DEC. 21st
1929

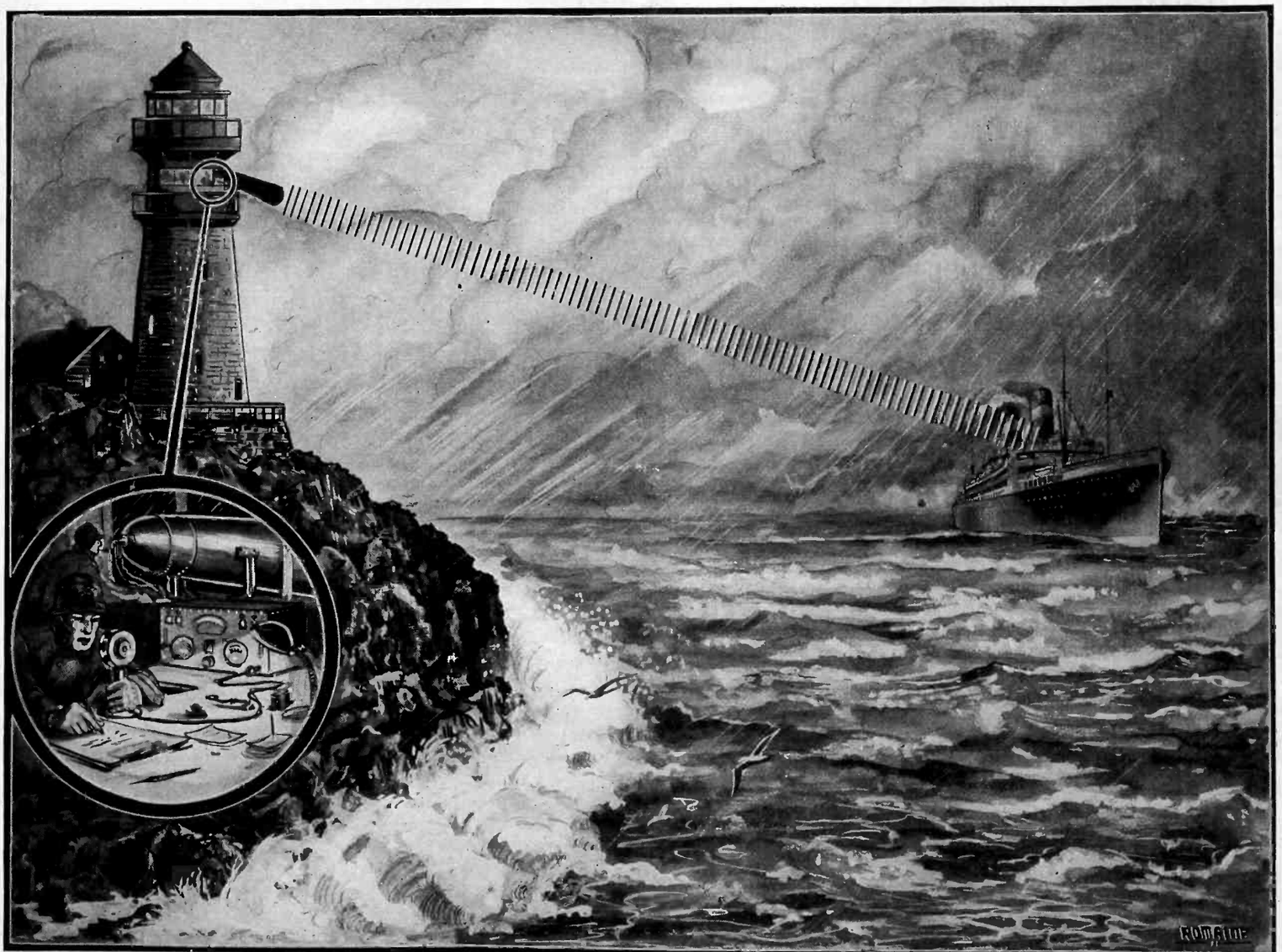
RADIO WORLD

REG. U.S. PAT. OFF.

15 CENTS

404th Consecutive Issue—EIGHTH YEAR

SUPERAUDIBLE SOUND TRANSMISSION



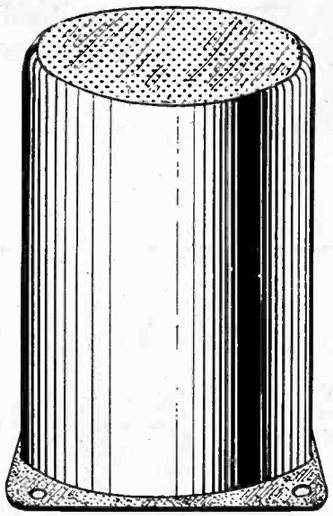
A lighthouse communicating with a ship at sea by means of a beam of modulated superaudible sound waves. Where light cannot penetrate these sound waves go through easily. See pages 5, 6 and 7.

HB 33 and HB 44 Construction

RADIO WORLD, published by Hennessy Radio Publications Corporation. Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager, all of 145 West 45th Street, New York, N. Y.

The Latest in Tuning Equipment

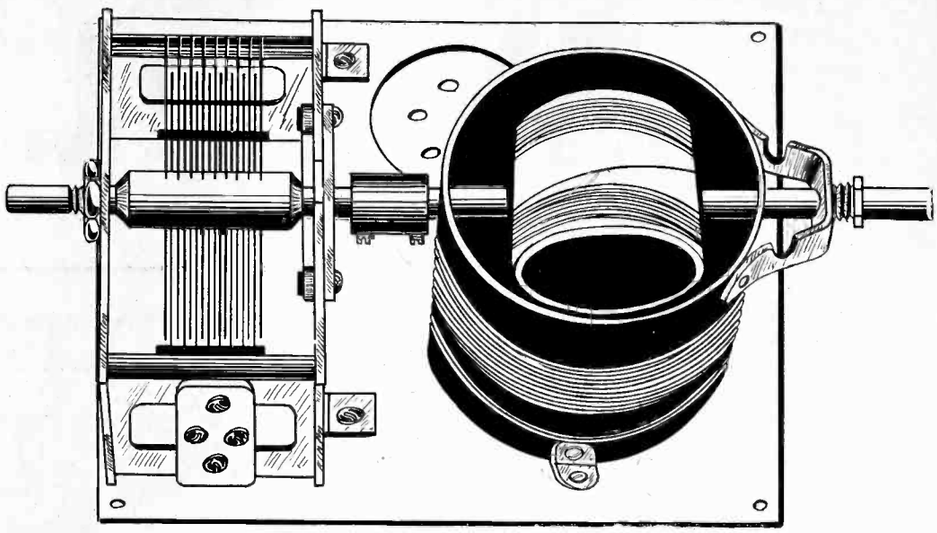
SHIELDED COIL



RF transformer in aluminum shield 2¾" square at bottom, 3¾" high. If metal subpanel is used no extra base is needed. Coils have brackets on. You must assemble in shield yourself and solder winding terminals to built-in lugs. For all circuits and stages, including screen grid tubes.

Cat. No. SH3 for .00035 mfd. $0.95
Cat. No. SH5 for .0005 mfd. $1.00
Cat. SHB (extra base) $0.10

BERNARD TWO-TUBE TUNER ASSEMBLY



For building a tuner consisting of a stage of screen grid radio frequency amplification and a detector, AC or battery-operated, use the Bernard two-tube tuner assembly. Suitable for single control with one drum dial or separately tuned stages with two flat-type dials. The assembly consists of antenna stage (BTL-AC or BTL-DC), having Bernard Tuner BT3A, a .00035 mfd. condenser, socket, link and aluminum base. The detector input stage (BTR-AC or BTR-DC) consists of the same parts, but the coil has a tuned primary with untuned input to detector. Assemblies are unwired but are erected.

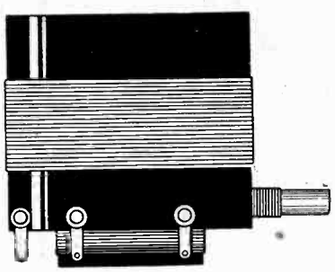
The condenser has shaft protruding at rear, so if two dials are used coil is put at front panel in either instance and condenser at front panel for the other.

For AC operation, 224 RF and 224, 227 or 228 detector, order Cat. No. BTL-AC and BTR-AC at $6.00.

For battery operation of filaments, 222 RF and 222, 240, 201A or 112A detector, order Cat. No. BTL-DC and BTR-DC at $6.00.

[Note: for drum dial single control an 80 mmfd. equalizing condenser is necessary. This is extra at $0.35. Order Cat. EQ-80.]

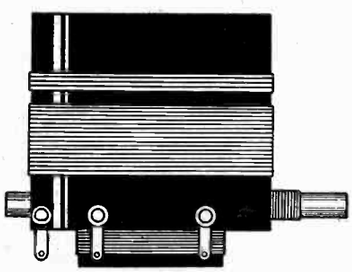
ANTENNA COUPLER



Cat. No. VA5—$0.85
FOR .0005 MFD. CONDENSER

Moving primary and fixed secondary, for antenna coupling. Serves as volume control
Cat. No. VA3 for .00035 mfd. $0.90

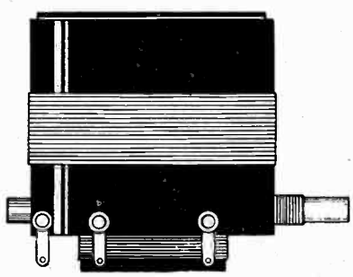
BERNARD TUNERS



Cat. No. BT5A—$1.35
FOR .0005 MFD. CONDENSERS

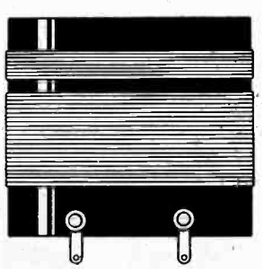
Bernard Tuner BT5A for .0005 mfd. for antenna coupling, the primary being fixed and the secondary tuned. This coil is used as input to the first screen grid radio frequency tube. Secondary has moving coil.
Cat. No. BT3A for .00035 mfd. ..$1.35

Bernard Tuner BT5B for .0005 mfd. for working out of a screen grid tube, tuned primary, untuned secondary. Primary has moving coil.
Cat. BT3B for .00035 mfd. ..$1.35



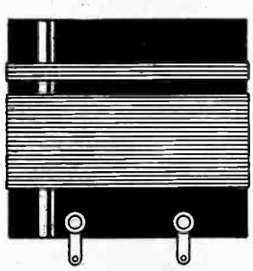
Cat. No. BT5B—$1.35
FOR .0005 MFD. CONDENSER

SG TRANSFORMER



Cat. No. SGS5—$0.60
FOR .0005 MFD. CONDENSER

Interstage radio frequency transformer, to work out of a screen grid tube, primary untuned.
Cat. No. SGS3 for .00035 mfd. $0.65



Cat. No. RF5—$0.60
FOR .0005 MFD. CONDENSER

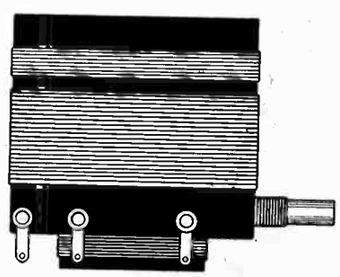
DIAMOND PAIR

Cat. No. RF5—$0.60
FOR .0005 MFD. CONDENSER

Antenna coil for any standard circuit, and one of the two coils constituting the Diamond Pair.
Cat. No. RF3 for .00035.$0.65

Cat. No. SGT5—$0.85
FOR .0005 MFD. CONDENSER

Interstage 3-circuit coil for any hookup where an untuned primary is in the plate circuit of a screen grid tube.
SGT3 for .00035 mfd...$0.90

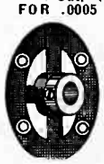


Cat. No. SGT5—$0.85
FOR .0005 MFD. CONDENSER

Order the Diamond Pair, Cat. DP5 for .0005 mfd. at $1.45

Order the Diamond Pair, Cat. DP3 for .00035 mfd. at $1.55

[Note: These same coils are for AC or battery circuit.]

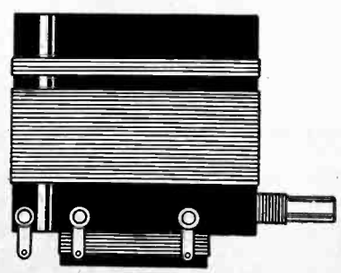


FL4 $0.30

Flexible insulated coupler for uniting coil or condenser shafts
Order Cat. FL4 at $0.30

Equalizing condenser, 80 mmfd., for connection across any tuning condenser where ganging is resorted to, or for equalizing independently tuned circuits to make dials track.
Order Cat. EQ80 at $0.35

STANDARD TUNER



The standard three-circuit tuner is used with primary in the plate circuit of any RF tube, AC or battery type, excepting only screen grid tube.

For .0005 mfd. order T5 at $0.85

For .00035 order Cat. T3 at $0.90

All coils have 2½" diameter, except the shielded coil, which is wound on 1¾".

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

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

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

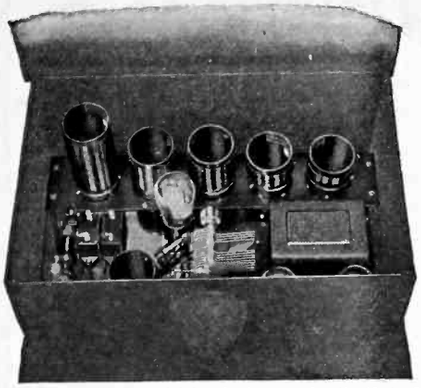
Screen Grid Coil Company,
143 West 45th Street,
New York, N. Y. (Just East of Broadway.)

Enclosed please find $..... for which please send at once the following parts:

☐ Cat. No. ..... at $ .....
☐ Cat. No. ..... at $ .....
☐ Cat. No. ..... at $ .....
☐ Please ship C. O. D.

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

Short Wave Circuit

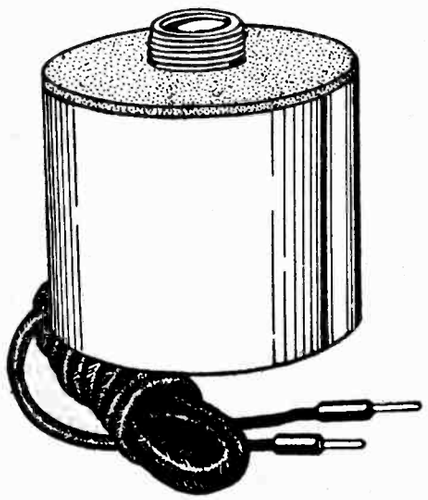


National Thrill Box, 4-tube short wave circuit, 15 to 535 meters, battery-operation of filaments; B supply, either batteries or eliminator.

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

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

Horn Unit $2.25



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

For Portable Use

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

Air-Column Horn

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

Acoustical Engineering Associates,
145 W. 45th St., N. Y. City (Just E. of Bway).
Please ship C. O. D.
☐ Cat. No. 225 @ $2.25 ☐ Cat. No. 596 @ $8.00

Name .....

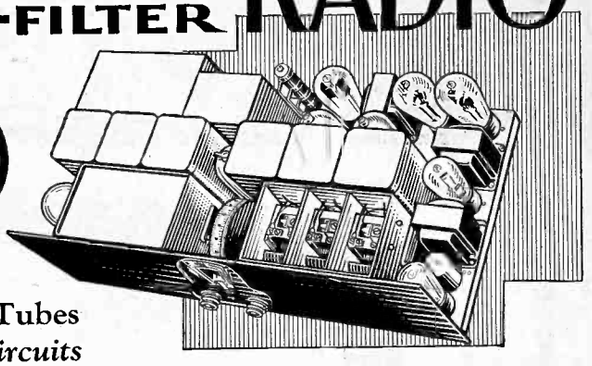
Address .....

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

FIVE-DAY MONEY-BACK GUARANTEE

For Christmas EVERY Day!

OWN the World's Premier Custom-Built BAND-FILTER RADIO



Screen Grid Tubes
Six Tuned Circuits

YOU don't have to be an acoustical expert to recognize superlative tone—nor a radio engineer to know when you're listening to a program from the other side of the world—sweet, clear, free from noise or interference.

But the more you know about the fine points of radio design, the greater your appreciation of what Hammarlund engineers have accomplished in the new Custom-Built "HiQ-30" Band-Filter Screen-Grid Radio.

Here's amazing power, sensitivity, selectivity, tone, beauty; with unlimited choice of cabinets and speakers. For the first time a unit-built chassis with the chief units ready-wired and factory-tested. A. C. and battery models, $139.50 to $1,175, complete, less tubes.

Ask your local custom-radio builder to demonstrate the "HiQ-30" and to build one for you. Or assemble it yourself. It is easy and perfect results are assured.

BLACKSTONE

Choice of
FINEST CABINETS
And Speakers

[MAIL COUPON for the 48 page "HiQ-30" MANUAL.]

The "HiQ-30" chassis fits standard stock cabinets. Nine beautiful, specially selected models are supplied by Hammarlund. Fully described in "HiQ-30" Manual.

WINDSOR

HAMMARLUND-ROBERTS, Inc.
424-438 W. 33rd St., New York, N. Y.

Enclosed 25c (stamps or coin) for 48-page "HiQ-30" Manual.

NAME .....

ADDRESS .....

....(RW-2)

NEW DRAKE'S ENCYCLOPEDIA—1,680. Alphabetical Headings from A-battery to Zero Beat, 1,025 Illustrations, 920 Pages, 240 Combinations for Receiver Layouts. Price, $6.00. Radio World, 124 W. 45th St., N. Y. C.

ARISTOCRAT FLOOR SPEAKER—With Molded Wood Horn and Horn Motor built in. Great value. $14.00. Acoustical Engineering Associates, 143 W. 45th St., N. Y. C.

HIGHEST RESISTANCE PHONES, $1.65—You can't beat them at the price. Send now. Guaranty Radio Goods Co., 143 W. 45th St., N. Y. C.

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

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And use this department if you have anything to sell. 10c a word, $1 minimum. Radio World, 145 W. 45th St., N. Y. City.

Hi-Q 30 Wholesale Prices!

Write or wire!

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

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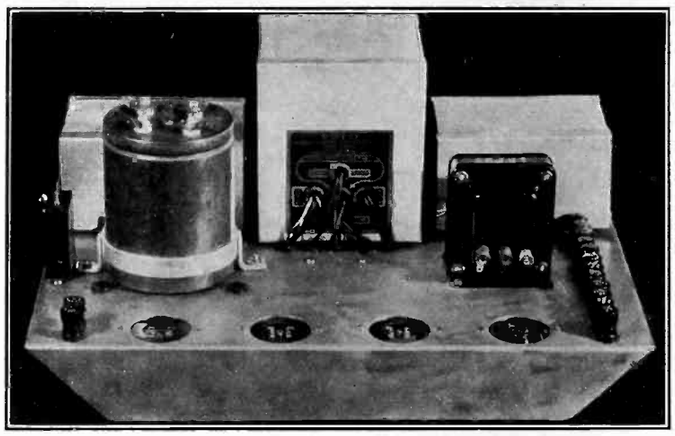
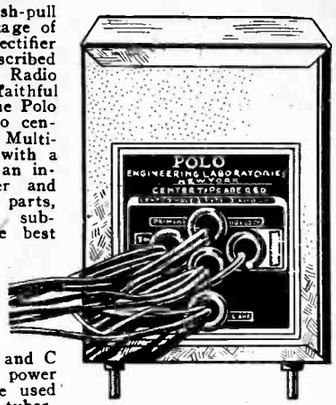
Power Amplifier Equipment

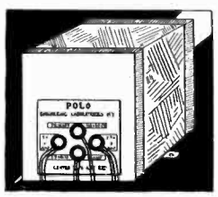


At left is illustrated a push-pull power amplifier, using a first stage of resistance coupled audio, 280 rectifier and two 245s in push-pull, as described in the November 2d issue of Radio World. Abounding volume and faithful tone reproduction are assured. The Polo Filament-Plate Supply, two Polo center-tapped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

Subpanel alone, cat. SPO @ $3.50



Polo 245 Filament Plate Supply (less chokes) has four windings, all save primary center-tapped (red), is 4½" wide, 5" high, 4" front to back. Weight, 9 lbs. Filament windings, 2.5 v. at 12 amps., 2.5 v. at 3 amps. (for 245 filaments), 5 v. at 2 amps. for 280 rectifier, and 724 v. @ 80 m.a., center-tapped. Order Cat. PFPS @ $7.50. [For 25 cycles order Cat. PFPS-25 @ $12.00.] [For 40 cycles order Cat. PFPS-40 @ $10.00.]



Polo Filament Transformer Only, four windings, consists of 50-60 cycles 110 v. winding, 2½ v. at 12 amps., 2½ v. at 3 amps., 5 v. at 2 amps. All windings, save primary, are center-tapped (red). Size, 4⅜" high x 3¾" wide x 3" front to back. Weight, 6 lbs. Order Cat. PFT @ $4.25.

[For 25 cycles order PFT-25 @ $7.00; for 40 cycles order PFT-40 @ $6.25.]

By-pass Condensers

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

Filter Condensers.

For high voltage filtration next to the rectifier, use 1 or 2 mfd. The 2 mfd. makes the output voltage a little higher.

Order Cat. HV-1 (1,000 v. DC, 550 v. AC).....$1.76

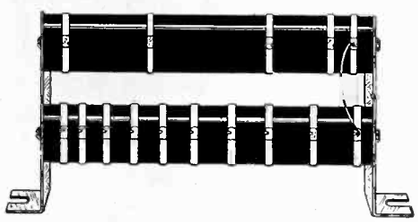
Order Cat. HV-2 (1,000 v. DC, 550 v. AC).....$3.52

Filament-Plate-Choke Block

Same as Filament-Plate Supply, except that two 50 henry chokes are built in. Six windings: primary, 110 v., 50-60 cycles; 2.5 v. at 12 amps.; 2.5 v. at 3 amps.; 5 v. at 2 amps.; 724 v. at 80 m.a.; choke All AC windings center-tapped (red), except primary. Connect either end of a choke to one end of other choke for midsection. Order Cat. P-245-FPCH @..$10.00

[For 40 cycles order P-245-FPCH-40 @ $13.50.]

[For 25 cycles order P-245-FPCH-25 @ $14.50.]



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

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

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

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

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

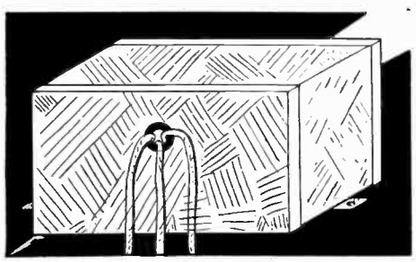
The Multi-Tap Voltage Divider is useful in all circuits, including push-pull and single-sided ones, where the current rating of 125 milliamperes is not seriously exceeded and the maximum voltage is not more than 400 volts. If good ventilation is provided, this rating may be exceeded 15 per cent.

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

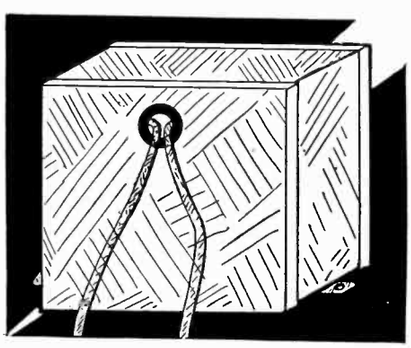
When the Multi-Tap Voltage Divider is placed across the filtered output of a B supply which serves a receiver, the voltages are in proportion to the current flowing through the various resistances. If a B supply feeds a receiver with two-stage audio amplifier, the last stage a single-sided 245, then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

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

Order Cat. MTVD at $3.95.



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



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

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

Please ship at once the following:

Quantity	Cat. No.	Product	Price
☐	PO-245-PA	Power amp. parts, 50-60 c.	$43.57
☐	PO-245-PA-40	Same, 40 cycles	46.07
☐	PO-245-PA-25	Same, 25 cycles	48.57
☐	PFPS	Fil. plate supply, 50-60 c.	7.50
☐	PFPS-40	Same, 40 cycles	10.00
☐	PFPS-25	Same, 25 cycles	12.00
☐	PFT	Fil. trans., 50-60 c.	4.25
☐	PFT-40	Same, 40 cycles	6.25
☐	PFT-25	Same, 25 cycles	7.00
☐	P-245-FPCH	Power-filter block	10.00
☐	P-245-FPCH-40	Same for 40 cycles	13.50
☐	P-245-FPCH-25	Same for 25 cycles	14.50
☐	PDC	Single choke	2.50
☐	PSC	Multi-tap volt. div.	3.95
☐	MTVD	Double c.-t. choke	3.71
☐	Q2-8, 2-18B	Mershon with bracket	5.15
☐	LV-1	200 v., 1 mfd. by-pass cond	.50
☐	HV-1	1,000 v., 1 mfd. filter cond.	1.76
☐	HV-2	1,000 v., 2 mfd. filter cond.	3.52
☐	SPO	Subpanel	3.50

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

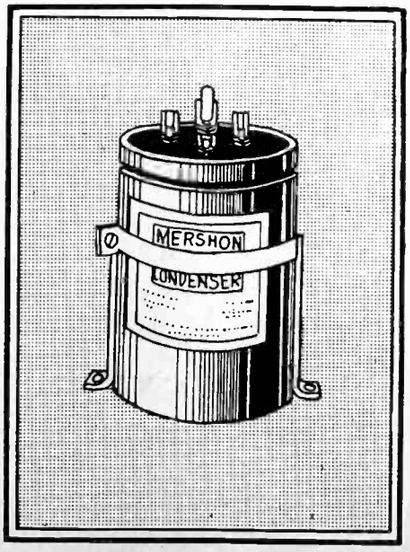
☐ Please ship C.O.D.

NAME.....

ADDRESS.....

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

5-DAY MONEY-BACK GUARANTEE!



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

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

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

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

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

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

"UNINTERRUPTED READER INTEREST"
EVERY WEEK — EVERY YEAR

RADIO WORLD

Vol. XVI, No. 14 Whole No. 404
December 21st, 1929
15c per Copy, $6.00 per Year
[Entered as second-class matter, March, 1922, at the Post Office at New York, N. Y., under act of March, 1879.]

Technical Accuracy Second to None
Latest Circuits and News
EIGHTH YEAR

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

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

Sound You Can't Hear

Transmission of Superaudible Waves for Signalling

By J. E. Anderson

Technical Editor

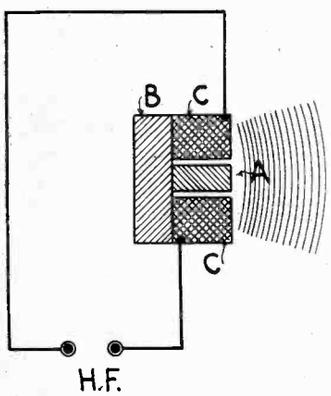


FIG. 1
CROSS SECTION OF A SUGGESTED MAGNETOSTRICTION GENERATOR OF HIGH FREQUENCY SOUND WAVES.

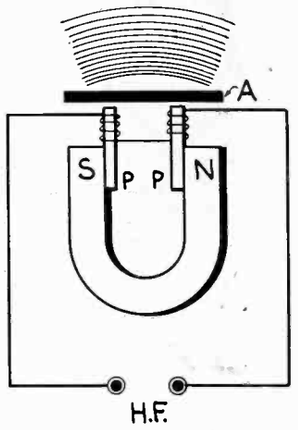


FIG. 2
HIGH FREQUENCY SOUND WAVES CAN ALSO BE GENERATED BY MEANS OF A DEVICE OPERATING ON THE HEADSET PRINCIPLE.

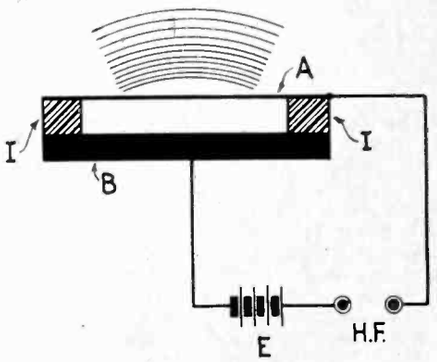


FIG. 3
A TINY CONDENSER TYPE SPEAKER CAN BE USED FOR GENERATING SUPERAUDIBLE SOUND WAVES.

IT is certain that in the future there will be a great deal of interest in superaudible sound vibrations and that innumerable uses will be found for them in communication. We discussed this subject briefly last week, indicating in what manner they could be made audible after transmission and also suggesting how they might be produced. We shall now give additional suggestions on the subject, particularly with regard to their transmission and generation.

It must be remembered that the art of transmitting intelligence by means of superaudible sound vibrations is still in the experimental stage and that it is impossible at this time to be as specific as when dealing with a developed art like broadcasting or the transmission and reception of radio waves.

The science of acoustics has lain practically dormant for thirty years. Just a few years ago there was practically no interest in the subject in physical laboratories. Very few scientific papers appeared in the technical journals throughout the world and the subject was treated lightly in the schools. Most attention was given to mechanics, electricity and magnetism.

BROADCASTING REVIVES ACOUSTICS

It was not until broadcasting was established that the subject of acoustics was revived. Talking pictures gave the subject an additional impetus and a tremendous one. At this time there is, perhaps, no other subject in physical science in which there is a greater interest and more rapid development.

At first the interest was mainly in the reproduction of audible sounds with the object of getting tone realism. This led to work on the acoustic properties of rooms and auditoriums to prevent echoes. Improvements have been made in every phase of the subject, but nearly all this work has dealt with sounds of audible frequencies. Very little has been done in the superaudible region.

During the war sound waves in water were made use of to a considerable extent both for communication and for the detection of the presence of enemy submarines. Superaudible sound waves have also been made use of in sounding the depths of the ocean. Of course, these applications of sound waves in water are not limited to superaudible frequencies but include audible sounds as well.

Sounding of the ocean is based on the known rate of travel of sound in water. A ship generates a sound of some kind under water. This sound may be a type of explosion or it may be a continuous sound. The sound transmitted from the ship travels down to the bottom of the ocean where it is reflected back to the ship. If the time it takes the sound to make the round trip is measured accurately the depth can be computed from the known velocity of sound in water and the time measured. If the velocity of sound in water is V, the time of a round trip is T, then the depth D is given by the formula D=TV/2.

CONTINUOUS WAVE METHOD

This applies to the case when an explosive sound is transmitted. If a continuous sound is transmitted the procedure is different. The transmitted and the reflected sound waves form a standing wave pattern with alternate loops and nodes. The distance between two adjacent nodes is one half wavelength. If the number of these half wavelengths and the length of each one are known the distance to the bottom is known. In order to make the distance an integral multiple of half wavelengths it is necessary to vary the frequency of the sound transmitted until there is a pressure node at the ship or at the transmitter. The bottom is always a pressure node.

The frequency of the sound when this condition is established is readily determined from the calibration of the oscillator. It remains to determine the number of half wavelengths between

Ear as Detector of Modul

Speaking Arc Transmits Signal at

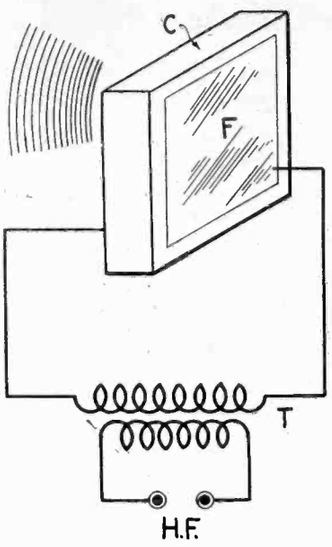


FIG. 4
THE PIEZO OSCILLATOR, OR SPEAKER, IS ONE CONVENIENT DEVICE FOR GENERATING SUPER-AUDIBLE SOUND WAVES.

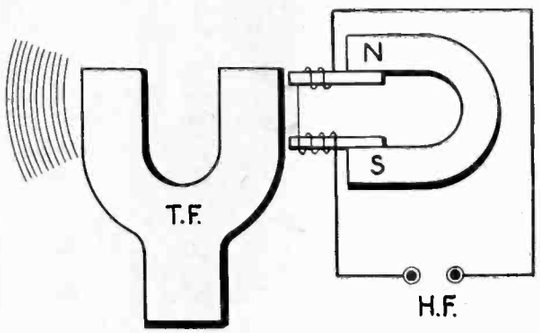
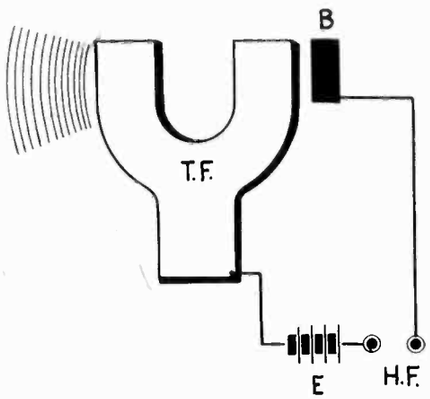


FIG. 5
A TUNING FORK CAN BE CONSTRUCTED SO THAT ITS NATURAL FREQUENCY FALLS ABOVE THE AUDIBLE LIMIT.



HIGH FREQUENCY TUNING FORK DRIVEN BY ELECTRIC ATTRACTION ON THE PRINCIPLE OF THE CONDENSER SPEAKER.

the bottom and the surface. This can be determined if the approximate depth is known or by means of another measurement. For example, the explosion method might give an approximate value of the depth and the continuous method a more accurate value.

In order to detect the reflected wave as it arrives to the surface it is necessary to have a sensitive sound detector, which may be a specially constructed microphone. If the depth of the water is considerable the reflected wave will be weak and a sensitive detecting device becomes necessary.

The detection of the presence of submarine is based on the fact that the submarine vibrates and sends out sound vibrations in the water. The vibrations may come from the hull or from the propeller. A sensitive water microphone attached to the detecting ship can pick up these vibrations. If there is one of these microphones on each side of the ship the direction of the submarine craft can be determined on the same principle as the direction of a radio station is determined or by the principle on which a human being can determine the source of a sound, that is, the binaural method of hearing.

GENERATORS OF SOUND

There are many different types of high frequency sound generators. Some are suitable for very high frequencies while others are suitable for audio frequencies and those frequencies just above the audible range.

In Fig. 1 is shown a cross section of a possible magnetostriction generator. B is a heavy metal plate very securely lodged in some support. A is a short length of magnetostrictive material such as monel metal, and CC is a coil of wire surrounding this rod, but not touching it. The rod may be attached to the plate B by means of a large machine screw.

The rod A has a certain natural frequency of vibration lengthwise. If an electric current having a frequency equal to this natural frequency of vibration be impressed at the terminals H F and thus sent through the coil CC the rod will be set into vibration at its natural frequency. The more nearly the frequency of the current is equal to the natural frequency of the rod, and the greater the driving current, the more vigorous will the lengthwise vibration of the rod be.

The frequency of the rod is determined by its mass, by its length, and by the elastic constants of the material. The rod will vibrate in a quarter wavelength because it is free at one end and rigid at the other. There is a motion loop at the free end and a motion node at the fixed end. The necessary constants for determining the frequency are known for all magnetostrictive materials so that a length which will give any desired frequency can be calculated.

The rod will also respond to current having harmonic frequencies of the fundamental natural frequency. The condition is that the frequency is such as to drive the rod in odd multiples of a quarter wavelength. Thus a rod which has a fundamental in the audible length can be driven at superaudible frequencies.

Since the free end of the rod moves to and fro sound waves will be generated in the air just as if the surface of the end were a diaphragm of a loudspeaker.

HEADSET GENERATOR

An ordinary headset can also be used as high frequency generator. As is well known when a heterodyne frequency is impressed on a headset and the frequency is increased, the sound can be heard up to the limit of audibility, somewhere between 10,000 and 20,000 cycles per second. As the pitch of the sound increases a time will come when nothing is heard because the sound is too feeble. However, if the headset is moved slightly to or from the ear the sound will be heard again. This is due to resonance in the air cavity between the diaphragm and the ear drum, which increases the intensity manifold.

When the sound ceases because its pitch passes beyond audibility it does not cease in the air, although it gets less and less intense due to the fact that the headset diaphragm cannot follow the rapid vibrations. In order to increase the intensity it is necessary to tune the diaphragm to the high frequency. To tune it it is necessary to make the diaphragm stiffer and at the same time, if possible, lighter in weight. The principle of the headset generator is shown in Fig. 2.

This method of generating high frequency sound waves is limited by the fact that the electromagnet ceases to be effective at the higher frequencies and also by the fact that the capacity across the armature winding will by-pass the high frequency driving current. Sometimes it is possible to tune the winding.

VIBRATING PLATE

It is not necessary that A in Fig. 2 be a round diaphragm such as those used in headsets. It may be a steel plate or a steel bar of suitable length and thickness, rigidly mounted in two supports. Or it may be rigidly mounted at one end and free at the other, but in that case the bar must be shorter for a given frequency of vibration.

Another method of generating high frequency sound waves is based on the principle of the condenser speaker. This is illustrated in Fig. 3. A is a light and rigid diaphragm or plate or bar of metal separated from another fixed plate B by insulators II. This condenser is polarized by means of a battery E and driven by a high frequency current impressed at H F. If the frequency of the driving current is equal to the natural frequency of the armature A the armature will vibrate vigorously and send out sound waves.

Instead of using a metal plate for A it may be made of glass or quartz covered with tin foil. The attraction will be between the plate B and the tin foil, but since the tin foil is attached to the non-conducting plate this will vibrate. A higher frequency is possible with the quartz or glass than with a steel plate. This condenser generator is not limited to the extent of the magnetically driven armature in Fig. 2.

A practical suggestion for the construction of this device may not be amiss. Let B be a circular plate ground plane on the side toward the armature plate. In the center of the plate turn

ated Superaudible Waves

Lower Than Radio Frequencies

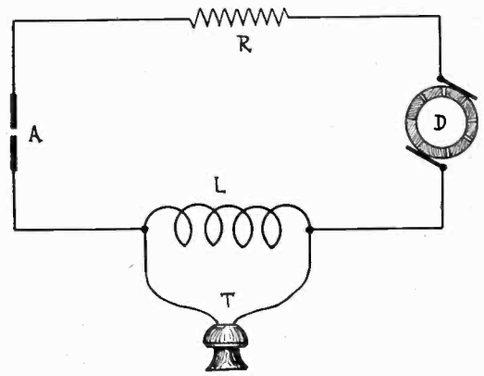


FIG. 7
THE SPEAKING ARC IS ONE OF THE OLDEST AND BEST KNOWN LOUDSPEAKERS. IT WORKS AT HIGH FREQUENCIES AS WELL AS AT LOW.

out a shallow recess a few thousandths inch deep. A flat-ground ring is thus left around the periphery of the plate. On this place a glass disc and clamp it on the metal plate. Cement a circular piece of tin foil in the center of the glass away from the metal plate. The glass, which should be thin, will serve as insulator and the member II becomes a part of the fixed plate.

PIEZO OSCILLATOR

Fig. 4 shows the principle of a piezo oscillator. C is the crystal cut in the form of a parallelopiped and covered on both sides with tin foil. The driving force is impressed across the plate by connecting the secondary of a transformer to the two pieces of tin foil. This plate has many natural periods of vibration as it can vibrate in all three of its dimensions as well as in harmonics of these modes of vibration.

The piezo crystal may be had in both Rochelle salt and in quartz. Rochelle salt is more piezo-active than quartz and can be obtained in larger pieces. Quartz is more readily available because it is used in frequency standards for radio transmitters. Quartz is also more suitable for the higher frequencies.

Several watts of power can be put into a tiny quartz crystal and a large part of this power can be radiated as high frequency sound.

TUNING FORK OSCILLATORS

Some of the oldest tone generators are tuning forks. These come in all frequencies from the lowest audible to the highest. But since they are mostly used for pitch determination in music they are usually in the musical range.

A tuning fork essentially is a bar of steel supported at its center. The fact that a fork is bent into the shape of a U does not materially alter the principle. Each prong is a quarter wavelength since it is free at one end and fixed at the other. Due to the construction it is uncertain just where the effective fixed end is and the effective end of one prong does not coincide with that of the other. When the form vibrates the two free ends always move in opposite directions, either away from or toward each other.

A tuning form can be maintained in continuous vibration by electrical means and two methods are illustrated in Figs. 5 and 6. In Fig. 5 it is driven by an electromagnet, which may well be a headset unit, and in Fig. 6 it is driven by electric force in the same manner as a condenser speaker.

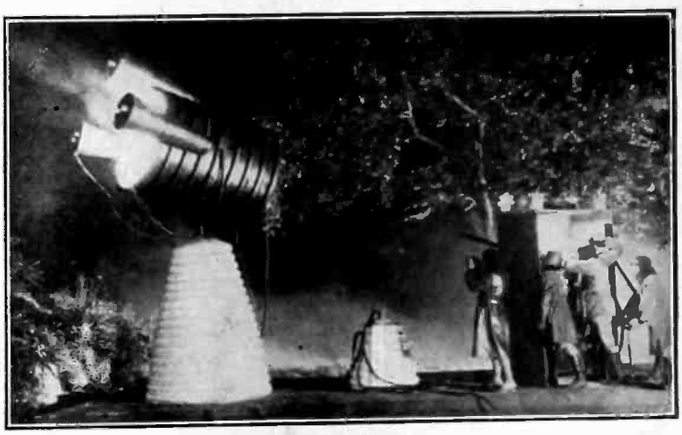
In either case the fork must be mounted rigidly. So must the driving member whether it be the headset unit or the electrically charged plate B in Fig. 6. As in the case of Fig. 3, the plate B must be insulated from the armature, the fork, and a polarizing voltage E must be impressed between the two.

Fig. 6 is more suitable for high frequency operation since it is not limited by the electromagnet nor by the capacity of the winding.

HARMONICS OF FORKS

Each fork has a given natural frequency of vibration. When the driving current or electric force has exactly this frequency the fork will vibrate with a large amplitude, and relatively little force is needed to maintain the vibration. If the driving frequency differs but slightly from the natural frequency of the fork, the amplitude will be extremely small.

A tuning fork has harmonics or higher natural frequencies of vibration, but these frequencies are not simple harmonic. That is, they do not bear an integral relationship with the fundamental frequency. For example, the second natural frequency is about 5.5 times the fundamental frequency instead of twice the fundamental.



(Underwood & Underwood)
SOUND WAVES OF EXTREMELY SHORT WAVES CAN BE TRANSMITTED IN A SHARP BEAM LIKE LIGHT WAVES BY A DEVICE SIMILAR TO THE ONE ILLUSTRATED HERE, WHICH SENT OUT "DEATH RAYS."

If a tuning fork is to vibrate at a very high frequency its prongs must be short and stubby. That is, the weight of the prongs must be concentrated near the base and the fork must be quite rigid.

THE SPEAKING ARC

The speaking arc is another sound generator which is not limited in frequency range. A simple circuit diagram of such an arc is shown in Fig. 7. A is a carbon electrode arc such as is used for illumination. A 200 volt direct current generator D supplies the necessary current to operate the arc and a resistance R is put in the circuit to control the current. A current of about 10 amperes is suitable. The distance between the two carbon electrodes should be several centimeters (1 inch equals 2.54 cm.). A large inductance L of low resistance is put in series with the circuit and across the coil is impressed the signal. T may be an ordinary microphone. If this is spoken into the voice will come out of the arc with remarkable fidelity.

Instead of speaking directly into the transmitter T the output of an audio amplifier may be connected across the coil L, and the signal may originally be derived from a pick-up unit and a phonograph or from a microphone.

If it is desired to transmit superaudible frequency sounds by means of the arc coil L should have a lower inductance, and particularly a lower distributed capacity, and the output of a vacuum tube oscillator operating at a superaudible frequency should be impressed across it. Of course, it is not necessary to use direct coupling between the source of the oscillation and the coil, but L may well be the secondary of a transformer, provided the transformer is such that the heavy current can flow through the secondary without serious complications.

MODULATED HF SOUND

If the high frequency current driving any of the devices in Figs. 1 to 7 is modulated by an audible frequency current the sound emitted by the sound generator will also be modulated. If a suitable detector for this modulated sound can be found it would be possible to transmit intelligence by carrier sound waves just as broadcasting is now conducted by carrier radio waves. As was explained last week, the ear detects modulated superaudible waves, so that the modulated sound waves should be audible without the aid of any mechanical or electrical devices whatsoever.

Condenser Leaks

THE ELECTROLYTIC condenser in my power pack passes a good deal of current, or at least it seems that way to me. I connect a milliammeter between the case of the condenser and the B minus side of the rectifier, and there is a deflection. It is not the same all the time but depends on how many of the sections of the condenser I use. Is this a characteristic of the condenser or is it a defect in mine only?—A. B. S.

If the current is not more than a few milliamperes it is a characteristic of the condenser as some current always flows through it, and of course, the current that does flow depends directly on the capacity you use, or on the number of sections in use. The amount of current that flows depends on the amount of impurities in the active metal electrode. A current of a few milliamperes does no harm for it simply adds a little to the bleeder current in the rectifier.

Constructional Helps to Bu

Separately Shielded Cascade Used in

By Herman

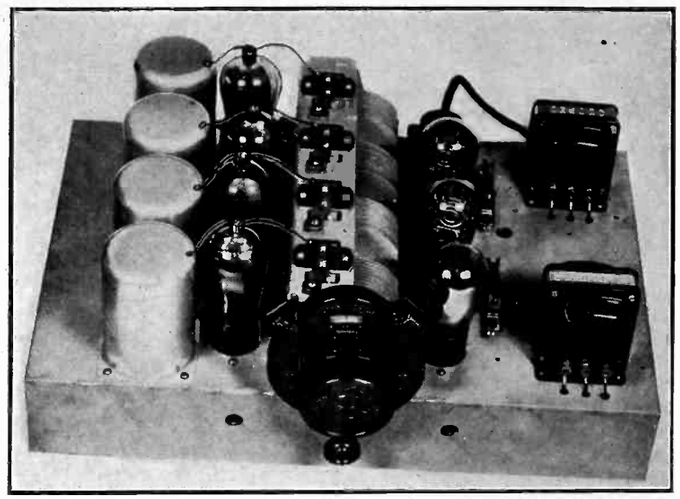


FIG. 1
TOP VIEW OF THE HB33 TAKEN FROM THE FRONT.

[*Herewith are published constructional data on the HB33 and HB44. The 33 is for battery operation of filaments. The 44 is for AC. Both use three stages of screen grid tuned RF, individually shielded, and shielded input to the screen grid detector. The first audio stage is resistance coupled. The second is push-pull transformer coupled. In the 33 the output tubes are 112A, in the 44 they are 245s. Next week, it is expected, the picture diagram of the wiring of the 33 will be ready for publication.—Editor*]

TWO ultra-sensitive companion circuits, the HB 33 for battery operation of filaments and optional use of B batteries or a B eliminator for plate supply, and the HB44, completely AC operated, use the same subpanel. Viewing the steel subpanel from the front, the shielded coils are at left, the sockets next, and the tuning condenser, a four-gang device, at center. This arrangement prevails also for the AC model.

The only difference is in the type of sockets used, the UX sockets being supplied for battery-operated model, the UY sockets for the other. These are the four sockets representing the three stages of screen grid radio frequency amplification and the screen grid detector. You yourself affix the sockets by means of 6/32 machine screws and nuts.

MOUNT CONDENSER FIRST

The first thing to mount on the subpanel is the four-gang condenser. The subpanel has holes drilled in it for this purpose, so no brackets are necessary. The holes are of two types: small ones and large ones. The small ones are for passing screws that one removes from the rotor or frame connection of the condenser. If the condenser is mounted on one side, the trimming condensers will be on top, easy of access. This is the only way the condenser can be mounted so that proper elevation will be preserved, in connection with the drilling in the cabinet, and proper safeguard made against short-circuiting. Between the condenser and the top of the subpanel at each of the eight points put two extended insulators, not for insulation but for elevation. ¾" No. 6/32 machine screws must replace those removed from the condenser.

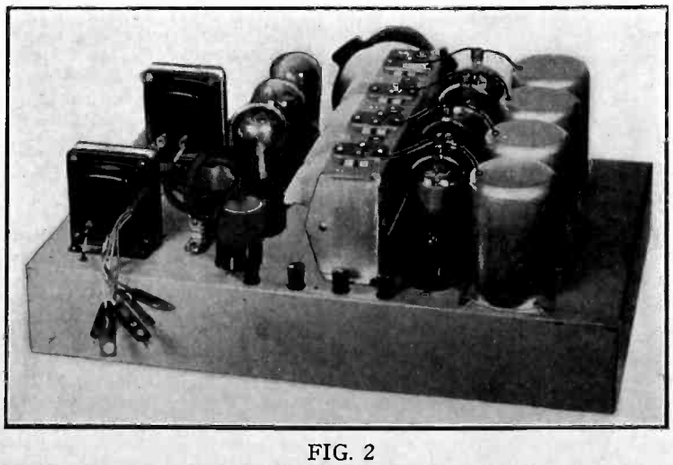


FIG. 2
REAR VIEW OF THE HB33. NOTE THE CABLE PLUG INSERTED IN SOCKET AT LEFT, ALSO THE TAGGED BATTERY ENDS OF THE CABLE.

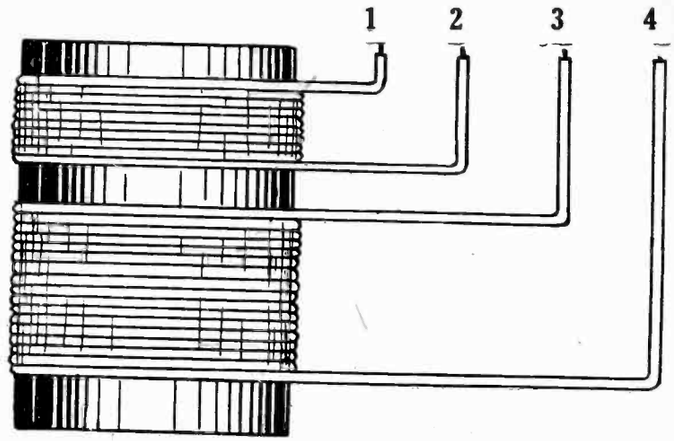


FIG. 3
HOW TO CONNECT THE COILS FOR MAINTAINING CORRECT POLARITY IN THE INTEREST OF STABILITY OF THE TUNER. THIS POLARITY IS TO BE OBSERVED FOR THE HB33 AND THE HB44, WHICH USE THE SAME COILS.

The large holes simply pass the heads of screws so that the grid connection to the stators will not be shorted to ground.

To make doubly sure of no continuity from grid to ground, remove the grid screws, also, and the lock washers used on them. Now put a flat insulating washer between the condenser and the lock washer, so that when you tighten down, the washer is in full view. These washers are a part of the condenser assembly.

Having finished this work of mounting, test for short circuits. Connect the pilot lamp furnished with the parts, and which is to be used for dial illumination, across a 1½ volt dry cell, to make sure it lights. Even if a 6 volt lamp is used, 1½ volts will give an indication. Of course higher voltage than 1½ may be used, if desired.

Now attach an insulated wire lead to one side of the pilot lamp bracket, and connect the lead to one side of the test cell, baring free end. Connect a wire lead from the other pole of the cell, with free end bared. Continuity will show up by illumination. If the two leads are connected between stator and rotor of each of the four sections at a time, no light should appear. If there is illumination, trace down and cure the short. When no light appears anywhere in the four places proceed with the rest of the assembly.

SOCKETS GO ON NEXT

Mount the four sockets in place at left. For the HB33 these are four UX or four-spring sockets. Mount with filament holes at rear. For the HB44, the AC model, place sockets with cathodes pointing toward front, all four sockets in the same relative position. This brings the plate at right, nearest in both models to the coil to which it will be connected ultimately.

In the HB33 the filaments of the three other sockets are placed toward the front panel. Notice this differs from the position of the sockets used in the tuner.

In the HB33 the eighth socket hole houses an AC socket of the UY or five-spring type, because a cable is plugged in, for battery connections. There are only five leads to the cable, taking care of (1) common A minus, B minus and C plus; (2), A plus; (3), B plus 22 to 45; (4), C minus 4½ and (5), C minus 9. The other lead, B plus 135 volts, is taken through a separate insulated wire lead from the midtap of the output transformer primary. Tie a knot above the subpanel so that any strain placed on this lead will be taken up by the knot instead of by the connection at the transformer post.

The two audio resistor mountings may be placed between the two audi transformers or in line next to the sockets, as shown in Fig. 1, above. The placement makes no difference. In the HB44 the resistors have to be mounted as shown in the photographs, because the other room is taken up by power apparatus.

The holes are provided for the audio transformers to be mounted on top in the HB33. In the HB44 the center-tapped output im-

ilders of HB 33 and HB 44

Tuner, With High Gain on All Waves

Bernard

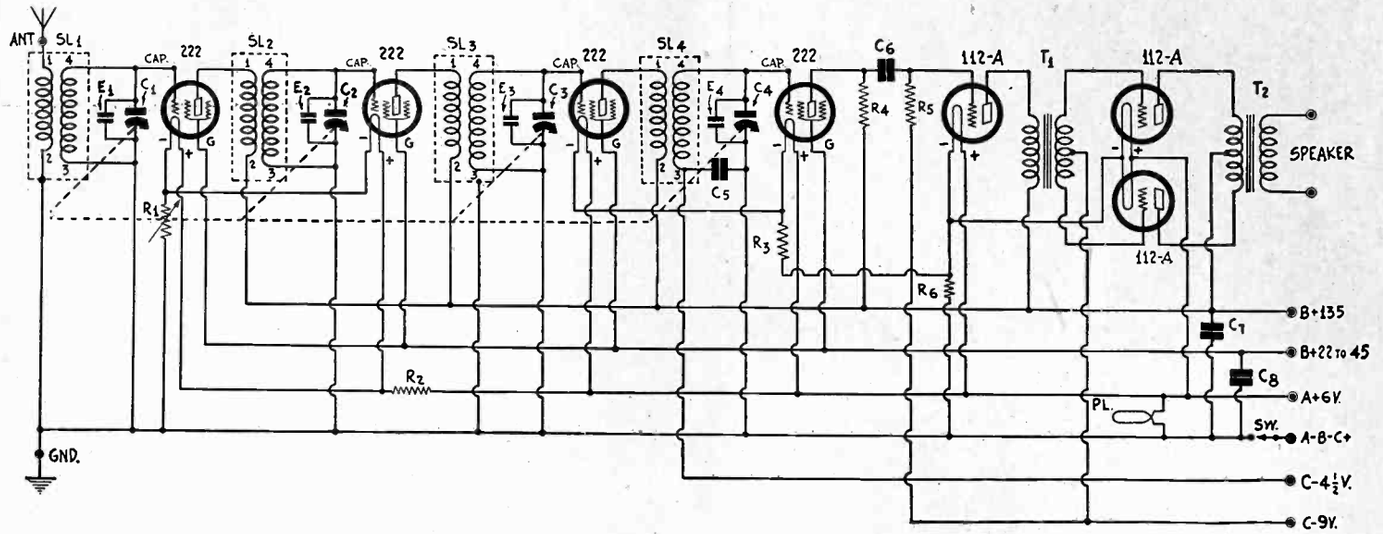


FIG. 4
CIRCUIT DIAGRAM OF THE HB33, A HIGHLY SENSITIVE SCREEN GRID RECEIVER, ECONOMICAL IN A BATTERY POWER CONSUMPTION, AND WORKABLE ON B BATTERIES OR B ELIMINATOR. THE DETECTOR BIAS SHOULD BE SUBJECTED ON EXPERIMENT, AND A SMALL CONDENSER TRIED FROM DETECTOR PLATE TO GROUND, AS EXPLAINED IN THE TEXT.

pedance is mounted on top, but the filter choke is mounted on bottom, as will be related more fully.

Now mount the coils. These have small toed-in brackets, and holes in the subpanel coincide with the holes in the brackets. Use 6/32 machine screws and nuts. In mounting the coils notice that the primary is on top and the secondary on bottom, and that the primary lugs come out on one side and the secondary lugs on the other. The same relative polarities of the connections is preserved as stated in a previous article, but the position of the primary on top may confuse some, so Fig. 3 is printed herewith to clarify this point.

Mount the coils so that the secondary connection lugs are toward the tuning condenser, hence the primary lugs are toward the left. You will find the outer (lower) terminal of the secondary at right, toward the front, the grid return at right toward the rear of the subpanel, the aerial or plate connection of the primary at left front and the ground or B plus connection at left rear. The distinction is made between aerial and plate, ground and B plus because the aerial coil has its primary going to antenna and ground, while the three other coils have primary going to plate and B plus.

The shields should not be put on until all the wiring has been completed. The reason is that you will handle the subpanel assembly considerably, and under certain circumstances may be tempted to use the shields for support. The coils are not high enough to be endangered by this.

Immediately the coils are in place the leads from them to the sockets may be wired. Be sure that the antenna binding post is insulated from the subpanel. A flat type insulator should be placed between the binding post head and the subpanel, another flat type underneath, and then a collar type insulator underneath, if the type of binding post is used that is intended for mounting on bakelite. The other type, for metal subpanels, needs either a small metal washer or a couple or flat type insulators between the head and the subpanel, to take up a little free room, so that the nut underneath will bite the collar at bottom.

LIST OF PARTS

SL1, SL2, SL3, SL4—Four stage individually shielded coil cascade for .00035 mfd. (Cat. SH-3 of Screen Grid Coil Co.).
C1, C2, C3, C4—Four gang .00035 mfd. condenser with equalizers E1, E2, E3, E4.
C5, C6—Two .01 mfd. mica fixed condenser.
C7, C8—Two 1.0 mfd. bypass condensers 200 volt DC working voltage.
R1, Sw—30-ohm rheostat with switch, knob, insulators.
R2, R3—Two 6.5-ohm fixed filament resistors.
R4—One .05 meg. Lynch metallized resistor.
R5—One 5.0 meg. Lynch metallized resistor.
R6—One 1-ohm fixed filament resistor.
T1—One push-pull input transformer.
T2—One push-pull output transformer.
PL—Pilot lamp and bracket.
Ant., Gnd. Speaker—Four binding posts.
One drilled steel cabinet, brown crinkle finish.
One vernier full-vision dial.
One flanged subpanel with seven UX sockets and one UY socket.
Four grid clips.
One 5-lead connector cable.

SUBPANEL GROUNDED A MINUS

In wiring from plates of three tubes to coils and plate of the detector tube to the plate resistor, be sure to make the proper connections. The subpanel will be worked from the bottom, and the socket springs are not marked. When you view the socket from top for the battery model, for instance, the filament holes will be at rear in the RF channel, hence the plate will be at left. If you turn the subpanel upside down in such manner as to cause the front to be at the rear, the same right-and-left relationship holds. Otherwise you would reverse the relativte positions and might get mixed up. Also remember that the G post goes to the B plus 22 to 45 volts, and is the screen grid, not the familiar control grid as in other tubes. The control grid in this instance is the cap of the tube.

In mounting the ground post, connect it to contact with subpanel without insulation, as the subpanel is then used as grounded A minus and may be picked up at any point for that purpose. Run the A— cable plug lead to ground post for this purpose. Then filament resistors too may go directly to subpanel.

The diagram of the HB33 should be followed as shown with two possible exceptions. One is that a fixed condenser from plate of the detector tube to ground sometimes improves detecting action, which is true if not enough inherent capacity exists from plate to filament in the tube, but if there is enough then the extra condenser is not to be used. In any instance the condenser should not be of more than .001 mfd., and it is preferable to use about .0005 mfd. Any fixed mica condenser from .0001 to .0005 mfd. will serve the purpose.

The second point is that the bias on the detector tube, marked minus 4 1/2 volts, may have to be changed somewhat, particularly in an upward direction. When grid bias detection is used, especially in a battery model receiver, sometimes the constructor wires everything "exactly according to the diagram" and yet receives no signals.

REASON FOR NO SIGNALS

The reason is, most likely, that the proposed detector tube is getting a bias that provides amplification instead of detection. This bias may be critical with some 222 tubes, and if so, put a potentiometer of 25,000 ohms or more resistance across 12 volts of C bias, or across a greater voltage, and connect grid return to the arm. Then move the arm until best detection is produced. Measure the voltage between the arm and negative filament. Then provide the necessary bias as follows: allow 2.7 volts dropped in the filament resistors R6 and R3, subtracting this from the reading obtained, and provide the difference through the external bias battery.

In wiring the cable, regard the five-prong socket with heater (large holes) toward you. This brings the grid at center rear, with cathode at left and plate at right. These words are used merely

Sensitivity Increased With H

Independent Bias Resistor Used for

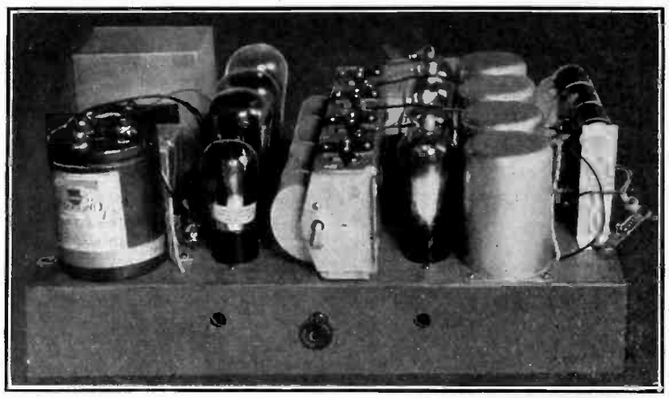


FIG. 5
HERE IS WHAT IS ALMOST AN ACCURATE FRONT VIEW OF THE HB44. SEE IF YOU CAN DISCOVER WHAT'S WRONG. COMPARE WITH ILLUSTRATIONS ON NEXT PAGE.

(*Continued from preceding page*)

descriptively, as no cathode, grid or plate is concerned. The equivalent leads to the heater springs are A plus and A minus, and so marked, so use the left-hand heater spring as A minus, by connection to ground binding post, the right-hand as A plus. Then your cable is automaticaly marked correctly as to these. The other marks on the cable, at the battery connection end, are P, C and G. Use P for B plus 22 to 45, C as C minus 4½ volts and G as C minus 9½ volts. You may mark these terminals on the cable accordingly.

PLACEMENT OF SHIELDS

After all wiring, put on the shields. It is necessary to drill a 6/32 hole on top of the shield to pass a lead to the cap of the tube and the stator connection of the tuning condenser. First solder this lead, which should be 8" long. It goes to the coil lug at right front, when you look at the top of the subpanel with dial toward you. All holes may be in the shields at center at the edge, where the shield curves at top, drilled midway between base dimension, except the shield for the detector, which should have its hole ½" off center, as it were, in the direction of the rear of the subpanel.

To attach the coils, take each one separately, hold it horizontally, at or near the bottom of the subpanel, and pass through it the lead that is to go to cap. Solder a grid clip where the lead passes the cap of the tube and solder the other end to the stator connection of the nearest section of the tuning condenser. It will be found the 8" lead is a little too long, but snip it down to size. Now mount the rheostat switch, insulating it with special insulators furnished with the parts, although insulation is only to avoid resort to a possibly poor automatic connection to A minus.

The circuit may be worked out of the cabinet for testing. Adjust the trimming condensers carefully, as previously described. (December 14th issue.)

You will find two extra holes on the front flap of the subpanel. These are at left and right. If desired you may put a trimming condenser of the variable type across the first and second tuned circuits and these holes make this possible. A little better sensitivity always results when this is done, although the convenience of strictly single tuning control without manipulated trimmers is preferred by most persons. The front panel trimming condensers need be of only small capacity, anything from 20 to 50 mfd.

RHEOSTAT HOLE

In putting the receiver in the cabinet it is well to provide for mounting brackets. Small brackets should be used, and so placed, two at each side, left and right, that the bracket is flush with the subpanel and cabinet bottom. Then the dial holes in the cabinet will coincide with the position of the parts.

However, it may be found in some instances that the hole for the rheostat does not coincide. Simply put the subpanel assembly in place in the cabinet and drill the subpanel flange through the hole that is in the cabinet. Use a ¼" drill and widen the hole with a taper reamer.

To mount the subpanel inside the cabinet it is necessary to remove the shaft of the four gang condenser. The movable plates of the condenser are thus removed. This is easily done. Simply loosen the eight set-screws on the condenser rotors and pull out the shaft. Then put the assembly in the cabinet, put the washer in place, slide the rod through the cabinet hole, condenser front, and washer. First put the rotor with plates totally unmeshed, in any position, except that the cutout plates are toward the condenser frame, and slide the shaft through this section. Repeat this process, except for washer, in the three other instances, and tighten down. It will be found that the rotors can be moved freely when the plates are totally out of mesh. Be sure that a rotor plate overlaps toward the front. Tighten down the setscrew at rear of condenser frame and the eight set-screws of the rotors. Then readjust the trimmers.

The pilot light bracket has two insulated wire leads. Knot these at the bracket to fasten to a screw that protrudes from the dial. The light will shine through two holes in the front of the cabinet called for convenience the front panel, although the cabinet front is a part of the cabinet itself.

Some may desire to wind their own coils for this circuit. Therefore they will desire to know the diameters and number of turns. Here are these data:

Diameter, 1¾ inches bakelite, outside diameter; height, 3".
Primary, 43 turns.
Secondary, 93 turns.
Size of wire, No. 29 enamelled.

These data do not coincide exactly with those for the commercial coils, the slight difference being accounted for by a difference in wire size, and not by a difference in performance.

These coils are for .00035 mfd. For .0005 mfd. use 80 turn secondaries.

SINCE the publication of the circuit diagram of the HB44, the super-sensitive AC receiver using three stages of tuned screen grid radio frequency amplification, screen grid detector, resistance coupled first audio and transformer coupled audio for push-pull output, reports have been received from builders of the circuit.

One man said that he had tuned in WHN from upper Manhattan, and that he was proud of the feat. It must be admitted that WHN, too, is in New York City, only about eight miles from where he lives. The point is that the immediate locality about his home is regarded as a dead spot so far as WHN is concerned, and that no one ever before had reported the reception of this station in the two square blocks which encompass the builder's home. So he was proud of the performance of the HB44 and immediately started building another as a Christmas present to his sister.

GOT PLENTY OF DISTANCE

He also submitted a list of distant stations so long as to be tiresome even to the designer of the circuit, particularly as these stations had been tuned in by the designer from his home in another part of the city as far back as last September.

Considerable experimental work was done on the HB44, hence it is an outperformer. Even now it is suggested that some slight changes be made from the design originally published, these changes being embodied in the schematic diagram published herewith. They reduce even the small hum originally present and increase the sensitivity, a strange but welcome combination. Usually when sensitivity rises, the hum increases.

The filter has been changed to incorporate the double choke that was originally used as the output device, as this is a husky unit and well suited to the purpose. The output device now becomes a smaller centertapped choke. The detector bias is obtained through an independent resistor, instead of from the voltage divider, as this reduced even the small hum originally present and heightened sensitivity. The grid return of the radio frequency tubes is somewhat critical, and to take care of this a Clarostat Humdinger, of 30 ohms, is used in series with the low end of the voltage divider. Then one end of the Clarostat resistor goes to grounded B minus and the other end to the first lug of the voltage divider. The lugs on the voltage divider may be considered to be in the order of their profusion, so you begin counting from that section where the lugs are numerous, and find that there are fifteen, of which fourteen are useful, two being interconnected, because the voltage divider consists of two series resistors.

BIAS FROM 2.7 VOLTS DOWN

The cathode connection of the radio frequency tubes goes to the midtap of the Humdinger, and this midtap is adjustable by a screwdriver, so adjust it for greatest sensitivity and leave it that way.

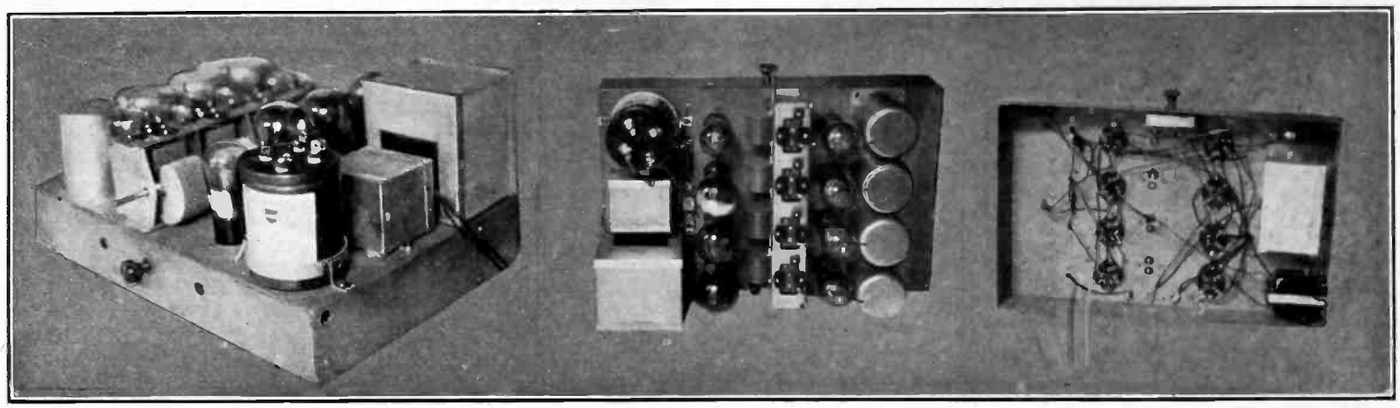
As about 90 milliamperes flow through this resistor you may obtain a total drop of 2.7 volts, but will find greatest sensitivity below 2 volts. There is no occasion for determining the bias voltage, as the sensitivity test, determined by listening for loudest response, is entirely sufficient.

When the circuit is built as shown it is truly remarkable. It is good indeed when built either way, as the changes are not revolutionary in any sense. Some may ask if the circuit is in its final form now, and the answer must be, let's hope not. The same layout and parts will be used, but if any improvements ever can be discovered, facts about them certainly will be published. When the day comes to say a circuit is final then the last incentive to improvement has disappeared, or the declarant is a hopeless egotist.

In connection with the change in the filter section, the capacities used necessarily had to be apportioned to other positions. So now we find that simply a 1 mfd. high voltage condenser, 1,000 volts DC continuous duty rating, 550 volts AC rating, is next to the rectifier.

um Reduction in the HB 44

Detector Stage, With Adjustable RF Bias



FIGS. 6, 7 AND 8

AN EXPERIMENTAL SET-UP OF THE HB44, AT LEFT, FIG. 6, IS AN ANGULAR VIEW. THE TUNING GANG CONDENSER IS MOUNTED DIRECTLY ON THE SUBPANEL. FIG. 7, CENTER, IS A TOP VIEW, AND FIG. 8 A BOTTOM VIEW. NOTE WHERE THE PUSH-PULL INPUT TRANSFORMER IS MOUNTED.

Then at the midsection of the double choke comes an 18 mfd. section of the Mershon electrolytic condenser, while at the end of the choke chain comes the other 18 mfd. section, leaving two 8 mfd. sections, one to bypass the approximately 180-volt lead, the other to bypass the biasing section for the push-pull 245 power tubes. The other bypass condensers are 1 mfd. each, low voltage rating (200 volts DC continuous duty). The only difference between a filter condenser and a bypass condenser is that the word filter is used generally where the voltage rating is high and by-pass when it is low.

EXTRAORDINARY RESULTS

Fig. 9 shows the circuit of the HB44, while Fig. 10 clarifies the connections to the voltage divider. This is a Multi-Tap Divider, and it will stand the strain without getting more than merely warm. It is a specialy designed instrument for high current circuits. The present circuit uses high current, but as AC operation renders that very economical, there is no disadvantage. Even if the operating cost were high, which it is not, any possessor of this circuit would feel he was spending his money in a good cause, as the results are extraordinary.

One thing is absolutely essential if you are to have any success at all with this circuit. You must know how to use the Mershon condenser. It is rated at more than 400 volts DC continuous duty, and will stand it, so there is no danger in this circuit whatsoever. But if you are unaware that the copper can is negative, and make a wrong connection, you will run into trouble. The bracket is connected to the subpanel, and the subpanel itself is used as grounded B negative, and all grid returns made thereto, so the can must be negative. Unless you go to extraordinary pains to insulate the copper case, and perhaps use it as some positive connection, as one man tried to do, you will come out all right. Also note that there are different capacities, two eights and two eighteens. The smaller capacities are nearer the edge of the copper case. There is a difference and you can measure it with a ruler, if your eye deceives you.

The directions for mounting parts for the tuner have been stated in reference to the HB33, which is the battery-operated counterpart of the HB44, and these directions should be followed. At the left-hand side, between the shields and the edge of the subpanel, the voltage divider is to be placed. You will have to drill two holes 7⅛" apart to secure the brackets of the voltage divider to the subpanel, and a few more holes to pass leads through. These brackets are insulated from all potentials on the divider, and do not constitute an automatic connection of the end of the voltage divider to negative. Anyway, between the lowest lug of the Multi-Tap and the grounded subpanel the Humdinger is placed, and the connection to negative of the B supply is made in that way.

POWER APPARATUS

As for mounting the power apparatus, the Polo filament-plate supply is placed at right rear, and holes therefor being in the subpanel. It is well to use a couple of insulating washers or other devices, simply to keep the Polo block elevated so that air will circulate underneath, but the case of the block ought to be grounded, and this may be done by soldering to a lug on one of the screws protruding under the subpanel after the block has been mounted, and connecting to ground.

Next to the filament-plate supply comes the output impedance, as you work toward the front of the subpanel. At front is the Mershon. The audio resistor mountings are lined up between this power apparatus and the sockets at right, the space between the mountings being just enough to enable connection of the specified .01 mfd. condenser. Be very careful to put three flat insulating washers between the mounting's hole and the subpanel, otherwise there might be a short, due ot the lug hardware of the mounting being flush with the bottom of the mounting itself. This admonition applies to the HB33 as well as to the HB44.

Underneath, at the "power" end, are placed the audio push-pull input transformer and the double choke used in the filtration. There is a knack to mounting these parts.

ORDER OF MOUNTING

The order of procedure is as follows: First mount the double filter choke, which is the large double choke, underneath. This is oblong. Put it in position so that its length runs in a front-and-back direction. The subpanel holes will guide you. A strip of metal that is spot-welded to the case of this large double choke extends far enough to enable the holes in the strip to be used for mounting purposes, but before tightening down on the screws it is necessary to insert cardboard strips to take up any play. Then tighten as hard as you desire. The strips go on both sides of the mounting flap. Rigidity must be preserved, because otherwise any possibility of vibration might evidence itself in hum.

The head of one of the screws will be under where the Mershon will rest, but the plane is made uniform by putting other screws in similar position, to afford an even resting place for the Mershon, even though these screws will serve no other purpose.

However, it is not the Mershon that is mounted now, but the audio transformer. This goes on the side flange, and holes are provided in the subpanel. Only three of the holes are used, as the fourth is almost inaccessible, except to a very deft person, or one who has a lifetime to devote to such things. There is no need to make the fourth connection. It is advisable to have the secondary toward the flange, therefore connect insulated wire to the secondary so that the connections can be made easily, without resort to establishing contact to the binding posts after the audio transformer is mounted. Now you may put the output choke in place, flap left to right.

In any of the wiring, since the subpanel is grounded B negative, or C minus, depending on the viewpoint, you may want to make connections to screws already driven through subpanel holes. However, do not solder to screws. It is bad practice and a lazy method. Use a lug, tighten it fast, and solder to the lug. Then if ever you desire to remove the mounted part you may do so easily.

There is a large round hole near the power transformer where all necessary leads may be dropped underneath the subpanel, since virtually all the wiring is done underneath. The filament leads and high voltage leads and some others go through this ½" hole. For some other leads it is necessary to drill a few 6/32 machine screw holes in the subpanel. Do not tap these holes.

A precaution that every one should take is to use wire that is well insulated. Steel when drilled or punched leaves a hard edge, as do nearly all metals used for subpanels, therefore the edge may cut into the insulation and cause a short. But if the insulation is strong this won't happen. The insulation on the leads coming out of the Polo filament-plate supply and double choke are strong enough for this safeguard, and see that any wire that you provide is at least as well insulated.

Mount the Mershon only after all the rest of the circuit is wired. Make the connections to the lugs on the Mershon.

GETS DX IN DAYTIME

The circuit, built exactly as diagrammed, has been working for several days in the laboratory, and has managed to do exceptional

Gets DX in Daytime

High Sensitivity Established in Stable Circuit

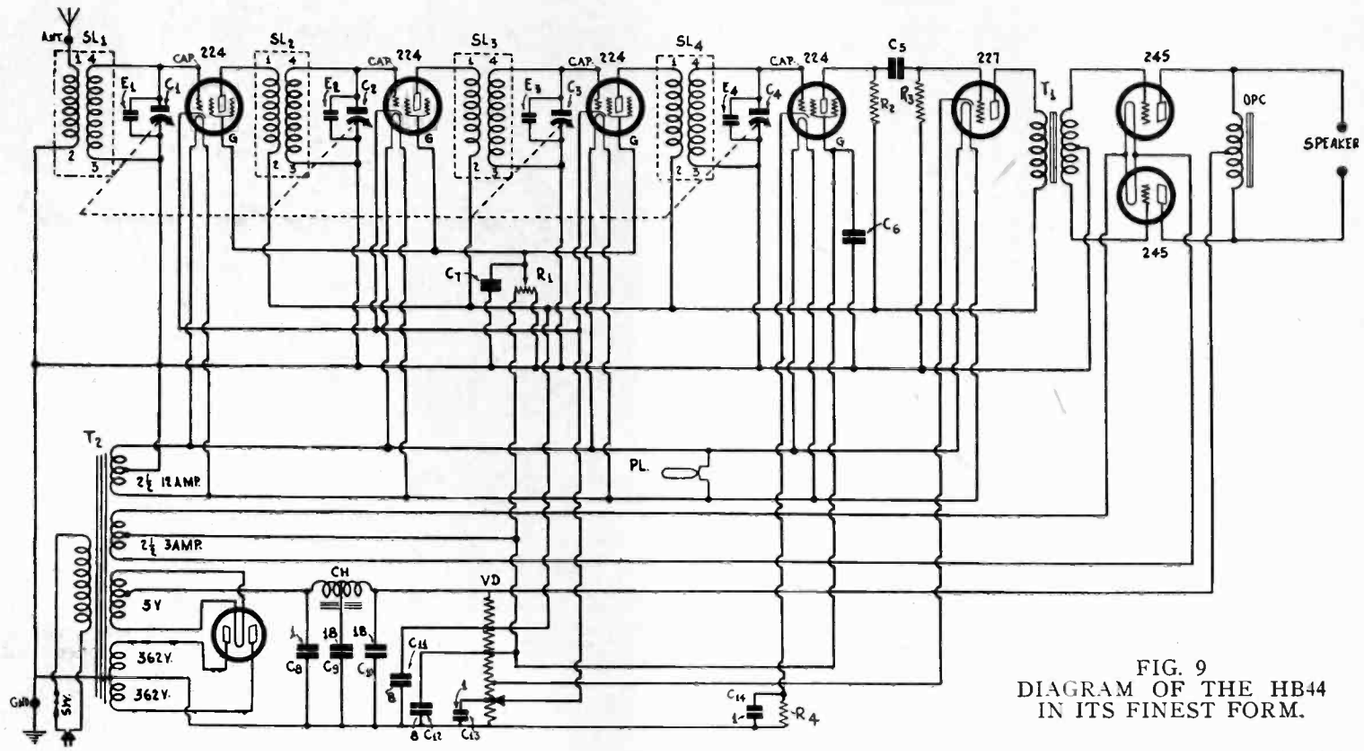


FIG. 9
DIAGRAM OF THE HB44 IN ITS FINEST FORM.

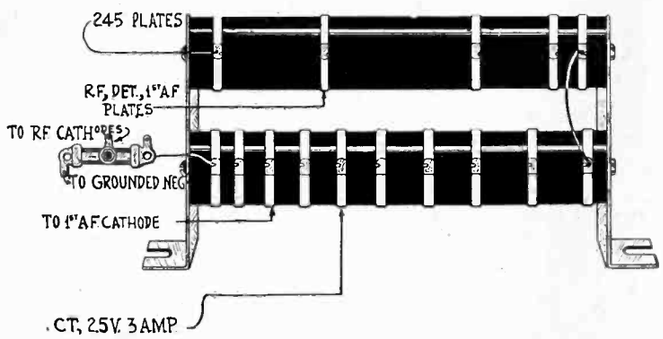


FIG. 10
HOW CONNECTIONS ARE MADE TO THE MULTI-TAP VOLTAGE DIVIDER.

work. Even in daytime it picks up distance, while at night steady speaker volume is obtained from stations throughout the United States and Canada. The entire wavelength spectrum may be tuned in, besides, but if by any chance the circuit tunes to higher wavelengths than are in the broadcast band, it may not tune low enough, so take off enough turns of wire, the same off of each secondary, to bring in the lowest wavelength. Then the highest will come in. The reason is that the relative position of the condenser in respect to the subpanel affects the actual capacity of the condenser. The subpanel may be regarded as part of the frame of the condenser, and the rotor plates function at this potential. The elevation of the condenser by means of elevating washers, to a height above the subpanel not exceeding ¼", should get rid of any odd tuning charactristics that would be present otherwise. Hence the coil data are given for a little more inductance than would be necessary in most instances, a better plan by far, since if the number of turns were too few it would not be easy to add more, whereas it is always easy to take off some turns, particularly as the wire adheres to the form and does not spring off.

The connection to the primary of the filament-plate supply is made by means of a through pendant switch. The leads from the power transformer primary are brought through to the rear of the cabinet, outside, and the switch is then attached, one lead being continuous, the other interrupted by the switch. Then an AC cable is connected to the equivalent binding posts at the end of the switch, and at the end of the cable a male plug is attached.

All the voltages desired should be obtained if the diagram is followed and the input is something around 110 volts. There will be discrepancies, of course, but nearly all of these are immaterial. If 150 volts show up on the plates, since that voltage is all-sufficient, accept it. The power tube bias voltage will run around 50 volts, and the same voltage is used for the screen grids, reduced effectively through positioning of the potentiometer knob.

In some instances instead of running the potentiometer to the same lug or lead that carries to the midtap of the power tubes filament winding, the lead for the potentiometer may go to the next highest lug on the voltage divider, with an extra 1 mfd. from this point to ground.

The circuit is sensitive, indeed, as has been stated, and is rated at 9 microvolts per meter, on an actual test, with laboratory instruments. This is not as great a sensitivity as develops in some other special receivers, but that does not deny the fact that 9 microvolts per meter is a greater sensitivity than is possessed by ninety-nine and nine-tenths percent. of all the receivers on earth. In fact, not one in 5,000 receivers in use is as sensitive as this.

The circuit takes four and a half hours to build, going at a steady, uninterrupted gait. If you work slowly it will take five to six hours, but, as has been suggested, it is worth every cent and every moment you put into it.

LIST OF PARTS

SL1, SL2, SL3, SL4—Four stage individually shielded coil cascade for .00035 mfd. (Four Cat. SH-3 of Screen Grid Coil Co.).
C1, C2, C3, C4—One four gang .00035 mfd. condenser with equalizers E1, E2, E3, E4 built in.
C5—One .01 mfd. mica condenser.
C6, C7, C13, C14—Four 1 mfd. 200 volt DC bypass condensers.
C8—One 1 mfd., 550 v. AC filter condenser.
C9, C10, C11, C12—One Mershon consisting of four condensers, two of 8 mfd. and two of 18 mfd. with bracket (Cat. Q 2-8, 2-18 B).
R1—One Electrad 25,000 ohm potentiometer with knob and two insulators.
R2—One 50,000 ohm Lynch metallized resistor (.05 meg.), with mounting.
R3—One Lynch 5.0 meg. metallized grid leak, with mounting.
R4—One 5,000 ohm resistor with mounting.
VD—One Multi-Tap Voltage Divider, 13,850 ohms, 14 taps.
T1—One push-pull input transformer.
OPC—One center-tapped output choke.
T2—One Polo filament-plate supply, Cat. PFPS (Note: For 40 cycles use PFPS-40, for 25 cycles use PFPS-25).
Ch—One double filter choke coil, 30 henrys each section, 100 ma.
SW—One pendant AC switch with 12 ft. cable.
PL—One 2.5 volt pilot lamp and bracket.
Speaker (+), (—), Ant., Gnd.—Four binding posts with insulators.
One Clarostat Humdinger, 30 ohms.
One subpanel 17½"x11½", with five UY and three UX sockets.
One vernier dial.
One brown crinkle finish drilled steel cabinet.
Four National grid clips.

Intermediate Tuning

Super-Heterodyne Coils Need Trimmers

By Knollys Satterwhite

[*Here is another installment of the serial article entitled "The Superheterodyne." Next week, issue of December 28th, additional information will be given on the Superheterodyne.—Editor.*]

IT is not necessary that the intermediate frequency transformers in the Superheterodyne have the same number of turns and the same size tuning condenser just so the transformers are resonant at the same frequency. This suggests the desirability of having a means of adjusting the transformers to the same frequency before they are put into the receiver. Accurate adjustment is not possible because as soon as the transformers are put into the circuit they will be different because the capacities have changed. But it is possible to adjust them so closely that the differences occurring later can be taken up by means of the trimming condenser which should be across each tuning condenser.

The best way of adjusting the intermediate frequency transformers externally is to compare them against a standard oscillator. For this standard one of the intermediate frequency transformers and a tube can be used. The other transformers, one at a time, are then connected into a similar oscillating circuit and adjusted until the beat between the oscillators is zero, or at least very low.

CONNECTION OF OSCILLATOR

Suppose the intermediate frequency transformers have been wound with the intention of tuning the secondary. Then the tuned circuit is connected in the grid circuit of a tube and the primary is connected to the plate circuit. Only one connection will produce oscillation, that is, only one connection of the primary leads after the secondary terminals have been connected arbitrarily. When oscillation has been produced mark the terminals so that they can be connected in the amplifier in the same manner. That is to say, the lead connected to the grid of the oscillator tube should later be connected to the grid of the tube following the transformer and the lead to the plate of the oscillator should be connected to the plate of the tube preceding the transformer in the amplifier.

When two oscillators, the standard and one other, have been connected up and when they are operated by the same plate battery, a beat note will be heard in a headset connected in series with the battery and the two plate circuits. If the two frequencies happen to be nearly the same at the beginning the beat note may not be heard because the two oscillate at the same frequency. A .5 mfd. condenser connected across the headset will loosen the coupling between the oscillator so that they will operate at different frequencies down to as low as 30 cycles. If the adjustment is within 500 cycles it is good enough.

ADJUST THE TURNS

Suppose a high frequency note is heard indicating that an adjustment of the turns is necessary. Which way should the turns be changed? That is, should they be increased or decreased? It is not convenient to add turns because that would require soldering a wire to one of the leads of the tuned winding and putting more wire on. It is more convenient to remove turns. In order to know what to do it is necessary to determine which transformer has the greater frequency. Suppose the finger is pointed to one of the grids of the oscillators without actually touching it. The beat frequency will change as the finger approaches because the capacity is being increased. Note the direction of the change in the beat frequency whether it is up or down as the finger approaches. Now point the finger to the grid of the other oscillator. The change in the frequency should now be in the opposite direction. By this means it is possible to determine which of the two circuits has the greater frequency of oscillation, remembering that the frequency of the oscillator toward the grid of which the finger is pointed decreases as the finger approaches.

Retain the transformer having the higher frequency. For the other substitute one of the transformers to be tested and repeat the experiment. Again retain the one having the higher frequency. In this manner it is possible to pick out the transformer which oscillates at the highest frequency in the whole set. Use this transformer as the standard.

REMOVING TURNS

When the transformer having the highest frequency is used as the standard, all the other transformers can be adjusted to that frequency by removing turns. In adjusting a given transformer do not remove more than one turn at a time, and do not cut the removed wire immediately but only remove it from the form. It may be necessary at any stage to put it back on again. When the adjustment begins the beat frequency may be above audibility. To test this point the finger toward the grid of the standard oscillator. If the beat is above audibility the finger should bring the note within the audible range.

This determined, remove a turn from the tuned circuit of the coil not in the standard oscillator. Note the beat note. Remove another turn and again note the change. A time will come when the beat note is low enough to fall within the limit of toleration, 500 cycles say. This may be either above or below the frequency of the standard oscillator.

When one of the transformers has been adjusted in this manner remove it from the circuit, not forgetting to mark the terminals as previously suggested. Put in one of the others. When all have been adjusted and marked all of the transformers, including the one used as standard, are ready to be put into the amplifier. Of course any excess wire may be cut off permanently as soon as a turn has been removed and it has been found that it is not necessary to put it back on again.

RAPID VARIATION OF FREQUENCY

It may be found that single turn will cause a great change in the frequency of oscillation. This will be the case when there is a relatively small number of turns and a relatively large capacity in the tuned circuit. In that event it is necessary to use a larger trimming condenser than when the number of turns on each transformer is large and the capacity in each tuned circuit is small. The trimmer condenser always should bear a certain relationship to the total capacity in the circuit, say 10 per cent.

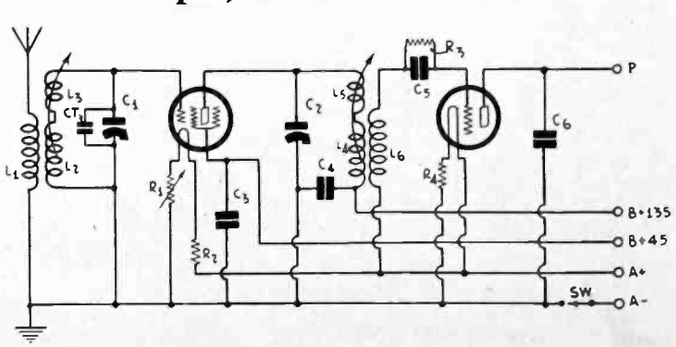
The adjustment of the intermediate filters after the coils have been put into the amplifier should be done after the shielding has been put in place. In order to reach the trimmer condenser from the outside of the shield the condenser may be mounted on the shielding and the knob made to extend outside. If the trimmer is of the type which is adjusted by means of a screwdriver it should be mounted inside the shield in such manner that it can be reached through a hole in the shielding by means of a wooden or other insulating screwdriver. Certain types of trimmers, notably those used for trimming radio frequency tuners, are so constructed that they could safely be mounted outside the shielding. If the adjusting screw is grounded any screwdriver can then be used for making the adjustment.

ADJUST FOR LOUDEST VOLUME

The simplest way to adjust finally is to tune in the Superheterodyne on a station and adjust for loudest volume, just as is done in radio frequency circuits. If the trimmer used is of the type which is adjusted by means of a knob, the adjustment is very easily done, but it will not necessarily remain in adjustment unless the knob is locked after its proper position has been found. In connecting the trimmer condensers across the tuned circuits, the rotor should be connected to the grounded or low RF potential side of the circuit. This should be observed for the type which adjusts with a screwdriver as well as for the knob type of condenser.

When the intermediate frequency transformer is of the tuned primary type the preliminary adjustment is done in the same way as when the tuned secondary type is used, but the tuned winding should be put in the plate circuit of the oscillator and the untuned winding in the grid circuit of the same tube. In removing wire from the tuned circuit in this case care should be exercised against possible short circuit. The loose wire is at high DC potential and if it touches the ground side where the insulation is weak or removed the battery will be short-circuited.

Simple, Practical Tuner



HERE IS A TUNER FOR BATTERY OPERATION, TO FEED A POWER AMPLIFIER. THE BERNARD TUNER ASSEMBLIES ARE USED. SEE ARTICLE IN NEXT WEEK'S ISSUE, DECEMBER 28TH.

Pointers on Wiring th

Compensation Provided for the Antenna Len

THE length of the antenna used with the Hammarlund HiQ-30 receiver affects the tuning characteristics to some extent, as it does in practically all other receivers. For this reason two binding posts are provided at the input, one connecting with a tap on the primary inductance and the other connecting with the end of the coil. When a short antenna is used the entire coil should be employed and when a long outdoor antenna is used it should be connected to that binding post which goes to the tap on the primary. If the entire coil is used when the antenna is long the signals are likely to be too great.

Of course, when the object is to receive stations remote from the receiver, the entire primary winding may be used even when the antenna is long.

There is also a certain dependence between the antenna and the length of the waves being received, no matter what the length of the antenna may be. Stations on the lower half of the broadcast band can be received with greater volume when the entire primary inductance is used, and those on the higher half may be received with greater intensity when only a part of the coil is used.

Because of these inevitable differences the operator of a HiQ-30 should try both binding posts to determine which gives the more satisfactory operation on the antenna at hand for stations of different frequencies and at different distances from the receiver. For routine reception, that is, for the reception of the most popular stations, which are likely to be local stations, it is usually best to connect the antenna to that post which gives the lower signal strength, because this will give volume aplenty under the stated conditions.

GRID BIAS PROVISION

In an AC operated receiver it is important to take every precaution against the entrance of hum into the signal. One of the means for minimizing hum, which is used in the HiQ-30, is the use of individual grid bias resistors for every tube, or stage, not only in the audio amplifier but also in the radio frequency amplifier. While it is not readily apparent by glancing at the circuit diagram that a separate resistor is used for the last stage in the HiQ-30, since the bias resistor appears to be a portion of the voltage divider, a close inspection will show that the plate current of the last stage alone flows through that portion of the voltage divided which is placed below the grounded point, and that is the sole criterion for the individuality of the resistor.

In the 227 tube stage preceding the push-pull there is also an individual resistor to provide the bias, but this is located in the usual position so there can be no confusion.

In the same manner the bias is obtained for the radio frequency tubes, except that in the first two the normal plate current is augmented in the bias resistors by means of resistors from B plus to the cathodes. Thorough by-passing is done on these resistors to minimize feedback both of the positive and negative types. Therefore neither oscillation at radio frequency nor decrease in the sensitivity will result.

GROUNDING THE HEATER

Another feature which reduces the hum is the grounding of the mid-point of the heater near the tubes by means of a center-tapped resistor across the heater winding. This is in addition to the center-tap on the 2.5 volt winding, which is not directly grounded.

The HiQ-30 is, of course, built on a metal subpanel, which is grounded. This permits grounding all components that should be grounded without the necessity of running long leads, and it also simplifies the job of wiring the circuit. This arrangement also helps to prevent hum since the panel is a better conductor than any wire could be.

Hum is also prevented by shielding, and this has been done with particular thoroughness in this receiver. The tuning condensers are individually shielded, as are the tuning coils in the band pass filter and the inter-tube tuners. All transformers, whether they are operating at power or audio frequencies, are shielded both magnetically and electrically. There is no chance for interaction among the parts.

AUDIO QUALITY

The audio frequency amplification is adequate to permit the use of the sensitive grid condenser grid leak method of detection without the slightest overloading in the detector. The constants of the grid leak and grid condenser have been chosen so as to effect the optimum compromise between detection efficiency and fidelity of audio output. The values of the by-pass condenser and the radio frequency choke in the plate circuit of the detector have been selected with the same object in view. Hence the audio output from the detector is undefiled with harmonics and contains all the essential frequencies in true proportion. It remains for the amplifier to increase the signal level to loudspeaker intensity without introducing either frequency or wave form distortion.

The first condition for retention of the good quality is that the applied plate voltages be adequate. The built-in power supply does deliver sufficiently high voltages without fluctuation. The second condition is that the grid bias values be chosen to meet the requirements of the tubes and the high plate voltages. These are provided for as has been described.

THE AUDIO TRANSFORMERS

It remains for the audio transformers to do their work without introducing any frequency distortion. These transformers have been designed and built especially for the HiQ-30 to the most exacting specifications. That they perform in a satisfactory manner becomes evident the instant one hears the performance of the receiver. There is a certain feeling of fulness and richness to the tone which is satisfying. This effect, of course, is a combination of the contributions of the band pass filter in the tuner, the audio frequency amplifier and the loudspeaker.

And what kind of speaker is recommended by the designers? That depends on the output transformer chosen. There is one for magnetic speakers of relatively high impedance and another for dynamic speakers of relatively low impedance. In this classification the inductor dynamic comes in the magnetic class. Naturally, since the output of the receiver is considerable, a speaker of a large cone should be used in order to radiate as much sound as possible. If an inductor or a dynamic type speaker is used its cone should be at least 10 inches in diameter.

A magnetic speaker, including the inductor type, has the advantage that no external source of direct current is required. The permanent magnet supplies the field, and this field is steady so that there can be no hum introduced into the signal by the speaker. Radio receivers emitting a hum are often wrongfully condemned when it actually is the speaker which is to blame for the trouble.

TUBES USED IN THE RECEIVER

The HiQ-30 requires three tubes of the 224 heater screen grid type. These step up the signal at radio frequency to an enormous

---

Right or

[The following questions are based on technical articles published in last week's issue. Read this week's issue carefully and know the answers to next week's questions before those questions art put.—Editor.]

(1)—A pretuner of the band pass filter type can be used in front of a radio receiver for increasing the effective selectivity to a high degree without at the same time cutting the side frequencies in the signal.

(2)—Satisfactory tuning characteristics in receivers can be obtained by combining the effects of a band pass filter and an ordinary tuner.

(3)—If a grid resistor, grid leak detector is used and it is desired to connect a phonograph pick-up to the detector grid so as to transform the tube to an amplifier it can be done simply by connecting the unit between the cathode and the grid. It is not necessary to open the radio frequency input circuit.

(4)—Putting a filter circuit in the supply line to an AC set does not take out line noises because most of the noise comes in as a radio frequency signal just as any desired signal.

(5)—Modulated sound waves of superaudible frequency can be heard without any form of detection.

(6)—An electric arc such as is used for arc lighting can be made to speak and act as a loudspeaker.

(7)—If a tuning fork of superaudible frequency were driven by a modulated electric current the modulation frequency would be heard due to the varying amplitude of the fork, but there would be no frequency distortion because the fork would vibrate at only one frequency.

(8)—Sound waves of very short length can be focused and transmitted in a narrow beam just like light.

(9)—The cause of motorboating in a radio receiver is the feedback in the radio frequency tuner.

(10)—The voltage drop in the leads to the heaters of AC tubes is entirely negligible even if fine hook-up wire is used.

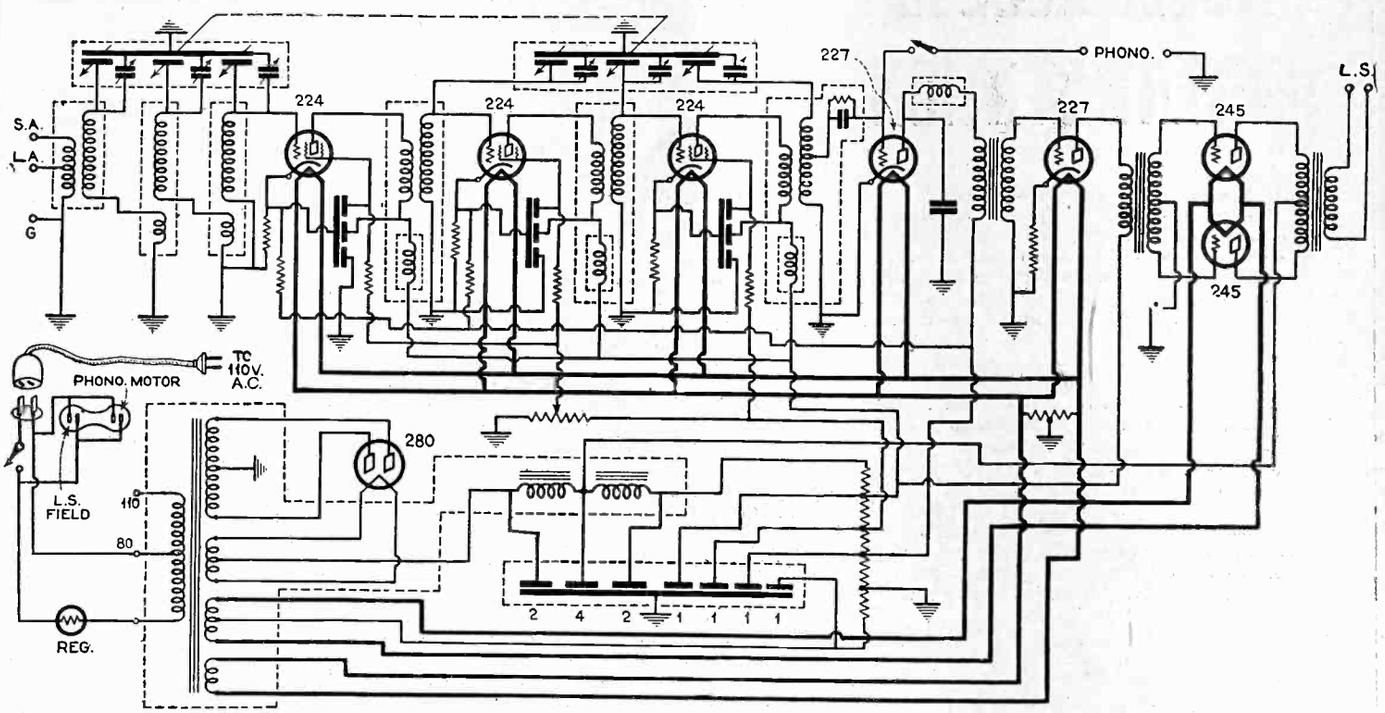
ANSWERS

(1)—Right. The characteristics of the band pass filter are such that the transmission between two predetermined frequencies is practically constant and of a high order and the transmission outside those frequencies is practically zero. If the two frequencies are chosen properly when the filter is designed the band will cover just 10 kilocycles. The filter can be used as a pre-selector as well as a tuner between tubes.

(2)—Right. A band pass filter can be made such that the transmission at the carrier frequency is slightly less than that at frequencies close to it. The ordinary tuner can be made such

e AC Model Hi-Q 30

th, Grid Bias Provisions Carefully Selected



Vrong?

that its peak coincides with the hollow in the band pass filter curve. The combined effect is a band pass curve with a flat top, provided that the constants of the two components are chosen correctly.

(3)—Right. If it were not for the grid condenser this could not be done because the tuning coil would short-circuit the pick-up unit, but the grid condenser has such a high impedance to audio frequencies that practically the full voltage generated in the pick-up unit is impressed on the grid. It will cause a partial short-circuit at the highest audio notes but this is an advantage for it takes out much of the scratch and other high frequency noise.

(4)—Wrong. It takes out much of the noise provided that the elements of the filter be chosen properly, because much of the noise actually does come into the set by way of the power line. If the noise is picked up by the antenna, however, the filter does not do much good, unless it is placed near the source of the noise.

(5)—Wrong. If they are superaudible sounds how can they be heard? They cannot without detection because detection in this case signifies making them audible. However, since the ear has the properties of a rectifier, intense modulated sound waves may be heard without an external rectifier.

(6)—Right. The singing and the speaking arc is a well-known phenomenon in physics. The arc intensity fluctuates at an audible rate and the change in the heat produces corresponding fluctuations in the air. A speaker of this type is capable of exceptional fidelity. The light also varies so that the arc could be used for transmitting sound through the medium of light. A photoelectric cell exposed to the varying light would pick up the light fluctuations and transform them to electrical vibrations. Direct current must be used on the arc.

(7)—Wrong. There would be a good deal of frequency distortion because the fork is a highly resonant system which would cut off the higher side frequencies. It would act the same as a highly resonant electric circuit in this respect.

(8)—Right. They can be focused the same way as light with a concave reflector. If the sounding source were placed in the focus of a long and narrow parabolic reflector the waves would move out in a narrow beam.

(9)—Wrong. The radio frequency tuner has nothing to do with the trouble. It is the impedance in the B supply circuit which is the cause of it.

(10)—Wrong. If the leads are fine there will be a high voltage drop in them because the current is heavy, and it may be that the tubes will not get enough voltage for proper operation. Either very heavy leads should be used or else individual leads should be run from the supply transformer to each tube.

degree, signifying that the receiver is exceptionally sensitive. The detector tube is a 227 type, as is the first audio frequency amplifier. The two final tubes in the push-pull stage are 245 type. These are easily capable of putting out an undistorted power of 3 watts, which is more than sufficient for any home. What is more, the receiver has an amplification so high that this output can be obtained from distant stations even when a small indoor antenna is used.

For rectifier in the power supply one 280 full wave rectifier is used. This can supply a current up to about 110 milliamperes, which is much more than the circuit requires. The power transformer and the chokes have been proportioned so that the full rated voltage is obtained when the normal current for all the tubes and the voltage divider is drawn.

The construction of the HiQ-30 is a simple matter. The various major units are already wired so that the construction is reduced to the assembly of mechanical parts, for each of which there is a definite niche. After the mechanical assembly the wiring is even more simple.

Fine Adjustment of Grid Bias

I HAVE A voltage divider with sliders on it but want to use a portion of the resistor for grid bias. Is it possible to adjust the grid bias for screen grid tubes with sufficient accuracy in this manner?—L. W.

It depends largely on how high the resistance is per turn on the voltage divider. You cannot vary the bias by smaller voltage steps than the drop in each turn. The drop in each turn also depends, of course, on the current flowing in the resistor. If the current is high there will be a considerable drop in each turn. This is likely to be the case when the circuit is arranged so that the resistor is also used for plate voltage purposes for then the entire plate and bleeder current will flow through that portion which is used for grid bias and this is likely to be quite high. A way out of the difficulty is to connect a high resistance with sliders on it across that portion of the main resistor which is used for bias. A very small current will flow through the high resistance and voltages can therefore be adjusted more accurately. For example, suppose that the total current involved is 85 milliamperes and that the highest grid voltage is 85 volts. The total resistance for bias should then be 1,000 ohms. If a 25,000 ohm resistor is connected across this 1,000-ohm section the total effective resistance will be 4 per cent less than 1,000 ohms and the grid bias will be correspondingly lowered. But this drop exists both in the 25,000 ohm and the 1,000-ohm resistors, since they are parallel. The drop in each turn of the 25,000 ohm resistor may be only as a small fraction of a volt whereas the drop in each turn of the 1,000 ohm resistor may be several volts.

BOARD ITSELF WOULD ASSESS EVERY STATION

Washington.

Assessment of a graduated scale of fees for all licensed users of the ether, and provision for handling charges for the handling of routine applications of all kinds, is recommended to the Senate by the Federal Radio Commission as a means of defraying the costs of administering radio in the United States.

Senate Asked Advice

In a report submitted in compliance with a Senate resolution for the creation of a license fee system, the Commission recommends three alternate proposals for levying fees upon holders of licenses of every character. The cost of radio regulation for the fiscal year ending June 30th, 1929, was declared to have been $628,103.29, of which $265,018.88 was expended by the Commission and the rest by the Department of Commerce.

It is recommended that a flat fee of $100 be assessed for handling applications for station licenses and a fee of $25 for construction or licensing applications for new service.

Renewals at $10

Applications for renewal of outstanding license would be taxable at $10 and applications for modification of existing licenses would entail a fee of $15. These fees, the report states, would total about $840,445 and would just about meet the expense of administering radio regulation, allowing for a natural increase in the expense and a decrease in revenue.

WSAI on Air Again After a Suspension

Washington.

WSAI, of the Crosley Radio Corporation, Cincinnati, which had been ordered off the air on the grounds that it had violated regulations as to frequency deviation, has been reinstated and its license renewed until January 31st.

KYA, of San Francisco, Cal., which also had been ordered off the air for alleged violations, was reinstated and given a 30-day license. It will operate on its former wavelength, pending action by the Commission on formal application for renewal of license.

WORTH THINKING OVER

NOW that radio is away beyond the point where it is regarded by the easy-money boys as a racket for the sale of stock to the shining lights on the sucker lists, there is no reason why Wall Street's up and downs should affect its stability. To be sure, those concerns that have been more interested in selling handsome certificates of doubtful value—and not even so doubtful to the knowing ones—instead of radio goods of value, have felt the effect of the recent deflation. However, radio, like the automobile, goes marching on and during the coming year will probably break all its own records. It's the old story of nothing being able to knock out something that the public insists on having.

New Manual

The Radio Manual, new and completely revised edition, by George E. Sterling and Robert S. Kruse, B.S., has just been published by D. Van Nostrand Company, New York. ($6.00)

As the name of the book indicates, it is a reference volume on radio theory and practice, which is indispensable to radio operators on sea and land and is useful to all who are interested in radio as a profession or a hobby. It is a store of information from which any one can draw with profit.

Chapter I takes up the elementary principles of electricity and magnetism and is especially recommended to those who wish to become acquainted with the basic principles underlying radio theory and science.

Chapter II deals with motors and generators, which is a subject that should be of interest to commercial radio operators and to operators for talking movies. There are in all nineteen chapters covering the entire field of radio as the art stands today.

Missouri Protests Wave Used in Denver

Jefferson City, Mo.

The Attorney General of Missouri, Stratton Shartel, has sent a protest to the Federal Radio Commission against the assignment of 630 kilocycles to KFEL and KFXF, at Denver, Col., claiming that this assignment will interfere with law enforcement in the State of Missouri.

The Attorney General states that this assignment will interfere materially with the operation of WOS at Jefferson City, Mo.

"We in Missouri are very anxious about this matter," the protest says, "because our radio broadcasts educational matters almost entirely and we are now planning upon using it to assist us in the enforcement of the laws of the State by establishing a hook-up with every sheriff's office and with members of the State police, which we expect to put into effect shortly."

Titles to Be Given After the Rendition

The Sylvania Products Company, tube manufacturers of Emporium, Pa., sponsors of the "Sylvania Foresters" program, has decided that instead of naming a selection prior to its rendition, the announcer will be instructed to declare it upon its conclusion. This is the idea of B. G. Erskine, president of the company. He said:

"I am not much different from any other broadcast listener. I seldom pay any attention to introductory announcements and it makes me mad as the devil when I have enjoyed an orchestral or vocal number to discover that its name is lost forever, after it is over. And I hope this improvement will generally be adopted, for my sake and for the forty million others who listen in."

Set Passes All Tests So Burglars Steal it

Evanston, Ill.

Burglars entered the home of John W. Morehead, at the approved midnight hour while the family was out of the city. The intruders had a grand time, testing Morehead's radio set for volume and clarity. Then the finicky housebreakers tested it thoroughly for DX. The receiver passing all these tests, they stole it.

Wide Inquir Into Statio

A far-reaching inquiry into all phases of regulation, which may widely affect the entire Committee on Interstate Commerce during it resolution passed granting the committee auth subjects to be considered has been prepared by the Committee. The outline as to be applied

Monopoly: Monopoly in manufacturing— If such monopoly, is it legitimate? Are m related?

Monopoly in communications—Does such m ated? If such monopoly exists, is it necessa

Legislation with reference to foregoing—Sh mission be barred from receiving licenses (a tic? (b) for broadcasting? Should the p persons found guilty of monopoly of radio cor of radio apparatus be included in bill? Should to persons found guilty of monopoly of radi ments or by other means or by unfair methods provisions of section 12 as to revocation of lic section 13, giving court authority to revoke of antitrust laws, be included in legislation? act of 1927) prohibiting operators of radio c companies, etc., and vice versa, if purpose or States and foreign countries or create a mono

Radio stations as common carriers: Shall riers? (a) shall broadcasting stations be re manner as point-to-point communications sy choose own programs but be regulated as to common-carrier obligation? Shall chain broa (a) as to furnishing service upon demand? (requirement as to furnishing facilities upon

Shall zone system be continued, modified,
Shall Congress regulate the matter of clear
Shall Congress regulate limits of power of
Shall Congress regulate the matter of cha
Shall license fees for radio stations be requir casting stations?
Shall larger powers of censorship be grante
Shall a special radio department be created
Should act provide for supervision of issues
Should provision be made requiring appro merican stations and stations in foreign co

Literatur

John Machaterre, 248½ W. 5th Ave., Columbu Ohio.
S. Leibowitz, 89 Pleasant St., Providence, R. I.
C. A. Simson, 1919 Burnet Ave., Syracuse, N. Y
Fred Rohde, 1962—72nd St., Brooklyn, N. Y.
David Garrick, 2932 Gladstone, Detroit, Mich.
Don D. Miller, 5439½ Ballard Ave., Seattle, Wash
Harold M. Hall, Box 335, Laguna Beach, Cali
H. C. Carlson, R. No. 1, Firth, Idaho.
Elmer K. Sterling, 332 S. Patterson Park Ave Baltimore, Md.
George Giles, 119B S. Missouri, Atlantic City, N. J
Nat. Seidman, 300 Berriman St., Brooklyn, N. Y
G. A. Swinford, 256 Herzberg St., Gadsden, Ala
Josef A. Liccardo, 91 New Jersey Ave., Brooklyn N. Y.
San Jon Garage, J. B. Gordon, San Jon, New Mex
J. O. Sneed, Box 305, Copperhill, Tenn.
Sol Alexander, 61 Sterling St., Newark, N. J.
Harley A. Boltz, 1639 E. Walnut, Des Moines Iowa.
C. Wallen, 80 Berkely St., Boston, Mass.
Walter E. Reitz, Jr., 1213 N. Patterson Park Avenue, Baltimore, Md.
W. W. Dowdle, Steens, Miss.
H. V. Zumwalt, R. 7, Box 269A, Seattle, Wash
Anton Adasiewics, Central Garage, Stambaugh Mich.
Arthur B. H. McKenney, 18, North 10th St. East St. Louis, Ill.
Alfred F. Stankus, 9710 Normal Ave., Chicago, Ill
Anthony Basharkwvica, 3878 Third Ave., New York City.
Walter D. Cunningham, 110 Carmathen St., St John, N. B.
L. L. Savage, Savage Radio Service, Carbondale Wash.
J. C. L. Crone, 2580-9 West, Seattle, Wash.
Marshall Chipman, R. No. 1, Grand Rapids, Mich
S. Patrette, 240 N. 15th St., San Jose, Calif.
Arthur Petit, 177—154th St., Harvey, Ill.
Nicholas S. Metro, 147 Thompson St., Buffalo N. Y.

Under Way
ns and Fees

Washington.

), involving communication, manufactures and
) industry, will be conducted by the Senate
sideration of the Couzens bill, pursuant to the
r to make this investigation. An outline of the
am C. Green, recently appointed counsel for
adio includes:
such monopoly exist? If so, how created?
oly in manufacturing and in communications

oly exist? If such monopoly exists, how cre-
or best interest of United States?
nanufacturers of apparatus used in radio trans-
r point-to-point transmission, foreign or domes-
ons of section 11 directing refusal of license to
ication through control of manufacture or sale
visions of section 11 directing refusal of license
mmunication through exclusive traffic arrange-
ompetition, be included in the bill? Should
, be included in the bill? Should provisions of
) licenses as part of punishment of violation
uld section 15 of proposed bill (sec. 17 of radio
nications systems owning interest in cable
is to restrain commerce between the United
be included in legislation?
dcasting stations be classed as common car-
l to serve the public upon demand in same
? (b) shall such stations be permitted to
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olished?
hannels?
dcasting stations?
ations?
Point-to-point communications stations? Broad-

mmission?
mmission to handle administrative matters?
ecurities by communications companies?
y Commission of traffic contracts between
es?

Wanted

F. Rastetter, 240 E. Oxford, Alliance, Ohio.
Robert P. Murphy, Box 269, Ft. Wayne, Ind.
F. A. Schneider, 214 S. 10th St., Reading, Pa.
Eugene B. Clark, Jr., Sunmount, Santa Fe, N. M.
C. J. Thielk, 312 W. Giddens, Tampa, Fla.
C. W. Brady, 4212 Agnes Ave., Kansas City, Mo.
Thos. Wm. Mallow, 4162 Lee Ave., St. Louis, Mo.
Ernest W. Fair, Box 64, Cap. Hill Sta., Oklahoma City, Okla.
Ralph L. Arthur, 910 St. Joseph St., So. Haven, Mich.
Capt. E. S. Coutant, c. o. Print Kraft, Stuart, Fla.
W. R. L. Dwyer, New Plymouth, Vinton Co., Ohio.
Fred. J. Merklein, 22 Moffat St., Brooklyn, N. Y.
Clifton L. Lane, 439 Bringhurst St., Philadelphia, Pa.
LeRoy Jordan, 4232 W. Monroe, Chicago, Ill.
A. Edenson, 651 Belmont, Chicago, Ill.
Jas. K. Barron, 48 Ida St., Troy, N. Y.
Stanley Levan, 239 Chestnut St., Reading, Pa.
Stephen L. Holland, 3 Syndicate St., Newport, N. H.
Roy C. Barrows, 31 Kelton St., Athol, Mass.
Alvin Miller, 5511 Market St., Philadelphia, Pa.
J. R. Yates, 62 Hazelhurst Ave., Richmond, Va.
Castle Radio Service, Box No. 5, Lafayette Hill, Pa.
H. C. Hyde, 1010 E. N. 3rd St., Sweetwater, Texas
Llewel Adams, c. o. S. R. Putnam, LaJolla, Calif.
Charles Stevenson, 135 Wash. Pl., Hasbrouck Hgts., N. J.
A. R. Scarborough, Sebastopol, Miss.
Wm. F. Sweitzer, 422 No. 11th St., Allentown, Penna.
Tom Harrington, A-1 Radio & Service, 3601 E. 10th, Long Beach, Calif.
Shinichi Seki, 1710 Fort Street, Honolulu, Hawaii.
G. H. Monk, 233 8th Ave., So. Charleston, W. Va.
Alvin W. Miller, 717 N. Ninth St., Reading, Pa.
Bernard J. Bruns, 13 S. Pulaski St., Baltimore, Md.
Guy O. Linderman, 137 Cable St., Bellingham, Wash.

Forum

I HAVE read RADIO WORLD since it was published, and I enjoy it very much.

I am pleased to see that you publish battery receivers, as there has been too much of electric sets.

I have built radio sets since 1919, so have some experience. I have not yet heard of an electric set sold at radio stores that can come up to battery sets.

I built the first Neutrodyne set that was in this state years ago and still have it as a souvenir. It still does its work. Now my special line is Supers.

I have been a pharmacist for years but go in for radio. As it is I build sets as a side line and repair them.

Gustave Simmons, Bilings, Mont.

* * *

THE most amazing thing to me in many a day was to see a letter in your October 12th issue in which complaint is made of a lack of AC circuits for home construction and it was suggested that too much attention was being given to battery circuits.

I have been interested in radio for a number of years and since the AC craze arrived have been lamenting loud and long the neglect of battery sets. I do know that some radio magazines practically quit printing anything whatsoever along the battery set line while the great majority of manufacturers quit making sets for battery operation. Recently there has appeared in some quarters a little recognition of how large a number of people there are who live where there is no power supply. I notice that Atwater Kent, Crosley and Radiola are offering rather up-to-date sets with screen grid tubes for battery operation. However I contend that even now the people who must use battery sets are not receiving half the attention that they should in proportion to their numbers.

It was a pleasure, then, to see in your October 12th number mention of what look like two good battery circuits. I refer to the "Push Pull Battery Model Diamond" and the "Battery Model of HB Compact."

Where I live, we are about 25 miles from the nearest station, WWVA, which has 5,000 watts power, while KDKA, 50,000 watts, is 65 miles away, but we find that many sets are not selective enough.

A sensitive set is particularly desirable here, for operation is quiet and distant signals should be well received where there is sufficient selectivity. Therefore the ideal battery set we are looking for should possess both selectivity and sensitivity. Naturally we want good tone. We are not so much interested in enormous volume. We find that a 112A gives pretty good volume and we feel that two such tubes in push pull would give us plenty of power.

Do you know of anything good in a battery-operated Superheterodyne? Most of them have been so expensive and also used so many tubes that the battery current was almost prohibitive but it seems to me that recent developments ought to overcome this.

J. Mack Gamble, Hannibal, Ohio.

A THOUGHT FOR THE WEEK

WHY not make it a Radio Christmas? Everybody is interested in radio—absolutely everybody from President Hoover, who broadcasts his messages for the information of the whole country, down to the youngster who wants to be thrilled by a bedtime story.

So let's make it a Radio Christmas and the radio dealer will call us blessed.

REVELATION OF RECORDS IS PUT IN EXACT FORM

Washington.

All doubts as to the methods to be used in broadcasting records were settled by the latest general order of the Federal Radio Commission, amending its previous order on this subject.

"The amendments were adopted to clear up clear up misunderstanding among broadcasters as to just what was required of them in the way of announcements of this sort," said Commissioner Lafount. "Under the existing order, broadcasters may coin their own descriptional phrases, and are not certain as to how far they may go."

Where a recording or transcript is made exclusively for broadcasting purposes and is not offered for sale to the public, the broadcasters must announce:

"This program is an electrical transcription made exclusively for broadcast purposes."

Words to Use

As to other mechanical reproductions broadcasting stations must be the exact words: "This is a talking machine record," "This is a phonograph record," or "This is a graphophone record," the amended order specifies. The full text of the amended order (No. 78) follows:

It is ordered that General Order No. 52 be, and the same is hereby amended to read as follows:

I.—Ordinary phonograph records, mechanical piano players, etc. All broadcasting stations shall announce clearly and distinctly the character of all mechanical reproductions broadcast by them, the announcement to immediately precede the broadcasting of each record. In such announcements each talking machine, phonograph or graphophone record used, whatever its character, shall be described by the use of the exact words: "This is a talking machine record," or "This is a phonograph record," or "This is a graphophone record"; each player piano selection used shall be described as played by "mechanical piano player"; every other mechanical reproduction shall be similarly described by the terms generally understood and used by the public and meaning such mechanical reproduction.

Exclusive Records

II.—Exclusive transcriptions for broadcast purposes. Where a recording or transcript is made exclusively for broadcasting purposes and is neither offered or intended to be offered for sale to the public, each such recording shall be immediately preceded and followed by the following statement: "This program is an electrical transcription made exclusively for broadcast purposes."

Broadcasting stations shall not use such records, transcriptions or piano player rolls when the length of the rendition thereof exceeds 15 minutes, unless provision is made for the announcement of the station call letters which must be given together with the statement above set forth at least once every 15 minutes.

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

RADIO UNIVERSITY

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

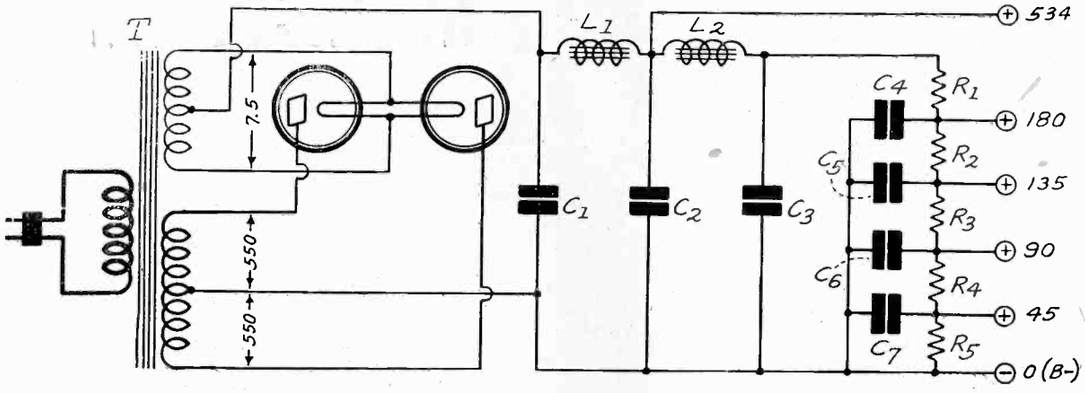

FIG. 814

THE CIRCUIT OF A HEAVY DUTY POWER SUPPLY USING TWO 281 RECTIFIER TUBES AND SUITABLE FOR USE ON A CIRCUIT IN WHICH THE LAST STAGE CONTAINS TWO 250 TYPE TUBES.

HEAVY DUTY B SUPPLY

I HAVE transformers and choke coils for a heavy duty B supply which I wish to hook up. Will you kindly publish a suitable diagram. One of the chokes has a rating of 10 henries and the other a rating of 30 henries. Please indicate the order in which these two coils should be connected. The B supply is supposed to operate a push-pull amplifier using two 250 tubes as well as a number of other AC tubes.—T. R. R.

The circuit diagram shown in Fig. 814 should meet your requirements. The 10-henry coils is L1 and the 30-henry coil L2. The plate supply for the two 250 tubes is taken from the junction of these two coils. If you need a voltage between 45 and 90 volts for the screen voltage on 224 tubes it can be obtained by connecting a 5,000 ohm potentiometer across R4 and connecting the screens to the slider.

INDUCED CURRENTS

A FEW YEARS ago we were told that metal bodies in the fields of tuning coils reduced the selectivity and therefore that every bit of metal had to be removed from the coils as far as was practical. But now inductance coils are put inside shields some of which are quite close to the coils and completely surround them. Don't these shields induce losses in the coils thereby decreasing the selectivity? It seems to me that radio engineers have made a complete about-face. Are they right now or were they right before?—W. H. C.

It is true that if pieces of metals are in the fields of coils currents are induced in them and that these currents lower the selectivity of the tuned circuits. But now-a-days when we have tubes which amplify tremendously and several tuners it is not necessary to make each tuner as selective as when only one or two tuners and possibly not more than one radio frequency amplifier were used. It is not necessary to take extreme precautions to get a high order of amplification because the tubes amplify enough and it is not necessary to make each tuned circuit of a selectivity more han average because several such tuners will make the overall selectivity satisfactory.

Moreover, it is necessary to use shielding because with the high amplification afforded by several stages of screen grid tubes the amplification is so high that radio frequency oscillation would be uncontrollable without the shielding. Also, without shielding there would be direct coupling between adjacent coils and this might actually lower the selectivity more than the shielding does.

INDUCTOR DYNAMIC

WHY is an inductor speaker called dynamic? It seems in no way different from a magnetic speaker of the double magnet type. Is as good quality possible from an inductor as from a regular dynamic?—J. J. K.

Every type of speaker must have a name and inductor dynamic is a good name for this speaker. No particular reproducer has a monopolistic right to the name dynamic as the term can be applied to any type that is powerful. The inductor dynamic is a magnetic speaker but so is the electro-dynamic speaker. In one a permanent magnet is used to establish a field, in the other an electromagnet. Even a dynamic could be made with a permanent magnet and many speakers have been made in this way in foreign countries. The main distinction between the inductor and the dynamic is that in the inductor the armature is a piece of iron and the armature coil is fixed and in the dynamic the armature coil is moving.

Sure, the inductor dynamic is capable of as good quality as the regular dynamic speaker. The quality of which each is capable is largely a matter how each has been constructed.

VOLTAGE ON THE CATHODE

WHAT IS the voltage usually applied to the cathode of a heater type tube? In radio articles I have frequently noted that voltage is measured with respect to a certain point. What does that mean? When the voltage at a certain point is measured what has any other point got to do with it? May be my conception of voltage is all wrong.—A. F. A.

The voltage at any point is meaningless taken by itself. It must be taken with respect to some other point. Mentioning the voltage on the plate we mean the voltage of the plate with respect to the cathode, or electron-emitting electrode. Likewise when we speak of the bias on the grid we mean the voltage on the grid with respect to the cathode or electron-emitting electrode. When we speak of the voltage on the filament, or on the heater, we mean the voltage at one end of it with respect to the other end, or we mean the voltage difference between the two ends.

The voltage on the cathode has no meaning at all unless some other point is specified. For any particular tube the voltage on the cathode is zero because that is the starting point for measuring voltages on the elements of the tube. If ground is taken as the point of zero voltage in the set as a whole, the voltage on the cathode with respect to ground may be different from zero. It may be negative or positive according to connections, but usually it is positive because in most instances the lowest voltage point in the circuit is grounded. Sometimes there is a voltage between the cathode and the heater. This may make the cathode negative or positive with respect to the heater depending on the connections.

Voltage has no more meaning than height or depth without some reference point. When we say that a building is so many feet high we mean that the top of the building is so many feet above the ground, and when we say that a well is so many feet deep we mean that the bottom is so many feet from the surface of the ground. It is the same with voltage.

HEAVY CURRENT DRAIN

WHEN THE plate current through a grid bias resistor is augmented by a resistor connected between B plus and the cathode is not the total current drawn from the B supply considerably increased? If so, what is the advantage of the cathode bleeder, since current drawn from the B supply is used in either instance?—W. H. P.

It is increased by the amount that flows through the resistor from the cathode to the B supply. But the scheme is not used except when the normal plate current in the tube is very small as in detector and resistance coupled circuits. The total current need not be more than the normal current in a transformer coupled circuit. If the scheme were not used with tubes in which the normal plate current is very small the grid bias resistor would have to be excessively large and it would result in high reverse feedback which would render the tube ineffective as detector or amplifier. For example, if the tube is a 240, having a mu of 30, and it is adjusted so that the grid bias is 3 volts, obtained from a resistor drop, the effective amplification is 14. If a grid battery of the same voltage is used the amplification is 21.4. The load

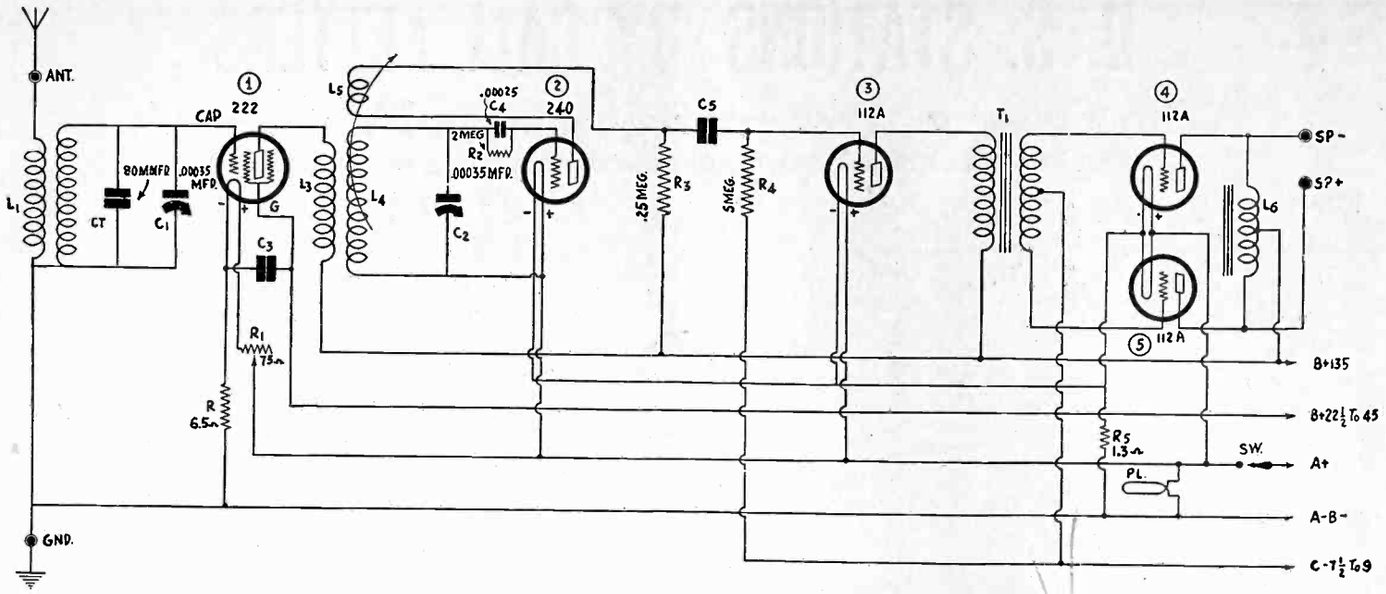

FIG. 815
FOR THE RECEPTION OF LOCAL STATIONS WITH GOOD QUALITY AND PLENTY OF LOUDSPEAKER VOLUME THIS CIRCUIT HAS BEEN FOUND TO GIVE COMPLETE SATISFACTION

resistance in each case is supposed to be 100,000 ohms and the internal resistance of the tube 40,000 ohms. A similar reduction results in the detector, except that it is greater.

MICROPHONIC NOISES

MY RECEIVER is very sensitive to mechanical jars and shocks, and it is very annoying because the set sings out even when the people above me walk around with a heavy step. Can you suggest a remedy for this condition?—H. J. G.

In most instances this trouble can be cured by simply putting in a different detector tube, one which is not so sensitive. The sensitivity is usually due to some structural defect in the tube, or a break in the grid support. In less severe cases it may be the first audio amplifier which is at fault, and the cure is the same. The trouble can often be ameliorated by loading the weak tube with a lead cap so that it will not vibrate so easily. However, there is no better way than to replace the tube. If jars in the building are transmitted to the receiver rubber buffers will help, or the receiver may be placed on a carpet.

CONDENSERS BREAK DOWN

I HAVE tried several electrolytic condensers in my power pack, but all have been defective. I am now wondering whether it is possible to get one that is all right. Surely if so many condensers are defective there is a structural weakness which accounts for the trouble.—P. C. C.

The probability is that all the electrolytic condensers you have tried have been all right. Not many of these condensers are defective. The trouble usually is that the voltage applied across the condensers is higher than the rated voltage. Keep the voltage below this level and there will be no trouble. When the rated voltage is exceeded the condenser acts as if short-circuited, often causing a sputtering sound in the loudspeaker.

FILAMENT CURRENT INTERMITTENT

I HAVE A filament current supply in which a dry type rectifier is used. At first the filament current was steady and the operation of the receiver entirely satisfactory, but lately the filament current has been quite irregular. The volume from the set, of course, has fluctuated sympathetically. What is the matter with the rectifier and how can it be remedied?—P. S. W.

The rectifier wears out in time, often in a short time, and the only remedy is to replace it with a new one. At least that is the simplest way of overcoming the trouble. If a rectifier unit wears out in a very short time you must overload it, that is, draw too much current from it. Perhaps you have to break the circuit up so that you can use two of the rectifier elements in parallel. That would be more economical than to overload a single one and overload it all the time.

TRAVELER WANTS LOUDSPEAKER

I AM TRAVELING from place to place with an amplifier and loudspeaker, setting the equipment up a few days or a week at a time. For traveling I need a light speaker but still I want something capable of good quality. Can you suggest a speaker that is comparatively light and of good quality?—J. J. O'B.

The lightest speaker capable of good quality is an inductor dynamic and it would seem that that would be suitable for the purpose. A further reduction in the weight of the equipment could be effected by using resistance coupling in the audio amplifier in place of the usual transformer coupling. Transformers capable of good quality are usually very heavy, especially compared with resistance couplers.

RECEIVER FOR LOCAL STATIONS

I AM LOOKING for a simple receiver to be used exclusively for the reception of local station. It should not have more than two tuners but the audio frequency amplifier should be capable of very good quality. I would prefer a push-pull output stage suitable for use with an inductor speaker.—E. D. S.

Fig. 815 seems to fill your requirements. The resistance coupler between the detector and the first audio tube insures good quality up to the first amplifier and the push-pull coupler following carriers on to the loudspeaker. Of course, the quality depends largely on how good the push-pull coupling transformer and the center-tapped output choke are.

U. S. STATIONS BY CALL LETTERS

With Location, Power, Frequency and Wavelength

FROM FEDERAL RADIO COMMISSION, AS CORRECTED TO DECEMBER 12TH

[The transmitter location of each station is given, but where the studio is located in some other city or town, the studio location is given also, designated by the letter "S." Where two different powers are given, the larger is usually for daylight use only. "Kc" stands for frequency in kilocycles, "kw" for power in kilowatts, ""M" for wavelength in meters.]

Station	Transmitter	Power	kc.	M.
WAAF	Chicago, Ill.	500	920	325.9
WAAM	Newark, N. J.	1&2kw.	1250	239.9
WAAT	Jersey City, N. J.	300	1070	280.2
WAAW	Omaha, Nebr.	500	660	454.3
WABC-WBOQ	Queens Co. N. Y. S.—New York City	5,000	860	348.6
WABI	Bangor, Me.	100	1200	249.9
WABO-WHEC	See WHEC-WABO			
WABZ	New Orleans, La.	100	1200	249.9
WADZ	Akron, Ohio	1kw.	1320	227.1
WAGM	Royal Oak, Mich.	50	1310	228.3
WAIU	Columbus, Ohio	500	640	468.5
WAPI	Birmingham, Ala.	5kw.	1140	263
WASH	Grand Rapids Twp., Mich.	500	1270	236.1
WBAA	W. Lafayette, Ind.	500	1400	214.2
WBAK	Harrisburg, Pa.	500	1430	209.7
WBAL	Glen Morris, Md. S—Baltimore, Md.	10kw.	1060	258.5
WBAP	Fort Worth, Texas	50kw.	800	374.8
WBAX	Wilkes-Barre, Pa.	100	1210	247.8
WBBC	Brooklyn, N. Y.	500	1400	214.2
WBBL	Richmond, Va.	100	1370	218.8
WBBM-WJBT	Glenview, Ill. S—Chicago, Ill.	25kw.	770	389.4
WBBR	Rossville, N. Y.	1kw.	1300	230.6
WBBY	Charleston, S. C.	75	1200	249.9
WBBZ	Ponca City, Okla.	100	1200	249.9
WBCM	Hampton Twp., Mich. S—Bay City, Mich.	500	1410	212.6
WBIS-WNAC	See WNAC-WBIS			
WBMS	Fort Lee, N. J.	250	1450	206.8
WBNY	New York, N. Y.	250	1350	221.1
WBOQ-WABC	See WABC-WBOQ			
WBOW	Terre Haute, Ind.	100	1310	228.3
WBRC	Birmingham, Ala.	1kw.&500w.	930	322.4
WBRE	Wilkes-Barre, Pa.	100	1310	228.3
WBRL	Tilton, N. H.	500	1430	209.7
WBSO	Wellesley Hills, Mass.	250	920	325.9
WBT	Charlotte, N. C.	5kw.	1080	277.6
WBZ	E. Springfield, Mass. S—Springfield, Mass.	15kw.	990	302.8
WBZA	Boston, Mass.	500	990	302.8
WCAC	Storrs, Conn.	250	600	499.7
WCAD	Canton, N. Y.	500	1220	245.8
WCAE	Pittsburgh, Pa.	500	1220	245.8
WCAH	Columbus, Ohio	500	1430	209.7
WCAJ	Lincoln, Nebr.	500	590	508.2
WCAL	Northfield, Minn.	1kw.	1250	239.9
WCAM	Camden, N. J.	500	1280	234.2
WCAO	Baltimore, Md.	250	600	499.7
WCAP	Asbury Park, N. J.	500	1280	234.2
WCAT	Rapid City, S. D.	100	1200	249.9
WCAU	Byberry, Pa. S—Philadelphia, Pa.	10kw.	1170	256.3
WCAX	Burlington, Vt.	100	1200	249.9
WCAZ	Carthage, Ill.	50	1070	280.2
WCBA	Allentown, Pa.	250	1440	208.2
WCBD	Zion, Ill.	5kw.	1080	277.6
WCBM	Baltimore, Md.	100	1370	218.8
WCBS	Springfield, Ill.	100	1210	247.8
WCCO	Anoka, Minn. S—Minneapolis, Minn.	7½kw.	810	370.2
WCDA	Cliffside Park, N. J. S—New York City, N. Y.	250	1350	221.1
WCFL	Chicago, Ill.	1&1½kw.	1290	232.4
WCGU	Coney Island, N. Y.	500	1400	214.2
WCKY	Crescent Springs, Ky. S—Covington, Ky.	5kw.	1480	202.6
WCLO	Kenosha, Wis.	100	1200	249.9
WCLS	Joliet, Ill.	100	1310	228.3
WCMA	Culver, Ind.	500	1400	214.2
WCOA	Pensacola, Fla.	500	1120	267.7
WCOC	Meridian, Miss.	1kw&500	880	340.7
WCOD	Harrisburg, Pa. (formerly WPRC)	100	1200	249.9
WCOH	Greenville, N. Y. S—Yonkers, N. Y.	100	1210	247.8
WCRW	Chicago, Ill.	100	1210	247.8
WCSH	Portland, Maine	500	940	319.0
WCSO	Springfield, Ohio.	500	1450	206.8
WDAE	Tampa, Fla.	1kw.	620	483.6
WDAF	Kansas City, Mo.	1kw.	610	491.5
WDAG	Amarillo, Texas	250	1410	212.6
WDAH	El Paso, Texas	100	1310	228.3
WDAY	W. Fargo, N. D.	1kw.	940	319
WDBJ	Roanoke, Va.	250&500	930	322.4
WDBO	Orlando, Fla.	1kw.	620	483.6
WDEL	Wilmington, Del.	250&350	1120	267.7
WDGY	Minneapolis, Minn.	1kw.	1180	254.1
WDOD	Chattanooga, Tenn.	2½&1kw.	1280	234.2
WDRC	New Haven, Conn.	500	1330	225.4
WDSU	New Orleans, La.	1kw.	1250	239.9
WDWF-WLSI	Cranston, R. I.	100	1210	247.8
WDZ	Tuscola, Ill.	100	1070	280.2
WEAF	Bellmore, N. Y. S—New York, N. Y.	50kw.	660	454.3
WEAI	Ithaca, N. Y.	500	1270	236.1
WEAN	Providence, R. I.	250&500	780	384.4
WEAO	Columbus, Ohio	750	570	526
WEAR	Cleveland, Ohio	1kw.	1070	280.2
WEBC	Superior, Wis. S—Duluth, Minn.	1kw.	1290	232.4
WEBE	Cambridge, Ohio.	100	1210	247.8
WEBQ	Harrisburg, Ill.	100	1210	247.8
WEBR	Buffalo, N. Y.	200&100	1310	228.3
WEBW	Beloit, Wis.	350	560	535.4
WEDC	Chicago, Ill.	100	1210	247.8
WEDH	Erie, Pa.	30	1420	211.1
WEEI	Wevmouth, Mass. S—Boston, Mass.	10kw.	590	508.2
WEHC	Emory, Va.	100	1370	218.8
WEHS	Evanston, Ill.	100	1500	199.9
WELK	Phila., Pa.	100	1370	218.8
WEMC	Berrien Springs, Mich.	1kw.	590	508.2
WENR-WBCN	Chicago, Ill.	50kw.	870	344.6
WEVD	Forest Hills, N. Y. S—New York City	500	1300	230.6
WEW	St. Louis, Mo.	1kw.	760	394.5
WFAA	Dallas, Texas	10kw.	800	374.5
WFAN	Philadelphia, Pa.	500	610	491.5
WFBC	Knoxville, Tenn.	50	1200	249.9
WFBG	Atoona, Pa.	100	1310	228.3
WFBJ	Collegeville, Minn.	100	1370	218.8
WFBL	Syracuse, N. Y.	750	900	331.1
WFBM	Indianapolis, Ind.	1kw.	1230	243.8
WFBR	Baltimore, Md.	250	1270	236.7
WFDF	Flint, Mich.	100	1310	228.3
WFI	Philadelphia, Pa.	500	560	535.4
WFIW	Hopkinsville, Ky.	1kw.	940	319
WFJC	Akron, Ohio	500	1450	206.8
WFKD	Wissinoming, Pa. S—Philadelphia, Pa.	50	1310	228.3
WFLA-WSUN	Clearwater, Fla.	1-2½kw.	900	331.1
WGAL	Lancaster, Pa.	15	1310	228.3
WGBB	Freeport, N. Y.	100	1210	247.8
WGBC	Memphis, Tenn.	500	1430	209.7
WGBF	Evansville, Ind.	500	630	475.9
WGBI	Scranton, Pa.	250	880	340.7
WGBS	Astoria, L. I., N. Y. S—New York City	500	1180	254.1
WGCM	Gulfport, Miss.	100	1210	247.8
WGCP	Newark, N. J.	250	1250	239.9
WGES	Chicago, Ill.	500	1360	220.4
WGH	Newport News, Va.	100	1310	228.3
WGHP	Fraser, Mich. S—Detroit, Mich.	750	1240	241.8
WGL	Fort Wayne, Ind.	100	1370	218.8
WGMS-WLB	See WLB-WGMS			
WGN-WLIB	Elgin, Ill. S—Chicago, Ill.	25kw.	720	413
WGR	Amherst, N. Y. S—Buffalo, N. Y.	1kw.	550	545.1
WGST	Atlanta, Ga.	250	890	336.9
WGY	S. Schenectady, N. Y.	50kw.	790	379.5
WHA	Madison, Wis.	750	940	319
WHAD	Milwaukee, Wis.	250	1120	267.7
WHAM	Victor Twp. N. Y. S—Rochester, N. Y.	5kw.	1150	260.7
WHAP	Carlstadt, N. J. S—New York City	1kw.	1300	230.6
WHAS	Jeffersontown, Ky. S—Louisville, Ky.	10kw.	820	365.6
WHAZ	Troy, N. Y.	500	1300	230.6
WHB	Kansas City, Mo.	500	950	315.6
WHBC	Canton, Ohio	10	1200	249.9
WHBD	Mt. Orab, Ohio	100	1370	218.8
WHBF	Rock Island, Ill.	100	1210	247.8
WHBL	Sheboygan, Wis.	500	1410	212.6
WHBQ	Memphis, Tenn	100	1370	218.8
WHBU	Anderson, Ind.	100	1210	247.8
WHBY	West De Pere, Wis. S—Green Bay Wis.	100	1200	249.9
WHDF	Calumet, Mich.	100	1370	218.8
WHDH	Gloucester, Mass.	1kw.	830	361.2
WHDI	Minneapolis, Minn.	500	1180	254.1
WHEC	WABO—Rochester, N. Y.	500	1440	208.2
WHFC	Cicero, Ill.	100	1500	199.9
WHIS	Bluefield, W. Va.	100	1420	211.1
WHK	Cleveland, Ohio	1kw.	1390	215.7
WHN	New York, N. Y.	250	1010	296.9
WHO	Des Moines, Iowa	5kw.	1000	299.8
WHP	Lemoyne, Pa. S—Harrisburg, Pa.	500	1430	209.7
WIAS	Ottumwa, Iowa	100	1420	211.1
WIBA	Madison, Wis.	100	1210	247.8
WIBG	Elkins Park, Pa.	50	930	322.4
WIBM	Jackson, Mich.	100	1370	218.8
WIBO	Desplaines, Ill. S—Chicago, Ill.	1&1½kw.	560	535.4
WIBR	Steubenville, Ohio	50	1420	211.1
WIBS	Jersey City, N. J.	250	1450	206.8
WIBU	Poynette, Wis.	100	1310	228.3
WIBW	(near) Topeka, Kan.	1kw.-500w.	580	516.9
WIBX	Utica, N. Y.	100-300	1200	249.9
WICC	Easton, Conn. S—Bridgeport. Conn.	500	1190	252
WIL	St. Louis, Mo.	100-250	1200	249.9
WILL	Urbana, Ill.	250-500	890	336.9
WILM	Wilmington, Del.	100	1420	211.1
WIOD-WMBF	Miami Beach, Fla.	1kw.	560	535.4
WIP	Philadelphia, Pa.	500	610	491.5
WISN	Milwaukee, Wis.	250	1120	267.7
WJAC	Johnstown, Pa. (Formerly WHBP.)	100	1310	228.3
WJAD	Waco, Texas	1kw.	1240	241.8
WJAG	Norfolk, Nebr.	1kw.	1060	282.8
WJAK	Marion, Ind.	50	1310	228.3
WJAR	Providence, R. I.	250-400	890	336.9
WJAS	North Fayette Twp. S—Pittsburgh, Pa.	1kw.	1290	232.4
WJAX	Jacksonville, Fla.	1kw.	1260	238
WJAY	Cleveland, Ohio	500	620	483.6
WJAZ	Mt. Prospect, Ill. S—Chicago, Ill.	5kw.	1480	202.6
WJBC	La Salle, Ill.	100	1200	249.9
WJBI	Red Bank, N. J.	100	1210	247.8
WJBK	Ypsilanti, Mich.	50	1370	218.8
WJBL	Decatur, Ill.	100	1200	249.9
WJBO	New Orleans, La.	100	1370	218.8
WJBT-WBBM	See WBBM-WJBT			
WJBU	Lewisburg, Pa.	100	1210	247.8
WJBW	New Orleans, La.	30	1200	249.9
WJBY	Gadsden, Ala.	50	1210	247.8
WJDX	Jackson, Miss.	500-1kw.	1270	236.1
WJJD	Mooseheart, Ill.	20kw.	1130	265.3
WJKS	Gary. Ind.	500-1½kw.	1360	220.4
WJR	Sylvan Lake Village, Mich. S—Detroit. Mich.	5kw.	750	399.8
WJSV	Mt. Vernon Hills, Va.	10kw.	1460	205.4
WJW	Mansfield, Ohio (Formerly WLBV.)	100	1210	247.8
WJZ	Bound Brook, N. J. S—New York City, N. Y.	30kw.	760	394.5
WKAQ	San Juan, P. R.	500	890	336.9
WKAR	E. Lansing, Mich.	1kw.	1040	288.3
WKAV	Laconia, N. H.	100	1310	228.3
WKBB	Joliet, Ill.	100	1310	228.3
WKBC	Birmingham, Ala.	100	1310	228.3
WKBF	Indianapolis, Ind.	500	1400	214.2
WKBH	La Crosse, Wis.	1kw.	1380	217.3
WKBI	Chicago, Ill.	50	1500	199.9
WKBN	Youngstown, Ohio	500	570	526
WKBO	Jersey City, N. J.	250	1450	206.8
WKBP	Battle Creek, Mich.	50	1420	211.1
WKBQ	New York, N. Y.	250	1350	221.1
WKBS	Galesburg, Ill.	100	1310	228.3
WKBV	Connersville, Ind.	100-150	1500	199.9
WKBW	Amherst, N. Y. S—Buffalo, N. Y.	5kw.	1470	204
WKBZ	Ludington, Mich.	50	1500	199.9
WKEN	Grand Island, N. Y. S—Buffalo, N. Y.	1kw.	1040	288.3
WKJC	Lancaster, Pa.	100	1200	249.9
WKRC	Cincinnati, Ohio	500	550	545.1
WKY	Oklahoma City, Okla.	1kw.	900	331.1
WLAC	Nashville, Tenn.	5kw.	1490	201.2
WLAP	Louisville, Ky.	30	1200	249.9
WLB-WGMS	Minneapolis, Minn.	500	1250	239.9
WLBC	Muncie, Ind.	50	1310	228.3
WLBF	Kansas City, Kans.	100	1420	211.1
WLBG	Ettrick, Va. S—Petersburg, Va.	250		
WLBL	Stevens Pt., Wis.	2kw.	900	331.1
WLBW	Oil City, Pa.	500	1260	238
WLBX	L. I. City, N. Y.	100	1500	199.9
WLBZ	Bangor, Maine	500	620	483.6
WCI	Ithaca, N. Y.	50	1210	247.8
WLEX	Lexington, Mass.	500	1360	220.4
WLEY	Lexington, Mass.	100-250	1420	211.1
WLIB-WGN	See WGN-WLIB.			
WLIT	Philadelphia, Pa.	500	560	535.4
WLOE	Chelsea, Mass. S—Boston, Mass.	100-250	1500	199.9
WLS	Crete, Ill. S—Chicago, Ill.	5kw.	870	344.6
WLSI-WDWF	See WDWF—WLSI.			
WLTH	Brooklyn, N. Y.	500	1400	214.2
WLW	Mason, Ohic S—Cincinati	50kw.	700	428.3
WLWL	Kearny, N. J. S—New York City	5kw.	1100	272.6
WMAC	Cazenovia, N. Y.	250	570	526
WMAK	Martinsville, N. Y. S—Buffalo, N. Y.	750	900	331.1
WMAL	Washington, D. C.	250-500	630	475.9
WMAN	Columbus, Ohio	50	1210	247.8
WMAQ	Addison. Ill. S—Chicago	5kw.	670	447.5
WMAY	St. Louis, Mo.	100-250	1200	249.9
WMAZ	Macon, Ga.	250-500	890	336.9
WMBA	Newport, R. I.	100	1500	199.9
WMBC	Detroit, Mich.	100	1420	211.1
WMBD	Peoria Hts., Ill.	500w.-1kw.	1440	208.2
WMBF-WIOD	See WIOD-WMBF.			
WMBG	Richmond, Va.	100	1210	247.8
WMBH	Joplin, Mo.	100-200	1420	211.1
WMBI	Addison, Ill. S—Chicago	5kw.	1080	277.6
WMBO	Auburn, N. Y.	100	1370	218.8
WMBQ	Brooklyn, N. Y.	100	1500	199.9
WMBR	Tampa, Fla.	100	1210	247.8
WMC	Memphis, Tenn.	500-1kw.	780	384.4
WMCA	Hoboken, N. J. S—New York City, N. Y.	500	570	526
WMES	Boston, Mass	50	1500	199.9
WMMN	Fairmont, W. Va.	250-500	890	336.9
WMPC	Lapeer, Mich.	100	1500	199.9
WMRJ	Jamaica, N. Y.	10	1420	211.1
WMSG	New York, N. Y.	250	1350	221.1
WMT	Waterloo, Iowa	250	600	499.7
WNAC-WBIS	Quincy, Mass. S—Boston, Mass.	1kw.	1230	243.8
WNAD	Norman, Okla.	500	1010	296.9
WNAT	Philadelphia, Pa.	100	1310	228.3
WNAX	Yankton, S. Dak.	1kw.	570	526
WNBF	Binghamton, N. Y.	50	1500	199.9
WNBH	New Bedford, Mass.	100	1310	228.3
WNBJ	Knoxville, Tenn.	50	1310	228.3
WNBO	Washington, Pa.	100	1200	249.9
WNBR	Memphis, Tenn.	500	1430	209.7
WNBW	Carbondale, Pa.	10	1200	249.9
WNBX	Springfield, Vt.	10	1200	249.9
WNBZ	Saranac Lake, N. Y.	50	1290	232.4
WNJ	Newark, N. J.	250	1450	206.8
WNOX	Knoxville, Tenn.	1kw.	560	535.4
WNRC	Greensboro, N. C.	250	1440	208.2
WNYC	New York, N. Y.	500	570	526
WOAI	San Antonio, Texas	5kw.	1190	252
WOAN	Lawrenceburg, Tenn.	500	600	499.7
WOAX	Trenton, N. J.	500	1280	234.2
WOBT	Union City, Tenn.	100-250	1310	228.3
WOBU	(near) Charleston	250	580	516.9
WOC	Davenport, Iowa	5kw.	1000	299.8
WOCL	Jamestown, N. Y.	25	1210	247.8
WODA	Paterson, N. J.	1kw.	1250	239.9
WODX	Springhill, Ala. S—Mobile, Ala.	500	1410	212.6
WOI	Ames, Iowa	5kw.	560	535.4
WOKO	Mt. Beacon, N. Y. S—Poughkeepsie, N. Y.	500	1440	208.2
WOL	Washington, D. C.	100	1310	228.3
WOMT	Manitowoc, Wis.	100	1210	247.8
WOOD	Furnwood, Mich. S—Grand Rapids, Mich.	500	1270	236.1
WOPI	Bristol. Tenn.	100	1500	199.9
WOQ	Kansas City, Mo.	1kw.	610	491.5

(Continued on next page)

Station	Transmitter	Power	kc.	M.
WOR	Kearny, N. J. S—Newark, N. J.	5kw.	710	422.3
WORC	Auburn, Mass. S—Worcester, Mass. (formerly WKBE)	100	1200	249.9
WORD	Batavia, Ill. S—Chicago, Ill	5kw.	1480	202.6
WOS	Jefferson City, Mo.	500-1kw.	630	475.9
WOV	Secaucus, N. J. S—New York City	1kw.	1130	265.3
WOW	Omaha, Neb.	1kw.	590	508.2
WOWO	Ft. Wayne, Ind.	10kw.	1160	258.5
WPAP	See WQAO-WPAP			
WPAW	Pawtucket, R. I.	100	1210	247.8
WPCC	Chicago, Ill.	500	560	535.4
WPCH	Hoboken, N. J. S—New York City	500	810	370.2
WPEN	Philadelphia, Pa. (formerly WPSW)	100-250	1500	199.9
WPG	Atlantic City, N. J.	5kw.	1100	272.6
WPOE	Patchogue, N. Y.	30-100	1420	211.1
WPOR	See WTAR-See WTAR-WPOR			
WPSC	State College, Pa.	500	1230	243.8
WPTF	Raleigh, N. C.	1kw.	680	440.9
WQAM	Miami, Fla.	1kw.	1240	241.8
WQAN	Scranton, Pa.	250	880	340.7
WQAQ	See WPAP—Cliffside, N. J. S—New York City, N. Y.	250	1010	296.9
WQBC	Utica, Miss.	300	1360	220.4
WQBZ	Weirton, W. Va.	60	1420	211.1
WRAF	LaPorte, Ind.	100	1200	249.9
WRAK	Erie, Pa.	50	1370	218.8
WRAW	Reading, Pa.	100	1310	228.3
WRAX	Philadelphia, Pa.	250	1020	293.9
WRBI	Tifton, Ga.	20	1310	228.3
WRBJ	Hatiesburg, Miss.	10	1500	199.9
WRBL	Columbus, Ga.	50	1200	249.9
WRBQ	Greenville, Miss.	100	1210	247.8
WRBT	Wilmington, N. C.	100	1370	218.8
WRBU	Gastonia, N. C.	100	1210	247.8
WRC	Washington, D. C.	500	950	315.6
WREC	Whitehaven, Tenn. S—Memphis, Tenn.	500&1kw.	600	499.7
WREN	Lawrence, Kans.	1kw.	1220	245.8
WRHM	Fridley, Minn. S—Minneapolis, Minn.	1kw.	1250	239.9
WRJN	Racine, Wis.	100	1370	218.8
WRK	Hamilton, Ohio	100	1310	228.3
WRNY	Coytesville, N. J. S—New York City, N. Y.	250	1010	296.9
WRR	Dallas, Texas	500	1280	234.2
WRUF	Gainesville, Fla.	5kw.	1470	204
WRVA	Mechanicsville, Va. S—Richmond, Va.	5kw.	1110	270.1
WSAI	Mason, Ohio S—Cincinnati, Ohio	500	1330	225.4
WSAJ	Grove City, Pa.	100	1310	228.3
WSAN	Allentown, Pa.	250	1440	208.2
WSAR	Fall River, Mass.	250	1450	206.8
WSAZ	Huntington, W. Va.	250	580	516.9
WSB	Atlanta, Ga.	1kw.	740	405.2
WSBC	Chicago, Ill.	100	1210	247.8
WSBT	South Bend, Ind.	500	1230	243.8
WSDA	See WSGH—See WSGH-WSDA			
WSFA	Montgomery, Ala	500	1410	212.6
WSGH	See WSDA—Brooklyn, N. Y.	500	1400	214.2
WSIX	Springfield, Tenn.	100	1210	247.8
WSJS	Winston-Salem, N. C. (formerly WJDZ)	100	1310	228.3
WSM	Nashville, Tenn.	5kw.	650	461.3
WSMB	New Orleans, La.	500	1320	227.1
WSMK	Dayton, Ohio	200	1380	217.3
WSOA	Deerfield, Ill. S—Chicago, Ill.	5kw.	1480	202.6
WSPD	Toledo, Ohio	500&1kw.	1340	223.7
WSSH	Boston, Mass.	100&250	1420	211.1
WSUI	Iowa City, Iowa	500	600	499.7
WSUN	See WFLA—See WSUN			
WSVS	Buffalo, N. Y.	50	1370	218.8
WSYR	Syracuse, N. Y.	250	570	526
WTAD	Quincy, Ill.	500	1440	208.2
WTAG	Worcester, Mass.	250	580	516.9
WTAM	Brecksville Village, Ohio S—Cleveland, Ohio	50kw.	1070	280.2
WTAQ	Township of Washington, Wis. S—Eau Claire. Wis.	1kw.	1330	225.4
WTAR	See WPOR—Norfolk, Va.	500	780	384.4
WTAW	College Station, Texas.	500	1120	267.7
WTAX	Streator, Ill.	50	1210	247.8
WTBO	Cumberland, Md.	50	1420	211.1
WTFI	Toccoa, Ga.	250	1450	206.8
WTIC	Avon, Conn. S—Hartford, Conn.	50kw.	1060	282.8
WTMJ	Brookfield, Wis. S—Milwaukee, Wis.	1kw.&2½kw.	620	483.6
WTNT	Nashville, Tenn. (formerly WBAW)	5kw.	1490	201.2
WTOC	Savannah, Ga.	500	1260	238
WWAE	Hammond, Ind.	100	1200	249.9
WWJ	Detroit, Mich.	1kw.	920	325.9
WWL	New Orleans, La.	5kw.	850	352.7
WWNC	Asheville, N. C.	1kw.	570	526
WWRL	Woodside, N. Y.	100	1500	199.9
WWVA	Wheeling, W. Va.	5kw.	1160	258.5
KCRC	Enid, Okla.	100&250	1370	218.8
KDB	Santa Barbara, Calif.	100	1500	199.9
KDFN	Casper, Wyo.	100	1210	247.8
KDKA	Wilkins Township, Pa. S—Pittsburgh, Pa.	50kw.	980	305.9
KDLR	Devils Lake, N. D.	100	1210	247.8
KDYL	Salt Lake City, Utah	1kw.	1290	232.4
KECA	Los Angeles, Calif. (formerly KPLA)	1kw.	1000	299.8
KEJK	Beverly Hills, Calif.	500	1170	256.3
KELW	Burbank, Calif.	500	780	384.4
KEX	Portland, Ore.	5kw.	1180	254.1
KFAB	Lincoln, Neb.	5kw.	770	389.4
KFBB	Great Falls, Mont.	500	1360	220.4
KFBK	Sacramento, Calif.	100	1310	228.3
KFBL	Everett, Wash.	50	1370	218.8
KFDM	Beaumont, Texas	500	560	535.4
KFDY	Brookings, S. D.	500&1kw.	550	545.1
KFEL	Denver, Colo.	250	640	475.9
KFEQ	St. Joseph, Mo.	2½kw.	560	535.4
KFGQ	Boone, Iowa	100	1310	228.3
KFH	Wichita, Kans.	500	1300	230.6
KFHA	Gunnison, Colo.	50	1200	249.9
KFI	Los Angeles, Calif.	5kw.	640	468.5
KFIF	Portland, Ore.	100	1420	211.1
KFIO	Spokane, Wash.	100	1230	243.6
KFIZ	Fond du Lac, Wis.	100	1420	211.1
KFJB	Marshalltown, Iowa	100	1200	249.9
KFJF	Oklahoma City, Okla.	5kw.	1470	204
KFJI	Astoria, Ore.	100	1370	218.8
KFJM	Grand Forks, N. D.	100	1370	218.8
KFJR	Portland, Ore.	500	1300	230.6
KFJY	Fort Dodge, Iowa	100	1310	228.3
KFJZ	Fort Worth, Texas	100	1370	218.8
KFKA	Greeley, Colo.	500&1kw.	880	340.7
KFKB	Milford, Kans.	5kw.	1050	285.5
KFKU	Lawrence, Kans.	1kw.	1220	245.8
KFKX	See KYW-KFKX			
KFLV	Rockord, Ill.	500	1410	212.6
KFLX	Galveston, Texas	100	1370	218.8
KFMX	Northfield, Minn.	1kw.	1250	239.9
KFNF	Shenandoah, Iowa	500&1kw.	890	336.9
KFOR	Lincoln, Nebr.	100&250	1210	247.8
KFOX	Long Beach, Calif.	1kw.	1250	239.9
KFPL	Dublin, Texas	15	1310	228.3
KFPM	Greenville, Texas	15	1310	228.3
KFPW	Siloam Springs, Ark.	50	1340	223.7
KFPY	Spokane, Wash	500	1340	223.7
KFQA	See KMOX-KFQA			
KFQD	Anchorage, Alaska	100	1230	243.8
KFQU	Holy City, Calif.	100	1420	211.1
KFQW	Seattle, Wash.	100	1420	211.1
KFQZ	Hollywood, Calif. S—Los Angeles, Calif.	250	860	348.6
KFRC	San Francisco, Calif.	1kw.	610	491.5
KFRU	Columbia, Mo.	500	630	475.9
KFSD	San Diego, Calif.	500&1kw.	600	499.7
KFSG	Los Angeles, Calif.	500	1120	267.7
KFUL	Galveston, Texas	500	1290	232.4
KFUM	Colorado Springs, Colo.	1kw.	1270	236.1
KFUO	Clayton, Mo.	500&1kw.	550	545.1
KFUP	Denver, Colo.	100	1310	228.3
KFVD	Culver City, Calif.	250	710	422.3
KFVS	Cape Girardeau, Mo.	100	1210	247.8
KFWB	Hollywood, Calif.	1kw.	950	315.6
KFWF	St. Louis, Mo.	100	1200	249.9
KFWI	San Francisco, Calif.	500	930	322.4
KFWM	Richmond, Calif.	500&1kw.	930	322.4
KFXD	Jerome, Idaho	50	1420	211.1
KFXK	Denver, Colo.	250	630	475.9
KFXJ	Edgewater, Colo.	50	1310	228.3
KFXM	San Bernadino, Calif. (formerly KFWC)	100	1200	249.9
KFXR	Oklahoma City, Okla.	100	1310	228.3
KFFXY	Flagstaff, Ariz.	100	1420	211.1
KFYO	Abilene, Texas	100&250	1420	211.1
KFYR	Bismarck, N. D.	500	550	545.1
KGA	Spokane, Wash.	5kw.	1470	204
KGAR	Tuscon, Ariz.	100	1370	218.8
KGB	San Diego, Calif.	250	1360	220.4
KGBU	Ketchikan, Alaska	500	900	331.1
KGBX	St. Joseph, Mo.	100	1370	218.8
KGBZ	York, Nebr.	500&1kw.	930	322.4
KGCA	Decorah, Iowa	50	1270	236.1
KGCI	San Antonio, Texas	100	1370	218.8
KGCR	Watertown, S. D.	100	1210	247.8
KGCU	Mandan, N. D.	100	1200	249.9
KGCX	Wolf Point, Mont.	100&250	1310	228.3
KGDA	Dell Rapids, S. D.	50	1370	218.8
KGDE	Fergus Falls, Minn.	50	1200	249.9
KGDM	Stockton, Calif.	50	1100	272.6
KGDY	Oldham, S. D.	15	1200	249.9
KGEF	Los Angeles, Calif.	1kw.	1300	230.6
KGEK	Yuma, Colo.	50	1200	249.9
KGER	Long Beach, Calif.	100	1370	218.8
KGEW	Fort Morgan, Colo.	100	1200	249.9
KGEZ	Kalispell, Mont.	100	1310	228.3
KGFF	Alva, Okla.	100	1420	211.1
KGFG	Oklahoma City, Okla.	100	1370	218.8
KGFI	Corpus Christi, Texas	100	1500	199.9
KGFJ	Los Angeles, Calif.	100	1420	211.1
KGFK	Hallock, Minn.	50	1200	249.9
KGFL	Raton, N. Mex.	50	1370	218.8
KGFW	Ravenna, Nebr.	50	1310	228.3
KGFX	Pierre, S. D.	200	580	516.9
KGGC	San Francisco, Calif.	50	1420	211.1
KGGF	Picher, Okla.	500	1010	296.9
KGGM	Albuquerque, N. Mex.	250&500	1230	243.8
KGHF	Pueblo, Colo.	250	1320	227.1
KGHI	Little Rock, Ark.	100	1200	249.9
KGHL	Billings, Mont.	500	950	315.6
KGHX	Richmond, Texas	50	1500	199.9
KGIQ	Twin Falls, Idaho	250	1320	227.1
KGIR	Butte, Mont.	250	1360	220.4
KGIW	Trinidad, Colo.	100	1420	211.1
KGIX	Las Vegas, Nev.	100	1420	211.1
KGJF	Little Rock, Ark.	250	890	336.9
KGKB	Brownwood, Texas	100	1500	199.9
KGKL	San Angelo, Texas	100	1370	218.8
KGKO	Wichita Falls, Texas	250&500	570	526
KGKX	Sandpoint, Idaho	15	1420	211.1
KGO	Oakland, Calif.	7½kw.	70	379.5
KGRC	San Antonio, Texas	100	1370	218.8
KGRS	Amarillo, Texas	1kw.	1410	212.6
KGU	Honolulu, Hawaii	500	940	319
KGW	Portland, Ore.	1kw.	620	483.6
KGY	Lacey, Wash.	10&50	1200	249.9
KHJ	Los Angeles, Calif.	1kw.	900	331.1
KHQ	Spokane, Wash.	1kw.	590	508.2
KICK	Red Oak. Iowa	100	1420	211.1
KID	Idaho Falls, Idaho	250	1320	227.1
KIDO	Boise, Idaho	1kw.	1250	239.9
KIT	Yakima, Wash.	50	1370	218.8
KJBS	San Francisco, Calif.	100	1070	280.2
KJR	Seattle, Wash.	5kw.	970	309.1
KLCN	Blytheville, Ark.	50	1290	232.4
KLO	Ogden, Utah	100&200	1370	218.8
KLPM	Minot, N. D.	100	1420	211.1
KLRA	Little Rock, Ark.	1kw.	1390	215.7
KLS	Oakland, Calif.	250	1440	208.2
KLX	Oakland, Calif.	500	880	340.7
KLZ	Denver, Colo.	1kw.	560	535.4
KMA	Shenandoah, Iowa	500&1kw.	930	322.4
KMBC	Independence, Mo. S—Kansas City, Mo.	1&2½kw.	950	315.6
KMED	Medford, Ore.	50	1310	228.3
KMIC	Inglewood, Calif.	500	1120	267.7
KMJ	Fresno, Calif.	100	1210	247.8
KMMJ	Clay Center, Nebr.	1kw.	740	405.2
KMO	Tacoma, Wash.	1kw&500	860	348.6
KMOX	KFOA—Kirkwood, Mo. S—St. Louis, Mo.	5kw.	1090	257.1
KMTR	Hollywood, Calif.	500	570	526
KNX	Los Angles, Calif. S—Hollywood, Calif.	5kw.	1050	285.5
KOA	Denver, Colo.	12½kw.	830	361.2
KOAC	Corvallis, Ore.	1kw.	550	545.1
KOB	State College New Mexico	10kw.	1180	254.1
KOCW	Chickasha, Okla.	250&500	1400	214.2
KOH	Reno, Nev.	100	1370	218.8
KOIL	Council Bluffs, Iowa	1kw.	1260	238
KOIN	Sylvan, Ore. S—Portland, Ore.	1kw.	940	319
KOL	Seattle, Wash.	1kw.	1270	236.1
KOMO	Seattle, Wash.	1kw.	920	325.9
KOOS	Marshfield, Ore.	50	1370	218.8
KORE	Eugene, Ore.	100	1420	211.1
KOY	Phoenix, Ariz.	500	1390	215.7
KPCB	Seattle, Wash.	50	1210	247.8
KPJM	Prescott, Ariz.	100	1500	199.9
KPO	San Francisco. Calif.	5kw.	680	440.9
KPOF	Denver, Colo.	500	880	340.7
KPPC	Pasadena, Calif.	50	1200	249.9
KPQ	Seattle, Wash.	100	1210	247.8
KPRC	Sugarland, Texas S—Houston, Texas	1kw&2½kw	920	325.9
KPSN	Pasadena, Calif.	1kw.	950	315.6
KPWF	Westminster, Calif. 5 to 10 kw.		1490	201.2
KQV	Pittsburgh, Pa.	500	1380	217.3
KQW	San Jose, Calif.	500	1010	296.9
KRE	Berkeley, Calif.	100	1370	218.8
KREP	Phoenix, Ariz. (formerly KFAD)	500	620	483.6
KRGV	Harlingen, Texas	500	1260	238
KRLD	Dallas, Texas	10kw.	1040	288.3
KRMD	Shreveport, La.	50	1310	228.3
KRSC	Seattle, Wash	50	1120	267.7
KSAC	Manhattan, Kans.	500&1kw	580	516.9
KSAT	Birdsville, Texas S—Fort Worth, Texas. (formerly KTAT)	1kw.	1240	241.8
KSCJ	Sioux City, Iowa	1kw.	1330	225.4
KSD	St. Louis, Mo.	500	550	545.1
KSEI	Pocatello, Idaho	250	900	331.1
KSL	Salt Lake City, Utah	5kw.	1130	265.3
KSMR	Santa Maria, Calif.	100	1200	249.9
KSO	Clarinda, Iowa	500	1380	217.3
KSOO	Sioux Falls, S. D.	2kw.	1110	270.1
KSTP	Westcott. Minn. S—St. Paul, Minn.	10kw.	1460	205.4
KTAB	Oakland, Calif.	1kw.	560	535.4
KTAP	San Antonio, Texas	100	1420	211.1
KTBI	Los Angeles, Calif.	750	1300	230.6
KTBR	Portland, Ore.	500	1300	230.6
KTBS	Shreveport, La.	1kw.	1450	206.8
KTHS	Hot Springs Nat'l Park, Ark.	10kw.	1040	288.3
KTM	Santa Monica, Calif. S—Los Angeles, Calif.	500	780	384.4
KTNT	Muscatine, Iowa	5kw.	1170	256.3
KTSA	San Antonio, Texas.	1&2kw.	1290	232.4
KTSL	Cedar Grove, La. S—Shreveport, La.	100	1310	228.3
KTSM	El Paso, Texas	100	1310	228.3
KTUE	Houston, Texas	5	1420	211.1
KTW	Seattle, Wash	1kw.	1270	236.1
KUJ	Longview, Wash.	10	1500	199.9
KUOA	Fayetteville, Ark.	1kw.	1390	215.7
KUSD	Vermillion, S. D.	500&750	890	336.9
KUT	Austin, Texas	500	1120	267.7
KVEP	Portland, Ore. (formerly KWBS)	15	1500	199.9
KVI	Des Moines, Wash. S—Tacoma. Wash.	1kw.	760	394.5
KVL	Seattle, Wash	100	1370	218.8
KVOA	Tucson, Ariz.	500	1260	238
KVOO	Tulsa, Okla.	5kw.	1140	263
KVOS	Bellingham, Wash.	100	1200	249.9
KWCR	Cedar Rapids, Iowa	100	1310	228.3
KWEA	Shreveport, La.	100	1210	247.8
KWG	Stockton, Calif.	100	1200	249.9
KWJJ	Portland, Ore.	500	1060	282.8
KWK	St. Louis, Mo.	1kw.	1350	221.1
KWKC	Kansas City, Mo.	100	1370	218.8
KWKH	Kennonwood, La.	10kw.	850	352.7
KWLC	Decorah, Iowa	100	1270	236.1
KWSC	Pullman, Wash.	500	1220	245.8
KWWG	Brownsville, Texas	500	1260	238
KXA	Seattle, Wash.	500	570	526
KXL	Portland, Ore.	100	1420	211.8
KXO	El Centro, Calif.	100	1200	249.9
KXRO	Aberdeen, Wash.	75	1310	228.3
KYA	San Francisco	500	1230	243.8
KYW	KFKX—Chicago, Ill.	5kw.	1020	293.9
KYWA	Chicago, Ill.	500	1020	293.9

New Corporations

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Radio Broadcasters of America—Atty. M. J. Cahn, 551 5th Ave., New York, N. Y.

Bischof Phonograph and Radio Exchange—Atty. H. Rosenblatt, 66 Court St., Brooklyn, N. Y.

Aeronautical Radio, Inc.—Corporation Trust Co. of America, Wilmington, Del.

Harry's Radio and Service Station—Atty. H. L. Jessop, 220 West 42nd St., New York, N. Y.

Radio Sport Shop, Schenectady—Atty. E. W. Snell, Schenectady, N. Y.

Great Neck Radio, Great Neck—Atty. J. F. Soviere, Jamaica, N. Y.

Radio Music Co.—Attys. Gilbert & Gilbert, 10 East 40th St., New York, N. Y.

Corona Radio and Music Stores, Corona—Attys. Winne & McDougal, Jamaica, N. Y.

Radio Dealers Association of America, New York—Prentice Hall, Inc., of Delaware, Dover, Del.

Simons Radio Service—**Atty. W. Klein, 1,440 Broadway, New York, N. Y.**

Prudential Radio Tube Corp., Newark—Attys. Green & Green, Newark, N. J.

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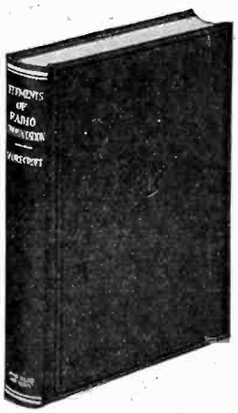

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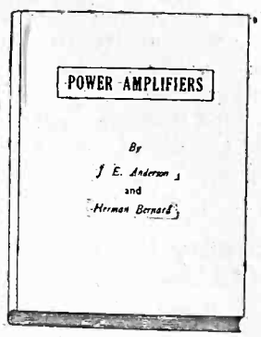

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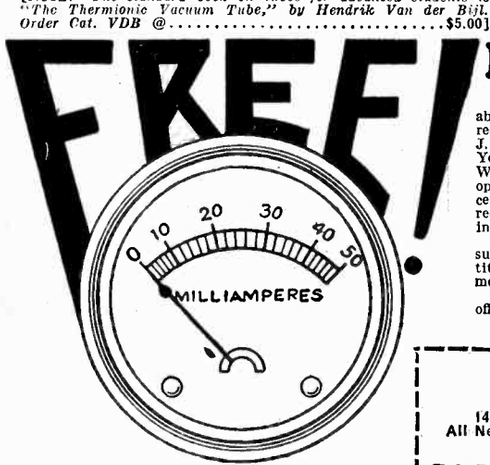

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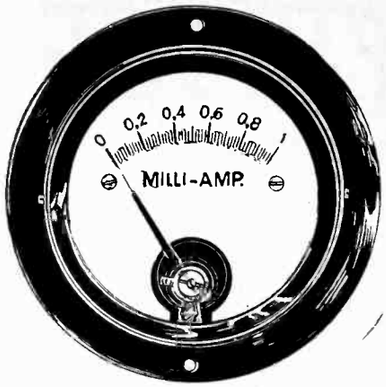

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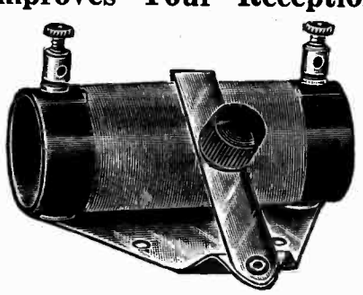

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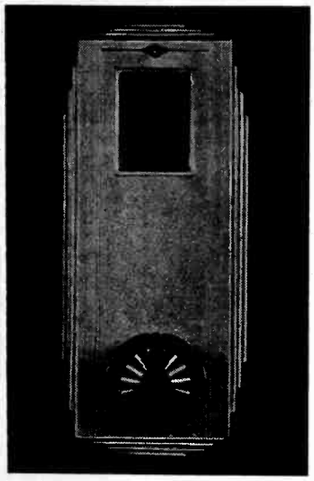

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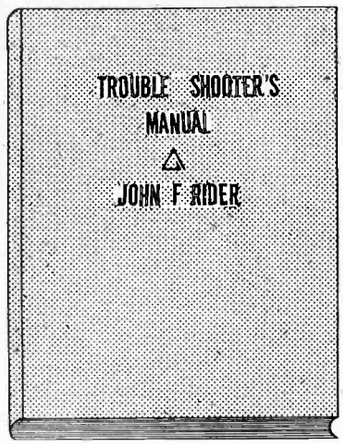

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ATWATER-KENT
10B, 12, 20, 30, 35, 48, 32, 33, 40, 38, 36, 37, 40, 42, 52, 50, 44, 43, 41 power units for 37, 38, 44, 43, 41.

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STEWART-WARNER
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GREBE
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All-AMERICAN
6 tube electric, 8 tube 80, 83, 84, 85, 86, 88, 6 tube 60, 61, 62, 65, 66, u and 8 tube A.C. power pack.

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

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

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

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AMRAD
70, 7100, 7191 power unit.

SPARTON
A.C. 89.

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

HERE ARE THE 22 CHAPTER HEADINGS

Servive Procedure
Practical Application of Analysis
Vacuum Tubes
Operating Systems
Aerial Systems
"A" Battery Eliminators
Troubles in "A" Eliminators
Trouble Shooting in "A" Eliminators
"B" Battery Eliminators
Troubles in "B" Battery Eliminators
Trouble Shooting in "B" Battery Eliminators
Speakers and Types
Audio Amplifiers
Trouble Shooting in Audio Amplifiers
Troubles in Detector Systems
Radio Frequency Amplifiers
Trouble Shooting in RF Amplifiers
Series Filament Receivers
Testing, and Testing Devices
Troubles in DC Sets
Troubles in AC Sets

"Mathematics of Radio"

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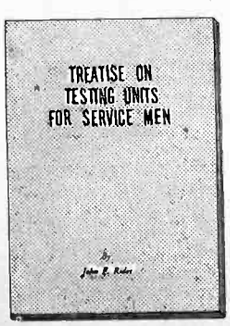
OHM'S LAW.
RESISTANCES: Basis for resistance variation, atomic structure, temperature coefficient, calculation of resistance variation, expression of ampere, volt and Ohm fractions, application of voltage drop, plate circuits, filament circuits, filament resistances, grid bias resistances.
DC FILAMENT CIRCUITS: Calculation of resistances.
AC FILAMENT CIRCUITS: Transformers, wattage rating, distribution of output voltages, voltage reducing resistances, line voltage reduction.
CAPACITIES: Calculation of capacity, dielectric constant condensers in parallel, condensers in series, voltage of condensers in parallel, in series, utility of parallel condensers, series condensers.
VOLTAGE DIVIDER SYSTEMS FOR B ELIMINATORS: Calculation of voltage divider resistances, types of voltage dividers, selection of resistances, wattage rating of resistances.
INDUCTANCES: Air core and iron core, types of air core inductances, unit of inductances, calculation of inductance.
INDUCTANCE REQUIRED IN RADIO CIRCUITS: Relation of wavelength and product of inductanee and capacity, short wave coils, coils for broadcast band, coupling and mutual inductance, calculation of mutual inductance and coupling.
REACTANCE AND IMPEDANCE: Capacity reactance, inductance reactance, impedance.
RESONANT CIRCUITS: Series resonance, parallel resonance, coupled circuits, bandpass filters for radio frequency circuits.
IRON CORE CHOKERS AND TRANSFORMERS: Design of chokes, core, airgap, inductance, reactance, impedance, transformers, half wave, full wave windings.
VACUUM TUBES: Two element filament type, electronic emission, limitations, classifications of filaments, structure, two element rectifying tubes, process of rectification, tungar bulb.
THREE ELEMENT TUBES: Structure of tube, detector, grid bias, grid leak and condenser, amplifiers, tube constants, voltage amplification, resistance coupling, reactance coupling, transformer coupling, variation of impedance of load with frequency, tuned plate circuit.
POWER AMPLIFICATION: Square law, effect of load, calculation of output power, undistorted output power, parallel tubes, push-pull systems, plate resistance.
GRAPHS AND RESPONSE CURVES: Types of paper, utility of curves, types of curves, significance of curves, voltage amplification, power amplification, power output, radio frequency amplification.
MULTIPLE STAGE AMPLIFIERS: Resistance coupling, reactance coupling, tuned double impedance amplification, underlying principles, transformer coupling, turns ratio, voltage ratio, tyes of cores, late current limitation, grid current limitation.
ALTERNATING CURRENT TUBES: Temperature variation hum, voltage variation hum, relation between grid and filament, filament circuit center tap, types of AC tubes.
SCREEN GRID TUBE: Structural design, application, amplification, associated tuned circuits, radio frequency amplification, audio frequency amplification.



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General Utility Tube Tester
AC-DC Receiver Tester
Eliminator Testers
Signal Generator for Receiver Testing
Oscillators
Cathode Ray Oscillograph
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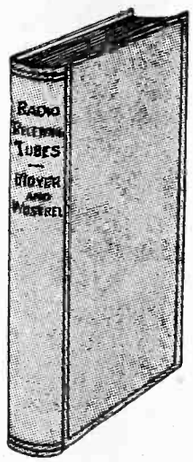

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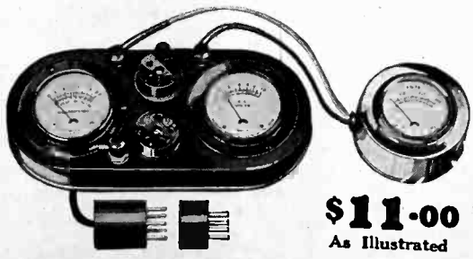

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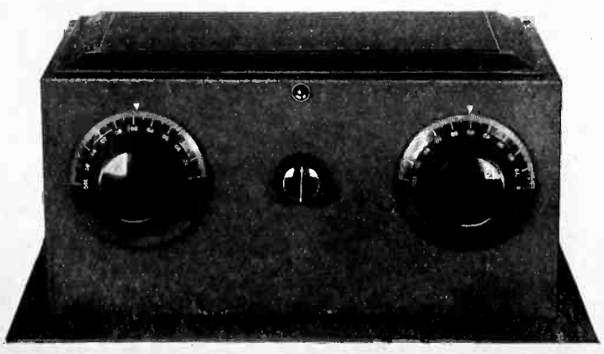
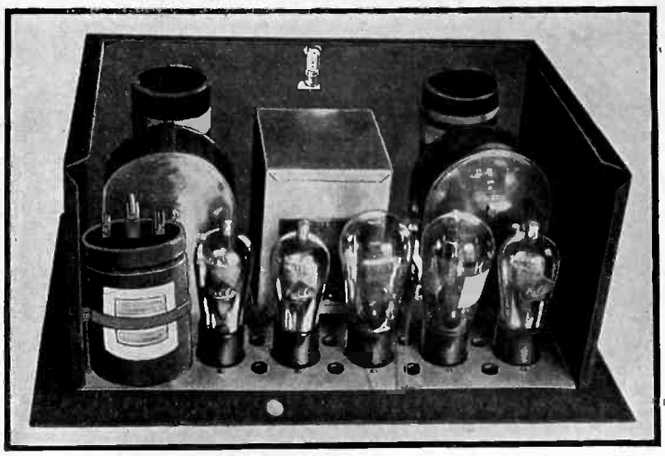


Front view of the HB Compact. The view is the same for AC or battery model. For batteries the switch is built in the rheostat. For AC a pendant switch is used at rear, in the AC cable.



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

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R3—One .075 meg. metallized resistor	.40
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One 7-lead battery cable	.50
	$23.75

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

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

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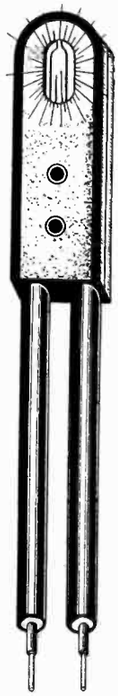
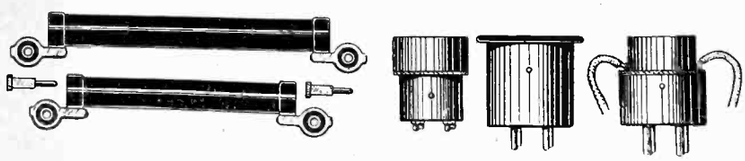
Complete



Illumination Tester, Vest Pocket Size, Shows Shorts and Opens Visually, also polarity of DC line. A Neon lamp is built in.

The three-meter assembly, in the crackle-brown finish carrying case, with slip-on cover in place. The handle is genuine leather. The buckled strap holds the cover on.

Illustration above is 2/3 scale.



J-111 Multiplier, upper left, with tip; below it, J-106 Multiplier with tip; plugs, left to right, J-19, conforms UV socket to UX plug; J-20, conforms UX tester socket to UV199 tube; J-24, to test Kellogg and old style Arcturus tubes.

Makes All Necessary Tests in a Jiffy and Simplifies Service Work!

THE new Jiffy Tester, J-245-X, is a complete servicing outfit. It consists of a three-meter assembly in a metal case, with slip-on cover and a cable plug. There are ten adapters. It is vital to have the complete outfit so you can meet any emergency.

With this outfit you plug the cable into a vacated socket of a receiver, putting the removed tube in the tester, and using the receiver's power for making these tests: plate current, up to 100 milliamperes; plate voltage up to 300 volts; filament or heater voltage (AC or DC), up to 10 volts.

Each meter may be used independently. One of the adapters—a pair of test leads, one red, the other black, with tip jack terminals—serves this purpose. Multiplier J-106 extends the range of the DC voltmeter to 600 volts, but this reading must be obtained independently, as must readings on the 0-60 scale of the DC voltmeter. Independent reading of the AC voltmeter for line of voltage is necessary; also to use 0-140 scale while Multiplier J-111 extends the AC scale to 560 volts for reading power transformer secondaries.

The other adapters permit the testing of special receiver tubes, so that tests may be made, in all, of 22 different tubes: 201A, 200A, UX199, UV199, 120, 240, 171, 171A, 112, 112A, 245, 224, 222, 228, 280, 281, 227, 226, 210, 250, Kellogg tubes and old style Arcturus tubes.

WHEN servicing a radio set, power amplifier, speech amplifier or sound reproduction or recording equipment, the circuits and voltages are almost inaccessible, unless a plug-in tester is used.

The Jiffy 245-X plugs in and does everything you want done. It consists of:

(1)—The encased three-meter assembly, with 4-prong (UX) and 5-prong (UY) sockets built in; changeover switch built in, from 0-20 to 0-100 ma.; ten vari-colored jacks, five of them to receive the vari-colored tipped ends of the plug cable; grid push-button, that when pushed in connects grid direct to the cathode for 224 and 227 tubes, to note change in plate current, and thus shorts the signal input.

(2)—4-prong adapter for 5-prong plug of cable.
(3)—Screen grid cable for testing screen grid tubes.
(4)—Pair of Test Leads for individual use of meters.
(5)—J-106 Multiplier, to make 0-300 DC read 0-600.
(6)—J-111 Multiplier, to make 0-140 AC read 0-560.
(7)—Two jack tips to facilitate connection of multipliers to jacks in tester.
(8), (9), (10)—Three adapters so UV199 and Kellogg tubes may be tested.
(11)—Illumination Tester.

The illumination tester will disclose continuities and opens and also the polarity of DC house mains. It is as handy as a pencil and fits in your vest pocket. It works on voltages from 100 to 400. There are two electrodes in a Neon lamp in the top of the instrument. On AC both electrodes light. On DC only one lights, and that one is negative of the line, the light being on the same side as the lead. Hence the illuminator shows whether tested source is AC or DC, and if DC, which side is negative.

Even the output of the speaker cord will show a light.

Also, the device will test which fuses are blown in fused house lines, AC or DC. Besides it tests ignition of spark plugs of automobiles, boats and airplanes, also faulty or weak spark plugs.

Just flash on the illumination tester momentarily. It will last about 4,000 flashes.

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☐ Please send me on 5-day money-back guaranty your J-245-X Jiffy Tester, complete, with all 10 adapters, and with Illuminated Tester FREE with each order. Also send instruction sheet, tube data sheet and rectifier tube testing information.

☐ Enclosed please find $15.82 remittance. Ship at your expense. [Canadian must be P.O. or Express M.O.]

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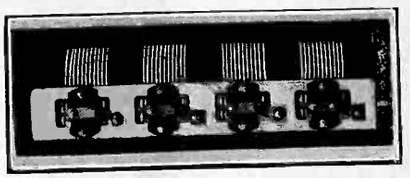

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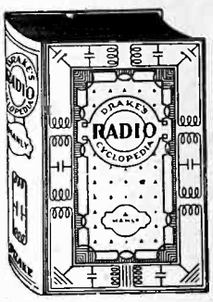

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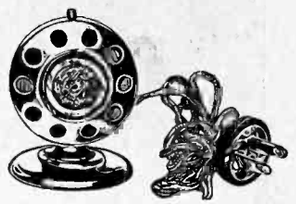
MICROPHONE LIGHTERS

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



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

Model B lighter, microphone design, on tray, with 5-ft AC cable and plug. Works on 110 volt AC, any frequency, and on direct current. Exactly the same lighter as the other, only tray is added. Price.....$1.50

This lighter is instantaneous. Hold button down only long enough to light a cigar or cigarette. The two models are furnished in attractive sprayed finish. Both are very compact! For instance, the tray is only 4½" in diameter. Use these lighters in your home and for holiday gifts.

The heater element is renewable.

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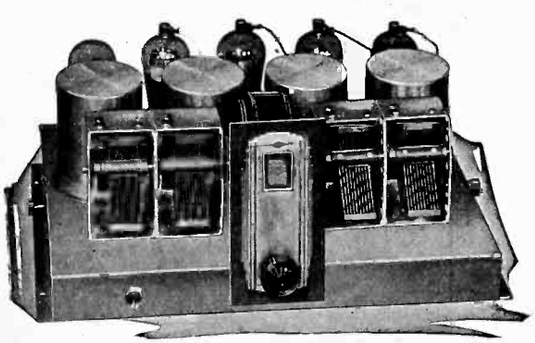
NATIONAL SCREEN GRID TUNER

MB-29

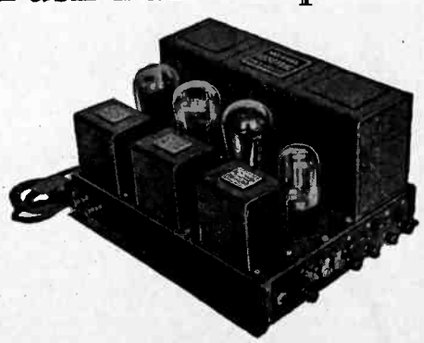


The most sensitive tuned radio frequency tuner so far developed, the MB-29 is long on distant reception, and penetrates seemingly unsurmountable barriers to reception. On the MB-29 the stations come in no matter where you are. The MB-29, designed by James Millen and Prof Glen H. Browning, is the choice of the most discriminating. It is designed only for AC operation, uses four stages of screen grid RF and a power detector (227). Use 135 to 180 volts on the detector. Testimonials from radio's hardest-boiled experts prove this is the circuit of circuits. Buy the parts and find fullest radio delight. You will be sure nobody else has a tuner as good as yours, unless he too has an MB-29. Complete component parts for National Screen Grid Tuner MB-29, mounted on frosted aluminum chassis, including rainbow modernistic drum dial HC. Order catalog No. MB-29-K, list price, less tubes, $69.50. Your price **$40.00**

Push-Pull Amplifier

The National Velvetone Push-Pull Power Amplifier (shown at right) consists of an AC-operated filament-plate supply, with two stage transformer audio amplifier and output transformer built in. Made only for 110-V., 50-60 cycles. Sold only in completely wired form, licensed under RCA patents.

The new Power Amplifier has been developed and built to get the very most out of the MB-29. It is a combination power supply and audio amplifier, using a 280 tube for a rectifier, one stage of transformer audio with a 227 tube and a stage of push pull amplification with two 245s. It furnishes all power for itself and for the MB-29, as well as the audio channel. Order catalog PPPA, list price, completely wired and equipped with phonograph jack, (less tubes) $97.50. Your price. **$55.00**



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

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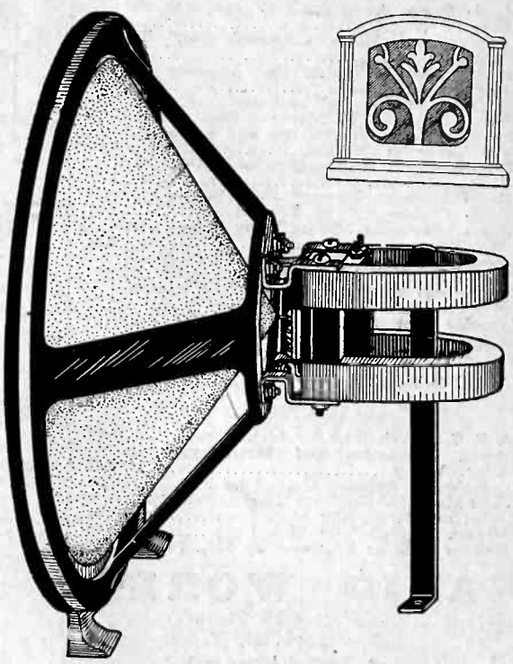
Highest Grade Speakers at Lowest Prices!

T-E-M-P-L-E F-A-R-R-A-N-D

Temple AC Dynamic Model 10, in a beautiful cabinet. The speaker chassis is one of the finest made. There are an output transformer and dry rectifier built in. The cabinet has decorated walnut front and back, with carved grille ornament. An AC switch is accessible underneath cabinet. Rear is removable for adjustment of resistor knob to match the impedance of your receiver's output tube. Connect plugged AC cable to 110 volts AC, 50 to 60 cycles, and connect tipped cords to speaker post of receiver. This remarkable speaker **Cat. TEM-10 at only** **$15.34**



Farrand Inductor Chassis, consisting of the unit, cone, spider, bracket, assembled, but not in a cabinet.

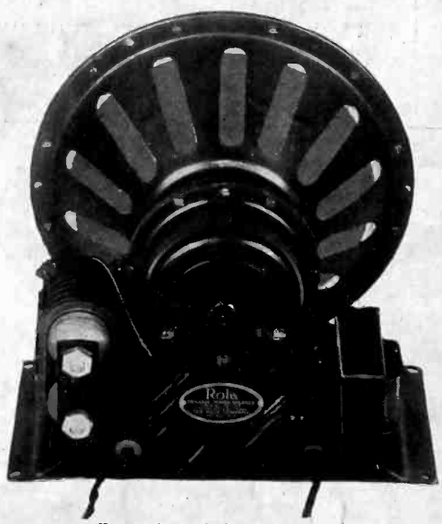
Model 6-G, 10″ extreme diameter of cone front rim **$9.00**

Model 10-G, 12″ extreme diameter of cone front rim **$10.00**

Model 10-G-PP for connection to push-pull, requiring no output device, because unit is constructed as a center tapped output impedance. Center tap is yellow and goes to B+. Tipped cords go direct to plates. Outside diameter 12″..... **$11.00**

Brookfield cabinet, No. 10 or No. 6 for those speakers, ... **$6.50**

R-O-L-A



Rear view of the Rola chassis

Rola Model D-10 dynamic chassis, less cabinet, for 110 volts 50-60 cycles AC. Dry rectifier and output transformer built in. The fine workmanship of this chassis is shown in the illustrations of the front and rear views. Extreme diameter of rim 9 inches but baffles with cutouts down to 7 inches may be used.

This is the biggest dynamic chassis bargain we have ever offered and enables you at low price to obtain one of the best chasses made. Tone is most excellent.

Order Cat. No. RO-10 at .....

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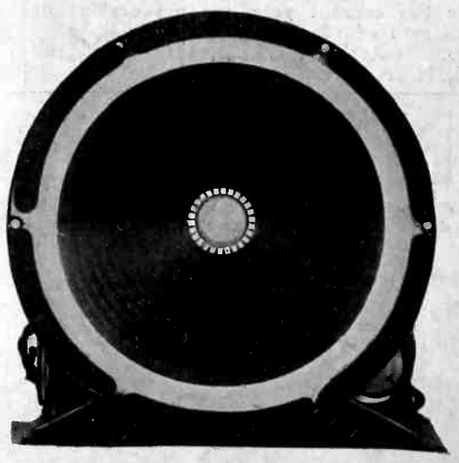

Front view of the Rola chassis. Holes are provided for attachment to your own baffle. The rim is protected by a lining of felt. The voice coil (center) is firmly mounted.

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

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Model 10-G-PP Farrand may be used in push-pull without any output device. Connect yellow lead to B+, tipped leads to power tube plates. May be used on single output by ignoring yellow lead.