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RADIO WORLD

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The First and Only National Radio Weekly
394th Consecutive Issue—EIGHTH YEAR

Price
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Per Copy

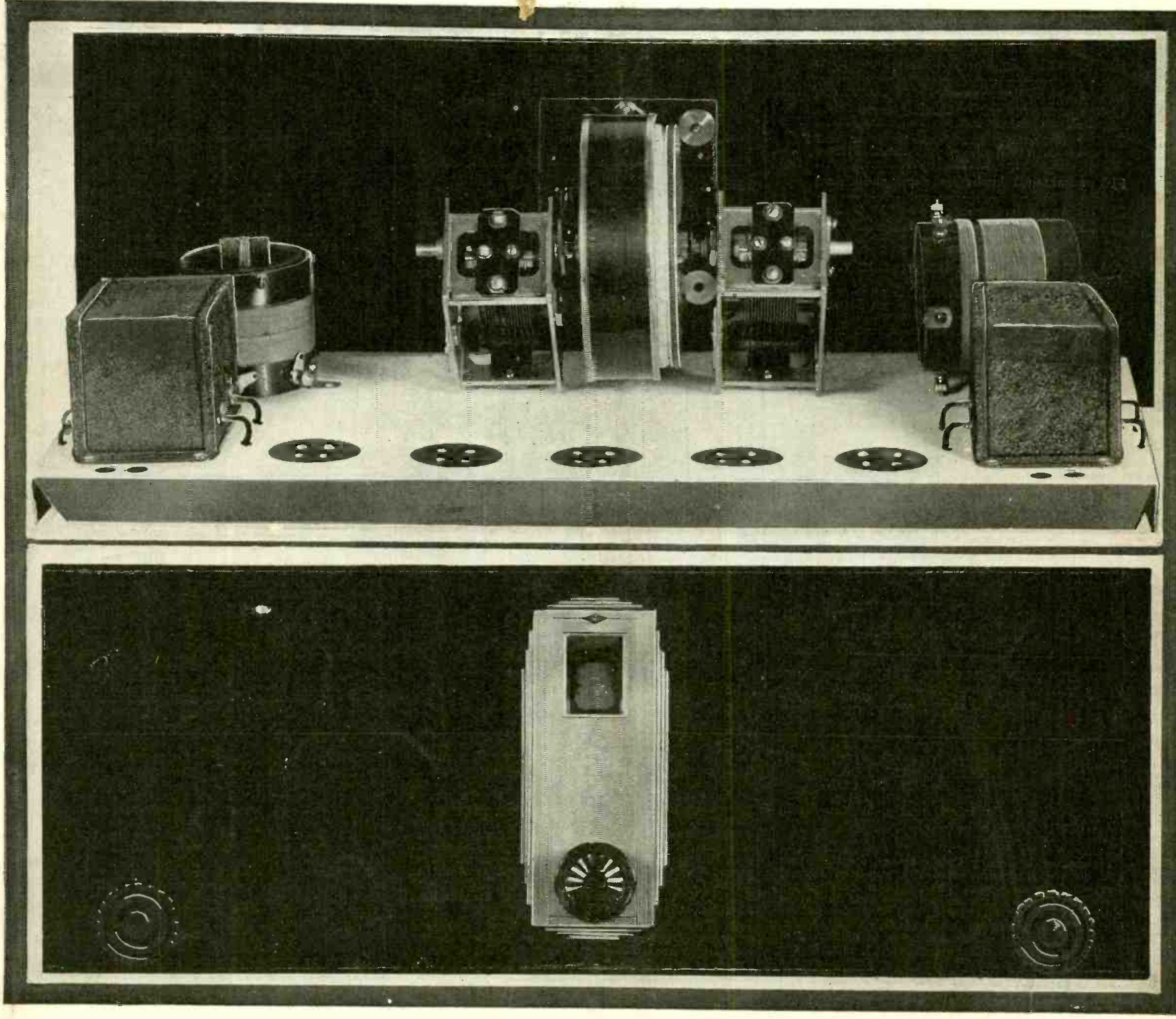
Superheterodyne Explained

How to See What You Hear

How to Use J-245 Tester

"Front End" for Power Pack

NEW PUSH-PULL BATTERY MODEL DIAMOND



Most Up-to-Date Appearance in New Push-Pull Battery Diamond. **See Pages 3, 4 and 5**

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, N. Y.; Herman Bernard, Secretary, 145 West 45th Street, New York, N. Y.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST, 24, 1912.

Of Radio World, published weekly, at New York, N. Y., for October 1, 1929.

State of New York,
County of New York, ss:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Roland Burke Hennessy, who, having been duly sworn according to law, deposes and says that he is the Editor of the Radio World, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business managers are: Publisher, Hennessy Radio Publications Corp., 145 West 45th St., N. Y. C. Editor Roland Burke Hennessy, 145 West 45th St., N. Y. C. Managing Editor Herman Bernard, 145 West 45th St., N. Y. C. Business Manager Herman Bernard, 145 West 45th St., N. Y. C.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of the stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Hennessy, Radio Publications Corp., 145 West 45th St., N. Y. C. Roland Burke Hennessy, 145 West 45th St., N. Y. C. Mrs. Mary J. McArthur, 1940 East 82nd St., Cleveland, O.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent, or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers, during the six months preceding the date shown above is .... weekly. (This information is required from daily publications only.)

ROLAND BURKE HENNESSY

Sworn to and subscribed before me this 30th day of September, 1929.

HARRY GERSTEN.

Notary Public, Kings Co, Clks. No. 136, Reg. No. 247. N. Y. Co. Clks. No 528 Reg. No. 0-364. My commission expires March 30, 1930.

Note.—This statement must be made in duplicate and both copies delivered by the publisher to the postmaster, who shall send one copy to the Third Assistant Postmaster General (Division of Classification), Washington, D. C., and retain the other in the files of the post office. The publisher must publish a copy of this statement in the second issue printed next after its filing.

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EVERY WEEK — EVERY YEAR
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Latest Circuits and News

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THE BATTERY MODEL PUSH-PULL

Diamond of the Air

A SCREEN GRID CIRCUIT COSTING $23.50 TO BUILD

By Herman Bernard

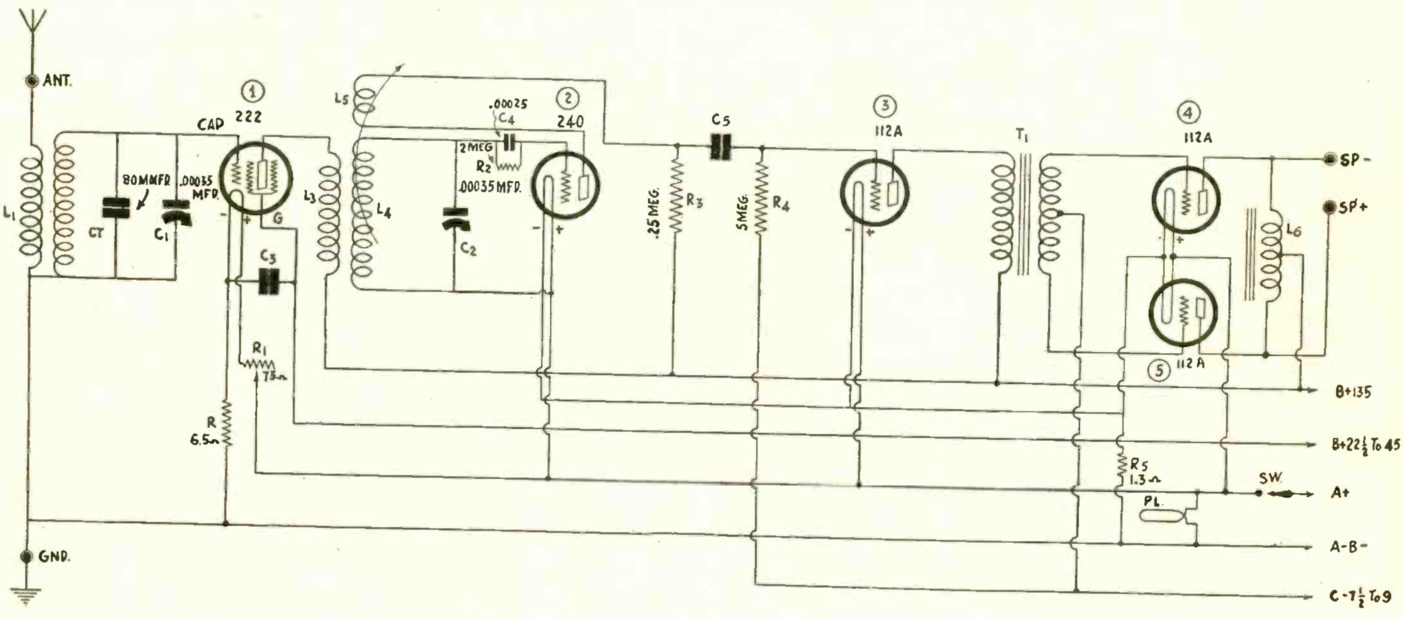


FIG. 1

THE PUSH-PULL DIAMOND FOR BATTERY OPERATION IS SHOWN HEREWITH FOR THE FIRST TIME. THE CIRCUIT IS EXTREMELY DEPENDABLE. PARTS COST $23.50, SO THIS DANDY RECEIVER IS WITHIN THE REACH OF ALL.

[*Although the Diamond of the Air certainly is a familiar circuit to readers of* RADIO WORLD, *this is the first time the circuit has been shown for battery operation with push-pull audio in the last stage. The four tube Diamond for battery operation consists of a single output tube, and blueprints are available, with list of parts. The audio coupling there is by transformers throughout. In the present instance the first stage is resistance coupling and the second is push-pull transformer coupling. There has been published the Push-Pull Diamond for AC, and a blueprint of this is available. We expect soon to publish a pictorial diagram of the present battery model push-pull circuit full size, in the columns of* RADIO WORLD.—*Editor.*]

THIS is the first time that a battery-operated push-pull model Diamond of the Air has been published. The circuit is one that has tested out superbly, and many of those who built the four tube battery model will be glad indeed to greet this one, because of its push-pull feature and because of its extremely beautiful appearance.

What is behind the front panel of a receiver is scarcely seen, and the less seen of it the better, as that means less trouble in the set. As soon as there is cause for complaint there is cause to lift the lid and to tinker. As all who built other Diamonds know well, this is one of the most trouble-proof receivers ever offered to experimenters, and one which in performance is

LIST OF PARTS

L1LE—Antenna coil RF3.
L3L4L5—Three circuit SG Coil, SGT3.
L6—Push-pull output impedance.
T1—Push-pull input transformer.
CE—Equalizing condenser 80mmfw.
CI, C2—Two .00035 mfd. tuning condensers with two brackets.
C3—One .01 mfd. mico condenser.
R—One 6.5 ohm filament resistor.
R1SW—75 ohm switched rheostat.
R2—One 0.25 meg. Lynch resistor.
R3—One 5.0 meg. Lynch resistor.
R4—One 1.3 ohm filament resistor.
Ant., Gnd., Sp (+), Sp. (—)—Four binding posts.
One 7x18" drilled front panel.
One self-bracketing subpanel, 7x17½", sockets affixed; already drilled and cut out; screws, nuts, insulatrs.
Two resistor mocrintings.
One National type H modermistic dial with color wheel, pilot bracket, lamp, hardware.
Two matched knobs.
Flexible link, insulating shaft.
Five vari-colored cable leads knob.

Modernistic Rainbow Dial

NEW PUSH-PULL BATTERY DIAMOND PRE

utterly dependable and wholly enjoyable. Sensitivity, tone and selectivity are there.

Five tubes are used in the push-pull model, because of the extra audio tube required. The first stage is a screen grid radio frequency amplifier, 222. The detector is a 240 high mu tube, working into a high resistance load, for greatest gain consistent with splendid tone quality. The first audio tube and the output pair are three 112As. The maximum undistorted power output of the last stage thus is 240 milliwatts, plenty for any home, unless excessive volume is desired for persons hard of hearing, or for those who delight in showing off the stupendous volume of a receiver at clearest tone. Both exacting needs may be filled easily by using two 171As as the output instead of two 112A's. This requires increasing the plate voltage to 180 volts and the negative bias from 40 to 45 volts, on the push-pull tubes alone. No change in the circuit wiring need be made, except to divorce the 180-volt B lead to the push-pull tubes from the 135-volt lead that serves the plates fo the other tubes.

Tried and True

There isn't a thing novel in the circuit as shown, but that statement will be welcomed by those who dote on the tried and true, and who prefer not to experiment to obtain results, but to have the results guaranteed beforehand. It is the kind of circuit one can duplicate and duplicate and always get the same high standard of results. Everything is familiar to any one who ever built a three tube radio receiver, except possibly the output impedance. This is a coil wound on a silicon steel core, and having a center tap. The extreme ends of the winding go to the plates of the push-pull tubes and to the speaker, while the center tap goes to B plus maximum voltage.

Even this method of push-pull output, which is excellent indeed, and works well into all types of speakers—magnetic, dynamic or inductor—has been published time and time again, but it is a curious fact that each republication brings the same type of doubting or protesting letters. The complaint is that such an output could not work, or the question is, how can it possibly work, and yet for nearly twenty years it has been working exceedingly well, and there are thousands on thousands of receivers in homes today that contain such an output. Perhaps in the homes of the very doubters and complainants themselves there are receivers with such an output.

Explanation of Output

The explanation is simple and no mystery. The push-pull circuit works, as you know, on the principle of equal and opposite voltages at any given instant. When the voltage is maximum in one tube it is maximum in the other tube, but in the opposite direction, that is, the magnitudes are equal, but the phases are opposite. So if the voltage on the grid of one of these tubes is positive by 9 volts, the voltage on the other is negative by 9 volts. The difference in potential between the grids of the push-pull pair is therefore the arithmetic sum of the two potentials, or 18 volts. These statements refer to signal voltages only, and not to DC voltages.

A confusing point seems to be: if the voltages are equal, how can they be different?

The equality refers to the magnitude. Suppose that two men are standing on the same step on a flight of stairs. Suppose one jumps up two steps at the same instant that the other jumps down two steps. How far has the up-jumper jumped? Two steps. How far has the down-jumper jumped? Two steps. Therefore two steps are two steps, no matter in which direction they are measured, but there is an opposition in phase. One man jumped up, the other down, and the number of steps between them is the difference between minus two and plus two, which is the arithmetic sum of both, or four. This is a difference in height, or, in the push-pull instance, in potential. In each individual instance the potential change was equal but opposite.

Pulsating Direct Plate Current

Now, in the output impedance there is a fluctuating current known as the signal current. All current in the plate circuit is always direct current, because it is always flowing in one direction only in any given circuit. The modulation makes the direct current fluctuate consonantly with the signal frequency, and to vary in magnitude with the volume and signal frequency. So an unsteady or pulsating direct current flows.

The whole "secret" of the operation of the output impedance for push-pull is that when the plate current from midtap to plate of one push-pull tube is flowing in one direction the plate current flowing from the tap to the plate of the other tube is flowing in the opposite direction. These equal and opposite currents meet at the midtap and the fluctuations cancel each other, being equal and opposite. From B plus to the tap the steady direct current is twice as great as each individual current from tap to plates but the signal current is zero.

The extreme voltages are impressed on the speaker simply by connecting a coil (the speaker magnetic coil winding) is parallel with a source of power. No direct current will flow in the speaker.

Brilliant New Appearance

On the appearance side, however, the battery model Push-Pull Diamond is new, in that it uses the new National modernistic drum dial with color wheel. The fetching satin-finish escutcheon is an eye appeal all to itself, but when one adds to that the fascinating rainbow feature, whereby colors flood the scale, one at a time, as the dial is turned, the thrill of the irresistible almost overpowers one's senses.

Besides these advantages, the numbers are legible by projection, which means that they are not directly read, but are cast upon a screen and read from this screen. Hence the same dial readings prevail no matter where or how you hold your head. The usual effect obtained with drum dials is that you get a different reading for different head positions. A station that comes in at 50 for a little fellow comes in at 48 for a tall man, because the altered angle of vision alters the apparent reading. But the new National dial is telescopic. You can be nodding yes to your best girl in your most energetic manner and the dial readings always will be the same.

The drive mechanism is the familiar velvet vernier.

The escutcheon is at center of the front panel and is the only tuning control. Two condensers with protruding shafts, front and back, are placed on one side and the other side of the drum. They are insulated from each other, as one grid return is to A plus, the other to A minus.

Cost of Parts is $23.50

At right is the tickler knob, at left is the switch-rheostat, a combination instrument. There is no need for a pilot window, as the drum dial is illuminated when the receiver is turned on.

CANADIAN BROADCASTING SCHEDULE

CITY	Call	Kc.	Meters	TIME	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Moncton, N. B.	CNRA	630	475.9	AS		1:45 - 3:30 PM 4:00 - 4:10 PM	1:45 - 3:30 PM 4:00 - 4:10 PM 9:00 -11:00 PM	1:45 - 3:30 PM 4:00 - 4:10 PM	1:45 - 3:30 PM 4:00 - 4:10 PM 8:30 -12.00 PM	1:45 - 3:30 PM 4:00 - 4:10 PM	1:45 - 3:30 PM
Quebec, P. Q.	CNRQ	880	340.9	ED			9:00 -11:00 PM		9:30 -12:00 PM		
Montreal, P. Q.	CNRM	730	411	ED			12:00*-12:30 PM 9:00 -11:00 PM		12:00*-12:30 PM 9:30 -12:00 PM		
Ottawa. Ont.	CNRO	690	434.8	ED		11:30*-12:30 PM 3:00 - 5:30 PM	11:30*-12:30 PM 3:00 - 5:30 PM 8:45 -11:00 PM	11:30*-12:30 PM 3:00 - 5:30 PM	11:30*-12:30 PM 3:00 - 5:30 PM 9:30 -12:00 PM	11:30*-12:30 PM 3:00 - 5:30 PM	11:30*-12:30 PM 3:00 - 5:30 PM
Toronto, Ont.	CNRT	840	357.1	ED			10:00 -11:00 PM		9:30 -12:00 PM		
London, Ont.	CNRL	910	329.7	ED			10:00 -11:00 PM		9:30 -12:00 PM		
Winnipeg, Man.	CNRW	780	384.6	CS	.9:00-10:00 PM	9:00 -10:00 PM	11:00 -12:00 PM	6:30 - 7:30 PM	9:00 -10:00 PM	6:30 - 7:30 PM	
Regina, Sask.	CNRR	960	312.5	MS					8:30 -10:30 PM		
Saskatoon, Sask.	CNRS	910	329.7	MS	2:30- 3:30 PM	2:30 - 3:30 PM	2:30 - 3:30 PM 10:00 -11:00 PM	2:30 - 3:30 PM	2:30 - 3:30 PM	2:30 - 3:30 PM	2:30 - 3:30 PM
Edmonton, Alta.	CNRE	580	517.2	MS			10:00 -11:00 PM				
Calgary, Alta.	CNRC	690	434.8	MS		9:30 -10:30 PM			9:30 -10:30 PM		
Vancouver, B. C.	CNRV	1030	291.3	PS		10:30*-11:30* 10:00 -11:00 PM	10:30*-11:30* 9:00 -11:30 PM	10:30*-11:30* 10:00 -11:00 PM	10:30*-11:00* 10:30 -11:00 PM	10:30*-11:30* 8:30 -11:30 PM	

* AM

For Single Tuning Control

SENTS FASCINATING FRONT PANEL VIEW

Simplicity and beauty often run together, and they do in this instance of the front panel of the battery model Push-Pull Diamond.

Looking behind the front panel we see the input transformer, output impedance, five sockets, tuning condensers, drum, two coils, subpanel and binding post insulators.

The simplicity in the rear view does not detract in any way from the fact that the circuit is an excellent one, designed to give splendid performance, bound to fulfill expectations, even though the circuit has been stripped of everything except its necessities. Nothing has been omitted that would be necessary, however, and a fine receiver can therefore be built, using parts that cost only $23.50.

The whole installation has been kept down to moderate size, without sacrifice, by careful placement of parts, and use of parts that do not take up too much room. The steel subpanel is only 7x17½". Thus many a person who has a console with limited width, or a bookcase with limited depth, will find it practical to insert this receiver.

Subpanel is Grounded A Minus

Sockets are built into the subpanel, and there are insulated bushings for the antenna, ground and two speaker binding posts. The ground post really is not insulated, but the inclusion of the black top insulator even in the instance of the ground post was for eye effect. In point of fact, a lug is secured to the ground post, underneath, and a hole already drilled in the subpanel makes room for a machine screw, so the lug can be fastened by a nut to the screw, hence being conductively coupled, and the subpanel is grounded that way. A minus is to be grounded, so the subpanel is used as A minus. This point confused some builders of preious Diamonds where a metal subpanel was used.

Let us suppose a set is wired with a baseboard. A wire is connected to A minus on the battery and is brought to the A minus binding post of the receiver. From then on connections are made to A minus from the receiver by running a wire to this binding post, or, where practical, different points that take A minus as the connection are soldered to a single lead which alone goes to the post.

Suppose instead of a baseboard you had a modern metal subpanel with sockets built in, and all holes already drilled where connections are to be made directly to the subpanel, and with insulators positioned where necessary.

Take the ground post, metallically connected to subpanel, as already explained. A minus is connected to the subpanel, too, in the same way, although at another place on the subpanel. Now we have A minus grounded and the subpanel represents that lead, just as if it were a wire coming from an A minus binding post. If you touch A plus to the subpanel you short the A battery. Why? Because A minus and the subpanel are at the same potential.

Features of Subpanel

Therefore the subpanel itself may be "picked up" for grounded A minus, and other A minus leads are thus rendered unnecessary. There is only one A minus externally, from A minus of battery to subpanel.

If you do not use a metal subpanel when building this receiver, be sure to connect every point shown as A minus or ground, by a wire run direct to the ground binding post, or indirectly to the ground binding post, and use this post for connecting A minus of battery.

The subpanel has self-bracketing flaps all around, so that not only are no brackets needed for support but the holes on the front elevation exactly coincide with a front panel holes, hence mounting one panel to the other is a cinch.

To enable the escutcheon to be placed exactly in the vertical center of the subpanel, a position in which it makes the best appearance, the height of the flap on the subpanel had to be specially determined, because the rear plate of frame of the drum assembly rests on the subpanel. Not only are special holes already drilled to take the holes of the drum plate, but a piece of the subpanel is cut away so that a protruding fixture on the drum will clear and will permit the firm mounting of the dial right on the subpanel. It is a fact, therefore, that the drum dial really does not rely on the front panel for support. The driving shaft protrudes through the front panel and through the escutcheon. The tickler shaft is lower down, at right, as the mounting shown on front cover was changed subsequently.

How Short Is Avoided

Also to enable the lower position of the tickler and rheostat knobs, relative to the dial knob, part of the subpanel is cut away at the factory. This helps the appearance, because if the rheostat and tickler knobs were higher than the knob that turns the drum drive, an aesthetic blunder would be committed. Instinctively one would think of a cone standing on its apex. Better taste compels that the eye be presented with the illusion of a cone standing, as it should, on its base.

The coils used for the circuit are the Diamond pair, but this time those for .00035 mfd. tuning are recommended, because the specified condensers thereby are smaller in size, but coil forms are no larger. Any feet on the condensers may be removed with a single pull at a pair of pliers, as the feet are not needed in this installation.

Two brackets help support the condensers. The right-hand bracket, as you look at the receiver from the front panel, is insulated, and so is the condenser shaft from the drum receptacle. This insulation is provided by connecting an insulated flexible coupler to the right-hand condenser, and a short piece of ¼" bakelite or hard rubber rod to the drum. Then the detector circuit's positive grid return is independent of the subpanel potential, and no short will result.

[*This concludes the first instalment of the series of articles on the Push-Pull Diamond for battery operation. Read the next instalment in the October 19th issue of* Radio World. *Readers should bear in mind that while this is a battery model receiver, that fact concerns really only the type of tubes used. A storage battery may heat the filaments, or an A eliminator may be used. B batteries may power the plates, or a B eliminator with a large filter capacity, such as the National 3580, will provide highly satisfactory plate voltage. In any instance batteries must be used for biasing the first and second audio stages. If a 180-volt B eliminator, like the 3580, is used 171A tubes are preferable for the output.*]

A THOUGHT FOR THE WEEK

THE FIGHT and baseball managers are said to be considering the advisability of calling off all affiliations with broadcasting stations. These gentry are inclined to be a bit chesty because the daily newspapers give them hundreds of thousands of dollars of free advertising every day. No wonder the "pug" handlers and bull-tosser impressarios don't want to share their whopping big profits with anybody. They're a hard bunch to deal with, for they are used to the idea of having folk eat out of their hands, but ignore their "rackets" for a few days and see how they'll come around and yelp for mercy.

U. S. A. SHORT WAVE BROADCASTING STATIONS

Station	LOCATION	KC.	METERS
KDKA (W8XK)	East Pittsburgh, Pa	4,791	62.50
(W8XS)			
(W8XP)	Portable	7,012	42.75
		11,878	25.24
KEJK (W6XAN)	Los Angeles, Cal	2,830	105.9
KEWE	Bolinas, Cal.	21,263	14.10
KFPY (W7XAB)	Spokane, Wash.	2,830	105.90
KFQU (W6XBH)	Holy City, Cal	9.671	31
KFQZ (W6XAL)	Hollywood, Cal.	2.770	108.20
KFVD (W6XBX)	Culver City, Cal	2.855	105
KFWB (W6XBR)	Los Angeles, Calif	2,855	105
		7,491	40
KFWO (W6XAD)	Avalon, Calif.	5,650	53.07
KGER (W6XBV)	Long Beach, Calif	6,142	48.86
KGB	San Diego, Calif.	4,600	65.18
KGDE	Barrett, Minn.	7.941	40
KHJ (W6XAU)	Los Angeles, Calif	2,880	104.1
KJBS (W6XAR)	San Francisco, Calif	4,914	61
KJR (W7XC, W7XO)	Seattle, Wash.	2,850	105.20
KMOX	St. Louis, Mo.	6.118	49
KMTR	Los Angeles, Calif	2,770	108.2
KNRC (W6XAF)	Santa Monica, Calif	2,770	108.2
KNX (W6XA)	Los Angeles. Calif	2,800	107.1
KOIL (W9XU)	Council Bluffs, Ia	4,910	61.06
KWE-KEWE	Bolinas, Calif.	21,263	14.1
KWJJ (W7XAO)	Portland, Ore.	5,600	53.54
WAAM (WX2BA)	Newark, N. J.	4.600	65.18
WABC (W2XE)	Richmond Hill, N. Y	5,124	58.5
WBRL (W1XY)	Tilton, N. H	2,750	109
WBZ	Springfield, Mass.	4.283	70
WCFL	Chicago, Ill.	8.050	37.24
WCGU (WTXBH)	Brooklyn, N. Y	5,552	54
WCSH (W1XAB)	Portland, Me.	4,700	63.79
WCX	Pontiac, Mich.	9,370	32
WEAO (W8XJ)	Columbus, Ohio	5,550	54.02
WGY (W2XAF)		5,521	31.48
(W2XAD)	Schenectady, N. Y	15,328	19.56
		59,964	52
WHK (W8XF)	Cleveland, Ohio	4,540	66.04
WJR-WCX (W8XAO)	Pontiac, Mich.	9,370	32
WJZ (W3XAL)	New York, N. Y	6,096 to 21.420	49.18 to 13.95
WLW (W8XAL)	Cincinnati, Ohio	5,764	52.02
WNAL (W9XAB)	Omaha, Nebr.	2,855	105
WOR (W2XAQ)	Kearny, N. J.	4.581	65.4
WOWO	Ft. Wayne, Ind	13,150	22.8
WRNY (W2XAL)	New York, N. Y	9,700	30.91
WSM (4XD)	Nashville, Tenn.	9,540	31.43
WTFF	Mt. Vernon, Va	5,352	56
KGO (W6XAX. W6XAN)	San Francisco, Calif	29,982 to 7,491	10 to 40

The Beat Phenomena

SMALL DIFFERENCE BETWEEN TWO

By Knolleys

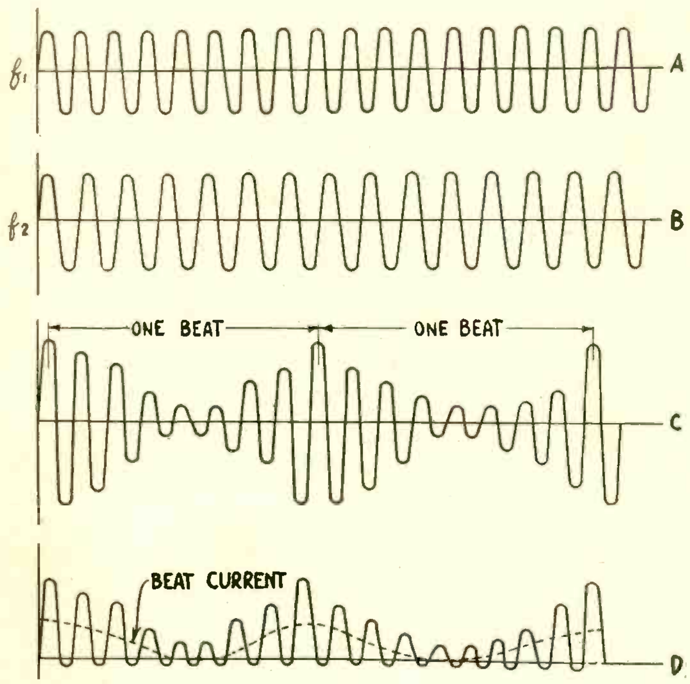


FIG. 1.
CURVES ILLUSTRATING THE PRODUCTION OF BEATS OR HETERODYNES AND A BEAT CURRENT WHEN THERE IS DISTORTION PRESENT.

THE Superheterodyne has always been the aristocrat among receivers. Ownership of one of them has been the goal of nearly every radio enthusiast. It has always been considered to be supreme in the qualities of sensitivity and selectivity. Tremendous volume has been associated with the circuit. Even the quality of its output has been considered to be nearly perfect. Because of this favorable attitude of the public toward the Superheterodyne, countless receivers of this type have been offered to the fans, and fortunately many of them have proved highly satisfactory. There is, however, a good deal of fiction associated with the circuit, and not all of the receivers have been superior.

While much has been written on the construction of different Superheterodynes, very little has been said about the theory of the superheterodyne. There have appeared in the technical press a few articles on the circuit, but these are not often available to the radio enthusiasts who would build their own. Books on radio touch but lightly on the principles of the Superheterodyne, often devoting no more than a single paragraph to it. A volume could easily be written about it without exhausting the subject.

Something Mysterious

This paucity of literature on the Superheterodyne has led many fans to believe that there is something mysterious about the circuit, something which only the specialists and engineers are capable of understanding. Of course, this is not so. It is just as easy to understand the Superheterodyne as any other radio receiver, because it works essentially on the same principles. The only difference is that the signal is reduced to audibility in two steps instead of a single step, most of the amplification occurring in the intermediate frequency level.

Whether a Superheterodyne is superior in any repsect to an ordinary receiver depends entirely on the design of the circuit. It is not necessarily the most selective, but with ordinary care in the design it is likely to be. Indeed, it is likely to be excessively selective for good quality. Neither is the circuit necessarily the most sensitive. Its sensitivity, too, depends on the design. It is not a great feat of design to get an extraordinarily high sensitivity, but this is not accomplished by adding a large number of tubes. Many Superheterodynes have failed to give satisfactory results because the amplification in the circuit was too high, making the set unmanageable. Others have failed because they were so selective that stations were too difficult to find.

It is a fallacy to attribute great output volume to a Superheterodyne. The volume that can be obtained depends on the audio frequency amplifier, and particularly on the last stage in the circuit. If the last tube in the circuit is a little 99, no more volume can be obtained if this tube is preceded by a ten-tube Superheterodyne than if it is preceded by an ordinary radio frequency receiver, provided, of course, that there is sufficient amplification ahead of the tube in each instance to load it up. Likewise, the tone quality does not depend so much on the radio frequency circuit, whether Superheterodyne or not, as it does on the type of audio-frequency amplifier used. The excessive selectivity which may occur in the Superheterodyne will mar the tone quality to an extent depending on the value of the selectivity.

The Volume Fallacy

In designing a Superheterodyne one should be guided by the following principles:

(a)—The sensitivity should be great enough to bring in signals which are just below the noise level.

(b)—The selectivity should not be any greater than is absolutely necessary to separate the signals from distant stations from those of strong local stations.

(c)—There should be adequate selectivity ahead of the first detector or modulator so that image interference may be reduced as much as possible.

(d)—The intermediate frequency should not be lower than about 60 kilocycles per second, nor higher than about 300 kilocycles.

(e)—The coupling between the local oscillator and the first detector or modulator should not be close.

(f)—The coupling should be such that only the fundamental frequency of the oscillator is introduced into the modulator, that is, the coupling should be selective.

The reasons for these will be brought out in the following discussion of the principles of the Superheterodyne:

The word **Superheterodyne** is made up of three different words, namely, **super,** meaning higher; **hetero,** meaning other or different, and **dyne,** meaning force. This compound word, a hybrid of Latin and Greek elements, is supposed to describe what the circuit is, but it does not do this so well, for it is not very illuminating to call a receiver "a higher other force." However, the name fits as well as many other accepted radio names and there is no reason for changing it to a more descriptive term, even if one could be found.

The Meaning of Heterodyne

The term **heterodyne** was introduced into radio by Fessenden to describe a method of reception of continuous waves whereby a local radio frequency which differed only slightly from the frequency of the signal to be received was impressed on the detector simultaneously with the incoming frequency. Later when regenerative tube receivers came into use the term was applied to the whistling sounds generated by the circuit when the tube oscillated and when the locally generated frequency differed only slightly from the frequency of the signal. Everybody is familiar with this whistle.

Most fans who have operated such a regenerative receiver no doubt have noticed that when the tuning condenser is turned slowly the pitch of this whistle varies throughout the whole gamut, from the very lowest audible sound to the very highest. The whistle is caused by the interaction between the frequency of the oscillating detector and the frequency of the signal.

There is present in the plate circuit of the detector tube a current having the frequency of the whistle. This current obviously does not stop when the whistle ceases to be heard. Its frequency simply passes the upper limit of audibility. As the tuning condenser is turned in the direction of increasing pitch, the frequency continues to increase indefinitely. As soon as the frequency is above the upper limit of audibility it is called a super-audible frequency, or a super-audible heterodyne. It is this super-audible frequency which is used in a Superheterodyne.

Heterodynes are not limited to electrical currents but occur whenever two periodic motions take place simultaneously. The most familiar example is the throbbing phenomenon which occurs when two musical tones of slightly different frequencies are sounded at the same time. The two tones are not heard separately but as a single tone, the intensity of which waxes and wanes at a rate depending on the difference in the pitch of the two separate tones. The phenomenon is called beats, and two tones which are interacting in this manner are said to be

In a Superheterodyne

FREQUENCIES PRODUCES THIRD CURRENT

Satterwhite

beating. The phenomenon is best observed when the two tones are sustained and when both are pure, that is, free from harmonics or overtones. But it can also be observed when two piano strings in the bass, and both close together, are struck simultaneously. The sound can both be heard and felt when one tries to whistle in unison with any sustained note.

Production of Beat Tones

If one of the beating tones is held at a fixed pitch and the pitch of the other is varied continuously from unison, the rapidity of the beats will increase gradually. At first the beats are very slow, then they increase until they can no longer be heard as separate beats, but rather as a tone. This occurs when the rapidity is about 16 per second. When the difference between the two tones is greater, the two tones can be heard separately as well as the subjective beat tone. This in acoustics is exactly simliar to the electrical heterodyne previously discussed, and for that reason the term beat is applied to electrical case quite as often as the term heterodyne. Thus two currents are said to beat with each other and to produce a beat current. The frequency of this beat current is limited only by the frequencies of the two currents which beat.

The coexistence of two currents of different frequencies, or of two tones of different pitch, is not sufficient for the production of a beat current or a beat tone. There must be distortion in the medium in which the action takes place. In the case of two weak tones, the distortion takes place in the ear of the listener. In the case of two very intense tones, the distortion may also occur in the air. In the electrical case the distortion takes place in the vacuum tubes. A detector tube is only a vacuum tube which has been adjusted so that the distortion is large and so that the beat current produced by the interaction between the two currents is large. The first detector in a Superheterodyne, the modulator tube, as we shall call it, is a tube adjusted in this manner.

Beats Illustrated

A graphical representation of the production of beats is shown in Fig. 1. At (a) is represented a simple harmonic disturbance of frequency f_1 and at (b) a similar disturbance of a lower frequency f_2. These simple harmonic disturbances may represent either pure alternating currents or pure tones. At (c) is represented the combined effect or these two simple harmonic disturbances when they are occurring simultaneously in the same medium. The amplitude of the curve in (c) varies regularly from maximum to minimum. The distance between one maximum to the next maximum represents the time or period of one beat, and the number of such periods per second is the beat frequency. This is equal to the difference between the two frequencies represented in (a) and (b), that is, to $f_1—f_2$.

As was pointed out above, the beat frequency does not represent a tone or a current of this frequency when the two beating frequencies occur in a distortionless medium. The condition for the production of such a beat current or beat tone is that the displacement in one direction is greater than that in the other. This is met in detector circuits where the operating point is on a curved portion of the characteristic of the device, and it is also met in rectifier circuits in which one side or the other of the current is wiped out entirely, provided there is an additional device which averages the resulting unidirectional pulsations.

This average current varies as the amplitude of the composite current (c). Curve (d), Fig. 1, shows approximately the shape of the composite current in the plate circuit of a grid bias detector resulting from two voltages of slightly different frequencies impressed on the grid. The negative loops are nearly wiped out while the positive loops are proportional to the voltage impressed. The dotted line through the positive loops is the average current and represents the beat current. This current can be selected by a suitable tuner and amplified.

Curve (d), Fig. 1, can also represent the output of a rectifier in which the rectification is not perfect, and since practically no rectifier is perfect at radio frequencies, it represents the output of any rectifier operating at radio frequency.

When a pure tone strikes the microphone in a broadcast station an electric current having the frequency of the tone is generated. This current is impressed on the radio frequency wave generated by the oscillator in the transmitting station, that is, an audio frequency and a radio frequency current are mixed. The resulting current is one of radio frequency having

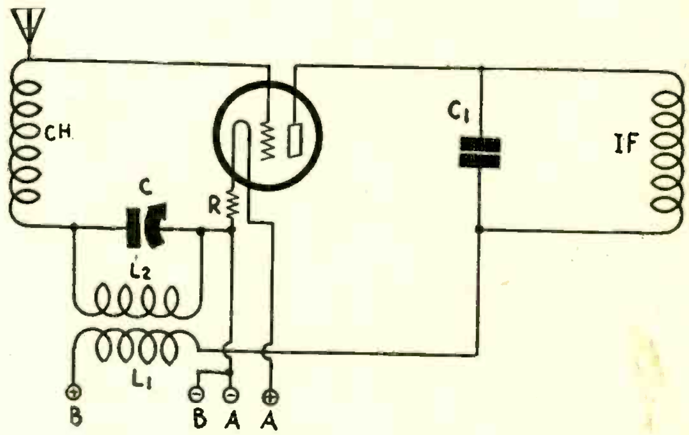


FIG. 2.
A SUPERHETERODYNE MODULATOR IN WHICH THE SIGNAL IS IMPRESSED ON THE OSCILLATOR, RESULTING IN CLOSE COUPLING.

a variable amplitude, and it is essentially of the same form as curve (c), Fig. 1. Analytically, this current can be represented as composed of three different currents, one having the frequency of the radio current generated by the oscillator, a second having the frequency of the sum of the oscillator frequency and the tone frequency, and a third having a frequency equal to the difference between the oscillator frequency and the tone frequency. All three are radio frequency currents.

If f is the frequency of the tone current and F the frequency of the radio current, the frequencies of the three products of the mixture, or modulation, are F, $F+f$, and $F-f$. F is called the carrier frequency, and the corresponding current the carrier current. $F+f$ is called the upper or superior side frequency and $F-f$ is called the lower or inferior side frequency.

When this composite radio frequency current is impressed on an antenna, a radio wave is radiated into space, and this wave has the same form as the current. In free space this wave does not exist as three separate entities, unless we are willing to admit that the "ether" is incapable of following the variations accurately. It exists as a single complex wave in which the amplitude varies according to the tone impressed on the carrier.

This complex wave strikes a receiving antenna and induces therein a voltage which has the same form as the wave transmitted. In the receiver the three components may exist as separate entities because of the distortion which occurs in the tubes and in other parts of the receiver. It is for this reason that either of the three components will cause heterodynes with a suitable local oscillation.

A Modulated Signal

The sound that falls on the transmitting microphone is rarely a pure tone, but in general consists of all audible tones, or combinations of many different tones. Hence there will be many side frequencies. If the highest audible frequency transmitted is 10,000 cycles per second and the lowest is 16 cycles per second, f in the formulas above may have any value from 16 to 10,000 cycles per second. Therefore, the superior side frequency may have any value between $F+16$ and $F+10{,}000$. This band of frequencies is called the upper or superior side-band. Likewise the band between $F-10{,}000$ and $F-16$ is called the lower or inferior side-band. In ordinary receivers the circuit is tuned to the carrier frequency F and never to the side frequencies. However, when the carrier frequency is high compared with the highest side frequency, and when the circuit is tuned to F, it is also approximately tuned to all the side frequencies, both upper and lower. There are exceptions, notably in Superheterodynes, and these will be discussed further on.

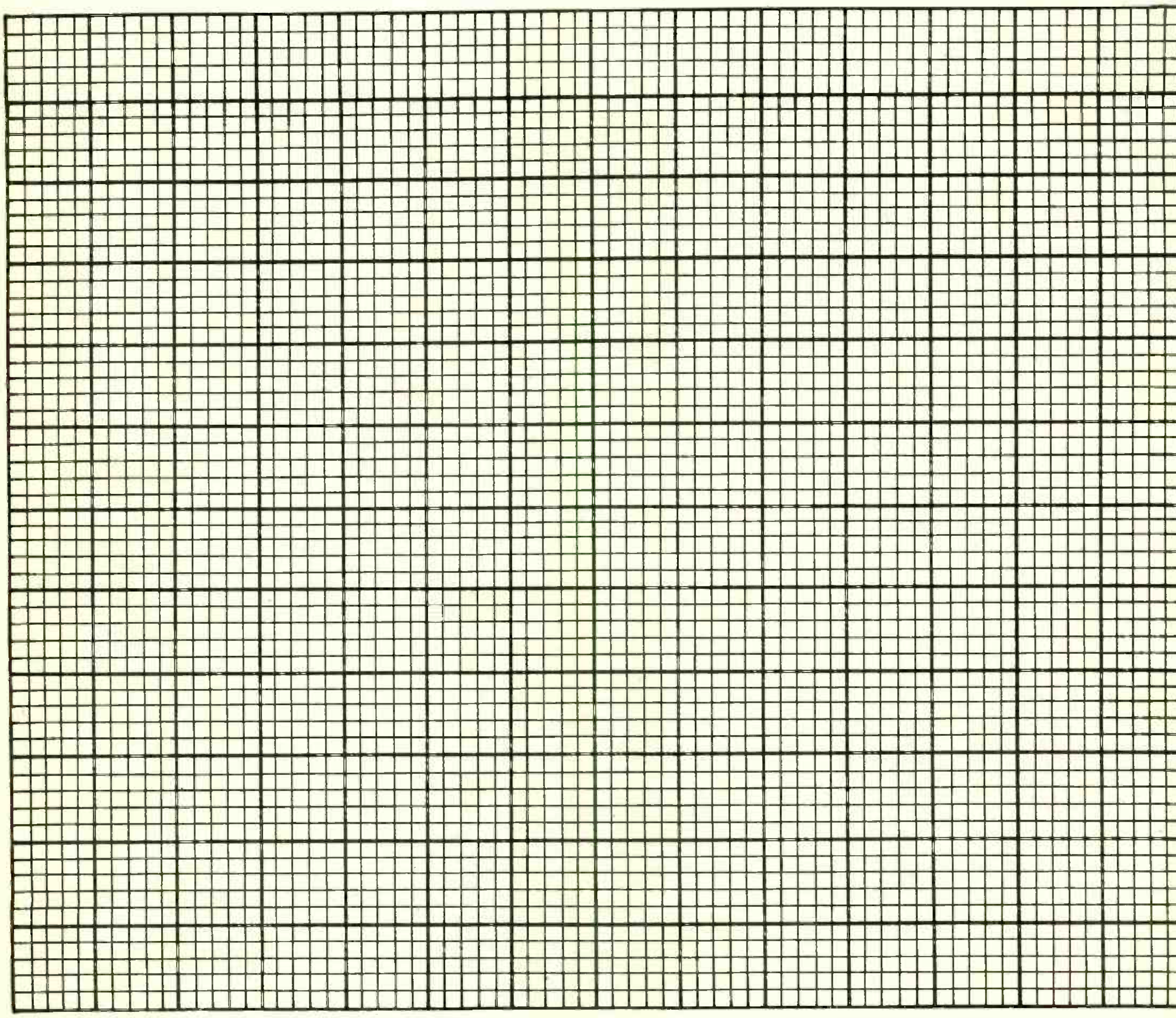
The object of any receiver is to retrieve from the complex radio wave all the original sounds that fell on the microphone, and this is done in the detector. This device inverts the process of the modulator, and consequently the detector is often called a demodulator.

The so-called first detector in a superheterodyne does not detect in the sense that it makes the signal audible. Electrically it functions in the same manner as the modulator in the transmitting station, and therefore it is desirable to call it a modulator rather than a detector. The difference between a detector, or demodulator, and a modulator is really only in the point of view. Both function because of the same property of a vacuum tube.

How to Plot and Read Curves

A Handy Method of Permanently Calibrating Performance

By Richard J. Stars



EXAMPLE OF CO-ORDINATE PAPER. EVERY FIFTH LINE IS MADE HEAVY FOR CONVENIENCE IN COUNTING AND LAYING OFF. THE HORIZONTAL LINES ARE THE ABSCISSAS, WHILE THE VERTICAL LINES ARE THE ORDINATES. WHETHER THE NUMBERS TO BE PUT AT LEFT, REPRESENTING ABSCISSAS, ARE TO BE REFERRED TO AS ORDINATES, IS DEBATABLE.

A CHARACTERISTIC curve is a graphical representation of the relation between two quantities which vary simultaneously in some manner. Familiar curves are those between the grid voltage and plate current of a vacuum tube. Such a curve is the grid voltage, plate current characteristic, the applied plate voltage being held constant.

When plotting such curve it is customary to use co-ordinate paper, or cross-section paper, the simplest of which is shown in the plate above. This is called rectangular co-ordinate paper because the lines are drawn at right angles to each other.

One vertical line is called the axis of ordinates and one horizontal line is called the axis of abscissas. All the vertical lines are ordinates and all the horizontal lines are abscissas. The intersection of the two axes is called the origin of co-ordinates, or simply the origin. Ordinates are measured from the axis of abscissas, positive upward and negative downward. Abscissas are measured from the axis of ordinates, positive to the right and negative to the left.

The origin can be chosen at any convenient point in the co-ordinate plane, either on the sheet available or outside it as the data at hand may require. Any point is referred to by giving its abscissa and its ordinate, thus (8, 4). This means the point is located 8 units to the right of the axis of ordinates and 4 units above the axis of abscissas. The point (0.0) is the origin. The abscissas are used usually for the independent variable, that is, for the one which is varied at will. The ordinates are used for the dependent variable, or the one which depends for its value on the independent variable. Thus if **e** is the grid voltage and **i** the plate current **e** is used for abscissas and **i** for ordinates. Any point on the curve is written **(e, i)**, or P **(e, i)**, the exact location of the point depending on the value assigned to **e** and the corresponding value of **i** obtained when measuring current

Measurement of Output

Beat Note Oscillator Provides Accurate Gauge

By J. E. Anderson and Herman Bernard

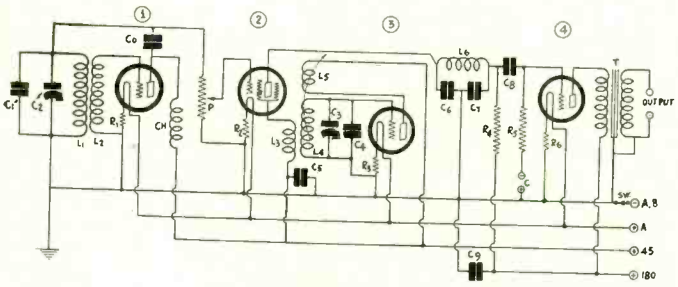


FIG. 102
CIRCUIT OF A BEAT OSCILLATOR FOR PRODUCING AUDIO FREQUENCIES FOR MEASUREMENT PURPOSES.

This article is an instalment of Power Amplifiers which has appeared weekly since June 1. It will soon be published in book form.

The first amplifier, 41-A, consists of three stages of resistance coupling and employs low-power tubes energized by direct current. The second amplifier, 42-A, is a stage of push-pull using medium power tubes heated by alternating current. The third amplifier unit, 43-A, is a stage of push-pull employing high power tubes heated by alternating current. The output stage may consist of one pair of tubes or several pairs, depending on the number of loudspeakers that must be used to fill a given theater with sound. The plate voltages for all the tubes in these amplifiers are obtained from rectified and filtered alternating current. The total potential amplification of these three units is one hundred million, or 80 decibels. In very small theaters amplifier 43-A is not required.

The question of quality of reproduction of music and speech in talking motion pictures is a complex one and cannot be taken up in a discussion of power amplifiers. Most of the distortion that does occur is due to imperfections in the photographic processes, and a comparatively small amount is due to defects in the electrical phases. However, there is one source of distortion which is due to optical and mechanical limitations and which can be corrected by electrical means. This we shall now discuss briefly.

The recording of the film is done by means of a narrow slit extending across the width of the sound track. This slit is about one-tenth of an inch long and .001 inch wide.

In one system of recording, that used in the Photophone, the effective length of this slit is varied according to the sound that is to be recorded. The width remains constant, as does the illumination. The film passes this slit at a rate of 90 feet per minute. The resulting exposure is of the variable area type. Due to the finite width of the slit, namely, .001 inch, the exposure is not uniform inside the exposed area, there being a blurring at the variable edge. This blurring results in amplitude distortion such that the higher the frequency the lower is the amplitude. When the width of the slit is equal to the wavelength on the film of the recorded sound, the amplitude is zero.

In another system of recording the length and width of the slit remain constant, but the intensity of illumination varies according to the sound to be recorded. At any instant the intensity of the light falling on the film is uniform over the entire slit but it varies from time to time. This exposure results in exactly the same type of distortion, but instead of a blurring of the edges it gives an exposure which is not like the variation in the sound.

There is a third method of exposure in which the intensity of the light and the length of the slit remain constant but in which the width of the slit varies. The analysis of this type is more complex than that of the other two types, and apparently it yields frequency distortion. This cannot be corrected.

Films of all these types are played by the same method. A narrow slit, which should be of exactly the same width as the recording slit used in the first two cases as the mean of the slit in the third case, is placed between a bright and steady source of light and the film. On the opposite side of the film is a photoelectric cell. The playing slit, being of finite width, repeats the errors introduced by the recording slit, and the resulting distortion is squared. If the recording and playing slits are of equal width, the frequency of first zero amplitude is still determined by the width of either slit and the length of the sound wave on the film. If the speed of the film is 90 feet per minute and the width of the slit is .001 inch, the first zero amplitude occurs at 18.000 cycles. If the slit is wider, or if the speed of the film is slower, the zero amplitude will occur at a lower frequency. The design of the apparatus must be such that the first zero amplitude occurs at a frequency higher than any that is essential to faithful reproduction.

We have spoken of the first zero above because beyond this the amplitude varies between zero and maximum periodically.

The distortion due to the use of a slit of finite width is both an amplitude distortion and a phase shift. The amplitude distortion can be corrected by suitable equalizers in the amplifier, and the phase shift does not seem to affect the quality. But even that could be compensated for in the amplifier if it were necessary.

After a power amplifier has been built and put into operation, what assurance is there that the quality of the sound it reproduces is as good as it should be or as good as one may think it is? Is it sufficient to rely on the quality of the individual parts that have gone into the construction of the amplifier? Is the ear a trustworthy edge by which to estimate the fidelity of the amplifier, or is it necessary to test the circuit by means of impartial meters?

The use of first rate parts in the construction of an amplifier is a first necessary condition for obtaining good quality, but it is not a sufficient guarantee that the quality of the sound will be first class. While the ear is the ultimate judge of quality in so far as it is the sense organ that must be pleased, it is far from a trustworthy guide of good quality from an engineering point of view. The ear is too easily satisfied, especially after it has become accustomed to the sound from a given source, for the ear is subject to habit and fatigue. The only impartial way of testing the quality of the output of an amplifier is to test it with accurate meters.

A Source of Tones

Hence those who build amplifiers professionally should equip themselves with some method for measuring the quality of the sound produced. Many such methods suitable for the purpose have been developed. Perhaps the simplest is one comprising a source of audio frequency tones, or corresponding currents, and a vacuum tube voltmeter for measuring the voltages developed at various points in the amplifier and at various selected frequencies in the audible range.

A very satisfactory source of audio frequency current is a beat oscillator with a suitable amplifier. This is extremely versatile in that any audio frequency can be generated with almost any intensity desired, and it is easy to calibrate and to operate. Moreover, it is relatively inexpensive.

The circuit diagram of one such arrangement is shown in Fig. 102. It comprises two radio frequency oscillators. (1) and (3), a detector, (2), and a power amplifier, (4).

The two oscillators generate two different radio frequencies, one of which is adjustable to any value whatever within the limits of the tuned circuit and the other fixed. The variable frequency oscillator is adjusted so that its frequency differs from the frequency of the fixed oscillator by an amount equal to the desired audio frequency.

Signal voltages derived from these two oscillators are impressed on the detector tube. In the particular case illustrated the output of one of the oscillators is impressed on the control grid of the screen grid detector tube and the output of the other is impressed on the screen grid of the tube. The output of the detector is in turn impressed on the grid circuit of the power amplifier tube. A radio frequency filter is interposed between the detector and the power amplifier for the purpose of separating the two radio frequencies from the audio frequency beat current. This filter comprises the elements L6, C6 and C7.

One condition for making use of the beat frequency for measuring purposes is that it be free from the harmonics of the fundamental beat frequency. It can be proved that if audio amplifier is distortionless and if either of the two beating radio frequency currents is free from its harmonics, the audio frequency output of the circuit will be free from harmonics of audio frequency. If, then, we adjust the power tube voltages and load so that the wave form distortion is negligible, and if we couple at least one of the radio frequency oscillators to the detector so that only the fundamental frequency is impressed on the detector, we shall have an audio frequency output which is practically pure, or free from harmonics.

(*Continued next week*)

As for the protrusion of the coil shaft which is joined to the flexible coupler on the condenser shaft, this coil shaft is adjustable backward or forward. If the coil has set screws, loosen these, and push the rod backward or forward as desired, either for purposes of joining to the flexible coupler or for sufficient extension of the coil shaft through the front panel to engage the tuning dial. The only limitation is that the tickler must not strike the stator form.

After the position of the coil shaft is obtained experimentally, tighten the screws on the coil hardware. It is not necessary to use these setscrews for securing the tickler at all, as when the coil shaft is anchored to the flexible coupler, the automatic connection to the condenser shaft affords all the rigidity, end-stop and other protection necessary.

If you are hampered for room in regard to the right-hand condenser, first determine if the condenser rotor turns smoothly enough. It should respond to light pressure. If not, loosen the nut at condenser rear and turn out the setscrew just a fraction of a turn. Now try the rotor. If satisfactory, anchor the locknut and with a pair of pliers snip off the excess of the screw into which this nut has been turned. The protrusion should not interfere with the Mershon condenser, but if it does, snip off as directed.

How to Bend Lug

On account of the power transformers position in the center, and the presence of a stator lug on the left-hand tuning condenser, sticking out at right angles, you can gain the necessary room simply by bending back this lug to a right angle. Use round pliers to hold

hole in the subpanel coincides with one in the cabinet. A single screw and nut serves both. The other Mershon bracket hole in the subpanel is intended for the low type of Mershon bracket. If the wrong bracket is obtained relocate the second hole for the bracket on the subpanel. The low bracket is so placed that the two turned-up ends for insertion of holding screw (for securing bracket to the condenser container) are at rear, while one mounting foot is at right rear, as explained, and the other is quite close to the detector socket.

One problem is that the Polo block's feet may be what seems too long. If the feet are on the table, as they may be, since the feet protrude through holes provided for them in the subpanel, the extra space occasioned by the automatic raising of the subpanel above the bottom flange of the cabinet cannot be taken up with spacing washers. The feet on the transformer block may be cut down to length as the one solution. Another alternative is to put the spacers between the top of the subpanel and the points where the feet enter the Polo block. Any one of these methods is all right. The spacers may be simply extra nuts. In the case of the Polo block these nuts are 10/32. At all other points they are 6/32.

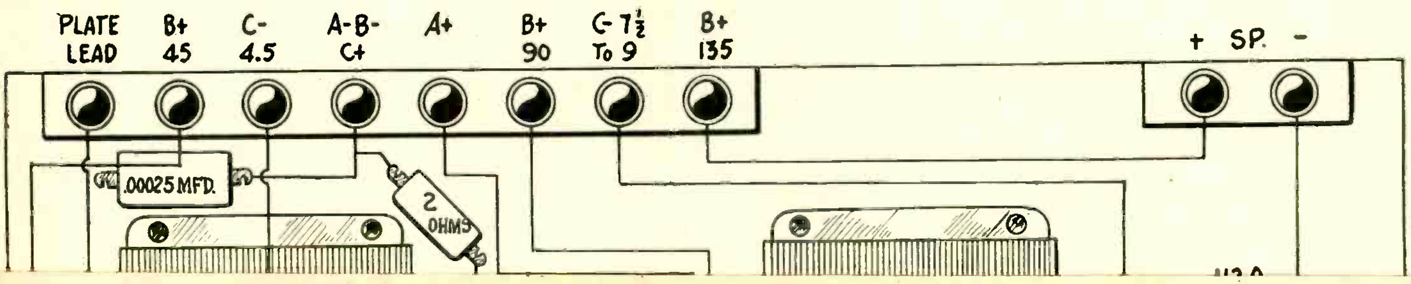
The fuse and holder may be located under the antenna while C5 is similarly placed under the tuning condenser.

The Polo block primary leads, for connection to the 110-volt line, are brought into one end of a pendant switch, outside the cabinet rear, and at the other end of this switch attach an AC cable. At the otherwise unused end of the cable a male plug is connected, for insertion in the wall outlet.

Two Stages of Audio

Circuit for Schoolboys Operates a Loudspeaker Very Well

By Jack Tully



How to Use the J-

OPENS AND SHORTS, FILAMENT PLATE AND GRID

By Herbert

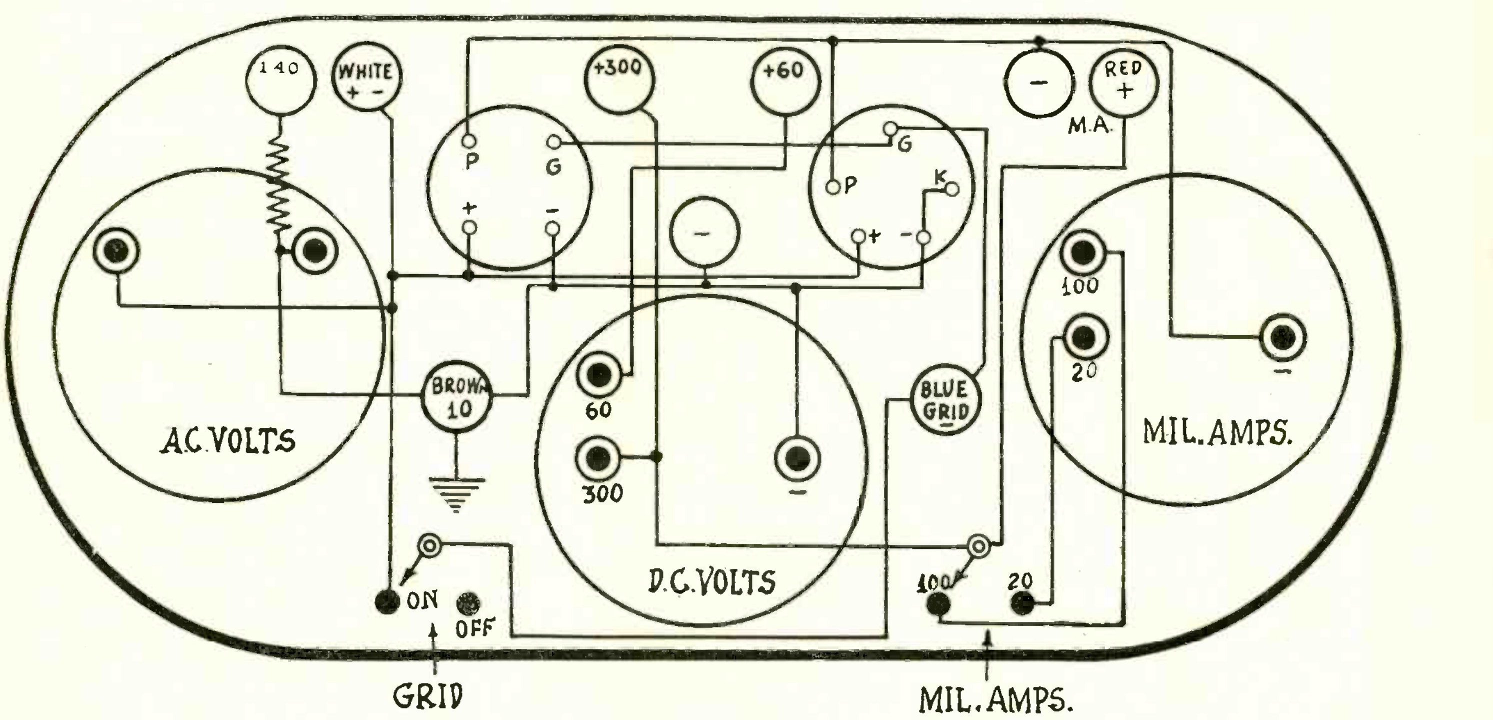


FIG. 1.

BOTTOM VIEW OF A THREE-METER TUBE AND CIRCUIT TESTER WHICH IS PROVIDED WITH TERMINALS SO THAT EACH METER CAN BE USED INDEPENDENTLY. THE DIAGRAM SHOWS A VIEW AS SEEN FROM THE BOTTOM. HENCE IN THE TESTER ITSELF THE POSITIONS OF THE EXTREME METERS ARE REVERSED.

FOR the radio service man, student and home experimenter there is nothing more useful than a set of meters with which various tests on receivers and tubes can be made. If these meters are contained in a single case which can be slipped into a coat pocket their usefulness and convenience are much enhanced.

The most important feature of such a set of meters, whether assmbled in one compact unit or not, is versatility. Not only should the set be capable of making tests on a receiver, but it should be so designed that the individual meters may be used separately.

Many test sets have been offered in the past with which most of the circuit tests could be made conveniently, but few have been designed so that the meters could be used separately, simply because no terminals were provided for this purpose. The manufacturrs now have recognized the need of such terminals for optional independent use of meters and at least one simple set is available which is so arranged that the meters can be used separately, or in combination, with equal facility.

Measuring AC Line Voltage

Fig. 1 shows the circuit diagram of this tester, as viewed from the bottom. The large circles in this figure represent the three meters built into the unit. The two circles next in size represent the tube sockets, or for UX type (four prong) tubes and the other for UY type (five prong) tubes. The nine circles next in size represent available terminals, all of which are of socket or jack type. The small circles with the black centers are meter terminals, none of which is directly available, but only through the jack terminals. The small circular black dots represent optional connections of the two single pole, double throw switches.

Now suppose it is required to measure an AC voltage less than 140 volts, for example, the line voltage supplying the radio set or the house lighting circuit. Remove all connections to the test set and make sure there are no tubes in the sockets. Then connect a pair of test leads, furnished with the outfit, from the line across the two terminals marked 140 and "white, +, —". Read the voltage on the meter marked "AC volts." This meter is on the right of the tester and on the left of the drawing. A DC voltage less than or equal to 140 volts can be measured on the same meter in the same way.

If it is required to measure DC voltages up to 300 volts the middle meter should be used. Remove any tubes that be in the tester as well as all other leads that may be connected to it. Plug in the positive lead from the DC voltage source in the jack marked "plus 300" and the negative lead in the jack marked simply (—). Read the voltage on the 0 to 300 volt scale on the meter marked "DC volts." If the voltage is less than 60 volts, plug the positive lead into the terminal jack marked "plus 60" and read the voltage on the 0 to 60 volt scale of the DC voltmeter.

Using the Milliammeter

The milliammeter at the left in the tester (at the right in the diagram) can be used for measuring currents up to 100 milliamperes. As before, all leads and tubes are removed from the tester. Set the switch marked "mil-amps." to 100. Now cut the line carrying the current to be measured at a suitable point and connect the leads thus provided to the two terminal jacks marked "M.A." Read the current on the 0 to 100 scale of the milliammeter on the left. If the pointer runs off the scale to the left, reverse the connections to the "M.A." jacks. If the current happens to be less than 20 milliamperes, throw the "mil-amps" switch to 20 and read the current on the 0-to-20 scale on the milliammeter.

Of course the object of first setting the switch on the 100 point is to protect the meter from possible burnout. Even this precaution is not sufficient, for the current may well be in excess of 100 milliamperes. However, if the line into which the meter is inserted is any part of a radio receiver, there is little likelihood that any damage will result, for even the current in the B supply rarely exceeds 100 milliamperes, and when it does, it is not so much in excess that any harm will come to the meter. It must not, however, be connected in any filament circuit.

It is when the meter is used for measuring resistance, for example, with the aid of a battery that precautions must be taken. In such cases the voltage applied in series with the meter and the unknown resistance should be the lowest possible, for example, 1.5 volts. If this does not give a readable current, the voltage can be increased until the current has a suitable value. The resistance is computed by dividing the voltage by the current.

245 Jiffy Tester

VOLTAGE AND PLATE CURRENT SPEEDILY REVEALED

E. Hayden

Tubes not in a receiver can be tested with this unit very easily. A filament voltage of a value suitable to the tube under test is applied across the filament (or heater) windings either from a battery or the secondary of a filament transformer. Reference to the circuit diagram shows that the leads from the voltage source can be plugged into jacks marked 'White" and "Brown 10," whether the voltage is for the AC or the DC tube. Either voltage can be read on the 0-10 volt scale of the AC voltmeter at the right on the unit. (At left in diagram.) Instead of plugging in one of the leads into "Brown 10" the (—) jack in the center of the tester can be used. Note that "Brown 10" is negative.

Testing Tubes

The object of a tube test, of course, is to get the plate current for various plate voltages, or the filament emission. The emission current is that obtained when the grid and the plate are connected together. In order to get a plate current we have to connect voltage source to the proper terminals. We can find the proper jacks by tracing out the circuit. First we note that the two plates are connected together and that the common lead from them is connected to the negative terminals of the milliammeter. There are two positive terminals, (100) and (20), on this meter. Either one can be selected by the "mil amps." switch.

The common side of this switch is connected to the "Red plus" jack and to the "plus 300" jack. Hence we can connect the positive of the plate voltage source to either "Red plus" or to "plus 300." The negative of the plate voltage source should be connected to the (—) jack in the center of the set, or to "Brown 10," which is the same thing. When the tube is put into the appropriate socket, the milliammeter will read the plate current and the DC voltmeter will indicate the value applied to the plate.

If the plate current is less than 20 milliamperes, set the milliampere switch on the 20 point, and if the voltage applied is less than 60 volts, use the "plus 60" jack instead of the 300 jack.

If the filament emission is required, use a plate voltage less than sixty volt and connect the grid and the plate together. Obviously, this can be done by first setting the grid switch on the off position and then by joining the "Blue grid" and the "M. A. —" jacks. A lead provided with suitable tips is furnished with the test unit for this purpose.

Note that when the grid switch is set on the "on" position the grid is returned to positive side of the filament. This refers only to storage battery tubes, but it is often desirable to know what the plate current is when the grids are returned thus. In order to get the plate current when the grid is returned to the negative end of the filament, set the grid switch on the "off" position and join jacks "Blue grid" and "Brown 10" or (—) in the center of the set. Otherwise the "off" position would read plate current at free grid potential.

Circuit Testing

When a receiver is to be tested for continuity of leads or open circuits, the extension cable is used. This has four tip terminals fitting into the tip jacks on the test unit. These are colored red, blue, white and brown, and they should be plugged into the jacks of corresponding color. The tube in the set should be removed and placed in the socket on the tester into which it fits. Then the plug end of the extension cord should be put into the receiver socket vacated by the tube just removed.

When this change has been made the tube is still in the circuit, and the only thing that has been accomplished is to cut in the meters at the proper places in the receiver. The red lead picks up the plate, the blue the grid, the white the plus side of the filament circuit, and the brown the negative side of the filament circuit as well as the cathode of the heater tube. When the grid switch is on the "off" position the receiver should function just as if the tube were in the receiver proper, but when the grid switch is on the "on" position, the input to the tube is short circuited and no signals should be received. With the grid switch on the "on" position the plate current should be much higher than when it is on the "off" position.

The left-hand meter (milliamperes) reads the plate current of the tube in question. If this current is less than 20 milliamperes, throw the "mil. amps." switch to the left and read the upper scale. The middle meter reads the voltage on the plate of the tube. In radio frequency circuits using transformer coupling, this voltage should be about the same as the applied voltage. When the circuit under test comprises a resistance coupler, the plate voltage indicated on the middle meter should be very small, the value depending on the applied voltage and on the value of the coupling resistor. In detector circuits it is sometimes impossible to read the plate current with the meter, the current is so small. When the coupler is an audio transformer or a choke coil, the voltage reading should be definitely lower than the applied voltage but still of considerable magnitude, except that for a detector the current is very small. If the voltage indicated is the same as that obtained by measuring it directly at the course, or at the plate voltage terminals on the receiver, the coupling unit is short-circuited. If no indication at all is obtained in these cases, the coupling unit is open. If it is open no plate current indication will be obtained.

The filament voltage is obtained on the 0-10 scale on the meter at the right in the tester (left in diagram).

Measuring Grid Bias

The grid voltage can be measured as follows: Connect all the colored cord terminals to their respective jacks except the red. Put the grid switch on the "off" position. Connect 60 plus to the 10 jack, which is already in use. Then connect minus DC jack to grid jack. For these two connections use the red and black test leads provided. Plug the four-lead cable into socket in set and read the grid voltage on the 0-60 volt scale of the center meter. If the meter reads backwards, reverse the connections. This should rarely be necessary for it would indicate a positive grid.

For testing screen grid tubes use the special lead provided with clips for tube cap. Connect one end to the cap on the tube in the tester and the other to the clip in the receiver which goes on the cap when the tube is in its normal position. Set the grid switch on the "off" position. Connect all the colored leads to their respective jacks and then plug the cable into the socket in the set. Read plate current. To test the control grid remove the connecting cable from the set and touch it on the 10 (brown) jack on the tester. This makes the grid voltage zero and the plate current should be increased.

When testing a receiver, begin with the first tube in it and proceed progressively until all the tubes have been tested.

A rectifier tube can be tested indirectly. First test the output voltage with the 0-300 voltmeter. If the expected voltage is obtained when the B supply is delivering normal current, the tube is all right. If the voltages are low when the circuit is delivering current, or if voltage is practically non-existent when no current is drawn, the tube may be at fault, or the filter may be. Or again, the supply transformer may be at fault. If the filament of the rectifier tube is not lighted it may have burned out or the transformer may not be supplying any current. Check the filament voltage with the 0-10 AC voltmeter. If the filament seems to be normal and if the circuit still seems to be dead, the filament emission may have dropped. The quickest way to determine this point is to put in a rectifier tube that is known to be good.

Many experimenters who use a tester often draw the wrong conclusions from their observations, especially when they first use the tester. For example, if a certain test fails to give the results expected, the conclusion almost invariably is that the tester is at fault. The circuit that is supposed to be tested is never suspected, notwithstanding that it had previously behaved in such manner that it was desirable to test it. Obviously, such conclusions are topsy-turvy.

If the meter is suspected it should at least be tested on a receiver which is known to be working properly. If the tester fails on a good receiver, then the connections of the tester should be checked up carefully. If all the connections are correct, and if the receiver under test is all right, then there is some reason for suspecting the test set.

The screen grid voltage is best measured by using the DS voltmeter of the tester separately. The tube is left in the socket of the receiver, and the grid switch is put on the "off" position. The red lead is connected between the plus 60 volt jack on the tester and the grid terminal of the socket of the tub under test. The black lead is connected between the minus terminal above the DC meter on the tester and minus A or the cathode of the tube in the set. If the reading is in excess of 60 volts move the r.d lead to plus 300 on the tester. If there is any impedance, such as a resistance, in the screen grid circuit the receiver end of the red lead can be moved to binding post on the receiver to which the screen grid is connected. The voltage should be higher when connected in this manner than when connected to the grid post on the socket, and the difference is a measure of the resistance between the two points. If no reading is obtained when the lead is touched to the grid post, and one is obtained

(*Continued on next page*)

Stroboscopic Observation

A METHOD OF DISCOVERING DEFECTS

By J. E.

Technical

If one touches very lightly any part of the diaphragm of a loudspeaker while it is sounding, one feels the vibrations plainly. But if one looks at the same point there is no apparent motion, especially if the sounding note has a high pitch. At very low frequencies it is possible to see the motion, provided that the amplitude is large, that is to say, if the sound produced is loud.

Often it is desirable to see the motion even when the pitch of the tone produced by the speaker is high. For example, it may be required to determine whether the diaphragm is vibration as a whole or in part, or whether there are any nodes on the diaphragm, that is, points where there is no vibration at all. While these nodes can be located by the sense of touch, it is more instructive to locate them by the sense of sight. How can this be done when the rate of vibration is so high that the eye cannot follow the motion?

We know how to detect a radio frequency which is far above the highest audible frequency. It is done by means of heterodynes or beats between the frequency to be detected and another frequency locally generated and mixed with the incoming frequency. The locally generated frequency can be adjusted until it differs by an audible amount from the incoming frequency, thus producing a low frequency which can be heard in the headphones.

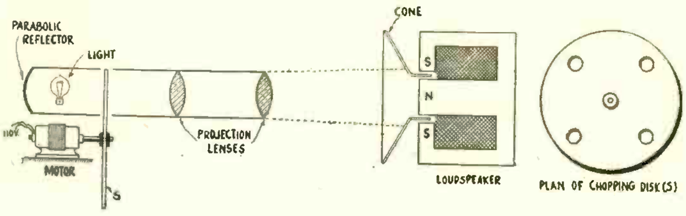


FIG. 1

A STROBOSCOPE ARRANGEMENT BY MEANS OF WHICH THE MOVEMENT OF A LOUDSPEAKER DIAPHRAGM CAN BE SLOWED DOWN SO THE EYE CAN FOLLOW IT. THE LIGHT CHOPPER S IS SHOWN AT THE RIGHT.

Stroboscopic Effect

There is a similar phenomenon in optics, known as the stroboscopic effect, by means of which any regularly recurring motion too rapid for the eye to follow may be slowed down, apparently, until it comes within the range of vision. There are numerous examples of such recurring motions in everyday experience, such as circular saws, gears, automobile wheels with spokes, certain pistons, airplane propellers, and loudspeaker diaphragms or armatures. All these usually move so rapidly that the eye cannot follow the motion, and the result is a blur.

A stroboscope is any optical arrangement whereby the eye gets only an occasional glimpse of the moving object, the glimpses occurring at regular intervals. These glimpses may be obtained by interposing a periodic shutter between the object viewed and the eye, or by illuminating the object by intermittent light. The rapidity of the glimpses obtained of the object viewed must be related to the speed of the object in a definite way if the apparent motion is to be slowed down. Consider a wheel having twenty spokes, placed at equal angles, and spinning at the rate of twenty times per second. If the eye is focused at any point on the wheel, 400 spokes will then pass the eye every second. This is much too rapid for the eye to follow.

Suppose now that this wheel is illuminated 390 times a second, so that the eye gets 390 glimpses of the spinning wheel. These glimpses are also much too rapid for the eye to see, and the wheel will appear to be continuously illuminated. But the wheel will appear to move at a rate of 10 spokes a second. If the rate of the intermittent illumination is increased to 400 times a second, the wheel will appear to stand still. If the speed of illumination is increased further, the wheel will begin to appear to move in the opposite direction, a phenomenon often noticed in the movies. The speed of the apparent motion is always

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(*Continued from preceding page*)

when connected to the binding post, there is an open between the two points.

There is little need for measuring the screen grid current.

Eighteen Tests in 5 Minutes

TEST NO. 1—To measure filament voltage, AC or DC.

Connect four-lead cable terminals to tester, color for color. Set grid switch on the "off" position. Take the tube from the set and plug into the tester. Plug four-lead cable into socket just vacated. Read filament voltage on 0-10 scale of AC voltmeter. Repeat for other tubes in set.

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

TEST NO. 2.—To measure plate current of any tube.

Proceed as in test No. 1. Set milliampere switch on 100. Read the corresponding scale. If current is less than 20 milliamperes throw switch over to 20 and read upper scale on the milliammeter.

TEST NO. 3—To measure the total plate current of a receiver.

Use milliammeter of tester as a separate meter. Open up the B minus lead to the receiver. Set milliammeter switch on 100. Connect the opened B minus leads to (—) and "red" jacks marked milliamperes. If needle goes backwards reverse the two leads. Use red and black leads for making the connections. If current is less than 20 milliamperes throw milliammeter switch to 20 and read upper scale.

TEST NO. 4—To measure plate voltage applied to any tube in the receiver.

Proceed as in Test No. 1. Read voltage on 0-300 scale.

TEST NO. 5—To test the condition of a tube.

Proceed as in Test No. 2. Note plate current. Throw grid switch on and again note plate current. The second reading should be considerably higher than the first (about twice). For normal value of plate current is the first position see table accompanying tester.

Eighteen Tests in Five Mi

TEST NO. 6—To measure the filament emission of a tube.

Proceed as in Test No. 2, except that the tube to be tested should be in the proper socket on the tester and the four-lead cable should be plugged into a suitable socket provided with the proper filament and plate voltages. Leave grid switch on the "off" position. With one of the leads furnished connect the grid and the plate by plugging in (—M. A.) and "blue." If a separate socket is not available use one of the sockets in the radio receiver having the appropriate filament and plate voltage. Short circuit the load impedance, such as a plate resistor or audio transformer. If the socket use is for an RF amplifier short-circuiting is not necessary.

TEST NO. 7—To measure the AC line voltage.

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

TEST NO. 8—To test for continuity of circuit, or to test for open circuit.

Apply Tests No. 1, No. 2 and No. 4. If the circuit shows filament voltage, plate voltage and plate current the circuits involved are continuous. If there is no indication there is an open somewhere. To locate the open use DC voltmeter and an external voltage source such as a 7½ volt battery. Plug black lead into (—) jack in center of tester and red lead in plus 60 jack. Connect the red to the plus side of external battery and connect another lead to the negative. Use the black and the new lead for exploring the uspected circuit. If the two leads are touched on opposites sides of the open no indication will be obtained on the meter. By this method the open can be bracketed in until its location is found.

TEST NO. 9—To test for shorts in condensers, resistors and coils.

# of Loudspeaker Movement

IN ARMATURES AND DIAPHRAGMS

Anderson

Editor

determined by the difference between the rate of illumination and the rate of passage of the spokes.

Vibrations of Loudspeaker

If the diaphragm or the armature of a loudspeaker is viewed in a suitable intermittent light, the movement is likewise apparently reduced. If the rate of the intermittent illumination is slightly slower than the rate of the forward and backward motion of the diaphragm, the motion appears to be so slow as if it were moved by the hand.

To be able to study the excursions of the diaphragm at all frequencies which may be impressed on the loudspeaker, the rate of the intermittent illumination should be controllable over a wide range, since the rate of illumination should always be slightly slower or slightly faster than the plunging movement of the diaphragm.

One arrangement for obtaining the effect is illustrated in Fig. 1. A bright source of light is placed on one side of a spinning disc containing a number of equi-spaced holes. On the other side if the spinning disc is projecting lens which throws the light on the object the motion of which is to be studied. The rate of illumination can be varied either by varying the speed of the motor or by varying the number of holes in the spinning disc.

Neon Lamp Illumination

In the arrangement shown a parabolic reflector is placed behind the lamp to utilize as much of the light as possible. The lamp is also inclosed so that no light can get out except in the beam projected by the lens system. The object of using a projection system is to focus the intermittent illumination on the spot it is desired to observe. With this arrangement it is not necessary to darken the room, provided the illumination on the spot studied is brighter than the illumination around it.

It is also possible to make use of the properties of a neon glow tube for obtaining the stroboscopic effect. In order to use this tube it is necessary to use an electric oscillator by means of which the voltage across the tube can be varied at a suitable frequency. When the voltage is low the lamp goes out; when it is high the lamp goes on. By this means the rate of illumination can be varied up to hundreds of thousands of times per second. Since the frequency of the current from an oscillator can be varied by means of variable condensers and since any desired frequency can be obtained, this method is especially convenient.

The disadvantage of using the glow tube is that the illumination is feeble. Therefore when it is used it is necessary to exclude other sources of light, or so much of other illumination that the light from the glow lamp appears bright in comparison with the diffused light.

When the stroboscope illustrated in Fig. 1 is used for exploring the movements of a loudspeaker diaphragm, the light beam should be directed at the spot to be studied. If at any point there is no motion the stroboscope will, of course, not reveal any motion. But if there is motion, no matter how rapid, it can be brought out by suitably adjusting the rate of the intermittent illumination.

The stroboscope is not unlike ultra-rapid motion pictures. In these the moving object is photographed at a high rate of speed and then projected at normal speed. The result is that the motion is slowed down.

There is also a true stroboscopic effect observable at times in moving pictures. For example, when an automobile comes into the field of view and gradually stops, the spokes in the wheels will appear to stand still for a moment, then reverse and appear to move backwards. This may again be followed by stand-still and a forward motion.

The intermittent illumination in this case comes from the projector and the rate is the same as the number of pictures projected per second. This may be from 16 to 24. The speed of the automobile, and the number of spokes that flash by the eye change as the car is retarded. When the frequency of the spokes passed the eye is equal to the rate of the intermittent illumination, the wheels appear to stand still, although the car moves forward.

nutes on J-245 Analyzer

Proceed as in Test No. 8. Preferably remove the part to be tested from the circuit. Connect the exploring leads to the two terminals of the part and note the voltage reading. If it is shorted the reading should be the same as when the two exploring terminals are touched together. If the condenser is good there should be no reading. If the resistor or coil is shorted full voltage should be obtained. If it is good, the reading should be reduced by an amount depending on the value of the resistance of the device.

TEST NO. 10—To determine the grid bias on a tube.

This can be obtained on any tube by using the DC voltmeter separately. Use the black and red leads and plug one into (—) and the other into plus 60 jacks. Connect the red to filament or cathode in the set and the black to the grid or to the F minus terminal of the coupling transformer ahead of the tube, or to the corresponding point on the grid leak. If the lead is connected to the grid inaccurate or no readings will be obtained, except in radio frequency circuits.

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

TEST NO. 11—To test for overload and distortion.

Proceed as for measuring current, plugging in the four-lead cable in the last tube socket in the receiver and note the plate current. If the milliammeter reading remains stationary, or fluctuates only slightly, on loud signals, the tube is not overloaded. If it jumps around widely the tube is seriously overloaded. In case of very serious overloading the tube ahead of the power tube can be tested in the same way, provided that the circuit is transformer coupled.

TEST NO. 12.—To test for proper bias.

Proceed as in Test No. 11 and note the needle of the milliammeter. If the needle kicks upward on loud signals the bias is too high; if it kicks downward, the bias is too low. If the needle stands still, the bias is correct. It will never stand still if the tube is overloaded.

TEST NO 13.—To determine the starting and stopping of oscillation.

Proceed as for obtaining plate current, plugging into the oscillator tube. The starting of oscillation is indicated by a sudden rise in the plate current. Stopping of oscillation is indicated by a sudden drop in the plate current.

TEST NO. 14—Testing screen grid tubes.

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

TEST NO. 15—To measure DC voltages up to 600 volts.

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

TEST NO. 16.—To measure UV type tubes (UV99).

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

TEST NO. 17.—To test Kellogg and old Arcturus tubes.

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

TEST NO. 18—To measure screen grid voltage.

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

These eighteen tests can be made in five minutes.

A "Front End" For

TWO STAGES OF SCREEN GRID AHEAD

By H. B

Double Screen Grid Circuit Used

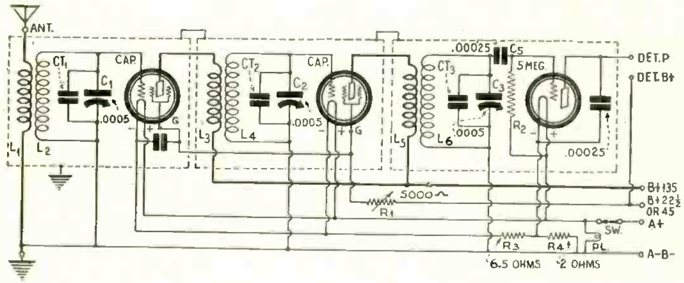


FIG. 1.

TUNER FOR FEEDING A POWER AMPLIFIER. THE TUBES ARE STORAGE—BATTERY HEATED. BATTERIES OR B SUPPLY MAY FEED THE PLATES.

LIST OF PARTS

C1,C2,C3—One Hammarlund battleship condenser, 3-gang, each section .0005 mfd. Cat. BST 50.
L1,L2,L3,L4,L5,L6—Three Hammarlund shield grid RF transformers. Cat. SGT 23.
CT1,CT2,CT3—Three Hammarlund 80 mfd. equalizers. Cat. EC80.
C4—One .01 mfd. mica condenser.
C5,C6—Two .00025 mfd. mica condensers.
R1—One Electrod 5,000 ohm Royalty, with switch, knob.
R2—One 5 meg. Lynch metallized grid leak.
R3—One filament resistor, 6.5 ohms.
R4—One 2 ohm filament resistor.
1,2,3—Three four-prong (UX) sockets.
Ant., Gnd., Sp. (+) Sp. (—)—Four binding posts.
One 20½x9" baseboard, ¾" thick.
One 7x21" bakelite front panel.
One Hammarlund drum dial with pilot light and knob. Cat. SDB1.
One Hammarlund HQS1 shield and one Hammarlund. Cat HQS double shield.
Two 222 tubes and one 112A tube.

A battery-operated screen grid tuner, to work into a two-stage power amplifier, is shown in the accompanying diagram. The filaments are storage-battery heated, but the plate voltages may be obtained from the power pack.

There are two stages of tuned radio frequency amplification and a tuned detector, each of the three stages being shielded separately. The physicial makeup of the shields for the first two stages is such that one piece of construction, with a wall approximately at center, is used.

Single Control, High Gain

The gain is high, as the coils have a large number of turns on the primaries. The coils have tapped primaries, but none of the taps is used.

Single drum dial tuning is provided. The three-gang condenser is placed so that the drum is attached at left on the condenser and the driving mechanism at right. This is handy for folk who are right-handed. The volume control is appropriately placed in a corresponding position at left.

Although roomy shields are used, the layout occupies only 20½x9 inches, so fits into a standard 7x21 inch table model cabinet, not requiring the usual extra depth of shielded circuits.

A diagram shows how to arrange the 7x21 inch front panel for symmetry and efficiency. The switch is on the volume control so an extra panel appurtenance is avoided.

Excellent results and dependability are assured. The design is intended to enable persons to modernize the "front" end,

Constructional Layout Solves Problems of Assembly

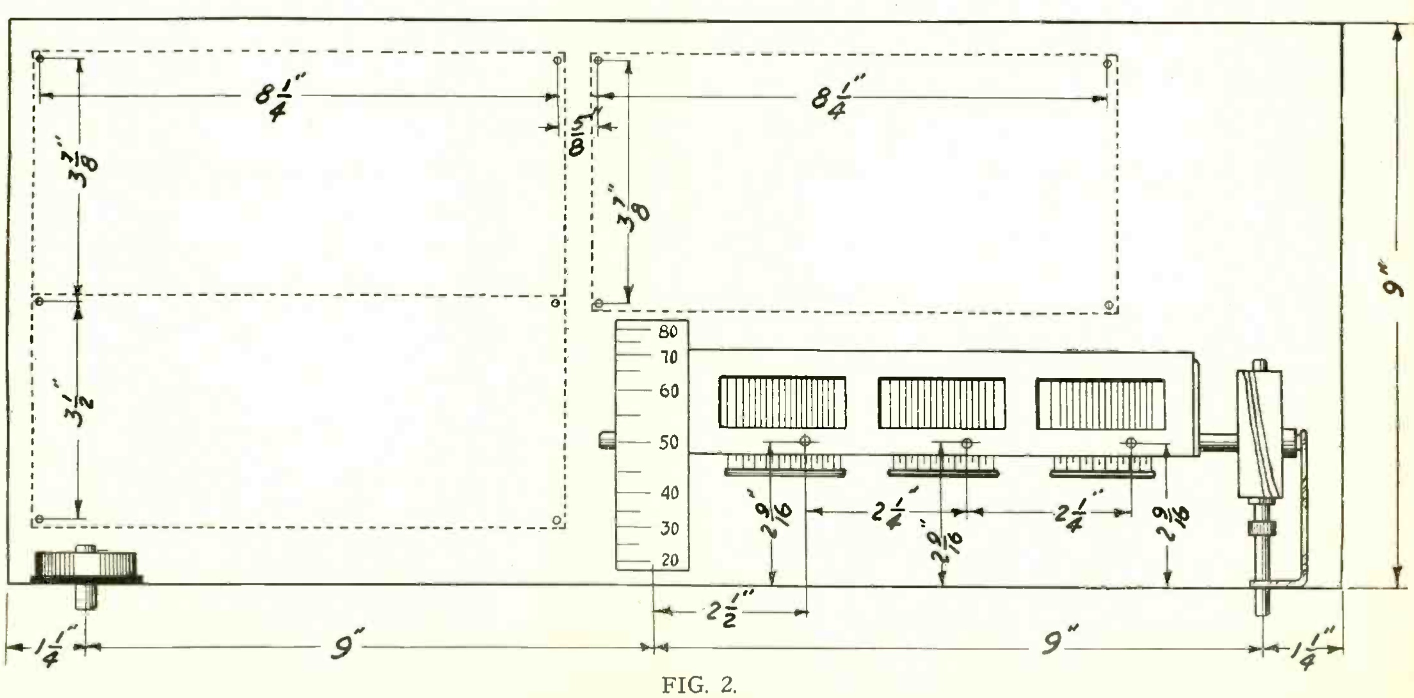


FIG. 2.

LAYOUT OF THE SHIELDED STAGES, DRUM AND DRIVE MECHANISM. THE DRIVE AT RIGHT ACTUATES THE DRUM AT CENTER BECAUSE BOTH ARE CONNECTED THROUGH THE CONDENSER SHAFT.

A Power Amplifier
OF DETECTOR FOR A BATTERY TUBES

Herman

where they have an audio amplifier and power source for the audio amplifier, although, of course, by extending the size a little two stages of audio may be included right in a 7x24 inch cabinet. It was not primarily intended that the audio be included, but it was assumed that audio is available already, as designs for such a circuit with audio will appear in a subsequent issue.

Standard Circuit for DX

The type of detection selected was grid leak-condenser, since there are two audio stages contemplated or available, and the volume control prevents overloading. The detector is a 112A tube, while the two radio frequency amplifiers are 222 tubes.

By using a first-class three-gang condenser and accurately wound coils, properly distanced from the walls of their respective shields, and adjusting the three equalizing condensers, CT1, CT2 and CT3, there is no difficulty whatever in bringing in far-distant stations with the single tuning control. The sensitivity is easily high enough to make the convenience of single dial tuning utterly practical and worth-while.

The circuit is wholly standard.

The first shield is grounded and the other shields likewise by interconnection. A lug at adjacent corner pillars of the shields, placed between the head of the fastening screw and the bottom of the shield, and left protruding, will facilitate interconnection.

The rotor of the three-gang condenser is grounded, as is A minus, and in the first two stages the grids are returned to this ground potential, so that the screen grid tubes are biased by the voltage drop in the sum of the resistance of R3 and R4. This is a little less than 3 volts, and while about twice as much as may be recommended on the slip included in tube cartons, is all right, indeed preferable.

Watch Subpanel Height

The detector circuit is returned conductively to A plus, this being done through the leak, R2. The condenser C5 stops the grid return from going through to A minus by way of the coil, so the leak is left free to maintain an independent return for the detector circuit. The positive return is more sensitive.

The distances between shield screw-holes are shown in one of the diagrams, also the relative positions of the drum, condenser gang and drive mechanism. These left-and-right and front-and-back dimensions hold for all installations, but the front panel heights hold only for a ¾ inch height of the subpanel itself, so if the subpanel is to be higher or lower, including its own thickness, raise or drop the holes accordingly. The arithmetic is done easily in conjunction with a study of the front panel layout.

The usual mounting legs of the condenser are ignored, and instead three holes intended for trimming condensers are used for mounting. The subpanel is pierced accordingly. These holes are No. 6 (for 6/32 machine screws) and the locations are shown 2 9-16 inches back from the subpanel front edge, and 2½ inches, 4¾ inches and 7 inches front the subpanel center. The separate distances are marked on the diagram, rather than the total lengths.

Ample Allowance Made

There is some leeway for mounting the drum. This is valuable. Often after a front panel is completed it is found necessary to push the drum over to the right, let us say, so that it will be exactly centered on the escutcheon pointers. But, alas, there is no possible movement to the right. The drum is as far over in that direction as it can go, stopped by the condenser frame, and the only remedy would be the tedious work of remounting the condenser. But in the present instance there is leeway left and right, and this applies to the drive mechanism no less than to the drum. Slight inaccuracies in drilling holes and otherwise preparing the front panel therefore need not necessarily prove fatal.

It is a fact that mounting this condenser in the unorthodox manner prescribed is tedious, for the following reasons:

For a countersunk panel of ¾ of an inch in height the 6/32 machine screws should be ⅞ of an inch long. They will penetrate the frame of the bathtub condenser at the points alternately reserved for the equalizers. The stator plates come close to the frame at this point. So close is the room that a 1 inch

Symmetrical Beauty of Front Panel

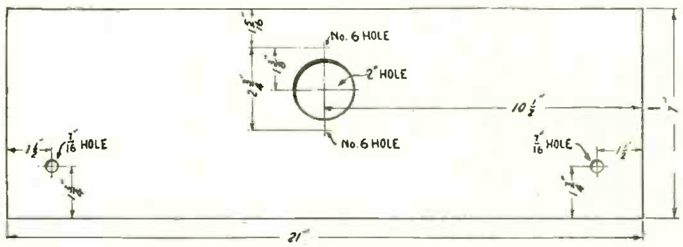


FIG. 3.
DIMENSIONS FOR THE FRONT PANEL. THESE MUST BE FOLLOWED CAREFULLY TO INSURE DRUM COMING IN EXACTLY THE RIGHT PLACE AND TUNING KNOB FITTING THE HOLE AT RIGHT.

screw would hit the stator, hence the condenser would be shorted, since the frame (rotor) is grounded. If you have only 1-inch shank screws you will avoid the difficulty by lowering the screw at bottom of the subpanel with an ordinary hexagonal nut.

Where Difficulty Arises

The difficulty arises in affixing a nut to the screw at the point where the condenser frame holes are penetrated on the inside. The ordinary nut will not do. It is too thick. The midget type 6/32 nut has to be used. Getting this nut on is a trick, simplified, however, by the aid of any pair of lay hands. Your wife can be very helpful. Mine was.

Use a jack-knife blade or a hooked scriber to hold the nut above the hole. Gently push the screw up to meet it. Then hold the screw firmly. Lightly turn the nut to the right by pushing the nut (not the screw) with a screwdriver or similar bladed instrument. As soon as the screw is caught, which will be after the nut has fallen into the condenser a few times and gotten half your goat, hold the nut firmly with a pair of pliers, and provisionally tighten the screw at the head end with a screwdriver. Do not tighten permanently or too strongly, as at this stage it is advisable to be able to shift a trifle to aid in placement of the two other screws and the fixation of their respective nuts. Then, when the assembly is semi-rigid, everything in proper place, fasten the screws permanently, but do not drive so hard as to push the shank against the condenser stator in any one of the three segments of the tuning capacity.

This work of condenser mounting is the only trying part of the assembly. The rest is smoothly-rolling fun.

Be Sure Drum Clears Bottom

For the trimming condensers there are available companion holes on the upper side of the condenser, and these are used for this purpose. As must be clear, the condenser is mounted with its normal "side" at bottom. The standard legs stick out at back. A point to watch is that the condenser is so mounted that the drum clears the subpanel. It will do this when the condenser is mounted on one side but will not do it when the condenser is mounted on the wrong side. With legs at back you can't go wrong.

The two coils for the radio frequency stages are mounted to the right, in the central line of the shield compartment, and equi-distant from the two sides of the shield, and 3 inches to the left. The socket is placed a total of centred 5½ inches to left. The third shield, for detector input, has the coil in the absolute center of the shield and the socket at the right.

Observe Five-Eighth Inch Clearance

Between the two shields, behind the drum, there must be a ⅝ of an inch space, reckoned from the holes in the adjoining middle posts, so the drum will not strike the pillar of the right-hand shield. This warning is contained in the constructional layout. The dotted lines show the shield walls, these being slightly outside of the pillar holes.

Right or Wrong?

Twenty Questions and Answers on Interesting Topics

QUESTIONS

(1)—The regulation of a B supply unit is improved if the shunt condenser next to the rectifier tube is omitted.
(2)—The output voltage of such a device is increased when the condenser is omitted.
(3)—By the use of a phase reverser tube it is possible to couple a single-sided amplifier to a push-pull amplifier by means of resistance without short-circuiting one side of the push-pull amplifier.
(4)—This coupling results in accurate 180-degree phase reversal for all frequencies.
(5)—Television has emerged from the laboratory and is now ready for the public as a new source of home entertainment.
(6)—Any radio receiver can be provided with power detection by simply changing the bias on the detector tube and increasing the plate voltage.
(7)—In a talking movie system employing both phonograph and photoelectric pick-up the same power amplifier is used for both.
((8)—No additional amplification of the signals from the photoelectric cell is needed because these signals are originally about as strong as those from the phonograph record.
(9)—The moving coil in a Bernard tuning coil is a tickler for causing regeneration.
(10)—A Mershon electrolytic condenser is dry.
(11)—The only condition for getting the greatest amplification out of a screen grid tube is that the load impedance be very high.
(12)—The coefficient of coupling between two circuits can never exceed unity.
(13)—The coefficient of coupling between two circuits is a measure of how closely the circuits are associated.
(14)—Detection by means of the Fleming valve, or by actual rectification of the radio signal, cannot be effected without an excessive reduction of selectivity.
(15)—Rectification by a Fleming valve is substantially linear if a high resistance is used in the circuit.
(16)—Ohm's law applies only to direct current circuits.
(17)—Kirchoff's second law is an extension of Ohm's law.
(18)—Kirchhoff's first law states that the algebraic sum of all currents flowing to a point where many conductors meet is zero.
(19)—A Wheatstone bridge is an electrical instrument for measuring electric potential.
(20)—Ohm's law can be used for measuring the inductance of a coil or the capacity of a condenser.

ANSWERS

(1)—Right. There is a small improvement in the regulation. That is to say, the voltage across the output terminals does not vary so much with changes in the current drawn.
(2)—Wrong. When the condenser is omitted the voltage across the voltage divider is considerably lower than when the condenser is used. The output voltage increases slightly as the capacity is increased.
(3)—Right. With a phase reverser tube this is possible provided that the coupling impedances are adjusted properly.
(4)—Wrong. The phase shift is different from 180 degrees at both the upper and the lower ends of the scale.
(5)—Wrong. It will be long yet before the technique has developed to the point where television is ready as a source of home entertainment.
(6)—Wrong. In order that power detection may be successful it is necessary that the radio frequency amplification be much higher than it is in ordinary sets.
(7)—Right. In one portion of the circuit, the amplifier is the same.
(8)—Wrong. Much more amplification of the signals from the photocell is required than of the signals from the phonograph pick-up and hence a special amplifier is used before the signals from the photocell are impressed on the common amplifier.
(9)—Wrong. It is a type of variometer whereby the inductance in the tuned circuit is increased and decreased as required by the value of capacity in the circuit. The effect is to widen the range of the tuner.
(10)—Wrong. No electrolytic condenser can be dry for an electrolyte is a solution or a dilute acid.
(11)—Wrong. This is the first condition that must be satisfied, but it is not a sufficient condition. The load impedance must also be coupled to the grid of the succeeding tube so as to take advantage of the voltage drop in the impedance.
(12)—Right. This follows from the definition of the coefficient of coupling. For two coils the definition is: the coefficient of coupling is equal to the mutual inductance between the coils divided by the square root of the product of the primary and secondary inductance.
(13)—Right. This is true no matter what type of coupling is used, direct or mutual inductance, resistance or capacity.
(14)—Wrong. If the resistance in series with the valve is of the same order of magnitude as the grid leak resistance sometimes connected across the tuned circuit ahead of the detector, the selectivity is also of the same order of magnitude. The reduction need not be large.
(15)—Right. It is substantially linear for the higher values of input. For low input voltages there is a slight departure from linearity. This is due to the rapidly increasing internal resistance of the valve as the voltage decreases.
(16)—Wrong. It applies to alternating current circuits as well, provided the proper impedances are used in place of pure resistances.
(17—Right. Ohm's law states that the total voltage drop in a simple circuit is equal to the emf in the circuit. Kirchhoff's second law says the same thing for each mesh in a complex network. In a simple circuit the two are identical.
(18)—Right. In effect, this means that no current can pile up at a point when a circuit is in a steady state. It also means that as much current must flow away from the point as flows to it.
(19)—Wrong. A Wheatstone bridge is an instrument for measuring resistance, capacity and inductance.
(20)—Right. If the emf is alternating and if the emf and the current are measured in effective values either the capacity of a condenser or the inductance of a coil can be measured by applying Ohm's law. The resistance in the circuit must be negligible.

Practicality of Single Control

IN the operation of a single dial tuning receiver, is it a fact that each tuned circuit is exactly the same as the other, or are there discrepancies in the tuning?—J. S. Q.

There are discrepancies, but they are kept down to a workable minimum, by expert design and construction. The tuning condensers, considering the respective sections of the gang, may be made so accurately as to differ at any setting no more than a fraction of one per cent. Such accuracy is attained by the best condenser manufacturers. But aside from the condenser, there are truant capacities in the tuned circuits, due to leads, shields, adjacency of parts, etc., as well as inductive discrepancies, so that, all told, there is more room for variation between respective tuned stages than the condensers alone would lead one to suppose. Nevertheless, ganged tuning is not only practical, as has been abundantly proved, but a receiver that is sensitive indeed can be built on this principle. The gain in modern circuits is usually so high that any sacrifice in sensitivity, as compared with the maximum obtainable from separately tuned stages, can be tolerated. Where there are several tuned stages, say, three or four, it would be risky at this time to advocate separate tuning of each, as the public does not want that. Two tuning controls are appreciated by many for the extra sensitivity.

Double Detection

WHAT does double detection mean?—O. T.

We do not know what it means, apart from the context. It might refer to an attempt to obtain detection of the negative and positive cycles of the radio frequency wave, in the same detector tube, a fantastic circuit pretending to accomplish this having been published in some newspapers a few years ago. In connection with a Superheterodyne double detection would refer to the fact that the mixture of the incoming frequency with the oscillator frequency is modulated in the "first detector," amplified at intermediate frequency, and converted into audio in the "second detector." Hence the "first detector" is really not a detector, since it is a modulator, but the modulation hookup is the same as for deetction, so hence the loose reference to the "first detector." A Superheterodyne has only one detector, the miscalled "second detector," which is the demodulator, as contrasted with the modulator. The output of the modulator is radio frequency, as the audio component in the plate circuit is not used. The output of the demodulator is audio frequency, and the radio component in the plate circuit is not used. The reference to both modulator and demodulator as "detectors" in a Superheterodyne has brought about the phrase "double detection" in reference to this particular circuit.

List of Stations by *Frequency* With Wavelength *Conversion*

[FROM FEDERAL RADIO COMMISSION LIST REVISED UP TO NOON, OCTOBER 2d]

** Canadian shared*
*** Canadian exclusive*
S-Studio

550 KC, 545.1 METERS
WGR-Buffalo, N. Y.
WEAO-Columbus, O.
WKRC-Cincinnati, O.
KFUO-Clayton, Mo.
S-St. Louis, Mo.
KSD-St. Louis, Mo.
KFDY-Brookings, S. D.
KFYR-Mismark, N. D.
KTAB-Oakland, Calif.

560 KC, 535.4 METERS
WIOD-Miami, Fla.
WLIT-Philadelphia
WFI-Philadelphia
KFDM-Beaumont, Tex.
WNOX-Knoxville, Tenn.
WOI-Ames, Iowa
KFEQ-St. Joseph, Mo.
KOAC-Corvallis, Ore.
KLZ-Dupont, Colo.

570 KC, 526 METERS
WNYC-New York, N. Y.
WMCA-Hoboken, N. J.
S-New York, N. Y.
WSYR-Syracuse, N. Y.
WMAC-Cazenovia, N. Y.
WSMK-Dayton, O.
WKBN-Youngstown, O.
WWNC-Asheville, N. C.
KGKO-Wichita Falls, Tex.
WNAX-Yankton, S. D.
WPCC-Chicago, Ill.
WIBO-Desplaines, Ill.
S-Chicago, Ill.
KUOM-Missoula, Mont.
KXA-Seattle, Wash.
KMTR-Hollywood, Cal.

***580 KC, 516.9 METERS**
WTAG-Worcester, Mass.
WOBU-Charleston, W. Va.
WSAZ-Huntington, W. Va.
KGFX-Pierre, S. D.
KSAC-Manhattan, Kans.
WSUI-Iowa City, Iowa

590 KC, 508.2 METERS
WEEI-N. Weymouth, Mass.
WEMC-Berrien Spgs., Mich.
WCAJ-Lincoln, Nebr.
WOW-Omaha, Nebr.
KHQ-Spokane, Wash.

***600 KC, 499.7 METERS**
WTIC-Hartford, Conn.
WCAC-Storrs, Conn.
WCAO-Baltimore, Md.
WREC-Whitehaven, Tenn.
WOAN-Lawrenceburg, Tenn
WEBW-Beloit, Wis.
KFSD-San Diego, Calif.
KWYO-Laramie, Wyo.

610 KC, 491.5 METERS
WFAN-Philadelphia
WIP-Philadelphia
WDAF-Kansas City, Mo.
WOQ-Kansas City, Mo.
KFRC-San Francisco

620 KC, 483.6 METERS
WLBZ-Bangor, Maine
WDBO-Orlando, Fla.
WDAE-Tampa, Fla.
WJAY-Cleveland, O.
WTMJ-Brookfield, Wis.
KGW-Portland, Ore.
KFAD-Phoenix, Ariz.

***630 KC, 475.9 METERS**
WMAL-Washington, D. C.
WOS-Jefferson City, Mo.
KFRU-Columbia, Mo.
WGBF-Evansville, Ind.

640 KC, 468.5 METERS
WAIU-Columbus, O.
KFI-Los Angeles, Calif.

650 KC, 461.3 METERS
WSM-Nashville, Tenn.

660 KC, 454.3 METERS
WEAF-Bellmore, N. Y.
S-New York City
WAAW-Omaha, Nebr.

670 KC, 447.5 METERS
WMAQ-Addison, Ill.
S-Chicago, Ill.

680 KC, 440.9 METERS
WPTF-Raleigh, N. C.
KPO-San Francisco

****690 KC, 434.5 METERS**

700 KC, 428.3 METERS
WLW-Mason, Ohio

710 KC, 422.3 METERS
WOR-Kearny, N. J.
S-Newark, N. J.
KFVD-Culver City, Calif.

720 KC, 413 METERS
WGN-WLIB-Elgin, Ill.
S-Chicago, Ill.

****730 KC, 413 METERS**

740 KC, 405.2 METERS
WSB-Atlanta, Ga.
KMMJ-Clay Center, Nebr.

750 KC, 399.8 METERS
WJR-Silver Lake, Mich.
S-Detroit, Mich.

760 KC, 394.5 METERS
WJZ-Boundbrook, N. J.
S-New York, N. Y.
WEW-St. Louis, Mo.
KVI-Des Moines, Wash.
S-Tacoma

770 KC, 389.4 METERS
KFAB-Lincoln, Nebr.
WBBM-WJBT-Glenview,
S-Chicago, Ill.

***780 KC, 384.4 METERS**
WBSO-Wellesley, Mass.
WTAR-WPOR-Norfolk, Va.
WEAN—Providence, R.I.
WMC-Memphis, Tenn.
KELW-Burbank, Calif.
KTM-Santa Monica, Cal.
S-Los Angeles, Calif.

790 KC, 379.5 METERS
WGY-Schenectady, N. Y.
KGO-Oakland, Calif.

800 KC, 374.8 METERS
WBAP-Ft. Forth, Tex.
KTHS-Hot Springs Nat'l Park, Ark.

810 KC, 370.2 METERS
WPCH-Hoboken, N. J.
S-New York, N. Y.
WCCO—Anoka, Minn.
S-Minneapolis.

820 KC, 365.6 METERS
WHAS-Jeffersontown, Ky.
S-Louisville, Ky.

830 KC, 361.2 METERS
WHDH-Gloucester, Mass.
KOA-Denver, Colo.

****840 KC, 356.9 METERS**

850 KC, 352.7 METERS
KWKH-Kennonwood, La.
WWL-New Orleans, La.

860 KC, 348.6 METERS
WABC-WBOQ-N. Y. City
KFQZ-Hollywood, Calif.

870 KC, 344.6 METERS
WLS-Crete, Ill.
S-Chicago, Ill.
WENR-WBCN-Chicago

***880 KC, 340.7 METERS**
WQAN-Scranton, Pa.
WGBI-Scranton, Pa.
WCOC-Columbus, Miss.
KLX-Oakland, Calif.
KPOF-Denver, Colo.
KFKA-Greeley, Colo.

***890 KC, 336.9 METERS**
WJAR-Providence, R. I.
WKAQ-San Juan, P. R.
WMMN-Fairmont, W. Va.
WMAZ-Macon, Ga.
WGST-Atlanta, Ga.
KGJF-Little Rock, Ark
WILL-Urbana, Ill.
KUSD-Vermillion, S. D.
KFNF-Shenandoah, Iowa

900 KC, 331.1 METERS
WFBL-Syracuse, N. Y.
WMAK-Martinsville, N. Y.
S-Buffalo, N. Y.
WKY-Okla. City, Okla.
WFLA-WSUN-
Clearwater, Fla.
WLBL-Stevens Point, Wis.
KHJ-Los Angeles, Calif.
KSEI-Pocatello, Idaho
KGBU-Ketchikan, Alaska

****910 KC, 329.5 METERS**

920 KC, 325.9 METERS
WWJ-Detroit, Mich.
KPRC-Houston, Tex.
WAAF-Chicago, Ill.
KOMO-Seattle, Wash.

***930 KC, 322.4 METERS**
WIBG-Elkins Park, Pa.
WDBJ-Roanoke, Va.
WBRC-Birmingham, Ala.
KGBZ-York, Nebr.
KMA-Shenandoah, Iowa
KFWM-Oakland, Calif.
KFWI-San Francisco

940 KC, 319.0 METERS
WCSH-Portland, Maine
WFIW-Hopkinsville, Ky.
WHA-Madison, Wis.
KOIN-Sylvan, Ore.
S-Portland, Ore.
KGU-Honolulu, T. H.
KFEL-Denver, Colo.
KFXF-Denver, Colo.

950 KC, 315.6 METERS
WRC-Washington, D. C.
KMBC-Independence, Mo.
WHB-Kansas City, Mo.
KFWB-Hollywood, Calif.
KPSN-Pasadena, Calif.
KGHL-Billings, Mont.

****960 KC, 312.3 METERS**

970 KC, 309.1 METERS
WCFL-Chicago, Ill.
KJR-Seattle, Wash.

980 KC, 305.9 METERS
KDKA-Wilkins Township.
S-Pittsburgh, Pa.

990 KC, 302.8 METERS
WBZ-E. Springfield, Mass.
S-Boston, Mass.
WBZA-Boston, Mass.

1000 KC, 299.8 METERS
WHO-Des Moines, Iowa
WOC-Davenport, Iowa
KPLA-Los Angeles, Calif.

***1010 KC, 296.9 METERS**
WQAO-WPAP-
Cliffside, N. J.
S-New York, N. Y.
WHN-New York, N. Y.
WRNY-Coytesville, N. J.
S-New York, N. Y.
KGGF-Picher, Okla.
WNAD-Norman, Okla.
KQW-San Jose, Calif.

1020 KC, 293.9 METERS
WRAX-Philadelphia.
KYW-KFKX-Chicago.
KYWA-Chicago.

****1030 KC, 291.2 METERS**

1040 KC, 288.3 METERS
WKEN-Grand Island, N.Y.
S-Buffalo, N. Y.
WKAR-E. Lansing, Mich.
WFAA-Dallas, Tex.
KRLD-Dallas, Tex.

1050 KC, 285.5 METERS
KFKB-Milford, Kans.
KNX-Los Angeles, Calif.
S-Hollywood, Calif.

1060 KC, 282.8 METERS
WBAL-Glen Morris, Md.
S-Baltimore, Md.
WTIC-Avon, Conn.
WJAG-Norfolk, Nebr.
KWJJ-Portland, Ore.

1070 KC, 280.2 METERS
WAAT-Jersey City, N. J.
WTAM-Cleveland, Ohio
WEAR-Cleveland, Ohio
WCAZ-Carthage, Ill.
WDZ-Tuscola, Ill.
KJBS-San Francisco

1080 KC, 277.6 METERS
WBT-Charlotte, N. C.
WCBD-Zion, Ill.
WMBI-Chicago, Ill.

1090 KC, 257.1 METERS
KMOX-KFOA-Kirkwood
S-St. Louis, Mo.

1100 KC, 272.6 METERS
WPG-Atlantic City, N. J.
WLWL-Kearny, N. J.
S-New York, N. Y.
KGDM-Stockton, Calif.

1110 KC, 270.1 METERS
WRVA-Richmond, Va.
KSOO-Sioux Falls, S. D.

***1120 KC, 267.7 METERS**
WDEL-Wilmington, Del.
WCOA-Pensacola, Fla.
WTAW-College Sta., Tex.
KUT-Austin, Tex.
WISN-Milwaukee, Wis.
WHAD-Milwaukee, Wis.
KFSG-Los Angeles, Calif.
KRSC-Seattle, Wash.

1130 KC, 265.3 METERS
WJJD-Mooseheart, Ill.
WOV-Secaucus, N. J.
S-New York, N. Y.
KSL-Salt Lake City, Utah.

1140 KC, 263 METERS
WAPI-Birmingham, Ala.
KVOO-Tulsa, Okla.

1150 KC, 260.7 METERS
WHAM-Victor Township
S-Rochester, N. Y.

1160 KC, 258.5 METERS
WWVA-Wheeling, W. Va.
WOWO-Ft. Wayne, Ind.

1170 KC, 256.3 METERS
WCAU-Byberry, Pa.
S-Philadelphia, Pa.
KTNT-Muscatine, Iowa
KEJK-Beverly Hills, Calif.

1180 KC, 254.1 METERS
WDGY-Minneapolis, Minn.
WHDI-Minneapolis, Minn.
WGBS-Astoria, L. I.
S-New York City.
KEX-Portland, Ore.
KOB-State College, N. M.

1190 KC, 252 METERS
WICC-Easton, Conn.
S-Bridgeport, Conn.
WOAI-San Antonio, Tex.

***1200 KC, 249.9 METERS**
WABI-Bangor, Maine.
WNBX-Springfield, Vt.
WEPS-Gloucester, Mass.
WORC-Auburn, Mass.
WIBX-Utica, N. Y.
KGW-Stockton, Calif.
WHBC-Canton, Ohio.
WLAP-Louisville, Ky.
WLBG-Ettrick, Va.
WNBO-Washington, Pa.
WPRC-Harrisburg, Pa.
WKJC-Lancaster, Pa.
WNBW-Carbondale, Pa.
WABZ-New Orleans, La.
WJBW-New Orleans, La.
WBBY-Charleston, S. C.
WBBZ-Ponca City, Okla.
WRBC-Knoxville, Tenn.
WRBL-Columbus, Ga.
KGCU-Mandan, N. D.
WJBC-LaSalle, Ill.
WJBL-Decatur, Ill.
WWAE-Hammond, Ind.
WRAF-Laporte, Ind.
WMT-Waterloo, Iowa
KFJB-Marshalltown, Iowa
WCAT-Rapid City, S. D.
KGDY-Oldham, S. D.
WIL-St. Louis, Mo.
KFWF-St. Louis, Mo.
KFKZ-Kirksville, Mo.
KGDE-Fergus Falls, Minn.
KGFK-Hallock, Minn.
WCLO-Kenosha, Wis.
WHBY-West DePere, Wis.
KFWC-Ontario, Calif.
S-Pomona, Calif.
KPPC-Pasadena, Calif.
KXO-El Centro, Calif.
KMJ-Fresno, Calif.
KSMR-Santa Maria, Calif.
KGEK-Yuma, Colo.
KGEW-Ft. Morgan, Colo.
KFHA-Gunnison, Colo.
KVOS-Bellingham, Wash.
KGY-Lacey, Wash.

***1210 KC, 247.8 METERS**
WJBI-Red Bank, N. J.
WGBB-Freeport, N. Y.
WINR-Bayshore, N. Y.
WCOH-Greenville, N. Y.
S-Yonkers, N. Y.
WOCL-Jamestown, N. Y.
WLCI-Ithaca, N. Y.
WPAW-Pawtucket, R. I.
WDWF-WLSI-
Cranston, R. I.
WMAN-Columbus, Ohio
WJW-Mansfield, Ohio
WEBE-Cambridge, Ohio
WBAX-Wilkes-Barre, Pa.
WJBU-Lewisburg, Pa.
WTAZ-Richmond, Va.
WMBG-Richmond, Va.
WSIX-Springfield, Tenn.
WRBU-Gastonia, N. C.
WJBY-Gadsden, Ala.
WMBR-Tampa, Fla.
WRBQ-Greenville, Miss.
WGCM-Gulfport, Miss.
KWEA-Shreveport, La.
KDLR-Devils Lake, N. D.
KGCR-Watertown, S. D.
KFOR-Lincoln, Neb.
WHBU-Anderson, Ind.
KFVS-Cape Girardeau, Mo.
WEBQ-Harrisburg, Ill.
WSBC-Chicago, Ill.
WCRW-Chicago, Ill.
WEDC-Chicago, Ill.
WCBS-Springfield, Ill.
WTAX-Streator, Ill.
WHBF-Rock Island, Ill.
WIBA-Madison, Wis.
WOMT-Manitowoc, Wis.
KPQ-Seattle, Wash.
KPCB-Seattle, Wash.

1220 KC, 245.8 METERS
WCAD-Canton, N. Y.
WCAE-Pittsburgh, Pa.
WREN-Lawrence, Kan.
KFKU-Lawrence, Kan.

1230 KC, 243.8 METERS
WNAC-Boston
WBIS-Boston
WPSC-State College, Pa.
WSBT-South Bend, Ind.
WFBM-Indianapolis, Ind.
KYA-San Francisco, Calif.
KFIO-Spokane, Wash.
KFQD-Anchorage, Alaska

1240 KC, 241.8 METERS
WGHP-Fraser, Mich.
S-Detroit, Mich.
KTAT-Ft. Worth, Tex.
WJAD-Waco, Tex.
WQAM-Miami, Fla.
WRBC-Valparaiso, Ind.

1250 KC, 239.9 METERS
WGCP-Newark, N. J.
WODA-Paterson, N. J.
WAAM-Newark, N. J.
WLB-WGMS-Minneapolis
WRHM-Fridley, Minn.
KFMX-Northfield, Minn.
WCAL-Northfield, Minn.
KFOX-Long Beach, Calif.
KXL-Portland, Ore.
KILO-Boise, Idaho

1260 KC, 238 METERS
WLBW-Oil City, Pa.
WJAX-Jacksonville, Fla.
KVOA-Tucson, Ariz.
KWWG-Brownsville, Tex.
KRGV-Harlingen, Tex.
KOIL-Council Bluffs, Ia.

1270 KC, 236.1 METERS
WJDX-Jackson, Miss.
WEAI-Ithaca, N. Y.
WFBR-Baltimore, Md.
WASH-Grand Rapids, Mich.
WOOD-Furnwood, Mich.
S-Grand Rapids, Mich.
WDSU-New Orleans, La.
KWLC-Decorah, Iowa
KGCA-Decorah, Iowa
KTW-Seattle, Wash.
KOL-Seattle, Wash.
KFUM-Colo. Springs, Col.

1280 KC, 234.2 METERS
WCAM-Camden, N. J.
WCAP-Asbury Park, N. J.
WOAX-Trenton, N. J.
WDOD-Chattanooga, Tenn.
WRR-Dallas, Tex.
WDAY-Fargo, N. D.
WEBC-Superior, Wis.
S-Duluth, Minn.

1290 KC, 232.4 METERS
WNBZ-Saranac Lake, N. Y.
WJAS-Pittsburgh, Pa.
KTSA-San Antonio, Tex.
KFUL-Galveston, Tex.
KLCN-Blytheville, Ark.
KDYL-Salt Lake City

1300 KC, 230.6 METERS
WBBR-Rossville, N. Y.
WHAP-Carlstadt, N. J.
S-New York, N. Y.
WEVD-Woodhaven, N. Y.
S-New York, N. Y.
WHAZ-Troy, N. Y.
KFH-Wichita, Kan.
WIBW-Topeka, Kan.
KGEF-Los Angeles
KTBI-Los Angeles
KFJR-Portland, Ore.
KTBR-Portland, Ore.

1310 KC, 228.3 METERS
WKAV-Laconia, N. H.
WEBR-Buffalo, N. Y.
WNBH-New Bedford, Mass.
WOL-Washington, D. C.
WGH-Newport News, Va.
WRK-Hamilton, Ohio
WAGM-Royal Oak, Mich.
WFDF-Flint, Mich.
WNAT-Philadelphia, Pa.
WFKD-Frankford, Pa.
S-Philadelphia.
WHBP-Johnstown, Pa.
WFBG-Altoona, Pa.
WRAW-Reading, Pa.
WGAL-Lancaster, Pa.
WRBI-Tifton, Ga.
WSAJ-Grove City, Pa.
WBRE-Wilkes-Barre, Pa.
WMBL-Lakeland, Fla.
WKBC-Birmingham, Ala.
KGHG-McGehee, Ark.
WOBT-Union City, Tenn.
WNBJ-Knoxville, Tenn.
KRMD-Shreveport, La.
KTSL-Cedar Grove, La.
S-Shreveport, La.
KFPM-Greenville, Tex.
WDAH-El Paso, Tex.
KTSM—El Paso, Tex
KGFI-Corpus Christi, Tex.
KFPL-Dublin, Tex.
KFXR-Okla. City, Okla.
WKBS-Galesburg, Ill.
WEHS-Evanston, Ill.
WCLS-Joliet, Ill.
WKBB-Joliet, Ill.
WKBI-Chicago, Ill.
WHFC-Cicero, Ill.
KWCR-Cedar Rapids, Ia.
KFJY-Ft. Dodge, Ia.
KFGQ-Boone, Ia.
WBOW-Terre Haute, Ind.
WJAK-Marion, Ind.
WLBC-Muncie, Ind.
WIBU-Poynette, Wis.
KFBK-Sacramento, Calif.
KGEZ-Kalispell, Mont.
KFUP-Denver, Colo.
KFXJ-Edgewater, Colo.
KMED-Medford, Ore.
WJDZ-Winston Salem, N. C.

1320 KC, 227.1 METERS
WADC-Akron, Ohio
WSMB-New Orleans, La.
KGIO-Idaho Falls, Idaho
KGIQ-Twin Falls, Idaho
KGHF-Pueblo, Colo.
KID-Idaho Falls, Idaho

1330 KC, 225.4 METERS
WDRC-New Haven, Conn.
WSAI-Harrison, Ohio
S-Cincinnati
WTAQ-Washington, Wis.
S-Eau Claire, Wis.
KSCJ-Sioux City, Iowa

1340 KC, 223.7 METERS
WSPD-Toledo, Ohio
KFPW-Siloam Springs, Ark.
KMO-Tacoma, Wash.

1350 KC, 221.1 METERS
WBNY-New York, N. Y.
WMSG-New York, N. Y.
WCDA-New York, N. Y.
WKBQ-New York, N. Y.
KWK-St. Louis, Mo.

1360 KC, 220.4 METERS
WLEX-Lexington, Mass.
WMAF-South Dartmouth, Mass.
WQBC-Utica, Miss.
WJKS-Gary, Ind.
WGES-Chicago, Ill.
KFBB-Great Falls, Mont.
KGIR-Butte, Mont.
KGB-San Diego, Calif.

1370 KC, 218.8 METERS
WMBO-Auburn, N. Y.
WSVS-Buffalo, N. Y.
WCBM-Baltimore, Md.
WBBL-Richmond, Va.
WHBD-Bellefontaine, O.
WHDF-Calumet, Mich.
WJBK-Ypsilanti, Mich.
WJDW-Emory, Va.
WIBM-Jackson, Mich.
WRAK-Erie, Pa.
WELK-Philadelphia.
WJBO-New Orleans, La.
WHBQ-Memphis, Tenn.
WRBT-Wilmington, N. C.
KGFG-Okla. City, Okla.
KCRC-Enid, Okla.
KGCI-San Antonio, Tex.
KGRC-San Antonio, Tex.
KFJZ-Ft. Worth, Tex.
KGKL-San Angelo, Tex.
KFLX-Galveston, Tex.
WFBJ-Collegeville, Minn.
WGL-Ft. Wayne, Ind.
KGDA-Dell Rapids, S. D.
KFJM-Grand Forks, N. D.
KWKC-Kansas City, Mo.
KGBX-St. Joseph, Mo.
WRJN-Racine, Wis.
KGAR-Tucson, Ariz.
KIT-Yakima, Wash.
KOH-Reno, Nev.
KZM-Hayward, Calif.
KRE-Berkeley, Calif.
KGER-Long Beach, Calif.
KLO-Ogden, Utah
KOOS-Marshfield, Ore.
KFBL-Everett, Wash.
KVL-Seattle, Wash.
KFJI-Astoria, Ore.
KGFL-Raton, N. M.
KGGM-Albuquerque, N.M.

1380 KC, 217.3 METERS
WCSO-Springfield, Ohio.
KQV-Pittsburgh, Pa.
KSO-Clarinda, Ia.
WKBH-LaCrosse, Wis.

1390 KC, 215.7 METERS
WHK-Cleveland, O.
KLRA-Little Rock, Ark.
KOY-Phoenix, Ariz.
KUOA-Fayetteville, Ark.
KOW-Denver, Colo.
KWSC-Pullman, Wash.
KFPY-Spokane, Wash.

1400 KC, 214.2 METERS
WCGU-Coney Isl., N. Y.
WSGH-WSDA-Bklyn, N Y
WLTH-Brooklyn, N. Y.
WBBC-Brooklyn, N. Y.
KOCW-Chickasha, Okla.
WCMA-Culver, Ind.
WKBF-Indianapolis, Ind.

1410 KC, 212.6 METERS
WBCM-Hampton, Mich.
S-Bay City, Mich.
KGRS-Amarillo, Tex.
WDAG-Amarillo, Tex.
KFLV-Rockford, Ill.
WHBL-Sheboygan, Wis.
WSGP-Savannah, Ga.

1420 KC, 211.1 METERS
WHDL-Tupper Lake, N.Y.
WHIS-Bluefield, W. Va.
WLBH-Patchogue, N. Y.
WMRJ-Jamaica, N. Y.
WLEY-Lexington, Mass.
WTBO-Cumberland, Md
WSSH-Boston, Mass.
WPOE-Patchogue, N. Y.
WIBR-Steubenville, O.
WILM-Wilmington, Del.
WEDH-Erie, Pa.
WMBC-Detroit, Mich.
WKBP-Battle Creek, Mich.
WQBZ-Weirton, W. Va.
KGFF-Alva, Okla.
KTAP-San Antonio, Tex.
KTUE-Houston, Tex.
KFYO-Abilene, Tex.
KICK-Red Oak, Iowa
WIAS-Ottumwa, Iowa
WLBF-Kansas City, Kan
WMBH-Joplin, Mo.
KLMP—Minot, N.D.
KGFW-Ravenna, Neb.
KFIZ-Fond du Lac, Wis.
KFXY-Flagstaff, Ariz.
KGFJ-Los Angeles, Calif
KFQU-Holy City, Calif.
KGGC-San Francisco.
KFXD-Jerome, Idaho
KGIW-Trinidad, Colo.
KGCX-Vida, Mont.
KFIF-Portland, Ore.
KORE-Eugene, Ore.
KFQW-Seattle, Wash.
KXRO-Aberdeen, Wash.

1430 KC, 209.7 METERS
WBRL-Manchester, N. H.
WHP-Harrisburg, Pa.
WBAK-Harrisburg, Pa.
WCAH-Columbus, Ohio
WGBC-Memphis, Tenn.
WNBR-Memphis, Tenn.

1440 KC, 208.2 METERS
WHEC-WABO-
Rochester, N. Y.
WOKO-Mt. Beacon, N. Y.
S-Poughkeepsie, N.Y.
WCBA-Allentown, Pa.
WSAN-Allentown, Pa.
WNRC-Greensboro, N. C.
WTAD-Quincy, Ill.
WMBD-Peoria Hts., Ill.
KLS-Oakland, Calif.

1450 KC, 206.8 METERS
WBMS-Fort Lee, N. J.
WNJ-Newark, N. J.
WIBS-Elizabeth, N. J.
WKBO-Jersey City, N. J.
WSAR-Fall River, Mass.
WFJC-Akron, Ohio
KTBS-Shreveport, La.
WTFI-Toccoa, Ga.

1460 KC, 205.4 METERS
WJSV-Mt. Vernon, Va.
KSTP-Westcott, Minn.
S-St. Paul, Minn.

1470 KC, 204 METERS
WKBW-Amherst, N. Y.
S-Buffalo, N. Y.
KFJF-Okla. City, Okla.
WRUF-Gainesville, Fla.
KGA-Spokane, Wash.

1480 KC, 202.6 METERS
WJAZ-Mt. Prospect, Ill.
S-Chicago, Ill.
WSOA-Deerfield, Ill.
S-Chicago, Ill.
WORD-Batavia, Ill.
S-Chicago, Ill.
WCKY-Villa Madonna, Ky.
S-Covington, Ky.

1490 KC, 201.2 METERS
WBAW-Nashville, Tenn.
WLAC-Nashville, Tenn.
KPWF-Westminster, Calif

1500 KC, 199.9 METERS
WMBA-Newport, R. I.
WLOE-Chelsea, Mass.
WMES-Boston, Mass.
WNBF-Binghamton, N. Y.
WMBQ-Brooklyn, N. Y.
WLBX-L. I. City, N. Y. C.
WCLB-Long Beach, N. Y.
WWRL-Woodside, N. Y.
WKBZ-Ludington, Mich.
WMPC-Lapeer, Mich.
WMBJ-Wilkinsburg, Pa.
S-Pittsburgh, Pa.
WOPI-Bristol, Tenn.
WPEN-Philadelphia, Pa.
KGHI-Little Rock, Ark.
WRBJ-Hattiesburg, Miss.
KGKB-Brownwood, Tex.
KGDR-San Antonio, Tex.
KGHX-Richmond, Tex.
WKBV-Brookville, Ind.
KPJM-Prescott, Ariz.
KVEP, Portland, Ore.
KWTC-Santa Ana, Calif.
KDB-Santa Barbara, Calif.
KUJ-Long View, Wash.

PRINCIPAL BILLS FORBETTERRADIO LISTED BY WHITE

Washington

Creation of a Communications Commission, with extension of life of the Federal Radio Commission meanwhile, are the chief radio proposals before Congress, said Representative White, of Maine, chairman of the house committee that deals with radio affairs.

Other radio matters likely to be acted on at the coming regular session said Representative White, are removal of the limitations on the power of the President in the appointment of members of the Commission, so as to do away with, the geographical distribution of its membership; and changes in existing law with reference to procedure to be followed by the Commission.

The Federal Radio Commission was created under Public Law No. 632, of the 69 the Congress, the radio act approved on February 23d, 1927. Under the terms of that act, the appointment of five members was authorized and not more than one of these five commissioners could be appointed from any of the five zones into which the country and its possessions are divided. The first commissioners, under that law, were to be appointed for the terms of 2, 3, 4, 5 and 6 years, respectively, from the effective date of the 1927 act, but their successors were to be appointed for terms of six years, except in the filling of vacancies.

Government Control Recommended in Canada

Washington.

The Royal Commission which was appointed in Canada to investigate the needs of radio broadcasting in the Dominion has recommended government control of radio broadcasting, according to a report to the Department of Commerce from Commercial Attache Lynn W. Meekins, Ottawa.

Lewis R. Miller, assistant U. S. trade commissioner at Sydney, Australia, has reported to the Department of Commerce that Australian radio trade is benefiting by government control of broadcasting. Added business resulted from the widespread interest aroused by the publicity given to the taking over of broadcasting, under government control, by the new Australian Broadcasting Company.

GREENE A BANK DIRECTOR

Nathaniel C. Greene, vice-president of the Polymet Manufacturing Corporation, 829 East 134th Street, New York City, recently was elected to the Board of Directors of the Fort Greene National Bank of Brooklyn.

WOR OUT OF C.B.S.

WOR, L. Bamberger & Co., Newark, N. J., has terminated its contract with the Columbia Broadcasting System and operates independently. WABC is the exclusive key station of the Columbia System in the New York area.

WORTH THINKING OVER

A CHICAGO daily newspaper publisner declares that at the present time 90% of his readers—he has more than three-quarters of a million daily—are listeners-in on the programs of a local station. Who says that 1929 doesn't promise to be a rip-snorting year for radio?

Forum

Circuit of Circuits

I EMBODIED Bernard's dynamic coils in my Screen Grid Universal and I am more than repaid for my effort. I have a cone speaker but it will not begin to handle the volume.

The range of these coils is determined a great deal by the number of turns on the rotor.

I am a farmer who dabbles in radio for a pastime. I have tried all your circuits as far back as I can remember, with splendid results. However, this latest HB compact circuit (as applied to my Universal), is far and away ahead of any set I ever saw or heard, bar none.

Accept my thanks for this circuit of circuits.

HELMER ROMNESS,
Zumbrota, Minn.

* * *

Can Not Be Best

I SUBSCRIBED for RADIO WORLD early in June and received as my first number the June 8th issue.

This was my first glimpse of RADIO WORLD and I am now a regular subscriber. There is a reason.

Of all radio magazines I have read to date, RADIO WORLD heads the list.

Technically, your paper cannot be beat and your Mr. Anderson and Mr. Bernard, I believe, are real authorities on radio.

I have studied the HB compact four tube battery model receiver and will build this set.

G. C. HANGMAN,
U. S. Navy.

* * *

Conspiracy of Silence

IT seems to me that the periodicals on radio when drawing up circuits adhere to the battery principle and keep the AC side of circuits back from the home constructor. This has disgusted more than one enthusiast who likes to roll his own. I constructed a seven-tube superheterodyne recently and rewired it twice. For my AC supply I used a tri-pack for plate voltage and power stage and a separate filament transformer for the 227 tubes. After a lot of experiments and patience I was utterly unable to get it to function, so tore it down.

It has seemed to me that the manufacturers have strived to keep AC construction out of the hands of home builders, which has got a lot of fans fed up.

JOHN STAMMERS, Toronto, Can.

Another News Scolding

PLEASE try to print more news. Remember that when a person is interested in radio that does not mean he is interested only in the technical side. Maybe a technician brings the copy home to study it some more, and some other member of the family, a lay person, picks it up. It is well to have considerable news in each issue to interest all whose interest in radio is popular, rather than technical. Besides, as some one pointed out last week, in Form, you have the field all to yourself. The monthly magazines are way late when they try to print news, because they have to go to press so long before the date of issue. You have the jump. Take it!

HENRY DODD,
Muncie, Ind.

BOARD RIDICULES N. Y. CITY CLAIM TO LAW IMMUNITY

Washington

The City of New York cannot operate its municipal station, WNYC, full time when the Federal Radio Commission has authorized part time only, it was contended by the Commission in a brief filed with the Court of Appeals of the District of Columbia.

The appeal of the city from the reallocation order requiring WNYC to share time with WMAC of Hoboken, N. J., is pending. New York City must adhere to the radio regulations, the Commission maintains.

The City of New York argues, according to the Commission's brief, that it had a proprietary right to operate its station full time, any restriction of which right violated the United States Constitution. The city contended further that, as a municipal corporation, its operation of the station was a governmental function.

In reply, the Commission asserted that the standing of the city as a municipality was in no way involved, and that it was operating the station in a proprietary capacity.

DILL, THE AUTHOR OF EQUALIZATION LAW CONDEMNS IT

Washington.

Senator Dill, of the State of Washington, who introduced the equalization amendment to the radio law, which requires distribution of broadcasting channels largely on a population basis, told the Federal Radio Commission he now opposes the amendment and doubts its constitutionality. He said public opinion forced the amendment into effect. But the amendment "hampers the Commission tremendously," he admitted.

As voluntary counsel for KWSC, Pullman, Wash., applicant for increased power, Senator Dill said:

"Personally I do not believe it is constitutional to say that a great section like the West can only have as many stations as a little area up in New England."

College Runs Station

The station, operated by the State College of Washington, applied for the channel assigned to WPG, Atlantic City, N. J., as a cleared channel. Senator Dill said he could not support the demand for a cleared channel, as he was not in sympathy with the view that cleared channels are necessary for maximum public service. He did, however, urge an increase in the station's power, and an assignment on whatever channel thought desirable by the Commission.

WPG and WLWL, New York City, as well as KGDM, which now share the 1,100 kilocycle channel applied for by the college station, made no presentation of evidence. Senator Dill made it clear that his constituent station had no complaint against them, and would be satisfied with a mere increase in power, or any other channel assignment desirable.

Case Improperly Presented

In opening the hearing, the presiding Commissioner, E. O. Sykes, brought out that, under General Order No. 40, promulgating the nation-wide reallocation of broadcasting facilities of last November, the application of KWSC was not properly brought before the Commission. The 1,100-kilocycle channel sought, he said, is assigned to the First Radio Zone, in the East, as one of its eight cleared channels, and hence could not be allocated to a Pacific coast station as a cleared hannel.

Senator Dill expressed the view that the "whole cleared channel matter is a waste of radio facilities." He said, however, he did not propose to argue it, but made the point that stations have no vested rights to the ether, and that, if this issue is raised and sustained, it must be remedied by a constitutional amendment.

SAMPSON'S NEW STORE

Harvey Sampson opened a new store, "Harvey's Radio," at 105 West 43rd Street, New York City, diagonally across the street from his former smaller shop. The new store is modernistically decorated. The decorations and fixtures cost $5,000. The 1930 sets, speakers, tubes and equipment are on display, also a full line of parts.

WCKY JOINS NBC CHAIN

The network of the National Broadcasting Company was recently enlarged by the addition of WCKY, Covington, Kentucky. This station operates on a wavelength of 202.7 meters (1480 kilocycles) and uses 5000 watts. It is operated by L. B. Wilson, Inc. This addition gives the NBC a total of 70 stations.

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 ....

W. C. Werner, 908 N. 14th St., Springfield, Ill.
John J. Vail, 7837 Emerald Ave., Chicago, Ill.
Chas. R. Towne, Box 98, Woodward, Iowa.
C. N. Oswald, 11 20th St., N., Great Falls, Mont.
Harry B. Prouten, 162 Franklin St., Auburn, N. Y.
Donald T. Hawley, 605 Franklin St., Plant City, Fla.
George W. Wells, 308 W. Baker St., Plant City, Fla.
Earl Wormley, 417 Bainbridge St., Elizabethtown, Pa.
Geo. E. Julien, 3620 Dwight St., San Diego, Calif.
A. Echeverria, P. O. Box 2475, Havana, Cuba.
Robert Davis, 134 W. 12th St., Erie, Pa.
W. H. Jackson, Jr., Box 95, Carthage, N. C.
John MacGregor, Box 64, New Glasgow, Nova Scotia, Can.
Ellia Scobey, R. R. 3, Box 3, Mt. Vernon, Iowa.
Theodore Johnson, Box 2, R. No. 3, Tustin, Mich.
P. M. Wakeman, U. S. C. G. Base Six, Ft. Lauderdale, Fla.
K. R. Humphries, W. U. Tel. Co., Lake City, S. C.
R. S. Rennie, Agincourt, Ont., Can.
R. W. Hyndshaw, Thedford, Neb.
Charles Littell, Jr., 222 Lonsdale Ave., Oakwood, Dayton, Ohio.
L. C. Johman, 725 South Blvd., Oak Park, Ill.
M. L. Story, Graford, Tex.
H. Dineen, 845 27th St., Milwaukee, Wis.
H. C. Leiner, 2130 No. 15th St., Phila., Pa.
K. V. MacDonald, 1409 S. Townsend, Syracuse, N. Y.
Harold Fox, 196 Pinehurst Ave., N. Y. City.
E. A. Dosek, Ulysses, Nebraska.
L. Edmonstone, 2245 3rd Ave., E., Owen Sound, Ont., Can.
J. M. Mascotti, 2171 Hillger Ave., Detroit, Mich.
J. Mayhall, 5526 Bryant, Pittsburgh, Pa.
H. Kelly, Lansing, Mich.
A. A. Geimer, 3663a So. Broadway, St. Louis, Mo.
M. L. Bengston, 408 Williamson Ave., Winslow, Ariz.
H. J. Saltzmann, P. O. Box 351, Clarksville, Tenn.
Hale's Radio Co., Oyster Bay, New York.
C. B. Smith, The Park Club, Pittsfield, Mass.
Arthur Miller, 1607½ Grove St., La Fayette, Ind.
O. Denzau, 397 E. 153rd St., New York City.
Robert White, 12 Ambrose St., Roxbury, Mass.
A. B. Aster, R. R. 6, Rushville, Ind.
F. Williams, Box 280, Claypool, Ariz.
Fred Damm, Carleton, Nebr.
Maurice McCann, Y. M. C. A., Racine, Wis.
T. L. Noble, Lake Monroe, Fla.
Gerald B. Fitzgerald, Sta. L., Washington, D. C.
J. L. Simmons, 2921 Burrell, Detroit, Mich.
Fred Breidenbach, 411 N. Bancroft St., Indianapolis, Ind.
Geo. E. Stockton, 22 Perry St., Trenton, N. J.
Wm. S. Bisbing, 5533 Ardleigh St., Phila., Pa.
C. A. Bernhard, Ukiah, Calif.
R. C. Eastin, Brandon, So. Dak.
Mr. Robert Albrecht, 404 Lott St., Yoakum, Tex.
Dr. White, 14½ So. Broadway, Peru, Ind.
F. A. Hanner, 1709 Bickett Blvd., Raleigh, North Carolina.
John A. Gaudet, 9 Thorndike St., W. Somerville, Mass.
Ray Bickler, Strasburg, No. Dakota.
J. C. Barto, 422 West St., Wilkinsburg, Penn.
O. K. Battery & Elec. Co, Navasota, Texas
J. Harle Gray, 306 Olive St., Knoxville, Tennessee.
S. Fred Diffenderfer, 302 Victory Ave., Schenectady, New York.
Geo. Doxey, 5907 Dexter Ave., Tampa, Florida.
Carl W. Schmitt, 229 Hawley Ave., Syracuse, New York.
E. Karniewski, New Bridge Ave., Hempstead, New York.
R. A. McNeill, Box 61, Atwater, Saskatcwan, Canada.
D. Turgeon, 4142 Rivard, Montreal, Canada.
Dr. Gastao Dessert, Caixa 222, Santos, Sao Paulo, Brazil.
Wm. Hunter, Box No. 28, Netcong, New Jersey.
Warren F. Andrews, 301 W. Blackwell St., Dover, New Jersey.
F. W. Chapman, 429 S. 3rd Ave, Ann Arbor, Mich.
J. A. Bellemar, 152 4th St., Shawinigan Fall, Can.
John A. Corrado, 81 William St., Newburgh, New York.
Leslie G. Lawrence, 3 Cannon St., Newton Highlands, Mass.

TREND IS TOWARD SUPER-POWER AS KNX GETS 50KW

Washington.

KNX, at Los Angeles, Calif., has been granted authority by the Federal Radio Commission to use 50 kilowatts, the maximum power allowable for broadcasting.

The Commission approved the application of the station for a construction permit to install a 50,000-watt transmitter and to increase the power from 5,000 watts to 25,000 watts, with an additional 25,000 watts for experimental purposes. All stations using 50,000 watts are authorized to broadcast on the same experimental basis.

KNX, owned by the Western Broadcasting Co., will operate full time on the 1,050 kilocycle channel which it now uses.

WABC Asks 50 KC

Former Radio Commissioner Sam Pickard, vice president of the Columbia Broadcasting System, has filed application with the Commission for permission to increase the power of WABC, New York, key station of the system, to 50,000 watts.

The Columbia has also asked permission to move its transmitter to a location closer to New York City, the exact site yet to be determined.

Mr. Pickard stated that the increase in power would increase appreciably the service range of the station. WABC now uses 5,000 watts and is on an exclusive channel.

Trend Toward Super-Power

The trend in broadcasting is definitely toward the use of greater power. The maximum now allowed by the Commission is 25,000 watts, with 25,000 watts additional for experimental purposes, but if this limit were not imposed stations of much greater power would be built quickly. The inducements to use more power are the greater service range and less interference from electrical disturbance, natural and man-made.

New Corporations

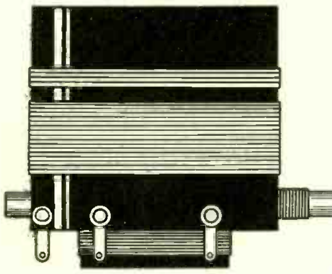
Klein-Shearn Radio; Atty., A. Lipton, 122 East 42d St., New York.
Star Radio, Inc., Newark; Atty., Charles Turkenkopf, Newark, N. J.
Radio Cord Broadcasting System, Inc., New York; Atty., U. S. Corp. Co., Dover, Del.
Brook-Pelham Radio & Music Co.; Atty., A. Remnek, 51 Chambers St., New York.
Judson Studios, radio broadcasting; Attys., Compton & Delaney, 501 5th Ave., New York, N. Y.
Beacon Radio Tube Corp., Newark; Atty., Herman B. J. Weckstein, Newark, N. J.
Associated Radio & Music Shops, Pittsburgh; Attys., Ball & Rubenstein, Wilmington, Del.
Fraink Radio Corp., Newark, N. J.; Atty., Louis D. Schwartz, New York.
International Television Corp., White Plains, N. Y.; Corporation Trust Co. of America.
Bolt Radio Co.; Atty., B. W. Burger, 154 Nassau St, New York.
Steinberg's Radio & Music Shop; M. Kozinn, 225 Broadway, New York.
Sherled Radio Corp.; Atty., D. Schlossberg, 277 Broadway, New York.

NEW ZEALAND HEARS KDKA

What is believed to be a new long distance broadcast record was recently established by KDKA when its broadcast on its regular broadcast wave of the arrival of the Graf Zeppelin at Lakehurst was picked up by Lloyd Grenlie, operator aboard Commander Byrd's ship the Eleanor Bolling, stationed at Dunedin, New Zealand. The approximate distance covered was 9,000 miles.

A NEW IDEA IN COILS!

The Bernard Tuner Works Screen Grid Tubes Up to the Hilt!

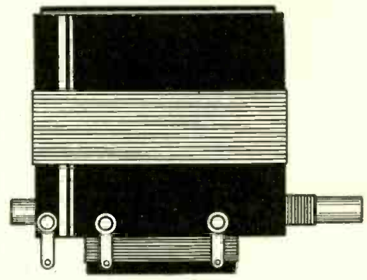


Cat. No. BT5A—$2.50
FOR .0005 MFD. CONDENSERS
Bernard Tuner for antenna coupling, the primary being fixed and the secondary tuned. This coil is used as input to the first screen grid radio frequency tube. The double-action tuning method invented by Herman Bernard is employed. Adjust an equalizing condenser across the tuning condenser so that exactly the same dial settings prevail through all circuits. This equalizer, 90 mmfd., once set, is left thus.
Cat. No. BT3A for .00035 mfd. $2.55

FOR the first time in radio a coil has been designed that permits working the screen grid tube up to the enormous amplification level that theory long promised but practice long denied.

The secret lies in tuning the plate circuit of the screen grid tube, and still covering the entire broadcast band. Herman Bernard, noted radio engineer, invented the solution—a tuned coil consisting of a fixed and a rotating winding in series, the moving coil turned by the same dial that turns the tuning condenser. An insulated link physically unites condenser shaft and moving coil. Thus when the condenser plates are entirely in mesh the moving coil is set for maximum inductance, that is, it aids the other part of the tuned winding. As the condenser is turned to lower capacity setting the moving coil aids less and less, until at the middle of the dial it acts as if fixed. From then on the moving coil bucks the fixed winding, greatly reducing the total effective inductance, and thus nullifying the effect of the high starting capacity.

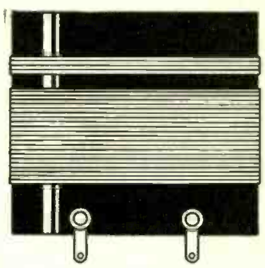
The Bernard Tuner is a two-winding coil for interstage coupling, working out of a screen grid tube, 222 or 224, and into any type tube. The tuned primary has coupled to it a still larger inductance, on separate inside form, for step-up, thus greatly increasing an already enormous amplification! This is Cat. No. BT5B for .0005 mfd., BT3B for .00035 mfd. Use BT5A or BT3A for antenna coupler, tuning the secondary, with an equalizing condenser across the antenna tuning condenser, so that the high minimum capacity of the tube's output will be duplicated at the input.



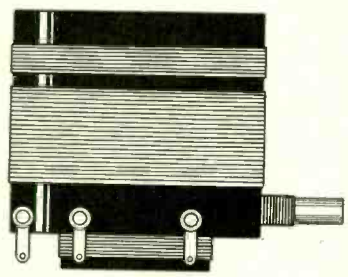
Cat. No. BT5B—$2.50
FOR .0005 MFD. CONDENSERS
Bernard Tuner for working out of a screen grid tube, consists of a rotary coil in series with a fixed coil, the two constituting a tuned primary, for tuning the combined rotary and fixed windings to exceed the broadcast band of wavelengths. The condenser shaft and rotary coil shaft are physically coupled so one motion turns both. Develops the highest possible amplification from the screen grid tube.
Cat. BT3A for .00035 mfd. $2.55

The Diamond Pair

Since 1925 the Diamond of the Air has been an outstanding circuit. It has undergone few changes. When power tubes and screen grid tubes appeared these were included. When AC operation became practical, the model was described for such use. Whether battery-operated or AC-operated, the Diamond of the Air is a dependable and satisfactory circuit. It uses a screen grid RF stage, tickled detector and two stages of transformer coupled audio. The same coils are used for both models, battery or AC. The secondaries are tuned. They are matched with fine precision, to permit ganged tuning.



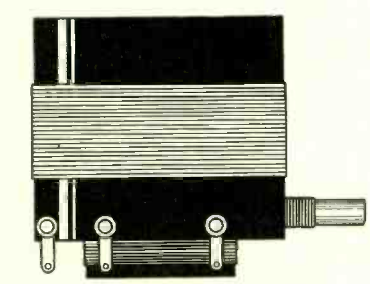
Cat. No. RF5—$0.75
FOR .0005 MFD. CONDENSER
Antenna coil for any standard circuit, and one of the two coils constituting the Diamond Pair. The secondary is carefully wound to match the inductance of the companion coil's secondary, so equality of tuning prevails.
Cat. No. RF3 for .00035...$0.80



Cat. No. SGT5—$1.25
FOR .0005 MFD. CONDENSER
Interstage 3-circuit coil for any hookup where an untuned primary is in the plate circuit of a screen grid tube. This primary has a large impedance (generous number of turns), so as to afford good amplification. Used in the Diamond of the Air.
SGT3 for .00035 mfd. $1.30

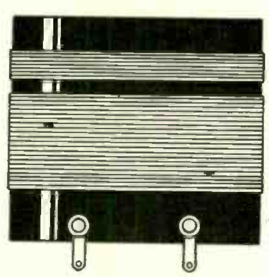
The Diamond Pair of coils for .0005 mfd. tuning are Cat. Nos. RF5 and SGT5. A circuit of excellent stability, extremely high selectivity and good sensitivity, the Diamond of the Air should be built with coils that permit full capitalization of the virtues of the circuit. Not only is the number of turns correct for this circuit on each coil, but the spacing between aperiodic primary and tuned secondary is exactly right. Note that the 3-circuit coil SGT5 (or SGT3) has a high impedance primary. This means good amplification from the screen grid tube, obtained in a manner that guarantees selectivity attainment.

ANTENNA COUPLER



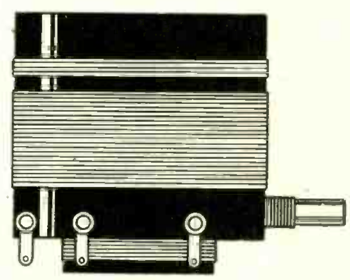
Cat. No. VA5—$1.10
FOR .0005 MFD. CONDENSER
Moving primary and fixed secondary, for antenna coupling, adjustable from a knob at the front panel, thus providing volume control.
Cat. No. VA3 for .00035 mfd. $1.15

SG TRANSFORMER



Cat. No. SGS5—$0.75
FOR .0005 MFD. CONDENSER
Interstage radio frequency transformer, to work out of a screen grid tube, where the generous-sized primary is in the untuned plate circuit.
Cat. No. SGS3 for .00035 mfd. $0.80

STANDARD TUNER



Cat. No. T5—$1.25
FOR .0005 MFD. CONDENSER
Standard three-circuit tuner, for antenna stage, or interstage coupling where primary is in the plate circuit of any tube except a screen grid. Provides abundant selectivity and gives smooth tickler action.
Cat. T3 for .00035 mfd. $1.30

SCREEN GRID COIL COMPANY, 143 West 45th St., New York, N. Y.
Just East of Broadway

Enclosed please find $.............. for which please ship at once, parcel post prepaid, the following coils:

Quantity Cat. No. Price	Quantity Cat. No. Price	Quantity Cat. No. Price	Quantity Cat. No. Price
☐ BT5A@$2.50	☐ RF5@$0.75	☐ VA5@$1.10	☐ SGSF@$0.75
☐ BT3A@$2.55	☐ RF3@$0.80	☐ VA3@$1.15	☐ SGS3@$0.80
☐ BT5B@$2.50	☐ SGT5@$1.25	☐ T5@$1.25	☐ FL4@$0.35
☐ BT3B@$2.55	☐ SGT3@$1.30	☐ T3@$1.30	☐ EQ80@$0.35

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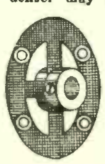
Insulated Link

A flexible coupling device to unite two independent ¼" shafts for single dial operation of a tuning condenser and a Bernard Tuner. If the condenser has shaft protruding from the rear, then the condenser may be panel-mounted and the coil shaft coupled by the link to either extension shaft of the condenser. If the condenser has no shaft protruding at rear, mount the Bernard Tuner on the front panel. It has shaft protruding at rear for coupling by the link to the condenser's front shaft. To make sure of insulated protection do not force the receptacles of the link together when mounting.



FL4..$0.35

Data on Construction

The coils are wound by machine on a bakelite form 2½" wide, and the tuned windings have identical inductance for a given capacity condenser, i. e., .0005 mfd. or .00035 mfd. Full coverage of the wave band is assured. The wire is silk insulated.

All coils with a moving coil have single hole panel mounting fixture. All others have base mounting provision. The coils should be used with connection lugs at bottom, to shorten leads.

Only the Bernard Tuners have a shaft extending from rear. This feature is necessary so that physical coupling to tuning condenser shaft may be accomplished by the insulated link.

[Note: Those desiring the 80 mmfd. equalizing condenser for use with the antenna model Bernard Tuner, BT5A or BT3A, should order EQ80 at $0.35.]

SCREEN GRID COIL COMPANY
143 West 45th 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.

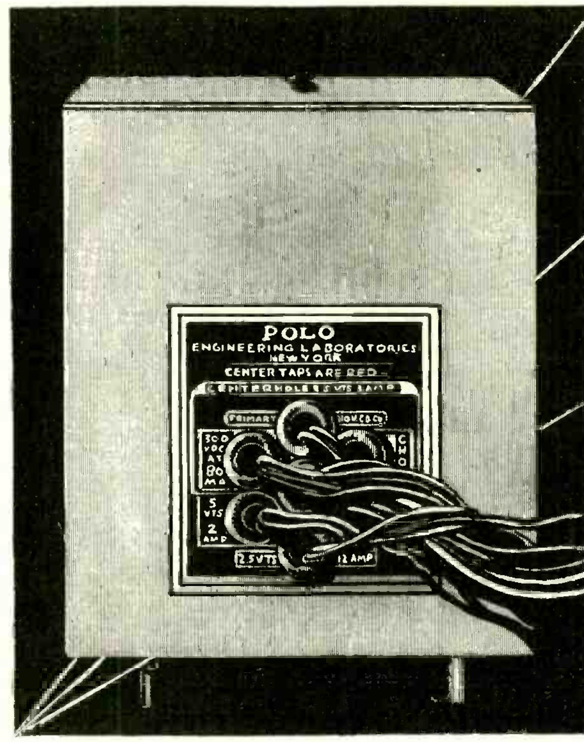
The two chokes are 50 henries each, and each choke is on a saparate core.

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.

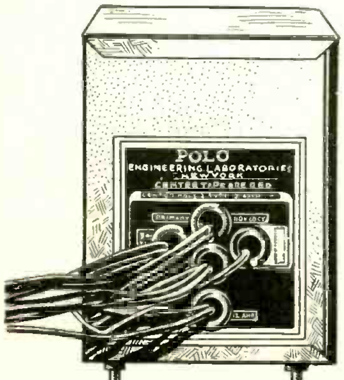
(5)—One transformer core with 1" x 1¾" cross-section; window opening 2⅛" x ¾". Two choke cores with ⅞" x 1¾" cross-section; window opening ½" x 1¾"; .014" air gap. The laminations are stamped from high-grade Silicon sheet steel having 1.92 watts loss per pound. The joints in the transformer are all overlapping,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



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

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.

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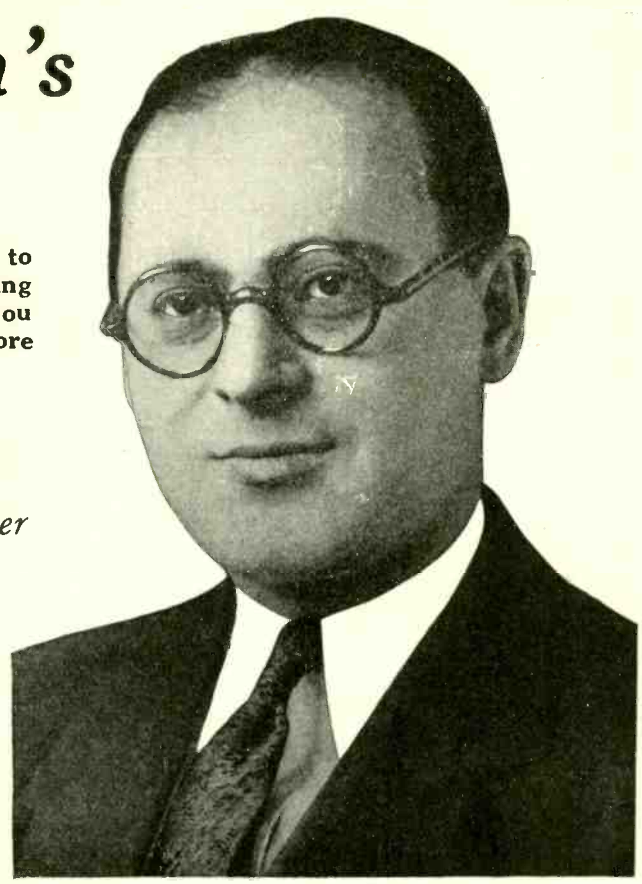
This book is worth hundreds of dollars to any one who shoots trouble in receivers—whether they be factory-made, custom-built or home-made receivers. The home experimenter, the radio engineer, the custom set-builder, the teacher, the student,—all will find this new book immensely informative and absolutely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



JOHN F. RIDER
Member, Institute of Radio Engineers

Wiring Diagrams of *All* These Receivers!

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

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

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

ATWATER-KENT
10B, 12, 20, 30, 35, 48, 32, 33, 49, 38, 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, 33, 34, 35, 35A, 342, 352, 352A, 362, 31, 32, 333, 353A, power supply ZE17, power supply ZE12.

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

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

FADA
50/80A receivers, 460A Fada 10, 11, 30, 31, 10Z, 11Z, 30Z, 31Z, 16, 17, 32, 16Z, 32Z, 18, special, 192A-192S and 192BS units, R80A, 480A, and SF 50/80A receivers, 460A receiver and R60 unit, 7 A.C. receiver, 475 UA or CA and SF45-75 UA or CA, 50, 70, 71, 72, C electric unit for special and 7 A.C. receivers, ABC 6 volt tube supply, 86V and 82W, E180Z power plant and E 420 power plant.

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

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

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

PHILCO
Philco-electric, 82, 86

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

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

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

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

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

WORKRITE
8 tube chassis, 6 tube chassis.

AMRAD
70, 7100, 7191 power unit.

SPARTON
A.C. 89.

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

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- PRACTICAL APPLICATION OF ANALYSIS
- VACUUM TUBES
- OPERATING SYSTEMS
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- "A" BATTERY ELIMINATORS
- TROUBLES IN "A" ELIMINATORS
- TROUBLE SHOOTING IN "A" ELIMINATORS
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- TROUBLES IN "B" BATTERY ELIMINATORS
- TROUBLE SHOOTING IN "B" BATTERY ELIMINATORS
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Securing information from the receiver owner, list of questions, practical chart system of repairs, circuits and operating conditions.

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

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

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

A REQUISITE FOR SERVICING!

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

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

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

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

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

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

Cat. M600 AC-DC $6.00

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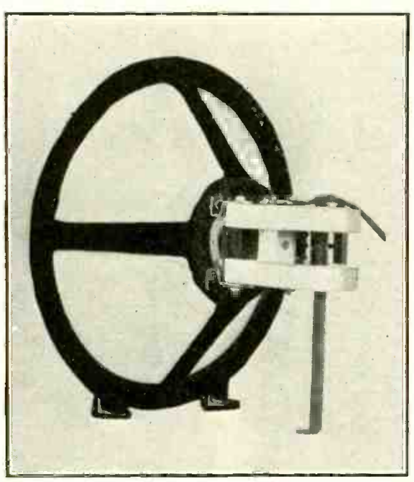

Absolutely the best tone quality, with amazing sensitivity, is assured when you use the Inductor Speaker on a fine audio amplifier. The chassis is sold completely erected with a supporting brace. The unit, cone spider and ring, are sturdily put together. Use a baffle board or box of your own choice. Baffle instruction sheet in each carton.

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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 which size, that matches the impedance of the output tube or tubes. See the list below.

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

Same as above, only 12" outside diameter, N12R for tubes in previous "R" Model, and N12G for tubes to previous "G" Model @ $12.95 net.

For push-pull, where you have no output transformer or midtapped impedance, order N12PP at $15.25 net, and the speaker is its own output device.

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A *Delight* to Radioists

was the Show Number of RADIO WORLD, dated September 21st, and containing a fascinating assortment of features.

The first instalment of the constructional article on the AC Model HB Compact, five tubes, including rectifier, was published in that issue, with five photographic illustrations that clarify the layout of parts, and with an exceptionally brilliant exposition of the functioning of the Bernard Dynamic Tuners used in the circuit. Read every word of this description by Herman Bernard and become convinced that these coils perform wonderfully in this screen grid circuit.

The first instalment of the article on how to build the Schoolboy's One-Tube DX Set, by Jack Tully, is what every youngster wants to read, especially as the parts cost only $4.28, and there is no end of fun experimenting with this circuit.

Coupling of screen grid tubes at radio frequencies is an important subject, and is treated in a most interesting manner by J. E. Anderson, technical editor, in his article, "Up Goes the Volume." He reveals the secrets of obtaining highest amplification from the screen grid tube as radio frequency amplifier.

"First Presentation of Detection by Linear Rectifier," by J. E. Anderson and Herman Bernard, being an instalment of their serially-published book, "Power Amplifiers," shows how to filter the plate circuit so as to get rid of the carrier frequency. The same principles applied to filtering a B supply to get rid of hum are used to eliminate the carrier and leave only the audio component, thus achieving detection with great selectivity and unlimited volume.

"Ohm's and Kirchoff's Laws Expounded." This is certainly an attractive subject, since one simply must not only know these two laws, but how to apply them. Bryant Holworthy has treated the subject masterfully.

STATIONS! STATIONS!

You are certainly interested in an up-to-date list of stations. How would you like several such lists? They're in the September 21st issue. There's the list of broadcasting stations by call letters, alphabetically arranged; the list of stations by frequencies and wavelengths; a list of U. S. short wave stations; a list of some foreign short wave stations, but the hours on the air of all of those published are included; then the lists of stations of the two big chains, with call letters, locations, frequencies and waves—the Columbia Broadcasting System and the National Broadcasting Company. And also there's a list of Canadian stations, with hours on the air!

Two full pages, with thirteen illustrations, reveal the new parts for the 1930 season, an attractive subject to all constructors.

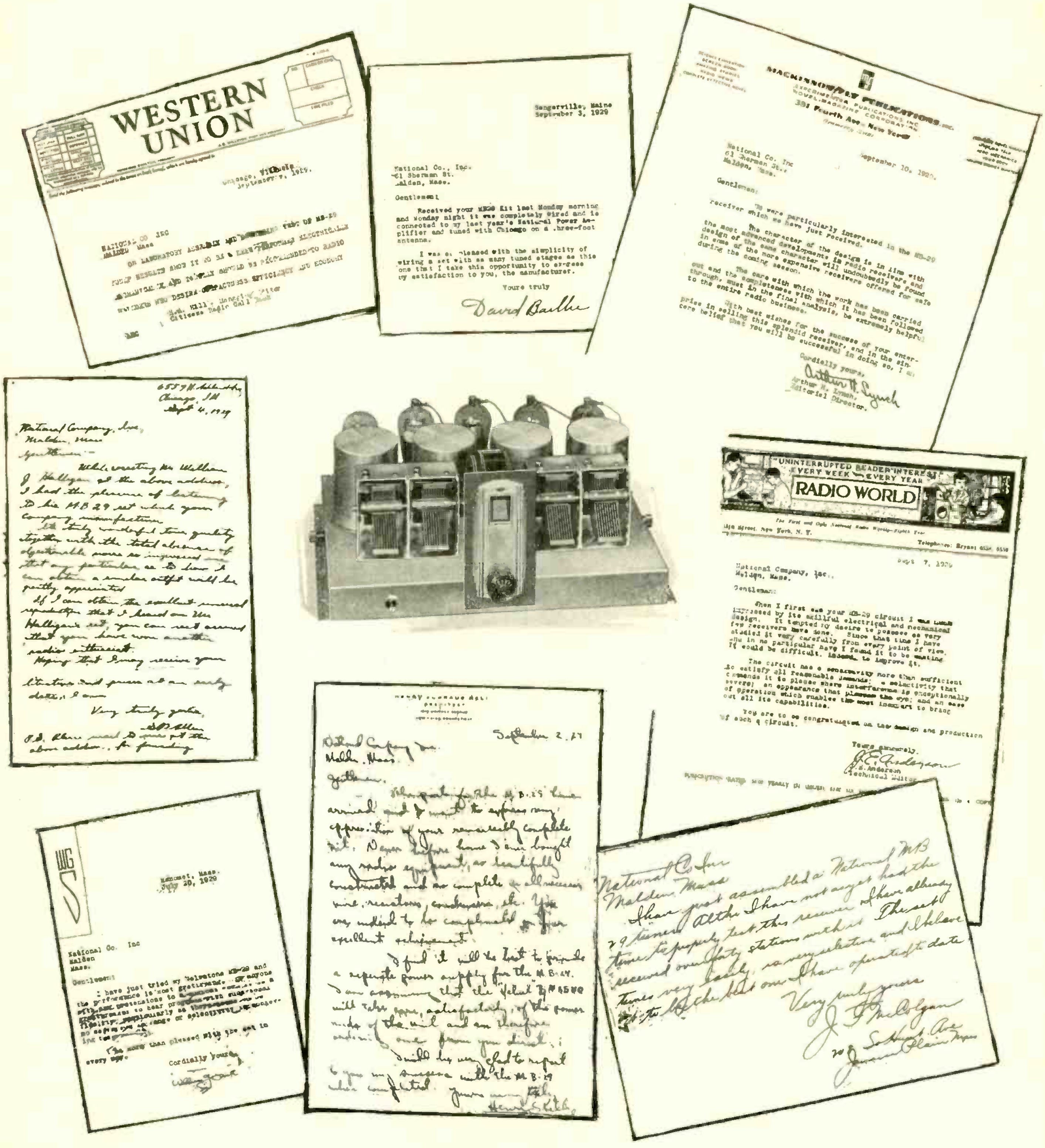
Besides these, there's an editorial page and two full pages of Radio University, where technical questions are answered. The tuning curves of the HB Compact, either battery or AC model, are published in Radio University, and you can thereby tell just how to tune in the stations at the right dial settings. Other questions on the HB Compact are answered.

Send 15c for a copy of the September 21st issue, or start your subscription with that issue.

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

An Outstanding Achievement

4 SCREEN GRID TUBES • POWER DETECTION • BAND SELECTOR TUNING • RAINBOW PROJECTOR DIAL



Sangerville, Maine
September 3, 1929

National Co., Inc.
61 Sherman St.
Malden, Mass.

Gentlemen:

Received your MB29 Kit last Monday morning and Monday night it was completely wired and is connected to my last year's National Power Amplifier and tuned with Chicago on a three-foot antenna.

I was so pleased with the simplicity of wiring a set with as many tuned stages as this one that I take this opportunity to express my satisfaction to you, the manufacturer.

Yours truly
David Barber

National Co. Inc
61 Sherman St.,
Malden, Mass.

September 10, 1929.

Gentlemen:

We were particularly interested in the MB-29 receiver which we have just received.

The character of the design is in line with the most advanced developments in radio receivers and design of the same character will undoubtedly be found in some of the more expensive receivers offered for sale during the coming season.

The care with which the work has been carried out and the completeness with which it has been followed through, must in the final analysis, be extremely helpful to the entire radio business.

With best wishes for the success of your enterprise in selling this splendid receiver, and in the sincere belief that you will be successful in doing so, I am

Cordially yours,
Arthur H. Lynch,
Editorial Director.

Sept 7, 1929

National Company, Inc.,
Malden, Mass.

Gentlemen:

When I first saw your MB-29 circuit I was impressed by its skillful electrical and mechanical design. It tempted my desire to possess as very few receivers have done. Since that time I have studied it very carefully from every point of view and in no particular have I found it to be wanting. It would be difficult, indeed, to improve it.

The circuit has a sensitivity more than sufficient to satisfy all reasonable demands; a selectivity that commends it to places where interference is exceptionally severe; an appearance that pleases the eye; and an ease of operation which enables the most inexpert to bring out all its capabilities.

You are to be congratulated on the design and production of such a circuit.

Yours sincerely,
J. E. Anderson
Technical Editor

Parts Used: Aluminum base, sockets, binding posts, NATIONAL Screen Grid Transformers, individual aluminum coil shields, 5 cord cable, A. C. switch, Volume Control, resistors and choke coils, all necessary by-pass condensers, NATIONAL Rainbow Dial, NATIONAL Weld-Built Condensers.

NATIONAL SCREEN GRID TUNER MB-29

List price, $69.50. Your price, $40.

Guaranty Radio Goods Co., 145 W. 45 St., N. Y. City

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!

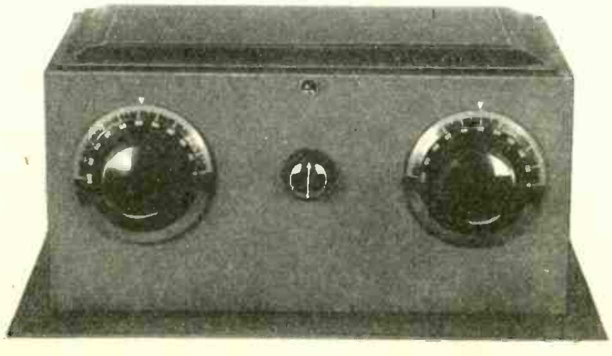
Selectivity

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.

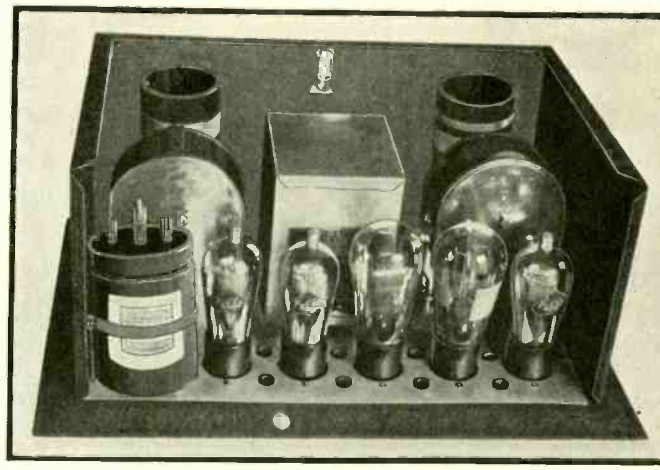
HB Compact, AC model, uses a 224 RF amplifier, a 224 space charge power detector, a 224 first audio and a 245 output tube, with 280 rectifier. Except for the space charge feature, not suitable in the battery model, and the larger power tube, not economically powered by batteries, the two models are fundamentally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

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

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

NAME ....

ADDRESS ....

CITY .... STATE ....

New J-245 Trouble-Shooting Jiffy Tester

Tests All Modern Circuits at Plate Voltages up to 300 Volts, Finds Shorts and Opens, Judges Tube Performance—All in a Neat, Small Steel Case with Crackle Finish in Brown

THE handiest, dandiest compact Jiffy Tester is the J-245, 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 and 281 tubes without extra adapters.

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

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

The switches are for change-over on the milliammeter, and for connecting and disconnecting the grid return to note a tube's "liveliness." How this is noted is explained in the instruction sheet accompanying the J-245.

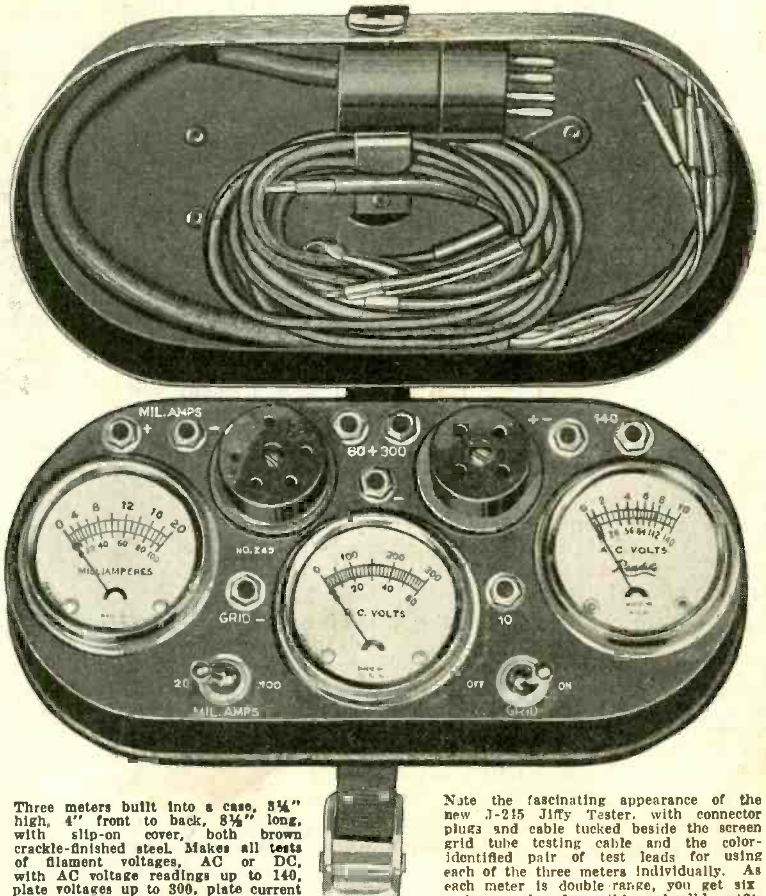
Two sockets are on the panel, one 5-prong, the other 4-prong, for holding the UX and UY tubes, including screen grid tubes, both AC and battery types. To enable full test of screen grid tubes, including AC 224 and DC 222, a screen grid cable is supplied.

The compact J-245 therefore tests all plate voltages up to 300 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 140, including AC line voltage. Besides, it reads screen grid 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., as described in the instruction sheet.

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 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. You don't need to know in advance how to use it. The instruction sheet gives a simple but comprehensive explanation. Besides, a tube data sheet tells how to determine if tubes are O.K.



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. Test leads and instruction sheet included.

$11.76

Note the fascinating appearance of the new J-215 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.

Remit $11.76 with order, and we pay cartage!

Successful Servicing Is Impossible Without Meters

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 is just the thing, and it is much more neatly made than you could possibly make a tester yourself, since, besides the engineering talent required to design such a device, thousands on thousands of dollars must be invested in dies. You reap the benefit of expert engineering design, quantity production and careful instruction as to use when you buy a J-245. 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!

NEVER again need you be stumped for want of the necessary measuring equipment. Suppose you want to know the AC line voltage or DC line voltage—the right hand meter gives it to you. Simply plug the red test lead into the "140" tip jack, the black test lead into the "+" tip jack. If you desire to read the plate current of one tube, insert the tube in the proper socket of the J-245, connect the plug (with the aid of the 4-prong adapter, if necessary) into the emptied socket of the receiver, switch the milliammeter to "O-20" reading, insert the four-colored cable leads into the corresponding marked and colored tip jacks and turn on the set. These are only some of the fifteen tests you can make.

Independent Access to All Three Meters Insures Versatility

BESIDES fetching appearance, sturdiness, compactness and low cost, the J-245 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 "O-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 more than 100%, and is a new feature.

YOU are all set to go when you possess the J-245. The only limitations you will possibly encounter, and these are rare instances, apply to the testing of the B voltages on 210 and 250 tubes, and to testing the 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 reads up to 300 volts. But a series resistor will extend the range. This multiplier is an extra, and those deeming it necessary may order Cat. No. J-10; at 88c net, to increase scale to O-600 volts.

Likewise, a Kellogg tube adapter is available, Cat. No. J-24 at 60c net. If UV199 tubes are to be tested, a pair of adapters is necessary, as these tubes have a unique base. The UX199 tubes can be tested without adapters. For UV199 tubes order Cat. No. J-19 at 60c net, which changes the UV socket of the receiver to accommodate the UX plug of the J-245, and Cat. No. J-20 at 36c net, to change the 4-prong socket of the J-245 to receive the UV199 tube.

NET PRICES AT MORE THAN 40% OFF LIST PRICE!

J-245, consisting of the complete outfit, less multiplier, UV adapters and Kellogg tube adapter. Net price....$11.76
J-106, resistor to be connected in series with O-300 voltmeter to increase reading to 600 volts. (Jack terminals optional. See coupon.) Net price J-106 only .... .88
J-19 and J-20, pair of adapters for testing UV199 tubes. Net price for both.. .96
J--24, Adapter for testing, Kellogg and old Arcturus tubes. Net price...... .60

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

Gentlemen: Enclosed please find $.............. Send me at once at your expense:

- ☐ One J-245 with instruction sheet, net price....$11.76
- ☐ One J-106 multiplier, net price.... .88
- ☐ Jack Terminals optional for J-106, order JT, net price.... .30
- ☐ One pair of UV adapters, J-19 and J-20, price of both, net .96
- ☐ One adapter for testing Kellogg and old type Arcturus tubes, J-24, net price .... .60

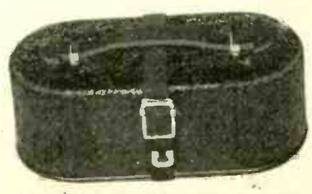
All prices are net and represent extreme professional discount already deducted.

Your name .... City..................................

Your address .... State..................................

5-DAY MONEY-BACK GUARANTY

A Neat Carrying Case



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

Order a J-245 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!