this connection is most easily made by putting a lug on the machine screw that holds down one side of the bracket of the Mershon condenser, and connecting a wire from one of the terminals of the paper condenser to the lug.

### DETAILS ABOUT THE MERSHON

The Mershon condenser provides almost all of the capacity used in the filter. This particular Mershon is the one having two anodes of 8 mfd. each and two of 18 mfd. each. The catalogue number, including bracket, is Q 2-8, 2-18B. The bracket should be of the low type to fit the holes provided. There are two

(*Continued on next page*)

# Bleeder Current Analyzed

## Often Impossible to Read It, So It Is Calculated

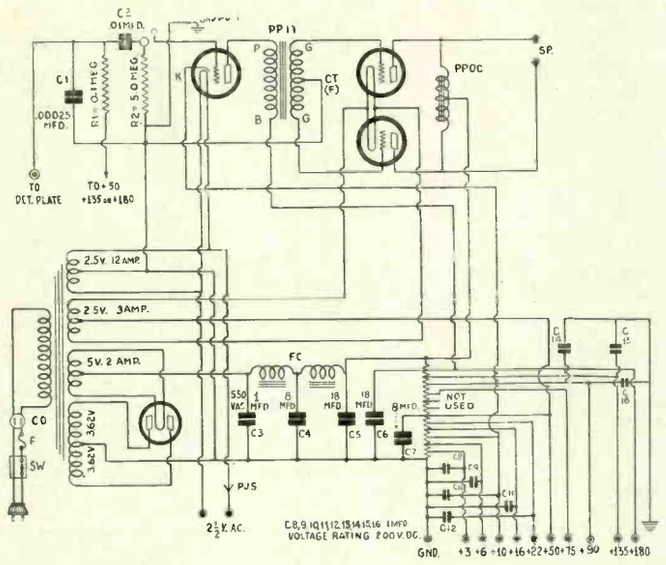



FIG. 2
CIRCUIT DIAGRAM OF THE 245 PUSH-PULL AMPLIFIER, INCLUDING PHONOGRAPH PICKUP JACK.

### LIST OF PARTS

**C1—One .00025 mfd. mica condenser.**
**C2—One .01 mfd. mica fixed condenser.**
**C3—One 1 mfd. filter condenser, 1,000 volts DC continuous working voltage rating, 550 volts AC (root mean square) continuous working voltage rating.**
**C4, C5, C6, C7—Four Mershon condensers in one copper casing, two of 8 mfd. and two of 18 mfd., with low bracket. Cat. Q2-8, 2-18B.**
**C8, C9, C 10, C11, C12, C13, C 14, C15, C16—Nine 1 mfd. bypass condensers, 200 volts DC continuous working voltage rating.**
**T1—One Polo Filament-Plate Supply transformer; 110 volt 50-60 cycle primary, 724 volt secondary center-tapped, 5 volt 2 amp. secondary center-tapped; 2.5 volt 3 ampere secondary center-tapped, and 2.5 volt 12 ampere secondary center-tapped. Cat. PFPS. (Note, for 25 cycles use Cat. P2FPS, for 40 cycles use P40FPS.)**
**FC, PPOC—Two center-tapped chokes for high current, one used as filter choke, other as push-pull output choke.**
**PPIT—One push-pull input transformer.**
**SW—One AC pendant through-switch, with 12-ft. AC cable and male plug.**
**F—One 2 ampere fuse, with holder.**
**CO—One convenience outlet (for dynamic speaker AC cable).**
**PJ, PJS—Phonograph pick-up jack with automatic switch and plug.**
**R1—One Lynch metallized resistor, 0.1 meg.**
**R2—One Lynch metallized grid leak, 5.0 meg.**
**R3—One Multi-Tap Voltage Divider, 13,850 ohms, 50 watt rating; fourteen taps, affording thirteen different voltages.**
**Two resistor mountings.**
**Roll of heavy insulated hookup wire for power work.**
**Fifteen binding posts.**
**One 15x9½" cadium plated steel subpanel, with self-bracketing flanges, one five-prong and three four-prong sockets built in; sockets marked to identify tubes that go in them; subpanel drilled and insulated where necessary; flat insulating washers; hardware.**
**Four Kelly tubes; one 280, one 227, two 245.**

*(Continued from preceding page)*

types of Mershon brackets available, but only the correct one is provided with the parts for this power amplifier.

The different capacities of the Mershon condenser may be distinguished easily. The smaller capacity is nearer the edge of the copper casing. In all instances the copper casing is negative. The anodes, represented by lugs on the insulated top of the casing, are positive. Attachment of the bracket to the subpanel automatically makes the case negative. The two smaller capacities are usually diametrically opposite each other.

So, to connect one of the 8 mfd. sections of the Mershon as the first electrolytic capacity in the filter circuit, simply bring the red insulated wire of the filter choke FC to one of the Mershon lugs nearer the edge of the copper casing.

Next use one of the 18 mfd. anodes of the Mershon, connecting it to the remaining lead emerging from the filter choke. As was pointed out, the grounding of the negative side is taken care of automatically.

The other 18 mfd. capacity is used to bypass the 180-volt lead, while the remaining 8 mfd. capacity is used for bypassing the 50-volt lead, to be across that part of the Multi-Tap Voltage Divider affording grid bias for the push-pull pair.

### SAME 50 VOLTS USED TWO WAYS

This same voltage of 50, used negatively for biasing these particular tubes, is available as a positive screen voltage for screen grid tubes, or for plate voltage for the grid-leak-condenser detector tube. This seeming double utility arises from the fact that the heater circuits are independent of the cathode, grid and plate circuits of the 227, 224 and 228 tubes, and of course are independent of the filament circuit of the two 245s.

The Multi-Tap Voltage Divider affords an assortment of voltages, and enough binding posts are provided to render available for immediate use all save two or these voltages. It is inconceivable that anyone would desire to use the two extra voltages in addition, but it is possible that some will want to use the omitted voltages, instead of one of two of those afforded by the circuit as shown. If so, the simple removal of the two leads from taps affording undesired voltages, to the two otherwise unused taps, affording the desired voltages, will effectuate the change.

It is highly advisable to bypass each used tap with a 1 mfd. low voltage condenser, if no other bypass condenser already is in that circuit. Since each voltage, except 50 volts and 180 volts already bypassed, requires this extra condenser of low voltage, those not desiring to use so many voltages may omit the undesired ones and thus economize on low-voltage condensers. Most persons, however, will prefer to have all ten voltages available: 3, 6, 10, 16, 22, 50, 67, 75, 135 and 180 volts. The highest voltage, which is 250 effective, is used only on the optput tubes, hence there is no reason for providing a tap for this voltage.

### VOLTAGES MAY BE READ DIRECTLY

By using a high resistance voltmeter you may determine the voltages by simple measurement, and without calculation of voltage drop on the basis of known values of resistance and the current flowing through each section of the divider. The values of current are different in each section. Through all sections flows the bleeder current, a little less than 22 milliamperes, when the power amplifier is worked with a tuner.

If the bleeder current is measured when there is no load on the rectifier except the Multi-Tap Voltage Divider itself, the reading will be in excess of 22 milliamperes, because the voltage is higher than 300 across the divider. This is due to the low total current. The more current drawn, the lower the voltage, principally because of the regulation of the rectifier tube, the resistance of which increases with increase in current.

When the plate current of the audio amplifier tubes or of the audio and radio amplifier tubes and detector is drawn from the power amplifier, it is impossible to read the bleeder current separately, as there is only one current flowing through each section of the voltage divider. This is the sum of the bleeder current and plate currents.

However, with the voltage across the two extreme terminals known, and the total resistance of the Multi-Tap Voltage Divider being 13,850 ohms, the current may be calculated. Hence, if the voltage is 300 volts, the current is the voltage divided by 13,850, or a little less than 22 milliamperes.

### DESCRIPTION OF DIVIDER

The Multi-Tap Divider consists of two enamelled wire-wound resistors, on separate cores, mounted one above the other on supporting end-brackets, and connected in series. This connection is made at the factory. The entire unit is tapped in resistance steps as follows: 3,000 ohms, 4,500, 2,000, 800, 700, 600. 550, 500, 450, 400, 200, 100 and 50. The zero lug is the fourteenth.

As might be surmised, the filter output high voltage is con-

# Ventilation in B Supply

## Helps Toward Humless Operation and Long Life

(*Continued from preceding page.*)

nected to the extreme lug that has its neighboring lug relatively far away from it (about 2"), to account for the 3,000 ohms, whereas the zero voltage lug (grounded terminal) has its neighboring lug very close by, on account of a resistance step of only 50 ohms separating them.

The same size wire is used all through, and the resistor will safely carry 125 milliamperes, which is more than the circuit will draw, by at least 25 per cent. The divider is rated at 50 watts.

### WHERE VOLTAGE DIVIDER GOES

The Multi-Tap Voltage Divider is mounted on the subpanel flange at rear, where the power apparatus and push-pull output choke are. One hole is 1¾" from legt, ¾" down from the top, as you look at the rear elevation, and the other hole is on the same level, 7¼" away. These holes may be for either 8/32 or 6/32 machine screws, depending on which you will use. The divider, mounted inside, clears the bottom when the lugs are bent back for that purpose.

To enable insertion of the Multi-Tap Voltage Divider it is necessary to snip off the excess of a couple of screws used for mounting other parts, one of these screws being a foot of the filament-plate supply. Otherwise these screws would obstruct the divider. The foot of the filament-plate supply is a 10/32 machine screw, hence will require some pressure if snippers are used. An easier way would be to saw it down first. If you have the filament-plate supply before you, with nameplate facing you, the foot in question is the one at right front.

### EASY TO DRILL THIS SUBPANEL

If for any reason such as the substitution of parts, it is necessary to drill holes, the work can be done very easily, for the steel will drill more handily than aluminum of equal gauge. The drill should not be pressed hard against the steel, for the drill will turn more readily with light downward pressure, for the metal will not burr and halt the drill, a difficuliyt common in working with aluminum.

Low voltage bypass condensers may be stacked up, as many as are needed, and where there are more than two, the additional ones should be mounted on top of the subpanel.

Before mounting the Mershon condenser be sure to put the two resistor mountings in place underneath the subpanel, as the screw for one of them otherwise will not pass the Mershon.

The filter choke and the push-pull output choke are identical, hence interchangeable. Put cardboard underneath the chokes to keep them rigid. The chokes should be mounted so that the anchoring strip attached to them comes flush with the extreme sides of the subpanel.

If the holes do not permit this, drill holes that will. Thus will the separation between filament-plate supply and the two identical choke combinations be increased, which is desirable for ventilation.

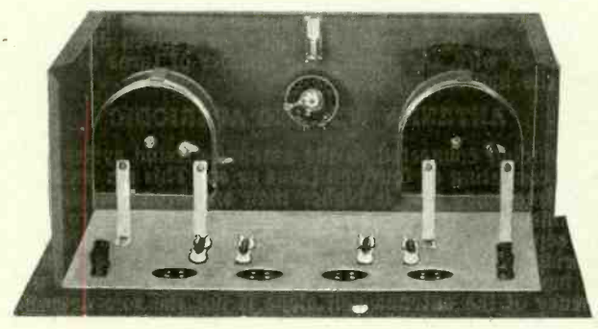
### ELEVATED FOR VENTILATION

For the same reason of ventilation the filament-plate supply is elevated from the subpanel, this being provided for at the factory by the insertion of elevating washers in the subpanel They are the same as insulating washers used elsewhere on the subpanel, as for bringing through the leads from the filament-plate supply, but insulation of the filament-plate supply is not desirable. Therefore simply attach the nuts to the feet of the filament-plate supply, and tighten them down, so that they strike the under side of the subpanel, hence ground the case of the filament-plate supply. These feet, by the way, are loose, but when the nut is driven all the way down the feet are drawn out tifht, and utter rigidity results.

The binding posts, other than the one used for grounded negative, are insulated. Atop the subpanel are collar type insulators, already in place in the subpanel. This type is known as an extruded washer. To insure insulation, a flat bakelite washer must be placed at the bottom, where the binding post screw protrudes. Simply drop the flat washer onto the screw. The lug is put on next, and finally the nut. Bend the lug away from the subpanel to avoid possibility of contact.

### PRECAUTIONS ABOUT GROUNDING

To ground the subpanel simply omit the flat washer. Scrape off the cadmium plate from the subpanel about the hole for the ground binding post, to make sure of good contact, and to make assurance doubly sure, jut a lug and extra nut on the screw that protrudes from the Mershon bracket. This screw you will find close at hand. Solder a short piece of wire between the ground post lug and the lug underneath where the Mershon condenser bracket is held tight.

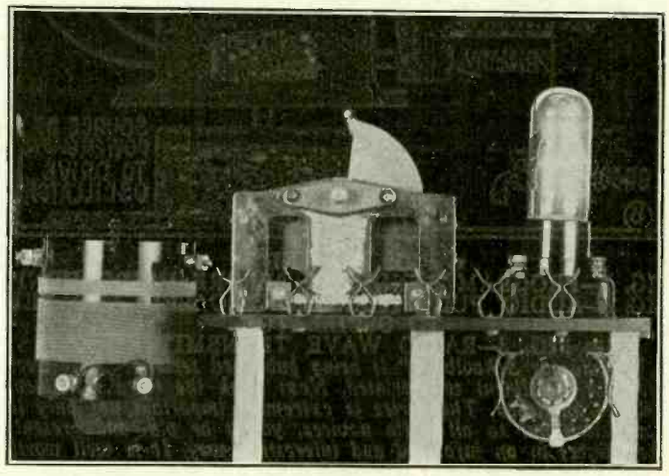


AN ECONOMICAL 4-TUBE BATTERY MODEL RECEIVER, THE HB COMPACT, USING RESISTANCE-COUPLED AUDIO.

### CIRCUIT WILL NOT OSCILLATE

I HAD a very good receiver and I thought I would improve it by installing S-M, Clough type, transformers. The tone seems to have improved all right, but the set will no longer oscillate. What is the reason? Are the transformers at fault? —S. B. M.

While the difference is due to a characteristic of the transformer it is not correct to say that the transformer is at fault. You yourself must assume the blame for making an inadequate change. The transformer you had in the first place had a relatively low DC resistance in the primary and therefore the voltage on the detector plate was practically the same as the applied voltage. There was enough to cause oscillation. The new transformer has a high resistance in the primary, a high pure resistance in fact, and the voltage drop in this is high. There is not enough left on the plate of the detector to cause oscillation.



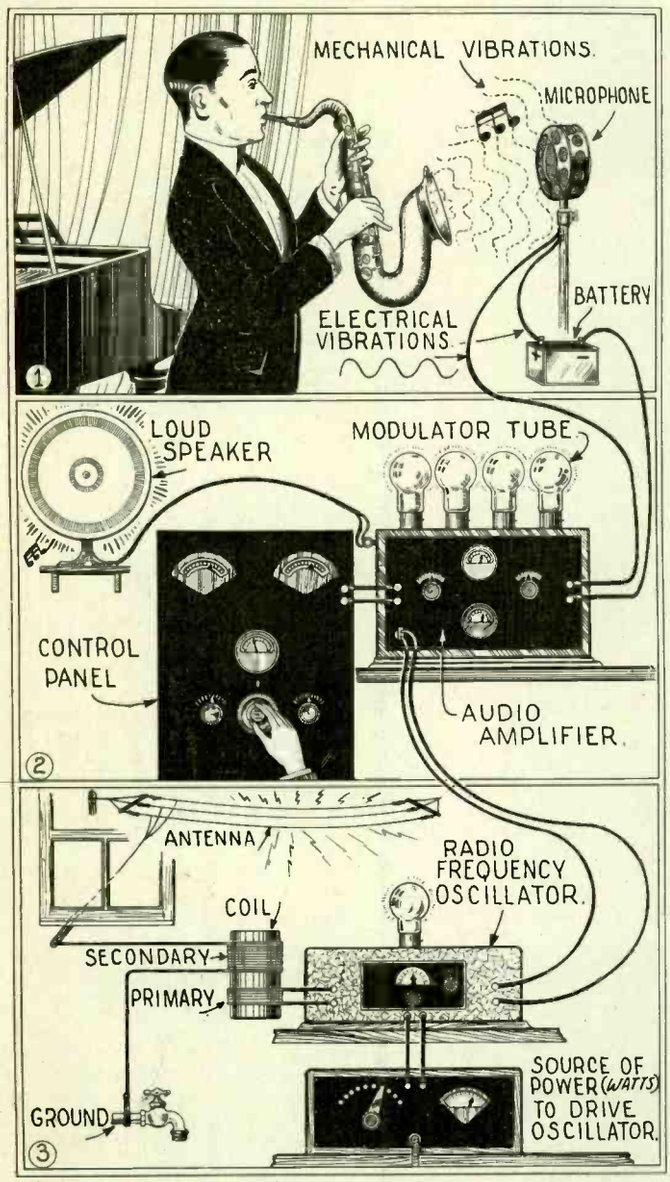
A ONE-TUBE CIRCUIT FOR SCHOOLBOYS. THE PARTS ARE MOUNTED ON A METAL SUBPANEL THAT HAS SOCKET BUILT IN.

The remedy is to increase the applied plate voltage to compensate for the extra drop. This may require an applied voltage several times as high as you used before. It may also be that you had no bypass condenser in the plate circuit and that you depended on the distributed capacity of the primary. If you had no condenser you should use one with the new transformer. Use .0005 mfd. and connect it from the filament to the transformer side of the tickler coil. You might also increase the number of turns. Connect the condenser first. If that is not enough to start regeneration increase the voltage. If that too fails to start regeneration increase the turns on the tickler.

# Tuning Phenomenon Ex

## How Selectivity is Obtained While Amplificat

*By J. E. Anderson and*




FIGS. 1, 2, AND 3.
FIG. 1—PROGRAM RENDERED BEFORE MICROPHONE.
FIG. 2—AUDIO PULSATIONS CONTROLLED AND FED TO OSCILLATOR.
FIG. 3—RADIO WAVE TRANSMITTED.

[*"Radio for Schoolboys," is being published serially. Last week the first instalment was printed. Next week the third instalment will be published. The series is extremely important not only to youngsters but to all radio novices, young or old, and presents the subject in an informed and interesting way. It is well worth your while to read every word.—Editor*]

**Questions Based on Last Week's Article**

(1)—Do radio waves move the air (ether) through which they travel?

(2)—State three differences between radio waves and sound waves.

(3)—State six functions performed by a broadcasting station.

(4)—Why can not the program be heard when one stands directly under the broadcasting stations antenna?

(5)—What is a carrier wave?

(6)—What is a sideband? How many are there and what are they called?

(7)—How many times a second does the radio wave oscillate between antenna and ground?

(8)—How many waves strike a receiving antenna?

(9)—What is the ether?

(10)—Is air the selected medium of radiation?

**[Answers on page 10.]**

### CHAPTER II
### The Reception of the Wave

THE radio frequency carrier wave generated by the broadcasting station is altered in intensity and frequency to a slight extent, because of the introduction of the audio frequencies, leaving the result still a radio frequency that may be received on a set and amplified.

To enable reception, some sort of antenna is used. It may be a wire stretched between poles on the roof, or hidden behind the moulding of the room, or even placed under the carpet. It may be a special type of coiled wire, called a loop. But the best antenna is one erected outdoors, since it produces louder results, and is more sensitive. A wire is run from the antenna into the house and is called the leadin. This leadin goes directly to the antenna post of the receiver.

#### WAVE INTRODUCED INTO FIRST COIL

A ground should be used, this being provided by a wire run from the nearest cold water pipe to the ground post of the set, or, if this is inconvenient, connection may be made to a heating radiator in the home. The place where the connection is made to the pipe or stem should be scraped to remove all paint or other foreign substance. A strip of copper, plain or tinned, is fastened to this cleaned surface by driving a screw through the binding holes. The device is called a ground clamp. It usually has a clip for attaching the wire, but it is well to solder this connection as an extra precaution.

Thus an antenna-ground system of the same general nature as the one at the broadcasting station is established. The modulated radio frequency waves strike the antenna and fluctuate between it and ground. The connection to the primary winding of the first coil in the receiver, a radio frequency transformer, brings these alternating voltages and currents into the coil. Because of the wire in the primary, a phenomenon of attraction and repulsion is produced, known as a magnetic field, because there is present a relatively strong influence in the immediate vicinity of the winding that partakes of the properties of a horseshoe magnet so familiar to you. But the magnetism in the present instance is not a steady one. The fluctuations of the radio frequency wave cause corresponding changes in the field about the coil, so that the field rises to positive, declines to zero and falls to maximum negative, exactly as does the original wave. Indeed, it is the same wave, coursing in the field of the coil.

Because the coil is able to support this kind of magnetic behavior it is said to have inductance. For a given diameter and given size of wire, the greater the number of turns of wire, the greater the inductance.

#### ANTENNA WINDING APERIODIC

The winding connected to the antenna-ground system usually is small, consisting of fourteen turns or so. This makes it have a natural frequency that is higher than any broadcast frequency. When one considers that the antenna and ground are like two plates separated by intervening air, and thus have the faculty of storing electricity, and that the aerial and the connecting wires have inductance as well, it is apparent that this natural frequency of the antenna coil alone is not the sole determining factor. There is added inductance and added capacity. This lowers the frequency, but the frequency is still above the highest broadcast frequency. Hence the antenna circuit receives all broadcast frequencies, and even other radio frequencies. It does not discriminate among frequencies or select any one of them. Not being selective, it is called aperiodic.

Coupled to the antenna or primary coil is another and larger winding, the secondary. Across this is connected an instrument that has two sets of metal plates, one set movable, the other set stationary. The greater the area of the adjacent plates, the gerater the capability of this device for storing electricity, the greater the capacity. Inductance in a coil and capacity in a condenser are companion characteristics.

Since one set of plates of the condenser is movable and the other stationary, the coupling between the two sets is varied as the shaft of the movable or rotary plates is turned. Thus the amount of capacity is changed. Likewise the rapidity of the charge and discharge of electricity is changed. The greater the capacity in use, the lesser the rapidity of this discharge.

#### CONDENSER TUNES CIRCUIT

Since the condenser is connected to the secondary winding there is a frequency relationship in the circuit. The inductance of the tuned winding is fixed, so that if inductance alone were

# pounded for Schoolboys

## ion is Increased To Attain High Sensitivity

*Herman Bernard*

concerned, the frequency at which greatest response would be received would be fixed, too. But the condenser introduces a variable factor. As the capacity is changed, the frequency at which keenest response is established likewise is changed.

Hence the radio waves that are received indiscriminately by the untuned antenna winding are picked up by the secondary, and the secondary is tuned. The process of selecting a desired frequency to the exclusion of all other frequencies is called tuning.

The antenna winding gives the radio waves impartially to the secondary, which begins to stop the impartiality by the tuning to which the secondary is subjected. It is the secondary that charges up the condenser with the radio frequencies, and both coil and condenser unite to be most effective at one frequency. The combination of fixed inductance and variable capacity accomplishes tuning by establishing a low resistance to the tuned or resonant frequency.

### HIGH IMPEDANCE NECESSARY

If you have any source of voltage and current, any moving electric force (electromotive force), and you put a stout piece of copper wire across it, you unite the two opposite voltages, and this is called a short circuit. If you did the same thing across the terminals of the secondary of the radio frequency transformer you would stop the signal from going any farther in the circuit. You would stop the coil and condenser from functioning. The copper wire's effect would predominate and there would be no agency upon which the radio frequency wave could work. Quite the opposite obtains when you turn the condenser so that the united efforts of coil and condenser alone make for keenest response at a given frequency.

The secondary is connected to one of the binding posts of a tube socket, called the grid post, because it connects to an element of a vacuum tube called the grid. The other socket posts are for the filament (negative and positive) and for the plate. Hence we are using a three-element vacuum tube, the elements being grid, plate and filament. The tube is used to magnify the radio frequency signal, hence as an amplifier.

### PARTS AND THEIR SYMBOLS

What a variable condenser looks like, and what the symbol for it is in radio schematic designs, are shown in Fig. 5. The arrow designates the moving or rotor plates of the condenser, the plain horizontal line the fixed or stator plates. The appearance of the coil, and its symbol, are shown also. The primary is drawn smaller in size to distinguish it from the secondary. How the transformer is connected with primary to antenna and ground, and with secondary to the tuning condenser and to the input of the vacuum tube, are depicted in Fig. 7. The symbols for antenna and ground are given, also for a fixed and a variable resistor.

From these representations we can construct the input circuit, consisting of primary connected to antenna and ground, secondary connected to negative A and to grid, with condenser across the secondary, and with the plate post, P, of the socket representing one connection of the output.

The tube, to operate, requires that its filament be heated, and it is assumed that a 6 volt storage battery is used, and that the tube filament requires 5 volts to attain the most efficient heat consistent with long life of the filament. Therefore, as we have 6 volts and require only 5 volts, we can introduce an instrument composed of fine wire wound on an insulated strip.

### PROPER FILAMENT VOLTAGE ESTABLISHED

This fine wire obstructs the flow of direct current supplied by the storage battery, and when interposed between the negative of the storage battery and the negative of the filament, will provide a filament voltage lower than the battery voltage. The amount of resistance required can be calculated. If the tube is a 201A, requiring 5 volts across the filament, under which condition .25 ampere flows, and we have 6 volts to start with, we know we must drop 1 volt at a current of .25 ampere. The resistance required, in ohms, equals the voltage (1) divided by the current (.25), or 4 ohms.

We have been able to construct a circuit theoretically for the reception of a particular radio frequency at greater strength than that of unwanted radio frequencies, but we have established only one tuned circuit, which ordinarily is not nearly enough. There are so many stations, some of them very powerful, using large power and relatively close at hand, that the waves of other strong stations would be mixed with the wave of the selected one in the output, so we repeat the tuning

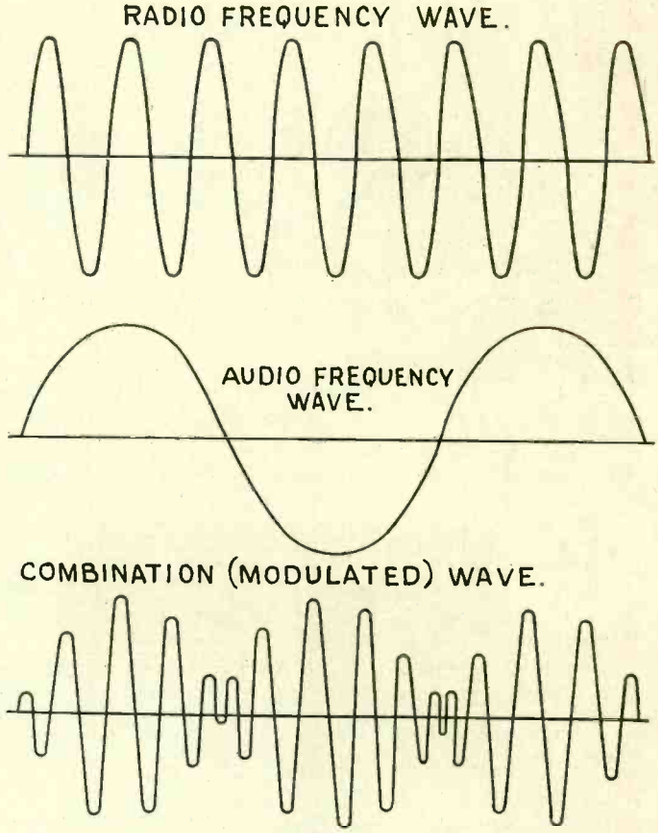



FIG. 4.
THE RADIO FREQUENCY, AUDIO FREQUENCY AND MODULATED RADIO FREQUENCY WAVES REPRESENTED BY GRAPHS.

process, to get better selectivity. At the same time the amplification is increased, because we are using another tube.

### ANALYSIS OF TUNER

Fig. 7 shows a tuner consisting of two stages of tuned radio frequency amplification and a final tube that makes it possible to hear the broadcast program when earphones are connected to the two binding posts representing the plate of the tube and B plus 45 volts. This final tube in the tuner is called the detector.

The first tube is coupled to the second by a radio frequency transformer similar to the one used in the antenna circuit, but the primary is in the plate circuit. The secondary is in the grid circuit as in the previous example. An additional positive voltage is used. As the filament heating source is called the A voltage, the plate power source is called the B voltage. These are arbitrary terms now standard.

Another newcomer in this circuit is a fixed condenser. This is shown conected from plate of the detector to F minus. It is used as a bypass condenser, to detour radio frequencies, which are not desired beyond the detector. Since the function of the detector is to furnish audio frequencies, it is advisable to concentrate on these and make the elimination of the radio frequencies as complete as possible.

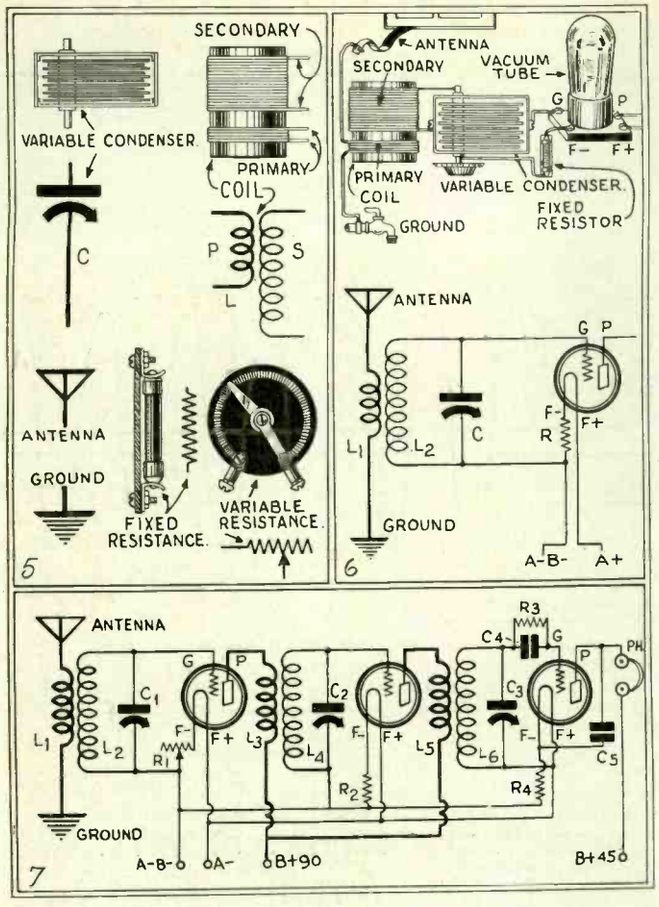
Another new point is that the secondary coil in the detector circuit has a fixed condenser connected between it and the grid post, with a fixed resistor across the fixed condenser. Another novelty is the fact that this winding is connected on the "low" side to the positive filament, whereas the two previous secondaries were connected to the negative A.

### THRICE-TUNED CHAIN

We tuned once, with a coil and variable condenser, then again, then again, so we have three tuned stages, two of which are radio frequency amplifier circuits, the third being the detector circuit.

With such an arrangement we can obtain sufficient selectivity for modern needs, tuning in the station we desire to the exclu-

(*Continued on next page*)




FIGS. 5, 6 AND 7.

FIG. 5.—PICTORIAL REPRESENTATIONS AND SYMBOLS FOR A VARIABLE CONDENSER, A RADIO FREQUENCY TRANSFORMER. ANTENNA, GROUND, A FIXED RESISTANCE AND A VARIABLE RESISTOR.

FIG. 6.—THE FIRST STAGE OF A TUNED RADIO FREQUENCY AMPLIFIER IN PICTORIAL AND SCHEMATIC FORMS.

FIG. 7.—A TWO-STAGE RADIO FREQUENCY AMPLIFIER AND DETECTOR. THE COMBINATION IS KNOWN AS A TUNER.

(*Concluded from page* 10)

sion of all others, and besides, if the volume is too great, we can reduce it by turning the knob of the variable resistor used in the first tube's filament circuit. Thus the heating of the filament, hence the intensity of performance of the tube, or its amplification property, is governed by the valuable resistor, called a rheostat. The function of the rheostat in this circuit is that of a volume control. It is well to place the volume control ahead of the detector.

The fixed resistor at the grid of the detector is of high resistance and is called a grid leak. The condenser across it is called the grid condenser. The object of the grid condenser and grid leak, working together, is to permit the tube to be operated in such a manner, when the secondary is returned to positive filament, that the carrier wave is eliminated, and only the original audible frequencies as conveyed to the microphone are reproduced. This action comprises detection.

A study of the performance of the vacuum tube when hooked up in different ways disclosed that this elimination of the carrier wave, and retention of the audio frequency variations, was not only practical but represented the use of a tube to comprise the most sensitive form of detection.

### RESULT IS MECHANICAL VIBRATION

So the detector reverses the function performed at the broadcasting station, since there the radio frequency wave was modulated with audio frequencies that lost their identity as such, and now the radio frequency is eliminated, and the audio frequency identity alone survives. In the first instance there was modulation, but now we are practising demodulation.

So the output of the detector tube, although it carries some stray radio frequency, consists mainly of variations that are a copy of the vibrations committed to the microphone. When we connect earphones at the detector output we introduce a device that has a diaphragm that will vibrate at these frequencies. Thus is electrical variation of current and voltage converted to mechanical vibration, the type of vibration we can hear.

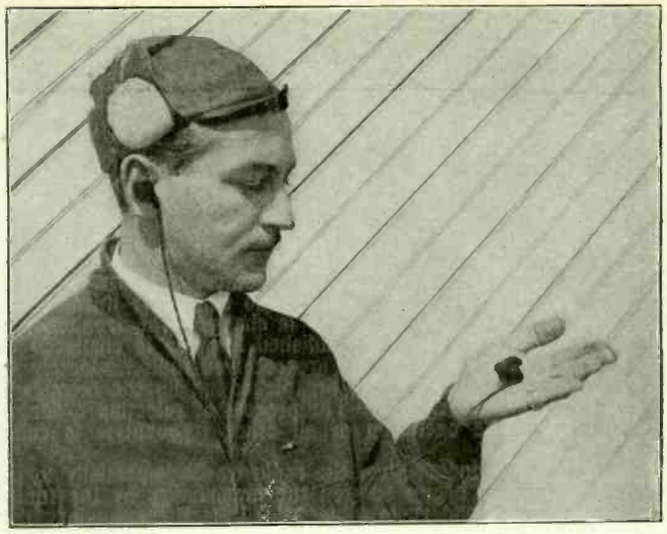


FIG. 9

MECHANICAL VIBRATIONS CAUSE AUDIBLE RESPONSE IN EARPHONES. THE SMALL OBJECT THE AVIATOR HOLDS IN HIS HAND IS A PAIR OF EARPHONES THAT FIT INSIDE THE EAR. THESE ARE USED ON AN AIRPLANE RECEIVER DURING FLIGHT. (Underwood & Underwood.)

Air is all around, and radiation must be made in the face of that fact of nature. Were there no air, or other gas, there would be vacuum, and radio waves travel better in vacuum than in any other medium.

### HOW THE WAVE STRENGTH DECLINES

Whatever the medium, the wave suffers decline in strength as it advances. This is called attenuation. The decline, in general is inversely as the distance. An aerial ten miles from a station is charged with a voltage and current one one-tenth as great as that in an aerial one mile away. But the intensity of the wave about the receiving antenna, called the antenna field of strength, may be very small indeed, and yet a receiver will produce a good response. Hence broadcast receivers often tune in at night stations that are 1,000 miles away or more.

Sometimes local or special conditions cause a wave to be weak or dead in some localities, yet stronger in places much farther away. With broadcast waves this is not so often true, but with short waves (higher frequencies) this passover is common, and is known as skip-distance.

## *ANSWERS*

**(See page 8 for questions)**

(1)—Radio waves do not move the air, any more than water moves a pipe through which the water flows. Air simply conducts the agitation.

(2)—Three differences between radio waves and sound waves are: (a), difference in frequency; (b), difference in speed they travel; (c), sound waves originate mechanically and radio waves originate electrically.

(3)—A broadcasting station does these six acts: (a), provides the program; (b), changes mechanical vibriations into audio frequency electrical vibrations with the aid of a microphone; (c), amplifies the audio frequency electrical vibrations; (d), generates a carrier wave; (e), mixes the audio frequency vibrations with the carrier frequency by modulation; (f), radiates the resultant modulated carrier.

(4)—Because the output of the antenna is radio frequency, far beyond the uppermost limit of hearing.

(5)—The officially assigned frequency generated by the oscillator at the station.

(6)—A sideband is a frequency that differs from the carrier to the extent of a modulated audio frequency. There are two main sidebands, one equalling the sum of the carrier and the modulation frequency, the other the difference between the two. The sum is the upper sideband, the difference the lower.

(7)—As many times as the cycles per second of the wave itself, that is, its frequency.

(8)—All waves radiated from anywhere on earth strike all antennas.

(9)—The ether is the medium of conducting radio waves and is a term used for convenience. There is no scientific definition of the ether or any concrete conception of what it is, or proof that it is any particular and separate entity.

(10)—No. Air is the inevitably utilized medium of conducting radio waves.

# A New Receiver System

## Pre-Selector Avoids TRF and Uses Positive Grids

*By Edgar J. Warren*

FROM time to time we hear of "revolutionary" discoveries in radio, discoveries which in a short time are supposed to render obsolete all existing radio receivers and transmitters. Notwithstanding all these radical discoveries radio development goes forward at a steady rate. The set of one year may be somewhat out of date the next year, or the next after that, but it is useful, nevertheless, and it plays just as well three or four years after it was put into service as it did at the beginning. It may not play quite so well as the latest set, but with a few minor changes it can be brought up to date.

But just because radio development in the past has taken a certain line there is no reason why it cannot take another road to improvement. There are admittedly many weaknesses in the present system as developed along conventional and classical lines. It is not scientific to deny the possibility that these weaknesses can ever be removed by developments based on entirely different conceptions. The scientific attitude is one of open-mindedness, a readiness to investigate every suggestion and possibility even though reason at first may object strenuously. Radio as it is today is replete with examples which prove that a shut-mind attitude is unsafe as a policy.

### NEUTRODYNE AT FIRST DERIDED

It will be remembered that the Neutrodyne was first greeted with scoffing, yet it developed into the first genuinely successful radio frequency amplifier. Even the amplifier tube was first met with a great deal of skepticism on the part of engineers, and the scoffing at the Theremin has not yet died, although there are now instruments of this type on the market and many musicians are busy acquiring the technique of playing it. There are numerous other examples that could be mentioned.

The discovery of a radio system radically new in design has been announced by Alger S. Riggs, tube engineer. This system is said to eliminate the need of negative grid bias, grid leak and condenser, and tuned radio frequency. Indeed, the tubes used, which have been developed especially for the system, do not even depend on the control grid at all.

Full details of the new invention are not yet available, but the device has been demonstrated successfully to a group of engineers.

### TELLS OF NEW SYSTEM

Riggs submitted the following explanation:

"In general, the system as at present conceived and evolved, consists essentially of a fundamental and revolutionary method of obtaining amplification by the use of electron discharge devices. Among other things, the system displaces the necessity of utilizing negative C bias throughout. In fact, in the major portion of the application of electron discharge devices the electron stream is not controlled by the grid at all.

"The radio set demonstrated does not use (a) negative C bias, (b) tuned radio frequency or (c) grid leak and condenser. As I demonstrated it, the set was in its semi-laboratory form, no production or design engineering having been applied toward its completion.

"In contradistinction to conventional practice, the signal at the antenna is first passed through a suitable selecting apparatus into the radio frequency amplifier capable of amplifying an extremely wide range of frequencies. The amplified radio frequency signal is then detected by a system which is termed 'threshold detection.' The detected audio frequency signal is passed into an audio amplifier, thence to the loud speaker.

### LOOSE COUPLING USED

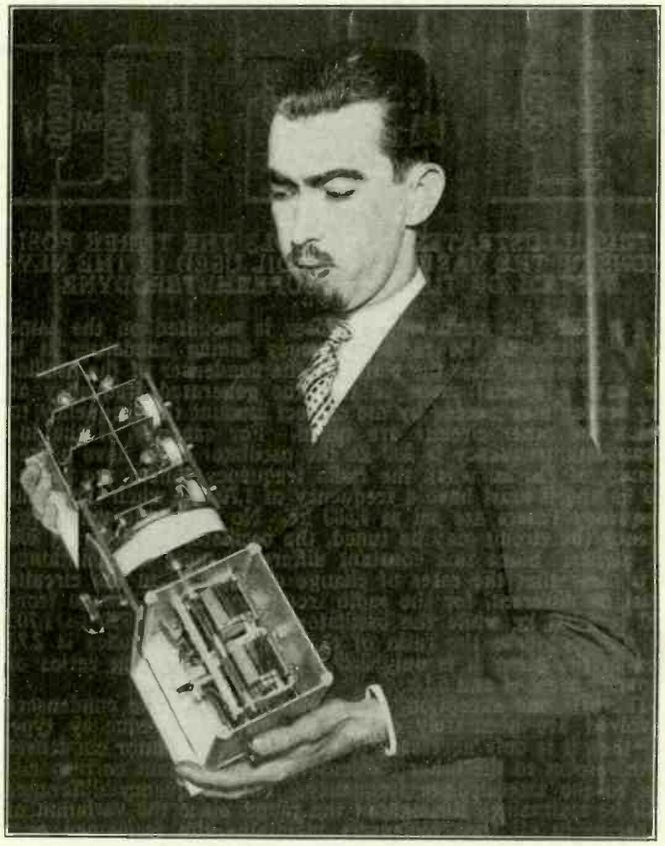
"The filter consists of two parallel resonant circuits loosely coupled capacitatively and very loosely coupled to the antenna; the filter output is connected to the radio frequency amplifier, which consists of five stages of radio frequency amplification. As the signal attenuation in the filter is of the order of 100-to-1, the radio frequency amplifier possesses unusual gain per stage to bring the signal level up to the proper point of detection.

"The 'threshold detector' operates on a principle entirely new and revolutionary, has the sensitivity of the grid leak and condenser with the possible quality and power handling capacity of the conventional negative C bias power detector. The detector is capable by adjustment of being made totally insensitive to the signal level below a predetermined limit, hence the term 'threshold detector.'

### CUT DOWN STRAYS

"The special advantage of the 'threshold detector' lies in the fact that extraneous 'ground noises' may be totally eliminated, provided their intensity is not comparable in strength to that of the signal being detected.

"The audio frequency amplifier consists of two tubes operating with a positive grid bias, and this audio amplifier is substantially aperiodic, that is, without frequency discrimination within the audible band, except in so far as may be controlled by the 'impedance match' of the loudspeaker to the audio amplifier.



(Underwood & Underwood)

ALGER S. RIGGS, INVENTOR OF A NEW SYSTEM OF RADIO RECEPTION, HOLDING A COMPACT RECEIVER BASED ON HIS NEW DEVELOPMENT.

Douglas H. Kenyon, of the patent law firm of Kenyon & Kenyon, predicted basic patents will be granted.

The former United States Commissioner of Patents, Thomas Ewing, one of those who witnessed the demonstration, agreed with Mr. Kenyon.

### RECEIVER IS COMPACT

The Riggs receiver is compact. Six tubes, each of very small size, are used, one being a detector and five amplifiers. All the tubes have been designed especially for the new system.

The Riggs system, it is claimed, covers radio receivers, broadcast transmitters, commercial radiotelephony, land line telephony, high frequency measurements, amplification of very high frequencies, and motion picture sound recording and reproducing systems.

Riggs is twenty-nine years old. He originally came from Charleston, S. C., but was educated abroad. He has been connected with several research laboratories.

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## *Importance of Bleeder Current*

When a condenser is used next to the rectifier tube, the DC voltage on open circuit across this condenser will reach the peak value of the AC voltage across each half of the high voltage winding. In the transformer under discussion this amounts to approximately 510 volts. Of course, the voltage across the other two condensers has the same value. Thus the condensers will be subjected to excessive stresses when the current is stopped without at the same time turning off the power. To avoid this the bleeder current should have a considerable value.

A bleeder current of 40 milliamperes will leave a current of the same value for the receiver when the transformer is working at rated output. Of course, if the set requires more than this current the bleeder current should be reduced, say to 30 or 20 milliamperes, according to the current required by the set.

# The RF Tuning in

## Effect of Selectivity at That Level—

*By Knollys*

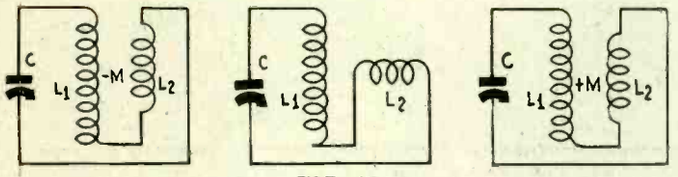



FIG. 18
THIS ILLUSTRATES IN SYMBOLS THE THREE POSITIONS OF THE VARIOMETER COIL USED IN THE NEW SYSTEM OF TUNING A SUPERHETERODYNE

WHEN the oscillator condenser is mounted on the same control as the radio frequency tuning condenser it is necessary that the plates of the condenser of the oscillator have a special shape so that the generated frequency at any setting may exceed by the correct amount the frequency to which the other circuits are tuned. For example, if the intermediate frequency is 200 kc the oscillator must have a frequency of 750 kc when the radio frequency tuners are set at 550 kc and it must have a frequency of 1,700 kc when the radio frequency tuners are set at 1,500 kc. No matter to what frequency the circuit may be tuned, the oscillator must be set 200 kc higher. Since this constant difference must be maintained it is clear that the rates of change of capacity in the circuits must be different, for the radio frequency tuners change from 550 to 1,500 kc while the oscillator changes from 750 to 1,700 kc. In one case the ratio of the extreme frequencies is 2.73 and in the other it is only 2.27. The corresponding ratios of capacity are 7.44 and 5.14.

There is one exception, and that is when all the condensers involved are accurately of the straight line frequency type, for then it is only necessary to displace the oscillator condenser with respect to the other condensers by an amount corresponding to the intermediate frequency. This frequency difference will be maintained throughout the range, since the variation of capacity in all the condensers maintains the frequency proportional to the displacement. If this is to succeed the distributed capacity in each circuit must have been taken into account when designing the straight line frequency condensers.

### CONSTANTS MAY DIFFER

When the oscillator condenser is put on the same control as the other tuning condensers it is not necessary that the inductances in all the circuits be the same. It is only necessary that the product LC of the inductance and the capacity in the radio frequency circuits be larger than the corresponding product in the oscillator circuit by the amount which determines the intermediate frequency. There are many different combinations possible, but to get the best combination in any case requires considerable calculation. The constants should be chosen so that the desired frequency band covers as much of the dial as possible. For example, when the dial is set at one extreme the circuit should be tuned to 550 kc, and when at the other extreme it should be tuned to 1,500 kc, if the broadcast band is desired. This adjustment is effected by proportioning the minimum capacity in each circuit to the variable portion of the capacity. The ratios of these capacities for the case when the intermediate frequency is 200 kc were given above.

If it is desirable to put the several condensers on the same control and still retain the possibility of choosing either the higher or the lower oscillator settings for any given signal within the tuning range, this is possible by a method which has been used by one of the authors for some time but which has never before been disclosed. The method involves the use of a small variometer in the oscillator circuit. All the tuned circuits are made equal and are adjusted so that all, including the oscillator, are tuned to the same frequency no matter what

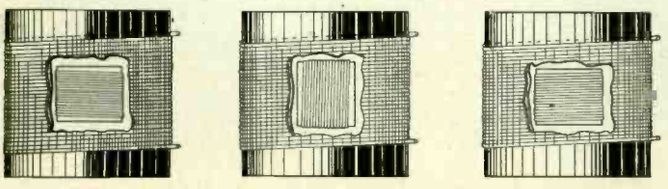


FIG. 19
A PICTORIAL ILLUSTRATION OF THE POSITONS OF THE ROTABLE COIL IN THE NEW SYSTEM OF TUNING.

that frequency may be within the tuning range. In this respect the entire tuner differs in no essential from the tuners in modern gang-controlled receivers.

### TWO-PART OSCILLATOR COIL

The oscillator inductance is made up of two parts, one fixed in position and the other rotable like a tickler coil. When the two portions are connected in series and placed so that there is no mutual inductance between them, the total inductance is equal to the inductance in any of the radio frequency tuners. In that position of the rotatable coil no signal can be received because the frequency generated by the oscillator is equal to the frequency of the carrier that is to be received. A very weak heterodyne note may be audible if there is any appreciable coupling between the radio frequency circuit and the audio amplifier, but the squeal will not be radiated.

Now when the rotatable coil is turned in the direction which increases the inductance, the generated frequency decreases, and at a certain value of the mutual inductance the frequency will be such that the heterodyne is equal to the intermediate frequency. The signal will then get through the filter. This is the lower setting of the oscillator. When the rotatable coil is turned from the position of no mutual inductance in the direction of decreasing inductance, the generated frequency increases, and at a certain point the frequency will be such that the heterodyne again will be equal to the intermediate frequency. This adjustment gives the higher oscillator frequency that will bring in the desired signal.

### PRINCIPLE ILLUSTRATED

This principle is illustrated symbolically in Fig. 18. In the middle the rotatable coil L2 is set at right angles to the fixed coil L1, the position in which there is no mutual inductance between the two coils. At left the rotatable coil is set parallel to the other in such a manner that the mutual inductance M is negative, and at right it is set parallel in such manner that the mutual inductance is positive. The left position gives the highest generated frequency, the middle gives the frequency of the carrier, and the left gives the lowest frequency.

Fig 19 is a pictorial illustration of the three positions of the two coils. To distinguish between the two end positions the lines representing the turns of wire have been drawn at slightly different angles. Of course, the sign of the mutual inductance depends on the way the two coils have been connected together.

Naturally, a Superheterodyne employing this method of tuning will have two controls, one for the condensers and another for the variometer. But it is superior to one in which the oscillator condenser is independently variable because the variometer is a vernier tuner. For any setting of the main control the variometer is used only to change the frequency of the oscillator by an amount equal to the intermediate frequency, either upward or downward in the frequency scale.

### ZERO CENTER SCALE

The scale associated with the variometer should be made with the zero in the center with graduations running in both directions. The readings might be made to correspond with the numbers of the broadcast channels, that is from 150 to 55. The number 150, corresponding to the 1,500 kc channel, would be at positions near the center of the scale and the number 55 would be at the extreme positions. To make this notation consistent, the center line should be marked with an infinity sign because it would be the position of the variometer if the main tuning condensers were set to receive a signal of infinite frequency. Fig. 20 indicates the kind of scale that would be employed.

Of course, the variometer dial could also be calibrated in terms of wavelengths. If that is done the center line would be marked zero and the graduation numbers would increase in both directions from this line. The calibration of the variometer scales does not depend on the shape of the plates of the tuning condensers but only on the rate at which the frequency of the oscillator changes as the variometer is turned.

### SUITABLE FOR LOW I F

This new method of tuning a Superheterodyne is better for low intermediate frequencies than for high, because a smaller rotatable coil and a lower mutual inductance can be used. This is fortunate in view of the fact that it is on low intermediate

# a Super-Heterodyne

## Novel Oscilliator Coil Is Described

*Satterwhite*

frequencies that it is more desirable to have a choice of either the higher or the lower frequency settings of the oscillator. The vernier effect is also better for the lower intermediate frequencies.

If the intermediate frequency is too high the arrangement does not work in all cases. The reason for this is that when the oscillator is set to receive on the higher frequency the rotatable coil is in opposition to the main coil and the tickler works on the two in opposite directions. This may cause the oscillator to stop when receiving broadcast frequencies near the 550 kc limit. This will not happen when the intermediate frequency is low because the rotatable coil then has little relative effect on the regeneration.

It will be observed on Fig. 20 that the calibration is not symmetrical about the central line on the variometer dial. The scale on the low frequency side covers a wider angle than it does on the high frequency side. The calibration in the sample scale has been calculated on the assumption that the mutual inductance between the fixed and the rotatable coils is proportional to the angle and that the intermediate frequency is 100 kilocycles. The inductances of the two coils and the mutual inductance are supposed to have been adjusted so that 550 kc on the low frequency side comes in at 90 degrees. The same carrier comes in at 51.8 degrees on the high frequency side under these assumptions. Thus the high side is considerably more crowded than the low side.

### COIL SERVES AS TRIMMER

The disadvantages of the new method of tuning which have just been mentioned are not of major importance. They merely weigh in favor of choosing a slightly lower intermediate frequency than would be selected if only the higher oscillator setting were to be used. The choice of intermediate frequency in any case is the result of a compromise among several conflicting factors.

It should be noted that when the variometer method of tuning a Superheterodyne is employed it is not essential that the oscillator circuit be accurately the same as the radio frequency tuners because the variometer can be used as a trimmer. Indeed, in some instances it may be advantageous to introduce a difference for the purpose of spreading the calibration scale over the entire variometer dial instead of spreading out over one quadrant only.

The accurate design of the oscillator coil to meet all the desirable conditions is not simple. But if it is not essential that the calibration of the variometer dial cover the entire 180 degrees, very little design is necessary. A small coil is simply placed inside a larger one and the turns on the two adjusted so that the total inductance, when the mutual inductance is zero, is about the same as the inductance in any of the radio frequency tuners. If all the stations cannot be brought in within 90 degrees on the low frequency side it is only necessary to add turns on the rotatable coil and to remove turns from the fixed.

### ADJUSTMENT OF COILS

After the coils have been adjusted so that the 550 kc signal comes in on the scale, the stations may be spread out by reducing the coefficient of coupling between the two coils, which is done by mounting the rotatable coil farther away from the fixed coil. By farther away is meant greater separation between the centers of the two coils. The closest coupling is illustrated in Fig. 19. The calibration of the variometer dial should not be done until the two coils and the coupling have been adjusted finally.

The rotatable coil dispenses with the necessity of specially shaped plates of an oscillator condenser that is ganged.

We have already emphasized the necessity of having a highly selective circuit ahead of the modulator in a Superheterodyne if image interference and repeat points are to be avoided. It is doubtful, however, that any appreciable advantage will be gained by using more than two tuned circuits.

If more than two tuners are used in tandem, complications arise. The circuit will be difficult to adjust to exact resonance, and if all the tuned circuits are not tuned to exactly the same frequency the selectivity actually obtained may be no better than if only two tuners were used. Moreover, if all the circuits are accurately in tune the selectivity may be so great that sidebands will be cut excessively. Sideband cutting in Superheterodyne is not by any means limited to the intermediate frequency filter. It occurs wherever there is frequency discrimination and it is proportional to the selectivity.

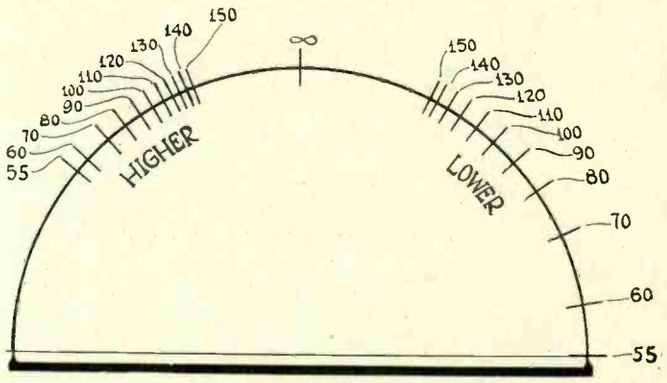



FIG. 20
A SCALE ILLUSTRATING THE DISTRIBUTIONS OF THE DIAL SETTINGS OF THE BROADCAST FREQUENCIES ON THE ROTABLE COIL CONTROL.

As we have said, if the intermediate frequency is high, say over 100 kc, it is not necessary that the pre-modulator selectivity be very great. Two moderately selective radio frequency circuits, with one amplifier between them, should be enough in any broadcast receiver. This, however, supposes that a relatively small antenna, or that loose coupling between the antenna and the first tuner, be used. If a long antenna closely coupled to the first tuner be used, the selectivity will not be high enough. If loose coupling results in weak signals, it is much better to boost them by adding another stage of intermediate frequency amplification than by employing close coupling.

### RADIO FREQUENCY TUNERS

In Fig. 21 is sketched a radio frequency circuit having two tuners with one screen grid amplifier ahead of the modulator. With ordinary radio frequency coils suitable to the tube involved this circuit should have adequate selectivity when the frequency of the intermediate filter is of the order of 200 kc, provided that a short antenna loosely coupled to L2 is used. Somewhat greater selectivity, but less sensitivity, can be secured with essentially the same coils if the secondary $L_4$ is tuned instead of the primary $L_3$. The second tube in this figure is the modulator and $L_6$ is the oscillator coil.

In order to facilitate the adjustment of the tuned circuits to enable the use of gang control a radio frequency amplifier is usually placed ahead of the first tuner as shown in Fig. 22. The antenna is coupled directly to the control grid of the first tube by means of a radio frequency choke coil or a resistor. The advantage of this arrangement is that the first two tuned circuits are then in similar positions with respect to stray capacities and shunt resistances. This arrangement may be used in a Superheterodyne when the addition of an extra tube is preferable to the use of a trimmer condenser in the first tuned circuit. The sensitivity will be considerably greater with the extra tube, but the selectivity may be somewhat less. Whether it will be less or not depends on the type of antenna that is used. If the coupling between the antenna and the

(*Continued on next page*)

$$T_F = \frac{1}{\sqrt{1+Q^2\left[1-\left(\frac{F_\lambda}{F}\right)^2\right]^2}} \quad \text{------ (1)}$$

$$(T_F)^2 = \frac{1}{1+Q^2\left[1-\left(\frac{F_\lambda}{F}\right)^2\right]^2} \quad \text{---- (2)}$$

$$T = \left\{\frac{1}{1+Q^2(1-R^2)^2}\right\}\left\{\frac{1}{\sqrt{\left[1+q^2(1-\lambda^2)^2\right]^3}}\right\} \quad \text{--(3)}$$

# Easy Formulas for Supers

## Reduction of Image Interference and Increase in Selectivity

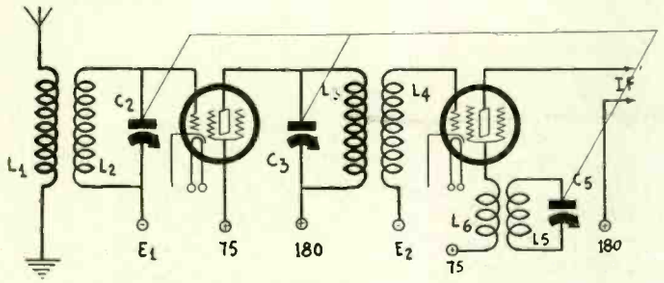



FIG. 21
A RADIO FREQUENCY CIRCUIT OF TWO TANDEM TUNERS PRECEDING THE MODULATOR. WITH ONE RADIO FREQUENCY AMPLIFIER.

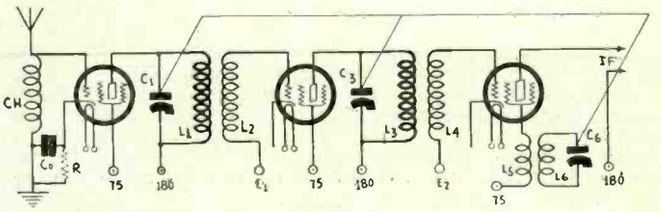



FIG. 22
A RADIO FREQUENCY CIRCUIT PRECEDING THE MODULATOR IN WHICH TWO AMPLIFIER TUBES ARE USED TO REDUCE THE EFFECT OF THE ANTENNA CONSTANTS ON THE FIRST TUNED CIRCUIT.

(*Continued from preceding page.*)

first tube is a potentiometer, with the control grid connected to the slider, a good volume control is available.

### SELECTIVITY AND SIDEBAND CUTTING

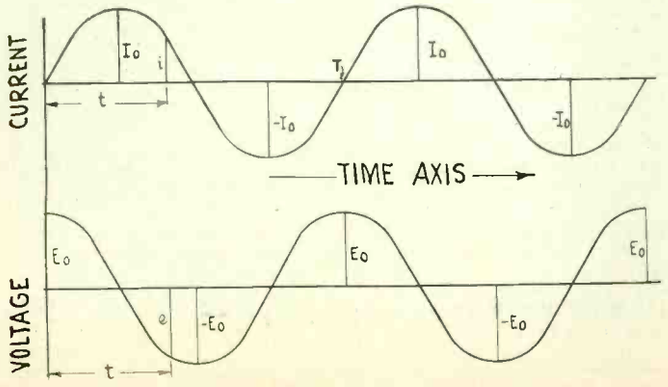
If the inductance and the total effective resistance at radio frequency in any tuned circuit are known it is possible to estimate the selectivity and the amount of sideband cutting. If L is the inductance, R the total effective resistance, and w is 6.28 times the frequency, the selectivity Q is defined by Lw/R. Thus the selectivity apparently increases as the inductance and the frequency increase and increases as the resistance decreases. But the change in the selectivity is not so simple as indicated by the above expression because the resistance increases as the frequency increases. When only a small frequency range is considered the selectivity can be taken as a constant. This is justified when the frequency range is that covered by the sidebands of a radio frequency carrier, and also the sidebands associated with a high intermediate frequency carrier. The value of the selectivity taken when dealing with tuned circuits is that corresponding to the resonant frequency.

If $F$ is any frequency in a sideband and $F_r$ is the resonant frequency, the ratio of the transmission of the side frequency to that of the carrier frequency is given by formula (1). This applies to a single tuned circuit. If there are two similar circuits accurately tuned to the same frequency, the transmission is the square of that given in (1), or that given by formula (2). If there are more than two tuned circuits the transmission is multiplied by itself once for each tuned circuit.

### CHARACTERISTICS DIFFER

Since the characteristics of the intermediate frequency tuned circuits will be different from those of the radio frequency circuits, another formula must be used for the filter. However, the expression differs only in the value of Q and the value of the frequency ratio.

It will be observed that the value of the transmission as given by the formulas does not depend on the absolute values of the frequencies involved but only on the value of the ratio of the frequencies. The more the square of the ratio differs from unity the greater is the suppression. Let $R$ be the frequency ratio in the radio tuner and let $Q$ be the selectivity. Let $r$ and $q$ be the corresponding values for each intermediate tuner. Then the total suppression at any one frequency can be expressed by formula (3), provided there are two equal radio frequency tuners and three equal intermediate tuners. The frequency referred to is an audio frequency but the frequencies involved in $R$ and $r$ are radio and intermediate frequencies, respectively. Formula (3) expresses the fact that the total suppression is the product of the suppression contributed by all the tuners in the circuit. It is assumed that all the circuits are accurately tuned, the two radio frequency tuners to the signal carrier and the three filter tuners to the intermediate frequency or subcarrier.




The meaning and use of these formulas can best be elucidated by means of numerical examples. Let us assume we have a Superheterodyne with two radio frequency tuners and three intermediate frequency tuners and that the intermediate frequency is 200 kc. Let the selectivity in each radio frequency tuner be 100 and that in each of the intermediate 50. Suppose we want to receive a signal on a 550 kc carrier. How much suppression will there be of an audio frequency of 10,000 cycles per second?

Then Q=100, $F_r$=550, $F$=560, and $R$=.982. Substituting these values in (2) we get .0738. Also we have $q$=50, $f_r$=200, $f$=200, and $r$=.952. If we substitute these values in (1) and take the cube we get .00928. The total suppression is obtained from (3) and is the product of the two factors just obtained. That is, T=.0738 x .0093, or .000686. Therefore the 10,000 cycle frequency is almost completely tuned out. Clearly, the selectivity assumed is entirely too high.

Let us try again by assuming a radio frequency selectivity of 25 and an intermediate selectivity of 10. Then if we take the same carrier and the same audio frequency as before and substitute directly in equation (3) we get .22 as the intensity of the 10,000 cycle frequency as compared with that of a very low frequency. Although a 78 per cent. suppression, as this number represents, is entirely too much, it is not as great as that which is encountered in many Superheterodynes.

### REDUCTION OF IMAGE INTERFERENCE

Formula (2) can be used to estimate the relative intensity of any interfering carrier with the desired carrier. Since the intermediate frequency is 200 kc the nearest carrier which might cause image interference is 400 kc higher or lower than the desired carrier. Suppose we wish to get the 550 carrier. The nearest broadcast carrier which might interfere therefore is 950 kc. The frequency ratio is 550/950, or .579. Substituting this and Q=25 in formula (2) we obtain 1/277 as the ratio of intensities. The second factor in equation (3) does not enter here because the intermediate filter does not discriminate between the image and the signal.

The suppression of the 10,000 cycle frequency will not be so great at 1,500 kc as at 550, but the difference is limited to the radio frequency selector. The frequency ratio $R$ is now only 1,500/1,510 and $r$ remains at 200/210. The selectivities we can assume to be the same as before, namely, Q=25 and q=10. Substituting these values in equation (3) we obtain .354. This compares with .22 at the other extreme of the broadcast range.

The selectivity in the radio frequency level must be relied on to suppress any image interference and that in the intermediate frequency level to suppress carriers which differ less than twice the intermediate frequency from the desired carrier.

Let us see how much a carrier differing by 20 kc from the desired carrier is reduced. At 550 kc the ratio is 550/570. Substituting this in the first factor of equation (3), together with a value of 25 for Q, we obtain .252. In the intermediate tuner the frequency ratio is 200/220. Substituting this ratio and q=10 in the second factor of formula (3) we obtain .0315. The undesired carrier is therefore about 0.8 per cent as strong as the desired when the two differ by 20 kc. The suppression of the undesired carrier is about twice as great in the intermediate frequency selector as in the radio frequency tuner.

[*Above is another instalment of the expert discussion of the Superheterodyne by two authors who know their subject with extreme intimacy and accuracy. The Superheterodyne is probably the most fascinating circuit in radio, but it presents problems, and these are analyzed expertly by the authors, and solutions are presented. Keep well informed on this circuit by reading* RADIO WORLD *each week.—Editor.*]

# AC Push-Pull Diamond

## How the Circuit is Arranged and Voltages are Distributed

*[The Push-Pull Diamond of the Air has been designed for battery or AC operation. The battery model was discussed in the October 13th and 20th issues, with additional data on that model and some preliminary information on the AC model in last week's issue, October 26th. The same fundamental circuit is used in both, consisting of a screen grid RF amplifier, a detector, a first stage of resistance-coupled audio and a push-pull output. In the battery model the output may be 112A or 171A pairs in push-pull, but for the AC model two 245s are used. Picture diagrams of the wiring of both models are in preparation and are scheduled to be published this month in these columns. Another instalment on the AC model will be published next week, issue of November 9th.—Editor.]*

THE AC Push-Pull Diamond of the Air is completely self-powered in its present form. This is both convenient and, in a sense, necessary, due to the use of 245s in the output. Nearly all separate B eliminators fail to provide sufficient voltage for the 245s or stand enough current to operate the plates of such a receiver. Hence specially selected parts were used.

In arranging the parts it was found better to use a separate center-tapped coil for the B filter choking system, rather than a power transformer that had the chokes built in. Thus symmetry of arrangement was more readily established also.

The power source is a filament-plate supply. This is standard for 110 volts 50-60 cycle input, but may be obtained specially for 110 volts 25 cycles or 110 volts 40 cycles. The center-tapped B filter choke is the same for the different frequencies, because it is large enough to filter well even at 25 cycles. The same type of center-tapped choke is used for the push-pull output, and will pass 100 milliamperes very easily, without heating or saturation, although the total plate current in the present receiver will not come near that. It is well, however, to make ample provision.

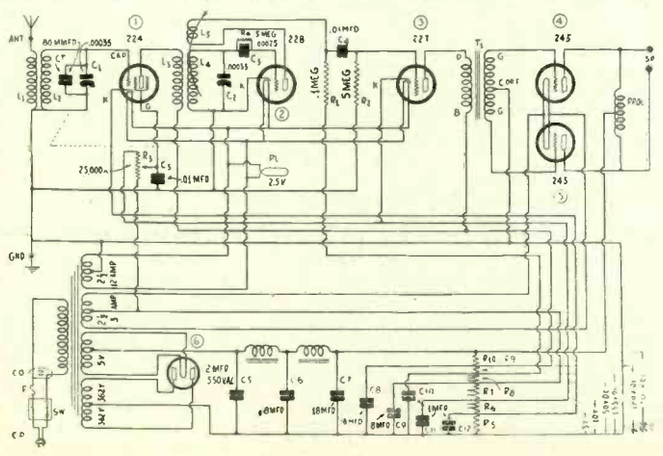
### EXCELLENT VOLTAGE DIVIDER

The same holds true of the voltage divider. It has a total resistance of 13,850 ohms, and fourteen taps, affording thirteen different voltages. Its rating is 50 watts, but this is conservative. It is usual to discount the wattage rating of a resistor used in a B supply by 50 per cent., as a margin of safety, but the Multi-Tap Voltage Divider is rated with the discount already deducted. It will pass 100 milliamperes without any trouble whatsoever, even at 500 volts.

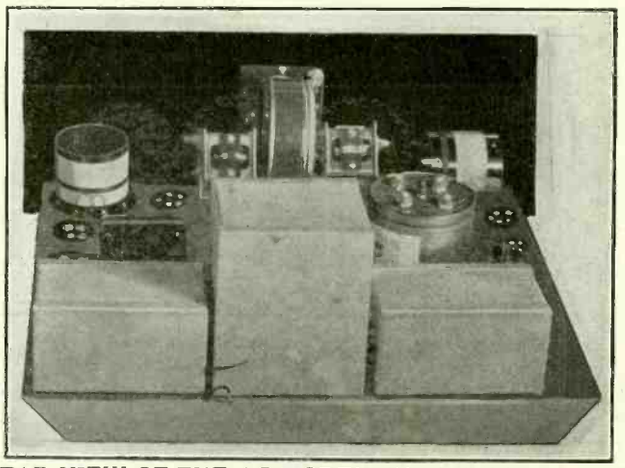
The total voltage across the divider in this circuit is 300 volts, approximately, any differences being occasioned by line voltage condition, unexpectedly high current drawn by several tubes in a receiver, due to their run-down condition, or to lack of sufficient capacity of the first filter condenser, C5. It is a fact that with the Polo filament-plate supply 1 mfd. will do, but 2 mfd. is used in the present circuit.

The 300 volts are distributed as follows: 250 for the power tubes' plates, 50 for biasing the power tubes. By using a high resistance voltmeter the proper tap on the voltage divider may be found, so that this proportion of voltages obtains. But if you have no such voltmeter, you may use the eighth tap from the low end of the divider.

You will find the divider consists of two tubings, one erected atop the other, and both mounted on the same brackets. The low end, the one connected to negative of the B supply, and which lead is grounded, is the extreme terminal at bottom where the lugs are close together. The high end, the one that goes to positive of the rectifier, at the choke chain output, is the extreme terminal at top where the nearest lug is about 2" away. The next lug from the high end would afford 180 volts,




SCHEMATIC CIRCUIT DIAGRAM OF THE AC MODEL PUSH-PULL DIAMOND.



REAR VIEW OF THE AC MODEL PUSH-PULL DIAMOND OF THE AIR.

the next 135 volts, the next three are not used, and the next is for the 50-volt bias.

### HOW BIAS IS ARRANGED

The arrangement of biasing in any instance is such that the filament or cathode, depending on the type of tube, is positive, because connected to a point higher up on the voltage divider than is the grid return. Thus the bias is the difference in voltage between the cathode or filament and the negative of the B supply. Since the filament or cathode is positive, the bias is negative.

The power tubes are on an independent filament circuit, heated by an individual winding (2.5 volts, 3 amperes). Therefore the same voltage drop used for biasing the push-pull pair is available as a positive bias for the plates or screen grids of other tubes. In the present circuit this 50 volt tap is used in only one extra stage, the first tube, a 224. The 25,000 ohm potentiometer R3 is connected across this 50 volts so that full 50 or less may be applied to the screen grid of the 224 tube, the lower voltages reducing the volume. This is a highly satisfactory method of volume control, and moreover introduces

(*Continued on page 20.*)

### LIST OF PARTS

**L1L2—One antenna coil, RF3, for .00035 mfd. tuning.**
**L3L4L5—One three-circuit screen grid coil, SGT3, for .00035.**
**C1, C2—Two .00035 mfd. tuning condensers, brackets.**
**CT—One 80 mmfd. equalizing condenser.**
**C3—One .00025 mfd. grid condenser with clips.**
**C4, C5—Two .01 mfd. mica condensers.**
**R1—One 0.1 meg. Lynch metallized resistor.**
**R2, R4—Two Lynch 5.0 meg. metallized grid leaks.**
**R3—One potentiometer, 25,000 ohms; knob.**
**T1—One push-pull input transformer.**
**PPOC—Two center-tabbed chokes and filter chokes (—).**
**Ant., Gnd., Speaker (—), Speaker (+)—Four engraved binding posts.**
**One Polo 245 power filament-plate, primary, 110 v., 50-60 cycles, with secondaries: 2.5 volts, 12 amps., 2.5 volts, 3 amps.; 5 volts, 2 amps.; 724 volts; all secondaries center-tapped; Cat. No. PFPS. (Note: for 40 cycles, 110 volts, use Cat. No. PFPS40; for 25 cycles, 110 volts, use PFPS25.)**
**C5—One 2 mfd. 550 volt AC (rms.) filter condenser.**
**C7, C8, C9, C10—Four Mershon condensers; two of 8 mfd., two of 18 mfd., in one case; bracket. Cat. Q 2-8, 2-18B.**
**C10, C11, C12—Three 1.0 mfd. bypass condensers, 200 volt DC.**
**R5, R6, R7, R8, R9, R10—One bracketed voltage divider, 13,850 ohms, 50-watt continuous duty rating; 14 taps, 7 taps not used separately in this circuit.**
**F—One 1-ampere fuse with base.**
**SW—One pendant through switch, AC type.**
**CO—One convenience outlet.**
**CP—One AC cable, 12 ft. long, with male plug.**
**One metal subpanel 20½"x11½", with three five-prong (UY) and three four-prong (UX) sockets built in, and holes drilled for parts.**
**One National type HC drum dial with new modernistic escutcheon and rainbow feature; pilot bracket and 2.5 AC volt lamp, PL.**
**One 7x21" front panel.**
**Flexible link and ¼" bakelite shaft.**
**One extra knob for tickler.**

# Midget Three, Only a

## Provides Good Quality and is Economical

*By Herber*

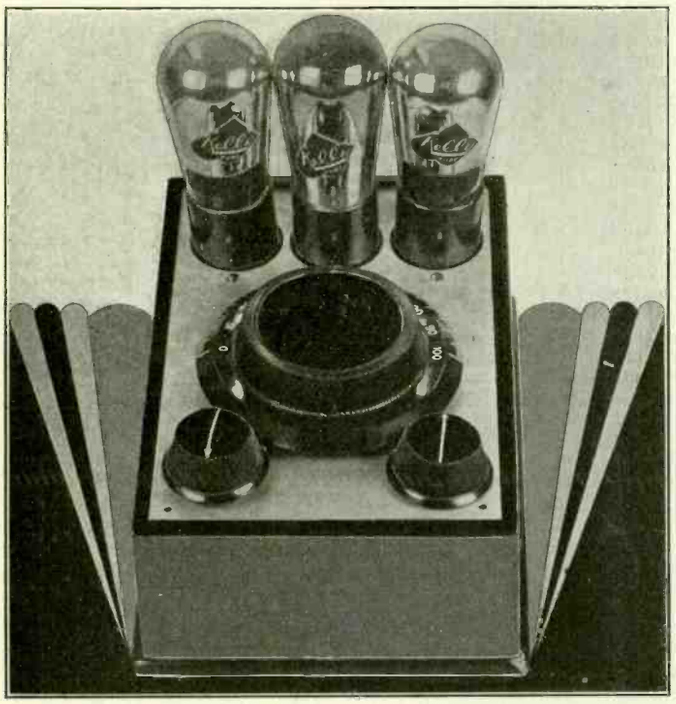


FIG. 1

FULL VIEW OF THE MIDGET THREE, A SPEAKER-OPERATING RECEIVER BUILT INTO A WALNUT CABINET ONLY 5½" WIDE, BY 7¾" LONG BY 3" HIGH, OVERALL. THE PANEL IS 5x7⅜".

THE Midget three tube set shown in the diagram and photographs works a speaker well. It is as compact as any one reasonably can expect—5½" wide, 7¾" long and only 3" high. Yet all the parts are contained on its top panel or inside the walnut box.

This compactness is attained by placing three sockets in a row at back, on the top panel, the 4" tuning dial directly below, and two knobs at lower left and right.

The left-hand knob is placed in position before the tuning dial is slipped onto the condenser shaft. The dial is pressed down far enough, or the knob elevated high enough, so that the knob strikes the dial rim. Therefore to turn the dial you manipulate the knob at lower left. This gives you vernier tuning, with a ratio of about 3-to-1. Hence the circuit may be tuned to resonance on the dot. An eyelet head serves as the dial indicator, this head being a part of the top panel construction.

### NECESSITY FOR LARGE PLATE WINDING

The circuit is so arranged that an aperiodic winding is used as is customary for the antenna-ground connections, and is tightly coupled to the secondary, which is center-tapped. This secondary has one-half of its winding in the grid circuit, the other half in the plate circuit, thereby producing feedback, which is controlled by the 30-ohm rheostat. A switch is built into the rheostat.

The necessity for use of such a large plate winding arises from the fact that resistance coupled audio amplification is used. A resistor in the plate circuit has a damping effect upon oscillations, but this is overcome, in the interest of producing regeneration, by the high inductance plate load.

The grid return is made to positive A, and as the tuning condenser is fastened to a metal top panel, this panel is A positive also. For the same reason the rheostat, conductively coupled to the panel by the mere fact of mounting thereon, is in the positive leg.

The top is shown in the main photograph, and as the sockets are built into the panel, and holes are provided for the rheostat and the vernier knob, no drilling need be done.

The vernier knob, by the way, is kept in position by attachment to a bakelite rod ¼" in diameter and 1¼" long, the knob's setscrew being tightened against the knob, while on the under side of the panel a bushing with a setscrew is placed on the shaft and tightened against the panel. Wobbly connection should not be permitted, as then the knob will not drive the dial.

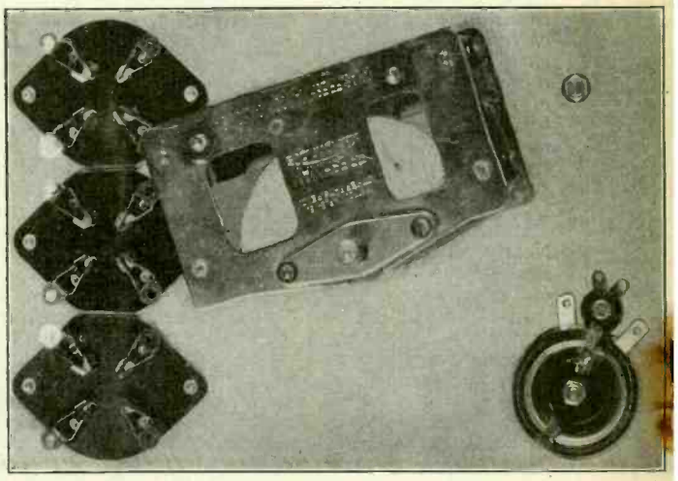


FIG. 2

A SUGGESTION FOR MOUNTING THE CONDENSER. THE ANGLE SHOWN ABSOLUTELY INSURES THE CONDENSER CLEARING THE SOCKET LUGS AS WELL AS THE VERNIER KNOB'S ATTACHMENT PIECE.

In any instance, however, it is permissible to turn the main dial itself for obtaining rough positions or to go from one end of the scale to the other in a hurry, then, if desired, the knob may be used as a vernier for closer tuning.

### MOUNT CONDENSER FOR CLEARANCE

The condenser used for tuning has to be mounted right way to clear socket lugs and rheostat. Several optional positions will become obvious when you start assembling the parts, but one of the photographs shows a sure solution that you may just as well follow.

The tuning condenser has a pigtail for insuring positive contact of rotor plates with the frame for electrical conduction, not relying only on friction. To make it possible to mount the condenser securely it is necessary to remove the screw holding the pigtail's lug, as well as to remove a footrest on the condenser frame and drill out the remnants of the eyelets that held this footrest. With a pair of pliers the footrest is easily pulled off. A drill will make quick work of removing what remains of the eyelets. Two mounting feet on the rear of the condenser are not used in this circuit but may be left intact.

Two special purpose tubes are recommended, the 240 high mu, one used as detector, the other as first audio amplifier. They are very inexpensive, and well worth using because of the greater volume they so readily afford. The last tube is a 112A.

## *Power Detection Not Strong*

I HAD a receiver which gave me very good service but I thought I would improve it by installing power detection. Now I don't get enough volume to operate the loudspeaker. Is power detection the bunk or have I made a mistake?—S. G. A.

Since we don't know what changes you made nor what set you changed we canot say definitely whether or not you made a mistake, but we do know that power detection is all right. Most likely you made the mistake that all that is necessary to change a receiver to power detection is to increase the grid bias. That is only a minor part of the change required. You must provide for a greater radio frequency amplification ahead of the detector and a higher plate voltage on the plate of the tube, as well as to increase the grid bias, precautions too often overlooked.

# Handful, Works Speaker

## in All Respects—Cabinet only 5½ x 7¾"

*t E. Hayden*

The maximum plate voltage used is 90 volts, and this voltage is applied to all the tubes. It is practical to use 201A tubes throughout without any wiring change, but the volume will not be so large.

The Midget is not supposed to be a high-powered receiver, but is a good, workable one, and will serve many purposes. It is excellent for testing antenna and ground installations where trouble ascribed to another receiver is suspected to be in the aerial system. It is an excellent experimental circuit for all novices, particularly schoolboys. And, more than any of these purposes, it is a good auxiliary receiver to have about the house. You will be sure of local programs, and they will come in with unbelievably good quality. And all you need to power the set are 90 volts of B battery, 4½ volts of C battery, and 6 volts for the filament supply. The 6 volt source may as well be three No. 6 dry cells connected in series, or six connected in series parallel. So this is a handy dry cell receiver.

### NO EARPHONES, PLEASE!

Do not worry about having to buy earphones. The Midget Three will certainly operate a loudspeaker. If you use the recommended tubes you'll be surprised.

The arrangement of parts in the interior is such that the free space under the vernier knob and rheostat accommodates one resistance coupling stage and the space under the detector socket the coil. There is room, of course, for the grid condenser and grid leak right close to the detector socket, which is at left as you look at the panel from the top.

The lug removed from the tuning condenser, the lug attached to the pigtail at the factory, is soldered directly to the A plus post of the detector socket.

It is not to be expected that this modest receiver will tune in stations from the other side of the ocean, but it will do exceedingly well on local reception, and after the locals have signed off, even sometimes before they have done so, you may expect some distance, not much, however.

On the favorable side are the recommendations of reliable reception, with good quality and good speaker volume; economy of first cost and operation, since for average use the dry cells will last a couple of months, the B batteries six months to a year, and the C battery a year or more. There is very little to buy, very little work to do, and yet you will have a really practical receiver. And remember that it is housed in a handsome little cabinet, one that looks well even when fine furniture is shown off against it. The cabinet, besides, has rubber mounting feet on it, so that you may place the receiver on the finest polished furniture without ever producing a scratch.

### CABLE AND BINDING POSTS

The battery cable emerges from the rear elevation of the box, and here too the binding posts are arranged, 1" down. It is not necessary to provide any insulation, as the wood itself is a sufficient insulator. Simply drill the binding post holes to upper left and right of the cable hole already in the box.

A triangular piece of wood is in each corner inside the box, the top of each piece of wood affording a place to secure the panel. Corresponding holes already are drilled in this panel, so after the connections are wired, the panel is simply put in place and screwed down. When wiring keep the panel as close as practical to the inside of the box, for then the leads from panel parts to interior parts may be shorter. These leads will find a place for themselves all right as you gently lower the panel into place, and no special precaution is necessary, except the single one that the moving plates of the tuning condenser must not be obstructed by any of these wires. This difficulty is completely avoided if you tie the leads together with string, in a position removed from the arc described by the condenser rotor plates.

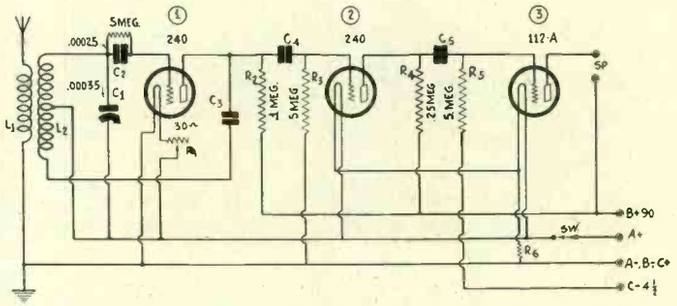



FIG. 3

CIRCUIT DIAGRAM OF THE MIDGET THREE. THE DETECTOR TUBE AND THE FIRST AUDIO TUBE ARE 240 HIGH MU. THE OUTPUT TUBE IS A 112A. IT IS POSSIBLE TO USE 201A TUBES THROUGHOUT WITHOUT ANY CHANGE IN THE CIRCUIT, BUT THE VOLUME WILL BE LESS.

Wiring is simplified if you bend the socket lugs back. Note the two large holes in each socket, and with these holes facing you, when you're looking at the bottom side of the socket, as you would when wiring, connect the two left-hand lugs together with a wire on sockets other than detector.

Bring the lead from these positive A connections to one side of the switch built into the rheostat, and to one side of the rheostat. Connect the other side of the switch to a cable three feet long, which will go to positive A battery, and connect the other side of the rheostat to F positive or the detector socket.

Under conditions just described the detector socket is at left, since the panel is upside down, as it were.

### AVOID SHORT THIS WAY

Bring a cable lead three feet long from the remaining large-hole lug of the detector socket for connection to minus on the A battery. To this minus lug of the detector socket solder the fixed resistor that serves the filaments of the two remaining tubes, and connect the other end of this resistor to the negative filament of these two tubes. To avoid shorting the minus and plus this resistor is soldered in place at a 45 degree angle and the lead is carried down to the socket lugs free and clear of any danger of shorting or obstructing.

The tuning coil is secured to the bottom of the box under where the detector socket will be. This coil is on a small diameter, say 1", and consists of 200 turns of fine wire, No 30 being suggested, center tapped. The primary is wound over the secondary and consists of 40 turns. It is well to put a piece of paper between primary and secondary windings, to avoid possibility of shorting, as you will be using enamel covered wire, and the friction due to winding otherwise may scrape off some of the enamel insulation.

### LIST OF PARTS

**L1L2—Antenna coil, small diameter, secondary center-tapped.**
**C1—.00035 mfd. tuning condenser.**
**C2—.00025 mfd. grid condenser with clips.**
**C3—.00025 mfd. fixed condenser.**
**C4, C5—Two .01 mfd. fixed condensers.**
**R1, Sw—30 ohm switch rheostat.**
**R2—0.1 meg. Lynch resistor.**
**R3, R5, grid leak—Three 5.0 meg. Lynch resistors.**
**R6—2 ohm filament resistor.**
**Ant., Grid., Speaker—Four binding posts.**
**Four—Leads for cable.**
**Drilled top panel with sockets in cabinet.**
**Four resistor mountings.**
**One dial.**
**Dummy knob and shaft, bushing.**
**Two 240 and one 112A Kelly tubes.**

## *Comparison of Amplifiers*

HOW does the quality of the output of amplifiers employing resistance and high grade transformers compare?—G. W.

If the resistance coupled amplifier has been designed properly, and if it is powered with a very good B supply unit, its quality is better than can be obtained with transformers. But it is much easier to get good quality with high grade transformers than with resistance coupling. Whether you use resistance or transformer coupling the quality you get depends very largely on the B supply unit you use and the care with which you have built the circuit so as to eliminate feed back through this unit. The very best transformers give almost as much trouble as resistance coupling, and in order to get the best possible quality out of either type it is necessary to use plenty of bypass condensers across the B voltage leads.

# A Shielded Screen-Grid Tu

## Assembly includes Bernard Dynamic Coil, Conden

*By James*

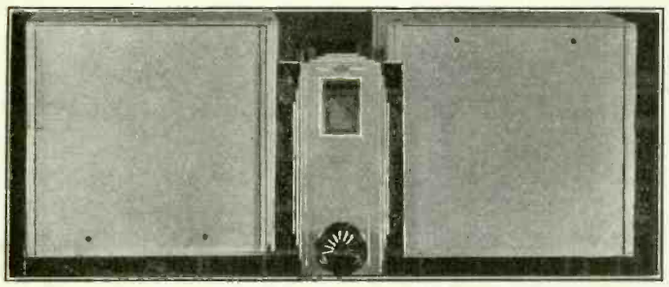


FIG. 1.
THE ASSEMBLY OF TWO SHIELDS AND NATIONAL MODERNISTIC DRUM DIAL. INSIDE EACH SHIELD IS A TUNING CONDENSER, A COIL AND A SOCKET

[*In last week's issue, October 26th, the first of a series of articles on the solution of mechanical problems was published. It dealt with the mounting of a three-gang tuning condenser in a shield compartment into which was built also the drive mechanism for turning the condenser, enabling the attachment of a drum dial at one end. This week another mechanical problem concerning shields is discussed, and in addition a tuner is provided that affords high gain, using the Bernard dynamic coils. Follow this series of articles in* RADIO WORLD *and find some of your most distressing mechanical problems solved.—Editor.*]

AN EXCELLENT tuner, to be fed into an audio amplifier independently provided, may be erected in shielded form to incorporate the Bernard tuners that provide such high gain from the screen grid tube.

Two special shields are constructed, one for the antenna stage, the other for the detector input, and both of these are interconnected and grounded.

One short side of the right-hand shield is drilled to accommodate the interstage coil, L4L5L6, and close by is a 1" diameter hole, to permit the bracket of the dial light to pass. The coil has a single hole mounting facility.

To the left front pillar of this shield the National dial's frame is attached. The corresponding short side of the shield at the other end has the same size mounting hole, but the condenser is placed there and the 1" hole is omitted.

Both the coil and the condenser have extended shafts, and these shafts are coupled by a link, inside the shield. Thus when the dial is attached to the coil shaft that protrudes from the shield, the motion that turns the movable coil also turns the condenser. As the condenser has an end stop, none need be provided on the coil.

### DRUM BUSHING ENGAGES BOTH

The other shield compartment is of the same general construction, with the 1" hole omitted from both short sides, however. The bushing on the drum has two set screws, and one is used for engaging the shaft extending into it on one side, and the other for the shaft extending into it on the other side.

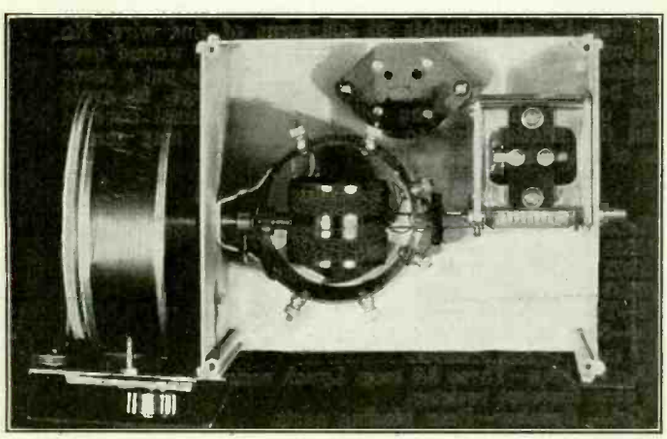


FIG. 2.
TOP VIEW OF THE ASSEMBLY OF RIGHT-HAND SHIELD AND DIAL. THE PILLAR AT LEFT FOREGROUND IS SECURED TO THE DIAL FRAME AT BOTTOM BY TIGHTENING THE SCREW THROUGH THE FRAME INTO THE THREAD OF THE PILLAR.

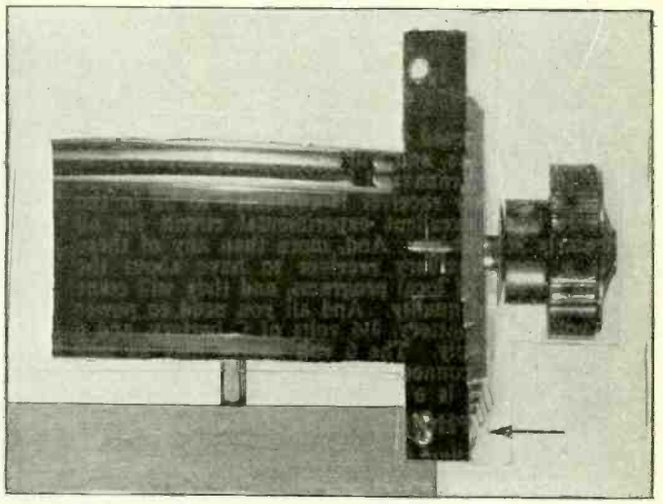


FIG. 3.
ARROW SHOWS WHERE THE SCREW IS PASSED THROUGH THE DIAL FRAME TO ENGAGE THE THREAD OF THE SHIELD PILLAR.

The operation of the Bernard tuner is such that the moving coil adds to the inductance of the tuned circuit on one side of zero coupling and subtracts from it at the other side of zero coupling. When the moving coil is at right angles to the fixed part of the tuned winding the coupling is zero.

It is important to get the moving coil working in the right direction, so that when the condenser plates are fully enmeshed the coupling between dynamic and static segments is maximum. This test is easily made, as the high wavelength stations do not come in when the dynamic coil is fastened the wrong way, and the lowest receivable wavelength, around 200 meters, comes in at about 30 when the moving coil is wrong.

When the circuit is functioning properly the whole scale is covered and the dial readings are standard on the basis of straight line frequency, although the condenser is of the modified type.

To make the change from wrong to right rotation of the dynamic coil, simply loosen the screw of the coupling link and turn the coil half way around, which is 180 degrees.

### HIGH GAIN AND SENSITIVITY

Since this design is for single tuning control, it is absolutely necessary to get the dynamic coils working properly, or you will get next to no reception. It is easy to attain the correct results, and these will insure high gain and excellent sensitivity.

Only the tuning arrangement is shown, as the switch and volume control will be placed on the front panel. These are in a composite unit, placed at left on the front panel, while at a corresponding position at right a dummy knob and shaft should be used, to balance the appearance.

Inside each shield a socket is placed, and there is just room for this. The socket should not be elevated much, as otherwise the cap of the screen grid tube, 222, would touch the top of the shield.

To facilitate connections it is well to wire the leads inside the can and bring them out to binding posts. For instance, the antenna shield assembly will have four posts—antenna, ground plate and B + 45. The aerial is connected to the antenna post, which is insulated from the shield. The ground is connected to the ground post, and A minus is connected to this same post, but inside the can the nut affixed to the screw shank will be tightened right against the shield. That is how the grounding is effected, by omitting the usual flat insulating washer from the inside. The plate post is insulated, however; it connects to the plate of the first bracket and so is the B + 45 post.

### B + LEAD TO THE DETECTOR

Besides these parts the bypass condenser C3 is placed inside the first shield, being attached directly to the shield on the inside, at one end, and to the 45-volt binding post at the other end.

The right-hand compartment contains the tuning condenser, coil, link coupler, socket, three binding posts and bypass con-

# ner for Battery Operation

## ser, Socket and Binding Posts in Each Compartment

*H. Carroll*

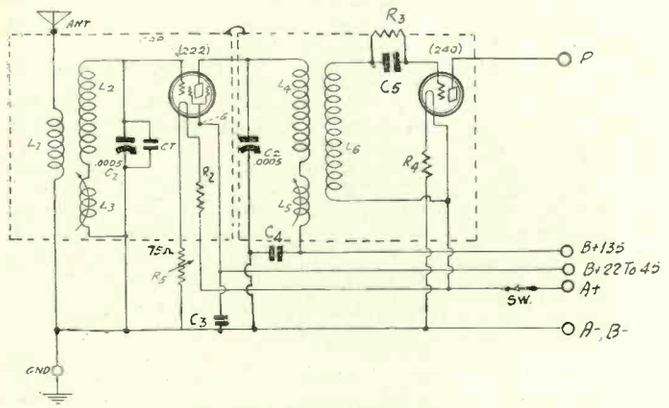



FIG. 4.

CIRCUIT DIAGRAM OF A TUNER FOR BATTERY OPERATOR OF FILAMENTS, USING THE SHIELD ASSEMBLY. THE B VOLTAGE ON THE DETECTOR IS APPLIED TO THE RESISTOR OR TRANSFORMER PRIMARY IN THE EXTERNAL AUDIO AMPLIFIER

densers, C4. The binding posts here are P1, B and P2, and represent connection to the tuned plate winding L4L5, for P1, the B plus 135-volt lead, B, and the detector output, P2, which goes to the audio channel.

No connection is shown to the detector plate in the schematic diagram, because this connection is a part of the audio amplifier wiring. It is assumed a power amplifier will be used with the tuner. B plus detector would be connected to the B post on the primary of the first audio transformer, or to one end of a resistor or audio impedance coil, depending on which type of coupling is used. The 45 volt tap of the B supply or B batteries is used for the detector no matter what the load.

If resistance or impedance load is used in the plate circuit the detector should be, as shown, a 240 high mu tube, but for audio transformer coupling the 201A tube will work better. No change in the circuit tuner need be made. Simply insert the type of detector tube better suited to your first audio coupler.

### FRONT PANEL ASSEMBLY

The assembly should be used with a subpanel, which may be a baseboard. Measure the height of the drive shaft of the National dial above the bottom of the baseboard. Then mark a bakelite front panel of 7x18" size to locate this hole, and, following the template furnished with the dial, drill the other dial holes. The rheostat switch and the dummy may be on same line as the dial knob.

The tube filaments should have storage battery supply, 6 volts.

### LIST OF PARTS

**L1L2L3—One Bernard Tuner for .00035 mfd.; Cat. BT5A (antenna coil).**
**L4L5L6—One Bernard Tuner for .00035 mfd.; Cat. BT5B (interstage coil).**
**C1, C2—Two .00035 mfd. tuning condensers with shaft extending front and rear.**
**Ct—One 80 mmfd. equalizing condenser.**
**C3, C4—Two .01 mfd. fixed condensers.**
**C5—One .00025 mfd. grid condenser with clips.**
**R1—One 75 ohm rheostat with switch (sw) built in.**
**R2—One 6.5 ohm fixed filament resistor.**
**R3—One 5.0 meg. Lynch metallized grid leak.**
**R4—One 4 ohm fixed filament resistor.**
**Ant., Gnd., P, B + 45—Four binding posts.**
**Two shields as described.**
**Two four-prong (UX) sockets.**
**Two coupling links.**
**One National modernistic drum dial with rainbow feature and 5-volt or 6-volt lamp and bracket.**
**Seven binding posts.**
**One 7x18" baskelite front panel.**
**One dummy shaft and knob.**

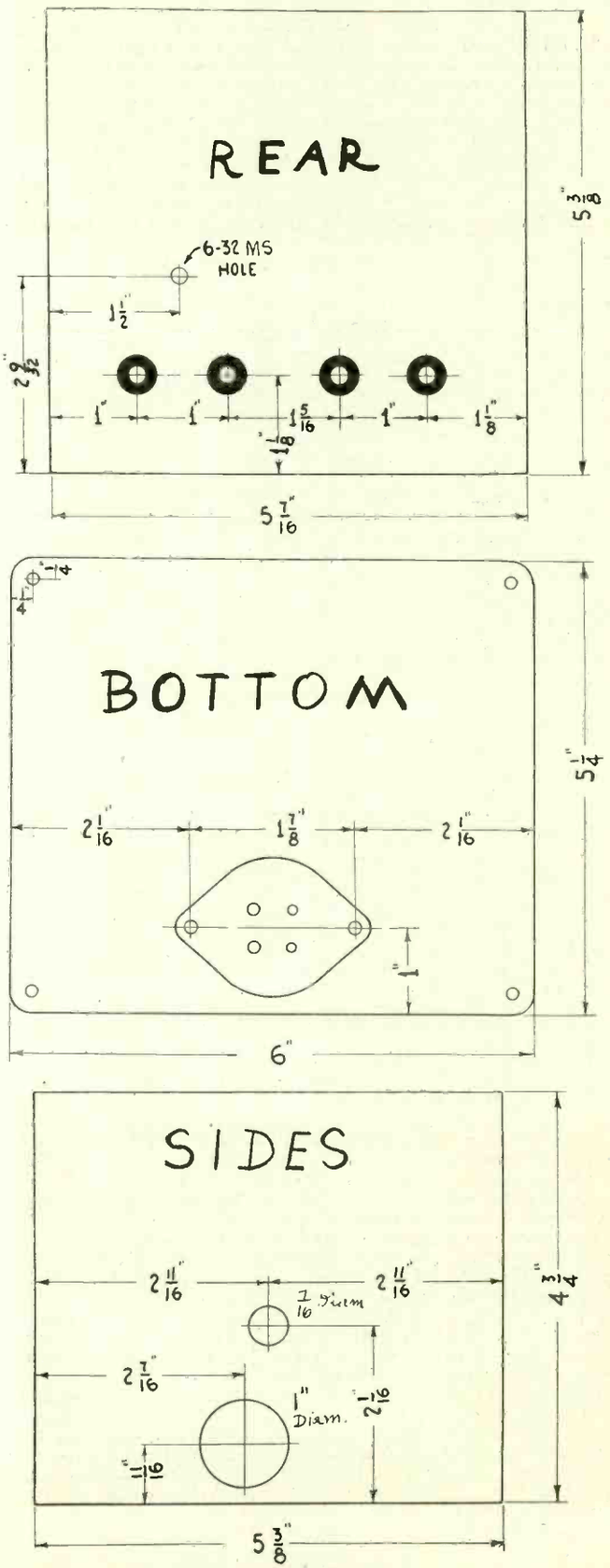



FIG. 4

THE DIMENSIONS FOR THE REAR, BOTTOM AND SIDE WALLS OF THE SHIELD ARE GIVEN, WITH POSITION AND SIZE OF HOLES.

# Rules for Tracing Noise

"Home-Made Static and How to Avoid It," published by the Radio Manufacturers Association, 32 West Randolph Street, Chicago, gives remedies for elimination or reduction of way-made interference. The booklet sets forth:

"The actual correction of the condition causing the interference is usually a simple matter. The most important step in eliminating or reducing interference is to trace it to a definite point or device. The means for accomplishing this are not always within the province of the radio set owner and the course must be pursued as follows:

### SHORT OUT ANTENNA

"(1) If your radio set is of the type which uses an antenna system (aerial and ground), the wire connecting to aerial and the wire connecting to ground should be removed from their respective binding posts and a small piece of wire substituted. Connect this wire directly across the aerial and ground posts. Such procedure then leaves the radio set effectively without an antenna system, which is the collector of energy for the set. The result is that any interference which is being picked up outside the radio set itself is reduced or eliminated when the collector system is removed. If the case is such that the interference is reduced or eliminated you may decide immediately that it is from an outside cause and not due to your radio set. If, however, the interference continues with equal volume, a careful analysis of the radio set should be made.

### WHEN TO CALL POWER COMPANY

"(2) When it is decided that the noise is due to outside causes and the source has been carefully checked, if it is found due to electric light or transmission wires, you shuold call the local power company and ask for assistance in reducing or eliminating the interference.

### CHECK LIGHTS, SOCKETS, SWITCHES

"(3) When satisfied that the interference is not due to electric light or transmission lines, and the set itself is free from internal noises, proceed carefully to check all lights, sockets, switches and electrical appliances in the house. Experience teaches that common sense and careful elimination of each probable interference producer will bring very satisfactory results. Once the faulty equipment is locted, the remedy is usually to connect a filter condenser of small capacity across the leads of the offending appliance. In 99 cases out of 100, this is found to be an effective solution."

The manual gives over a dozen wiring diagrams showing how to install filters on electrical appliances of various types.

# Push-Pull Diamond

(*Continued from page* 15.)

this control in the very first tube. A better position could not be devised.

As all grid returns are made to negative of the B supply, all are grounded. This includes even the detector, which is operated at zero bias, because of interconnection of cathode and grid return.

The detector tube may be a 227 or a 228, the 228 being preferable, because it is an AC high mu tube, working best into a high impedance plate load. In the push-pull AC Diamond this load is a 0.1 meg. resistor. The volume increase when the 228 is used instead of the 227 is about 2½ times. This is very considerable and in part accounts for the high sensitivity of the entire circuit.

Fairly strong coupling between antenna coil and tuned secondary is used at the input to the receiver, there being 14 turns on the primary, L1, ¼" space, and 60 turns on the secondary L2, the diameter being 2½" and the wire No. 24 silk insulated.

The primary, L3, of the three-circuit tuner is specially designed for connection in the plate circuit of a screen grid tube, and should have from 24 to 36 turns. You will find 24 enough, but 36 will give most volume at a sacrifice in selectivity that you may care to make if your location justifies it. The secondary L4 has 60 turns, as before. The diameter is 2½", the separation ¼". The tickler L5 is set wound on a 1¼" diameter and has 20 turns. This is usually enough to produce oscillation, but if not, you may connect a .000025 mfd. fixed condenser from the detector side of C4 to grounded negative of the B supply, or add more turns to the tickler, or increase the detector plate voltage from 135 volts to 180 volts, or resort to all three remedies.

The coil data and oscillation recommendations apply both to the battery model and AC model.

The parts are arranged on a 7x20" subpanel, 11½" front to back, and the front panel is 7x21". The circuit has single tuning control, with tickler and potentiometer knobs placed on the front panel in symmetrical positions. The switch emerges from the rear of the receiver and is of the through type of pendant switch, which means that both wires are carried through the switch, although only one side is switched, the other being continuous. As separate leads are used, consisting of the primary wires of the filament-plate supply and the AC cable, the union of the one pair with the other is established at the posts inside the switch.

# Right or Wrong?

[*Here are ten more questions. They are based on material published in last week's issue of* Radio World. *If you read that issue carefully you should be able to answer the questions. Verify your efforts by consulting the answers herewith. Next week's questions will be based on material published in this week's article.—Editor.*]

(1)—When the magnetic lines threading a coil of wire changes there is induced in the coil an electromotive force and the intensity of the induced emf is proportional to the rate of change

(2)—Lenz law states that when an emf is induced in a coil the direction of the force is such as to tend to oppose the motion or the change in the magnetism.

(3)—Only alternating currents flowing in the inducing coil will induce electromotive forces in a coil.

(4)—When magnetism changes in space there is a difference of potential between two points in space whether or not those two points are connected by a wire.

(5)—By image interference is meant the interference of one radio frequency carrier with another.

(6)—It is possible to select an intermediate frequency such that there will be no image interference at all in the receiver.

(7)—The radio frequency wave emanating from a transmitting antenna cannot be heard because the frequency is above the audible limit, and for no other reason.

(8)—The least popular amplifier at this time is one employing a resistance coupled stage and one push-pull 245 stage.

(9)—An amplifier such as that described in the preceding statement is not sufficiently sensitive to be used with a phonograph pick-up. That is, the output from the amplifier, using an average pick-up unit, will not be great enough to operate a loudspeaker.

(10)—The reason music from a Theremin sounds like that from a musical saw is that the notes slide gradually from one to the other in both instruments.

### ANSWERS

(1)—Right. This is true no matter how the magnetism changes, by the movement of a permanent magnet, by the movement of a coil carrying current, by the changes of a current in a coil.

(2)—Right. The induced electromotive force is such that if a current flows as a result of it, the change in the magnetism due to that current is opposed to the change in the magnetism causing the emf. This is only a case of "to every action there is an equal and opposite reaction."

(3)—Wrong. Alternating currents will induce emfs in other circuits but so will changing currents of any kind, or more generally, changing magnetism.

(4)—Right. This is not generally realized but it is a fact. The wire in the field has nothing to do with the potential difference between its ends.

(5)—Wrong. Image interference is due to a clashing of two nearly equal intermediate frequencies which are produced between the oscillator and two carrier frequencies, these differing by twice the amount of the intermediate frequency.

(6)—Wrong. Absolutely it is impossible, practically the condition can be approached by using a high intermediate frequency. The interfering image is present but it has been reduced in intensity by the radio frequency tuner to such a value that it cannot cause any trouble.

(7)—Wrong. In the first place the wave cannot be heard because it exists in a medium in which the ear is not functioning. In the second place only, the frequency is too high. The eye is an organ which responds directly to the type of wave used in radio, but any radio wave that has yet been created has been too low in frequency for the eye to receive it.

(8)—Wrong. This type of receiver is one of the most popular and is gaining in popularity all the time.

(9)—Wrong. If a phonograph pick-up unit of average sensitivity is connected to the grid circuit of this amplifier there will be ample volume in the loudspeaker.

(10)—Right. The whining sounds are due to continuously changing pitch. Similar effects can be produced by stringed instruments or with some wind instruments in which the tension on the vibrating string or the length of the string or the resonant air column can be changed continuously.

### MANNIE HOFFMAN WEDS

Mannie Hoffman and Miss May Apter, of Brooklyn, N. Y., were married recently. Mr. Hoffman is with the Sanford Radio Corporation, 480 Canal Street, New York City, and previously was with Wireless Egert. They will live in Brooklyn.

## A Thought for the Week

*THERE comes again from a certain part of the lay press, which does more guessing than knowing, a wail to the effect that the broadcasting stations are getting more commercial all the time and that advertising periods are becoming a public nuisance. Let the gentlemen of the press try to figure out what kind of progress would result if the advertisers on the air were to stop spending money for talent. Such a course would reduce the popularity of radio to a minimum and it would take years to recover from the effects of such a calamity.*

**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.**

## LARGER CONDENSER HELPS

I HAVE an AC receiver which hummed intolerably. I partially corrected this by connecting a larger by-pass condenser across the B supply lead which serves the radio frequency, the detector and the first audio tubes. Is there any reason for not using an electrolytic condenser in the same place so that every trace of hum will be removed. Will there be any adverse effects on the low note reproduction if I put in a large electrolytic condenser? Please point out any bad effects which would result.—C. A. P.

The sky is the limit to the condenser in this place. There is no known exception to this statement. The larger the condenser the better. There will not only be no deleterious effects on the low notes, but these notes will come through better with the larger condenser. It is not certain that the larger condenser will take out the last trace of hum, because the hum may not enter the amplifier by way of the common B supply. But if increasing the condenser a little helped in this direction it is reasonable to suppose that a still larger condenser will take out a considerable portion of the residual hum.

## AMPLE B SUPPLY

MY receiver consists of one screen grid radio frequency amplifier, one 227 type detector, one stage of resistance coupled audio and a stage of push-pull audio using two 245 tubes. Will the Polo 245 Power Supply furnish sufficient power to operate my receiver? If not, will you suggest one that will which can be obtained at a reasonable price.—A. C. C.

The Polo 245 B Supply has been designed to deliver more power than is required to operate a receiver like yours, so it should be ample in your case.

## REMOTE CONTROLS

ARE there any devices on the market which enable one to to tune a receiver from a distance? I wish to install my receiver in a closet with the exception of the loudspeaker and a small control which can be placed on an end table near my easy chair. If there are such devices, do you regard them practical and how do they operate?—F. S. B.

There are such devices. Usually they are constructed so that a limited number of stations can be tuned in by pressing certain buttons on the control. Not all the devices work on the same principle, but one, which is only the size of a small cigar box, operates on a relay principle, a multiple-conductor cable running between the control box and the receiver. One button is for starting the receiver, another for stopping it, and a number of other buttons for selecting desired stations. The buttons control a motor which drives the tuning mechanism. The particular button pressed determines where the motor stops.

## DISTINCTION BETWEEN COIL AND CONDENSER ANTENNA

I READ so much about coil and condenser antennas. What is the difference between them, if any? If there is a difference which is the better? I want to use the best because I am located where it is difficult to receive stations.—G. E.

A coil antenna is simply a loop—a coil of wire wound on a frame. It is tuned with an ordinary tuning condenser, and it responds to the magnetic component of the radio wave. It is directional. A condenser antenna is a condenser in which the plates have been separated by a distance from three feet to 100 feet or so. It may consist of two parallel plates of large dimensions, or of two long parallel wires, or of a vertical wire and the earth. If you look out of your window and see an antenna, it is a million to one that it is a condenser antenna.

## EXPLAIN YOURSELF

JUST one question please. I have read your articles on the Superheterodyne and like them very much, but you have me guessing in the Oct. 19 issue. You say that F1—F2 is equal to F2—F1 while everybody knows that one is the negative of the other. If you are right I know nothing about algebra. Please explain what you mean.—E. B.

If the two frequencies involved were equal in both expressions one would indeed be the negative of the other, but even that would not vitiate the explanation of beats. What is a negative beat? But in the expression referred to F2 does not have the same value while F1 does. When you put F2 ahead of F1, F2 is greater than F1; when you reverse their positions F2 is smaller than F1 by the same amount. Hence if f is the absolute difference between the two, F2 in one case is 2f greater than it is in the other. This was explained in the article.

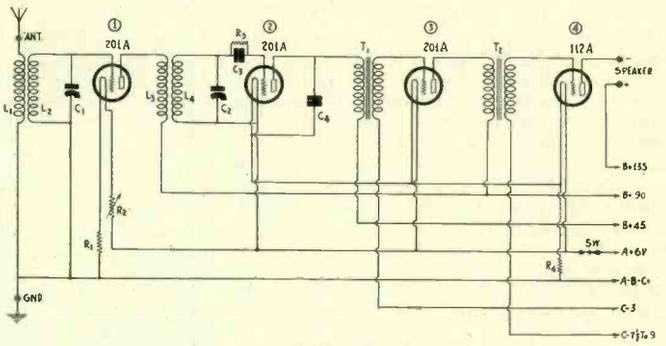



FIG. 803

THERE IS NO BETTER VOLUME CONTROL FOR A BATTERY RECEIVER THAN A RHEOSTAT IN THE FILAMENT CIRCUIT OF THE FIRST RADIO FREQUENCY AMPLIFIER.

## ASKING TOO MUCH

WILL you please design and publish a band pass filter for an intermediate frequency amplifier which has absolute 10 kc selectivity.—V. B.

We appreciate your confidence in our ability along this line, but we must decline the attempt at the absolute. A band pass filter will be published before the end of the Superheterodyne series which is now running. But it will not be one of absolute 10 kc selectivity. It will be physically possible to build.

## VOLUME CONTROL IN BATTERY SET

WHAT do you regard as the best volume control for a four tube battery receiver? I have such a receiver, transformer coupled, but I cannot control the volume satisfactorily. Please show a diagram illustrating the connection of the volume control.—J. B. K.

There is no better volume control in a battery operated set than a rheostat in the filament leg of the radio frequency amplifier. You will find a diagram of a four tube receiver in Fig. 803. R2 in the positive leg of the filament of tube No. 1 is the control. For a 201A tube a 20 ohm rheostat is large enough. The particular circuit shown does not have a tickler, but if yours has it can be used as both a volume and selectivity control.

## PROPAGATION OF RADIO WAVES

PERHAPS you can clear up a mystery which has perplexed me a good deal. We have been told that radio waves and light waves are the same in nature, differing only in the wavelength or frequency. We know that the intensity of light varies inversely as the square of the distance from the source, but we are told that radio waves vary inversely as the distance from the transmitter. Why do light waves die out much more quickly than radio waves if they are the same?—M. J.

The difference between the two lies in the manner in which the waves are constrained to move. If there is no constraint they behave the same way, that is, they vary inversely as the square of the distance. If they are constrained to move in a plane they vary inversely as the distance, and if they are constrained to move in a straight line, they don't vary at all. Light as from a candle travels outward in all directions and hence the intensity varies inversely as the square of the distance. Radio waves travel in a plane, the surface of the earth being considered as a plane, hence radio waves decrease as the first power of the distance. If light is forced to travel in a beam or through a quartz rod of uniform cross section, the light does not vary in intensity with distance. The same would be true of radio waves, if they could be constrained in that manner. Radio beams are actually in use between England and Australia, between England and Canada and between other countries. The radio waves are concentrated in the same manner as the light from a search light. Very low power is needed to reach receivers at great distances because there is relatively little spreading out of the energy.

# PRICE BLURBS OVER AIR SEEN AS OFFENSIVE

Washington.

Advertising methods of many individual broadcasting stations in which prices of commodities are quoted were criticized by the chairman of the Federal Radio Commission, Ira E. Robinson.

Asserting that he did not believe "that the people are going to stand for the advertising methods now being used by broadcasters," Mr. Robinson declared that the national networks also are "offenders." His observations were made during hearings before the Commission on applications of stations for changes in their broadcasting assignments.

The broadcasters, said Mr. Robinson, "are being forced to quote prices and resort to direct selling methods by the advertisers themselves." He said he was inclined to believe that there would be "revulsion on the part of listeners, and they will quit tuning in when these programs are on the air."

### CHAINS BOLDER NOW

In the early days of broadcasting, he stated, the chains merely mentioned the sponsor of a particular program, but now "they are on the verge of quoting prices." He said that he recalled that one of the chains recently quoted the price of a particular make of automobile, according to "The United States Daily."

"It is strange to me that we can not support the 600 stations which have these valuable franchises without resorting to such offensive methods," he continued.

The expressions respecting advertising were made during the hearing to WGBS, of New York City, on its application for full time operation on the 970 kilocycle channel. The station was represented by Daily Paskman, who discussed briefly plans he had for the creation of a new national network.

### CITES COMPETITORS

Twenty stations throughout the country, he said, already have expressed their desire to join a third chain, while 30 others have opened negotiations, provided his stations get the "proper radio facilities from the Commission."

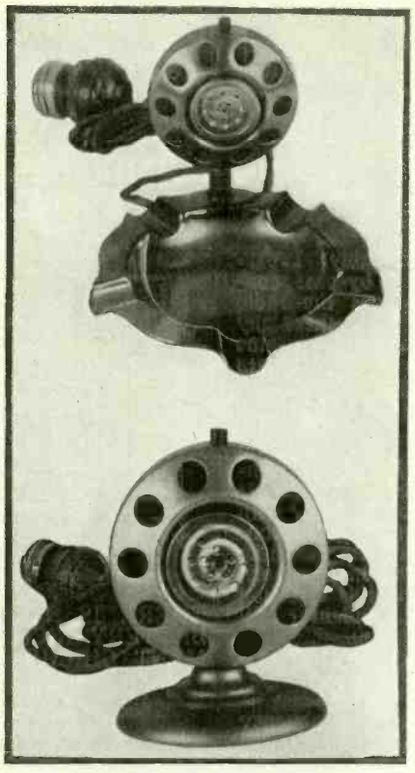
Mr. Paskman declared that his station "quotes prices" at certain hours during the day, and under cross-examination, declared it was hardly befitting to radio to resort to such means for a livelihood. He declared he was justified in so doing because other broadcasters and even the chains resort to practically the same methods.

Mr. Robinson said he believed the people have had an "overdose," of entertainment, and that the country people he knew did not prefer theatrical stars, but do appreciate a speech like that of the British prime minister, Ramsay MacDonald.

### ELECTRAD'S GRATITUDE

The board of directors of Electrad, Inc., elected Henry G. Richter vice-president in charge of engineering and Edward Metzger vice-president and general manager in charge of credits, general office and factory supervision. These motions were made in recognition of the conscientious service of Richter and Metzger.

## A NEW DEVICE



MICROPHONES IN APPEARANCE, THESE NEW PRODUCTS ARE ELECTRIC CIGAR AND CIGARETTE LIGHTERS. THEY WORK IN AC OR DC. THE SWITCH AT TOP IS PRESSED TO PRODUCE HEAT AT THE CENTER. ONE MODEL HAS A RECEPTACLE BASE.

# SEVEN SHIFTS FOR FLORIDA

Washington.

To eliminate interference with reception and to improve radio conditions generally within the State, the Federal Radio Commission has changed the broadcasting assignments of a group of stations in Florida. Recommendations for the realignment were made by the engineering division of the Commission after Commissioner E. O. Sykes had held public hearings in Florida during the Summer. The change in assignments were announced as follows:

WQAM, Miami, shifted from 1,240 kilocycles to 560 kilocycles, retaining its power of 1,000 watts.

WDAE, Tampa, shifted from dividing time with WDBO, Orlando, on 620 to full time on 620 kilocycles.

WRDF, Gainesville, shifted from 1,470 kilocycles to limited time operation on 830 kilocycles, retaining 5,000 watts power.

WIOD, Miami Beach, shifted from 560 kilocycles with 1000 watts, to 1,120 kilocycles with 500 watts night and 1,000 watts day.

WFLA - WSUN, Clearwater, Fla., shifted from 900 kilocycles with 1,000 watts to 1,240 kilocycles with 1,000 watts night and 2,500 watts day.

WCOH, Pensacola, shifted from 1,120 kilocycles with 500 watts to 1,340 kilocycles with 500 watts.

WMBR, Tampa, shifted from 1,210 kilocycles with 100 watts to 1,370 kilocycles with 100 watts.

# SAME WAVE BY TWO AT NIGHT SPLITS BOARD

Washington.

Chairman Ira E. Robinson, of the Federal Radio Commission, contends that two broadcast stations with a wide geographical separation should be permitted to broadcast on the same channel during the evening hours so that each station may present a variety of programs to the listeners. He points to the successful operation of WGY, Schenectady, N. Y., and KGO, Oakland, Calif., as evidence of the feasibility of such operation.

The opinion was expressed during a hearing on the application of WOV, New York, for a modification of its license permitting full time operation on the 1,130 kc. channel simultaneously with KSL, Salt Lake City, Utah, after representatives of WOV had testified that the two stations had broadcast simultaneously one evening and that no complaints of interference had been received in the service area of either station.

Commissioners H. A. Lafount and William D. L. Starbuck, however, contended that if "doubling up" were permitted interference would ruin reception over large areas and defeat the purpose of the exclusive channel to serve listeners remote from broadcasting stations.

## Secretary Must Answer Letters Sent to Board Under a New System

Washington.

The Federal Radio Commission has new rules.

The secretary's office, under the new system, answers all mail, whatever its character. All communications, including applications, first go to the secretary's office, and then are routed to the particular division to which they apply. No communications, other than official orders of the Commission, will carry the signatures of Commissioners, but will be signed by the secretary.

Under the radio act, as amended, the United States is divided into five geographical radio zones, and a Radio Commissioner is appointed to represent each zone. The law, it was explained, specifies only that the Nation be divided into five radio zones, and that radio facilities be distributed among these zones on an equitable basis. These zones, which are disproportionate in size, are set off on the basis of population.

## Bill Keeps Executive Work in Board Hands

Washington.

A bill to extend indefinitely the administrative life of the Federal Radio Commission will be introduced in both houses of Congress at the regular session, according to Senator Dill, of Washington, and Representative Wallace White, Jr., of Lewiston, Maine, co-authors of the present radio law.

If the bill is not passed before December 31st, the Radio Commission will become an apellate body for decisions rendered by the Department of Commerce, to which administrative authority will revert.

# WGY TEST CASE TO FIX COURT'S REVIEW POWER

Washington.

Two questions presented in the WGY case, which will be reviewed by the Supreme Court of the United States, relate to the powers of the Court of Appeals of the District of Columbia and the nation-wide reallocation of broadcasting facilities, according to a statement by the Federal Radio Commission.

The "broad and important question of the Commission's power to regulate radio communication," the statement said, is not raised in the case.

The Supreme Court issued a writ of certiorari for the purpose of reviewing the decision. The Court of Appeals held that the Commission had erred in assigning WGY, Schenectady, N. Y., operated by the General Electric Company, to limited time operation, whereas prior to the allocation it had operated full time.

The statement, drafted by the Commission's legal division, set forth:

"Two main questions are presented by the Commission:

"(1)—Whether the appeal provided for by section 16 of the radio act of 1927, as amended, constitutes the Court of Appeals of the District of Columbia an administrative tribunal with the power completely to review action of the Commission for the purpose of entering whatever judgment it thinks the Commission should have entered; or whether by that section the Court of Appeals acts only as a judicial body with power only to correct errors of law, and

"(2)—Whether General Order No. 40 of the Commission, which is its allocation of broadcast channels, was held invalid by the Court of Appeals, and, if so, whether the holding was proper."

# First Commercial Televisor

One of the outstanding features of the Chicago Radio Show was the first commercial home televisor, demonstrated at the De-Forest Radio Company's booth. This device was an actual production model of the Jenkins Television Corporation and represented the type of equipment which the corporation again said will be available to the public soon.

The Jenkins televisor is in a wooden cabinet measuring about 18 by 18 by 24 inches. The front panel contains a recessed opening or shadow-box, through which the pictures can be viewed. A magnifying lens in the shadow-box enlarges the radio pictures so that as many as eight persons may view them at one time. Directly below the shadow-box opening is a metal panel with two toggle switches, one to control the "loudspeaker" and "picture" functions, and the other to start, accelerate and stop the motor.

Underwood & Underwood

DR. C. FRANCIS JENKINS SEATED BEFORE A COMMERCIAL MODEL TELEVISOR AS PUBLICLY EXHIBITED AT THE RECENT CHICAGO RADIO SHOW. THIS DEVICE IS IN PRODUCTION, STATES THE MANUFACTURER, AND IS READY FOR IMMEDIATE HOME USE.

The Jenkins televisor must be employed in combination with a short-wave radio receiver to tune in the television signals, and a suitable amplifier to amplify the signals without introducing distortion.

The device is commercial and intended for immediate use in the average household.

The frequency band used in television is 100 kilocycles wide and the radio frequency tuner must receive all frequencies in this band with equal strength if the image is to be distinct.

# WTAM on 50 kw By Board Permit

Washington.

A license to employ the maximum broadcasting power of 50,000 watts was granted WTAM, of Cleveland, by the Federal Radio Commission.

The station, operating on 1,070 kc. on a cleared channel basis during evening hours, has been using 3,500 watts of power. A construction permit to build a 50,000 watt transmitter was granted the station in April.

Under the license granted, the station is authorized to use 25,000 watts on a regular basis and 25,000 watts experimentally, pursuant to the Commission regulation establishing the maximum permanent allocation of power at 25,000 watts.

WTAM, operated by WTAM & WEAR, Inc., also was authorized to set up its old transmitting equipment for auxiliary use.

**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.**

## Literature Wanted

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

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

**Name** .....

**Address** .....

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

**State** .....

Frank Willenborg, 1020 W. Liberty Street, Cincinnati, Ohio.

Robert Gabriel, 631 Trenton Avenue, Price Hill, Cincinnati, Ohio.

Fred C. Nolte, 16 Lincoln Avenue, Mt. Healthy, Ohio.

Paul L. Haaf, 8435 Burns Avenue, Hartwell, Ohio.

A. D. McCallum, Hamilton, Ohio.

E. Taylor, Upper Monteve, Nelson, New Zealand.

Edwin Growell, 2706 Guadalupe Street, Austin, Texas.

# Seven Stations Adopt Ad. Code

Standards to govern broadcast advertising so that objectionable practices will be eliminated and radio as an advertising medium "will increasingly enjoy and deserve the confidence of the public," have been adopted by seven broadcasting stations in New England.

The stations are WBZA, WEEI, WNAC, and WSSH, Boston, WHDH, Gloucester, and WLEX, Lexington. The Better Business Bureau of Boston cooperated in the foundation of the standards.

## NEW CORPORATIONS

Elsmere Radio and Hardware Corp.—Atty. J. J. Guadagno, Jr., 1,560 Broadway, New York, N. Y.

Ward Radio Shops—Atty. A. Leichter, 7 East 44th St., New York, N. Y.

Unity Radio Stores—Attys. Rothstein & Rothstein, 225 Broadway, New York, N. Y.

Gibraltar Radio Supply Co.—Atty. L. Lewin, 886 Quincy St., Brooklyn, N. Y.

Freshman Radio Corp.—Atty. D. B. Williams, 1,440 Broadway, New York, N. Y.

Schwartz Radio Corp.—Attys. Dreschsler, Orenstein & Legg. 225 5th Ave., New York, N. Y.

Wolkmer Radio Products Corp., New York—Corporation Trust Co. of America, Wilmington, Del.

Brooklyn Radio Stores Corp., Wilmington, Del. —Corporation Trust Company of America.

R-F Radio Shop—Attys. Becker & Fink, 15 Park Row, New York, N. Y.

# Multi-Tap Voltage Divider

*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 the total number of useful lugs is fourteen. The resistances stated are those between respective lugs and are to be added together to constitute 13,850 ohms total.

## *Rated at 50 Watts*

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 and 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.

## *Same one for Single or Push-Pull*

The Multi-Tap Voltage Divider is useful in all circuits, including push-pull and single-sided one, where the current rating of 125 milliamperes is not seriously exceeded and the maximum voltage is not more than 300 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, 3, 1, and 0.5. By suitable connection of grid returns the lower voltages may be used for negative bias or even for positive voltage on the plates. Even 0.5 volt is provided for negative bias of a space charge detector (224 tube) in resistance-coupled audio.

## *No Calculation Necessary*

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.

You do not need to calculate the voltage from current and resistance values, but can measure the voltage with a high resistance voltmeter, so you will know just which tap to use, or simply use the taps that give best results as determined by ear test.

Order Cat. MTVD at $3.95.

---

Polo Engineering Laboratories,
143 W. 45th St., N. Y. City.

Gentlemen: Enclosed please find $3.95 for which please send at once one Multi-Tap Voltage Divider, 13,850 ohms, 14 taps, mounted on brackets, 50 watt rating; Cat. MTVD.

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


Latest Model National Velvet-B, Type 3680, 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.)

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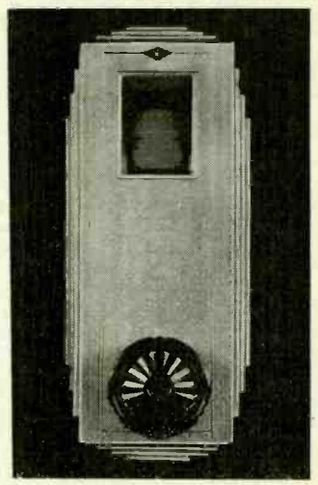
**MODERNISTIC PROJECTION DIAL WITH RAINBOW FEATURE**



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.

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# ALL PARTS FOR MIDGET 3

Circuit described by Herbert E. Hayden, all parts, exactly as specified, including socketed drilled panel and cabinet.....$10.71
Two 240, one 112A Kelly Tubes.....$3.45 extra

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# Surpassing Results from HB Compact!

## *Screen Grid Circuit for AC or Batt ery Operation Is a Knockout!*

THE screen grid tubes, both AC and battery types, 222 and 224, promised much. They could be used to provide actual amplification of 150 per stage, as compared with 8 per stage for a general purpose tube. If only the screen grid tube could be used at full practical amplification! Then a few tubes would do the work of many! At radio frequencies it was found that tuning the plate circuit put the mule kick into the set. But the whole wave band could not be tuned in. So Herman Bernard invented a coil—the Bernard dynamic tuner—that accomplished the trick. Full amplification plus full wave-band coverage! That's why his HB Compacts, only four tubes (plus a 280 in the AC model) perform like eight-tube sets! The sensitivity is incredibly high.

**Sensitivity**

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

**Realism**

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

**Economy**

And this amazingly sensitive, most thrilling and utterly economical circuit gives you all the selectivity you will require, unless you live close to a powerful broadcasting station. So you get a super-abundance of results, in an unusual but thoroughly tried and tested, positively proven circuit!

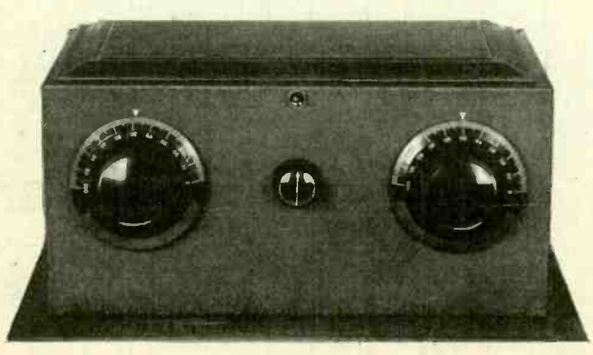
**Selectivity**

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

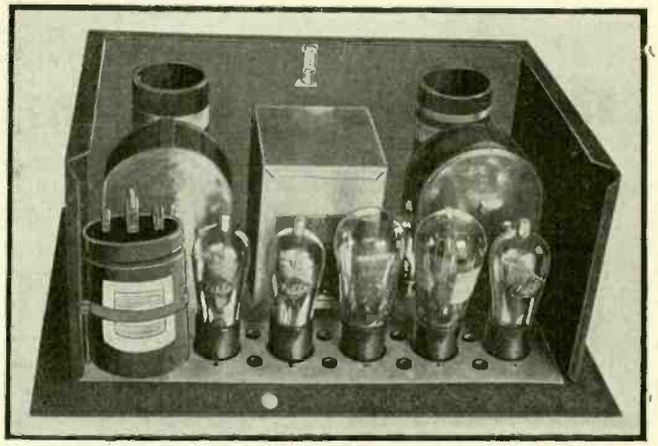
HB Compact, AC model, uses a 224 RF amplifier, a 224 space charge power detector, a 224 first audio and a 245 output tube, with 280 rectifier. Except for the space charge feature, not suitable in the battery model, and the larger power tube, not economically powered by batteries, the two models are fundamentally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

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

Order what individual parts you want.



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



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

## Component Parts for HB Compacts

### AC MODEL

| | |
|---|---|
| L1L2L3—Bernard Antenna Tuner BT5A | $2.50 |
| L4L5L6—Bernard Interstage Tuner BT5B | 2.50 |
| CT—One 80 mmfd. equalizer | .35 |
| C1, C2—Two .0005 Dustproof @ $2.50 | 5.00 |
| C, C3, C4, C5—Four .01 mfd. @ .35 | 1.40 |
| C7—One 1 mfd. 500V AC | .85 |
| C8, C9, C10, C11—Mershon Q2-8, 2-18B | 5.75 |
| C12, C13—Two 1 mfd. 200 V. DC @ .50 | 1.00 |
| R—One 25,000 ohm wire-wound pot. | 1.50 |
| R1, R2, R3, R4—.5, 1.0, .05 5.0 meg. @ .35 | 1.40 |
| T1—Polo 245 Power Supply Cat. P245PS | 10.00 |
| 2500, 4400, 774, 50, 8 (20 watt) Voltage Divider | 1.75 |
| PL—Bracket and 2.5 v. AC lamp | .70 |
| OC, C6—Output choke, 2 mfd. 500 v. AC cond. | 3.85 |
| SP—, SP+—Two binding posts @ .10 | .20 |
| Three National grid clips @ .06 | .18 |
| F—One 1 amp. cart. fuse with base | .50 |
| Aluminum socketed subpanel, 9½x14¼", 8 brackets | 3.25 |
| Steel cabinet, crackled brown finish, 7x15x9½ | 4.00 |
| 3 Insulating washers @ .03 | .09 |
| Two full-vision dials with pointers @ 75c | 1.50 |
| One AC pendant switch, double opening | .40 |
| One 12 ft. length AC cable | .72 |
| Two rolls Corwico braidite @ .35 | .70 |
| Two flexible couplers (links) @ .35 | .70 |
| | $50.79 |

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

[National Company's coils, soon to be released Cat. BTS5, BTP5 @ $5 each, may be used instead of BT5A and BT5B listed above @ $2.50 each. National Velvet Vernier full-vision dials, instead of plain dials listed above, counterclockwise, @ $1.75 each.]

### BATTERY MODEL

| | |
|---|---|
| L1L2L3—One Bernard Tuner for antenna circuit, for .0005 mfd. tuning (BT5A of Screen Grid Coil Co.) | $2.50 |
| L4L5L6—One Bernard Tuner for screen grid interstage coupling, for .0005 mfd. tuning (BT5B of Screen Grid Coil Co.) | 2.50 |
| C1, C2—Two .0005 mfd. Dustproof tuning condensers @ $2.50 | 5.00 |
| CT—One Hammarlund 80 mmfd. equalizing condenser | .35 |
| C3, C4, C5—Three .01 mfd. mica fixed condensers @ .35 | 1.05 |
| R1—One .25 meg. metallized resistors | .30 |
| R2, R4—Two 5.0 meg. metallized resistors @ .30 | .60 |
| R3—One .075 meg. metallized resistor | .40 |
| R5, SW—One 75-ohm rheostat with switch attached | .80 |
| R6—Two resistors, one 1.3 ohms, the other 6.5 ohms (both) | .45 |
| Ant., Gnd., Sp.—, Sp.+. Four binding posts (all) | .40 |
| One drilled steel cabinet 7" high, 9½" front to back, 15" wide | 4.00 |
| Two dials with pointers (both) | 1.50 |
| One pilot light bracket with 6-volt DC lamp | .70 |
| One 9½x14¼" satin finish aluminum subpanel with sockets affixed, and supplied with insulated bushings, supporting brackets, and resistor clips | 2.00 |
| Two insulated links (flexible couplers) (both) | .70 |
| One 7-lead battery cable | .50 |
| | $23.75 |

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

[National Coils for the battery model, vernier condensers, see note under AC Model.]

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

[The AC Model is now being described. See pages 12 and 13 of this issue.]

*Please Use This Coupon*

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Enclosed please find $. ..... for which please send me component parts for the HB Compact as checked off above.

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# Component Parts for PUSH-PULL AC DIAMOND

***Check off parts you want. Each part is sold separately.***

| | |
|---|---|
| ☐ L1, L2—RF3, antenna coil | $ .80 |
| ☐ L3, L4, L5—SGT3, screen grid, 3-circuit coil | 1.30 |
| ☐ C1, C2—two .00035 mfd., extended shafts; brackets | 2.06 |
| ☐ CT—80 mmfd. equalizer | .35 |
| ☐ C3—Grid condenser with clips | .21 |
| ☐ C4, C5—Two .01 mfd. | .70 |
| ☐ R1—One 0.1 meg. | .30 |
| ☐ R2, R4—Two 5.0 meg. | .60 |
| ☐ R3—Potentiometer, 25,000 ohms or more; knob | 1.50 |
| ☐ T1—Push-pull input transformer | 3.41 |
| ☐ PPOC—Special push-pull output choke | 3.41 |
| ☐ Ant., gnd., Sp. (—), Sp. (+)—4 posts | .40 |
| ☐ Polo PFPS with double choke | 10.91 |
| ☐ C5—Filter condenser 2 mfd., 550 v. AC | 2.94 |
| ☐ C7, C8, C9, C10—Mershon Q 2-8, 2-18, bracket | 5.75 |
| ☐ C10, C11, C12—Three 1 mfd. 200 v. DC | 1.50 |
| ☐ R5, R6, R7, R8, R9, R10—Voltage divider, 13,850 ohms, 50 watts, 14 taps, bracket | 3.95 |
| ☐ F—1 amp. fuse with base | .50 |
| ☐ SW—Through pendant switch AC | .40 |
| ☐ CO—One convenience outlet | .20 |
| ☐ CD—12 ft. AC cable, male plug | .70 |
| ☐ Socketed, drilled metal subpanel | 3.80 |
| ☐ National type HC new modernistic rainbow dial, pilot bracket, 2.5 v. AC lamp | 3.13 |
| ☐ 7x21" drilled front panel | 1.95 |
| ☐ Two flexible links, insulating ¼" shaft | .76 |
| ☐ Knob for tickler | .18 |
| ☐ Screen grid clip | .06 |
| ☐ All parts | $49.77 |
| ☐ Kelly tubes, one 224, one 228, one 227, one 280, two 245 | $13.25 |

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Enclosed please find $..... for which please express at once the parts for the Push-Pull AC Diamond of the Air as checked off above.

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# 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 |

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# Aluminum Subpanel

The best appearance of the New Diamond of the Air results from using the official aluminum subpanel, 10 x 20 inches, with the four sockets built in, and with self-bracketing front. Hardware and insulating washers supplied with each sub-panel. The aluminum sub-panel is exactly the same as the one used in the laboratory models of the battery operated and the AC Screen Grid Diamonds. Holes are drilled for mounting parts, but as this aluminum drills like bakelite you can drill any holes you want.

# Parts for Shielded SG Tuner

*(As described by James H. Carroll)*

| | |
|---|---|
| ☐ L1L2L3—One Bernard Tuner for .00035 mfd.; Cat. BT5A (antenna coil) | $ 2.55 |
| ☐ L4L5L6—One Bernard Tuner for .00035 mfd.; Cat. BT5B (interstage coil) | 2.55 |
| ☐ C1, C2—Two .00035 mfd. Tuning Condensers with shafts extending front and rear | 1.96 |
| ☐ CT—One 80 mfd. equalizing Condenser | .35 |
| ☐ C3, C4—Two .01 mfd. Fixed Condensers | .70 |
| ☐ C5—One .00025 mfd. Grid Condenser, with clips | .21 |
| ☐ R1—One 75-ohm Rheostat, with switch (SW) built in | .80 |
| ☐ R2—One 6.5 ohm Fixed Filament Resistor | .25 |
| ☐ R3—One 5.0 meg. Lynch Metallized Grid Leak | .30 |
| ☐ R4—One 40-ohm Fixed Filament Resistor | .20 |
| Seven Binding Posts | .70 |
| ☐ Two Shields, as described, with sockets | 5.00 |
| ☐ Two Coupling Links | .70 |
| ☐ One National Modernistic Drum Dial with rainbow feature and 5-volt or 6-volt lamp and bracket | 3.13 |
| ☐ One Dummy Knob and Shaft | .30 |
| ☐ Drilled Front Panel | 1.85 |
| ☐ All parts | $21.63 |

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**DC FILAMENT CIRCUITS:** Calculation of resistances.
**AC FILAMENT CIRCUITS:** Transformers, wattage rating, distribution of output voltages, voltage reducing resistances, line voltage reduction.
**CAPACITIES:** Calculation of capacity, dielectric constant, condensers in parallel, condensers in series, voltage of condensers in parallel, in series, utility of parallel condensers, series condensers.
**VOLTAGE DIVIDER SYSTEMS FOR B ELIMINATORS:** Calculation of voltage divider resistances, types of voltage dividers, selection of resistances, wattage rating of resistances.
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| ☐ | 0-50 Milliamperes D.C. | No. 350 |
| ☐ | 0-100 Milliamperes D.C. | No. 390 |
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## Equip Yourself Now With Necessary Meters!

To do your radio work properly you need meters. Here is your opportunity to get them at no extra cost. See the list of nine meters at left. Heretofore we have offered the choice of any one of these meters free with an 8-weeks subscription for RADIO WORLD, at $1, the regular price for such subscription. Now we extend this offer. For the first time you are permitted to obtain any one or more or all of these meters free, by sending in $1 for 8-week's 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. 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**

# FLECHTHEIM

## 1,000 v. DC
## 500 v. AC(rms)
## *Filter Condensers at Professional Discounts*


*Filter Condenser, Actual Size*

## *Result of Years of Experimenting*

UNBELIEVABLY compact, light in weight, made of the highest grade materials, these condensers are the result of many years of patient and constant research. The marvelous achievement is exemplified and substantiated by independent tests.

Types HV can be used to replace all types of condensers having a continuous working voltage up to 1,000 volts DC and will give utmost satisfaction and dependability for a rectified AC voltage up to and including 550 volts rms. Hence, it is just the filter condenser you want for 171A, 245 or 210 power packs, single or push-pull.

## *Twelve Telling Points*

(1) Rated conservatively at voltages up to 1,000 volts DC (500 rms. AC.)
(2) Tested and re-tested at 1,500 volts DC.
(3) Breakdown voltage of 2,500 volts DC.
(4) Breakdown voltage, foil to case, 5,000 volts AC.
(5) Power factor (voltage loss) less than 1%.
(6) Resistance over 600 megohms per mfd.
(7) Negligible dielectric losses.
(8) Capacity is non-inductive and is accurate to within 5% of rating.
(9) Remarkably compact size; all capacities same height.
(10) Great saving in weight.
(11) Highly perfected terminal connectors and insulators.
(12) Proved by fatigue tests to have longer life.

### THREE-IN-ONE

Type HV244 is a high-grade capacity bank to operate at voltages up to and including 750 rms AC. Just the unit to use for a B supply for the 250 tubes, single or push-pull. Consists of a bank of condensers tapped 0-2-4-4 mfd. The 2 mfd. section is made to withstand the terrific punishment of voltage surges, and sudden transient line voltages.

**ACOUSTICAL ENGINEERING ASSOCIATES**
143 West 45th Street, New York, N. Y.

Please send at once the Flechtheim condensers specified below. Quantity desired is marked in square.

☐ Send C.O.D. (check off).
☐ Remittance enclosed. (check off).

| | Type | Capacity Mfd. | | Size | List Price | Net Price |
|---|---|---|---|---|---|---|
| ☐ | HV 5 | .05 | 2 | x1¼x ⅝ | $1.75 | $1.03 |
| ☐ | HV 10 | .10 | 2 | x1¼x ⅝ | 2.00 | 1.18 |
| ☐ | HV 25 | .25 | 2 | x1⅛x ⅝ | 2.25 | 1.33 |
| ☐ | HV 50 | .50 | 2 | x1¼x ⅝ | 2.50 | 1.47 |
| ☐ | HV 100 | 1 | 2 | x1⅛x ⅝ | 3.00 | 1.76 |
| ☐ | HV 200 | 2 | 2 | x1⅛x1⅛ | 5.00 | 2.94 |
| ☐ | HV 400 | 4 | 2 | x1⅛x2⅜ | 9.00 | 5.29 |
| ☐ | HV 244 | 0-2-4-4 | 3 3/16 | x4 x2¾ | 25.00 | |

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

# Component Parts for 245 Push-Pull Power Amplifier

(as described and specified by Herman Bernard)
Check off which parts you desire. All parts sold separately

☐ C1—One .00025 mfd. mica condenser..... .21
☐ C2—One .01 mfd. mica fixed condenser..... .35
☐ C3—One Flechtheim 1 mfd. filter condenser, 1,000 volts DC continuous working voltage rating, 550 volts AC (root mean square) continuous voltage rating ..... 1.76
☐ C4, C5, C6, C7—Four Mershon condensers in one copper casing, two of 8 mfd. and two of 18 mfd., with low bracket. Cat. Q2-8, 2-18B..... 5.75
☐ C8, C9, C10, C11, C12, C13, C14, C15, C16—Nine 1 mfd. bypass condensers, 200 volts DC continuous working voltage rating..... 4.50
☐ T1—One Polo Filament-Plate Supply transformer: 110 volt 50-60 cycle primary, 724 volt secondary center-tapped, 5 volt 2 amp. secondary center-tapped; 2.5 volt 3 ampere secondary center-tapped, and 2.5 volt 12 ampere secondary center-tapped. Cat. PFPS ..... 7.50
☐ FC, PPOC—Two center-tapped chokes for high current one used as filter choke, other as push-pull output choke ..... 6.82
☐ PPIT—One push-pull input transformer..... 3.41
☐ SW—One AC pendant through-switch, with 12-ft. AC cable and male plug..... 1.10
☐ F—One 2 ampere fuse, with holder..... .50
☐ CO—One convenience outlet (for dynamic speaker AC cable) ..... .50
☐ PJ, PJS—Phonograph Jack with automatic switch and plug ..... 1.42
☐ R1—One resistor, 0.1 meg..... .30
☐ R2—One grid leak, 5.0 meg..... .30
☐ R3—One multi-tap voltage divider, 50 watt rating; fourteen taps affording thirteen different voltages; 13,850 ohms..... 3.95
☐ Two resistor mountings.
☐ Roll of heavy insulated hookup wire for power work.
☐ Fifteen binding posts..... 1.50
☐ One 15x9 ⅛" cadmium plated steel subpanel, with self-bracketing flanges, one five-prong and three four-prong sockets built in; sockets marked to identify tubes that go in them; subpanel drilled and insulated where necessary; flat insulating washers; hardware..... 4.00

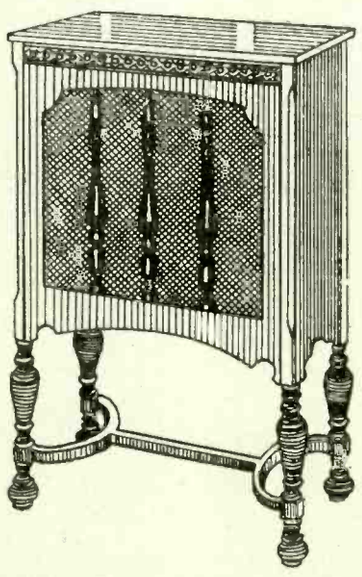
☐ All parts ..... $43.57
One 280, one 227, two 245 Kelly tubes..... 7.75
Ferranti AF5CC push-pull input instead of above input transformer ..... 9.60

[Note: For 40 cycles 110v. order Polo P40 FPS at $10; for 25 cycles 110v. order Polo P25 FPS at $11.]

**Guaranty Radio Goods Co.**
**143 West 45th Street,**
Just East of Broadway
NEW YORK 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**

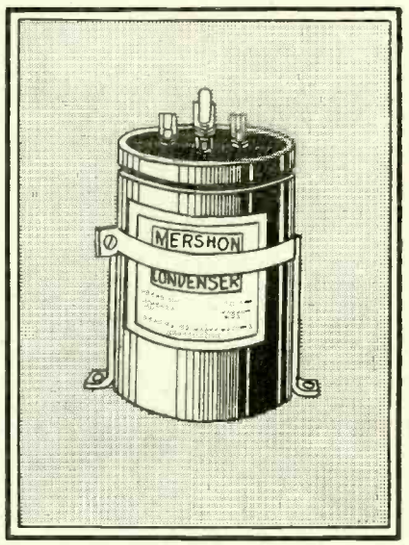


The speaker cabinet is walnut finish, 33" high, 24½". wide,. 17½". deep,. with. carved. legs Golden cloth grille covers front opening. Built inside is No. 595 molded wood horn with baffle and No. 203 driving motor unit that stands 250 volts without filtration. Horn and motor removable. Table alone is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

**Acoustical Engineering Associates**
143 WEST 45th STREET NEW YORK CITY

# MERSHON

## *Electrolytic Condensers* at Professional Discounts




Mershon Electrolytic Condensers for Filtering Circuits of B supplies, rated at 400 volts D.C., or for by-pass condensers, give enormous capacities in compact form. We offer, at attractive discount, genuine Mershons made by the Amrad Corporation.

### Cat. No. Q 8 — $4.67 NET

Consists of four Condensers of 8 mfd. each, all in one small copper case (less brackets), List Price, $7.95.....

[Cat. Q 8B same as above, but includes mounting bracket. No brackets sold separately..... $4.87]

### Cat. Q 2-8, 2-18 — $5.55 NET

Consists of four Condensers, two of 8 mfd. each, and two of 18 mfd. each, all in one small copper case (less brackets), List Price, $9.45.....

[Cat. Q 2-8, 2-18B, same as above, but includes mounting bracket. No brackets sold separately..... $5.75]

Mershon electrolytic condensers are instantly self-healing. They will break down only under an applied voltage in excess of 415 volts D.C. (commercial rating; 400 volts D.C.) but even if they do break down because overvoltaged, no damage to them will result, unless the amount of leakage current and consequent heating of the electrodes and solution cause the solution to boil. 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 bypassing, from intermediate B + to ground or C + to C —, for enabling a good audio amplifier to deliver true reproduction of low notes. Suitably large capacities also stop motorboating.

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

How to connect: The copper case (the cathode) always is connected to negative. The lugs at top (anodes) are connected to positive. Where there are two different capacities the SMALLER capacity is closer to the copper case.

Mershons of equal capacity may be connected in series for doubling the voltage rating, or in parallel (any combination) to increase the capacity to the sum of the individual capacities, the rating remaining the same, 400 volts.

When series connection is used, the copper case of one condenser the anode of which goes to the high voltage should be connected to a lug or to lugs of the other condenser. The copper case of the second condenser goes to the negative.

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.

### OTHER CAPACITIES OF MERSHONS

["S" stands for single condenser, "D" for double, "T" for triple and "Q" for quadruple. First figure between hyphens denotes quantity, second capacity per anode.]

Cat. No. S-8, list price $4.10; net, $2.41
Cat. No. S-9, list price $4.25; net, $2.49
Cat. No. S-18, list price $4.80; net, $2.82
Cat. No. S-40, list price $5.40; net, $3.17
Cat. No. S-72, list price $10.00; net, $5.88
Cat. No. D-8, list price $5.25; net, $3.08
Cat. No. D-9, list price $5.75; net, $3.38
Cat. No. D-18, list price, $6.15; net, $3.62
Cat. No. T-8 list price $6.30; net, $3.70
Cat. No. T-9, list price $6.45; net, $3.79
Cat. No. T 1-8, 2-18, list price $7.90; net, $4.65
Cat. No. 1-18, 2-9, list price $7.50; net, $4.41

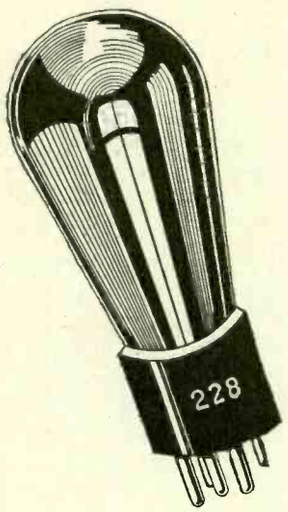
[Note: Add 20c to above prices if bracket is desired. No brackets sold separately.]

*No. C.O.D. orders on Mershon Condensers*

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

# *New* High Mu AC Tube

## 228 Provides Higher Amplification and is an Excellent Power Detector




228 AC High Mu Tube, with an amplification factor of 45 is an exclusive contribution to tube science by Kelly laboratories.

WHEN signals are weak in an up-to-date AC receiver using 227 tube as detector or audio amplifier, replace the 227 with the new 228 high mu AC tube and be amazed at the difference in volume.

The up-to-date receivers have high impedance primary in the first audio transformer, or have a resistor in the plate circuit, so the high mu tube is a boon indeed.

As a detector the 228 can be used with leak and condenser, with grid returned to cathode, or as a negative bias (power) detector. See table, lower left corner.

Since the 228 has the same base, same prongs and same heater voltage as the 227, it can be used for replacement and improvement, and without requiring any wiring changes or any other changes. Simply insert the 228 in the socket from which the 227 is removed.

**228**
**$2.50**

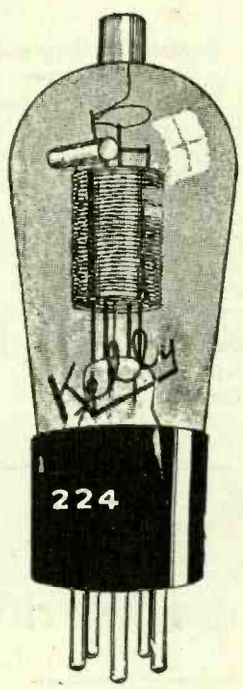
### CHARACTERISTICS OF THE 228

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.

***The plate current under normal operation is less than one milliampere. Hence the 228 tube imposes minimum load on the B supply.***

***The 228 is not suitable as a radio frequency amplier.***

## 224 at $3.00—245 at $2.25—227 at $1.50—226 at 95c




The screen grid tubes have proved not only their capability but their dependability, and in AC circuits the 224 AC screen grid tube is popularly used as amplifier and detector, with the 245 as output, singly or in push-pull. Safe and satisfactory, Kelly 224 tubes are made with the same expertness and precision that characterizes the entire line of Kelly tubes. Our products are used by laboratories, technicians, experimenters and general consumers because of proven merit.

The Kelly 224 screen grid tube is not only excellent as a radio frequency amplifier but as a detector, especially applicable as a space charge detector.

A suitable high impedance load should always be in the plate circuit of any screen gride tube. For RF a large untuned primary, or a tuned primary, for detection and AF a resistor of 50,000 ohms or higher, usually considerably higher, or a high impedance inductance. You will find Kelly 224 fully meets your most exacting requirements.

The 224 and 227 are 5-prong (UY) tubes, the 245 and 226 4-prong (UX) tubes.

## Battery Type Screen Grid 222 at $3.50

The battery operation the 222 screen grid tube is an important contribution, because enabling such high amplification that battery circuits are put on a par with AC circuits in performance. The 222 is the most popular battery-operated tube for up-to-date circuits and the Kelly model is made to produce clear reception and have exceptionally long life.

## 5-Day Money Back Guarantee!

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, we are not even satisfied, and will promptly refund your money on the foregoing 5-day basis.

If at any time after the five days expire, after receipt of tubes by you, there should develop any adverse condition for which you deem the tube at fault, you may communicate directly with us, and we will give the matter prompt attention. Our aim is to render a real service and through such efforts have we built up our volume of business.

Kelly Tube Company, 143 West 45th St., N. Y. City

Enclosed please find $..... for which ship at once 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
- ☐ 171A AC power tube @.....$0.95
- ☐ 210 AC power tube @.....$4.50
- ☐ 250 AC power tube @.....$6.00
- ☐ 280 AC rectifier @.....$1.75
- ☐ 281 AC rectifier @.....$3.50
- ☐ 222 battery screen grid.....$3.50
- ☐ 240 battery high mu.....$1.25
- ☐ 112A battery power tube.....$0.95
- ☐ 171A battery 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

ALL PRICES QUOTED ARE SELLING PRICES AND ARE NET

Name .....

Address .....

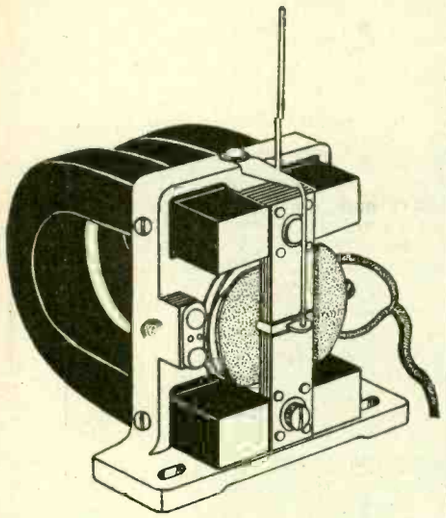
City ..... State.....

☐ Put cross here if C.O.D. shipment is desired.

### Types of Tubes and Their Voltages

| Tube | Fil. Volt | Amplifier Plate Volts | Amplifier Neg. Bias | Detector Plate Volts | Detector Neg. Bias | Remarks |
|---|---|---|---|---|---|---|
| 228 | 2.5 AC | 180 | 2.5 | 180 | 6 | Heater type. 5 prongs. |
| 224 | 2.5 AC | 180 | 1.5 | 180 | 6 | Heater type; SG volts. 75 |
| 245 | 2.5 AC | 250 | 50.0 | — | — | — |
| 226 | 1.5 AC | 135 | 9.0 | — | — | — |
| 227 | 2.5 AC | 180 | 9.5 | 180 | 18-25 | Heater type |
| 171A | 5ACorDC | 180 | 40.5 | — | — | — |
| 210 | 7.5 AC | 350 | 27.0 | — | — | — |
| 250 | 7.5 AC | 450 | 84.0 | — | — | — |
| 280 | 5.0 AC | 350AC | — | — | — | Full-wave rectifier |
| 281 | 7.5 AC | 700AC | — | — | — | Half-wave rectifier |
| 222 | 3.3 DC | 135 | 1.5 | 135-180 | 4-7 | SG volts, 45 |
| 240 | 5.0 DC | 135-180 | 3-4.5 | 135 | 1.5-3 | — |
| 112A | 5.0 DC | 135 | 9.0 | 135 | Leak-cond. | — |
| UX199 | 3.3 DC | 90 | 4.0 | 90 | Leak-cond. | — |

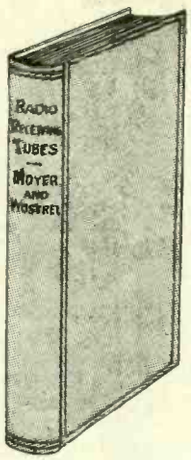
## New Junior Model
# POLO UNIT $4



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.

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

# NEWEST BOOK ON VACUUM TUBES




"RADIO RECEIVING TUBES," by James A. Moyer and John F. Wostrel, first edition just off the press. No radio service man, experimenter or student of radio should be without this authoritative book on the principles and applications of vacuum tubes. It answers all your questions relating to receiving, amplifying and rectifying tubes. It 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.

**Price $2.50**

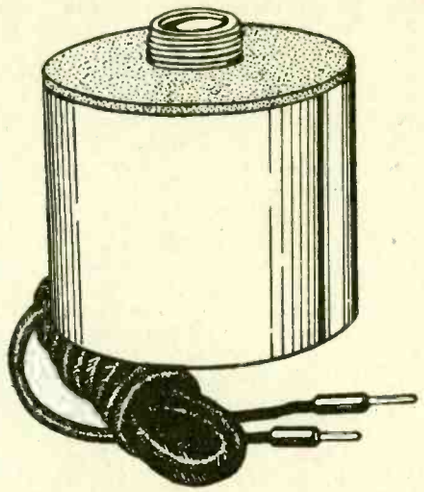
**RADIO WORLD**
145 West 45th Street, New York City
(Just East of Broadway)

# 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

# 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.

The 225 unit and 596 horn built into a ply-walnut table 33" high, 24½" wide, 17½" front to back. Shipping weight, 50 lbs. Cat. No. 597 . . @ $20.00

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
☐ Cat. No. 597 @ $20.00

Name .....

Address .....

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

FIVE-DAY MONEY-BACK GUARANTEE

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**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.**

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

# Quick Action Classified Ads

## Radio World's Speedy Medium for Enterprise and Sales

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

**EXPERIENCED RETAIL SALESMEN**
DAVEGA DIVISION OF THE ATLAS STORES CORPORATION IS NOW IN NEED OF SEVERAL HIGH-POWERED EXPERIENCED RETAIL RADIO SALESMEN WHO WOULD LIKE TO ASSOCIATE THEMSELVES WITH THE LIVEST RETAIL RADIO SALES ORGANIZATION IN THE UNITED STATES—A COMPANY THAT PERMITS ITS MEN TO EARN IN SALARIES AND COMMISSIONS UNUSUALLY LARGE WEEKLY INCOME, PLUS UNLIMITED OPPORTUNITIES FOR PROMOTION. INTERVIEWS WILL BE TREATED IN CONFIDENCE. SEE ED. LEVY, SALES MANAGER, DAVEGA, INC., 114 EAST 23 STREET, NEW YORK.

**ARTISTS** and Art Students are printing 250 signs or pictures an hour without machinery. Sample and particulars, 10c. Straco, 1014 Mulberry, Springfield, Ohio.

**BARBECUE,** Broil, Grill all meats, fowl, fish with electric table appliance size chafing dish. Chrome finish $20, nickel, $15. Also bakes waffles and cooks like stove. Cleveland Neaco Products, 2012 West 83rd St., Cleveland, O.

**RADIO TROUBLE FINDER**—Explains and describes 102 possible radio ailments. Fully illustrated. Also list of Radio Broadcasting stations. *Our* reduced price 50c for a limited time. Anthony's Book Shop, Box 2711 W. P. Station, Cleveland. O.

**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**

## Import Your Own Goods

German Export Magazine published in English offers numerous bargains in latest articles, novelties and new inventions. Also opportunities for obtaining profitable distributing agencies. Sample copy 60 cents postpaid (none free or on memo). Two monthly copies $1.00. Subscription price $3.00 per year for 12 monthly copies with special privileges.
Square Deal Supply Co., R-246 Fifth Ave., N. Y.

**DYNAMIC SPEAKER**
Build your own with our castings. Set of machined castings, $8.00; not machined, $5.00. Full set blue prints and instructions included. Prices of complete parts on request.
**IMPERIAL RADIO SPEAKER CO.**
1453 East 174th St., Cleveland, Ohio

**TYPE 222 NATIONAL** screen grid tuning unit, never used. $10.00 post-paid. E. D. Miner, Phillips, Wis.

**BRAND NEW CROSLEY** Tip-Top Musicone, $37.50 list, your price, $3.90. Dandy magnetic speaker on walnut pedestal. P. Cohen, Suite 1214, at 143 West 45th Street, N. Y. City.

**AGENTS WANTED**
**CARTER WINDOW WASHER.** Exclusive Distributor wanted. **BIG PROFITS.** Cleans, Dries, Polishes, one operation. Territory closing fast. Act quick. CARTER PRODUCTS, 985½ Front Street, Cleveland, Ohio.

**HAVE AN EXPERT PUT YOUR SPEAKER IN SHAPE!**
If your present speaker, no matter of what kind, is not giving proper results, send it to us, prepaid. We will test it FREE and let you know what's wrong, telling you cost of repairs. Our charges are very reasonable. Six years' experience Loudspeakers and units repaired. Burnt-out coils replaced. Jaynxon Laboratories, 57 Dey Street, New York City.

# Polo 245 Power Supply

## Scientifically Engineered, It Insures Superb Performance

THE Polo 245 Power Supply consists of a filament transformer, a high-voltage (plate) winding and two separate chokes, all built in a single cadmium-plated steel casing, for powering 224, 227, 228 and 245 tubes. The output may be a single 245 or two 245s in push-pull, because the chokes are large enough and strong enough to handle 100 milliamperes, while the power tube filament winding will easily take care of the two 245s. The entire supply is exceedingly compact and will fit in a cabinet that has the usual 7" high front panel. The high-voltage winding is of sufficiently high AC voltage to produce full 300 volts when the maximum direct current through any part of a voltage-dividing resistor is 80 ma. Of the 300 volts 250 are applied to the output tube's plate and 50 to its grid for negative bias.

All windings except the primary (110 volts, 50 to 60 cycles) are center-tapped, including the 5-volt winding for the 280 rectifier tube. The impedance bridge method is used for establishing the electrical center. Taking the positive rectifier voltage from the center of the 5-volt winding, instead of from either side of the filament, is a small extra advantage, but shows an extra stroke of careful workmanship to insure superb performance.

Another interesting point is that the high-current winding for all the 2.5-volt AC tubes to be used in a receiver or amplifier is rated at 12 amperes. This means that six heater type tubes may be worked well within the limits of the winding (total of 10.5 amperes used), while seven tubes may be used with the permissible excess of only .25 ampere over the rating (total 12.25 amperes). Of course the two or three other tubes (280, 245) are additionally supplied, from their individual windings. Hence a total of ten tubes may be worked (including 245 push-pull and 280 rectifier).

This is no mere estimate, but a scientific fact. The wire used on this 12-ampere winding is the equivalent of No. 9. Please read our chief engineer's report herewith.

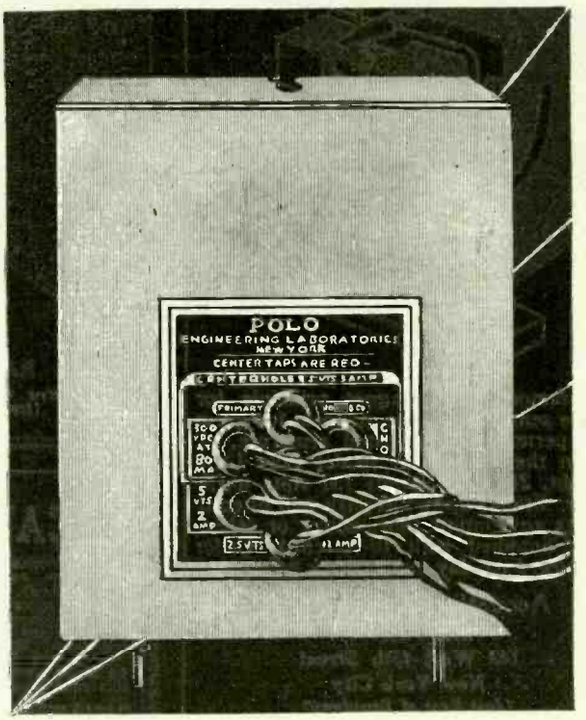
The two chokes are 50 henries each, and each choke is on a saparate core.

The 245 Power Supply weights 16 pounds. The shipping weight is 17 pounds.

For 40-cycle current, 110 volts, a special supply 2" higher, is made. Cat. P245, S40 (Code Cyclone). Price $13.50.

The 245 Power Supply, with chokes, is made also for 25 cycles, 110 volts. Only this particular combination is made for 25 cycles, although the filament-plate supply (less chokes) and the filament supply (less chokes and high-voltage winding) are made for 40 cycles.

For 25 cycles order Cat. No. P245 S 25 4⅝" wide x 5⅛" front to back x 9⅛" high. Shipping weight 25 lbs. (Code Cypress) at.....$14.50




Polo 245 Power Supply, including two chokes built in, size 4⅝" wide x 5⅛" front to back, 6⅛" high. Cat. No. P245 PS 110 volts, 50-60 cycles (code Cyclops).....$10.00

Cat. No. P245, S40, for 40 cycles, 110 volts; size 4⅝" wide x 5⅛" front to back, by 8⅛" high (code Cyclone).....$13.50

# Chief Engineer's Report on Polo 245 Power Supply

*By Walter J. McCord, Chief Engineer*

Every precaution has been taken to produce a 245 power supply of superb performance, and in proof thereof I take pleasure in submitting for close study by engineering minds the specifications followed, with advice to novices.

(1)—Overall dimensions of the casing, 4⅝" wide x 5⅛" front to back x 6⅛" high.

(2)—Filament and plate secondary windings as follows: 724 volts at 100 mils, center tapped at 362; 5 volts at 2 amperes, center tapped; 2.5 volts at 3 amperes, center tapped; 2.5 volts at 12 amperes, center tapped.

(3)—Two 50-henry chokes, DC resistance of each, 420 ohms.

(4)—Primary draw with all secondaries worked at maximum, 88 watts.

(5)—One transformer core with 1" x 1¾" cross-section; window opening 2⅛" x ¾". Two choke cores with ⅞" x 1¾" cross-section; window opening ½" x 1¾"; .014" air gap. The laminations are stamped from high-grade Silicon sheet steel having 1.92 watts loss per pound. The joints in the transformer are all overlapping, holding the magnetic leakage to a minimum.

(6)—Size of wire and resistance of each winding as follows: Primary—No. 24 wire, DC resistance, 5.2 ohms. Plate Sec.—No. 30 wire, DC resistance, 104.5 ohms. 5 v.—No. 18 wire, DC resistance, .102 ohms. 2½ v., 3 a.—No. 18 wire, DC resistance, .051 ohm. 2½ v., 12 a.— .059 x .180 rectangular wire (equals approximately No. 9 wire), DC resistance, .008 ohm.

(7)—Total weight of block 16 lbs.

(8)—Casing is made of sheet steel and is cadmium plated. Four ¾" mounting screws are placed in the bottom, permitting the block to be mounted to the base, in a very small space, as no space is required for mounting flanges.

(9)—Care should be taken in connecting the leads so that none of the secondaries is shorted. A shorted secondary, either a direct short or through a defective condenser, soon will burn out a transformer. Care should be taken also in connecting the primary to the proper current. The primary should be connected to 110 v. 50-60 cycles AC, never to 220 volts, neither should it be operated on a line voltage of 130 or over.

### NO C. O. D. ORDERS.

Polo Engineering Laboratories, 57 Dey St., N. Y. City. Enclosed please find $——, for which ship at once the following:

| | |
|---|---|
| P245 PS (code Cyclops) | $10.00 |
| P245 S40 (code Cyclone) | 13.50 |
| P245 S25 (Code Cypress) | 14.50 |
| PFT (code Cyclist) | 4.25 |
| P40 FT (code Cyanide) | 6.25 |
| PFPS (code Cymbal) | 7.50 |
| P40 FPS (code Cylinder) | 10.00 |

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### FILAMENT-PLATE SUPPLY

The Polo 245 Power Supply, less the two built-in chokes, is available to those desiring to utilize chokes they now have, and who do not find the compactness afforded by the consolidated unit absolutely necessary.

The Filament-Plate Supply has the same voltages on the secondaries, at the same ratings, as does the unit that includes the chokes.

Polo Filament-Plate Supply, consisting of five windings; primary 110 v., 50-60 cycles. Cat. No. PFPS (code Cymbal), $7.50.

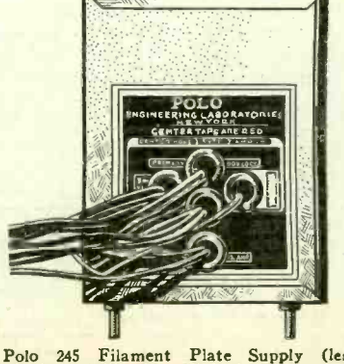
Same as above, except for 40 cycles 110 v. AC. and a little greater height. Cat. P40 FPS (code Cylinder), $10.00.

### FILAMENT SUPPLY

A filament transformer only, in a smaller container than any of the others, but with the same voltage and current ratings, provides 2.5 v. at 3 amperes, 2.5 v. at 12 amperes, 5 v. at 2 amperes.

The Polo Filament Transformer, consisting of four windings as described; primary, 110 v. 50-60 cycles. Cat. No. PFT (code Cyclist) $4.25.

Same as above, except for 40 cycle, 110 v. AC. Cat. P40 FT (code Cyanide). $6.25.

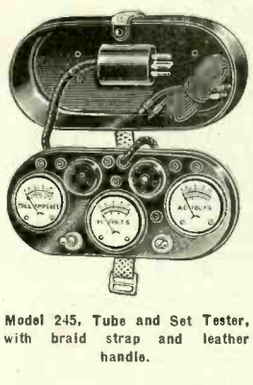



Polo 245 Filament Plate Supply (less chokes) is 4½" wide, 5" high, 4" front to back. Weight 9 lbs.

# The New Readrite TUBE and SET TESTER

Model 245

Tests Screen Grid



Model 245, Tube and Set Tester, with braid strap and leather handle.

What a comforting assurance it is to have a tube-and-set-testing outfit in shooting trouble in a receiver! You want one that is compact, and reliable and that tests the new tubes as well as the old.

These advantages are provided by the new Readrite Model 245, over-all dimensions, 4 x 8½ x 3¼".

This tester is especially designed for the new sets with screen grid and 245 power tubes. The case cover is a unique feature, providing space to carry all cords, cable and adapter. The three double-reading meters are: milliammeter 0-20, 0-100; D.C. voltmeter 0-60, 0-300; A.C. voltmeter 0-10, 0-140.

The plug attached to the cable is connected into the set socket for testing the set and the tubes. The cable leads are connected to the tip jacks, as required, depending on the reading range required of the two voltmeters. Extra cords permit the use of each meter individually.

You can test not only AC and DC tubes, including screen grid, for filament and plate voltage and plate current, but also line voltage, whether AC or DC.

Complete, compact, beautiful to behold, the Model 245 is built in a metal case, with metal slip-on cover, both finished in attractive enamel with Oriental finish. Eye appeal and technical appeal are combined in the Model 245, which is a boon to every service man and experimenter.

We manufacture a complete line of meters, AC and DC, as well as other types of tube and set-testing devices. Send for our catalogue. Mention "Radio World."

**Readrite Meter Works**

[ESTABLISHED 1904]

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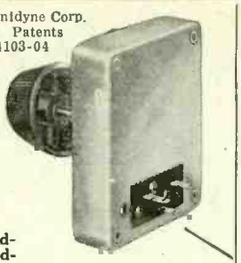

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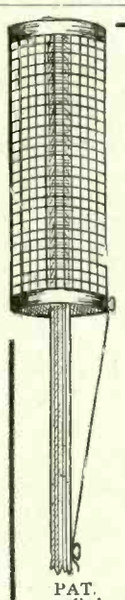

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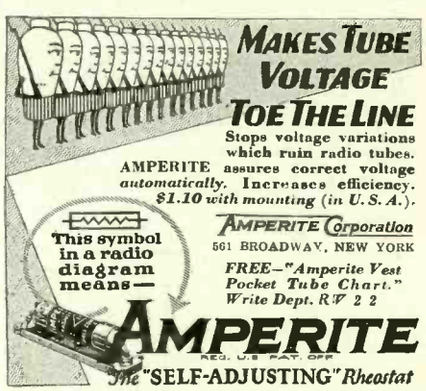


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**R. C. A.**
60, 62, 20, 64, 30, 105, 51, 16, 32, 50, 25 A.C., 28 A.C., 41, Receptor S.P.U., 17, 18, 33.

**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, 36, 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, 392A, 40A, 35PX, 35APX, 352PX, 352APX, 37A, 35P, 35AP, 352P, 352AP, 34P, 342P, 35, 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, 20, 31, 10Z, 11Z, 30Z, 31Z, 16, 17, 32, 16Z, 32Z, 18, special, 192A-192B 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 BA power plant.

**ALL-AMERICAN**
6 tube electric, 8 tube 80, 83, 84, 85, 86, 88, 6 tube 60, 61, 62, 65, 66, 6 and 8 tube A.C. power pack.

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

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

**WORKRITE**
8 tube chassis, 6 tube chassis.

**AMRAD**
70, 7100, 7191 power unit.

**SPARTON**
A.C. 89.

**MISCELLANEOUS**
DeForest F5, D10, D17, Super Zenith Magnavox dial, 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:*

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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.

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