Dec. 20
1930

$15 REMOTE CONTROL BOX

Price,
15 Cents
Per Copy

RADIO WORLD
REG. U.S. PAT. OFF.

The First and Only National Radio Weekly

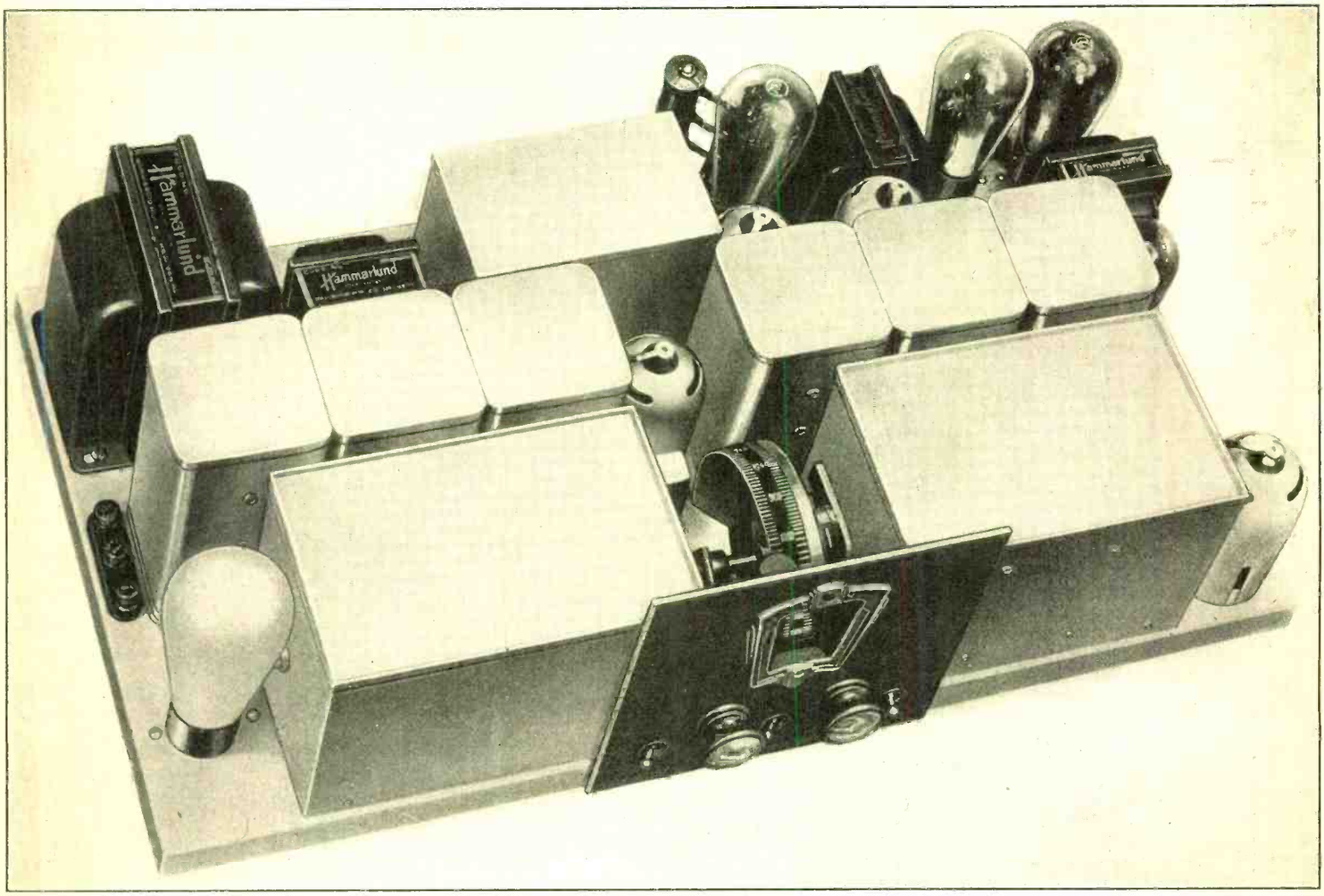
456th Consecutive Issue—NINTH YEAR

Diagrams of the New Philco Sets

Transmitting Circuits

Battery Victoreen Changed to AC

THE HI-Q 31 CUSTOM-BUILT RECEIVER



A Real Performer, the New HI-Q 31. See Article on Pages 5, 6 and 7

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.

REMOTE CONTROL TUNER

This Will Be the 1931 Sensation!

THE standard Supertone Remote Control Box permits control of all three operations up to 12 feet from *any* tuned radio frequency set: (1), tuning; (2), volume; (3), switching everything on or off. For AC operation. Requires only 45 to 180 B volts taken from set. No molestation of receiver. No aerial required. All parts, as specified by Herman Bernard, including filament transformer (less two 227 tubes.)

Order Cat. RCB @ $12.81
If 12-ft. radius is desired, instead of 6-ft., order Cat. RCB-12 @ $14.23
The battery model parts, 6-ft. radius, are Cat. RCB-BAT (less two 201A tubes) @. $9.34
For 12-ft. radius order Cat. RCB-BAT-12 @.$10.46

EFFICIENT AC short-wave converter, 10 to 200 meters with total of only two plug-in coils. Filament transformer built in. Three 227 tubes used. Single tuning control. Hammarlund condenser. Equipped with AC switch. Works with any broadcast receiver, either TRF or Superheterodyne. No molestation of receiver. No grunting, body capacity or squeals. All parts and coils as specified by Herman Bernard. Order Cat. SUP-3FS @ $9.58

BATTERY MODELS

Cat. SUP-327-B, same appearance, uses three 227 heaters in series, across 6 v. battery. All parts, coils 6.61
Cat. SUP-230-B. uses three new 2-volt 230 tubes, filaments in series. All parts, coils.. 6.61
[We will supply 227 tubes on request @ 90c each, 201A tubes @ 73c each.]

SUPERTONE PRODUCTS CORP.
216 Wallabout Street Brooklyn, N. Y.

DOUBLE RANGE POTENTIOMETER; made by Centralab, designed for volume control. 10,000 and 20,000 ohms. Price, $1.05. Guaranty Radio Goods Co., 143 W. 45th St., New York.

Ansonia Gothic Speaker - - $3.95

Magnetic speaker in genuine, beautiful walnut cabinet. Order Cat. AN-G at $3.95.

Square Model (same unit and cone) Cat. AN-S at $3.67

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

Fixed Condensers

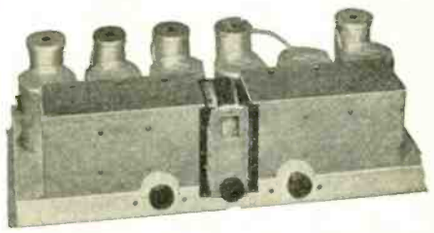
Dubilier Micon fixed condensers, type 642, are available at following capacities and prices:

.0001 mfd.	10c	.006	20c
.00025 mfd.	10c	.00025 with clips.	20c
.0003 mfd.	10c	All are guaranteed	
.00035 mfd.	12c	electrically perfect and	
.001	12c	money back if not	
.0015	12c	satisfied within five	
.002	18c	days.	

Order Cat. MICON .0001 etc. at prices stated.

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

Parts for the Best Circuits



NEW NATIONAL DE LUXE MB-30 SCREEN GRID TUNER—This is one of the most sensitive tuners ever developed, averaging 1 microvolt per meter, and at some frequencies attaining ¼ microvolt per meter. Its selectivity is most remarkable, and without material sideband cutting, due to use of Vreeland band pass filter and pre-selector circuits. Six tuned circuits, perfectly aligned and tested with laboratory equipment that cost more than $1,000. The circuit, which is for AC only, uses four 224 and one 227 tubes and requires a power amplifier that will power the heaters as well. All parts mounted on chassis, ready for wiring. Steel chassis, 21⅞x10¾x1⅛". Order Cat. MB-30-P, list price $85 less tubes; net price.....$48.97

WIRED MODEL, Cat. MB-30-W, list price $95 less tubes; net price.....$54.86

MB-29-A TUNER, a smaller version of the MB-30, using four instead of six tuned circuits, but including also the pre-selector and band pass filter circuits. Uses three 224 and one 227. Aluminum chassis 15¾x10¾x1⅛". Order Cat. MB-29-AP, list price $69.50 less tubes; net price..... $40.66

WIRED MODEL, Cat. MB-29-AW, list price $79.50, less tubes; net price.....$46.74

NATIONAL VELVETONE Push-Pull Power Amplifier, using one 227, two 245's and one 280; two stages of transformer coupling, with output transformer; heater voltage for five extra tubes; plate voltage for tuner. A matched unit for the MB-30 or MB-29-A. Phonograph jack built in. Velvetone comes completely wired. Licensed by RCA. Order Cat. PPPA, list price $97.50, ess tubes: net price.....$57.33

HI-Q 31

HAMMARLUND HI-Q-31—The latest development in custom-set building, a 9-tube circuit, using a 3-stage band-pass filter pre-selector, three stages of 224 RF, 224 power detector, 227 first audio, two 245's for push-pull output, and a voltage regulator tube. Chassis is 23⅜x12¾". Order Cat. AC-31-B, list price of complete parts, $159.80, less tubes; net price.....$91.06

WIRED MODEL HI-Q-31—Order Cat. AC-31-BW, list price, $184.80, less tubes; net price.....$111.06

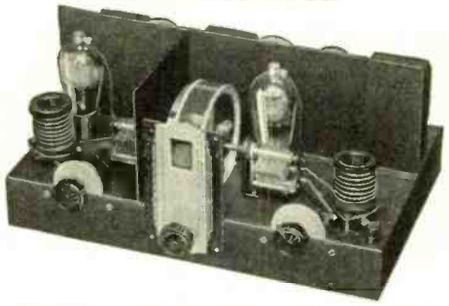
HI-Q AC TUNER WITH POWER SUPPLY (less audio)—Order Cat. AC-31-TPS, list price $148.55, less tubes; net price.....$82.78

HI-Q-AC TUNER ONLY (for use with external power supply)—Order Cat. AC-31-T, list price, $107.20, less tubes; net price.....$61.09

HI-Q-31 FOR BATTERY OPERATION—Order Cat. BAT-31-B, list price, $119.55, less tubes; net price $68.14

HI-Q-31 TUNER FOR BATTERY OPERATION (less audio)—Order Cat. BAT-31-T, list price $102.95, less tubes; net price.....$58.89

Short Waves



NATIONAL 5-TUBE THRILL BOX—A remarkably sensitive short-wave outfit, noted for reception of foreign stations. Uses 224 RF, 224 detector, 227 first audio, 227 push-pull second audio. A separate A and B supply is required. See below. Standard set of four pairs of coils included (21.2 to 2.61 megacycles). Humless operation, even on earphones. Single tuning control. No grunting, no backlash, no hand capacity. Order Cat. AC-8W-5, list price, less tubes, less B supply, $79.50; net price $46.74

NATIONAL SW POWER UNIT—Furnishes heater voltage and B voltage for the AC Thrill Box. Uses 280 rectifier. Comes in wired form only. Licensed under RCA patents. Order Cat. 5880, list price, less tube, $34.50; net price.....$20.28

BATTERY MODEL THRILL BOX—This uses the new 2-volt tubes; two 232 screen grid, three 230 and one 231, in same general circuit. Order Cat. DC-8W-5, list price $75; net price.....$44.10

WIRED MODEL AC THRILL BOX—Order Cat. AC-8W-5-W. List price, $89.50, less tubes, less power unit; net price.....$52.62

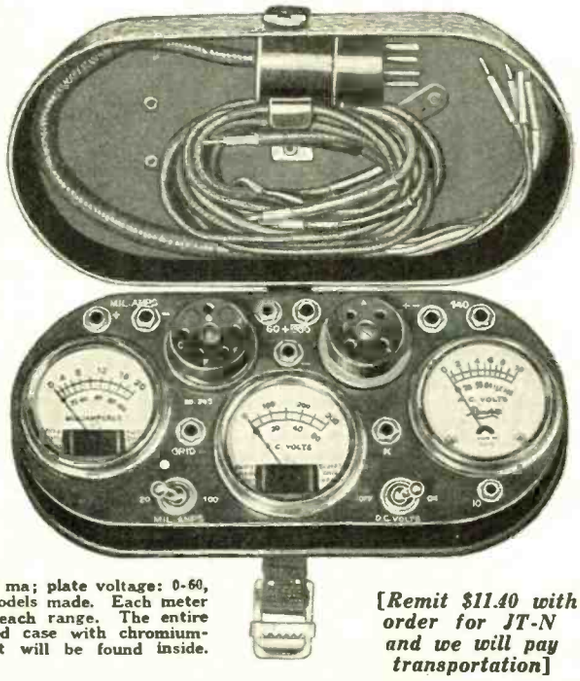
WIRED MODEL BATTERY THRILL BOX—Order Cat. DC-8W-5-W. List price, $85, less tubes; net price..... $49.98

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

The New Jiffy Tester

Chromium-Plated Case and Accurate Meters

A NEW and improved Jiffy Tester, improved in both performance and appearance, is Model JT-N. The meters are of the moving iron type. Tested on precise batteries, they show errors not exceeding 2%. As for appearance, the case is first copper plated, then nickel plated, then chromium plated, giving a lustrous, permanent, non-peeling non-rusting finish. It is the same finish found on hardware in fine automobiles. The handle and lock strap are genuine leather.



Jiffy Tester, Model JT-N, consists of three double-reading meters, with cable plug, 4-prong adapter, test cords and screen grid cable, enabling simultaneous reading of plate voltage, plate current and filament or heater voltage (DC or AC), when plugged into the socket of any set. The ranges are filament, heater or other AC or DC: 0-10 v, 0-140 v; plate current: 0-20, 0-100 ma; plate voltage: 0-60, 0-300 v. It makes all tests former models made. Each meter is also independently accessible for each range. The entire device is built in a chromium-plated case with chromium-plated slip-cover. Instruction sheet will be found inside. Order Cat. JT-N.

[Remit $11.40 with order for JT-N and we will pay transportation]

GUARANTY RADIO GOODS CO.

143 WEST 45th STREET (Just East of Broadway) NEW YORK, N. Y.

RADIO MAP

OF NORTH AMERICA

22 x 22 inches, printed in two colors, bound in cover.

Shows every city from Balboa to Edmonton which has a broadcasting station.

Indexed by states, provinces and cities with key for instant location on map.

Call letters, power and frequency given for each station.

Accurate; up-to-date

Scale in miles gives distances between any two cities. Time zones correctly marked.

Just what you have been wanting.

25 cents

THE RADEX PRESS

1368 E. 6th St. Cleveland, Ohio

Horn Unit $1.95

Fidelity Unit, Cat., FDU.

The Fidelity unit is pre-eminent for horn type speakers such as exponential 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, or tubes requiring no extra voltage source. Standard size nozzle and thread. Works great from AC set, battery set or any other set, push-pull or otherwise. The casing is full nickel finish, highest polish.

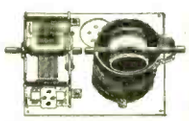
This unit can be used in a portable without any horn attached and will give loud reproduction.

Order Cat. FDU, with 50-inch tipped cord; weight, 2¼ lbs.; size, 2¾-inch diameter, 2⅝-inch height. (This is the large size). Price..... $1.95

GUARANTY RADIO GOODS CO.

143 West 45th Street, New York City

TUNER ASSEMBLIES



A tuning condenser with coil to match, mounted on an aluminum base that has socket built in. The condenser shaft goes in a dial (not furnished). The tuned circuit includes a fixed and a movable winding (rotor coil) in series. The moving coil is used as a trimmer, set once and left thus, so two separate dials are made to read alike, or gang tuning is made pactical. No equalizing condensers needed. Do not couple the adjoining shafts.

For antenna circuit, input to 226, 201A, UX199, 240, 230, 232 and 222, or any other tube fitting four-prong UX socket, or for interstage coupling for 226, 201A, 199, 240 or 230, but NOT interstage for 232 or 222, order cat. BT-L-DC ..... @ $1.25

For interstage coupling for 232 and 222, order cat. BT-R-DC ..... @ $1.25

For antenna circuit as RF input to 224 or 227, or for 227 interstage coupling, (five-prong UY socket furnished) order cat. BT-L-AC ..... @ $1.25

For interstage coupling for 224 (5-prong UY socket furnished, order cat. BT-R-AC ..... @ $1.25

SCREEN GRID COIL CO.

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

A BEAUTIFUL GIFT FOR THAT RADIO FRIEND

ARISTOCRAT FLOOR SPEAKER

With Molded Wood Horn and Horn Motor built in into a walnut finish cabinet. Must come and take it away. Good value. $4.95.

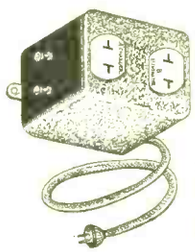
GUARANTY RADIO GOODS CO.

143 West 45th Street New York, N. Y.

DEALERS and SERVICE MEN!
STANDARDIZE ON

For Permanent Replacement—Accurate—Guaranteed
Write for descriptive catalogue "W"
LYNCH MFG. CO., INC., 1775 Broadway, New York

BRACH RELAY



ONLY 99c

List price, $4.50

Connect relay's cable plug to 105-125 volt AC line. Connect B eliminator cable plug to relay socket so marked; connect trickle or other charger's plug to relay socket so marked; connect one side of A battery to binding post, other side to A set. Then turning on your set twins on B eliminator and turns off charger, turning off set turns on charger and turns off B eliminator.

GUARANTY RADIO GOODS CO.
143 West 45th Street
New York City—Just E. of B'way

Set of SOCKET WRENCHES *FREE*

FOR turning nuts down or up there is nothing as efficient and handy as a socket wrench. Here is a set of three wrenches for hexagonal nuts, enabling use with 5/32, 6/32, 8/32 and 10/32 nuts. Fit the nut into the proper socket and turn down or up. The three different size sockets, one size on each wrench, enables use of three different outside diameters of nuts, but at least ten different sizes of threads. Send $1.00 for eight weeks subscription for RADIO WORLD and get this set of three wrenches FREE!

RADIO WORLD, 145 W. 45th St., New York, N.Y.
Enclosed $1.00 for 8 weeks. Send wrenches.

Name .....

Address .....

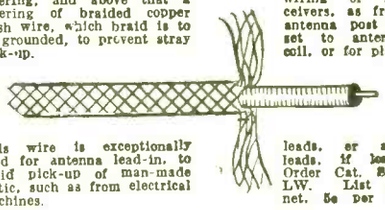
City..... State.....

☐ Cross here if extending existing subscription.

SHIELDED LEAD-IN WIRE

No. 18 solid wire, surrounded by a solid rubber insulation covering, and above that a covering of braided copper mesh wire, which braid is to be grounded, to prevent stray pick-up.

Also used to advantage in the wiring of receivers, as from antenna post of set to antenna coil, or for plate



This wire is exceptionally good for antenna lead-in, to avoid pick-up of man-made static, such as from electrical machines.

leads, or any leads, if long. Order Cat. SH-LW. List 9c, net. 5c per ft.

GUARANTY RADIO GOODS CO.

143 West 45th St., New York, N. Y.

Songwriters Service Co.

6719 Hollywood Boulevard, Dept. R. W.
Hollywood, California

Talking Pictures offer new opportunities. Your songs personally submitted to Picture Studios, revised for publication by Hit Writers. Words, Music. Arranging, everything pertaining to songs.

Just Off the Press!

The NEW HiQ-31 MANUAL

Brimming with valuable data on the latest HAMMARLUND development, the new "HiQ-31" Manual will more than interest you. And also, there is a wealth of information on power amplifiers, house wiring methods, etc., in the manual.

Get the most interesting radio book ever published—TODAY! Fill in the blank below—NOW!

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

HAMMARLUND-ROBERTS, INC., Dept. RW-12,
424-438 W. 33rd Street, New York, N. Y.

Enclosed 25c (stamps or coin) for which please send copy of the HiQ-31 Manual.

NAME..... ADDRESS.....

IS THIS YOUR FIRST VIEW

of the series of articles on short-wave converters? If so, be sure to get the recent issues dealing with the absorbing topic of bringing in short waves on your broadcast receiver.

In the November 8th issue of RADIO WORLD there began this remarkable series dealing with the construction of short-wave converters that really do work, and that work well. Besides, the cost of parts is low. One model, 30 to 110 meters, no plug-in coils, may be built of parts costing less than $5, while another model, 10-200 meters, two plug-in coils, using somewhat superior parts, can be built for less than $10. Surely these are prices within the reach of all.

Low price and high achievement go hand in hand in these designs by Herman Bernard.

Send in $1.50 for a three-months subscription for RADIO WORLD and we will send you as a free premium the issues of November 8th, 15th, 22nd and 29th, and December 6th and 13th, bringing the complete series up to date, and besides, we will send you FREE a blueprint of the AC model with external filament supply.

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

Enclosed please find $1.50 for which enter my subscription for RADIO WORLD, for three months, and as a premium send me free the November 8th, 15th, 22d, and 29th, and Dec. 6th and 13th issues, bringing up to date the series of articles on short-wave converters of extremely low price.

Name .....

Address .....

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

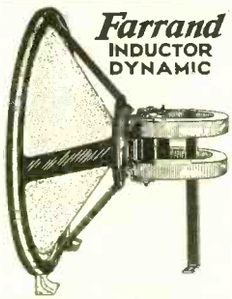
The inductor dynamic offers high sensitivity and true tonal response. It requires no exciting field current, unlike other dynamics. Order model R for 112 or 112A, and Model G for all other output tubes.

Cat. 9-G (9" extreme outside diameter) $8.49

Cat. 9-R $8.49

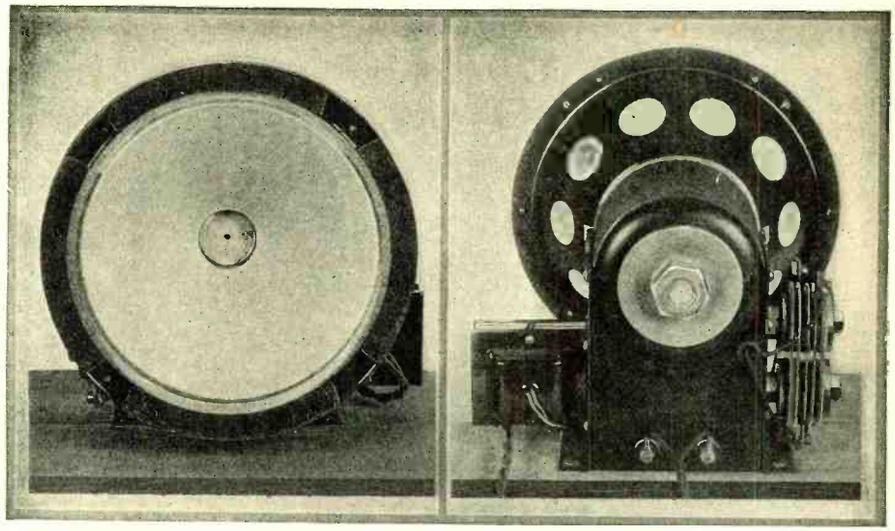
Cat. 12-G (12" extreme outside diameter) $10.03

Cat. 12-R $10.03



GUARANTY RADIO GOODS CO.
143 W. 45th St., New York, N. Y.

Erla Dynamic Chassis, Westinghouse Rectifier



One of the most sensitive and most faithful dynamic speaker chasses, the Erla, has a 9-inch outside diameter cone, with built-in Westinghouse Rectox dry metallic rectifier, output transformer and mounting board. Equipped with 10-ft. A.C. cable and plug, to go into house socket, 110 v. 50-60 cycle, and two 10-ft. tipped leads for connection to set. Will stand up to output of 250 tubes in push-pull, but will work well on any set, battery-operated or A.C. Order Cat. ER-D-AC. List price $25.00; net price **$10.50**

6v. DC model, to be energized by your 6-volt storage battery. Order Cat. ER-6-v. @..... 8.50

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

Save Money on Tubes!

Get a Guarantee Just the Same!

QUALITY tubes at enormously reduced prices enable you to save money and obtain full satisfaction. **Any tube will be replaced on request within thirty days of its sale!**

These tubes are made by a manufacturer of national reputation and are not "distress merchandise." No tube is shipped until it is carefully checked on a Readrite No. 9 Radio Test Kit.

Type	List Price	Your Cost	Type	List Price	Your Cost	Type	List Price	Your Cost
☐ 201A	$1.25	49c	☐ WD-12	$3.00	59c	☐ 245	$2.00	59c
☐ 226	1.75	49c	☐ 200A	4.00	59c	☐ 280	1.90	59c
☐ 199-UX	2.50	59c	☐ 171A	2.25	59c	☐ 224	3.30	59c
☐ 199-UV	2.75	59c	☐ 171AC	2.25	59c	☐ 222	4.50	95c
☐ 120	3.00	59c	☐ 112A	2.25	59c	☐ 281	7.25	95c
☐ WD-11	3.00	59c	☐ 227	2.20	59c	☐ 210	9.00	95c

☐ 250, List $11.00, your cost, 95c.

[Remit with order for tubes and we pay postage]

DIRECT RADIO CO.
Room 504, at 1562 Broadway, New York, N. Y.
(Between 46th and 47th Streets)

Quick Action Classified Ads

Radio World's Speedy Medium for Enterprise and Sales

7 cents a word—$1.00 minimum—Cash with Order

IMPORTED NOVELTY OF MYSTERY. Fascinating and amusing, sample 15c, Ray-Hud Co. Box 471, West Tulsa, Okla., Dept. R.

MAJESTIC, RADIOLA, etc. Drum Dial Cable by foot or mile. Service men's test prods, 50c, 75c, $1.00. Blan, the Radio Man, Inc., 89 Cortlandt St., New York.

MAGICALLY CLEANS FALSE TEETH—WHATAJOY Wonder Cleaner. Instantly removes film. Cleans and purifies plate. Approved by licensed chemist. Costs about 5c per mo. A big treat awaits you. Prepaid 25c. WHATAJOY LAB., Alhambra, Cal.

FOR SALE HiQ 30 CHEAP. F. L. Hanson, Ilion, N. Y.

BARGAINS in first-class, highest grade merchandise. B-B-L phonograph pick-up, theatre type, suitable for home with vol. control, $6.57; phono-link pick-up with vol. control and adapter, $3.32; steel cabinet for HB Compact, $3.00; four-gang .00035 mfd. with trimmers built in, $1.95; .00025 mfd. Dubilier grid condenser with clips 18c. P. Cohen, Room 1214, at 143 West 45th Street, N. Y. City.

SONG WRITERS—Poems, Melodies. Opportunity. Tommie Malie, RW-4215 North Ave., Chicago.

"A B C OF TELEVISION" by Yates—A comprehensive book on the subject that is attracting attention of radioists and scientists all over the world. $3.00, postpaid. Radio World, 145 West 45th St., N. Y. City.

POWERS PACKS, 110 volts, 60 cycle. Supply 1½, 2½ and 5 volts AC, 165 volts DC. Complete with 280 tube $6.25. Cash Radio, 1013 N. McDonel St., Lima, Ohio .

OUR CONVERTER makes your radio public address system. Bay Laboratories, Box 1183, San Francisco, Calif.

POWER UNIT CONSTRUCTION—The book that enables you to wind your transformers, chokes, and figure correct size resistors for the voltage control, and other valuable information. Price .50. Shipped C. O. D.. Ralph B. Davis & Co., Prestonsburg, Ky.

HORN UNIT, $2.25—This is the Fidelity Unit and has stood the test of time. Guaranty Radio Goods Co., 143 W. 45th St., New York.

"UNINTERRUPTED READER INTEREST"
EVERY WEEK — EVERY YEAR

RADIO WORLD

Vol. XVIII. No. 14 Whole No. 456
December 20th, 1930
[Entered as second-class matter, March, 1922, at the Post Office at New York, N. Y., under act of March, 1879]
15c per Copy, $6.00 per Year

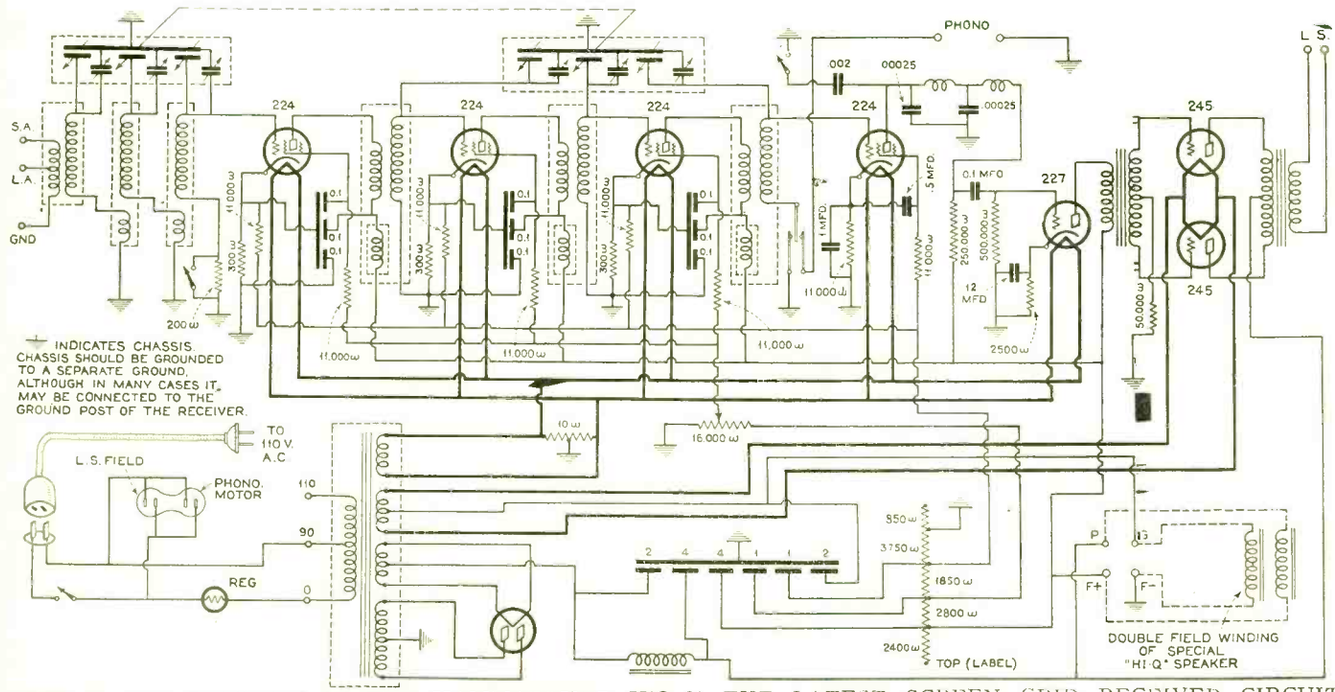
NINTH YEAR
Latest Circuits and News
Technical Accuracy Second to None

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

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

The Hi Q-31 Receiver

By Lewis W. Martin



HERE IS THE DIAGRAM OF THE HAMMARLUND HiQ-31 THE LATEST SCREEN GRID RECEIVER CIRCUIT, EMBODYING THE MOST UP-TO-THE-SECOND IMPROVEMENTS, AS THE AUTHOR SETS FORTH IN THE TEXT.

ULTRA-MODERN broadcast receiver design and production necessitate a most thorough personal knowledge of radio engineering and its many ramifications, the assistance of a laboratory that is complete in every detail, and of a group of highly trained, skilled machinists and toolmakers. Thus absolute accuracy is insured, to afford a positive foolproof product. That no name has been more closely related with equipment of this nature than Hammarlund is more than familiar, and especially with the HiQ receivers. And each year has seen the launching of a new model replete with latest developments.

Blending the many outstanding advantages, which created such great popularity for the HiQ-30, with more than a score of recent distinctive advancements, the result of a solid year of intensive research and experimentation, the Hammarlund engineering department has this year again produced a truly modern receiver. This latest HiQ is known as the HiQ-31.

A nine-tube model, it uses a new type band filter circuit, and the extremely efficient screen grid tubes in a high-gain three-stage radio frequency amplifier, as well as in the detector circuit, accordingly affording unusual brilliance of reproduction, yet with sensitivity and selectivity.

As in the HiQ-30, this excellent receiver uses specially designed parts and complete laboratory units, providing a peak of efficiency otherwise unobtainable.

The nine tubes in the set include a voltage regulator, one-80 rectifier, four screen grid tubes, a -27 and two -45 tubes.

The new three-stage band filter and screen grid radio frequency units are two of the salient features of the HiQ-31. Utilizing an ingenious capacitative and inductive coupling method, with special compensating and balancing methods, maximum amplification over the entire broadcast spectrum and absolute stability with corresponding absence of regenerative distortion are afforded. With ten kilocycle tuning from the lowest frequency to the highest frequency points, there isn't the slightest trace of sideband cutting.

Both these units are operated by a single illuminated knob control vernier dial, with an indicator drum etched in kilocycles.

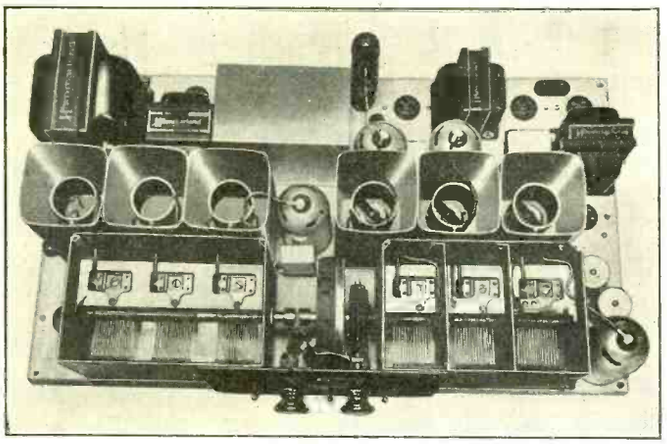
In the band filter unit we have a three-gang "battleship" type condenser, each section having a capacity of .0005 mfd., the condenser closed in an aluminum shield. Three radio frequency coils, each enclosed in a sealed copper can, compose the other part of this unit.

The radio frequency unit also contains a three-gang "battleship" type condenser, with .0005 mfd. capacity sections. This condenser is not only housed in an aluminum shield, but its sections are shielded from each other. The radio frequency coils, of which there are three, are also housed in sealed copper shields, with a polarized radio frequency choke coil in each housing. In the condenser shield there is also a special phonograph switch, for use with the screen grid detector.

The variable condensers in both these units are supplied with trimming condensers to afford absolute synchrony of circuits. The method of adjustment is simple, it being necessary only to tune in a station at about 1,500 kilocycles as loudly as possible, reducing the volume until the signal is barely audible with the volume control and setting the set-screws either to the right or to the left, until the signal intensity is greatest.

To insure certain true signal reproduction, extreme isolating methods have also been used. Individual grid bias resistors for all tubes, radio frequency choke coils in all the screen and plate return leads, as well as in the detector plate circuit, with a large by-pass condenser for every choke and resistor, have been inserted.

(Continued on next page)



TOP VIEW OF Hi Q-31

The voltages on the elements, with respect to signal variations, are kept exceedingly constant, insuring stability, as far as feedback through the voltage supply is concerned, due to the aid of these by-pass condensers.

Large Copper Shields Used

Going back again to the shielding. The isolation of the bias resistors, screen and plate circuits would be futile if no provision were made for eliminating capacitative and inductive back coupling. Since it is imperative to carry the isolation of the various stages to the coils, to the tuning condensers and to the tubes, to prevent this back coupling every coil as previously mentioned is placed in a copper shield, of as large dimensions as is practical. This eliminates all possible capacity coupling between the coils, eliminating also the possibility of oscillation. Inductive coupling is accordingly prevented, so that no coupling between the coils remains.

The shielding, as you have noted, is also carried to the condensers, and even to the screen grid tubes, so that capacity and inductance coupling between the elements of any two tubes is zero. As to the tuning condensers, this shielding serves to reduce back coupling, and in the RF unit, where there are shields between each section. It is necessary here, due to the tube circuits involved. In the band filter there are no tubes.

Tube Shields Slotted

That the shielding has been carried out to an extent found only in the most elaborate experimental receivers is certainly evident. This thorough shielding with the excellent circuit design, affords titanic amplification throughout the band, with no distorting effects.

A point about the tube shields. Since these shields closely surround the tubes, some means must be taken to provide ventilation and prevent overheating. This is accomplished by slots on the sides as well as a hole on the top. The heat thus generated is carried away in a continuous air draught.

The antenna coupler primary is tapped for long and short antenna, to equalize the characteristics of different antennas with respect to the receiver.

In combination with these units and the screen grid detector, a newly designed volume control, and a local-distance switch are used. This switch permits the selection of local or distant station with ease and correspondingly affords smooth control of the volume.

Resistance Audio Stage

To further the quality of reproduction, a specially designed stage of resistance coupled audio amplification is used after the -24 detector tube. A -27 tube is used in this audio stage. This is followed by a stage of push-pull audio, two -45 tubes being used. The volume obtainable is enormous it being about 5,000 milliwatts. The transformers used in this stage have extremely large cross section cores of treated laminations. This permits high primary currents without saturation. Coupled with the heavy windings and a 1:1 winding ratio, absolute true response from as low as 50 kilocycles to as high as 8,000 cycles, is afforded. These transformers are completely shielded in an enameled steel case, with terminal lugs for sub-panel connections.

For those who have a penchant for a predominance of bass notes, or the treble, there is a tone control switch. This may also be used to minimize interference, particularly in the reception of distant stations.

The power supply is designed for 110 volts, 60 cycles. Automatic voltage regulation is used, here, to preserve the efficiency of the tubes, and also maintain a constant volume level.

Husky Power Transformer

The power transformer has a very large core and has very large size windings, to permit continuous operation, without the slightest degree of overheating. The primary of this transformer is tapped at 90 volts for the voltage regulator. The chokes also use heavy cores, and fixed air gaps, as well as over sized windings to insure perfect filtering action.

There are two type chokes, one having an inductance of 30 henries, and the other an inductance of 40 henries. The 30 henry choke has a resistance of 320 ohms, and is rated at 100 milliamperes, while the 40 henry choke has a resistance of 600 ohms, and is rated at 60 milliamperes. The 30 henry choke is a permanent part of the supply the use of the 40 henry choke being dependent upon the type of speaker used. This point will be discussed shortly.

The condenser has six sections: 2, 4, 4, 1, 1, and 2 mfds., rated at 600, 500, 400, 200, 200, and 200 volts respectively. They are mounted in a steel case with pig-tail connections.

How Speaker is Used

And now as to the speaker. The receiver is designed to permit the use of a special direct current speaker, to effect a saving of power and afford absolute hum-free reproduction. There are two windings in this speaker for field excitation, a 3,000 ohm coil being used as the second filter choke in the B supply and an 850 ohm coil used as a grid biasing resistance for the -45 tubes. Due to the energizing of the speaker field direct from the power supply of the receiver, there is absolutely no hum, permitting reproduction of a striking brilliance.

Alternating current speakers can also be used, it only being necessary to use the special choke having an inductance of 40 henries, and to change a few connections on the voltage divider, where such provisions are made.

The receiver also has provision for phonograph connection. When the dial is brought up to the lowest setting, automatic connection for the playing of the records is made.

Balanced Phonograph Pickup

The special phonograph pickup used here is delicately balanced, affording correct needle position for minimum needle scratch and perfect reproduction. Powerful cobalt magnets further afford excellent pickup and fidelity over the entire audible range.

A special phonograph motor and turnable is also provided, this being of the induction type. It is hum-free and noiseless. It has a high starting torque, providing exact turntable speed from the moment the switch is turned on. An extremely efficient governor is provided, insuring absolutely no change or variation in the turntable revolutions per minute.

Built on Metal Chassis

The speaker, pickup, and motor are the special accessories, which have been designed particularly for the HiQ-31.

The complete HiQ-31 is built on a strong metal chassis, 12¾" x 23⅜". All the wiring is of the sub-panel type. This together with the unit construction, exact wiring and testing of each and every unit and part, provides extreme building simplicity.

The standard size of the chassis permits an unrestricted choice of cabinets. Nine types are offered, in period styles with and without provision for phonograph. The panel arrangement, with its two handsome knob controls, three tiny bronze toggle switches and statuary dial escutcheon, is certainly most attractive for the simplest or most elaborate cabinet or console.

The Technical Side

Thus far a general outline of the HiQ-31 has been offered. Now, a detailed study of every component of this receiver will be presented.

When a receiver is operated close to a broadcasting station comparatively large voltages may be developed in the antenna circuit. If these large radio frequency voltages reach the voltage of the first radio frequency amplifying tube, they will cause partial rectification or detection, as it is more popularly known, to take place. The amount of rectification is dependent in this case upon the strength of the radio frequency voltage impressed on the grid as well as the operating characteristics of the tube. If detection does occur, the first radio frequency tube will act like a mixing tube and accordingly cause the modulation of one station to be impressed on the carrier of the station to which the set is tuned. The evident result is interference between the two stations, interference which is known as "cross talk." That it is not a case of ordinary poor selectivity is clearly shown by the fact that as soon as one station signs off the interference from the other station will also disappear. As long as excessive radio frequency voltages are impressed on the grid of the first tube, this trouble will be experienced, no matter what degrees of selectivity may be present in the circuits following the tube.

Therefore if this trouble is to be eliminated the circuits between the antenna and the grid of the first tube must be sufficiently selective to reduce the voltage from any interfering station to a point where it will be so small that rectification does not occur. The following tuned circuits will then further reduce the interfering voltages to negligible values.

Avoidance of First-Tube Detection

Now, it is impossible to design a practical singly tuned circuit that will have sufficient selectivity to prevent detection from occurring in the first tube. Even a very low loss circuit would cause a reduction of about 25 to 1 in the voltage of a carrier

Right or Wrong?

Try to Answer Correctly and Vertify Result

QUESTIONS

(1)—If stations tune in and out completely on one division of the tuning control dial, that is an infallible indication that the circuit is very selective.

(2)—It makes no difference whether the oscillator in a superheterodyne is coupled to the grid or the screen circuit of the modulator in a superheterodyne.

(3)—The fact that a superheterodyne is possible proves conclusively the existence of side-bands because the intermediate frequency is either the higher or the lower side frequency of the carrier.

(4)—If it is desired to spread out a narrow band of frequencies over the entire scale of the tuning condenser it can be done by using a relatively small tuning capacity and a large zero setting capacity.

(5)—When the circuit is designed in the manner suggested in (4) the selectivity is sacrificed for convenience in tuning.

(6)—A step-down transformer having two heavy leads and two thin-wire leads should be connected so that the heavy leads go to the high voltage line and the thin to the low voltage filaments.

(7)—The sensitvity of a photo-electric cell is the same for all colors of light so that the output is the same no matter what the light is provided that the amount of light is the same.

(8)—There is a loss of signal voltage in the modulator of a superheterodyne so that if the receiver is to be sensitive it is necessary to add another stage of intermediate frequency amplification to compensate for the loss.

(9)—A shore-wave converter of the superheterodyne type or any superheterodyne may fail because the voltage impressed on the modulator by the oscillator overloads the modulator and the other tubes in the circuit.

(10)—When the modulator of the superheterodyne overloads, either because the signal voltage or the oscillator voltage is excessive, the receiver will have many repeat points.

(11)—The more sensitive a voltmeter the less current it takes to operate it and the more accurate will the readings be when taken with that meter.

ANSWERS

(1)—Wrong. All it may mean is that the capacity in the circuit changes rapidly as the dial is turned. This apparent selectivity occurs when the capacity in the circuit is small and the inductance relatively large.

(2)—Right. It may be coupled to the grid circuit, the screen circuit, or the plate circuit and the result will be about the same provided the effective degree of coupling between the oscillator and the modulator is the same in all cases. If the coupling is in the grid circuit the effectiveness of a given coupling between the oscillator and the pick-up is greater than when the coupling is in the plate circuit because of the amplification factor of the tube. The coupling in the screen circuit falls between the other two.

(3)—Wrong. The fact that a superheterodyne works proves that a tube distorts considerably if it is adjusted to do so but it proves nothing about the existence or non-existence of side bands.

(4)—Right. This method is used by amateurs and special condensers are made for the purpose. For example, in one condenser used by amateurs there are four rotor plates, two of which are complete circles. Thus only two plates are effective in changing the capacity, the two circular plates serving as a large zero setting capacity.

(5)—Wrong. The selectivity remains the same as it would be if all the plates were cut so as to cause a change in the capacity, but stations appear on the dial much farther apart, which has nothing to do with selectivity.

(6)—Wrong. If the transformer is connected in this manner the high voltage line will be practically short-circuited and the fuses in the house are sure to go. The winding to be connected to the power line is always made of finer wire than the winding that is to be used for heaters and filaments. In a power transformer in which there is a high voltage winding, this winding is made of still finer wire because it will operate at much lower current. The size of the wire is determined by the current it will carry and not by the voltage across it.

(7)—Wrong. The sensitivity of a photo-electric cell depends greatly on the color of the light, usually being greater the shorter the wavelength of the light, that is, the farther it is away from the red in the direction of the blue.

(8)—Right. The loss may be the equivalent of the amplification in two tuned stages, but the actual loss depends on the efficiency of the first detector or modulator.

(9)—Right. If the signal voltage is weak and the radio frequency voltage from the oscillator is strong the modulator as well as most of the succeeding tubes may overload before the signal is audible. All that is heard under these conditions is a terrific roar.

(10)—Right. If the overloading is not so strong as to paralyze the circuit, any one station will come in strongly at many settings of the dial, especially the strong local stations.

(11)—Right. High sensitivity in a voltmeter simply means that it requires a very small current to operate it. The sensitivity may be expressed in terms of ohms per volt but that does not alter the fact. A sensitive meter always has a high resistance per volt.

Fine Selectivity in the HiQ-31

(Continued from preceding page)

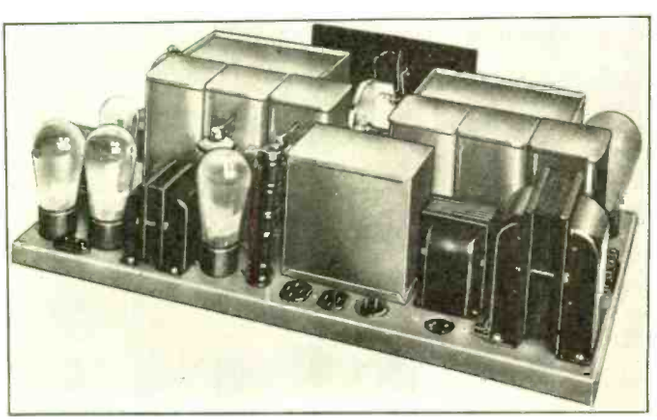
cycles from the resonant frequency of the circuit is attenuated only by a factor of 10 if a single circuit is used. On the other hand, the three tuned circuits used in the HiQ-31 pre-selecting method, produce under the same conditions an attenuation of the order of 500. This degree of attenuation is sufficient to reduce any interfering voltages to a point where they cannot cause rectification to occur in the first tube. In this manner all possibility of cross talk is eliminated.

Flat Top Curve

Another salient point is that the tuning curve has a flat top over a band ten kilocycles wide. The flat top and steep sides of this curve are a characteristic of coupled circuits. If we calculate or measure the characteristics of a simple tuned circuit, we obtain a resonance curve. If we couple two tuned circuits together very loosely, we obtain the same type of curve although the selectivity will be greater. By suitably altering the coupling between the two tuned circuits we can obtain a number of different characteristics. The question of which is most desirable now makes it appearance.

Suppose we go back a bit. It will be recalled that the wave radiated by a broadcasting station consists of a carrier and two side bands which extend in frequency to either side of the carrier by an amount equal to the highest audio frequency modulation. At the present time the modulation of radio broadcasting stations is limited by law to a maximum of 5,000 cycles. Accordingly the transmitter wave consists of a band of frequencies ten kilocycles or 10.000 cycles wide. If the carrier frequency is 1,000 kilocycles, then the two sidebands cause the transmitter wave to extend over a band from 995 to 1,005 kilocycles.

If the receiver is to give high quality reproduction, these side-



REAR VIEW OF THE HIQ-31

band frequencies must not be suppressed in any part of the receiver. The characteristics of a perfect tuning system would therefore be one which was flat over a band of frequencies 10 kilocycles wide, so that all the sideband frequencies would be passed without loss, and which had perfectly straight sides, so that all other frequencies would be completely suppressed. That such characteristics can be closely approached is our own accepted fact.

[*This concludes the first instalment. Next week, in the December 27th issue, the second and concluding instalment will be published.—Editor.*]

A Converter for Remo

By Herman

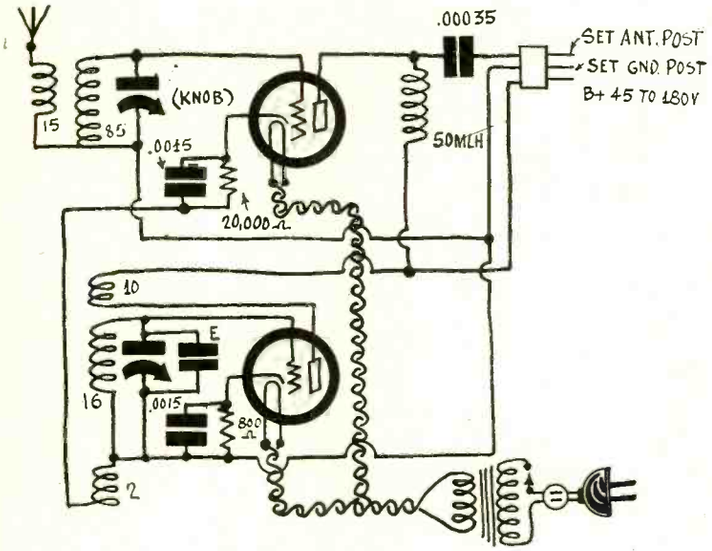


FIG. 1

SUCCESS in converting any tuned radio frequency receiver into a Superheterodyne, and at the same time instituting remote control of tuning, is easy. The diagram for accomplishing this is shown in Fig. 1.

Two coil systems wound on one form may be used. First there is the modulator grid coil for tuning the tube at top. This consists of two windings. For .00025 mfd. condenser, use 80 turns of No. 32 enamel covered, for .0005 mfd. 60 turns, on a bakelite form 1¾ inches in diameter. The primary has 15 turns in either case.

The other coil, a transformer, will be something of a surprise, since it will consist of only 16 turns of the same kind of wire on the same size diameter, for the secondary, while the tuning condenser is only .0001 mfd. The tickler winding has 10 turns of the same kind of wire, with ⅛-in. space between itself and the oscillator secondary. These two windings should be in the same direction, whereupon the "cold" potential connections would be side by side, that is, ground and B plus. Therefore grid and plate connections would be relatively far apart.

The foregoing coil data apply only when no shielding is used.

The principle of operation is the same as that used in other converters, but this device is intended primarily for use in turning a TRF set into a Superheterodyne, with remote control of tuning and even of volume.

The carrier frequency is tuned in by the condenser across the modulator coil, and as this is not critical, it affords a really good volume control, and requires no dial, only a knob. The oscillator generates a frequency that is different from the signal frequency by a frequency equal to the intermediate frequency. That intermediate frequency is one to which your broadcast receiver is tuned. But, of course, it should be a tuned radio frequency receiver, since if you have a Superheterodyne already, there is little advantage in adopting the present particular conversion sys-system.

What the intermediate frequency shall be is something you will decide for yourself. It is hoped that your tuned radio frequency receiver is sensitive at the high frequencies, and if it is, by all means use some frequency around 1,500, 1,600 or 1,700 kc., if your set tunes that high, or, if it doesn't, then use, say, 1,450 kc or any other frequency near that. Take the precaution, however, to select a frequency on which there is no station within the sensitivity range of your receiver, as otherwise there would be interference.

Range Difficulties Solved

If your set is not sensitive in the suggested region, then use the highest frequency you can. This will change converter dial settings, and run you off the scale perhaps, but to take up this displacement, an equalizing condenser, E, is included. As you lower the intermediate frequency while seeking the best one, you need more capacity of this equalizer in circuit so that you will be able to tune in the lowest broadcast frequency.

Here is one circuit, let us thankfully relate, that finds no difficulty in tuning in the entire wave band. Suppose you have a tuned radio frequency receiver that does not fully cover the broadcast spectrum of frequencies. If you will use this converter you will be able to tune in the entire band, and more. With the obvious risk of taking away your breath, may we relate that when a .0005 mfd. tuning condenser of straight frequency line characteristics was used with a coil having an oscillator secondary of 14 turns of No. 32 enamel wire, the lowest broadcast frequency, 550 kc (545 meters) came in at 89 on the dial, while 1,500 kc, the highest frequency (200 meters), came in at 45. It was possible to tune as high as 3,000 kc. No modulator tuning was used, as that would have restricted the frequency range to the modulator's own frequency limitations, that of the broadcast band.

So, with a single coil and a single condenser, using no plug-in device, no switching or anything other than the simple tuned circuit, waves were tuned in from 550 meters to about 90 meters.

Frequencies Analyzed

This wide coverage arises from the use of a high intermediate frequency. The one actually used was 1,580 kc. This frequency is the highest attainable frequency on the particular tuned radio frequency receiver used, one of the Neutrodyne type (Balkite, A5). WGY's second harmonic comes in at 0 dial setting, and as WGY is on 790 kc the highest attainable frequency was twice that.

The situation may be viewed mathematically as follows: The broadcast frequency to be tuned in is 1,500 to 550 kc, a range of 1,050 kc, and the intermediate frequency is 1,580 kc. There are two possible settings to be used for any one carrier frequency, but as these are separated by twice the intermediate frequency, or 3,160 kc, the possibility of receiving the same station at two settings with any particular coil-condenser combination may be

LIST OF PARTS
For Fig. 1

One 2-inch dial.
Mixer coils on two forms for .00025 and .0001 mfd.
One 50-millihenry radio frequency choke coil
One 2½-volt filament transformer, primary 105-120 volts, 50-60 cycles
One .00025 mfd. tuning condenser
One .0001 mfd. tuning condenser
One .00035 mfd. fixed condenser
One .0001 mfd. (100 mfd.) equalizing condenser (E)
Three 0.1 mfd. fixed condensers in one case (250 volt rating; black lead is common)
One 20,000-ohm biasing resistor, with pigtails
One 800-ohm biasing resistor, with lugs
One 6-foot AC cable, with male plug at one end, and convenience outlet socket near the plug
One four-lead cable, 6 feet
One walnut finish wooden cabinet 6½x5x2⅜ inches inside.
One panel to fit
One AC switch, of the shaft type
Two knogs, one for battery switch, ether for .00025 mfd. modulator tuning condenser

How Remote Control Is Worked on Converter

Tuning the tuned radio frequency receiver from a distance is accomplished by use of either the AC model Superheterodyne converter shown in Fig. 1, or the battery model shown in Fig. 2, since a cable connects converter and receiver. How long this cable will be depends on how far the set is from the converter. The standard cable connection in six feet, but if desired another cable may be connected to extend the length twelve feet more, or two additional ones to extend the length twenty-four feet more, then making the total thirty feet.

The remote control tuning is accomplished because the frequency changing, or tuning, takes place exclusively in the converter, once the broadcast set is fixed at some favorable frequency.

Remote control of volume arises from the fact that the knob-actuated condenser that tunes the modulator is a rough tuner, and by detuning slightly the volume may be reduced considerably, although for strong signals a larger variation of this condenser is necessary to turn down the volume to a small amount.

Even the broadcast set itself may be turned on and off from the remote control converter, by including a 6-foot AC cable lead that goes from the continuous side of the line and the switched side, and providing a convenience outlet near the plug end of the cable. Insert the set's AC cable plug into this outlet. The set switch is kept on all the time, since the switch that actuates the juice to the converter does likewise to the set.

te Tuning of TRF Set

Bernard

LIST OF PARTS
For Fig. 2

One 2-inch dial
Mixer coils on one form for .00025 and .0001 mfd.
One 50-millihenry radio frequency choke
One .00025 mfd. tuning condenser
One .0001 mfd. tuning condenser
One .00035 mfd. fixed condenser
One .0001 mfd. (100 mmfd.) equalizing condenser (E)
Three 0.1 mfd. fixed condensers in one case (250-volt rating; black lead is common; unite the three reds to constitute 0.3 mfd.)
Two 4-ohm filament resistors with mountings
One .00025 mfd. fixed condenser with grid leak clips
One 5 meg. grid leak to fit in grid condenser
One A battery switch
One 5-lead cable, 6 feet long
Two knobs, one for AC switch, other for .00025 mfd. modulator tuning condenser
One walnut finish wooden cabinet 6½x5x2⅜ inches wide
One panel to match

neglected, as it arises at only the extremely highe frequency settings, fortunately. Then we have to choose between the high or low frequency oscillator settings, and of course will choose the high, mainly because it is the more sensitive, and also because the low would restrict the tuning range.

Oscillator Range

Therefore, having decided on the high oscillator frequency, we know that the oscillator always must be tuned to a frequency that exceeds the incoming carrier frequency by 1,580 kc, for the given example. The lowest broadcast frequency is being 550 kc, the oscillator setting for this is 550 plus 1,580, or 2,130 kc. The other extreme of the broadcast band, 1,500 kc, requires an oscillator frequency of 3,080. Therefore the oscillator should tune from 2,130 to 3,080 kc, which is, again, a range of 1,050 kc.

With any given tuning condenser, the smaller the inductance of the coil the larger the frequency range that may be tuned in, so with a normal condenser for broadcast work, .0005 mfd., the broadcast stations would be crowded on the dial, and this congestion would be even greater as short waves were brought in with the same inductance-capacity arrangement. Not only would it be easier to skip the short-wave station than to get it, but this inverse difficulty even would exist as to broadcasting stations, other than strong locals.

The solution lies in the choice of a small tuning capacity, since the coil must be small anyway, while proportioning the two. Even so, a higher minimum capacity is desired than for normal broadcast reception. The trimmer will supply as much of this as is needed, as its total capacity is equal to the capacity of the oscillator tuning condenser.

Band-Spanning Characteristic

The use of a high minimum capacity for high frequency work is desirable, indeed perhaps necessary, and it is common practice with radio amateurs to use such capacity arrangements, so that a given frequency, whether of carrier or oscillator, will be audible over a greater width of the dial scale. This helps in finding stations. Particularly is this of advantage when a smaller band of frequencies than now considered is the total desired to be tuned in, and for this reason the high-minimum-capacity types are called band-spanning condensers.

The required frequency range of the oscillator, 2,130 kc to 3,080 kc in the cited instance, requires that the tuning circuit cover only 1.050 kc.; whereas the coil-.0001 mfd. combination as given afforded oscillator frequencies of 1,900 to 3,500 kc, so that the broadcast band levied no difficult tax on the oscillator, which exceeded demands by 3-to-1, on a frequency basis. This 3-to-1 ratio of itself need not be taken as indicative of dial crowding, since the frequencies change fast at the low capacity settings and it is easy to "get a ratio" when really there isn't much excess.

Few Turns, Big Change

The situation as it exists in the oscillator circuit is fully depicted so that it will be realized there is ample leeway, and that no hesitancy need be felt if the intermediate frequency you must use is one lower than the cited instance of 1,580 kc. Also, from the foregoing discussion of the oscillator, it is obvious that the number of oscillator secondary turns is critical, since the frequencies are high. For instance, two more turns on the oscillator secondary than actually necessary will change the dial setting for 660 kc

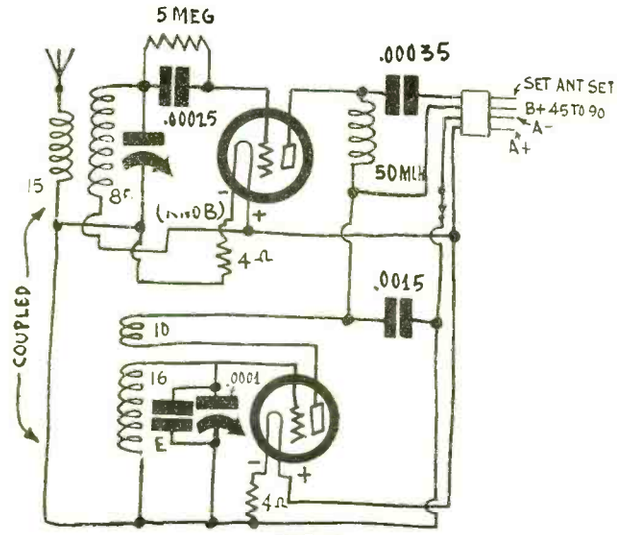


FIG. 2
THE BATTERY-OPERATED COUNTERPART USES TWO 201-A TUBES. A 6-VOLT STORAGE BATTERY IS ASSUMED, AS IS B-- CONNECTION TO "A" BATTERY

(WEAF) from the 80th division to the 56th division of the dial scale. Would you suspect that merely two turns would have such an effect?

Hence, if the station settings are too low on the oscillator, as judged by standards familiar to you, then remove turns from the oscillator secondary. There need be no concern over the other end of the oscillator tuning spectrum. The oscillator frequency necessary to bring in the highest frequency broadcast station certainly will be reached, provided less than full setting of the equalizer is used.

The Superheterodyne converter works real well, and it increases the selectivity over what you normally would enjoy. The sensitivity under the new arrangement may be equal to or less than the sensitivity of the receiver worked alone, but even so, more distance is usually attainable, due to higher selectivity killing off interference that would prevent or spoil distance reception.

With proper sensitivity in the receiver, it may be necessary to use an aerial, or to alter the aerial connection on the set.

The installation data are:

(1)—Connect the output of the converter to the antenna post of the tuned radio frequency receiver or Neutrodyne, and leave the aerial where it was, at the antenna post of the set.

(2)—Connect the ground lead of the converter to the ground post of the set, and leave the ground at the post on the set where you found it.

(3)—Connect the B plus lead of the converter to a positive B voltage of from 45 to 180 volts, which ever is handiest, which voltage may be obttained from the receiver.

[*Continued next week, with additional coil data and constructional details.*]

Advantages Listed In Converter Operation

Advantages obtainable from use of a Superheterodyne converter of the simple designs depicted in Figs. 1 and 2 are the following:

(1) Convenience in tuning.
(2) Remote control of tuning, volume and switching.
(3) Improvement in selectivity.
(4) Assurance of full coverage of the broadcast band of wavelengths.
(5) Improved conditions for the reception of distant stations.
(6) Equalized sensitivity over the full broadcast spectrum, due to the same amount of intermediate frequency amplification, applicable to the fixed intermediate carrier generated in the converter.
(7) Opportunity to have only a small tuning arrangement in sight, while the broadcast receiver is hidden in a closet, or table recess, or placed in the cellar.
(8) Extremely low cost, as the device can be built for AC operation, of parts costing less than $12, affording 6-foot radius, and for battery operation at less than $10.

15-200-Meter Converter

It May Be Used as Broadcast Pre-Amplifier

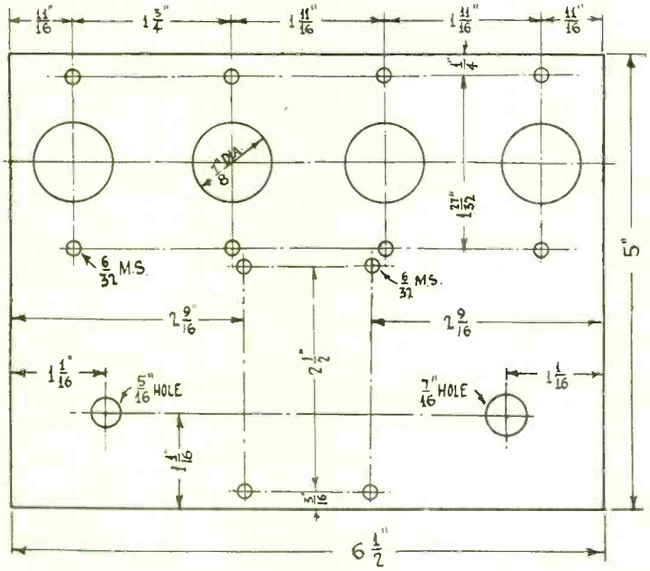


FIG. 7
DIAGRAM OF PANEL DIMENSIONS AND HOLES.

[*The series of articles on short-wave converters that work with any set, begun in the November 8th issue, and printed weekly, is concluded this week with the publication of the full-scale picture diagram of the AC model,* 15 *to* 200 *meters, and the following sidelights.*—EDITOR.]

THE three-tube short-wave converter, which may be used with any receiver, with only two plug-in coils to cover 15 to 200 meters, uses power modulation in the AC model, but leak-condenser modulation in the battery-operated model. In both instances three 227 tubes are used. For battery operation the heaters are connected in series across a 6-volt storage battery, thus affording 2 volts per tube. The diagram was published in schematic form last week, issue of December 6th.

The diagrams of the AC model, both pictorial and schematic, are published this week. The biasing resistor in the modulator circuit is shown as 20,000 ohms, while last week it was given as 2,500 ohms. Modulation results in either instance, but with the smaller value of resistance the tube is worked higher up on its characteristic curve, and may overload sooner, so the 20,000 ohm value perhaps is preferable, since the intensity of any oscillator in a converter or Superheterodyne receiver is always a possible overload danger to the modulator.

Wiring Made Easy

The pictorial diagram makes it easy to wire the converter, since the parts are shown in their proper places, with the exception of two, a 50-millihenry radio frequency choke and a three-in-one 0.1 mfd. condenser. Because these two parts are placed under sockets, in actual physical layout, they are put on the side in the diagram to prevent obscuring the wiring.

The wafer type of sockets is used, and this has no marks on it, so the diagram is doubly helpful in determining which are the grid, plate, heater and cathode connections, when the bottom of the panel greets the eye.

LIST OF PARTS FOR FIGS. 8 AND 9

One Hammarlund special junior midline condenser, 200 mmfd.; single hole panel mount.
Three ¼-millihenry radio frequency choke coils.
One 50-millihenry radio frequency choke coil.
Two plug-in coils constructed on tube base forms.
Four UY sockets (three for 227 tubes, one for coils).
Two .00035 mfd. mica dielectric fixed condensers.
One .0015 mfd. mica dielectric condenser.
One three-in-one 0.1 mfd. condenser (three 0.1 mfd. in one case; two reds paralleled to constitute 0.2 mfd.).
One 20,000-ohm biasing resistor, with pigtails.
One 800-ohm biasing resistor with lugs.
One 5 x 6½-inch panel, drilled for sockets, condenser and switch.
One walnut finished wooden cabinet to fit panel.
One knob with pointer moulded at rim.
One 2-inch dial.
One filament transformer, 2½-volt secondary (center tap not needed); 8 ampere capacity. (Thin leads go to AC line.)
One AC switch of the shaft type; single hole panel mount.
One AC cable with male plug.
One four-lead cable (blue, yellow, black, red).

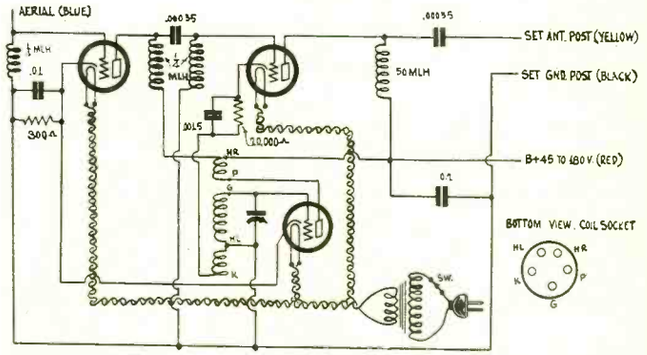


FIG. 8
THE 15-200 METER CONVERTER WITH POWER MODULATOR. THE BIASING RESISTOR IS 20,000 OHMS. THE BIASING RESISTOR AT LEFT, VALUE NOT CLEARLY PRINTED, IS 800 OHMS.

Positively Excellent.

The converter is an excellent one, and even those who believe that all short-wave adapters and converters are unreliable, are invited to try this model, which can be built of parts, including filament transformer, that cost a total of less than $10.

Another model for AC operation, but without the filament transformer, which would have to be external in that instance for lack of room, was described in the November 8th, 15th, 22d and 29th issues, and may be built of parts, less transformer, costing under $5. The more inexpensive model tunes from 30 to 110 meters and uses no plug-in coils, but a switching arrangement instead.

Adapters of Little Value

As for so-called adapters, little may be said in their favor, as they are really one-tube regenerative receivers that plug into a set's detector socket. Since there is no standard detector circuit, one can not be certain in advance of what the constants and voltages are, and regeneration might fail. Even when it succeeds there are critical tuning, body capacity and squealing to contend with, whereas there is no squealing, no body capacity, no grunting and no other such difficulties with the converters. And the converters do work. Positively yes.

The sensitivity of the combination depends largely on the receiver, and it is well to select the most sensitive point of the set for intermediate frequency, and then advance the volume control so that full capital is gained from this sensitivity asset.

May Be Five-Fold Difference

The difference between any casual setting, and the correct setting may constitute a volume difference of 500 per cent. If the receiver is of the type that may be made to oscillate, then of course work it just under the point of oscillation, which affords greatest sensitivity.

It should be remembered that the receiver dial itself may be used as a vernier any time very fine tuning is found advisable, and also that a substantial change in the intermediate frequency, by which is not meant the slight alteration for vernier action, will change the converter dial settings rather substantially. So pick out a good intermediate frequency, depending on your receiver's characteristics, and use the same intermediate all the time.

Another fact of importance is that the converter may be left in operation, with its dial preferably at zero, when the receiver itself is used for broadcast reception. Thus the receiver becomes endowed with a pre-amplifier, and signals that formerly came in weak will come in strong. This pre-amplifier advantage is one that will come in handy to many.

Nothing Wrong

It should not be suspected that anything is wrong if the broadcast stations come through as the set dial is turned, even though the converter is in operation, for the previously-mentioned reason: pre-amplification is being supplied.—Herman Bernard.

Picture Diagram of 15-200-M Converter

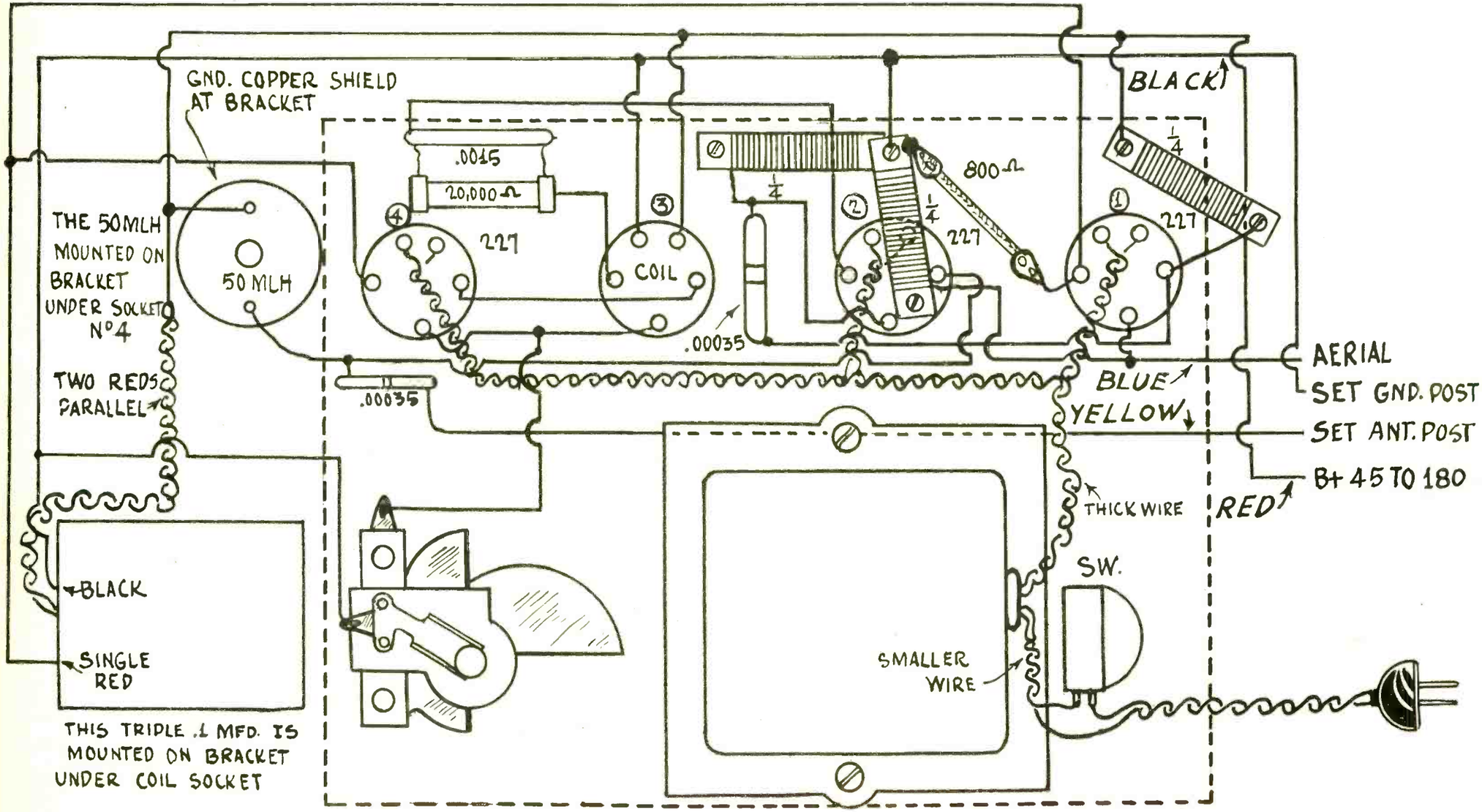


Fig. 9

Full-scale pictorial diagram of the circuit shown schematically in Fig. 8.

The Latest Philco Receivers,

Philco Models 20 and 20A

PHILCO Models 20 and 20A are for AC supply and the two differ only in that the 20A has been designed for line frequencies as low as 25 cycles. These circuits are shown diagrammatically.

The circuit incorporates three screen grid tubes of the 224 type, one 227 AF amplifier and two 171A tubes in the push-pull output stage. The rectifier tube is of the 280 type.

The volume control in these circuits consists of two potentiometers on the same control, one of which varies the radio frequency input to the first stage and the other the grid bias on the RF amplifiers.

The detector tube is one of the 224 screen grid tubes and it works into a resistance-capacity coupler. A filter consisting of a resistance (18) in series with the coupling resistor (17) and a condenser (14) is used to prevent audio frequency oscillation.

The filter in the B supply contains two chokes, one of which is the field winding of the dynamic speaker. The other choke is tuned with a condenser to the principal hum frequency so that the hum is trapped out. The plate current for the power stage flows through the first choke only.

Philco Models 77 and 77A

Models 77 and 77A of this line are practically the same as Models 20 and 20A, respectively, except that the power stage contains two 245 tubes. The diagrams of both of these circuits is given in Fig. 2. Of course, the grid bias resistance for the two power tubes has a value appropriate to the tubes used, that for the 245 being 800 ohms and that for the 171A being 1,400 ohms. A tone control is built into the 77 and 77A models and it consists of a butterfly switch for cutting in different capacities across the 227 amplifier.

Philco Models 96 and 96A

These two receivers are essentially the same but the 96 is designed for use on an AC line having a frequency from 50 to 60 cycles while the 96A is for any line having a frequency from 25 to 60 cycles, the voltage in each case falling within the 100-130 volt range. The two differ mainly in that the 96A has larger by-pass condensers in certain positions in the filter. Both receivers are diagrammed in Fig. 3.

There are several noteworthy features in this circuit. Note especially the type of detector that is used. The plate and the grid of the 227 tube are joined together so that the detector is really a diode, or Fleming oscillation valve. A small polarizing voltage is impressed on the rectifying circuit, and this voltage is the drop in that portion of the voltage divider which lies between F and E. The first audio amplifier is coupled directly to the detector without any stopping condenser and the necessary bias for the amplifier is obtained through the drop in the coupling resistor, or more accurately, it is the steady potential across the condenser marked (26). The coupling resistance is the sum of (20) and (21).

The coupling between the first and second audio tubes is standard resistance-capacity, but there is also a resistance-capacity filter in series with the plate resistor and another in series with the grid return. The grid leak at this point is a high resistance potentiometer which is used as volume control.

In the plate circuit of the second audio tube is a tone control consisting of a butterfly switch which may be used for connecting different capacities across the line and thus shunt out different proportions of the high frequencies.

The Output Stage

The output stage is a standard 245 tube push-pull amplifier, which is coupled to the dynamic speaker with a regular push-pull output transformer. The field winding of the speaker constitutes the second choke in the filter, but the current for the power tubes does not flow through it.

The grid bias for the various amplifier tubes ahead of the detector is obtained from drops in resistance associated with that tube and the grid returns are so connected that the volume is automatically held at a nearly constant value once the manual control has been set at the desired value.

Philco Models 296 and 296A

These two models differ only in that the 296A is for line frequencies between 25 and 60 cycles while the 296 is for frequencies of 50 to 60 cycles. These are also the same as the 96 and 96A, respectively, except that provision has been made for a phonograph pick-up. The complete circuit diagram is given in Fig. 4.

The pick-up is connected so that when the radio signal is to be amplified the phonograph pick-up is shortened and when the phonograph signals are to be amplified the unit is cut into the grid circuit of the 227 amplifier tube, the connection being made between the grid and ground. Thus the bias on the tube remains the same for both radio and phonograph amplification.

There are three terminals at the input of Models 96 and 296, one for local stations, another for distant stations, and a third for the ground connection. The ground and the distant antenna are standard but the connection for the reception of local stations is unique. The lead is connected through a condenser to one side of the 110 volt line. To the lead either the antenna or the ground may be connected.

One feature in Models 296 and 296A not present in Models 96 and 96A is the ground of the heater winding center, as shown at A in Fig. 4. Two equal condensers are connected in series and then connected across the 2.5 volt winding serving all the heater

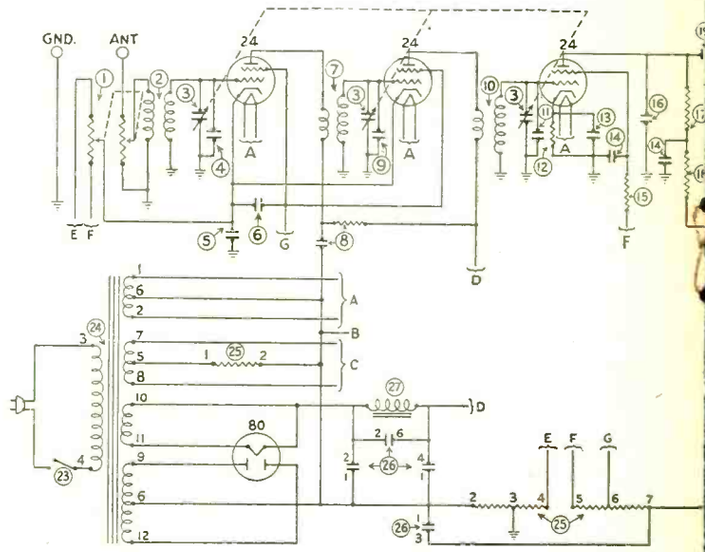


FIG. 1

COMPLETE DIAGRAM OF MODELS 2 THE PHILCO LINE OF RECEIVERS. T A 224 TUBE AS A DETECTOR AND TW OUTPUT TUBES. A DUAL, MANUAL TROL IS USED, ONE CONTROLLING T THE FIRST RADIO FREQUENCY TU OTHER THE GRID BIAS ON THE FIRS

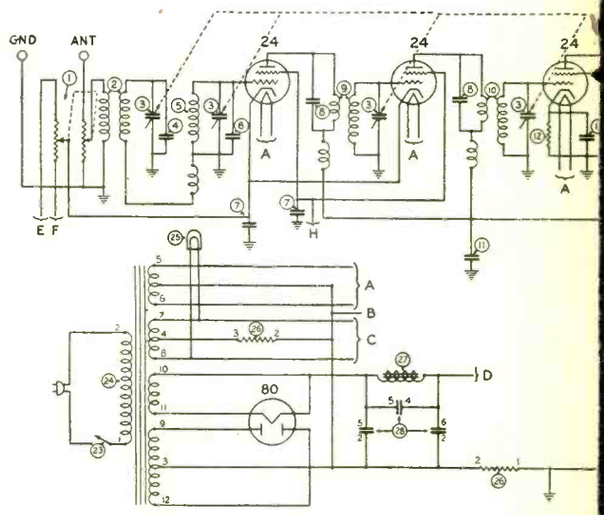
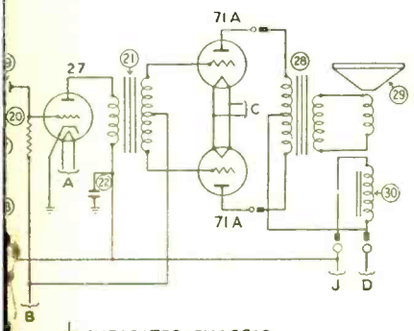


FIG. 2

THIS IS THE CIRCUIT DIAG MODELS 77 AND 77A, WHICH A SAME AS MODELS 20 AND 20 PUSH-PULL OUTPUT TUBES A A TONE CONTROL IN ADDITI CONTRO

Models 20, 77, 96, and 296



⏚ INDICATES CHASSIS
SPEAKER PLUG AND SOCKET CONNECTIONS SHOWN —O●—
TERMINAL 5 OF (26) IS DUMMY TERMINAL

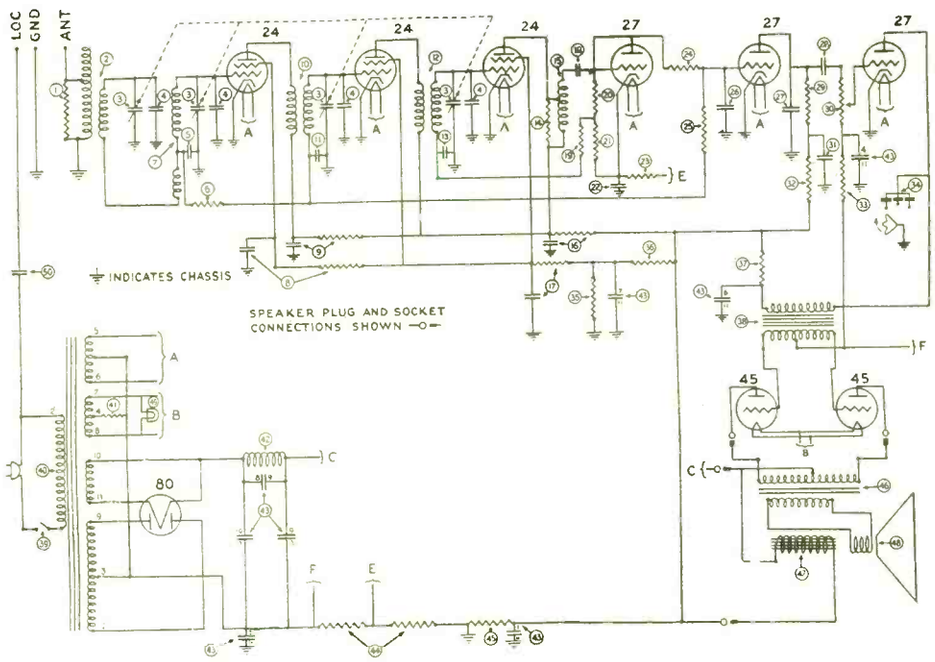


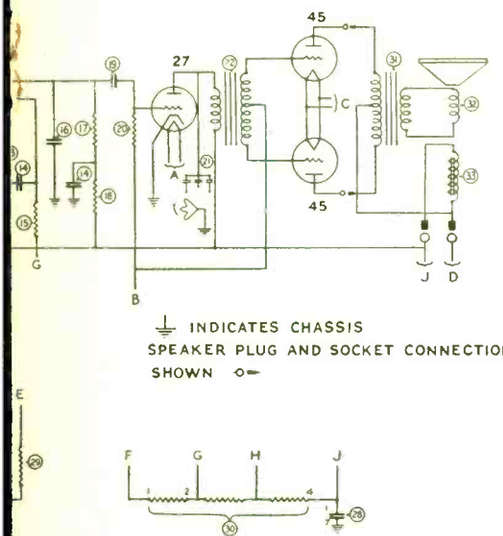
FIG. 3
PHILCO MODELS 96 AND 96A WHICH IS DIAGRAMMED HERE IS SIMILAR TO MODELS 77 AND 77A IN MOST RESPECTS BUT IT EMPLOYS A TWO-ELEMENT DETECTOR, THE 227 TUBE BEING USED FOR THE PURPOSE. THIS DETECTOR IS ARRANGED SO THAT IT SERVES AS AN AUTOMATIC VOLUME CONTROL.

0 AND 20A OF
'HIS EMPLOYS
WO 171A FOUR
VOLUME CON-
HE INPUT TO
BE AND THE
T TWO TUBES.

s. The object of these condensers is to prevent hum by estab-
ng a ground at the neutral point in the heater circuits. This
ure is especially valuable at the higher broadcast frequencies.
center point on this winding, it will be noted, is connected to
same point as the grid returns of the power tubes and the most
ative point in the circuit. Thi sis usually grounded but in this
ance a higher potential point is ground in order to get the
er voltages on the detector and the automatically controlled
s.

will be noted that many of the by-pass condensers are con-
ed to ground instead of to the lowest potential point. This is
e to eliminate as far as possible interaction among the stages
he amplifier, such as would cause oscillation at radio frequency
motorboating at audio frequency.
n all of these models the filter circuit is the same. First there

is a shunt condenser, thee follows a tuned choke coil, and then another shunt condenser. This is followed by the field coil of the dynamic speaker. In no case does the plate current of the power stage flow through the second choke, that is, the field coil. A tuned filter such as is used in these circuits is very effective in suppressing hum provided that the circuit is tuned to the principal hum frequency, which is 120 cycles for a 60 cycle line and 50 cycles for a 25 cycle line.



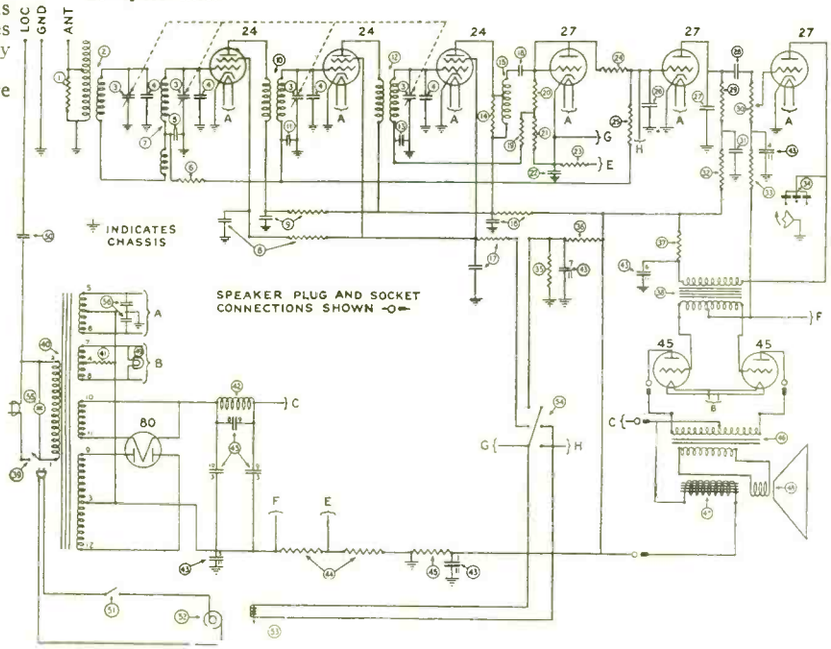


FIG. 4
THE DIAGRAM OF PHILCO MODELS 296 AND 296A. THESE CIRCUITS DIFFER FROM MODELS 96 AND 96A IN THAT THEY ARE ARRANGED FOR USE WITH A PHONOGRAPH PICK-UP UNIT, WHICH IS CUT INTO THE GRID CIRCUIT OF THE FIRST AUDIO AMPLIFIER. AMPLIFIER TUBE.

RAM OF THE PHILCO
RE ESSENTIALLY THE
A EXCEPT THAT THE
RE 245S. IT CONTAINS
ON TO THE VOLUME

Transmitti

By J. E.

TRANSMITTING tubes are available in many different power ratings, ranging from 7.5 watts for the 210, which is also a receiving tube, to large 5,000-watt tubes and even larger. The 210 tube, which has already been described, is usually rated at 7.5 watts when used as an oscillator in a small transmitting set.

The small 210 tube has been used extensively by amateurs in low power transmitters, not only to radiate the rated wattage of 7.5 watts but considerably greater wattage. This they did by increasing the voltage to higher values than the rated value of 350 volts. In Fig. 1 is a transmitting circuit in which two of these relatively small tubes may be used, although the somewhat sturdier tubes of similar ratings to be described below would be preferable. In this circuit the 210 tubes are used as modulator and crystal controlled oscillator. The characteristics of this tube were given in connection with receiving tubes.

The De Forest Audion 510 is a 15-watt transmitting tube which has been designed with special emphasis on its stability

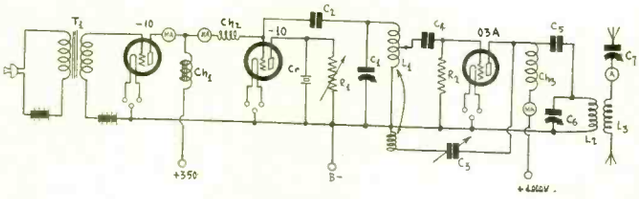


FIG. 1

A THREE-TUBE PHONE TRANSMITTING CIRCUIT CONTAINING TWO TYPE—10 TUBES FOR MODULATOR AND OSCILLATOR AND ONE TYPE —03A FOR RADIO FREQUENCY POWER AMPLIFIER. THE OSCILLATOR IS CRYSTAL CONTROLLED. THE HEISING SYSTEM OF MODULATION IS USED.

with changing temperature, that is, stability of frequency of oscillation. Because of this fact it is especially suitable for use as a self-exciter oscillator when the tube is to be in continuous service and the frequency is to remain constant. It may be used in circuits of frequencies up to 30 megacycles. While it is particularly suitable for use in self-exciter oscillators, it is also useful when the frequency of the circuit is maintained constant by means of a quartz crystal.

CHARACTERISTICS OF THE 510

Normal rating watts	15
Filament voltage	7.5
Filament amperage	1.25
Amplification factor	8.0
Max. plate current, amperes	.06
Max. DC plate voltage, modulated	425
Max. DC plate voltage, unmodulated	500
Average plate resistance, ohms	5,450
Average mutual conductance, micromhos	1,550

Type of base, UX.
Type of filament, oxide coated.
Use, oscillator or amplifier.

THE 503A

The De Forest Audion 503A is a 50-watt tube which may be used as an oscillator or a radio frequency amplifier in small transmitting sets. It may also be used as a modulator or audio frequency amplifier, provided that the plate wattage dissipation does not exceed 75 watts. It requires a grid bias of 25 volts when used as amplifier, provided that the plate voltage does not exceed 1,200 volts.

CHARACTERISTICS OF 503A

Normal rating, watts	50
Filament voltage	10
Filament amperage	3.25
Voltage amplification factor	25
Max. plate current, amperes	0.175
Max. DC plate voltage, modulated	1,000
Max. DC plate voltage, unmodulated	1,250
Max. plate power dissipation, watts	100
Plate resistance, ohms	5,000
Mutual conductance. micromhos	5,000

Base, Standard 50-watt base.
Type filament, special thoriated tungsten.
Use, oscillator.

The De Forest Audion 511

The 511 Audion is similar to the 503A in most respects but it has a lower amplification factor and may be used as oscillator, modulator and amplifier.

CHARACTERISTICS OF 511

Normal rating, watts	50
Filament voltage	10
Filament amperage	3.25
Amplification factor	12
Max. plate amperage	0.175
Max. DC plate voltage, modulated	1,000
Max. DC plate voltage, unmodulated	1,200
Max. plate dissipation, watts	100
Plate resistance, ohms	3,400
Mutual conductance, micromhos	3,530

Base, standard 50-watt.
Type filament, special thoriated tungsten.

When used as AF power amplifier or modulator—

Max. plate voltage	1,250
Normal plate voltage	1,000
Grid bias, volts	55
Plate current, milliamperes	72
Normal output, watts	10

When this tube is used as an oscillator, a negative bias is required to prevent damage to the tube, due to the relatively low output impedance. Normal grid bias, as an oscillator, is obtained by using a grid leak of about 5,000 ohms.

The De Forest Audion 545

The 545 Audion is another 50-watt tube which is essentially an audio frequency amplifier for use in the output stage of a high power public address system and also for use as modulator in a medium power transmitter.

CHARACTERISTICS OF THE 545

Normal rating, watts	50
Filament voltage	10
Filament amperage	3.25
Amplification factor	5
Max. plate voltage	1,250
Max. plate dissipation, watts	75
Normal plate voltage	1,000
Grid bias, volts	150
Plate current, milliamperes	75
Normal output, watts	20
Plate resistance, ohms	2,100
Mutual conductance, micromhos	2,380

Base, standard 50-watt.
Type filament, special thoriated tungsten.
Use, AF amplifier and modulator.

De Forest Audion 552

The De Forest 552 is a 75-watt tube designed especially for use as an oscillator or radio frequency amplifier up to frequencies as high as 30 megacycles. It has a standard UX base, but the plate lead is brought out on the side of the glass envelope and the grid at the top by means of flexible leads. This arrangement of the high potential terminals is used to minimize the capacity between the grid and the plate, as well as between either of these and the filament. It also increases the insulation of the high potential terminals.

CHARACTERISTICS OF THE 552

Normal rating, watts	75
Filament voltage	10
Filament amperage	3.25
Amplification factor	12
Max. plate current, amperes	0.1
Max. DC plate voltage, modulated	2,000
Max. DC plate voltage, unmodulated	3,000
Max. plate dissipation, watts	100
Plate resistance, ohms	6,000
Mutual conductance, micromhos	2,000

Base, UX and two flexible leads.
Type filament, special thoriated tungsten.
Use, oscillator in short-wave transmitters.

De Forest Audion 504A

The De Forest 504A Audion is a 250-watt transmitting tube designed especially for oscillator or radio frequency power amplifier in transmitting sets of medium power, but it is also

ng Circuits

Anderson

useful as a modulator. Due to its sturdy construction and the manner in which the leads are brought out, it can be used on frequencies up to about 15 megacycles. At the higher frequencies it is necessary to take extreme precautions against excessive grid current.

CHARACTERISTICS OF THE 504A

Normal rating, watts	250
Filament voltage	11
Filament amperage	3.85
Amplification factor	25
Max. plate current, amperes	0.20
Max. DC plate voltage, modulated	2,000
Max. DC plate voltage, unmodulated	2,500
Max. plate dissipation, watts	250
Plate resistance, ohms	5,000
Mutual conductance, micromhos	5,000

Base, standard 250-watt base.
Type filament, special thoriated tungsten.
Use, Oscillator and RF power amplifier.

The De Forest 504 Audion is like the 504A in all respects, except that its filament is of pure tungsten and that consequently the required filament current is 14.75 amperes.

De Forest Audion 520B

The De Forest Audion is a 5.000-watt transmitting tube that may be used as oscillator, modulator. or radio frequency power amplifier in high power broadcast and short-wave transmitters. It can also be used in heavy-duty tube bombarders and in radio frequency furnaces and in similar applications.

The tube is water cooled by means of a water jacket construction which allows a large quantity of water to circulate slowly at low pressure. This permits the use of tap water as the cooling agent. The large quantity of water takes care of sudden overloads which would normally damage the anode.

CHARACTERISTICS OF THE 520B

Normal rating, watts	5,000
Filament voltage	11
Filament amperage	30
Amplification factor	15
Max. plate current, amperes	0.8
Max. DC plate voltage, modulated	10,000
Max. DC plate voltage, unmodulated	10.000
Max. plate dissipation, watts	5,000
Plate resistance, ohms	2,600
Mutual conductance, micromhos	5,770

Base, flexible leads.
Type filament, tungsten.
Use, oscillator or RF amplifier.

De Forest Audion 500

Audion 500 has been designed especially for use in tube bombarders and radio frequency furnaces. and may be used either as oscillator or as modulator. It is so constructed that the interelectrode capacities are very small and it may be used as an oscillator on frequencies as high as 15 megacycles. It is air cooled and when used as oscillator will dissipate 300 watts. It is not provided with a base, the elements being connected with flexible leads.

CHARACTERISTICS OF THE AUDION 500

Normal rating. watts	500
Filament voltage	15
Filament amperage	8.5
Amplification factor	15
Max. plate current, amperes	0.35
Max. DC plate voltage, modulated	2,000
Max. DC plate voltage, unmodulated	2,000
Max. plate dissipation, watts	300
Plate resistance, ohms	3,800
Mutual conductance, micromhos	3,950

Base. none, flexible leads.
Type filament, tungsten.
Use, oscillator, modulator.

Crystal Controlled Phone Transmitter

In Fig. 1 is a three-tube transmitting circuit employing a —10 type modulator tube, a similar oscillator tube, crystal controlled, and an —03A type radio frequency power amplifier. There is a milliammeter in the plate circuit of each tube to measure the plate current and an AC ammeter in the antenna to measure the radio frequency output. The modulator is of the Heising type and the oscillator the tuned plate type.

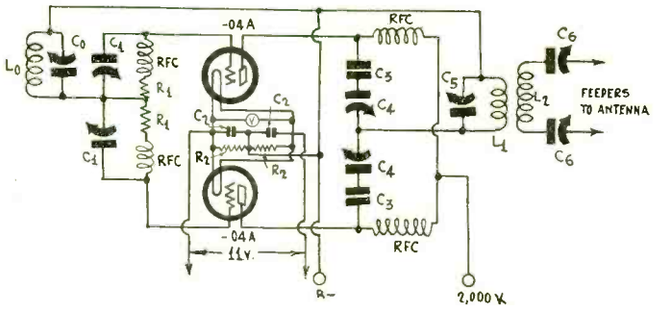


FIG. 2
A TWO-TUBE TRANSMITTING CIRCUIT IN WHICH THE TWO TYPE —04A TUBES ARE CONNECTED IN PARALLEL. THE OSCILLATOR IS OF THE TUNED GRID, TUNED PLATE TYPE.

List of Parts

T1—One microphone-to-tube transformer.
Ch1—One 30-henry choke coil.
Ch2, Ch3—Two radio frequency choke coils consisting of 150 turns of No. D.C.C. on a one-inch form.
Cr—One quartz crystal.
C1, C6, C7—Three 250 mmfd. tuning condensers.
C3—One 250 mmfd. tuning condenser, double spaced.
C2, C4, C5—Three 250 mmfd. fixed condensers.
L1—Twenty-five turns of No. 18 DCC wire on a 3.5-inch form.
L2, L3—Twelve turns of ¼-inch ribbon 4 inches in diameter.
R1—A variable grid leak.
R2—One 2,500 ohm resistance.

A Power Transmitter

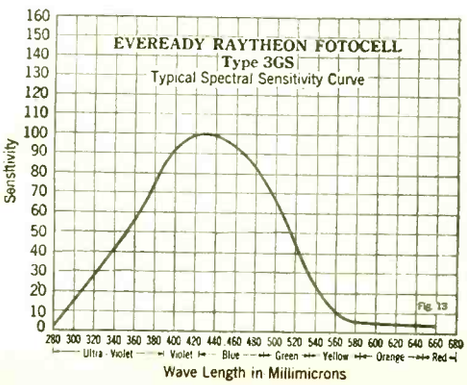
In Fig. 2 is a transmitting circuit employing two —04A type tubes connected in parallel. The oscillator is of the tuned grid, tuned plate type. The values of the different inductances, condensers and resistances are as follows:

List of Parts

Co. C5—Two 280 mmfd. tuning condensers.
C1, C4—Four 100 mmfd. variable condensers.
C2—Two 0.08 mfd. fixed condensers.
C3—Two 0.002 mfd. fixed condensers.
C6—Two 250 mmfd. variable condensers.
Lo—Eleven turns of 5/16-inch copper tubing 3.75 inch diameter (inside) for 3,500kc., and 5 turns for 7,000kc.
L1—Twelve turns of 5/16-inch copper tubing, 3.75 inch diameter (inside) for 3,500kc., and 7 turns for 7,000kc.
L2—Ten turns of 5/16-inch copper tubing, 3.75 inch inside diameter.
R1—Two 5.000-ohm resistors.
R2—Two 20-ohm resistors.
RFC—Four radio frequency chokes.

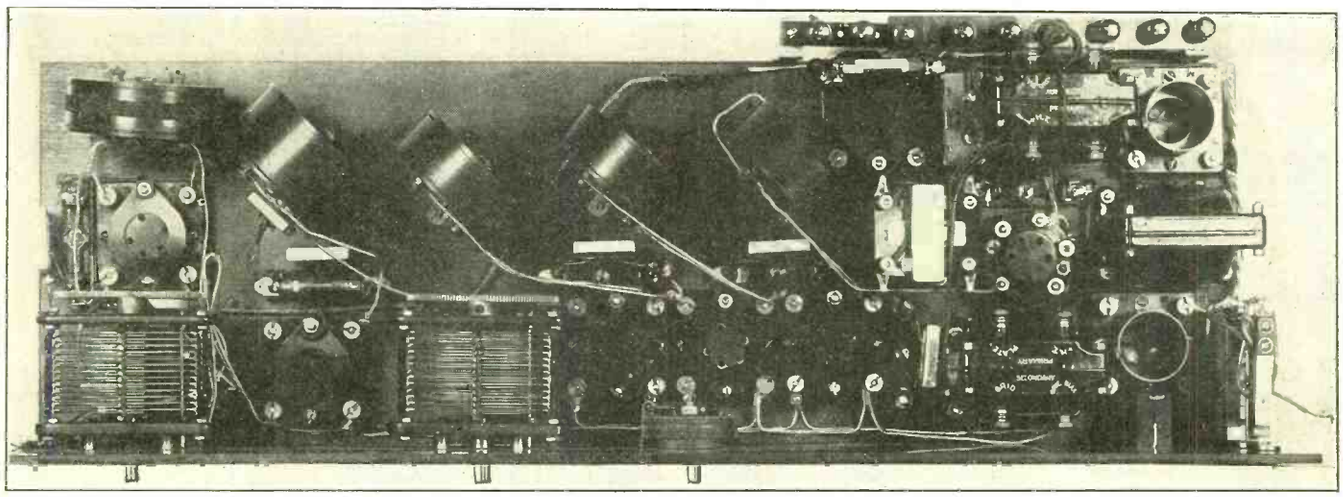
Condensers C1 in this circuit are grid condensers and resistances R1 are grid leaks. The two radio frequency chokes in series with the grid leaks might be called grid chokes and their object is to provide a higher impedence than would be afforded by a resistance alone. In a transmitting circuit high value grid leaks cannot be used successfully. due to the high grid current that flows. Condensers C3 and C4 are connected in series for safety since the voltage across the two is 2,000 volts.

THE SPECTRAL SENSITIVITY OF A TYPICAL GASEOUS PHOTO - ELECTRIC CELL, SHOWING MAXIMUM SENSITIVITY IN THE BLUE-VIOLET REGION. THE PHOTO CELL WAS DISCUSSED LAST WEEK, ISSUE OF DECEMBER 13TH.



Conversion of Batt

By John C.



THE A. C. SUPERHETERODYNE LAYOUT

[*Last week the first instalment was published of this article on converting a battery-operated Victoreen Superheterodyne to AC operation. An external power pack is used, with a tuned choke to trap out the hum. The pack is the featured discussion this week. Next week the final instalment will be printed.—Editor.*]

IN constructing the external power pack with which the set is to be operated, a departure from the usual assembly detail is the use of three voltage divider resistors. Two of them total 17,000 ohms (a multi-tap voltage divider) and the additional one one is about 7,000 ohms, making a grand total of 24,000 ohms, and providing five extra voltage taps in addition to the twenty of the first group. These resistors are seen to be mounted vertically.

The location of the transformer with respect to the double choke is such that the leakage field of the transformer is practically nil at the place where the double choke is located. This placement acts to reduce the residual hum.

With some ordinary tuned radio frequency circuits that are not overly sensitive this precaution is not as assential as in the case where the set is a sensitive Superheterodyne.

Another feature is the incorporation of a tuned series choke placed in the negative lead, adjacent to the plug-in connection for the field of the dynamic speaker, across which field is placed a small bleeder resistor. The choke inductance value is not as great as that of the double choke which is customary in power pack circuits and is around ten henries.

The parts list herewith will enable the fan to duplicate this described pack, and it is suggested that the arrangement of the parts be adhered to, as it has been tested out thoroughly from all aspects and will not be found lacking in the degree of precision necessary to insure success.

Placement of the Parts

Looking down on the top of the assembly with the cable exits facing you, the power transformer is found at the extreme left-hand upper corner, and immediately in front of it is the dry condenser block, and at the lower left-hand side is found the Polo double henry choke, 30 henries in each section.

At the upper right-hand corner are the voltage divider resistors all connected in series and directly to the front of these is the 280 tube socket with the high tension terminals facing the resistors.

The tuned choke that is connected in the negative side of the circuit is located at the lower center directly behind the cable exit.

Spanning over two-thirds of the length of the assembly are two bakelite assembly strips. Finally there are four two mfd condensers of the high voltage type mounted to the Polo double choke. The connections are shown in the circuit diagram.

The load voltage of the high voltage system of this assembly is 360 volts, and as the resistance of the divider is 24,000 ohms the divider current is 15 milliamperes. It is customary in some assemblies to use a somewhat heavier bleeder current when the demands of the particular system require it, but 15 milliamperes are plenty in this instance. The steady load of the seven 227s as used in this set plus the plate load of the two 245s will provide more current than the dynamic field will require, hence the field is bypassed with a shunt resistor to handle the difference.

A short shaft that projects directly in front of the switch operates a compression type carbon disc resistor for the minute regulation of the detector plate voltage where such regulation is required.

The Polo PT-245 transformer is one that will operate up to ten 227s, and two 245s at their rated heated and filament voltages, the primary input being 96 watts, at 120 volts.

10/32 Screws for Transformer Mounting

The case of the power pack mounts an extra switch placed in series on the 110-volt line so as to preclude the accidental turning on of the AC switch on the set if you are making voltage adjustments of the pack circuit. This switch is open when the case or the top is removed from the assembly, thus assuring safety.

All the parts that are provided with mounting lugs are to be attached to the bottom of the case, the transformer with 10/32 machine screws and nuts and the balance with 6/32 machine screws and nuts.

The connecting cable between the power pack and the set is the type popular some years ago, and has twelve leads. Both the set and the power pack are provided with similar terminal boards that carry terminals lettered consecutively from A to L. These letters correspond to colored cable wires, and include two that are of the metal mesh shielded type. These two carry the 110 volts AC to the switch in the set, the shielded mesh being grounded to prevent the cable acting as an antenna, and also to prevent the picking up of line noises.

The preliminary test of the converted Superheterodyne showed this to be an absolute necessity, and the wiring diagram of the power pack will reveal the connecting of a condenser to one side of the 110-volt line. This condenser also helps to bypass line noises.

Cable Details

The case of the power pack, and that of the associated apparatus, are likewise grounded for the same purpose. The cable is four feet in length from end to end, which is ample for most needs, and the voltage drop in the 16-ampere lead wires that feed the heaters of the seven 227s if less than 1/10th of a volt, but you must remember to have low resistance joints on this line especially, and the 245 power tube filament supply as well.

These leads are respectively of No. No. 12 and No. 16 cotton covered wire.

The leads of the 16 ampere winding on the transformer should be led to the terminal posts on the board of the pack. These are 14/20 brass screws, with two nuts and two washers each, and the terminals, of the high density current cable, are made of four pieces of ½ inch by 1/16th inch brass strip an inch long, to which the wire is securely soldered, and a ¼ inch screw "body hole" is drilled near the end of the strips that fit the above posts in the power pack. The other terminals are slotted to fit over the regular binding posts on the terminal board of the set.

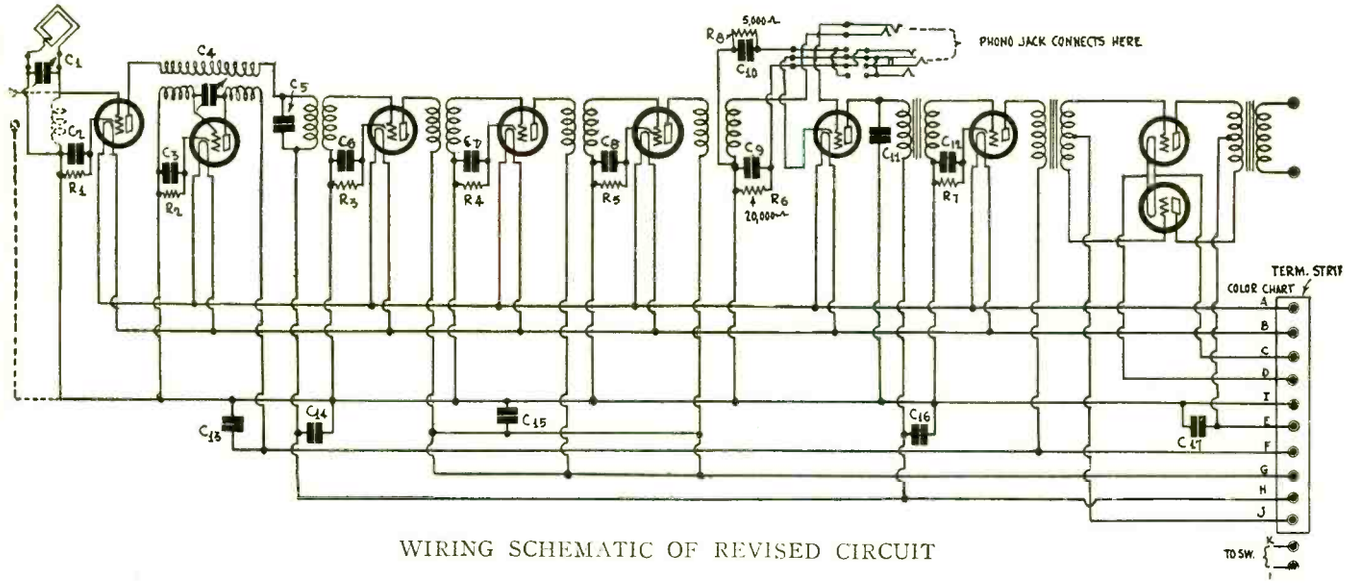
The leads that are for the 245 filaments, i.e., 2½ volts at 3 amperes, are supposed to be of the same current carrying capacity. Accordingly these are to be of No. 16 DCC wire and are to be securely soldered to (two of) the binding posts of the terminal board above the lead outlet of the transformer.

The cable wires that convey this current to the set are to be af the same size wire, and in addition to the regular cotton covering are to be insulated with a single layer wrapping of friction tape.

The No. 12 DCC wire leads are to be similarly treated, and

ery Victoreen to AC

Williams



WIRING SCHEMATIC OF REVISED CIRCUIT

these two pairs of leads are to be separately twisted, in the same direction.

Color Designations

The alphabetical designations for the wires of the cable are as follows:

		Color
A, B, C, D	No. 12 DCC 2½ volts, 16 amperes.	.....
E	250 volts PWR B+	Red, Black tracer
F	110 volts fiirst audio B+	Black
G	90 volts RF and oscillator B+	Blue
H	45 volts detectors B+	Green
I	Common return	Blue, Yellow tracer
J	C—PWR	White
K	Twisted shielded mesh for 110	
L	Volts (4 feet doubled.....	.....

To handle the above there are twelve binding posts on the binding post assembly on the set.

It is not necessary to observe the particular order outlined above, the prime requisite being to obtain correct connections, properly identified, and good insulation in the completed set assembly.

The conversion of the battery-operated set to the AC form does not involve changes that in any way impair its operational characteristics, except for the improvement due to the addition of the push pull 245 power amplifier.

The alterations, as previously forecast, are the general shifting of the parts toward the left-hand end of the subpanel as a comparison of this week's picture with that of last week's will show.

The coils of the intermediate amplifier are not affected by the shift of the parts, that is, they are not made to cover less space than before, but the oscillator coil is close to the left-hand margin of the subpanel, necessitating the exchange of the positions of the loop and the oscillator tubes and at the same time making the left-hand tuning condenser the oscillator tuner and the right hand one the loop tuner.

The second change is consequent upon the first, but it results in the wiring arrangement that ultimately works out to be good. The picture shows the arrangement of the parts, but it may be of some assistance to the reader if the placement is recounted again with the present arrangement.

Beginning at the extreme left-hand end, the oscillator tuner condenser, tube socket and coil are seen to have a common center. and the grid bias resistor mount for this tube is at the immediate left, with the shunt condenser in position.

Distance Recounted

The next common center to the right is that of the input transformer of the intermediate frequency amplifier and the loop tube socket. with its grid bias resistor mount directly adjacent and the shunt condenser in position. Next, to the right, is the center of the second intermediate transformer and the loop tuning condenser.

The two tuning condensers are seven inches apart, with the tube socket in between them.

Two and three-quarter inchs to the right from the second condenser center, on the subpanel, is the first of three intermediate tube sockets mounted close together. The external size of the tube sockets is 2 3/16 inches square. The three grid bias resistor mountings with shunt condensers attached are seen adjacent to the sockets.

The four intermediate frequency coils are separated just 3½ inches each.

The disposition of the rest of the apparatus is made in accordance with the room available with due regard to the influence of the external fields of the audio transformers.

The Audio End and the Power Amplifier

The first audio transformer is at the center of the subpanel, with its primary terminal board facing the detector tube, and directly at the top to the left is seen the second audio stage tube socket, with its grid bias resistor and 1 mfd. shunt fixed condenser, and to the immediate right is the input transformer, and lastly, at the extreme right, is a 245 power tube socket.

At the center, directly to the right of the first audio transformer is the detector tube with its resistor mount directly adjacent, and to the extreme right center is the push-pull output transformer.

Below the detector tube is the other input transformer and to its right is the second 245 tube socket. Right below it, mounted on the front panel, is the AC switch, from which two wires are to be run to the terminal strip at the upper right-hand side of the subpanel.

Mounted on the rear side of the front panel at the lower right are seen three jacks, the one nearest the subpanel being the one for the phonograph pickup plug.

When the Superheterodyne was in the battery-operated form there was a second jack for cutting in on the output of the first audio stage, when reduced volume was desired. This jack will be used for the same purpose in the present hookup, but the connection will not be detailed on the sketch, to avoid confusion. The third jack was for the speaker output connection and it is to be connected to the two terminals of the output transformer, the actual connection not being detailed.

The grid bias for the 245s is obtained via cable lead J from the power pack, directly from the voltage divider. All the other bias voltages are obtained from the condenser-bypassed resistors in the set assembly.

Completing the Cable

The connection cable consists of twelve wires. It has been found that it is advisable to run the short 110-volt leads from the terminal board of the set to the AC switch with the shielded lead wire, as there was some line noise pickup from this short run, the shielded coating is to be grounded.

Another connection refinement to reduce line pickup is to connect a .01 mfd condenser in series between the B minus and ground. This has been done on the power pack. but the average fan might not be aware of it in this particular case, so it is mentioned for his convenience. The cable wires are to be grouped together and tied at intervals with good twine which is preferably waxed, and then the whole is to be carefully taped with friction tape so that when you are through there is an equivalent of two layers. This makes a permanent job and a good electrical one as well.

(Continued next week)

Adding to the Volume

By C. R. Bell

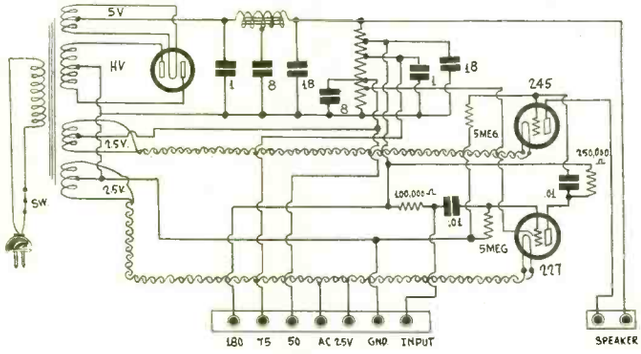


FIG. 1
THE CIRCUIT DIAGRAM OF A TWO-STAGE POWER AMPLIFIER AND A B SUPPLY CAPABLE OF POWERING NOT ONLY THE AMPLIFIER BUT ALSO THE RADIO FREQUENCY PORTION OF THE RECEIVER.

IT often happens that the output of a receiver is not sufficient to operate the loudspeaker at the level desired because there is not enough amplification in the circuit. In such cases the easiest solution of the problem is to add a stage or two of amplification. In most instances of this kind it is not necessary to have a high-gain amplifier but one that can handle the required volume without an appreciable distortion. As is well known, the best quality amplifier is one using resistance coupling, and this form of amplifier not only has this advantage but it also costs less to build and requires less room.

It is true that resistance-coupled amplifiers often give trouble in the form of oscillation of motorboating, but it gives no more than any other amplifier capable of similar quality. Moreover, the difficulty can always be overcome by simple means in case it should appear.

When adding a power stage to a receiver that is not already provided with high voltage, it is necessary to make this provision, and the easiest way is to build in a B supply unit having the required output voltages. This supply, then, can also be used for the remaining part of the receiver.

Power Amplifier and B Supply

In Fig. 1 is a circuit diagram of a power amplifier and a B supply of the type just mentioned. It contains one 227 tube, one 245, and one 280. A resistance-capacity coupler is provided for coupling the 227 tube to the amplifier or detector that precedes the depicted part of the circuit and there is also a resistance coupler between the 227 and the 245 power amplifier. The output of the power tube is shown to go directly to the loudspeaker, but this does not have to be taken literally because in most instances there is a coupling transformer in the dynamic speaker used. If the speaker is of the dynamic type having a matching transformer as an integral part, the primary of that transformer should be connected to the output leads indicated.

Note the manner in which the grid bias for the tubes is obtained. The mid-tap of the 2.5 volt winding for the power tube is connected to a point on the voltage divider 50 volts up from the negative end, while the grid return of this tube is grounded, or is made to the negative end. Thus the bias on the power tubes is just 50 volts. The bias for the 227 tube is obtained in a similar manner but the cathode of this tube is made to a point on the voltage divider which is considerably below the tap used for the power tube. The bias on the 227 should be around 13.5 volts.

Many Taps on Divider

The voltage divider used has many taps at the low potential end and it is easy to find one for each tube which will give the correct bias. This is best done with the aid of a high resistance voltmeter, but if none is available it may be found by trial, especially for the 227 tube. If a milliammeter is available that should be used in the plate circuit of the 245 tube and the midpoint of the 2.5 volt winding should be connected to that point on the voltage divider which will make the plate current 32 milliamperes. When this has been done the bias for the other tube can be adjusted by ear to the best value. In judging the quality it is advisable to listen to the low notes on very strong passages. If the bias is either too low or too high there will be distortion of a marked nature.

FREE AID TO A NEW JOB!

SITUATIONS WANTED AND HELP WANTED ADVERTISEMENTS WITHOUT COST!

RADIO WORLD will publish, FREE, under the heading of Radio Situations Wanted or Help Wanted, advertisements for those who are seeking radio situations or for employers who are adding to their working forces.

Address: Industrial Dept., RADIO WORLD, 145 W. 45th St., N. Y. C.

SITUATIONS WANTED

EXPERIENCE FIVE YEARS, custom set builder and designing. 25 years old, single, reliable. Knew radio when Electro Importing Co. was the only supply house available to amateurs. Would like factory or laboratory work—go anywhere. Floyd Hoskins, Jr., care Hotel Atlantic, Bay and Hogan Sts., Jacksonville, Fla.

RADIO SERVICE-MAN wishes position in either store or factory. Have three years outside experience. Am now student of National Radio Institute, Washington, D.C. L. Schudde, 155 Meserole St., B'klyn, N. Y.

RADIO MAN, 3 YEARS EXPERIENCE, desires work. Write Frank Lavallee, 218 Baxter St., Pawtucket, R. I.

YOUNG MAN WANTS WORK IN RADIO LABORATORY or radio repairing. Have had Technical School Training, and experience. Also have an Amateur Ticket. Matthew Ajeman. 75 Park Street, Rockland, Mass.

COMPETENT RADIO SERVICEMAN. Weston test equipment. Go anywhere. Casey, 325 E. 4th St., Jacksonville, Fla.

YOUNG MAN 30 YEARS OF AGE wishes position in service and installation work. J. Hamilton, 329 So. 6th Ave., Mt. Vernon, N. Y.

WILL GIVE SERVICES, 7 to 8 hours daily, for opportunity to learn radio service work. Have chauffeur's license. Prefer 42nd Street, New York City, district. Box 156, Radio World.

RADIO SALESMAN AND SERVICEMAN, one who can meet the public. Fifteen years of practical experience and theory on receiving sets and installations. I am no wizard but can get results and make satisfied customers. Would consider any location. Robert J. Fogg, Reading, Mich.

YOUNG MAN WISHES CONNECTION with a Radio Research Laboratory which is interested in the reduction of received static only. Write S. Stella, 958 How Ave., Bronx, New York City.

EXPERIENCED. Good general knowledge of technical radio work, construction and repairing. Am 30 years of age and married. Reference: Radio and Television Institute, Chicago, Ill. Steve Marko, 139 Brighton Drive, Akron, Ohio.

YOUNG MAN 19, TECHNICALLY INCLINED, desires position as assistant in radio laboratory. Formerly connected with Pilot experimental tube laboratory. Write August L. Oechsli, 280 Linwood St., Brooklyn, N. Y., or phone Applegate 8631.

RADIO SITUATION WANTED. Radio Repair and serviceman, 21 years old, High School education, three years experience, would consider radio position of any kind, anywhere in United States. Kenneth P. Henderson, 115 Honeoye St., Shinglehouse, Pa.

EXPERIENCED RADIO SERVICE MAN wants position. Write Thomas E. Martin. Keota, Iowa.

30 YEARS OF AGE, A COLLEGE GRADUATE. Primarily a sound engineer (R.C.A.) with expert knowledge of installation, service, maintenance and repair of sound motion picture systems as well as all kinds of amplifiers and public address systems. Aso of acoustical problems (treatments of theatres, etc.). This knowledge is backed by eight years' experience in the electrical and radio field, enahling me to install, service and repair expertly any and all radio sets and accessories on the market. I am free to travel, speak several languages and am equipped with all necessary tools, meters and latest type analyzer and checker. Although I made, of course, a good deal more, I am willing to start at $30.00 per week. I am prepared to furnish excellent references.—Address Able Box X. care of Radio World.

NATIONAL RADIO INSTITUTE GRADUATE, with three years' experience in building and repairing receivers. Would like to obtain position. William B. Floyd, Box 22, Monroe, Virginia.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Those not answered in these columns are answered by mail.

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.

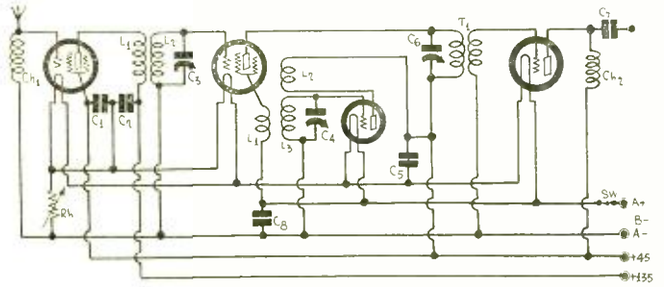


FIG. 871
A DIAGRAM OF A FOUR-TUBE SHORT-WAVE CONVERTER DESIGNED FOR USE WITH SMALL BATTERY TUBES.

All-Wave Super

WOULD it be possible to build a receiver on the superheterodyne principle capable of covering all the waves from the broadcast to the shortest used with an intermediate frequency of 250 kilocycles? If not, please explain why it is not practical.—W. H. J.

It is quite possible and many such circuits have been built and they are now receiving stations from all over the world. Of course, not all of these have intermediate frequencies in the neighborhood of 250 kc but the IF is not all important. The only thing to watch out for is to see that the coupling between the oscillator and the radio frequency tuned circuit is not so close that the two interlock at the higher signal frequencies. If the coupling is made variable by means of an adjustable pick-up coil the scheme is quite feasible with an IF of 250 kc. Also, if the plug-in coil system is such that the pick-up coil is wound on the oscillator form the system is practical because a pick-up coil can be chosen for each coil so that there will be no interlocking at the higher frequency end of the tuner.

* * *

Best Type of Band-pass Filter

THERE are many types of band-pass filter and I am wondering which is the best to use in an intermediate frequency amplifier using 224 type screen grid tubes. Will you kindly describe one which you believe is the best.—B. F. L.

There is no best band-pass filter because the same effect can be obtained with many different ones. The simplest is probably the ordinary radio frequency transformer with tuned primary and tuned secondary. It is only necessary to adjust the mutual inductance between the two coils, tune the two circuits to the same frequency when each is unaffected by the other, and to see that the filter so formed works between equal impedances. Since it works between the plate circuit of one tube and the grid circuit of the next, there should be a grid leak across the second tuned circuit to match the plate resistance of the first tube. Since there is some grid conductance at AC it is well to make the grid leak, which is in shunt, a little higher than the plate resistance of the first tube. For example, if the plate resistance is 800,000 ohms the grid leak might be one megohm. An absolute match is not essential. It is not easy to get an exact match because the tube impedance should also match the input impedance to the filter and it is practically impossible to match them.

* * *

Coupling Between Coils

IS there any mutual inductance between two solenoids placed side by side or must one be inside the other or end to end, in order that there should be mutual inductance between them.—C. D.

There is mutual inductance between the coils no matter how they are placed with respect to each other, except when the fields of the two coils are at right angles. The fields are at right angles when the axes of the coils are at right angles and when the center line of one cuts the center line of the other in the middle. There are also certain other positions when the fields are at right angles.

* * *

226 Versus 227 Tube

KINDLY state the advantage of using type 227 tubes in a set instead of type 226 tubes.—N. C.

The 227 tubes use a heater element and are practically free of hum. The 226 tubes, on the other hand, may cause a slight hum.

Full-Wave Rectification

I UNDERSTOOD that it took two tubes for a full-wave rectifier, and I know some use two tubes. Is it possible to do it with one?—M. L.

Yes, the 280 tube is a full-wave rectifier, containing two rectifying plates. This tube will serve up to about 300 volts. For higher voltages, it is advisable to use two separate tubes of the 281 type, each having only one rectifying plate.

* * *

How Coil Range is Determined

HOW do you determine the inductance of an oscillator coil when the intermediate frequency is nearly equal or even greater than the frequencies to be covered?—B. C. F.

The first thing that is done is to decide on the intermediate frequency and then on the lower frequency limit to be reached by the tuner in which the coil is placed. Then these two are added to give the lower limit of the tuning range of the oscillator. For example, suppose that the intermediate frequency is 1,500 kc and the lowest frequency to be tuned in is 550 kc. The sum of these two is 2,050 kc. Now to get the required inductance we have to know the capacity of the tuning condenser to be used across the coil. Suppose this is 250 mmfd. Since there will be some distributed capacity in the circuit we have to make allowance for this, and in this assumed case it is reasonable to allow 25 mmfd. Hence our total capacity is 275 mmfd. From the frequency and the capacity we can apply the well known formula for calculating the inductance. It turns out to be 21.9 microhenries. This is a very small coil and it would be better to use a condenser of only 125 mmfd., making the coil twice as large.

* * *

Tuned Input on Short-wave Converter

IS there any advantage in having an untuned stage of RF ahead of the tuned modulator over connecting the antenna directly to the primary of the transformer ahead of the modulator tube? If there is any advantage is it sufficient to offset the disadvantages?—B. F. E.

The untuned amplifier adds a little to the sensitivity and it also eliminates the uncertainties of the antenna characteristics from the tuned circuit. The increased sensitivity alone is probably not enough to justify the extra tube but the elimination of the characteristics of the antenna from the tuned circuit does with some to spare.

* * *

High Vacuum Photo-Electric Cell Ionization

IN your curves on the photo-electric cells you gave an ionizing voltage for the gaseous cells but not for the high vacuum cells. Is there no voltage at which the high vacuum cells ionize and if not, why?—J. R. H.

The ionization occurs because of gas in the cell, and the greater the amount of gas, within limits, the lower is the ionization voltage. Since it is impossible to get a perfect vacuum even the high vacuum cells contain some gas, so that if the illumination and the applied anode voltage are high enough there will be ionization. But in the high vacuum cells the ionizing point is so high that it is not met with in ordinary practice. Amplifier tubes are supposed to be high vacuum devices but they often ionize when the voltage on the plate is too high. The same is true of photo-electric cells.

* * *

Four Tube Converter for Battery Tubes

WILL you please publish a diagram of a short-wave converter for DC tubes. I have in mind a four-tube circuit like the one you published in the Nov. 15 issue, but it should be for battery tubes, preferably the new 2-volt tubes.—K. L. P.

You will find the diagram of such a converter in Fig. 871. It may be built with two 232 tubes and two 230. The coils and condensers may be exactly the same as the corresponding parts in the de luxe circuit published in the Nov. 15 issue, except that the leads on the oscillator coil are not brought out in the same manner, the change being necessary because of the different voltages impressed on the modulator tube. Ch1 may be one of the small ¼ millihenry choke coils specified in many short-wave converters or it may be a grid leak. Still a better arrangement is to use a 500,000 ohm potentiometer, connecting the grid to the slider. This provides a means for varying the input for controlling the volume. It is more convenient to control the volume at the converter than at the radio receiver. Rh must be adjusted to suit the applied filament voltage. If this is 3 volts Rh should be set at 4 to 5 ohms.

INTERFERENCE IN TELEVISION STIRS EXPERTS

Washington.

A description of a process by which commercial television may be established has been presented to the engineering conference of the Federal Radio Commission.

Dr. C. B. Jolliffe, the Commission's Chief Engineer, was in charge of the meeting, which was addressed by Philo T. Farnsworth, of San Francisco, inventor of the process. The present picture transmissions are made with from 40 to 60 lines. The new system makes possible the transmission of 300 line pictures on a 6-kilocycle channel.

Working on Interference Trouble

Impending plans for the reallocation of the country's television transmitters was one of the subjects brought up. Dr. Jolliffe said that ways and means were being worked out to redetermine the extent of interference that exists between the present television transmitters, and also there was a discussion of the method of combining the visual and voice transmissions.

Resolution Adoption

The following resolution was voted unanimously.

"Resolved, that it is the sense of this conference that the following principles shall be followed in making allocations on the frequency bands allocated to experimental visual broadcasting between 1,500 and 3,000 kilocycles.

"1. No assignments for simultaneous operation shall be made within 150 miles of an experimental visual broadcast station, and within the same 100 kilocycle band.

"2. The staggering of carrier frequencies within the licensed band is permitted by arrangement among the licensees provided no interference results in neighboring channels.

"3. Engineering principles should take precedence over management details in the allocation of channels.

"The adoption of this resolution shall have no prejudicial effect in the consideration of future applications for visual broadcast stations which are shown not to respond to its requirements."

Mr. Farnsworth gave a brief technical talk about the new system, but did not go into details about circuits and transmission methods. Mr. Farnsworth explained how it would make facsimile transmission possible on frequency bands one-one-hundredth of present band widths, or 100 facsimile messages with the same facilities now required for a single message or picture.

Tell Your Friends

YOU read Radio World no doubt because some special features appeal to you, or because Radio World provides technical information or help in solving your radio problems not found in other radio publications. Then, too, it is on hand every week—no long waits between numbers...If you find it good reading, your friends doubtless will, also. You will do them a real service by telling them about this big return for only $6.00 a year (52 issues). Shorter periods: $3.00 for six months; $1.50 for three months; trial subscription, 8 weeks for $1.00. Radio World, 145 West 45th St., New York City.—Advt.

What Results with Television?

Sees No Entertainment in It

FOR quite a number of months I have been conducting experiments on the fascinating subject of television. As a matter of fact, I've been in the field for two years. Naturally, at first, this picture reception was very unsatisfactory. It was so poor that out of two hours of operation I could not expect more than 10 or 15 minutes of reception. Of course, I might not have been using the right equipment for such reception.

But the question was to decide what was adequate.

Practically all short wave receivers were of the regenerative type. Although performing the trick they would not prove to be fully satisfactory. I was even to a certain degree disappointed with a special non-regenerative receiver, yet it proved to be the most reliable of all.

Unless one has a very sensitive receiver here in Detroit the reception is bound to be interfered with by continuous police broadcasts of three stations, of which WCK is the strongest. Secondly, the second harmonic (1840 kc) of WMBC (1420 kc) is constantly interfering with the reception of the Jenkins' transmitter W2XCR.

By the way, I've read somewhere that the sw. band from 100-150 meters is reserved for television transmission exclusively. Are police broadcasts in this line?

Now to the stations and their quality of pictures.

W3XK is the only station which I can receive without difficulty and with 100 per cent reliability. There was no night this station has disappointed me. When W2XCR, W2XR and W9XAP have given no results, W3XK came as the old standby. Of late W9XAP, the Chicago Daily News' station, comes in, too, with regularity but not by far what I've expected after all the newspaper stories.

The quality of the pictures of the different stations received by me is about the same all the way around with the exception of more or less static which will bring more distortion. In my judgment there is no entertaining value in any of the present broadcasts to justify the expense. It's all right for an amateur to sit and fish for good reception but no one else will find satisfaction except for a point which cannot be overlooked, namely, that he is privileged to follow television development as he has followed radio broadcast development in former years.

All in all, I receive regular television broadcasts from four stations: W3XK, W2XCR, W2XR and W9XAP.

HENRY HEFNER,
17303 Goulburn Avenue,
Detroit, Mich.

A THOUGHT FOR THE WEEK

SOMEBODY has invented an electric car for the purpose of having one sound kill another and thus reduce unwelcome noise to a minimum. Herewith is our order for a couple of electric ears if the makers can guarantee they will murder the unheavenly noises made by some marauding banjoists who usually cut in and spoil our joy in listening to Rubinstein's melody in F. We wouldn't object even if a trio of Zylophonists who blah effectively if not sweetly somewhere out in the West were silenced forever and for aye.

WARN STATIONS BEFORE SHIFT COURT ADVISES

Washington.

A recent opinion of Chief Justice George E. Martin of the Court of Appeals of the District of Columbia holds that radio stations should be forewarned of impending changes in frequency assignments. This opinion was delivered during the course of the oral arguments in the case of the Louisville "Courier Journal" versus the Federal Radio Commission in which the newspaper's station, WHAS, appeals from the decision of the Commission putting it in the list of twenty-six station operating shifted in frequency and "demoted." The order was blocked on a stay issued by the Court of Appeals.

Counsel for the Kentucky station contended that the Commission's original order was in violation, not only of the terms of the radio law requiring a formal hearing, but also conflicted with the due process provisions of the Fifth Amendment of the Constitution.

No Hearing, He Says

Hhe said the Commission had ordered the shift before any hearing was held, but subsequently amended this order to provide for a hearing.

Duke M. Patrick, Assistant General Counsel for the Commission, contended that the original procedure was not now involved in the case, since the Commission had amended the general order, and has scheduled a hearing preparatory to placing the shift in effect. He said the sole purpose of the Commission's order was to eliminate objectionable cross-talk interference for listeners, entailed by inadequate geographical separation among the stations for the kilocycle or "geographical separation" between them.

Cites Big Investment

The substance of the Chief Justices opinion was that, due to the term of the license being restricted to 90 days, and also because of the large financial investment involved, it was his opinion that a station should not be shifted from one channel assignment to another before it has been given opportunity to present a case before the regulatory body.

Tube-Operated Piano Demonstrated

A new kind of musical instrument has appeared on the scene in the form of an electrical device with a keyboard that resembles a small piano. The instrument is consists essentially of a stretched copper wire arranged in the field of an electromagnet activated by an amplifier.

The keys of the keyboard control tunable oscillators that influence the of vibration of the copper wire and thus oscillators can be made to emit a wide variety of sounds that range from the flute and piccolo to the lower tones of the organ.

This instrument is known as the Martenot, after its inventor, Maurice Martenot, a pianist of note. The instrument was demonstrated before the Philadelphia Symphony Orchestra recently, and it is expected that a recital will be given at Carnegie Hall, New York City.

OUST A THIRD OF ALL ON AIR, PLEA TO HOUSE

Washington.

Representative White of Lewiston, Maine, thinks that there are too many broadcasting stations and accordingly has introduced at a recent session of the House of Representatives a resolution calling for the investigation of the manner and reasons why the several broadcasting stations have obtained licenses. Representative White said:

"I introduced this resolution because several of the Merchant Marine and Fisheries committee are of the opinion that there are too many radio stations, and we desire to get a survey of the situation to determine why some licenses have been granted.

"Under the original radio act it was the belief of the Committee that it would give the Federal Radio Commission a chance to cut down the number of radio stations, but since that time there has been no decrease in number.

"In fact, even where a radio station's license has lapsed the Federal Radio Commission has not taken advantage of the opportunity to keep a station off the air, but instead has issued licenses to fill the gaps.

"It has been our contention that it has not eliminated stations from the air because the Commission is not certain of its power, and is afraid of getting into too much litigation.

Wants ½ or 1/3 Ousted

"Whether or not the Commission has the power to take a station from the air has never been decided, and at present such a case is before the courts.

"The excuse for not attempting to eliminate some stations is not well founded. There should be a reduction of one-third to one-half of them."

Big Progress Made in Airplane Beacons

The contributions of radio science to the advancement of aerial signalling is noteworthy. Not the least of these is the directional radio beacon of which there have been several important improvements made in the past few months.

In the beginning the type of beacon installed operated a visual indicator, and with that came the demand for automatic volume control. This was developed at the Bureau of Standards, and it relieved the airplane pilot of the necessity of manual manipulation of the direction-finding loop.

Later in connection with the above an additional device was developed which served as a distance indicator. This device is still in more or less of an experimental stage of but with it the pilot can estimate the location of the landing field with reasonable accuracy.

A type of receiving circuit by means of which a pilot can fly a chosen course is one in which the variation of a current in a shunt circuit affects two independent reeds of an indicating device to which is associated a pointer and scale. The deviation of the pointer off the scale is the measure of the deviation of the plant from the chosen course. Only by continuous experimental work are improvements possible.—J. C. W.

Forum

WHO-WOC Synchronization

IN your magazine have occurred several times statements to the effect that the synchronization of WHO and WOC is a complete success.

I can assure you that such is not the case and that anyone who made the least attempt to check up the matter in areas where the power of the two stations is somewhere nearly equal would be forced to my conclusion.

Radio dealers tell me they do not dare to tune in WHO-WOC when demonstrating a set because the bad reception is likely to be blamed on the set.

I carry a portable radio around Eastern Iowa and have plenty of opportunity to test the reception. In locations where one of the stations is relatively strong the reception is not bad because the other station is too weak to affect it much. At a place like Grinnell or even at Iowa City the reception is often so poor that there is no pleasure in listening to it. Right now the signal is coming in loud and then fading to a fuzzy effect about every six seconds.

The best one could say of the WHO-WOC synchronization, as I have observed it, is that in certain areas rather near one or the other station, or beyond it on the far side, the reception is not seriously interfered with, but for areas in between the two stations or fairly equi-distant north or south (e. g. Grinnell, Marshalltown, Cedar Falls) the reception is not satisfactory but is good enough at times so that it seems as if the perfection of some automatic device to hold the synchronization more closely would make it really the success which has been mistakenly claimed for it.

GEORGE H. ROGERS,
4943 Winthrop Avenue,
Chicago, Ill.

WHO OWNS ETHER? IS BEFORE COURT

Washington.

The Supreme Court has recently been asked to decide in a case involving regulatory rights that has been brought before it by three Chicago broadcasters. The issue here is, Who owns the Air?? The complainants, whose case is before the Court on appeal claim that their broadcasting station represents an investment and property right executed before the Federal regulations came in to being, and, according to the Government, cannot impose confiscatory regulation upon them now, for to do so would violate the Constitution. Solicitor-General Thatcher, representing the Government, states that the air is free for the use of all, and there can be no vested or property rights in the use of the ether.

The following is an excerpt from the Solicitor-General's brief

Opinion Given

"The doctrine of prior appropriation can have no application to broadcasting because the ether, whatever its unknown physical properties may be, cannot be appropriated, possessed, owned or controlled.

"Even the courts are powerless to protect the appellants' asserted right to exclude others from its use. Foreign stations may invade with impunity his alleged right to broadcast without interference on the wavelength he employs."

WJZ-WBAL AND WEAF-WTIC IN A WAVE TIE-IN

Washington

The Federal Radio Commission has recently been petitioned by the representatives of the National Broadcasting Company to grant it permission to engage in synchronizing experiments during the regular operating hours, the aim being to supplement the elaborate experiments already under way. The first practical application of the proposed synchronization would be the simultaneous operation of station WBAL, Baltimore, and station WJZ of New York. Also WEAF of New York is to operate with WTIC of Hartford, Conn.

Now Share Frequency

The application also asks permission to make the alterations to enable WBAL and WTIC, which now share time equally on the 1,060 kilocycle channel, operating, in effect, on alternate days, to broadcast full time. The Hartford station uses 50,000 watts power, while WBAL is licensed for 10,000 watts.

WJZ, which would be linked on the 760 kilocycle channel it now occupies with the Baltimore station, uses 30,000 watts, and is one of the N. B. C. "key" stations.

Two for 660 kc

WEAF, employing 50,000 watts power, would operate simultaneously with WTIC on its wavelength of 660 kilocycles.

Synchonization is the operation of two or more broadcasting stations on the same wave length without distorting interference, regardless of the fact that high power might be used.

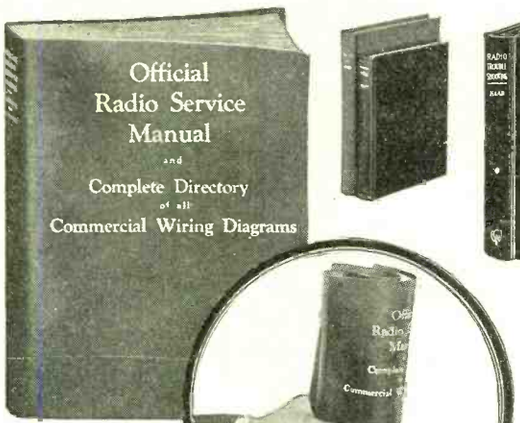
Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

Wm. H. Fadely, R. F. D. No. 2, Box 16, Mt. Jackson, Va.
Oscar Ise, 1517 Coit Ave., East Cleveland, Ohio.
Douglas Mendenhall, Box No. 286, Spearfish, S. D.
Jack P. Erschen, 604 Greendale, Pittsburgh, Pa.
L. Portnoy, 85 Middleton St., Brooklyn, N. Y.
John R. Walters, 5108 Walworth, Cleveland, Ohio.
Frank Jurman, 619 S. 20th St., Belleville, Ill.
Harold Sheerer, 8 Leon St., Somerville, Mass.
Lionel W. Kinsey, Humboldt, Neb.
J. W. Eichinger, P. O. Box 333, Ames, Iowa.
O. W. Wendelburgh, Care Union Trust Co., Cleveland, Ohio.
Irving L. Stephens, 722 W. 5th Ave., Mitchell, S. D.
John A. Milbury, 1006 North Caroline Ave., S. E., Washington, D. C.
Howard C. Searing, Stewartsville, N. J.
W. A. Zilinski, Corn Belt Hotel, Gilman, Ill.
Micah Jenkins, 89½ Broad St., Charleston, S. C.
The Radio Shop, 1440 Central Ave., St. Petersburg, Fla.
Frank Williamson, 5 W. Main St., San Angelo, Texas.
Benjamin Milch, 551 Snediker Ave., Brooklyn, N. Y.
William Mullally, 30-30 83rd St., Jackson Heights, L. I.
Walter R. Lewis, Barnesville, Pa.
J. D. Findley, Jr., 2406 Second Ave., Altoona, Pa.
John L. Hodell, 433 Arbor Road, Cleveland, Ohio.
John F. DeFonso, 6149 Rinchart St., Philadelphia, Pa.
Z. S. Hallworth, 7365 Claridge St., Philadelphia, Pa.
A. E. Shafer, 517 Hemlock St., Jackson, Miss.
John Curtin, 1690 Washington St., Boston, Mass.

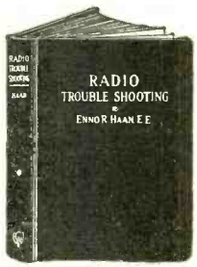
A Complete Line of Radio Books!

SERVICE MANUAL **RAMSAY** **HAAN** **RADIO MANUAL** **ANDERSON and BERNARD**



"Official Service Manual," by Gernsbach and Fitch, 1,000 illustrations; diagrams of commercial receivers and power amplifiers; 352 pages; includes course on servicing. Weight, 2½ lbs. Complete 5-page index. Flexible leatherette cover, loose-leaf binding. Order Cat. ORSM @ $3.50

The index to the commercial wiring diagrams takes up five pages alone. The index is an alphabetical array of the manufacturers' names, with model names and numbers stated.



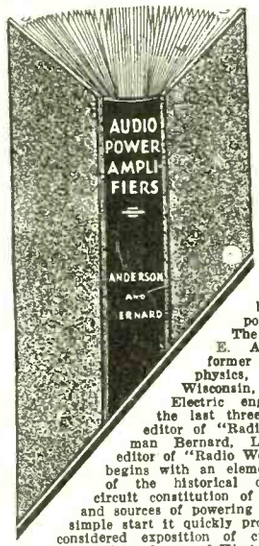
"Radio Trouble Shooting," by E. R. Haan, passes over theory, tells what to do to cure troubles. 300 illustrations, flexible binding 361 pages 6x9". Order Cat. HAAN... @ $3.00

"Experimental Radio by R. R. Ramsey, Ph.D., Prof. Physics, Indiana University. 255 pages, 168 illustrations. Cloth cover. Order Cat. REX.....@ $2.75

"Fundamentals of Radio," by Ramsey. 374 pages, 402 illustrations. Order Cat. RFM @ $3.50

The new edition of "The Radio Manual" answers questions about the principles, methods, or apparatus of radio transmitting and receiving. A complete course in radio operation in a single volume.

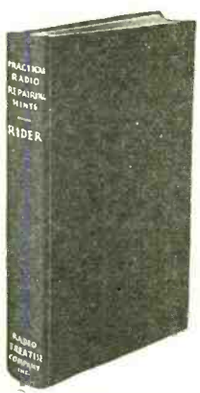
20 big chapters include: Elementary Electricity and Magnetism; Motors and Generators; Storage Batteries and Charging Circuits; The Vacuum Tube; Circuits Employed in Vacuum Tube Transmitters; Modulating Systems and 100% Modulation; Wavemeters; Piezo-Electric Oscillators; Wave Traps. Nearly 900 pages, 369 illustrations; flexible fabrikoid cover. Order Cat. MAN @ $6.00



An understanding of audio amplifiers of all types, and of the use of tubes in audio channels, is a prerequisite today, when audio amplification is to the fore in radio, in public address systems and in the talkies.

"Audio Power Amplifiers" is the first and only book on the important subject. The authors are J. E. Anderson, M.A., former instructor in physics, University of Wisconsin, former Western Electric engineer, and for the last three years technical editor of "Radio World"; Herman Bernard, LL.B., managing editor of "Radio World." The book begins with an elementary exposition of the historical development and circuit constitution of audio amplifiers and sources of powering them. From this simple start it quickly proceeds to a well-considered exposition of circuit laws, including Ohm's laws and Kirchhoff's laws. The determination of resistance values to produce required voltages is carefully expounded. All types of power amplifiers are used as examples: AC, DC, battery operated and composite. But the book treats of AC power amplifiers most generously, due to the superior importance of such power amplifiers commercially. Tube characteristic tables and curves profusely included. Cloth cover, 193 pages. Order Cat. APAM ....@ $3.50

BOOKS BY JOHN F. RIDER



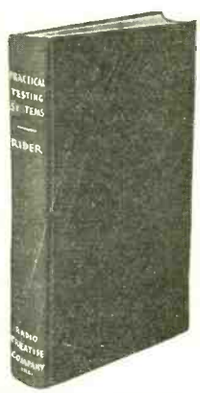
Two new books by Rider are:

(1)—"Practical Radio Repairing Hints," a handbook for the radio worker. Replete with facts and figures, hints and kinks. No Theory. No Formulae. In it you will find explanations of the modern radio systems, automatic volume control circuits, new forms of voltage distribution . . . auomobile radio sets, public address systems, etc. Order Cat. PRRH ..... @ $2.00

(2)—"Practical Testing Systems," the first complete collection of accurate and practical testing circuits of interest to the service man, professional se builder and experimenter. Among the many testing systems described in this book are tube testers, capacity measuring systems, signal generaors, radio frequency oscillators, audio oscillators, vacuum tube voltmeters, resistance testers, continuity testers, etc. Material for the man who wants a simple test uni or desires a laboratory arrangement. Order Cat. PTS ..... @ $1.00

Other books by Rider are:

"Trouble Shooter's Manual," the first comprehensive volume devoted exclusively to the topic. It is not only a treatise for service men, telling them how to overcome their most serious problems, and diagramming the solutions, but it is a course in how to become a service man. It gives details of servicing and includes more than 100 actual factory-drawn diagrams of commercial receivers. 240 pages, 8 x 11," 200 illustrations. Order Cat. TSM ..... @ $3.50



"Supplement No. 1," containing 115 diagrams of commercial receivers, supplementing the diagrams in "Trouble Shooter's Manual," but not duplicating any. These 115 diagrams are supplied loose. They are a necessary adjunct to those in "Trouble Shooter's Manual." Order Cat. SUPP-1 ..... @ $1.20

"Mathematics of Radio," by Rider, 128 pages, 8½ x 11", 119 illustrations, bridges the gap between the novice and the college professor. It gives a theoretical background so necessary for a proper understanding of radio and audio circuits and their servicing. Formulas for capacity, inductance, impedance, resistance, etc., are explained. Flexible cover. Order Cat. MOR..... @ $2.00

TWO MASTERPIECES BY PROF. MORECROFT

"Principles of Radio Communication," by Prof. John H. Morecroft, second edition. Prof. Morecroft, of the Electrical Engineering Department of Columbia University and past president of the Institute of Radio Engineers, is a noted authority. Prior electrical and mathematical knowledge required. 1,001 pages and 831 illustrations. Cloth-bound. Order Cat. M-PRIN. ..... @ $7.50

"Elements of Radio Communication," written in plain language, requiring little foundation knowledge of radio, is another fine Morecroft book. The book is a complete course on the eelments of radio, containing much material never before published. 226 pages, 170 illustrations and a complete index. Cloth bound. This is one book you must have in your library. Order Cat. M-ELEM. @ $3.00

THREE BOOKS BY MOYER AND WOSTREL

The need for an up-to-date book on radio tubes that answers all the important questions has been filed by James A. Moyer, Director of University Extension, and John F. Wostrel, instructor in radio engineering. Division of University Extension, Massachusetts Oepartment of Education. This book is a complete discussion of tube principles, functions and uses. The essential principles underlying the operation of vacuum tubes are explained in as non-technical a manner as is consistent with accuracy. The book covers the costruction, action, reactivation testing and use of vacuum tubes as well as specifications for vacuum tubes and applications for distant control of industrial processes and precision measurements. 297 pages, cloth bound. Order Cat. MWT. ..... @ $2.50

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

"Practical Radio Construction and Repairing," 319 pages, a companion volume to the above. New edition. new price. Order Cat. MWC. ..... @ $2.50

The SUPERHETERODYNE

This is a new volume by Anderson and Bernard dealing with the principles and practice of the Superheterodyne method of receiving. It explains the function of the oscillator, the modulator, the pre-modulator selector, and the intermediate frequency amplifier. It explains the cause of repeat points and gives methods for avoiding them or minimizing their effect. It expounds the relative advantages and disadvantages of high and low intermediate frequencies, and shows the effect of selestivity on the quality.

It illustrates various forms of oscillators and tells of the advantages of each. Different types of modulators and pick-up systems are explained and their advantages stated. Different methods of coupling in the intermediate frequency amplifier are shown.

Image inerference is discussed in detail and methods given by which it may be reduced.

A special method of ganging the oscillator to the radio frequency condensers is explained, a method which allows either the high or the low oscillator setting to be selected by means of a variometer in the oscillator circuit.

One section is given over to coil design fo the radio frequency tuners, the oscillator, ano the intermediate frequency filter.

Audio amplifiers suitable for Superheterodynes are also described. These include transformer, resistance, and push-pull amplifiers both for AC and DC.

While the book is primarily intended to e pound the principles of the Superheterodyne, the practical phase has not been neglected. Detailed descriptions of AC and DC Superheterodynes, designed in conformity with best practice and sound applications of the principles, have been included in the book. These descriptions are well illustrated. Order Cat. ABSH ..... @ $1.50

FOOTHOLD ON RADIO

In simple English that any one can understand, the technical side of radio is presented by Anderson and Bernard in their book, "Foothold on Radio." Any one who can read English can understand this book. It is intended for the sheer novice. The treatment is non-mathematical. The origin of he broadcast wave, its radiation, reception, amplification are set forth in clear language. Side bands are explained simply. The types of receiving circuits are illustrated, described and contrasted. A chapter is devoted to loudspeakers, explaining the different kinds and the principles of their operation. Performance is compared. Audio coupling is fully explained, also the action of the vacuum tube, with a special analysis of plate current and its behavior. Those who have been thirsting for a book that readily reveals the marvels of the radio science will appreciate this little volume. Paper cover 60 pages, fully illustrated. Order Cat. For ..... @ $1.00

Radio World, 145 West 45th Street, New York, N. Y.

Enclosed please find $..... for which please send at once, postpaid, books indicated by my crosses

☐ Cat. ORSM	@	$3.50	☐ Cat. PRRH	@	$2.00
☐ Cat. HAAN	@	3.00	☐ Cat. PTS	@	1.00
☐ Cat. REX	@	2.75	☐ Cat. TSM	@	3.50
☐ Cat. RFM	@	3.50	☐ Cat. SUP-1	@	1.20
☐ Cat. MAN	@	6.00	☐ Cat. MOR	@	2.00
☐ Cat. APAM	@	3.50	☐ Cat. M-PRIN	@	7.5
☐ Cat. FOR	@	1.00	☐ Cat. M-ELEM	@	3.0
☐ Cat. ABSH	@	1.50	☐ Cat. MWT	@	2.5
☐ Cat. TEL	@	3.00	☐ Cat. MWP	@	2.50
☐ Cat. DRA	@	6.00	☐ Cat. MWC	@	2.50
☐ Cat. PRK	@	3.50	☐ Cat. RTT	@	7.50

Name .....

Address .....

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

☐ Check here if C. O. D. is desired.

"A B C OF TELEVISION"

"A B C of Television, or, Seeing by Radio," by Raymond Francis Yates, editor of "Television," formerly editor of "Popular Radio." 210 pages (5¾ x 8⅜"). 100 illustrations. Cloth bound. This book is not a dull, technical treatise. Rather, it is a popular, easily understood and practical book containing descriptions of television systems, and also detailed information concerning many fascinating television experiments that may easily be conducted with modest equipment. It is not a book for engineering "high-brows" nor is it a superficial treatise written merely to entertain and amaze the novice. It is an intensely practical volume written for those who want to do things. It stresses the "how" of the art as well as the "why." In its essence, it is an academic treatise brought down to the level of the lay mind. Engaging in its simplicity, penetrating and wide in its scope, it stands as the first popular American book devoted to television and telephotography. The book contains two hundred fifty pages profusely illustrated. The reading matter is arranged in simple stepping stones dealing with the problems of scanning, amplification of light modulated signals, photo-electric cells and neon lamps. The book has been written especially for those who wish to build and use television receivers and transmitters for entertainment and research purposes. It is written for amateurs and experimenters who crave action and results rather than high-sounding theory. Order Cat. TEL.....@ $3.00

"Drake's Encyclopedia," new edition, 2½" thick, weighs 3¾ lbs., 920 pages, 1,025 illustrations. Order Cat. DRA. .....@ $6.00

"Principles of Radio," by Keith Henney, M.A., former director, laboratory, Radio Broadcast. 477 pages, 304 illustrations. Order Cat. PRK.....@ $3.50

"Radio Telegraphy and Telephony," by Rudolph L. Duncan and Charles E. Drew, of Radio Institute of America. Order Cat. RTT.....@ $7.50

Remit with Order for Books and We Pay Postage