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RADIO WORLD

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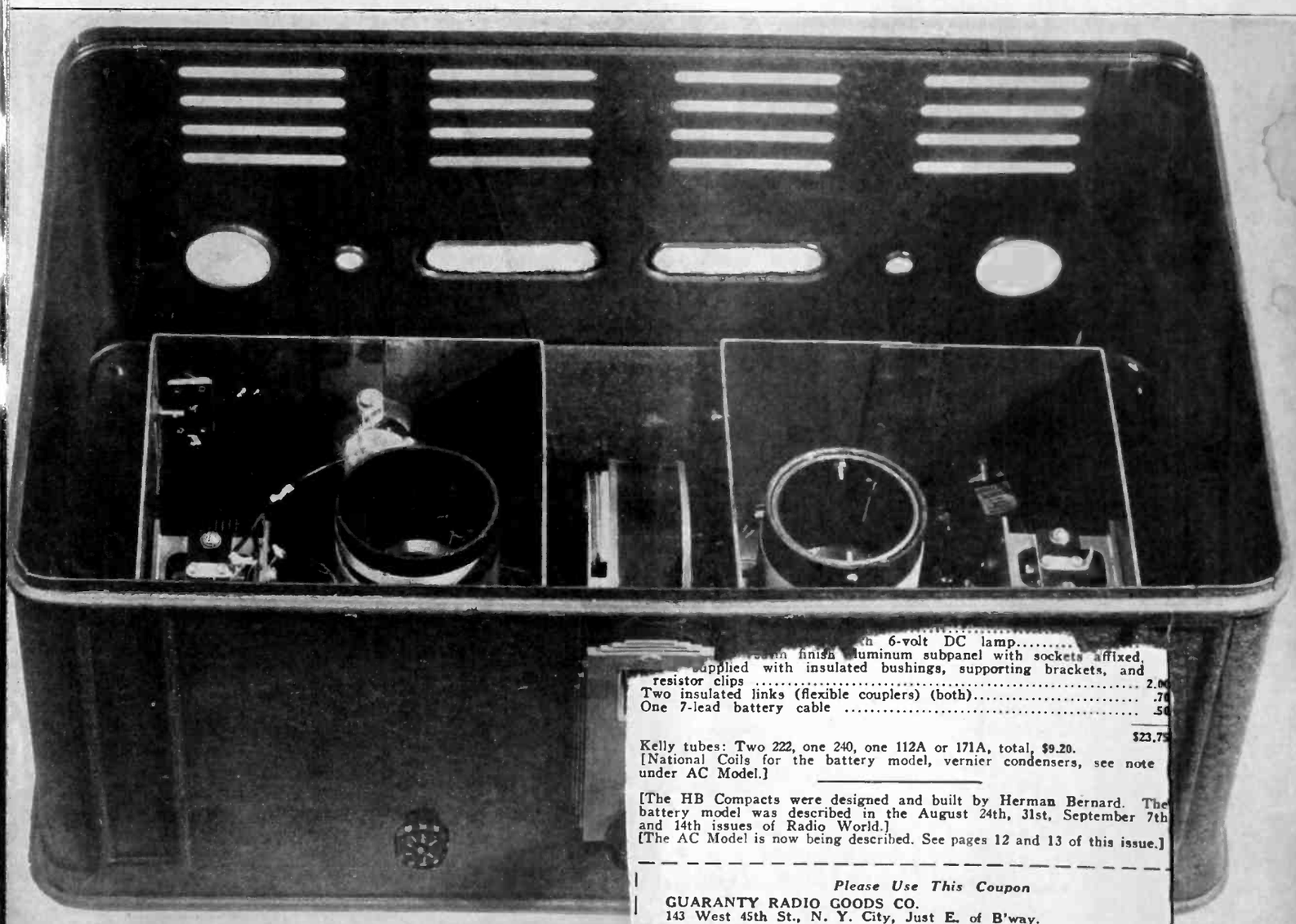
399th Consecutive Issue—EIGHTH YEAR

HIGH GAIN RF, PUSH-PULL AF!



...h 6-volt DC lamp.....
...finish aluminum subpanel with sockets affixed, ...supplied with insulated bushings, supporting brackets, and resistor clips 2.0
Two insulated links (flexible couplers) (both)..... .7
One 7-lead battery cable 5

$23.7

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.]
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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 .....

The HB22, a five-tube circuit for storage b... in a steel cabinet. Se... pages 5, 6 and 7

Have You Seen the NEW RADIO NEWS?

OCCASIONALLY a man gets so close to radio that he doesn't see the broader aspects of the industry. *Certainly* it is all right to know about the newest receivers, and how to build them. *Certainly* the newest discoveries in servicing and handling radio parts and sets should be told clearly and at length in the magazine he reads. The NEW RADIO NEWS brings you all this every month.

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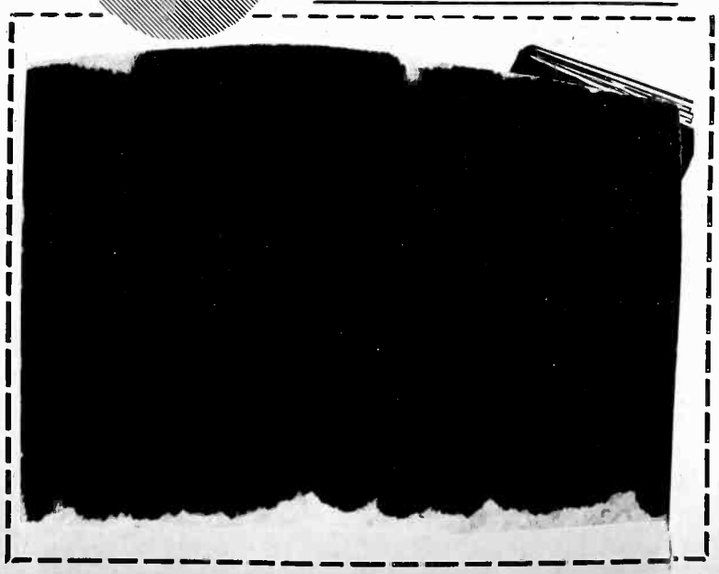


Surpassing Results from HB Compact!

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

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

Sensitivity

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

Realism

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

Economy

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

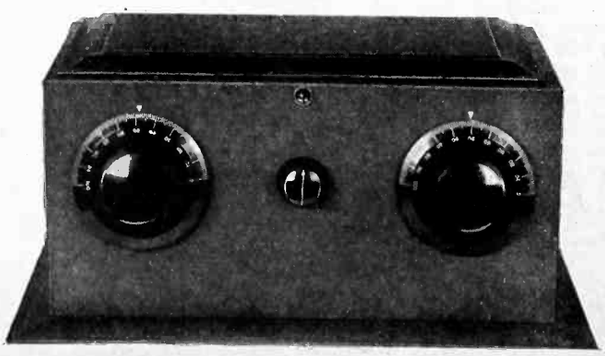
Selectivity

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

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

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

Order what individual parts you want.



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

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

Component Parts for HB Compacts

AC MODEL

L1L2L3—Bernard Antenna Tuner BT5A	$2.50
L4L5L6—Bernard Interstage Tuner BT5B	2.50
CT—One 80 mmfd. equalizer	.35
C1, C2—Two .0005 Dustproof @ $2.50	5.00
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

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Radio-Craft
for the
Professional-Serviceman-Radiotrician

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Attention
Radio Service Men

RADIO-CRAFT is now engaged in compiling an international list of names of qualified radio service men throughout the United States and Canada, as well as in foreign countries.

This list, which RADIO-CRAFT is trying to make the most complete one in the world, will be a connecting link between the radio manufacturer and the radio service man.

RADIO-CRAFT is continuously being solicited by radio manufacturers for the names of competent service men; and it is for this purpose only that this list is being compiled.

There is no charge for this service to either radio service men or radio manufacturers. It is simply an extra service that RADIO-CRAFT will perform for the industry.

The greatest need of the industry at this tme (as the president of the Radio Manufacturers Association and many other authorities in the trade emphasize) is *trained and experienced radio service men.* We are asking every reader who is a professional service man to fill out the blank printed below or (if he prefers not to cut the page of this magazine) to put the same information on his letterhead or that of his firm, and mail it to RADIO-CRAFT.

The data thus obtained will be arranged in systematic form. It will constitute an official list of radio service men throughout the United States and Canada, and foreign countries, and will be available to radio manufacturers very shortly. This list makes possible increased cooperation for the benefit of the industry and all concerned in the betterment of the radio trade.

Address *National List of Radio Service Men,* care RADIO-CRAFT, 98 Park Place, New York, N. Y.

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Please enter the undersigned in the files of your National List of Radio Service Men. My qualifications are as set forth below:

Name (please print) C. C. WILSON

Address RR # 2 (City) ALEXANDRIA (State) IND.

Firm Name and Address In Business for Self
(If in business for self, please so state)

Age 23 Years' Experience in Radio Construction 5 In Professional Servicing 2

Have You Agency for Commercial Sets? NO (What Makes?)

What Tubes Do You Recommend? Cunningham

Custom Builder? YES (What Specialties?)

Study Courses Taken in Radio Work from Following Institutions
International Correspondence School

Specialized in Servicing Following Makes
service all makes

What Testing Equipment Do You Own? Weston 537 and others

Other Trades or Professions —

Educational and Other Qualifications

Comments

(Signed)

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Latest Circuits and News

EIGHTH YEAR

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How to Wire Shield Stages

In the New HB22 High-Gain Receiver

By Herman Bernard

Managing Editor

[*Here is the second and final constructional article on the HB22. The first instalment appeared last week, issue of November 9th. Next week, November 23rd, other phases will be discussed.—Editor.*]

THE HB22 is the first circuit to embody the new dynamic tuners in shielded stages. The shields, moreover, are very substantially made of solid wall construction, with only top and bottom removal. The material is cadmium-plated steel, a full 1/16" thick. Thus they are heavy, durable, sturdy, non-rattling and effective. Steel is an excellent magnetic shield.

The circuit may be built on a bakelite or hard rubber front panel, or in a steel cabinet with crackle brown finish, where the front of the cabinet is itself the front panel. How the steel cabinet layout sizes up is illustrated on the front cover and in Fig. 5.

As it is too much to expect any one to drill large holes in 1/16" steel, the cabinet comes already drilled for the National modernistic dial with color wheel, and for the two other shafts. One of the two small knobs is for the switch rheostat, the other is on a dummy shaft used for symmetrical purposes.

USE OF REGENERATION OPTIONAL

If it is desired to make some actual use of the right-hand knob, a 50-mmfd. variable condenser, of the junior or midget type, may be mounted in insulated fashion, and connected from plate of the detector to plate of the screen grid tube. This introduces regeneration in the detector, if the coils are connected in proper phase, as will be explained. This is cited merely as a practical possibility, for the circuit is sensitive enough not to need the aid of regeneration. The .00025 mfd. condenser in the detector plate circuit will have to be removed if regeneration fails on the upper wavelengths.

The shielded stages, BAS3A for the antenna stage, BDS3A for the detector stage, come already assembled, but not wired. The constructor probably will greatly prefer to wire his own shielded stages, as this is work he likes to do, and there is hardly any necessity for spending several dollars extra to obtain wired stages.

UNITED SHAFTS MUST TURN EASILY

The first test to make is for easy turning of the united shafts of tuning coil and condenser.

For those not familiar with the dynamic radio frequency tuners, it should be stated that the tuning condenser shaft is coupled to the coil shaft by a link. Thus when either projecting shaft is turned, the condenser and coil are turned, the same motion actuating both. In that way the moving coil, or dynamic segment, is made to act as a variometer, adding to the maximum total effective inductance at maximum capacity setting of the condenser, behaving at right-angle position as if it were a fixed coil, and reducing the effective inductance as the condenser is then turned to lower capacity settings. In that way the wave band is fully covered, and a generous margin besides, even though the minimum capacity in the interstage tuning system is extraordinarily large, something like 58 mmfd., due to the high amplification obtained from a tuned plate circuit.

As single tuning control is used, the first tuned circuit must be made to behave like the second tuned circuit, even though two circuits, input and output, of the same tube are tuned. This identity of of behavior is accomplished by introducing an extra capacity across the input, represented by the 80 mmfd. equalizing condenser.

ADJUST THROUGH AN APERTURE

A hole in the shield where this condenser is mounted renders the adjusting screw accessible, so the adjustment is easily made, and once made is not molested.

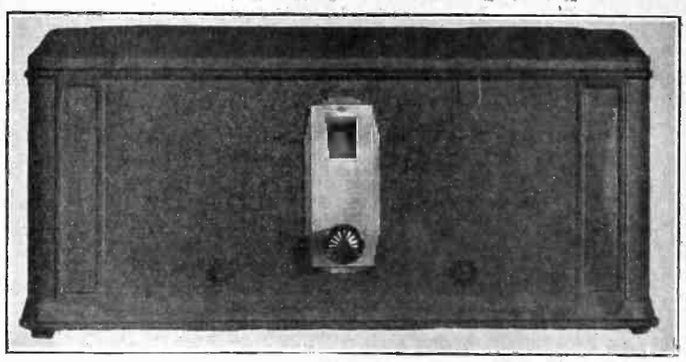


FIG. 5

FRONT VIEW OF THE HB22 IN A STEEL CABINET. THE NEW NATIONAL MODERNISTIC DIAL WITH RAINBOW FEATURE IS USED.

The easy turning of the united shafts is accomplished by using the condenser mounting position as the guide. The hole for the condenser is accurately placed for you, and the hole for the single mounting fixture of the coil support is made a little oversized. Therefore the coil is moved until its shaft can be slid in and out of the coupling bushing. Then you know the coil is in the right physical position and that when the mounting nut and the coupling bushing's setscrews are tightened down there will be no binding of the shaft at any point.

There is a hole in one shield, about 1" in diameter, which permits passing the pilot bracket of the National dial. This shield goes on the right-hand side as the front panel faces you. At rear of the shield are binding posts.

The other shield is mounted so that the binding posts are at rear, also.

All binding posts should be tested with an indicating device, such as a voltmeter. Connect one terminal of the meter to one terminal of a suitable voltage source, using the other terminals of the meter and voltage source as test points. With one test lead touch the projecting screw that is attached to the binding post, and with the other lead touch the shield itself. There should be no indication. If one appears, the binding post is shorted, and should be removed. It has insulating provision built in, but needs the aid of an extension washer outside, at the cap side of the post, and a small flat insulating washer on the inside, as an extra precaution. The short, if present, can be readily remedied by proper fastening of the insulating washer on the inside in conjunction with the extending effect of the metal washer used on the outside.

SOCKET IS INSIDE, TOO

Inside the shield, built into the bottom, is the socket. The bottom should be so placed that when the tuning condenser capacity is decreased, the plates move toward the socket. This is the only way the whole assembly will function, and is the way the shield comes to you, but it is just as well to watch this point and avoid confusion.

Assembled in the antenna stage shield also are the coil and the equalizing condenser, as stated previously, as well as the switch rheostat of 75 ohms, the .01 mfd. bypass condenser and the link.

How Method of Connect

Every Detail Set Forth with Faithful

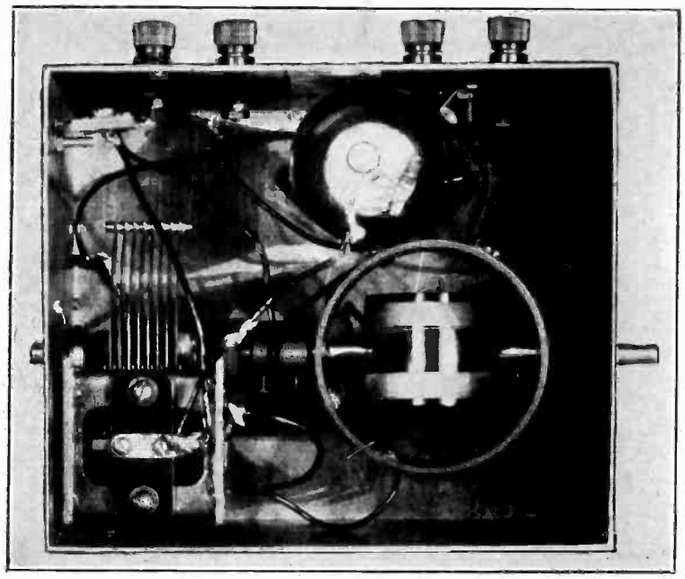


FIG. 6
TOP VIEW OF THE ANTENNA STAGE SHIELD AFTER IT IS WIRED. THE PARTS COME ALREADY ASSEMBLED IN THE SHIELD BUT THE CONSTRUCTOR HAS TO DO THE WIRING.

The rheostat is insulated from the shield by a pair of insulators, one placed inside, the other outside. In the event you desire to use the right-hand knob for a regeneration condenser, insulate this, too.

The .01 mfd. bypass condenser is connected from the binding post used as B plus 45, to ground, by screwing down one side of the condenser through a hole in the shield without using insulation, and by connecting directly to the post for the other end. This work is done for you already at the factory, but it is helpful to know the method of grounding. Incidentally, one side of the equalizing condenser connects to ground in the same way, directly to the shield.

Both shields are grounded, the first shield due to connection you must make from the receiver side of the switch to the shield, and the other shield by the metallic conduction afforded by the drum. In any event, if a metal subpanel is used, the conduction is afforded by that, too, so no special lead need be connected to the interstage shield for grounding purposes.

WIRING THE FIRST SHIELD

In wiring the first shield, all the connections except from plate, filament and G post of socket, may be soldered with the bottom of off the shield. The wires running from filament plate and G post (screen grid) are soldered to the lugs of the socket, and measured so that a bared end of each lead will reach the lugs on the desired sired binding posts for plate and G connections, and filament springs may be connected to their proper places.

When lugs are used on the binding posts be sure to bend them in the direction away from the shield, to prevent shorting.

The tuning condenser being mounted on the shield, and having a pigtail connection besides that terminates at a lug affixed to the shield, the rotor is established at ground potential. The stator of the tuning condenser, besides going to one terminal of the secondary, connects to a flexible lead that has a National grid clip on it. This clip connects to the cap of the 222 tube used as the radio frequency amplifier. The flexible lead and grid clip are furnished with the antenna stage shield.

As previously observed, the secondary is tuned in the first stage, and the grid return is made to the shield, which is grounded A minus when the switch is closed.

HOW CIRCUITS ARE UNITED

In the interstage shield the coil's primary is in the tuned circuit. The secondary, which affords a step-up ratio, is untuned. Again the tuning condenser has rotor grounded, but the coil it tunes has its plate return made to a positive B potential, 135 volts being recommended. Hence the condenser's rotor and the coil the condenser tunes are not solely parallel, the resistance of the B supply being in series with the coil. Hence an .01 mfd. bypass condenser is used for electrical union of the circuits without losses. The condenser is connected from the plate return lead of the coil to the shield. This connection is made from a binding post to a screw inserted in a hole drilled in the shield at the factory. This assembly is familiar now, since it is a counterpart of the assembly and connection of the .01 mfd. condenser used to bring a grounded potential to the G post of the first tube through the 45-volt binding post.

The secondary is untuned in the detector input shield, hence no complications arise in connecting the grid return to positive A. The wire is run from the coil directly to the A plus spring of the second socket.

In series with the secondary are the usual leak and condenser for this type of detector, the condenser being of .00025 mfd. capacity and having clips that hold the 2 meg. grid leak. From shield to F minus of the socket a 4 ohm resistor is connected to drop the 6 volts of the storage battery to the 5 volts required for the filament of the 201A tube used as detector. The .00025 mfd. condenser from detector plate to ground may be wired from the P post of the first audio transformer to ground, or from the binding post representing the plate of the detector tube to the shield.

THREE POINTS CLEARED UP

Only three points may not be clear in the actual wiring. One is the connection of the relative position of the coil terminals in and their proper destinations, another the identity of the socket lugs, the third the peculiar rheostat connection.

As for the coil terminals, let us take the coil in the antenna stage shield first. The primary is wound with blue insulated wire and consists of 14 turns. The secondary is wound with strawberry colored insulation next to the fixed part of the secondary. The moving coil already is connected for you in series with this fixed winding. Therefore, you have four terminals to consider: two for the primary, these antenna and ground, and two for the secondary, these being control grid (cap of tube) and ground. The shield is considered as grounded A minus meanwhile.

The two-winding coil, considering the united segments of the secondary now as one winding, therefore, has four terminals. Fortunately, the primary lugs are on one side of the shaft, the secondary lugs on the other side of the shaft. Trace out these leads by examining the coil itself. Look inside the core, see where these leads connect to lugs. You will find some of the blue insulation on the inside leads of the primary. Wire the beginning of the primary to the antenna post on the shield, the end of the primary

---

Right or

QUESTIONS

(1)—Generally, a resistor has the same resistance to both alternating and steady, direct current.

(2)—An audio frequency amplification of 400 is unusually high, in up-to-date receivers.

(3)—The greater part of the amplification in a Superheterodyne occurs in the intermediate frequency amplifier.

(4)—If the intermediate frequency in a Superheterodyne is not an exact multiple of 5 kc the receiver will squeal.

(5)—A good volume control for a circuit embodying AC screen grid tubes is a potentiometer with which the voltage applied to the screen may be varied.

(6)—A band pass filter can be constructed by coupling inductively two circuits tuned to the same frequency when the two are not coupled, the band width depending on the degree of coupling.

(7)—By the use of a band pass filter it is possible not only to pass with practically equal strength all frequencies within a band but it is also possible to pass the higher side frequencies with greater intensity than the carrier so as to build up the higher audio frequencies.

(8)—The best quality of reproduction is obtained by suppressing the higher audio frequencies and bringing out the bass very strongly.

(9)—Push-pull is only a fad and will quickly pass when the public realizes that enough volume can be obtained with a single output tube.

(10)—If one 245 tube requires a grid bias of 50 volts, two such tubes in push-pull require 100 volts bias.

ANSWERS

(1)—Wrong. The resistance of a resistor is always greater for alternating current than for steady, direct current, and it is higher the higher the frequency. The reason for this is that as the frequency increases the current travels in a thin layer near the surface of the wire so that increasing the frequency has the same effect as to decrease the cross-section of the wire.

(2)—Wrong. An amplification of 400 is not at all high and

ing Coils Affects Phase

Clarity for Wiring HB22 Shielded Stages

to the shield itself. The beginning is near the end of the coil form. Trace this down to the proper lug, which is the one nearer the rear extension of the shaft. In this way then, by examining the lugs and which terminals reach them, you will make sure the primary is properly connected.

The secondary is connected with the lug that joins to moving coil going to the flexible lead with grid clip on it, this same point going to the stator of the tuning condenser. The remaining lug of the secondary, the one nearer the shaft, goes to ground.

These directions maintain the phase at the output as it existed at the input, because the coil connections and the tube circuit both reverse the phases, and an even number of complete reversals produces the original result.

So much for the antenna stage shield.

The second or interstage shield, for detector input, has the tuned circuit for the primary, as the highest amplification is obtained from the screen grid tube, at radio frequencies, when the plate is tuned.

The antenna coil had two forms: the primary and fixed part of the secondary on the stator form, the dynamic part of the secondary on the rotor form. But the interstage coil has three forms: the outside stator, containing the fixed part of the tuned primary, the rotor form, containing the dynamic part of the secondary, and, as a third form an inside stator on which the pickup coil is wound, this being the untuned secondary with step-up ratio. But there are only four terminals, at that: two for the tuned primary, two for the tuned secondary.

Consider the coil held with moving coil at bottom, single hole mounting fixture at front. The right-hand lug nearer the fixture goes to B+, the lug accommodating the flexible lead from tickler goes to plate of the *222* tube, lug at left nearer the fixture goes to A+, and the remaining lug to grid condenser.

The respective leadout wires are plainly visible. The secondary wires are especially plain, so it might be well to wire these first. Then you can tackle the other winding as directed.

These connections are simplified by standard construction of the coils. The windings for one circuit will be found terminated on one side of the coil shaft, the windings for the other circuit on the other side, in regard to the coils in both stages. If regeneration is used it may be necessary to reverse the connections of the secondary and also omit the plate bypass condenser of .00025 mfd.

The problem of socket spring identification is solved by realizing that the larger pair of holes is for the filament, with negative fila- is quite common. It is true that the audio amplification is lower

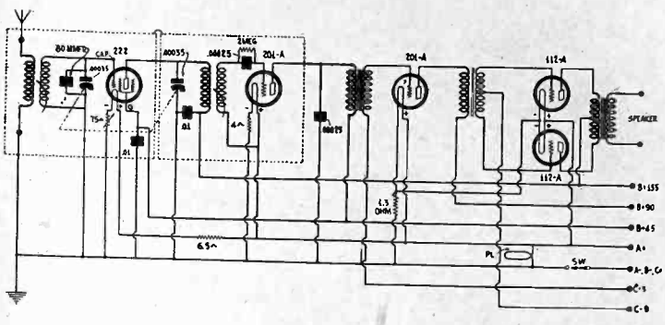


FIG. 7
CIRCUIT DIAGRAM OF THE WIRING OF THE HB22, A HIGH-GAIN RECEIVER, USING A SCREEN GRID TUBE AND PUSH-PULL AUDIO.

ment at left, positive filament at right, as the socket is viewed from top, the large holes toward you. The plate spring is on the same side as the F plus lug, the screen grid spring on the same side as F minus.

When you turn the socket upside down, as you will when wiring to the springs, the relative positions are reversed, although the absolute positions remain unchanged. With large holes toward you, socket upside down, the negative filament and the grid posts are at right, the positive filament and plate posts at left. Trace out the springs to these points.

The rheostat connection is not easy to show in a schematic diagram, but a few words will reveal the situation. The rheostat is insulated from the shield, but one side of the switch in the rheostat is connected to the shield. So A minus and ground are run to the insulated ground binding post, then over to one side of the switch, the other side of the switch going to the shield. Turn the switch on and A minus, ground, B minus and C plus become effective, and the shield itself represents this potential.

Why the rheostat is insulated, since one side goes to A minus anyway, may be asked. The reason is that some rheostats do not connect electrically when mounted on a shield, because of an insulation base, so if insulation is taken for granted, any rheostat may be used without special directions.

The audio circuit is standard. One stage of single-sided transformer coupling is used and one stage, the output, push-pull. The output is taken through a transformer. The push-pull input transformer has a center tapped secondary, the output transformer a center tapped primary.

The circuit is designed for the use of a storage battery or suitable 6-volt A eliminator, and for optional use of B batteries or a B eliminator. If 180 volts maximum are available from a B eliminator at a drain of about 52 milliamperes, then two 171A tubes may be used as the output pair, the negative bias on only the last stage being increased to from 40 to 45 volts total. Even the 112A pair may be used at 180 volts by increasing their negative bias to about 15 volts. For a little longer tube life and retention of the 112As, the 180-volt B eliminator post may be ignored, and the 135 volt post used, the diagram being followed in that respect.

[*A picture diagram of this circuit housed in the steel cabinet is in preparation for early publication in these columns.—Editor.*]

LIST OF PARTS

One shielded antenna stage dynamic tuner, consisting of tuning condenser, tuning coil, socket, bypass condenser, switch rheostat, link, equalizing condenser, binding posts, grid clip and flexible lead, assembled in a cadmium-plated steel shield. Cat. BAS3A.
One shielded detector stage dynamic tuner, consisting of tuning condenser, tuning coil, socket, bypass condenser, link, grid leak, grid condenser, filament resistor and four binding posts, assembled in a cadmium-plated steel shield. Cat. BDS3B.
One 6.5 ohm filament resistor.
One 4 ohm filament resistor.
One 1.3 ohm filament resistor.
One .00025 mfd. fixed condenser.
One first stage audio transformer.
One push-pull input transformer.
One push-pull output transformer.
Three UX (four prong) sockets.
One subpanel.
One steel cabinet.
Two binding posts, speaker plus, speaker minus.
One National modernistic dial with rainbow feature and 5 volt or 6 volt pilot lamp.
Seven insulated leads to batteries.
Dummy shaft and knob, with fastening bushing.
Four insulating front panel washers.

Wrong?

when power detection is used than when the older types of detection is employed, because of high gain established at radio frequencies.

(3)—Right. That is true in every well-designed Superheterodyne. In nearly all cases, also, the greater part of the total selectivity occurs in this part of the receiver.

(4)—Right. It will squeal. But it will also squeal if the intermediate frequency is an exact multiple of 5 kilocycles. The best way to reduce the squealing is to make the receiver very selective in the radio frequency level before the modulator.

(5)—Right. That is a good volume control both for AC and battery-operated screen grid tube amplifiers. It is about the only good control for AC tubes, but a rheostat in the filament circuit is at least as good a control when battery-operated tubes are used.

(6)—Right. This is one of the simplest band pass filters and it is especially suitable for a Superheterodyne intermediate frequency amplifier. If the inductances and capacities in the two tuned circuits are equal and if the band width at 200 kc is to be 10 kc wide, the mutual inductance should be nearly .05L, where L is the inductance in either circuit. That is, the coefficient of coupling should be 5 per cent.

(7)—Right. If the resistance in the filter circuit is of appreciable value, the resonance curve will be practically flat on top; if, on the other hand, the resistance is very small, there will be a considerable hollow at the top. In that case the side frequencies corresponding to the higher audio frequencies will be amplified more than those corresponding to the lower audio frequencies.

(8)—Wrong. That is what many people believe because of much publicity for low notes. Best quality results when there is no discrimination whatsoever among frequencies.

(9)—Wrong. Push-pull will stay and it will become even more popular than it is today. If one tube in the output stage gives a certain volume, two tubes of the same kind in push-pull will give very much better quality at the same volume, and considerably more volume at the same quality.

(10)—Wrong. If one tube requires 50 volts bias, two tubes in push-pull require the same bias.

The Five Types of Speakers

Dynamic, Inductor, Magnetic, Condenser and

By J. E. Anderson

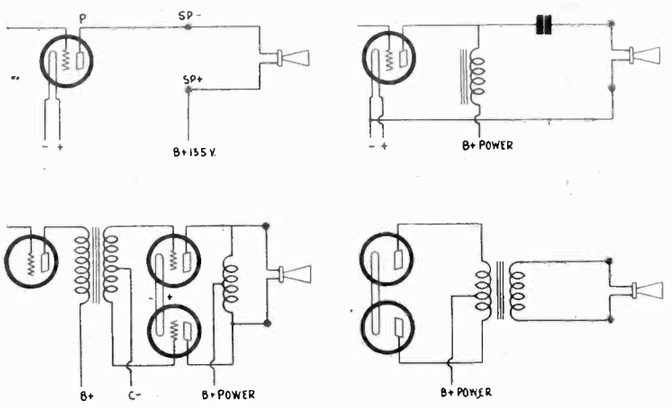


FIG. 10

DIRECT COUPLED SPEAKER CONNECTION, UPPER LEFT. CHOKE-CONDENSER FILTERED OUTPUT, UPPER RIGHT. PUSH-PULL INPUT AND OUTPUT, USING CENTER-TAPPED COIL, LOWER LEFT. PUSH-PULL OUTPUT TRANSFORMER, LOWER RIGHT.

Questions

[*The following twenty questions are based on the instalment published in last week's issue, dated November 9th. The answers will be found at the end of the present article.—Editor.*]

(1)—What is the purpose of a bypass condenser connected from plate of the detector tube to A minus or ground? What is the maximum capacity to use for this purpose?

(2)—Is the output of the detector tube directly audible? Why? What is necessary to produce audibility?

(3)—What relationship does the output power tube (last audio stage) bear to the audio frequency amplification?

(4)—What is an audio frequency transformer and by what phenomenon does it function?

(5)—Cite two types of loads for a detector output tube, to be connected in the plate circuit.

(6)—What are series connection, parallel connection, a series-parallel connection?

(7)—When constants are connected in series as a rule is the newly established value greater or less than the value of any one of the components alone? State the exception. When constants are connected in parallel is the result greater or less, as a rule? State the exception.

(8)—Is the resistance value of a resistor the same to direct current regardless of the amount of current passed through it?

(9)—Does the resistance value of a coil to alternating current change, and if so, on what basis?

(10)—What is the impedance of a constant in which alternating current is flowing?

(11)—By virtue of what ratio does an audio transformer step up the voltage?

(12)—What is the distinguishing characteristic of a high mu tube, and what type of load does its plate circuit require? Cite two examples of high mu tubes.

(13)—In practice is the load in the grid circuit of the succeeding tube higher or lower than the load in the plate circuit of the preceding tube?

(14)—Should the grid circuit of a battery-heated amplifier tube be connected to a voltage source positive or negative in respect to the negative filament? What is this difference of potential called? What is its purpose?

(15)—How many stages of audio frequency amplification are used ordinarily?

(16)—What is the object of adding an extra stage of audio?

(17)—What are the two main problems arising when the audio frequency amplification is made exceedingly large?

(18)—What are the two general ways of connecting a loudspeaker to the output tube? State the object of each.

(19)—What is a distinguishing characteristic of push-pull?

(20)—What are the two types of output for push-pull?

[*Turn to page 11 for the answers to these twenty questions.*]

[*This is the fourth consecutive instalment of the series on "Radio for Schoolboys." The transmission and reception of a radio wave, radio frequency amplification, audio frequency amplification, detection and types of circuits were discussed in the October 26th, November 2d and 9th issues. Another instalment will be published next week.—Editor.*]

THERE are three types of speakers in general home use, and one in restricted use. The three are: (1) dynamic, (2) magnetic, and (3) inductor. The fourth type is the condenser speaker.

A dynamic speaker derives its name from the fact that it has a physically moving coil, actuated by the audio frequency variations in current and voltage. The word dynamic means forceful.

There are two principal coils in a dynamic speaker: the dynamic or moving coil, called the voice coil, and the field coil.

For any loudspeaker to function there must be magnetism, an electrical condition of repulsion and attraction.

Just as the voltage in a radio frequency coil or in an audio frequency transformer sets up a magnetic field by virtue of the flow of current, so the field coil of a dynamic speaker contributes the electro-magnetism. The direct current voltage applied to the terminals of the field coil cause direct current to flow through this winding, and the field is therefore in a steady magnetic state. There must be a magnet in every speaker, and it is obvious that in the dynamic speaker this magnet is not a permanent magnet like the horseshoe type but is an electro-magnet.

CONVERSION TO MECHANICAL ENERGY

The audio frequency currents and voltages from the output of the receiver are fed into the voice coil, usually through an output transformer, and therefore a changing magnetic field exists in the voice coil. The field coil tends to maintain the moving coil in a steady or neutral state, while the unsteady magnetic field moves the voice coil against this force, for the strength is greater, and the electrical pulsations at audio frequencies are thus converted into mechanical vibrations of the same frequencies.

When the moving coil moves in one direction it would have a tendency to stick at the new position, but the effect of the field coil is to bring the moving coil back to neutral position. Therefore all the while the program is being heard the voice coil is moving back and forth.

The voice coil is the moving part or armature. A short tubular projection physically attached both to the voice coil and to a cone, causes the voice coil to communicate its motion to the cone, which helps radiate the sound. Therefore the cone performs as a sounding board, although it is made of parchment, paper, fabric or other material.

PURPOSE OF A BAFFLE

The radiating qualities of the cone alone are not sufficient, therefore, an extension sounding board, in this instance usually an actual board, is used. It is called a baffle. It is a flat surface with a hole in it large enough to accommodate the outer edge or periphery of the cone. A rigid support or spider is used in constructing the speaker, the unit or drive mechanism being at rear, and a circular frame at front. To this circular front brace piece the edge of the cone is affixed, and this facilitates attachment to the baffle.

The purpose of the baffle being to act as an auxiliary sounding board, it best achieves that end when accentuating the radiation in a forward direction, that is, in the direction out from the cone. At the same time the baffle, if large enough, tends to prevent the sound waves from retreating to the drive mechanism of the speaker, a condition known as back coupling and which, if not prevented, will cause distortion, since the same wave is radiated twice, the primary and secondary radiations being at different times, hence out of phase.

If, in addition to the baffle at front, the speaker is placed in a box, whether this box be a separate unit or a compartment of a console, over-accentuation of low notes will result. The baffle itself helps the low note reproduction, but the box, unless specially constructed, may make some low notes so strong that the reproduction sounds boomy, as if the program were emanating from a barrel.

OPEN EXCEPT AT FRONT

This condition is caused by box resonance. The box acts as a damper upon the middle and upper frequencies, hence causes the

And Their Performance

Horn Models Explained and Compared

and Herman Bernard

lower audio frequencies to be relatively more pronounced. The longer audio waves, being of greater length than the shortest distance between the edge of the cone and the sides and particularly the back of the box, find their exit obstructed. In a very real sense they are muffled.

One way of reducing box resonance is to make the rear and other than front part open, as by using cane, which permits easy exit of sound waves, or steel made to imitate cane.

The dynamic speaker is itself sensitive to low notes, and when the effect of the baffle is combined with that of a box, the boominess characteristic of so many commercial receivers housed in consoles is the disappointing result. If tone considerations are to be the deciding point it is usually better to have the speaker apart from the radio installation, in a separate cabinet, even though the consolidation effected by a console is then lost. The extra cabinet may be acoustically open, that is, not seriously obstructing middle and upper frequencies, which may be accomplished by padding the inside with cotton batting or other soft material which prevents the echoing effects, or by making the box acoustically open, or by combining both safeguards.

THE MAGNETIC UNIT

The magnetic unit consists of a coil or two coils placed in the field of a permanent magnet, usually iron, which has been magnetized. The audio frequency current is passed through the magnet coils and moves a piece of metal, called the armature, which is so mounted between the coils as to have a springy effect. This motion takes place between the pole pieces, which are square or oblong, usually of stacked pieces of metal of the same size, called laminated pole pieces. The object of the pole pieces is to direct the flux most effectively toward the moving part. Flux is the name given to the field set up by and about the magnet coils.

The magnetic unit may be very sensitive. But it has some limitations. The armature may strike the pole pieces, due to the extremely tiny gap between them, often only a few thousandths of an inch on each side, that is, between one side of the armature and either nearer side of a pole piece. The smaller the gap the greater the sensitivity of the unit, the greater the danger of loud passages causing the pole pieces to be struck by the armature. When this overload takes place the speaker rattles most annoyingly.

In the magnetic type speaker the permanent or horseshoe magnet, or pair of such magnets mounted side by side, perform the function of tending to maintain the armature in a steady state. The audio frequency current derived from the output tube or tubes of the receiver sets up a correspondingly varying magnetic field, another instance of electro-magnetism, and this field exerts attraction and repulsion on the armature, causing it to move at a frequency corresponding to the frequency of the audio current fed to the magnet coils. The armature would stick or freeze were not the two poles of the permanent magnet there to bring it back into neutral position again, after every movement of the armature off center.

In the magnetic speaker, the unit has a rod attached to the armature, and this rod, or coupling pin, is affixed to the center or apex of a cone by a setscrew. Two tiny metal cones, perhaps an inch in diameter, are attached to the apex front and back, and these pieces are themselves called apexes and contain the extending bushing that has the setscrew in it. The coupling pin emerging from the armature passes through this bushing to be engaged by the setscrew. Thus is the cone or other diaphragm vibrated.

THE INDUCTOR UNIT

The inductor unit is of the same general type as the magnetic, even though the inductor is sometimes referred to as an inductor dynamic. It is hard to imagine the inductor to be in any class except the magnetic because of the construction and principle of operation.

So when an inductor unit, or inductor dynamic or inductor magnetic is mentioned, the reference is always to the same type of unit, which may as well simply be called an inductor. Otherwise the terms become confusing.

The words used to designate different types of speakers are not of themselves revealing, so, unless some particular meaning is accepted, the terms tend to become confusing. For instance, all speakers are dynamic, in the sense that they have a moving part. Also, all save one type are inductors, since they utilize the phenomenon of induction. And all certainly are magnetic, in the sense that they operate by the use of magnetism, whether the magnet be a horseshoe type, called permanent magnet, or a coil type, where the voltage across the coil causes a magnetic

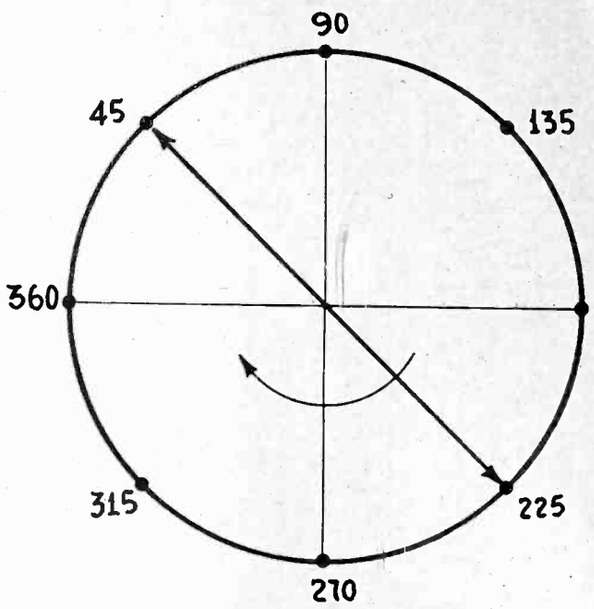


FIG. 11

A CIRCLE HAS 360 DEGREES. IF THE DOUBLE ARROW IS WHIRLED AROUND, THE POINTERS REPRESENT THE 180-DEGREE DIFFERENCE IN THE PHASES OF THE VOLTAGES OF THE TWO PUSH-PULL TUBES AT ANY INSTANT.

effect, this type of magnet being called an electro-magnet, or a plate type of magnet. While in most instances the word applied to a particular type designates a condition present also in another type, nevertheless usage has made the terms dynamic, magnetic and inductor sufficiently informative and contrasting, as outlined.

POINT OF DIFFERENCE

The inductor unit differs from the magnetic principally in the fact that the armature or moving part instead of vibrating toward the two pole pieces, in the direction of the width of the air gap, moves like a piston in the direction of the length of the air gap. Thus the armature may be exceedingly close to the pole pieces, without striking them, since the separation between the armature and the pole pieces is not supposed to change during the operation of the unit. Hence high sensitivity may be developed without danger of rattling caused by the armature striking the pole pieces.

In other respects the inductor speaker is extremely sensitive, hence, although the danger of the armature hitting the pole pieces is small, the air gap may be widened, to reduce the danger markedly, and still the inductor is much more sensitive than the magnetic unit.

Also, the sensitivity is more impartial.

The magnetic unit is deficient on low note reproduction, a condition that acquired no importance until audio amplification was developed to a point in very recent years where receivers, factory-made, custom-built or home-constructed, enabled low notes actually to come through. It then became necessary to provide loudspeakers to reproduce these low notes, which are ordinarily weaker than other notes. The dynamic and the inductor speakers were the answer. In some instances filters were built into speakers, particularly into dynamics, to reduce the response on high notes, and thus give relative preponderance to low notes, and soon a condition developed, existent at this writing, where there was general over-accentuation of low notes. The pendulum had swung to the other extreme.

THE CONDENSER SPEAKER

The fourth type of speaker, recently having made its debut commercially, is the condenser type. This consists of two plates, separated by an insulating material, usually some special form

Theory and Operation of

Variation of High Voltage Applied to

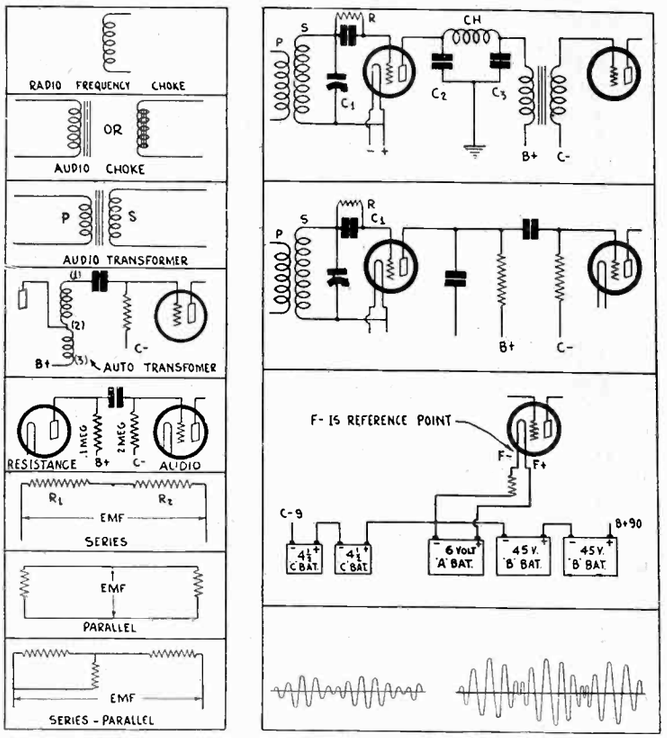


FIG. 12

CHOKES, TRANSFORMER, AUTO TRANSFORMER, RESISTANCE COUPLING, SERIES, PARALLEL AND SERIES-PARALLEL CONNECTIONS ARE SHOWN AT LEFT. A PLATE FILTER CIRCUIT FOR ELIMINATING RADIO FREQUENCIES FROM THE AUDIO AMPLIFIER, A CONDENSER ALONE FOR THIS PURPOSE, BATTERY CONNECTIONS TO A TUBE, AND HOW A 1-TO-2 RATIO AUDIO TRANSFORMER ENLARGES THE VOLTAGE ARE SHOWN AT RIGHT.

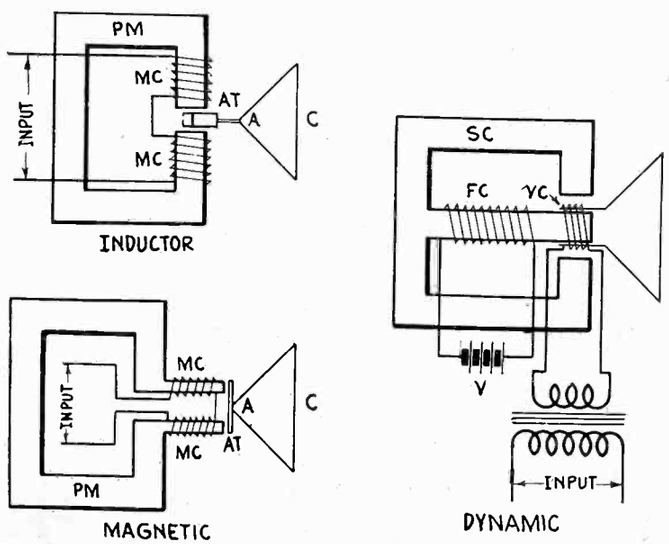


FIG. 13

IN THE INDUCTOR AND MAGNET DIAGRAMS THE DESIGNATIONS ARE PM, PERMANENT MAGNET; MC, MAGNET COIL; AT, ARMATURE; A, APEX; C,, CONE. AN UNBALANCED TYPE OF MAGNETIC IS SHOWN FOR SIMPLICITY. IN THE DYNAMIC SC IS THE STEEL CORE; FC, FIELD COIL; VC, VOICE COIL; V, DIRECT CURRENT VOLTAGE SOURCE. FOR AC OPERATION A DEVICE IS BUILT IN TO FURNISH DIRECT CURRENT VOLTAGE. THE OUTPUT TRANSFORMER, ALSO BUILT IN, IS ILLUSTRATED. IT USES THE OUTPUT OF THE RECEIVER AS INPUT TO THE SPEAKER.

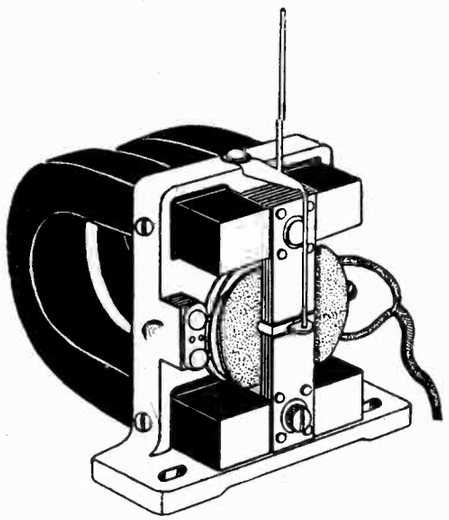


FIG. 14

A magnetic unit is shown at right. The coupling pin is at top, welded to a rocker which connects to the armature. The pole pieces are laminated. The magnet coils are in the speckled area.

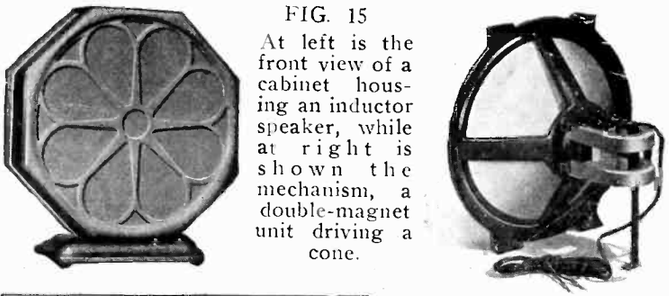


FIG. 15

At left is the front view of a cabinet housing an inductor speaker, while at right is shown the mechanism, a double-magnet unit driving a cone.

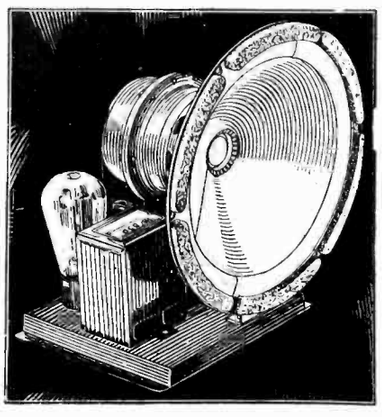


FIG. 16

A dynamic speaker, AC model. As a rectifier is needed to filter the AC so that direct current is applied to the field coil, a rectifier tube is used in this instance. Other dynamic speakers have metallic rectifiers

(*Continued from preceding page*)

of rubber, a high voltage being impressed on the plates. The condenser speaker operates on the principle of electrostatic attraction. When two conductors are at a difference of potential (voltage) they are pulled toward each other by an amount depending on the voltage.

The theory of the condenser type of speaker raises doubts as to whether its sensitivity can be even nearly as great as that of the other types, but leaves no doubt as to the possibility of the highest order or tonal qualities. Any diminished sensitivity can be atoned for by extra amplification, particularly at audio frequencies, as by using an extra stage of audio.

The relatively high direct current voltage that must be applied to the plates of the speaker, may have to be so high that any chance touching of two oppositely polarized plates might cause more than momentary pain. Suitable precautions in construction, to render these opposite poles inaccessible, and precaution in making the connection to the receiver, would remedy this condition. The remaining point is that the insulating medium, being rubber, is likely to be perishable. Condenser type earphones and speakers made in Germany long before any appeared on the American market were notoriously subject to this defect.

The contrast in performance between the magnetic speaker on the one hand and the three other types of speakers on the other accounted for a rapid decline in the popularity of the magnetic unit. The dynamic suddenly swung into almost uproarious popular favor, then the inductor appeared and won much apprecia-

New Condenser Speaker

nsulated Plates Causes Audible Vibration

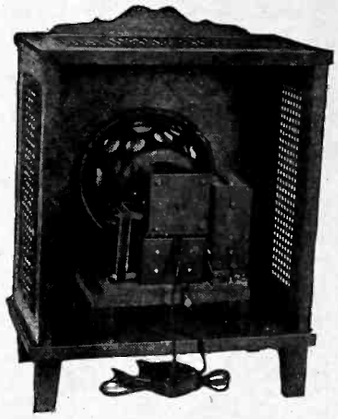


FIG. 17

An acoustically open baffle box in which a dynamic speaker is placed. The top and sides are cane, with the back either entirely open or with cane there, too. This type of construction greatly reduces box resonance.

FIG. 18

At left is a horn speaker housed in a baffle box. The tone chamber has a winding shape for extra length in small space. Above is the unit used.

tion. The condenser speaker has shown up well in the public's first trial of this type.

Only a restricted number of manufacturers make inductor and condenser speakers, whereas the number making dynamic speakers is exceedingly large, hence the dynamic, which at its best is a fine instrument, is all too often heard at its worst, because of lack of scientific engineering by the manufacturer, or commercial ideas of just what particular type of distortion, as, for instance, an overdose of sensitivity to low notes, will produce the greatest sales. Utterly wretched dynamics abound in the world market, while some of the very best speakers made are dynamics.

The speaker first in popularity in point of time, the horn type, is seldom used in home installations, because it is recognized now that chamber with a very long tone travel, built so that the opening is wider progressively on a fixed ratio, is necessary, and this type of construction takes up much more room. To save room the horn may be made in curled form, but even so takes up considerable space, if its performance is to be anything like that of the best dynamics, inductors and condenser speakers. Hence horn speakers of proper acoustical design, called exponential horns, are used largely in public address systems, auditoriums, theatres and the like, but are not popular in homes. Magnetic horn units are used. They vibrate a metal diaphragm directly, instead of a sounding board indirectly. Thus the unit is screwed onto the nozzle of the horn. One type of horn speaker, made for talking movie reproduction and like purposes, uses a special dynamic unit to work the metal diaphragm.

The purpose of the horn is to enable the small diaphragm in the magnetic or other unit to take hold of a large amount of air and thus transfer a larger amount of electric energy into acoustic or sound energy. The horn is really nothing but an air transformer corresponding to a step-down electric transformer. If there is no horn the small diaphragm will vibrate easily because there is no appreciable air pressure on it. If there is a long horn which tapers in the right way the air pressure on the diaphragm is very great, and that is what is needed. The horn is an impedance matching device which enables the high impedance diaphragm work effectively into the extremely low impedance of free air. Th larger the mouth of the horn the better is the matching at the open end, provided that the rate of expansion of the horn has the proper value.

Answers

[*The questions answered below will be found on page* 8]

(1)—The purpose of the detector bypass condenser is to detour the radio frequencies that are in the plate circuit of the tube, to keep them out of the audio amplifier. The capacity of this condenser should not exceed .001 mfd., although smaller values may be used.

(2)—The output of a detector tube is not directly audible. The fluctuations are at frequencies within the audible range, but are in the form of changes in direct current and voltage in the plate circuit. To produce audibility it is necessary to connect some device, like earphones, in the plate circuit, so that the changing values of current and voltage will actuate the diaphragm of the device and produce from the electrical vibrations the mechanical vibrations that are audible.

(3)—The power tube has to have a large enough undistorted power output to be able to handle the signal amplified by the audio frequency channel.

(4)—An audio frequency transformer is a two-winding coil on one metal core. The transformer functions by virtue of the coupling between the magnetic field of the primary and the magnetic field of the secondary, utilizing the phenomenon of electromagnetism.

(5)—Two type of detector plate loads are (a) resistor and (b) impedance coil.

(6)—A series connection is one in which the component parts are so connected that the end of one joins the end of another, and the electromotive force is applied to the two remaining free ends. A parallel connection is one in which one end of one part is connected to one end of the other part, and the remaining ends of both parts are connected together. The electromotive force is applied to the joined terminals. A series-parallel connection is one in which both series and parallel methods are used.

(7)—When constants are connected in series the rule is that the result is greater in value than the value of any one of the components alone. The exception is in the case of condensers, where the value with series connection is less than the independent value of any one or more of the components. When constants are connected in parallel the opposite to the foregoing holds true.

(8)—The resistance value of a resistor to direct current remains the same regardless of the amount of current.

(9)—The AC resistance of a coil varies with frequency. The greater the frequency, the greater the resistance.

(10)—The impedance of a constant is the resistance to alternating current.

(11)—An audio transformer steps up the voltage by virtue of the larger number of turns in the secondary. The step-up is directly proportional to the ratio of turns.

(12)—A high mu tube's distinguishing trait is its high amplification capability under proper load and voltage conditions. Two examples of high mu tubes are the 240, which is called a high mu tube, and the 222, which is called a screen grid tube.

(13)—The load on the grid circuit is larger in practice than the load in the plate circuit.

(14)—The grid return of an amplifier circuit should be connected to a voltage negative in respect to the negative filament. The difference in potential between the negative filament and the grid, as established by the grid return connection, is called the negative grid bias. The purpose of negative bias is to prevent distortion and incidentally to reduce the plate current drain for any given value of plate voltage.

(15)—Ordinarily two stages of audio frequency amplification are used.

(16)—The object of adding an extra stage of audio amplification is to produce a louder result.

(17)—When audio frequency amplification is made exceedingly large the main problems are preservation of tone quality and maintenance of stability.

(18)—The two main ways of connecting a loudspeaker are (a), directly in the plate circuit, and (b), through a filter. The object of the direct method is to attain a result most economically, which may be done when the plate current is not large. The object of the filtered output is to keep the direct plate current out of the speaker windings, to save the speaker from possible ruin, and also in some instances to preserve tone quality.

(19)—A distinguishing characteristic of push-pull is that the voltage impressed on the pair of tubes at any instant is different in phase, but not in time, by 180 degrees, which difference is called the voltage phase difference.

(20)—The two types of output for push-pull are (a), a center-tapped impedance coil and (b), an output transformer consisting of a center-tapped primary and an untapped secondary.

e.e.w.

Superheterodyne Sh

An oscillator is used to reduce the

By Knollys

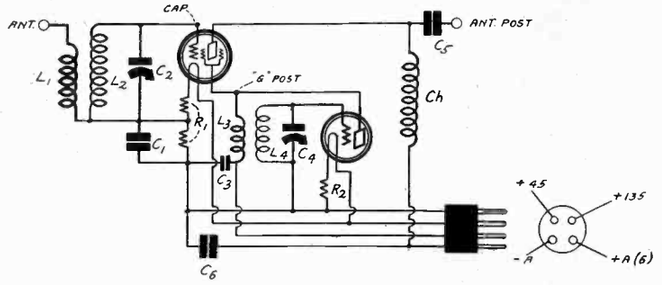


FIG. 32
THE CIRCUIT DIAGRAM OF SHORT WAVE ADAPTER WORKING ON THE SUPERHETERODYNE PRINCIPLE AND WHICH CAN BE USED AHEAD OF ANY BROADCAST RECEIVER.

[Herewith is another installment of the work, "The Superheterodyne." The series was begun in the October 12th issue and continued October 19th, 26th, November 2d and 9th. Another article will appear next week.—Editor.]

SINCE the transformer with tuned primary and secondary is one of the simplest band pass filters, it may be well to give a few suggestions on the design of such a filter. Let the inductances of the primary and the secondary be the same and let it be designated by L. Then since the two circuits are to be tuned to the same frequency, the condensers must also be the same in value, and let this value be designated by C. It is only necessary to determine the amount of mutual inductance M necessary to give a transmission band of the desired width.

It can be shown that the two response maxima are determined by the two equations $Z - Mw$ and $Z + Mw$, in which Z is the total impedance in either circuit, M the mutual inductance, and w is 6.28 times the frequency. If the resistance in the circuits be neglected $Z = Lw - 1/Cw$. Substituting this in the two equations and solving for w, we find the two values $w_1 = 1/[C(L - M)]^{1/2}$ and $w_2 = 1/[C(L + M)]^{1/2}$. The first of these is higher than the frequency of either tuned circuit and the second is lower by about the same amount If frequency ratios be used one is exactly as much above as the other is below..

If we let $r = w_1/w_2$, we can combine the two equations and determine M in terms of r and L. The relation is $M = (r^2 - 1) L/(r^2 + 1)$. Let us apply this to an intermediate frequency filter having a transmission band between 195 and 205 kilocycles. In this case the frequency ratio r is 205/195. Substituting this value in the equation for M we find the relation $M = .05L$. That is, the mutual inductance between the two tuned coils is only one-twentieth of the inductance of either tuning coil. This is very loose coupling.

In designing the two tuned circuits they may be adjusted to 200 kc. We have already found that if the tuning condenser is .0005 mfd. the inductance should be 1.266 millihenries. The mutual inductance in this particular case would then be 63.3 microhenries.

The Superheterodyne was originally devised for the purpose of receiving short wave signals under conditions requiring a high order of selectivity, and was done during the war. If the principle was good in those days it should be equally good for the reception of short wave signals, both code and broadcast, under present conditions. And, indeed, that is the case.

One method of receiving short wave signals is to reduce the frequency in steps, using two intermediate frequency amplifiers and two local oscillators. Indeed, this method is even applicable to broadcast frequencies and has been used for that purpose to some extent. However, such a receiver tends to be entirely too selective. But for the reception of very short wave signals the method seems to be nearly ideal, especially where a high order of selectivity is required.

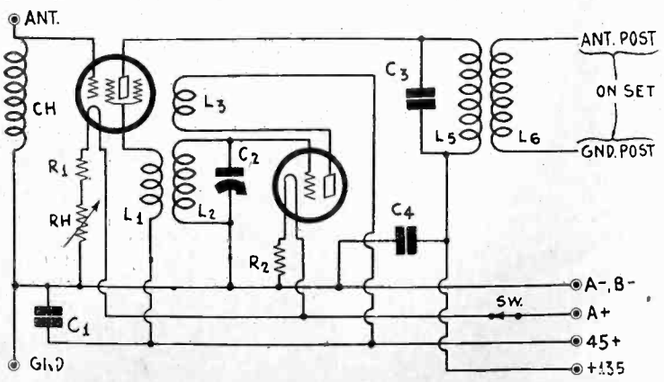


FIG. 33
THE CIRCUIT OF A SHORT WAVE ADAPTER SIMILAR TO THAT IN FIG. 32 BUT WITH THE FIRST SHORT WAVE TUNER OMITTED FOR EASE OF TUNING.

SHORT WAVE ADAPTER

This suggests the use of the Superheterodyne principle in a short wave adapter with any broadcast receiver, either of the Superheterodyne or the ordinary type. Methods of doing this are best explained with the aid of circuit diagrams. Fig. 32 shows one such circuit employing a screen grid tube for modulator and a three-element tube for oscillator. DC tubes are used in this adapter, but, of course, it will work with AC tubes as well, suitably charged.

The input transformer L1L2 may be an ordinary short wave tuning coil of the plug-in type. The primary L1 should have a relatively small number of turns and the secondary L2 should be wound to suit the tuning condenser C2 and the waveband that it is desired to cover. It is customary in short wave tuners to make the tuning condenser of 140 micromicrofarads.

The oscillator L3L4C4 may be of similar design except that L3 should have a relatively larger number of turns. The tuning condenser may well be of the same capacity as the first tuning condenser. If a set of plug-in coils is used for each of the tuned circuits, no special size of oscillator coil is needed because no matter what the intermediate frequency may be there will be one oscillator coil which will oscillate at some setting of the condenser for every frequency to which the first circuit may be tuned.

If the adapter depicted in Fig. 32 is to be used ahead of any broadcast receiver any intermediate frequency within the tuning range of that receiver can be selected by simply tuning the broadcast receiver to a signal of that frequency. For example, the broadcast receiver may be tuned in on WGY and the frequency of that station will then become the intermediate frequency. When the receiver has been tuned to this frequency it is only necessary to connect the adapter ahead of it and tune the high frequency level with C2 and C4, using the proper pair of coils.

EXAMPLE OF TUNING

Let us take for simplicity an intermediate frequency of 1,000 kc. The broadcast receiver is tuned to that frequency, either by tuning in a broadcast station operating on that frequency or by setting the dials by previous calibration. Then the short wave adapter is connected to the set as indicated in the figure and the two tuners in the adapter set for the particular short wave station desired. The first tuner, L2C2, is tuned to the frequency of the short wave signal and the oscillator, L4C4, is set for a frequency which is 1,000 kc. greater or less than the frequency of the desired signal. When the two tuners are set properly the short wave signal will come through the loudspeaker of the broadcast receiver.

It should be noted that if the broadcast receiver contains a single tuning control, no particular tuning is required, for wherever the dial is set the circuit will be in tune for some frequency, and that frequency will be about as good as any other to use as intermediate. But if the dial is calibrated it may be well to set it in the vicinity of 1,000 kc. or 300 meters.

It is usually said that it is next to impossible to manipulate a short wave receiver having two or more tuning circuits, and that is a fact. It will be rather difficult to find the right combination that will bring in any given signal on the adapter shown in Fig. 32, although it will not be quite so difficult as if the tuners were functioning in the same way. As soon as we shall have disposed of some of the details of the circuit in Fig. 32 we shall present circuits which are less difficult and more practical.

It will be noted that the filament and plate return leads terminate in a plug which points to a socket. This is not to be taken as one of the sockets in the broadcast receiver, but rather as a separate socket wired for the convenience of the adaptation. The voltages indicated on the socket may be obtained from the same sources used in the broadcast receiver, but preferably they should be provided by separate batteries, especially the two plate voltages. However, the by-pass condenser C1, C3, and C6, if large enough, prevent any serious troubles in case the same sources are used. None of these condensers should be less than .01 mfd. and the larger they are the better it is.

Grid bias for the tubes in the circuit are provided by voltage drops in the ballast resistors. R1 should have a total resistance of 25 ohms, all of which may be placed above the grid return since a high bias is desirable for a modulator tube. R2 is a resistor of 4 ohms.

It will be noted that the tickler coil in the oscillator circuit is placed as a whole in the screen grid circuit and that the same voltage is applied to the plate of the oscillator and the screen grid. We showed this method of modulation before and at that time we

ort Wave Adapters

frequency to the broadcast band

Satterwhite

came to the conclusion that it was not so good as some of the other methods explained, due to the very close coupling between the oscillator and the modulator. Part of the objectional features of this does not apply in this case because the intermediate frequency is high and the first tuner is sharp enough to eliminate any image interference that might result. When we come to the more practical adapters we shall show a different method of modulation, necessitated by the fact that the first tuner is omitted.

A COUPLING DILEMMA

When hooking up an adapter of this sort there is always a question as to what kind of coupling should be used between the modulator and the broadcast receiver. In order that the modulator should work efficiently it must encounter a high impedance at the intermediate frequency. But the input circuits of most broadcast receivers have low impedances. If all had low impedances it would only be necessary to interpose a radio frequency step-down transformer between the modulator and the broadcast receiver. But some broadcast receivers have high input impedances. An adapter should fit all kinds of receivers, unless it is built for a particular receiver. Another condition that must be satisfied is that the connection between the adapter and the receiver should be as simple as possible. Again, the simple connection should be safe, that is, there should be no danger of short-circuiting any batteries or other voltage supplies.

The output device in Fig. 32 consists of a radio frequency choke coil Ch and a stopping condenser C5. This combination is simple and safe, but if the antenna post on the condenser is connected to the corresponding post on the receiver the matching will not be good in all cases. However, it will work in all instances. The coupling will be more efficient if the output terminal of the adapter is connected to the grid side of the first tuned circuit in the broadcast receiver, but unfortunately, this is not often accessible from the outside of the cabinet.

MORE PRACTICAL ADAPTER

Fig. 33 represents an adapter which is easier to tune than the one shown in Fig. 32 and at the same time employs a more effective coupling between the modulator and the broadcast receiver. It is not so selective, however, for there is no high frequency tuning. The only trouble that this might cause is image interference between two high frequency signals which happen to be separated in the frequency scale by twice the intermediate frequency selected. For example, if the intermediate frequency is 1,000 kc. and it is desired to receive a signal the frequency of which is 6,000 kc. there may be interference at both the upper and the lower oscillator settings, in one case with signals on 8,000 kc. and in the other with signals on 4,000 kc.

If the intermediate frequency were fixed as it is in the regular Superheterodyne, this might render the adapter useless in many instances, because the short wave band is even more crowded than the broadcast band, and there would be little chance of getting clear signals. But since the intermediate frequency may have any value in the broadcast range it can always be selected so that any image interference may be avoided, and the selection is accomplished by merely retuning the broadcast receiver. If there is a single control on the broadcast receiver, as has been pointed out, the selection of a suitable frequency is done very simply by turning the single control, except that C3 in the adapter may also have to be turned.

The possibility of avoiding image interference is due to the fact that most of the potentially interfering frequencies may be used in other parts of the world. However, if it cannot be avoided in any other way, it is always possible to use a tuned input as suggested in Fig. 32. In extreme cases convenience must be sacrificed for results.

DETAILS OF DESIGN

A short antenna should be connected to the antenna binding post, or if only a long antenna is available, a condenser of about .0001 mfd. should be connected in series with it before it is connected to the post on the adapter. The input choke coil Ch should be a small radio frequency choke. There are coils available wound with fine wire on forms no larger than a grid leak resistance. Of course, larger coils can be used also, but a necessary condition for suitability is that it have a very small distributed capacity. In place of a choke coil a resistor of about 100,000 ohms can be used also.

The three circuit tuner in the oscillator can be any one of a number of commercial coils designed for short wave reception. L2 is the largest winding on the coil and L3 is the tickler. The remaining winding, L1, is usually not an integral part of the three circuit tuner but is mounted on the base into which the form for the other windings is plugged. It is adjustable in most instances to allow for variation of coupling. This is done because ordinarily it is connected

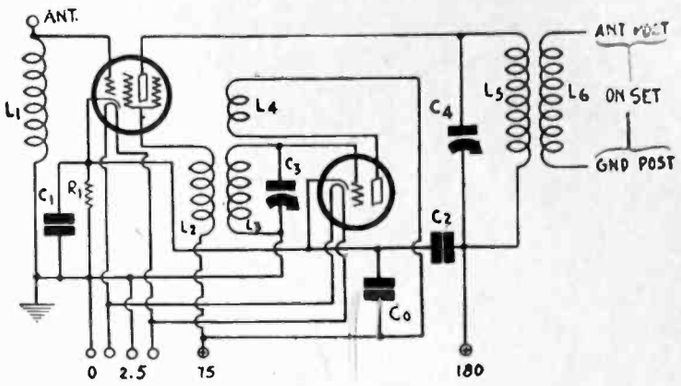


FIG. 34
A CIRCUIT LIKE THAT IN FIG. 33 BUT ADAPTED FOR USE WITH AC TUBES.

in the antenna circuit and is used for all the coils in the set. The adjustable feature is also advantageous when it is used as pick-up coil in the modulator. While it is desirable to have a variable pick-up coil, fixed coils are not ruled out by any means, provided that each plug-in coil in a set has its own pick-up coil suitable for the frequency range of the coil. In any event the pick-up coil should not be large, or the coupling should not be close.

The tuning condenser C2 should be the usual size, namely, 140 micromicrofarads.

The output transformer L5L6 can be an ordinary radio frequency transformer intended for broadcast reception, but it should be connected in reverse. That is, the large winding should be tuned and connected in the plate circuit of the modulator and the small winding should be the secondary. If the coil is an antenna coupler and if the receiver has a similar coil, the matching will be good and the adapter will work efficiently. If the coupling is close between the two tuned circuits, assuming there is a tuned circuit in the receiver next to the antenna, there will be the double maximum effect discussed under intermediate frequency filters. If this is not desired C3 can be adjusted so that the signal is loudest. C3 should have a capacity of .0005 mfd. and L5 should match.

STRAY COUPLING REDUCED

Stray coupling in the adapter circuit is reduced by means of by-pass condensers C1 and C4, each of which should not be less than .01 mfd.

As in the previous case discussed, the battery leads may be run to the voltage source in the broadcast receiver, but preferably they should be run to separate batteries.

R1 should be a 25 ohms resistor and the rheostat Rh one of a maximum resistance of 20 or 30 ohms. The object of the rheostat is to control the volume. Of course, for this purpose the volume control in the broadcast receiver can be used also. R2 is a 4 ohm resistance or equivalent ballast.

The tubes used are one screen grid tube and one 201A type tube. A 112A type tube also makes a good oscillator and can be used interchangeably with the other.

A filament switch Sw is a convenient addition to the adapter when the installation is permanent. Or in place of this, the plug-in arrangement shown in Fig. 32 can be used in this circuit.

When using the adapter the antenna should be removed from its post on the receiver and connected to the corresponding post on the adapter, and then L6 should be connected as indicated.

AC TUBE ADAPTER

When AC tubes are used in the adapter, the circuit in Fig. 33 takes the form of that in Fig. 34. The first tube in this circuit is an AC screen grid tube and is used as a modulator. The second tube is a 227 type and is the oscillator.

The specifications of the various coils and condensers are the same as those of the corresponding parts in Fig. 33. The designations are slightly different, however, but this should not cause any confusion.

The grid bias on the two tubes is made the same for simplicity, and it is obtained from the drop in resistor R1. The current through this resistor is the combined plate currents of the two tubes and the screen grid current of the first, a total of about 6 milliamperes. This may be used in the determination of the value of the grid bias resistor. A bias of about 5 volts may be applied to each tube, for this is approximately the value needed on the screen grid tube when it is used as detector, and on the

Receiving ICW Signals

An auxiliary oscillator produces audible beat

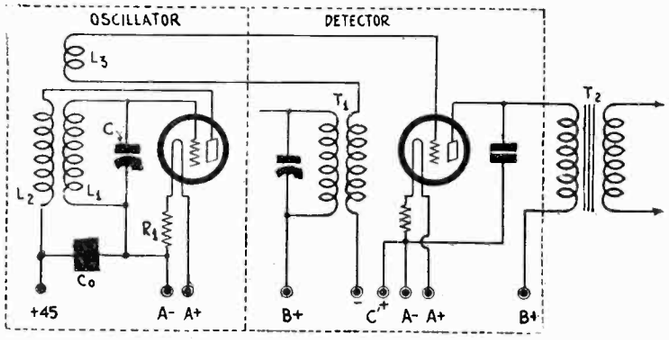


FIG. 35

INTERRUPTED CONTINUOUS WAVE SIGNALS CAN BE RECEIVED AUDIBLY BY USING AN AUXILIARY OSCILLATOR COUPLED TO THE FINAL DETECTOR IS ILLUSTRATED IN THIS DRAWING.

227 to make it a good oscillator. From these value of bias and plate current we get 833 ohms for R1. This is an odd value which can only be obtained by using a variable resistance covering this value. However, the circuit will work well if the nearest fixed commercial resistor is used, say one of 750 ohms.

Since the grid bias resistor is in the plate circuits, as well as the grid circuits, of both tubes, it constitutes a coupler. In order to eliminate this undesired coupling the condenser C1 across the resistor should be fairly large. A capacity of 0.1 mfd. is suggested, although one of .01 mfd. may be used since only high frequencies are involved.

VOLTAGES REQUIRED

The usual screen grid voltage of 75 volts is provided for the modulator and the usual plate voltage of 180 volts for the plate of that tube. Since the oscillator will work well with a plate voltage of 75 volts, this is also used for that tube in order to simplify the circuit. The heater current for both should be supplied by a 2.5-volt, center-tapped winding not used for any of the tubes in the broadcast receiver, or better still, a transformer not used for anything else, except that if the plate voltages are supplied by an independent B supply the 2.5 winding may be an integral part of this unit.

While the normal plate and screen voltages of 180 and 75 volts have been indicated in Fig. 34, it may be that better modulation will result if a different combination is used. One of these voltages, say the plate voltage, may be left at the normal value and the other varied until the best combination is obtained. The only criterion for correct combination is the greatest output. When the screen grid voltage is varied, the bias required for either modulation or amplification changes, so that whatever the bias may be there will be one screen grid voltage which will give better results than any other, and that voltage, of course, is the one to use when maximum sensitivity is required.

When the screen grid voltage is changed the plate voltage on the oscillator is also changed and therefore the intensity of oscillation is changed. Therefore part of the change in volume is due to the change in the modulation efficiency of the screen grid tube and part to the change in the oscillation intensity of the oscillator. If the voltage on the oscillator plate is made too low, oscillation will stop and no signals can be received.

While the adapters described above have been designed to work into a broadcast receiver, they can also be used to work into a specially constructed intermediate frequency amplifier followed by an audio amplifier, thus making a complete short wave Superheterodyne. An intermediate frequency of about 600 kc would be suitable for such a receiver, and this can be obtained with tuners used in broadcast receivers.

SHIELD FROM BROADCAST WAVES

If the intermediate frequency be chosen in the broadcast band, as has been suggested above, it is desirable to shield the intermediate frequency amplifier from broadcast signals, for if it is not, the tuners in the amplifier will pick up the broadcast station to which they are tuned, and this station will interfere with the signals desired. This type of interference is often noted even in Superheterodynes in which a low intermediate frequency is used, when the intermediate frequency amplifier is not shielded. The interference will be greater the higher the intermediate frequency for the antenna effect of leads and the loop effect of the coils are greater on the higher frequencies. However, no trouble will be experienced from this source if the intermediate amplifier is constructed in the manner of modern radio receivers with a grounded shield surrounding each stage or each tuned circuit.

RECEPTION OF UNMODULATED SIGNALS

Most of the signals existing in the ether are of the unmodulated type, or at least they are modulated in such a way that they cannot be heard if received by the ordinary broadcast receiver. They are of the interrupted continuous wave type. In order to hear these signals on any type of receiver it is necessary to introduce an oscillator into the circuit and adjust its frequency until it differs by an audible amount from the frequency of the radio frequency existing in the grid circuit of the detector to which the oscillator is coupled.

A method of coupling this auxiliary oscillator is illustrated in Fig. 35. A simple oscillator is shown at left and the detector in the receiver at right. The oscillator coil consists of three windings, as usual. L1 is the winding which in conjunction with condenser C determines the frequency. L2 is the tickler or plate winding, and L3 the pick-up winding which is connected in series with the grid lead of the detector tube.

The interrupted continuous wave signal is impressed on the detector by the radio frequency transformer T1 and the locally generated frequency by the pick-up coil. The two frequencies mix in the detector, producing a beat note in the plate circuit. This beat is amplified by the audio frequency amplifier, the first transformer of which is shown, and then transmitted to the loudspeaker.

If the receiver is to be versatile it is necessary that the frequency of the oscillator be variable and for that reason condenser C is variable. Suppose that the signal to be received is on a frequency of 200 kc. It may be the original frequency received from some station or it may be the intermediate frequency of a Superheterodyne. In order to hear the signal it is necessary to set the local oscillator by means of condenser C so that its frequency is either greater or less than 200 kc by an audible amount. Since the human ear is most responsive to a frequency of about 800 cycles per second, this frequency may be chosen. The oscillator in this case would be set at either 200,800 or 199,200 cycles per second.

OSCILLATOR MAY BE LOCKED

If the receiver in question is a Superheterodyne the signal at the detector will always have the same frequency when the circuit is accurately tuned. For that reason the setting of the oscillator in Fig. 35 will always be the same as long as the same beat frequency is desired. Hence condenser C may be locked in position once the frequency has been adjusted. Even when the oscillator has been locked in position it is possible to vary the audible beat note when desired, because the intermediate frequency in a Superheterodyne is not fixed but depends on the setting of the high frequency oscillator in that circuit. Suppose the oscillator in Fig. 35 is adjusted so that the beat note is 800 cycles when the Superheterodyne has been tuned very accurately.

If now the oscillator in the Superheterodyne is readjusted ever so little, the beat note will change by a considerable amount. Deviation from the 800 cycle beat would mean detuning of the Superheterodyne, but this would not necessarily reduce the sensitivity of the receiver, for it may happen that a beat frequency of 1,000 or 600 cycles can be heard more distinctly than one of 800 in some instances. A detuning of 200 cycles in either direction is not great enough to cause any appreciable diminution in the intensity of the interrupted continuous wave signal at the detector.

The audibility of any note depends on the type of noise present as well as on the peculiarities of the listener's ears. It may also happen that the audio amplifier used is especially efficient on some frequency, and this frequency can be selected by a slight touch of the Superheterodyne oscillator dial.

Suppose the receiver employed is not a Superheterodyne. Any given signal is then fixed in frequency. In that case condenser C in Fig. 35 should be adjustable so as to provide a means of varying the audible beat note. Moreover, it should be variable over a wide range in order to provide a means of receiving more than one carrier.

This auxiliary oscillator is discussed here because in principle it is the same as a Superheterodyne. The oscillator in Fig. 35 becomes the frequency changer, the detector the modulator as well as the detector, the beat frequency becomes both the intermediate and audio frequency, and the audio frequency amplifier serves the dual purpose of intermediate and audio amplifier.

Enormous Amplification

Produced in Four Stage All-Screen-Grid Tuner

By H. B. Herman

TO build the battery-operated circuit diagrammed herewith, which uses three stages of tuned screen grid amplification and a screen grid detector, requires a width of about 18" and a depth of 12", so plenty of room is taken up, to be sure, but the circuit performance is high.

The reason for the occupation of such a large space for merely a tuner is the size of the shields. These are 5x5 5/8x6", a size required for efficiency. Thus 12" are taken up by the width of the two shields when they are lined up, and besides there is the added distance occasioned by the drum of the dial and the shafts that extend from both sides of each shield.

Inside each shield are the necessary parts for the particular stage. So more than 16" in width are used up this way.

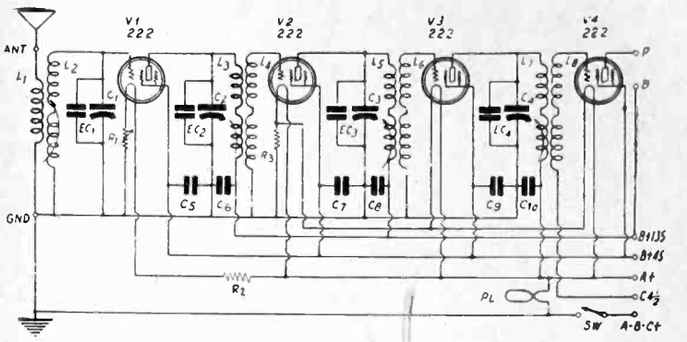
The three tuned plate circuits develop a higher starting capacity than the antenna stage's tuned circuit, but the equalizing condensers are included in all stages because dissimilarities even in the plate circuits will require compensation, whereas the main addition of capacity will take place in the first stage. So the adjustment in the first stage will require that most of the 80 mmfd. capacity of the equalizer be used, whereas in the succeeding stages considerably less than the total capacity must be used.

The bypass condensers, C6, C8 and C10 are in parallel, but it is just as well to have these three 1 mfd. capacities that way, as 3 mfd. is by no means excessive, and the bypassing may be done directly from B post on a shield to the grounded shield itself, thus reducing common coupling through the B plus lead at radio frequencies.

The voltages should be used as shown, with the single exception that less than 45 volts may be tried on the detector screen grid alone (G post of socket), about 16 volts being the minimum. The particular voltage will depend somewhat on the load on the detector tube. This load preferably should be a resistor, and .05 or .075 meg. (50,000 or 75,000 ohms) will work well.

This tube is worked as a power detector, since the exceedingly high radio frequency amplification ahead of the detector makes impractical the use of any other type of detector. It is better to have the first stage of audio—the amplifier being independent of the present circuit—resistance coupled, with the previously recommended value of plate resistor, while another resistor, about 5 meg., should be used in the first audio grid circuit. The last audio stage may be push-pull transformer coupled. A pair of 171A tubes, if for battery operation of the filaments, or a pair of 245s for an AC power pack to be used in conjunction with this tuner, will give excellent results.

Those who like to experiment with space charge detection may do so by reversing the leads to cap and G post of the detector tube. Then the grid clip goes to a positive voltage, say 16 to 45 volts, various values being tried, while the G post is used as the control grid, and to this one end of the secondary L8 is connected. For space charge detection the negative bias, shown as 4½ volts, may have to be reduced, and the grid return may be made even to negative filament or to ground or to 1½ volts of negative C bias. The bias and screen cap voltages of the space charge detector are critical, and no one set of values can be given as assuredly best.



THE BIAS IN THE FIRST STAGE IS ALWAYS NEGATIVE, BUT BECOMES MORE NEGATIVE AS THE VOLUME IS REDUCED BY MANIPULATION OF THE RHEOSTAT. THE NEXT TWO RF STAGES HAVE A BIAS OF 2.7 VOLTS, DUE TO THE DROP IN THE FILAMENT RESISTOR R3. THE POWER DETECTOR HAS A BIAS OF 7.2 VOLTS NEGATIVE, CONSISTING OF THE 2.7 VOLTS DROP PLUS 4½ BATTERY VOLTS. SOMETIMES 3½ BATTERY VOLTS GIVE MORE VOLUME.

There are four solid-side shields, with removable top and bottom, the socket being affixed to the bottom. A fifth space at extreme left rear represents where two tight-fitting stages of resistance-coupled audio may be used, as this much amplification at audio frequencies is all-sufficient for this receiver. If such a circuit is built, then the first audio tube should be a 240 high mu, with a 0.25 meg. resistor in the plate circuit, 135 volts applied to the plate, and the negative bias on a 5.0 meg. leak being 3 volts. Then the output tube would be a 171A, with 180 plate volts and 40 to 45 volts negative bias. The second grid leak, like the first, would be 5.0 meg.

The first and second shields are arranged to left and right respectively of the drum dial, the other shields at rear, with a pulley and belt at right to communicate the shaft motion of the front pair to the rear pair.

The Bernard dynamic tuners are used in all stages of radio frequency, including the detector input. The interstage coupling is by means of an tuned primary feeding an untuned pick-up coil, the grid returns being to negative A, the shield potential.

The shield arrangement set forth in another article in this issue is followed, except that the detector shield has no grid leak and condenser in it, and an extra post makes provision for the grid bias, total of 4½ volts external. The actual bias on the detector is 7.2 volts, due to additional 2.7 volts from the drop in a filament resistor (R3). So the radio frequency amplifiers are biased 2.7 volts negative automatically, except that the bias on the first tube is altered by the volume control.

[Further information on the construction and operation of this receiver will be published next week, issue of November 23d.—Editor.]

LIST OF PARTS

Shielded antenna stage, BAS3A, consisting of Bernard tuner BT3A, .00035 mfd. tuning condenser, 75-ohm switch rheostat with knob, 80 mmfd. equalizing condenser, grid clip, flexible lead, socket, fixed condenser .01 mfd., binding posts, all assembled but not wired.

Two shielded interstages, BIS3B, each consisting of Bernard tuner BT3B, .00035 mfd. tuning condenser, 80 mmfd. equalizing condenser, grid clip, flexible lead, socket, fixed condenser .01 mfd., binding posts, all assembled but not wired.

Shielded power detector stage, BPD3B, same as above, except extra post is for C bias.

C6, C8, C10—Three 1.0 mfd. 200 volt bypass condensers.

R2—6.5 ohm filament resistor.

R3—10 ohm filament resistor.

P, B—Two output binding posts.

National modernistic dial with rainbow feature, pilot lamp PL, and knob.

Dummy knob, shaft and bushing.

Drilled steel cabinet, brown crackle finish.

Subpanel.

Brackets.

Five leads for cabling to batteries.

Four Kelly tubes, 222.

GERMANY HAS TELEVISOR

(Underwood & Underwood)

A HOME TELEVISION RECEIVER WAS EXHIBITED AT THE RECENT RADIO EXPOSITION IN BERLIN, GERMANY, MADE BY MIHALY. THE COMPARATIVE SIZE OF THE RECEIVER AND IMAGE CAN BE SEEN FROM THE PHOTOGRAPH.

Picture Diagram of Battery Model Push-Pull Diamond

[*The October 12th, 19th and 26th, and November 2nd and 9th issues contained articles on the new Push-Pull Diamond of the Air. The same fundamental circuit is used for battery operation of filaments or for AC. Those desiring to build this excellent receiver in either or both forms should consult these recent issues. Articles on the battery model contain many facts pertinent to the AC model, and vice versa. This week the picture diagram of the battery model is featured. Plans have been made for early publication of the picture diagram of the AC model.—Editor.*]

THE picture diagram of the wiring of the new battery model Push-Pull Diamond of the Air shows the top and bottom views of the subpanel. In each instance the wires are shown as they actually appear. If the subpanel is turned bottom side up, the front becoming the back, then the relative direction of the leads is reversed, as compared with the top view. The bottom view as diagrammed avoids this reversal completely.

It is the simplest and best way of showing the wiring. The other and poorer method by far is to show only the top view with top leads solid and underneath leads dotted. But then in your mind you might have to reverse the direction of leads as you wire the subpanel underneath.

This easily would lead to error. The method used herewith precludes such error and assures splendid results.

USE THE OFFICIAL SUBPANEL

The best way to build the receiver is to use the official cadmium-plated steel chassis, which has sockets affixed, a self-bracketing flange all around, and all necessary holes drilled and, where required, insulated as well.

A possible exception exists in the case of the grid condenser holes, these two being specially drilled, and insulating washers, furnished with the subpanel, affixed.

Also the official subpanel provides for proper placement of parts. There are two cutouts, one oblong to give operating room to the switch rheostat, the other a large circle to pass the form of the three-circuit coil so that the shaft and knob will match up with the rheostat.

DIAL ACCURATELY MOUNTED

A special provision included in the subpanel is accurate mounting facility for the new National modernistic dial with rainbow feature.

The front panel should be 7 x 18", and is obtainable commercially that has the proper holes already drilled. Under the two holes for rheostat and three-circuit tuner are two smaller holes, corresponding to a pair on the front flange of the subpanel. Pass a *6/32* screw through each such hole from the rear, affix a nut at front, tighten down and nip off the protruding excess of the screw. Then mount the rheostat to clear. At right the tickler mounting cannot possibly give any trouble even if the screw is put in the wrong way, because no moving part is near it.

But use two 6/32 machine screws in these instances, making sure to have them of the flat-head type.

ORDER OF THE TUBES

You can leave the front panel attachment to be made after the subpanel has been wired.

Note that the order of tubes from left to right is (1) first audio, (2) RF, (3) detector, (4) and (5) push-pull pair. This is an excellent order of assembly and also makes possible the highly symmetrical appearance.

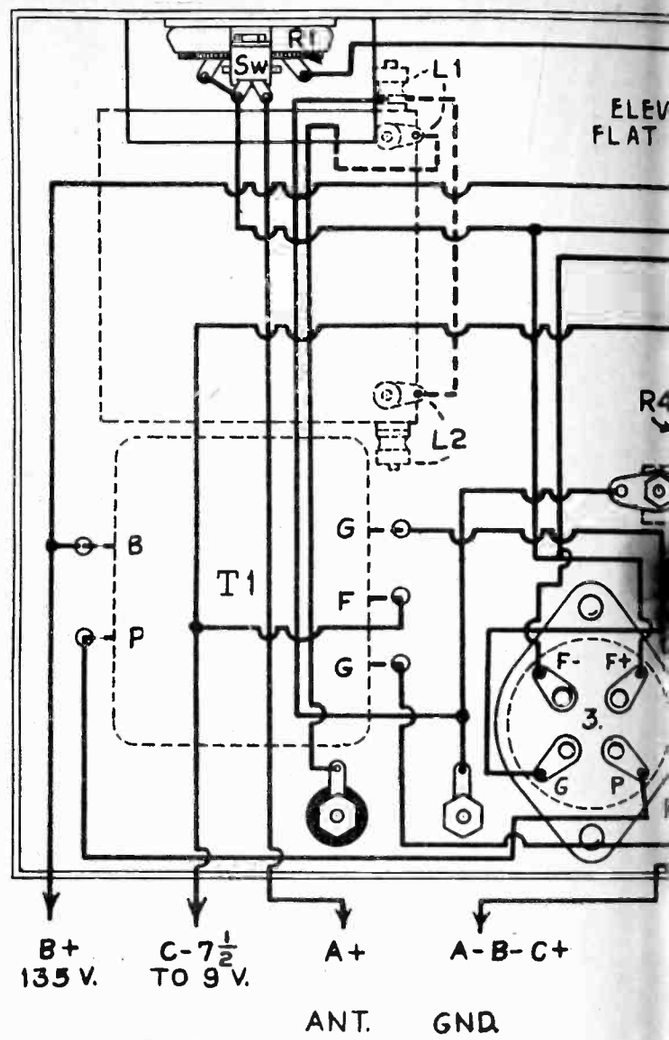
If the wiring is done as diagrammed, then fine results are assured, except the possibility that the tickler leads need reversal if regeneration fails. Suppose there is no regeneration. Remove the tickler lead from detector plate and connect instead to B+, removing the B+ lead and connecting that to plate. This simple operation is what is meant by reversal of leads.

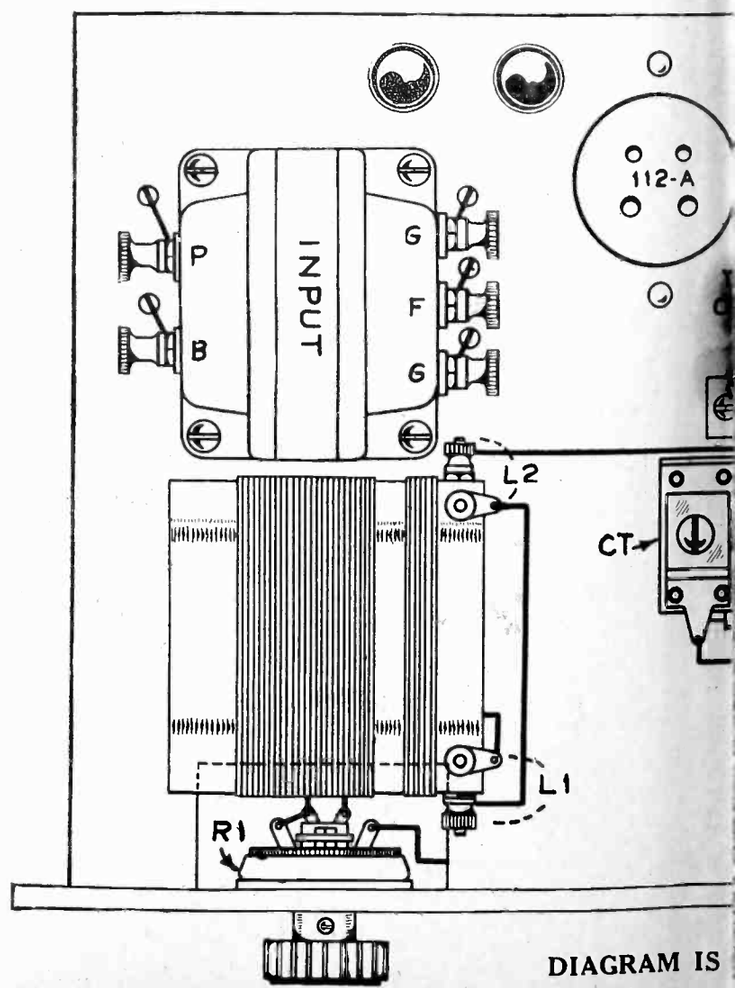
The picture diagram is based on the use of the officially prescribed parts, concerning which there is a commercial announcement in the advertising columns.

MAKING AN OSCILLATOR

I WISH to build an oscillator, but I don't know how to connect the coil so that the tickler works in the proper way. Can you give a rule which will help?—D. C.

Suppose you wind one long coil on the same form with sufficient turns to make both the tuned winding and the tickler. Cut the wire of this coil so that the turns are divided in the ratio of about 3-to-2. Connect the inner end of the larger portion to the grid and the inner end of the smaller portion of the coil to the plate. The outer end of the larger portion goes to the filament and the outer portion of the smaller to the plate battery. Then you will have the two coils connected properly to produce oscillation. You can tune either winding with a condenser. You can also connect the tuning condenser between the grid and the plate.





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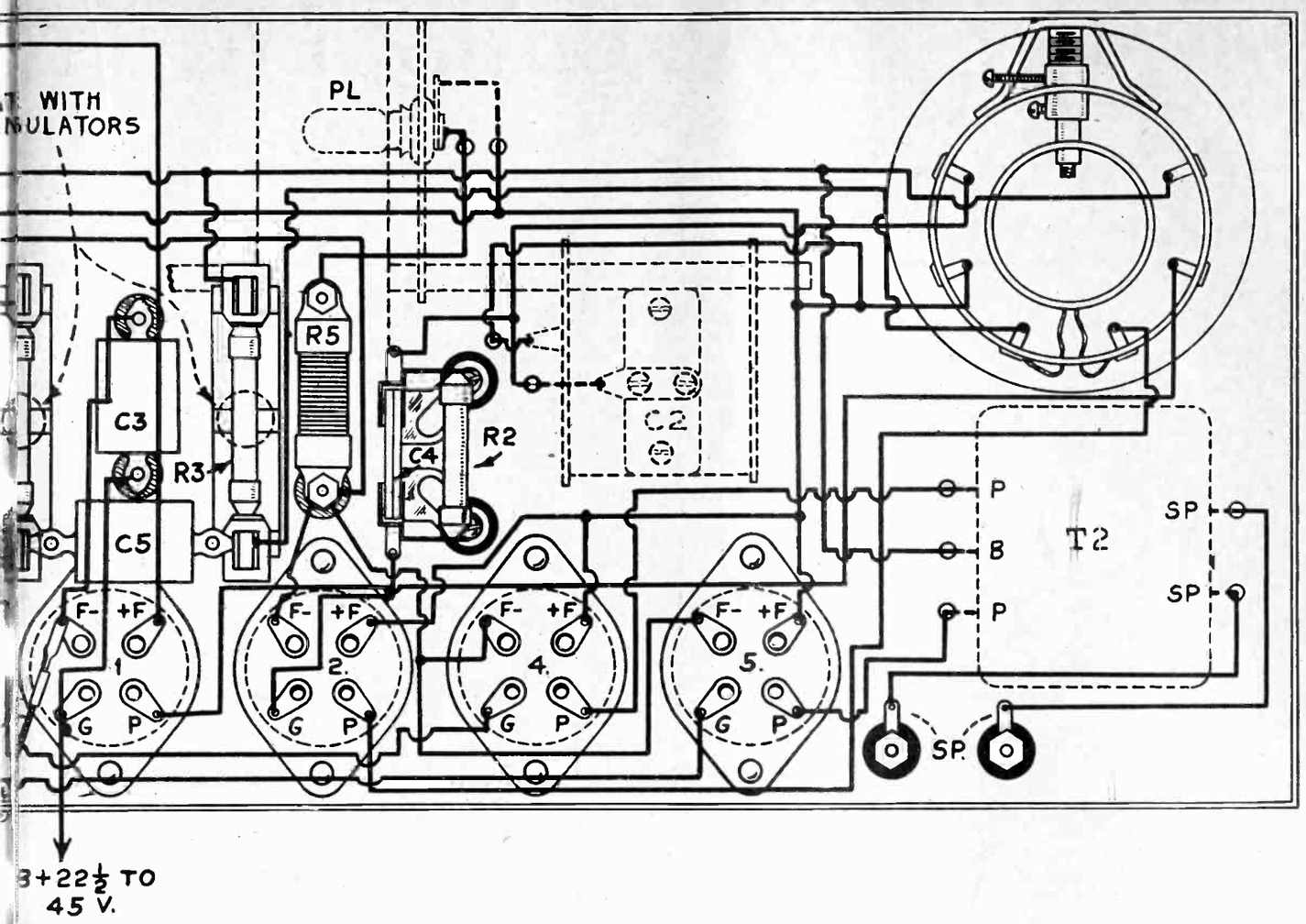
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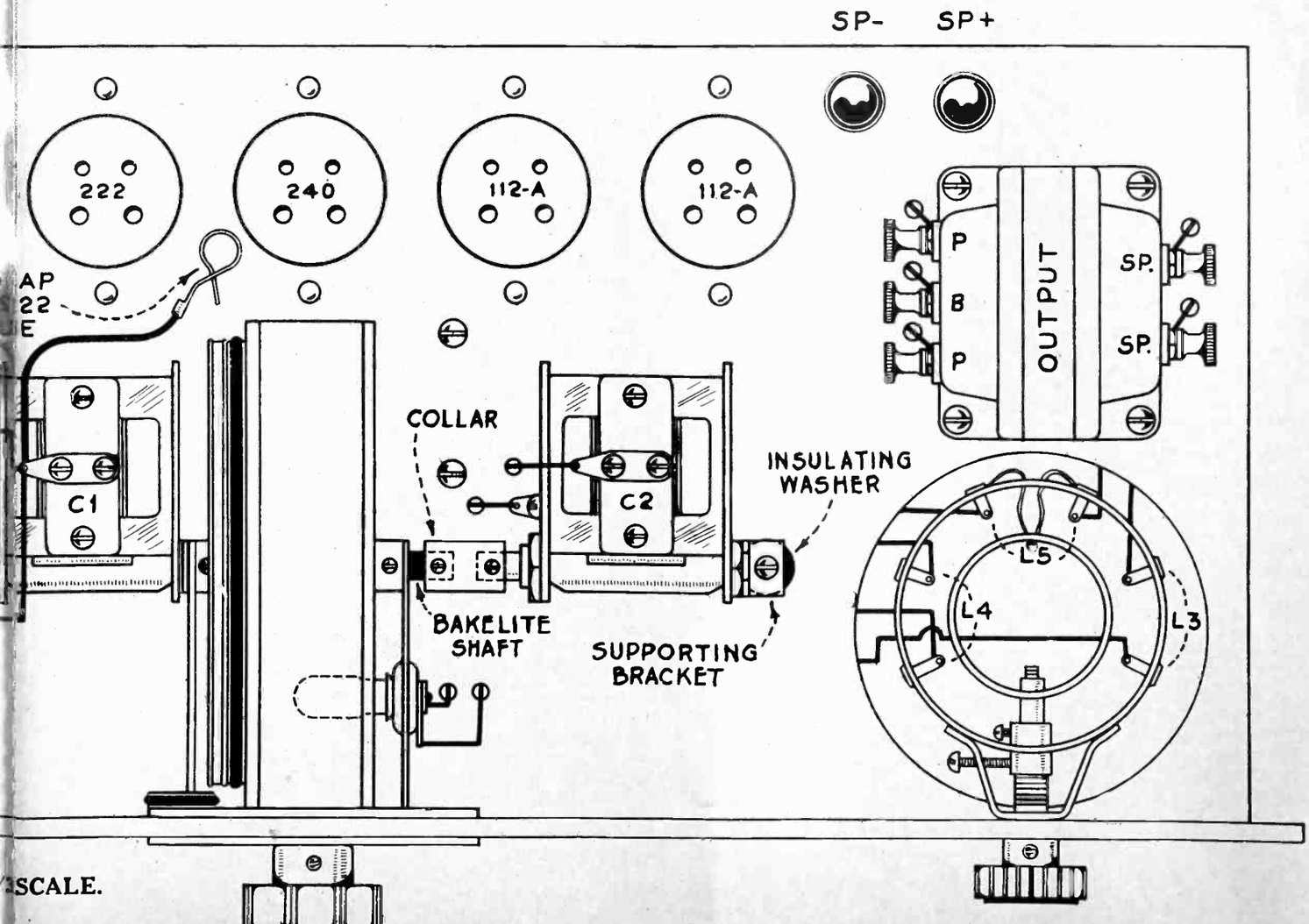
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Tuning by W

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By J. E.

Technical

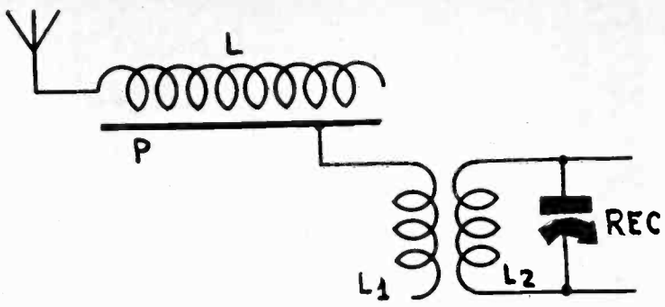

FIG. 1
THE CIRCUIT OF A WAVE CONDUCTOR FOR THE SELECTIVE RECEPTION OF RADIO SIGNALS.

THERE are very few things in radio, whether good or bad, that have not been exploited thoroughly. However, there is one good thing that has almost entirely escaped the attention of radio engineers and experimenters, and that is wave resonance.

Wave resonance! What might that be? The term is not familiar. Does it signify something new in radio that has not been known until recently, or does it signify something which has been known for a long time and only lain dormant in radio literature?

Wave resonance is not new, for it is considerably older than broadcasting. It has not entirely lain dormant, either, but practical engineers in the radio field have been sound asleep, judging by the advantage they have taken of its possibilities. The principle has reposed in the subconscious mind of some of the engineers while they have been pursuing other lines of development.

The principle of wave resonance is explained in J. A. Fleming's book, "Elements of Wireless Telegraphy and Telephony," which was published in the early part of 1918. Dr. Fleming treated the subject briefly in mathematical terms, and apparently most of those who have read his discussion treated the wave resonance coils as an interesting curiosity.

COHEN TAKES IT UP

Immediately after the war Dr. Louis Cohen, then connected with the War Department in a consulting capacity, took up the problem of wave resonance and brought out the wave resonance coil as a substitute for an aerial. Following Dr. Cohen's publication of the principles of the wave resonance coil, popular articles appeared in the radio press and a few amateurs constructed coils with some success. But it did not gain much popularity and the subject was dropped.

Dr. Cohen, however, did not abandon it. He continued to develop both the theory and application of the coil, and some of his results are published in the October issue of the Proceedings of the Institute of Radio Engineers. His paper contains a rather complete mathematical exposition of the theory of wave resonance together with many suggestions for practical application.

In another paper in the same issue by Dr. Cohen and Major Blair, Signal Corps, U. S. Army, the wave resonance principle is discussed in conjunction with transmission, and the authors promise that more on the subject will be published in a later issue. The interesting point in these discussions is that the resonance wave coil can be applied to the solution of many radio problems met both in reception and transmission, particularly multiplex communication.

MATHEMATICAL COMPLEXITY

To give a complete exposition of wave resonance it is necessary to employ mathematics, and the formulas are not at all simple. In fact, they are exceedingly complex, and cannot be reproduced here. However, it is possible to explain the principle qualitatively so that any one interested can experiment intelligently with wave resonance.

Let us first resort to an analogy. Suppose a heavy hope be stretched between a rigid support in a wall and the hand. Give the rope a sudden jerk to one side at right angles to its length. A kink in the rope will be produced and this kink will travel the length of the rope to the wall. There it will be reflected and returned to the starting point. The reflected kink, however, will be in the opposite direction to the incident kink. That is, if the incident kink was to the left, the reflected kink will be to the right.

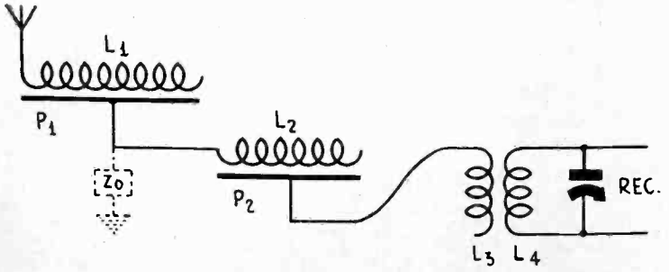

FIG. 2
TANDEM CONNECTION OF TWO WAVE CONDUCTORS FOR INCREASING THE SELECTIVITY OF WAVE RESONANCE TUNER.

If the rope be given a second jerk in the original direction at the instant the reflected kink comes back to the hand, the second kink that travels down the rope will be larger than the first. By timing the jerks properly it is possible to start and maintain a wide swing of the rope with very little effort. Probably every reader has done this very thing already without thinking of kinks, incident or reflected, or suspecting that there is anything extraordinary about it. Well, there is not, for the thing is quite ordinary and that is why it was picked as an analogy.

QUITE A COMMON THING

It is just a case of simple resonance on a string. A much prettier illustration of this is standing waves on a stretched string vibrated by a tuning fork. The string can be made to vibrate in one section, or in any number of sections, by suitable excitation. In this instance it is not plain that the resulting effect is due to the combination of a wave or kink traveling down the string in one direction and coming back again in the opposite, but the motion is the same as that of the rope, because the conditions are similar.

Now, that string, or rope, has two properties by virtue of which the wave motion takes place. One is tension or tautness; the other is mass per unit length. The rope is stretched and it is heavy.

Now suppose we have a wire stretched between two points and, instead of giving it a jerk with the hand, we give it an electrical jerk. That is, we introduce an emf. suddenly into it. The situation is analogous. The mechanical tension in the wire, if any, has no significance at all in this instance; neither has the mass per unit length. But if the analogy is to be good there must be something to take their places. Well, the wire has distributed capacity to earth, and that is the tension in the electrical case. It also has inductance per unit length, and that is the electrical mass per unit length. (The capacity is really the reciprocal of tension.)

AN ELECTRIC WAVE

Suppose we introduce an electric jerk at some point in the wire. An electric wave or kink travels in each direction from this point to the ends of the wire, where the kinks are reflected, returning in the opposite directions, and in opposite phase. If we choose the point for introducing the emf. at one end the kink travels down to the opposite end and comes back by reflection, and this is quite analogous to the case of shaking the stretched rope back and forth. However, we have to introduce a kick every time the kink comes back and at the exact instant if there is to be much of a wave, especially if each kick is very feeble.

The electrical kink that travels down the wire is a current, of course. There is associated with the current wave a voltage wave such that where the current is least the voltage is greatest. At the ends of the wire there can be no current and at these points the voltage is greatest. There is an effect in the rope analogy which corresponds to the voltage. It is the tension of the rope in the direction at right angles to the rope. At the end of the rope at the hand there is no such tension and the motion is greatest. At the fastened end there is no motion, but the tension is greatest.

The rope with one tied and one free end is really analogous to a wire grounded at one end and open at the other. The grounded end corresponds to the end at which the hand swings the rope. The wire which is grounded at neither end is analogous to a string fastened at both ends, such as a piano string. A kink is introduced into the piano string by striking it at some point.

EFFECT OF RADIO WAVE

We got to the point where we introduced a sudden emf. at some point in the wire. When a radio wave strikes the wire we introduce an emf. at every point. Let the emf. be a sudden jerk such as would be produced by a spark of static. A kink travels in both directions from every point, but the effects of the jerks at all the points combine to produce a unified result, a certain current-voltage wave traveling to the ends and reflecting. If there were no resistance in the wire the wave would continue forever traveling back and forth, but due to resistance it soon dies out, just as the sound from a piano string dies out a short time after it has been struck.

If a continuous radio wave, such as the wave from a broadcast station, strikes, the wire will continue to be agitated electrically, just as the rope was agitated when the hand carried one end back

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and forth. But the agitation will not be orderly unless the wave is timed properly to the natural frequency of the wire, which depends on the distributed capacity and the inductance per unit length. Neither will the current in the wire be large unless this timing is correct, nor will the voltage at the ends rise to appreciable value without proper timing.

The emf. introduced into the wire must be timed so that every new pulse will aid the reflected wave already in the wire. If this timing is not exact, the emf. will tend to stop the wave already set up in the wire.

TUNING THE WIRE

Now, if the frequency of the radio wave which is agitating the wire is within our control, as was the frequency of the swinging hand at the end of the rope, we can vary it so that it is in step with the incident and reflected waves in the wire. In that way it is possible to get a very wide swing, that is, currents and voltage amplitudes, in the wire even with a very feeble radio wave. If the adjustment of the frequency is very good, very high voltages will be built up at the ends of the wire, and very large currents in the middle of the wire. The lower the resistance in the wire the higher the voltages and the greater the currents that will be built up with a given intensity of radio wave.

Ordinarily we cannot control the frequency of the radio wave. Then if we want to tune the wire we have to do something else to effect proper timing. The only thing that can be done is to change the constants of the wire so that the time it takes a wave to travel down the wire and back again is equal to the time between similar pulses in the incoming radio wave. Theoretically we can do that by changing either the inductance per unit length or the distributed capacity, but practically we cannot tamper with the inductance. The wire is what it is and we cannot change its nature, and hence its inductance, very easily. But we can change the capacity of the wire without difficulty. That is, we can either increase or decrease the electrical tension of the wire. If we increase the tension, that is, decrease the capacity, we shorten the time it takes a kink to make a round trip on the wire. If we decrease the tension, that is, increase the capacity of the wire, we lengthen the time of the round trip of a kink.

HOW TUNING IS DONE

If the wire is horizontal its capacity is greater the closer it is to earth or to a grounded conductor, such as another wire placed close to and parallel with the other. Therefore to change the electrical tension of the oscillating wire it is only necessary to change the distance between it and the earth, or between it and the grounded conductor. The simplest way in practice would be to use a grounded plate under the oscillating wire, and then raise or lower the plate.

But suppose the oscillating wire, is several hundred feet long. It would not be very practical to build a large metal plate of equal linear dimensions and then attempt to raise and lower it. Tuning that way would be very cumbersome, indeed. We have to find another way, or else abandon the idea.

We started out to expound wave resonance, but so far we have not said anything about it directly. Yet we have explained it, for wave resonance is that form of resonance in which an electric wave is made to travel back and forth along a conductor having distributed inductance and capacity, by means of a periodic alternating emf. having a period equal to the natural period of vibration of the conductor.

But where does the resonance wave coil come in? Such a coil is a long conductor having distributed capacity and inductance, all twisted up so that it has a comparatively high inductance per unit length. It is a lumped inductance, but it is not the lumped inductance that enters into the problem of the resonance wave coil, but rather the distributed.

To have a straight wire several hundred feet long in a receiving set is not practical. But we can have an ordinary antenna terminating in a coil that is small enough to fit into a reasonable space. The theory of such an arrangement is essentially the same as that of a simple straight wire. Mathematically it is much more complex, but practically it is less so, and we are interested only in the practical phase of the problem.

THE RESONANCE WAVE COIL

Turn to Fig. 1. Here we have a long conductor, one part of which is strung out like an ordinary antenna and the other part of which is coiled up to form the coil L. Both ends of this conductor are open, that is, not connected to anything. We have, then, a conductor such as we have been discussing with the exception that we have coiled up one end of it in order to get most of the wire into a compact case. We digress here to make another analogy. This time it is the piano string which fits the case the best. This lumped inductance at the end of the antenna is similar to a weight fastened to one end of the piano string, the rest being plain wire.

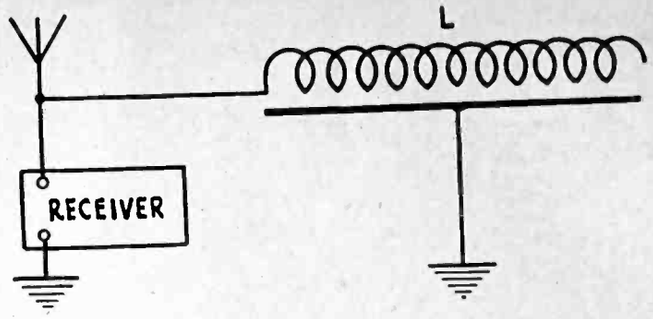

FIG. 3
THE CONNECTION OF A WAVE CONDUCTOR FOR TUNING OUT ONE INTERFERING SIGNAL.

The radio wave that is to be received generates an emf. in the antenna portion of the conductor, but the wave set up in it travels to both ends, at which the high resonance voltages are built up when the distributed capacity is adjusted properly for the frequency of the wave being received.

The straight heavy line in Fig. 1, marked P, is the edge of a metal plate about the same length as the coil L. This plate is mounted parallel with the coil in such manner that the distance P and L can be varied by means of a knob. To tune it is only necessary to turn the knob and the plate moves up or down according to the direction of turning.

Coil L1 in Fig. 1 is the primary of a radio receiver, or the usual antenna coil. The arrangement shows how to use the resonance wave coil as a pretuner in a receiver to take advantage of the exceptionally sharp tuning characteristic of wave resonance.

CONSTANTS OF THE COIL

Before we proceed let us give an idea of the dimensions of the resonance wave coil L. For broadcast reception it may be wound on tubing two inches in diameter, using enough wire to make a winding about eight inches long. The wire is the usual insulated magnet wire employed in other radio tuners. It is well to use the heavier sizes for sharpest tuning. The plate under the coil might be made of copper or aluminum of heavy gauge. Its length should be at least equal to that of the coil over it, and its width somewhat in excess of the diameter of the coil. It should be mounted in guides and raised and lowered by means of a screw to which the knob is attached. The length of this screw depends on the range of the tuner. The longer the screw the greater the range. The pitch of the screw might well be small because the tuner will be very sharp and hence slow motion is desirable.

While the plate P in Fig. 1 is not grounded as it should be according to the preceding discussion, it nevertheless affects the capacity of the coil. By connecting the plate to the high side of L1, loose electric coupling between the receiver and the antenna is achieved.

TANDEM TUNING

If a greater selectivity than one wave conductor affords is desired, two such wave conductors can be used in tandem, tuning both to the same frequency. How this is done practically is illustrated in Fig. 2. The selectivity is increased considerably but the sensitivity of the arrangement is not decreased appreciably at the same time.

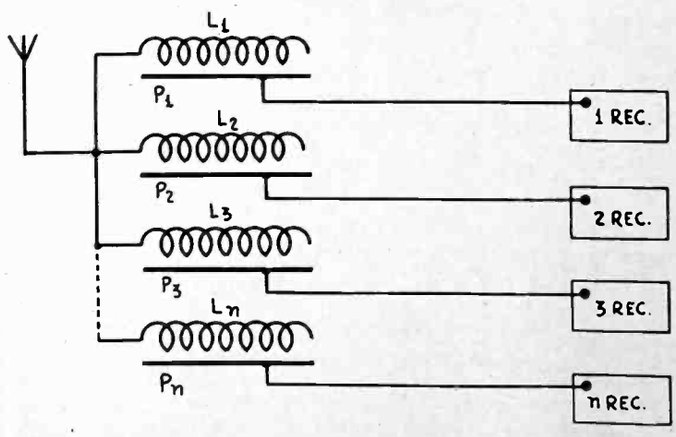

FIG. 4
THIS SHOWS HOW MANY WAVE CONDUCTORS MAY BE CONNECTED IN PARALLEL FOR MULTIPLEX RECEPTION WITH A SINGLE ANTENNA.

A THOUGHT FOR THE WEEK

WHEN a couple of he-men have a dispute, they fight it out and let it go at that. When big business gets into a snarl, the disagreeing parties merge. Note: the R. C. A. and the Victor and other concerns that have been making faces at each other, have joined forces. The almighty dollar is a great welder of conflicting interests.

RADIO WORLD

The First and Only National Radio Weekly

***Eighth* Year**

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Next week, November 23d, Radio World will publish its 400th consecutive weekly issue, a world's record in the field. Radio World is stronger now than ever before.

Baseball and Fights Off the Air

BROADCASTING has been the "menace" to a goodly number of attractions whose purpose is nothing more serious than parting the public from as much of its money as possible, all consistent with giving it something of value. We look nowadays no farther than the research endowment funds for examples of altruism, so when we find radio dealt with sharply we know there has been offhand consideration of the money bags to be regarded as

When broadcasting became popular enough to be regarded as an institution, immediately the theatre raised the cry of "menace," and war was declared on the new medium. Actors' contracts had clauses written into them, prohibiting them from engaging in any and all forms and kinds of broadcasting, for hire or otherwise. The movies felt their attendance declining and joined the cry against broadcasting, just as the legitimate stage had raised its venerable voice against the movies. It was found there was no stopping the flicker drama, no matter how shallow the plot or the star that must be in every scene to be appreciated. The kindred arts had found the common blood of their kinship, and it ran thicker than the aerated water of the new medium. It did not occur to the movie industry that better art and technique would mean better attendance, no more than the legitimate stage was impressed with the possibility of improving itself to earn the laurels and pieces of eight it felt it deserved.

Every schoolboy knows now, as Macaulay might have put it, that the legitimate stage, the movies and the phonograph industry came to recognize broadcasting as an allied art, too, a part of the entertainment business, and the opera and vaudeville stage came to the same state of doleful acceptance of the blood relationship, later to grow really enthusiastic over it, if millions expended on putting the movies, vaudeville, the phonograph, the musical comedy and the dramatic stage into radio are any indication.

It was found that the best way to promote the welfare of the senior art that was thus afflicted by painful competition was to buy into the junior art, so now a large movie producing corporation owns half interest in a great chain system of broadcasting, a vaudeville chain and booking office combination is a hand in the glove of radio, and a decadent legitimate stage in these United States is taking doses of radio as if for resuscitation.

So when the promoters of sporting events, such as prize fights and organized baseball, come to the common opinion that radio is a "menace," history again proves itself a phonograph record being played over and over again. So the sporting interests whose sportsmanship is something less than their graspiness, may be expected to do an about-face at no far-distant date.

Tex Rickard, who died recently, and who was the outstanding example in all the world as a promotor of championship prize fights, in his time had various views on broadcasting's effect on attendance. He found the low-priced seats to the big fights less generously patronized, the lowness of the price being a matter of opinion, as sometimes the minimum was $27.50 for a seat 500 feet from the ring. But he finally countenanced, without openly encouraging, the erection of a broadcasting station at Madison Square Garden, and for a while undertook the pleasant task of signing checks to cover the large expense. But the seats so far from the ring that one had to have two excellent eyes and a costly pair of binoculars or a telescope to see what was going on, and then only if the massed humanity in front would sit down, still were not filled to overflowing. It may have been that American prosperity had made real fight fans able to buy seats nearer the scene of battle, or that the number of persons with remote eyesight was diminishing, an example of declining American physiological attainment, or that the habit grew steadier, as hearts grew bolder, of gate crashers all crowding down into any unoccupied costly points of vantage near enough to make one feel he was really at the fight. Nevertheless, as the report was persistent that bleacher seats at ball games were not so much in demand as previously, so it was assumed that the poorer seats at fights were less patronized than previously for the same reason: the event was broadcast, the noise of battle, the crowd effect, could be enjoyed just as well at home, and the details as presented orally by experts could be grasped fully as well as if a novice were himself in impersonal attendance, with that far-off look in his eyes.

So now there is a threat that the big fights and the big ball games are not to be on the air any more, a concerted effort to make professional sport still more professional and still less sporting. In that way it is hoped that the cheaper seats will be filled, likewise the coffers of the promoters, although there is no lament that the American public has failed to pay some homage in gold to those very promoters.

It is an easy prediction that the promoters both of big fights and the two leading professional baseball leagues will change their minds. These events may be off the air for a while, but they will return. The reason is the same in this instance as governed the final outcome of the early warfare waged upon radio by the phonograph record makers, the movies, the stage and the opera. All these agencies subsist by virtue of public support, and the public that makes possible these undertakings, save opera, is the same public that demands that the events be broadcast. It is no way to gain public favor by defying public demand. The public expects as a part of the price it pays for the support of these sports and entertainments that broadcasting be not only tolerated but encouraged, and wants the privilege of listening in or chipping in, as it sees fit, and even though for each individual there is more listening than chipping. Somebody is willing to pay the promoters of the event directly and in a good check for the privilege of broadcasting it.

Both organized baseball and organized boxing gain much by the interest aroused in them by the very fact of broadcasting. All conflicting conditions are eventually self-equalizing, as for instance any lack of immediate kicking-in by listeners is made up by the vast publicity given to baseball and fights by the newspapers, at great expense to the newspapers, and at no expense to the promoters, since these two branches of the sporting business spend next to nothing advertising in newspapers. If baseball and pugilism decide to prohibit broadcasting, how would they like the newspapers to prohibit the publication of news about baseball and fights? If the newspapers would commit such a dense act for a week, thus being no denser than the baseball and fight promoters now are, what would happen to attendance? The newspapers print news and comment on pugilism and baseball because their readers—the customers—want it. Thereby circulation is gained, and with greater circulation come a greater amount of advertising of all good sorts, and higher rates for such advertising. Why should not baseball and pugilism be now a party to the same economic cycle, as they must be inevitably? The two mighty snobs of sports will kiss the hand they now cast aside.

Baseball in particular is keenly desired as a broadcasting feature not only because it is the great American spectator-sport, but because it has a still greater future. What the future of pugilism may be is hard to tell, for, despite the fleshy thrill of seeing or listening to the broadcast of a good fight well fought, the event never consists of anything other than two men in the ring clouting each other, perhaps one knocking the other unconscious. States that ban cock fights make up a nation that bans bull fights, and some day the human being may be elevated to the same height of protective esteem as the cock and the bull.

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RADIO UNIVERSITY

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

MAGNETIC AND INDUCTOR SPEAKERS

WHAT is the difference between a magnetic and an inductor dynamic speaker? I have examined both types and I cannot see any difference in principle.—J. D. K.

The principal difference between the two types of speaker is the mounting of the armature with respect to the pole pieces. In the magnetic the armature is pulled directly toward the pole faces; in the inductor it is pulled in a direction parallel to the pole faces. In the magnetic the displacement is limited by the distance between the armature and the pole faces. In the inductor this limitation is not imposed.

ROAR IN THE SPEAKER

I HAVE built the battery model Screen Grid Diamond just as you described it. In fact, I have built many, but in only one have I met with trouble. There is a strong roar in the loudspeaker whenever I turn up the volume above bare audibility. What may cause it?—W. W. O.

Oscillation at some frequency is very often the cause of such a condition. The frequency at which this oscillation may take place may have any value from zero up to millions of cycles per second. It may be due to feedback in the power supply, if the frequency is within or below the audio range. If the frequency is a very high one, as is likely, it may be due to capacity feedback in the radio frequency portion of the set, probably between the elements of the tubes. First test circuit for oscillation by noting if the plate current increases when the roar starts. Then try to determine the frequency. If it is low, by-pass condensers across the B supply will help. If the frequency is very high, two million cycles per second or more, use grid suppressors. For extremely high frequencies the suppressor may be a choke coil obtained by winding a few turns on a form the size of a lead pencil.

RESISTANCE COUPLING AND SCREEN GRID TUBES

I HAVE tried screen grid tubes in resistance coupling as you have suggested, but I have not had any luck. The screen grid tube does not amplify as well as a general purpose tube of the 201A type. Are you just giving us a good time or have I missed something? I am still willing to try if you will assure me the screen grid tube will work all right in resistance coupling. —M. McPh.

We doubt that you have tried resistance coupling as we have suggested it, for such amplifiers work, and there is no doubt about that. In other words, we believe you have missed some of our suggestions on the subject. The primary condition is that a fairly high resistance be used in the plate circuit of the tube. When that has been selected you have to adjust the voltages on the elements of the tube. If you use rated control and screen grid voltages, you must raise the voltage on the plate until the effective voltage is about equal to the rated voltage. If the plate resistor is high, that means you have to raise the applied plate voltage to a very high value. Now if you don't have a voltage high enough, you can use the highest you have and then reduce the screen grid voltage. The idea is that you cannot get any amplification if the screen grid voltage is greater than the effective voltage on the plate. The effective plate voltage must always be greater than the effective plate voltage no matter what the impressed signal may be. Look up the discussion on the screen grid tubes in the series of articles on power amplifiers.

WHAT IS VOLTAGE DIVIDER

WHAT is the difference between a voltage divider and a potentiometer? I have seen these terms used when they mean apparently the same thing. If they do, why have two different terms?—J. C.

As the term potentiometer is often used in radio it means the same thing as a voltage divider. A potentiometer is an instrument used in electrical measurement of potential difference between two points on a conductor and the electromotive force of a cell, or any other electromotive force. In this instrument a voltage divider is used and for this reason the two terms have come to be used interchangeably. A voltage divider is a resistor with a tap or a slider on it by means of which any portion of the voltage drop in it can be utilized. If the current through the resistor and the resistance between one end and the tap are known, then the voltage drop between that end and the tap is known. This drop can be balanced against any electromotive force of difference of potential. When the voltage divider is so used it becomes a potentiometer.

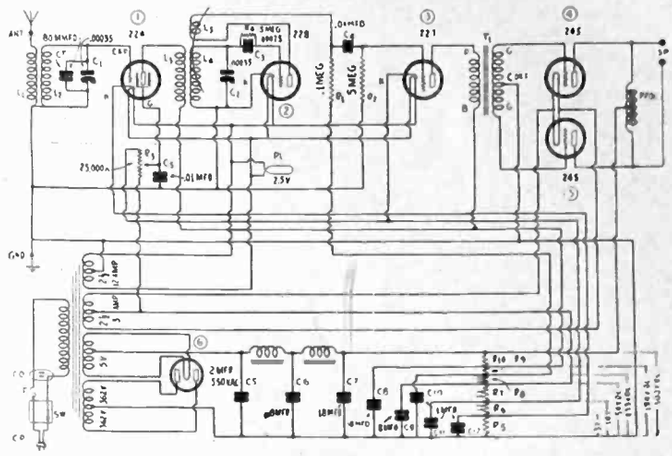


FIG. 806
DIAGRAM OF A COMPLETE AC SCREEN GRID RECEIVER WITH REGENERATION IN THE DETECTOR. IF THE CIRCUIT WLL NOT OSCILLATE INCREASE THE PLATE VOLTAGE ON THE DETECTOR.

TUNE ENTIRE WINDING

I CONSTRUCTED the receiver shown on page 17, Nov. 2 issue of RADIO WORLD, using an ordinary antenna coupler, the secondary of which I tapped at the center for the filament connection. The circuit does not oscillate and it does not cover the broadcast band.—C. McK.

Connect the tuning condenser across the entire winding L2 and the tuning will cover the broadcast band. The set will oscillate more easily too. When you connect the condenser this way, however, there will be body capacity to some extent if you use a simple dial for tuning.

SELF AND MUTUAL INDUCTANCE

WHAT is the difference between self and mutual inductance? —C. McD.

Before it is possible to distinguish between the two it is necessary to explain what inductance is. This may be done from different points of view. When current flows through the winding of a coil there is a certain magnetic field associated with that coil. The inductance is the total magnetic field associated with the coil when unit current is flowing. That is one way of defining inductance, and it is self inductance. Another way is to define it in terms of voltage induced. If the current flowing in the wire changes at the rate of one unit of current per second then the inductance is numerically equal to the reactive voltage across the coil. This also defines self inductance.

If there is a second coil near the one in which current is flowing part of the magnetic field of the first will thread the second. If the current in the first is one unit, then the mutual inductance is the field of the first that threads the second coil. Also, if the current in the first coil is changing at the rate of one unit of current per second, the mutual inductance is numerically equal to the electromotive force induced in the second coil.

CURRENT CARRYING CAPACITY

I HAVE a filament transformer one winding of which is rated at 12 amperes and another of which is rated at 3 amperes. Both have a voltage of 2.5 volts. Is it possible to draw more than 3 amperes from one winding if the current drawn from the other winding is correspondingly less? When I draw the full rated current from the 12 volt winding I don't get the full voltage across the heaters of the tubes? Is the winding over rated or is there some other explanation of the low voltage? —S. C.

This interchange of the windings is not possible. The current carrying capacity of a transformer largely depends on the size of wire used in the winding. Do not exceed the rated current. It may be possible that the rating of the transformer is too optimistic, but it is more likely that the fall in the voltage is due to the use of too fine wire between the transformer and the tubes. Twelve amperes is a heavy current and it does not take much resistance in the wire to cause an appreciable drop in the voltage. In wiring such circuits make sure that the wire is heavy enough, especially that portion which carries the current of more than one tube.

LAFOUNT ASKS PUBLIC'S VOTE TO UPLIFT AIR

Washington.

In an effort to obtain the type of program best liked by the public and thus raise radio programs to a higher plane, a plan is being worked out by Federal Radio Commissioner Harold A. Lafount. It is his plan to put a special Government program over each of the network some evening during the Winter.

"Having seriously studied the fundamentals embodied in the present radio programs, in an effort to reach a basis for program improvement," Mr. Lafount said, "I feel sure that the broadcasters, the Federal Radio Commission and the public would be brought closer together and a more nearly ideal program situation could be arrived at, if these test programs were presented for the approval or disapproval of radio listeners.

"The programs should be as diversified as possible under the time limitations, and should include both classical and popular music, educational and information features, and any additional factors of superlative program development deemed to be of public interest.

"The public would be urged to comment, not solely as a patriotic service, but also for the benefit which might result by the expression of opinion, and by this means a standard could certainly be approached whereby the broadcasters and the commission could more easily fulfill their desire to please a majority of the people.

"A portion of each program could be devoted to governmental activities. Even the President might see fit to address the people on some subject of first importance.

"This plan would in a measure, meet the demands of those who advocate a Government-owned station for dissemination of information of Government agencies."

Offending Stations Must Answer Charges

Washington.

A new order requiring all stations guilty of violation of any of the orders or regulations of the Federal Radio Commission to send in a written reply within three days of receipt of such a notice, to the supervisor or radio inspector from whom the notification was received, was recently adopted by the Federal Radio Commission.

Not only does the answer have to be written in triplicate form, says the order, but must state in detail what steps are being taken to remedy the trouble.

New Corporations

West New York Radio Shop, Jersey City—Atty. Abraham Natovitz Jersey City.

Rex Radio, Inc., Newark—Attys. Saul & Joseph E. Cohn, Newark, N. J.

Arc Radio Corp.—Atty. E. Sharer, 1746 East 7th St., Brooklyn, N. Y.

Radio Jobbers—Attys. Hammerman & Caminez, 15 Park Row, New York, N. Y.

Washington Radio Corp.—Atty. I Cohen 88 Rivington St., New York, N. Y.

The Village Radio Shop, South Orange, N. J.—Attys. Lum, Tamblyn & Colyer, Newark, N. J.

Exchange Radio Corp.—Attys. Schneider & Herdes, 128 West 66th St., New York, N. Y.

Cannon Radio Stores—Atty. W. L. Schneider 1133 Broadway, New York, N. Y.

Silver King Radio Corp., Philadelphia—Corp. Guarantee and Trust Co., Dover, Del.

Mulhorn Radio Corp., Philadelphia—Capital Trust Co. of Delaware.

J. C. Battery and Radio Service—Atty. S. B. Miners, College Point, New York.

Forum

CLOUGH EXPLAINS CIRCUIT

I NOTE in Forum of your October 26th issue that there appears to be some question existing in the mind of one of your readers, Mr. Philip M. C. Armstrong, regarding the operation of choke coupled resonated push-pull transformers, such as are exemplified by the Silver-Marshall models 257 and 227. I trust that you will use this brief reply in order to clear Mr. Armstrong's mind on a few points.

In the first place, I believe that Mr. Armstrong has misquoted me in his statement that I had advocated push-pull amplification for the elimination of harmonics generated in the detector circuit. Explicitly, this is not true, for the push-pull circuit will always give a more or less exact reproduction of the wave form which it receives from the detector for amplification. The only connection by which detector distortion of this form could be corrected would be by application of the push-pull system to the detector itself, which has been done by several experimenters. I believe that I was quite explicit on this point in an article on push-pull amplification published in "RADIO BROADCAST" in the February issue of this year.

As I interpret Mr. Armstrong's criticism I believe that in discussing the phase relationships existing in the push-pull amplifier, he has lost sight of the fact that the windings connected into each side of the circuit are practically unity coupled in good design. To say that they are unity coupled is simply a brief way of saying that all the flux existing in the core by virtue of the primary excitation links both halves of the secondary winding completely. This is equivalent to saying that the voltages across the two halves of the windings must be equal and, due to the fact that the two windings are in the same direction, the outer ends of the secondary must be in an exactly oposite phase with respect to the mid-tap or ground terminal of the secondary. This is exactly as things should be in a well-ordered push-pull amplifier.

In view of this, Mr. Armstrong's question should be cleared up when he considers that in the resistance coupled push-pull device no such definite controlling element enters to keep the voltages applied to the two grid circuits of definitely equal magnitude; whereas, in the transformer coupled circuit, these two voltages are always definitely related to a single quantity, the magnetic flux in the core.

Obviously, if there are any harmonics in the detector output, these are also manifested in the magnetization winding in the iron and, thereby, in the voltage applied to the grids by the secondary. However, if harmonics are generated in the plate circuits of the amplifier tubes, these cancel to a large extent in the output transformer which is evidently the phenomenon which Mr. Armstrong has, in some way, confused in his mind.

KENDALL CLOUGH,
Chief Engineer, Silver-Marshall, Inc.

Telephotos to Plane

Washington.

In a report to the Department of Commerce, A. Douglas Cook, Assistant Trade Commissioner at Berlin, states that the German Lufthansa, the largest air transport company operating in Europe, has undertaken the transmission of pictures from a Berlin transmitting station to airplanes of the company, in flight.

CLEAR CHANNEL STATIONS FIRST IN POLL CHOICE

Washington.

The clear channel stations are the favorites of farmers and amateurs, according to a tabulation completed by experts of the Federal Radio Commission of replies to a questionnaire to ascertain what stations are most popular. The questionnaire was sent to these classes of listeners-in.

Taking the country as a whole, from the 4,141 replies received, 72 per cent. indicated their first choice was clear channel stations, the percentage for amateurs being 73 and for farmers 65.

The replies received from 403 persons in New York showed that 85 per cent. favored clear channel stations, while in New Jersey 99 per cent. favored such stations.

Connecticut, New Mexico, Vermont and Wyoming were 100 per cent. in favor of the clear channel stations.

Twenty Stations Fail to Renew Licenses

Washington.

Twenty broadcasting stations were deleted from the official list recently by the Federal Radio Commission for failure to file applications for renewal of their broadcasting licenses.

The following are the stations ordered off the air:

WEPS, Gloucester, Mass.
WHBC, Canton, Ohio
WRK, Hamilton, Ohio
WDAE, Tampa, Fla.
WTNT, Nashville, Tenn.
KGHX, Richmond, Tex.
WRBC, Valparaiso, Ind.
KGCU, Mandan, N. Dak.
KDB, Santa Barbara, Calif.
KUOM, Missoula, Mont.
WHDL, Tupper Lake, N. Y.
WIBR, Steubenville, Ohio
WBBY, Charleston, S. C.
WMBL, Lakeland, Fla.
KGHG, McGehee, Ark.
KTBS, Shreveport, La.
KFKZ, Kirksville, Mo.
KLPM, Minot, N. Dak.
KSEI, Pocatello, Idaho
KGDR, San Antonio, Tex.

Microphone Detects Icebergs Six Miles Off

Montreal.

A method of detecting the presence of icebergs by observing their explosions as they disintegrate has been perfected by Dr. Howard T. Barnes of McGill University, who has been experimenting off the coast of Newfoundland.

Various attempts were made to detect the presence of the icebergs with a marine microphone by listening for the explosions but the results were negative. Finally an improvised microphone, consisting of a rubber hose with a funnel attached to one end, proved successful. A sheet of rubber was stretched over the funnel to make the microphone waterproof. With this device it was found that explosions could be recorded up to a distance of six miles, which is great enough to safeguard ships against collision with the bergs.

RESTRICTION ON CHAINS VETOED BY 3-TO-2 VOTE

Washington.

The [illegible] of Commissioner E. O. Sykes to prevent broadcasting of the same programs over 5,000 watt stations located in the same State and also to require all stations of 5,000 watts or more who subscribe to chain programs to obtain permission from the Federal Radio Commission before they could go on, was recently vetoed by the Commission by a vote of three to two. Commissioner [illegible] and Chairman Ira Robinson voted for it.

This action followed the receipt of letters of protest and the plea made by Merlin H. Aylesworth, president of the National Broadcasting Company, who stated that such a ruling would jeopard the operations of his company's network and deprive the public of the excellent network programs.

The proposed chain regulation, said Commissioner Sykes, would obviate much objectionable duplication of programs.

Permission was obtained by Mr. Aylesworth to submit a plan for regulation of the networks.

Two German Co[illegible] Are Making Televisors

Washington.

According to a report from Trade Commissioner [illegible] E. Wallis, Jr., in Berlin, Germany, the television exhibits at the sixth German radio exhibition indicate that this branch of science is showing progress.

Steps have already been taken by the German Federal Post Office, which controls all broadcasting in Germany, says the report, to arrange with manufacturers of television apparatus to standardize their sets to operate on one definite frequency.

Of the three manufacturers of television parts, two have started commercial production and the other will start production at the beginning of the next year.

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 .....

G. Cook, P. O. Box 291, Montgomery, Ala.
V. Boyce, 1212 E. 73rd St., Chicago, Ill.
ert Foote Heflin, Ala.
ar C. Gause, Experimental Radio Station, [illegible]
ett, So. Pa.
man Greenspan, 927 56th St., Brooklyn, N. Y.
Suttan, 1106 Bryn Mawr St., Scranton, Pa.
Berman, 3 Stanwood Terrace, Boston Mass.
rence Schwartz, 582 Schenck Avenue, Brook[illegible]
N. Y.
ry H. Smedley, 4220 Westminster Ave., [illegible]
lelphia, Pa.
nk Falk, 1923 Greene Ave., Brooklyn, N. Y.
le Gregoire, 2912 Domdurand St., Montreal,

ard Westcott, 1352 E. 57th St., Brooklyn,

Kiss Korrech, 657 Caudwell Ave., Bronx,

ley Morse, Waterbury, Vermont.
. Morley, 1536 Green St., Philadelphia, Pa.
y Bros., Radio Shop, 802 6th St., Lubbock,

G. Myers 1827 Sixth Ave., Grinnell, Iowa.
. Ralston, 817 Division St., E. Cedar Rapids,

H. Irvine, A. A. M., Mt. Pleasant Ave., E.
hn, N. B., Canada.
R. Prescott, 43 Trenton St., Melrose, Mass.
h Colsher, care of John Colsher, R. R. 10,
burg, Indiana.
onohue, 306 Boynet St., Pittsburgh, Pa.
s R. Crooks, 3 Dublin Street, Halifax,
Canada.
C. Tucker, Jr., Box 8, Blackstone, Virginia.
or A. Urso, 1082 President St., Brooklyn,

in A. Willis, Room 184, West Block Elec. &
bs., Dept. Trade and Com., Ottawa, Canada.
J. Stucke, 524 South Street, San Antonio,

C. Johnson, 225 West 9th St., Hutchinson,
s.
ald Hunt, 2314 So. Michigan St., South Bend,
a.

WNYC IS LOSER IN COURT PLEA FOR FULL TIME

Washington.

The Court of Appeals of the District of Columbia upheld the action of the Federal Radio Commission in refusing an exclusive wave and full time to New York City municipal station WNYC. The order requiring WNYC to share time equally with WMCA on 570 kilocycles was upheld.

The Court held that the action of the Commission was not arbitrary or unreasonable, but in the public interest. The contention of the New York City representatives that in operating the station the city was performing a governmental function was overruled by the court, which held that private activity was concerned. The plea by WNYC of a vested right to the wave was overruled.

Speaker As a Nuisance Defined by Magistrate

In a letter to the forty-six magistrates in New York City, Chief Ma[illegible] William McAdoo expresses the o[illegible] that a radio loudspeaker, under certa[illegible] conditions, may be classed as a nuisance. [illegible] letter said:

"As you know, there is a [illegible] spread complaint all over the city by [illegible] who are annoyed and kept from sle[illegible] by the loud-speaking radios in apartm[illegible] tenement houses and other buildi[illegible] many complaints come to this office urg[illegible] to ask you gentlemen to treat th[illegible] ses seriously.

"The person who starts a loud [illegible] under conditions where it is found t[illegible] and disturb other people and kee[illegible] from proper rest, in my opinion, is g[illegible] a disorderly act, and where it is p[illegible] and annoys a considerable number o[illegible] he or she can be charged under [illegible] 1,530 with maintaining a nuisance."

New Jiffy Tester, J-245-x, Analy

Plate Voltmeter Range Enlarged to 600 volts, AC

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

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

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

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

INSTRUCTIONS FOR J-245-X

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

Service Procedure

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

Filament Volts

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

Grid Volts

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

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

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

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

Reverse leads if DC voltmeter reads below zero.

Grid Condition

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

Plate Voltage

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

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

Plate Current

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

Cathode Volts

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

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

Screen Grid Volts

(G post of socket)

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

Control Grid Volts

(cap of tube)

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

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

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

GENERAL

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

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

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

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

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

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

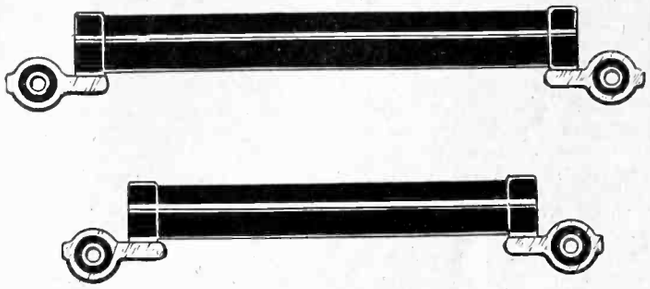
To test for shorts in condensers, resistors, etc. With tube in tester connect condenser under test to jacks —MA and +MIL-AMPS. If milliammeter shows change in reading the part tested is shortened. Resistors, etc., may be tested by the same method as noted above for continuity tests, or by disconnecting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

Testing Rectifier Tubes

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

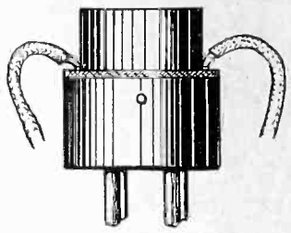
zes All Tubes, Sets and Circuits

oltmeter Range Extended to 560 volts—Dandy Outfit!

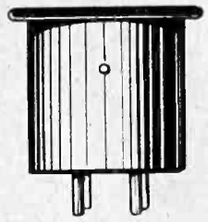


J-560 multiplier increases 140 volt AC range to 560 volts. Supplied with jack terminals (top illustration). J-106 multiplier increases 300 volts maximum of plate voltmeter to 600 volts, with jack terminals.

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



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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PLEASE USE THIS COUPON!

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

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

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

Name.....

Address.....

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

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

New Jiffy Tester, J-245-x, Analy

Plate Voltmeter Range Enlarged to 600 volts, AC

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

Three meters built into a case, 3½" high, 4" front to back, 8½" long, with slip-on cover, both brown crackle-finished steel. Makes all tests of filament voltages, AC or DC, with AC voltage readings up to 140, plate voltages up to 300, plate current up to 100 ma. Tests 4-prong and 5-prong tubes, including screen grid tubes. Makes all tests to 600 volts DC, 560 volts AC, of all tubes, in conjunction with five accessories included at $15,82.

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

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

INSTRUCTIONS FOR J-245-X

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

Service Procedure

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

Filament Volts

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

Grid Volts

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

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

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

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

Reverse leads if DC voltmeter reads below zero.

Grid Condition

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

Plate Voltage

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

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

Plate Current

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

Cathode Volts

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

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

Screen Grid Volts

(G post of socket)

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

Control Grid Volts

(cap of tube)

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

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

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

GENERAL

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

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

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

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

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

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

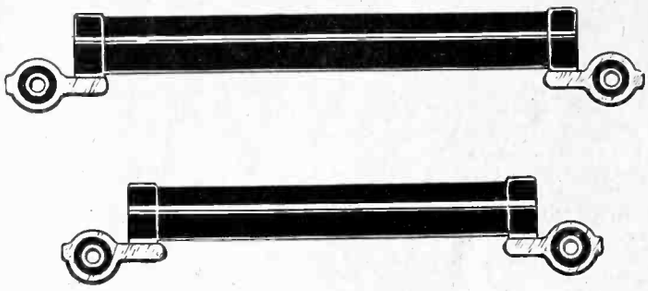
To test for shorts in condensers, resistors, etc. With tube in tester connect condenser under test to jacks —MA and +MIL-AMPS. If milliammeter shows change in reading the part tested is shortened. Resistors, etc., may be tested by the same method as noted above for continuity tests, or by disconnecting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

Testing Rectifier Tubes

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

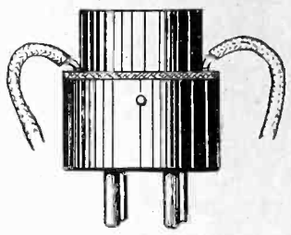
zes All Tubes, Sets and Circuits

oltmeter Range Extended to 560 volts—Dandy Outfit!

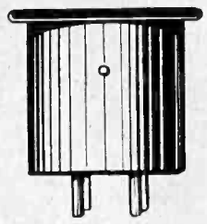


J-560 multiplier increases 140 volt AC range to 560 volts. Supplied with jack terminals (top illustration). J-106 multiplier increases 300 volts maximum of plate voltmeter to 600 volts, with jack terminals.

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



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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PLEASE USE THIS COUPON!

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

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

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

Name.....

Address.....

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

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

New Jiffy Tester, J-245-x, Analy

Plate Voltmeter Range Enlarged to 600 volts, AC

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

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

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

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

INSTRUCTIONS FOR J-245-X

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

Service Procedure

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

Filament Volts

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

Grid Volts

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

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

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

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

Reverse leads if DC voltmeter reads below zero.

Grid Condition

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

Plate Voltage

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

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

Plate Current

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

Cathode Volts

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

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

Screen Grid Volts

(G post of socket)

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

Control Grid Volts

(cap of tube)

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

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

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

GENERAL

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

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

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

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

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

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

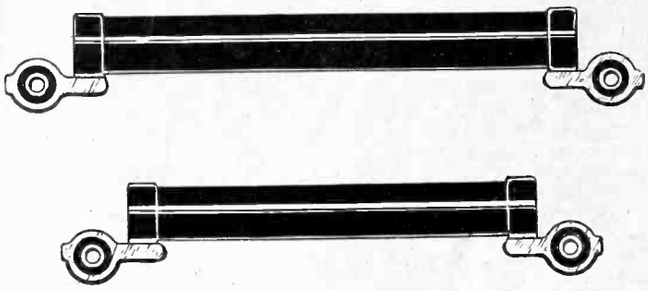
To test for shorts in condensers, resistors, etc. With tube in tester connect condenser under test to jacks —MA and +MIL-AMPS. If milliammeter shows change in reading the part tested is shortened. Resistors, etc., may be tested by the same method as noted above for continuity tests, or by disconnecting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

Testing Rectifier Tubes

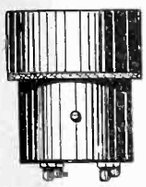
Usually this testing is done after all other tubes and circuits are checked If the proper voltages are furnished to the plates at the different sockets then the rectifying tube would not require testing. The comparative method of testing is done by substituting a tube of known value for the one in the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

zes All Tubes, Sets and Circuits

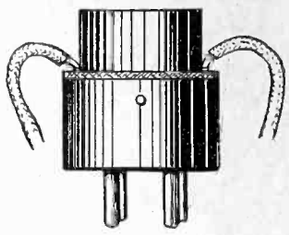
oltmeter Range Extended to 560 volts—Dandy Outfit!



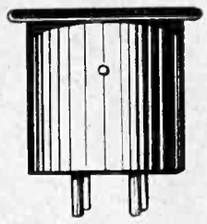
J-560 multiplier increases 140 volt AC range to 560 volts. Supplied with jack terminals (top illustration). J-106 multiplier increases 300 volts maximum of plate voltmeter to 600 volts, with jack terminals.



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



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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PLEASE USE THIS COUPON!

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

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

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

Name.....

Address.....

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

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

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"The public would be urged to comment, not solely as a patriotic service but also for the benefit which might result by the expression of opinion, and by this means a standard could certainly be approached whereby the broadcasters and the commission could more easily fulfill their desire to please a majority of the people.

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Obviously, if there are any harmonics in the detector output, these are also manifested in the magnetization winding in the iron and, thereby in the voltage applied to the grids by the secondary. However, if harmonics are generated in the plate circuits of the amplifier tubes these cancel to a large extent in the output transformer which is evidently the phenomenon which Mr. Armstrong has, in some way, confused in his mind.

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KDB, Santa Barbara, Calif.
KUOM, Missoula, Mont.
WHDL, Tupper Lake, N. Y.
WIBK, Steubenville, Ohio
WBBY, Charleston, S. C.
WMBL, Lakeland, Fla.
KGHG, McGehee, Ark.
KTBS, Shreveport, La.
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Hugh Colsher, care of John Colsher, R. R. 10, Greensburg, Indiana.
J. Donohue, 306 Boynet St., Pittsburgh, Pa.
James R. Crooks, 3 Dublin Street, Halifax, N. S., Canada.
L. C. Tucker, Jr., Box 8, Blackstone, Virginia.
Victor A. Urso, 1082 President St., Brooklyn, N. Y.
Edwin A. Willis, Room 184, West Block Elec. & Gas Labs., Dept. Trade and Com., Ottawa, Canada.
Wm. J. Stucke, 524 South Street, San Antonio, Texas.
A. C. Johnson, 225 West 9th St., Hutchinson, Kansas.
Donald Hunt, 2314 So. Michigan St., South Bend, Indiana.

WNYC IS LOSER IN COURT PLEA FOR FULL TIME

Washington.

The Court of Appeals of the District of Columbia upheld the action of the Federal Radio Commission in refusing an exclusive wave and full time to New York City municipal station WNYC. The order requiring WNYC to share time equally with WMCA on 570 kilocycles was upheld.

The Court held that the action of the Commission was not arbitrary or unreasonable, but in the public interest. The contention of the New York City representatives that in operating the station the city was performing a governmental function was overruled by the court, which held that private activity was concerned. The plea by WNYC of a vested right to the wave was overruled.

Speaker As a Nuisance Defined by Magistrate

In a letter to the forty-six magistrates in New York City, Chief Magistrate William McAdoo expresses the opinion that a radio loudspeaker, under certain conditions, may be classed as a nuisance. His letter said:

"As you know, there is a wide-spread complaint all over the city by people who are annoyed and kept from sleeping by the loud-speaking radios in apartments, tenement houses and other buildings. Many complaints come to this office urging me to ask you gentlemen to treat these cases seriously.

"The person who starts a loud-speaker under conditions where it is found to annoy and disturb other people and keep them from proper rest, in my opinion, is guilty of a disorderly act, and where it is persistent and annoys a considerable number of people, he or she can be charged under Section 1,530 with maintaining a nuisance."

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Edwin A. Willis, Room 184, West Block Elec. & Gas Labs., Dept. Trade and Com., Ottawa, Canada.
Wm. J. Stucke, 524 South Street, San Antonio, Texas.
A. C. Johnson, 225 West 9th St., Hutchinson, Kansas.
Donald Hunt, 2314 So. Michigan St., South Bend, Indiana.

WNYC IS LOSER IN COURT PLEA FOR FULL TIME

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The Court held that the action of the Commission was not arbitrary or unreasonable, but in the public interest. The contention of the New York City representatives that in operating the station the city was performing a governmental function was overruled by the court, which held that private activity was concerned. The plea by WNYC of a vested right to the wave was overruled.

Speaker As a Nuisance Defined by Magistrate

In a letter to the forty-six magistrates in New York City, Chief Magistrate William McAdoo expresses the opinion that a radio loudspeaker, under certain conditions, may be classed as a nuisance. His letter said:

"As you know, there is a wide-spread complaint all over the city by people who are annoyed and kept from sleeping by the loud-speaking radios in apartments, tenement houses and other buildings. Many complaints come to this office urging me to ask you gentlemen to treat these cases seriously.

"The person who starts a loud-speaker under conditions where it is found to annoy and disturb other people and keep them from proper rest, in my opinion, is guilty of a disorderly act, and where it is persistent and annoys a considerable number of people, he or she can be charged under Section 1,530 with maintaining a nuisance."

A THOUGHT FOR THE WEEK

WHEN a couple of he-men have a dispute, they fight it out and let it go at that. When big business gets into a snarl, the disagreeing parties merge. Note: the R. C. A. and the Victor and other concerns that have been making faces at each other, have joined forces. The almighty dollar is a great welder of conflicting interests.

RADIO WORLD

The First and Only National Radio Weekly

***Eighth* Year**

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

Next week, November 23d, Radio World will publish its 400th consecutive weekly issue, a world's record in the field. Radio World is stronger now than ever before.

Baseball and Fights Off the Air

BROADCASTING has been the "menace" to a goodly number of attractions whose purpose is nothing more serious than parting the public from as much of its money as possible, all consistent with giving it something of value. We look nowadays no farther than the research endowment funds for examples of altruism, so when we find radio dealt with sharply we know there has been offhand consideration of the money bags to be regarded as

When broadcasting became popular enough to be regarded as an institution, immediately the theatre raised the cry of "menace," and war was declared on the new medium. Actors' contracts had clauses written into them, prohibiting them from engaging in any and all forms and kinds of broadcasting, for hire or otherwise. The movies felt their attendance declining and joined the cry against broadcasting, just as the legitimate stage had raised its venerable voice against the movies. It was found there was no stopping the flicker drama, no matter how shallow the plot or the star that must be in every scene to be appreciated. The kindred arts had found the common blood of their kinship, and it ran thicker than the aerated water of the new medium. It did not occur to the movie industry that better art and technique would mean better attendance, no more than the legitimate stage was impressed with the possibility of improving itself to earn the laurels and pieces of eight it felt it deserved.

Every schoolboy knows now, as Macaulay might have put it, that the legitimate stage, the movies and the phonograph industry came to recognize broadcasting as an allied art, too, a part of the entertainment business, and the opera and vaudeville stage came to the same state of doleful acceptance of the blood relationship, later to grow really enthusiastic over it, if millions expended on putting the movies, vaudeville, the phonograph, the musical comedy and the dramatic stage into radio are any indication.

It was found that the best way to promote the welfare of the senior art that was thus afflicted by painful competition was to buy into the junior art, so now a large movie producing corporation owns half interest in a great chain system of broadcasting, a vaudeville chain and booking office combination is a hand in the glove of radio, and a decadent legitimate stage in these United States is taking doses of radio as if for resuscitation.

So when the promoters of sporting events, such as prize fights and organized baseball, come to the common opinion that radio is a "menace," history again proves itself a phonograph record being played over and over again. So the sporting interests whose sportsmanship is something less than their graspiness, may be expected to do an about-face at no far-distant date.

Tex Rickard, who died recently, and who was the outstanding example in all the world as a promotor of championship prize fights, in his time had various views on broadcasting's effect on attendance. He found the low-priced seats to the big fights less generously patronized, the lowness of the price being a matter of opinion, as sometimes the minimum was $27.50 for a seat 500 feet from the ring. But he finally countenanced, without openly encouraging, the erection of a broadcasting station at Madison Square Garden, and for a while undertook the pleasant task of signing checks to cover the large expense. But the seats so far from the ring that one had to have two excellent eyes and a costly pair of binoculars or a telescope to see what was going on, and then only if the massed humanity in front would sit down, still were not filled to overflowing. It may have been that American prosperity had made real fight fans able to buy seats nearer the scene of battle, or that the number of persons with remote eyesight was diminishing, an example of declining American physiological attainment, or that the habit grew steadier, as hearts grew bolder, of gate crashers all crowding down into any unoccupied costly points of vantage near enough to make one feel he was really at the fight. Nevertheless, as the report was persistent that bleacher seats at ball games were not so much in demand as previously, so it was assumed that the poorer seats at fights were less patronized than previously for the same reason: the event was broadcast, the noise of battle, the crowd effect, could be enjoyed just as well at home, and the details as presented orally by experts could be grasped fully as well as if a novice were himself in impersonal attendance, with that far-off look in his eyes.

So now there is a threat that the big fights and the big ball games are not to be on the air any more, a concerted effort to make professional sport still more professional and still less sporting. In that way it is hoped that the cheaper seats will be filled, likewise the coffers of the promoters, although there is no lament that the American public has failed to pay some homage in gold to those very promoters.

It is an easy prediction that the promoters both of big fights and the two leading professional baseball leagues will change their minds. These events may be off the air for a while, but they will return. The reason is the same in this instance as governed the final outcome of the early warfare waged upon radio by the phonograph record makers, the movies, the stage and the opera. All these agencies subsist by virtue of public support, and the public that makes possible these undertakings, save opera, is the same public that demands that the events be broadcast. It is no way to gain public favor by defying public demand. The public expects as a part of the price it pays for the support of these sports and entertainments that broadcasting be not only tolerated but encouraged, and wants the privilege of listening in or chipping in, as it sees fit, and even though for each individual there is more listening than chipping. Somebody is willing to pay the promoters of the event directly and in a good check for the privilege of broadcasting it.

Both organized baseball and organized boxing gain much by the interest aroused in them by the very fact of broadcasting. All conflicting conditions are eventually self-equalizing, as for instance any lack of immediate kicking-in by listeners is made up by the vast publicity given to baseball and fights by the newspapers, at great expense to the newspapers, and at no expense to the promoters, since these two branches of the sporting business spend next to nothing advertising in newspapers. If baseball and pugilism decide to prohibit broadcasting, how would they like the newspapers to prohibit the publication of news about baseball and fights? If the newspapers would commit such a dense act for a week, thus being no denser than the baseball and fight promoters now are, what would happen to attendance? The newspapers print news and comment on pugilism and baseball because their readers—the customers—want it. Thereby circulation is gained, and with greater circulation come a greater amount of advertising of all good sorts, and higher rates for such advertising. Why should not baseball and pugilism be now a party to the same economic cycle, as they must be inevitably? The two mighty snobs of sports will kiss the hand they now cast aside.

Baseball in particular is keenly desired as a broadcasting feature not only because it is the great American spectator-sport, but because it has a still greater future. What the future of pugilism may be is hard to tell, for, despite the fleshy thrill of seeing or listening to the broadcast of a good fight well fought, the event never consists of anything other than two men in the ring clouting each other, perhaps one knocking the other unconscious. States that ban cock fights make up a nation that bans bull fights, and some day the human being may be elevated to the same height of protective esteem as the cock and the bull.

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

RADIO UNIVERSITY

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

MAGNETIC AND INDUCTOR SPEAKERS

WHAT is the difference between a magnetic and an inductor dynamic speaker? I have examined both types and I cannot see any difference in principle.—J. D. K.

The principal difference between the two types of speaker is the mounting of the armature with respect to the pole pieces. In the magnetic the armature is pulled directly toward the pole faces; in the inductor it is pulled in a direction parallel to the pole faces. In the magnetic the displacement is limited by the distance between the armature and the pole faces. In the inductor this limitation is not imposed.

ROAR IN THE SPEAKER

I HAVE built the battery model Screen Grid Diamond just as you described it. In fact, I have built many, but in only one have I met with trouble. There is a strong roar in the loudspeaker whenever I turn up the volume above bare audibility. What may cause it?—W. W. O.

Oscillation at some frequency is very often the cause of such a condition. The frequency at which this oscillation may take place may have any value from zero up to millions of cycles per second. It may be due to feedback in the power supply, if the frequency is within or below the audio range. If the frequency is a very high one, as is likely, it may be due to capacity feedback in the radio frequency portion of the set, probably between the elements of the tubes. First test circuit for oscillation by noting if the plate current increases when the roar starts. Then try to determine the frequency. If it is low, by-pass condensers across the B supply will help. If the frequency is very high, two million cycles per second or more, use grid suppressors. For extremely high frequencies the suppressor may be a choke coil obtained by winding a few turns on a form the size of a lead pencil.

RESISTANCE COUPLING AND SCREEN GRID TUBES

I HAVE tried screen grid tubes in resistance coupling as you have suggested, but I have not had any luck. The screen grid tube does not amplify as well as a general purpose tube of the 201A type. Are you just giving us a good time or have I missed something? I am still willing to try if you will assure me the screen grid tube will work all right in resistance coupling. —M. McPh.

We doubt that you have tried resistance coupling as we have suggested it, for such amplifiers work, and there is no doubt about that. In other words, we believe you have missed some of our suggestions on the subject. The primary condition is that a fairly high resistance be used in the plate circuit of the tube. When that has been selected you have to adjust the voltages on the elements of the tube. If you use rated control and screen grid voltages, you must raise the voltage on the plate until the effective voltage is about equal to the rated voltage. If the plate resistor is high, that means you have to raise the applied plate voltage to a very high value. Now if you don't have a voltage high enough, you can use the highest you have and then reduce the screen grid voltage. The idea is that you cannot get any amplification if the screen grid voltage is greater than the effective voltage on the plate. The effective plate voltage must always be greater than the effective plate voltage no matter what the impressed signal may be. Look up the discussion on the screen grid tubes in the series of articles on power amplifiers.

WHAT IS VOLTAGE DIVIDER

WHAT is the difference between a voltage divider and a potentiometer? I have seen these terms used when they mean apparently the same thing. If they do, why have two different terms?—J. C.

As the term potentiometer is often used in radio it means the same thing as a voltage divider. A potentiometer is an instrument used in electrical measurement of potential difference between two points on a conductor and the electromotive force of a cell, or any other electromotive force. In this instrument a voltage divider is used and for this reason the two terms have come to be used interchangeably. A voltage divider is a resistor with a tap or a slider on it by means of which any portion of the voltage drop in it can be utilized. If the current through the resistor and the resistance between one end and the tap are known, then the voltage drop between that end and the tap is known. This drop can be balanced against any electromotive force of difference of potential. When the voltage divider is so used it becomes a potentiometer.

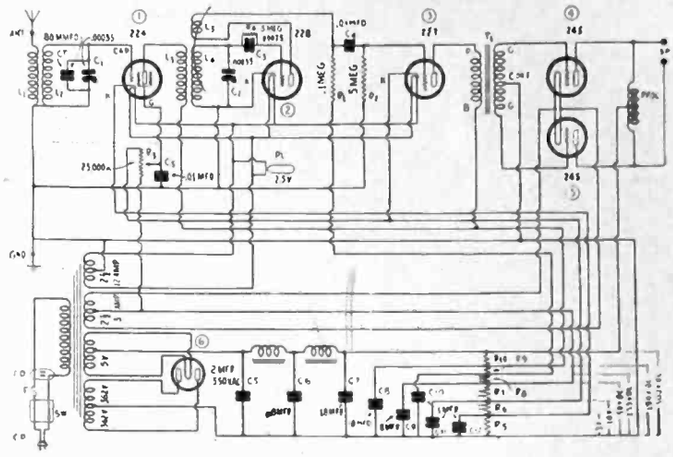

FIG. 806
DIAGRAM OF A COMPLETE AC SCREEN GRID RECEIVER WITH REGENERATION IN THE DETECTOR. IF THE CIRCUIT WLL NOT OSCILLATE INCREASE THE PLATE VOLTAGE ON THE DETECTOR.

TUNE ENTIRE WINDING

I CONSTRUCTED the receiver shown on page 17, Nov. 2 issue of RADIO WORLD, using an ordinary antenna coupler, the secondary of which I tapped at the center for the filament connection. The circuit does not oscillate and it does not cover the broadcast band.—C. McK.

Connect the tuning condenser across the entire winding L2 and the tuning will cover the broadcast band. The set will oscillate more easily too. When you connect the condenser this way, however, there will be body capacity to some extent if you use a simple dial for tuning.

SELF AND MUTUAL INDUCTANCE

WHAT is the difference between self and mutual inductance? —C. McD.

Before it is possible to distinguish between the two it is necessary to explain what inductance is. This may be done from different points of view. When current flows through the winding of a coil there is a certain magnetic field associated with that coil. The inductance is the total magnetic field associated with the coil when unit current is flowing. That is one way of defining inductance, and it is self inductance. Another way is to define it in terms of voltage induced. If the current flowing in the wire changes at the rate of one unit of current per second then the inductance is numerically equal to the reactive voltage across the coil. This also defines self inductance.

If there is a second coil near the one in which current is flowing part of the magnetic field of the first will thread the second. If the current in the first is one unit, then the mutual inductance is the field of the first that threads the second coil. Also, if the current in the first coil is changing at the rate of one unit of current per second, the mutual inductance is numerically equal to the electromotive force induced in the second coil.

CURRENT CARRYING CAPACITY

I HAVE a filament transformer one winding of which is rated at 12 amperes and another of which is rated at 3 amperes. Both have a voltage of 2.5 volts. Is it possible to draw more than 3 amperes from one winding if the current drawn from the other winding is correspondingly less? When I draw the full rated current from the 12 volt winding I don't get the full voltage across the heaters of the tubes? Is the winding over rated or is there some other explanation of the low voltage? —S. C.

This interchange of the windings is not possible. The current carrying capacity of a transformer largely depends on the size of wire used in the winding. Do not exceed the rated current. It may be possible that the rating of the transformer is too optimistic, but it is more likely that the fall in the voltage is due to the use of too fine wire between the transformer and the tubes. Twelve amperes is a heavy current and it does not take much resistance in the wire to cause an appreciable drop in the voltage. In wiring such circuits make sure that the wire is heavy enough, especially that portion which carries the current of more than one tube.

LAFOUNT ASKS PUBLIC'S VOTE TO UPLIFT AIR

Washington.

In an effort to obtain the type of program best liked by the public and thus raise radio programs to a higher plane, a plan is being worked out by Federal Radio Commissioner Harold A. Lafount. It is his plan to put a special Government program over each of the network some evening during the Winter.

"Having seriously studied the fundamentals embodied in the present radio programs, in an effort to reach a basis for program improvement," Mr Lafount said, "I feel sure that the broadcasters, the Federal Radio Commission and the public would be brought closer together and a more nearly ideal program situation could be arrived at, if these test programs were presented for the approval or disapproval of radio listeners.

"The programs should be as diversified as possible under the time limitations, and should include both classical and popular music, educational and information features, and any additional factors of superlative program development deemed to be of public interest.

"The public would be urged to comment, not solely as a patriotic service, but also for the benefit which might result by the expression of opinion, and by this means a standard could certainly be approached whereby the broadcasters and the commission could more easily fulfill their desire to please a majority of the people.

"A portion of each program could be devoted to governmental activities. Even the President might see fit to address the people on some subject of first importance.

"This plan would in a measure, meet the demands of those who advocate a Government-owned station for dissemination of information of Government agencies."

Offending Stations Must Answer Charges

Washington.

A new order requiring all stations guilty of violation of any of the orders or regulations of the Federal Radio Commission to send in a written reply within three days of receipt of such a notice, to the supervisor or radio inspector from whom the notification was received, was recently adopted by the Federal Radio Commission.

Not only does the answer have to be written in triplicate form, says the order, but must state in detail what steps are being taken to remedy the trouble.

New Corporations

West New York Radio Shop, Jersey City—Atty. Abraham Natovitz Jersey City.

Rex Radio, Inc., Newark—Attys. Saul & Joseph E. Cohn, Newark, N. J.

Arc Radio Corp.—Atty. E. Sharer, 1746 East 7th St., Brooklyn, N. Y.

Radio Jobbers—Attys. Hammerman & Cammer, 15 Park Row, New York, N. Y.

Washington Radio Corp.—Atty. I Cohen 88 Rivington St., New York, N. Y.

The Village Radio Shop, South Orange, N. J.—Attys. Lum, Tamblyn & Colyer, Newark, N. J.

Exchange Radio Corp.—Attys. Schneider & Herdea, 128 West 66th St., New York, N. Y.

Cannon Radio Stores—Atty. W. L. Schneider 1133 Broadway, New York, N. Y.

Silver King Radio Corp., Philadelphia—Corp. Guarantee and Trust Co., Dover, Del.

Mulhorn Radio Corp., Philadelphia—Capital Trust Co. of Delaware.

J. C. Battery and Radio Service—Atty. S. B. Miners, College Point, New York.

Forum

CLOUGH EXPLAINS CIRCUIT

I NOTE in Forum of your October 26th issue that there appears to be some question existing in the mind of one of your readers, Mr. Philip M. C. Armstrong, regarding the operation of choke coupled resonated push-pull transformers, such as are exemplified by the Silver-Marshall models 257 and 227. I trust that you will use this brief reply in order to clear Mr. Armstrong's mind on a few points.

In the first place, I believe that Mr. Armstrong has misquoted me in his statement that I had advocated push-pull amplification for the elimination of harmonics generated in the detector circuit. Explicitly, this is not true for the push-pull circuit will always give a more or less exact reproduction of the wave form which it receives from the detector for amplification. The only connection by which detector distortion of this form could be corrected would be by application of the push-pull system to the detector itself, which has been done by several experimenters. I believe that I was quite explicit on this point in an article on push-pull amplification published in "RADIO BROADCAST" in the February issue of this year.

As I interpret Mr Armstrong's criticism I believe that in discussing the phase relationships existing in the push-pull amplifier, he has lost sight of the fact that the windings connected into each side of the circuit are practically unity coupled in good design. To say that they are unity coupled is simply a brief way of saying that all the flux existing in the core by virtue of the primary excitation links both halves of the secondary winding completely. This is equivalent to saying that the voltages across the two halves of the windings must be equal and, due to the fact that the two windings are in the same direction, the outer ends of the secondary must be in an exactly oposite phase with respect to the mid-tap or ground terminal of the secondary. This is exactly as things should be in a well-ordered push-pull amplifier.

In view of this, Mr Armstrong's question should be cleared up when he considers that in the resistance coupled push-pull device no such definite controlling element enters to keep the voltages applied to the two grid circuits of definitely equal magnitude; whereas, in the transformer coupled circuit, these two voltages are always definitely related to a single quantity, the magnetic flux in the core.

Obviously, if there are any harmonics in the detector output, these are also manifested in the magnetization winding in the iron and, thereby, in the voltage applied to the grids by the secondary. However, if harmonics are generated in the plate circuits of the amplifier tubes, these cancel to a large extent in the output transformer which is evidently the phenomenon which Mr Armstrong has, in some way, confused in his mind.

KENDALL CLOUGH,
Chief Engineer, Silver-Marshall, Inc.

Telephotos to Plane

Washington.

In a report to the Department of Commerce, A. Douglas Cook, Assistant Trade Commissioner at Berlin, states that the German Lufthansa, the largest air transport company operating in Europe, has undertaken the transmission of pictures from a Berlin transmitting station to airplanes of the company, in flight.

CLEAR CHANNEL STATIONS FIRST IN POLL CHOICE

Washington.

The clear channel stations are the favorites of farmers and amateurs, according to a tabulation completed by experts of the Federal Radio Commission of replies to a questionnaire to ascertain what stations are most popular. The questionnaire was sent to these classes of listeners-in.

Taking the country as a whole, from the 4,141 replies received, 72 per cent. indicated their first choice was clear channel stations the percentage for amateurs being 74 and for farmers 65.

The replies received from 403 persons in New York showed that 85 per cent favored clear channel stations while in New Jersey 99 per cent favored such stations.

Connecticut New Mexico Vermont and Wyoming were 100 per cent in favor of the clear channel stations.

Twenty Stations Fail to Renew Licenses

Washington.

Twenty broadcasting stations were deleted from the official list recently by the Federal Radio Commission for failure to file applications for renewal of their broadcasting licenses.

The following are the stations ordered off the air.

WEPS, Gloucester, Mass
WHBC, Canton, Ohio
WRK, Hamilton, Ohio
WDAE, Tampa, Fla
WTNT, Nashville, Tenn
KGHX, Richmond, Tex
WRBC, Valparaiso, Ind
KGCU, Mandan, N. Dak
KDB, Santa Barbara, Calif
KUOM, Missoula, Mont
WHDL, Tupper Lake, N. Y.
WIBR, Steubenville, Ohio
WBBY, Charleston, S. C.
WMBL, Lakeland, Fla
KGHG, McGehee, Ark
KTBS, Shreveport, La
KFKZ, Kirksville, Mo
KLPM, Minot, N. Dak
KSEI, Pocatello, Idaho
KGDR, San Antonio Tex

Microphone Detects Icebergs Six Miles Off

Montreal.

A method of detecting the presence of icebergs by observing their explosions as they disintegrate has been perfected by Dr Howard T. Barnes of McGill University, who has been experimenting off the coast of Newfoundland.

Various attempts were made to detect the presence of the icebergs with a marine microphone by listening for the explosions but the results were negative. Finally an improvised microphone, consisting of a rubber hose with a funnel attached to one end, proved successful. A sheet of rubber was stretched over the funnel to make the microphone waterproof. With this device it was found that explosions could be recorded up to a distance of six miles, which is great enough to safeguard ships against collision with the bergs.

RESTRICTION ON CHAINS VETOED BY 3-TO-2 VOTE

Washington.

The proposal of Commissioner E. O. Sykes to prevent the broadcasting of the same programs over 5,000 watt stations located in the same State and also to require all stations of 5,000 watts or more who subscribe to chain programs to obtain permission from the Federal Radio Commission before they could go on, was recently vetoed by the Commission by a vote of three to two. Commissioner Sykes and Chairman Ira Robinson voted for it.

This action followed the receipt of letters of protest and the plea made by Merlin H. Aylesworth, president of the National Broadcasting Company, who stated that such a ruling would jeopard the operations of his company's network and deprive the public of the excellent network programs.

The proposed chain regulation, said Commissioner Sykes, would obviate much objectionable duplication of programs.

Permission was obtained by Mr. Aylesworth to submit a plan for the regulation of the networks.

Two German Concerns Are Making Televisors

Washington.

According to a report from Trade Commissioner James E. Wallis, Jr., in Berlin, Germany, the television exhibits at the sixth German radio exhibition indicate that this branch of science is showing progress.

Steps have already been taken by the German Federal Post Office, which controls all broadcasting in Germany, says the report, to arrange with manufacturers of television apparatus to standardize their sets to operate on one definite frequency.

Of the three manufacturers of television parts, two have started commercial production and the other will start production at the beginning of the next year.

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 .....

G. G. Cook, P. O. Box 291, Montgomery, Ala.
H. V. Boyce, 1212 E. 73rd St., Chicago, Ill.
Robert Foote Heflin, Ala.
Edgar C. Gause, Experimental Radio Station, Kennett, So. Pa.
Hyman Greenspan, 927 56th St., Brooklyn, N. Y.
A. Suttan, 1106 Bryn Mawr St., Scranton, Pa.
I. Berman, 3 Stanwood Terrace, Boston Mass.
Lawrence Schwartz, 582 Schenck Avenue, Brooklyn, N. Y.
Harry H. Smedley, 4220 Westminster Ave., Philadelphia, Pa.
Frank Falk, 1923 Greene Ave., Brooklyn, N. Y.
Emile Gregoire, 2912 Domdurand St., Montreal, Can.
Howard Westcott, 1352 E. 57th St., Brooklyn, N. Y.
Joe Kiss Korrech, 657 Caudwell Ave., Bronx, N. Y.
Stanley Morse, Waterbury, Vermont.
T. J. Morley, 1536 Green St., Philadelphia, Pa.
Brady Bros., Radio Shop, 802 6th St., Lubbock, Texas.
W. G. Myers 1827 Sixth Ave., Grinnell, Iowa.
I. W. Ralston, 817 Division St., E. Cedar Rapids, Iowa.
A. H. Irvine, A. A. M., Mt. Pleasant Ave., E. St. John, N. B., Canada.
H. R. Prescott, 43 Trenton St., Melrose, Mass.
Hugh Colsher, care of John Colsher, R. R. 10, Greensburg, Indiana.
J. Donohue, 306 Boynet St., Pittsburgh, Pa.
James R. Crooks, 3 Dublin Street, Halifax, N. S., Canada.
L. C. Tucker, Jr., Box 8, Blackstone, Virginia.
Victor A. Urso, 1082 President St., Brooklyn, N. Y.
Edwin A. Willis, Room 184, West Block Elec. & Gas Labs., Dept. Trade and Com., Ottawa, Canada.
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New Jiffy Tester, J-245-x, Analy

Plate Voltmeter Range Enlarged to 600 volts, AC

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

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

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

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

INSTRUCTIONS FOR J-245-X

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

Service Procedure

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

Filament Volts

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

Grid Volts

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

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

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

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

Reverse leads if DC voltmeter reads below zero.

Grid Condition

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

Plate Voltage

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

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

Plate Current

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

Cathode Volts

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

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

Screen Grid Volts

(G post of socket)

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

Control Grid Volts

(cap of tube)

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

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

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

GENERAL

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

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

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

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

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

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

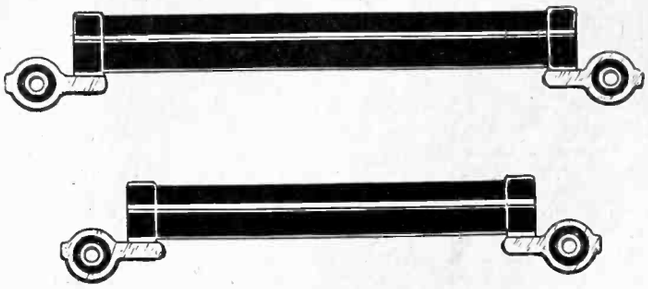
To test for shorts in condensers, resistors, etc. With tube in tester connect condenser under test to jacks —MA and +MIL-AMPS. If milliammeter shows change in reading the part tested is shortened. Resistors, etc., may be tested by the same method as noted above for continuity tests, or by disconnecting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

Testing Rectifier Tubes

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

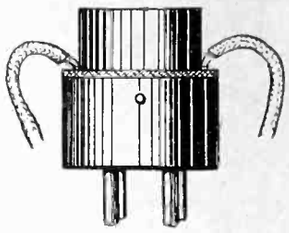
zes All Tubes, Sets and Circuits

Voltmeter Range Extended to 560 volts—Dandy Outfit!

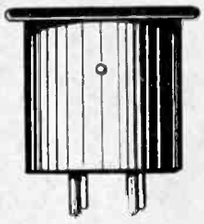


J-560 multiplier increases 140 volt AC range to 560 volts. Supplied with jack terminals (top illustration). J-106 multiplier increases 300 volts maximum of plate voltmeter to 600 volts, with jack terminals.

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



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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PLEASE USE THIS COUPON!

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

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

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

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

New High Mu AC Tube

228 Provides Higher Amplification and is an Excellent Power Detector

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

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

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

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

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

228
$2.50

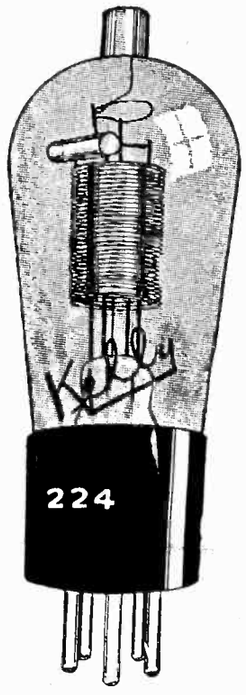
CHARACTERISTICS OF THE 228

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

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

The 228 is not suitable as a radio frequency amplier.

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



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

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

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

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

Battery Type Screen Grid 222 at $3.50

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

5-Day Money Back Guarantee!

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

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

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

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

- ☐ 228 AC high mu, @.....$2.50
- ☐ 224 AC screen grid @.....$3.00
- ☐ 245 AC power tube @.....$2.25
- ☐ 226 AC amplifier @.....$0.95
- ☐ 227 AC det.-amp. @.....$1.50
- ☐ 171A AC power tube @.....$0.95
- ☐ 210 AC power tube @.....$4.50
- ☐ 250 AC power tube @.....$6.00
- ☐ 280 AC rectifier @.....$1.75
- ☐ 281 AC rectifier @.....$3.50
- ☐ 222 battery screen grid.....$3.50
- ☐ 240 battery high mu.....$1.25
- ☐ 112A battery power tube.....$0.95
- ☐ 171A battery power tube.....$0.95
- ☐ 201A battery tube.....$0.65
- ☐ UX199 battery tube.....$1.25
- ☐ Matched pair of 245s for push-pull (for both).....$4.50
- ☐ Matched pair 171As for AC Push-Pull (for both).....$1.90

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Types of Tubes and Their Voltages

Tube	Fil. Volt	Amplifier Plate Volts	Amplifier Neg. Bias	Detector Plate Volts	Detector Neg. Bias	Remarks
228	2.5 AC	180	2.5	180	6	Heater type, 5 prongs.
224	2.5 AC	180	1.5	180	6	Heater type; SG volts, 75
245	2.5 AC	250	50.0	—	—	—
226	1.5 AC	135	9.0	—	—	—
227	2.5 AC	180	9.5	180	18-25	Heater type
171A	5ACorDC	180	40.5	—	—	—
210	7.5 AC	350	27.0	—	—	—
250	7.5 AC	450	64.0	—	—	—
280	5.0 AC	350AC	—	—	—	Full-wave rectifier
281	7.5 AC	700AC	—	—	—	Half-wave rectifier
222	3.3 DC	135	1.5	135-180	4-7	SG volts, 45
240	5.0 DC	135-180	3-4.5	135	1.5-3	—
112A	5.0 DC	135	9.0	135	Leak-cond.	—
UX199	3.3 DC	90	4.0	90	Leak-cond.	—

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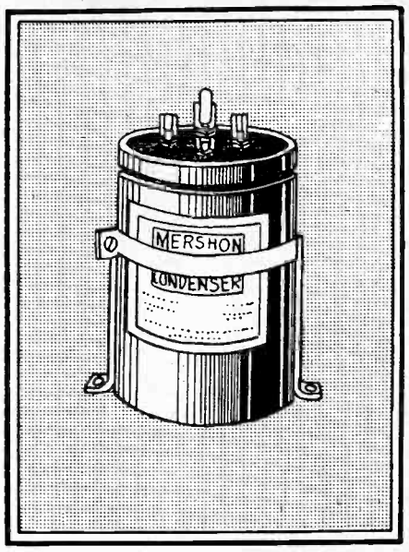
at Professional Discounts



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

Cat. No. Q 8 — **$4.67 NET**

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

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

Cat. Q 2-8, 2-18 — **$5.55 NET**

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

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

Mershon electrolytic condensers are instantly self-healing. They will break down only under an applied voltage in excess of 415 volts D.C. (commercial rating; 400 volts D.C.) but even if they do break down because overvoltaged, no damage to them will result, unless the amount of leakage current and consequent heating of the electrodes and solution cause the solution to boil. Voltages as high as 1,000 volts will cause no particular harm to the condenser unless the current is high enough to cause heating, or the high voltage is applied constantly over a long period.

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

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

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

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

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

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

Parts for SG Tuner

(Three stages RF, power detector, all shielded, all 222 tubes, as described in this issue.)

☐ Shielded antenna stage, BAS3A, all parts ☐ assembled but not wired	5.50
☐ Two shielded interstages, BIS3B, assembled, unwired	11.00
☐ Shielded power detector stage, BPD3B, assembled unwired	5.50
☐ Three 1.0 mfd. @ 50c	1.50
☐ 6.5 and 10 ohm fixed filament resistors	.90
☐ Two binding posts for output @ 10c	.20
☐ National dial with 5 or 6 volt lamp, rainbow feature modernistic escutcheon	3.13
☐ Dummy knob, shaft, bushing	.35
☐ Drilled steel cabinet, crackle brown finish	4.00
☐ Subpanel	3.00
☐ Five leads for cabling to batteries	.15
☐ Two pulleys and belt	1.25
☐ Brackets	.36
☐ All parts	$36.34
Four Kelly tubes, 222	$14.00

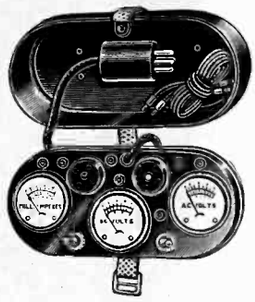
Remit with order and we pay postage. Canadian must be express or Postal Money Order. C. O. D. you pay cartage.

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

The New Readrite TUBE and SET TESTER

Tests Screen Grid

Model 245



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

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

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

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

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

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

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

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

Readrite Meter Works
[ESTABLISHED 1904]
12 College Avenue **Bluffton, Ohio**

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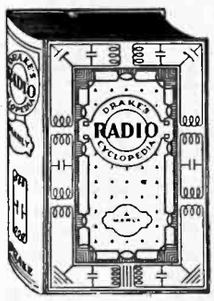

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This alphabetical arrangement lets the experienced worker refer directly to the one thing in which he is interested at the moment without hunting through non-essentials. The needs of the beginner are cared for.

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

Every new thing in radio is covered in detail.

1,680 Alphabetical Headings from A-battery to Zero Beat
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OF THE PRINCIPAL ARTICLES

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

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

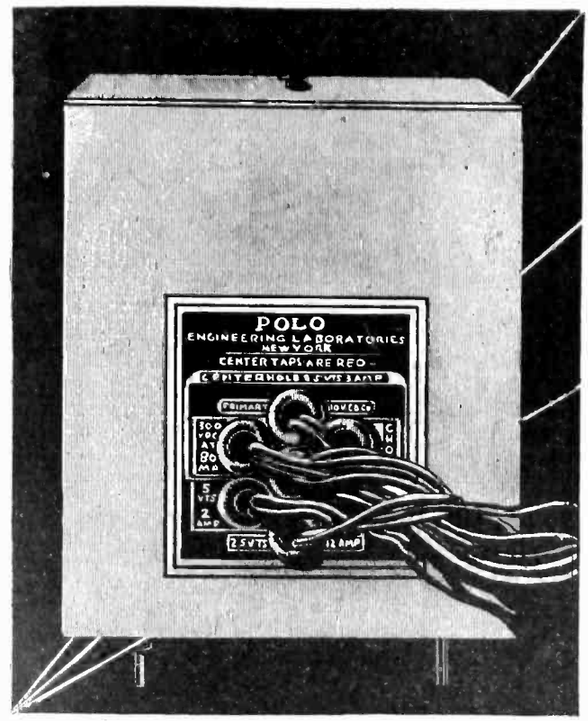
Another interesting point is that the high-current winding for all the 2.5-volt AC tubes to be used in a receiver or amplifier is rated at 12 amperes. This means that six heater type tubes may be worked well within the limits of the winding (total of 10.5 amperes used), while seven tubes may be used 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 on its base is 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 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

In ordering by telegraph use code designations.

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FILAMENT-PLATE SUPPLY

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

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

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

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

FILAMENT SUPPLY

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

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

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

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

Component Parts for PUSH-PULL AC DIAMOND

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

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

- ☐ All parts $51.77
- ☐ Kelly tubes, one 224, one 228, one 227, one 280, two 245 .....$13.25

Guaranty Radio Goods Co.,
143 W. 45th St., N. Y. City
(Just East of Broadway)

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

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

Name .....

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

Component Parts for PUSH-PULL BATTERY DIAMOND

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

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

- ☐ All parts $23.91

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

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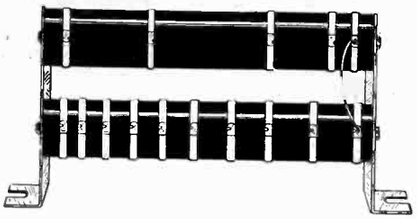
Multi-Tap Voltage Divider



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

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

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

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

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

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

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

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

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

Order Cat. MTVD at $3.95.

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

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

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One Tube?
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Circuits for Schoolboys—Easy to Build, Very, Very Inexpensive!

A One Tube Receiver, parts costing $4.28!
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The construction of these circuits, with a pictorial diagram as one of the illustrations, was described by Jack Tully, himself a schoolboy, in RADIO WORLD See list below.

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☐ Oct. 5th, Three-Tube Single Dial Speaker Set, by Jack Tully.
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15 cents a copy Order at once while these copies are available

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Farrand Inductor

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

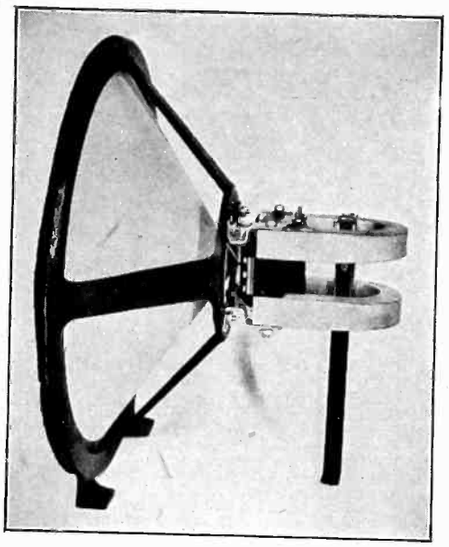
A new principle is involved in the Inductor Chassis. The armature moves up and down, in a wide gap, instead of from side to side in a tiny gap. Hence the armature does not strike the pole pieces.

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

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

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

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



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

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

GUARANTY RADIO GOODS CO.
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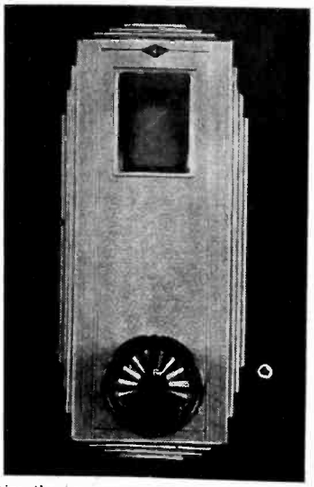
NATIONAL

MODERNISTIC PROJECTION DIAL WITH RAINBOW FEATURE



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

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

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

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

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

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

Latest Model National Velvet-B, Type 3680 in handsome crackle finish black metal casing, for use with sets up to and including six tubes. Input 105-120 volts AC, 50 to 60 cycles. Output 180 volts maximum at 35 milliamperes. Three variable output intermediate voltages. (Det., RF, AF) Eliminator has excellent filter system to eliminate hum, including 30 henry choke and 18 mfd. Mershon condenser. No motorboating! (Eliminator Licensed under patents of the Radio Corporation of America and associated companies.)

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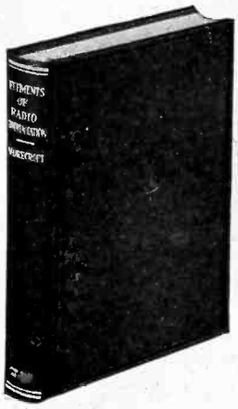

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[NOTE: *The standard book on tubes for advanced students is "The Thermionic Vacuum Tube," by Hendrik Van der Bijl. Order Cat. VDB @.....$5.00*]

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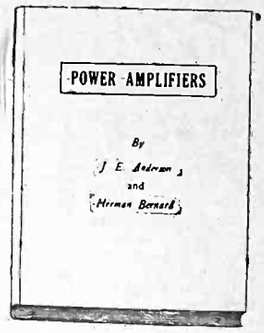

More than 200 pages and more than 100 illustrations are devoted to an analysis of this outstanding radio subject. "Power Amplifiers" is authoritative, original and comprehensive. It is free from the traditional errors that have crept into this subject. The theoretical part of the book can be understood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

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

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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
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FREED-EISEMANN
NR5, FE18, NR70, 470, N R 5 7, 457, NB11, NB80 DC.

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

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

PHILCO
Philco-electric, 82, 86.

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

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

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

DAY FAN
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COLONIAL
26, 31 A.C., 81 D.C.

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SPARTON
A.C. 80.

MISCELLANEOUS
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