CIRCULATION THIS ISSUE OVER 200,000 COPIES

CITIZENS RADIO CALL BOOK

A Complete Radio Cyclopedia

Featuring in this issue:

Super Heterodyne

Low Loss Tuner

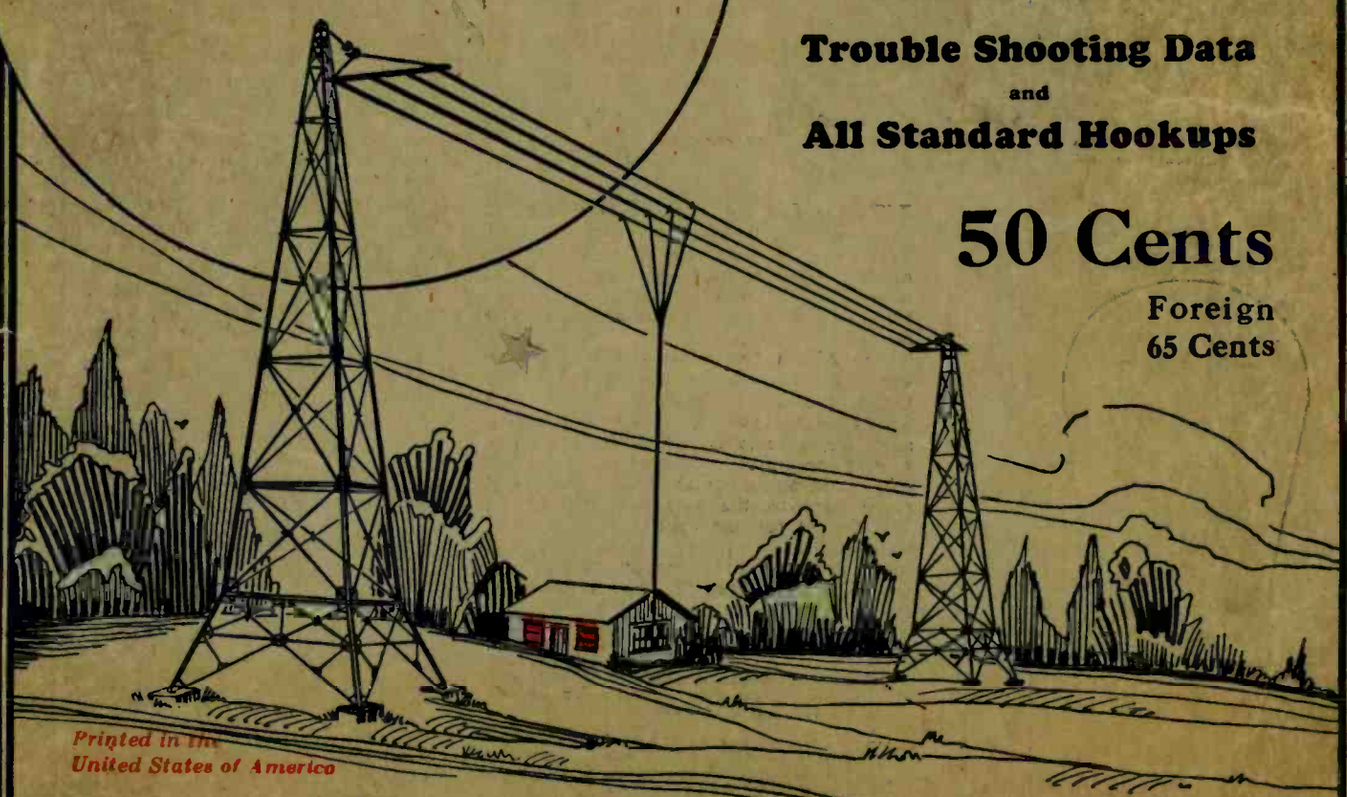
Trouble Shooting Data

and

All Standard Hookups

50 Cents

Foreign
65 Cents



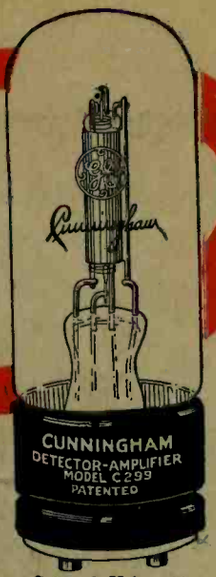
Printed in the
United States of America

See Page 194 for Amateur Section Coupon

Quality plus Service since 1915

C-12 — Similar to C-11 with standard base

C-11—1.1 Volt .25 amp. Dry Battery Det. and Amp. Special Base



C-299—3 Volts .06 amp. Dry Battery Det. and Amp.

C-300—6 Volts Gas Content Detector

Cunningham RADIO TUBES

For Clear Radio Reception

WHATEVER type of receiving set or circuit you are using—one or more of these five Cunningham receiving tubes will be ideal for obtaining maximum distance reception with perfect reproduction of both voice and music.

Three of the five tubes are designed to use dry batteries for filament lighting. C-299, the latest development in Radio Tubes, is compact in design and highly amplifier, a detector and as an audio-frequency amplifier. When used for the efficient in operation as a radio frequency latter purpose, the output of two stages is sufficient for the operation of a small loud speaker.

The most remarkable feature of this tube is the new patented filament used which draws only .06 amperes at 3 volts

C-12 is identical to C-11 in operating characteristics, but is mounted on a standard base to permit the use of a dry battery tube in sets equipped with standard sockets without the aid of special adaptors.

Whenever storage battery supply is available for filament lighting, the C-300 will be the best tube to use as a detector because it is the most sensitive for the reception of distant and weak signals.

Under the same condition, C-301A will be the best tube for amplification at either radio or audio frequency, because it gives greater gain per stage than any other tube on the amateur market. The new patented filament used, similar to that in C-299 draws only .25 amperes at 6 volts, reducing the necessity of frequent storage battery charging.

C-301A—6 Volts ¼ amp. Amplifier

Price the Same on All Five Types
C-301 A
C-300
C-299
C-11 C-12
$4.00

C-11 is a dry battery tube with a special base for use in sets having special sockets. It is a good detector and audio-frequency amplifier. The filament is lighted from a single dry battery and draws .25 amperes.

The care and operation of each model of Receiving Tube is fully explained in our new 40-page "Radio Tube Data Book." Copies may be obtained by sending ten cents to our San Francisco office.

Patent Notices Cunningham tubes are covered by patents dated 2-18-08, 2-18-12, 12-30-13, 10-23-17, 10-23-17, and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.

E. T. Cunningham Inc.

Branch Chicago

Home Office: 182 Second St. San Francisco, Calif.

Branch New York

FROST-RADIO

Ask Your Neighbor

FROST-RADIO presents the latest and most perfected development in loud speakers

Popularly Priced
$12.50
in black finish
$20
in silver or gold finishes

"TRUE REPRODUCTION Musette OF VOICE AND MUSIC"

The introduction of *MUSETTE*, the new **FROST-RADIO** loud speaker, has brought about a wonderful advance in the development of radio. You can purchase one of these new **FROST-RADIO** loud speakers with the assurance that all of the problems heretofore existing have been overcome.

True Tone Reproduction

In *MUSETTE* we have succeeded beyond every other manufacturer in securing a true reproduction of the human voice *and of all musical instruments*. This alone is a remarkable enough achievement. Our engineers, not satisfied with this, however, have designed a unit for *MUSETTE* which *covers the entire acoustical range*. There are no degrees of pitch or tone which *MUSETTE* will not reproduce faithfully and accurately, without distortion or harshness.

Note These Big Features

MUSETTE has a cast aluminum throat and base. This is the ideal acoustical material for the true reproduction of sound. *MUSETTE* has a specially designed unit, built according to the latest known discoveries of radio engineering. The bell is a richly beautiful single casting of polished BAKELITE, immensely strong, yet resilient and eminently satisfactory for this purpose.

Your Choice of Three Types

MUSETTE comes in a standard finish of black crackle base, with polished BAKELITE bell, complete with cord. It also is supplied in de luxe type with silver filagree finish base and throat, with black bell, and in a rough cast gold finish base, with maroon BAKELITE bell. Silver and gold finish types are equipped with cord and plug.

No. 10B— **FROST-RADIO** *Musette*, black stipple finish, black bell..$12.50
No. 12S— **FROST-RADIO** *Musette*, Florentine silver finish with black bell.....$20.00
No. 13N—**FROST-RADIO** *Musette*, Etruscan gold finish, with maroon color bell $20.00

Ask Your Neighborhood Dealer

HERBERT H. FROST, Inc.

154 WEST LAKE STREET, CHICAGO, ILLINOIS.

NEW YORK CITY CLEVELAND KANSAS CITY LOS ANGELES

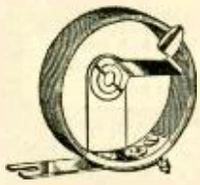
FROST-RADIO

Ask Your Neighbor

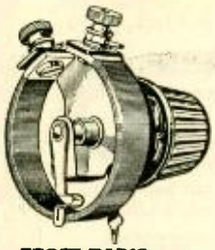
FROST-FONES
in two popular styles

YOU can select your **FROST-FONES** from our two types—genuine BAKELITE, or Aluminum Shell style—with perfect assurance of value, satisfaction and long service. Economies of production enable us to offer our Aluminum Shell Type at a lower price. They are the equal in sensitiveness and clearness of any head fones on the market. Being extremely light in weight they do not tire the head, no matter how long they are worn. Supplied in 2000 and 3000 ohm windings. Our genuine BAKELITE fones are a de luxe headset for those who wish the best in construction and finish, at a reasonable price. Made with built-in terminal blocks, and according to the highly perfected designs of head fone builders of more than a quarter century of manufacturing experience.

No. 161, **FROST-FONES**, Aluminum Shell Type, 2,000 ohm double headset..... $4.00
No. 171, **FROST-FONES**, Aluminum Shell Type, 3000 ohm double headset..... $5.00
No. 172, **FROST-FONES**, Genuine Maroon BAKELITE Type, 3200 ohm double headset..... $6.00

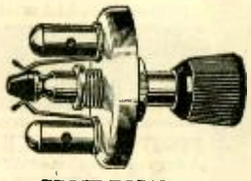


FROST-RADIO
No. 630, Resistance Unit, for dry cell tubes, 0-35 ohms.....30c



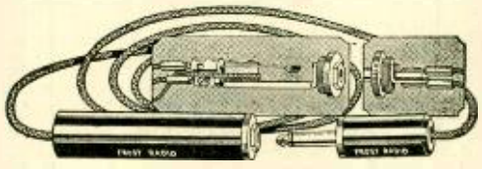
FROST-RADIO
No. 600 — Metal Frame Plain Rheostat, 6 ohm.....65c
No. 602 — Metal Frame Plain Rheostat, 35 ohms.....65c
No. 606 — Metal Frame Plain Rheostat, 25 ohms.....65c
No. 603—Metal Frame Potentiometer, 0-400 ohms.....65c
No. 605—Metal Frame Potentiometer, 0-200 ohms.....65c

FROST-RADIO
No. 601—Metal Frame Vernier Rheostat, 6 ohms.....80c
No. 604—Metal Frame Vernier Rheostat, 35 ohms.....80c
No. 613 Metal Frame Vernier Rheostat, 25 ohms.....80c

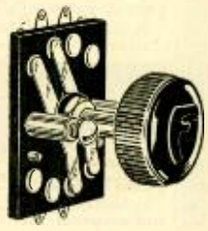


FROST-RADIO
No. 608 Push-Pull Battery Switch, single hole mounting, complete 30c

FROST-RADIO
No. 620, BAKELITE Potentiometer Cut-Out Switch.....50c



FROST-RADIO
No. 332—30-foot Extension Cord, complete with plug and jack housing, twin conductor cord $2.50
No. 336—Mounted Jack only, 75c



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No. 621, BAKELITE Series-Parallel Switch.....50c

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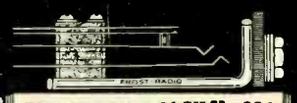
FROST-RADIO JACKS



FROST-RADIO JACK No. 124
For Hazeltine and similar circuits. List price . 90c

FROST-RADIO JACK No. 125
For Hazeltine and similar circuits. List price . 90c

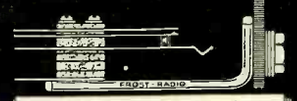
FROST-RADIO JACK No. 126
For Hazeltine and similar circuits. List price . 90c

FROST-RADIO JACK No. 130
For Hazeltine and similar circuits. List price . 90c

FROST-RADIO JACK No. 131
A double-circuit jack of superb quality. List price 80c

FROST-RADIO JACK No. 133
A dependable first quality open circuit jack. List price . . 60c

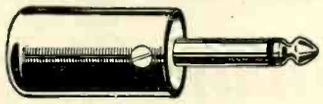
FROST-RADIO JACK No. 134
A closed circuit jack that is widely used. List price 70c



FROST-RADIO JACK No. 135
The ideal jack for filament-control purposes. List price . 85c

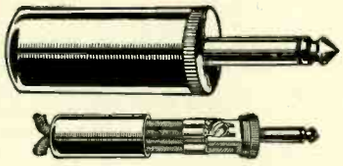
FROST-RADIO JACK No. 136
Another high quality filament-control jack. List price . . 90c

FROST RADIO ACCESSORIES



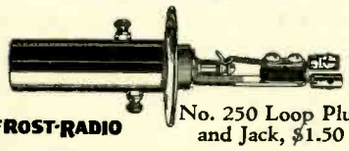
No. 137 **FROST-RADIO**
Cord Tip Plug, $1.25

No. 139 **FROST-RADIO**
Cord Tip Plug, 50c



No. 140 **FROST-RADIO**
2-Fone Plug, 60c

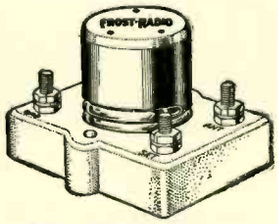
No. 138 **FROST-RADIO**
Multiphone Plug, $2.20



FROST-RADIO No. 250 Loop Plug and Jack, $1.50

No. 712 Musselman Selective Antenna, 75 feet, $5.00

No. 501 **FROST-RADIO**
Jac-Box, complete with cord and plug, $2.50



No. 700 **FROST-RADIO**
Protector, complete, $1.50

HERBERT H. FROST, Inc.
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FROST-RADIO PAN-TAB JACKS

FROST-RADIO JACK No. 224
4 spring, for radio frequency circuits. List price $1.00

FROST-RADIO JACK No. 225
5 spring, for radio frequency circuits. List price $1.00

FROST-RADIO JACK No. 226
6 spring, for radio frequency circuits. List price $1.00

FROST-RADIO JACK No. 230
4 spring, for radio frequency circuits. List price $1.00

FROST-RADIO JACK No. 231
A double-circuit jack of superb quality. List price 90c

FROST-RADIO JACK No. 233
A dependable first quality open circuit jack. List price 70c

FROST-RADIO JACK No. 234
A closed circuit jack that is widely used. List price 80c

FROST-RADIO JACK No. 235
The ideal jack for filament-control purpose. List price 95c

FROST-RADIO JACK No. 236
Another high quality filament-control jack. List price $1.00

Tell 'Em You Saw It in the Citizens Radio Call Book

FROST-RADIO

Ask Your Neighbor

GENUINE BAKELITE MOULDED

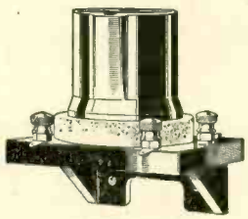
GENUINE BAKELITE MOULDED

On this page you will find apparatus moulded from genuine Bakelite

HERE are eleven popular items of **FROST-RADIO** in which genuine moulded Bakelite is used for bases, frames, sockets, etc. This material has been proven unsurpassed for radio uses, possessing a remarkably high dielectric strength, extreme hardness, imperviousness to moisture, and fine finish.

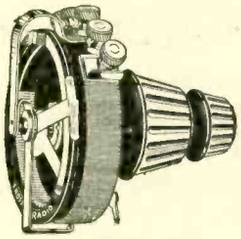
Because of our immense production we are one of the largest users of genuine Bakelite in the United States. We have produced a material which is second to none in quality, and which offers you lifetime service and satisfaction.

Please note particularly the shock-absorber line of **FROST-RADIO** Sockets, in both single and gang types, for panel or table mounting. Note also the new No. 614 Heavy Duty Double Spring Socket, and the complete line of Tube Control Units, Rheostats and Potentiometers we offer.



FROST-RADIO

No. 618, BAKELITE Shock-Absorber Socket, standard base type, for panel or table mounting $1.25

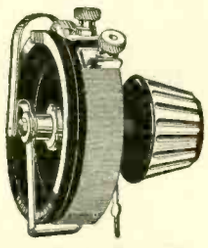


FROST-RADIO

No. 607, BAKELITE Tube Control Unit, combining 6 ohm Vernier Rheostat and 400 ohm Potentiometer, $1.75

No. 609, Same as No. 607, but with 25 ohm Rheostat and 400 ohm Potentiometer. $1.75

No. 610, Same as No. 607, but with 35 ohm Rheostat and 400 ohm Potentiometer. $1.75



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No. 654, BAKELITE Potentiometer, 0-400 ohms....$1.25

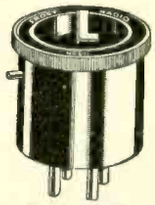
No. 655, BAKELITE Potentiometer, 0-200 ohms....$1.25

FROST-RADIO

No. 616, BAKELITE Shock-Absorber Socket, 3-Gang UV-199 C-299 Base Type, ...$3.25

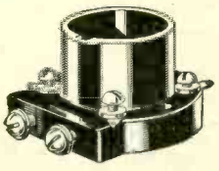
FROST-RADIO

No. 617, BAKELITE Shock-Absorber Socket, UV-199 C-299 Type, for panel or table mounting.....$1.25



FROST-RADIO

No. 611, BAKELITE Adapter for UV-199 C-299 Tubes.....50c

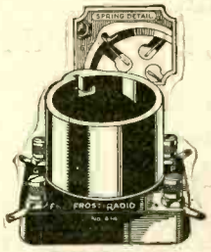


FROST-RADIO

No. 612, BAKELITE Socket for UV-199 C-299 Tubes, panel or table mounting 60c

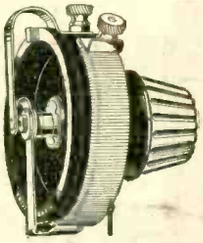
FROST-RADIO

No. 619 BAKELITE Shock-Absorber Socket, 3-Gang Standard Base Type.....$3.25



FROST-RADIO

No. 614 BAKELITE Heavy Duty Socket 65c



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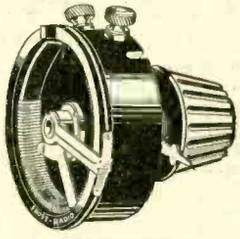
No. 650, BAKELITE Plain Rheostat, 6 ohms.....$1.10
No. 652, BAKELITE Plain Rheostat, 35 ohms.....$1.10
No. 656, BAKELITE Plain Rheostat, 25 ohms.....$1.10



FROST-RADIO

No. 651, BAKELITE Vernier Rheostat, 6 ohms.....$1.25
No. 653, BAKELITE Vernier Rheostat, 35 ohms.....$1.25
No. 657, BAKELITE Vernier Rheostat, 25 ohms.....$1.25

HERBERT H. FROST, Inc.

154 WEST LAKE STREET, CHICAGO, ILLINOIS.

NEW YORK CITY CLEVELAND KANSAS CITY LOS ANGELES

Telmaco Acme Receiver

The Ideal Receiver for all Seasons

The Telmaco Acme Receiver is truly portable. Tubes, batteries, loop, loud speaker, everything built into set. No outside loop, no aerial, no ground required.

Illustration above shows Telmaco Acme Receiver in beautiful two-tone Mahogany cabinet. Set may be easily and quickly transferred from mahogany cabinet to traveling case shown below

Acme 4-Tube Reflex Circuit

Used securing selectivity, distance and volume with minimum battery consumption.

Complete in itself. Easily carried from room to room in your home or to office, neighbors, etc. Take it along and have music, entertainment, speeches, news, market reports wherever you happen to be.

Instantly ready for use as it is. You can use external antenna and ground, loop and loud speaker if desired. 4 tubes (fully protected by shock absorber sockets)—equal to 7 tubes, due to reflexing and use of crystal detector.

Size of Case 8"x10" x18". Weighs only 27 pounds complete. Easily carried.

Reasonably Priced Write for free illustrated circular fully describing Telmaco Acme Receiver. Complete Telmaco 64 page catalog containing 20 circuits in blue and describing the best in radio sent postpaid for 10c.

Dealers! Catalog and Price List furnished to all bona fide dealers making request on their business stationery.

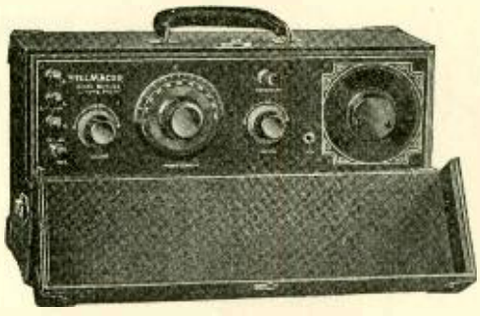


Illustration shows Telmaco Acme Receiver in beautiful traveling case. Set can be easily and quickly transferred to beautiful mahogany cabinet shown above.

TELMACO

Quality Radio Exclusively—Established 1918

Radio Division

TELEPHONE MAINTENANCE CO.

20 South Wells Street Dept. J Chicago, Illinois

Vol. 5 FALL, 1924 No. 2

Contents This Issue

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Chas. O. Stimpson, President. J. R. Mac Farland, Vice-President
D. H. Bell, Secretary and Treasurer

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With the Editor

THE past six months have brought out many new designs in radio apparatus; new discoveries have been made and circuits that before were considered only workable by the expert, are today simplified for the layman.

WE hope you will use our Circuit Section and become a regular "Radio Fan"—much fun may be had by those who have never built anything in the radio line.

WE have taken the Amateur Section out of the main part of the book so that the amateur and broadcast listener may both be better served. This was done by requests from both amateurs and broadcast listeners.

THIS issue is the most complete Radio Cyclopedia ever put together of its kind and we shall be untiring in our efforts to see that the Citizens Radio Call Book remains the leader in its field.

NEW YORK CITY	BOSTON, MASS.	PHILADELPHIA, PA.	EXPORT OFFICE
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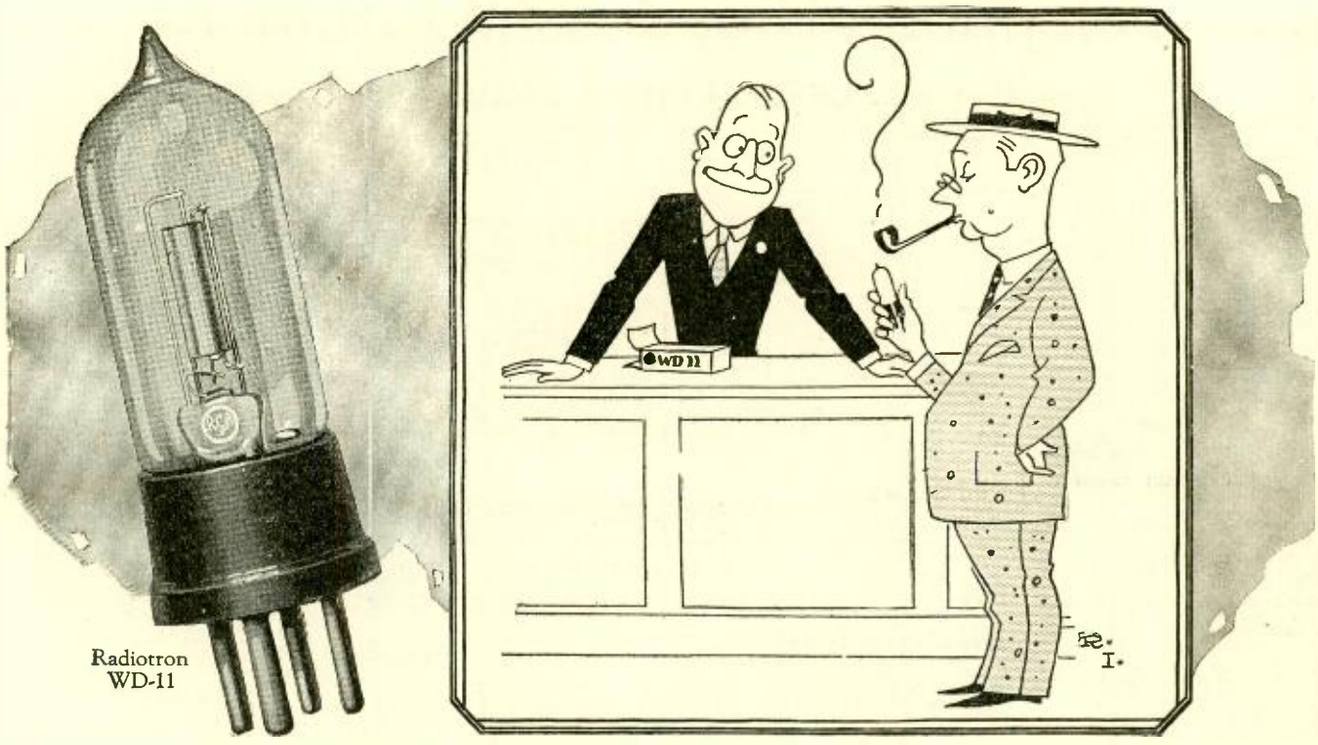
			Tel. Cortlandt 5336



Radiotron
WD-11

Don't Buy *Just Tubes!*

All Radiotrons
Now $4.00

It isn't a genuine WD-11 unless it's a Radiotron.
It isn't a genuine WD-12 unless it's a Radiotron.
It isn't a genuine UV-199 unless it's a Radiotron.
It isn't a genuine UV-200 unless it's a Radiotron.
It isn't a genuine UV-201-a unless it's a Radiotron.

If you go into a reliable store and ask for a vacuum tube, you will probably get a genuine Radiotron, because most reputable dealers carry nothing else. And most buyers mean "Radiotron" when they say "tube." But the wise man *says* "Radiotron." And he takes the precaution to look for the name on the base, and the RCA mark on the glass. Those names have a history of invention, research and development back of them that has resulted in the production of the finest tubes possible today. And they have a history of *best performance* right within every fan's experience. That's why knowing fans buy by the name: Radiotron.

Radio Corporation of America
Sales Offices: Suite 6010
233 Broadway, NewYork 10 So. LaSalle St., Chicago, Ill.
433 California St., San Francisco, Cal.

Radiotron

REG. U. S. PAT. OFF.

Telephone Broadcasting Stations

For the United States

KDKA—Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa. 326 meters, 920 kilocycles, class B. Daily ex Sun, 9:45 am, market; 11:15, concert; 11:55, Arlington time signals; 12 noon, weather and market; 5:30, dinner concert; 6:30, children's period; 7:40, market, 8; concert. Tues & Thurs, 10 pm, concert. Sun, 9:45 am & 7 pm, church services; 1:45 & 5:30 pm, concert. Sun practically all day beginning at 11 am. Eastern standard time. Slogan: "The Pioneer Broadcasting Station of the World." 1000 watts.

KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, O. 270 meters, 1110 kilocycles, class A. No regular schedule, experimental station only. 500 watts.

KDPT—Union-Tribune & Southern Electrical Co., 3rd & E St., San Diego, Calif. 244 meters, 1130 kilocycles, class A. Daily ex Sat & Sun, 1:30-2:30 pm. Daily ex Wed & Sun, 6-6:45 pm. Wed, 8-10 pm. Pacific standard time. Slogan: "Radio for All." 50 watts.

KDYL—Newhouse Hotel, Salt Lake City, Utah. 360 meters, 832 kilocycles, class C. 100 watts.

KDYM—The Savoy Theatre, San Diego, Calif. 280 meters, 1070 kilocycles, class A. 100 watts.

KDYQ—The Oregon Institute of Technology, Portland, Ore. 360 meters, 834 kilocycles, class C. Schedule irregular. Slogan: "The Radio-School." 100 watts.

KDYW—Smith Hughes & Co., Phoenix, Ariz. 360 meters, 834 kilocycles, class C. 20 watts.

KDZB—Frank Seifert, Bakersfield, Calif. 249 meters, 1249 kilocycles, class A. 100 watts.

KDZE—Rhodes Department Store, Seattle, Wash. 270 meters, 1110 kilocycles, class A. Mon, Tues, Wed & Thurs, 12:30-1:30 pm. Pacific standard time. 100 watts.

KDZF—Automobile Club of Southern California, Figueroa St. at Adams, Los Angeles, Calif. 278 meters, 1080 kilocycles, class A. 500 watts.

KDZR—Bellingham Publ. Co., Bellingham, Wash. 261 meters, 1150 kilocycles, class A. Daily, 7-8 pm. Thursday, silent. Pacific standard time. 50 watts.

KFAD — McArthur Bros., Central & Madison, Phoenix, Ariz. 360 meters, 908 kilsocycles, class C. 100 watts.

KFAE — State College of Washington, Pullman, Wash. 330 meters, 908 Kilocycles, class B. Mon, Wed & Fri, 7:30-9 pm. Pacific standard time. Slogan: "Your Service Station." 500 watts.

KFAF—Western Radio Corp., Denver, Colo. 360 meters, 834 kilocycles, class C. Mon, Tues, Fri & Sat, 8-9 pm. Thurs, 7:30-8 pm, news and music. Mountain time. Slogan: "The Voice from the Rockies, Out Where the West Is." 50 watts.

KFAJ—University of Colorado, Boulder, Colo. 360 meters, 834 Kilocycles, class C. 100 watts.

KFAR — Studio Lighting Service Co., Hollywood, Calif. 280 meters, 1070 kilocycles, class A. 100 watts.

KFAW—The Radio Den, 115 No. Broadway, Santa Ana, Calif. 268 meters, 1120 kilocycles, class A. Daily ex Sun, 4:30-5 pm, news. Mon & Thurs, 6:30-7:30 pm, concert. Pacific standard time. Slogan: "KFAW—Kept from Awful Winters." 10 watts.

KFAY—Virgin's Radio Service, Medford, Ore. 283 meters, 1070 kilocycles, class A. 50 watts.

KFBB—F. A. Buttrey & Co., Havre, Mont. 360 meters, 834 kilocycles, class C. 50 watts.

KFBC—W. K. Azvill, 5038 Cliff Place, San Diego, Calif. 278 meters, 1080 kilocycles, class A. 20 watts.

KFBE—R. H. Horn, San Luis Obispo, Calif. 360 meters, 834 kilocycles, class C. 10 watts.

KFBG—First Presbyterian Church, So. 10th & G Sts., Tacoma, Wash. 360 meters, 833 kilocycles, class C. 50 watts.

KFBK—Kimball, Upson Co., 610 California St., Sacramento, Calif. 283 meters, 1060 kilocycles, class A. Daily ex Sun, 5:30-6 pm. Pacific standard time. Slogan: "The Gateway to California." 100 watts.

KFBL — Leese Bros., 2818-22 Rucker Ave., Everett, Wash. 224 meters, 1300 kilocycles, class A. Daily ex Sun, 7:15-8:15 pm. Sun, 2-3 pm. Pacific time. Slogan: "The Way to Port Gardner Bay." 10 watts.

KFBS—Chronicle News & Trinidad Gas & Electric Sup. Co., Trinidad, Col. 280 meters, 1070 kilocycles, class A. 10 watts.

KFBU—The Cathedral, Laramie, Wyo. 283 meters, 1070 kilocycles, class A. 50 watts.

KFCB—Nielsen Radio Sup. Co., 311 No. Central Ave., Phoenix, Ariz. 238 meters, 1249 kilocycles, class A. time. Slogan: "When its Wintertime in Michigan its Summertime down here." 20 watts.

KFCF — Frank A. Moore, 707 Baker Bldg., Walla Walla, Wash. 360 meters, 834 kilocycles, class C. 100 watts.

KFCH—Electric Service Station, Inc., 14 No. 30th St., Billings, Mont. 360 meters, 834 kilocycles, class C. 10 watts.

KFCL — Leslie E. Rice, Union Stock Yards, Los Angeles, Calif. 236 meters, 1270 kilocycles, class A. 500 watts.

KFCM—Richmond Radio Shop, Richmond, Calif. 244 meters, 1220 kilocycles, class A. Daily ex Sun, 1-2 pm. Tues & Fri, 8-9 pm. Pacific standard time. Slogan: "Out Where the West Ends." 100 watts.

KFCP—Ralph W. Flygare, 2421 Jefferson Ave., Ogden, Utah. 360 meters, 834 kilocycles, class C. 25 watts.

KFCV—Fred Mahaffey, Jr., 14 5th St., Houston, Texas. 360 meters, 834 kilocycles, class C. 10 watts. Daily ex Sun, 7:30-8 pm. Sun, 2-3 pm. Central standard time.

KFCZ — Omaha Central High School, Omaha, Neb. 258 meters, 1160 kilocycles, class A. Daily ex Sat & Sun, 3-4 pm. Mon, Tues, Thurs, 7:30 to 9 pm. Central standard time. 50 watts.

KFDD—St. Michael's Cathedral, Boise, Idaho. 252 meters, 1200 kilocycles, class A. 10 watts.

KFDH—University of Arizona, Tuscon, Ariz. 268 meters, 1120 kilocycles, class A. Daily 7:30-8:30 pm. Mountain time. Slogan: "Climate, Copper, Cattle, Cotton." 150 watts.

KFDJ—Oregon Agricultural College, Corvallis, Ore. 360 meters, 834 kilocycles, class C. 50 watts.

KFDL—Knight-Campbell Music Co., 1228 Corona St., Denver, Colo. 226 meters, 1330 kilocycles, class A. 5 watts.

KFDX—First Baptist Church, Shreveport, La. 360 meters, 834 kilocycles, class C. 100 watts. Sun, 11am and 7:45 pm. Central time.

KFDY—South Dakota College of Agriculture & Mechanical Arts, Brookings, S. D. 273 meters, 1100 kilocycles, class A. 100 watts.

KFDZ—Harry Q. Iverson, 2510 Thomas Ave., S. Minneapolis, Minn. 231 meters, 1304 kilocycles, class A. 5 watts.

KFEC—Meier & Frank Co., Portland, Ore. 248 meters, 1190 kilocycles, class A. 50 watts.

KFEJ—Guy Greason, 1724 S. Jay St., Tacoma, Wash. 360 meters, 834 kilocycles, class C. 10 watts.

KFEL—The W. L. Winner Radio Shop, 435-14th St., Denver, Colo. 254 meters, 1190 kilocycles, class A. Daily ex Sun, 9, 10, 11 am, 12 noon, 2, 3 pm. Thurs, 10-12 pm, sleep wrecker program, 8-9 pm, Fri. Sun morning serv, 9-10 am. Mountain standard time. Slogan: "The Best in the West." 50 watts.

KFEQ — Scroggin & Co. Bank, Oak, Nebr. 268 meters, 1120 kilocycles, class A. 100 watts.

KFER—Auto Elec. Service Co., 12 N. 10th St., Ft. Dodge, Iowa. 231 meters, 1304 kilocycles, class A. 10 watts.

KFEX—Augsburg Seminary, 8th & 21st Ave., Minneapolis, Minn. 261 meters, 1150 kilocycles, class A. 100 watts.

KFEY—Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho. 360 meters, 834 kilocycles, class C. Schedule irregular. Pacific standard time. Slogan: "The Voice of the Coeur d'Alenes." 10 watts.

KFFB—The Jenkins Furniture & Owybee Hotel, Boise. Idaho. 240 meters, 1249 kilocycles, class A. 10 watts.

KFFE—Eastern Oregon Radio Co., Inc., Pendleton, Ore. 360 meters, 834 kilocycles, class C. 10 watts.

KFFP—First Baptist Church, 600 Rollins, St., Moberly, Mo. 266 meters, 1140 kilocycles, class A. 50 watts.

KFFR—Nevada State Journal, Sparks, Nev. 226 meters, 1360 kilocycles, class A. 10 watts.

KFFV—Graceland College, Lamoni, Iowa. 360 meters, 834 kilocycles, class C. 100 watts.

KFFY—Pincus and Murphey Inc., Music House, Alexandria, La. 275 meters, 1090 kilocycles, class A. Daily ex Sun, 12:30 pm to 1:15. Wed & Sat. 9-10 pm. Central standard time. "Alexandria, in the Heart of Louisiana." 50 watts.

KFGC—Louisiana State University, Baton Rouge, La. 254 meters, 1180 kilocycles, class A. 100 watts.

KFGD—Chickasha Radio & Elec Co., Chickasha, Okla. 248 meters, 1197 kilocycles, class A. Slogan: "Queen of the Washita." 200 watts.

KFGH—Stanford University, Calif. 273 meters, 1100 kilocycles, class A. 250 watts. Schedule irregular.

KFGL—Arlington Garage, Arlington, Ore. 234 meters, 1304 kilocycles, class A. 5 watts.

KFGQ—The Crary Hardware Co., Boone, Iowa. 226 meters, 1327 kilocycles, class A. 10 watts. Schedule irregular.

KFGX — First Presbyterian Church, Orange, Tex. 250 meters, 1199 kilocycles, class A. 500 watts.

KFGZ — Emmanuel Missionary College, Berrien Springs, Mich. 268 meters, 1120 kilocycles, class A. Mon, Wed, Fri & Sun, 7 pm, bedtime story. Sun, 9:30-10:45 am, and 7:45-9 pm, studio Chapel Service. Mon, 7:45-9 pm, Instrumental. Wed, 8-9 pm, lecture and music. Fri 9-10 pm, sacred music. Central standard time. Slogan: "The Radio Lighthouse." 500 watts.

KFHA—Western State College of Colorado, Gunnison, Col. 252 meters, 1190 kilocycles, class A. 50 watts.

KFHD—Utz Elec. Shop Co., 12th & Faraon Sts., St. Joseph, Mo., 226 meters, 1365 kilocycles, class A. Mon, 8-9:30 pm, Central standard time. 100 watts.

KFHH—Ambrose A. McCue, Neah Bay, Wash. 261 meters, 1150 kilocycles, class A. 50 watts.

KFHJ—Fallon & Co., 23 W. Figueroa St., Santa Barbara, Calif. 360 meters, 833 kilocycles, class C. 100 watts. Slogan: "The Paradise of Southern California."

KFHR—Star Elec. & Radio Co., 1637 Westlake Ave., Seattle, Wash. 240 meters, 1250 kilocycles, class A. Slogan: "The Voice of the Charmed Land." 50 watts.

KFHS—Clifford J. Dow, Lihue, Hawaii. 275 meters, 1090 kilocycles, class A. 30 watts.

KFI—Earle C. Anthony, Inc., 1000 So. Hope St., Los Angeles, Calif. 469 meters, 620 kilocycles, class B. 500 watts. Daily ex Sun, 5-5:30 pm. 5:30-6 pm, Evening Herald and Examiner news bulletin; 6:45-8 pm, Organ recital, lectures, orchestra; 8-9 pm, dance orchestra; 9-10 pm, program from Examiner studio; 10-11 pm, orchestra. Wed, Fri & Sat, 11-12 pm, Ambassador Hotel orchestra. Sun, 10-10:45 am, Church Service; 6:45-8 pm, Theatre program; 9-10 pm, studio program; 10-11 pm, orchestra. Pacific standard time.

KFIF—Benson Technical Student Body, Portland, Ore. 360 meters, 834 kilocycles, class C. 100 watts.

KFIO—North Central High School, Spokane, Wash. 252 meters, 1190 kilocycles, class A. 50 watts

KFIQ—First Methodist Church, Yakima, Wash. 242 meters, 1240 kilocycles, class A. Sun, 11 am and 7:30 pm. Wed, 7 pm, Organ recital. Pacific standard time. 50 watts.

KFIU—Alaska Elec. Light & Power Co., Juneau, Alaska. 226 meters, 935 kilocycles, class A. Mon, Wed & Fri. 7-8 pm. Southeastern Alaska time. 10 watts.

KFIX — Reorganized Church of Jesus Christ, Independence, Mo. 240 meters, 1249 kilocycles, class A.

KFIZ—The Daily Commonwealth & O. A. Huelsman, 22 Forest Ave., Fond du Lac, Wis. 273 meters, 1100 kilocycles, class A. 100 watts.

KFJB—Marshall Elec. Co., Marshalltown, Iowa. 248 meters, 1210 kilocycles, class A. 10 watts.

KFJC—Seattle Post-Intelligencer, Seattle, Wash. 270 meters, 1110 kilocycles, class A. Slogan: "Hello, Folks." 100 watts.

KFJF—National Radio Mfg. Co., 406 No. Hudson St., Oklahoma City, Okla. 252 meters, 1190 kilocycles, class A. Daily ex Sun, 12 midnight to 12:45, music. Mon, Wed, Thurs & Sat. 7-8:30 pm, news, weather, sports, music. Thurs & Fri, 7-10:30 pm, news, weather, sports, concerts. Sun, 11 am and 8 pm. Central standard time. Slogan: "Radio Headquarters." 20 watts.

KFJI—Liberty Theatre, Astoria, Ore. 252 meters, 1190 kilocycles, class A. 10 watts.

KFJK—Delano Radio & Elec. Co., 407 N. Main St., Bristow, Okla. 233 meters, 1290 kilocycles, class A. 100 watts.

KFJL — Hardsocg Mfg. Co., Ottumwa, Iowa. 242 meters, 1240 kilocycles, class A. Mon, Wed & Fri, 8-9:30 pm. Central standard time. Slogan: "When the West Is at Its Best." 10 watts.

KFJM—University of No. Dakota, Grand Forks, N. D. 280 meters, 1071 kilocycles, class A. 100 watts.

KFJQ—Electric Construction Co., (Valley Radio Div.), De Mers Ave., Grand Forks, N. Dak. 280 meters, 1071 kilocycles, class A. 5 watts.

KFJR—Ashley C. Dixon & Son, Stevensville, Mont. 258 meters, 1160 kilocycles, class A. Slogan: "The Bitter Root Valley Broadcasting Station." 5 watts.

KFJV — LeGrand Radio Co., Towanda, Kansas. 226 meters, 1330 kilocycles, class A. Slogan: "The Smallest Tower in the U. S. with a Broadcasting Station." 10 watts.

KFJX — Iowa State Teachers' College, Cedar Falls, Iowa. 280 meters, 1071 kilocycles, class A. No fixed schedule. 50 watts.

KFJY — Tunwall Radio Co., 13 No. 10th St., Ft. Dodge, Ia. 246 meters, 1220 kilocycles, class A. Sun, 11 am and 7:30 pm, church services. No regular week day schedule. 50 watts.

KFJZ—Headquarters Troop, 112th Cavalry, Texas Nat'l Guard, P. O. Box 184, Ft. Worth, Texas. 254 meters, 1190 kilocycles, class A. 20 watts.

KFKA—Colorado State Teachers' College, Greeley, Colo. 273 meters, 1100 kilocycles, class A. 50 watts. Schedule not determined as yet.

KFKB—Brinkley-Jones Hospital Ass'n., Milford, Kan. 286 meters, 1071 kilocycles, class A. Daily ex Sun, 10-12 am and 8-10 pm. Central standard time. Slogan: "Kansas First, Kansas Best, (KFKB)." 500 watts.

KFKQ — Conway Radio Laboratories, Conway, Ark. 250 meters. 1200 kilocycles, class A. Tues & Fri, 8-9 pm. Central standard time. Slogan: "Known for Knowledge Quest (KFKQ)." 100 watts.

KFKV—F. F. Gray, 3200 Richardson St., Butte, Mont. 283 meters, 1071 kilocycles, class A. 50 watts.

KFKX—Westinghouse Elec. & Mfg. Co., City Park, Hastings, Nebr. 285 meters, 880 kilocycles, class B. Mon & Thurs, 9:30-10:30 pm. Central standard time. Daily 6:15-7:15 pm, (Eastern time) relay from KDKA, Pittsburgh. Tues & Thurs, 11:30 pm to 1 am, (Eastern time) relay from Pittsburgh, Penna. 1000 watts.

KFKZ—Nassour Bros. Radio Co., 120 E. Pikes Peak Av., Colorado Springs, Colo. 234 meters, 1280 kilocycles, class A. 10 watts.

KFLA — Abner R. Willson, 1321 W. Platinum St., Butte, Mont. 283 meters, 1060 kilocycles, class A. 5 watts.

KFLB—Signal Elec. Mfg. Co., Box 75, Menominee, Mich. 248 meters, 1210 kilocycles, class A. 5 watts.

KFLD—Paul E. Greenlaw, Franklinton, La. 234 meters, 1301 kilocycles, class A. 30 watts.

KFLE — National Educational Service, Inc., 939 So. University, Denver, Colo. 268 meters, 1110 kilocycles, class A. Daily 7-7:30 pm. Mountain standard time. Slogan: "The Station with the Good Modulation." 100 watts.

KFLQ—Bizzell Radio Shop, Little Rock, Arkansas. 261 meters, 1150 kilocycles, class A. 20 watts.

KFLR—Korber Wireless Station, University of New Mexico, Albuquerque, N. Mex. 254 meters, 1180 kilocycles, class A. Fri, 8-10 pm, October to May (inclusive). Mountain time. Slogan: "The Sunshine Center of America." 100 watts.

KFLU—San Benito Radio Club, San Benito, Texas. 236 meters, 1225 kilocycles, class A. Mon, Thurs, 8:30-9:30 pm. Sat, 10-11 pm. Central standard time. Slogan: "Heart of Magic Valley." 50 watts.

KFLV — Swedish Evangelical Mission Church, 1503 Fourth Ave., Rockford, Ill. 229 meters, 1304 kilocycles, class A. 100 watts.

KFLW—Missoula Elec. Supply Co., Missoula, Mont. 234 meters, 1280 kilocycles, class A. 5 watts. Schedule irregular. Mountain time. Slogan: "Missoula the Scenic Center of Montana."

KFLX—Geo. R. Clough, 1214 40th St., Galveston, Tex. 240 meters, 1249 kilocycles, class A. 10 watts.

KFLY—Fargo Radio Supply Co., Fargo, N. Dak. 231 meters, 1304 kilocycles, class A. 20 watts. Slogan: "Radio Satisfaction." 20 watts.

KFLZ—Atlantic Automobile Club, 7 W. 3rd St., Atlantic, Ia. 273 meters, 1098 kilocycles, class A. 100 watts.

KFMB—Christian Church, Little Rock, Ark. 254 meters, 1199 kilocycles, class A.

KFMQ—University of Arkansas, Fayetteville, Ark. 263 meters, 1140 kilocycles, class A. Schedule not yet arranged. 100 watts.

KFMR—Morningside College, Sioux City, Iowa. 261 meters, 1153 kilocycles, class A. 10 watts.

KFMT—Dr. Geo. W. Young, 909 W. Broadway. Minneapolis, Minn. 231 meters, 1300 kilocycles, class A. Tues & Thurs, 8-10 pm. Central standard time. Slogan: "Dr. Young's Minneapolis Station." 10 watts.

KFMW—M. G. Sateren, 127 Blanche St., Houghton, Mich. 226 meters, 1130 kilocycles, class A. Slogan: "The Copper Country Station." 5$ watts.

KFMX — Carleton College, Northfield, Minn. 283 meters, 1071 kilocycles, class A. 500 watts.

KFNF — Henry Field Seed Co., 323 Sycamore St., Shenandoah, Iowa. 266 meters, 1145 kilocycles, class A. 500 watts.

KFNG—Wooten's Radio Shop, Coldwater, Miss. 254 meters, 1180 kilocycles, class A. Wed, 8-9 pm. Sat, 9:30-10:30 pm. Sun, 4-5 pm. "Service Thru the Air." Central standard time. 10 watts.

KFNL — Radio Broadcast Ass'n., Paso Robles, Calif. 240 meters, 1249 kilocycles, class A. 10 watts.

KFNV—L. A. Drake, Santa Rosa, Calif. 234 meters, 1300 kilocycles, class A. 5 watts.

KFNY—Montana Phonograph Co., Helena, Mont. 261 meters, 1153 kilocycles, class A. 5 watts.

KFNZ—Royal Radio Co., Burlingame, Calif. 231 meters, 1304 kilocycles, Class A. 10 watts.

KFOA — Rhodes Dept. Store, Seattle, Washington. 455 meters, 659 kilocycles, class B. Mon, Wed & Fri, 8:30-10 pm. Fri & Sat, 12:30 am to 1:30 noon. Pacific standard time. Slogan: "Pacific Northwest Station." 500 watts.

KFOB—Glenwood Technical Ass'n. 920 5th Ave., N. Minneapolis, Minn. 224 meters, 1350 kilocycles, class A. 5 watts.

KFOC—First Christian Church, Whittier, Calif. 236 meters, 1290 kilocycles, class A. 100 watts.

KFOD—The Radio Shop, Wallace, Idaho. 224 meters, 1350 kilocycles, class A. 10 watts.

KFOF — Rohrer Elec. Co., Marshfield, Ore. 240 meters, 1250 kilocycles, class A. 10 watts.

KFOJ—Moberly High School Radio Club, Moberly, Mo. 246 meters, 1220 kilocycles, class A. 5 watts.

KFON — Echophone Radio Shop, Long Beach, Calif. 234 meters, 1290 kilocycles, class A. 100 watts.

KFOO—Latter Day Saints University, Salt Lake City, Utah. 261 meters, 1150 kilocycles, class A. 10 watts.

KFOQ—Ora W. Chancellor, 3216 Ave. O, Galveston, Texas. 240 meters, 1250 kilocycles, class A. 50 watts. Fri, 8 pm. Central time.

KFOR—David City Fire & Electric Co., 343 N. 5th St., David City, Nebr. 226 meters, 1330 kilocycles, class A. 10 watts.

KFOT—College Hill Radio Club, First St. & Erie Ave., Wichita, Kans. 231 meters, 1300 kilocycles, class A. 50 watts.

KFOU—Hommel Mfg. Co., 416 23rd St., Richmond, Calif. 254 meters, 1180 kilocycles, class A. 100 watts.

KFOV—David Elec. Corp., 510 Pierce St., Sioux City, Iowa. 234 meters, 1280 kilocycles, class A. 10 watts.

KFOX—Technical High School, (Board of Education) Omaha, Nebr. 248 meters, 1210 kilocycles, class A. 100 watts.

KFOY — Beacon Radio Service, 446 Jackson St., St. Paul, Minn. 226 meters, 1330 kilocycles, class A, 50 watts.

KFPB—Edwin J. Brown, Seattle, Wash. 224 meters, 1332 kilocycles, class A.

KFPG—Garretson & Dennis, 826 W. 7th St., Los Angeles, Calif. 238 meters, 1260 kilocycles, class A. 100 watts.

KFPH—Howard C. Mailander, 992 Lake St., Salt Lake City, Utah. 242 meters, 1240 kilocycles, class A. 50 watts.

KFPL—C. C. Baxter, 205 Grafton St., Dublin, Tex. 242 meters, 1240 kilocycles, class A. 20 watts. Mon, Thurs, Fri, 8:30 pm. Sun, 7 am, Central time.

KFPM—New Furniture Co., Greenville, Texas. 242 meters, 1240 kilocycles, class A. 10 watts. Daily ex Sun, 2-2:30 and 7 pm. Wed, Thurs, Fri, 8 pm, Sun, 11 am. Central time.

KFPN — Missouri Nat'l. Guard, Headquarters Company, 70th Infantry Brigade, Jefferson City, Mo. 242 meters, 1240 kilocycles, class A. 10 watts.

KFPO — Colorado Nat'l. Guard, Forty-Fifth Division Tank Co., 1321 Aconia St., Denver, Colo. 231 meters, 1300 kilocycles, 500 watts.

KFPP—G. & G. Radio & Elec. Shop, 110½ E. 4th St., Olympia, Wash. 236 meters, 1270 kilocycles, class A. 20 watts.

KFPR — Los Angeles County Forestry Dept. Los Angeles, Calif. 231 meters, 1300 kilocycles, class A. 500 watts.

KFPV—Heintz & Kohlmoos, 219 Natoma St., San Francisco, Calif. 236 meters, 1270 kilocycles, class A. 50 watts.

KFPW—St. Johns Church, Carterville, Mo. 268 meters, 1120 kilocycles, class A. 20 watts.

KFPX—First Presbyterian Church, Pine Bluff, Ark. 242 meters, 1240 kilocycles, class A. 100 watts.

KFPY—Symons Investment Co., Spokane, Wash. 283 meters, 1060 kilocycles, class A. 100 watts.

KFQA—The Principia, 5539 Page Ave., St. Louis, Mo. 261 meters, 1150 kilocycles, class A. 50 watts.

KFQB — Searchlight Publ. Co., Fort Worth, Tex. 254 meters, 1180 kilocycles, class A. 100 watts. Daily ex Sun, 6 pm. Mon, Tues, Fri, 8:30 pm. Sun, 11 am. Central time.

KFQC—Kidd Bros. Radio Shop, 311 Second St., Taft, Calif. 227 meters, 1320 kilocycles, class A. 100 watts.

KFQD—Chovin Supply Co., Anchorage, Alaska. 280 meters, 1070 kilocycles, class A. 100 watts.

KFQE—Dickenson-Henry Radio Laboratories, 211 No. Cascade Ave., Colorado Springs, Colo. 224 meters, 1340 kilocycles, class A. 5 watts.

KFQF—Minneapolis Radio Repair Shop, 2544 Pleasant Ave. So., Minneapolis, Minn. 224 meters, 1340 kilocycles, class A. Tues & Thurs 9:15 pm. First Sat of each month 12 midnight. Central, standard time. Slogan: "The Flour City of the World." 50 watts.

KFQG — Southern Calif. Radio Ass'n. Armory, Exposition Park, Los Angeles, Calif. 226 meters, 1330 kilocycles, class A. 100 watts.

KFQH—Radio Service Co., 274 Middlefield Road, Burlingame, Calif. 231 meters, 1298 kilocycles, class A. Schedules irregular, new station. Pacific standard time. Slogan: "Keep Faith Quit Hammering (KFQH)." 100 watts.

KFQI—Thomas H. Ince Corp., Culver City, Calif. 234 meters, 1280 kilocycles, class A. 100 watts.

KFQJ—Harbour-Longmire Co., 311 W. Main St., Oklahoma City, Okla. 236 meters, 1270 kilocycles, class A. 50 watts.

KFQK—Democrat Leader, Fayette, Mo. 236 meters, 1270 kilocycles, class A. 10 watts.

KFQL—Oklahoma ree State Fair Ass'n. Muskogee, Okla. 252 meters, 1190 kilocycles, class A. 20 watts. Sun, 9:30-10:30 pm. Mon, 7-7:30 pm. Wed. 8-9 pm. Central time.

KFQM—Texas Highway Bulletin, Austin, Tex. 268 meters, 1120 kilocycles. class A. 100 watts. Daily ex Sun, 7-7:30 pm. Central standard time.

KFQN—Third Baptist Church, Portland, Oregon. 283 meters, 1060 kilocycles, class A. 10 watts.

KFQO — Meier Radio Shop, Russell, Kans. 261 meters, 1150 kilocycles, class A. Mon & Fri, musical concert & late oil news. Wed musical concert. Central standard time. 10 watts.

KFQP—Geo. S. Carson, Jr., 906 College St., Iowa City, Iowa. 224 meters, 1340 kilocycles, class A. 10 watts.

KFQR—Walter LaFayette Ellis, 625 E. 6th St., Oklahoma City, Okla. 250 meters, 1200 kilocycles, class A. 10 watts. Daily 9:30-10 pm. Central time.

KFQS—Dickeuson-Henry Radio Laboratories, Hiawatha Garden, Manitou, Colorado. 246 meters, 1220 kilocycles, class A. 10 watts.

KFQT—Texas Nat'l. Guard, 36th Signal Company, Denison, Texas. 252 meters, 1190 kilocycles, class A. 10 watts.

KFQU—W. Riker, Holy City, Calif. 234 meters, 1280 kilocycles, class A. 100 watts.

KFQV—Omaha Grain Exchange, Harney & 19th Sts., Omaha, Nebr. 231 meters, 1300 kilocycles, class A. 100 watts. (Portable).

KFQW — Photo Radio & Elec. Shop, North Bend, Wash. 248 meters, 1210 kilocycles, class A. Mon, Wed, & Fri, 8-9:15 pm. Pacific standard time. 50 watts.

KFQX—Alfred M. Hubbard, 310 Green Bldg., Seattle, Wash. 233 meters, 1290 kilocycles, class A. 250 watts.

KFQY — Farmers' State Bank, Belden, Nebr. 273 meters, 1100 kilocycles, class A. 10 watts.

KFQZ — Taft Radio Co., Hollywood, Calif. 240 meters, 1250 kilocycles, class A. 250 watts.

KFRA—Marwin S. Olson, Carver, Minn. 240 meters, 1250 kilocycles, class A. 100 watts.

KFRB—Hall Bros., Beeville, Texas. 248 meters, 1210 kilocycles, class A. 250 watts.

KFSG—Echo Park Evangelistic Ass'n. Los Angeles, Calif. 278 meters, 1069 kilocycles, class A. 500 watts.

KFSY—The Van Blaricom Co., Helena, Montana. 261 meters, 1150 kilocycles, class A. 10 watts.

KGB — Tacoma Daily Ledger, Tacoma, Wash. 252 meters, 1190 kilocycles, class A. Mon, Wed, & Fri 7-9 pm. Pacific coast time. Slogan: "The Voice from the Lumber Capital of America and the Gateway to Mt. Tacoma." 50 watts.

KGG—Hallcock & Watson Radio Service, 192 Park St., Portland, Ore. 360 meters, 834 kilocycles, class C. Not broadcasting during summer months. Slogan: "The Rose City." 50 watts.

KGO — General Elec. Co., 5555 East 14th St., Oakland, Calif. 312 meters, 960 kilocycles, class B. Daily ex Sat & Sun (Sat, 12:30 pm) 1:30 and 6:45 pm, stock, market, news, and weather reports. Mon, Wed & Fri, 3 pm, musical program. Mon, 4-5:30 pm, Hotel St. Francis Orchestra. 5:30-6 pm, Kiddies' Klub and Aunt Betty, 8-9:45 pm, educational program. Tues, Wed, Thurs, Fri & Sat, 4-5:35 pm, Orchestra. Tues, Thurs & Sat, regular program 8-9:45 pm. Mon, Tues, Thurs & Sat, 10 pm to 1 am, dance music. Sun, 11-12 noon, Church Services, 3:30 to 5 pm, concert; 7:30-8:30 pm, Church Services. Pacific standard time. 1000 watts.

KGU — Marion A. Mulrony, 236 So. King St., Honolulu, Hawaii. 360 meters, 834 kilocycles, class C. 500 watts.

KGW—The Morning Oregonian, Portland, Oregon. 492 meters, 610 kilocycles, class B. Daily ex Sun, 11:30 am, 5 pm, 7:30 pm, 8-11 pm. Sun, 8-9 pm. Pacific standard time. Slogan: "Keep Growing Wiser (KGW)." 500 watts.

KGY—St. Martins College, Lacey, Wash. 258 meters, 1160 kilocycles, class A. Sun, Tues & Fri, 8:30-9:30 pm. Pacific standard time. Slogan: "Out Where the Cedars Meet the Sea." 50 watts.

KHJ—Times-Mirror Co., Los Angeles, Calif. 395 meters, 760 kilocycles, class B. 500 watts.

KHQ—Louis Wasmer, 2020 13th Ave., Seattle, Wash. 360 meters, 834 kilocycles, class C. 100 watts.

KJQ—Gould, the Light Man, 615 E. Main St., Stockton, Calif. 273 meters, 1100 kilocycles. class A. Wed & Sat, 9-11 pm. Pacific standard time. 5 watts.

KJR—Northwest Radio Service Co., 1328 Sixth Ave., Seattle, Wash. 283 meters, 1070 kilocycles, class A. 50 watts.

KJS—Bible Institute of Los Angeles, 536 S. Hope St., Los Angeles, Calif. 360 meters, 834 Kilocycles, class C. Sun, 10:45 am to 12:30 pm, 6-6:45 pm. Tues & Thurs 8-9 pm. Pacific standard time. Slogan: "King Jesus Service (KJS)." 750 watts.

KLS—Warner Bros., 22nd & Telegraph Ave., Oakland, Calif. 360 meters, 834 kilocycles, class C. Daily ex Sun, 11:30 am to 1 pm. Sun, 12 noon to 1 pm, Radio Church of America. Pacific standard time. Slogan: "The City of Golden Opportunity." 250 watts.

KLX—Oakland Tribune, Oakland, Calif. 509 meters, 586 kilocycles, class B. Daily ex Sun, 3-5 & 7-7:30 pm. Mon, Wed & Fri, 8-10 pm. Pacific standard time. Slogan: "Where Rail and Water Meet." 500 watts.

KLZ—The Reynolds Radio Co., Inc., 1534 Glenarm St., Denver, Colo. 283 meters, 1060 kilocycles, class A. Mon & Sun, 9-10 pm. Thurs, 8:15-9:30 pm. Mountain time. Slogan: "'Tis a Privilege to Live in Colorado," followed by bird whistle. 500 watts.

KMJ — San Joaquin Light & Power Corp'n., Fresno, Calif. 248 meters, 1210 kilocycles, class A. Schedule irregular. 50 watts.

KMO—Love Elec. Co., 818 N. L. St., Tacoma, Wash. 360 meters, 834 kilocycles, class C. 10 watts.

KNT—Grays Harbor Radio Co., Aberdeen, Wash. 263 meters, 1153 kilocycles, class A. 250 watts.

KNV—Radio Supply Co., 815 S. Main St., Los Angeles, Calif. 256 meters, 1199 kilocycles, class A. 100 watts.

KNX—Electric Lighting Supply Co., 216 W. Third St., Los Angeles, Calif. 360 meters, 834 kilocycles, class C. 100 watts.

KOB—New Mexico College of Agriculture & Mechanic Arts, State College, N. M. 360 meters, 834 kilocycles, class C. Daily 11:35 am, and 9:55 pm, time signals, Weather Bureau reports, crop statistics and press information. Mon, Wed & Fri, 7:30-8:30 pm, concerts, lectures, etc. Standard mountain time. Slogan: "Sunshine State of America." 500 watts.

KOP—Detroit Police Dept., Macomb & Beaubien Sts., Detroit, Mich. 286 meters, 1050 kilocycles, class A. Daily ex Sun, 1 pm and 6:30 pm, police reports. Eastern standard time. Slogan: "Safety First." 500 watts.

KPO—Hale Bros., Inc., San Francisco, Calif. 423 meters, 710 kilocycles, class B. Daily ex Sun, noon, time signals; 2:30-3:30 pm, studio program. Daily ex Sat & Sun, 1-2 & 4:30-5:30 pm, Fairmont Hotel. Fri, 12:45-1:30 pm. Sat, 1-2, 3:30-5:30 pm, 8 pm to midnight, orchestra. Mon, Tues, Wed & Thurs, 5:30 pm, children's hour; 7-7:30 pm, dinner concert; 8-11 pm, concert. Daily ex Fri, 10 pm, time signals. Sun, 11-12:15 pm, church services; 8:30-10 pm, orchestra. Pacific coast time. 500 watts. Slogan: "The City at the Golden Gate."

KQP—Apple City Radio Club, Hood River, Oregon. 360 meters, 834 kilocycles, class C. 10 watts. Slogan: "The Home of the Hood River Apple."

KQV—Doubleday-Hill Elec. Co., 719 Liberty Ave., Pittsburgh, Penna. 270 meters, 1110 kilocycles, class A. Daily ex Sun, 10:30-11 am, music. Daily ex Sat & Sun, 3-3:30 pm, music. Mon, Wed & Fri, 8-9 features; 9-10, concerts. Tues, 8-10 pm. No Sunday programs unless announced. 500 watts. Eastern time.

KQW—Chas. G. Herrold, 467 First St., San Jose, Calif. 360 meters, 834 kilocycles, class C. 50 watts. Slogan: "The Voice of the Garden City."

KRE—Berkeley Daily Gazette, Berkeley, Calif. 275 meters, 1090 kilocycles, class A. 50 watts.

KSD—Post-Dispatch, 12th & Olive Sts., St. Louis, Mo. 546 meters, 550 kilocycles, class B. Daily 9:40, 10:40, 11:40 am, 12:40, 1:40, 2:40, 4:00 & 8 pm, with occasional midnight programs. Central standard time. 500 watts.

KSS—Prest & Dean Radio Co. & Radio Research Society, Long Beach, Calif. 360 meters, 834 kilocycles, class C. 20 watts.

KTW—First Presbyterian Church, Seattle, Wash. 360 meters, 834 kilocycles, class C. 750 watts.

KUO—Examiner Printing Co., San Francisco, Calif. 360 meters, 834 kilocycles, class C. Slogan: "The Voice of the West." 150 watts.

KUS—City Dye Works & Laundry Co., Los Angeles, Calif. 360 meters, 834 kilocycles, class C. 100 watts.

KUVQ—Kreetan Co., Johnswood, Drummond Island, Mich. 450 meters, 666 kilocycles, class B. 1000 watts.

KUY—Coast Radio Co., El Monte, Calif. 256 meters, 1170 kilocycles, class A. 50 watts.

KWG—Portable Wireless Telephone Co., 530 E. Market St., Stockton, Calif. 360 meters, 834 kilocycles, class C. 100 watts.

KWH—Los Angeles Examiner, Los Angeles, Calif. 360 meters, 834 kilocycles, class C. 500 watts.

KXD — Modesto Herald Publ. Co., Modesto, Calif. 252 meters, 1190 kilocycles, class A. 5 watts.

KYQ—The Electric Shop, Honolulu, Hawaii. 270 meters, 1110 kilocycles, class A. 100 watts.

KYW — Westinghouse Station, Chicago, Ill. 536 meters, 560 kilocycles, class B. Daily 6:30, 7 & 8 am, morning exercises; 9:30 am, news comment on financial & commercial markets. This feature is also broadcast every half hour—on the hour and half hour—during the day and night; 6:35-7 pm, Children's bedtime story; 7-7:30 pm, dinner concert; 10:15 pm to 1:30 am, late show. Tues & Thurs, 10:30 am, farm and home service; 11:35 am, table talk; 2:35-4 pm, afternoon frolic; 10-11:30 pm "at home" program. Wed & Fri, 7:30-8 pm, & 9:30-12:30 midnight revue. Tues, Wed, Thurs & Fri, 8-8:58 pm, musical program. Tues & Fri 8:20-8:45 pm, American Farm Bureau Federation. Thurs, 8-8:20 pm, "Twenty minutes of good reading." Sun, 11 am, Central Church Service; 2:30 pm, Chapel Service; 7 pm, Chgo. Sunday Evening Club. Central standard time. Slogan: "The Twenty Four Hour Station." 1000 watts.

KZM—Western Radio Institute, 13th & Harrison Sts., Oakland, Calif. 360 meters, 834 kilocycles, class C. 50 watts.

KZN—The Desert News, Salt Lake City, Utah. 360 meters, 834 kilocycles, class C. 500 watts.

WAAB—Valdemar Jensen, 137 S. St. Patrick St., New Orleans, La. 268 meters. 1120 kilocycles, class A. 100 watts.

WAAC—Tulane University of Louisiana, New Orleans, La. 360 meters, 834 kilocycles, class C. Fri, 7:15 pm. trade reports; 8-9:15 pm, educational and entertainment. Central standard time. 400 watts.

WAAD—Ohio Mechanics Institute, Cincinnati, Ohio. 360 meters, 834 kilocycles, class C. 25 watts.

WAAF—Chicago Daily Drovers Journal, 844 Exchange Ave., Chicago, Ill. 286 meters. 1050 kilocycles, class A. 200 watts.

WAAM — I. R. Nelson Co. Bond St., Newark, N. J. 263 meters, 1140 kilocycles, class A. Daily ex Fri, Sat & Sun 11-12 noon & 7-11 pm. Eastern standard time. Slogan: "Electrical Repairing and Manufacturing." 250 watts.

WAAN—University of Missouri, Columbia, Missouri. 254 meters, 1180 kilocycles, class A. 50 watts.

WAAW—Omaha Grain Exchange, 19th & Harney Sts., Omaha, Neb. 286 meters, 1050 kilocycles, class A. Daily ex Sun, 8:35, 9:45, 10:45, 11:45 am, & 1 pm, markets. Mon & Thurs, 7:30 to 9 pm, concerts. Central standard time. Slogan: "Where Agriculture Accumulates Wealth, (WAAW)." 500 watts.

WABB—Dr. J. B. Lawrence, 2006 Market St., Harrisburg, Pa. 266 meters, 1120 kilocycles, class A. 10 watts.

WABD—Parker High School, 1st & St. Clair Sts., Dayton, Ohio. 283 meters, 1060 kilocycles, class A. 10 watts.

WABE—Y. M. C. A., Washington, D. C. 283 meters, 1060 kilocycles, class A. 100 watts.

WABH — Lake Shore Tire Co., 1014 Hancock St., Sandusky, Ohio. 240 meters, 1250 kilocycles, class A. 10 watts.

WABI—Bangor Railway & Elec. Co., 84 Harlow St., Bangor, Maine. 240 meters, 1250 kilocycles, class A. Schedule irregular. Eastern standard time. Slogan: "The Pine Tree Wave." 100 watts.

WABK—First Baptist Church. Worcester, Mass. 252 meters, 1190 kilocycles, class A. 10 watts.

WABL—Connecticut Agricultural College, Storrs, Conn. 283 meters, 1060 kilocycles, class A. 100 watts.

WABM — F. E. Doherty, 901 Genesee Ave., Saginaw, Mich. 254 meters, 1180 kilocycles, class A. Daily 10:15 & 11:30 am, 2:30 & 6 pm. Eastern standard time. 100 watts.

WABN—Ott Radio, Inc., La Crosse, Wis. 244 meters, 1230 kilocycles, class A. Daily 3-4:30 pm. Mon 11 pm; 12:30. Thurs, 9-11 pm. Central standard time. Slogan: "LaCrosse, Wis., the Beautiful." 500 watts.

WABO—Lake Ave. Baptist Church, Lake Ave., Rochester, N. Y. 252 meters, 1190 kilocycles, class A. 10 watts.

WABP—Robt. F. Weinig, 522 Wooster Ave., Dover, Ohio. 266 meters, 1130 kilocycles, class A. 100 watts.

WABQ—Haverford College Radio Club. Haverford, Penna. 261 meters, 1153 kilocycles, class A. 50 watts.

WABR—Jesup W. Scott High School, Toledo, Ohio. 270 meters, 1110 kilocycles, class A. Fri, 8 pm, concert. Sat, 2 pm, football scores of Scott team. Eastern standard time. 50 watts.

WABT—Holliday-Hall Elec. Engineers. Geo. Washington Hotel, Washington, Penna. 252 meters, 1190 kilocycles, class A. 100 watts.

WABU—Victor Talking Mach. Co., Point & Linden Sts., Camden, N. J. 226 meters, 1320 kilocycles, class A. 100 watts.

WABW—The College of Wooster, Dept. of Physics, Wooster, Ohio. 234 meters, 1280 kilocycles, class A. 20 watts.

WABX—Henry B. Joy, 1830 Penobscot Bldg., Detroit, Mich. 270 meters. 1110 kilocycles, class A. 150 watts.

WABY—John Magaldi, Jr., 815 Kimball St., Phila., Pa. 242 meters, 1240 kilocycles, class A. 50 watts.

WABZ—Coliseum Place Baptist Church. New Orleans, La. 263 meters, 1140 kilocycles, class A. Sun, 11 am to 12 noon, 7:45-9 pm. Wed, 8:45-10 pm. Central standard time. Slogan: "The Station with a Message." 50 watts.

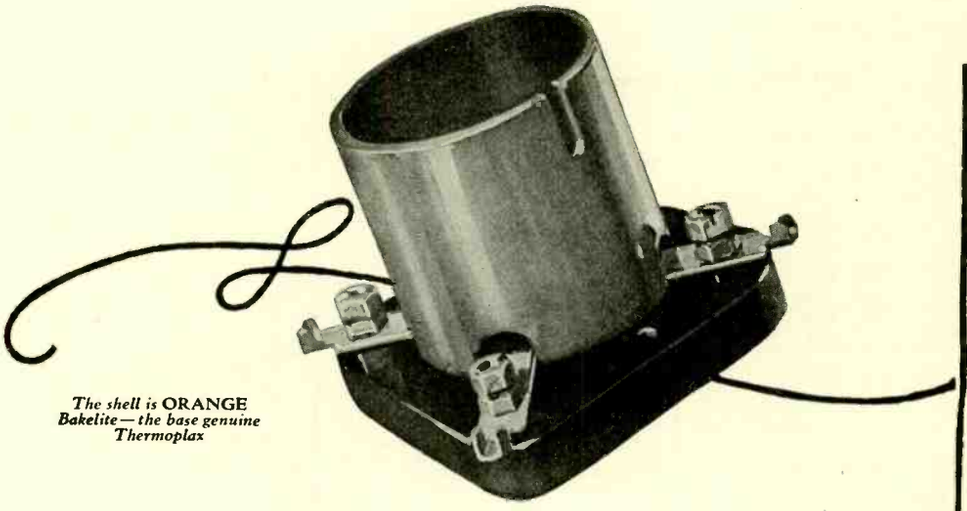
WBAA—Purdue University, W. Lafayette, Ind. 283 meters, 1060 kilocycles, class A. 250 watts.

WBAD—Sterling Elec. Co., 31 S. 5th St., Minneapolis, Minn. 360 meters, 834 kilocycles, class A. 100 watts.

WBAK—Penna. State Police, Harrisburg, Penna. 400 meters, 750 kilocycles, class B. 500 watts.

WBAN—Wireless Phone Corp., 193 Ellison St., Paterson, N. J. 244 meters, 1220 meters, class A. 100 watts.

WBAO—James Millikin University, Decatur, Ill. 275 meters, 1090 kilocycles, class A. Schedule irregular. 50 watts.



The shell is ORANGE
Bakelite—the base genuine Thermoplax

At Last—A Radio Socket Worthy of This Famous Trade Mark

After months of experiment and research the Cutler-Hammer engineers announce this masterpiece of radio socket design. With features never before found in any socket, it brings to your set a degree of efficiency that means added miles of range and hours of clearer, more enjoyable reception.

Capacity has been absolutely minimized—without sacrifice of mechanical strength, and its base of ebony black Thermoplax in beautiful color contrast with the thin shell of orange Bakelite adds as much to the appearance of any set as this socket's construction does to its efficiency.

You'll like all of its many exclusive features—the silvered bronze contacts that afford *permanently* perfect contact; the slotted binding nuts; the handy terminals for soldering; the wide spacing of current carrying parts.

You'll like its appearance—neatness—small size. You'll like the way the tube is inserted and removed without twisting. And best of all, you'll like the price, 90c. *This socket that meets the specifications of the most exacting radio engineer costs no more than most of those on the market today.* Until all dealers have been stocked, you can be supplied direct from the factory at the retail price plus 10 cents for packing and postage. Be sure you have the genuine—it will pay you in every way to refuse all substitutes.

THE CUTLER-HAMMER MFG. CO.
Member Radio Section, Associated Manufacturers of Electrical Supplies
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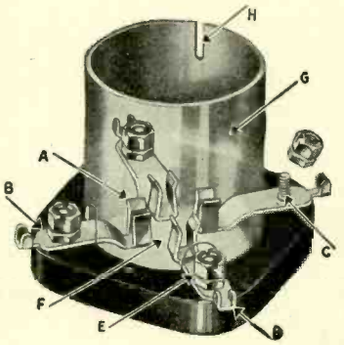
C-H

These Exclusive Features Assure Better Reception



A
Perfect contact. Both sides of tube prong cleaned when inserted—no contact or wear on soldered end.

B
All metal parts *silver* plated—perfect contact for the life of the set. Silver may tarnish but its contact resistance does not change.

C
One piece contact construction. The binding post is NOT a part of the circuit—the wire to the socket always touches the contact strip which carries the current direct to the tube prong—no joints to cause losses.

D
Convenient terminals for soldering—full length to allow bending down for under-wiring. Ears hold wire in place for soldering.

E
Extra handy binding posts—tight connections with either wrench or screw-driver. Lock washers hold terminals rigid.

F
Wide spacing of current carrying parts both in air and insulation—true low-loss construction.

G
A minimum of both metal and insulation for low capacity. Shell of thin Bakelite—the base of genuine Thermoplax.

H
The tube is held in place by merely a vertical motion—no twisting to separate bulb from base.

The attractive orange shell helps identify this better socket, but the famous C-H *trade mark both on the socket and on the orange and blue box is your genuine protection*

C-H **RADIO SOCKET**

Tell 'Em You Saw It in the Citizens Radio Call Book

WBAP—The Star Telegram, Fort Worth, Texas. 476 meters, 630 kilocycles, class B. Daily 9, 10, 11am, 12 noon, 1, 2, 3 pm, market reports. Daily ex Sat & Sun, 7:30-8:30 pm & 9:30-11 pm. Central standard time. 1000 watts.

WBAV—Erner & Hopkins Co., 146 N. Third St., Columbus, Ohio. 390 meters, 770 kilocycles, class B. Daily 12 noon to 1 pm. Tues & Fri, 8-10 pm. Eastern standard time. Slogan: "We Broadcast a Variety (WBAV)." 500 watts.

WBAX—John H. Stenger, Jr., Box No. 104, Wilkes-Barre, Pa. 360 meters. 834 kilocycles, class C. Wed 8:30 pm to midnight. Eastern standard time. Slogan: "In Wyoming Valley." 100 watts.

WBAY—Western Elec. Co., 463 West St., New York City, N. Y. 492 meters, 611 kilocycles, class B. 500 watts.

WBBA—Plymouth Congregational Church, Newark, Ohio. 240 meters, 1250 kilocycles, class A. 20 watts.

WBBD—Barbey Battery Service, Reading, Pa. 234 meters, 1304 kilocycles, class A. 50 watts.

WBBE—Alfred H. Marcy, 113 W. Raynor St., Syracuse, N. Y. 246 meters, 1220 kilocycles, class A. 10 watts.

WBBG—Irving Vermilya, Mattapoisett, Mass. 248 meters, 1210 kilocycles, class A. Wed, 8-10 pm, dance music. Sun, 10:45 am to 12 noon, Church Services. Eastern standard time. Slogan, "The Voice. from Cape Cod." 500 watts.

WBBH—John J. Bell, 1511 Gordon St., Port Huron, Mich. 246 meters, 1220 kilocycles, class A. 50 watts.

WBBI—The Indianapolis Radio Club, 1721 No. Somerset St., Indianapolis, Ind. 234 meters, 1280 kilocycles, class A. 20 watts.

WBBJ — Neel Elec. Co., West Palm Beach, Fla. 258 meters, 1160, kilocycles, class A. 50 watts.

WBBL—Grace Covenant Church, Richmond, Va. 283 meters, 1060 kilocycles, class A. 50 watts.

WBBM—Frank Atlass Products Co., 110 Park Pl., Lincoln, Ill. 226 meters, 1330 kilocycles, class A. 200 watts.

WBBN—A. B. Blake, 225 N. Front St., Wilmington, N. C. 275 meters, 1090 kilocycles, class A. 10 watts.

WBBP—Petoskey High School, Petoskey, Mich. 246 meters, 1210 kilocycles, class A. 10 watts.

WBBR—Peoples Pulpit Ass'n. Rossville, N. Y. 244 meters, 1230 kilocycles, class A. 100 watts.

WBBT — Lloyd Bros., 3157 Frankford Ave, Phila., Pa. 234 meters, 1280 kilocycles, class A. 5 watts.

WBBU—Jenks Motor Sales Co., & Monmouth, Ill. 224 meters, 1340 kilocycles, class A. 10 watts.

WBBV—Johnstown Radio Co., 324 Market St., Johnstown, Penna. 248 meters, 1210 kilocycles, class A. 5 watts.

WBBW — Ruffner Junior High School, Norfolk, Va. 222 meters, 1350 kilocycles, class A. 50 watts.

WBBY — Washington Light Infantry, Charlestown. So. Car. 268 meters, 1120 kilocycles. class A. 20 watts.

WBBZ—Noble B. Watson, 233 Iowa St., Indianapolis, Ind. 227 meters, 1320 kilocycles, class A. 50 watts.

WBL—T and H Radio Co., Anthony, Kansas. 254 meters, 1180 kilocycles, class A. 100 watts.

WBR — Penna. State Police, Capitol Bldg., Butler, Penna. 286 meters, 1050 kilocycles, class A.

WBS—D. W. May, Inc., 325 Central Ave., Newark, N. J. 360 meters 834 kilocycles. class C. Daily ex Sun, 11 am to 12, and 1-2:30 pm, Sun, 1-3 pm. Tues, Thurs & Fri, 7:30-9:30 pm. Eastern standard time. 100 watts.

WBT — Southern Radio Corp., 1116 Realty Bldg., Charlotte, N. C. 360 meters, 834 kilocycles, class C. Slogan: "The Queen City of the South." 500 watts.

WBZ—Westinghouse Elect. & Mfg. Co., 82 Worthington St., Springfield, Mass. 337 meters, 890 kilocycles, class B. Daily ex Sun, 12:55 pm, time signals, weather and markets; 6 pm, dinner concert; 7 pm, baseball scores; 7:05 pm, addresses and markets; 7:30 pm, Kiddies' Twilight Tales; 7:40 Musical program (ex Fri); 10:55 pm, Arlington time signals and a official U. S. weather forecasts. Wed, 11:30 dance program. Fri, 10 pm, music. Sun, 10:45 am, Church Service; 6:30 pm, China Vesper Services; 7:30 pm, music. Eastern standard time. 1000 watts.

WCAD—St. Lawrence University, Canton, N. Y. 280 meters, 1070 kilocycles, class A. Daily, 11 am. Wed, 8 pm. Fri, 10:30 pm. Eastern standard time. Slogan: "The Voice of the North Country." 250 watts.

WCAE—The Pittsburgh Press and the Kaufman & Baer Co., Pittsburgh, Pa. 462 meters, 650 kilocycles, class B. Daily, 12:30, 3:30, 4:30, 6:30-10 pm. Mon, Tues & Thurs, 11 pm to 12:30 am. Sun, 3:30 and 6:30 pm. Eastern standard time. Slogan: "The Workshop of the World." 500 watts.

WCAG—Clyde R. Randall, 2813 Calhoun St., New Orleans, La. 268 meters, 1110 kilocycles, class A. Mon & Thurs, 8-9 pm. Central standard time. Slogan: "The Little Noise from New Orleans." 50 watts.

WCAH — Entrekin Elec. Co., 321 W. 10th St., Columbus, Ohio. 286 meters, 1050 kilocycles, class A. Slogan: "The Heart of Ohio." 100 watts.

WCAJ—Nebraska Wesleyan University, University Place, Neb. 280 meters, 1070 kilocycles, class A. Daily, 10:30 am, weather, news, sports. Tues, 7 pm, children's hour. Fri, 9 pm, music, lectures. Central standard time. Slogan: "Where Culture Aids Justice (WCAJ)." 500 watts.

WCAK—Alfred P. Daniel, 2504 Bagby St., Houston, Texas. 263 meters, 1140 kilocycles, class A. Daily, 7-8 pm. Central standard time. Slogan: "Where 18 Railroads Meet the Sea." 10 watts.

WCAL—St. Olaf College, Dept. of Physics, Northfield, Minn. 360 meters, 834 kilocycles, class C. Daily ex Sun & Mon, 9:45 am, chapel service. Thurs, 9 pm, music. Fri, 8:30 am, lecture. Sat, 12 midnight, music. Sun, 11 am, church services, and 8:30 pm, sacred program. Central standard time. Slogan: "The College on the Hill." 500 watts.

WCAO—Sanders & Stayman Co., 319 N. Charles St., Baltimore, Md. 360 meters, 34 kilocycles, class C. 50 watts.

WCAP—Chesapeake & Potomac Telephone Co., 725 13th St., N. W. Washington, D. C. 469 meters, 640 kilocycles, class B. Mon & Wed, 7:30-10 pm. Fri, 7:30-11 pm. Sun, 11 am & 4 pm, service, 6:20 to 9:15 pm. Eastern standard time. 500 watts.

WCAR—Southern Radio Corp. of Texas, 324 N. Navarro St., San Antonio, Texas. 360 meters, 834 kilocycles, class C. Mon, Thurs & Sat, 8:30-9:30 pm. Central standard time. Slogan: "The Gateway to Mexico." 100 watts.

WCAS—The William Hood Dunwoody Industrial Institute, 818 Superior Blvd., Minneapolis, Minn., 280 meters, 1220 kilocycles, class A. Mon, 7-7:30 pm. Tues, 8:15-9:30 pm; 9:30-10:45 pm, alternate weeks. Central standard time. Slogan: "The Flower City of the World." 100 watts.

WCAT—South Dakota State School of Mines, Rapid City, S. D. 240 meters, 1249 kilocycles, class A. 100 watts.

WCAU—Durham & Co., 1936 Market St., Philadelphia, Pa. 286 meters, 1050 kilocycles, class A. 100 watts.

WCAV—J. C. Dice Elec. Co., 113 W. Capitol Ave., Little Rock, Ark. 360 meters, 834 kilocycles, class C. Wed & Fri, 8:30 pm. Central standard time. 20 watts.

WCAX—University of Vermont, Burlington, Vt. 360 meters, 834 kilocycles, class C. 50 watts.

WCAY — Milwaukee Civic Broadcasting Assn., Inc., Hotel Antlers, Milwaukee, Wis. 266 meters, 1130 kilocycles, class A. Daily, 11:15, 11:15 am, 12:15, 3-4, 6:30-7:30 pm. Mon & Fri, 8-9 pm. Tues, Thurs & Sat, 10:30-12 pm. Sun, 10:30 am. Central standard time. 250 watts.

WCBA—C. W. Heimbach, Queen City Radio Broadcasting Station. 1015 Allen St., Allentown, Pa. 280 meters, 1071 kilocycles, class A. Wed & Sun, 8:15 pm. Eastern standard time. Slogan: "Sunshine Jolliers." 10 watts.

WCBC—University of Michigan, Dept. of Elec. Engineering, Ann Arbor, Mich. 280 meters, 1071 kilocycles, class A. Schedule irregular. Eastern standard time. 200 watts.

WCBD — Wilbur Glenn Voliva, Shiloh Park, Zion, Ill. 345 meters, 870 kilocycles, class B. Mon, 8-10:15 pm. Thurs, 2:30-3:45 & 8-10:15 pm. Sun, 9-10:45 am, 2:30-6 pm, 2nd & 4th Sun 8:10:15 pm. Central standard time. Slogan: "Where God Rules Man Prospers." 500 watts.

WCBE—Phalt Radio Co., 4521 Chestnut St., New Orleans, La. 263 meters, 1140 kilocycles, class A. Sun, 1-2 pm. Mon & Thurs, 9-10 pm. Central standard time. 5 watts.

WCBF—Paul J. Miller, 1133 Creedmore Ave., Pittsburgh, Pa. 236 meters, 1270 kilocycles, class A. 50 watts.

WCBG—Howard S. Williams, Evangelist, Pascagoula, Miss. (Portable). 254 meters, 1180 kilocycles, class A. Irregular dates, 7:45-9 pm. 10 watts.

WCBH—University of Mississippi, Oxford, Miss. 242 meters. 1235 kilocycles, class A. Mon, Wed & Fri 8 pm, 20 watts,

WCBI—Nicoll, Duncan & Rush, Bemis, Texas. 226 meters, 1330 kilocycles, class A. 100 watts.

WCBJ—J. C. Mans, 822 Main St., Jennings, La. 244 meters, 1230 kilocycles, class A. 20 watts.

WCBK—E. Richard Hall, 2801 Central Ave., St. Petersburg, Fla. 266 meters, 1130 kilocycles, class A. 500 watts.

WCBL—Northern Radio Mfg. Co., Houlton, Maine. 280 meters, 1070 kilocycles, class A. 50 watts.

WCBM — Chas. Swarz, Charles St. & North Ave., Baltimore, Md. 229 meters, 1310 kilocycles, class A. 50 watts.

WCBN—James P. Boland, Lieut. U. S. A., 3rd F. A., Fort Benjamin, Harrison, Ind. 266 meters. 1130 kilocycles, class A. 50 watts.

WCBO—Radio Shop, Inc., 189 Union Ave., Memphis, Tenn. 250 meters, 1200 kilocycles, class A. Sun, 8-9 pm. 20 watts.

WCBQ—First Baptist Church, Nashville, Tenn. 236 meters, 1270 kilocycles, class A. 100 watts.

WCBR — Chas. H. Messter, 42 Doyle Ave., Providence, R. I. (Portable). 246 meters, 1220 kilocycles, class A. 5 watts.

WCBT — Clark University, Worcester, Mass., 238 meters, 1260 kilocycles, class A. 250 watts.

WCBU—Arnold Wireless Sup. Co., Arnold, Pa. 254 meters, 1180 kilocycles, class A. Wed, Sat & Sun, 9:12 pm. Eastern standard time. Slogan: "The Fifty Watt Station in the Fifty Kilowatt Town." 50 watts.

WCBV—Tullahoma Radio Club, Tullahoma, Tenn. 252 meters, 1190 kilocycles, class A. Thurs, 9:30-9:30 pm. 10 watts.

WCBW—Geo. P. Rankin, Jr., & Maitland Soloman, Macon, Ga. 226 meters, 1330 kilocycles, class A. 10 watts.

WCBY—Forks Electrical Shop, Buck Hill Falls, Pa. 268 meters, 1120 kilocycles, class A. 10 watts.

WCBZ—Coppotelli Bros. Music House, Chicago Heights, Ill. 248 meters, 1210 kilocycles, class A. Mon & Fri, 8:30 pm. Slogan: "Where the Lincoln and Dixie Highways Meet." 50 watts.

WCK—Stix, Baer & Fuller, Washington St., St. Louis, Mo. 360 meters, 833 kilocycles, class C. Daily, 12 noon & 3 pm. Mon, Wed & Fri, 7-8 pm. Fri, 11 pm. Central standard time. 100 watts.

WCX—Detroit Free Press, 117 Lafayette Blvd., Detroit, Mich. 517 meters, 580 kilocycles, class B. Slogan: "The Call of the Motor City." 500 watts.

WDAE — Tampa Daily Times, Tampa, Fla. 360 meters, 834 kilocycles, class C. 250 watts.

WDAF—The Kansas City Star, Kansas City, Mo. 411 meters, 730 kilocycles, class B. Daily ex Sun, 3:30-4:30, music; 6-7, program; 5:50 to 6, market, weather, time signal, road report. Mon, Wed & Fri 8-9:30 pm, program. Wed, 5-5:30, child talent. Mon, 5-5:30, Boy Scout. Sun, 4-5 pm, religious service or band concert. Central standard time. Slogan: "Nighthawks, 'The Enemies of Sleep.'" 500 watts.

WDAG—J. Laurence Martin, Amarillo, Texas. 263 meters, 1140 kilocycles, class A. Tues & Thurs, 8-10 pm. Schedule irregular. Central standard time. Slogan: "Where Dollars Always Grow (WDAG)." 100 watts.

WDAH—Trinity Methodist Church, El Paso, Texas. 268 meters, 1120 kilocycles, class A. Slogan: "The Climatic Capital of America." 50 watts.

WDAR—Lit Bros. Dept. Store, Philadelphia, Pa. 395 meters, 760 kilocycles, class B. Daily, 12-8 pm. Mon, Wed & Fri evenings. Eastern standard time. Slogan: "Quaker City Siren." 500 watts.

WDAS—Samuel A. Waite, 692a Main St., Worcester, Mass. 360 meters, 834 kilocycles, class A. 5 watts.

WDAU—Slocum & Kilburn, New Bedford, Mass. 360 meters, 834 kilocycles, class C. 100 watts.

WDAY—Radio Equip. Corp., 119 Broadway, Fargo, N. D. 244 meters, 1230 kilocycles, class A. Daily ex Sun, 9:15 am, music, weather, news; 1 pm, markets; 5 pm, music, news, baseball scores. Sun, 10:30 am, church service; 5 pm, concert. Central standard time. Slogan: "The Biggest Little City in the World." 50 watts.

WDBB—A. H. Waite & Co., 32 Weir St., Taunton, Mass. 229 meters, 1310 kilocycles, class A. 10 watts.

WDBC—Kirk, Johnson & Co., Lancaster, Pa. 258 meters, 1160 kilocycles, class A. 50 watts.

WDBD—H. E. Burns, Martinsburg, W. Va. 268 meters, 120 kilocycles. class A. Tues, Thurs & Sat, 9-10:30 pm. Eastern standard time. Slogan: "We Do Better Daily (WDBD)." 5 watts.

WDBF—Robt. G. Phillips, 254 W. Federal St., Youngstown, Ohio. 246 meters, 1220 kilocycles, class A. 50 watts.

WDBH — C. T. Sherer Co., Worcester, Mass. 268 meters, 1120 kilocycles, class A.

WDBI—Radio Specialty Co., Inc., 819 Third St. S., St. Petersburg, Fla. 226 meters, 1330 kilocycles, class A. Schedule irregular. 10 watts.

WDBJ—Richardson-Wayland Elec. Corp., 106 Church Ave., S. W., Roanoke, Va. 229 meters, 1310 kilocycles, class A. 20 watts.

WDBN—Maine Elec. Light & Power Co., Bangor, Maine. 252 meters, 1190 kilocycles, class A. 5 watts.

WBBO — Rollins College, Winter Park, Fla. 240 meters, 1250 kilocycles, class A. 50 watts.

WDBP—Superior State Normal School, Superior, Wis. 261 meters, 1150 kilocycles, class A. 50 watts.

WDBQ—Morton Radio Sup. Co., Andrews Bldg., Salem, N. J. 234 meters, 1080 kilocycles, class A. 10 watts.

WDBR—Tremont Temple Baptist Church, Boston, Mass. 256 meters, 1170 kilocycles, class A. 100 watts.

WDBS—S. M. K. Radio Corp., 39 E. 3rd St., Dayton, Ohio. 283 meters, 1060 kilocycles, class A. 5 watts.

WDBT — Taylor's Book Store, Hattiesburg, Miss. 236 meters, 1270 kilocycles, class A. Tues & Fri, 9 pm. 10 watts.

WDBU—Somerset Radio Co., 45 Water St., Skowhegan, Maine. 258 meters, 1160 kilocycles, class A. 10 watts.

WDBW — The Radio Den, Columbia, Tenn. 268 meters, 1120 kilocycles, class A. Daily ex Sun; 12 noon, markets, weather. Tues, Thurs & Sat, 8-9 pm. Central standard time. Slogan, "The Dimple of the Universe." 20 watts.

WDBX—Otto Baur, 138 Dyckman St., New York, N. Y. 233 meters, 1290 kilocycles, class A. 5 watts.

WDBY — North Shore Congregational Church, 1011 Wilson Ave., Chicago, Ill. 258 meters, 1160 kilocycles, class A. 500 watts.

WDBZ — Boy Scouts of America, City Hall, Kingston, N. Y. 233 meters, 1290 kilocycles, class A. 5 watts.

WDM—Church of the Covenant, Washington, D. C. 234 meters, 1280 kilocycles, class A. 50 watts.

WDZ—James L. Bush, Star Store Bldg., Tuscola, Ill. 278 meters, 1082 kilocycles, class A. Daily ex Sun, 9:30, 10, 10:30, 11, 11:30 am, 12 noon, 12:30, 1, 1:15 pm, Chicago Board of Trade grain markets. Central standard time. 10 watts.

WEAA — Frank D. Fallain, 321 First Ave., Flint, Mich. (Station Police Headquarters). 280 meters, 1070 kilocycles, class A. Daily ex Sun, 7:15 pm, police broadcasts and music. Also emergency broadcasts. Eastern standard time. Slogan: "The Vehicle City." 100 watts.

WEAF — American Telephone & Telegraph Co., 195 Broadway, New York City, N. Y. 492 meters, 610 kilocycles, class B. Slogan: "The Voice of the Millions." 500 watts.

WEAH—Board of Trade, 120 S. Market St., Wichita, Kan. 280 meters, 1070 kilocycles, class A. Daily ex Sun, 9, 10, 11 am, 12 noon, 1 pm. Sat last broadcast 12 noon. Tues, 9-10 pm, musical program. Fri, 9-10:30 pm, dance music. Central standard time. Slogan: "Kansas Grows the Best Wheat in the World." 50 watts.

WEAI — Cornell University, School of Elec. Engineering, Ithaca, N. Y. 286 meters, 1050 kilocycles, class A. Schedule irregular. 500 watts.

WEAJ—University of South Dakota, Vermillion, S. D. 283 meters, 1060 kilocycles, class A. Mon, 8 pm, music by College of Music. Special broadcasts each week, usually Fri, 8 pm. Central standard time. Slogan: "University of South Dakota for South Dakotans." 100 watts.

WEAM—Mayor W. L. Smalley, North Plainfield, N. J. 252 meters, 1199 kilocycles, class A. 100 watts.

WEAN—The Shepard Stores, Providence, R. I. 273 meters, 1110 kilocycles, class A. Daily ex Mon & Thurs, 12-1 & 4-5 pm, 8 pm. Mon, 7:30 pm. Thurs, 6 pm. Eastern standard time. 100 watts.

WEAO—Ohio State University, Electric Engineering Dept., Columbus, Ohio. 360 meters, 834 kilocycles, class C. 500 watts.

WEAP—Mobile Radio Co., 313 Chatham St., Mobile, Ala. 360 meters, 834 kilocycles, class C. Daily ex Sun, 4-5 pm. Tues, Thurs & Sat, 7:45-8:45 pm. Sun, 11 am to 12 noon, 7:30-9 pm. Eastern standard time. 100 watts.

WEAR — Baltimore American & News Publ. Co., Baltimore, Md. 360 meters, 834 kilocycles, class C. 50 watts.

WEAS—Hecht Bros., Washington, D. C. 360 meters, 834 kilocycles, class C. 100 watts.

WEAU—Davidson Bros. Co., Sioux City, Iowa. 275 meters, 1090 kilocycles, class A. Daily ex Sun, 8:45 am, opening grain quotations; 10 am, grain & livestock, weather; 11 am, grain, livestock, weather; 1 pm, closing grain quotations; 5 pm, livestock summary, sport scores. Mon, Wed & Fri, 7:30-8:30 pm, special entertainment. Central standard time. Slogan: "The Heart of the Corn Belt." 100 watts.

WEAY—Iris Theatre, Radio Dept., Houston, Texas. 360 meters, 834 kilocycles, class C. Daily 11 am, 2:30-3:30 pm, 10 pm. to 12 midnight ex Sun, 12 noon to 1 pm. Sun, 11 am, 8-9 pm, 9:30-11 pm. Fri & Sat, 8-12 pm. 500 watts.

WEB—The Benson Radio Co., Inc., 918 Pine St., St. Louis, Mo. 273 meters, 1130 kilocycles, class A. Mon, Wed & Fri, 8-10:30 pm. Sat, 11 pm to 1 am. Central standard time. Slogan: "A Wave Length Ahead." 500 watts.

WEBA—The Electric Shop, 131 Church St., New Brunswick, N. J. 233 meters, 1290 kilocycles, class A. Mon & Thurs, 8-10 pm, talks, orchestra, etc. Eastern standard time. 35 watts.

WEBC — Walter C. Bridges, 1011 N. 21st St. Superior, Wis. 242 meters, 1240 kilocycles, class A. 10 watts.

WEBD—Electrical Equip. & Serv. Co., Anderson, Ind. 246 meters, 1220 kilocycles, class A. 10 watts.

WEBE—Roy W. Waller, 319 Wall Ave., Cambridge, Ohio. 248 meters. 1210 kilocycles, class A. Fri, 7:30-9 pm, talks, news, music and market reports. Eastern standard time. 10 watts.

WEBH — The Edgewater Beach Hotel-Chicago Evening Post Broadcasting Station, 5525 Sheridan Rd., Chicago, Ill. 370 meters, 810 kilocycles, class B. Daily ex Sun & Mon, 7:30-8:30 pm, 9:30-10:30 pm, 11:30-12:30 am. Sun, 7-9 pm. Central standard time. 1000 watts.

WEBI—Walter Gibbons, 121 Dock St., Salisbury, Md. 242 meters, 1240 kilocycles, class A. 15 watts.

WEBJ—Third Avenue Railway Co., 2396 Third Ave., New York, N. Y. 273 meters, 1100 kilocycles, class A. Sun, 11 am to 1 pm, 4-5 pm. Tues & Fri 7-9 pm. Eastern standard time. 500 watts.

WEBK—Grand Rapids Radio Co., Grand Rapids, Mich. 261 meters, 1150 kilocycles, class A. 20 watts.

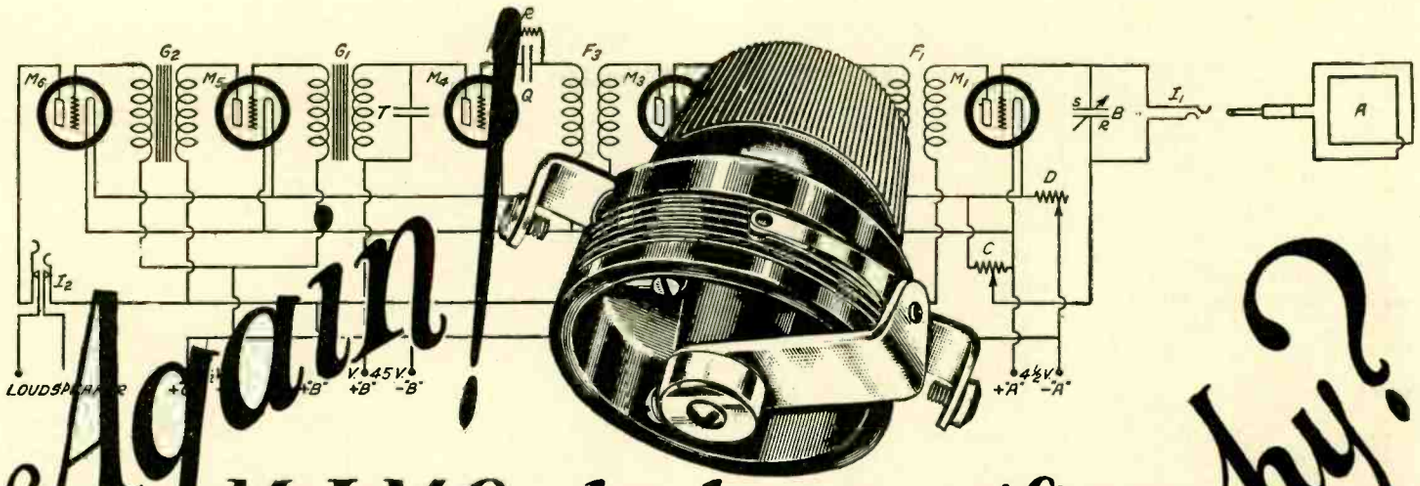
WEBL—Radio Corp. of America (Portable). 226 meters, 1330 kilocycles, class A. 100 watts.

WEBO—Radio Company, Hamilton, Ohio. 250 meters, 1200 kilocycles, class A. 5 watts.

WEBP—E. Budd Peddicord, 815 Roosevelt St., New Orleans, La. 242 meters, 1240 kilocycles, class A. Mon & Thurs, 9-10 pm. Tues, 8:30-9:30 pm. Wed, 8-9 pm. Fri, 8:30-10 pm. Sat, 9 pm, weather. Sun, 6:30-7:30 pm. Central standard time. 10 watts.

WEEI—Edison Elec. Illuminating Co., Boston, Mass. 303 meters, 990 kilocycles, class A. Afternoon & evening programs. Sat, silent. Eastern standard time. 500 watts.

WEV—Hurlburt-Still Elec. Co., McKinley Ave. & San Jacinto St., Houston, Texas. 360 meters, 834 kilocycles, class C. Slogan: "Heavenly Houston." 50 watts.



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IN a recent issue of Popular Radio Mr. L. M. Cockaday specifies the Unity Vernier Rheostat for use in the Popular Radio Portable Set. Previously he used it for the detector tube of his famous 4-circuit tuner. Why? And why is the Unity used by such well-known set manufacturers as Garod, Bristol, Amrad, Moon, and many others? And why does station WGN (formerly WDAP) offer them repeatedly as prizes, giving away hundreds of them during the year? Ask anyone who has used the Unity on his set—or better still try it yourself and the answer will soon be forthcoming!

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because of its unique cut-out switch—tube can be turned on or off at any point without changing adjustment.

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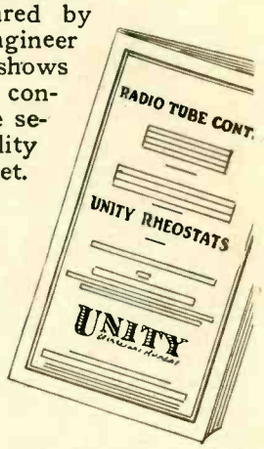
Write for FREE Copy of "Tube Control"—

A helpful booklet for the set-builder prepared by J. E. Jenkins, engineer station WGN. It shows what proper tube control means to the selectivity and quality of a receiving set.



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WEW—St. Louis University, University Sta., St. Louis, Mo. 280 meters, 1070 kilocycles, class A. Daily 9 & 10 am, 2 & 5 pm, market and weather reports, lectures & entertainers. Central standard time. 100 watts.

WFAA—The Dallas News & Dallas Journal, Dallas, Texas. 476 meters, 630 kilocycles, class B. Daily 10:30, weather, cotton, market, reports, highway bulletins; 12:30-1 pm, lectures, markets; 2:30-3 pm, markets, news, baseball; 3:30-4 pm, 4:30-5 pm, 5:30-6 pm, news, baseball, bedtime tales; 6:15-7 pm, baseball finals; 8:30-9:30, concert, weather. Wed, same as daily, including 12:30 pm. Sun, 6-7 pm, Bible class; 9:30-11 pm, weather, concert. Tues, Thurs & Sat, same as daily, including 11 pm to 12 midnight, concert. Central standard time. Slogan: "Working for All Alike (WFAA)." 500 watts.

WFAB—Carl F. Woese, 802 McBride St., Syracuse, N. Y. 234 meters, 1280 kilocycles, class A. 100 watts.

WFAM—Times Publ. Co., 18 N. Sixth St., St. Cloud, Minn. 360 meters, 834 kilocycles, class C.

WFAN—Hutchinson Elec. Serv. Co., Hutchinson, Minn. 286 meters, 1050 kilocycles, class A. Daily ex Sun, 12 noon. Tues, Wed & Thurs, 8 pm. Central standard time. Slogan: "Gateway to Minnesota's Ten Thousand Lakes." 100 watts.

WFAQ—Missouri Wesleyan College, Cameron, Mo. 360 meters, 834 kilocycles, class C. 10 watts.

WFAT—New Columbus College, Sioux Falls, S. D. 258 meters, 1160 kilocycles, class A. 50 watts.

WFAV—University of Nebraska, Lincoln, Neb. 275 meters, 1090 kilocycles, class A. Daily 9:45 am and 12:40 pm, weather forecast, road report, time, news. Central standard time. Slogan: "The Home of the Cornhuskers." 250 watts.

WFBB—Eureka College, Eureka, Ill. 261 meters, 1250 kilocycles, class A. Schedule not as yet arranged. 150 watts.

WFBG—The Wm. F. Gable Co. Store, Altoona, Pa. 261 meters, 1150 kilocycles, class A. From 12 noon at intervals of two hours until midnight. Eastern standard time. Slogan "The Original Gateway to the West." 100 watts.

WFBH—Concourse Radio Corp., New York, N. Y. 273 meters, 1100 kilocycles, class A. 500 watts.

WFI—Strawbridge & Clothier Store, Philadelphia, Pa. 395 meters, 760 kilocycles, class B. Daily ex Sun, 10:15 am, 1 pm, 1:50, 3, 6:30, 7 pm. Tues, Thurs & Sat, 8 pm, concert. Sun, alternating 10:30 am & 7:30 pm; also 4:30, chapel service. Eastern standard time. 500 watts.

WGAL—Lancaster Elec. Sup. & Construction Co., 23 E. Orange St., Lancaster, Pa. 248 meters, 1210 kilocycles, class A. Slogan: "The Garden Spot of the U. S. A." 10 watts.

WGAN—Cecil E. Lloyd, 216 W. Romana St., Pensacola, Fla. 360 meters, 834 kilocycles, class C. 50 watts.

WGAQ—W. G. Patterson, Youree Hotel Bldg., Shreveport, La. 252 meters, 1190 kilocycles, class A. Mon, 9 pm, dance music. Mon & Sat, 8 pm, musical program; 9 pm, dance music. Central standard time. 150 watts.

WGAZ—South Bend Tribune, South Bend, Ind. 275 meters, 1090 kilocycles, class A. Mon, Wed & Fri, 7-9 pm. Central standard time. Slogan: "Broadcasting from the Hoosier State." 250 watts.

WGI—American Radio and Research Corp., Medford Hillside, Mass. 360 meters, 834 kilocycles, class C. Mon silent night. Daily, 7-9:30 pm, special features. Eastern standard time. Slogan: "Amrad—The Voice of the Air." 100 watts.

WGL—Thomas F. J. Howlett, 2303 N. Broad St., Philadelphia, Pa. 360 meters, 834 kilocycles, class C. 500 watts.

WGN—Chicago Tribune, Drake Hotel, 140 E. Walton Pl., Chicago, Ill. 370 meters, 810 kilocycles, class B. Daily ex Sun, 9:35, 10:01, 10:31, 11:01 & 11:31 am; 12:01, 12:31, 1:01 & 1:25 pm, Board of Trade quotations; 2:30 pm, "Trib-lets;" 5:30 pm, "Skeesix;" 5:50 pm, closing quotations; 6 pm, market summary. Daily ex Mon and Sun, 6:30-7:30, 8:30-9:30, 10:30-11:30 pm. Sun, Uncle Walt, 11 am, 5 pm and 9:15 pm. Central standard time. 1000 watts.

WGR—Federal Tel. Mfg. Corp., Hotel Statler, Buffalo, N. Y. 319 meters, 940 kilocycles, class B. Daily ex Sun, 11:45 am & pm, weather forecast; 12 noon, markets, produce & live stock markets; 12:30 pm, organ, Hotel Statler; 6:30-7:30 pm, orchestra; 7:30 pm, news, reports, bulletins, American Boy story. Mon, Wed & Fri, 9 & 11 pm, concert. Sun, 3 & 4 pm, organ recital. No reports ex weather on Sat & Sun. Eastern standard time. Slogan: "Key City of Industry." 750 watts.

WGY—General Elec. Co., Schenectady, N. Y. 380 meters, 790 kilocycles, class B. Daily ex Sat & Sun; 11:40 am, fruit and vegetable report; 5 pm, closing New York stock quotations; 5:10 pm, produce market; 5:15 pm, news. Daily ex Sun; 11:30 am, New York stock quotations; 11:50 am, weather; 11:55, Arlington time signals. Mon, Tues, Thurs & Fri, 1 pm, talks to women; 7:45 pm, regular program. Mon, 5:20 pm, weekly review of sports. Wed, 5:30 pm, adventure story. Fri, 5:30 pm, children's stories; 7:45 pm, health talks; 10:30 pm, late program. Thurs, 7:45 pm, talks on new books. Sat, 9:30 pm, dance program. Sun, 6:30 or 7 pm, evening services. Eastern standard time. 1000 watts.

WHA—University of Wisconsin, Madison, Wis. 360 meters, 834 kilocycles, class C. 500 watts.

WHAA—State University of Iowa, Iowa City, Iowa. 484 meters, 620 kilocycles, class B. Mon to Fri incl, 12:30-1 pm. Sun, 9-9:30 pm. Tues, 8 pm. Thurs & Sat, occasionally 7:30-9 pm. Central standard time. 500 watts.

WHAD—Marquette University, 1115 Grand Ave., Milwaukee, Wis. 280 meters, 1070 kilocycles, class A. 100 watts.

WHAG—University of Cincinnati, Dept. of Elec. Engineering, Cincinnati, Ohio. 222 meters, 1350 kilocycles, class A. 100 watts.

WHAK—Roberts Hardware Co., Clarksburg, W. Va. 258 meters, 1150 kilocycles, class A. Schedule irregular. 15 watts.

WHAM—Eastman School of Music, University of Rochester, Gibbs St., Rochester, N. Y. 283 meters, 1060 kilocycles, class A. Daily ex Sun, 3:30-4 pm, 5-6 pm, 7-7:30 pm. Tues, Wed, Thurs & Fri 7:30-8:45 pm. Sat, 10:45 pm to 12:30 am. Eastern standard time. 100 watts.

WHAP—Otto and Kuhns, 160 S. Water St., Decatur, Ill. 360 meters, 834 kilocycles, class C. 50 watts. Schedule irregular.

WHAR—Seaside Hotel, Atlantic City, N. J. 275 meters, 1090 kilocycles, class A. Daily ex Sun, 2-3 and 7:30-9 pm. Eastern standard time. 200 watts.

WHAS—The Courier-Journal and The Louisville Times, 326 W. Liberty St., Louisville, Ky. 400 meters, 750 kilocycles, class B. Daily 4-5 pm. Daily ex Sun & Mon, 7:30-9 pm. Sun, 9:57-10:40, Church Service. Central standard time. "My Old Kentucky Home," played on chimes, opens and closes each night concert. 500 watts.

WHAV—Wilmington Elec. Spec. Co. Inc., 405 Delaware Ave., Wilmington, Delaware. 360 meters, 834 kilocycles, class C. Wed, 9-11 pm. Slogan: "Down Where the Peaches Grow." 100 watts. Eastern time.

WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y. 380 meters, 790 kilocycles, class B. Mon, 9-11 pm. Second Monday of each month a transcontinental test program from midnight to 1:30 am. Eastern standard time. Slogan: "Broadcasting from the Oldest School of Engineering in America." 500 watts.

WHB—Sweeney School Co., Sweeney Bldg., Kansas City, Mo. 411 meters, 730 kilocycles, class B. Slogan: "The Heart of America." 500 watts.

WHK—The Radiovox Co., 5005 Euclid Ave., Cleveland, Ohio. 283 meters, 1060 kilocycles, class A. 100 watts.

WHN—Loew's State Theatre Bldg., Broadway at 45th St., New York City, N. Y. 360 meters, 834 kilocycles, class C. Daily 10, 11 am, 12-1 pm, 2:15-3:15, 3:15-5:30, 6-7 pm. Mon, Wed & Sat, 7:30-12 pm. Tues, Thurs & Fri, 9:30-12 pm. Sun, 3-6 pm, 9:30-12 pm. Eastern standard time. Slogan: "The Voice of the Great White Way," and "The Human Interest Station." 500 watts.

WHQ—E. M. Tellefson, Mackinac Island, Mich. 300 meters, 999 kilocycles, class A. 2000 watts.

WHO—Bankers Life Co., Des Moines, Iowa. 526 meters, 570 kilocycles, class B. 500 watts.

WIAB—Joslyn Automobile Co., 320 Church St., Rockford, Ill. 252 meters, 1190 kilocycles, class A. 50 watts.

WIAC—Galveston Tribune, Galveston, Texas. 360 meters, 834 kilocycles, Class C. 100 watts. Not operating at present.

WIAD—Howard Miller, 6318 No. Park Ave., Phila. Penna. 234 meters, 1180 kilocycles, class A. Fri, 10:15 pm. Eastern standard time. Slogan: "The Voice from the Birthplace of Liberty." 100 watts.

WIAF—Nola Radio School, 327 St. Charles St., New Orleans, La. 234 meters, 1239 kilocycles, class A. Schedules periodically. 10 watts.

WIAK—Daily Journal-Stockman, Stock Yards, Omaha, Nebr. 278 meters, 1080 kilocycles, class A. 200 watts.

WIAR—Paducah Evening Sun, Paducah, Kentucky. 360 meters, 834 kilocycles, class C. 100 watts.

WIAS—Home Elec. Co., Burlington, Ia. 283 meters, 1060 kilocycles, class A. Sun, 9-9:30 am, Organ; 10:30-12 noon, First Methodist Church. Tues, 8 pm, concert. Thurs, 7 pm, orchestra and organ. Sat, 11-12 pm, Ralph Howard at the "Mighty Voiced Wurlitzer Organ." Slogan: "Burlington, On the Mississippi." 100 watts.

WIAU—American Trust & Savings Bank, Le Mars, Iowa. 360 meters, 834 kilocycles, class C. 30 watts.

WIK—K & L Elec. Co., 427 Olive St., McKeesport, Pa. 234 meters, 1280 kilocycles, class A. 100 watts.

WIL—Continental Elec. Sup. Co., 808 Ninth St., Washington, D. C. 360 meters, 834 kilocycles, class C. 10 watts.

WIP—Gimbel Bros., Philadelphia, Penna. 509 meters, 590 kilocycles, class B. Daily 1-2, 3-4, 6-7:30 pm. Tues, Thurs & Sat, 8 pm to midnight. Eastern standard time. Slogan: "Watch Its Progress (WIP)." 500 watts.

WJAB—American Elec. Co., 1521 "O" St., Lincoln, Nebr. 229 meters, 1310 kilocycles, class A. Daily 3 pm, Mon, Wed & Sat, 7:30 pm. Central standard time. 100 watts.

WJAD—Jackson's Radio Engineering Laboratories, 801 Austin St., Waco, Texas. 360 meters, 834 kilocycles, class C. Mon & Fri 9-10 pm. Sun, 11 am and 8 pm. Central standard time. 150 watts.

WJAF—Muncie Press & Smith Elec. Co., Muncie, Ind. 360 meters, 834 kilocycles, class C. 10 watts.

WJAG—Daily News, Norfolk Nebr. 283 meters, 1060 kilocycles, class A. Daily ex Sat, 12:15 & 5:30 pm. Central standard time. Slogan: "The World's Greatest Country Daily." 250 watts.

WJAK—Rev. Clifford L. White, Church of Christ, Greentown, Ind. 254 meters, 1180 kilocycles, class A. Daily ex Sat, 6-7 pm, music and sermonette. Thurs, 8-9 pm, special concert. Sat, 7-8 pm, comments on Bible School lesson. Central standard time. Slogan: "The Radio Parson." 30 watts.

WJAL—The Roberts Hardware Co., 213 W. Pike St., Clarksburg, W. Va. 258 meters, 1160 kilocycles, class A.

WJAM—D. M. Perham, 332 W. 3rd Ave. West, Cedar Rapids, Iowa. 268 meters, 1120 kilocycles, class A. Slogan: "The Cereal City of the World." 20 watts.

WJAN—Peoria Star Co., Peoria, Ill. 280 meters, 1070 kilocycles, class A. Daily ex Sun, 9-9:15, 11:30 am, 1:30, 5:30 pm. Sun, 11:30 am & 7:45 pm. Tues & Thurs, 9:15-10:15 pm. Central standard time. Slogan: "The Grand View City of Illinois." 100 watts.

WJAR—The Outlet Company, Providence, R. I. 360 meters, 834 kilocycles, class C. Sun, 7:20 & 9 pm, Organ recital. Mon, Wed & Fri 10-11 am, housewives exchange. Daily ex Sun, 1:05-2 pm, music and misc. program. Daily ex Sun & Thurs, 7 pm, evening concert. Fri, 10:45-12 pm. Eastern standard time. Slogan: "The Southern Gateway to New England." 500 watts.

WJAS—Pittsburgh Radio Supply House, Pittsburgh, Penna. 286 meters, 1050 kilocycles, class A. Daily ex Sun, 7:30-10 pm. Eastern standard time. Slogan: "World's Jolliest Aerial Station." 500 watts.

WJAX—Union Trust Co., Cleveland, Ohio. 390 meters, 770 kilocycles, class B. Daily ex Sun, 9:30 am, women's program; 10:05, markets. Daily ex Sat & Sun, 2 & 3 pm, markets. Tues, 7:30 pm, First Sat. each month, session of "Night Caps on Lake Erie," commencing at midnight, until 4 am. Eastern standard time. Slogan: "The Wave from Lake Erie." 500 watts.

WJAZ—Chicago Radio Laboratory, 332 S. Michigan Ave., Chgo., Ill. 268 meters, 1120 kilocycles, class A. 20 watts.

WJD—Denison University, Granville, Ohio. 229 meters, 1310 kilocycles, class A. Slogan: "The College on the Hill." 50 watts.

WJH—Wm. P. Boyer Co., 812 Thirteenth St. N. W., Washington, D. C. 273 meters, 1100 kilocycles, class A. Daily ex Sun, 3 & 4 pm. Tues, 7:45-10 pm. Sun, 8 pm, Church Services. Eastern standard time. 50 watts.

WJY—Radio Corp. of America, New York, N. Y. 405 meters, 740 kilocycles, class B. Daily ex Sun, 4-6 pm, concert. Tues, Thurs, Fri, 7:35-11:30 pm, concert. Sun, 2:30-5 pm, 6-6:30 pm, Church Services. Eastern standard time. 500 watts.

WJZ—Radio Corp of America, 33 West 42nd St., New York, N. Y. 455 meters. 660 kilocycles, class B. Daily ex Sun, 1-2, 4-6, 7-11:30 pm. Sun, 10 am to 1 pm, 2:30-5 & 7-10:30 pm. Eastern standard time. 500 watts.

WKAA—H. F. Paar, (Republican Times) 1444 E. 2nd Ave., Cedar Rapids, Iowa. 268 meters, 1110 kilocycles, class A. 100 watts.

WKAD—Charles Looff, (Crescent Park) E. Providence, R. I. 240 meters, 1249 kilocycles, class A. 10 watts.

WKAF—W. S. Radio Sup. Co., 725 10th St., Wichita Falls, Texas. 360 meters, 834 kilocycles, class C. 100 watts.

WKAP—Dutee W. Flint, Cranston, R. I. 360 meters, 834 kilocycles, class C. 200 meters.

WKAQ—Radio Corp. of Porto Rico, P. O. Box 868, San Juan, Porto Rico. 360 meters, 834 kilocycles, class C. Wed & Fri 8-10 pm, Band concerts. Intercolonial time. Slogan: "The Island of Enchantment." 500 watts.

WKAR—Michigan Agricultural College, East Lansing, Mich. 280 meters, 1070 kilocycles, class A. Daily ex Sun, 12 noon, weather; 8 pm, concert. Central standard time. 500 watts.

WKAV—Laconia Radio Club, Laconia, N. H. 254 meters, 1181 kilocycles, class A. 50 watts.

WKBF—Dutee Wilcox Flint, Cranston, R. I. 286 meters, 1050 kilocycles, class A. 500 watts.

WKY—Wky Radio Shop, Okla. City, Okla. 360 meters, 834 kilocycles, class C. Daily 9 am, weather. Mon, Wed. & Fri, 9-10:30 pm, concert. Central standard time. 500 watts.

WLAG—Cutting & Washington Radio Corp., 18 W. Franklin St., Minneapolis, Minn. 417 meters. 720 kilocycles, class B. Closed down until Fall. 500 watts.

WLAH—Samuel Woodworth, 425 Brownell St., Syracuse, N. Y. 234 meters, 1280 kilocycles, class A. 100 watts.

WLAL—Naylor Elec. Co., 24 W. 2nd, Tulsa, Okla. 360 meters, 834 kilocycles, class A. Mon, Wed & Fri, 8 pm. Daily 12 noon, market; 6 pm, baseball. Sat, 6:45 pm, Sun, 11 am & 7:30 pm. Central standard time. Slogan: "Oil Capital of the World." 100 watts.

WLAP—W. V. Jordon, 306 W. Brokenridge St., Louisville, Ky. 286 meters. 1050 kilocycles, class A. 20 watts.

WLAQ—Arthur H. Schilling, 108 Elm St., Kalamazoo, Mich. 283 meters, 1060 kilocycles, class A. 10 watts.

WLAW—Police Dept., City of New York, New York, N. Y. 360 meters, 834 kilocycles, class C. 500 watts.

WLAX—Greencastle Community Broadcasting Station, Greencastle, Ind. 231 meters, 1300 kilocycles, class A. Tues & Thurs, 8-9 pm. Central standard time. 10 watts.

WLBL—Wis. Dept. of Markets, Whiting Hotel, Stevens Point, Wis. 278 meters, 1080 kilocycles, class A. Daily ex Sun, 8:45 am, potatoes, cabbage, strawberries, etc.; 9:45 am, weather, butter and egg markets, also repeating 8:45 broadcast; 10:45 am, weather, Chgo. Livestock markets; 11:45 am, Wis. cheese market, weather; 12:30 pm, review of all markets; 12:50 pm, weather and time signals; 1:45 pm, Chgo. Poultry and hay markets. Wed, 8 pm, special musical program. Daily, 6-7 pm, Hotel Whiting Orchestra. Central standard time. Slogan: "Wisconsin, Land of Beautiful Lakes (WLBL)." 500 watts.

WLS—Sears, Roebuck & Co., Sherman Hotel, Chicago, Ill. 345 meters, 870 kilocycles, class B. Daily ex Sat & Sun, 1-2 pm. Tues, 6:30 pm to 1 am. Wed, 6:30-11 pm. Thurs, 6:30-8 pm, & 10:15 pm to 1 am. Fri, 6:30 to 11 pm. Sat, 7:45 pm to 1 am. Sun, 6:30-8 pm. Central standard time. 500 watts.

WLW—Crosley Radio Corp., Cincinnati, Ohio. 423 meters, 709 kilocycles, class B. Daily ex Sat & Sun, 11 am, 1:30, 3, 4, pm. Mon & Wed. 8-10 pm, Tues & Thurs. 10-12 pm. Sun, 9:30 & 11 am, 9 pm. Sat, 11 am & 1:30 pm. Central standard time. 500 watts.

WMAC—Clive Meredith, Fernwood St., Cazenovia, N. Y. 261 meters, 1150 kilocycles, class A. 200 watts.

WMAF—Round Hills Radio Corp. So. Dartmouth, Mass. 360 meters, 834 kilocycles, class C. Daily ex Sun, 5:30 & 7:30 pm. Sun, 3:30-5:15 pm, 7:20-10 pm. Eastern standard time. Slogan: "The Voice from Way Down East." 100-500 watts.

WMAK—General Supply Co., 144 N. 13th St., Lincoln, Nebr. 254 meters, 1180 kilocycles, class A. Slogan: "We Make a Hit (WMAH)." 100 watts.

WMAK—Lockport Board of Commerce, Lockport, New York. 360 meters, 834 kilocycles, class C. 500 watts.

WMAL—Trenton Hardware Co., Trenton, N. J. 256 meters, 1170 kilocycles, class A. Mon & Thurs, 7:30-9 pm, music. Sun, 4-5 pm, Chapel Services. Eastern standard time. Slogan: "The Home of Good Music." 50 watts.

WMAN—The First Baptist Church, Broad & Jefferson Ave., Columbus, Ohio. 286 meters, 1050 kilocycles, class A. Sun, 10:30 am to 12 noon, 7:30-9 pm, Church Services. Central standard time.

WMAP—Utility Battery Service, 665 Northampton St., Easton, Pa. 246 meters, 1220 kilocycles, class A. Schedule irregular. 150 watts.

WMAQ—The Daily News, Hotel LaSalle, Chicago, Ill. 448 meters, 670 kilocycles, class B. Daily ex Sat & Sun, 4-5 pm. Wed & Fri, 2:35 pm. Mon, 6-7 pm. Tues, Wed, Thurs & Fri, 6-7 & 8-10 pm. Sat, 8-10 pm. Central standard time. 500 watts.

WMAV—Alabama Polytechnic Institute, Auburn, Ala. 254 meters, 1200 kilocycles, class A. Schedule irregular. 250 watts.

WMAW—Wahpetou Elec. Co., 224 Dakota Ave., Wahpeton, N. Dak. 254 meters, 1190 kilocycles, class A. 50 watts.

WMAY—Kingshighway Presbyterian Church, Kingshighway & Cabanne St., St. Louis, Mo. 280 meters, 1071 kilocycles, class A. Sun, 10 am, 3 & 8 pm. Tues, 7 pm. Central standard time. Slogan: "May Every Byway Hear Kingshighway." 100 watts.

WMAZ—Mercer University, Macon, Georgia. 261 meters, 1150 kilocycles, class A. 100 watts.

WMC—Commercial Appeal, 30 N. 2nd St., Memphis, Tenn. 500 meters, 600 kilocycles, class B. Daily 9:45 am, 12:30 & 8:30 pm ex Wed evening. Tues & Fri, 11 pm. Central standard time. Slogan: "Memphis Down in Dixie." 500 watts.

WMH—Ainsworth-Gates Radio Co., 605 Main St., Cincinnati, Ohio. 309 meters, 970 kilocycles, class B. Wed, 8-11 pm, Thurs, 8-10 pm. Sat, 10-12 pm. Central standard time. Slogan: "The Station on the Hill." 750 watts.

WNAC—Shepard Stores, Boston, Mass. 278 meters, 1080 kilocycles, class A. Daily 12-2 pm, 4-5, 8-10 pm. Mon, Wed & Fri 6-7:30 pm. Sun, 11-12 noon, 4-5 & 7:45-9:30 pm. Eastern standard time. 100 watts.

WNAD—University of Oklahoma, Norman, Okla. 360 meters, 834 kilocycles, class C. 50 watts.

WNAL—Omaha Central High School, 20th & Dodge Sts., Omaha, Nebr. 258 meters, 1160 kilocycles, class A. 20 watts.

WNAP—Wittenberg College, Dept. of Physics, Springfield, Ohio. 275 meters, 1090 kilocycles, class A. No regular schedule. Fri, 8 or 8:30 pm. Central standard time. 100 watts.

WNAR—First Christian Church, Butler, Missouri. 231 meters, 1300 kilocycles, class A. Sun, 11 am & 7:30 pm. Central standard time. 20 watts.

WNAT—Lennig Bros. Co., 827 Spring Garden, Phila., Penna. 360 meters, 834 kilocycles, class C. 250 watts.

WNAW—Peninsula Radio Club, Fort Monroe, Va. 360 meters, 834 kilocycles, class C. 5 watts.

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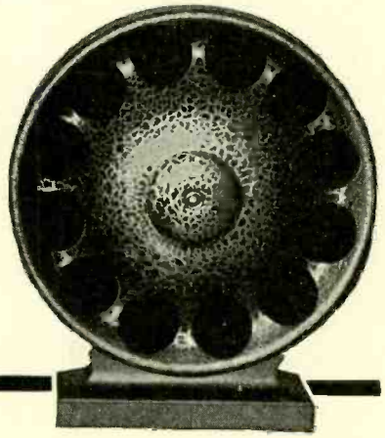

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WNAX — Dakota Radio Apparatus Co. Inc., Wagner Block, Yankton, S. Dak. 244 meters, 1290 kilocycles, class A. Daily ex Sun, 11:30 am, weather, markets; 4:30 pm, 9 pm, concert on Wed. Central standard time. 100 watts.

WNYC—Dept. of Plant and Structures, 2510 Municipal Bldg., New York, N. Y. 526 meters, 570 kilocycles, class B. Daily 7:30-11:30 pm. Eastern standard time. 1000 watts.

WOAC—Page Organ Co., 404 N. Main St., Lima, Ohio. 266 meters, 1130 Kilocycles, class A. 50 watts.

WOAD—Friday Battery & Elec. Corp., Sigourney, Iowa. 360 meters, 834 kilocycles, class A. 20 watts.

WOAE — Midland College, Fremont, Nebr. 280 meters, 1070 kilocycles, class A. 15 watts.

WOAF—Tyler Commercial College, Tyler, Texas. 360 meters, 834 kilocycles, class C. Daily ex Sun, 12 noon, market; 8 pm, weather, concert; 10:15 pm; Sun, 11 am, 7:30 pm, Church Services. Central standard time. 10 watts.

WOAI—Southern Equip. Co., San Antonio, Texas. 385 meters, 780 kilocycles, class B. Daily ex Sun, 10:30 am, 12:15 pm, 3, 6, 7-7:20 pm. Tues & Thurs. 7:30-8:30, 9:30-10:30 pm. Sun, 11 am, 9:30-10:30 pm. 500 watts. Slogan: "The Winter Playground of America." Central time.

WOAN—Vaughan Conservatory of Music, Lawrenceburg, Tenn. 360 meters, 834 kilocycles, class C. 150 watts.

WOAR—Henry P. Lundskow, Burlington Rd., Kenosha, Wis. 229 meters, 1310 kilocycles, class A. 50 watts. Sun, 5-7:30 pm. Wed, 7-9 pm. Mon, special program. Central standard time. Slogan: "The Gateway to Wisconsin." 100 watts.

WOAT—Boyd M. Hamp, 215 Market St., Wilmington, Delaware. 360 meters, 834 kilocycles, class C. 50 watts.

WOAV —Penna. Nat'l. Guard, 2nd Battalion 112th Inf. PN. G., 6th & Parade Sts.: Erie, Penna. 242 meters, 1240 kilocycles. class A. Tues, 8:30-10 pm. Thurs, 8-9:30 pm. Sat, 9:30-11 am, 1-3:30 pm. Sun, 10:30 & 7:45 pm, Church Services. Eastern standard time. Slogan: "Wayne Rangers." 50 watts.

WOAW—Woodmen of the World, 1315 Farnum St., Omaha, Nebr. 526 meters, 570 kilocycles, class B. Week days 6:30-8 pm, 9-11 pm. Wed, silent. Thurs, 6-6:30 pm, Children's story hour. Sun, 9-10:45 am, religious services; 6-7 pm, Bible study hour; 9-11 pm. Central standard time. Slogan: "The Gateway to the East and to the West." 500 watts.

WOAX—Franklyn J. Wolff, 600 Ingham Ave., Trenton, N. J. 240 meters, 1250 kilocycles, class A. Daily, official weather reports. Mon, nights concert. Eastern standard time. Slogan: "The Voice from Trenton." 500 watts.

WOC—Palmer School of Chiropractor, Davenport, Iowa. 484 meters, 620 kilocycles, class B. Daily 9 am, market; 10 am, household hints; 10:55 am, time signals; 11 am, weather, markets; 11:15 am (Sat only), closing markets; 12 noon, chimes; 12:15 pm, weather; 1 pm, closing markets (ex Sat); 5:45 pm (Tues only), chimes; 6 pm (Tues only), weather and sports; 7 pm, sports and weather, (ex Tues). Mon, Wed & Fri, 8 pm, music. Thurs & Sat, 9 pm. Orchestra. Mon, 10 pm, music. Central standard time. Slogan: "In the State Where the Tall Corn Grows." 500 watts.

WOI—Iowa State College, Ames, Iowa. 360 meters, 834 kilocycles, class C. Daily ex Sun, 9:30, weather; 12:30 pm, chimes concert; 12:35 pm, weather, livestock markets; 12:45 pm. educational talk, 9:30 pm, weather. Sun, 10:45 am, Sacred Chimes concert; 11 am, Chapel Service. Mon. 8:15 pm, musical program. Central standard time. 500 watts.

WOO — John Wanamaker. Philadelphia, Penna. 509 meters, 590 kilocycles, class B. Daily ex Sun, 11 am, Organ; 11:30, weather; 11:55, time signals, U. S. Naval Observatory; 12 noon, luncheon music; 4:45 pm and 5 pm, Organ, sports and police reports, (after Dec. 24th, changed to 5:15 & 5:30 pm); 9:55 & 10:02, time signals and weather forecast. Mon, Wed & Fri, 7:30-11 pm, concert. Sun either at 10:45 am or 7:45 pm; Sun, 2:15, Sun School; 3:15 pm, Grand Organ. Eastern standard time. 500 watts.

WOQ—Western Radio Co., Kansas City, Mo. 360 meters, 834 kilocycles. class C. Daily ex Sun, 10:50-11:10 am, time signals and weather forecast. Mon, Wed & Fri, 7:30-8 pm, music. Tues, Thurs & Sat, 8-9:30 pm, concert. Sat, 7-7:30 pm & 11-11:30 pm, religious service. Sun, 11 am to 12:30 pm, 7-7:45 pm, religious service; 8-9:30 pm, religious service. Central standard time. 500 watts.

WOR—L. Bamberger & Co., Newark, N. J. 405 meters, 740 kilocycles, class B. Daily ex Sun, 2:30-4 pm, 6:15-7:30 pm, music. Mon, Wed & Sat, 8-11 pm, concert. Eastern standard time. Slogan: "One of America's Greatest Stores." 500 watts.

WOS—State Marketing Bureau, Capitol Bldg., Jefferson City, Mo. 440 meters, 680 kilocycles, class B. Daily ex Sun, 8 am, 9, 10, 11 am, 12 noon, 1 pm, 2, 5 pm, weather, hog, livestock, poultry, butter, egg grain reports, etc. Mon, Wed & Fri, 8-9:30, concerts and public addresses. Central standard time. Slogan: "Watch Our State (WOS)." 500 watts.

WPAB—Penna. State College, Dept. of Elec. Engineering, State College, Penna. 283 meters, 1060 kilocycles, class A. 500 watts.

WPAC—Donaldson Radio Co., 210 Tiger Bldg., Okmulgee, Okla. 360 meters, 834 kilocycles, class C. Mon, Wed & Fri, 10 pm. Sun, 10 am, 9 pm, Church Services. Central standard time. 200 watts.

WPAH—Wisconsin Dept. of Markets, (U. S. Bureau of Agricultural Economics) Waupaca, Wis. 360 meters, 834 kilocycles, class C. Daily ex Sun, 9:30 am, 10:30, 11:30 am, 12:30 pm, 2:30, 4:30 pm, markets and weather, news. Central standard time. 500 watts.

WPAJ—Doolittle Radio Corp., 39 Center St., New Haven, Conn. 268 meters, 1120 kilocycles, class A. 10 watts.

WPAK—North Dakota Agricultural College, Fargo, N. Dak. 283 meters, 1060 kilocycles, class A. Mon, Wed & Fri, 7:30-8:15 pm. Central standard time. 100 watts.

WPAL—Avery & Loeb Elec. Co., 114 N. Third St., Columbus, Ohio. 286 meters, 1050 kilocycles, class A. 100 watts.

WPAM—Auerbach & Guettel, Topeka, Kansas. 275 meters, 1090 kilocycles, class A. Daily 1 pm, markets. Mon & Wed, 9:30 pm. Sat, 8 pm, music. Central standard time. 100 watts.

WPAP—Theo. D. Phillips, 222 Lexington Ave., Winchester, Ky. 360 meters, 834 kilocycles, class C. 35 watts.

WPAQ — General Sales & Engineering Co., Frostburg, Md. 360 meters, 834 kilocycles, class C. 10 watts.

WPAR—Ward Battery & Radio Co., 200 W. Main St., Beloit, Kans. 236 meters, 1270 kilocycles, class A. 10 watts.

WPAU — Concordia College, Moorhead, Minn. 286 meters, 1050 kilocycles, class A. 10 watts.

WPAZ—Dr. John R. Koch, Cor. Capital & Warrier Sts., Charleston, W. Va. 273 meters, 1100 kilocycles, class A. Mon & Wed, 7-8 pm. Fri, 7:30-8:30 pm, Orchestra. Sun, 3-4 pm. Sacred concert. Eastern standard time. Slogan: "Charleston, The Storehouse of the Nation." 10 watts.

WQAA—Horace A. Beale, Jr., Parkesburg, Penna. 360 meters, 834 kilocycles, class C. 500 watts.

WQAC—Gish Radio Service, Amarillo, Texas. 234 meters, 1280 kilocycles, class A. Daily ex Sun, 5-6:30 pm. Wed & Fri, 9-10 pm, concert. Central standard time. Slogan: "Where Quality Alone Counts (WQAC)." 100 watts.

WQAE — Moore Radio News Station, Springfield, Vt. 275 meters, 1090 kilocycles, class A. Daily ex Sun, 7-7:30 pm. Sun, 2-4 pm, Church Services. Eastern standard time. Slogan: "Among the Green Hills of Vermont." 50 watts.

WQAF — Sandusky Register, 128 W. Water St.. Sandusky, Ohio. 240 meters, 1250 kilocycles, class A. 5 watts.

WQAM—Electrical Equip. Co., 42 N. W. 4th St., Miami, Fla. 283 meters, 1060 kilocycles, class A. Sun & Wed, 9-11 pm. Daily 12 noon ex Sun and Holidays. Eastern standard time. Slogan: "Most Southern Radiocasting Station in the U. S." 100 watts.

WQAN — Scranton Times, 222 Spruce St., Scranton, Penna. 280 meters, 1070 kilocycles, class A. Daily 12:30-1 pm, 4-4:30, 7:30-8 pm. Tues & Fri 8-10:30 music. Eastern standard time. Slogan: "The Voice of the Anthracite." 100 watts.

WQAO — Calvary Baptist Church, 123 W. 57th St., New York City, N. Y. 360 meters, 834 kilocycles, class C. Sun, 10:30-12 noon, 7:45-10 pm. Eastern standard time. 100 watts.

WQAQ—Abilene Daily Reporter, Abilene, Texas. 360 meters, 834 kilocycles, class A. Tues, Thurs & Fri 8-9 pm. Sun morning and evening Church Services. Central standard time. Slogan: "The Capital of West Texas." 100 watts.

WQAS—Prince-Walter Co., Lowell, Mass. 266 meters. 1130 kilocycles, class A. Mon & Fri evenings. Wed afternoon. Eastern standard time. Slogan: "The Workshop of the World." 100 watts.

WQAV — Huntington & Guerry, Inc., Greenville, S. C. 258 meters, 1160 kilocycles, class A. Tues, Thurs & Sat, 7:30-8:30 pm. Eastern standard time. Slogan: "The Textile Center of the South." 15 watts.

WQAX—Radio Equipment Co., 120 W. Madison St., Peoria, Ill. 248 meters, 1210 kilocycles, class A. 100 watts.

WQJ — Calumet Baking Powder and Rainbo Gardens, 4810 No. Clark St., Chicago, Ill. 448 meters, 670 kilocycle, class B. Daily ex Sun, 3-4 pm, style talks, domestic and science, household hints, etc; 7-8 pm, musical program; 10 pm to 2 am, Rainbo Gardens Orchestra. Sun, 8-10 pm, musical program. Central standard time. Slogan: "Where Quality Justifies (WQJ)." 500 watts.

WRAD — Taylor Radio Shop, Marion, Kansas. 248 meters, 1210 kilocycles, class A. 10 watts.

WRAF — The Radio Club, Inc., 719 Michigan Ave., LaPorte, Indiana. 224 meters, 1340 kilocycles, class A. Sun. Mon & Thurs, 8:30 pm. Central standard time. 20 watts.

WRAL—Northern States Power Co., St. Croix Falls, Wis. 248 meters, 1210 kilocycles, class A. Wed, 10-11:30 pm, concert. Central standard time. Slogan: "Royal Order of Interstate Knob Twisters." 100 watts.

WRAM — Lombard College, Galesburg, Ill. 244 meters, 1230 kilocycles, class A. Tues, 8-9 pm. Mon & Wed, 4-5 pm. Central standard time. 100 watts.

WRAN—Black Hawk Elec. Co. Waterloo, Iowa. 236 meters, 1270 kilocycles, class A. Slogan: "We radiate All News (WRAN)." 10 watts.

WRAO—St. Louis Radio Service Co., 5735 Bertmer Ave., St. Louis, Mo. 360 meters, 834 kilocycles, class C. Daily ex Sun, 4:15-5 pm, concert. Sun, 3-5 pm, concert. Central standard time. 20 watts.

WRAV — Antioch College, Dept. of Physics, Yellow Springs, Ohio. 242 meters, 1240 kilocycles, class A. Wed, 8 pm. Thurs, 10:30 pm. Sun, 7 pm. Central standard time. Slogan: "The Station Under the Bell." 100 watts.

WRAW—Avenue Radio Shop, Reading, Penna. 238 meters, 1260 kilocycles, class A. 10 watts.

WRAX — Flexon's Garage, Gloucester City, N. J. 268 meters, 1120 kilocycles, class A. Mon, Wed & Fri evenings. 100 watts. Easter ntime.

WRAZ — Radio Shop of Newark, 89 Lehigh Ave., Newark, N. J. 233 meters, 1290 kilocycles, class A. 50 watts.

WRBC — Immanuel Lutheran Church. Valpariso, Ind. 278 meters, 1074 kilocycles, class A. Sun, 10:30 am & 7:30 pm, Church Service. Mon, 8 pm. Central standard time. Slogan: "World Redeemed by Christ." 500 watts.

WRC—Radio Corp. of America, 3308 14th St., N. W., Washington, D. C. 469 meters, 640 kilocycles, class B. Mon, Wed & Fri, 3-4 pm. Tues, Thurs & Sat, 7:30-11 pm. Daily 5:15--6 pm, Code practice; 6 pm, Children's Hour. Sun, silent. Eastern standard time. Slogan: "The Voice of the Capital." 500 watts.

WRK—Doron Bros. Elec. Co., Hamilton, Ohio. 360 meters, 834 kilocycles, class C. Fri, 8:15 pm. Sun, 2:15 pm, concert. Eastern standard time. Slogan: "The Oldest Station in Existence." 200 watts.

WRL — Union College, Radio Club, Schenectady, N. Y. 360 meters, 834 kilocycles, class C. Schedule irregular. 500 watts.

WRM—University of Illinois, Urbana, Ill. 360 meters, 834 kilocycles, class C. Schedule not arranged as yet. 500 watts.

WRR—City of Dallas, Police and Fire Signal Dept., Dallas, Texas. 360 meters, 834 kilocycles, class C. Daily ex Sun, 11:30 am to 12:30 pm, music and markets; 2:45-3:30 pm, police reports and music; 8-8:30 pm, music (ex Wed). Central standard time.

WRW—Tarrytown Radio Research Laboratories, Tarrytown, N. Y. 273 meters, 1100 kilocycles, class A. Mon, 7-8 pm & 9-11:30 pm. Tues, Wed. Fri & Sat, 9-11:30 pm. Thurs & Sat, 8-9 pm, 10:30-11:30 pm. Eastern standard time. Slogan: "Everything in Radio." 500 watts.

WSAC — Clemson Agricultural College, Clemson, S. C. 360 meters, 834 kilocycles, class C. Mon, Wed & Fri, 7 pm. Eastern standard time. 500 watts.

WSAD—Fosters, Jewelers, Dorrance & Weybosset Sts., Providence, R. I. 261 meters, 1150 kilocycles, class A. Daily 2:30-4 pm, Tues, Wed, Fri & Sat, 618 pm. Thurs, 9:30-11 pm. Sun, 2-4 pm. Eastern standard time. 100 watts.

WSAH—A. G. Leonard, Jr., 4801 Woodlawn Ave., Chicago, Ill. 248 meters, 1210 kilocycles, class A. Daily ex Sun, 5:30-6:30 pm. Fri, 8:45-10 pm. Central standard time. 500 watts.

WSAI—U. S. Playing Card Co., Cincinnati, Ohio. 309 meters, 970 kilocycles, class B. Mon & Thurs, 10-12 pm. Tues, 7-10 pm. Sat, 8-10 pm & 12 midnight. Central standard time. 1000 watts.

WSAJ—Grove City College. Grove City, Penna. 254 meters, 1180 kilocycles, class A. Schedule irregular. College entertainments, athletic games, etc. Wed, 7:30-9 pm. Eastern standard time. 250 watts.

WSAL—Franklin Elec. Co., Brookville, Ind. 246 meters, 1220 kilocycles, class A. 50 watts.

WSAP—Seventh Day Adventist Church, New York, N. Y. 263 meters, 1140 kilocycles, class A. 250 watts.

WSAR — Doughty & Welch Elec. Co., Fall River, Mass. 254 meters, 1181 kilocycles, class A. 10 watts.

WSAU—Camp Marienfeld, Chesham, N. H. 229 meters, 1310 kilocycles, class A. 10 watts.

WSAV — Clifford W. Vick Radio Construction Co., 1801 Carter Bldg., Houston, Tex. 360 meters, 834 kilocycles, class C. 100 watts.

WSAX — Chicago Radio Laboratory, Chicago, Ill. 268 meters, 1120 kilocycles, class A. 20 watts.

WSAY—Port Chester Chamber of Commerce, Port Chester, N. Y. 233 meters, 1304 kilocycles, class A. 100 watts.

WSAZ — Chase Elec. Shop, Pomeroy, Ohio. 258 meters, 1160 kilocycles, class A. 50 watts.

WSB—Atlanta Journal, Atlanta, Georgia. 429 meters, 700 kilocycles, class B. Daily 12 noon to 1 pm, entertainment; 2:30, markets: 3:30, sporting summary; 5 pm, press flashes, music, bed time story, etc.; 8-9 pm, entertainment; 10:45-12 midnight, entertainment. Central standard time. Slogan: "The Voice of the South." 500 watts.

WSK—Reiss Steamship Co., Sheboygan, Wis. 300 meters, 999 kilocycles, class A. 1000 watts.

WSL—J. & M. Elec. Co., 26 Bank Pl., Utica, N. Y. 273 meters, 1100 kilocycles, class A. Daily ex Sat & Sun, 11-11:30 am; 5-6 pm. Mon, Wed & Sat, 8-9 pm, Sun, 10:30-12 noon; 7:30-9 pm, Church Services. Eastern standard time. 100 watts.

WSOE—School of Engineering and Wisconsin News, 415 Marshall St., Milwaukee, Wis. 246 meters, 1220 kilocycles, class A. Daily ex Sat & Sun, 9-10 am; 5:30-6:30 pm. Mon & Fri, 9-12 pm. Tues & Thurs, 7:30-9 pm. Sat, 5:30-6:30 pm. Sun, 12:30-1:30 & 7:30-8:30 pm. Central standard time. Slogan: "In the Land of Sky Blue Waters." 100 watts.

WSY—Alabama Power Co., Birmingham, Ala. 360 meters, 834 kilocycles, class C. Sun. 9:30 am to 12:30 pm; 7:45-9:45 pm. Central standard time. 500 watts.

WTAB—Fall River Herald, Fall River, Mass. 266 meters, 1130 kilocycles, class C. Tues & Thurs, 8 pm. Eastern standard time. 100 watts.

WTAC—Penna. Traffic Co., Washington St., Johnstown, Penna. 275 meters, 1090 kilocycles, class A. Daily ex Sun, 4 pm. Sun & Thurs, 7:30 pm. Eastern standard time.

WTAH — Carmen Ferro, Belvidere, Ill. 236 meters, 1249 kilocycles, class A. 10 watts.

WTAJ—The Radio Shop, Inc., Portland, Maine. 236 meters, 1270 kilocycles, class A. Wed & Sun, 7:45 pm. Eastern standard time. Slogan: "The Sunrise Gateway of America." 20 watts.

WTAL—Toledo Radio & Elec. Co., 433 Superior St., Toledo. Ohio. 252 meters, 1190 kilocycles, class A. Tues & Thurs, 8:45 pm; Sat, 9 pm. Eastern standard time. 10 watts.

WTAM — Willard Storage Battery Co., 246 E. 131 St., Cleveland, Ohio. 390 meters, 768 kilocycles, class B. Daily ex Sun, 11:30 am to 2 pm; 6-7:30 pm. Mon, Wed, & Sat, 8 pm to 12 midnight. Eastern standard time. Slogan: "The Voice of the Storage Battery." 1000 watts.

WTAP—Cambridge Radio & Elec. Co., Cambridge, Ill. 242 meters, 1240 kilocycles, class A. Daily 12:15-1:15 pm; 9:30-10:30 pm. Central standard time. 50 watts.

WTAQ — S. H. Van Gorden & Son, Osseo, Wis. 254 meters, 1180 kilocycles, class A. Daily 10:30 am, 12:15 pm, market and weather. Sun & Fri, 8 pm, musical program. Central standard time. Slogan: "The Voice of the Wilderness." 100 watts.

WTAR—Reliance Elec. Co. Inc., 526 Harrington Ave., Norfolk, Va. 280 meters, 1071 kilocycles, class A. Tues, 7:30-10 pm. Sun, 8 pm, Church Services. Eastern standard time. Slogan: "Down in Old Virginia." 100 watts.

WTAS—Chas. E. Erbstein, R. F. D. No. 6, Box 75, Elgin, Ill. 286 meters, 1050 kilocycles, class A. Daily ex Sun, 8 pm. Sun, 2-5 pm. Central standard time. 500 watts.

WTAT—Edison Elec. Illuminating Co., 39 Boylston St., Boston, Mass. 244 meters, 1230 kilocycles, class A. 100 watts. (Portable).

WTAU—Ruegg Battery & Elec. Co., 4th & Clay Sts., Tecumseh, Nebr. 360 meters, 834 kilocycles, class C. 10 watts.

WTAW—Agricultural & Mechanical College of Texas, College Station, Texas. 280 meters, 1071 kilocycles, class A. 50 watts.

WTAX — Williams Hardware Co., Streator, Ill. 231 meters, 1300 kilocycles, class A. Mon, 9-10 pm. Wed, 12 midnight to 2 am. Central standard time. Slogan: "Tappa Kegga Nails." 50 watts.

WTAY—Oak Leaves Station, Oak Park Arms Hotel, Oak Park, Ill. 283 meters, 1060 kilocycles, class A. Daily 6:45-7:45 & 9-9:45 pm. Central standard time. Slogan: "Something for Every Taste." 500 watts.

WTAZ—T. J. McQuire, Lambertville, N. J. 283 meters, 1060 kilocycles, class A. Mon, 8-10:30 pm. Eastern standard time. 15 watts.

WTG—Kansas State Agr. College, Denison Hall, Manhattan, Kans. 485 meters, 620 kilocycles, class B. Daily ex Sun, 9:55 am, weather. Central standard time. 1000 watts.

WTL—H. G. Saal Co., Webster Hotel, 2150 Lincoln Park, West Chicago, Ill. 268 meters, 1120 kilocycles, class A. 10 watts.

WWAD—Wright & Wright, Inc., 2215 No. Broad St., Phila. Penna. 360 meters, 834 kilocycles, class C. Mon & Thurs, 8:30 pm. Eastern standard time. Slogan: "Penn City Station. WWAD." 100 watts.

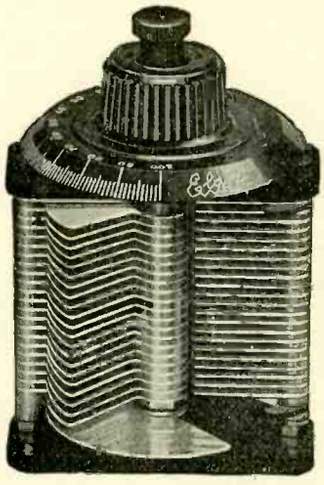
WWAF—Galvin Radio Sup. Co., 521 Market St., Camden, N. J. 236 meters, 1260 kilocycles, class B. Mon, 10-11 am. Wed, 6-7 pm. Fri, 9-11 pm. 500 watts.

WWJ—Ford Motor Co., Dearborn, Mich. 273 meters, 1100 kilocycles, class A. Wed, 8-10 pm, concert. Eastern standard time. 500 watts.

WWJ—Detroit News, Detroit, Mich. 517 meters, 580 kilocycles, class B. Daily ex Sun, 9:30 am, 9:45, 10:25, 11:55 am, 12:05, 3-4 pm (ex Mon), 4-4:15, 5-6 pm. Daily ex Sat, 7-8:30 pm, concert, alternate weeks; 8:30-10 pm concert alternate weeks. Tues, 9:45 am, ironing day special. Sun. 11 am, Church services; 4 pm, concert; 5 pm, Detroit News Orchestra. Eastern standard time. 500 watts.

WWL—Loyola University, New Orleans, La. 280 meters, 1120 kilocycles, class A. 100 watts.

Your Condenser Makes a Difference



Pick Up Those Distant Stations Louder and Clearer. Eliminate Noise and Interference. Get More Pleasure Out of Your Receiving With

Elgin ELRACO Precision Condensers

Elgin ELRACO Precision Condensers

If you are experienced in building radio receiving sets, you know the necessity for correctly designed and accurately made radio parts. If you are building your first set, you will profit by the experience of others.

Elgin Elraco Precision Condensers are designed and made to give you better results in your receiving.

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It is this combination of correct design and precision in construction which has made Elgin Elraco Condensers the choice of so many leading manufacturers of high grade radio equipment.

Cost was not a consideration in designing Elgin Elraco Precision Condensers, and yet they cost no more than many ordinary condensers.

You will like the correct and neat design and precise construction of Elgin Elraco Condensers but above all, you will appreciate the difference they make in your receiving.

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Plates are specially hard rolled aluminum, of uniform thickness throughout. Uniformly spaced.

End plates are made of Celeron which makes for efficient dielectric and great tensile strength.

Stops are provided for minimum and maximum capacities.

Terminal leads, mounting screws and template, with instructions for mounting come with each condenser.

3" diameter composition dials 50c extra.

Plates	Capacity	Plain	Vernier
3	.000063 M.F.	$1.75	
11	.00025 M.F.	2.40	$4.00
17	.00035 M.F.	2.75	
23	.0005 M.F.	3.00	4.50
43	.001 M.F.	4.00	5.50

A feature of the Vernier Type Condenser is the adjustable vernier shaft which makes it possible to use the condenser on any thickness of panel and with dials of different thicknesses.

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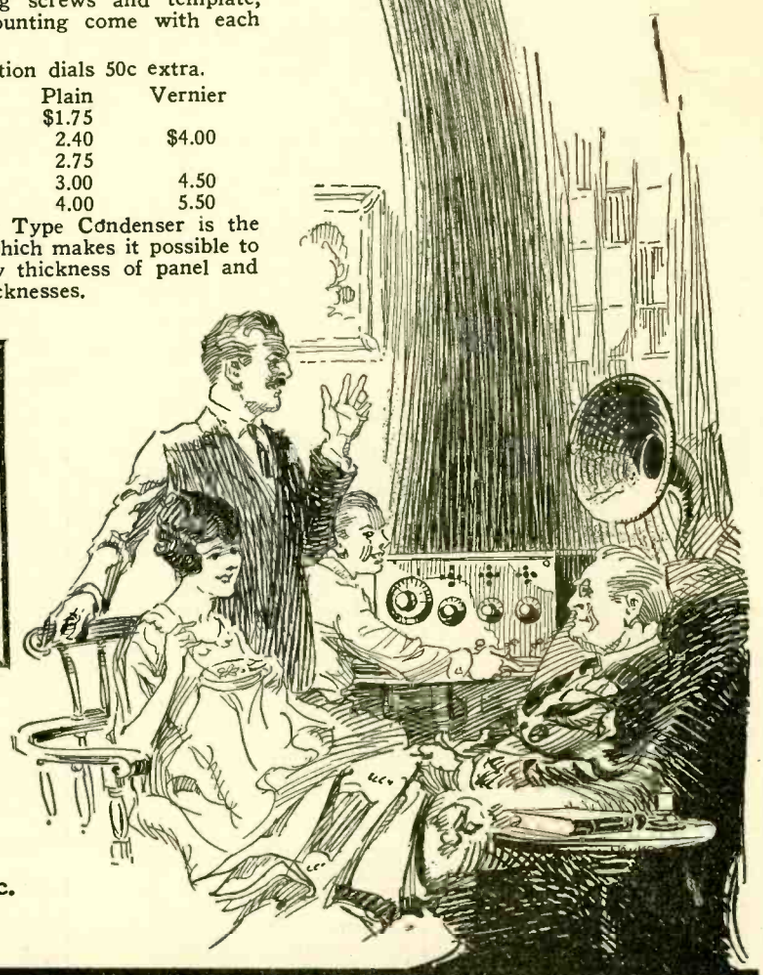
Full description on request.



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Birmingham, WSY
Mobile, WEAP

Alaska:

Anchorage, KFQD
Juneau, KFIU

Arizona:

Phoenix, KDYW, KFAD, KFCB
Tucson, KFDH

Arkansas:

Conway, KFKQ
Fayetteville, KFMQ
Little Rock, KFLQ, KFMB, WCAV
Pine Bluff, KFPX

California:

Bakersfield, KDZB
Berkeley, KRE
Burlingame, KFNZ, KFQH
Culver City, KFQI
El Monte, KUY
Fresno, KMJ
Hollywood, KFAR, KFQZ
Holy City, KFQU
Long Beach, KFON, KSS
Los Angeles, KDZF, KECL, KFI, KFPG, KFPR, KFOG, KFSG, KHJ, KJS, KNV, KNX, KUS, KWH.
Modesto, KXD
Oakland, KGO, KLS, KLX, KZM
Paso Robles, KFNL
Richmond, KFCM, KFOU
Sacramento, KFBK
San Diego, KDPT, KDYM, KFBC
San Francisco, KFPV, KPO, KUO
San Jose, KQW
San Luis Obispo, KFBE
Santa Ana, KFAW
Santa Barbara, KFHJ
Santa Rosa, KFNV
Stanford University, KFGH
Stockton, KJQ, KWG
Taft, KFQC
Whittier, KFOC

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Colorado Springs, KFKZ, KFQE
Denver, KFAF, KFDL, KFEL, KFLE, KFPO, KLZ
Greeley, KFKA
Gunnison, KFKA
Manitou, KFQS
Trinidad, KFBS

Connecticut:

New Haven, WPAJ
Storrs, WABL

Delaware:

Wilmington, WHAV, WOAT

District of Columbia:

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Pensacola, WGAN, WLAV
St. Petersburg, WCBK, WDBI
Tampa, WDAE
West Palm Beach, WBBJ
Winter Park, WBBO

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Macon, WCBW, WMAZ

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Kellogg, KFEY
Wallace, KFOD

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Belvidere, WTAH
Cambridge, WTAP
Chicago, KYW, WAAF, WDBY, WEBH, WGN, WJAZ, WLS, WMAQ, WQJ, WSAH, WSAX, WTL
Chicago Heights, WCBZ
Decatur, WBAO, WHAP
Elgin, WTAS
Eureka, WFBB
Galesburg, WRAM
Lincoln, WBBM
Monmouth, WBBU
Oak Park, WTAY
Peoria, WJAN, WQAX
Rockford, KFLV, WIAB
Streator, WTAX
Tuscola, WDZ
Urbana, WRM
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Brookville, WSAL
Fort Benjamin Harrison, WCBN
Greencastle, WLAX
Greentown, WJAK
Indianapolis, WBBI, WBBZ
La Porte, WRAF
Muncie, WJAF
South Bend, WGAZ
Valpariso, WRBC
W. Lafayette WBAA

Iowa:

Ames, WOI
Atlantic, KFLZ
Boone, KFGQ
Burlington, WIAS
Cedar Falls, KFJX
Cedar Rapids, WJAM, WKAA
Davenport, WOC
Des Moines, WHO
Fort Dodge, KFER, KFJY
Iowa City, KFQP, WHAA
Lamoni, KFFV
Le Mars, WIAU
Marshalltown, KFJB
Ottumwa, KFJL
Sigourney, WOAD
Sioux City, KFMR, KFOV, WEAU
Shenandoah, KFNF
Waterloo, WRAN

Kansas:

Anthony, WBL
Beloit, WPAR
Manhattan, WTG
Marion, WRAD
Milford, KFKB
Russell, KFQO
Topeka, WPAM
Wichita, KFOT, WEAH

Kentucky:

Louisville, WHAS, WLAP
Paducah, WIAR
Winchester, WPAP

Louisiana:

Alexandria, KFFY
Baton Rouge, KFGC
Franklinton, KFLD
Jennings, WCBJ
New Orleans, WAAB, WAAC, WABZ, WCAG, WCBE, WEBP, WIAF, WWL
Shreveport, KFDX, WGAQ

Maine:

Bangor, WABI, WDBN
Houlton, WCBL
Portland, WTAJ
Skowegan, WDBU

Maryland:

Baltimore, WCAO, WCBM, WEAR
Frostburg, WPAQ
Salisbury, WEBI

Massachusetts:

Boston, WDBR, WEEI, WNAC, WTAT
Fall River, WSAR, WTAB
Lowell, WQAS
Mattapoisett, WBBG
Medford, Hillside, WGI
New Bedford, WDAU
South Dartmouth, WMAF
Springfield, WBZ
Taunton, WDBB
Worcester, WABK, WCBT, WDAS, WDBH

Michigan:

Ann Arbor, WCBC
Berrien Springs, KFGZ
Dearborn, WWJ
Detroit, KOP, WABX, WCX, WWJ
Drummond Island, KUVQ
East Lansing, WKAR
Flint, WEAA
Grand Rapids, WEBK
Houghton, KFMW
Kalamazoo, WLAQ
Mackinac Island, WHQ
Menominee, KFLB
Petoskey, WBBP
Port Huron, WBBH
Saginaw, WABM

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Hutchinson, WFAN
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Hattiesburg, WDBT
Oxford, WCBH
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Cameron, WFAQ
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Fayette, KFQK
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Kansas City, WDAF, WHB, WOQ
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St. Joseph, KFHD
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Butte, KFKV, KFLA
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Helena, KFNY, KFSY
Missoula, KFLW
Stevensville, KFJR

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David City, KFOR
Freemont, WOAE
Hastings, KFKX
Lincoln, WFAV, WJAB, WMAH
Norfolk, WJAG
Oak, KFEQ
Omaha, KFCZ, KFOX, KFQV, WAAW, WIAK, WNAL, WOAW
Tecumseh, WTAU
University Place, WCAJ

Nevada:

Sparks, KFFR

New Hampshire:

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Laconia, WKAV

New Jersey:

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Camden, WABU, WWAF
Gloucester City, WRAX
Lambertville, WTAZ
Newark, WAAM, WBS, WOR, WRAZ
New Brunswick, WEBA
North Plainfield, WEAM
Paterson, WBAN
Salem, WDBQ
Trenton, WMAL, WOAX

New Mexico:

Albuerque, KFLR
State College, KOB

New York:

Buffalo, WGR
Canton, WCAD
Cazenovia, WMAC
Ithaca, WEAI
Kingston, WDBZ
Lockport, WMAK
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Rochester, WABO, WHAM
Rossville, WBBR
Schenectady, WGY, WRL
Syracuse, WBBE, WFAB, WLAH
Tarrytown, WRW
Troy, WHAZ
Utica, WSL

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Wilmington, WBBN

North Dakota:

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Grand Forks, KFJM, KFJQ
Wahpeton, WMAW

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Sandusky, WABH, WQAF
Springfield, WNAP
Toledo, WABR, WTAL
Wooster, WABW
Yellow Springs, WRAV
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Chickasha, KFGD
Muskogee, KFQL
Norman, WNAD
Oklahoma City, KFJF, KFQJ, KFQR, WKY
Okmulgee, WPAC
Tulsa, WLAL

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Astoria, KFJI
Corvallis, KFDJ
Hood River, KQP
Marshfield, KFOF
Medford, KFAY
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Portland, KDYQ, KFEC, KFIF, KFQN, KGG, KGW

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Butler, WBR
Easton, WMAP
East Pittsburgh, KDKA
Erie, WOAV
Growe City, WSAJ
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San Juan, WKAQ

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Providence, WCBR, WEAN, WJAR, WKAD, WSAD

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Clemson, WSAC
Greenville, WQAV

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Rapid City, WCAT
Sioux Falls, WFAT
Vermillion, WEAJ
Yankton, WNAX

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Lawrenceburg, WOAN
Memphis, WCBO, WMC
Nashville, WCBQ
Tullahoma, WCBV

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Amarillo, WDAG, WGAC
Austiu, KFQM
Beeville, KFRB
Bemis, WCBI
College Station, WTAW
Dallas, WFAA, WRR
Denison, KFQT
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North Bend, KFQW
Olympia, KFPP
Pullman, KFAE
Seattle, KDZE, KFHR, KFJC, KFOA, KFPB, KFQX, KHQ, KJR, KTW
Spokane, KFIO, KFPY
Tacoma, KFBG, KFEJ, KGB, KMO
Walla Walla, KFCF
Yakima, KFIQ

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Clarksburg, WHAK, WJAL
Martinsburg, WDBD

Wisconsin:

Fond du Lac, KFIZ
Kenosha, WOAE
La Crosse, WABN
Madison, WHA
Milwaukee, WCAY, WHAD, WSOE
Osseo, WTAQ
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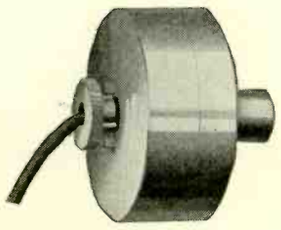

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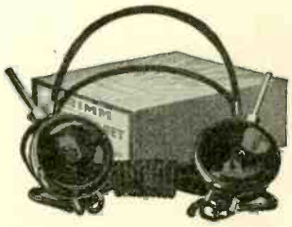

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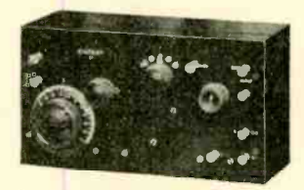

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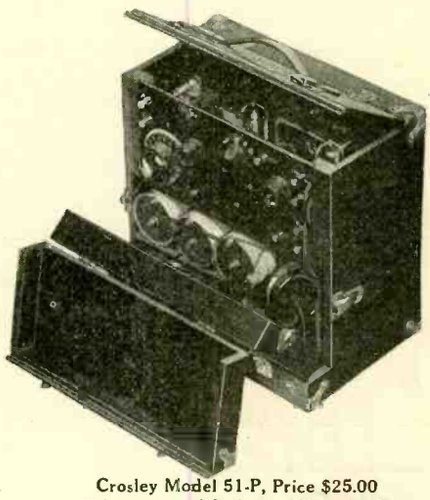

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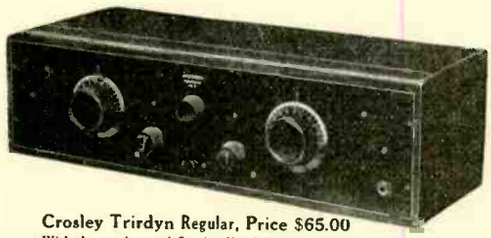
West of Rockies—add 10%

Crosley Head Phones, Better—Cost Less, $3.75



Crosley Trirdyn Regular, Price $65.00
With three tubes and Crosley Head Phones $80.75

Crosley Trirdyn Special, Price $75.00
With three tubes and Crosley Head Phones $90.75

MAIL THIS COUPON TODAY

The Crosley Radio Corporation,
1141 Alfred St., Cincinnati, O.
Gentlemen: Please mail me free of charge your complete catalog of Crosley instruments and parts together with booklet entitled "The Simplicity of Radio".

Name_____

Address_____

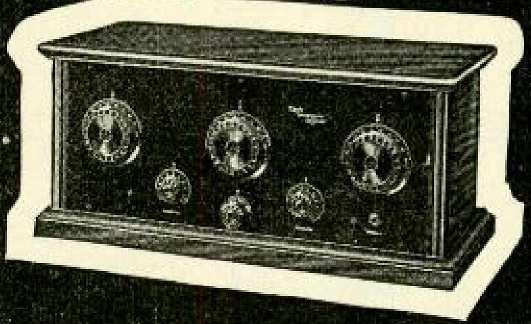
LOG SHEET
PERSONAL RECEIVER RECORD

CALL	CITY	DIAL 1	DIAL 2	DIAL 3	REMARKS	CALL	CITY	DIAL 1	DIAL 2	DIAL 3	REMARKS

LOG SHEET
PERSONAL RECEIVER RECORD

CALL	CITY	DIAL 1	DIAL 2	DIAL 3	REMARKS	CALL	CITY	DIAL 1	DIAL 2	DIAL 3	REMARKS

The GREATER Neutrodyne



New Model B
EAGLE

Model BS—A New Eagle Artistic Console Cabinet, Price $100—An artistic Console cabinet, for the EAGLE, in American Walnut or Mahogany, with fume-proof compartments for bettery and charger. Ask our dealer to show you this beautiful installation.

Balanced Receiver

THE greatest circuit made greater by epochal refinements. The NEW ***Model B*** Receiver enormously emphasizes the outstanding dominance of the ***EAGLE Balanced Neutrodyne.***

Every Vital Part Manufactured in the EAGLE Factory

Every instrument that must carry any responsibility for the efficiency of the EAGLE Model B Receiver is made in the EAGLE factory under the supervision of EAGLE engineers.

EAGLE Instruments *Only* in EAGLE Receivers

The vastly improved instruments described in the adjoining panel CANNOT BE PURCHASED ANYWHERE AT ANY PRICE, except as incorporated in the NEW MODEL B EAGLE Receiver. Developed explicitly for the EAGLE Model B.

INSIST Upon These Advantages

You want the very latest improvements in your radio set. Then you want these ADVANTAGES—multiple switch, ball-bearing, die-cast condensers, and the recently developed, revolving resistor element rheostat.

Price..***$175.00***

Get a Year's GUARANTEE on the Next Set You Buy—

The EAGLE Is Warranted for ONE YEAR

Licensed by Independent Radio Manufacturers, Inc. NEUTRODYNE Reg U S Pat Off. Pat March 27 1923 and April 1, 1924. Other Patents Pending.

Because

Ball-Bearing Die-Cast CONDENSERS

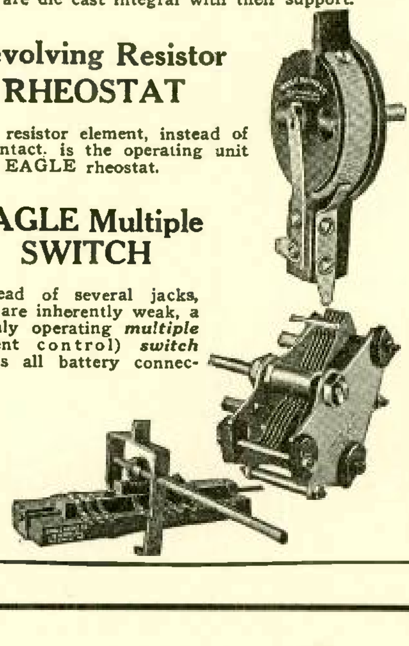
An entirely new departure in condensers. Both rotor bearings are ball-bearing. Rotor and stator plates are die cast integral with their support.

Revolving Resistor RHEOSTAT

The resistor element, instead of the contact, is the operating unit in the EAGLE rheostat.

EAGLE Multiple SWITCH

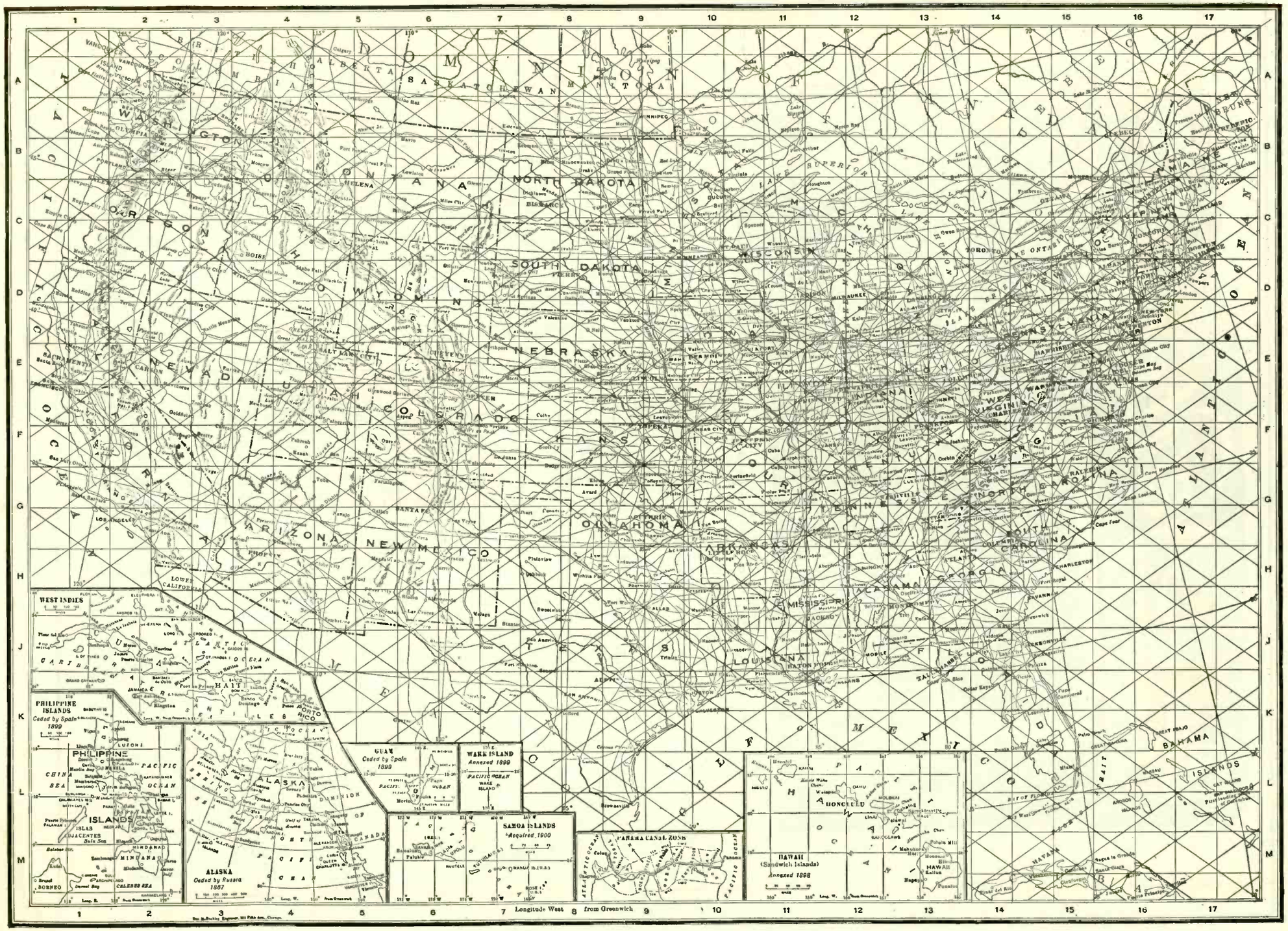
Instead of several jacks, which are inherently weak, a smoothly operating ***multiple*** (filament control) ***switch*** controls all battery connections.



Eagle WE SOAR ABOVE EAGLE RADIO COMPANY NEWARK NEW JERSEY **Radio Co.**

19 BOYDEN PLACE

DISTANCE CHART



The lines on this map are drawn 100 miles apart

AMRAD

S-TUBE RECTIFIER

Improved Type N. 4000-1

WHAT THE OWNERS SAY

"Reported in Ealing, New Zealand, 8000 miles from here; Alaska 3 times; Hawaii 4 times; 47 states, Cuba 8GT; ship in Panama Canal; all Canadian districts but one, and London. . . . Any piece of apparatus like the 'S' Tube deserves more than honorable mention."

9-AHZ, Geo. K. Shirling, Kansas City, Mo.

"While using 'S' Tubes I was heard in Greenland by WNP and in Honolulu by KHL. . . . I had the purest DC in town."

6-CMS, W. H. Hardy, 4928 Seventh Ave., Los Angeles, Calif.

"Enclosed find money order for two solutions of Electrolyte for your AMRAD Mershon Condenser. . . . While writing I might say I am more than pleased with the 'S' Tube."

Canadian 3SP, 50 Lorne Crescent, Brantford, Ont.

"The 'S' Tubes I have are doing splendidly. . . . They sure work great. Hope to receive last two orders soon."

Edmund P. Crocker, Nantucket, Mass.

"I worked 9-CO in Minnesota, 1300 miles, in middle of the day. Used 4 'S' Tubes. In constant use over 18 months without any trouble. . . . have worked 7-FY, Portland, Ore., 2500 miles."

3-BQP, Henry Conrad, West Philadelphia, Pa.

"The 'S' Tubes in use here have been in daily operation for nearly a year, and will stand more high voltage than when first used."

3-OE, Oscar W. Lummis, Camden, N. J.

"Tests conducted between 'S' Tubes, Thermionic and Electrolytic Rectifiers rate 'S' Tubes as best in every way. Lower cost in the end."

1-CPI, Waldo J. Kelley, 26 Winsor Ave., Watertown, Mass.

"The 'S' Tubes recently ordered and received have proved so satisfactory that I am enclosing money order to cover the cost of two more. . . . They have proved all you claimed for them and more."

9-MY, James C. Scott, De Pere, Wisconsin.

"As for distance with these tubes, they can't be beat. . . . F. B. and note D. C."

2-BGO, J. Gresh, Jr. 650 Henry St., Linden, N. J.

"Have used the 'S' Tubes six months, and am more than pleased with them. I have used all kinds of rectifiers, but the 'S' Tube is my choice."

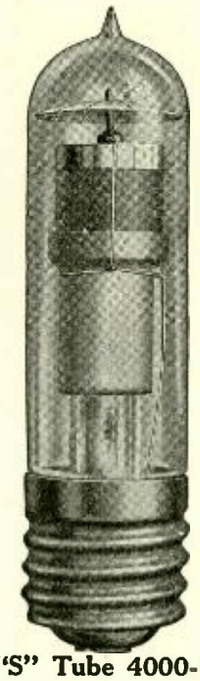
9-CFK, Clarence L. Arundale, Lewiston, Ill.

AND HUNDREDS MORE!

Receiving Specialties

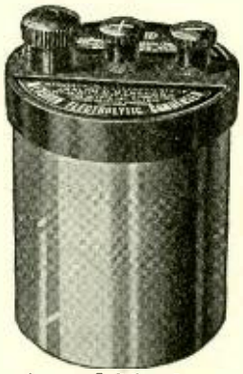
In addition to complete sets, this Corporation has specialized for years in the manufacture of several receiving specialties, including the famous Basketball Variometer, Ampliformers, and a new plate Condenser.

Shall we send literature?



"S" Tube 4000-1

Order from your Dealer. Help build a convenient source of supply for yourself and your friends.



Amrad Mershon Condenser

Electrolytic Type. Results in better smoothing of the A. C. ripple. Economical. Most Efficient.

NO FILAMENT TO BURN OUT

The "S" Tube Rectifier was first marketed in 1921. Since that time several improvements have been made. It is very significant that many of the unsolicited comments from "S" Tube users (at the left) refer to earlier types.

Wide Variety of Uses

Rectifies alternating current to produce D. C. plate supply for power tubes.

May be used to replace "B" Batteries. (See "A B-Battery from your Lamp Socket" in Sept., 1924, *Radio Broadcast.)* Also charges Storage "B" Batteries.

For use where D. C. is desired under conditions requiring dependable, economical performance.

Improved Type 4000-1

The new "S" Tube is now provided with a 1½" mogul base, which further increases dielectric strength. It is tubular in shape, which facilitates handling. The current carrying capacity has been doubled. It is rated to carry 100 mil. amps. at 1000 volts D. C. per tube.

Orders Filled in Rotation

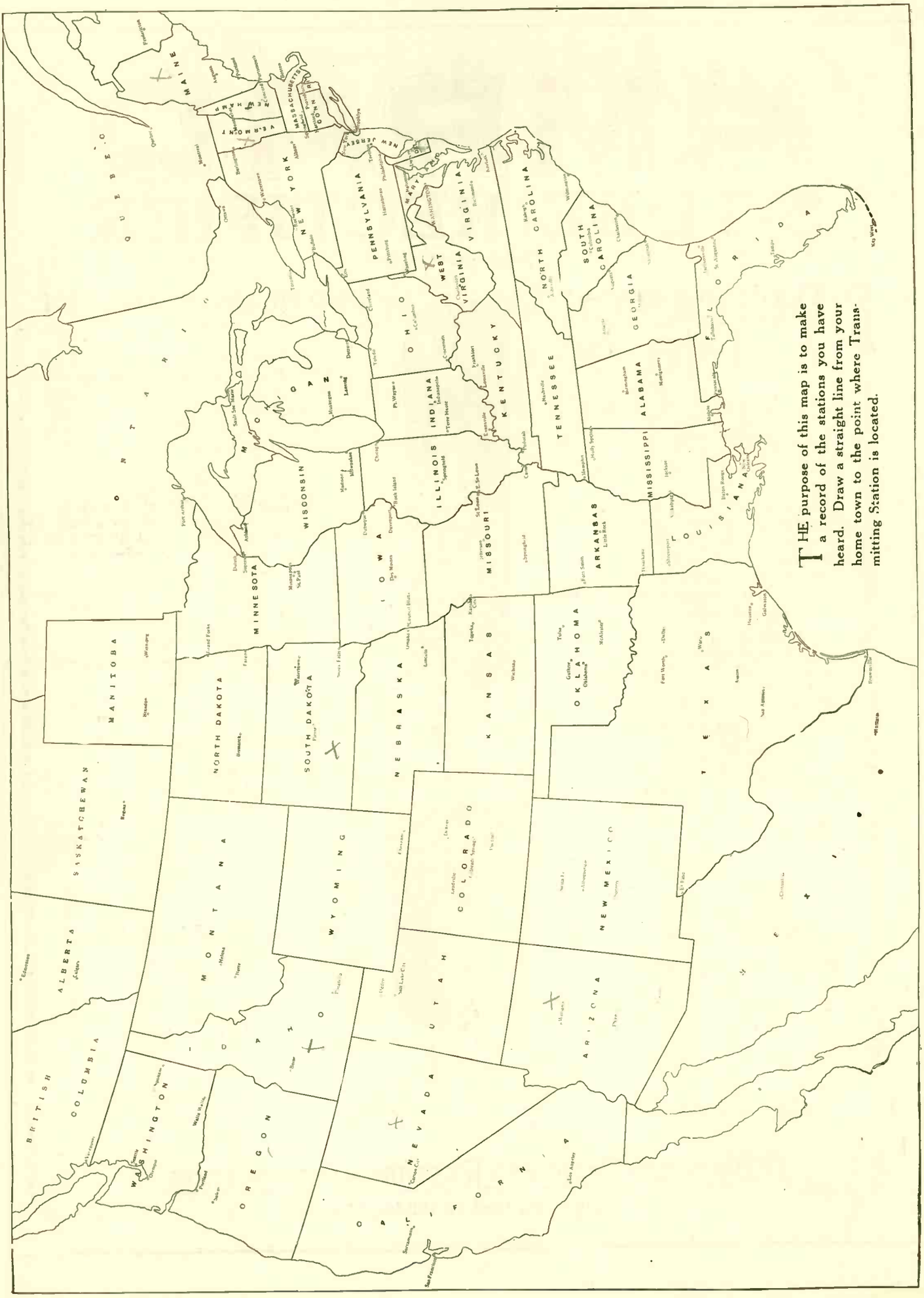
Production facilities have been increased and deliveries are improving. Order from your Dealer for best service. If he is not stocked, he will obtain your order just as promptly as possible. Place your order at once.

For details, write for Bulletin J-3

AMERICAN RADIO AND RESEARCH CORPORATION

Dept. C. C., Medford Hillside, Mass.

BLANK RECORDING MAP



ALL-AMERICAN

now brings you

DISTANCE, VOLUME AND QUALITY with ONE TUBE

Self-Tuned Radio Frequency Transformers —Wound to Suit the Tube

OUT of a year of many experiments and numerous failures to achieve in a practical instrument the theoretical possibilities of broad-tuned Radio Frequency Amplifiers, has come a simple but far-reaching discovery. Radio Frequency Transformers can and must be *adapted to the characteristics of the particular vacuum tube* whose grid voltage they supply. That truth—with All-American scientific research and All-American precision manufacturing—has made radio history.

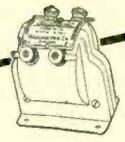
SELF-TUNED RADIO FREQUENCY TRANSFORMERS *have arrived*—and All-American, naturally enough, has brought them. Never before has an instrument been built which will amplify so effectively, over the entire radiocast range, as will the new All-American Types R-199 and R-201A. Together with the new Type R-140 All-American Universal Coupler, they have made possible a *new standard of efficiency* in Radio Frequency and Reflex receivers.

As an example of this, we offer ALL-AMAX JUNIOR (1 Tube) and ALL-AMAX SENIOR (3 Tube). Both are *All-American-coupled throughout*, and both exemplify the new standard of performance.

Build an ALL-AMAX—using the complete panel scheme and wiring plan shown in your KEY BOOK—and you will never go back to an ordinary reflex set. Distance and power are yours!

All-Americans—Precision-Made for Reliability

Sold by all the Better Dealers



Standard Audio Frequency Transformers
"All-American for Reliability"

Ratio 3 to 1	R-12, $4.50
Ratio 5 to 1	R-21, 4.75
Ratio 10 to 1	R-13, 4.75

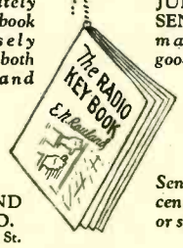
Long Wave Transformer
For High Amplification and no distortion of side bands at 4,000 to 20,000 meters (75 to 15 Kilocycles) . . R-110, $6.00

Power Transformers
For *Tone Quality* in a Third Stage, or for Loud Volume with Clearness.

Input Type	R-30, $6.00
Output Type	R-31, 6.00

Rauland-Lyric
A Laboratory-Grade Audio for the Musically Fastidious.
Rauland-Lyric . . . R-500, $9.00

An absolutely new kind of book—immensely valuable to both beginner and expert.



ALL-AMAX JUNIOR and SENIOR; *also many other good hook-ups.*

Sent for 10 cents, coin or stamps.

RAULAND MFG. CO.
2678 Coyne St.
CHICAGO
Pioneers in the Industry

Self-Tuned Radio Frequency Transformers
"Wound to Suit the Tube"
Effectively amplifying all Frequencies within the Radiocast Range.

For "199" Tubes	R-199, $5.00
For "201A" Tubes	R-201A, 5.00

10,000 Meter Transformer
It gives superior results in beat reception, filtering out a 30 Kilocycle Frequency with high selectivity and no side-band distortion R-120, $6.00

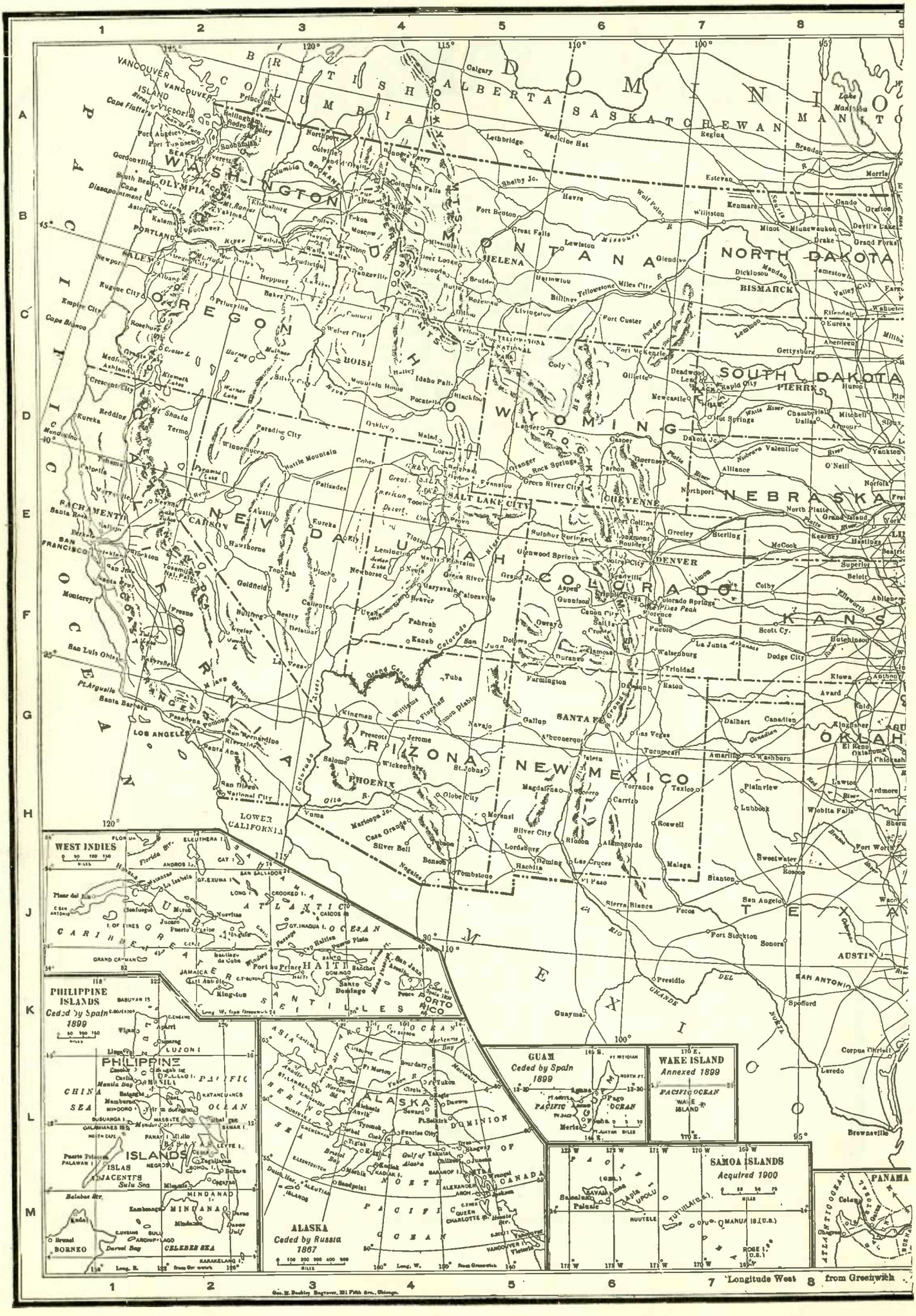
Radio Frequency Coupler
(Oscillator Coupler.) A uniform output at 150 to 650 meters . . R-130, $5.00

Universal Coupler
Sets a new standard of efficiency as an antenna coupler. As a radio frequency transformer in tuned stages it is unsurpassed R-140, $4.00

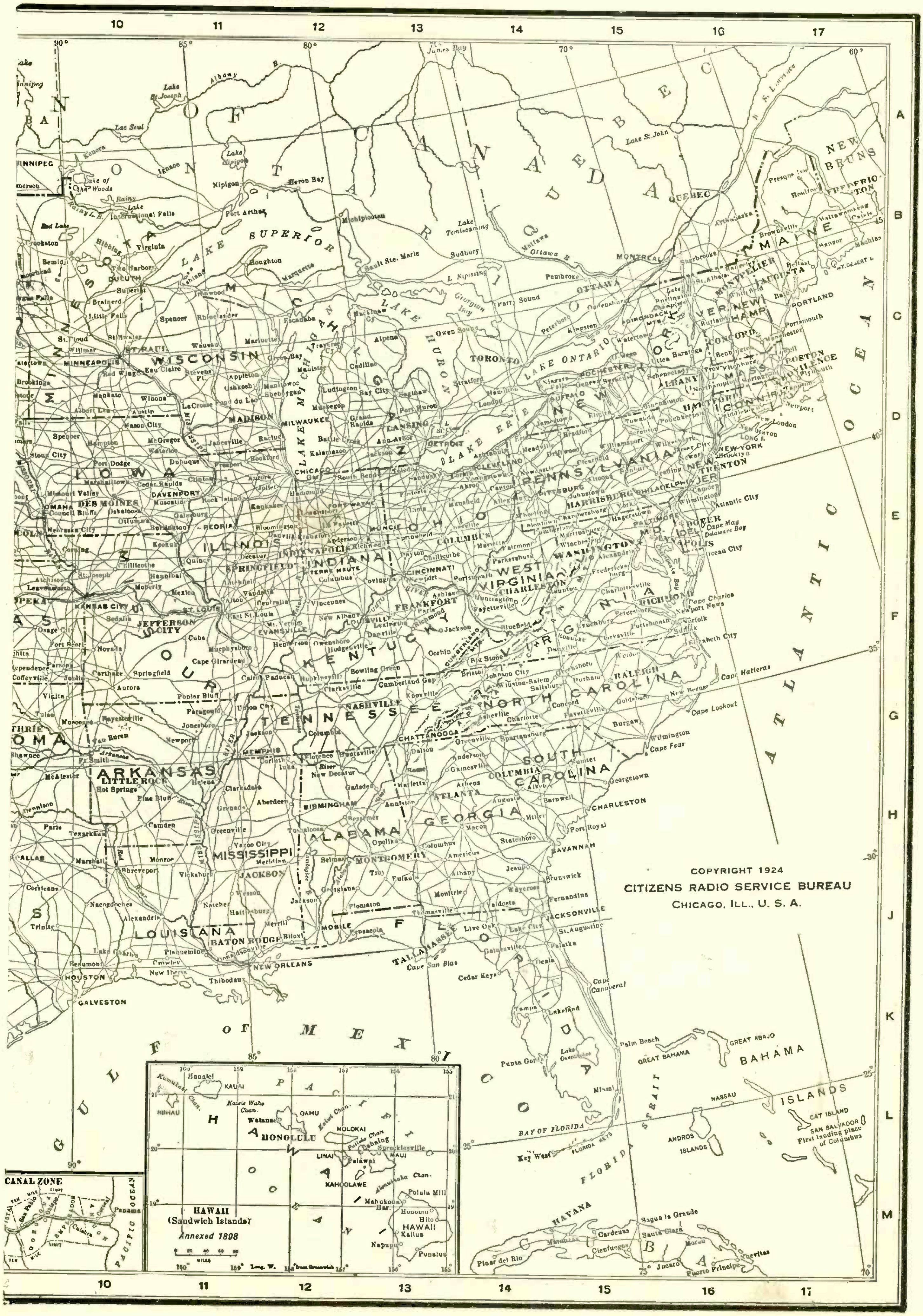
ALL-AMERICAN
TRADE MARK

Largest Selling Transformers in the World

MAP OF THE



UNITED STATES



Dear Jim:

You know how I've been spending my money for parts.

Well, last night our home-made "superhet" was making a lot of noise but little music, when I happened to remark to Nell that a couple of new vernier condensers at $7 each might improve it.

And she snapped right back at me, that one new hat at $14 would improve *her* con-sid-er-ably, and what was more she intended to be improved. Women are so inconsiderate.

I was ready to kick the set to pieces and give up Radio forever, when Eddie who works at Whump's Radio Store called to ask about a little bill which had escaped my mind.

I asked him to look over the set and see if he could tell what was causing the trouble.

"What's the use?" he said. "The set is probably O. K. Why don't you get some batteries you can recharge when they run down? That's what's making it noisy."

Well, to make the story short, I got him to trust me for a set of Willard A's and B's, and you should hear that "super" perform now.

Wife Nell hasn't said any more about the hat either.

Yours for better reception,

Sam.

WILLARD RADIO BATTERIES

WTAM

[The Voice of the Storage Battery]

WTAM is the Radio Research Laboratory and Broadcasting Station of the Willard Storage Battery Company, Cleveland, Ohio.

Its function consists of research which is being done to improve the quality of radio reception and the broadcasting of radio programs for your entertainment.

Write for WTAM's own booklet, "Better Results from Radio." Most interesting booklet ever published on this subject. Mailed to you with our compliments.

Tear me off the page and mail me to WTAM. I'll bring you "Better Results".

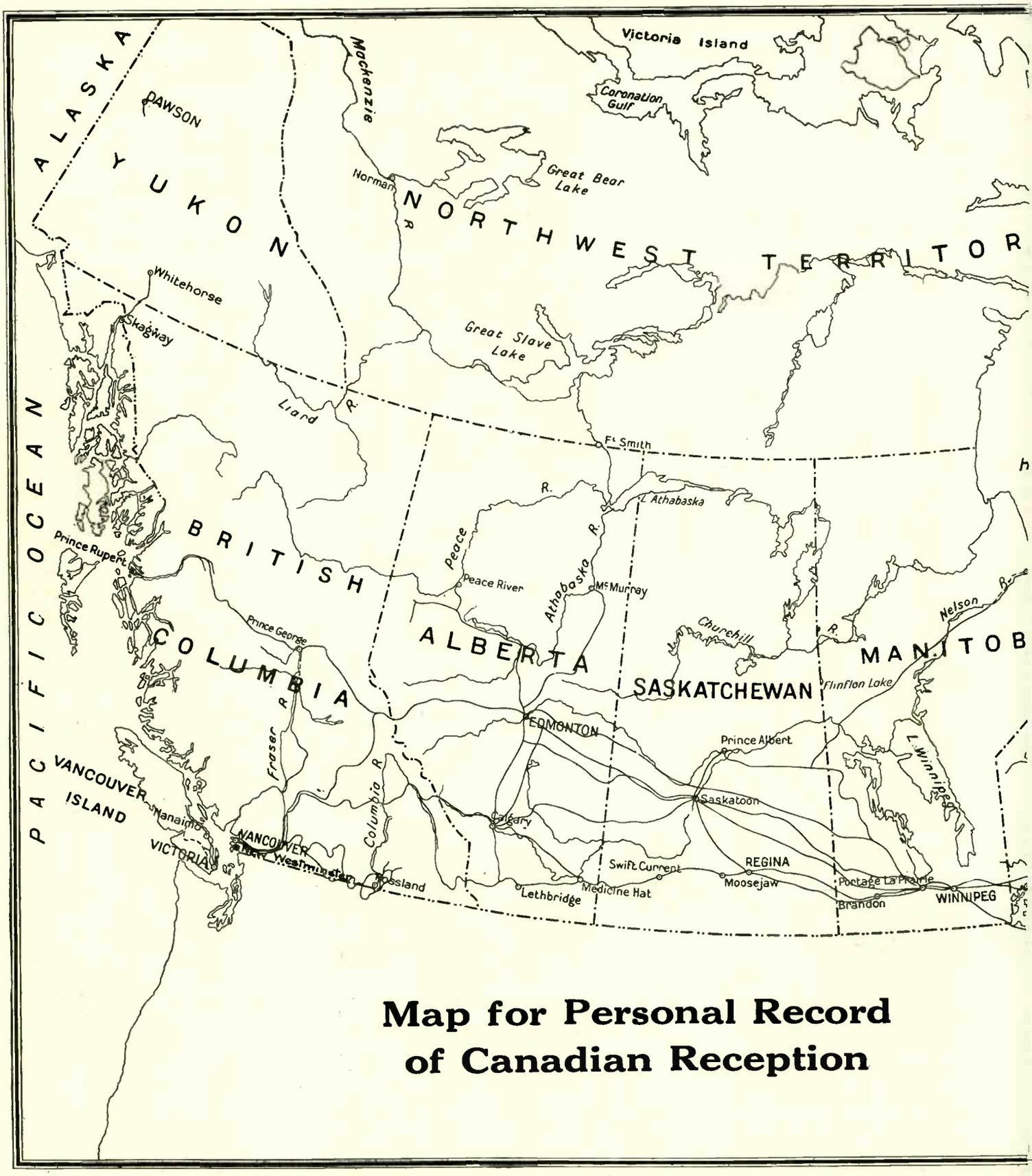
..... Name

..... City and State

..... Street Address

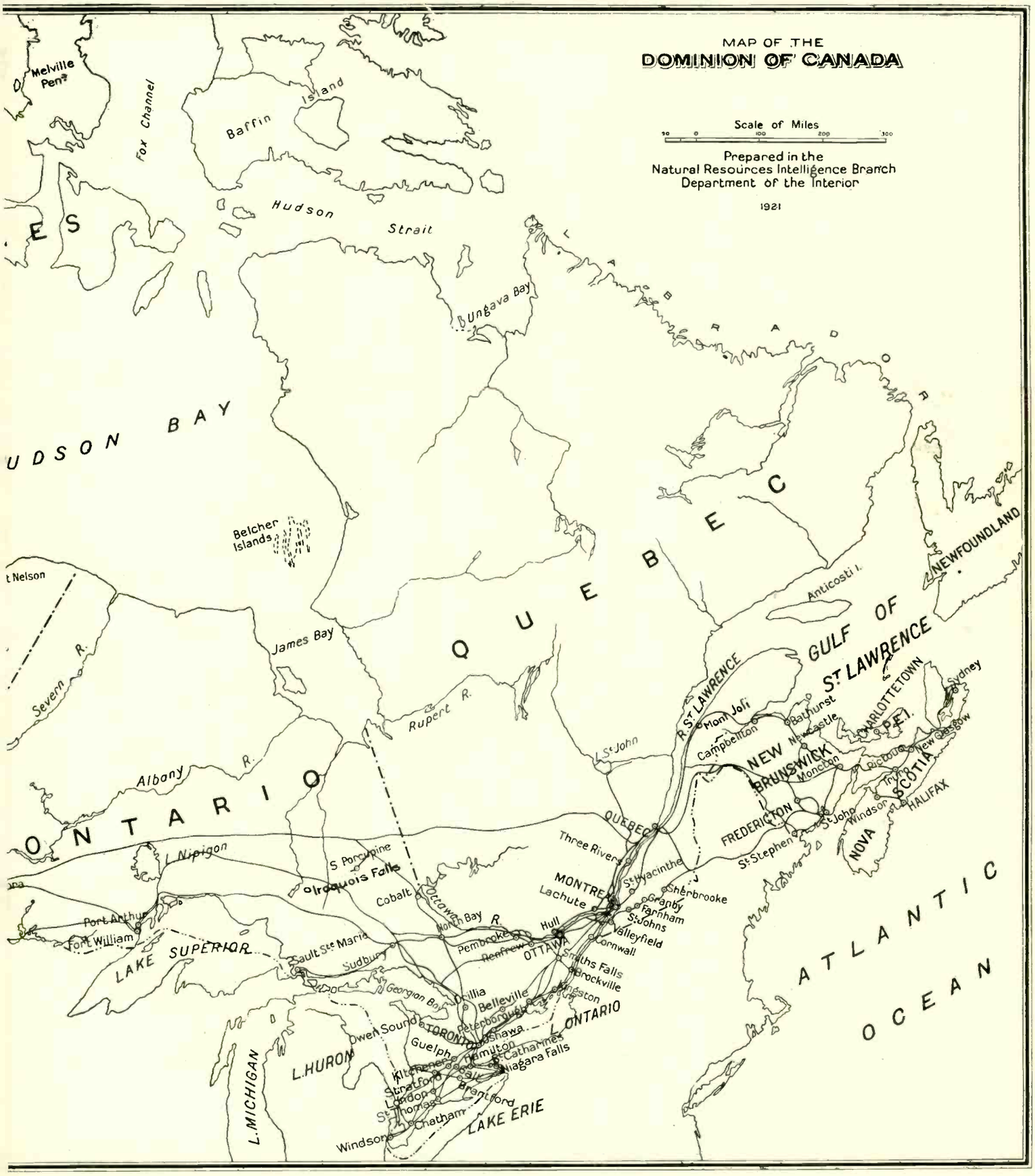
CB1

Map Of



Map for Personal Record of Canadian Reception

Canada



Canadian Broadcasting Stations

CFAC—The Calgary Herald, Calgary, Alberta. 430 meters, 697 kilocycles, 2000 watts.

CFCA—Star Publ. & Printing Co., 18 King St. W., Toronto, Ontario. 400 meters, 749 kilocycles, 2000 watts.

CFCF—Marconi Wireless Telegraph Co. of Canada, Ltd., 1047 Canada Cement Bldg., Montreal, Quebec. 440 meters, 681 kilocycles. Daily ex Sun 1-1:30 pm, music, weather, stocks. Mon & Fri 7:30-9:30 pm, bedtime stories, reports and music. 500 watts. Eastern Standard time.

CFCH—Abitibi Power & Paper Co., Ltd., Iroquois Falls, Ontario. 400 meters, 749 kilocycles, 500 watts.

CFCK—Radio Supply Co., Ltd., 10229-101st St., Edmonton, Alberta. 410 meters, 731 kilocycles. 250 watts.

CFCL—Centennial Methodist Church, Victoria, B. C. 400 meters, 749 kilocycles, 500 watts.

CFCN—W. W. Grant Radio, Ltd., 708 Crescent Road, N. W., Calgary, Alberta. 440 meters, 681 kilocycles, 1750 watts. Tues 11:30 pm to 1:30 am, Sat 10 pm to 12 midnight, Sun 11 am to 12:30 pm. Standard Mountain Time. Slogan: "The Voice of the Prairie."

CFCQ—Radio Specialties, Ltd., 791 Dunsmuir Ave., Vancouver, B. C. 450 meters, 666 kilocycles, 40 watts. Daily ex Sun & Wed 7:30-8 pm. Sun 7:30-8:30 pm, music and entertainment. Pacific Standard time.

CFCR—Laurentide Air Service, Ltd., Nickle Range Hotel, Sudbury, Ontario. 410 meters, 731 kilocycles, 200 watts.

CFCT—The Victoria City Temple, 1110 Douglas St., Victoria, B. C. 410 meters, 731 kilocycles, 500 watts.

CFCU—Jack V. Elliot, Ltd., 123 King St. W., Hamilton, Ontario. 410 meters, 731 kilocycles, 20 watts.

CFCW—London Radio Co., 314 Dundas St., London, Ontario. 430 meters, 697 kilocycles, 600 watts.

CFDC—Sparks Company, Wallace & Fitzwilliam Sts., B. C. 430 meters, 697 kilocycles, 50 watts.

CFHC—Henry Birks & Sons, Ltd., 708 Crescent Road, N. W., Calgary, Alberta. 440 meters, 681 kilocycles, 1000 watts.

CFLC—Chas. Guy Hunter, 551 Adelaide St., London, Ontario. 430 meters, 697 kilocycles, 100 watts.

CFQC—The Electric Shop, Ltd., 144 Second Ave. North, Saskatoon, Sask. 400 meters, 749 kilocycles, 200 watts. Daily ex Sun 1-1:30 pm. Mon, Tues, Thurs & Fri 7:30-9 pm. Sun 9 pm, Church Service. Slogan "The Hub City of the West."

CFRC—Queen's University (Dept. of Electrical Engineering), Fleming Hall, Queen's University, Kingston, Ontario. 450 meters, 666 kilocycles, 1500 watts.

CFXC—Westminister Trust Co., Columbia & Begbie Sts., New Westminister, B. C. 440 meters, 681 kilocycles, 50 watts.

CFYC—Victor Wentworth Odlum, Mercantile Bldg., 318 Homer St., Vancouver, B. C. 400 meters, 749 kilocycles, 20 watts.

CHAC—Radio Research Club, 51 Sachville St., Halifax, N. S. 400 meters, 749 kilocycles, 500 watts. Nightly with news service, government reports and musical programs, 8 p.m., Eastern standard time. Slogan "Come to Nova Scotia."

CHBC—The Albertan Publ. Co., Ltd., 708 Crescent Road, N. W., Calgary, Alberta. 410 meters, 731 kilocycles, 500 watts.

CHCE—Western Canada Radio Supply, Ltd., 919 Fort St., Victoria, B. C. 400 meters, 749 kilocycles, 20 watts.

CHCM—Riley & McCormick, Ltd., 708 Crescent Road, N. W., Calgary, Alberta. 440 meters, 681 kilocycles, 1000 watts.

CHCS—The Hamilton Spectator, Spectator Bldg., Hamilton, Ontario. 410 meters, 731 kilocycles, 2000 watts. Daily 6:30-7 pm and 10 to 11 pm, music and entertainment.

CHNC—Toronto Radio Research Society, 46 Lauder Ave., Toronto, Ontario. 350 meters, 856 kilocycles, 200 watts.

CHXC—J. R. Booth, Jr., 28 Range Road, Ottawa, Ontario. 435 meters, 697 kilocycles, 1200 watts.

CHYC—Northern Elec. Co., Ltd., 121 Shearer St., Montreal, Quebec. 341 meters, 881 kilocycles, 500 watts. Wed 9-11 pm, Sun 7-11 pm. Eastern Standard time.

CJBC—Jarvis Street Baptist Church, Toronto, Ontario. 312 meters, 967 kilocycles, 4000 watts.

CJCA—The Edmonton Journal, Ltd., Journal Bldg., Edmonton, Alberta. 450 meters, 666 kilocycles, 500 watts.

CJCD—T. Eaton Co., Ltd., Queen St., W., Toronto, Ontario. 410 meters, 731 kilocycles, 100 watts. Mon, Wed & Fri 4-5 pm. Eastern Standard time.

CJCE—Sprott Shaw Radio Co., Room 1604, Tower Bldg., Vancouver, B. C. 400 meters, 749 kilocycles, 150 watts.

CJCF—The News-Record, 39 S. Cameron St., Kitchener, Ontario. 295 meters, 1030 kilocycles, 300 watts.

CJCK—Radio Corp. of Calgary, Ltd., 1731 College Lane, Calgary, Alberta. 316 meters, 950 kilocycles, 500 watts.

CJCM—Dr. J. L. P. Landry, Mont-Joli, Quebec. 312 meters, 967 kilocycles, 500 watts. Daily 5-6 pm, news in French and music, 10:30 pm to 1:00 am, news in French and English, vaudeville. Mon, Wed, Sat 8:30-10 pm, music and talks in French. Eastern Standard time. Slogan, "Trois semaines en bas de Quebec (three weeks below Quebec)."

CJGC—London Free Press Printing Co., 440 Richmond St., London, Ontario. 430 meters, 697 kilocycles, 200 watts.

CJSC—The Evening Telegram, 81 Bay St., Toronto, Ontario. 430 meters, 697 kilocycles, 500 watts.

CKAC—La Presse Publ. Co., Ltd., Cor. St. James St. & St. Lawrence Blvd., Montreal, Quebec. 425 meters, 714 kilocycles, 2000 watts. Daily ex Sat 4 pm, weather, news, stocks, 4:30 pm musical teas. Mon, Wed & Fri 1:45 pm, classical concert, 4:30 pm, dance orchestra. Tues, Thurs & Sat 7 pm, kiddies stories in French and English, 7:30 pm, classical concert, 8:30 pm, studio entertainment, 10:30 pm, dance orchestra. Sun 4:30 pm sacred concert. Midnight Frolics, first and third Tuesday of each month. Eastern Standard time.

CKCD—Vancouver Daily Province, 142 Hastings St. W., Vancouver, B. C. 410 meters, 731 kilocycles, 2000 watts.

CKCE—Canadian Independent Tel Co., Ltd., Wallace Ave. & Ward St., Toronto, Ontario. 450 meters, 666 kilocycles, 2000 watts.

CKCI—Le "Soleil" Limitee, C. W. Lindsay Bldg., Cor. St. John & St. Eustache St., Quebec, Que. 310 meters, 970 kilocycles. 200 watts Thurs & Sat 8:30 pm.

CKCK—Leader Publ. Co., Ltd., Regina, Sask. 420 meters, 713 kilocycles, 2000 watts.

CKCO—Dr. G. M. Geldert (For Ottawa Radio Ass'n), 282 Somerset St. W., Ottawa, Ont. 400 meters, 749 kilocycles, 200 watts. Sun & Tues 7-10 pm, music and entertainment.

CKCX—P. Burns & Co., Ltd., 712 Rosedale Crescent, Calgary, Alberta. 440 meters, 681 kilocycles, 1000 watts.

CKLC—Wilkinson Elec. Co., Ltd., 2119 Seventh Ave. N. W., Calgary, Alta. 400 meters, 749 kilocycles, 200 watts.

CKOC—Wentworth Radio Sup. Co., Ltd., Hamilton, Ontario. 410 meters, 731 kilocycles, 100 watts. Slogan, "In the Garden of Canada."

CKY—Manitoba Telephone System (Provincial Govt.), Winnipeg, Manitoba. 450 meters, 666 kilocycles, 500 watts. Daily ex Sun, 12:30-1:30 pm. Daily ex Sat & Sun 4-5 pm. Tues & Fri, 8:15-10:30 pm. Thurs 8:30 pm (rented to Canadian Nat'l Railways ("CNRW"). Sun 7 pm, Church Service. Central Standard time. Slogan, "Manitoba's Own Station."

CNRC—Canadian Nat'l Railways, Calgary, Alberta. 440 meters, 681 kilocycles, 1000 watts.

CNRE—Canadian Natl Railways, Edmonton, Alberta. 450 meters, 666 kilocycles, 500 watts.

CNRM—Canadian Nat'l Railways, Montreal, Quebec. 341 meters, 881 kilocycles, 2000 watts.

CNRO—Canadian Nat'l Railways, Jackson Bldg., Bank St., Ottawa, Ont. 435 meters, 689 kilocycles, 500 watts. Wed & Sat 7:30 pm, stock reports, 8pm Chateau Laurier Hotel Orchestra, 8:45 studio program, 10:30 dance program. Slogan, "The Largest Railroad System in the World." Eastern Standard time.

CNRR—Canadian Nat'l Railways, Regina, Sask. 420 meters, 713 kilocycles, 2000 watts.

CNRS—Canadian Nat'l Railways, Saskatoon, Sask. 400 meters, 749 kilocycles, 500 watts.

CNRT—Canadian Nat'l Railways, Toronto, Ont. 400 meters, 749 kilocycles, 2000 watts.

CNRW—Canadian Nat'l Railways, Winnipeg, Manitoba. 450 meters, 666 kilocycles, 2000 watts.

Branston Announces

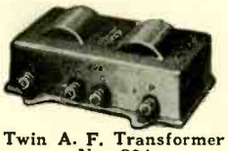
Eight Matched Transformers

$35.00

New Super Transformers and *New* Kit No. R-199

Three Stage Long Wave R. F. Transformers

Contains three perfectly matched long-wave transformers each designed to give highest voltage amplification per stage without distortion. Price $13.50.



Twin A. F. Transformer No. 204

Two carefully designed A. F. Transformers in one unit giving all the amplification possible with wonderful tone reproduction thru-out the musical scale. Price $8.00.

Single Stage Long Wave R. F. Transformer No. R-205

Gives highest amplification on long wave or Super-Heterodyne circuits. None more efficient at any price. Price $4.50.

No. R-201 Long Wave Tuned R. F. Transformer, $4.50.

No. R-203 Special Tuned Coupling Transformer, $4.50.

Short Wave R. F. Transformer No. R-202

Efficiently designed Short Wave R. F. Transformer with self-supporting coil windings. Will function with maximum amplification over entire broadcast wave band. Excellent for your Reflex Set. Price $4.50.

JUST Released! New ideas; novel innovations; everything simplified. The cumulative result of a studied endeavor to offer the Radio enthusiast a Kit of Transformers that are different; improved and above all else, efficiently compact. The very latest advance in the Radio art, for the benefit of those who wish to excel and take a permanent pride in a personally constructed receiver. All the benefits of unceasing research; all the excellence of experienced craftsmanship.

Designed by a radio engineer who has specialized in Super-Heterodyne construction. He had tested all standard makes of transformers which would make possible a satisfactory receiver for strictly loop reception.

It was felt that present day receivers are too cumbersome; requiring eight, ten and more tubes. It was further realized that there is a desire and a demand for a receiver equipped for amplifying distant stations to the volume and clarity of local broadcasts.

This has now been accomplished by incorporating short wave radio frequency into the set. By causing various tubes to do double duty, we have been enabled to reduce the number of tubes to seven UV 199's or 201A and to diminish the size of the required panel to 7" x 21".

In order to dispense with unnecessary constructional detail, simplify the wiring, and impart to the panel an appearance of symmetrical beauty; the three long wave R. F. transformers were embodied and enclosed in a single compact case, into one unit. Exactly the same procedure has also been applied to the design of the two stage Audio Frequency transformers. A single unit which functions like two transformers.

This method affords a saving in space, permits shorter leads; and in every way promotes efficiency.

Our major problem was to properly design these transformers. After a year of diligent research we arrived at a satisfactory solution of each problem and final tests have proved that, here, in actual practice, are the transformers which have hitherto been only theoretically possible.

A receiver built with these transformers, has done all that other receivers can do and—a little more. Greater distance, increased selectivity; easier tuning. In short, ideal reception, with none of the slight faults of immature principles. Only two tuning controls are required; which allows an accurate logging of stations received.

Every transformer is assembled with precision, perfectly matched to a standard resonant frequency and tested for mechanical and electrical defects. Each is further subjected to an oscillation test and all are absolutely guaranteed.

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Map of

The World

Foreign Broadcasting Stations

GREAT BRITAIN

The times given are according to British Summer Time

London (2LO), 365 m. Weekdays, 4-5 pm, con.; 6-6:45 pm, children; 7-7:30 pm, time sig., news, talk; 8-10 pm music; 10-10:30 pm, time sig., news, talk; 10:30-11 pm, music. On Mon. and Wed. the Savoy Bands are relayed until 11:30 pm., and on Sat. until midnight. Sat. only, 4-6 pm, con. Tues., Thurs. and Fri, 1-2 pm, con.

Aberdeen (2BD), 495 m. Birmingham (5IT), 475 m. Bournemouth (6BM), 385 m. Cardiff (5WA), 350 m. Glasgow (5SC), 420 m. Manchester (2ZY), 375 m. Newcastle (5NO), 400 m. Afternoon prog. from most stations, 3:30-4:30 pm; 6-6:45 pm, children; 7-7:30 pm., time sig., news, talk; 8-10 pm, music; 10-10:30 pm, time sig., news, talk; 10:30-11 pm, music. Savoy Bands relayed as in London times.

Bradford (2LS), 310 m. Edinburgh (2EH), 325 m. Leeds (2LS), 346 m. Liverpool (6LV), 318 m. Plymouth (5PY), 330 m. Sheffield (6FL), 303 m. Programs relayed.

AUSTRALIA

2BL, Broadcasters (Sydney) Ltd., Sidney, N. S. W. 350 meters, 850 kilocycles. Daily 2-4 am, Pacific standard time, 500 watts.

2FC, Farmer & Co., Ltd, Sydney, N. S. W. 1100 meters, 270 kilocycles. Daily 2-4 am, Pacific standard time. 5000 watts.

2FL, Farmer & Co., Ltd., Sydney, N. S. W. 770 meters, 389 kilocycles. Daily 2-4 am, Pacific coast time. 500 watts.

2SB, Sydney Broadcasters, Ltd., Sydney, N. S. W. Daily 1-3 am, Pacific Coast time. 500 watts.

3AR. Associated Radio Co., Ltd., Melbourne, Victoria. 480 meters, 624 kilocycles. Daily from 2-4 am, Pacific Coast time. 1600 watts.

3FL, Farmer & Co., Ltd, Melbourne, Victoria. 400 meters, 749 kilocycles. Daily 2-4 am, Pacific standard time. 500 meters.

3LO, Farmer & Co., Ltd., Melbourne, Victoria. 1720 meters, 174 kilocycles. Daily 2-4 am, Pacific standard time. 5000 watts.

5MA, Millswood Auto & Radio, Ltd., Adelaide, S. Aust. 850 meters, 352 kilocycles. Daily 2:30-4:30 am, Pacific Coast time. 3000 watts.

CONTINENT

The times are according to the Continental system; for example, 16:30 is 4:30 pm, and 08:00 is 8 am (B.S.T.)

AUSTRIA

Vienna (RH), 600 m. Daily, 16:30, con. (Wed.); 20:00, con. (Mon. and Fri.).

BELGIUM

Brussels (SBR) (Radio-Electrique), 262-270 m. Daily, 17:00, orch.; 18:00, news; 20:00, lec. or children; 20:15, news and con.; 22:00 news.

Haeren (BAV), 1,100 m. 13:00, 14:00, 16:50, 18:50, weather (weekdays only); 19:00, con. (irr.); 22:00, con. (Tues. and Thurs., irr.).

CZECHO-SLOVAKIA

Kbely (OKP), 1,150 m. Weekdays, 10:00-11:30, 12:30, 17:00 and 18:00, Stock Ex.; 19:15-21:00, con., lec., news, weather.

Komarov (Brunn), 1,800 m. Weekdays. 14:30, Stock Ex., news; 11:00-12:00, con. (Sun.).

Prague (PRG), 1,000 m. 19:00, weather and music. 1,800 m.; 08:00, 12:00, weather; 12:30, 16:00, news. 4,500 m.; 10:00, 14:20, news (irr.); 15:00 and 22:00, con., etc. (irr.).

DENMARK

Lyngby (OXE), 2,400 m. 10:30, 16:30, 21:45, weather; 20:00, con., lec., etc. (Sun.), 20:30 (weekdays).

FRANCE

Paris (Radio-Paris, Clichy), 1,780 m. Sun., 12:45, orch.; 13:45, news; 16:45, con.; 17:45, news; 20:30, news; 21:00, con.; 22:00, dance. Weekdays, 12:30, Stock Ex.; 12:45, orch.; 16:30, markets; 16:45, con.; 17:45, exchanges, news, women; 20:30, lec., news; 21:00, con.; 22:00, dance (not daily). *Note*—On 2nd and 4th Sat. of the month a gala evening con. is provided by *Le Matin*, Paris, at 21:00.

Eiffel Tower (FL), 2,600 m. Daily, 07:40, weather; 10:40, markets; 11:00, weather (Sun.); 12:00, markets; 12:15, time sig.; 14:00, relay of PTT con. on Sun. (irr.); 15:40, Stock Ex. (weekdays); 17:30, stock quotations (weekdays); 18:10. con.; 20:00, weather; 21:00, lec. or con. (Wed. and Sun.); 23:10, weather.

L'Ecole Superieure des Postes et Telegraphes (PTT), 450 m. 14:00, con. (irr., but if on Sun. relayed by FL on 2,600 m.); 15:30, con. (irr.); 16:00, lec. and con. (Thurs.); 20:00, English conversation, lec. or con. (Tues.); 20:30, lec. or play (Mon.); 20:45, con. (Sun.); relayed by FL; 21:00, lec., con. or transmission from Paris theatre (Wed.,* Thurs., Fri., Sat. and Sun.*).

*Relayed by FL on 2,600 m.

Le Petit Parisian. 352 m. Music and lec., etc., 21:30 Thurs. and Sun., other days (irr.).

Lyons (PTT), 470 m. Daily 10:30,* 11:30, 11:45, 12:15, 16:15, Stock Ex.; 20:00, news and con.

*This transmission may be followed by short con.

Nice (radio), 360 m. 11:00, 17:00, con. and news; 21:00, con. (irr.).

GERMANY

Berlin 1 (Vox Haus), 430 m. 10:00, markets; 10:15, news; 12:15, Stock Ex.; 12:55, time sig.; 13:05, news; 14:15, Stock Ex.; 17:30-19:00, orch. (17:30, 18:00 and 19:00, news, etc.); 19:00, children (Sun. and Wed.); 19:30, English lesson (Mon. and Thurs.), lec. other days; 20:00, lec. (daily, except Sun.); con. and dance (Sun.); 21:00, con., news, weather (daily, except Sun.); 22:15, dance (Thurs. and Sat.). *Note* — Cons. from 19:00 are also relayed on 500 m. by Berlin 2.

Berlin (Telefunken Co.), 290 m. 20:00, tests (irr.). 750 m.; 19:30 or 20:00, opera (irr.).

Konigswusterhausen (LP), 680 m. 10:50-11:50, con. (Sun.) 2,400 m.; news throughout day from about 07:30. 2,800 m.; 11:50-12:50, con. (Sun.); 22:40 (weekdays) (irr.). 3,150 m.; stock quotations throughout day from about 07:30 (weekdays only). 4,000 m.; express news service almost throughout day.

Breslau, 415 m. 12:55, time sig.; 13:00, weather and Stock Ex., news; 16:30, children (Sun.); 17:00, orch. (weekdays); 19:00, lec. (irr.); 20:00, con. or lec. (daily except Wed. and Sat.); 20:30 con. (Sun. and Wed.); 21:00, con. (daily); 22:00, con. (daily, except Sun. and Wed.).

Frankfort - on - Main, 467 m. 08:00, service (Sun.); 11:55, time sig. and news (daily); 16:00 children (Sun.); 16:30, orch. (weekdays); 19:30, Esperanto lesson (Fri.), lec. (other weekdays), con. and news (Sun.); 20:30 con. and news (weekdays); 21:00, late con. (daily, except Thurs. and Sun.), dance (Fri.). *Note*—The *Frankfurter Zeitung* provides Sun. and Thurs. evening cons.

Hamburg, 392 m. 08:00, time sig., news, weather (weekdays, 11:00 Sun.); 10:00, con. (Sun.); 16:00, time sig., news; 16:15, news, menus. etc.; 17:00, children (Wed. and Sun.), women 11:55, time sig., and news (daily); 16:00, children (Sun.); (Mon.). con. and lec. (other days); 18:00, educational hour (Mon., Wed. and Fri.), lec. (Tues.); 19:00, con. and lec. (Sun.); 20:00, con. and news (daily); 22:00, time sig., weather and news (daily).

Konisberg, 460 m. 08:30, markets (Wed. and Sat.; 11:30, con., weather and sermon (Sun.); 12:55, time sig. (daily); 14:00, news, Stock Ex. (weekdays); 16:30, lec. or con. (weekdays), children (Sat.); 20:00. lec. (Wed. and Fri.); 20:30, con., weather and news (daily); 22:00, dance (Sat.).

Leipzig, 452 m. 13:00, news, Stock Ex. (weekdays); 16:30, orch. (daily); 17:30, lec. (daily, except Sun.); 19:30 lec. (weekdays); 20:15, con. and news (daily); 21:30, dance, news (Sun.)

Munich, 485 m. 14:00, news, weather (daily); 15:00, con. (Sun.); 17:00, children (Wed.); con. (Sun.) 18:00, con. (weekdays); 19:45, lec. (Mon., Tues. and Wed.); 20:15, con. and dance (Sat.); 21:00, con. (weekdays except Sat.); 22:00, news, weather, time sig. (daily).

Munster, 407 m. New station now being tested. No fixed prog., but somewhat similar to Konigsberg.

Stuttgart, 437 m. 16:30, con. (daily); children (Sat.); 18:00, time sig., weather (daily); 20:00, lec. or Esperanto lesson (Mon.); 20:30, con. (daily); 21:30, time sig., weather and con. (daily).

HOLLAND

The Hague (PCGG), 1,070 m. 14:40. con. (Sun.); 20:10, con. (Thurs.); 20:40, con. (Mon.).

Hilversum (NSF), 1,050 m. Owing to repairs prog. irr.

Amsterdam (PA5), 1,050 m. 11:00, con. (daily); 19:40, con. (Wed.); 20:40, news; 21:00, con. (irr.). (PCFF), 2,000 m.; weekdays, 07:55, 08:50, 09:40, 10:55, 11:10, 11:25, 11:55, 12:45, 14:40, 15:55, news, etc.; 13:10, 13:25, 13:40, 13:55, 14:10 and 14:55, Stock Ex.

Ymuiden (PCMM), 20:10, con. (Sat.).

HUNGARY

Buda-Pesth, 2,000 m. 11:00-12:00, con. 3,000 m.; 12:30-13:00, news (daily).

ITALY

Rome (Radioraldo), 470 m. Daily, 11:30, news; 12:00, time sig., con. (latter irr.); 15:20, Stock Ex.; 16:30, con. 452 m. (Unione Radiofonica Italiana). Daily, 16:30, tests; 21:00, con. or opera. 540 m.; 18:00, con. (irr.), 1,800 m.; 20:00, orch. or con. 3,200 m.; 10:00, tests, etc. (irr.).

PORTUGAL

Lisbon, 375-410 m. 22:00, tests (irr.).

SPAIN

Madrid (Radio Iberica), 392 m. 22:00-24:00, con. Wed. and Sun.; other days, 19:00-21:00. 480 m. (PTT); 18:00-20:00, con. (Sun.). 1,800 (about) m.; 13:00, lec.; 20:30, con. (irr.).

Cartagena (EBX), 1,200 m. 12:00-12:30 and 17:00-17:30, con. or lec. (irr.).

SWEDEN

Gothenburg, 460 m. 19:00-21:00, con. (Tues., Fri. and Sat.). 680 m.; 19:00-21:00, con. (Mon., Wed. and Thurs.).

Stockholm (Telegrafverket), 440 m. 11:00, service relayed from St. Jacob's Church, Stockholm (Sun. only); 19:00-21:00, con. (Fri., Sat. and Sun.); 19:00, con. (Mon. and Wed.).

Stockholm (Radio Akt.), 470 m. 19:00-21:00, con. (Sun. and holidays); 19:00, con. (Tues., Thurs. and Sat.).

SWITZERLAND

Geneva (HB1) (Ste. Romande), 1,100 m. 13:15. weather, Stock Ex., news, con. (irr.); 17:00, lec. (irr.); 20:00, weather; 20:30, lec. or con. (daily, except Wed. and Thurs. during holiday months).

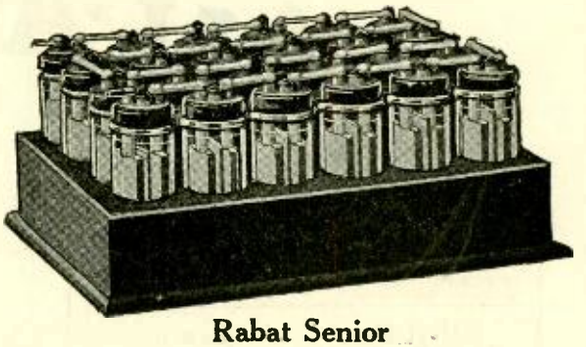
Lausanne (HB2), 460 m. 18:00, con. (weekdays); 20:30, con. (Sun.). 780-800 m.; 08:00, 13:00, weather; 13:30, time sig.; 17:00, children (Thurs. only); 18:55, weather; 20:15, con. or lec. (daily). 1,080 m.; 10:50, weather; 13:00, con. or lec. (Tues., Thurs. and Sat.); 14:00, weather; 15:00, orch. (Tues., Thurs. and Sat.); 18:55, weather; 20:00, orch. (Tues., Thurs. and Sat.); 22:15, dance (almost daily). *Note*—Prog. and times subject to alteration during summer months.

Zurich University, 500 m. 20:30-22:00, tests, lec., con. (Tues., other days irr.).

MEXICO

CYB, El Buen Tono S. A., 500 watts.
CYG, Secretaria de Guerra, 500 watts.
CYL, La Casa del Radio, 500 watts.
CYR, Rosseter & Co., Mazatlan, 100 watts.
CYX, Excelsior-Parker, 500 watts.
CYZ, Mexican Radio League, 100 watts.

Give Clearer Tones



Rabat Senior
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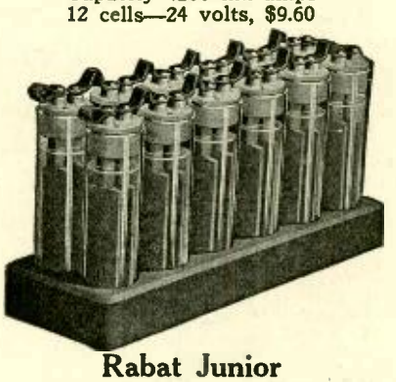

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A specially constructed Junior charger will charge one Senior or 3 Junior batteries at a time. Price $1.40.

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How to Build the Improved and Simplified Thirty-Kilocycle Super-Heterodyne

By A. ELKINS, Technical Editor

I. A Brief Review of the Super-Heterodyne as it Stands Today

Practically all radio engineers now acknowledge the absolute supremacy of the Super-Heterodyne as the most sensitive and the most selective of receiving circuits, especially for radiocast reception. This has been achieved not without opposition from those who maintain that the Super-Heterodyne is too complicated a circuit for use by the ordinary listener. However, the same argument was applied with still greater apparent force to prove that the gasoline automobile could never compete with the "less complicated" electrical and steam-propelled vehicle. Recent developments have gone far toward proving with the Super-Heterodyne what the last decade has proved with the gasoline car—that even a complicated mechanism can be so well built, from parts so thoroughly able to perform their respective functions, that the operation of the device becomes as simple as the design is complicated.

Very great progress has already been made, since the first appearance of the Super-Heterodyne, toward simplicity in operation, and it is no longer true that even the building of a Super-Heterodyne need be a risky and adventurous proceeding. As in the wiring-up of any multi-tube set, it is still necessary to be very careful and thorough in the placing and soldering of wires, but even this difficulty has been decidedly reduced by the development of parts which can be used in such a way as to simplify greatly the wiring scheme.

For the benefit of those who are not familiar with the Super-Heterodyne principle, we will outline in this section the few fundamental facts which should be understood before attempting to build or operate a "Super."

Every experimenter who has built a radio frequency amplifier for radiocast wave lengths appreciates the strong tendency of vacuum tubes used for this purpose to go into self-oscillation, producing howls which immediately drown out the signals. Various methods for preventing this oscillation make up a large part of the new discoveries in radio circuits during the past year or two. In addtion to the trouble from howling, there is always the alternative of (1) the tuned transformers, introducing a control for each stage, or of (2) untuned coupling with its requirement of a broad tuned radio frequency transformer, and some unavoidable sacrifice of selectivity.

All of these well-known difficulties in the practical application of radio frequency amplifiers are avoided entirely, and very great selectivity obtained, by the Super-Heterodyne circuit. In employing it, we no longer seek to amplify, at all, the oscillations of very high frequency which constitute the "carrier-wave" of radiocasting, but instead we immediately reduce all such high frequency waves to pre-determined lower frequency, which is low enough so that the tendency to oscillate is no longer troublesome, and still high enough so that it is not audible to the ear. When once reduced to such a frequency, the signals can be amplified through as many stages as desired—each one much more effective, and decidedly more stable, than even the best stabilized short-wave stage.

The method by which radiocast waves of anywhere from 550 kilocycles up to 1,350 kilocycles or more are reduced to an intermediate frequency of from 30 to 50 kilocycles, is the fundamental idea of the Super-Heterodyne. It follows entirely from the fact that if two series of vibrations are present at the same time, and their frequencies are nearly the same, another frequency is produced equal to the difference between the first two frequencies. The common example of this is in the tuning of a piano. If the two strings of one of the low notes on a piano—say the lowest "C," which should vibrate 32 times per second—are not exactly in tune with each other, one of them may perhaps be vibrating 33 times instead of 32. This will result in the production of a beat-frequency of one vibration per second: that is, the sound will be heard to grow louder and fainter once every second.

This condition may frequently be noticed in pianos which are in need of tuning, and it can always be produced in a correctly tuned piano by holding the finger against one of the strings near its end while the key is struck. It will be noticed that by varying the position of the finger on the string just as a violinist moves the fingers of his left hand, the rapidity of this beat-note can be changed from perhaps one beat every second up to beats so rapid that they cannot be counted. This changing of the beat-frequency by moving the fingers on a string is fundamentally the same operation as turning the oscillator dial on a Super-Heterodyne receiver; in each case we are varying a frequency which is only a little different from the fixed frequency of another train of waves also present, in order to produce a beat-frequency equal to the difference between the two rapid frequencies.

In the case of the Super-Heterodyne, the variable frequency is

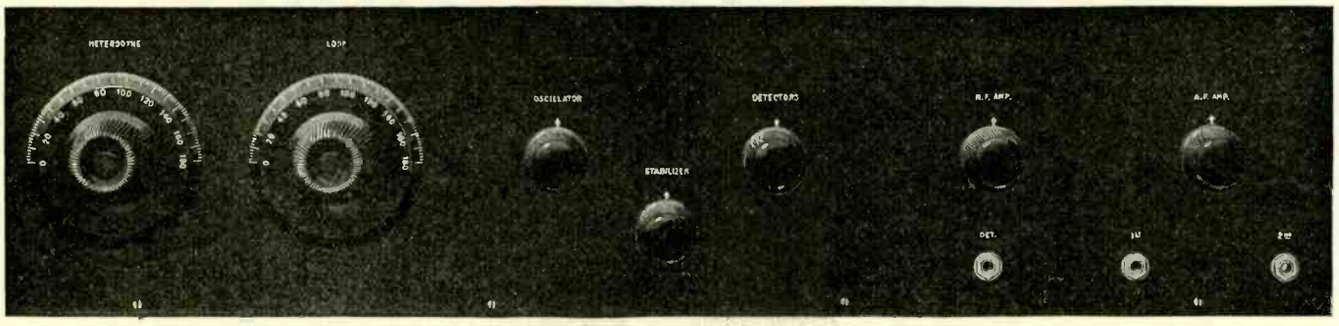

Fig. 1—Front view of receiver

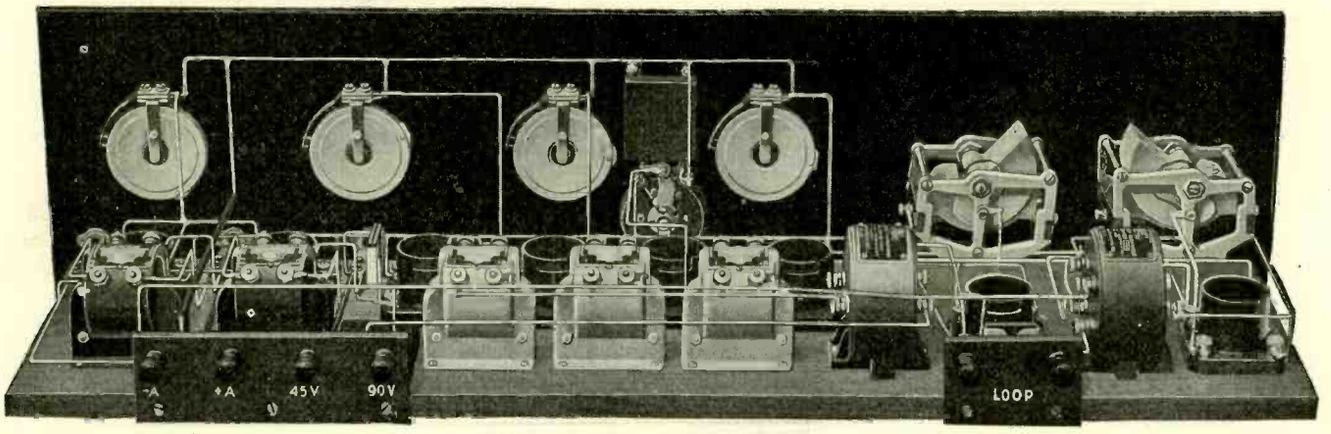

Fig. 2—Rear view of receiver

produced by an electron tube called the oscillator. Connected to a circuit which is tuned by a variable condenser, it generates continuous wave oscillations of any desired radio frequency over the range to be received. Then, if we are tuning in to a 1,000 kilocycle station, and are using an intermediate frequency of 30 kilocycles, it is only necessary to tune the oscillator to generate either 970 or 1,030 kilocycles, and if this oscillator circuit is then coupled into the tuner of our receiving set, the two frequencies together will combine to produce the desired 30 cycle wave. Then all we have to do is to introduce also into the circuit the primary of a sharply tuned transformer, commonly known as a filter, and the secondary of the filter will send out a voltage which oscillates at the desired beat-frequency, these oscillations carrying, by the variations in their amplitude, the sound waves from the radiocast. This low-frequency carrier-wave is amplified through as many stages as may be desired, with little or no tendency to howl, and can then be rectified in a detector tube as usual and conducted to the loud speaker or audio amplifier, as an ordinary telephone current.

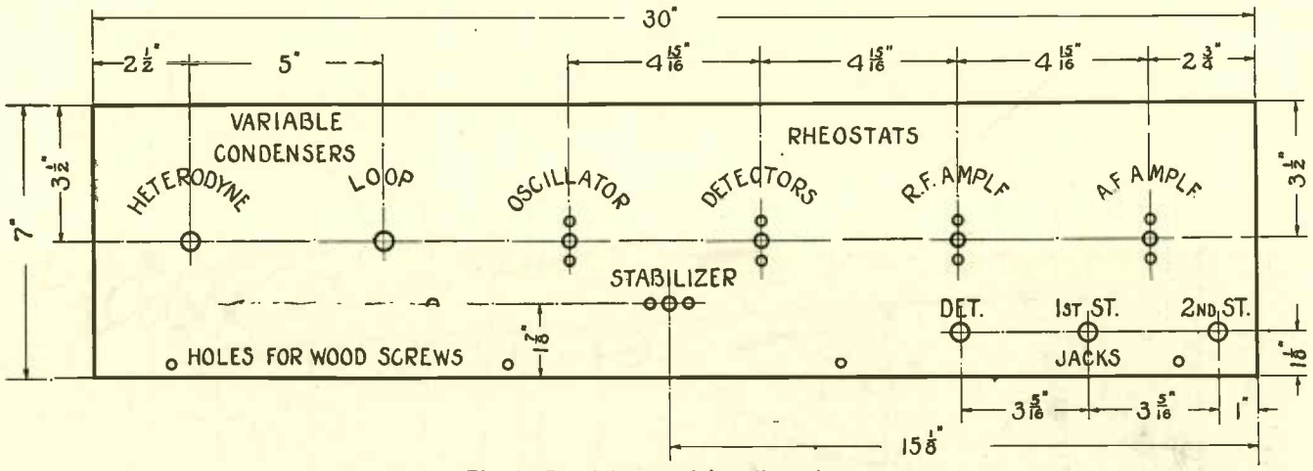

Fig. 3—Panel layout giving dimensions

II. Recent Advances in Super-Heterodyne Practice

As has been suggested above, the recent widespread experimentation in beat-frequency reception has borne fruit in many improvements of considerable importance. The more valuable of these are briefly discussed in this section.

The object of the Super-Heterodyne method is of course to eliminate the difficulties of amplification inherent in higher frequency oscillation. It naturally follows that the lower a frequency we can use for the intermediate stages, the more perfect will be our conquest of such difficulties—it being understood of course that the beat-frequency must be above the audible limit of 10,000 cycles. Not only must this beat-frequency be inaudible, but it must be far enough above the audible limit, so that transformers having their peak efficiency at the beat-frequency chosen will not amplify any audio frequency disturbances which may be present in the beat-frequency current.

This means one of two things: Either the beat-frequency must be very much above the audible limit, or the transformers must have a characteristic which slopes down very steeply indeed as we come from the beat-frequency down toward the audio range. The necessity for this sloping down of the characteristic is one of the reasons why air-core transformers have had some popularity, in spite of the tone distortion which is very likely to result from imperfect matching of such instruments, and the continual danger of interstage coupling by leakage, which must be guarded against very carefully indeed if air-core transformers are used. The chart herewith illustrates these conditions graphically—also showing how, in the absence of a suitable iron-core transformer for inter-stage use, it is possible to tune the air-core transformer with a variable condenser so as to bring its peak to resonance with the filter. The latter method is not, of course, very popular, owing to multiplicity of controls.

Under these circumstances it is not difficult to see the value to the Super-Heterodyne builder of an iron-core transformer, broadly tuned so as to avoid the necessity of matching, possessing at 30,000 cycles an amplification peak at least as high as any air-core transformer, and yet sloping off rapidly below this peak so that audio frequencies are attenuated rather than amplified. The use of such a transformer (marked R-110 in the diagram) in all stages except the first is one of the fundamental reasons for the great advance in tone quality and "quietness" represented by the set described in this article.

Another obstacle which has heretofore stood in the way of the use of beat-frequencies as low as 30 kilocycles is the necessity for even amplification of the "side-band." The nature of this "side-band" will be understood by remembering the formation of a beat-frequency by the inter-action of two other frequencies. In this same way a "carrier-wave" frequency of say 1,000,000 cycles, combined with an audio frequency of 4,000, produces a resultant frequency of 1,004,000 and also of 996,000. Since the important audio frequencies vary from about 4,000 per second down to almost zero, any radio frequency amplifier suitable for radiocast use must amplify equally all frequencies from 4,000 *less* than the carrier-frequency up to 4,000 *above* it. Now a band eight kilocycles wide is of little consequence when we are dealing with "carrier-waves" around 1,000 kilocycles. However, when we reduce the carrier frequency to 50 kilocycles, the lower four kilocycle "side-band" begins to extend well down from the peak of the sharp resonance curve of an air-core transformer, unless it has a "rounded off" peak. If now, in order to secure still greater stability and ease of amplification, we come further down to say 30 kilocycles intermediate frequency, the still greater relative width of the "side-band" represents, as indicated graphically in the chart, the reason why the slightest discrepancy in the matching of air-core transformers may introduce a serious distortion of tones.

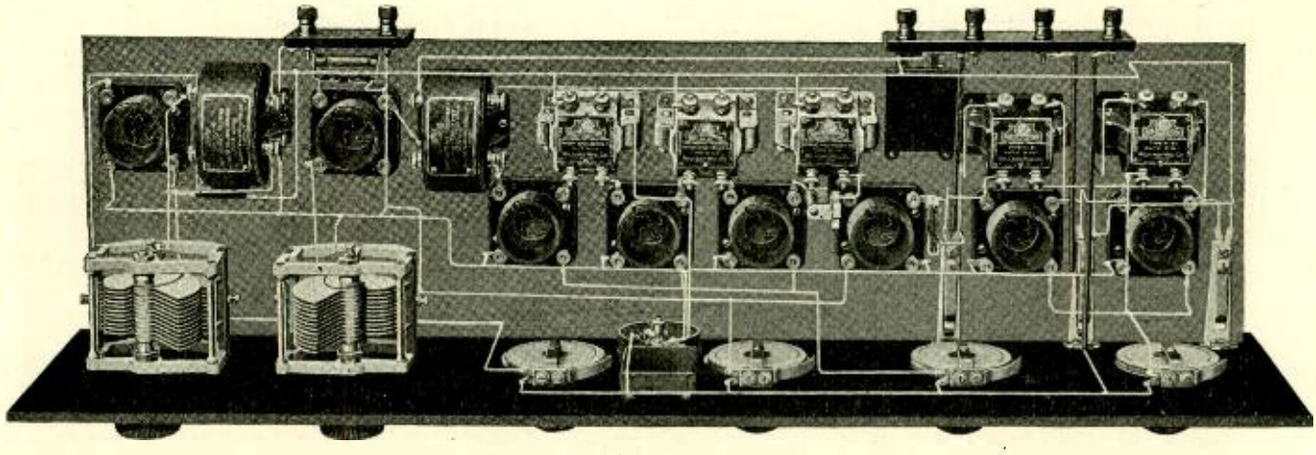

Fig. 4—Looking down on receiver

With any fairly well designed iron-core instrument this difficulty disappears, but another is likely to come in, as suggested above—the curve may now be so flat that the transformer amplifies "noise currents" of audio frequency which may be present in the beat-frequency current. Hence the necessity of using, in a 30 kilocycle Super-Heterodyne, an inter-stage transformer having an amplification curve of just the right shape.

Improvements of considerable importance have also been made in

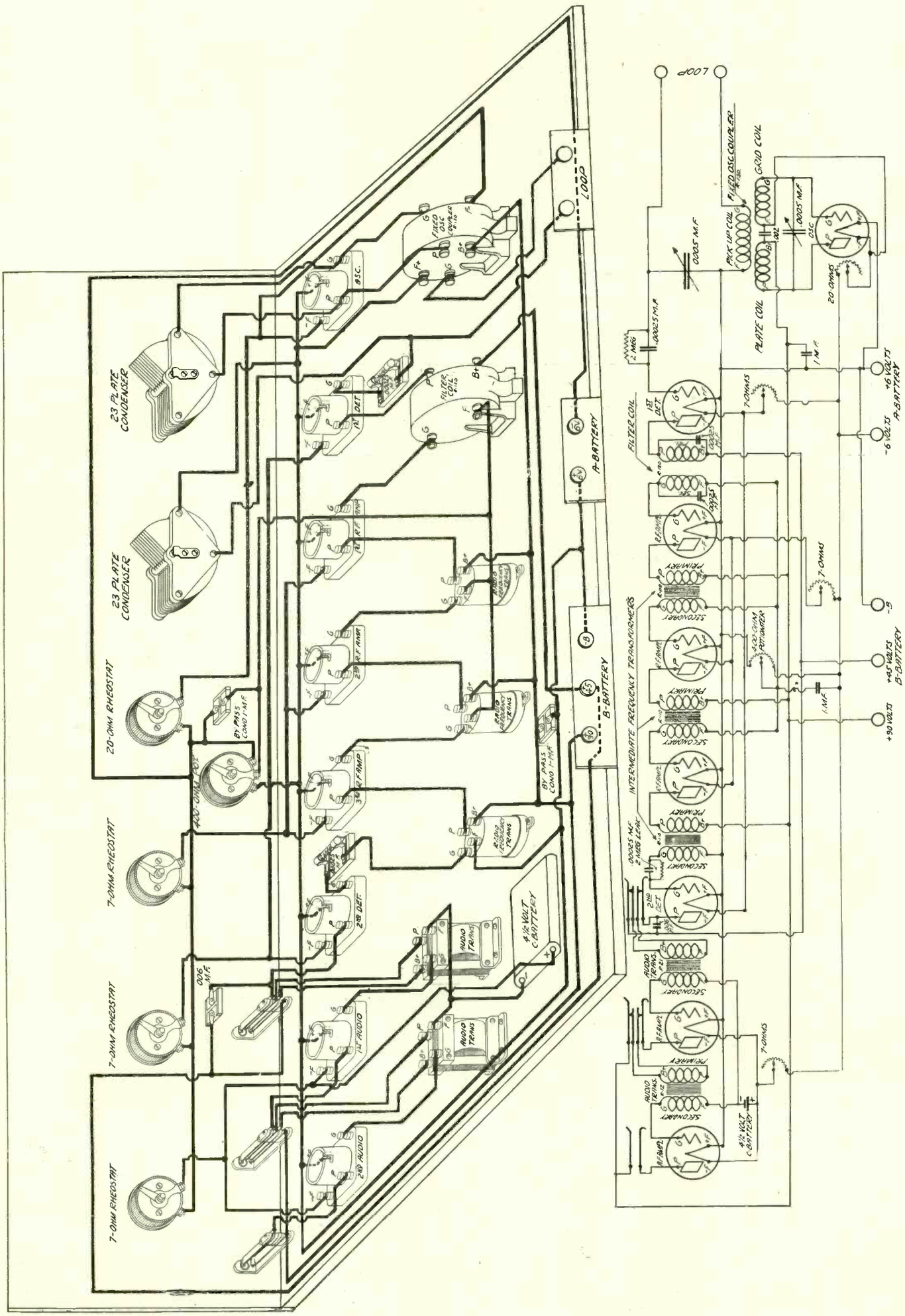

Fig. 5—Graphic illustration and schematic diagram of complete receiver

other parts of the Super-Heterodyne layout. Simplified wiring must be considered a matter of importance in any radio set, and especially so in one having a large number of tubes. It will be seen in the photographs that the wiring at the input end of the set here illustrated is of remarkable simplicity as compared with earlier hook-ups. The reasons will be found in the employment of two instruments which have just recently been brought out. The first of these (shown at R-130 in the diagram) contains three coils, all coupled together inductively. One is in the grid circuit of the oscillator tube and one in the plate circuit, these two providing the grid-plate coupling which produces the oscillating circuit. The third coil is connected in series with the loop antenna, giving the required coupling between tuner and oscillator. The second of these recent-type instruments (shown at R-120 in the diagram) is a filter transformer having an amplification peak which is steep-sided for selectivity, yet well rounded off at the top in order to pass the side-bands without distortion. Both of these instruments have, built inside their bakelite cases, the necessary fixed condensers, as shown in the wiring diagram. This results in a very decided simplification of the wiring necessary on the base board.

III. Construction of an 8-Tube, 30-Kilocycle Super-Heterodyne

In this article are given three photographs of an 8-tube receiver which embodies all of the recent improvements discussed in the above paragraphs. Most of the wiring of the set is plainly seen in the actual photographs, but since a few of the wires are not visible throughout their entire length, we have shown also a full perspective view of the entire set, with the parts slightly re-arranged in order that every wire may be in full view. It will be understood, of course, that in actual construction of the set the arrangement of parts shown in the photographs is preferable, since it has been very carefully worked out for the fewest, shortest and best placed lead wires, consistent with proper spacing of parts. The set is not a bulky one; in fact its over-all length is considerably less than that of earlier sets, largely due to the simple and compact layout at the input end.

As to the choice of the actual parts to be used, in some cases there is considerable latitude. It may be remarked, however, that in order to use the simplified wiring indicated, it is essential to use a filter having the fixed tuning condenser ncorporated in the instrument itself, as mentioned above; also that the by-pass condenser used with the oscillator coupler shall be likewise built in as a part of the coupler. It is very important that the variable condensers used should have a low dielectric loss, and for this reason it is bad practice to use condensers with a separate or fly-leaf vernier. No vernier rheostats are required. A C-battery for the audio stages is shown in the diagram, although its use is not at all necessary; in fact, none was

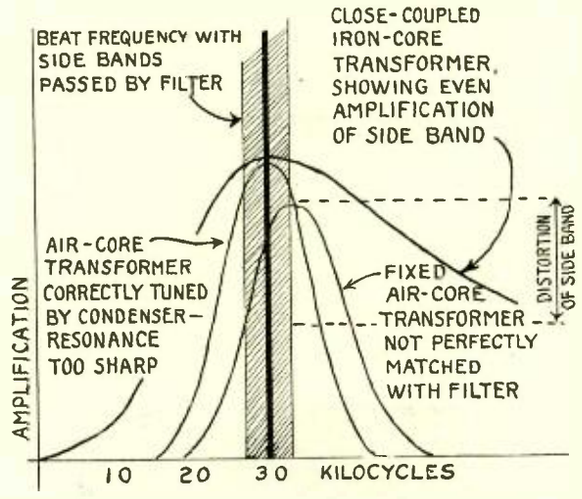

Fig. 6—Graphs showing amplification at different frequencies

used in the actual set photographed. The C-battery, of course, reduces the drain on the plate batteries, and may contribute somewhat to better tone quality, but represents a slight added complication.

Any receiver using a large number of tubes calls for special care in the selection of sockets, since the danger of bad contacts at the socket springs increases with the number of tubes used. Sockets having side contact, thus taking the one-sided pressure off from the locating pin of the tube and equalizing the contact on all four prongs, have been proved to be a decided step in advance, and a number of sockets embodying this feature are now on the market. At the same time, complication in sockets is to be avoided, and, as in so many other radio parts, the simplest is likely to be the best.

Rectfication in both the first and second detector tubes of this set is by the ordinary grid-condenser method. Other methods have been tried out, and have been found to give no better results than the common method, which has therefore been adopted. Best results will usually be obtained by the use of grid condensers of about .00025 microfarad capacity on the first detector, and .0005 on the second detector.

A plate voltage of 45 volts is sufficient for normal operation of the set. Increased volume can of course be obtained by the use of 67 or 90 volts in the B-battery, if the added expense is not objectionable.

To readers who have been accustomed to view in the line of improvements various complicating devices frequently seen in Super-Heterodyne, it should be said that practically all of these devices have been tried out in connection with the set here described, and their value has been found to be very slight, since they are, for the most part, simply devices for overcoming the defects of imperfectly designed parts. For example, various types of shielding have been tried, but with a 30-kilocycle set using suitable parts well placed, there is but little occasion for the use of shielding, and it is not surprising that its introduction was found to be unnecessary.

Likewise the device of so-called regeneration in the loop antenna adds a needless complication to the control, since it requires an additional variable condenser. With the present set, we recommend

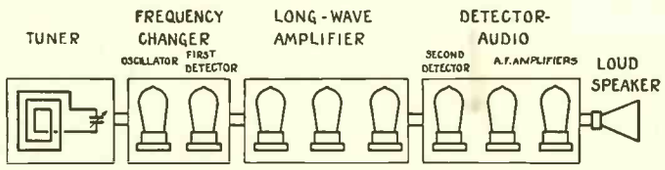

Fig. 7—Illustrating each unit of super heterodyne receiver

the use of a simple loop antenna, wound 10 turns on 4-ft. cross arms in helix form, spaced about ½ in. between turns. Any good standard loop antenna designed for use with a .0005 mfd. tuning condenser will also be found satisfactory.

The set illustrated uses eight tubes of the 201-A type. These are commonly employed in Super-Heterodynes, and while it is possible to use dry-cell tubes, it will be found much more satisfactory to provide a 6 volt storage battery and use the 201-A's. The amplification obtained per stage is thus considerably greater than with dry-cell tubes, and the battery economy is better, since eight tubes of any type represent a heavy current drain on a dry-cell "A" battery.

For the experimenter who likes to wind his own coils, it may be said that it is by no means impossible to wind by hand an oscillator coupler which will give satisfactory results, though the neat compactness of the photograph could hardly be expected. In the case of the filter transformer, however, it is not advisable to attempt a home-made job, since, as explained above, the shape of the characteristic has such an intimate effect on the performance of the set. A filter wound so as to pass the side bands will most likely be found wanting in selectivity. If any coils are used which do not have the fixed condensers built in, by a reliable factory, it is highly important to use reliable, accurately-marked condensers. The same holds true, though in a less degree, for the .006 and 1 mfd. condensers, which must be provided separately in any case.

In a set as simple as the one in the photographs, there is but little need of detailed directions as to assembling. Once the panel is drilled according to the layout given, and the parts attached as shown to it and to the baseboard, it is merely a matter of following the wiring diagram. This has been given both in conventional and pictorial form, so that either or both can be used for reference, as well as the actual photographs of the set. Probably the best practice is to proceed first with the wiring of the "A" battery or filament circuits, including of course the rheostats. It can then be tested, if desired, by inserting tubes and connecting the "A" battery, before any of the other wiring is installed. Whether or not this has been done, when the complete wiring has been completed and the entire set is ready for test it is well to insert only one tube at a time, in each socket successively, in order to make absolutely sure that no error in wiring shall result in a wholesale blowout of tubes.

The layout given does not include a voltmeter, as, in the judgment of the designer, the expense of the meter is not warranted by any value it may have in operation of the set. Once the tubes are installed, and faintly lighted by turning the rheostats part way on, we have only to turn them up until further increases of filament current give no increase in volume of sound. When this point is found, the tubes are operating at their correct voltage.

The usual two stages of audio frequency amplification are used (indicated by R-21 and R-12 in the diagram) since they give more volume in the loud speaker as distinguished from distance range than could be obtained from two additional intermediate-frequency stages. No special type of audio transformer is required, but it must be remembered that no matter how good the rest of the set may be, its entire performance may be ruined by imperfect audio amplification. The virtues of audio-frequency transformers depend to a high degree on the quality of the machinery as well as the workmanship used in their manufacture, and no assurance of reliability is as effective as the knowledge that the transformer carries the stamp of a well-known and well-equipped factory.

As to the receiving range which may be expected of an improved Super-Heterodyne, this depends more on atmospheric conditions than on the set itself. It is generally recognized that any really good eight-tube "Super" will, under ordinary conditions, bring in any signal which has sufficient strength to be distinguishable from minute atmospheric disturbances. If this were not the case, it would be common practice to use more than three intermediate-frequency stages.

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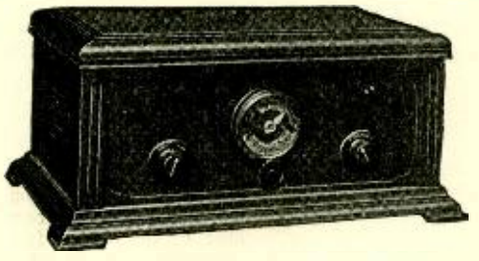
Without tubes or batteries. **$150.00**



TRF-5 (as illustrated)—is identical with the above but encased in smaller cabinet without built-in Reproducer. Cabinet measures: *height*, 9⅝ in.; *length*, 20½ in.; *depth*, 14¾ in.

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By LLOYD C. GREENE
Radio Editor of the Boston Globe

If you cannot afford a Super Heterodyne Receiver choose a Concert Selector.* This truly remarkable receiver embodies rare features in its design and circuit arrangement and unquestionably marks a distinct step toward the perfection of radio concert reception.

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PERHAPS the biggest problem facing the radio world today is interference caused by radiating receivers. It is true that we have other interferences to contend with in static and code signals but these are mere nothing by comparison with that which is universally known to the radio fan as "squealing." The regenerative receiver, at whose door the blame for the squealing nuisance is properly placed, has served its purpose and served it well. As the horse-drawn vehicle was superseded by the automobile to meet the demands of modern transportation, so the regenerative receiver is rapidly giving way to radio apparatus more modern and better suited to present radio needs and eventually must disappear from use.

The Concert Selector is designed to meet present day conditions, requirements and demands. The first and paramount requirement which any modern receiver must meet is that its design shall preclude any tendency to oscillate and produce "squeals" under ordinary operating conditions. The Concert Selector admirably meets this requirement in a simple and most effective manner.

Any modern receiver which would so much as flirt with the word "efficiency" should have sensitivity or range, selectivity and volume and embody a minimum number of vacuum tubes. Many radio sets are selective and not sensitive, or sensitive and not selective. There is little satisfaction with any set lacking either of these virtues. The Concert Selector is sensitive, selective and gives sufficient volume to operate a loud speaker on distant stations. To accomplish this it uses four vacuum tubes, UV-199s or C-299s. The current consumption of these four tubes however is less than that of an ordinary set using one UV-201-A vacuum tube. What is more either type of battery, dry cell or storage, may be advantageously used with the Concert Selector. It will work on 3 volts, 4½ volts or 6 volts filament lighting source. The voltage on the plates of the tubes may be varied at will, but need not exceed 67½ volts to operate loud speakers as against 90 and 120 on other receivers—another economical feature.

Another requirement of any good receiver is stability and simplicity of operation. Unfortunately in many types of receivers either and sometimes both these virtues are lacking. The Concert Selector owes its stability to a design which obviates all critical adjustments by dispensing with regeneration and so-called "radio frequency controls" in the form of potentiometers which latter as commonly used are really nothing more than makeshift devices for controlling regeneration. In tuning in broadcasts on the Concert Selector operation of the set has been reduced to simplicity itself. There are three controls, namely, "clarifier," "selector" and "R. F. amplifier." The "R. F. amplifier" control, located at the right hand, is set for the wave length of the station desired. The correct setting of this dial for any wave length is plainly indicated in the tuning chart. This dial setting will always remain the same for any given wave length so that once it is set for a station no further attention need be given it. Next set the clarifier dial at about 50 degrees. The middle or selector dial should now be turned carefully until the desired station is heard. If the selector dial setting falls on a number below 50 degrees, reduce the clarifier setting for best reception; if above 50, increase the setting of the clarifier. The great advantage of this method of tuning is that the amplifier control is set in advance of the station selector control. Therefore when the desired station is found on the selector dial it alone comes in highly amplified and cannot be missed.

In building the Greene Concert Selector readers are urged to follow instructions closely and to the letter and not to deviate from them in the slightest detail. There is a reason for this. Building a radio set is a lot like making a cake. When the recipe is followed and the proper ingredients included something edible results. If instructions are not followed failure results. This applies to radio as well as to the cake. I cannot enumerate here all of the things you should not do if you decide to contruct this receiver but I can assure you that if you will follow the directions you will be certain of a very satisfactory receiver when it is completed. It has been my experience in writing for radio experimenters that most failures in building radio sets are a result of trying to improve upon a device and ignoring directions. As a final word of warning I must tell you that if you do not follow the specifications for building the Concert Selector your results will be as highly unsatisfactory as any you have ever had.

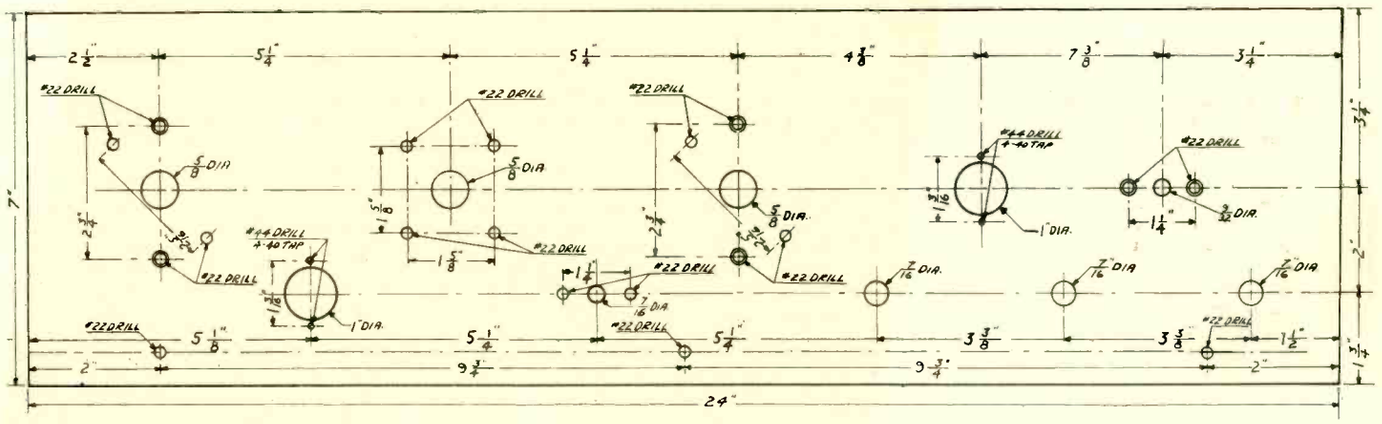


Fig. 1. Detail of front panel. The three holes along lower edge are for wood screws which fasten panel to baseboard. Holes indicated by double rings are countersunk

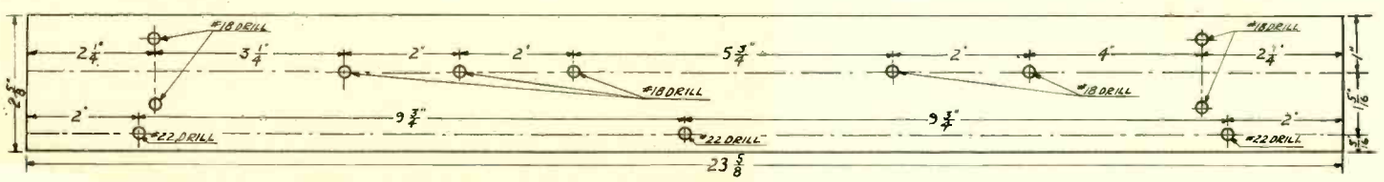
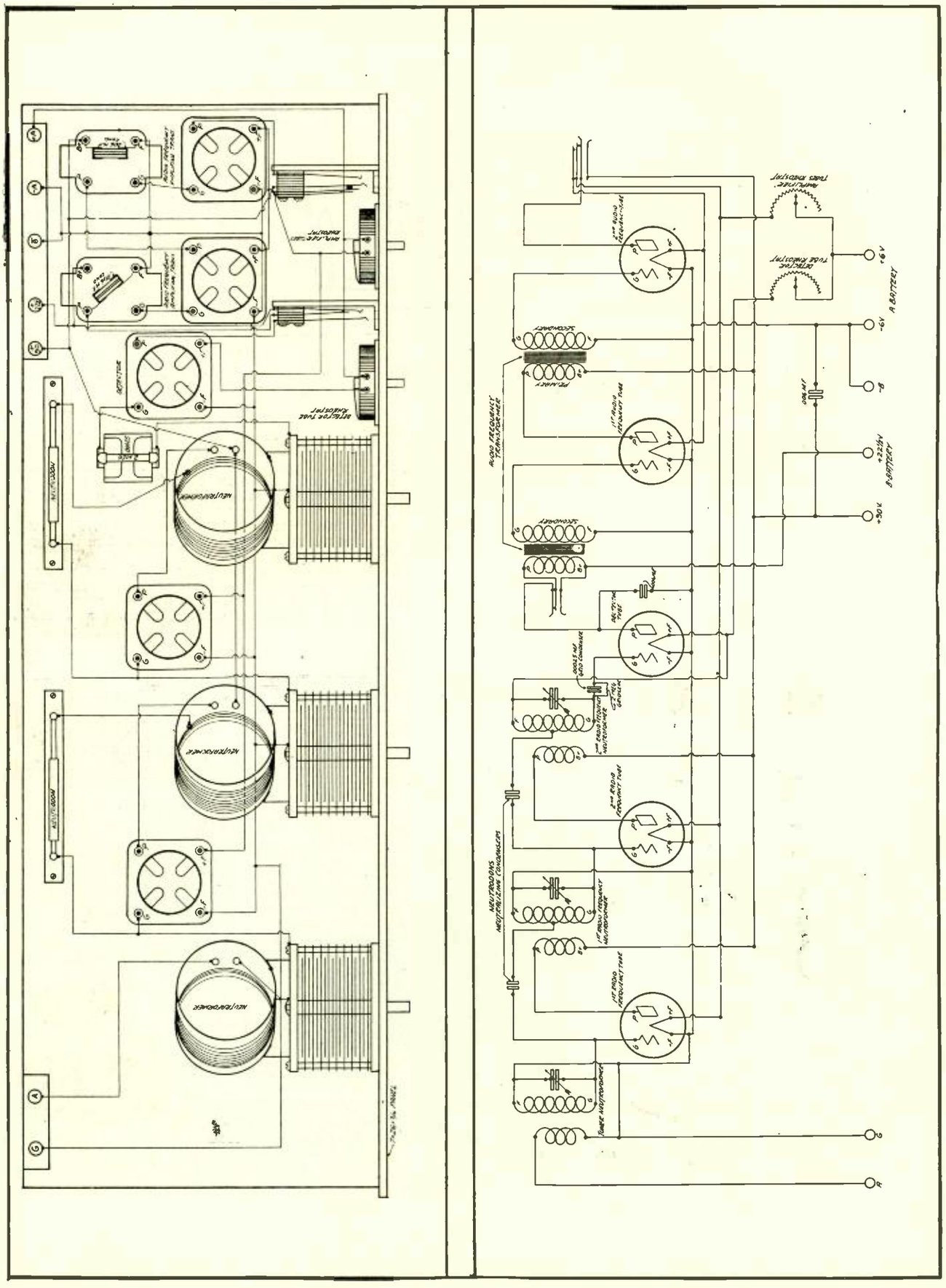


Fig. 2. Detail of back panel. The three holes along the lower edge are for wood screws which fasten panel to baseboard. All other holes are for binding posts. Use drill sizes indicated

Neutrodyne-Receiver



W O R K R I T E R A D I O S E T S W O R K R I G H T

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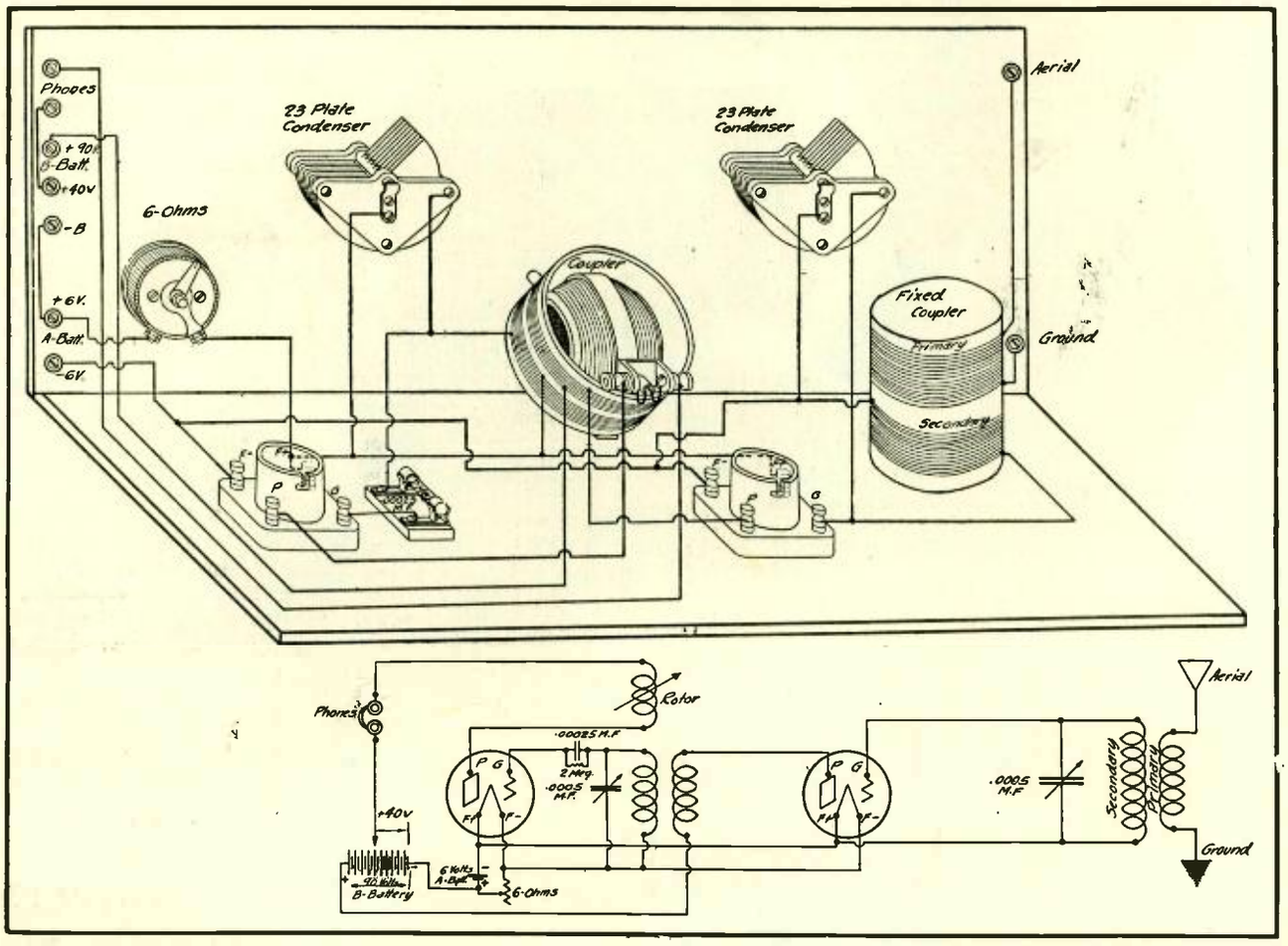
SUPER NEUTRODYNE RADIO SETS

Tell 'Em You Saw It in the Citizens Radio Call Book

Non-Radiating Regenerative Circuit



WITH the constantly increasing number of radio listeners, the problem of radiation from the regenerative sets has become acute and any circuit that reduces or eliminates this feature will be welcomed by all radio fans.

In the above circuit are several very interesting features. In the first place due to the untuned antenna, the set tunes independent of antenna length, which is a decided advantage. The tuning is exceptionally sharp and for that reason micrometer dials must be used on condensers.

Under certain conditions of wiring the feed backs between some of the wires may render it advisable to run the lead from the fixed coupler to a potentiometer instead of directly to negative "A" but this is not ordinarily necessary. A variable grid leak is strongly recommended because of the variation of operating characteristics of the tubes available on the market.

This set has given remarkable results, as it will tune out local stations on less than one-half degree on the dial and for distant stations require exceptional careful tuning even with a micrometer dial control.

The circuit operates very well with hard tubes but a soft detector tube may be used, in which case the proper "B" battery voltage must of course be used. Audio amplification can be added in the usual way.

For the advanced amateur who is interested in rather startling results, some very remarkable effects will be secured by placing an eleven plate condenser across the tickler coil, but it is not recommended to any one that is not possessed of a great deal of patience.

Care should be used in connecting the condenser with the rotary plates to the lowest possible potential in all cases, and as the set is somewhat sensitive to body capacity, shielding is advisable, although when operating properly the body capacity effect is hardly noticeable.

The selectivity and success of this circuit depends upon the use of the best parts obtainable and inefficient parts will ruin operation of circuit both as to distance and selectivity.

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Ask any Radio Fan or Radio Dealer what he thinks of Carter Products and he will reply that for quality and excellency of service they have no equal.

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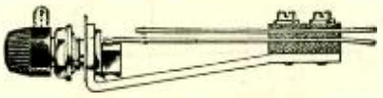

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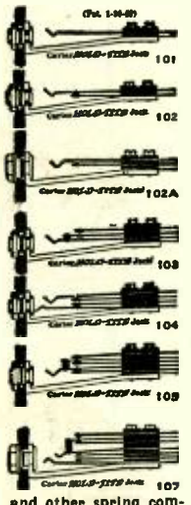

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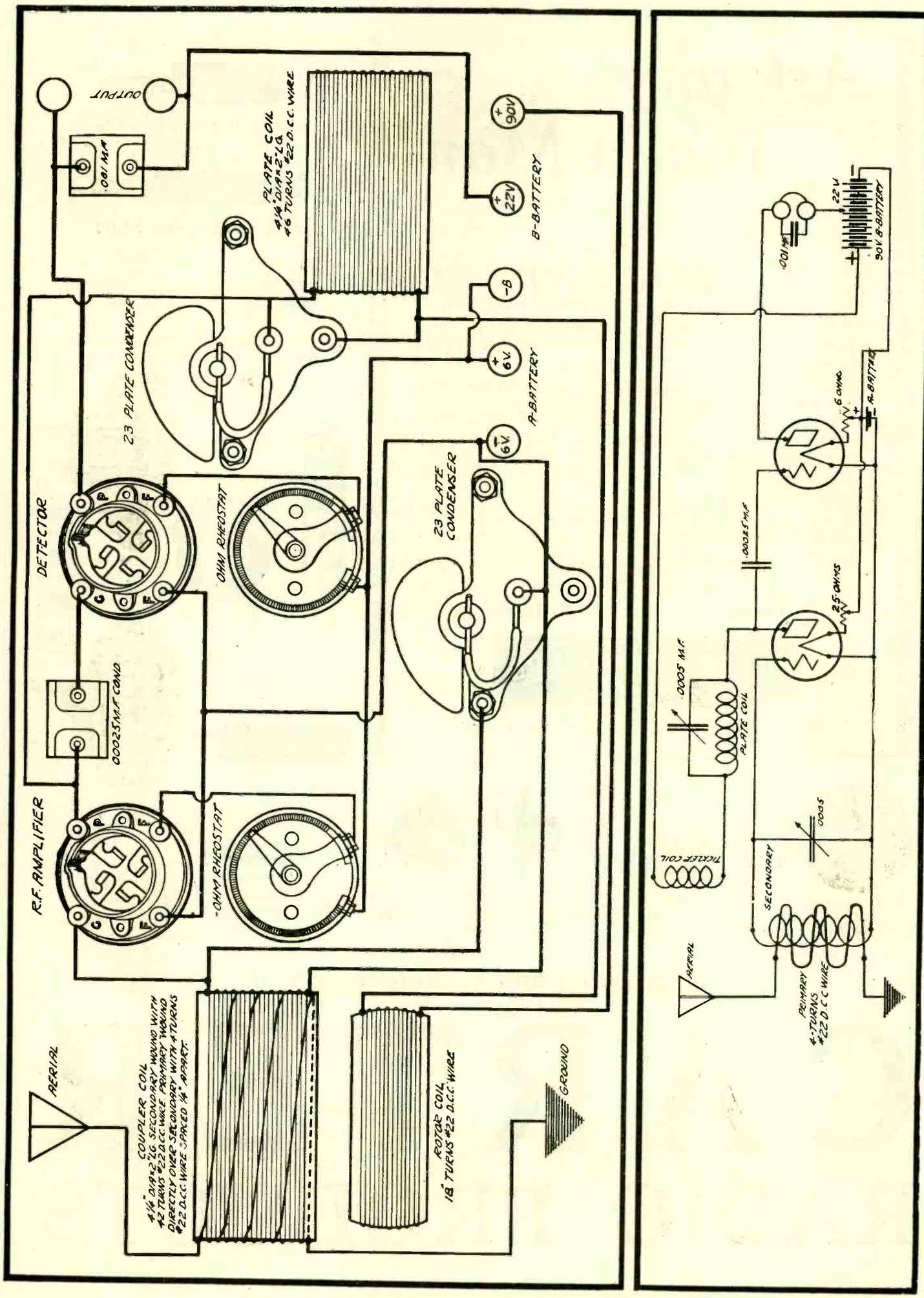
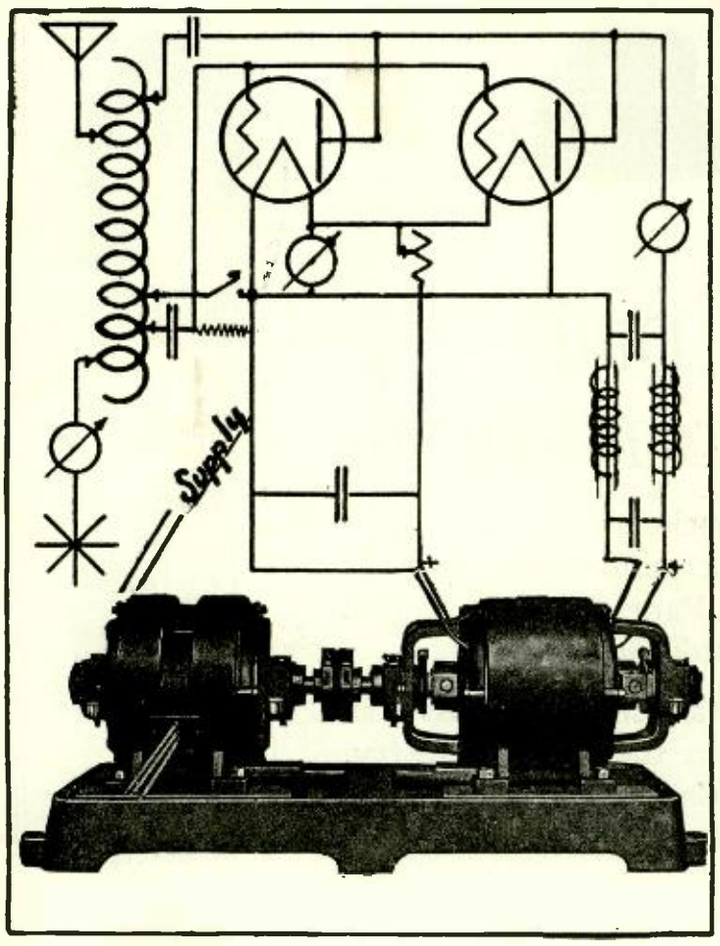
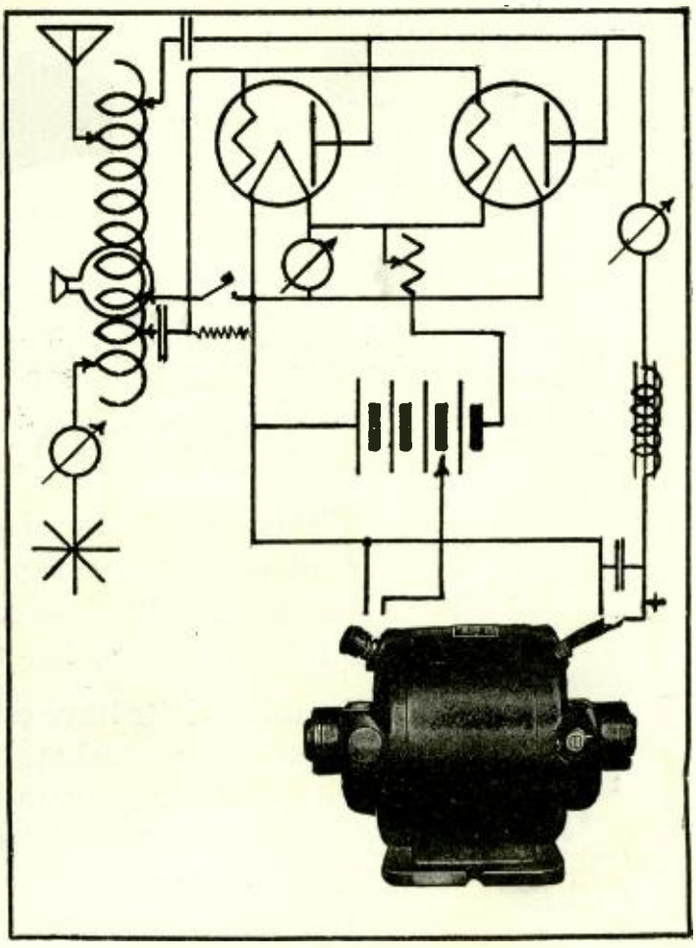
Superdyne Receiver





ITEM 35



ITEM 45

A Few Good Combinations

Item		Description	Recommended for	
2	350 V	40 Watt	2-5	watt with separate Fil. supply.
7	500 V	100 "	4-5	" with separate Fil. supply.
8	500 V	150 "	5-5	" 2 mod.-1 mast. osc.-2 osc. sep. Fil. supply.
13	1000 V	300 " dbl. comm.	2-50	" with separate Fil. supply.
15	1000 V	500 " " "	3-50	" or 2-50 watt and 4-5 watt as speach amplifier and mast. osc. Sep. Fil. supply.
16	1000 V	650 " " "	4-50	" with separate Fil. supply.
20	1500 V	600 " " "	2 to 3-50	" with separate Fil. supply.
24	2000 V	500 " " "	1-250	" with separate Fil. supply.
26	2000 V	1000 " " "	2-250	" with separate Fil. supply.
31	500 V	100 " -10 V 60	Watt Same as item	7 but with Fil. supply.
35	1000 V	300 " -12 V 150	" " " "	13 " " " "
41	2000 V	500 " -14 V 200	" " " "	24 " " " "

Many other sets for various combinations of tubes. Special sets made to order.

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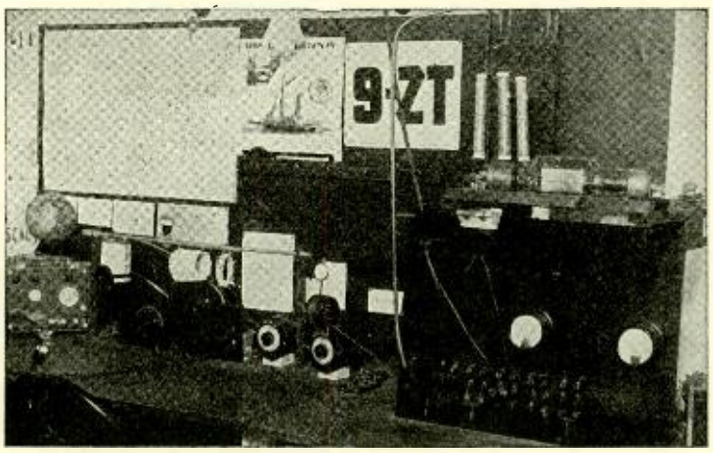
Wallace Wins 1923 Hoover Cup

DONALD CLAIRE WALLACE, of 9ZT-9XAX, Minneapolis, has been adjudged by the A.R.R.L. Board of Directors to have the best all-round home-made amateur station amongst those entered in the competition for the 1923 Department of Commerce Cup. This trophy, commonly known as the Hoover Cup, is an annual award of merit established by Secretary Hoover for the duration of his administration, and is awarded under the auspices of the A.R.R.L. It is one of the highest honors in Amateur Radio, and Wallace wins it fairly after years of hard work. E. L. Lester, 5NK, Houston, Texas, was runner-up in the estimation of the judges.



A General View of 9ZT-9XAX

It is difficult to appreciate the amount of hard work and stick-to-it-iveness required to build and operate an amateur station which, after the test of a year's time, is adjudged "the best." Hence it is very fitting that Mr. Wallace describe 9ZT and tell its history and accomplishments in his own words.

A DESCRIPTION OF 9ZT

By Don C. Wallace

Station 9ZT is the near realization of a lifelong ambition; namely to have a workable and useful amateur station. Compromises have had to be made; compromises between efficiency, practicability, workability, time of construction, and pocket book. It is part of the obligation of an amateur to have his station always in commission, somehow, some way. His masts may blow down, transformers burn out, and minor mishaps occur. 9ZT has been in commission always. Scarcely has any day gone by in the entire twelve months that this has not been true.

The entire set, in so far as is practical, was made by the operator himself. The station is operated by one man almost entirely. In a five-room bungalow, one bed room is designated as the "Radio Room." It likewise serves as a sewing room, nursery and guest room. When visiting "hams" operate, they can "turn in" to finish the night in peaceful sleep.

The question has often been asked where the time for operation comes from. This was planned for long ago; first by selecting a location close to work, just one and one-half miles from the center of downtown Minneapolis. The electrical efficiency of the station suffered thereby, but it was this or no radio at all. A "flivver" allows the extra half-hour sleep in the morning and saves a half hour at night. By going to bed at nine, going to sleep promptly and getting up sometime after midnight for two hours, an average of eight hours sleep per night is had which helps in fitness for the day's work.

The Transmitter

The transmitter utilizes one 250-watt Radiotron tube and the Hartley circuit. Simplicity exists thruout the entire layout. Extra apparatus is not connected in or near the circuit to add to the many losses which we know already exist.

Figure 1 is a general view of the station, with the transmitter at the right. The panel originally housed a set using two 50-watt tubes and in those days ICW and phone were cut in and out by the small D.P.D.T. switches. One now switches from high to low power, and the other cuts in a 1½ turn absorption loop for ICW or phone. The transmitting inductance behind the panel is wound with 33 turns of No. 9 wire five inches in diameter. Concentrated inductance has proven best, for though it gets hot, it delivers more antenna current than the larger inductances that now rest peacefully in the attic.

The tube is mounted so air will freely circulate about it. This allows an input 20% greater than could otherwise be used. The grid circuit is short, the UC-1806 .002-microfarad grid condenser being suspended in midair. A 200-turn honeycomb coil as a radio frequency choke is connected in series with the grid leaks as shown in the diagram. Four 5,000-ohm grid leaks are connected in series-parallel, giving an effective 5,000 ohms. The grid current meter, which in normal operation shows about 10 percent of the reading of the 0-500 plate milliammeter, is a Jewell 0-100 milliampere meter. The filament is heated from a Thordarson 300-watt transformer. The voltage developed was only 10.5 so additional windings were slipped around the core, care being taken to balance each side of the mid-tap. The filament voltage is maintained constant by a bakelite extension back of the key using "dime" contacts. The contacts on the extension short-circuit a resistance of a few ohms that is connected in series with the primary of the filament transformer when the key is down. Another feature of the set is an anti-key-clincker. The combination shown in the diagram has a negligible click compared with the commonly used 1-microfarad condenser across the key.

The antenna ammeter is mounted at the center of the window pane to the right of the picture, through which the lead-in enters. It is a Jewell 0-12 thermoammeter and when the key is down the needle hovers between 12 and the stop beyond. All meters and tubes are in clear sight of the operator; one glance tells all, and this feature has no doubt saved the tube on several occasions. The antenna and counterpoise leads are of ⅜-inch copper tubing, polished.

The send-receive switch at the lower left-hand corner of the transmitter panel is of the quick-throw type, connected as shown in the wiring diagram. By slowly pulling the switch the filaments are first heated; then the antenna connected to the transmitter, and the plate power put on. For receiving, the switch is simply pushed in.

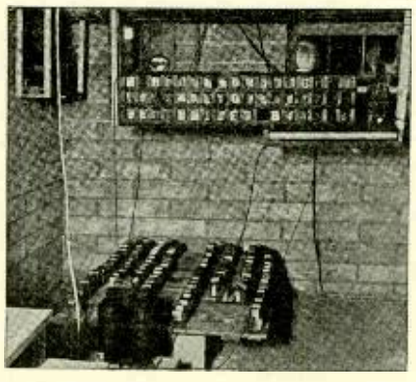


Fig. 2—The Plate Supply, in the Basement

It has been found poor policy to change waves, and except in rare instances, only two waves have been used; 215 meters and 115 meters. Those who wish to communicate with 9ZT can count on finding him on the same wave day after day. A General Radio wavemeter, special type, 75-2000 meters, is one of the most useful pieces of apparatus around the station. The antenna

current is six amperes on 115 meters. Several months ago 9ZT secured permission to use low waves, but the last week in December 9XAX was received as a call for this work.

Plate current is furnished by a transformer-rectifier-filter system in the basement directly beneath the radio room. This apparatus is shown in Fig. 2. Radio-frequency choke coils, mounted on the back of the transmitter panel upstairs, isolate the

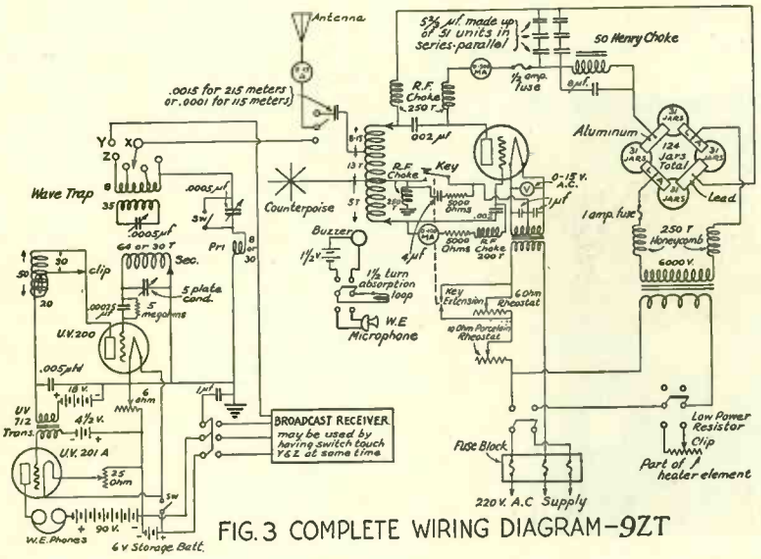


FIG. 3 COMPLETE WIRING DIAGRAM—9ZT

set itself from the power supply. Each of the two choke coils is made by winding 250 turns of No. 28 D.C.C. wire on a cardboard tube 4 inches in diameter.

The plate transformer is an old 3-kilowatt line transformer saved from the junk man. About 3500 to 4000 volts are applied to the plate of the tube. The electrolytic rectifier has 124 jars, and needs little attending. The submerged area of lead is 2 by 3½ inches, and the submerged area of aluminum is 1½ by 3½ inches, the strips being six inches long in each case and bolted together. Once every eight months new aluminum is inserted and the solution is changed once in four months. The solution for the rectifier was all mixed at one time in a tub and consists of ten gallons of Chippewa Battery water with two pounds of "20 Mule Team Borax" dissolved in it and a teaspoonful of household ammonia added. After all settlings had gone to the bottom, the jars were filled.

The filter system consists of 5⅔ microfarads of condenser across the high voltage line with a trap consisting of a Radio Corporation UP-1654 choke with 8 microfarads across it connected in the positive lead ahead of the other condenser. The condenser across the line is made up of 51 UC-490 condensers in series-parallel, three in series being placed across the line.

In the upper left-hand corner of Fig. 2 can be seen the storage battery for the receiving set and the rectifier for charging it.

The Receiver

The general view of the station (page 43) shows the receiving equipment quite well It will be recognized as a "low-loss" tuner, designed for selectivity, efficiency, and simplicity in operation. Such a receiver was the only answer to working through local interference, for there are many radio stations in a community such as the Twin Cities. A coupled wave-trap assists in weeding out stray key clicks and other interference. The sending antenna is used to receive with, although a single-wire antenna is often used. The wiring of the complete receiver, which includes a stage of audio amplification, is shown in the diagram.

A basket-wound coil of either 7 or 21 turns is used in the antenna circuit. When the larger coil is used the antenna circuit is tuned by means of a General Radio type 247 condenser connected in series with it. With the smaller coil it is left untuned.

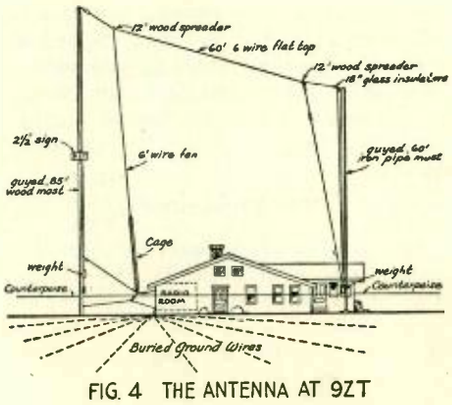


FIG. 4 THE ANTENNA AT 9ZT

The secondary circuit of this set consists of a basket-wound coil with a Cardwell condenser, cut down to five plates, connected across it. The three rotary plates are cut so as to give a uniform wave-length increase as the dial is turned. The wave-length range with a 64-turn secondary coil made of No. 17 wire is from 135 to 235 meters. When a 30-turn coil is put in place of the larger coil the wave-length range is from 65 to 135 meters. An 18-turn coil goes down still lower and 1XAM has been worked on 56 meters with ease. The primary and secondary coils can be seen in Fig. 1, suspended from the wooden rod in the left of the photo.

The plate inductance is wound on a cardboard tube with a small rotor in one end. It is not magnetically coupled to the secondary coil. The set oscillates freely over the entire range and little adjustment of the plate coil is ever necessary. Tuning either the primary or plate coil does not disturb the secondary tuning, so the secondary circuit can be calibrated quite accurately. The General Radio wavemeter comes in handy in finding the wavelength of stations received.

The UV-200 detector tube and UV-201 amplifier tube, with their associated apparatus, are mounted behind a hard rubber panel. Care has been taken to make all leads short and direct, thus avoiding losses. Western Electric phones are used.

The Antenna

Figure 4 is a general view of the antenna system, showing the arrangement better than the photograph, Fig. 5. All dimensions will be apparent from the drawing. The 85-foot wooden mast is very sturdy and

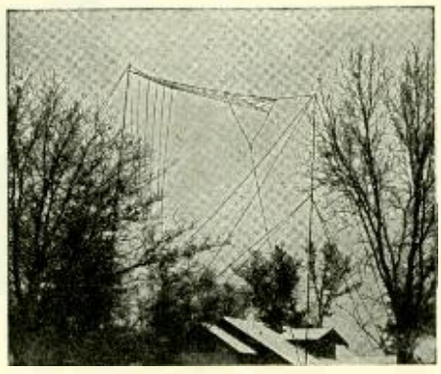


Fig. 5—The Antenna at 9ZT

well-guyed. Previous to the time it was erected 9ZT lost two masts in Minnesota storms, so this one was put up to stay. (The description of this mast, with the story of how it was put up, single handed, is a story in itself. We will tell about that later.—Dept. Ed.)

The flat top is of six wires, each sixty feet long. The wires are 7 No. 22 enameled and stranded, on 12-foot wooden spreaders. Eighteen-inch plate glass insulators are used throughout the antenna and counterpoise system. There is one of these at each end of the antenna where the halyard joins the flat top. These insulators are a feature of the station that cannot be overlooked and their construction is illustrated in Fig. 5. The rubber bushing is omitted in the counterpoise insulators and those used to guy

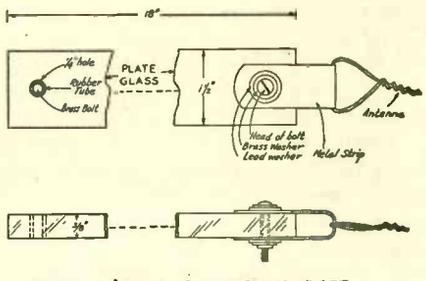


FIG. 6 18" GLASS INSULATORS USED AT 9ZT

the lead-in. Using a broken three-cornered file, a brace, and plenty of turpentine, the glass is drilled very easily.

This antenna was put up nearly a year ago and has withstood all storms since that time. The counterweight at one end lessens

the strain on the system. A heavy wind storm will raise the weight, lessening the strain on the antenna, and sleet cannot break it down. The pulley line is flexible galvanized steel cable and will not freeze to the blocks as readily as rope.

The counterpoise has 23 wires and is more or less radial in shape. It is made mostly of cast off wire, the remains of earlier antennas. Arranged like the spokes of a wheel with the station as the hub, the covered circular areas is about 170 feet in diameter—thanks to the kindness of the neighbors. The 18-inch plate glass insulators mentioned above are used thruout. All joints in both the antenna and counterpoise are carefully soldered.

9ZT's "DX" List

9ZT's signals have been heard in Alaska, New Zealand, Australia, Hawaiian Islands, Mexico, Panama, South America, Porto Rico, Cuba, England, France, and aboard WNP. Stations in every Province of Canada and every state of the Union have been worked. WNP has been worked, and also

The 1923 Hoover Cup, Won by 9ZT-9XAX

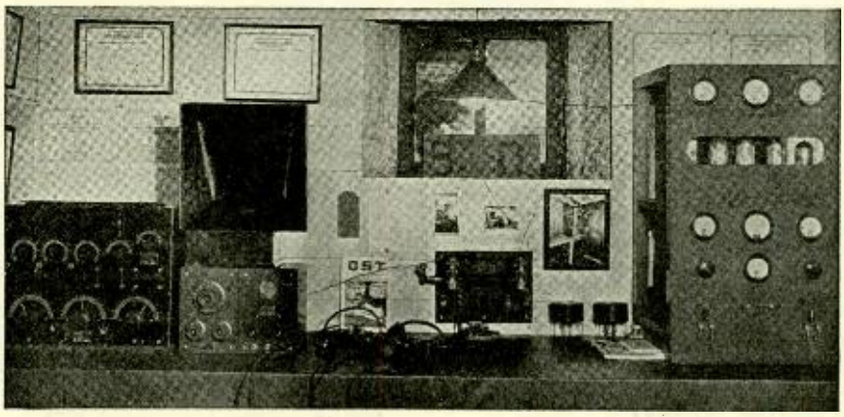
French 8AB, the latter by the process of 1XW acting as the receiving station, relaying 8AB's transmission to 9ZT.

One Sunday morning seven districts were worked after arising at six. 5ZA at Roswell, New Mexico, was worked after 8:30 A.M., broad daylight at both places, and the distance was 1200 miles. Stations on the West Coast have been worked as early as 5 P.M. their time. All U. S. districts have been worked in one night, and up to eleven different districts, including Canadians of course, have been worked in a single night. On 115 meters, using the call 9XAX, 1XAM is worked night after night. One year ago 1QP was worked night after night on 200 meters with the regularity of inter-city communication. That reliable work can be done in the summer time was proven when 9ZT worked 47 West Coast stations during last May. Stations on both coasts are worked consistently and regularly the year around. Examination of the station records and log confirm these records and show the remarkable consistentcy of 9ZT's signals.

8ZD-8VE, Pittsburgh, Pa.

Radio station 8ZD-8VE is owned and operated jointly by P. E. Wiggin, old 8XH, and F. B. Westervelt of 8VE, and is located at the home of the latter at 5306 Westminister Place, Pittsburgh, Penn. The station is in a basement room about 15 feet square. The walls are painted white, heat is provided by a furnace in an adjoining room and everything is arranged for the convenience of operators and visitors who come to pound brass in the early hours of the morning.

On the right of the table is the main transmitter which employs five 50-watters



arranged for C.W. phone or chopper. When phone is used the Heising system of modulation is employed, two 50-watters acting as oscillators, three as modulators and a 5-watter as speech amplifier. The Hartley circuit is used. Plate current is furnished by a Westinghouse 1000 volt motor-generator set under the table. The filaments are supplied with A.C. On the front of the panel are meters for indicating values of D.C. plate voltage, antenna current, oscillator grid current, modulator plate current, filament voltage, oscillator plate current and modulation. The filament rheostats are located on each side of the modulation meter and the switch below is for changing filament voltmeter from the oscillator tube circuit to the modulator tube, as each has separate rheostat control. The other two switches break the 110-volt 60-cycle A.C. lines to the filaments and motor-generator set. Power to the station is supplied direct to the operating room by a three wire 110-220 volt line capable of standing a 200 ampere load, so there is "power to burn."

To the left of the transmitter is the send-receive switch which starts and stops the motor generator set, closes the filament circuits and transfers the antenna and counterpoise from receiver to transmitter.

The receiving apparatus consists of a Westinghouse RC set that has been altered to cover the wave length band between 85 and 275 meters. To the left of the RC set is an old C.R.L. Paragon with detector and two-stage amplifier. Baldwin and Western Electric phones are used when headphones are desired, while a Callophone (lour speaker) may be used at times on strong signals.

On the other side of the room is equipment arranged in regular ham style for rapid changes in circuit. A 500-watt experimental tube is used at times in this set-up. A good wavemeter and other experimental apparatus are also in the station and come in handy.

The antenna consists of two 6-wire cages 6 inches in diameter and spaced about 10 feet apart. It is 70 feet high and 65 feet long and is used in conjunction with a 10-wire fan counterpoise. The antenna and counterpoise lead-ins are brought through holes in the window panes directly above the change-over switch.

The transmitter first described, using one 50-watt tube with pure D.C. plate supply, was used at 8ZD last winter and worked every state with the exception of two, and was heard in every district, Canada, Panama, Porto Rico and in England. A traffic record was also established in the handling of 2855 relay messages between February 15 and March 15 of last year. On the call, 8ZD, only D.C.C.W. is employed, while phone, chopper, I.C.W. or A.C.C.W. may be used on 8VE.

"If it *can* be QSR'd it *will* be" is the motto of this station.

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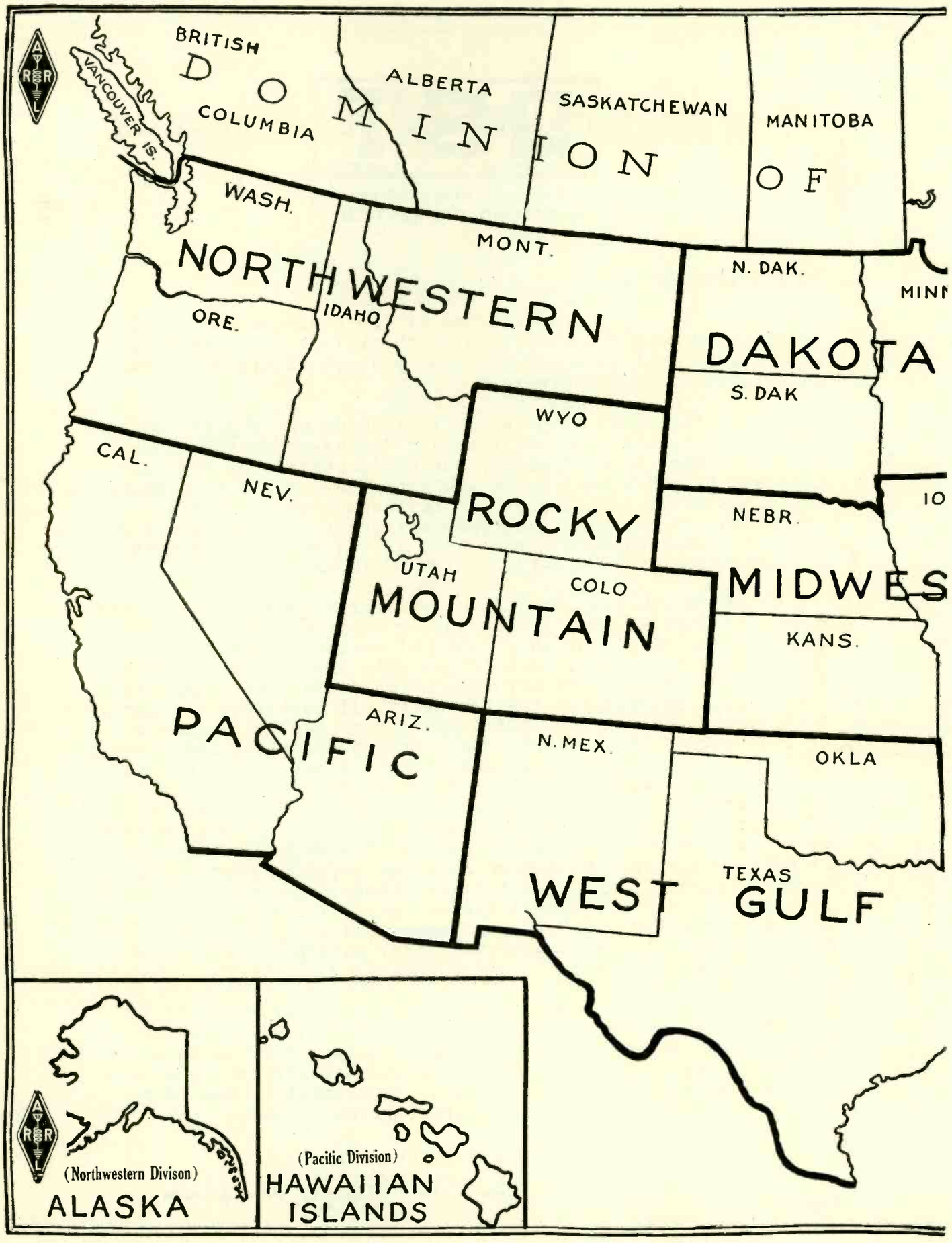

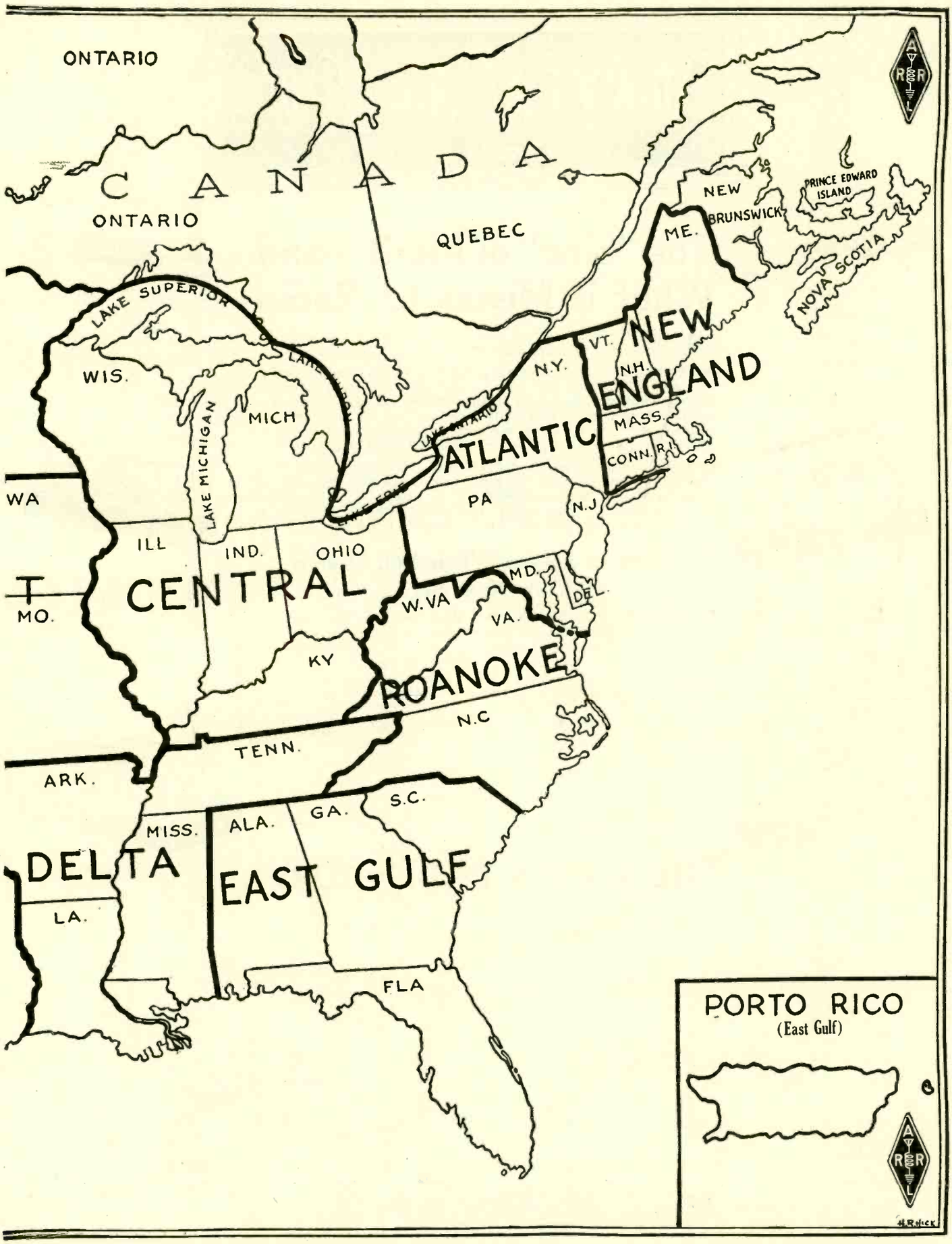

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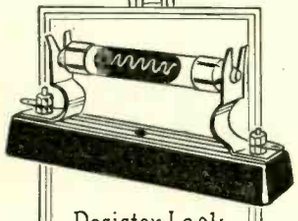
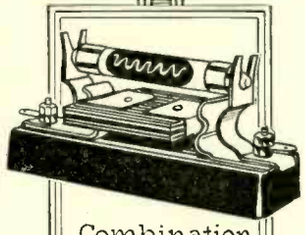
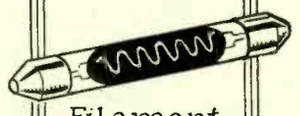
Resistors and Grid Leaks



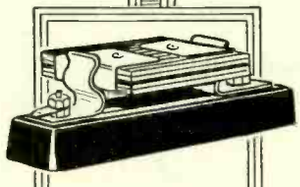
Resistor-Leak Mounting



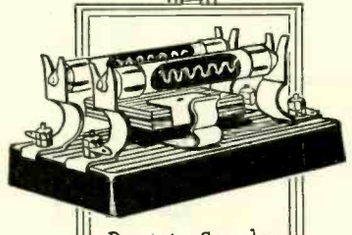
Combination Gridleak Condenser Mounting



Filament Ballast Resistors



Condenser Mounting



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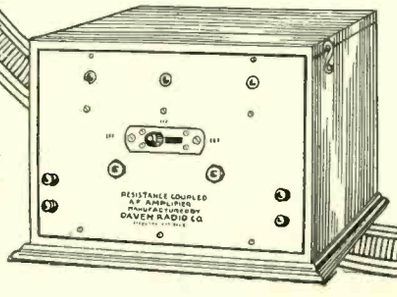
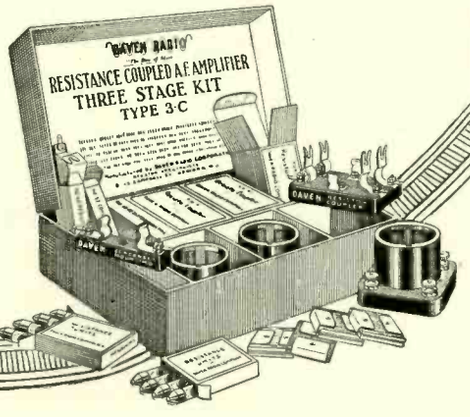


De Luxe Amplifier



Type 3-C Kit

The How and Why of Resistance Coupled Amplification

By ZEH BOUCK

1. What is Resistance Coupled Amplification?

Resistance coupled amplification is a system of intensifying current variations through the magnifying action of the three element vacuum tube. It is called resistance coupled amplification because the output of one tube is passed on and inputted to the succeeding tube through the functioning of a high resistance included in the plate of the preceding tube.

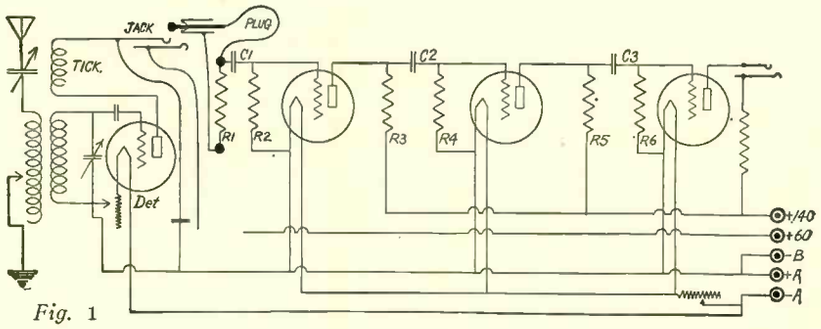


Fig. 1

Figure 1 is the circuit of a three-step resistance coupled amplifier. Taking one of the coupled units as an example—bulb one and bulb two—the action of the amplifier is as follows: With an incoming signal, radio telephonic or telegraphic, the plate current of tube one necessarily varies in strength. This causes changes in the potential existing across the terminals of resistance R3, because the instantaneous voltage across any resistance is always equal to the momentary value of the current times the resistance.

This varying potential is applied to the grid of the second tube through capacity C2—an isolating condenser (sometimes referred to as a coupling condenser because of its position) placed in the circuit to isolate the grid from the very high positive potential applied to the plate of the preceding tube through resistance R3.

R4 is a gridleak which, through leakage, prevents the accumulation of excessive charge on the grid which would cause the tube to choke, resulting in distortion or rendering it inoperative.

The average values for the circuit are: Coupling resistors, R1, R3 and R5, 100,000 ohms each; isolating condensers, C1, C2 and C3, .006 mfd. each; gridleaks, R2 R4 and R6, respectively 1 megohm, ¼ megohm and 50,000 ohms. These values will seldom require variation when using the UV201A and similar tubes. Exceptions to these standards will be described farther on in this article.

2. What is the advantage of Resistance coupled Amplification over other systems?

The outstanding superiority of the resistance coupled amplifier is the quality of output. There are certain characteristics in inductive windings which give rise to frequency partiality. An amplifying transformer is composed of two highly inductive windings, the primary and the secondary, and it is inherently impossible for a transformer to give the same degree of amplification at all frequencies. The result is distortion which, in defiance of improved design, is still noticeable to a greater or less degree varying with the excellence of the instrument. Corrective measures, such as elaborate filters, are possible, but these are only a pound of cure and beyond the facilities of the radiocast fan.

The relation between the input and output of a resistance coupled amplifier is practically linear. Less technically, the elimination of all inductive windings results in amplifying all frequencies to practically the same degree, limiting distortion to stresses imposed by unfavorable characteristics of the tube. The output of a correctly designed and operated resistance coupled amplifier is auditively perfect.

3. How does Resistance Coupled Amplication compare with transformer coupled intensification in efficiency?

This really depends on the criterion of efficiency. The amplification per stage of resistance coupled amplifiers is not so great as that of transformer coupled arrangements. Also, for the correct operation of an R. C. amplifier, from one and a half to twice the usual amplifying plate voltage is necessary. However, **results per dollar** is the ultimate standard of efficiency, and in this consideration the resistance coupled amplifier ranks first.

Three stages of resistance coupled amplification cost slightly less than two steps of transformer intensification, the former giving volume equal to the best and superior to the general run of the latter. Regardless of the extra "B" battery, the very low plate consumption, the "modulation down" (to be explained later) and the absence of "C" battery reduces the maintenance cost to an economy. Also, when the unequaled purity of tone—the quality—is considered, the efficiency of this amplifying system is doubly established.

4. How many stages of Resistance Coupled Amplification can be used? What are the values for additional steps?

Three steps are sufficient for all ordinary purposes, giving amplification generally greater than the output of a two-stage transformer coupled amplifier. Two steps inputted from an efficient regenerative or reflex tuner will operate a loudspeaker with fair volume.

More than three stages are not to be recommended in conjunction with reflex and superheterodyne receivers. Two steps will generally give sufficient volume and obviate the complications to which additional stages may give rise.

For radio reception purposes, four stages is the practical limit. This means at least a five tube receiver. Switching or jack arrangement should always be provided for cutting out the last tube, for it will be necessary only on very weak signals and for concert or dance entertainment. A UV201A or a similar tube will seldom give satisfactory results as the fourth bulb on loud signals. The signal strength will generally exceed the capacity of the tube and distortion will result.

A 216A tube, or similar power bulb is recommended in the fourth stage. A coupling resistance of 100,000 ohms, and a gridleak of the same value should be used with this tube.

Employing a UV201A, a coupling resistance of 100,000 ohms is recommended with a gridleak of 50,000 ohms.

The preferred circuit for a four-stage resistance coupled amplifier is shown in Figure 2. The indicated switching arrangement makes possible the elimination of the last tube, transferring the output from the fourth to the third bulb and controlling the filament. A small double-pole double-throw switch is used for this purpose. (The so-called "Anti-capacity" switch is quite convenient.) The values of the first three steps are identical with those outlined in our opening paragraphs.

6. Can Resistance Coupled Amplification be used successfully with a crystal detector?

Yes and no. It cannot be applied directly to the output of a crystal detector—that is, connecting it to a simple crystal receiver. The resistance coupled amplifier is essentially a current operated device. One stage of transformer coupled amplification should be interposed between the crystal detector and the resistance coupled amplifier, as shown in Figure 8. The primary of the amplifying transformer is merely substituted for the telephone receivers, regardless of the tuning circuit. It may be necessary to reverse the primary connections.

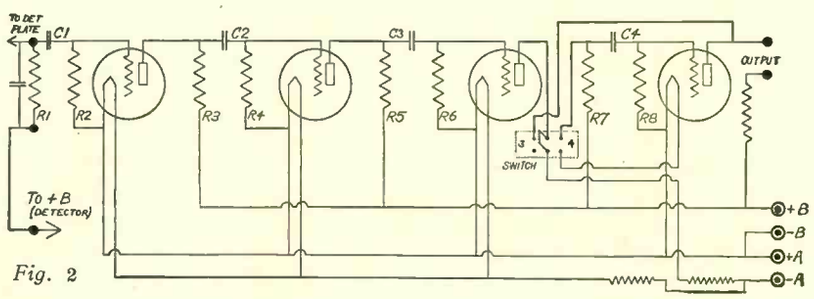


Fig. 2

The resistance coupled amplifier can, of course, be applied successfully to the output of a crystal rectified reflex receiver, such as the typical one tube reflex. This is a very desirable combination, the clarity and quality of the crystal detector being maintained throughout amplification.

7. Can Resistance Coupled Amplification be added to a transformer coupled amplifier? Is this worth while?

Yes, this can be done quite readily and is often desirable. However, no more than one stage of transformer coupled am-

plification should be used before the resistance amplifier. If two transformer stages are used the distortion will be such that the great advantage of the resistance coupled amplifier, quality, will be lost.

Figure 3 shows the manner of connecting the resistance-coupled amplifier to the output of a transformer coupled intensifier. Two stages of R. C. will be sufficient.

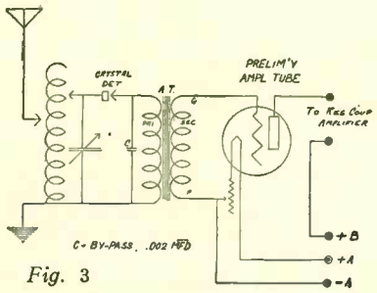


Fig. 3

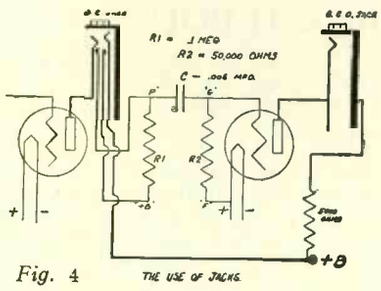


Fig. 4

8 Can Resistance Coupling be used for radio frequency amplification?

Yes. Some of the early radio frequency amplifiers employed this system. Unfortunately, resistance coupling for radio frequency amplification is comparatively ineffectual on the broadcast wavelengths in which the average reader is interested. The coupling resistor is virtually shunted by the plate to filament capacity of the preceding tube and by the grid to filament capacity of the succeeding tube, all of which forms more or less of a bypass about the resistor through which the high-frequency currents detour.

A radio frequency resistance coupled amplifier will work on the broadcast frequencies, but not so satisfactory as to recommend it in preference to the more usual forms of amplification.

Resistance coupling is efficient on waves above two thousand meters, which makes it quite satisfactory as an intermediate frequency amplifier in super-heterodyne arrangements. This system was employed by Paul Godley, well known engineer, in his famous pioneer trans-Atlantic reception on amateur wave-lengths.

9.—How can I use jacks in a Resistance-Couped Amplifier?

This is quite simple—in fact almost self-explanatory. The manner of connection will be immediately apparent to the majority of enthusiasts employing the Resisto-Coupler who are already familiar with the method of connecting jacks to transformer coupled amplifiers.

Figure 4 shows the principle of wiring the double circuit jack—the type most commonly employed—between two stages of resistance coupled amplification. Additional stages may be adapted in the same manner. The outside prongs of the jack run to the plate and plus "B" battery, while the inner prongs are led to the coupling resistor. **The outer prong to the plate must connect to the inner prong leading to the upper side (isolating condenser) of the resistor when the jack is closed.**

10. Should the gridleak values be changed?

The gridleak resistances for the UV201A and similar tubes may be fixed almost arbitrarily as given for diagram 1. The values for tubes of rather different characteristics will be given farther on in this article.

If the enthusiast desires to experiment, the gridleak resistances may be increased to just below that value at which distortion and blocking of the tube takes place on loud signals. The greatest amplification will be secured at this adjustment. In some cases it may be possible to eliminate the grid leak on the first tube.

11. Should variable resistors be used—and is it desirable to experiment with the values?

Variable resistors, while they will generally work well, are not necessary. The values are uncritical, and variable resistances are often accompanied with characteristics which make them less suitable as coupling resistors.

Any value of coupling resistor between fifty thousand and one hundred and fifty thousand ohms will give almost unchanging amplification, a preference being given to the one hundred thousand ohms resistor as being the most efficient.

When inputting from a reflex set, or a transformer coupled stage, slightly better amplification is sometimes secured by using a low value in the first stage—a 50,000 ohm resistor.

12. Can dry cell tubes be used in the Resistance Coupled Amplifier? If so, what are the resistance values?

Yes. Practically any modern amplifying vacuum tube can be employed successfully in a resistance coupled amplifier. For the UV199, the C299, the Western Electric "N" tube, the WD 12, the deForest D2 and D3 and the Meyers tube (an exceptionally fine tube for this purpose!) the values for a three-stage amplifier are exactly the same as those specified for the UV201A—i.e., coupling resistors of 100,000 ohms and the 1st, 2nd and 3rd stage gridleaks respectively 1,000,000 ohms, 250,000 ohms and 50,000 ohms. Should a fourth stage be desired—the coupling resistor and gridleak should be equivalent to those of the third stage.

13. Is the Resistance Coupled Amplifier stable?

The resistance coupled system is probably the most stable of all amplifying arrangements due to the fact that plate inductances, with their accompanying feedback, are eliminated.

However, in the case of poor tubes, and when three of four stages are inputted from a multitube tuner such as the reflex, howling may occasionally be encountered. The various tubes should be tried in different stages in an endeavor to secure a satisfactory combination.

If howling exists only when the final stage is used, the ohmage of the last coupling resister (or of the last two in extreme cases) should be increased—say to 250,000 ohms, and in a few instances even higher. These very high ohmages, however, will seldom be necessary, and probably only in a case of poorly matched tubes.

Adjustment of gridleaks will also often insure stability. In such cases, placing the fingers across the gridleak prongs will indicate the stage in which this resistance should be decreased.

Cases of instability will be few and far between, and only on such occasions when similar faults would arise to a still more annoying degree with a transformer or impedance coupled amplifier.

14. Is a bias necessary?

No. The action of the resistance coupled amplifier is such that it functions with the effect of a negative bias being applied at audio frequency. That is, the varying positive charge on the coupling side of the isolating condenser induces similar negative fluctuations on the grid side. This causes the plate current to "modulate down"—to decrease when the amplifier is working.

The bias, or more correctly the operating point of the tube, may also be controlled by varying the ohmages of the coupling resistors and gridleaks as suggested in the stability experiments.

15. What plate voltages shall I use?

The experimenter may go as high as twice the maximum potential recommended by the manufacturer of the tube. The actual applied voltage is greatly reduced by the coupling resistance which is in series with the plate supply. Voltages of at least one hundred should be used on all tubes.

Employing the suggested 100,000 ohm coupling resistors and the UV201A or the C301A tubes (an excellent and widely used combination), a 140 volt "B" battery will give very fine results. A lower potential of 110 volts will also output satisfactory volume.

When inputting to a resistance coupled amplifier from a detector tube, the plate voltage of the detector bulb should be doubled or tripled, again compensating for the coupling resistor. The detector plate potential should be increased until the tube detects most efficiently, or, in the case of a regenerative receiver, the set regenerates and oscillates in the normal manner.

Due to this increase in the detector plate voltage, jacks should never be introduced into the detector circuit. Plugging in the comparatively low resistance phones in this particular circuit would completely upset the adjustment, placing an inoperatively high potential on the plate of the detector. If jacks are used, it is advised that they be placed after the first, second and third stages.

Due to the fact that there is no plate resistor included in the plate circuit of the last tube, it is often good practice to place a resistance of from 5,000 to 50,000 ohms in series with the telephone receivers or loudspeaker to lower the plate current in this circuit to a value more nearly normal. Tapping the plate voltage at a lower potential will secure the same result.

16. What are the most efficient values for the isolating condensers? Are they critical, and do they require change of adjustment?

The capacity of the isolating condensers is not at all critical, and may be anything from .0025 to 1 mfd. The lowest operative capacity is not advised in coupling the last tube of a four-stage amplifier. A good compromise, all the way through, is the .006 mfd. Micadon which is quite as easily obtainable as the lower capacities. No adjustment is necessary.

17. Can Resistance Coupled Amplification be added to any set or output? How can it be attached to different commercial types of equipment?

Resistance coupled amplifiers may be used with any type or make of receiving set. Regardless of the diversification of circuits and receivers, resistance coupling is connected to all of them in exactly the same manner. The following procedure should be observed when inputting from any make or receiver design:

In the majority of instances the experimenter will desire to connect the resistance coupled amplifier to a detector output. The amplifier is wired to the "A" battery in the usual way. The input posts on the amplifier are connected to the telephone posts on the receiver or to a plug plugging into a telephone jack. An amplifying "B" battery should be provided and the plus side connected to the indicated post on the amplifier. It now only remains to complete the connections through the minus of the amplifying "B" battery.

The minus "B" battery terminal on the detector or tuner should be carefully inspected. In the majority of cases the experimenter will find that this post leads to either plus or minus of the "A" battery. In many instances the minus "B" and one of the "A" battery terminals are combined in a single post. If such is the arrangement in the case of the reader, the minus of the amplifying "B" battery should be connected to the plus terminal of the detector "B" battery.

Figure 5 shows three stages of resistance coupled amplification connected to a standard three circuit regenerative set in compliance with the principles outlined above.

When amplifying the output of a transformer coupled stage, or a reflex receiver, no extra amplifying battery is really necessary, though as before explained the higher the voltage, within certain limits, the more efficient the amplification. The plus high voltage may be merely tapped from

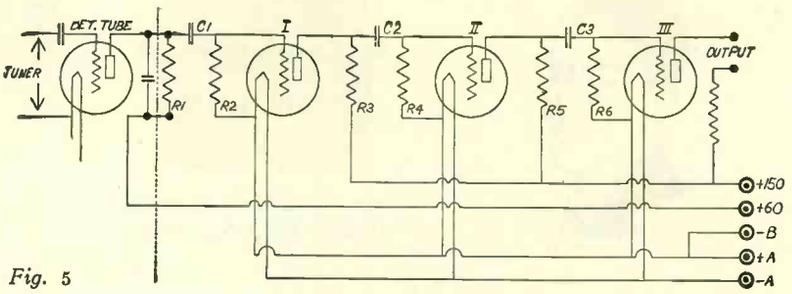


Fig. 5

the positive terminal of the battery already in the circuit. The minus terminal of any additional battery is similarly connected—applying the accumulative potential to the plates of the resistance coupled amplifiers.

How to Use Kilocycles for Designating Radio Waves

The advantages of this practice have been familiar to radio engineers for some time, and it is probable that it will eventually replace the use of wave length in meters. As a matter of fact, wave length is a somewhat artificial conception in the handling of radio apparatus and is one of the difficult things for the beginner to understand. The frequency of the radio wave is the same as the frequency of the alternating current which flows in the radio transmitting or receiving set.

As often happens in technical matters, the idea of "kilocycles" is simpler than the forbidding aspect of the word suggests. "Kilo" means a thousand, and "cycle" means one complete alternation. The number of kilocycles indicates the number of thousands of times that the rapidly alternating current repeats its flow in either direction in the antenna in one second. The smaller the wave length in meters, the larger is the frequency in kilocycles.

The reason that kilocycles are coming into use and displacing meters is that the necessary separation of the frequency of transmitting stations to prevent interference is the same, no matter what the frequency may be. This necessary separation is variable and quite misleading when expressed in meters. Thus the number of radio messages that can be transmitted simultaneously without interference can be correctly judged from the kilocycles but not from the meters. For example, the amateurs will in the future work in a band of wave lengths from 150 to 200 meters, but this is a frequency band from 2,000 to 1,500 kilocycles. This is an enormously wider band when considered from the viewpoint of kilocycles than, for example, the band having the same width in meters from 1,000 to 1,050 meters, which is 300 to 286 kilocycles. While it is possible to carry on fifty simultaneous radio telephone communications between 150 and 200 meters, only one could be carried on between 1,000 and 1,050 meters.

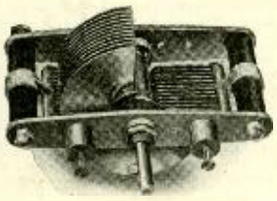
In accordance with the recommendation of the Second National Radio Conference, the Department of Commerce and other Government departments will hereafter follow the practice of specifying in even values of kilocycles rather than meters. The conference recommended the practice of expressing wave frequency in kilocycles per second with wave length in meters in parentheses thereafter. The relation between the two is very simple. To obtain kilocycles, divide 300,000 by the number of meters; to obtain meters, divide 300,000 by the number of kilocycles. For example, 100 meters=approximately 3,000 kilocycles. 300 meters=1,000 kilocycles, 1,000 meters=300 kilocycles, 3,000 meters=100 kilocycles. The accompanying table may be used for rapid and accurate conversion either from kilocycles to meters or meters to kilocycles.

10.....	29980	700.....	428.3	1390.....	215.7	2110.....	142.1	2840.....	105.6	4140.....	72.42	6450.....	46.48
20.....	14990	710.....	422.3	1400.....	214.2	2120.....	141.4	2850.....	105.2	4160.....	72.07	6500.....	46.13
30.....	9994	720.....	416.4	1410.....	212.6	2130.....	140.8	2860.....	104.8	4180.....	71.73	6550.....	45.77
40.....	7496	730.....	410.7	1420.....	211.1	2140.....	140.1	2870.....	104.5	4200.....	71.39	6600.....	45.43
50.....	5996	740.....	405.2	1430.....	209.7	2150.....	139.5	2880.....	104.1	4220.....	71.05	6650.....	45.09
60.....	4997	750.....	399.8	1440.....	208.2	2160.....	138.8	2890.....	103.7	4240.....	70.71	6700.....	44.75
70.....	4283	760.....	394.5	1450.....	206.8	2170.....	138.1	2900.....	103.4	4260.....	70.38	6750.....	44.42
80.....	3748	770.....	389.4	1460.....	205.4	2180.....	137.5	2910.....	103.0	4280.....	70.05	6800.....	55.09
90.....	3331	780.....	384.4	1470.....	204.0	2190.....	136.9	2920.....	102.7	4300.....	69.73	6850.....	43.77
100.....	2998	790.....	379.5	1480.....	202.6	2200.....	136.3	2930.....	102.3	4320.....	69.40	6900.....	43.45
110.....	2726	800.....	374.8	1490.....	201.2	2210.....	135.7	2940.....	102.0	4340.....	69.08	6950.....	43.14
120.....	2499	810.....	370.2	1500.....	199.9	2220.....	135.1	2950.....	101.6	4360.....	68.77	7000.....	42.83
130.....	2306	820.....	365.6	1510.....	198.6	2230.....	134.4	2960.....	101.3	4380.....	68.45	7050.....	42.53
140.....	2142	830.....	361.2	1520.....	197.2	2240.....	133.8	2970.....	100.9	4400.....	68.14	7100.....	42.23
150.....	1999	840.....	356.9	1530.....	196.0	2250.....	133.3	2980.....	100.6	4420.....	67.83	7150.....	41.93
160.....	1874	850.....	352.7	1540.....	194.7	2260.....	132.7	2990.....	100.3	4440.....	67.53	7200.....	41.64
170.....	1764	860.....	348.6	1550.....	193.4	2270.....	132.1	3000.....	99.94	4460.....	67.22	7250.....	41.35
180.....	1666	870.....	344.6	1560.....	192.2	2280.....	131.5	3020.....	99.28	4480.....	66.91	7300.....	41.07
190.....	1578	880.....	340.7	1570.....	191.0	2290.....	130.9	3040.....	98.62	4500.....	66.63	7350.....	40.79
200.....	1499	890.....	336.9	1580.....	189.8	2300.....	130.4	3060.....	97.98	4520.....	66.33	7400.....	40.52
210.....	1428	900.....	333.1	1590.....	188.6	2310.....	129.8	3080.....	97.34	4540.....	66.04	7450.....	40.24
220.....	1363	910.....	329.5	1600.....	187.4	2320.....	129.2	3100.....	96.72	4560.....	65.75	7500.....	39.98
230.....	1304	920.....	325.9	1610.....	186.2	2330.....	128.7	3120.....	96.10	4580.....	65.46	7550.....	39.71
240.....	1249	930.....	322.4	1620.....	185.1	2340.....	128.1	3140.....	95.48	4600.....	65.18	7600.....	39.45
250.....	1199	940.....	319.0	1630.....	183.9	2350.....	127.6	3160.....	94.88	4620.....	64.90	7650.....	39.19
260.....	1153	950.....	315.6	1640.....	182.8	2360.....	127.0	3180.....	94.28	4640.....	64.62	7700.....	38.94
270.....	1110	960.....	312.3	1650.....	181.7	2370.....	126.5	3200.....	93.69	4660.....	64.34	7750.....	38.69
280.....	1071	970.....	309.1	1660.....	180.6	2380.....	126.0	3220.....	93.11	4680.....	64.06	7800.....	38.44
290.....	1034	980.....	305.9	1670.....	179.5	2390.....	125.4	3240.....	92.54	4700.....	63.79	7850.....	38.19
300.....	999.4	990.....	302.8	1680.....	178.5	2400.....	124.9	3260.....	91.97	4720.....	63.52	7900.....	37.95
310.....	967.2	1000.....	299.8	1690.....	177.4	2410.....	124.4	3280.....	91.41	4740.....	63.25	7950.....	37.71
320.....	936.9	1010.....	296.9	1700.....	176.4	2420.....	123.9	3300.....	90.86	4760.....	62.99	8000.....	37.48
330.....	908.6	1020.....	293.9	1710.....	175.3	2430.....	123.4	3320.....	90.31	4780.....	62.72	8050.....	37.25
340.....	881.8	1030.....	291.1	1720.....	174.3	2440.....	122.9	3340.....	89.77	4800.....	62.46	8100.....	37.02
350.....	856.6	1040.....	288.3	1730.....	173.3	2450.....	122.4	3360.....	89.23	4820.....	62.20	8150.....	36.79
360.....	832.8	1050.....	285.5	1740.....	172.3	2460.....	121.9	3380.....	88.70	4840.....	61.95	8200.....	36.56
370.....	810.3	1060.....	282.8	1750.....	171.3	2470.....	121.4	3400.....	88.18	4860.....	61.69	8250.....	36.34
380.....	789.0	1070.....	280.2	1760.....	170.4	2480.....	120.9	3420.....	87.67	4880.....	61.44	8300.....	36.12
390.....	768.8	1080.....	277.6	1770.....	169.4	2490.....	120.4	3440.....	87.16	4900.....	61.19	8350.....	35.91
400.....	749.6	1090.....	275.1	1780.....	168.4	2500.....	119.9	3460.....	86.65	4920.....	60.94	8400.....	35.69
410.....	731.3	1100.....	272.6	1790.....	167.5	2510.....	119.5	3480.....	86.16	4940.....	60.69	8450.....	35.48
420.....	713.9	1110.....	270.1	1800.....	166.6	2520.....	119.0	3500.....	85.66	4960.....	60.45	8500.....	35.27
430.....	697.3	1120.....	267.7	1810.....	165.6	2530.....	118.5	3520.....	85.18	4980.....	60.20	8550.....	35.07
440.....	681.4	1130.....	265.3	1820.....	164.7	2540.....	118.0	3540.....	84.70	5000.....	59.96	8600.....	34.86
450.....	666.3	1140.....	263.0	1830.....	163.8	2550.....	117.6	3560.....	84.22	5050.....	59.37	8650.....	34.66
460.....	651.8	1150.....	260.7	1840.....	162.9	2560.....	117.1	3580.....	83.75	5100.....	58.79	8700.....	34.46
470.....	637.9	1160.....	258.5	1850.....	162.1	2570.....	116.7	3600.....	83.28	5150.....	58.22	8750.....	34.27
480.....	624.6	1170.....	256.3	1860.....	161.2	2580.....	116.2	3620.....	82.82	5200.....	57.66	8800.....	34.07
490.....	611.9	1180.....	254.1	1870.....	160.3	2590.....	115.8	3640.....	82.37	5250.....	57.11	8850.....	33.88
500.....	599.6	1190.....	252.0	1880.....	159.5	2600.....	115.3	3660.....	81.92	5300.....	56.75	8900.....	33.69
510.....	587.9	1200.....	249.9	1890.....	158.6	2610.....	114.9	3680.....	81.47	5350.....	56.04	8950.....	33.50
520.....	576.6	1210.....	247.8	1900.....	157.8	2620.....	114.4	3700.....	81.03	5400.....	55.52	9000.....	33.31
530.....	565.7	1220.....	245.8	1910.....	157.0	2630.....	114.0	3720.....	80.60	5450.....	55.01	9050.....	33.13
540.....	555.2	1230.....	243.8	1920.....	156.2	2640.....	113.6	3740.....	80.17	5500.....	54.51	9100.....	32.95
550.....	545.1	1240.....	241.8	1930.....	155.3	2650.....	113.1	3760.....	79.74	5550.....	54.02	9150.....	32.77
560.....	535.4	1250.....	239.9	1940.....	154.5	2660.....	112.7	3780.....	79.32	5600.....	53.54	9200.....	32.59
570.....	526.0	1260.....	238.0	1950.....	153.8	2670.....	112.3	3800.....	78.90	5650.....	53.07	9250.....	32.41
580.....	516.9	1270.....	236.1	1960.....	153.0	2680.....	111.9	3820.....	78.49	5700.....	52.60	9300.....	32.24
590.....	508.2	1280.....	234.2	1970.....	152.2	2690.....	111.5	3840.....	78.08	5750.....	52.14	9350.....	32.07
600.....	499.7	1290.....	232.4	1980.....	151.4	2700.....	111.0	3860.....	77.67	5800.....	51.69	9400.....	31.90
610.....	491.5	1300.....	230.6	1990.....	150.7	2710.....	110.6	3880.....	77.27	5850.....	51.25	9450.....	31.73
620.....	483.6	1310.....	228.9	2000.....	149.9	2720.....	110.2	3900.....	76.88	5900.....	50.82	9500.....	31.56
630.....	475.9	1320.....	227.1	2010.....	149.2	2730.....	109.8	3920.....	76.49	5950.....	50.39	9550.....	31.39
640.....	468.5	1330.....	225.4	2020.....	148.4	2740.....	109.4	3940.....	76.10	6000.....	49.97	9600.....	31.23
650.....	461.3	1340.....	223.7	2030.....	147.7	2750.....	109.0	3960.....	75.71	6050.....	49.56	9650.....	31.07
660.....	454.3	1350.....	222.1	2040.....	147.0	2760.....	108.6	3980.....	75.33	6100.....	49.15	9700.....	30.91
670.....	447.5	1360.....	220.4	2050.....	146.3	2770.....	108.2	4000.....	74.96	6150.....	48.75	9750.....	30.75
680.....	440.9	1370.....	218.8	2060.....	145.5	2780.....	107.8	4020.....	74.58	6200.....	48.36	9800.....	30.59
690.....	434.5	1380.....	217.3	2070.....	144.8	2790.....	107.5	4040.....	74.21	6250.....	47.97	9850.....	30.44
				2080.....	144.1	2800.....	107.1	4060.....	73.85	6300.....	47.59	9900.....	30.28
				2090.....	143.5	2810.....	106.7	4080.....	73.49	6350.....	47.22	9950.....	30.13
				2100.....	142.8	2820.....	106.3	4100.....	73.13	6400.....	46.85	10000.....	29.98
						2830.....	105.9	4120.....	72.77				

McMurdo Silver, Assoc. I.R.E., well-known for his startling work on the Super-heterodyne, has achieved new laurels with his easily-constructed Portable Super.

"The Portable Super-Heterodyne"

is McMurdo Silver's own description of his Portable Super, which has called forth the praise of editors, engineers and fans alike. It tells in plain, non-technical language, accompanied by Photographs and Detail Drawings, all about the Portable Super-heterodyne—how to build it, and how to secure results you never hoped to obtain outside of a Laboratory. Send for your copy at once. Price, 50c.



Silver .0005 Low Loss Non-Vernier Condenser No. 301

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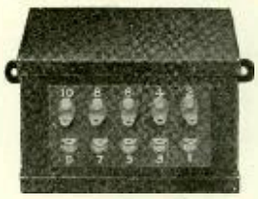
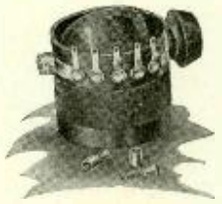


Silver 50 KC R F Transformer Unit No. 401

This Unit represents the most advanced design in Intermediate Transformers. For use with two stages of Amplification, which will give better results than any other three stage Amplifier. May be used with any Standard Tubes on the market, and will give 1½ to 2½ times the amplification of any other transformers available. Laboratory sealing and matching obviates all possibility of trouble, and eliminates hours of fruitless testing and trouble-shooting. Price, $14.00.



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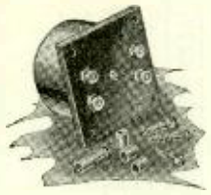
The smallest and most compact coupler now on the market. It assures you marvellous results in any circuit. Wave length range 150-550 Meters. Price, $2.50.



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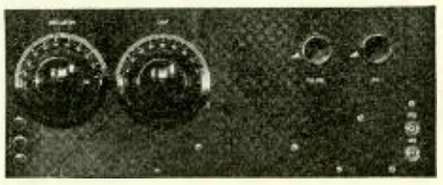
The one Transformer that will give that Amplifier of yours real Selectivity. You can use it with any 30-50 KC Iron-Core Transformers now available. Price, $3.50.

at last— the *portable* super-heterodyne



Here is a list of the Parts used by McMurdo Silver in his Portable Super. These Parts make it possible for even a novice to build the set with only a Screw Driver, a pair of Pliers and a Soldering Iron—that literally bring it from the Laboratory to your Kitchen Table.

2 Silver .0005 Low Loss Condensers No. 301	ea.	$ 4.50
2 4" Moulded Dials—Tapered Knobs	ea.	1.00
1 Howard 6½ Ohm Rheostat		1.00
1 Howard 200 Ohm Potentiometer		1.50
3 Insulated Top Binding Posts	ea.	.05
1 Carter 102A Jack		.80
1 Carter 101 Jack		.70
1 Silver R.F. Transformer Unit No. 401		14.00
1 Silver Oscillator Coupler No. 101		2.50
2 Silver 199—Sockets	ea.	.50
2 Jefferson Audio Transformers No. 41	ea.	4.25
1 Silver 5-Gang Panel Mounting 199 Socket No. 501		3.00
2 .5 MFD By-Pass Condensers	ea.	.90
2 .00025 Mica Condensers with Leak Clips	ea.	.45
2 .002 Mica Condensers	ea.	.40
1 .0075 Mica Condensers		.60
1 .000045 Balancing Condenser		1.50
1 5 Meg Ohm Grid Leak		.50
1 2 Meg Ohm Grid Leak		.50
1 7x18x3/16" Bakelite Panel, Drilled, Grained and engraved		6.00
1 7x4x½" Oak Base Board, Bus-Bar, Spaghetti, Screws, Nuts, Solder, Flexible Lead Wire		1.25
Total		$58.00

Shipped Prepaid Anywhere in the U. S.

ACCESSORIES recommended by McMurdo Silver

7 U.V. 199 Tubes	ea.	$4.00
4 Small Burgess or Ever Ready B Batteries	ea.	1.25
3 Red Seal Dry Cells	ea.	.35
2 Ever Ready or Burgess C Batteries	ea.	.60
1 Collapsible Loop with Center Tap		6.50
1 7x18 Mahogany Cabinet		7.50

Silver 5-Gang Socket No. 501

This Socket meets a crying need for a 5-Gang Cushioned 199 Socket. The shells are of the highest grade brass, and extra quality spring stock is used for the Contact springs. Provided for Panel or Table mounting. Price, $3.00.

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Construction of the Portable Super-Heterodyne

By McMURDO SILVER, Assoc. I. R. E.

THE cost of a super-heterodyne receiver is such that the average builder would not possess more than one, which means that the portable super must be capable of giving approximately the same results as a larger set employing bigger tubes and

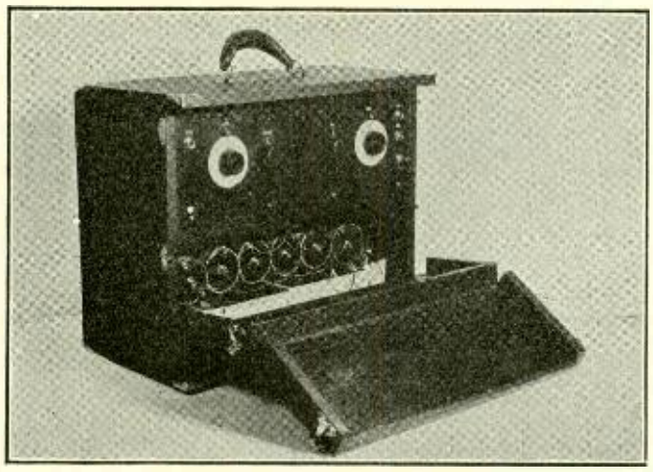


Fig. 1. An experimental portable, indicating how the set and batteries may be mounted in a portable cabinet

storage batteries. A large amount of work was done to develop this receiver, a little of which is reviewed here and many sets were built, some so disguised that even Major Armstrong himself would not recognize them.

The design had to be practically fool proof so that the average builder could assemble it with the assurance of getting perfect results, yet it must be so simple that no gymnastic feats would be necessary in wiring or assembling it and it must employ standard parts easily procurable at a minimum cost.

Battery size and current consumption were of very great importance, and to some extent determined the size of the set. It was possible, by the use of UV 199 tubes and an ultra-efficient circuit to decrease the B battery current consumption to approximately sixteen milliamperes, as against the average forty milliamperes for an eight-tube 201-A set. This increased the battery life, and permitted the use of four of the small-size 22½ volt batteries, together with three dry cells for the filaments, which were placed directly behind the set in its cabinet.

In a set of this type, the efficiency must be as high as possible, and the possibilities of trouble very remote. Reflexing being out of it, it was necessary to use a standard circuit but so improve it that fewer tubes could be made to do the work of the eight generally considered necessary. These tubes had to operate from dry cells, which meant that a real step ahead had to be made to get approximately the same results out of seven UV 199's that had been previously obtained from eight 201A's for sensitivity.

The amplifier used in this receiver does not depend upon regeneration for its amplification to any great extent and it cannot be made to oscillate even though the grids are run 8 to 10 volts negative, and in this respect differs from the intermediate amplifier which have been described in various publications in that their potentiometer control was extremely critical and the amplification obtained was mostly of a regenerative nature with resultant poor quality. The potentiometer used in this set cannot be made to cause the amplifier to oscillate, and operates practically as a true volume control.

In improving a standard circuit, two things of major importance were done. The first detector circuit was made regenerative, which gave considerable increase in amplification, as well as sharpened up the loop tuning condenser. The split-loop method was used, which proved most satisfactory for this type of set. The next step was to improve the amplifier. Suffice it to say that after considerable experimentation, an RF transformer unit

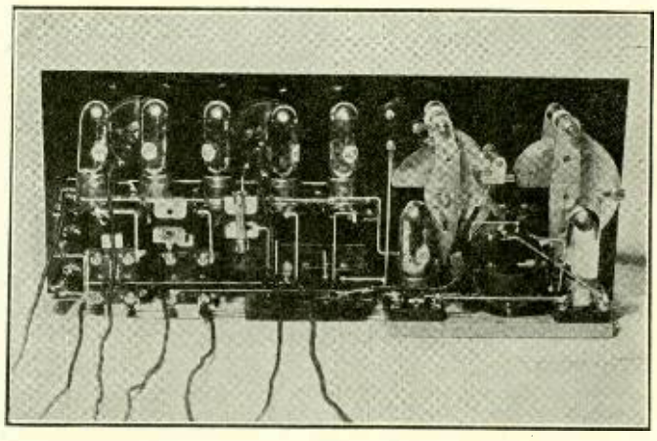
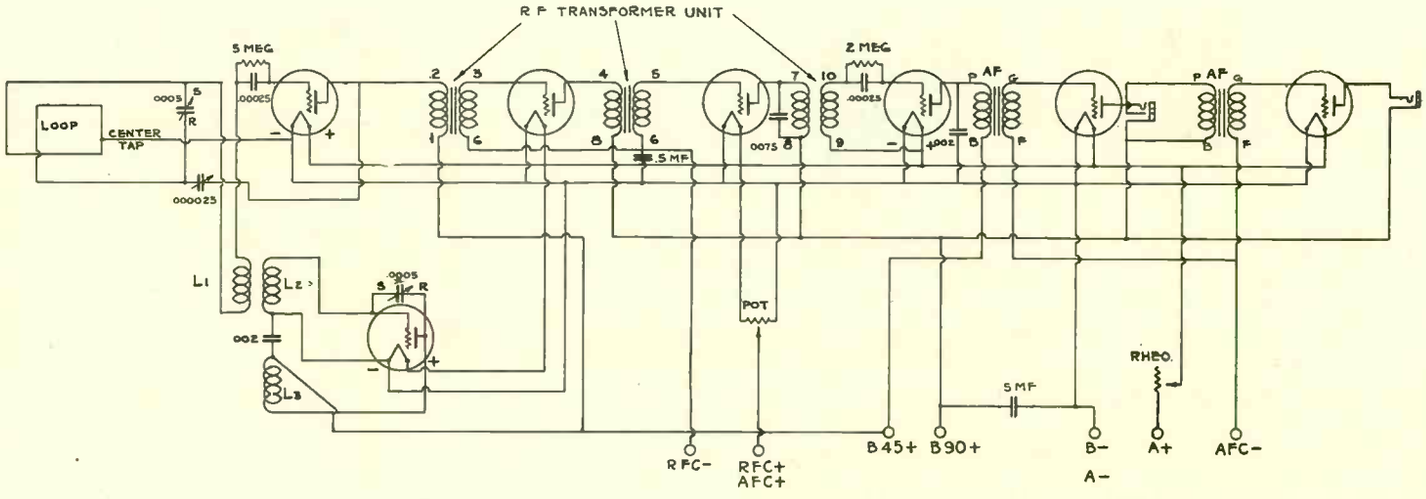


Fig. 2. Rear view of the portable, completely wired. This should be carefully studied before wiring is begun

was developed which eliminated all possibility of trouble, and gave amplification with two intermediate stages equal to what had previously been obtained with three stages. The sensitivity of the set was such that it would still go down to the noise level in nine out of ten locations, and the absence of the third stage elimi-



SCHEMATIC DRAWING
SILVER PORTABLE SUPER-HETRODYNE

Fig. 4

nated a tube and its battery drain, saved some space, simplified the construction of the set, and, most important, cut out a good deal of noise previously experienced with three stage amplifiers.

Grid condensers and leaks were used on both rectifier tubes, as they were found somewhat preferable to C batteries, from the standpoint of sensitivity, ease of assembly and current-consumption, despite general belief to the contrary.

Careful consideration was given to the audio amplifier, and a Standard transformer was chosen for its excellent curve, good quality and its generally satisfactory operating characteristics.

The seven tubes in the set surely "do their stuff" to use a popular expression, for coast to coast reception is quite common with the set during the summer months in Chicago, in many cases with loud-speaker volume. Its selectivity is such that when located three hundred feet from WGN's antenna, in a Ford car, WGN could be entirely eliminated with a six degree oscillator dial movement, and any other Chicago stations, and several within a fifty mile radius, brought in with sufficient volume to be heard above traffic noise at seven o'clock in the evening. The same happened near WEBH and WMAQ, so the results were not at all freaky. Five miles away from local stations they could be eliminated with a four degree oscillator dial movement, and a five to ten degree loop dial movement. Two stations in the same direction, each about fifteen miles away, operating at 283 and 286 meters were tuned in, with a dead spot between them where neither could be heard. These results bore out the writer's belief that two stages of intermediate amplification were sufficient, for the results were almost up to those of a special eight tube 201A set, and better on distance in every respect than several standard five tube neutrodynes using five 201A tubes and 100 to 150 foot antennas. When it is realized that the super used an 18 inch loop and seven UV 199's the full significance of these results will be appreciated.

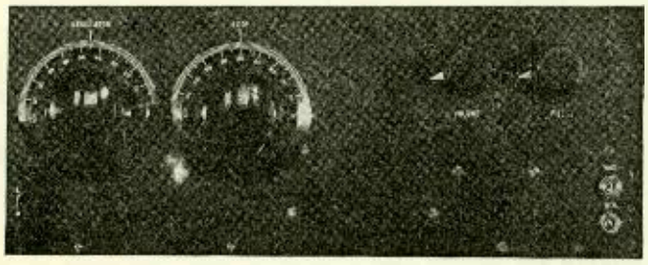


Fig. 3. Front panel of the final model. Note extreme simplicity

The final model, described in this article, is entirely contained in a standard 7x18 cabinet, with all parts mounted on the panel or on two small sub-bases. All batteries are placed behind the set, in the same cabinet, or if a permanent installation is to be made, leads may be brought out to larger type B's, and six A's in series-parallel or a small storage battery. The only additional equipment needed outside the tubes and batteries is a loop with a center-tap and a pair of phones or a loud-speaker. Below is a list of the material needed, which should cost about $50.00, without cabinet.

2—.0005 low loss condensers.
2—3 inch or 4 inch dials, preferable moulded (vernier types may be used if desired).
1—six or seven ohm rheostat.
1—150 to 400 ohm potentiometer.
3—binding posts, insulated type.
1—three-spring jack.
1—one-spring jack.
1—on-off switch if desired (not shown in set).
1—RF transformer unit (50 kilocycles).
2—RF intermediate frequency transformers.
1—oscillator coupler (can be constructed—see text).
2—UV 199 sockets.
2—audio transformers.
1—five-gang UV 199 socket, or five single sockets.
2—.5 MF bypass, condensers, large type preferably.
2—.00025 mica condensers with leak clips.
2—.002 mica condensers with leak clips.
1—.0075 mica condenser.
1—.000025 condenser. Any low loss small vernier type may be used.
1—3 to 5 megohm grid leak, good quality.
1—1 to 2 megohm grid leak, good quality.
1—7x18x3/16 Bakelite panel.
1—7x18 cabinet.
bus-bar, spaghetti, screws, solder, flexible lead wire and baseboard 7x4¼x½.
Tools needed: 1 pair side-cutting pliers, 1 screw-driver, 1 hand-drill with drills, 1 soldering iron with rosin core solder.

The oscillator coupler may be made by winding two sections separated 1/16 inch apart on a 2¼ inch bakelite tube, each section containing 28 turns of No. 28 DSC wire. The rotor coil, shown in Fig. 4 as L1, consists of 20 turns of the same wire on a 1½ inch tube, rotatable within the stator tube carrying coils L2 and L3. The range of this oscillator, with a .0005 condenser is about 150 to 550 meters more than sufficient for broadcast reception.

If the builder does not wish to incorporate the 50 KC transformer unit in the set he may substitute two standard long wave iron core transformers and a filter. It is doubtful, however, if transformers can be obtained which will give the amplification per stage that those incorporated in the unit give—a voltage gain of 34 per stage between 199 tubes.

The filter may be made by turning out a wood form 1½ inches in diameter with three slots ¼-inch wide and 9/16-inch deep turned in it, each separated by a ⅛-inch wall of wood. In the two outside slots are placed 1600 turns each of No. 36 Single Silk Enameled wire, connected in series aiding. The center slot is wound with 800 turns of the same wire, and when shunted by a .003 condenser will tune the transformer to about 30 KC. The outside coils are the secondary, and the inside the primary. This substitution is not recommended, and it mentioned merely for those who want to experiment with equipment they already possess. For operation at 50 KC the value of condenser used across the primary will be from .001 to .0015.

The construction of the set may now be started by laying out the panel with a rule and scriber following the dimensions of Fig. 6. The two holes for the gang-socket marked "X" on the drawing will have to be relocated on a line 3½ inches down from the top if single sockets on a wood support are used here. The support would be ½ inch thick, 9 inches long, and no wider than necessary to accommodate the sockets.

The panel may be grained after all holes have been drilled and countersunk by rubbing it in one direction only with fine sand paper and oil. After graining the two indicating marks for the condenser dials should be cut with a scriber above the shaft-holes and on a vertical line with them. These cuts may be filled with Chinese White or some other white compound. All oil should, of

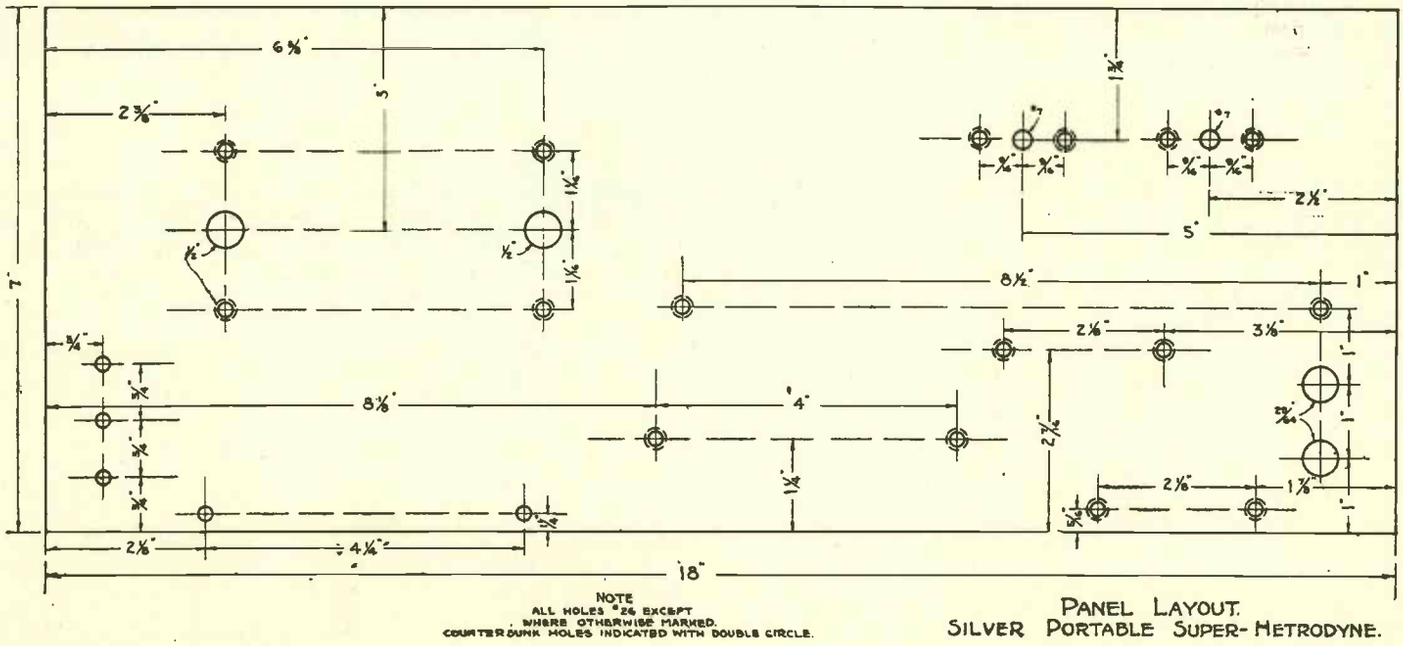


Fig. 6

course, be wiped from this panel and it can be cleaned off with a cloth saturated with alcohol.

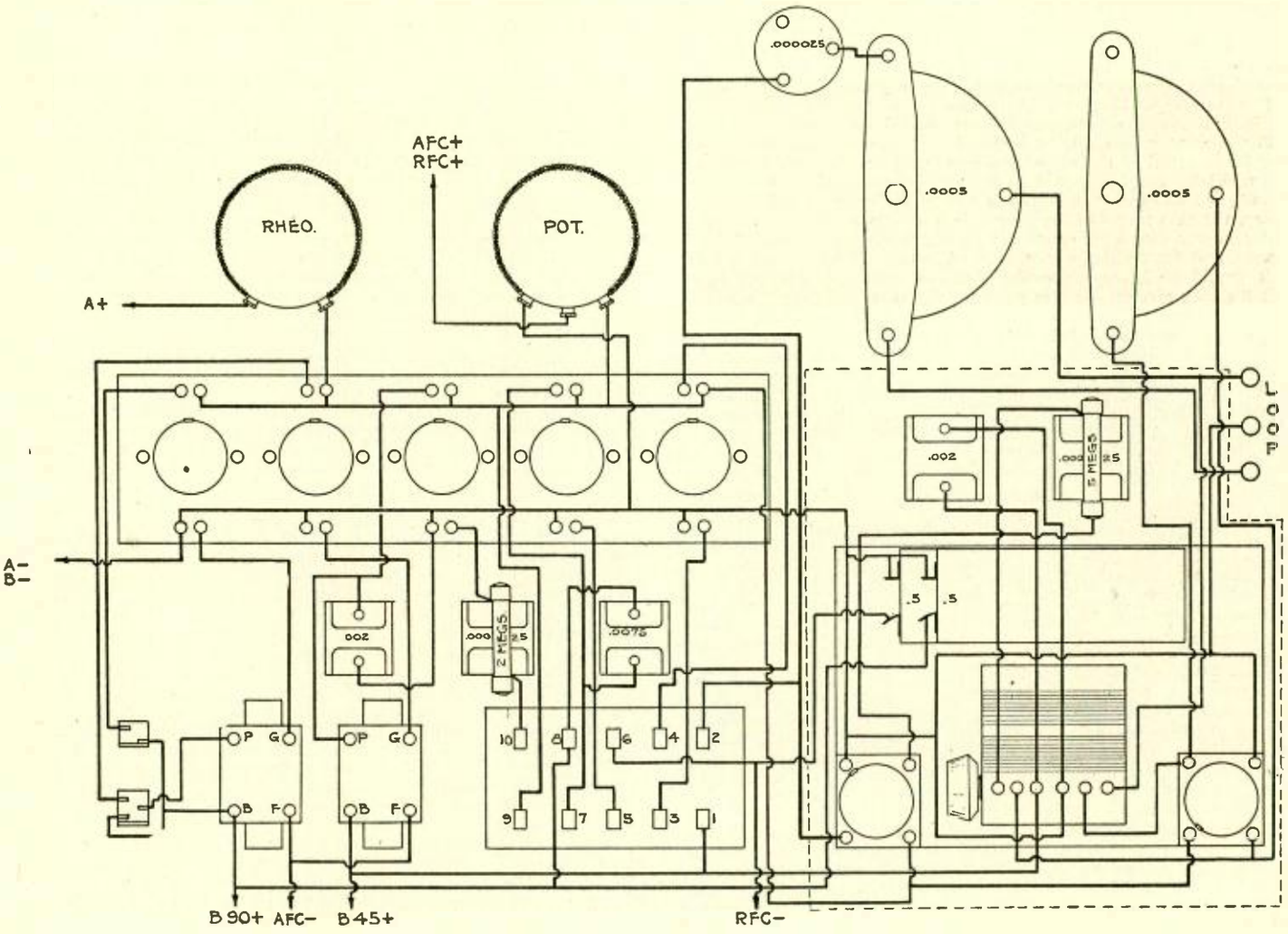
The parts may now be mounted on the panel starting with the two variable condensers and the three binding posts at the right hand end. Next put on the RF transformer unit, the two audio transformers, the Jacks, rheostat and potentiometer and gang socket. If individual sockets are used throughout for the tubes the small board used for supporting them should be screwed in position above the transformers with the sockets fastened to it equally spaced between centers.

The small base-board carrying the by-pass condensers, oscillator coupler, and first two sockets should be screwed to the panel in the proper position beneath the variable condensers and the two sockets and coupler fitted on it in such a fashion that the tubes will not strike the condensers nor will they project too far

recommended only where the constructor has had previous wiring experience, since the space is limited.

No battery binding posts have been provided on the set in accordance with the present design trend. Battery leads are brought out directly from the wiring itself which eliminates the binding posts and a certain amount of additional wiring had they been used. These leads, which may consist of No. 18 lamp cord, should be soldered to the wiring at some point where it terminates in an instrument binding post so that any strain on them will be taken up by instruments in the set. The leads may be braided and tagged for their proper connections and should be from 3 to 4 feet long so that if external batteries are used they may be carried out through a hole in the back of the cabinet to the batteries.

Assuming the set to have been completely wired it is now ready to be hooked up and tested.



to the rear or the sides. Their positions may be marked after which they should be screwed in place on the base-board. All wood screw holes should be started with a No. 45 drill and No. 4 or 5 round head screws ¾-inch long used. Machine screws may be 6/32-inch round or flat head with nuts and are used for fastening the instruments to the panel and where necessary lugs to the fixed condensers.

All lugs which have previously been put on the various binding posts should be tinned using rosin core solder and a hot, well tinned iron. We are now ready to begin with the wiring. The small base-board should be removed from the panel and all wiring done on it that can be before it is replaced in position under the variable condensers. The easiest method of fastening down the by-pass condensers to this sub-base is to solder their cases together and then placing the condensers one above the other and flat on the base-board directly below the two variable condensers, solder the ends of their cans to the heads of two wood screws in the sub-base itself.

The balancing condenser is fastened to the upper frame support of the loop condenser by means of two lugs soldered together which will provide a firm mounting. All mica condensers are soldered directly to the wiring itself and may be put in place as the wiring progresses.

The wiring may be done either with bus wire or with magnet wire, say No. 20 or 22, with the insulation scraped off, run in spaghetti. This later method is the easiest and will be perfectly satisfactory. The bus bar wiring is somewhat difficult and is

The accessories required will be a single 4½ volt C battery, 3 dry cells, 90 volts of B battery, seven 199 tubes, a pair of phones with plug, and a loop. All these parts are standard with the exception of the loop which may be any standard loop on the market from which a center tap has been taken. This center tap need not be in the exact center of the loop but may be one turn either side of the center. The three leads from the loop should be brought out through wire having a comparatively heavy insulation such as lamp cord and should be twisted together so that their positions relative to each other will remain constant even though the loop position is varied. These leads should not be over 3 feet long.

A loop may be built if desired by winding 16 turns of No. 18 solid or stranded wire on a form, roughly, 24 inches on a side. The winding can be in either spiral or solenoid form and should be spaced ¼-inch between turns. A standard loop wire may be used for this purpose very nicely, and Litz is to be avoided. If a spiral loop is used the outside end of the loop should always go to the binding post connecting to the grid of the first detector tube.

If an antenna is to be used with the set a coupling coil can be made by winding 50 turns of No. 24 DSC wire on a 3-inch tube tapped at the center. The three leads from this coil go directly to the set in place of the loop. A 10 turn primary coil of the same wire wound on the same tube is connected between the antenna and ground. This coil may be located either at the center of the tube or toward the grid end of the 50 turn coil and if desired may

be placed directly on top of it. A suitable antenna would consist of a single wire 30 to 70 feet long or a small indoor antenna anywhere from 30 to 50 feet long.

In the preliminary test of the set the center tap feature of the loop or tuning coil should be ignored. This may be done by short circuiting the two bottom binding posts on the set and leading them directly to the inside end of the loop. The center tap is left unconnected and the outside end of the loop goes to the top binding post on the set. This will render the loop tuning control rather broad and will simplify the preliminary testing of the outfit.

The batteries and loop having been connected, a single tube should be inserted in the audio socket at the right hand end of the set, and the rheostat just turned on. The phone plug being inserted, a slight click should be heard as it goes into the last jack. If the grid post of the socket is touched, a slight click will also be heard. The second detector and first audio tube should now be inserted in their sockets and the rheostat adjustment left unchanged. A click or squeal should be heard when the grid terminals of these tubes, or their sockets are touched. The two RF tubes may now be inserted, and the potentiometer moved from its postive to its negative end, with 1½ volts C battery on the RF tubes. A scraping noise should be heard as the arm is moved over the risistance sector, getting slightly louder as the negative end is reached. If the grid terminals of the RF sockets are touched, a squeal or click as before should be heard.

The oscillator tube, at the left end, and the first detector should now be inserted in their sockets, making all seven tubes in place. The oscillator coupler should be set full in, the balancing condenser all out, and the five megohm leak put in the clips of the first condenser, the two megohm leak being in the second detector grid condenser clips. The loop condenser should be set at about 20 to 30 degrees, and the oscillator condenser adjusted. At some point a sharp click should be heard, indicating that the oscillator is in resonance with the loop circuit. At this point no signal can be heard, but if an outdoor antenna is used, the set is radiating slightly. This click adjustment is the only setting of the set where radiation is likely to occur, and it is practically negligible, especially on a loop.

An oscillator adjustment about five to ten degrees either side of this click is proper for a given loop condenser setting, and is where a station can be heard. These two points, one either side of the click, will hold over the entire wave length range of the set, which is from about 200 to 600 meters. This means that each station may be heard at two oscillator adjustments, which is often a convenience, as if interference is noticed on one point, the other may be resorted to.

This click may be reduced in strength, or eliminated, by loosening the oscillator coupling. This should be done on a very weak signal, resetting both loop, oscillator, and possibly balancing condensers for each adjustment of the oscillator coupler. The coupling should be as loose as possible for good signal strength, and when once adjusted, should be left permanently set, as any change in its setting, throws off the loop and oscillator condenser logging for stations heard.

After a weak station has been heard, the potentiometer arm should be moved from its positive to the negative end. The signal will increase in strength until the amplifier goes into oscillation with a thud or until it squeals. If oscillating, signals will be heard as a squeal, as on a regenerative set, although the same is true if the balancing condenser is set too far in. If the signal is strongest at the negative end, increase the RF C battery to 3 or 4½ volts, and adjust the potentiometer for best signals.

If the set is now working properly and signals have been received the loop should be disconnected from the set and re-connected using its center tap. Starting with the balancing condenser all out, a signal should be tuned in. Some difficulty may be experienced unless the oscillator dial reading for some station has been recorded since the loop condenser will be very sharp, probably sharper than the oscillator condenser. After the station has been found the balancing condenser should be moved in very slightly and the loop and oscillator re-tuned for best signals. This procedure should be continued until the balancing condenser has been so far increased as to cause instability or bad hand capacity in the set. It should always be kept at a point low enough to prevent hand capacity effect and instability of the set which will be evidenced by oscillation of the first detector on the lower waves or bad clicking at certain dial adjustments.

Trouble Shooting. The first thing to do when getting ready to look for trouble in a super-heterodyne is to check over the wiring very carefully against the diagram and make sure that there are no leaky joints due to excessive soldering paste and that all connections are tight and firm. It often happens in using rosin core solder than an apparently good joint is made whereas, actually the rosin has run in between the wire and the lug preventing contact. This type of trouble should be checked for very carefully and if soldering paste is to be used all connections should be wiped off with alcohol after they have been made.

Broad Tuning. Broad tuning in the receiver may be due to too tight oscillator coupling, that is, the oscillator coils being to close together, improper setting of the balancing condenser, potentiometer too far positive or defective grid condensers. The .0075 condenser is somewhat critical and in case trouble is experienced with broad oscillator tuning it should be adjusted starting with a value of .006 and adding fixed condensers in parallel until .0085 has been reached. The best value should be left in the set. If the oscillator coupling is too tight, broad tuning may result and this coupling should always be loosened when testing on a weak signal to a point where the volume is almost ready to fall off. It should be operated as loosely as possible.

Once the best adjustment for the balancing condenser and the oscillator coupler has been determined they should be left permanently set since there is one best adjustment for each, and changing their values will only result in throwing the loop or oscillator dial station logging somewhat off.

Hand capacity effect may be overcome by grounding the negative filament lead or center tap of the loop. The by-pass condensers also may contribute to this effect and none of them should be omitted as they are all vital to the stable operation of the set. In connecting the set up the stationary plates of both variable condensers should always go to the grid sides of the circuit and the rotors connected, in the case of the oscillator to the plate, and in the case of the loop condenser to the plate side of the loop. This is very important.

It is advisable in all cases to ground the RF transformer can and audio transformer cores and mounting brackets to the negative side of the filament to eliminate any possibility of trouble.

Squealing. Any radio set improperly operated will squeal and it will be noticed that if the potentiometer arm is moved too far negative the set may squeal. This is correct but if continual squealing is noticed it will be due either to the radio amplifier, audio amplifier or first detector. In the case of the first detector, resetting the balance condenser will overcome the condition. In the audio amplifier grounding the cores and mounting brackets of the transformers to the negative side of the filament will help matters, but if this doesn't overcome it, the use of grid leaks of a value of 100.000 to 250.000 ohms across the audio transformer secondardies will help. Small condensers in the same positions of a value of not over .00025 may also assist but should not be used unless necessary since they flatten the quality of the received signal. It is also well in this type of trouble to reverse the direction of the wiring to the primaries of the audio transformer which sometimes helps. It should never be necessary to reverse the secondary wiring, however.

Squealing in the radio amplifier may be overcome by grounding the can of the RF transformer unit and by preventing the grid and plate leads of the tubes from running parallel to each other any more than is absolutely necessary. Switching tubes often helps also.

Noises. The location of the noise should first be checked by removing the loop from the set. If the noise ceases it indicates that it is picked up on the loop and is in the nature of a local disturbance which cannot be eliminated on any set. If it persists after the removal of the loop it may be assumed that the noise is in the set and the first detector tube should be removed. If the noise still persists it is in some circuit further on in the set; if it ceases it indicates that it is in the detector circuit. If it perists it is further along in the set and the tubes should be removed successfully, working toward the second detector and audio amplifier until the noise ceases. If it ceases abruptly upon the removal of one tube, the noise is probably in that circuit and may be corrected by checking in accordance with suggestions offered in other paragraphs. If it decreases gradually after each tube is removed it is a cumulative noise and is probably due to some poor common wiring such as filament on B battery leads or possibly C battery wiring.

Another very common source of noise is dirty rheostat or dirty tube contacts. The tube contact pins should be scraped clean with a knife and the socket springs bent up so that there is no question as to their making good contact with the tubes. Batteries as previously mentioned may also cause this trouble.

Tubes. Tubes should be shifted from one position to another in the set in an endeavor to locate their best operating positions as while they are theoretically uniform they vary slightly in manufacture and it will be found that certain tubes while inoperative in some positions will give excellent results in others. It is generally unnecessary to buy extra tubes in order to obtain a good set although it is always advisable to have one extra tube on hand in case of emergency, or for matching purposes.

Microphonic noises in the set are due to the second detector and audio amplifiers and may be overcome by shifting these tubes. This is the type of noise noticed when the table on which the set is located is thumped or the set otherwise jarred. The most critcal tubes in the set in their order are the first RF stage, second RF stage (nearest second detector), the oscillator tube, first detector, second detector and audio tubes.

Loop. A short circuit or open circuit in the loop will cause instability in a set and perhaps absence of signals. The loop should be carefully checked for this. The center tap need not be located at the exact center of the loop but may be one turn either way of it. The loop wires may be supported on wooden cross pieces or Bakelite but if of wood they should be shellaced or varnished.

The three leads from the loop should be of wire of quite heavy insulation such as lamp cord and should be braided together in order that their relative positions with respect to each other will not vary when the loop is rotated. If the wires were loose and change positions as the loop was rotated the adjustment of the balancing condenser would be somewhat thrown off.

Oscillator Coupler. Practically no trouble will be experienced with this coupler except broken wiring or short circuited turns. If the turns are short circuited the coupler must be re-wound and, of course, the same applies if there is an open circuit. Open circuits may be located by clicking the windings with a pair of head phones and a dry battery.

Oscillator Circuit. This may be checked for proper oscillation by connecting the phones in series with 45 volt B lead and taking all tubes but the oscillator out of the set. If it is oscillating a "plunk" will be heard both upon touching and removing the finger from either the grid or plate terminals of the tube socket. No trouble should be experienced here, and the only caution is to keep the .002 condenser, shown between the two inside terminals of the stator winding as close to the coupler as possible, preferably directly on top of it.

First Detector Circuit. This may be checked by connecting the phones in series with the 45 volt B lead and removing all tubes but the first detector. If a buzzer-driven wave-meter or a powerful local station is operating it should be possible to hear it very faintly on the head phones. In any event a slight click should be heard when the grid terminal of the tube is touched.

RF Amplifier. If this is functioning properly it will be noticed that as the potentiometer arm is moved from the positive toward the negative side the scraping sound will increase very slightly in intensity, which is correct. If the grid terminals of the tubes are touched the set will probably squeal or a loud click or plunk will be heard. It is probable that the amplifier will not oscillate, which condition would be indicated by a plunk heard at one setting of the potentiometer followed by squealing, but if it does oscillate too high a value of C battery is being used and the potentiometer arm is not grounded or if a poor combination of tubes is used in the RF amplifier it will account for this trouble. In first testing the amplifier the C battery on the radio frequency amplifier should be started at 1½ volts, increased to 3, and then to 4½, leaving it at the value giving the most satisfactory results.

Audio Amplifier. Very little trouble will be experienced which has not been taken up under previous sub-headings and it is unnecessary to enter into further details here.

Grid Leaks. The first detector leak may vary between 3 and 5 megohms and should be of first class manufacture. The second detector leak may vary between 1 and 3 megohms and should also be of first class manufacture. Noise may often be traced to the grid leaks.

Fixed Condensers. These condensers should be carefully tested with the phones and dry cells for leakage. When the circuit is first made between the phones, batteries and condensers a click will be heard which is entirely correct but other than this click there should be no noise at all. The by-pass condensers are preferably of the large type and may vary between ½ and 2 MF and should also be tested for noise.

The other two by-pass condensers shown with a value of .002 may vary between .002 and .005 but should preferably be kept close to the former value. Never solder directly to a mica condenser; always fasten lugs to the condenser with machine screws and nuts. An exception is in the case of the .5 MF by-pass condensers and Muter mica condensers, to which the wiring may be soldered directly.

Potentiometer and Rheostat. These instruments should be checked for good contact and clean resistance wire sectors before assembly. It is often found that potentiometers are supplied with enameled wire from which none of the insulation has been removed so that the arm may not make contact with the windings.

Transformers. All transformers may be checked for continuity of circuit by means of a head phone and battery clicked across the various windings.

If the windings do not click out the transformers are defective and should be returned to the manufacturers for repairs or replacement. The intensity of the click is not of very great importance since the resistance of the windings in the transformers used varies from circuit to circuit.

Jacks. These should be checked for good contact both when the plug is in and when it is out, and care should be taken in soldering to them that no soldering paste is run into the insulating section supporting the springs.

Tube Sockets. Care should be taken to see that the springs make good contact with the tubes and that no surplus soldering paste is run in where it might cause leakage between different contacts on the socket strips.

Variable Condensers. These should be examined carefully from time to time to see that no dust accumulates on their insulating supports and on the plates. Pigtailed condensers should be used whenever possible. In the case of the vernier condenser it is often found that grounding the vernier rod bearings to the rotor plate sections will eliminate noise which may be encountered as the condensers are adjusted in tuning the set.

If after you have checked your set over carefully you still find it impossible to obtain the results of which you believe the set capable, do not hesitate to communicate with the writer, who is always at your service, in case you encounter any unsurmountable difficulties.

Troubles That May be Experienced in Radio Receiver Operation and Their Remedies

By MESSRS STARK and SONKIN

TO the radio amateur, the fun in having a radio receiver, is very largely that of experimenting with various circuits, parts, etc. To make it work, especially when it "doesn't want to," is the ultimtae goal of every experimenter.

To aid the radio constructor and experimenter in locating or

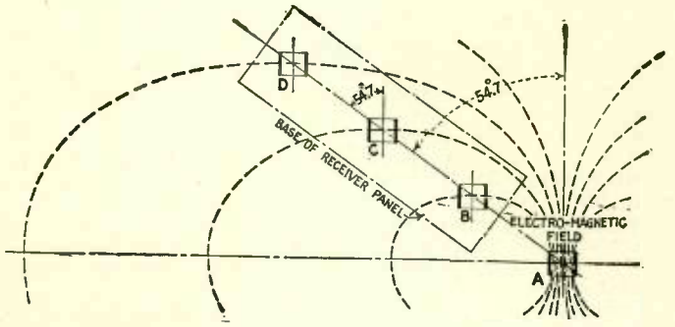


Fig. 1. A simple explanation of the critical angle at which all Neutroformers must be mounted

diagnosing radio receiver troubles, the following rather complete "Trouble Shooting" section is included in this article.

Internal Controllable Troubles

This discussion on internal receiver troubles is particularly given from the point of view of Neutrodyne circuit receivers, both home and factory built.

The Wiring

Obviously, if the wiring of a receiver is wrong, particularly the filament "A" battery or plate "B" battery wiring, one is very liable to burn out the vacuum tubes. Such a trouble will result in the loss of several dollars, and one hardly ever finds the trouble or can remedy it, before the loss occurs. The answer to this problem of wrong connections, is to carefully study the wiring of your receiver both in schematic and picture form, and in addition, to study the assembly information given, and to understand the use of the various parts in the circuit. In wiring up the receiver, check off with a heavy pencil, each wire, as it is placed in position, as shown on the schematic and picture diagram. Then after the receiver is completely wired, and before it is tested out with the vacuum tubes, be sure that you have again checked the receiver to verify the correctness of the wiring.

In general all wiring should be as short as possible, going from one terminal to the other in a straight line. Exception, however, is made in the case of grid and plate leads, particularly

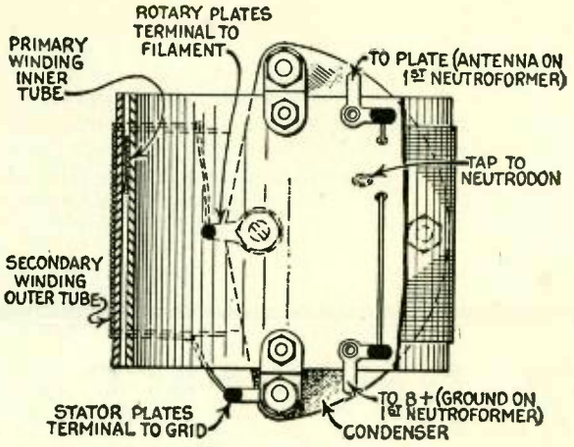


Fig. 2. A section of a Neutroformer showing the relative position of its windings and their terminals

in amplifiers, where it is desirable to keep these leads as far apart as possible. Practically ½" spacing should exist between all wiring in a radio receiver. Again all wires should cross any other wires at right angles to one another. There is no great advantage to covered wires, such as that covered by insulating tubing or "spaghetti," as it is usually called, over bare wire, except that one is less liable to cause a short circuit.

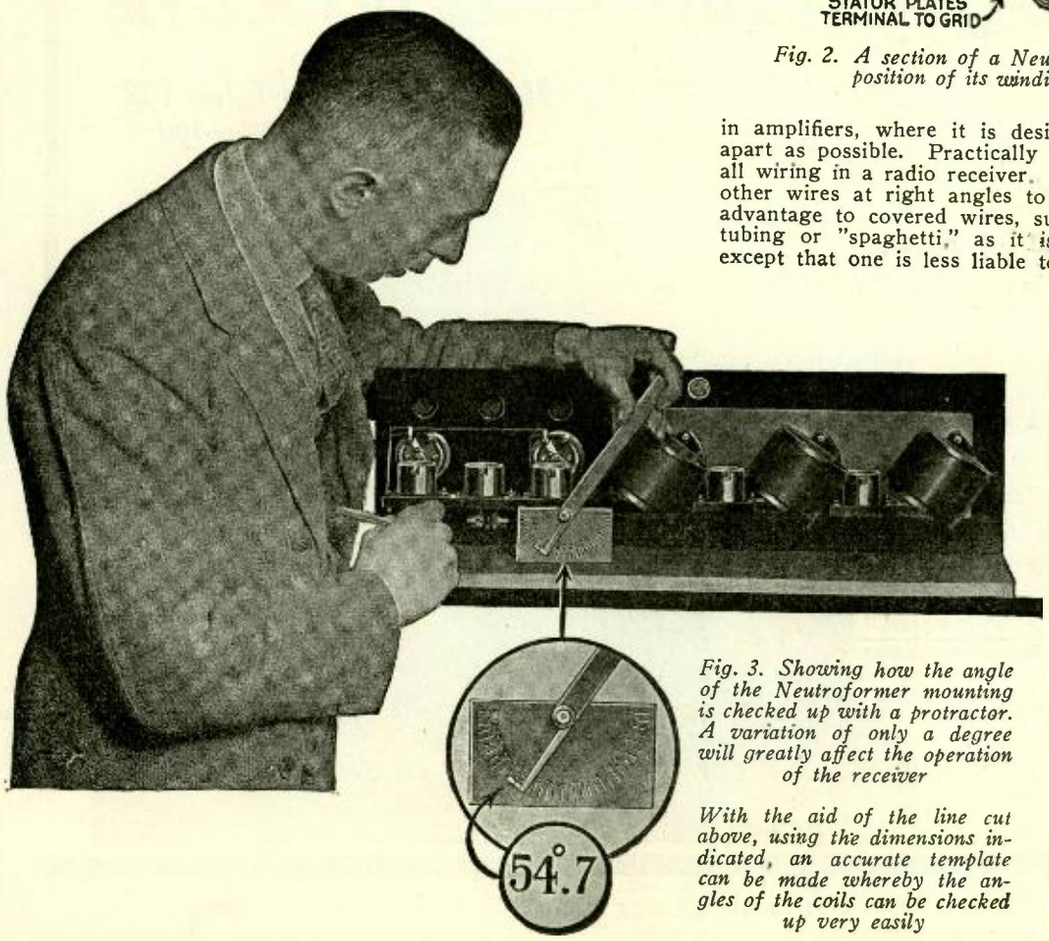


Fig. 3. Showing how the angle of the Neutroformer mounting is checked up with a protractor. A variation of only a degree will greatly affect the operation of the receiver

With the aid of the line cut above, using the dimensions indicated, an accurate template can be made whereby the angles of the coils can be checked up very easily

The Neutroformers

The Neutroformers, as used in Neutrodyne circuit receivers, are essentially tuned radio frequency transformer units, and consist of two inductance coils and a variable condenser. The two inductance coils are wound on concentric bakelite tubes, one enclosed inside of the other, the inside coil being the primary winding having a small number of turns, and the outside coil or secondary, having a large number of turns. The two inductance coils and their respective bakelite tubes are mounted upon the variable condenser, across the terminals of which are connected the two leads from the secondary inductance coil.

In the factory this Neutroformer unit is very accurately inspected for mechanical defects, the condenser unit in particular being given several rigid mechanical inspections. After the unit is assembled and ad-

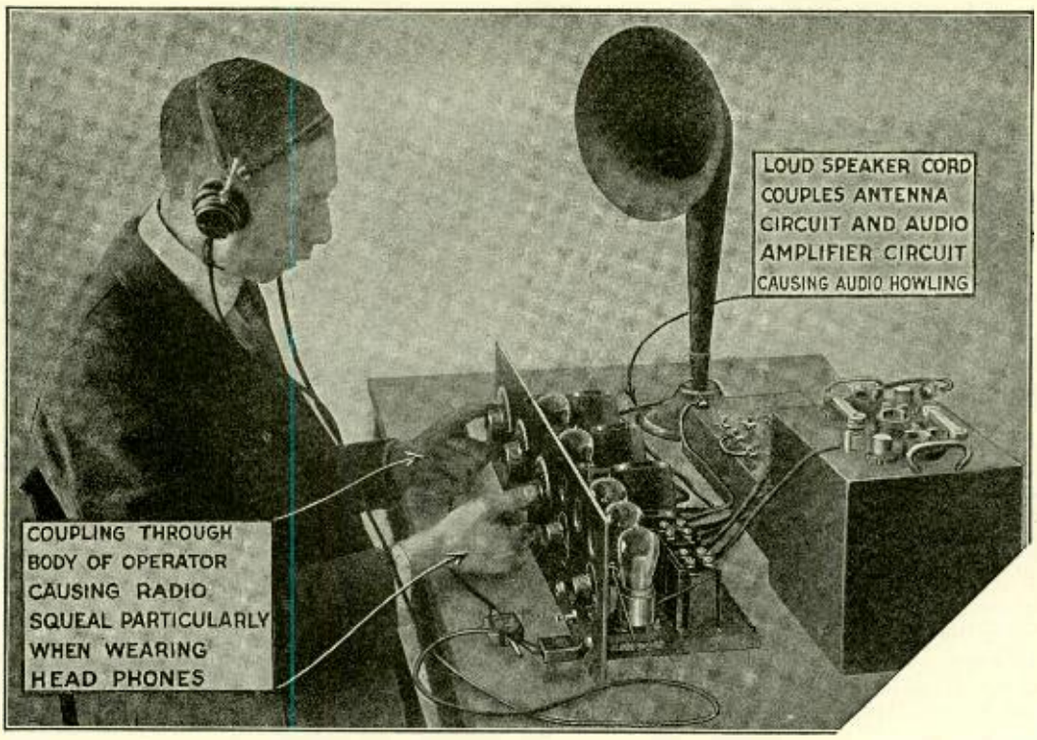


Fig. 4. A picture of how not to do it. Don't place the loud speaker at the antenna end of the receiver and likewise make sure that no radio frequency coupling exists through the body of the operator. Neither should the antenna lead come in from the right and run close to and parallel with the receiver

justed for mechanical alignment (that is, the relationship of the inductance with respect to the variable condenser), the unit is calibrated at its maximum wave length.

A set of three Neutroformers is very accurately matched for wave length readings, so that all Neutroformers are identical. This method of calibration is a very precise laboratory method, using a calibrated radio frequency oscillator, the practical results being, that the dial readings on any Neutrodyne receiver, are practically identical. This is one of the greatest advantages in radio receiver operation, and an advantage made possible only with the advent of the Neutrodyne circuit. The only trouble that may occur, is the possible shorting of the Neutroformer terminals or the breaking of the wire in the primary or secondary inductance windings. An open circuit may be very easily checked by inserting a battery and telephones in series with the wiring or windings and noting if a click is heard when the circuit is completed.

Another important point in connection with the Neutroformers, is the mounting of the Neutroformers with respect to one another on the panel. In Neutrodyne circuit receivers, the magnetic coupling between the various inductance units has been practically eliminated by placing the Neutroformers at an angle of 54°.7, with respect to the base line of the receiver. A simple theoretical explanation of the reason of this peculiar angle is given in the drawing of Fig. 1; a simple summary being that when the Neutroformers are at this angle with respect to one another, the magnetic lines of force from one inductance, cut the wires in another inductance at right angles to the axis of the coil, thus not setting up any voltage or potential difference across the coil.

Such an electrical system needs be very accurately placed if it is most effective, and consequently, if the angle of the Neutroformers is slightly different from 54°.7 (either above or below) receiver difficulties will undoubtedly be encountered, particularly in obtaining neutralization by the adjustment of the Neutrodon condensers.

In spite of all precautions, it is not a foregone conclusion that when the receiver is assembled the windings of all Neutroformer coils will be at the same angle with respect to one another and to the panel, and also at an equal distance from each other. Rough handling or the placing of a heavy object on the receiver or in contact with the Neutroformers may cause them to be forced out of position. If a receiver is correctly wired and yet is inoperative at the upper end of the wave length range but not at the lower, one should carefully check up the Neutroformer angles, as this is the usual trouble.

In wiring the Neutroformers, the diagram in Fig. 2 will be of aid as it shows clearly the terminals and their proper connections. The top terminal of the primary winding, or inside winding (with Neutroformer assembled on panel in accurate position) is connected to the plate socket terminal (P), the bottom primary terminal to the positive 90 volt lead terminating at the "amplifier +" binding post on the terminal block. The top of the secondary winding is already connected to the rotary plates of the variable condenser which in turn is connected to the negative filament terminal (F —) of the following tube socket. The lower terminal of the secondary coil is already connected with the stationary plates of the variable condenser and should also be connected to the grid terminal (G) of the following tube. These Neutroformer wiring instructions apply only to the second and third ones as the first left hand Neutroformer primary winding is connected to the antenna and ground binding posts on the terminal block. On the second and third Neutroformers only, the little loop near the top of the secondary winding must be carefully scraped free from insulation and connected to the Neutrodon or neutralizing condenser.

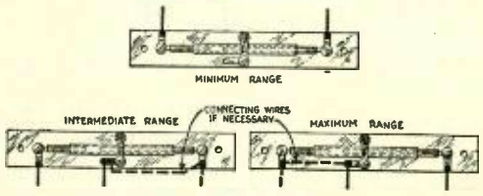


Fig. 5. The capacity range of the Neutrodon may be changed by following the connections above

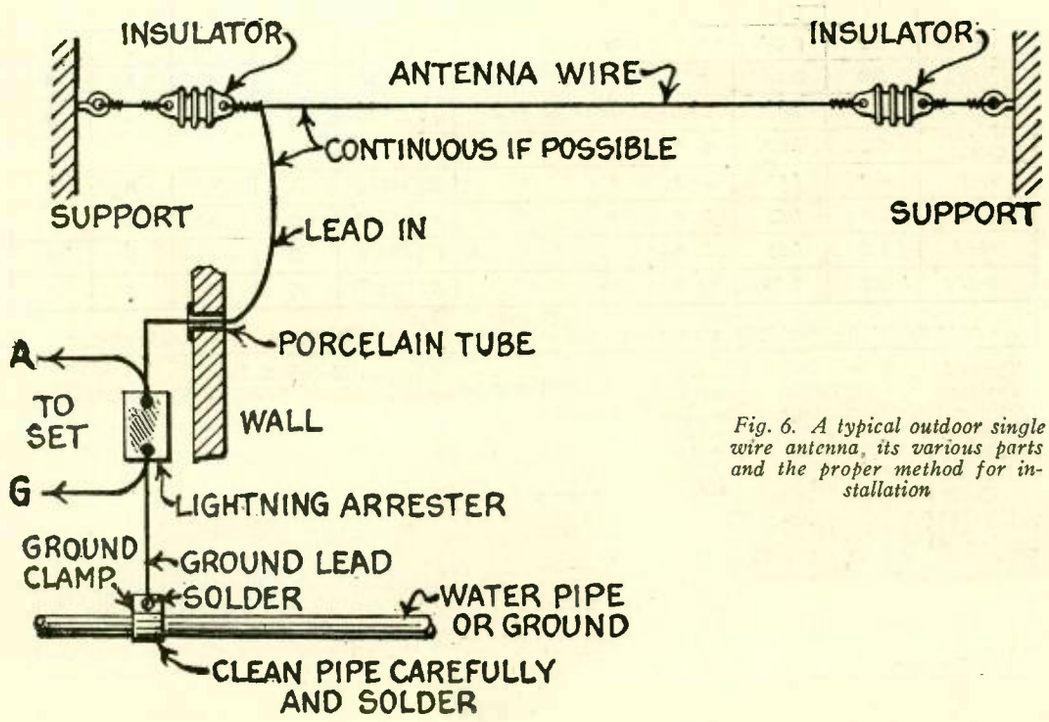


Fig. 6. A typical outdoor single wire antenna, its various parts and the proper method for installation

If at any time for any particular wave length setting, especially at the higher wave lengths, one of the dials reads considerably lower than the other two, the trouble may be due to a short circuited turn on the secondary of the Neutroformer coil. It can be located at the tap, or at the ends of the coils where the leads are brought through the tubes. The trouble is that the insulation has become scraped by manhandling or careless soldering at the tap, and adjacent turns touch, producing a short circuited turn. It can be remedied by gently pulling the turns away from each other, and painting the bare spots with a little collodion or "new skin," or a little insulating varnish.

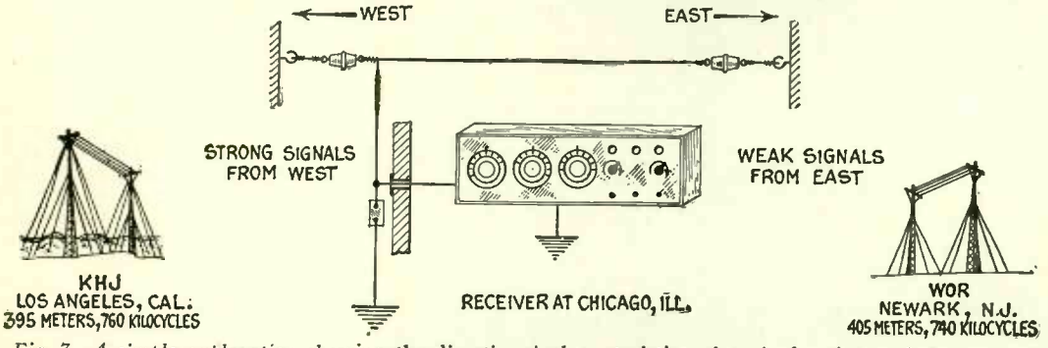


Fig. 7. A simple explanation showing the directional characteristics of a single wire outdoor antenna

3. Fixed Condensers

In a Neutrodyne circuit receiver, fixed condensers are used in one of three ways, or possibly in any of these three ways. The first is used as a grid condenser, the second as a by-pass condenser (usually connected between the "amplifier +" binding post and the "amplifier —" binding posts) and the third as a by-pass across the primaries or secondaries of the audio frequency transformers.

The grid condenser usually has a capacity of .00025 microfarads, although in many cases a grid condenser of .0005 microfarads is used. The grid leak may have a resistance of one or two megohms, either size usually being found to work satisfactorily. In general the greater the resistance of the grid leak, the greater the possibility of receiving more distant signals, as less current is absorbed by the grid leak, and hence more current gets on to the grid of the detector tube.

The fixed by-pass condenser across the "amplifier +" and the "amplifier —" binding post usually has a large capacity of the order of from .006 microfarads to possibly one microfarad. Inasmuch as this condenser is placed directly across these two points of high voltage, it can be seen that if this by-pass condenser is defective or shorted, the "B" batteries will become used up very rapidly. Likewise, if connection to this by-pass condenser is not properly made, it may cause the receiver to become noisy and a snapping and crackling noise may be heard in the telephones. Using an excessive "B" battery voltage may break down the insulation in such a fixed by-pass condenser, although this is a very rare occurrence. However, such a by-pass condenser should never have a smaller capacity than .006 microfarads. If the by-pass condenser is "open" it will cause the receiver to become inoperative over its entire wave length range. The best method to determine whether the condenser is open or not is to substitute another condenser of the same size and if the receiver improves in behavior, obviously, the original condenser was defective.

The by-pass condenser used across the audio frequency transformer windings usually has a capacity of the order of from .001 microfarads to possibly .006 microfarads and hardly ever gives any trouble; it being well, however, to check any condenser on the receiver for short-ing or leaking because of excessive soldering flux flowing into the condenser between its plates.

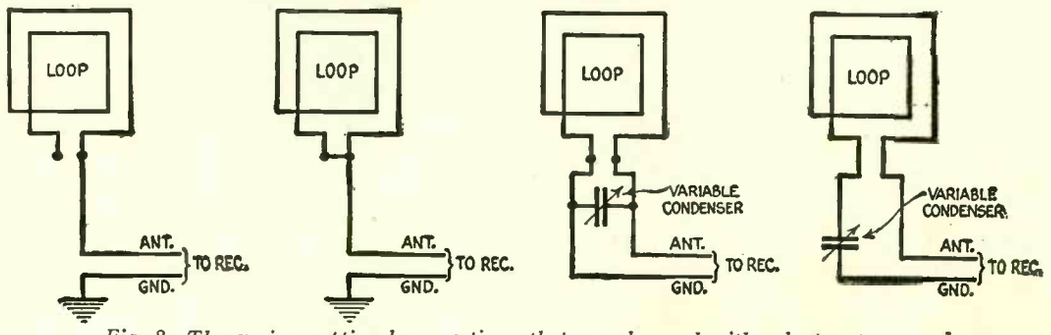


Fig. 8. The various optional connections that may be used with a loop antenna and applicable to any type of radio receiver

OPERATING DATA FOR VACUUM TUBES

TYPE OF TUBE	FILAMENT VOLTAGE	FILAMENT CURRENT (AMPERES)	"A" BATTERY SOURCE	PLATE VOLTAGE	USED AS			
					DETECTOR	R.F. AMPLIFIER	A.F. AMPLIFIER 1ST. STAGE	A.F. AMPLIFIER 2ND STAGE
WD-12	1.1	0.20	1 DRY CELL	22½ TO 90	A	X	C	D
UV-199	3.0	0.06	3 DRY CELLS	22½ TO 90	D	A	C	D
UV-201-A C-301-A	5.0	0.25	6 VOLT STORAGE BATTERY OR 4 DRY CELLS	45 TO 120	C	A	A	A
UV-201 C-301	5.0	1.00	6 VOLT STORAGE BATTERY	45 TO 120	D	A	B	B
UV-200 C-300	5.0	1.00	6 " " "	18 TO 22½	A	Y	Z	Z
VT-1	4.0	1.10	6 " " "	22½ TO 67½	A	Y	B	B
VT-2	6.0	1.35	6 " " "	90 TO 350	D	B	B	A
216-A	6.0	1.35	6 " " "	67½ TO 120	D	B	B	A
UV-202	8.0	2.35	10 " " "	90 TO 500	X	D	B	A

LEGEND
A = EXCELLENT B = VERY GOOD C = GOOD D = FAIR X = POOR Y = VERY POOR Z = UNSUITABLE

Type of Vacuum Tube	Filament Voltage	Filament Current Amperes	Rheostat Required For— 1 Tube On— 4.5 Volts	1 Tube On— 6 Volts	4 Tubes On— 4.5 Volts	4 Tubes On— 6 Volts
UV-201-A } C-301-A {	5.0	.25	.....	20 ohm	.....	6 or 8 ohm
UV-200 } C-300 {	5.0	1.0	.....	6 or 8 ohm	.....	.....
UV-199 } C-299 {	3.0	.06	30 ohm	60 ohm	30 ohm	30 ohm
DV-2	4.5	.25	.....	6 or 8 ohm	.....	6 or 8 ohm
DV-3	3.0	.06	30 ohm	60 ohm	30 ohm	30 ohm
DV-6	2.7	.3	8 ohm	30 ohm	6 ohm	6 or 8 ohm
WE-"J"	4.0	1.1	.....	6 ohm	.....	2 ohm
WE-216-A	6.0	1.35	.....	6 ohm	.....	2 ohm
WD-11 } WD-12 {	1.1	.25	.....	(1½ volt supply, one to five tubes, inclusive, 6 ohm)		

Fig. 9. Operating data and sizes of rheostats necessary for most efficient operation of vacuum tubes

Variable Condensers

The variable condensers on Neutrodyne receivers are those condensers which, as part of a Neutroformer unit, are connected in parallel with the Neutroformer secondary inductance coils. These variable condensers are very carefully adjusted in the factory, mechanically, and in addition, each set of Neutroformers, together with their condensers, are matched up with great accuracy on a wave meter. This is done to insure that the wave length readings of all dials will be practically identical, the reading of dial 1 varying with the antenna used. If, at any time, the readings of dials 2 and 3 diverge or differ more than two degrees on any wave length, in all probability the rotating plates of the variable condensers have been bent out of place. By careful adjustment these plates can be centralized between the stationary plates and the dial readings can be restored to their uniform settings.

It may be found of advantage, particularly to the inexperienced "radio fan," to use some sort of a vernier dial. However, if care is used in slowly moving the dials, and particularly by grasping them at the outer edges, very little difficulty will be experienced in picking up distant stations and selecting one station from another. Vernier attachments or dials are no

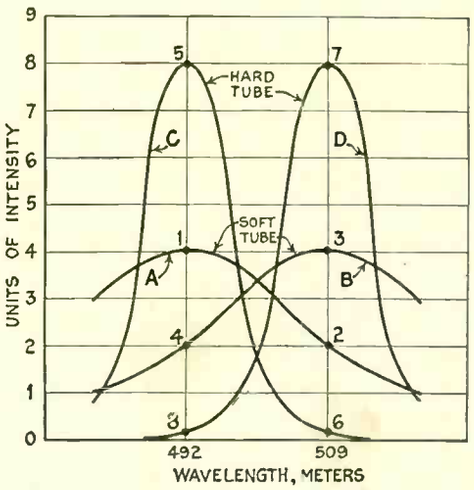


Fig. 10. Showing the relative efficiency of operation of both "soft" and "hard" detector vacuum tubes

broken, thus shorting the condenser. If this occurs through any cause, replace the glass tube with a new one, or in an emergency, use a piece of insulating tubing or "spaghetti" for insulation in place of the glass. The copper wires forming the other side of the condenser are cut off at the proper lengths, as has been determined by careful laboratory experimental work and should never be changed in length. The adjustment of the metal tube will practically always allow great enough capacity variation of the Neutrodon to completely neutralize the receiver, but as an added advantage Neutrodons have been so designed that if the connections are changed in the three different ways shown by the line drawing of Fig. 5 the capacity range of the condenser is increased from the minimum shown at the top, to the intermediate range shown at the lower left, and finally to the maximum capacity range shown at the lower right of the drawing. In rare cases it may be desirable to also add the wire connecting from the center tap to either of the end terminals, but this should never be resorted to except as a final experiment, providing difficulty is had in properly neutralizing the receiver under ordinary conditions and according to the instructions in this article.

External Controllable Troubles

The Antenna System

The best antenna for a Neutrodyne set is one consisting of a single wire of about 100 to 125 feet long, strung between supports that are as high as possible from the ground. The antenna must be insulated at each end by insulators of the highest quality. Whereas the antenna itself may be either of bare or insulated wire, it is extremely important that in no case it touch any structures such as chimneys, trees, neighboring buildings, etc., and that it should be at least several feet from any obstructions. The accompanying diagram of Fig. 6 shows a typical outdoor antenna installation.

The antenna lead-in should in all cases be part of the antenna itself. By this is meant that the antenna wire stretched between the two supporting points is continued directly down from one end to connect to the receiving set. It is not necessary to cut the wire and then connect the lead-in to the antenna. This latter practice requires careful scraping of the antenna wires and secure soldering to insure good electrical contact and maximum efficiency. Making the antenna and lead-in all in one obviates the necessity of soldering. It is also important that the lead-in should be kept away from buildings, trees, and other obstructions.

The antenna lead-in, as it comes to the set, should be kept away from the set. It is poor policy to bring the antenna back along the length of the receiver, so that the electric field around it affects the receiver. This usually results in trouble and makes the receiver inoperative. It may be necessary at times to insert the antenna lead-in within a shield. This shield can best be of flexible copper braid or a copper tube, which should be connected to ground.

It is a very great advantage in installing an outdoor antenna or an indoor antenna, for that matter, to have the antenna directional. By directional it is meant that the antenna system will receive signals with greater efficiency from one direction than from another. The simplest method of erecting a directional antenna is: always connect the lead-in to the end of the antenna pointing toward the station from which it is desired to receive the signals. The diagram of Fig. 8 indicates the layout of such a directional antenna system.

An indoor antenna differs from an outdoor antenna only in that it is placed entirely indoors and therefore must be shorter and lower than the outdoor antenna. As a result the reception and intensity of the received signals must be considerably weaker than the corresponding signals as obtained from an outdoor antenna.

An indoor antenna may be made of ordinary insulated wire such as annunciator or bell wire and concealed about the room by placing it behind picture moulding, etc.

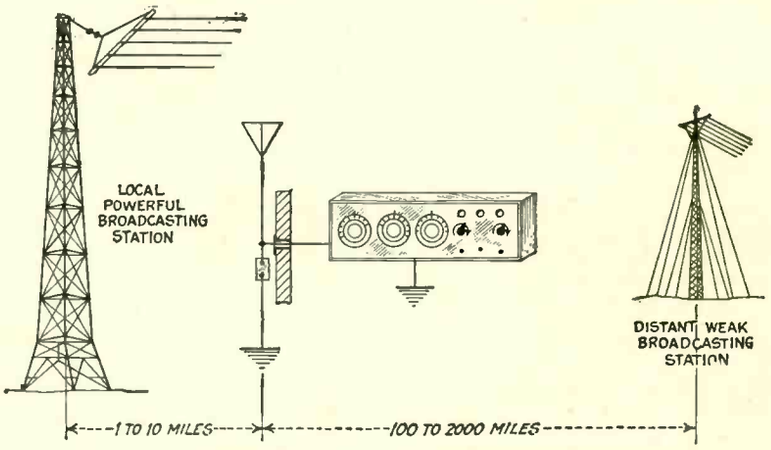


Fig. 12. Showing interference between local and long distance broadcasting stations

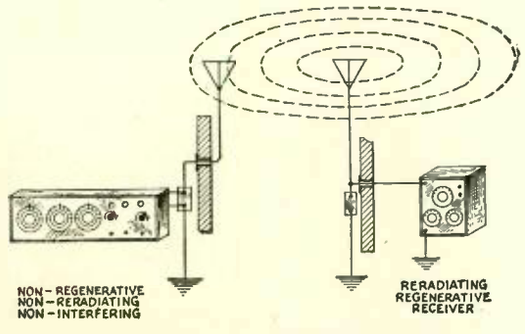


Fig. 11. How the re-radiating regenerative receiver disturbs the whole neighborhood of radio broadcast listeners

The Ground Connection

The ground connection is one of the most important factors for the proper operation of any receiving set. In the city, especially in congested districts, the ground is extremely important. The cold water pipe system of the house is usually the best ground connection. The pipe or connection to which the ground is made must be very carefully scraped and cleaned so that the metal shows bright. A ground clamp will be of great aid in making a good connection, and can be installed in a few moments. The ground wire from the receiving set to the clamp must be securely attached to the clamp, and preferably soldered. It has been proven time and time again that reception has been increased from very poor to astounding results merely by removing the ground clamp, cleaning the insulating paint, dirt, etc., between the clamp and ground proper, and cleaning and soldering all connections.

Vacuum Tubes

The low filament battery consumption of "XL" filament tubes, namely, the types UV-201-A and C-301-A, or "hard" tubes, as they

Neutrodons

There is one other important unit in the Neutrodyne set, in which is focused the neutralizing adjustment of the receiver. This is the Neutrodon, or the small variable condenser, having a capacity of the order of 1 to 10 micro-microfarads. This condenser will not cause any difficulty unless the glass tube which insulates the sliding metal tube from the enclosed wires becomes disadvantage if one wishes to spend the extra money.

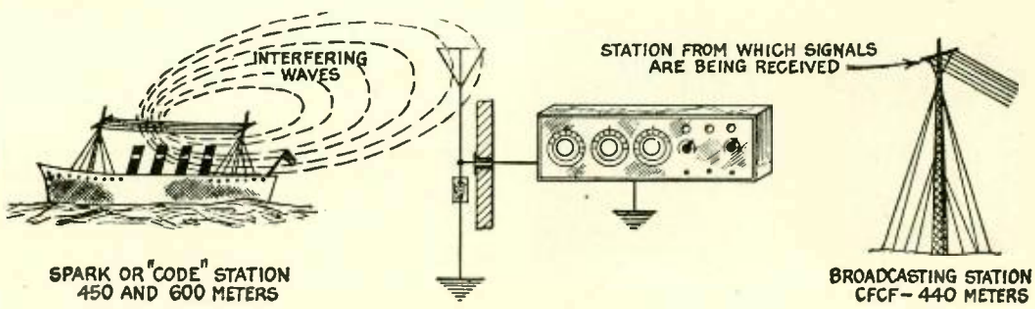


Fig. 13. Showing how both ship and shore spark stations interfere with the reception of broadcasting programs

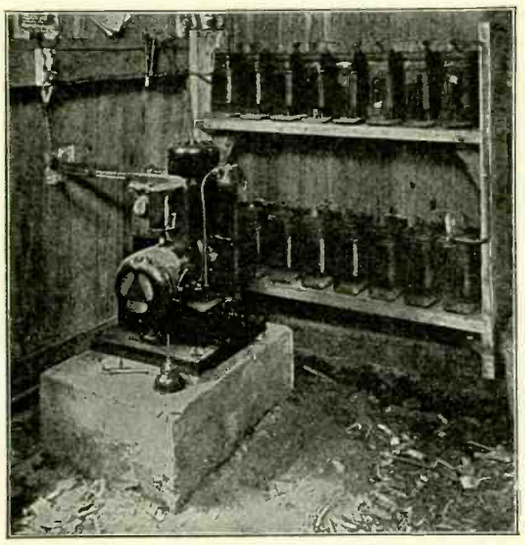


Fig. 14. A photograph of an isolated power plant which may cause receiver interference

are called, has made their use almost universal, supplanting almost entirely the earlier UV-201 and C-301 types. However, the types UV-199, C-299 and WD-11, which are dry battery tubes, are fairly popular. The "UV" type tubes are known as Radiotrons and the "C" type tubes are known as Cunninghams. These tubes are made from identical specifications, and can be used interchangeably in any receiver.

Below in Fig. 9 is a table of the various vacuum tubes on the market, showing their adaptability as detectors or amplifiers. In addition there is given a list of tubes and rheostats required for circuit use on a five-tube set, allowing for separate detector tube filament control and combined amplifier tube filament control.

We have recommended in all cases the use of the UV-201-A or C-301-A tubes because of their greater amplification. However, when these tubes, or others, are used in a Neutrodyne receiver, there are times when the receiver does not seem to function properly. Among the various causes that may render the receiver inoperative is the fact that the tubes themselves are defective. By interchanging the tubes among themselves one may arrive at a combination which gives best results. Some tubes act better as radio frequency amplifiers and some better as audio frequency amplifying tubes. There is no way of telling beforehand; trial alone will tell. The table of Fig. 9 was compiled from such practical information.

One of the chief causes for tubes becoming inoperative after being used for some time is the excessive filament current to which they are sometimes subjected. Rheostats are put into the receiver to regulate the filament current of the vacuum tubes and should be adjusted so that the maximum signals are obtained with a minimum amount of filament current. It is a well established fact that when the XL filament tube, such as the "UV" and "C" type tube, is adjusted to a certain filament current, the maximum signal strength is obtained. Any further increase in the filament current *will not* and *should not* increase the signal strength.

The 2 ohm power rheostat previously furnished with some Neutrodyne receivers to control the amplifier tubes is so designed that when using UV-201-A or C-301-A tubes, one need but turn the rheostat knob until the contact lever just makes contact with the resistance strip. This will give the proper signal strength. Further decreasing the resistance by turning the rheostat knob further to the right will not increase the intensity of the signals. It will only diminish the life of the tubes and render them inoperative in a short period of time. If it is necessary to cut out all the resistance to obtain the loudest signals, either the filament battery is discharged or one or more of the tubes are defective.

"Bootleg" tubes are very inferior to the genuine product and therefore must be scrupulously avoided.

Detector Tubes: The choice of a detector tube is dependent upon the type of service the broadcast listener desires. If he is content with consistent results from broadcasting stations at medium distances, no better tube can be used as a detector than either the UV-201-A or the C-301-A. Should he desire to listen to broadcasting stations at great distances, in other words to try for "DX" reception, the "soft" tube type UV-200 or C-300 should be used.

The "hard" tube requires no adjustment of its filament current beyond the initial adjustment to obtain signals. Thereafter the filament rheostat need not be adjusted every time the receiver is used. Local powerful broadcasting signals will not swamp or overloads "hard" detector tube but on the contrary such signals will be more efficiently rectified. Signals obtained when using a "hard" tube as a detector in this case will be several times as loud as those obtained with a "soft" detector tube. The relative lack of sensitivity of a "hard" tube for weak signals renders the receiver in which it is used, seemingly more highly selective than when a "soft" detector tube is used. The "soft" tube of the UV-200 or C-300 type is very sensitive to weak signals. It is therefore an excellent tube to be used for the reception of long distance signals. A "soft" tube contains a slight amount of gas, and due to partial ionization, or the breaking down because of electronic bombardment of the gas, it becomes extremely sensitive. It therefore requires very careful adjustment of its filament current and its plate potential, in order that the most sensitive point be obtained. This makes the tube a rather critical device, and requires some experience to obtain the maximum results. Due to the gaseous ionization, a "soft" tube is somewhat noisy in operation, and therefore a compromise must be made between the tube noise and the strength of signal desired.

Signals of various intensity will require different adjustments of the filament current of a "soft" tube. For fairly strong signals from nearby stations it is not necessary to adjust the filament current of the tube to the maximum sensitive point. For weak signals, it is absolutely necessary to obtain the most critical point of operation. Thus, the filament current required for strong signals is less than that required for weak signals. In tuning in for any particular station, it is best to reduce the filament current of the detector tube until the signals obtained are fairly weak. Then turn the dials of the receiver until maximum signals are obtained. The signal then obtained should not be very strong. Now the filament current of the detector tube

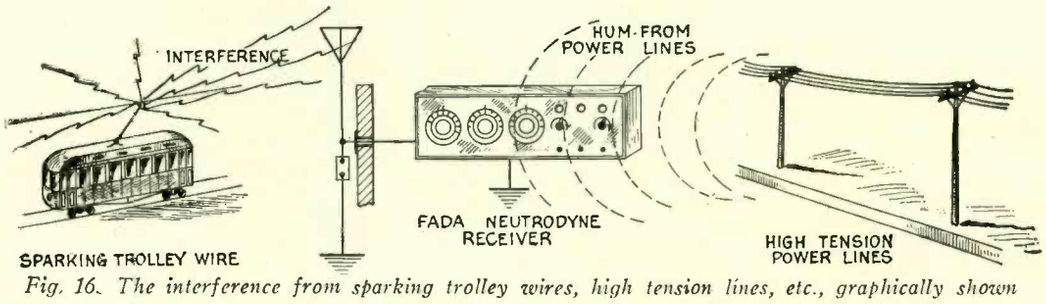


Fig. 16. The interference from sparking trolley wires, high tension lines, etc., graphically shown

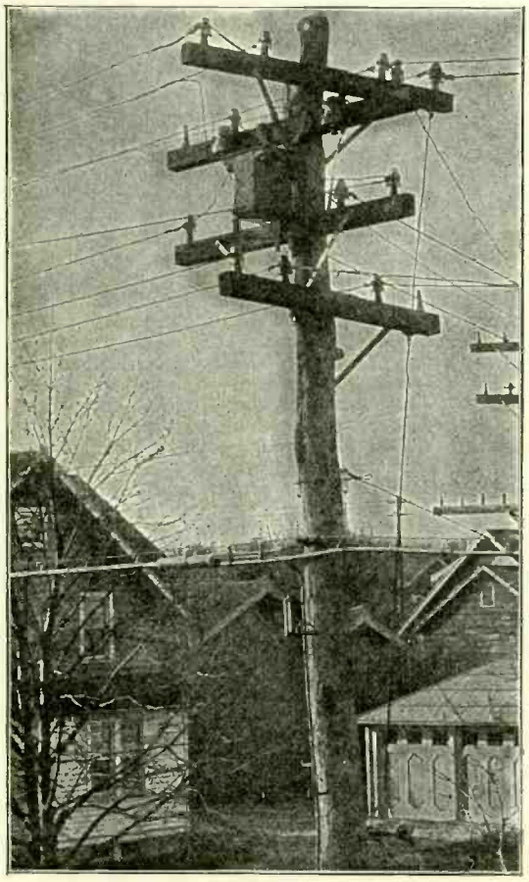


Fig. 15. Faulty power transformers and leaky insulators on power lines may cause a great deal of interference to the broadcast listener

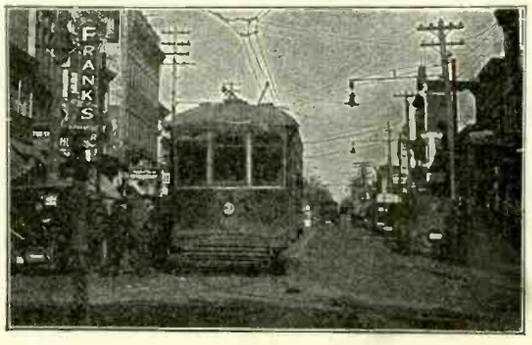


Fig. 17. The brilliant flashing of overhead trolley wires can be distinctly heard in a radio receiver hundreds of feet away

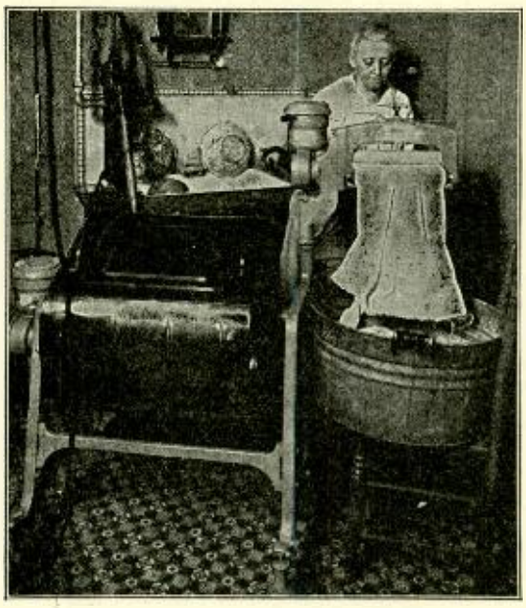


Fig. 18. Even the housewife is sometimes a radio bug-a-boo, for many of the electrical household appliances, especially those that are motor driven, cause noises that disturb the serenity of many radio fans

is increased until maximum response is obtained. If this procedure is followed the receiver will be tuned exactly to the incoming wave length of the broadcast signals. Following this method the operator will not be confused by the seemingly broad tuning obtained when listening to strong signals and with his detector tube adjusted for extreme sensitivity.

The plate voltage required for a "soft" detector tube is usually between 16 and 25 volts. This voltage is best determined by listening to the "hiss" which is very characteristic of the "soft" detector tube when it is adjusted to its critical point of operation. The best plate voltage is that voltage at which a reasonable adjustment of the filament is necessary to obtain this "hiss" point. If the plate potential is low, more filament current will be required to obtain the hiss point, than if the plate potential is higher. If, after adjusting the plate voltage throughout the entire possible range, this point is not obtained, either the filament battery is low and insufficient filament current is obtained, or the particular detector tube is defective, and should be replaced.

The diagram of Fig. 10 shows comparative curves of the signal strengths obtained from two broadcasting stations near to each other in wave length, when both "soft" and "hard" type detector tubes are used. When the receiver is very carefully tuned to obtain the maximum signal from the broadcasting station operating on 492 meters and a "soft" tube is used we obtain, let us say, four units of intensity, as indicated at the point "1" of curve "A." If the receiver be detuned to a wave length of 509 meters, and the "soft" tube still adjusted at its sensitive point, signals are still received with considerable intensity from the station broadcasting on 492 meters, as indicated at point "2" on the same curve, and we obtain two units of intensity. A second broadcasting station operating on 509 meters, having the same intensity as the first broadcasting station, will give us the curve "B," and a signal strength of four units as indicated at point "3." If the receiver be detuned to 492 meters, we will receive two units of intensity from the 509 meter station, as indicated at point "4." Thus if two broadcasting stations are operating on adjacent wave lengths of 492 and 509 meters, and the receiver tuned to either one, signals from the other will be obtained, having intensities of four to two, in other words, we will hear both signals, both stations thus interfering with each other. (The particular wave lengths are chosen here for explanatory purposes only.)

If a "hard" tube is used as a detector tube, we will find that when the receiver is tuned to either of the two broadcasting stations, the signals will be considerably louder, due to the fact that the "hard" tube is not limiting or choking up on the strong signals, as indicated on points "5" and "7" of curves "C" and "D" respectively. The intensities in this case are of eight units in value. If the receiver is detuned from the wave length at which it is receiving, the insensitivity of the tube will cause the signal to disappear very rapidly. Thus the signals obtained at 509 meters from a 492 meter station and vice-versa, will be entirely negligible, when a "hard" tube is used, and no interference between the stations obtained.

The rule to be followed therefore is, for consisent broadcast reception over reasonable distances to use a "hard" tube, with its accompanying stability and quiet operation; for long distance reception to use a "soft" tube, with its correspondingly critical adjustment and noisy operation.

The contact pins of the vacuum tubes are tipped with little balls of solder. This solder soon becomes oxidized, and results in a poor contact causing considerable noise and improper operation of the receiving set. *It is very important that this oxide be cleaned from time to time with the aid of a knife or piece of very fine sandpaper, so that the tube contacts are bright and clean.*

External Uncontrollable Troubles

Interference from Nearby Re-Radiating Regenerative Receivers

Ofttimes the individual complains of the squeals and howls which he experiences when tuning in for any broadcasting station. These howls and squeals are due part of the time to the close proximity of radiating regenerative receivers in the hands of inexperienced or wilful broadcast listeners.

These regenerative receivers are usually of the single circuit type and when improperly adjusted, act as miniature broadcasting stations and heterodyne or "beat" with the incoming signals. Not only do they beat with the broadcasting station signals, but also with every other improperly adjusted radiating regenerative receiver, thereby multiplying manifold the disturbance and discomfort of broadcast listeners. This great annoyance can only be eliminated by a campaign of education whereby the sale of radiating regenerative receivers is curbed, those in existence properly rebuilt so as to be unobjectionable, and by instructing the users of these objectionable receivers as to the proper method of adjusting them. We urge the user of a radiating regenerative receiver to be careful in adjusting his regeneration control so as to prevent his receiver from "spilling over" or whistling often, thereby becoming a nuisance to the community.

The diagram of Fig. 11 gives one an idea of how the interference from radiating regenerative receivers may cause interference to broadcast listeners. Such radiation may affect other receivers in the vicinity of a radius of from "in the other apartment" to possible several miles. These radiated waves have the same property as the original broadcasted waves and are capable of passing through such material interfering bodies as walls, houses and other structures.

A Neutrodyne receiver is not a regenerative receiver and therefore cannot possibly radiate. The possessor of a Neutrodyne receiver should be proud to know he is not contributing to the bedlam of noise in the atmosphere but assisting in his way to enable everyone to really enjoy the broadcasted programs.

Interference from Nearby Powerful Local Broadcasting Stations

A sensitive receiver, such as the Neutrodyne receiver, capable of receiving broadcasted signals from great distances with sufficient volume to operate a loud speaker, must of necessity be swamped by the extremely powerful nearby broadcasting stations. Neutrodyne receivers, even when within a few miles of such broadcasting stations, as is entirely possible in the larger cities, such as New York City, Philadelphia, and Chicago, can be so tuned that one may reach out through local interference and still be able to listen to distant broadcast programs.

The drawing of Fig. 12 gives one a graphical idea of what such local interference from powerful broadcasting stations may mean. Powerful signals, shown by the magnitude of the large transmitting station at a distance of from one to ten miles from the receiver, drown out the signals of the distant and weak broadcasting station which may be one hundred to two or three thousand miles away from the receiver.

To be able to obtain distant signals through the local signals, requires very careful tuning of the three Neutroformer dials and an extreme adjustment of the filament current of the "soft" detector tube. If one is using a "soft" detector tube, such as the UV-200 or C-300, one may still hear signals from the nearby powerful broadcasting stations, even when the receiver is considerably detuned from the actual wave length at which this local station is broadcasting. This is due to the extreme sensitivity of a "soft" tube. However, when the receiver is exactly tuned to the wave length of a distant station, the interference from the local station becomes considerably lessened.

If one desires to listen only to local broadcasting stations, and experiences interference between local broadcasting stations, as is the case in the heart of the larger cities, the use of a "hard" tube, such as the UV-201-A or the C-301-A, as a detector, will increase the selectivity of the receiver considerably.

Within a short distance of a powerful broadcasting station it is entirely possible to obtain extremely loud signals with the receiver without the use of an antenna. The radio broadcast listener, in this case, by turning his set around, will find a certain position at which he will obtain a minimum signal for each station. He is thus able to reduce the direct reception of an undesired station when he is using his receiver with its antenna for the reception of the desired signals.

Interference from Distant Broadcasting Stations on the Same or Nearly the Same Wave Length to Which the Receiver Is Tuned

Very often distant broadcasting stations near in wave length to each other or to the wave length of local broadcasting stations will produce heterodyne or "beat" notes. The ordinary receiver is not capable of differentiating between two broadcasting stations that are close enough to each other in wave length to produce this audible "beat" note.

Neutrodyne receivers are possibly the most selective receivers on the market today. Under ordinary conditions it is possible to differentiate between two stations differing in wave length as close as five meters, which corresponds to about one or two degrees on the condenser dials. In some particular cases it is also possible to tune between distant stations of about the same intensity, differing only two or three meters in wave length, by carefully adjusting the tuning dials and the filament current of the "soft" detector tube.

Additional selectivity between interfering stations can be obtained by means of the directional effects of receiving antenna. It is a well known fact that a long single wire antenna with the receiving set at one end, is capable of receiving signals more strongly in the

direction away from the open end, in other words if the open end of the antenna is towards the East, the reception will be much better from the West.

The multiplicity of broadcasting stations allocated to the wave length in the neighborhood of 360 meters causes considerable difficulty in differentiating between them.

Interference from Spark Transmitting Stations

Interference from spark or "code" transmitting stations, contrary to the average belief, is not due to radio amateurs or "hams," but in most cases is due to commercial ship and shore stations operating on wave lengths within the bands given over to broadcasting stations. The wave length range in the neighborhood of 450 meters is used by a number of these spark transmitting stations, and therefore interference at this wave length is to be expected. Nearby powerful spark stations will break through on any wave length on all receivers, although the particular wave length at which the interfering stations are transmitting is actually either 450 meters or 600 meters.

In the drawing of Fig. 13 interference from a ship spark station is graphically shown. Such a ship station operating on 450 meters interferes with reception of signals from a broadcasting station operating on 440 meters.

The annoyance which this interference is causing broadcast listeners is being remedied by re-allocating these stations to wave lengths higher than those used by all broadcasting stations. Ultimately all spark stations will be replaced by a different type of radio transmitter, which will free the air from this objectionable interference.

Interference from Power Lines, Electric Lights and Other Sources

Many of the noises heard in the loud speaker or telephones of a radio set are not only due to the defects in the receiver and its auxiliary apparatus, as described in the previous paragraphs but also to electrical disturbances coming from sources outside the receiver. A good test for the location of these disturbances is to disconnect the antenna entirely from the receiver. If the noises or disturbances diminish in intensity or disappear entirely, one may be sure that their source is external to the receiver.

Power circuits, especially in the smaller communities as well as in the larger cities, through their distributing power lines and auxiliary apparatus, such as lightning arrestors, transformers, insulators, and motors and generators are one of the great sources of radio receiver interference. These disturbances are generally due to a faulty piece of apparatus or a poor connection and can be, at all times, remedied by the power companies. The power companies themselves are much interested when disturbances from these sources are experienced, for it means to them a defect in their system with its attendant losses in power. They are, therefore, at all times willing to remedy the trouble. As a matter of fact some of the larger power companies employ radio trouble shooting crews, who, with the aid of small portable loop receiving sets, continuously inspect the companies' property to locate and remedy such troubles.

Such industrial applications of electrical power, as arc lights, telephone and telegraph lines, street cars, and electrical railroad motors and generators and their electrical equipment are another source of trouble. The trouble from these sources are somewhat difficult to remedy, for they are so varied in nature and not controllable. Their functioning requires that they become the source of disturbance. In some cases, however, in sparking apparatus, such as sparking commutators, the shunting of a large condenser, having a capacity of from one to ten microfarads, and able to carry the current, across the breaking point in circuit, will remedy the trouble.

A third large class of disturbing apparatus can be found in the various household appliances, such as door bells, the electric light switching systems, sewing machine motors, vacuum cleaners, flat irons, electric washing machines and other motor driven apparatus, violet-ray outfits, electric irons and heating apparatus. The commutators and brushes of all motors and generators should be kept in perfect condition so that sparking does not exist. The brushes should be replaced from time to time and the commutators of the machine brightened up by means of a little sandpaper until the sparking is eliminated. Placing a condenser of about one or two microfarads across the terminals of the machine and sometimes in addition a small choke coil, such as a small Honeycomb coil, in each wire leading to the apparatus will assist in eliminating interference from these sources. Electrical heating apparatus should be examined from time to time to see that perfect contact exists between all parts within the apparatus. Alternate heating and cooling of the various parts of the apparatus result in the expansion and contraction of these parts, soon loosen the connections and cause sparking which ofttimes gives rise to considerable trouble. This can be remedied by opening up the apparatus and tightening down all connections.

Among the miscellaneous other devices which contribute to the general discomfort of the broadcast listener, are the X-ray machines, storage battery chargers, electric elevators, and the ignition systems of automobiles and stationary gas engines. Inserting small choke coils in each wire of the current supply line leading to X-ray machines remedies this trouble. Cleaning up the contacts of mechanical storage battery chargers will remedy that source of trouble. Trouble from ignition systems can best be remedied by completely shielding all parts of the system and in addition, inserting small choke coils in each line of the system.

The radio listener must remember, however, that these disturbances originate in apparatus which serves the community in various ways. Radio broadcast listening is a source of diversion and entertainment. The signals obtained from local or powerful stations are of such intensity as to swamp or over-ride all disturbances from the majority of the above sources, but the weak signals from distant stations are of the same intensity as the disturbances. Therefore, one must be content at times to listen to the local broadcasting stations, for real entertainment and to distant stations as an exciting experience, which is covered with many sometimes humorous trials and tribulations.

Fading of Received Signals

"Fading" is another natural phenomenon which manifests itself especially in the reception of distant broadcast signals, causing them to vary considerably in intensity and quality. The signal may at one moment be extremely loud and of good quality. Then suddenly the signals will diminish in intensity and the quality become poorer, until after a few moments they become almost inaudible, only to return to its former intensity after another few moments. This variation may be gradual or quite rapid.

This phenomenon is entirely uncontrollable and one must be at the mercy of the natural forces when listening to long distance stations. Your receiver has not become detuned. It is not necessary to twist your dials to restore the station. Leave the dials of the receiver alone, the station will return to its normal intensity in a few moments. Owners of the radiating regenerative receivers are especially urged when fading occurs not to readjust their receivers. They only cause their own receivers to oscillate producing the beat notes and squeals so objectionable at the present time. *LEAVE YOUR DIALS ALONE.*

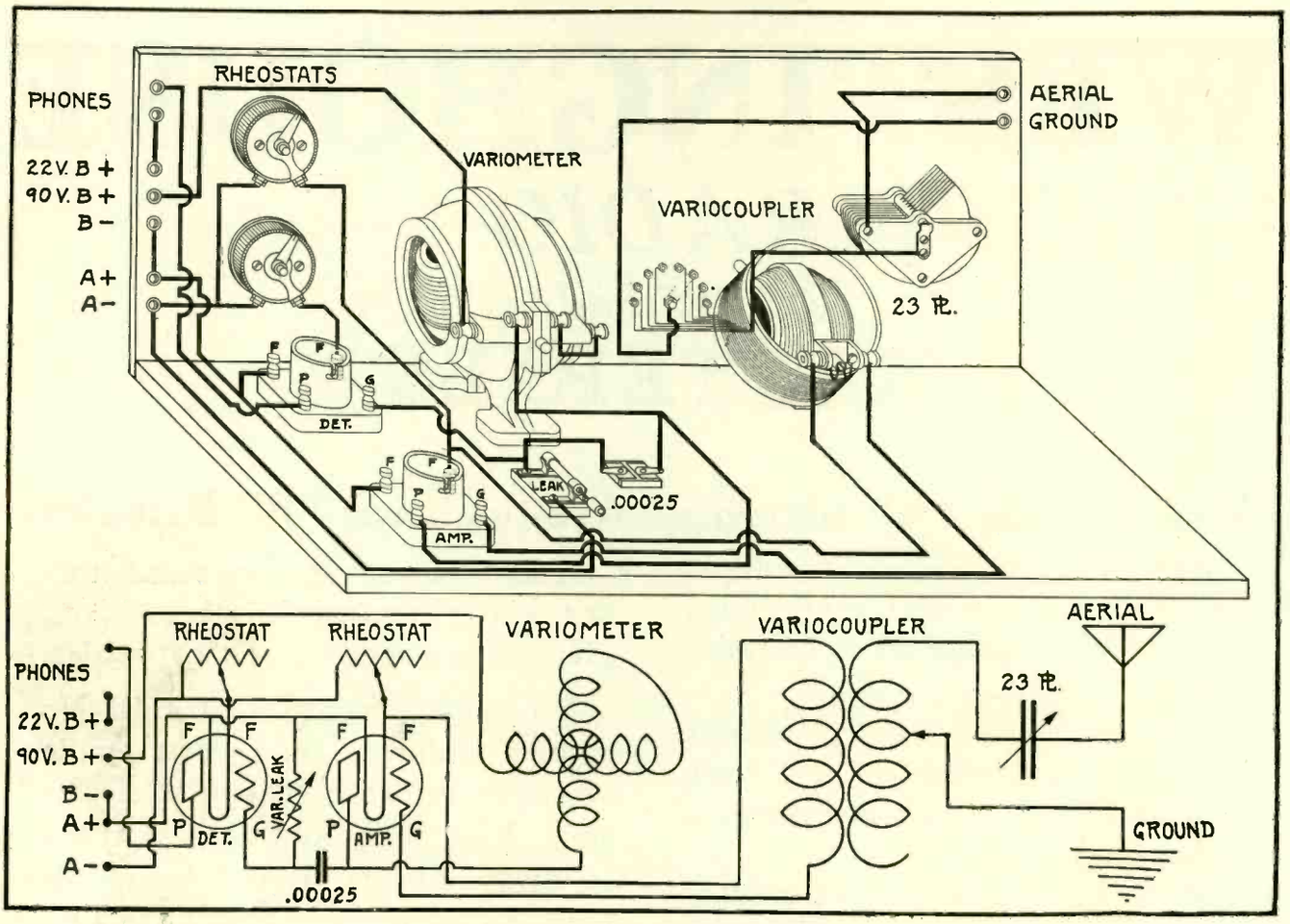
Static or Atmospheric Disturbances

Atmospheric disturbances or "static" as it is commonly called, are due to uncontrollable atmospheric electrical disturbances, which affect any and every radio receiver on any wave length that it may be tuned to at any particular time. This disturbance manifests itself in a variable noise, having at different times very characteristic tones. These tones have been classifide by radio engineers as "grinders," "clicks" and "rumbling" types of static. Static is more intense during the Summer months than during the Winter months, because of the great humidity and occurrence of thunderstorms during this period. It is especially strong, even in the Winter time, just before a severe storm. In fact the amount of static present is used by power companies to forecast the coming of a storm and to provide for the additional load.

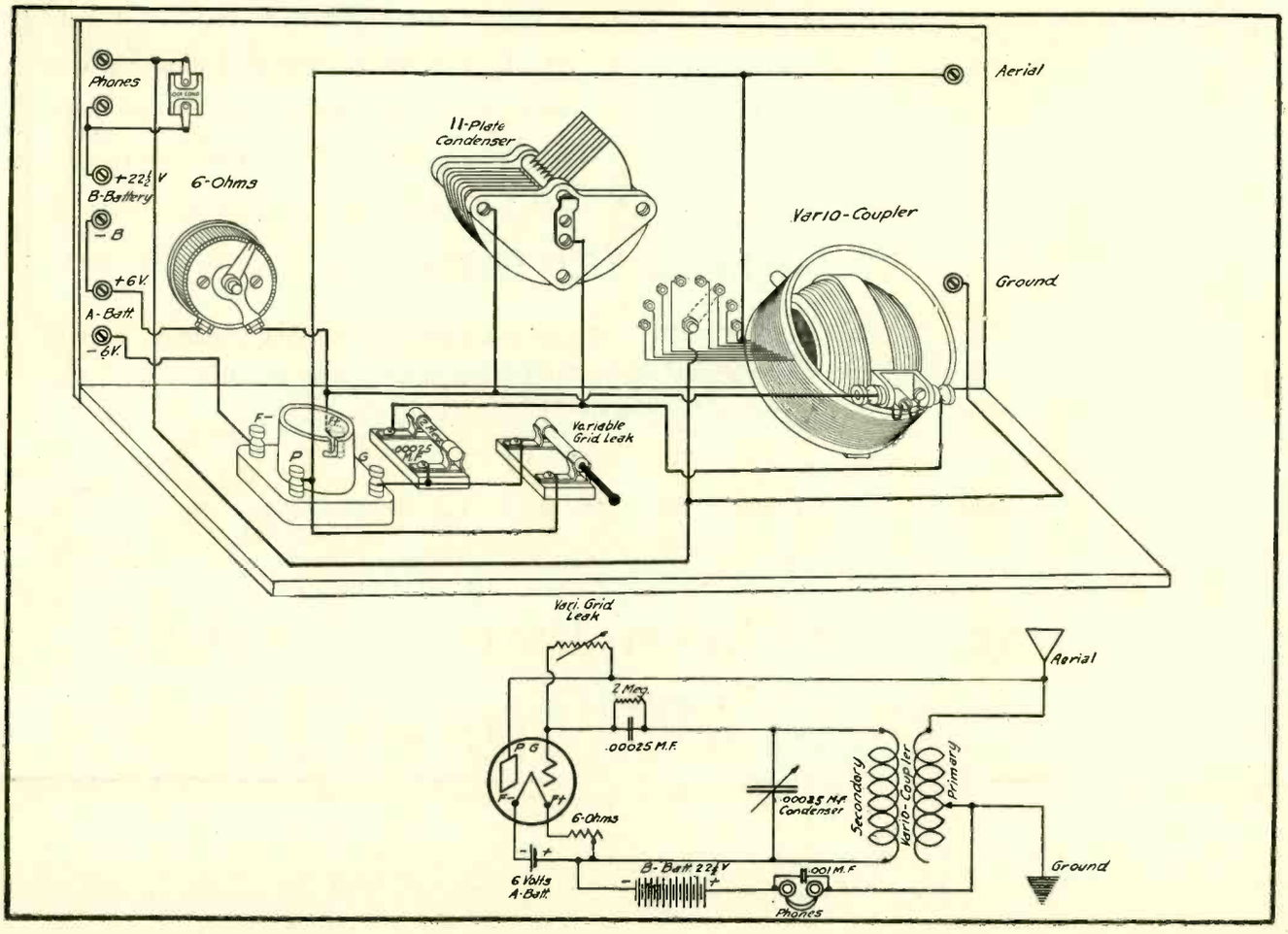
In general, the effect of static upon any radio receiver can be minimized by using short outside aerials or by means of indoor aerials or loops. The smaller exposure of a short inside aerial or loop to electro-magnetic waves or disturbances, means that less static is picked up by such systems and therefore a more favorable signal to static ratio is obtained.

In summarizing, when experiencing trouble with your radio receiver, it is best to determine whether or not this trouble exists within the receiver or in the auxiliary apparatus attached to the receiver or to the uncontrollable natural phenomenon. This may best be determined by disconnecting the antenna from the receiver.

Receiver Using One Stage of Tuned Radio Frequency Amplification

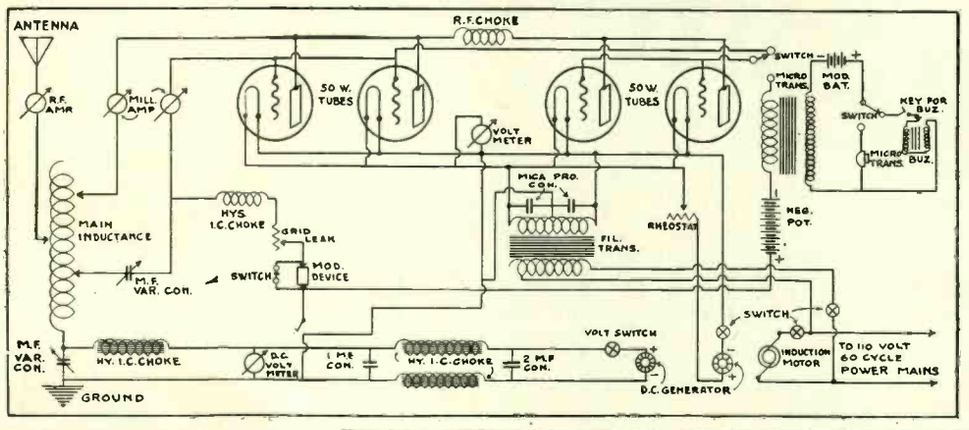


Kaufman Circuit



TRANSMITTING CIRCUITS

SCHEMATIC DIAGRAMS—Continued



Colpitt's Circuit

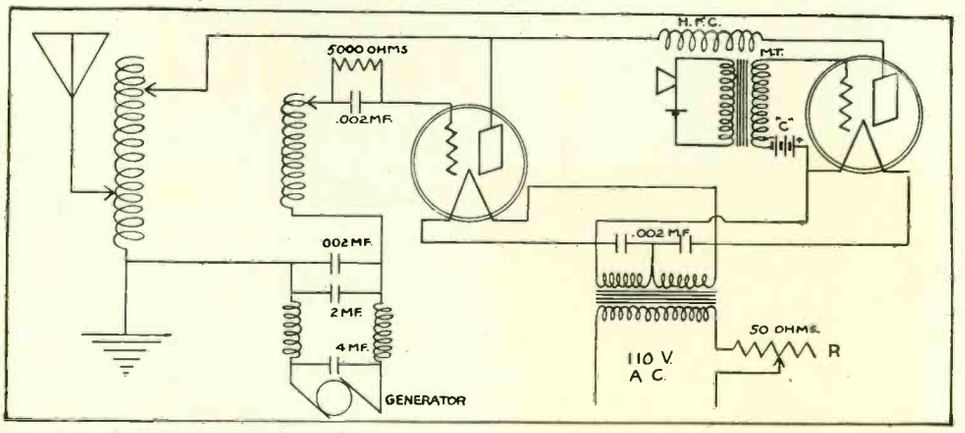
Parts consist of: .0015 M. F. and .003 M. F. Variable Condenser. 1 M. F. and 2 M. F. Fixed Condenser. Main Inductance. 30 turns ⅜" Copper Tubing. Radio Frequency chokes. Ironcore chokes. 4—50 watt tubes. 2000 Ohm Rheostat, 1000 volt and 40 volt D. C. Generator. 200 watts. Induction motor. Microphone transformer. "C" Battery. High frequency buzzer. Key. Microphone Transmitter. Filament transformer. Protective condensers. Double throw switches.

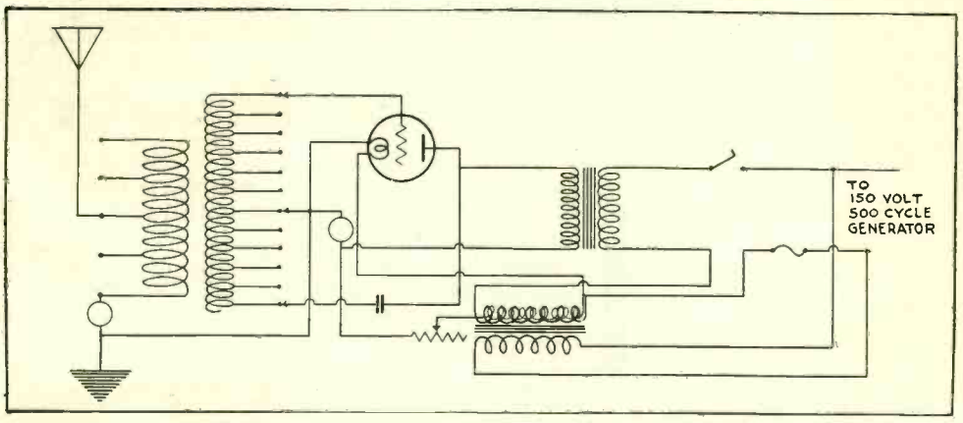
Filament Voltmeter, 0-15 Plate Voltmeter, direct current, 0-1500; Plate Milliammeter, direct current 0-1000; Grid Milliammeter, direct current, 0-100; Antenna Ammeter, thermo couple type, 0-8.

Reverse Feed Back Circuit

Parts consist of: D. C. Motor Generator. Protective condensers. Tuning inductance consisting of 20 turns No. 4 wire 8" in diameter. Grid coil about 20 turns, tapped at 15-17-19 and 20th turns, wound with No. 18 D. C. C. wire in reverse direction to and placed inside of antenna inductance.
5 to 10,000 Ohm Grid Leak. Filament lighting transformer. Microphone transformer. Microphone transmitter. "C" Battery. High frequency choke coil and 2 5-watt tubes.

Filament Voltmeter, alternating current, 0-10; Plate Voltmeter, direct current, 0-500; Plate Milliammeter, direct current, 0-200; Antenna Ammeter, thermo couple type, 0-3.





Meissner Circuit

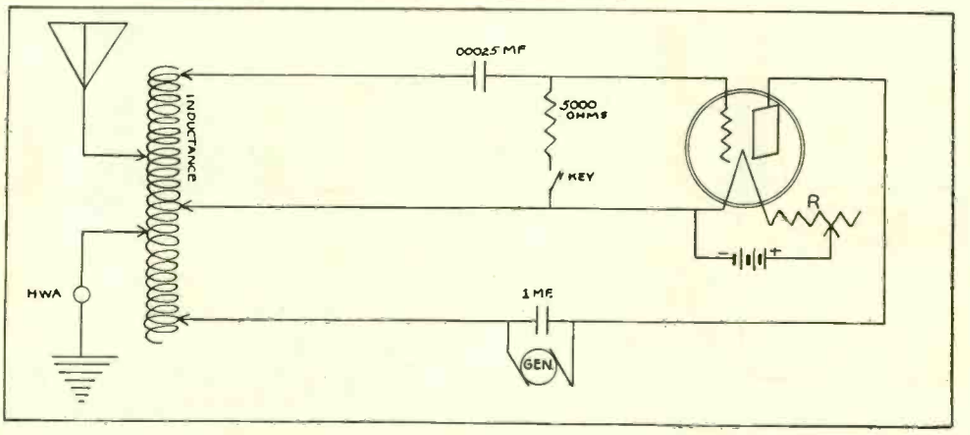
Parts consist of: Plate and Grid Coupling coils wound with No. 18 wire spaced ⅛" apart and tapped every 5 turns. 500 cycle 150 volt motor generator. Antenna coil consisting of 30 turns Litzendraht tapped every 2 turns and mounted so as to slip over coupling coil. .004 M. F. Grid Condenser. Key.

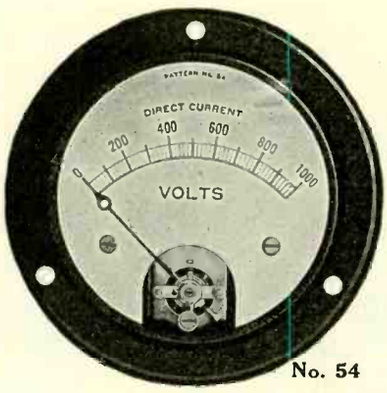
Power and Filament Transformers. Filament Voltmeter, alternating current, 0-10; Plate Voltmeter, alternating current, (with special 0-1000 calibration for 500 cycles, alternating current; Plate Milliammeter, direct current, 0-1000; Antenna Ammeter, thermo couple type, 0-2.

The Hartley Circuit

Parts consist of: One CW inductance. Two fixed condensers, Telegraph key. 5000 ohm grid leak. Filament battery and rheostat. DC Generator.

Filament Voltmeter, direct current, 0-10; Plate Voltmeter, direct current, 0-500; Plate Milliammeter, direct current, 0-100; Antenna Ammeter, thermo couple type, 0-2.





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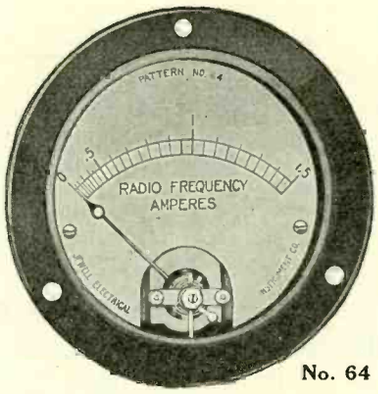

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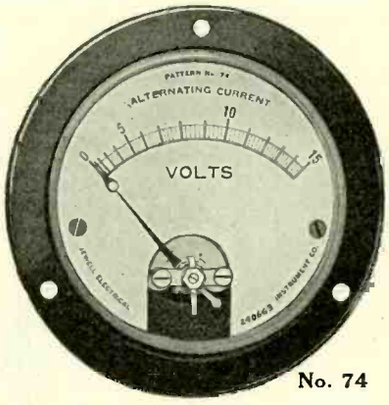
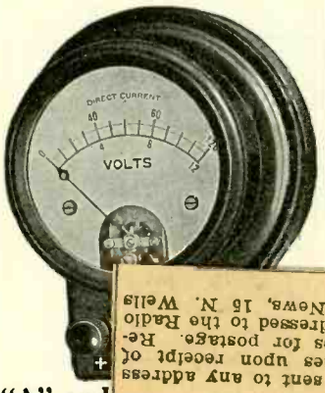


No. 74

—THE JEWELL TRIO—

(FAMOUS AMONG AMATEURS)



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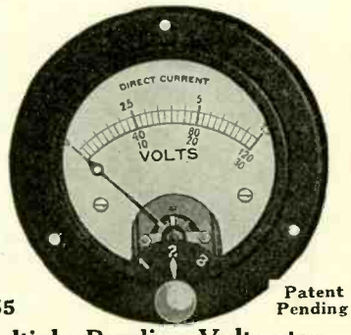
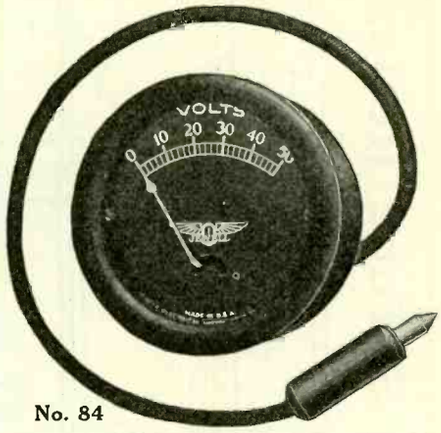


No. 55 — Patent Pending

Multiple Reading Voltmeter

For receiving sets. Self containing switch.



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Test your "B" batteries often. Over 60% of all radio troubles is traceable to run down or poor batteries.

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A new issue of The Daily News booklet of American radio broadcasting stations is ready for distribution and copies may be had free in the radio department or at window 7 in the office of The Daily News.

The booklet is corrected from Government records to June 15 and contains a complete list of the broadcasting stations operating in the United States and Canada. Stations are listed both geographically by states and cities and alphabetically according to call letters, with a tabulation of owners, locations and wave lengths. The booklet has sixteen pages, six of which are ruled for the logging of stations heard. It is provided with a two-page map of the United States and lower Canada, upon which are indicated distances from Chicago and the extent of the several time belts.

A booklet will be sent to any address in the United States upon receipt of two cents in stamps for postage. Requests should be addressed to the Radio Editor, The Daily News, 15 N. Wells Street, Chicago, Ill.

No. 95

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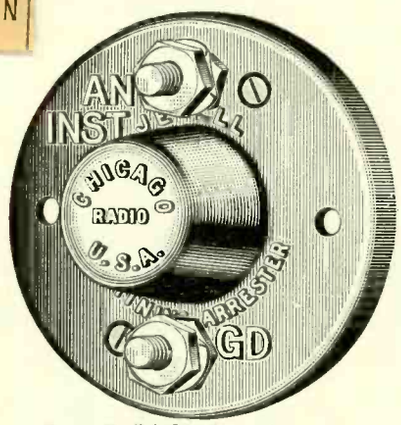

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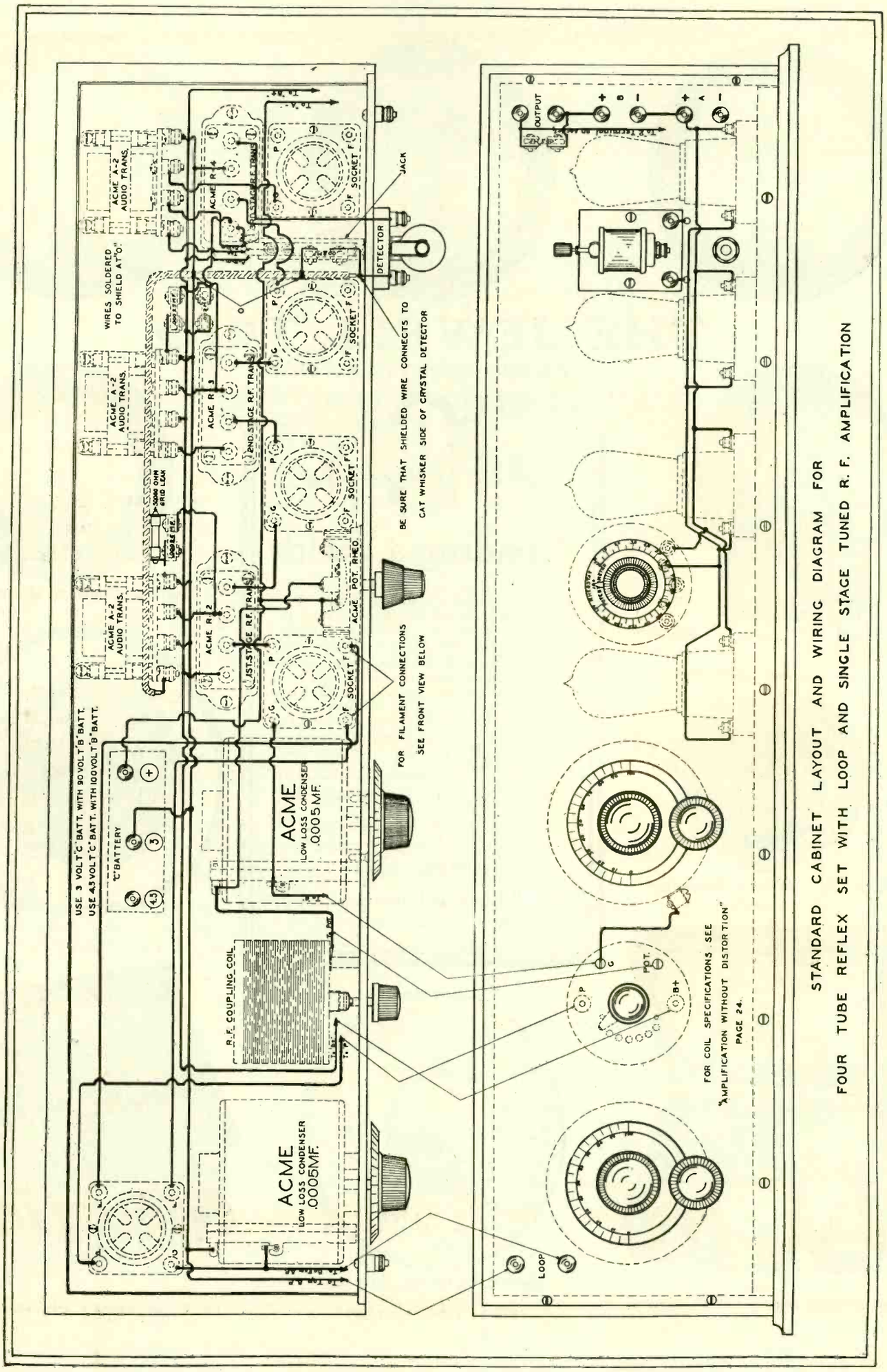
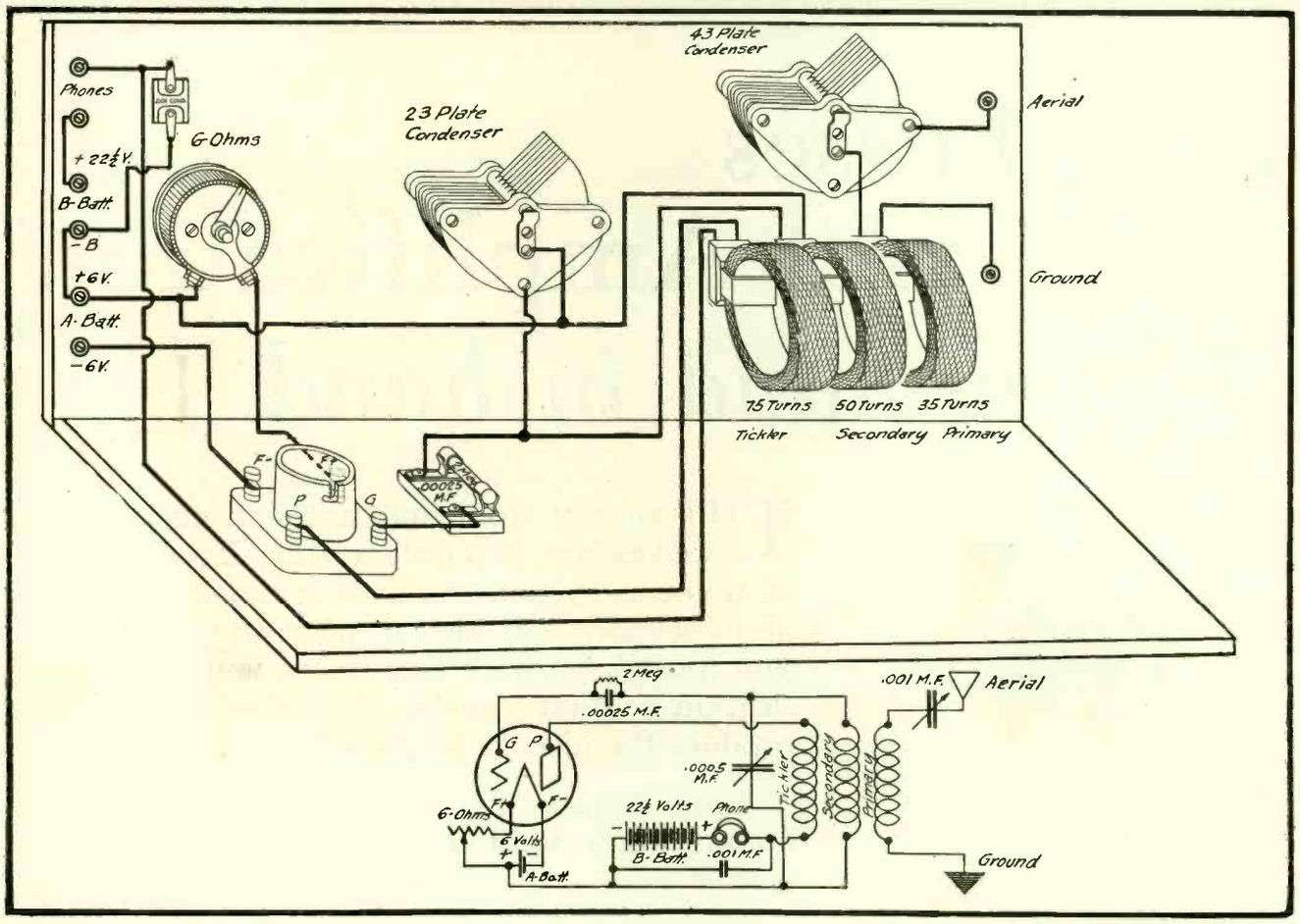
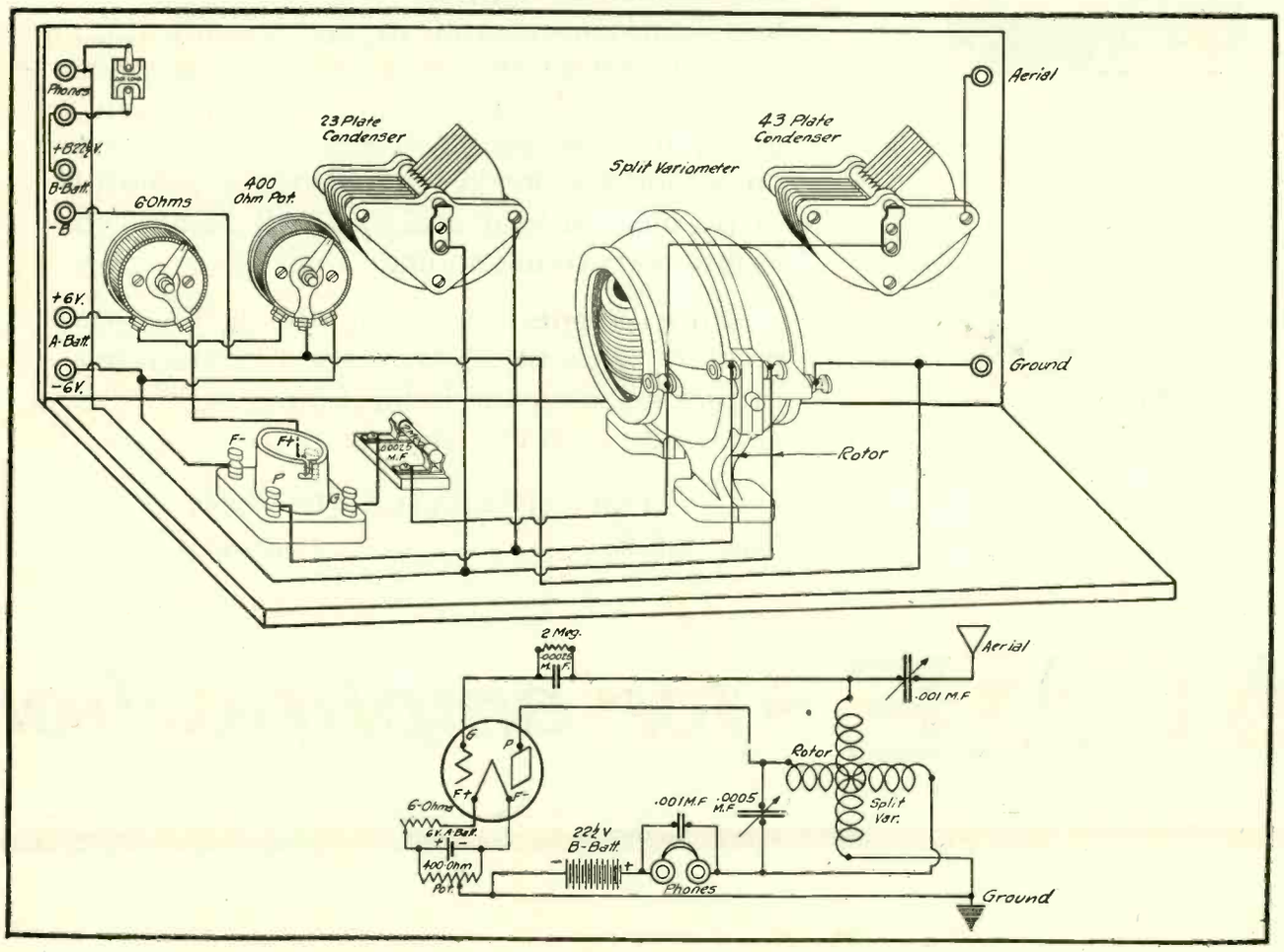
5 Tube Reflex Circuit

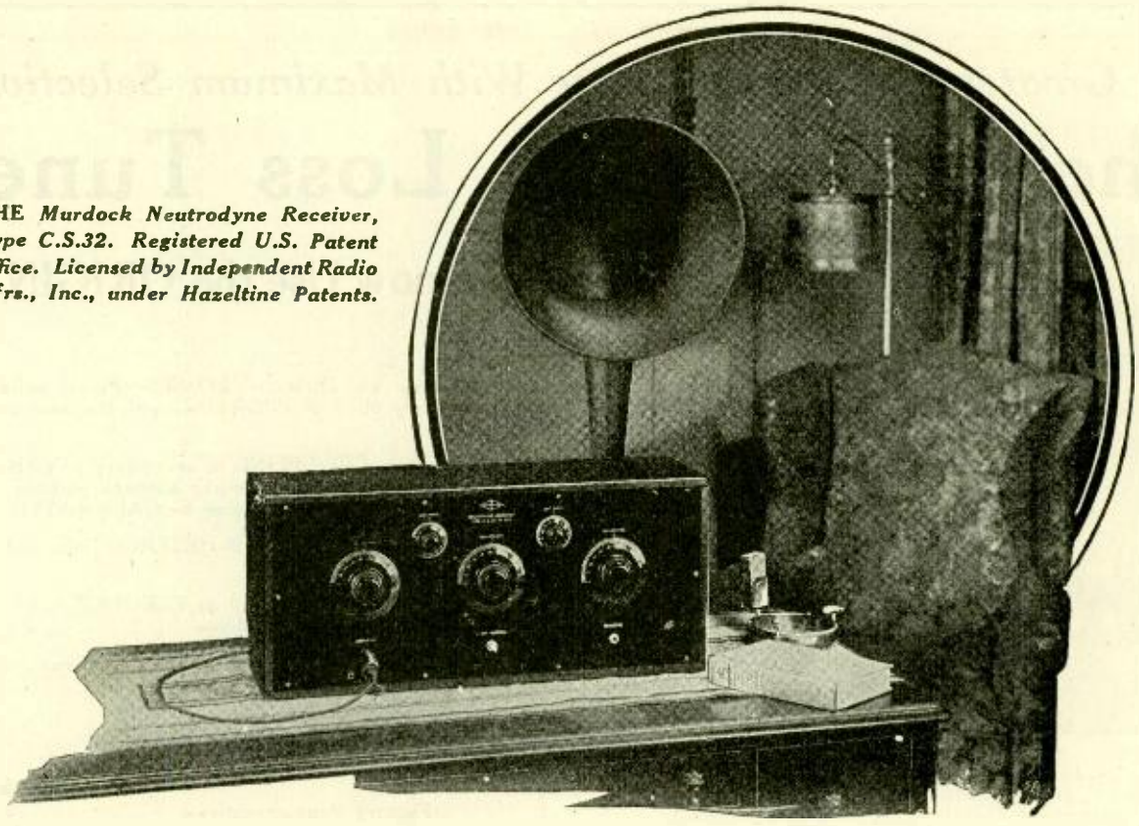


Three Circuit Honeycomb Coil Regenerative Receiver



Monoplex Receiver





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Construction of Low Loss Receivers for Amateur Short Wave and Broadcast Stations

(45 to 210 Meters and 225 to 550 Meters)

By A. ELKINS, Technical Editor

THERE has been a considerable amount of interest recently in the design and construction of good low loss receivers for amateur and broadcast reception. Two types will be described, one to cover a range of 45 to 210 meters and the other from 225 to 550 meters. Before going into the details of these receivers, let us consider what is required.

Maximum reception range is usually a primary requirement. This means that the best possible use must be made of the voltage induced in the receiving antenna by the desired transmitting station. It means that the antenna resistance must be as low as possible. When a tuned secondary circuit, coupled to the antenna

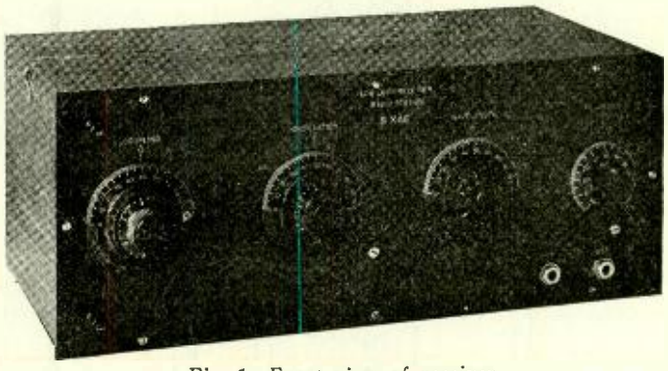


Fig. 1—Front view of receiver

circuit, is used, the resistance of this circuit must also be as low as possible, at the radio frequency corresponding to the wave length of the transmitting station. As will be seen, a tuned secondary circuit is most advisable from the standpoint of selectivity, without which there usually is considerable difficulty in receiving distant stations.

Now it is usually not possible to secure an extremely low antenna resistance and, in any event, this resistance changes from day to day. A variable antenna-secondary coupling is therefore advisable to secure maximum signal strength with maximum selectivity. It works out this way. The lower the antenna resistance, the looser this coupling may be for best signal strength, and the higher the antenna resistance, the closer it must be. If the antenna resistance is within a reasonable limit, a fairly loose coupling may be used and selectivity is greatly improved over that possible with a close coupling. In short, the receiver may be adapted for efficient use with antennae of different or varying resistance.

Another thing is the fact that the shorter the wave length received, the looser the coupling should be for best results with any given antenna and secondary resistance. This again shows that coupling should be variable for maximum results over a wide band of wave lengths. This coupling is not critical in practice, however, so that a variable coupling does not add a difficult adjustment to be made when tuning.

Selectivity is as great a consideration as maximum reception range. Selectivity means the ability to receive from one sending station alone without any interference from any other station. At the receiving station this means that antenna resistance must be very low if the antenna circuit is to be tuned. In practice it is seldom possible to decrease antenna resistance to the point where the desired selectivity is obtained.

Right here it is to be most strongly emphasized, that wherever selectivity is lacking, excessive resistance is the cause. Resistance means poorer selectivity. It is just as well then to leave the antenna circuit untuned and at the same time eliminate one tuning control. This also greatly helps to reduce, in most cases to a practically neglible value, disturbing receiving radiation. We must then look to the secondary circuit for tuning and, since the resistance of this circuit may easily be made exceedingly low, this circuit may be made very selective not only by reducing its actual resistance but by using regeneration and the proper value of coupling for maximum signal strength, which in all cases will be looser than if resistance were high. Regeneration is the cheapest form of radio frequency amplification. Those who have done considerable experimenting will agree with this. However, far better signal strength is secured, whether or not regeneration is used, if the resistance of our tuning circuit is as low as possible. This is conclusively proven in practice as well as in theory. And it is true regardless of the wave length received, although the effects of resistance are more noticeable on the shorter waves. Or, more accurately, the shorter the wave the higher the frequency and therefore the greater the resistance which, if greater, is naturally more noticeable.

Now, to repeat, a circuit having high resistance will not be selective. Much thought has been given to loss reduction in condensers, but losses must also be reduced in the inductance, since it is as much a part of a tuned circuit as the capacity. These losses may be reduced by using wire having a low radio frequency resistance (for the frequency band or wave band to be received) and by reducing the equivalent resistance introduced by poor dielectrics close to the secondary coil (such as wire insulation and material used for coil mounting). A self-supporting coil would be much better than one wound on any kind of insulating form whether or not the form were partially cut away. As little insulation as possible should be used and used very carefully. Losses in the grid input circuit which is in shunt to and directly coupled to the secondary circuit may be reduced by using a detector socket having a glazed porcelain, hard rubber or molded Bakelite base. If the detector tube has a metal shell it makes no difference if the socket shell is of metal, provided its construction is good. Much money is wasted in cheap sockets. The insulation in the grid condenser must also be of high quality and those fixed Mica condensers (sometimes known as "postage stamps") having grid leak mountings are excellent. If possible avoid connecting any kind of a switch into the tuned secondary or the grid input circuit of the detector tube.

It is not advisable to build a receiver to cover too wide a band of wave lengths ,as this only helps to spoil its efficiency at least on a portion of the band.

General Construction Remarks

The following directions will apply for either a short wave, 45 to 210 meter, or to a broadcast, 225 to 550 meter, wave receiver.

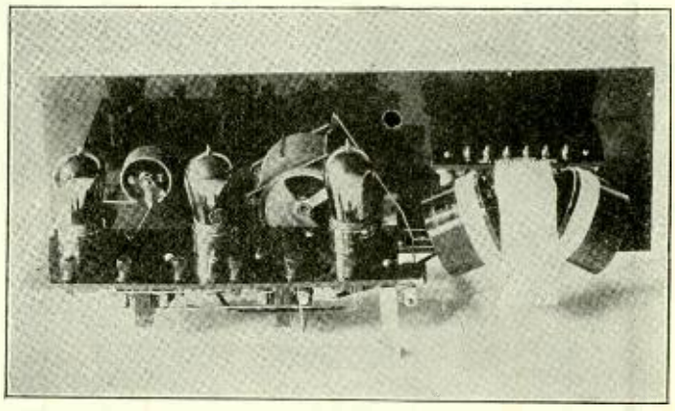


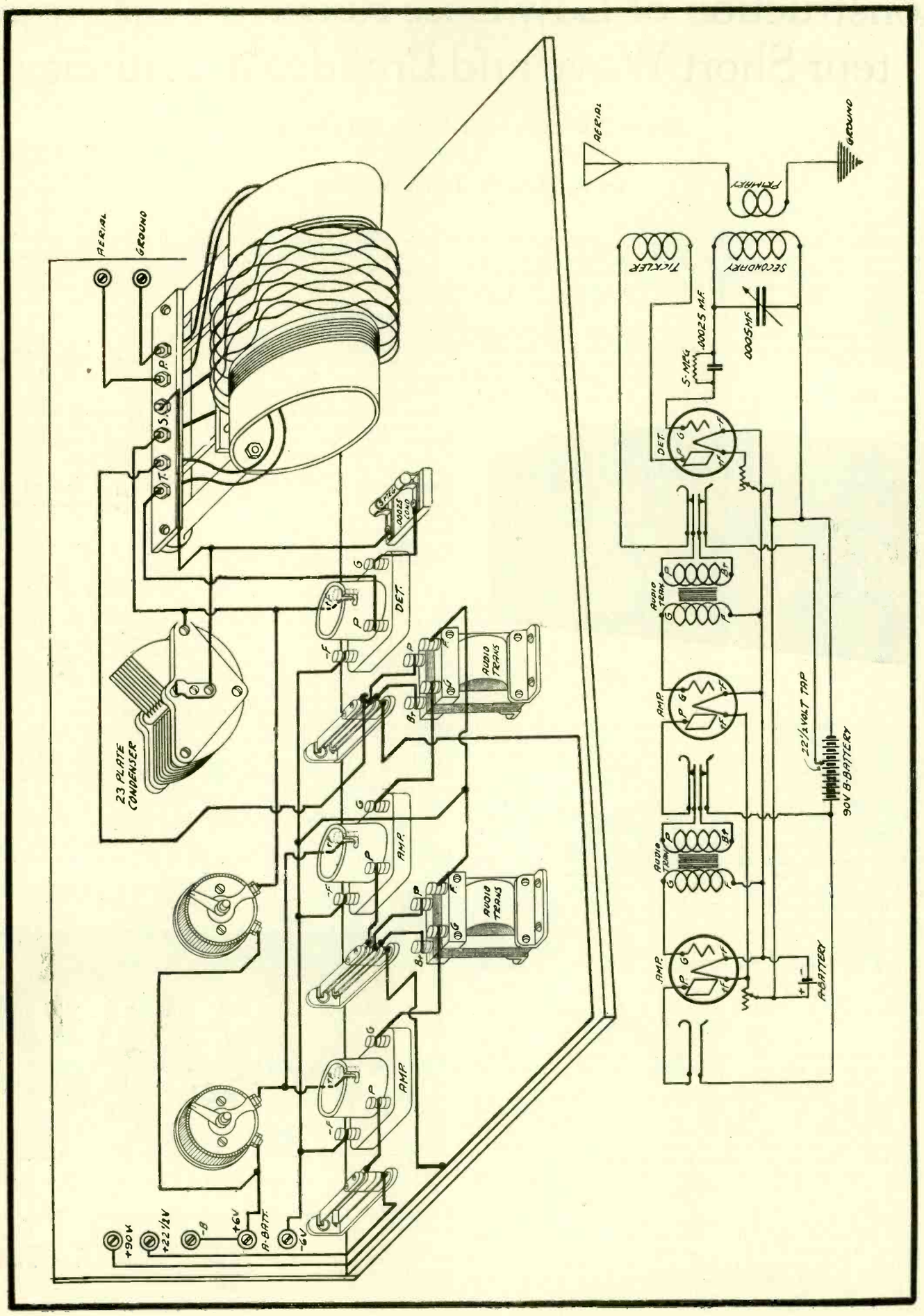
Fig. 2—Rear view of receiver

It is suggested that the constructor make templates for the front panel and sub panel to accommodate the various parts selected. Suggestions as to the layouts will be found in the illustrations. but it is realized that each individual constructor may have certain ideas which he wishes to incorporate.

List of Parts Required

1—Special tuning unit for desired wave length range with un tuned antenna. Must have low losses.

1—Variable condenser either 0.00025 or 0.0005 mfd. capacity.



Graphic illustration and schematic diagram of complete receiver

having lowest possible losses and lowest possible minimum capacity. A "square law" type is preferable to a "straight line" capacity type.

2—Audio frequency transformers of standard make, low ratio for broadcast reception or high ratio for radio telegraph reception.

3—Vacuum tube sockets of high quality having glazed porcelain, hard rubber or molded Bakelite base. May have metal shell if construction is good.

1—Mica grid condenser, 0.00025 mfd. capacity having grid leak mountings.

1—Grid leak resistance unit of high quality having guaranteed resistance of 5 megohms.

1—Mica by-pass (fixed) condenser having approximately 0.002 mfd. capacity.

3—Rheostats suitable for use with tubes to be employed—should be of highest quality obtainable.

2—Double circuit jacks having high grade insulation, springs and contacts.

1—Single circuit, open, jack of same quality.

6 or 8—Binding posts, 6 for amateur receiver and 8 for broadcasting receiver if "C" or grid-biasing battery is used.

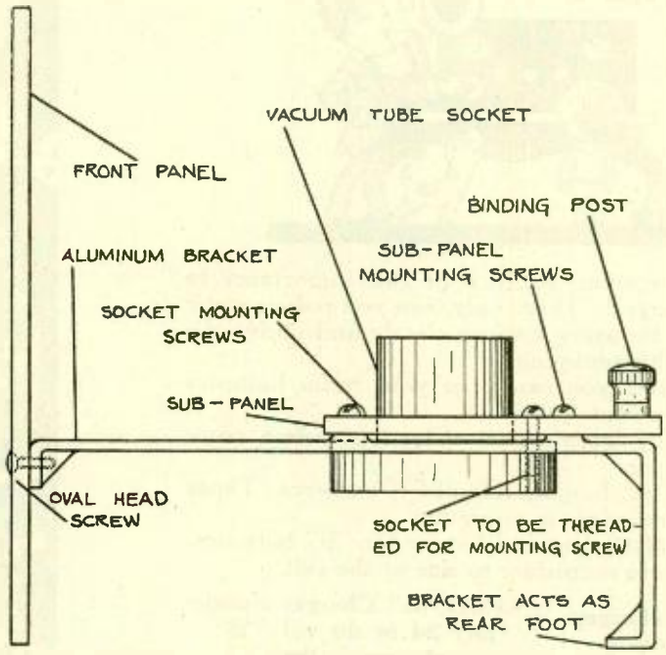


Fig. 3—Showing how sub panel is mounted

1—Front panel 7"x24"x3/6" of hard rubber or Bakelite.

1—Sub panel, 3/16" thick, of hard rubber or Bakelite, cut to size required to accommodate sockets, transformers and battery binding posts.

Miscellaneous brass strips for sub panel, mounting brackets, bus-bar, wood screws, machine screws, hexagonal nuts, No. 12 or No. 14 DCC wire, No. 20 DCC wire.

The Special Tuning Unit

For the 45 to 210 meter range the antenna coil may have 6 turns of No. 14 DCC wire on a 2¾" Bakelite tube 2" in length and having a thin wall. The secondary coil is "stagger-wound" of No. 12 DCC as follows: On a wooden block about 5"x5" draw a perfect circle 4⅛" in diameter (2 1/16" radius) and mark off its circumference into 14 equal spaces. At each of these 14 points place a round steel wire peg about 3" long and 3/32" in diameter of cross section. Starting at any peg in this circle, pass the No. 12 DCC wire outside of this first peg, inside of the next two, outside of the next one and so forth until 21 turns are wound on. Then secure the turns with waxed thread and carefully lift the coil off the winding form. The tickler coil has 10 or 12 turns of No. 20 DCC wire closely wound on a 2¾" Bakelite tube 2" in length. In both antenna and tickler coils, the winding may be close to one end of the tube to allow room for mounting each on a shaft. The method of mounting the three coils will be left to the constructor's ingenuity, but if a special tuning unit is purchased it should be completely assembled ready for installation on the rear of the receiver panel.

The secondary coil should be tapped at the 8th turn from the grid end which is to connect to the positive filament terminal of the detector socket and a short flexible lead with clip, arranged to be slipped to the opposite end of the coil or to this 8th turn tap This eliminates any possibility of leakage or undesired capacity effects due to switch taps on the front panel.

For the 225 to 550 meter broadcast receiver the antenna coil may have 10 turns of No 14 DCC wire, the secondary 45 turns of No. 14 DCC wound in the manner previously described and the tickler may have 16 turns of No. 20 DCC wire. Both antenna and tickler coil forms (tubes) may be 2" long and 2¾" in diameter.

Any metal used in mounting must be non-magnetic and connected to ground so as to be at ground potential.

The Variable Secondary Condenser

For the 45 to 210 meter receiver this condenser should have a maximum capacity of 0.00025 mfd. and as low a minimum as possible, at least not over 0.00001 and preferably 0.000005 mfd.

It should be of the "Square Law" type to avoid the crowding together of stations at the lower end of the dial scale. For the 225 to 550 meter receiver this condenser should have a maximum capacity of 0.0005 mfd. and a reasonably low (say 0.00001 mfd.) minimum capacity. It should also be of the "square law" type, although in either this or the above case a "straight line" condenser is perfectly useable.

Audio Frequency Transformers

For the 45 to 210 meter receiver the constructor may not be much interested in good quality speech reception since the greatest use it will be put to will probably be radio-telegraph (or code) reception In this case high ratio transformers having a fairly well defined resonance peak around 900 to 1000 cycles are most desirable. For the 225 to 550 meter receiver or wherever quality of reproduction is desired the transformers must, as far as possible, amplify all frequencies from about 15 to 10,000 cycles equally. This means that their primary, no load inductance must be high which, in turn, requires that the turns ratio be low, not over about 4 to 1. However, a low turn ratio with too small a primary coil or a core which is too small is as undesirable as one having too high a ratio. Select the best.

Vacuum Tube Sockets

Since the UV201-A or C-301-A tubes are about the best audio frequency amplifiers available it is just as well to use one as detector and avoid the critical adjustments necessary with a good "soft" tube. Standard sockets, therefore, are used, although the constructor, if he desires, may substitute if the sub-panel is drilled accordingly. The base should be of porcelain, hard rubber or molded Bakelite and metal shells are O. K. if the tubes have metal shells at their base.

Grid Condenser and Leak

A Mica grid condenser having a capacity of 0.00025 mfd. will be suitable for most tubes. It should have grid leak mountings. The leak resistance should be 5 megohms to secure the proper smooth regeneration control. If the value is too low the tube will go into oscillation too suddenly, it will "flop" too quick. A variable grid leak is permissible but it should be the best obtainable from both electrical and mechanical standpoints.

By Pass Condenser

Should have a mica dielectric and a capacity of about .002 mfd. If one having .001 mfd. is available, use it.

Rheostats

10 ohm rheostats will be suitable for the UV.201-A (C-301A) tubes but 30 ohm rheostats are required for UV 199 or C-299 tubes with a 4½-volt battery. If WD 11 or 12 (C 11 or 12) tubes are used with a 1.5 volt battery the rheostats may each be 10 ohm. Quality is desirable in rheostats.

Jacks

The jacks must have high grade insulation and the contacts should be of pure silver. The springs may be of phosphor bronze.

Front Panel

The front panel should be 7"x24"x3/6" and drilled to accommodate the tuning unit, secondary condenser, rheostats and jacks.

Sub-Panel

This panel should be drilled to accommodate the sockets, transformers and battery binding posts, all battery wires being brought into the cabinet through a hole in the rear. The sockets are pushed through the large holes and secured with machine screws and hexagonal nuts to this panel so that only the shells are above the panel and all connections are made beneath. The transformers may be mounted beneath the panel so that they are "underslung," their tops pointing down when panel is in position.

The Care of Radio Batteries

THE "A" batteries used in radio receivers are for the purpose of lighting the filaments of the vacuum tubes. They may be either of the dry cell or storage battery type. The former are used with specially designed vacuum tubes without having a low filament voltage and low filament current consumption. The latter are for tubes having high filament current consumption, and where more than two or three of such tubes are being used. Dry cells are good only until they are discharged by constant use and thereafter must be replaced with fresh ones.

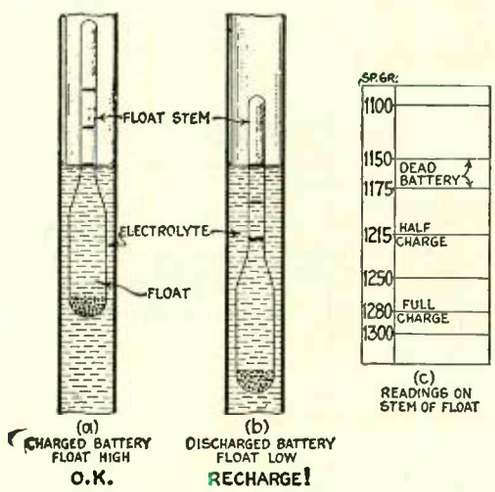


Fig. 1—A hydrometer and an explanation of its readings

They cannot be recharged very economically. Old or discharged "A" batteries of either type produce undesired "hissing" and "frying" and "popping" noises.

Storage "A" batteries should in all cases be kept up to their proper charge. In use, charged storage batteries will gradually lose their power and thereafter will not have enough power to light the filaments of the tubes to which they are connected. The results will be that the signals received will become weaker and weaker until at last they fade entirely. This

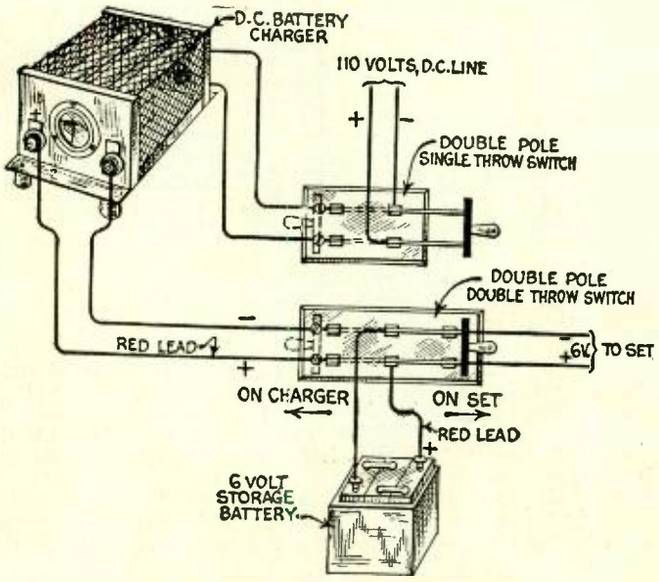


Fig. 2—Schematic wiring diagram of connections for direct current storage battery charging

condition can, of course, be remedied by recharging the storage battery.

It is highly desirable to have what is known as a "hydrometer" with which storage batteries may be tested for their condition of charge. A hydrometer is a glass vessel into which some of the liquid from the storage battery can be drawn. A glass device called a "float" is enclosed in the tubular glass hydrometer vessel. This "float" will assume various depths in the liquid, depending upon the condition of the charge of the storage battery. It is a device which registers what is called, the "specific gravity of the liquid" in the storage battery, and thus the condition of its charge.

The drawing of Fgure 1 shows the hydrometer float enlarged and the correct method of reading the specific gravity. A freshly charged battery will have a specific gravity of 1275 and one which is discharged will only read 1150. The float has a thin glass stem, which is either marked in terms of specific gravity, or by means of three red bands indicating the three conditions of charge of the battery; namely, "fully charged," "half charged," and "dead". The float will be high, or read at the lowest mark for a freshly charged battery as in "a", and will be low, or read at the highest mark, for a discharged battery as in "b".

A Neutrodyne set using four UV-201-A tubes and one UV-200 tube will draw about two amperes of current from a storage battery, and if this battery is of, say "ninety ampere-hour" capacity we can expect about forty-five hours of service. The battery charger employed in charging such a battery is usually of the two or five ampere type. A two ampere charger will recharge the above battery in about fifty-five hours, and a five ampere charger will do the same work within about twenty hours. From this we can see that if a two ampere charger is used one must charge the battery as often as it is used. In other words, it is preferable to charge the storage battery during the idle periods, rather than wait until the battery becomes entirely discharged, inasmuch as it will take too long to put it back into its original fully charged condition. The best plan is to charge the battery at night directly after one is through receiving and to shut off the charger the

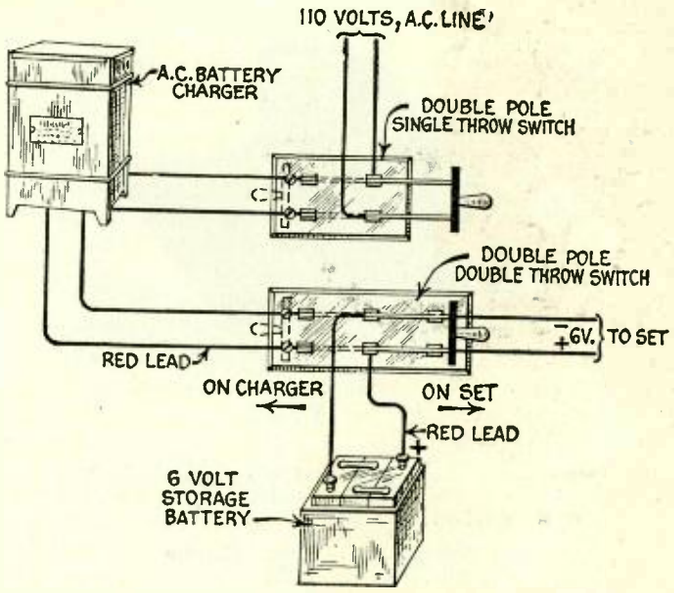


Fig. 3—Schematic wiring diagram of connections for alternating current storage battery charging

next morning. In this way the storage battery is always in good condition, and one need never be disappointed in losing a desired broadcasted program because of a run-down "A" battery. The drawings of Figs. 2 and 3 show the proper connections for charging storage "A" batteries from either direct current (d. c.) or alternating current (a. c.).

It is undesirable to allow an "A" battery to run down entirely or become dead. This results in a noisy receiving set, weakens the battery, and requires a much longer time to recharge it. A run-down battery has an internal chemical reaction, or bubbling. which causes uneven filament current, and hence a noisy receiver.

In filling the battery with water and acid and in using a hydrometer, one must be careful not to allow the acid to run over the top of the battery and down the sides, and over the floor This will destroy the rugs, carpets and floors of the home. It also corrodes the terminals and connecting wires, resulting in poor contact, the attendant noise, and a disastisfied broadcast listener. If the terminals of the battery become corroded, they should be carefully scraped and cleaned. After the "A" battery leads are connected to the terminals of the battery, a little vaseline rubbed over the terminals will prevent corrosion.

"B" batteries used in radio receivers are either of the dry cell type or of the wet battery type. The former have a very definite life, after which the battery becomes useless and must be replaced with another. Wet batteries can be recharged after they have become discharged.

The chief complaint with "B" batteries as used with the high power receiver is that they run down after a short while. Radio broadcast listeners, in the past, have been accustomed to one, two or three-tube sets using tubes of the UV-201 type, wherein the "B" battery consumption was small and a "B" battery life of six months to a year was not uncommon. With the advent of more sensitive and more powerful receivers, however, UV-201-A tubes

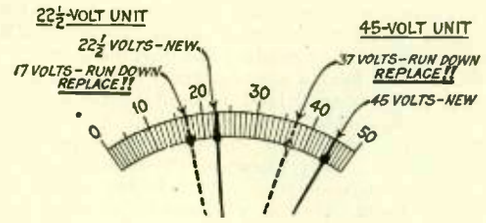


Fig. 4—The scale of a typical volt meter for battery testing

were used in greater numbers and the drain upon the "B" batteries became much greater than before. A comparison between the two types of tubes may be made as follows; Using 67½ volts as the plate potential a single UV-201 type tube draws 2.5 milliamperes, whereas the UV-201-A tube with the same voltage draws 3.5 milliamperes or an increase of forty percent. With a higher voltage of ninety volts the plate current drawn is 3.9 and 6.0 milliamperes respectively, or approximately 50% increase for the UV-201-A over the UV-201 tube. The life of a "B" battery is of course decreased more rapidly when dawing 6

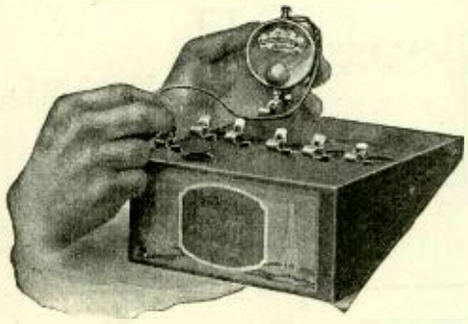


Fig. 5—The proper way to use such a battery testing volt meter

milliamperes than when drawing 3.9 milliamperes. The plate current drawn by the UV-201-A tube varies with the plate voltages used as follows:

Plate Voltage	Plate Current
22½ volts	0.5 milliamperes
45 "	1.5 "
67½ "	3.5 "
90 "	6.0 "
135 "	11.0 "

From this it can be seen that increasing the plate voltage, increases considerably the current that must necessarily be drawn from the "B" battery.

This all means that the life of the "B" battery may be materially lengthened by not using a higher voltage than is necessary to obtain the desired results. Not only is the high plate potential objectionable from the point of view of "B" battery life, but the increased potential will contribute considerably to distortion, thereby rendering the received programs unenjoyable.

In receiving sets, using four or five vacuum tubes of the UV-201-A or C-301-A type it is recommended that the amplifier voltage be limited to 90 volts, in order that a reasonable "B" battery life and minimum distortion be obtained. The plate current drawn by the detector tube is about one to two milliamperes and therefore does not enter into the matter of "B" battery drain.

"B" batteries, of the dry cell type, when new, will have an open circuit voltage of a little over 22½ volts for the 22½ volt units and somewhat over 45 volts for the 45 volt units. As the batteries are used, the voltage drops gradually at a very definite rate until a certain voltage is reached, whereupon it drops very rapidly and the batteries become useless. Just before the batteries start to deteriorate, an active chemical decomposition takes place within them. This decomposition manifests itself by considerable "sputtering and popping" noises in the telephones or loud speaker. Replacing with new "B" batteries completely eliminates this noise. When the "B" battery potential drops to about 17 volts in the case of the 22½ volt units or to 35 volts in the case of the 45 volt units it is necessary that the batteries be replaced. The drawing of Fig. 44 shows the scale of a simple and inexpensive voltmeter for reading "B" battery voltage. The pointer readings are clearly shown, it being indicated when to replace worn out "B" batteries

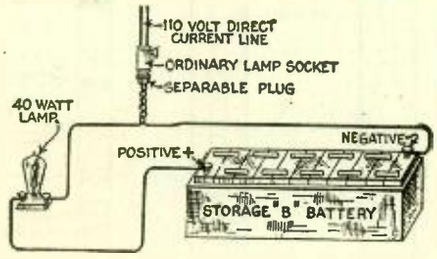


Fig. 7—Connections for "B" battery charging from direct current

with new ones. The photograph of Fig. 5 shows how such a voltmeter is used.

The use of additional "B" batteries of the dry cell type in parallel with the ones already installed will reduce the current drain upon the "B" batteries, and thereby increase their life considerably.

As a substitute for the dry "B" batteries, the wet or storage "B" batteries may be used. These batteries are manufactured by several of the reliable storage battery manufacturers and can be obtained in all sizes and in all voltages as required. These batteries require a little care and must be recharged from time to time. One of the battery manufacturers produces an outfit which contains the charger.

Wet or storage "B" batteries when first used with Neutrodyne

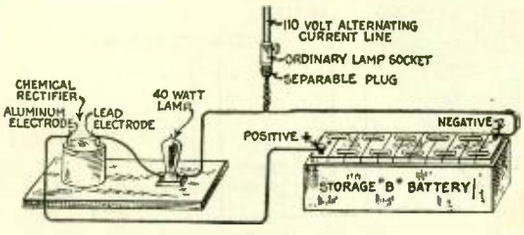
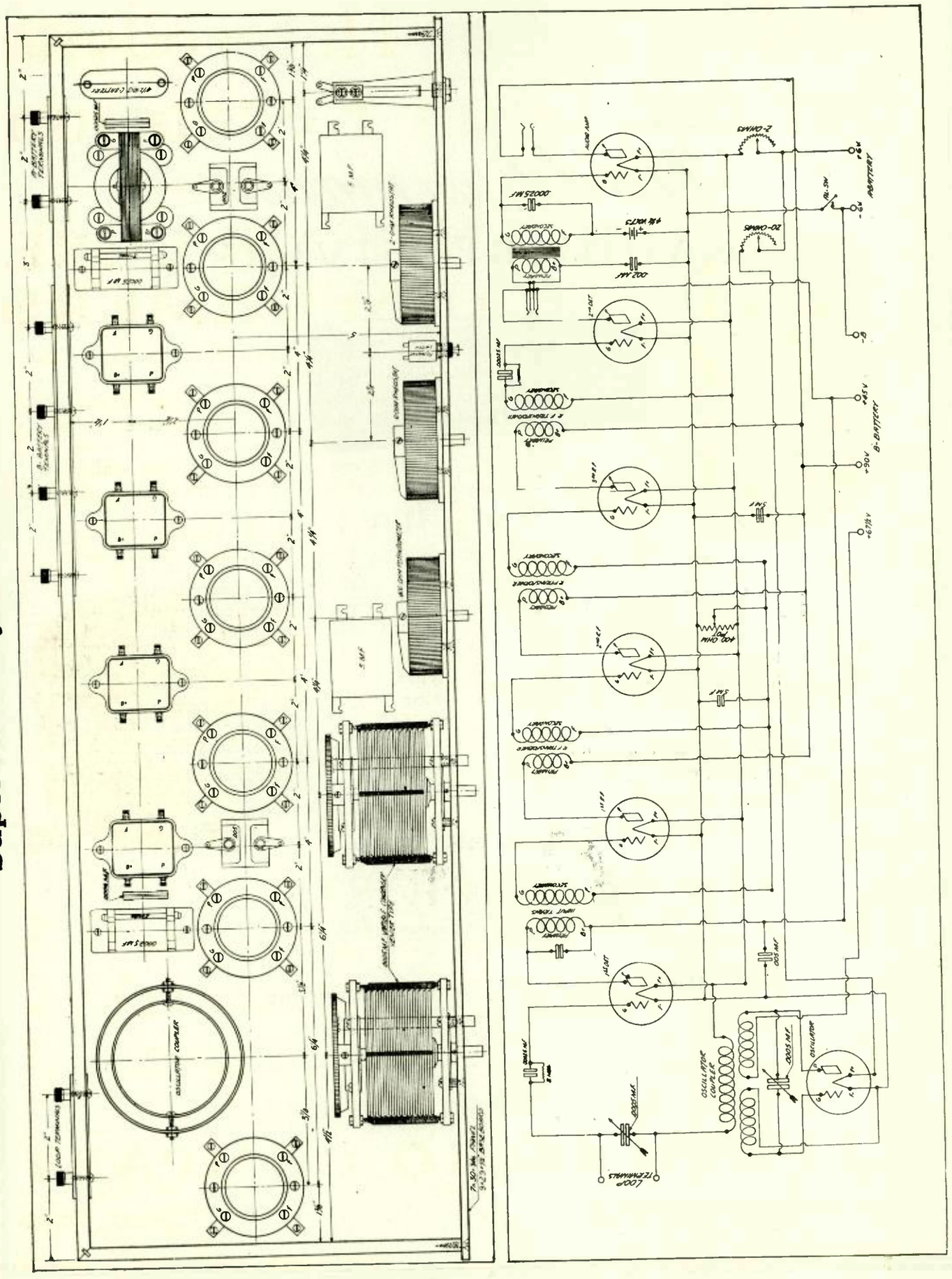


Fig. 6—Connections for "B" battery charging using alternating current

receivers may cause the receiver to operate imperfectly at audio or possibly radio frequencies. A reduction in the battery voltage soon restores the equilibrium of the set, and in extreme cases the addition of a resistance of 100 ohms or so in series with the "amplifier+" or "B" battery lead, will entirely eliminate the disturbance

Fig. 6 gives the connections to be followed when charging storage "B" batteries from a regular 110 volt alternating current (a. c.) line, and Fig. 7 for the 110 volt direct current (d. c.) line.

Super-Heterodyne Receiver



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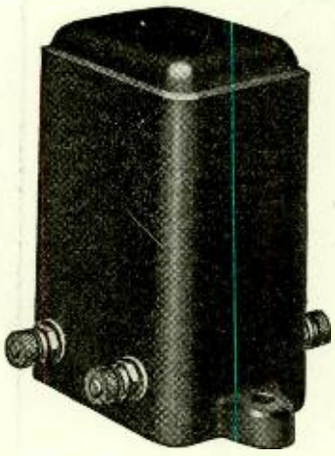

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are designed to work on a narrow band of wave lengths and to pass only certain desired frequencies.

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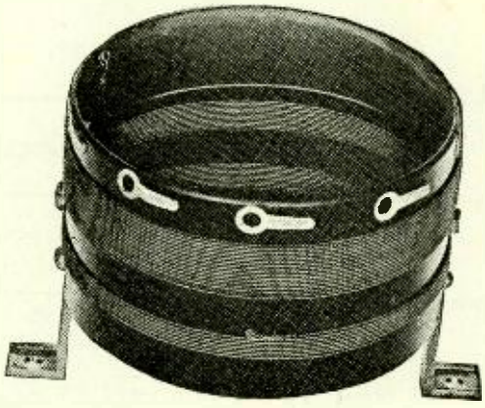

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No. 1. This sheet shows full size panel layout giving dimensions and can be used as a template. Very handy when laying out apparatus that is mounted on front panel.

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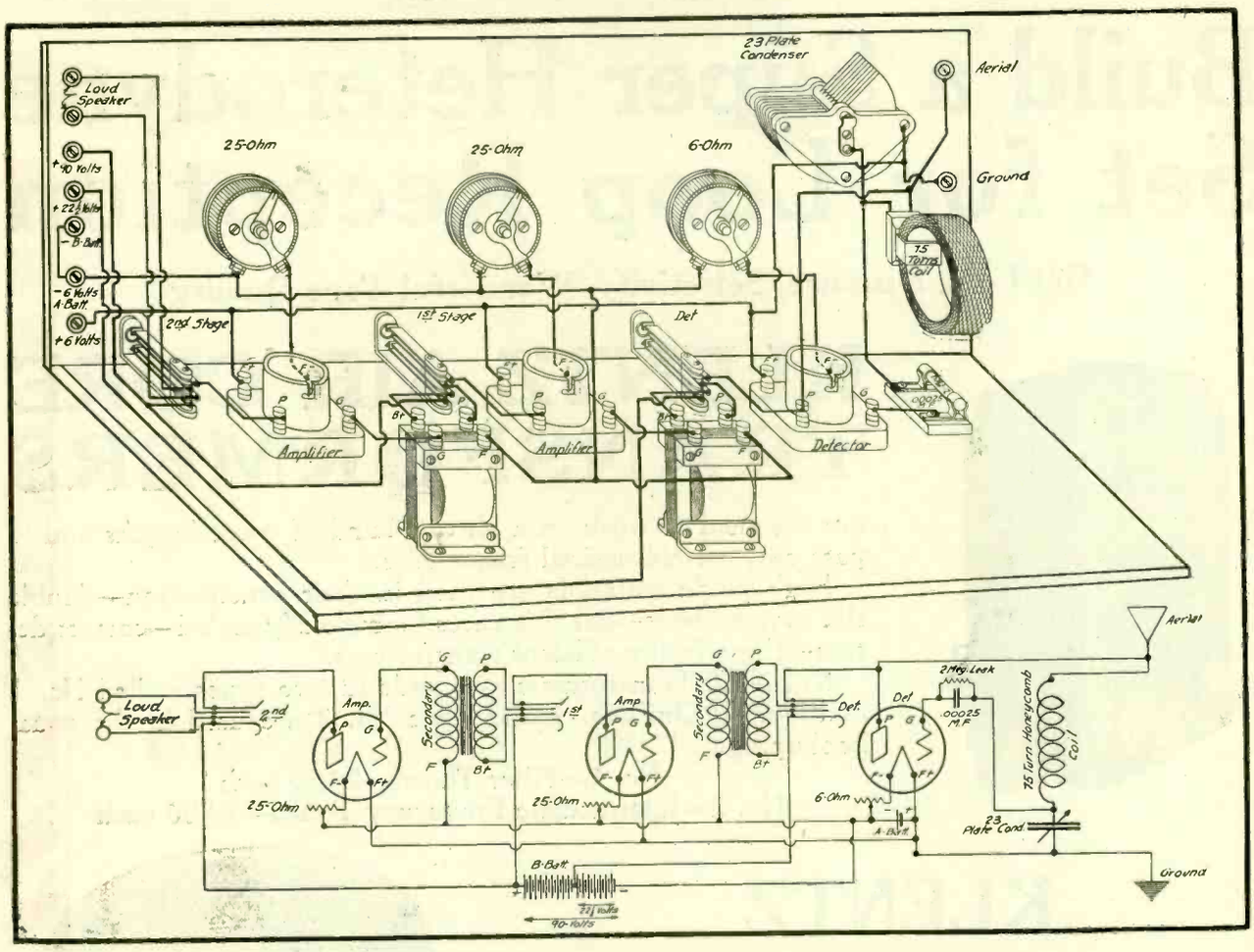
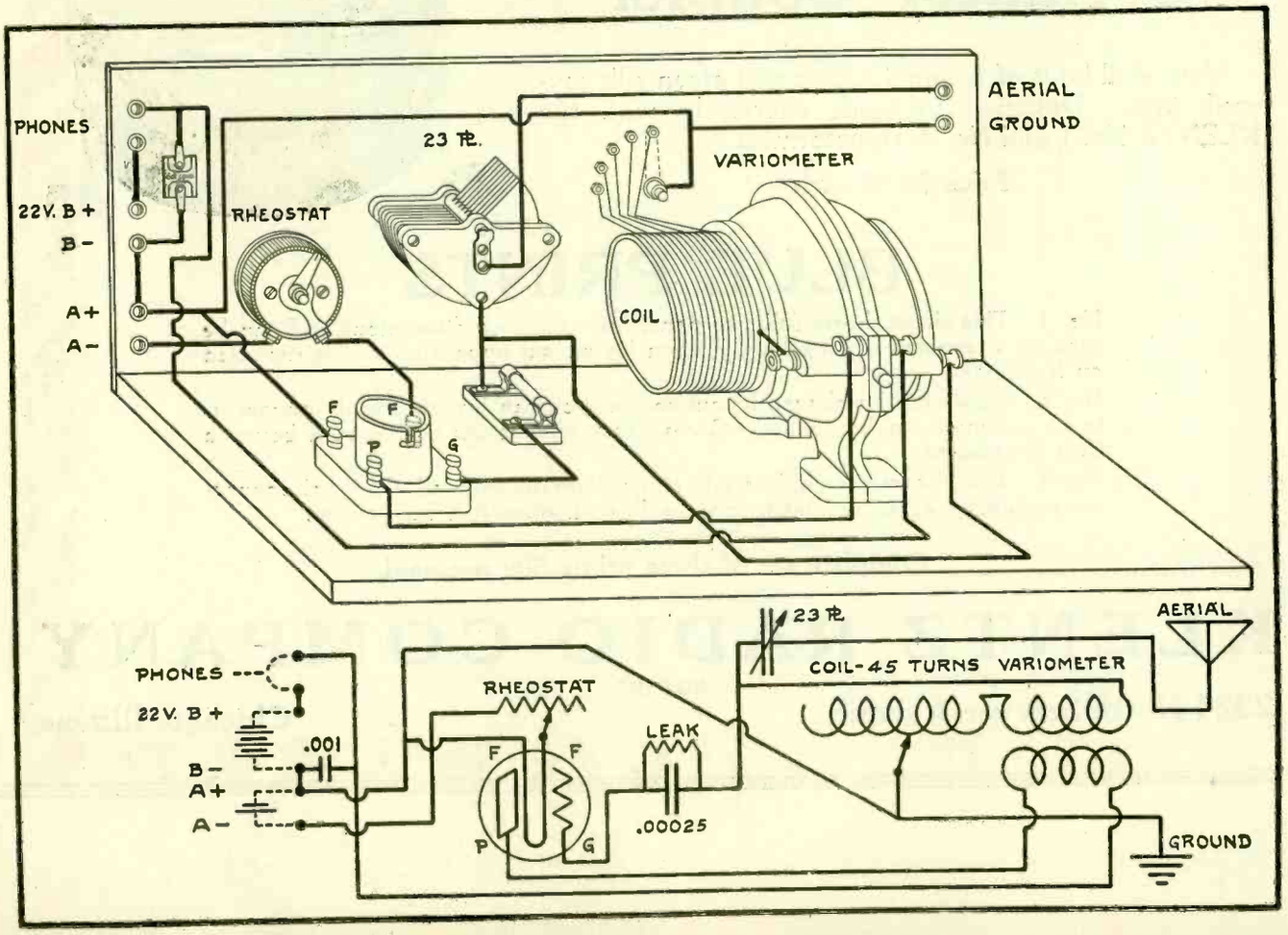
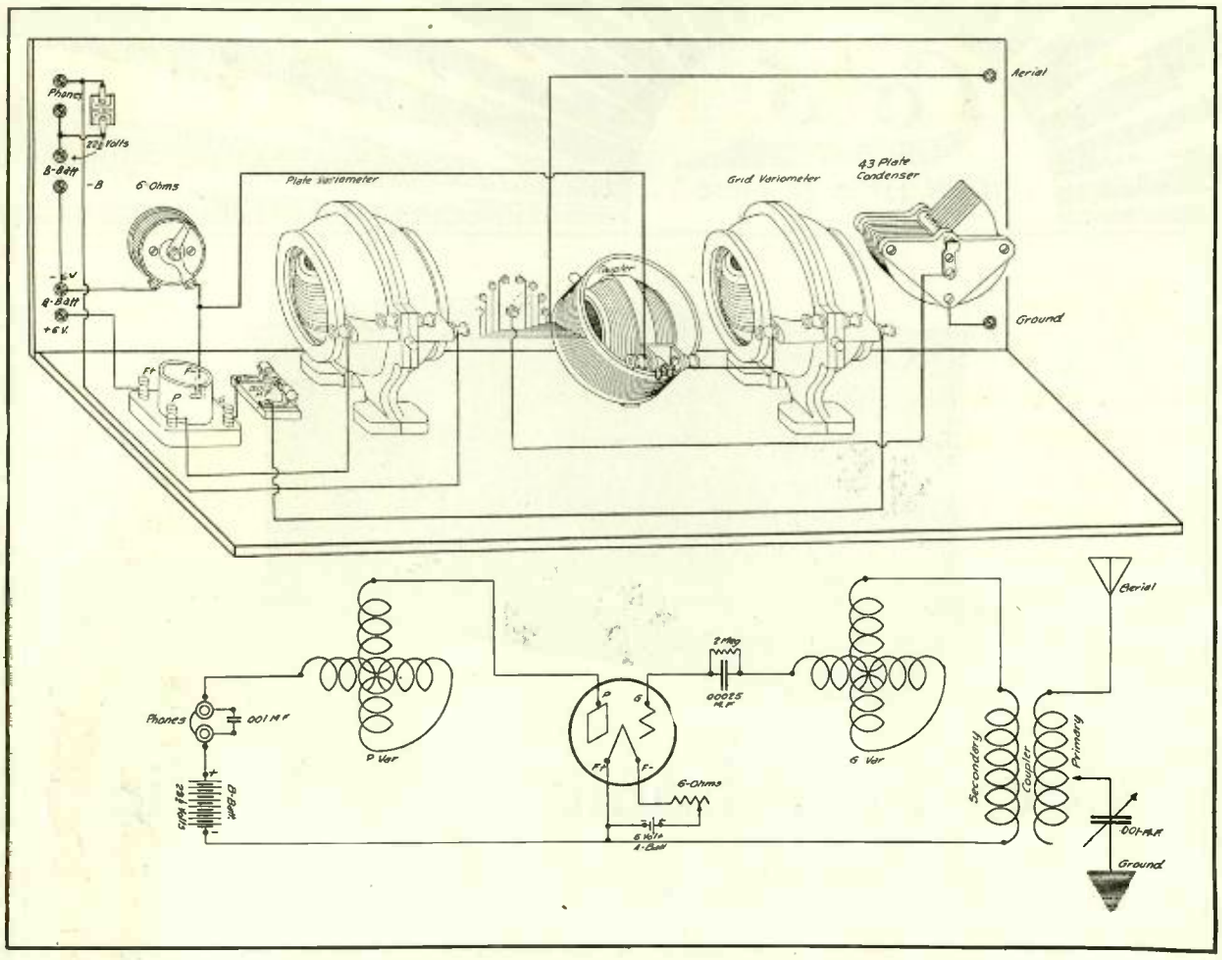


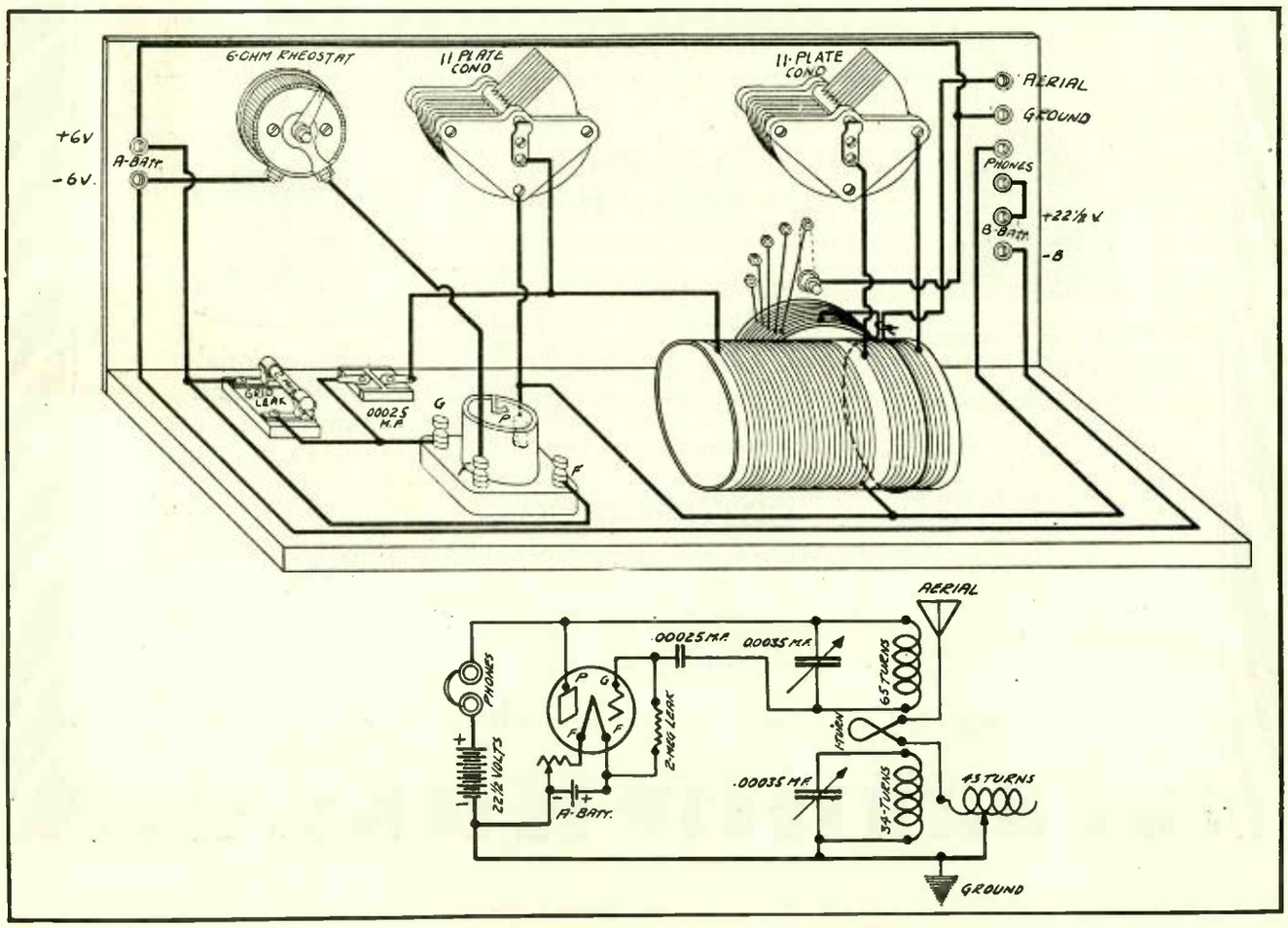
Single Circuit Regenerative Receiver



Three Circuit Regenerative Receiver



Cockaday Receiver



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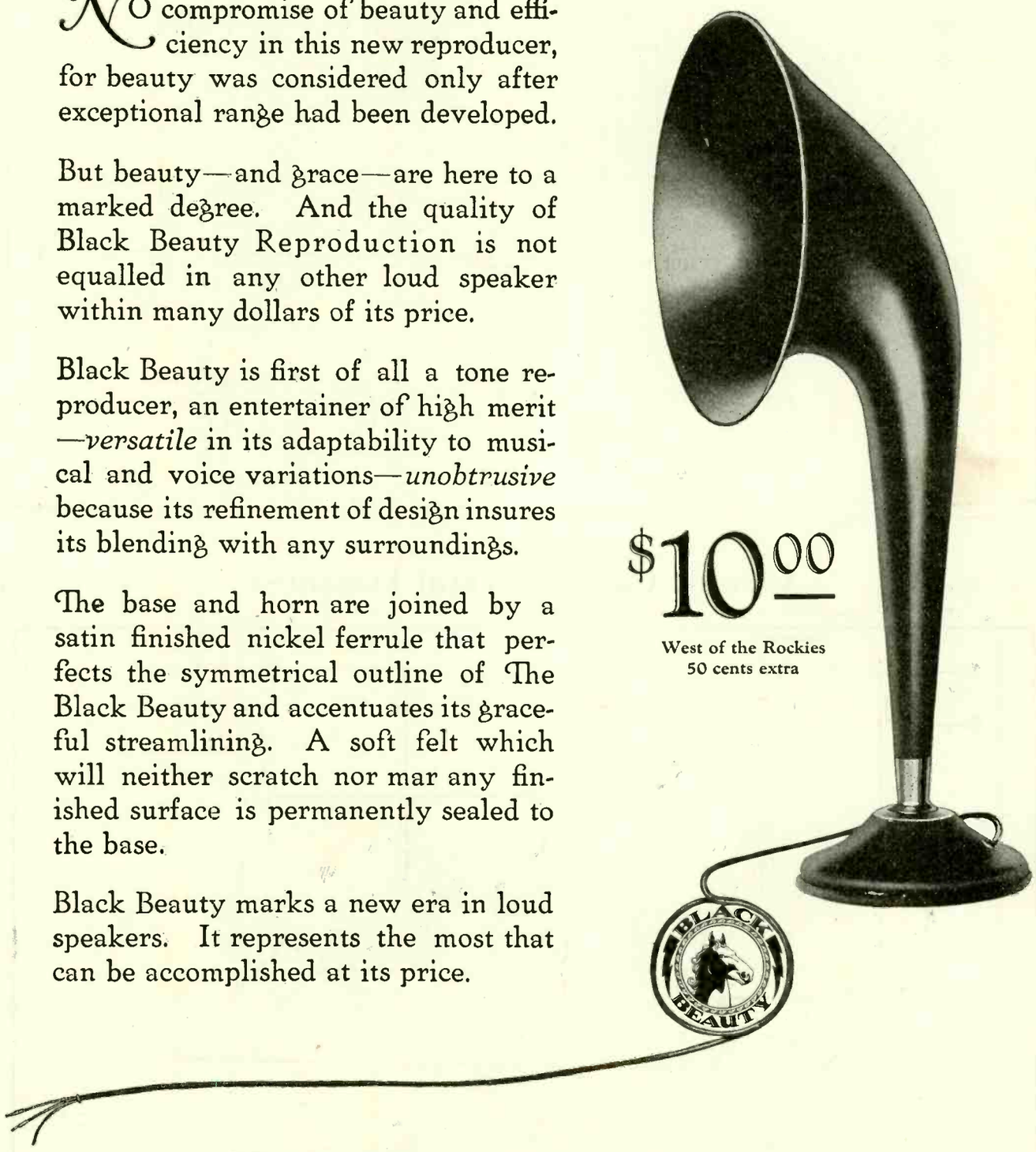
Black Beauty marks a new era in loud speakers. It represents the most that can be accomplished at its price.



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50 cents extra

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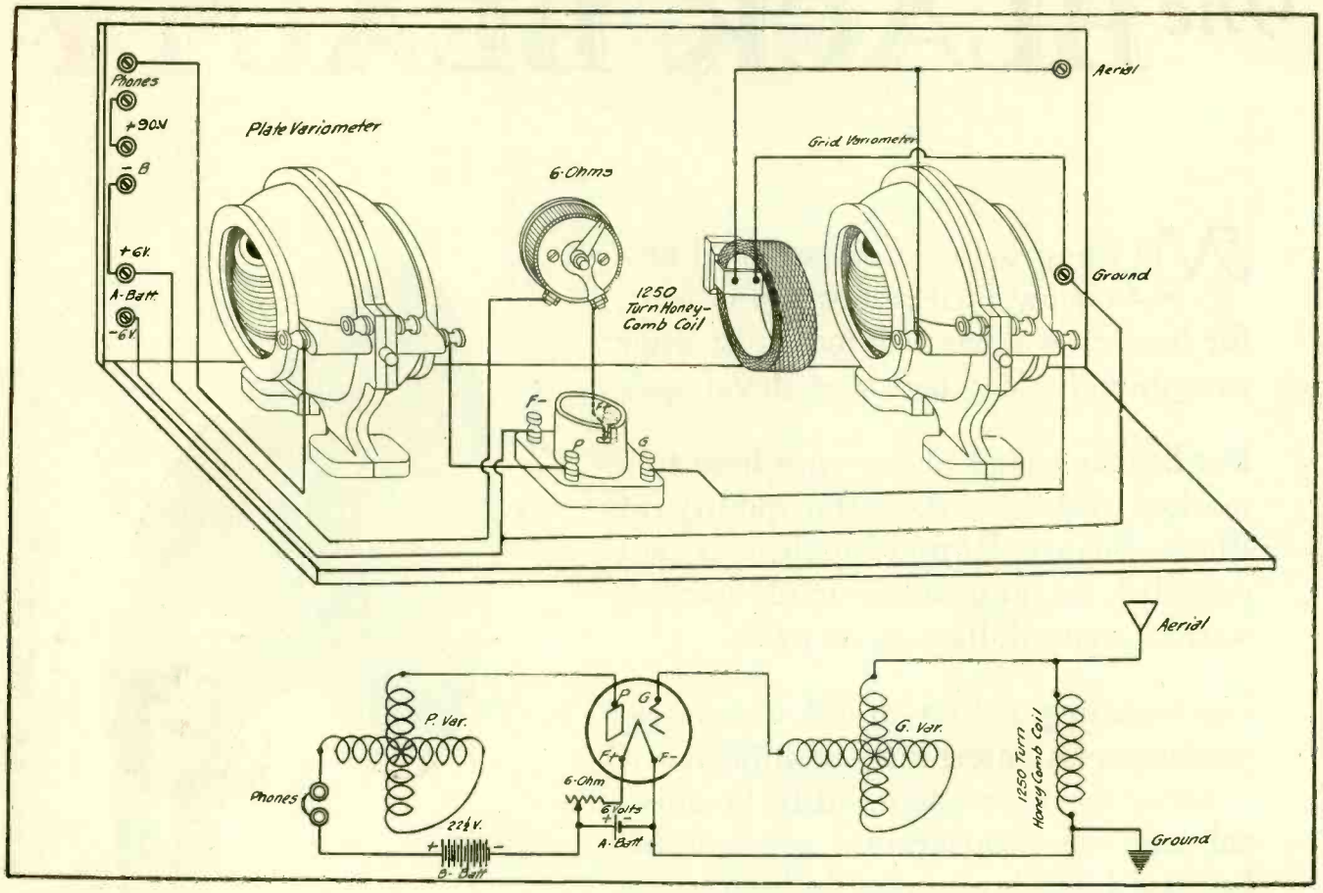
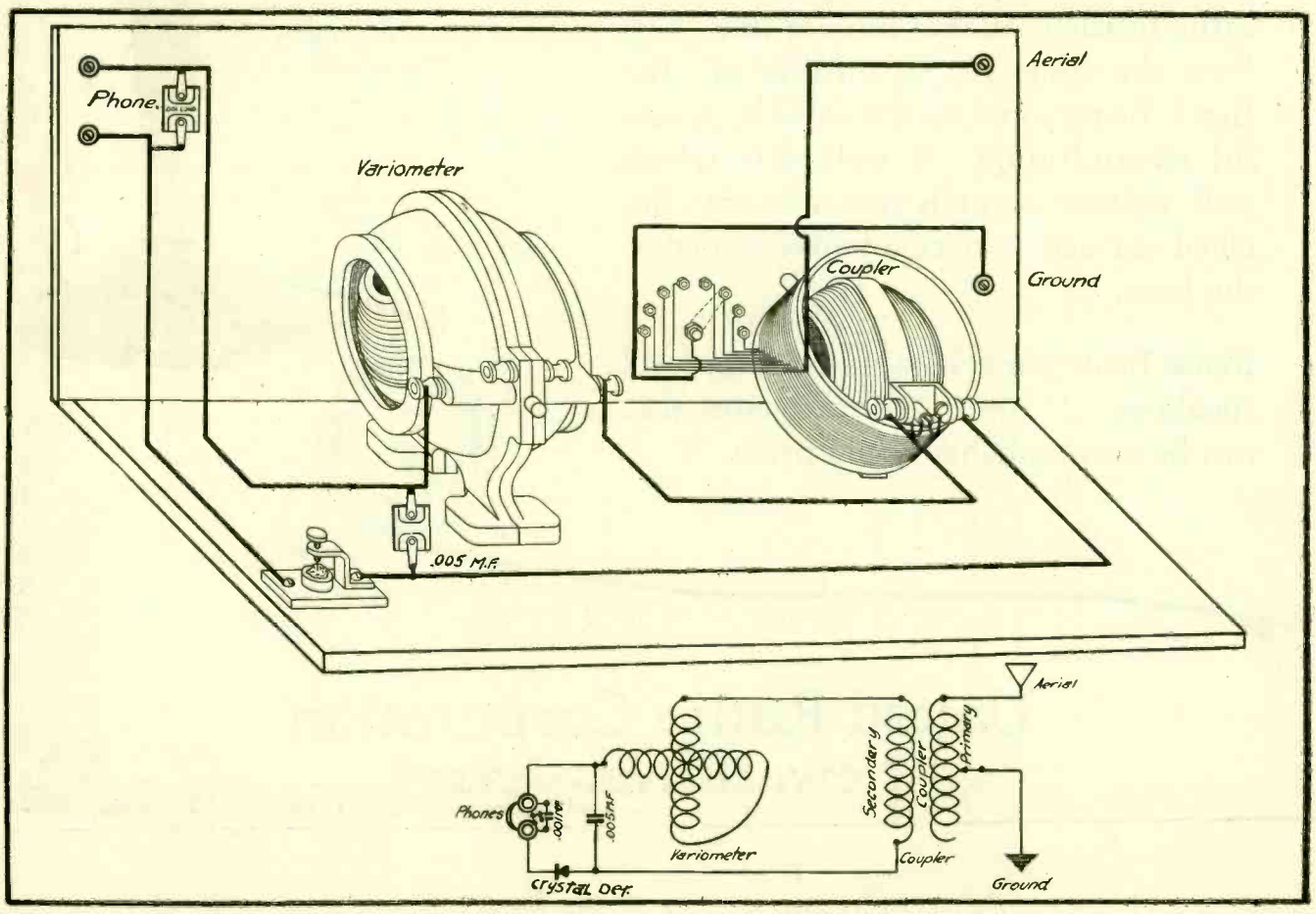


Circuit Using Crystal Detector



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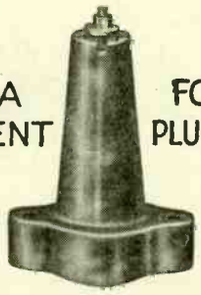

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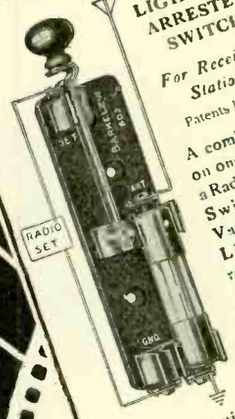

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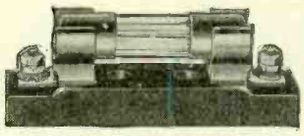

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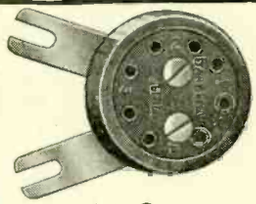

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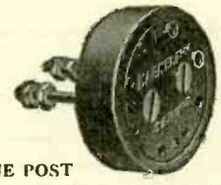

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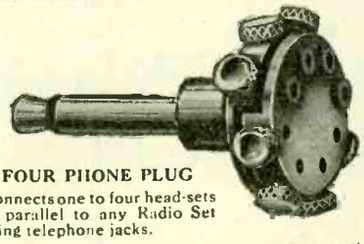

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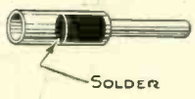
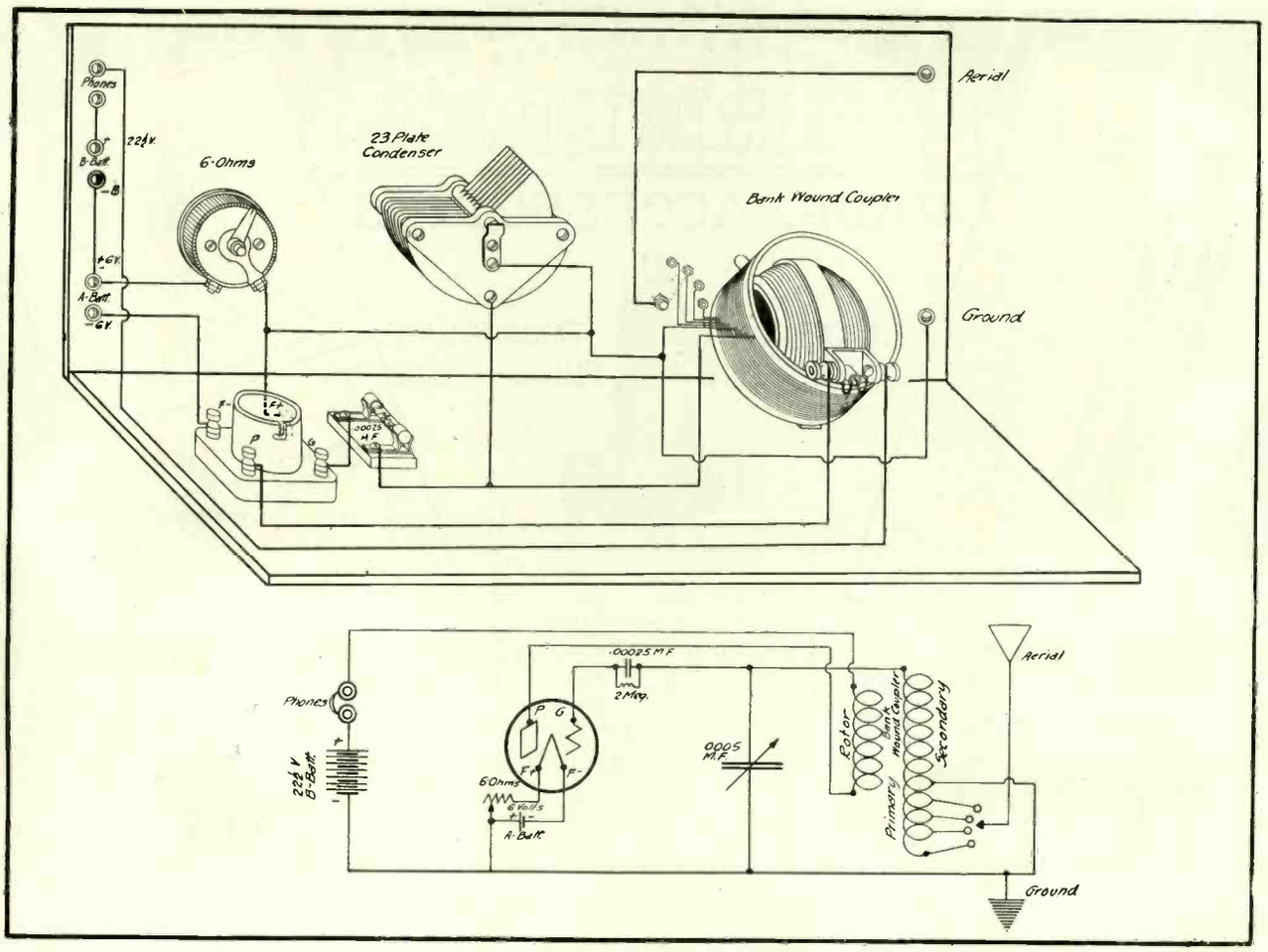
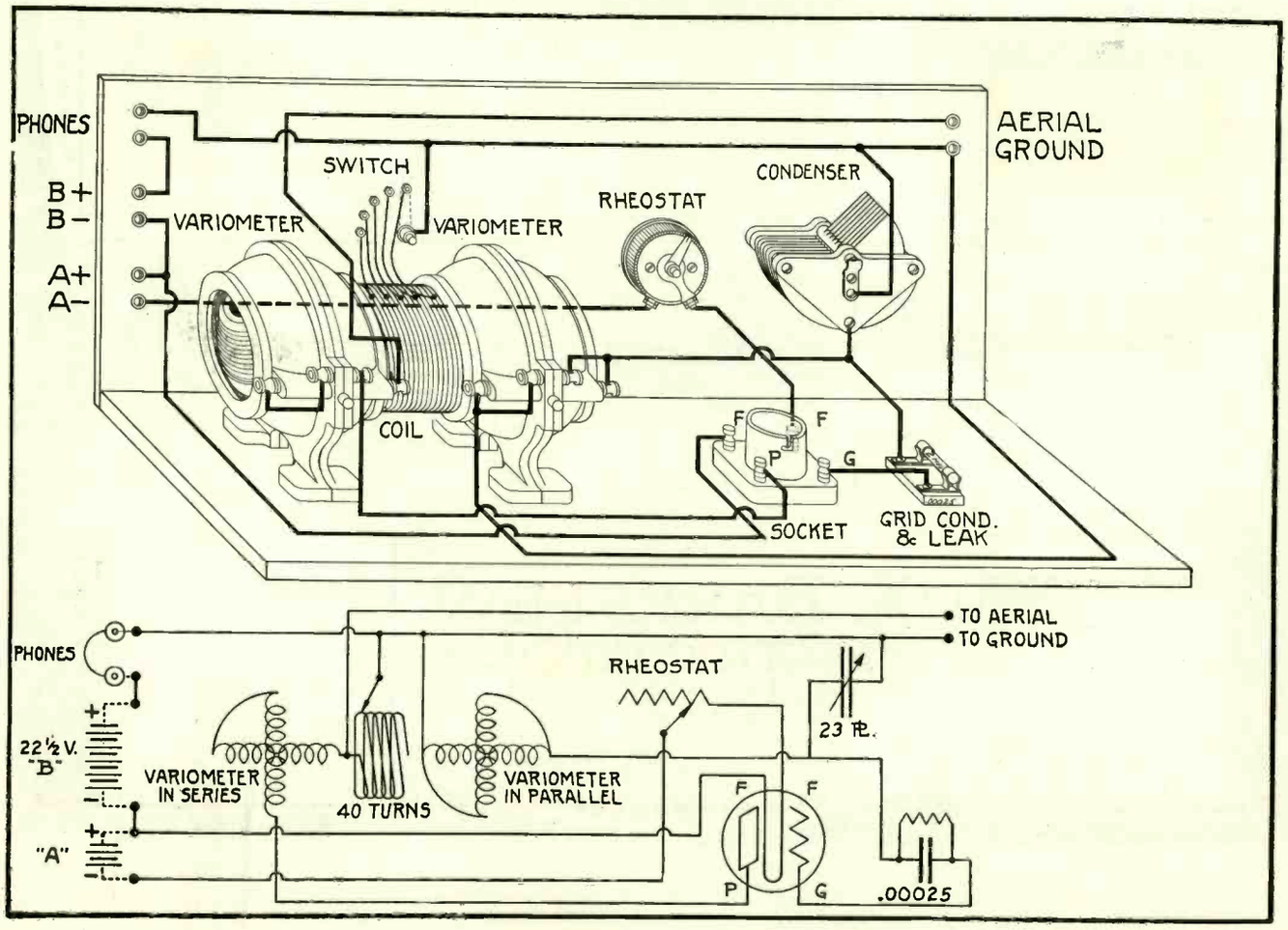
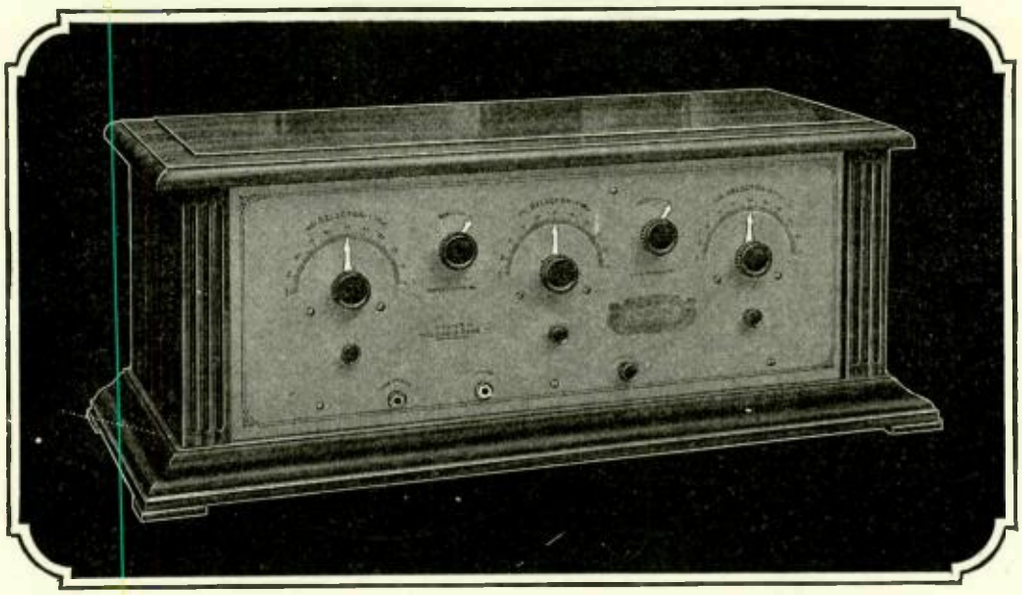


Haynes Circuit



Twin Variometer Circuit





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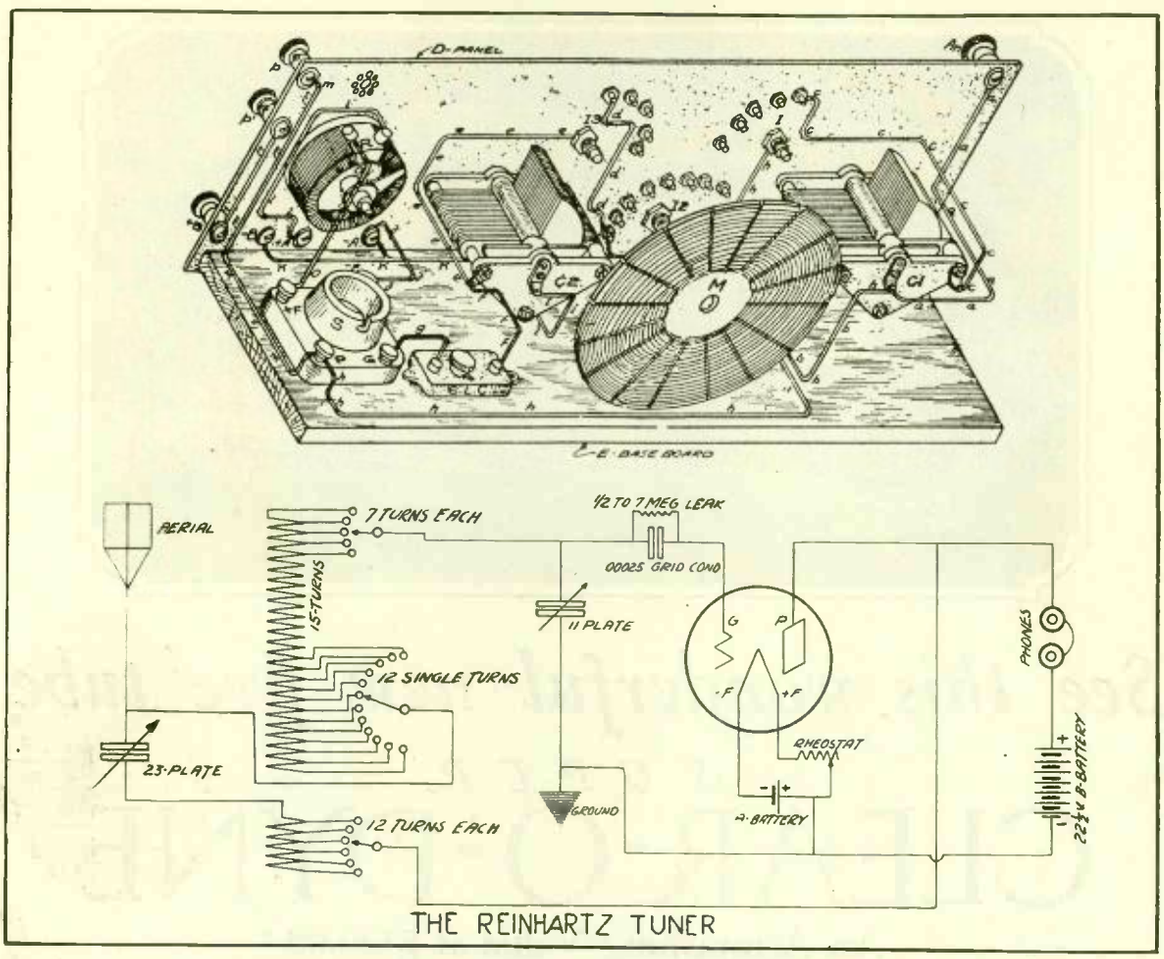

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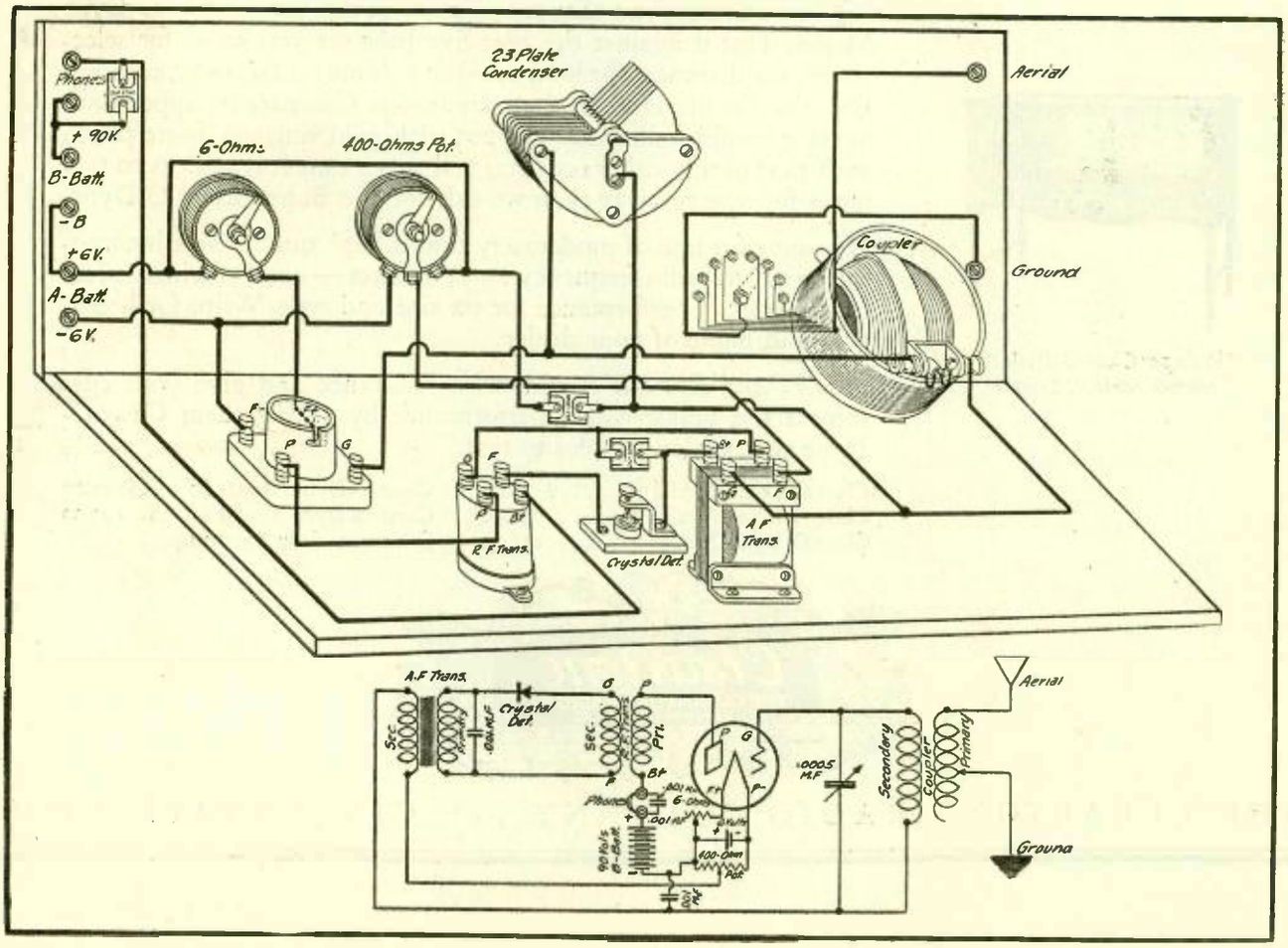

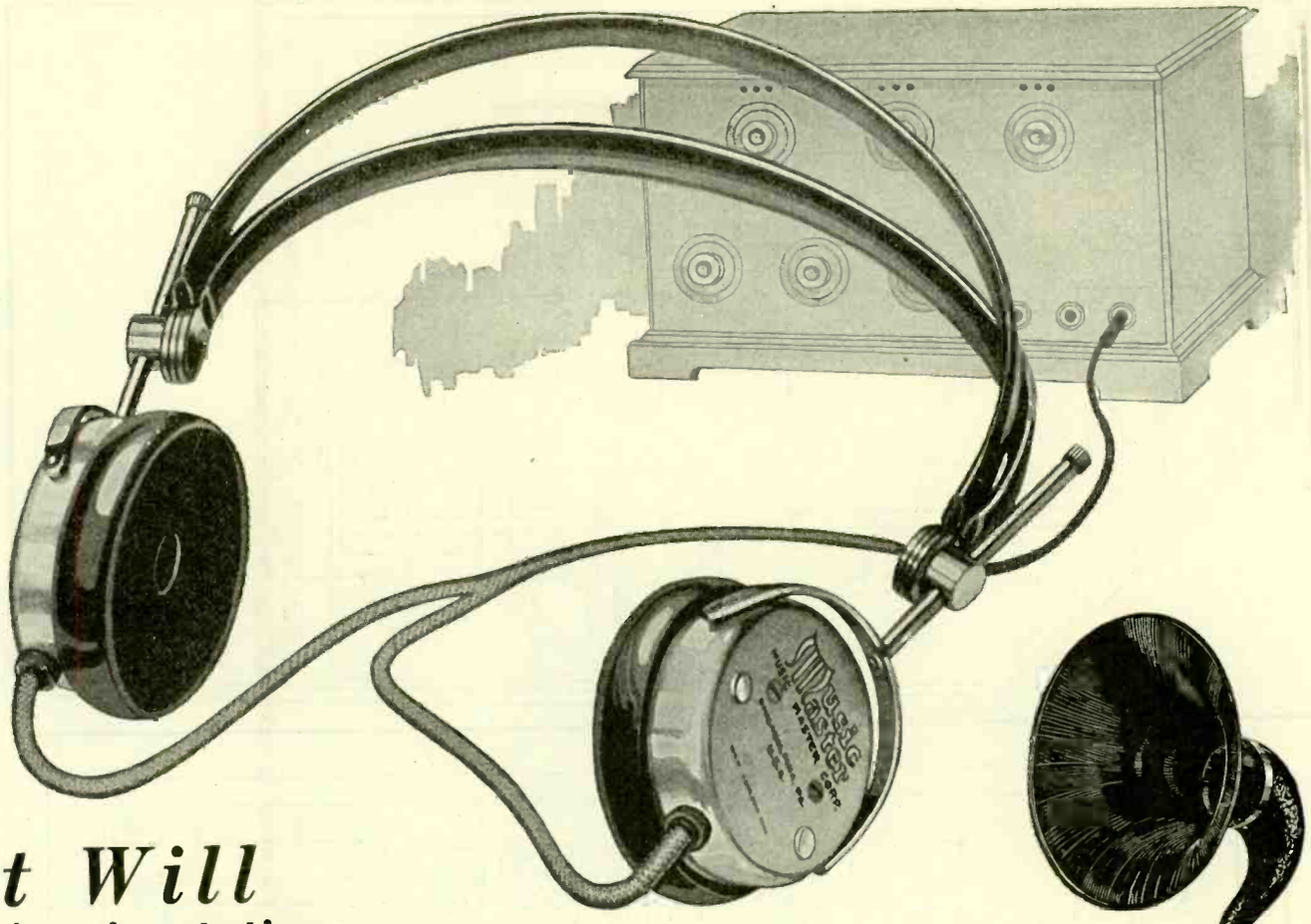

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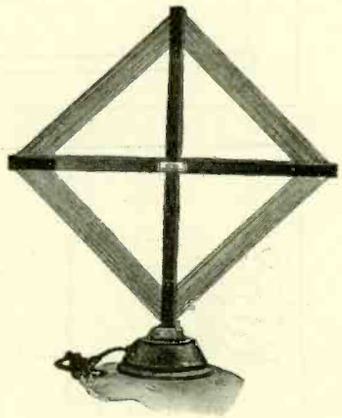

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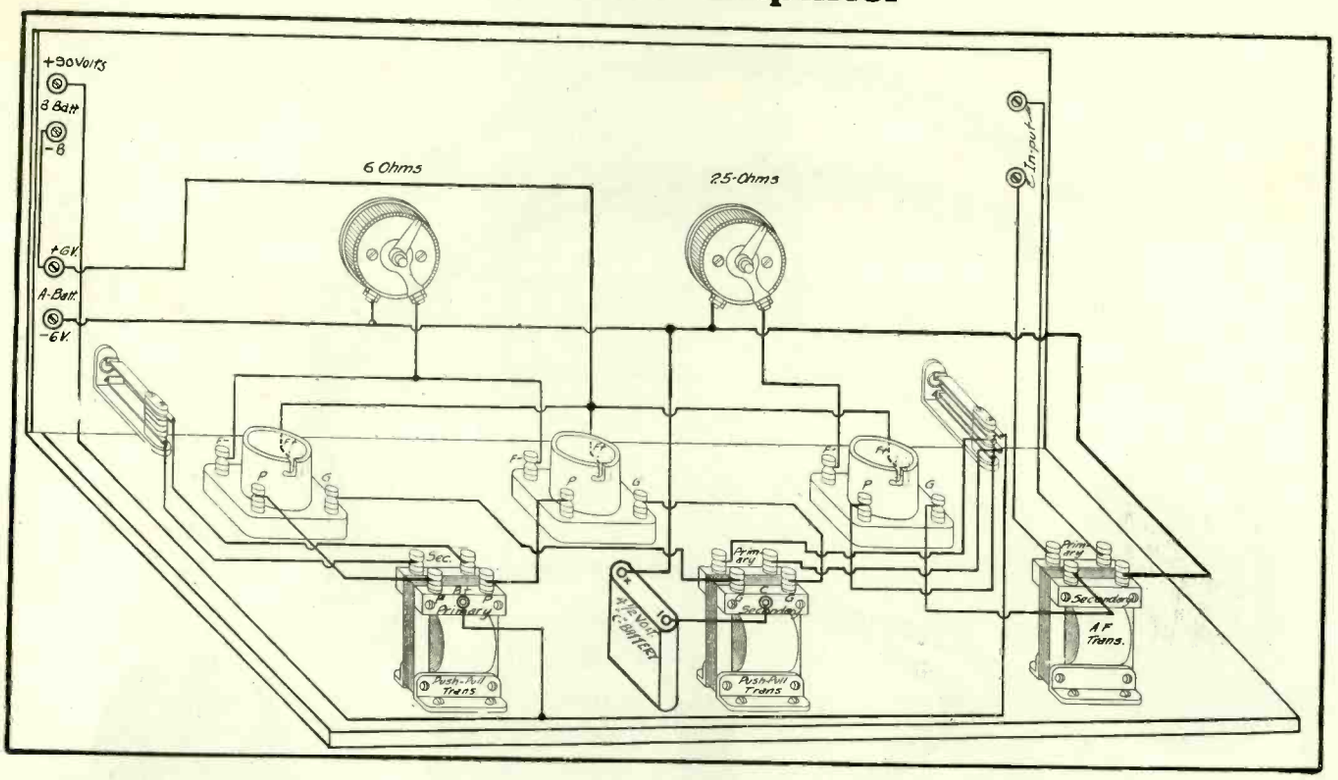
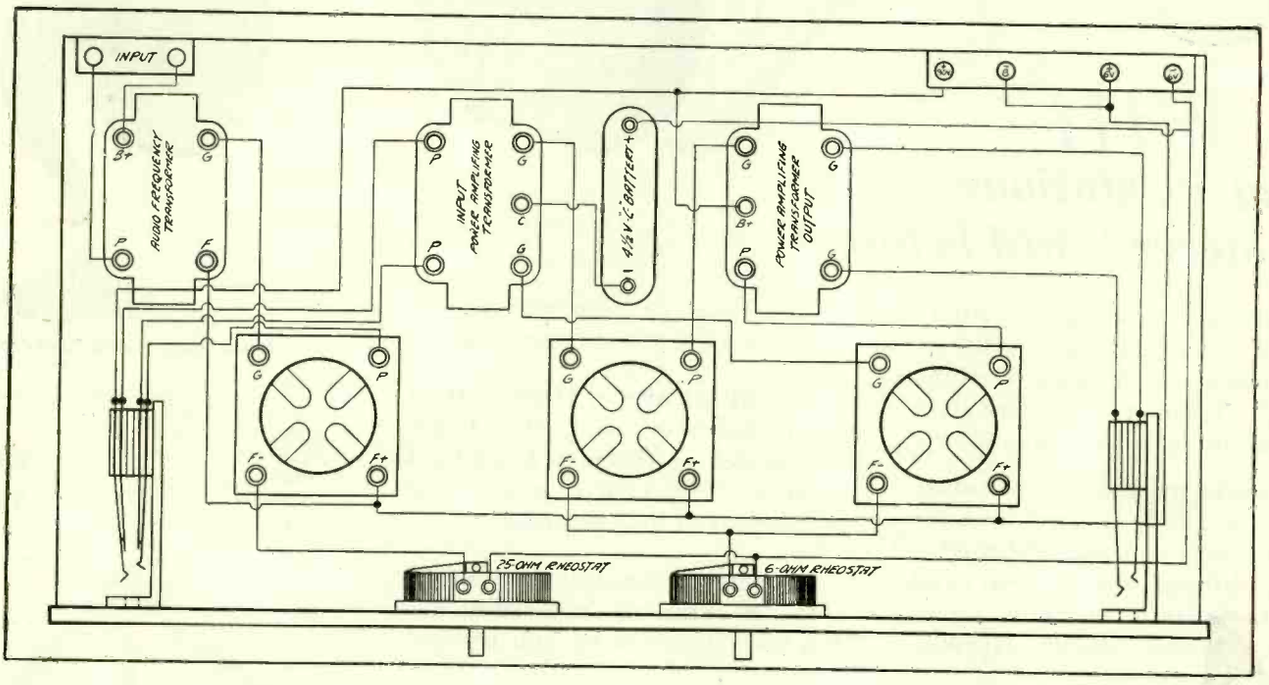
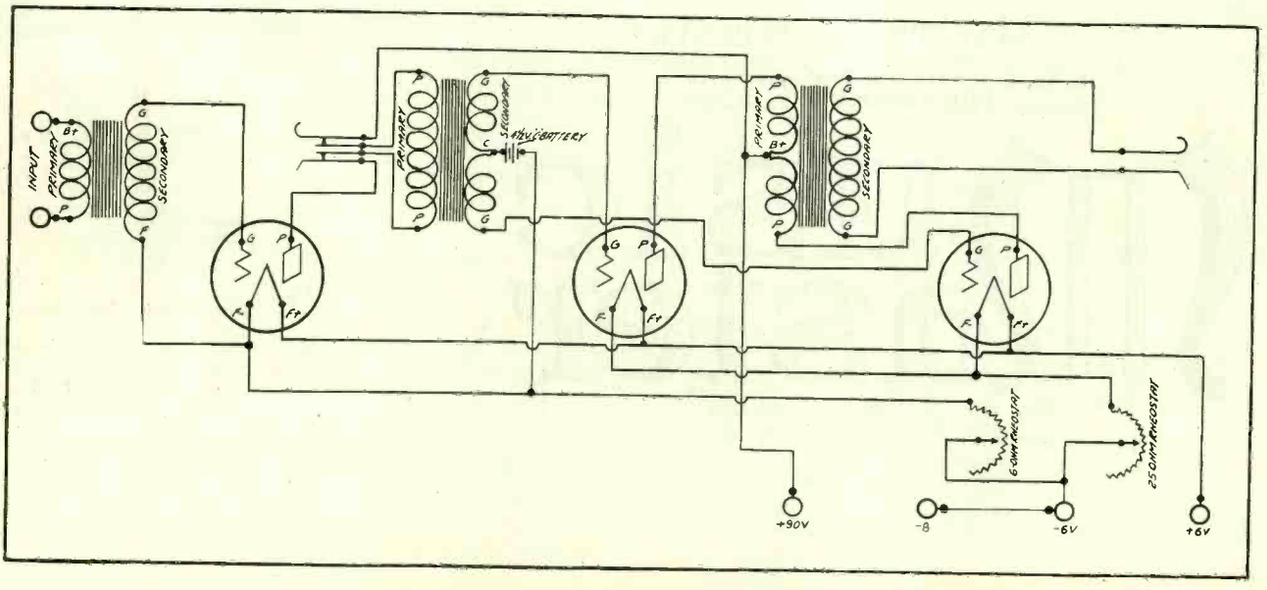
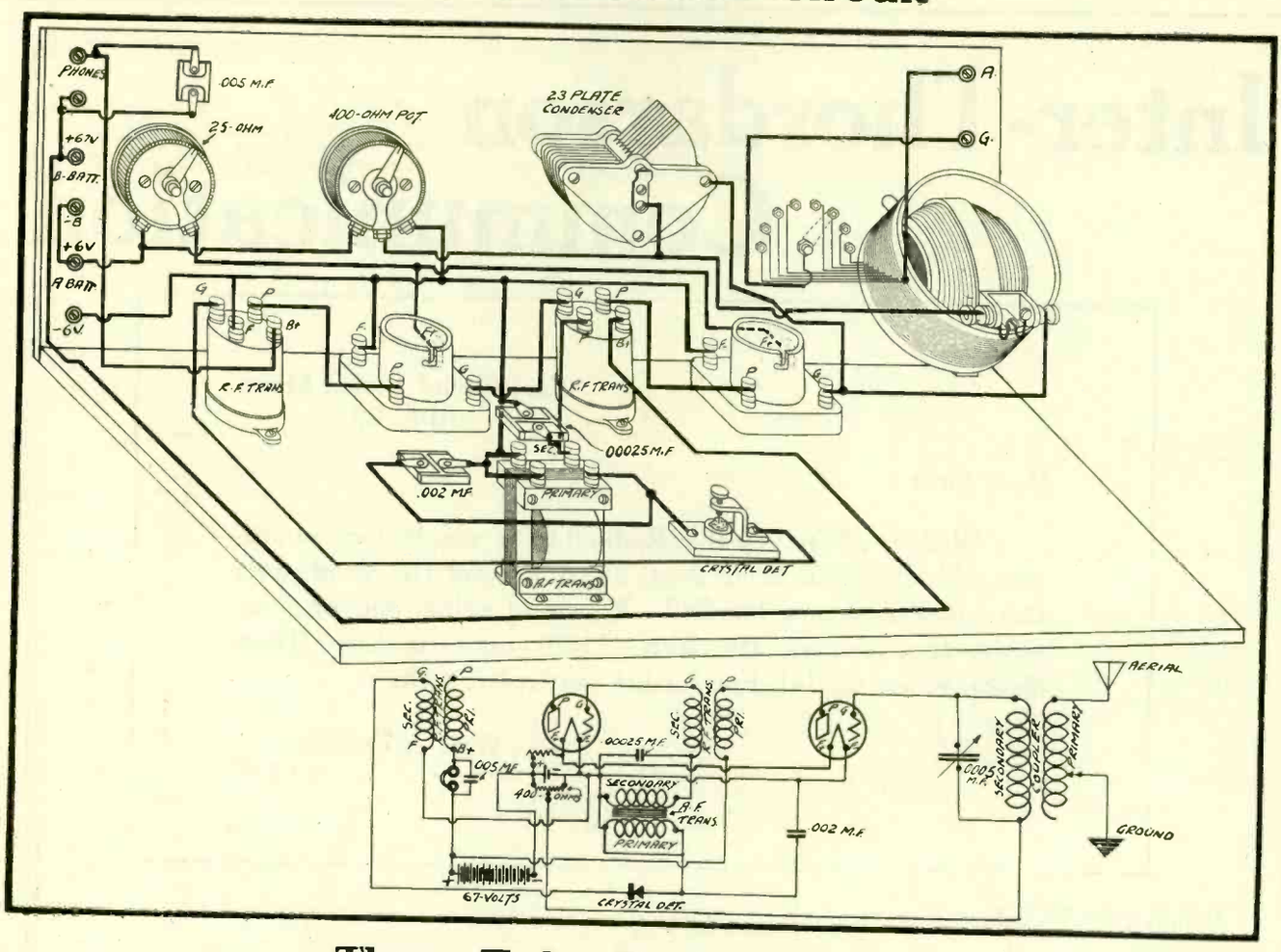
Push Pull Amplifier



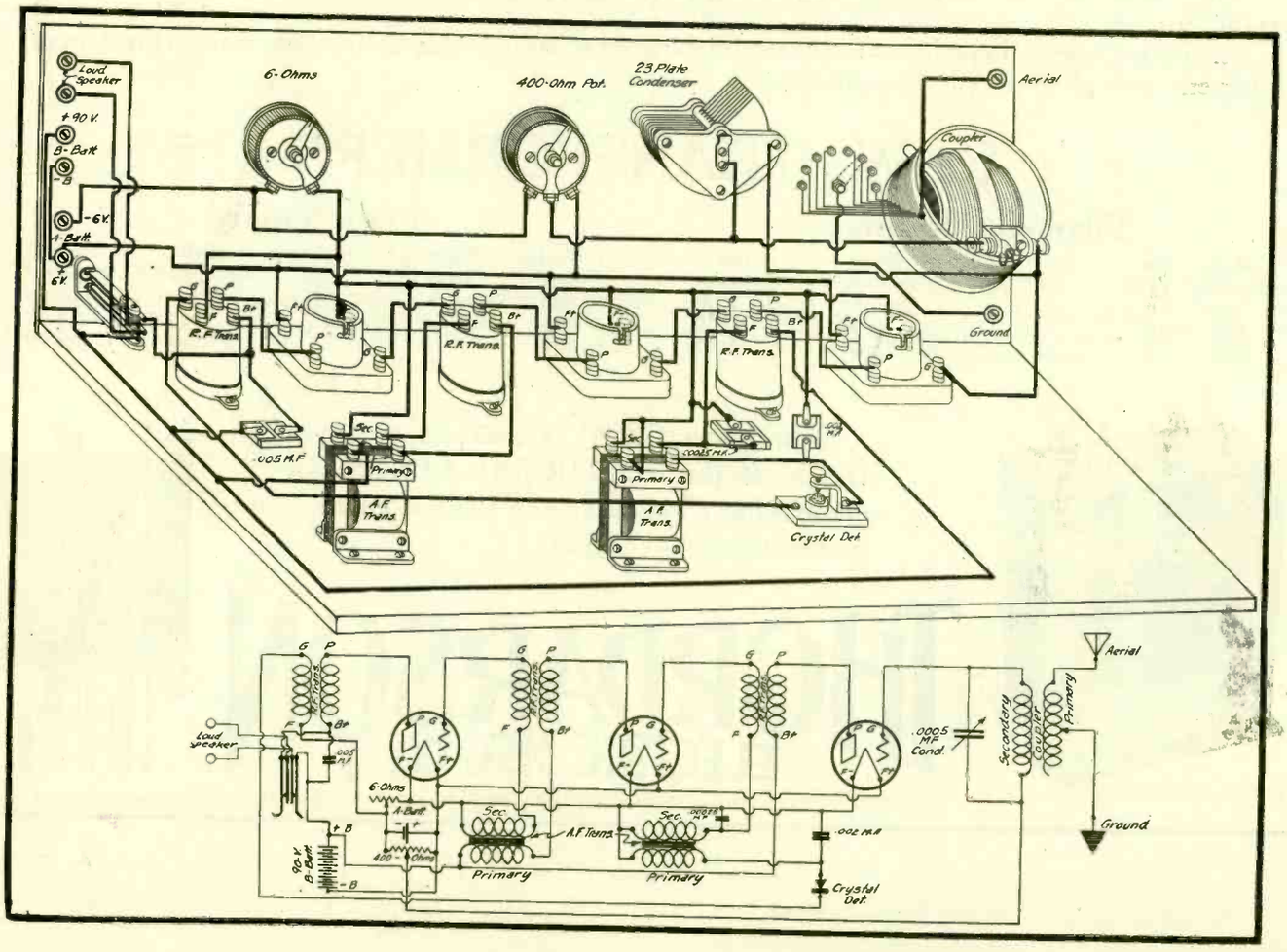




Two Tube Reflex Circuit



Three Tube Reflex Circuit



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are designed for use in every known "hook-up." By standardizing on Premier, you are assured of the utmost in Radio reception.

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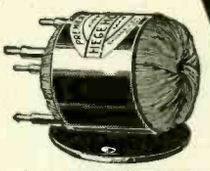

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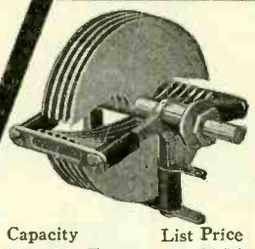
Smallest Audio-Transformer made, and yet the most efficient for volume and tone quality (about the size of an English walnut). Gives maximum reproduction volume — minimum distortion. 100% shielded. New patented design makes this possible. Mounts anywhere—saves space in assembly. Ratios 1-3, 1-4, 1-5, $3.50. 1 to 10, $4.50.



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Premier "CROFOOT" Vario Condenser

"The Condenser with the Red Stripe"

A real achievement in scientific engineering. It has the greatest tuning ratio and the widest tuning range of any standard condenser yet made. Capacity .0005 M. F. has minimum (full out) capacity of only .000007 M. F., with a tuning ratio of 1 to 74. Light, compact, and small size. 3 inches in dia., weight 11 oz. In operating efficiency it is unexcelled.

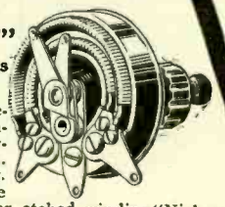
Capacity	List Price
.0001 M. F.	$2.75
.00025 M. F.	3.25
.00035 M. F.	3.50
.0005 M. F.	3.75

VERNIER TYPES COMPLETE WITH "EZTOON" DIAL 75 CENTS EXTRA

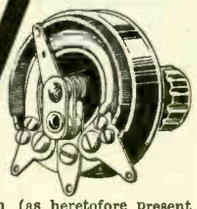
Premier "MICROSTAT" Super-Vernier Rheostat

Gives perfect control of the current delivered to the filament of radio tubes. New principle—two windings in parallel; one 6 ohm, other 40 ohms. Absolutely noiseless. Infinite control—handles any tube. "Nichrome" wire wound. Capacity 3 amperes. Bakelite moulded—silver etched dial. One hole mounting. New Reduced Price, $2.50.

Premier "DUOSTAT" Two Rheostats in One



Windings independent of one another. Each operates one tube. Simplifies wiring. Base Bakelite moulded dial silver etched, winding "Nichrome" wire. Made for all types of tubes. No. 12, two windings, each 7 ohms; No. 13, two windings, each 25 ohms; No. 14, two windings, each 40 ohms. New Reduced Price, $2.50.



Premier "Double-Disconnect" Potentiometer

Double circuit breaker automatically disconnects A and B battery circuits, thus positively eliminating A battery drain (as heretofore present in all Potentiometers) and absolutely prevents accidental burning out tubes with B battery voltage. Genuine "Nichrome" wire wound. Bakelite base. Silver etched dial. Price: 250 ohm, $2.50; 400 ohm, $2.50; 500 ohm, $2.50.

Premier "Micrometer" Vario-Coupler

Highly Selective

180-degree orientation and 20 Antenna Taps. Wound with No. 21 single silk wire. Eighty turns on stator—55 on rotor. Wave lengths range 150 to 800 meters. All metal parts brass—stays "put" at any angle. Bakelite button on each tap wire, permitting easy, safe soldering.

The New Premier "LO-LOSS Tube Socket

Has the lowest leakage to radio frequency current of any bakelite socket. Ideal for radio frequency. Molded bakelite base. Minimum capacity between terminals. Self-cleaning one piece contact springs. Maximum spring deflection without set. Cam action bayonet lock. Smooth as silk. Visual contact inspection. Made for both Standard and U. V. 199 Tubes. Price 90c.

A number of well known items in the Premier Line are listed here. It will pay you, however, to send for our Bulletin No. 94, which gives detailed description of the entire line. It will be sent FREE on request.

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We have ready for distribution individual diagrams of each of the most popular "hook-ups," including Harkness Reflex, Neutrodyne, Super-Heterodyne, Tuned Radio Frequency, Regenerative, etc.

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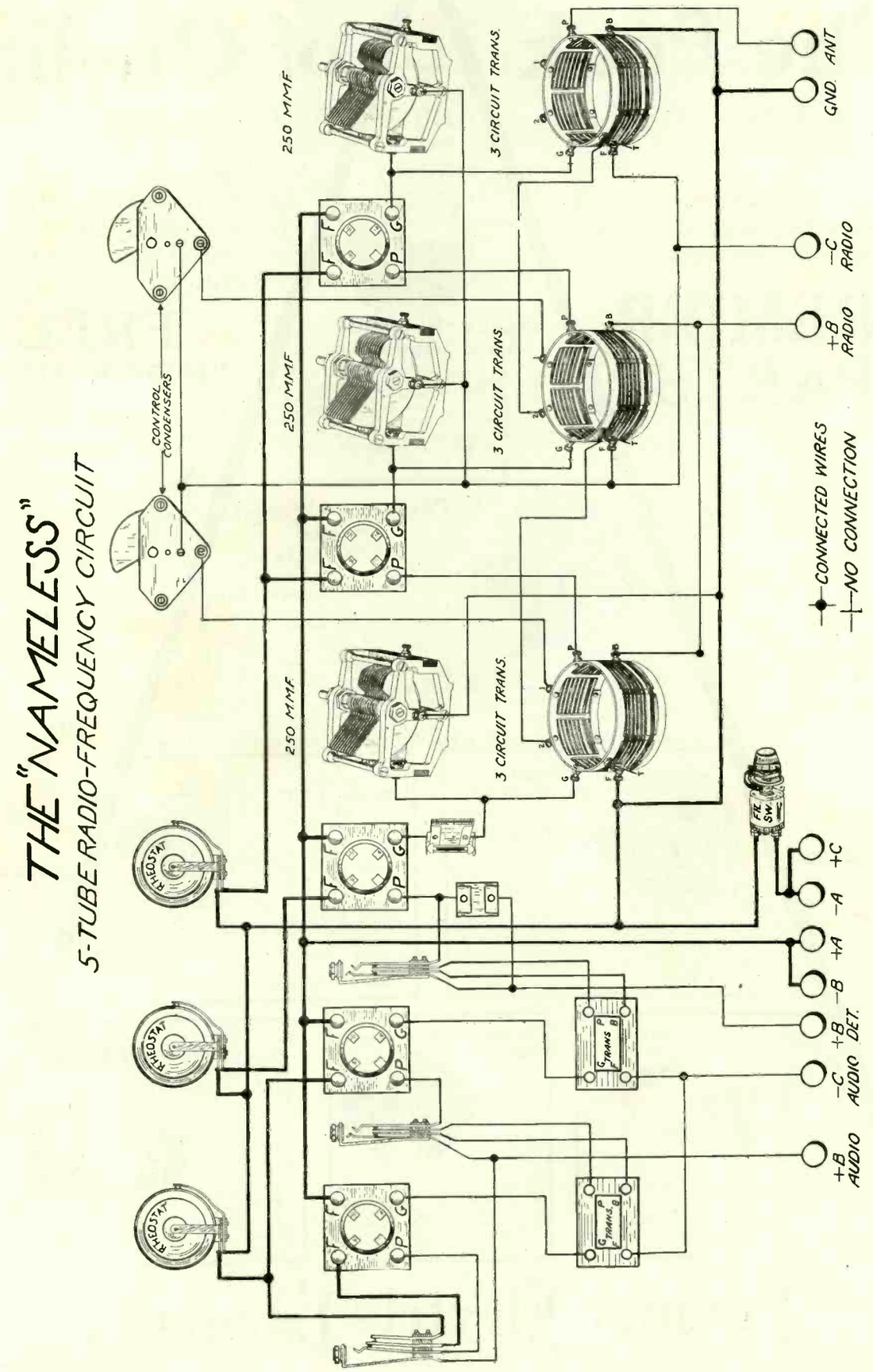
The Nameless Circuit



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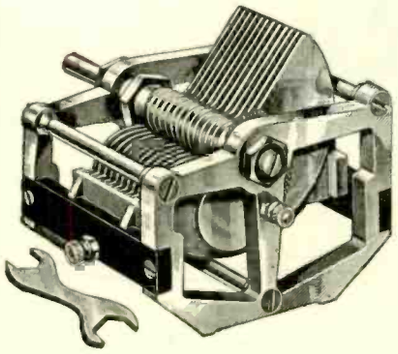
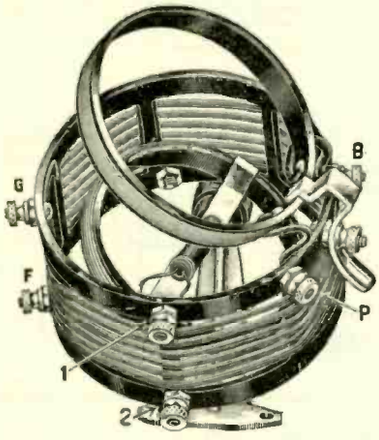
EVERY part that Bremer-Tully has placed on the market has been a success. The originality of design and superiority of construction has won for Bremer-Tully the enviable position of leadership. Bremer-Tully parts faithfully fulfill every claim made for them. You cannot buy better parts—and seldom if ever equal, no matter what you pay.



B-T Laboratory Type Low Loss Condenser

The only Low Loss straight line wave length condenser. Unequalled two-step, thrust, lubricated bearing. Can be adjusted without changing alignment of plates. Pigtail connection. Grounded rotor, special cutaway end plates. Special die cast construction insured improved contact and lowest resistance. Made in four styles, 7, 11, 23 and 35 plates.

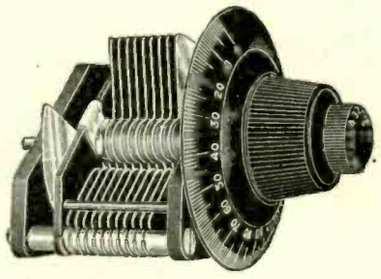
Write for "20 Point" Folder.



The New B-T Low Loss Tuner

Two types. For broadcasting 200 to 565 meters. Short-wave work 50 to 150 meters. (These ranges covered with B-T 11-plate "Lifetime" Laboratory Condenser) $5.00

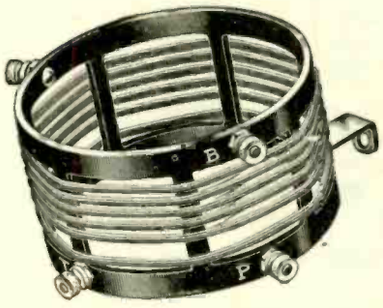
In tickler feed back circuits—nothing equals this tuner for selectivity and volume. Adjustable untuned primary, permits adaptation of tuner to any circuit or location. Special skeleton coil frame. No taps or switches. Binding Post Terminals with tinned soldering lugs—Pigtailed rotor.



B-T Vernier Variable Condenser

The first "vernier"—Single Vernier plate, active only on one side gives unequalled sensitivity—it cannot be short circuited. Vernier entirely independent. Perfect plate alignment. Patented positive contact between vernier and rotor plates. Made in 11, 23 and 43 plate types.

Plain Condensers, same construction as above only without vernier, made in 3, 5, 11, 17, 23 and 43 plate types.



The B-T Air Core Transformer

The most efficient transformer for tuned Radio Frequency Circuits. Special "Series-bank" winding on skeleton frame with minimum dielectric gives greater selectivity and volume. Binding post terminals, properly marked. Can be mounted on condenser or baseboard.

200 to 565 meters
Ratio 2 to 1, 4 to 1, or 8 to 1.

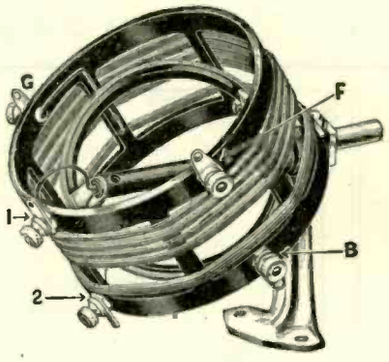
The B-T "Nameless" Circuit

The five tube circuit that has gotten longer distances—better tone, greater volume—and is more selective than any other five tube set. Write for illustrated folder.

Ask your dealer to show you "Nameless" Kit No. 3.

"Better Tuning"

(Now in 6th Edition) Tells you why and shows you how. Complete instructions and diagrams for progressive construction from Crystal to five tube R.F. and Reflex Circuits. Sent on receipt of 10c.



B-T Oscillator Coupler

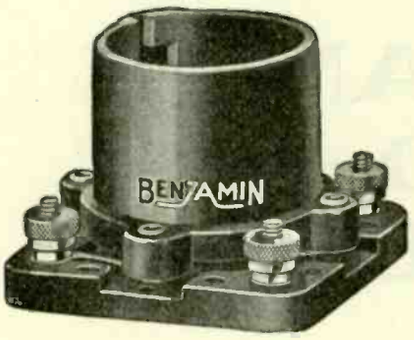
For Super-Heterodyne and other circuits requiring an oscillator coupler. B-T "Series-bank" wound on B-T skeleton insulation frame.

The low capacity winding requires a condenser of only 500 M.M.F. (B-T Laboratory type 23 plate) to tune from 205 to 725 meters—thus insuring stability and uniformity of power, due to the high ratio of inductance to capacity.

Pick-up coil can be locked after being set at best position.

BREMER-TULLY MFG. CO., 532 So. Canal Street, Chicago

Stop Tube Noises



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CLEARER RADIO TONE

L. H. Simon, Principal of the Radio School of the Oregon Institute of Technology, Portland, Ore., after thorough tests, makes the following authoritative statements regarding the advantages of the Cle-Ra-Tone Socket:

"The spring suspension feature effectually absorbed sudden impacts that ordinarily would cause microphonic noises, especially with tubes having thoriated filaments. The vibration was eventually transmitted to the tube, especially if it were a sustained shock but did not seem to be objectionable. There is an apparent advantage over the conventional sponge-rubber method of absorbing comparatively slight shocks, whereas the spring suspension method takes care of really heavy jars.

"From an electrical standpoint the design of the Cle-Ra-Tone represents just as much an advance in engineering design. The insulation is excellent and the contact to tube terminals perfect and permanent. The self-cleaning feature of the spring contacts with the slot in them is decidedly novel ◆ ◆ ◆ Any corrosion is neatly shaved off the tips of the tube prongs as they pass across the little slot in the contact springs."

Prevents unnecessary mechanical noises. The tube holding element "floats" on perfectly balanced springs. Vibration is thus counteracted and so-called "Tube Noises" are done away with. The shock absorbing feature protects tubes. Not affected by stiff bus wiring. Indispensable for and used by leading makers of portable sets.

Tube terminals automatically cleaned by slots in springs. No rubber parts to deterioriate. Made of molded Bakelite. Bottom of base has smooth bosses for accurate mounting. In two sizes—one for standard base and the other for UV-199, etc., tubes. Both sizes are made with screw binding posts or lugs for soldering.

BENJAMIN Radio Battery Switch

Lightest and neatest switch made. Positive and sure contacts. Requires only one ¼-inch hole in panel. It's in when it's "off," which prevents accidental switching in of battery. Push-pull feature an advantage. Requires no washers for mounting on panel. Only one adjustment necessary, which is taken care of by a locking nut. Single contact, lessening chances of breaking the circuit by accidental loosening of contacts. Takes up very small space on panel, light in weight, therefore ideal for portable sets.

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Glossary of Circuits

Crystal Receiver

A CRYSTAL set no doubt is the most simple and cheapest type of set to build and operate, and is what most beginners start with. The variometer and coupler employed need not be of any special design or make, as any type will work satisfactorily. One important thing to remember is to use a good crystal detector that will hold its adjustment. This is about the only important feature in the set, as the crystal is the sensitive part of the machine.

Autoplex Receiver

The autoplex receiver is a super regenerative circuit, and will of course give a comparatively greater amplification to those signals which are too weak for good detection than it will to the stronger impulses of local stations. This means it is a better set for long distance reception than for local work.

The best material should be used in constructing this set, as any defective or poor apparatus used will immediately throw it off. It will be noticed that the tuning of this set is very critical, therefore it would be advisable to use verniers on the dials, as the slightest move will throw the set out of oscillation.

Most any kind of tubes may be used and it will be found that the filament adjustment is not at all critical.

Honey Comb Coil Receiver

One of the oldest and reliable regenerative circuits that can be depended upon is the simple honey comb coil arrangement.

This set is very easily constructed, as can be seen by glancing at the drawing of the set. The honey comb coils are shown mounted on the back of the panel. They are generally mounted on the front, so they can easily be moved back and forth and allow ample room for a full 45 degree variation of the primary and tickler coil.

The feature of using honey comb coils is that they may be quickly changed for any desired wave length the user desires to listen to.

If, after the set has been constructed, it does not oscillate, try reversing the leads of the tickler coil, as this is where the trouble usually lies. Burning the filament of the tube too high and using over 22½ volt B battery often causes a squealing noise. A UV 200 or C 300 tube will give best results.

Amplified Ultraudion

The Ultraudion set is no doubt the simplest and most inexpensive type of tube set that one can construct. Many of these sets in Chicago today are receiving concerts regularly each night from coast to coast.

This receiver is shown with a two step amplifier, but may be used without it, as all the amplifier does is to operate a loud speaker. To construct without the amplifier, omit everything beyond the first jack.

The receiver and amplifier will work very well on both local and long distance stations. If receiver tunes broadly, cut down on the length of the aerial to about 50 feet.

Single Circuit Regenerative Receiver

Of all the standard regenerative circuits published, the single circuit tuner is the most simple to construct, and easiest to tune, as it is not critical.

The variometer is a standard one which is split so that the connections from the rotor and stator are separate, thus giving four leads as in the form of a coupler. (A coupler that will tune to 600 meters can also be used instead of the standard variometer.)

The coil mounted on the side of the variometer may either be 3 or 4" in diameter wound with 50 turns of No. 22 DCC wire, tapped each tenth turn. The object of this coil is to load up the secondary circuit by connecting it series to the stator of the variometer.

The rotor of the variometer acts as a tickler coil. This is to get the plate circuit in resonance with the grid circuit.

Haynes Circuit

Very little apparatus is necessary in the construction of this receiver and the wiring will be found quite simple. With the use of a 75-foot aerial, stations can be heard all over the country from coast to coast.

The variocoupler contains all the inductance used in the set. The primary and secondary are one continuous winding consisting of 50 turns bank wound. The primary circuit consists of a few single turns, while the remainder of the winding is used as the secondary. This serves to make a separate oscillating circuit of it and the variable condenser.

The rotor of the variocoupler is wound with about 35 turns of No. 20 DSC wire. This acts as a tickler coil and is connected in the plate circuit of the set, thus making it regenerative.

All the parts used in the receiver are of standard make.

Cockaday Four Circuit Tuner

Going a little beyond the three circuit tuner, Laurence M. Cockaday has designed a receiver in which four circuits are employed, insuring absolutely elimination of interference, unlimited range and ease of tuning.

The primary circuit consists of a single turn of tinned copper bus wire 1/16" square, the secondary winding consisting of 65 turns of No. 18 DCC wire, stabilizer 34 turns of No. 18 DCC wire and the antenna tuning coil 40 turns of No. 18 DCC wire double bank wound.

No variations of coupling are necessary in a set of this type, therefore eliminating coupler, variometer and feed back coil, thus allowing a fixed regeneration feature that will stay put over the entire wave length's range.

It will be noted from the diagram that the primary inductance consists of only a single turn of wire, this being inductively coupled to the secondary. The wave length of the primary current is controlled by the bank wound inductive coil. As the inductive effect of this coil is used for adjusting the wave length, care should be taken in locating it in the set so that it will not have any inductive effect on the other coils.

The other three coils are all in inductive relation to each other. The antenna tuning is done by varying the primary coil by use of the switch lever. Regeneration and all secondary units are controlled by the use of the two (11 plate) variable condensers.

When tuning the receiver, one will at first find difficulties; but after a little practice and when more familiar with the set, it will seem very easy.

Reinartz Receiver

Undoubtedly the Reinartz receiver using the spider web coil is a very popular type of tuner. Its popularity is in the fact that it can easily be constructed and operated.

The spider web coil consists of two separate windings on the same form with three sets of taps.

The primary, grid circuit and plate circuit are controlled by tap switches. After the taps have been set for the wave length desired, the two condensers are used and are then tuned accordingly. For best results use a soft detector tube. Dry cell tubes may be used but will reduce the volume to some extent.

One Tube Reflex

This set no doubt is the simplest and most inexpensive receiver that can be built, to operate a loud speaker with enough volume to fill a small room by the use of only one tube.

The tube performs a double duty, serving for both radio and audio frequency amplification, thereby cutting in half the cost of the tubes for a circuit of two stages of amplification and a corresponding decrease in both A and B battery consumption.

It is necessary to use an amplifying tube with about 90 volt B battery for best results. The set requires an aerial about 50 feet long.

Two Tube Reflex

This receiver will operate a loud speaker for stations located within a radius of 15 to 30 miles when using an antenna from 75 to 100 feet long. It will bring in stations within a radius of 1000 miles on the head phones. The maximum volume of this set is only that to be expected from one stage of audio amplification.

Three Tube Reflex

The three tube reflex set will operate on a loop and gives loud speaker volume for station located within 500 miles. Its conservative range using head phones is from 800 to 1000 miles. The circuit shown is for use with an aerial from 25 to 75 feet long. To use a loop, simply disconnect the two wires connected to the rotor of the coupler and connect same to the loop terminals.

Four Tube Reflex

This is the set to build for volume and loud speaker reception; 2000 miles can easily be accomplished with the use of a 75-foot antenna.

The set is somewhat the same as the three tube reflex and can be used with a loop by making the same changes. When used with an aerial the coupler of the receiver should be one that will afford very loose coupling between the primary and secondary circuit, otherwise the receiver will not be very selective.

Five Tube Reflex

This is a deluxe set for use in districts where interference is at its maximum. It is extremely selective. It is also extremely

sensitive and has a range only limited by interference and the sensitiveness of the tube used in the first socket.

Tuning—As this set has coupled circuits, it is more difficult to tune. Brief tuning directions are given here. (1) Set both condenser dials at about 90. (2) Set switch on tap six. (3) Bring potentiometer arm up until set is just below the oscillating condition. (4) Rock either dial from 80 to 100, noting the resonance point. If set spills into oscillation at the resonance point, turn back the potentiometer until set is just below the spilling point at resonance. Resonance will then be indicated by a wiping increase and decrease of the static noise as the condenser is turned through it.

Now move the set condenser one point at a time down the scale, meanwhile rocking the other one and keep the set below the oscillating point by means of the potentiometer.

When the potentiometer has reached its positive end, move switch to tap five and advance potentiometer again. When 220 meters or the lower end of the dials is reached, the switch will be on tap 1 or 2.

Loop Tuning

A loop is not sharp with reference to the maximum volume from a given station. It has, however, an extremely sharp minimum. Thus to eliminate interference the loop should be turned at right angles to the station which interferes without regard to the station which you wish to receive. It will be possible then to bring in the station you wish unless it also comes within the area of minimum reception.

A spiral loop should have the inside turn connected to the grid of the first tube. When using a solinoid or box type loop, the side connected to the grid should be turned away from the interfering station.

"Nameless" Circuit

The "nameless" circuit is a five tube radio frequency amplifier set with a new and unique method of oscillation control. The wiring diagram shows two stages of tuned radio frequency, detector and two audio amplifiers with three rheostats adjusting all five filaments. Three tuning condensers resonate the grid circuits and two small "control" condensers, panel mounted for maximum flexibility, adjust the oscillation. It may also be built as a four tube set by omitting the first tube and transformer, connecting antenna and ground to second transformer instead.

The superlative signals brought in by the "nameless" set are entirely due to the three circuit transformers which are shown in the diagram. In addition to the usual primary and secondary coils found on the conventional R. F. transformer, these have a third winding, which, associated with the control condensers, give a very positive and delicate building up of volume on distant stations. A signal so weak as to be barely audible when tuned in to maximum on the three main dials, that is, with the same volume as the commoner type of R. F. amplifiers, can be tremendously amplified by merely moving the two control condensers slightly.

The "Nameless" circuit has been greatly improved by using a new "series-bank" method of winding on a low-loss-skeleton coil framework similar to Bureau of Standards precision inductance forms. A wave band of 200 to 565 meters can be covered using standard condensers of 250 MMF (11 plate), thus obtaining all the stations without taps or switches. Crowding on the lower waves is eliminated by the use of a straight line capacity condenser. The use of low-loss apparatus throughout strengthens weak signals and gives far sharper tuning than heretofore. Local stations can be cut out with ease on an outside antenna of moderate length and long distance broadcasters brought in without the necessity of waiting for a so-called "silent night."

Three Circuit Regenerative Receiver

The three circuit tuner is another one of the old reliable circuits which can always be depended upon for a long distance reception and selectivity. This circuit was the only one used in the early days of broadcasting, and was most popular because of its dependability.

The rotor of the variocoupler, and the variometer in the grid circuit, offers an exceptionally good method of obtaining a fine adjustment in the tuned circuit.

The primary circuit is controlled by varying the inductance by use of the switch lever.

The 43 plate variable condenser in series with the antenna helps to get a finer adjustment in the primary circuit.

To get the best results out of a set of this type, it takes quite a little patience at first to get familiar with the adjusing of the plate and grid variometers.

The positions of all parts of the set are plainly shown on the drawing, and would suggest that the location of the parts be followed out as closely as possible, for the reason that if the variometers and coupler are mounted too close together, an inductive effect will take place between them, which will interfere with the proper functioning of the receiver.

Tuned Plate Receiver

The tuned plate receiver is similar to the three circuit regenerative set, except that in place of a grid variometer for tuning the secondary and grid circuit, a 23 plate condenser is shunted across the secondary of the coupler. This makes the set tune more sharper.

Kaufman Circuit

The Kaufman circuit is a new method of getting extreme regeneration without distortion or noises by the use of a variable grid leak connected between the plate and grid of the tube.

It will be noticed that two grid leaks are used. The one connected across the grid condenser need not be variable, as no critical adjustment is needed there. The resistance of the second leak will be found to be quite critical, and is for this reason it should be variable.

The variocoupler may be of any standard make, providing it has several taps on the primary. The secondary circuit is tuned by the use of a 23 plate variable condenser.

This circuit covers both local and long distance reception very nicely, being very sensitive and loud on long distance stations.

Receiver Using One Stage of Tuned Radio Frequency Amplification

When it is desired to greatly increase the range of a receiving set, one may easily do so by adding one stage of radio frequency amplification.

By making a few minor changes in the so-called "three circuit regenerative receiver" and adding another tube, this circuit can easily be arranged to contain one step of tuned radio frequency amplification ahead of the detector tube.

It can be seen that the tuning circuit is not at all altered, except that the grid variometer has been omitted and the grid condenser changed from the first tube to the second one.

The entire circuit is thus converted into an amplifier, and, of course, an amplifier tube must be substituted for the detector tube formerly used. This makes it necessary to use 90 volts on the first tube. For the plate circuit of the detector tube a tap is made at approximately 22½ volts from the 90 volt B battery.

Twin Variometer Circuit

This circuit consists of two variometers with the aerial inductance mounted between them. One of the variometers is connected in the usual way, but this other is arranged so that the rotor and stator are connected in parallel.

The aerial inductance is a cardboard or bakelite tube about 3" long and large enough in diameter so that the rotor of each variometer will turn freely. The winding consists of 40 turns of No. 20 DCC wire which is tapped every tenth turn.

When this set is properly constructed the signals come in strong and clear, and it is very quiet in operation. The tuning will be found quite critical. This is an advantage which gains clear and distinct reception.

In order to avoid body capacity effect, the condenser connections must be wired exactly as shown. Any type tube may be used without changing the circuit. Excellent results have been obtained by using WD 12 tubes.

Monoplex Receiver

The feature of a monoplex receiver is that it may be built at a comparatively low cost, since only a few parts are required in its complete makeup. The wiring is so simple that the prospective builder will have no difficulty in following the drawing shown. The tuning will be found to be somewhat critical at first, but after a little practice it will soon become very simple.

Superdyne Receiver

This is one of the very recent circuits which have appeared to be most successful in the many attempts to combine regeneration and radio frequency amplification.

The circuit differs from the usual radio frequency circuit in the use of the tickler coil. It is found in all tuned radio frequency circuits, that when all the circuits are tuned alike oscillations begin. Various methods have been tried to neutralize this tendency. In the superdyne, it is accomplished by use of the tickler coil, which may be adjusted so as to bring enough energy from the plate circuit to the grid circuit in the reverse direction.

When all connections are properly made, there should be no popping or squealing. If this occurs, try reversing the leads to the rotor of the coupler.

Three-Tube Superflex Receiver

The three-tube superflex has been designated by an old time radio fan as a three-tube reflex with the "bugs" left out. As practically every one who has experimented with reflex circuits is painfully aware, the principal trouble encountered in receiving sets of this type has been whistles and howls due to self-oscillation in the tubes.

In the superflex circuit as illustrated, the placement of every part has been carefully established through laboratory test, and every undesirable interference has been carefully eliminated.

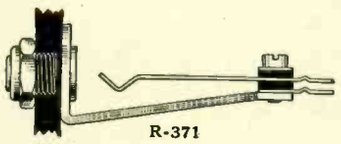
The operative advantages of this receiver are simplicity and uniformity of tuning, and while two condensers are used, it will be found that the settings are practically identical and a station once properly logged can always be picked up at the same points.

The first stage of radio frequency amplification embodies an air core transformer and condenser, similar to that used in Neutrodyne receivers, and is tuned by means of the condenser across the secondary winding of the transformer coils.

The second stage of radio is by means of a reflex transformer. The one used in the commercial superflex set has been especially designed for operation in this circuit.

KING
QUALITY
RADIO PARTS

FOR the 1924-25 season we have added many new items to our line. All of these additions are made to the same King quality standards to which our products have always conformed. A few of them are shown below.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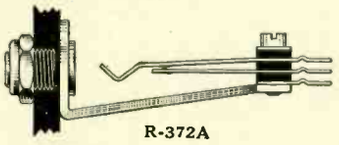
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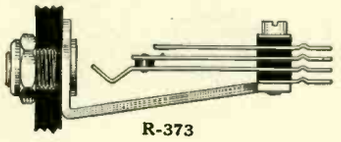
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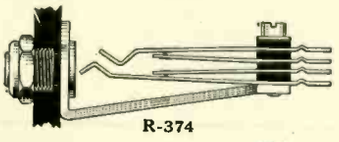
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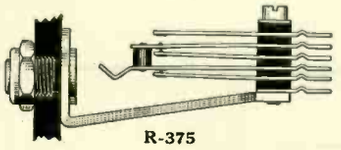
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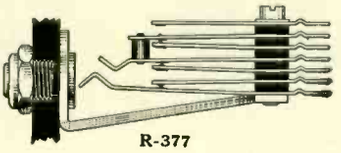
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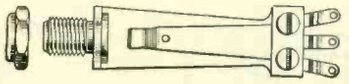
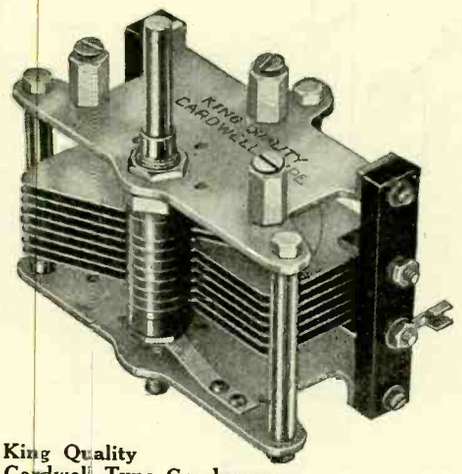


King Quality Jacks

A new and greatly improved type of jack. Terminals staggered to insure easy soldering, over-all length much shorter than old style straight frame. Soldering flux cannot run into space insulators.



King Quality Cardwell Type Condensers

Type No.	Plates	Max. Cap. MF.	Min. Cap. MMF.
R-190	11	.00025	10.0
R-191	15	.00032	12.0
R-192	17	.00035	9.0
R-193	21	.0005	18.0
R-194	41	.001	20.0

King Quality Plug

R-470

Accommodates two pairs of phones and is adaptable to all makes of plugs. Case is genuine Bakelite supplied in either black or mahogany finish.

King Quality All-Bakelite Dials

R-300—4" dial
R-301—3" dial
R-303—2¼" Rheostat dial
R-410—Rheostat knob

A one-piece, all-Bakelite dial with a specially designed knob which gives a perfect grip. Supplied in either black or mahogany Bakelite.

King Quality Potentiometers

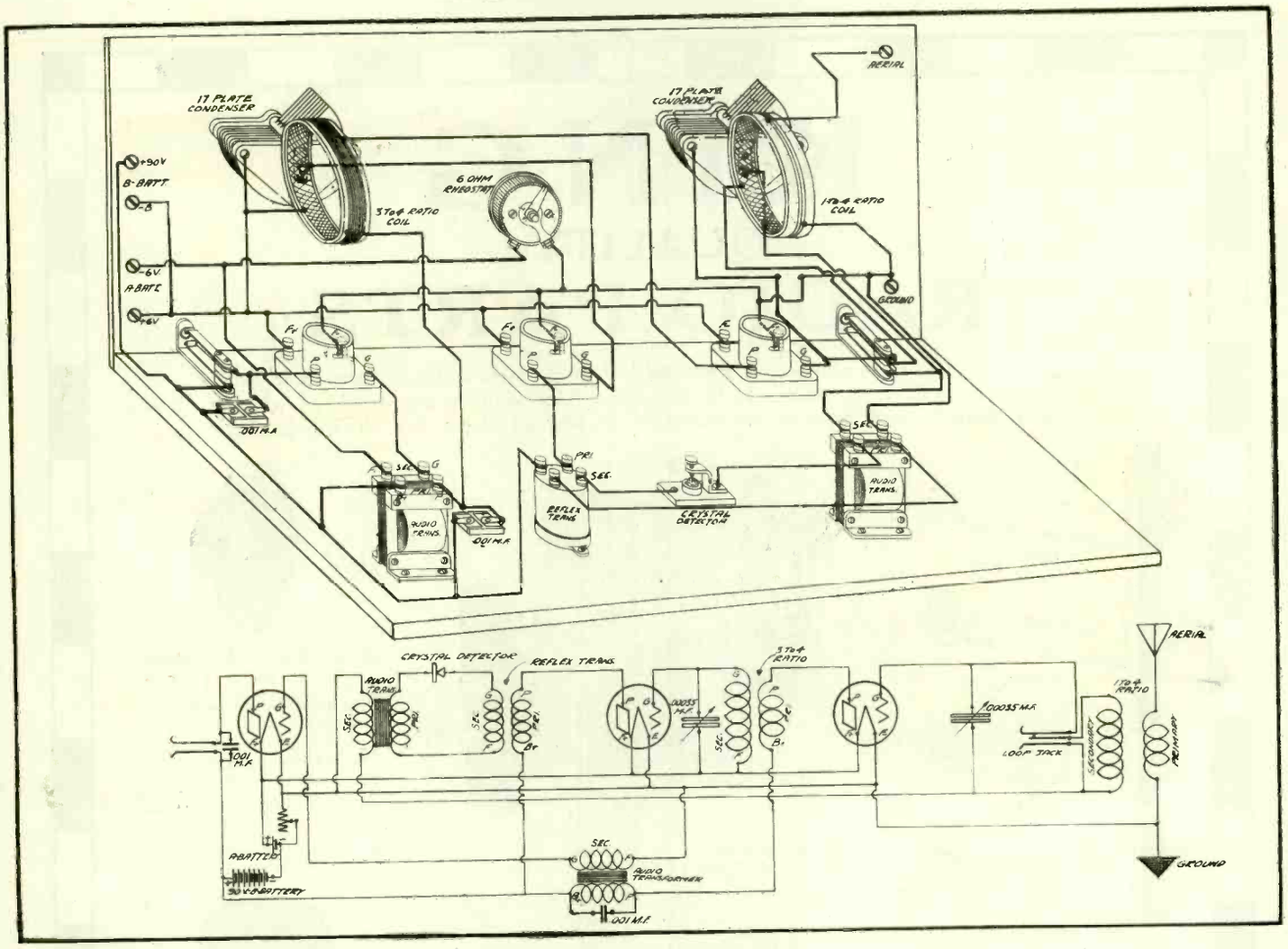
R-590—Straight knob, coarse knurl.
R-591—Taper knob, fine knurl.

Designed along the same lines as our rheostats. 400 ohm resistance. Supplied in either black or mahogany Bakelite.

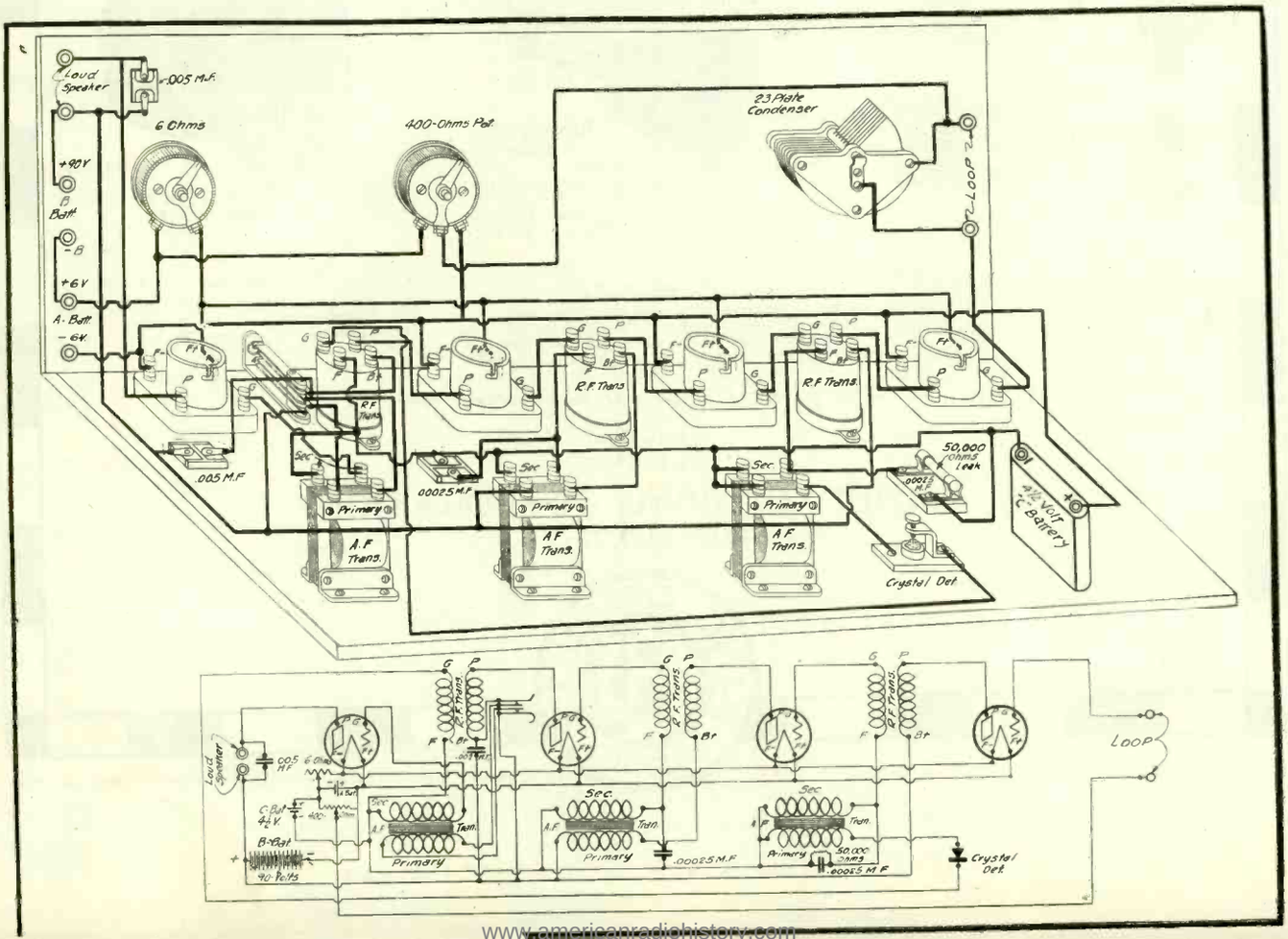
Write for the 1925 King Quality Radio Catalog.

KING
MANUFACTURING CORPORATION
BUFFALO, N. Y.

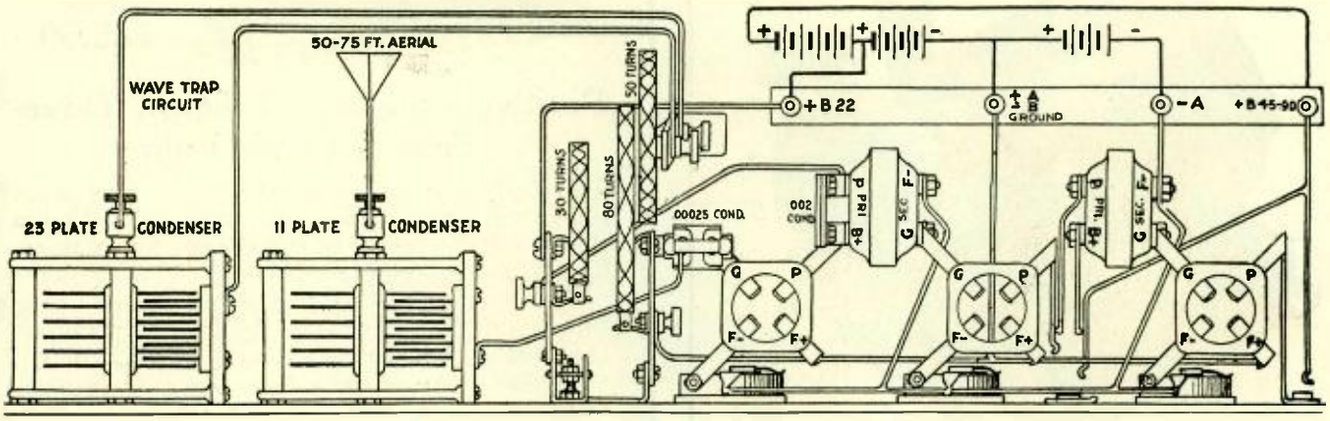
Superflex Receiver

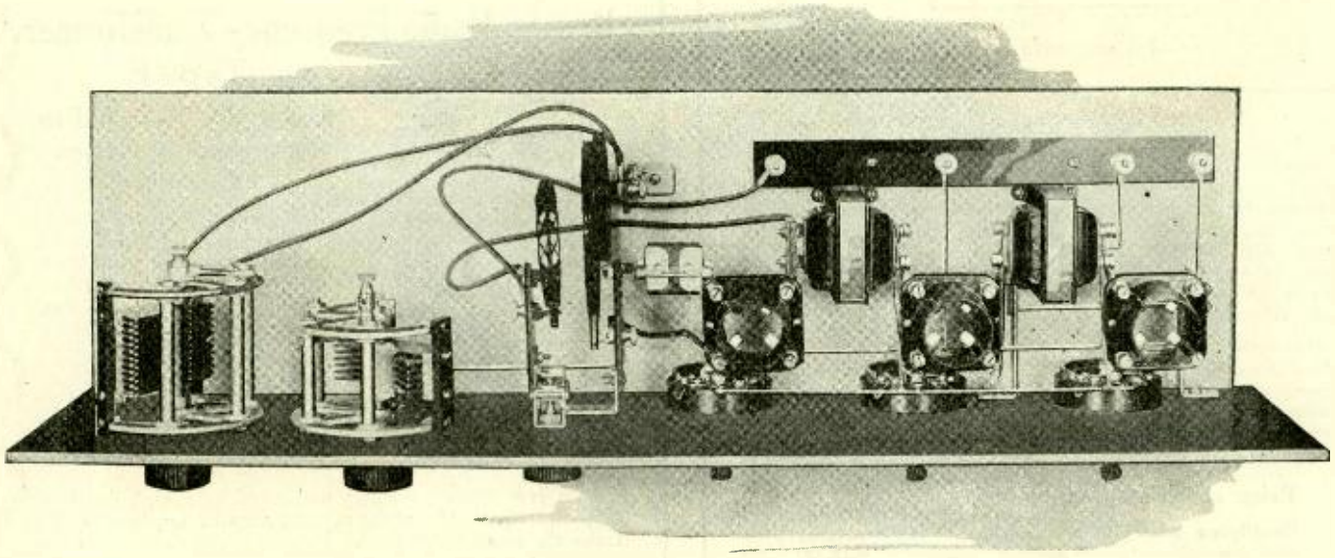


Four Tube Reflex

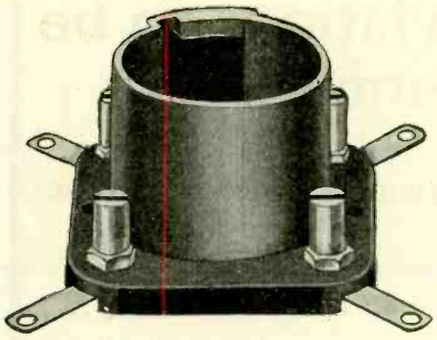


Flewelling Single Circuit Receiver Wiring Diagram

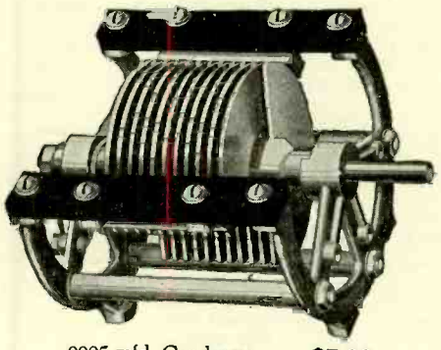




Top View of Receiver

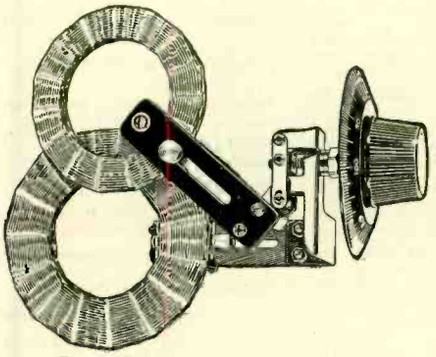


Standard Socket **75c**
No. 199 Socket **75c**



.0005 mfd. Condenser . **$7.00**
.00025 mfd. Condenser . **6.00**
[Vernier Included]

Audio or Radio Uniformer . **$5.00**



Tuner Complete . **$7.25**
Coils Less Than 50 Turns . **1.00**
Coils 50 to 100 Turns . . **1.25**
Single Coil Mounts . . . **.75**

BUELL E. J. Flewelling

RADIO APPARATUS DE LUXE

The Flewelling Socket by a departure from the usual method of making contact, secures an extra firm contact on the brass of the tube terminals instead of the lead end. It locks tight with a sure contact grip and requires no downward pressure on tube.

Extra wide spacing of contacts make it a true "Low-Loss" socket. Extension terminals for direct connection insure greatest efficiency. It costs no more to have the best. Insist on Flewelling Sockets at your dealer's.

Flewelling Condenser is of mechanical superiority that can be appreciated at a glance. Its rugged construction assures long life. Its extra heavy 1-16 inch plates will not warp out of alignment. They are die cast using S. A. E. specification bearing metal. Extra large ball bearings insure free action of rotor plates. Bearing plates and "drag" on rotor are all adjustable independent of each other.

The condenser is the most important element in your set. In its selection you may save a few cents, but never without the sacrifice of the important features you desire. Buy a Flewelling Condenser and you know you have the best.

Flewelling Uniformers are designed to eliminate all unneccessary and detrimental wiring in set construction such as tuned radio-frequency, untuned radio-frequency loop sets—in fact any type of set from the simple one-tube to the various types of Super-Heterodyne. The advantage of wiring elimination is readily and most aptly appreciated in the latter type.

The Uniformer case is of polished hard rubber—a material of the lowest loss as a dielectric. It is recessed and terminals are so spaced that the Flewelling Socket assembles readily in unit construction with a true "factory made" appearance. A six-tube assembly measures but 19 inches in length and 3 1-2 inches in width. This enables you to construct a neat compact set in a phonograph cabinet or any small cabinet. Ask your dealer for Flewelling Uniformers.

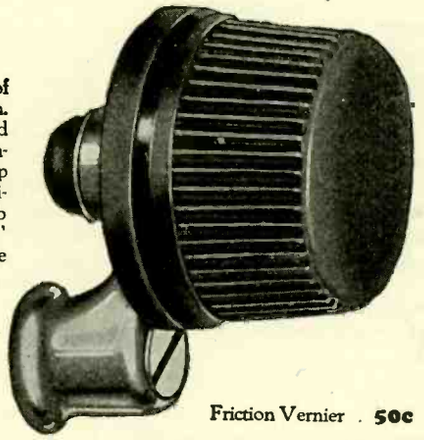
The Flewelling Type S Tuner is of basket weave design having exceptionally low distributed capacity. With 80 and 30 turn coils, as it is regularly supplied, when connected in series with a .0005 mfd Flewelling Condenser in a single circuit "hook-up" will cover a range of 220 to 550 meters with very sharp tuning. [This is without the use of taps and providing the aerial is of correct capacity.]

The Flewelling Type S Tuner with two stages of audio will bring distant stations up to loud speaker volume. Coils are interchangable, however a wide range can be covered without change. This tuner must be seen to be appreciated to the utmost. Ask your dealer to show it to you.

BUELL MANUFACTURING COMPANY

2975-77 Cottage Grove Avenue
CHICAGO

The Flewelling Vernier is of our own "heavy duty" type design. Gives a ratio of 20 to 1 when used on a 4 inch dial. It is highly recommended to those desiring fine, sharp tuning. The friction disc is of especially prepared gum rubber. The knob is of correct size to have a real "feel." Rugged construction throughout. See it at your dealer's.



Friction Vernier . **50c**

International Morse Code and Conventional Signals and List of Abbreviations to be Used in Radio Communication

INTERNATIONAL MORSE CODE AND CONVENTIONAL SIGNALS

To be Used for all General Public Service Radio Communication

1. A dash is equal to three dots.
2. The space between parts of the same letter is equal to one dot.
3. The space between two letters is equal to three dots.
4. The space between two words is equal to five dots.

A · —	N — ·	1 · — — — —
B — · · ·	O — — —	2 · · — — —
C — · — ·	P · — — ·	3 · · · — —
D — · ·	Q — — · —	4 · · · · —
E ·	R · — ·	5 · · · · ·
F · · — ·	S · · ·	6 — · · · ·
G — — ·	T —	7 — — · · ·
H · · · ·	U · · —	8 — — — · ·
I · ·	V · · · —	9 — — — — ·
J · — — —	W · — —	0 — — — — —
K — · —	X — · · —	
L · — · ·	Y — · — —	
M — —	Z — — · ·	

Period	· · · · · ·
Semicolon	— · — · — ·
Comma	· — · — · —
Colon	— — — · · ·
Interrogation	· · — — · ·
Exclamation point	— — · · — —
Apostrophe	· — — — — ·
Hyphen	— · · · · —
Bar indicating fraction	— · · — ·
Parenthesis	— · — — · —
Inverted commas	· — · · — ·
Underline	· · — — · —
Double dash	— · · · —
Distress call	· · · — — — · · ·
Attention call to precede every transmission	— · — · —
General inquiry call	— · — · — — · —
From (de)	— · · ·
Invitation to transmit (go ahead)	— · —
Warning—high power	— — · · — —
Question (please repeat after........)—interrupting long messages	· · — — · ·
Wait	· — · · ·
Break (bk.) (double dash)	— · · · —
Understand	· · · — ·
Error	· · · · · · · ·
Received (O. K.)	· — ·
Position report (to precede all position messages)	— · — ·
End of each message (cross)	· — · — ·
Transmission finished (end of work) (conclusion of correspondence)	· · · — · —

INTERNATIONAL RADIOTELEGRAPHIC CONVENTION

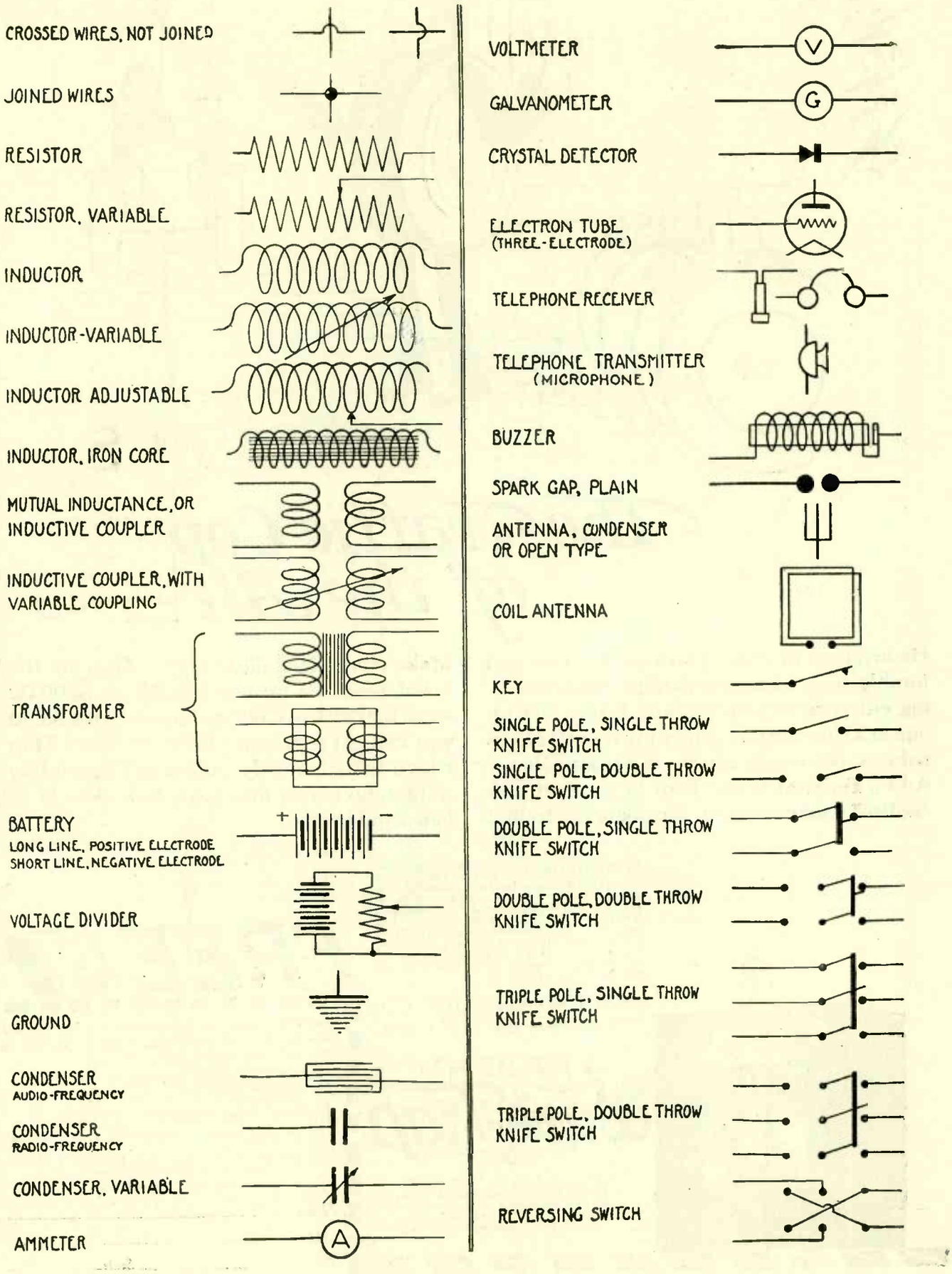
List of Abbreviations to be Used in Radio Communication

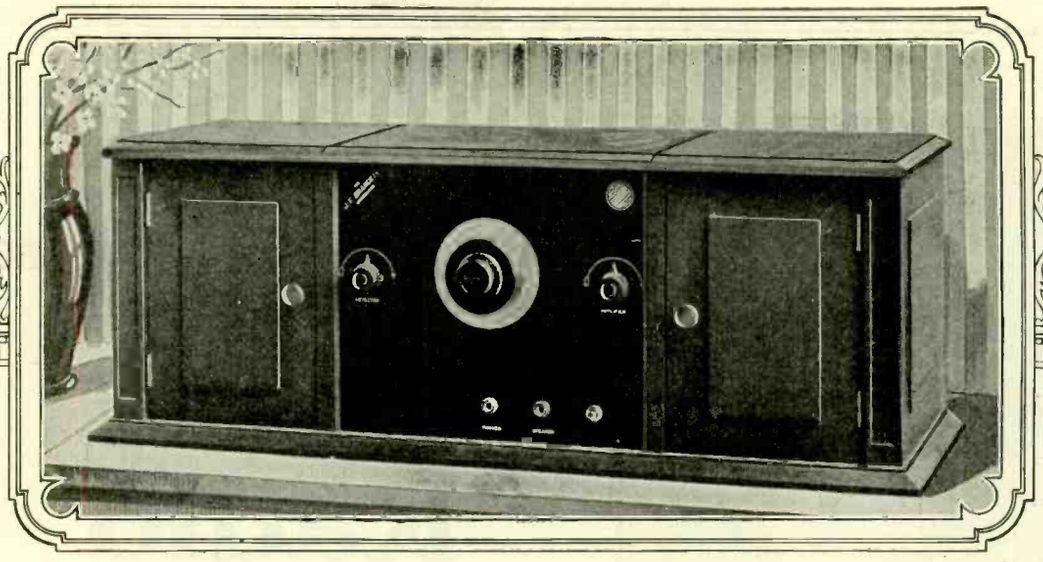
Abbreviation	Question	Answer or Notice
PRB	Do you wish to communicate by means of the International Signal Code?................	I wish to communicate by means of the International Signal Code.
QRA	What ship or coast station is that?	This is.............
QRB	What is your distance?..........	My distance is................
QRC	What is your true bearing?......	My true bearing is......degrees.
QRD	Where are you bound for?........	I am bound for.............
QRF	Where are you bound from?......	I am bound from.............
QRG	What line do you belong to?......	I belong to the............Line.
QRH	What is your wave length in meters?	My wave length is..........meters.
QRJ	How many words have you to send?	I have..........words to send.
QRK	How do you receive me?..........	I am receiving well.
QRL	Are you receiving badly? Shall I send 20?	I am receiving badly. Please send 20.
	· · · — · for adjustment?...........	· · · — · for adjustment.
QRM	Are you being interfered with?...	I am being interfered with.
QRN	Are the atmospherics strong?.....	Atmospherics are very strong.
QRO	Shall I increase power?...........	Increase power.
QRP	Shall I decrease power?...........	Decrease power.
QRQ	Shall I send faster?..............	Send faster.
QRS	Shall I send slower?.............	Send slower.
QRT	Shall I stop sending?............	Stop sending.
QRU	Have you anything for me?......	I have nothing for you.
QRV	Are you ready?.................	I am ready. All right now.
QRW	Are you busy?...................	I am busy (or: I am busy with......). Please do not interfere.
QRX	Shall I stand by?...............	Stand by. I will call you when required.
QRY	When will be my turn?..........	Your turn will be No.............
QRZ	Are my signals weak?...........	Your signals are weak.
QSA	Are my signals strong?...........	Your signals are strong.
QSB	Is my tone bad?................. / Is my spark bad?................	The tone is bad. / The spark is bad.
QSC	Is my spacing bad?..............	Your spacing is bad.
QSD	What is your time?..............	My time is........
QSF	Is transmission to be in alternate order or in series?............	Transmission will be in alternate order.
QSG	....	Transmission will be in series of 5 messages.
QSH	....	Transmission will be in series of 10 messages.
QSJ	What rate shall I collect for.... $	Collect............
QSK	Is the last radiogram canceled?...	The last radiogram is canceled.
QSL	Did you get my receipt?.........	Please acknowledge.
QSM	What is your true course?........	My true course is........degrees.
QSN	Are you in communication with land?	I am not in communication with land.
QSO	Are you in communication with any ship or station (or: with......)?	I am in communication with.......... (through..........).
QSP	Shall I inform......that you are calling him?	Inform..........that I am calling him.
QSQ	Is...... calling me?.............	You are being called by..........
QSR	Will you forward the radiogram?..	I will forward the radiogram.
QST	Have you received the general call?	General call to all stations.
QSU	Please call me when you have finished (or: at......o'clock)?....	Will call when I have finished.
QSV*	Is public correspondence being handled?	Public correspondence is being handled. Please do not interfere.
QSW	Shall I increase my spark frequency?	Increase your spark frequency.
QSX	Shall I decrease my spark frequency?	Decrease your spark frequency.
QSY	Shall I send on a wave length of......meters?	Let us change to the wave length ....meters.
QSZ	....	Send each word twice. I have difficulty in receiving you.
QTA	....	Repeat the last radiogram.
QTE	What is my true bearing?.........	Your true bearing is..............degrees from..............
QTF	What is my position?...........	Your position is........latitude...... longitude.
TR	Position report?	

*Public correspondence is any radio work, official or private, handled on commercial wave lengths.

When an abbreviation is followed by a mark of interrogation, it refers to the question indicated for that abbreviation.

Symbols Used in Radio Diagrams





The Ultimate Radio Receiver
ONE DIAL — SIX TUBES

THE "BRANDOLA" is the latest achievement in radio. In its simplicity of control, purity of tone, volume, extreme sensitivity and clear reception of distant stations combined with its very accurate logging, the "BRANDOLA" is far in advance of any radio receiver now offered to the public.

OPERATION. As you will note in the illustration, the "BRANDOLA" has but one dial to adjust—so simple, that a child of six years can tune in local and distant stations with the same ease and confidence as its parents. It is very selective in its operation—a simple adjustment of the one dial and you may choose between the many programs in the air.

TONE QUALITY. The newest and most improved method of amplification is employed exclusively in the construction of this wonderful receiver. By the use of Resistance Coupled Amplification, reception of music has been transferred into the realms of higher musical expression.

LOGGING. The "BRANDOLA" logs perfectly. When you listen in, note the position of the dial, jot it down in your log book for future reference. Because of its simplicity of operation, the number of stations you may listen to in one evening, is only limited by the number you may choose to hear. The slightest turn of the dial absolutely eliminates one station and brings in another.

The "BRANDOLA" may be purchased at any first class Radio Store. If you cannot obtain it, write us and we will mail list of nearest dealers.

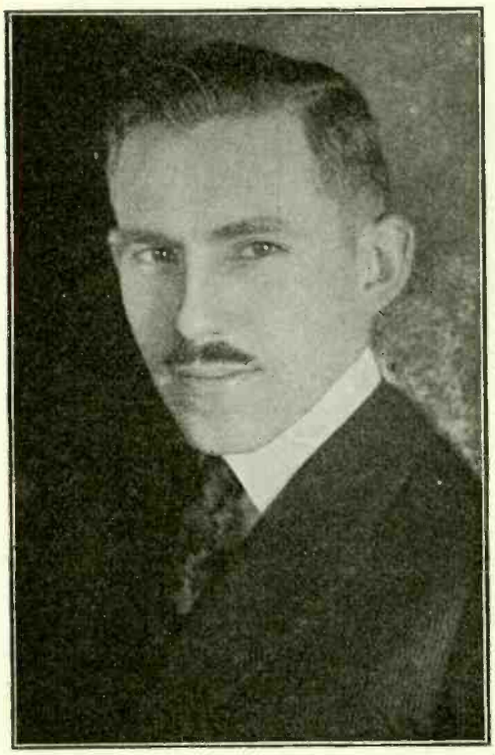
TRADE BRANDOLA MARK

Any Dealer will be glad to demonstrate the "BRANDOLA" for you—try it yourself and see how simple it is to operate.

List Price $125.00

The Brandola

The J. F. Brandeis Corp., 36 Oxford St., Newark, N. J.



DOCTOR WM. D. REYNOLDS
President

—KLZ—

The Reynolds Radio Co., Inc.

ESTABLISHED 1914

are the

Radio Pioneers

of

Colorado

We are the largest wholesalers in radio sets and equipment, exclusively, covering Colorado, Wyoming, Montana, Utah, So. Dakota, Nebraska, Kansas, New Mexico, Texas, etc.

We are exclusive jobbers in this territory for the new Freed-Eisemann Neutrodyne, Kennedy and Sleeper-Monotrol sets.

Wholesalers and Retailers

For These Quality Lines

Kennedy	Kodel	Erla	Federal
Freed Eisemann	Shermatram	Rauland	Howard
Crosley	Bremer-Tully	Thordarson	Frost
Sleeper	Nathaniel Baldwin	Branston	Bradley
Chas. Freshman	General Instrument	Walnart	Belden
Acme	Remler	Electrahot	Jewel
Electrad	Gilfillan	Brach	Willard
Dubilier	Cardwell	N & K	Cutler-Hammer
Kilbourne and Clark	Cosmopolitan	Na-ald	Westinghouse
Scientific	Fleron	Burgess	Weston
Signal	Kellogg	Cunningham	Shamrock
Consrad			Testrite

New Catalog Just Out—Dealers Wanted

The REYNOLDS RADIO COMPANY, Inc.

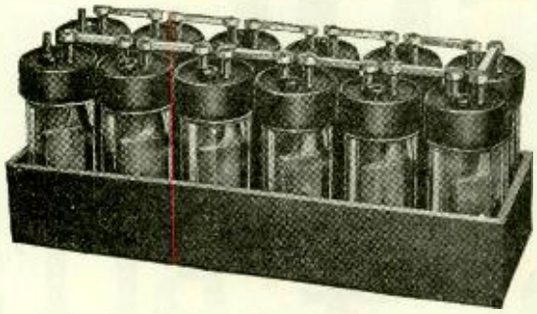
WHOLESALE :: 1534 Glenarm Street :: RETAIL

DENVER KLZ COLORADO

"When You Think Radio—Think Reynolds Radio"

World Batteries

"To Purchase a World is to Purchase Economy"



Special Introductory Price

$3.50 C.O.D.

4 Batteries in Series (96 Volts) $13.00

World Storage "B" Battery

12 Cells—24 Volts—*Solid Rubber Case*

To ten million homes with Radio Sets—and to countless millions of prospective buyers—this WORLD Storage "B" Battery brings a new conception of battery economy and performance. Here is a battery that pays for itself in a few weeks—will last for years, and can be recharged at a negligible cost. ***And you save $2.00 by ordering now.***

For a limited time ***only,*** and to introduce this new and superior Storage "B" Battery to the Public, we are selling it for $3.50. Regular Retail Price is $5.50. You save $2.00 by ordering NOW.

A ***Superior*** Battery Equipped With Solid Rubber Case.

Has heavy duty 2⅛" by 1" by ¼" plates and plenty of acid circulation. Extra heavy glass jars allow ready observation of charge and prevent leakage and seepage of current. It holds its charge while idle, at constant voltage. You will find this battery a boon to long distance reception. It does away with a great many noises so often blamed on "static." If you order ***now,*** you save $2.00.

World Storage "A" Batteries

Two-Year Written Guarantee

Famous for Guaranteed Quality and Service. Backed by Years of Successful Manufacture and Thousands of Satisfied Users.

6 Volt, 100 Amps	$12.50
6 Volt, 120 Amps	14.50
6 Volt, 140 Amps	16.00

Send No Money

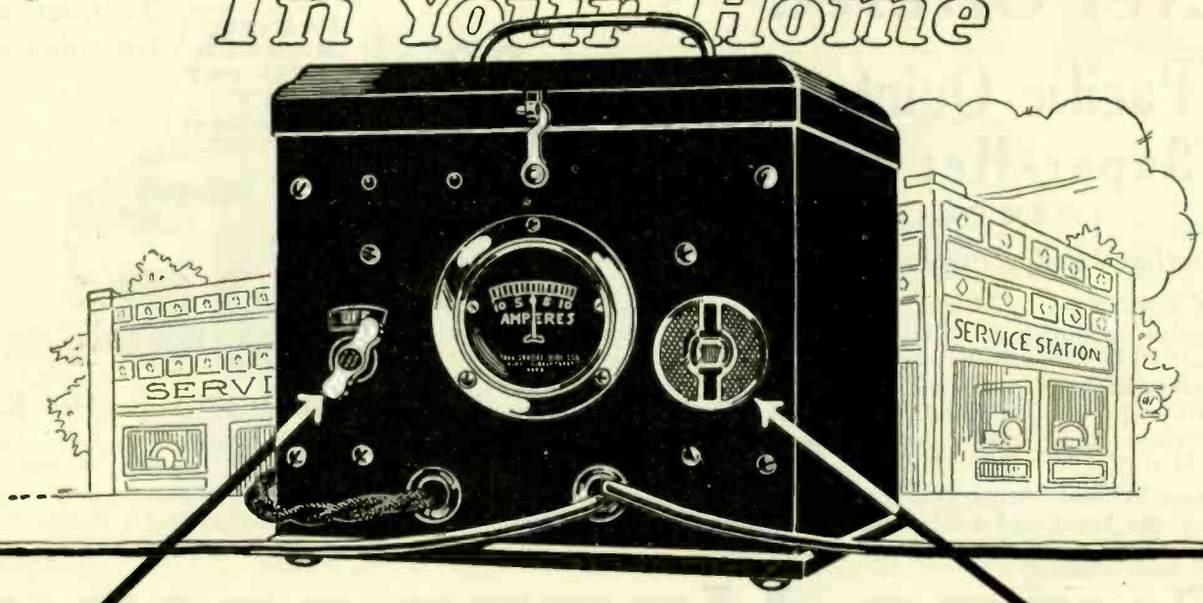
Just state number and kind of batteries wanted, and we will ship order the day it is received. When shipment arrives, examine the battery or batteries before you pay one penny. Then pay C.O.D. charges. 5% discount for cash in full with order. Remember, ***"to purchase a World is to purchase economy."*** Send your order TODAY.

WORLD BATTERY COMPANY

1219 So. Wabash Ave. **Dept. 26** **Chicago, Ill.**

Save You 50%

The Little Service Station In Your Home



This Latest Creation in Battery Chargers Keeps "A" and "B" Batteries as Healthy as the Day You Bought Them

Three turns govern each kind of charging

For 6 volt "A" Batteries

For 24 volt "B" Batteries

For 48-72 Volt "B" Batteries

Plug for "B" Battery Attachment

THE most versatile battery charger ever produced! That's the tribute paid the new Sterling No. 19 Rectifier by radio engineers.

A turn of the switch and you are ready to charge six volt "A" Batteries; another turn and the charger is adjusted to give your 24 volt "B" Storage Battery its full share of new life; a third turn prepares your 48 to 72 volt "B" Storage batteries for the same treatment.

The Sterling Rectifier has always been recognized as "the battery charger without a weakness." The new advanced model gives to the radio user a device in which explicit faith can be placed—a charger that is better than the best you could get before.

The Sterling meter on the front of the rectifier always gives an accurate indication of the charging rate in amperes. The entire charger is fully enclosed in a dust proof container with handle for portability.

It is noiseless in operation—rugged—compact. Total absence of sparking. Has a simple adjusting screw with micrometer adjustment including positive locking device.

It is rich in appearance. It is untiring in its work. It keeps your batteries healthy.

Height 6⅞"—Width 7¼"—Depth 6¼"—Weight 9½ lbs.

Type No. 19 for charging both "A" and "B" Batteries. List Price $22.50.

Type Nos 17 for "A" Batteries only, $18.50.

Add $1.50 West of Rocky Mountains

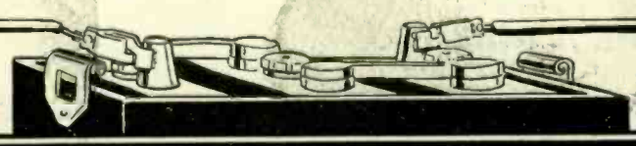
Other Sterling Radio Devices

Audio and Radio Frequency Transformers — Pocket Meters, Rheostats — Panel Type Meters, Microcondensers

THE STERLING MANUFACTURING CO.

Cleveland, Ohio

Sterling PORTABLE RECTIFIER



The Greatest Radio Value Ever Offered

"Pacific Quintet" Super-Het Kit

(45,000 Cycle)

$15.00

(In Canada) $20.00

Satisfaction Guaranteed
Finely finished merchandise built for real work.

Another Leader Product of the Popular "Pacific" Line

AN UNUSUAL VALUE, made possible through huge quantity production. BUILD YOUR OWN SUPER-HETERODYNE. Rebuild or convert your old set to a modern and advanced type Super-Heterodyne. All other parts required are standard. HOOK-UP PRINT with complete and simple instructions packed with each "PACIFIC QUINTET" KIT.

Foresight and Advanced Engineering Efficiency now bring the latest and most popular developments within a price range to suit the average pocket-book.

"Pacific Quintet" Super-Het Kit
Consisting of 1 Pacific "Ranger" No. 30 Oscillator Coupler, 3 Pacific "Ranger" No. 25 Intermediate Frequency Transformers and 1 Pacific No. 20 "Ranger" Filter Transformer.

SUPER-HETERODYNE

DISTANCE
SIMPLICITY
VOLUME

The ideal radio receiver. That most sensitive of all circuits devised for extreme long distance reception with small loop antenna and dry cell tubes.

TRULY A REMARKABLE RECEIVER

Build a 45,000 Cycle Super-Heterodyne Receiving Set for $45.00

MATERIAL REQUIRED FOR ASSEMBLY OF 45,000-CYCLE SUPER-HETERODYNE WITH PACIFIC QUINTET SUPER-HET KIT

1	Pacific Quintet Super-Het Kit, consisting of 1 Pacific "Ranger" No. 30 Oscillator Coupler, 3 Pacific "Ranger" No. 25 Intermediate Frequency Transformers and 1 Pacific "Ranger" No. 20 Filter Transformer		$15.00
1	Cabinet		5.00
2	.0005 MF Variable Condensers (Approximately 23 plate)	@ $2.00	4.00
1	.006 MF Mica Condenser		.75
3	.0025 MF Mica Condensers	@ .40	1.20
3	.00025 MF Mica Condenser	@ .35	1.05
1	.0005 MF Mica Condenser with Grid Leak		.45
1	1 MF Condenser		1.00
2	6 Ohm Rheostats	@ .75	1.50
1	4 V. Meter		3.00
1	Chelton Midget Condenser or Equivalent		1.50
2	Audio Frequency Transformers (Any standard 3 to 1 ratio recommended, preferably shielded)	@ 2.50	5.00
1	Open Circuit Jack		.30
1	Filament Control Jack		.45
8	UV 199 or C 299 Sockets	@ .50	4.00
7	Binding Posts	@ .05	.35
1	Panel 6"x26" to 30"x3/16"		3.50
1	Base Board 8"x26" to 30"x⅞"		.50
2	4½ Volt "C" Batteries	@ .40	.80
1	1½ Volt "C" Battery		.20
30	Feet No. 14 Tinned Copper Wire		.45
			$45.00

Note: Aside from the Pacific Quintet Kit, other parts of higher or lower price may be used to suit

OF IMPORTANCE TO THE RADIO PUBLIC

The Baldwin-Pacific Line is a quality line throughout. Every item built to the highest standard of efficiency from only the best materials. Scientific design, expert workmanship and attractive appearance prevails. Made for those who want the best and the greatest value for their money. The broad guarantee of absolute satisfaction prevails.

JOBBERS and DEALERS—Right policy, attractive prices and guaranteed quality apply to this line. Strong publicity to follow—trade paper, show cards, etc. Order now for prompt delivery.

BALDWIN PACIFIC QUALITY GUARANTEED SAN FRANCISCO

Baldwin Pacific & Co.
Representatives
Manufacturers - Distributors
Pacific Bldg. San Francisco

Los Angeles 1111 S. Wall St. | Denver 311 Kittredge Bldg. | Minneapolis 524 Boston Block | Indianapolis 336 Burgess Ave. | St. Louis 1724 Olive St. | Chicago 53 W. Jackson Blvd. | New York 220 Broadway | Philadelphia 4241 Sansom St. | Boston 100 Boylston St.

Use the Coupon Below

Baldwin-Pacific Quintet Super-Het Kit is designed to give maximum amplification on a frequency band of from 40 to 50 kilocycles (40,000 to 50,000 cycles).

The use of this outfit is attended with many advantages. No potentiometer or other positive grid biasing device is necessary with them to stabilize the circuit. This results in economy in "B" batteries and in tubes, both as regards life and number required for a given degree of amplification.

Type No. 25 Pacific "Ranger" Transformer is of the iron-core variety and is designed for use in the intermediate frequency stages.

Type No. 20 Pacific "Ranger" Transformer is of the tuned, air core or filter class, and used as the final or detector output transformer as shown in circuit accompanying each kit.

SENT TO ANY ADDRESS Upon Receipt of $15.00, or by Parcel Post or Express C.O.D.

Baldwin Pacific & Co. San Francisco

Gentlemen: Ship the "Pacific Quintet" Super-Het Kit with complete and simple assembly instructions.

If Not entirely satisfied upon receipt I will return immediately and you are to refund.

.....Check .....Money Order .....Cash sent you herewith.

Name.....

Address.....

My Dealer's Name Is.....

STORAD
RADIO BATTERIES

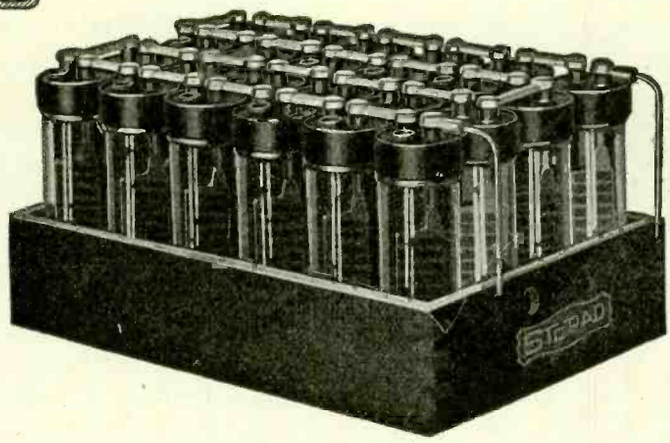
STORAD Leads the Way

STORAD Storage "B" Batteries are designed and manufactured by Storage Battery Engineers who know radio and its battery requirements.

STORAD is a pioneer in the Storage "B" Battery field. The following points emphasize its superiority:

STORAD has especially designed combination perforated rubber and treated wood separators.

STORAD has a special patented top combining the advantages of the soft and hard rubber tops.



STORAD has heavy glass jars made up according to exact specifications especially for this purpose.

STORAD has heavy plates 5/16" thick. These are necessary for high capacity, long life and constant voltage.

STORAD has a capacity of 4½ amp. hrs. It's a heavy duty battery.

STORAD has welded on cable terminals which eliminate the use of expensive, troublesome and corrosive clips which more often than realized are the cause of noisy and poor reception.

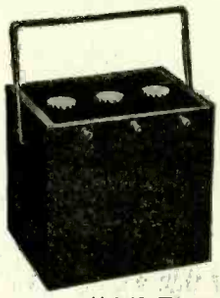
STORAD is compact.

The STORAD Storage "B" Battery is built in two sizes—24 and 48 volt units. Capacity for both sizes, 4½ ampere hr. (4500 M. A. H.)

Get STORAD from your dealer. Ask for them by numbers.

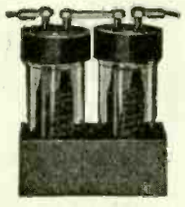
STORAD Storage "B" Battery No. 4548—48 volt.
STORAD Storage "B" Battery No. 4524—24 volt.

OTHER STORAD PRODUCTS



STORAD "A" Battery

A heavy duty Storage Battery for radio work. Has full 100 amp. hr. capacity. Handy carrying handle. Ask for STORAD "A" Battery No. R. A. 100.



STORAD "C" Battery

Every radio set needs a "C" Battery for best reception. STORAD "C" Batteries are rechargeable. Made in 4 volt units. May be used as additional "B" Battery if needed. No. 2-C.

STORAD "B" Battery Charger

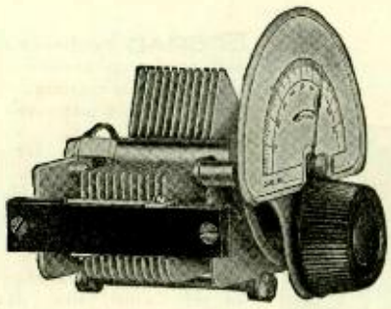
A chemical rectifier that will charge 48 volts of "B" Batteries at a time. Inexpensive to operate. Complete instructions with each charger. Ask for part No. 4R.

Insist That Your Dealer Supply You with STORAD Battery Products

THE CLEVELAND ENGINEERING LABORATORIES CO.

2427 Superior Viaduct, N. W. **Cleveland, Ohio**

Signal Quality is Always Supreme



The New Signal Vernier Variable Condenser

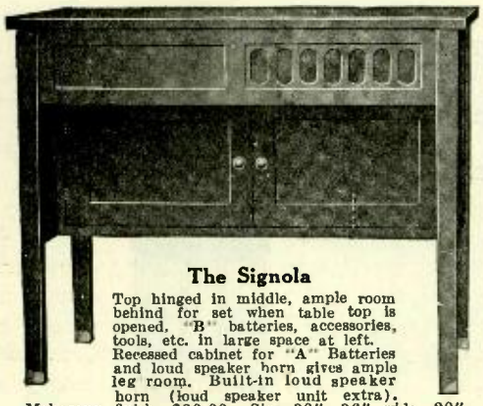
Everything yet developed in radio has been taken in consideration in the designing of this condenser:

SIGNAL FEATURES

1 Soldered Rotor
2 Pigtail Connection
3 Logging Dial
4 Adjustable Stator Plates
5 Soldered Stator Plates
6 Ample End Spacing
7 Unique Clock Hand
8 Main Shaft Free from Dial
9 Cone Bearings
10 Grounded Rotor
11 Mountings of Coils

SIZES AND PRICES

11 Plate	$4.50	23 Plate	5.00
17 Plate	4.75	43 Plate	6.00



The Signola

Top hinged in middle, ample room behind for set when table top is opened. "B" batteries, accessories, tools, etc. in large space at left. Recessed cabinet for "A" Batteries and loud speaker horn gives ample leg room. Built-in loud speaker horn (loud speaker unit extra). Mahogany finish, $30.00. Size 30", 36" wide, 20" deep.

The Aristocrat

Built-in loud speaker (unit extra) ample space for superheterodynes, neutrodynes and all other sets. "B", "A" Batteries, battery charger, etc. Size over all 42" high, 36" wide, 16" deep. $55.00.

WHEN a man wants the most for his money in quality and service he buys a Signal product.

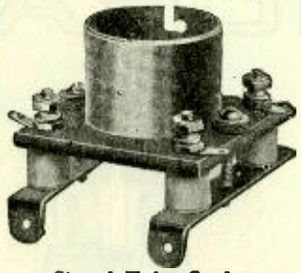
The fact that a line of products has been on the market as long as the Signal line assures him that every item in the line is right.

Signal Electrical Products have been on the market for over thirty years. During that time they have ceaselessly been making satisfied boosters for Signal. Time is the test of *Quality* and *Service*. When you buy a Signal Product you are sure you are buying the best.

Ask your dealer to show you the Signal Radio Products—Condensers, Tube Sockets, Rheostats, Potentiometers, Radio Tables, Radio Cabinets and Loop Aerials.

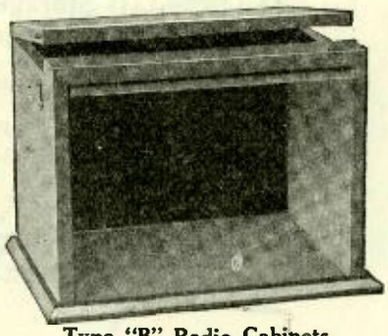
Descriptive folders gladly mailed on request.

Signal Collapsible Loop Aerial will work with any set that can use a loop. Price $8.50.



Signal Tube Socket

Metal tube with Formica Base. Heavy phosphor bronze spring, rubber feet, extra brackets for panel mounting, rubber bushing for base mounting. Nothing better made. Price.....$0.85 each



Type "B" Radio Cabinets

Signal Radio Cabinets have been purchased by the big majority of set builders.

Built by radio engineeers, they have all the elements that appeal to the average set builder and meet all his requirements.

Size	Mah. Finish	Solid Walnut
7x9x7	$3.32 list	$4.89 list
7x10x7	3.40 list	4.98 list
7x12x7	3.57 list	5.26 list
7x14x7	3.82 list	5.63 list
7x18x8	4.32 list	6.37 list
7x21x8	4.70 list	6.93 list
7x24x8	5.08 list	7.49 list
7x26x8	5.55 list	8.05 list
7x30x8	5.93 list	8.74 list
7x28x10	6.25 list	9.20 list
8x36x8	12.00 list	16.00 list
8x40x10	18.00 list	24.00 list

SIGNAL Electric Mfg. Co.

Factory and General Offices
1919 BROADWAY
MENOMINEE, MICH.

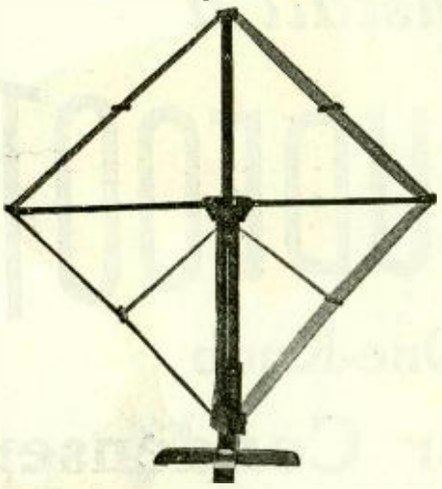
Boston
Chicago
Los Angeles
Minneapolis
Montreal
Philadelphia
Seattle
Toronto
Winnipeg
Havana, Cuba
New York
Pittsburgh
San Francisco
St. Louis

You'll find our local address in your telephone directory

THE AMPLIFEX LOOP

A Revelation and a Revolution in Loop Construction

Open

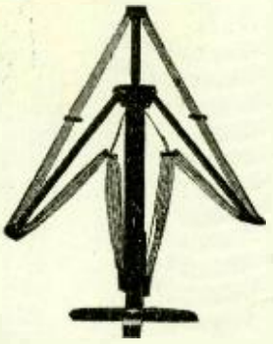


TRADE MARK

AMPLIFEX

PATENT PENDING

Partly Closed



THE AMPLIFEX LOOP collapses by simply turning a thumb nut in the center.

WOUND with 40 strands No. 38 double silk covered enamelled Litz wire. Has a COMPASS in the base for directional adjustment.

THE AMPLIFEX LOOP by a series of six numbered binding posts can be tapped for six combinations giving 3, 4, 6, 9, 10 and 13 turns with a wave length range of 88 meters to 1,000 meters WITHOUT ANY DEAD-END LOSSES. THE MOST IMPORTANT AND REVOLUTIONARY FACTOR IN LOOP CONSTRUCTION.

When extended the Loop is 43″ high and 39″ wide. Beautifully finished in mahogany with all metal parts nickel-plated.

PORTABLE—DIRECTIONAL—EFFICIENT

List Price $18.50

DEALERS: Our Jobbers listed below are working in close co-operation with us in the proper distribution of our products. Dealers who are interested in selling the finest product of its kind on the market, should write us for details.

DISTRIBUTED BY:

E. B. Latham & Co., New York City.
Central Electric Co., Chicago, Ill.
Carter Electric Co., Atlanta, Ga.
Indianapolis Elec. Supply Co., Indianapolis, Ind.
National Elec. & Supply Co., Washington, D. C.
Doubleday Hill Elec. Co., Pittsburgh, Pa.
Atlantic Radio Co., Boston, Mass.
F. D. Pitts Co., Boston, Mass.
Wetmore Savage Co., Boston, Mass.
Stern & Co., Hartford, Conn.
Union Elec. & Supply Co., Providence, R. I.
Robertson Cataract Co., Buffalo, N. Y.
Haas Elec. Sales Co., Cleveland, Ohio.
Jones Beach Co., Philadelphia, Pa.
Erner Hopkins Co., Columbus, Ohio.
Northeastern Radio, Inc., Boston, Mass.
Narragansett Radio Corpn., Providence, R. I.

Western Representatives: Keeler White Company, San Francisco, Los Angeles and Seattle.

Write us for descriptive circulars and results of actual tests made.

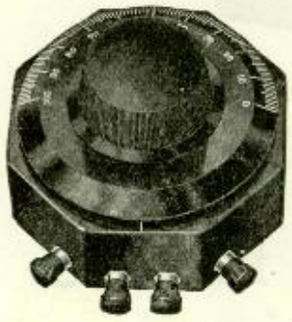
MANUFACTURED BY

Amplifex Radio Corporation

ARLINGTON, MASSACHUSETTS

Years of experience in the building of precision instruments and tone-arms have made possible these radio achievements.

Extra quality in everything, unusual care in workmanship and assembly have made Saal items a standard of their own.



Price $8.50

Saal Octaformer

The Saal Octaformer has an important use as a radio frequency amplifying transformer, and can be easily employed in almost every radio receiving circuit.

It is an ideal building unit from Crystal Set to the maximum multi-tube receiver. Every stage gives perfect reception for that power; greater range, greater selectivity and better volume. Combines all coils and condensers thereby making the construction of sets simple.

The Saal Octaformer also serves efficiently as a wave trap ahead of any standard receiving set.

Octagon shape, 4¼ inches, each.....$8.50

Saal Symphony Grande Loud Speaker

The ideal loud speaker for use with elaborate receiving sets. Beautifully designed and finished in gold or silver of the finest quality.

From sound chamber upward to the very tip of the bell unrestricted amplification reproduces with absolute fidelity all radio broadcast.

Sound chamber is made of cast aluminum, a wonderful tone conductor. Is backed by an additional wall which prevents any possible chance of vibration. The bell is constructed of redmanol or bakelite, will not warp, chip or crack. No battery or power is needed, just plug in on any good set and the room is filled with the broadcast program. Height 21½ inches.

Finished in gold stiple with 13 inch Mahogany Bell.....

Finished in silver or black stiple with 13 inch black bell.....$35.00

Price $35.00

Price $7.50

Saal Loud Speaker Phonograph Attachment

This attachment will convert your present phonograph horn to radio use. It is the same instrument as used in our SAAL GRANDE LOUD SPEAKER and will reproduce good clear radio broadcast.

In many instances, the phonograph horn is found superior to cheap loud speakers, and so the Saal Loud Speaker attachment finds favor.

Each in carton with ferrule to fit phonograph....$7.50

Saal Concert Grande Loud Speaker

Whatever the broadcast program, this loud speaker will recreate the true, original tones of the artist right in your own home.

Note the uniform flare from the base to the very tip of the bell—unrestricted amplification. All materials are non-vibrating—a most important point in the elimination of distortion.

The aristocratic appearance and graceful design of this horn make it a close contestant for first place with the SAAL SYMPHONY GRANDE LOUD SPEAKER.

No battery or power needed—just plug in on any good set. Height 21½ inches.

Black crackle finish with 13 inch Black Bakelite Bell.....$25.00

Price $25.00

Manufactured and Guaranteed by

DEALERS WANTED EVERYWHERE

H. G. SAAL COMPANY

1800 Montrose Ave. CHICAGO

DEALERS WANTED EVERYWHERE

Tell 'Em You Saw It in the Citizens Radio Call Book

NATIONAL

Trade Mark Reg.

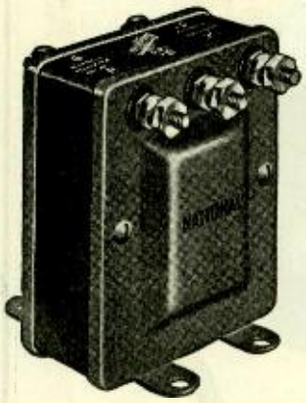
TRANSFORMERS

Mean Better Amplification

Now, you may select the National Transformeer to meet your particular needs.

Audio Frequency—Radio Frequency

Each National Transformer is designed to perform a certain function, to give you better amplification. Then National Transformers are made from the best materials available in a factory devoted exclusively to the manufacture of high grade transformers. You will like the design and appearance of National Transformers. You will like the many little refinements in construction. But above all, you will like their better amplification.



The Dreadnaught

The transformer for musical critics. Amplifies perfectly over the whole scale without distortion. A bigger and better transformer in every way. Finished in battleship gray. You will notice the difference in your amplification when you use the National Dreadnaught.
Cat. No. 600.....$6.00

PUSH-PULL

Amplify both sides of the wave. Get greater volume with no distortion.

National Dual Amplifiers
Cat. No. 1200, the pair.....$12.00

The Cruiser

Radio Frequency

Special split winding for use with audio frequency. Designed especially for use in reflex circuits. Covers entire wave band, 200-600 meters without distortion.
Cat. No. 400.....$4.00

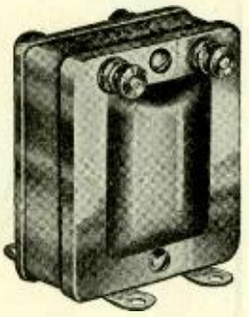
WIRING DIAGRAM

Complete wiring diagram of 1 tube, single control reflex circuit. Makes a good set. Blue print will be mailed to you on receipt of 2c stamp to cover postage.

Audio Frequency

This is the popular National Audio Frequency Transformer which is giving satisfaction in thousands of sets. Leading manufacturers of high class radio equipment are using this model in their sets. You can depend upon it for perfect satisfaction. Small in size, great in efficiency.

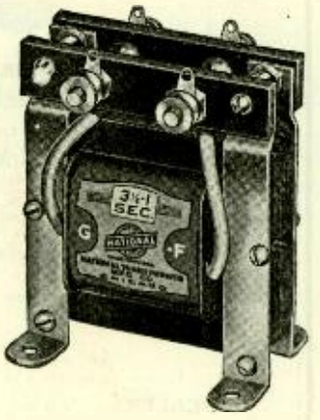
Cat. No. 200, 3½ to 1.....$4.00
Cat. No. 202, 6 to 1..... 4.50



The U-Type

Stripped of the case, the National U Type Transformer is built for service. Construction the same as No. 600, with the needed extra weight in the core. Fine for mounting under panels and in enclosed sets.

Cat. No. 300, 3½ to 1.....$3.75
Cat. No. 302, 6 to 1..... 4.25



National Transformers are fully guaranteed. See them at your dealer's. If he cannot supply you, send your order with his name to

National Transformer Manufacturing Company

Manufacturers of Transformers of All Types

Dept. G., 154 Whiting Street **Chicago, Illinois**

HOWARD RADIO COMPANY—CHICAGO

4248 N. Western Ave.

HOWARD STANDARD RHEOSTAT WITH DIAL CONTROL. Note the simplicity of this rheostat and the convenience of drilling only one hole in the panel for mounting. HOWARD Rheostats are guaranteed to give uniform service, perfect filament control and maintain constant resistance under continuous duty. HOWARD Rheostats meet every radio requirement. Workmanship and materials are of the highest quality. The bases are of special heat resisting materials preserving shape and finish under all operating conditions. Slide contacts are phosphor bronze, insuring perfect electrical connections and the resistance elements constructed of special non-corrosive resistance wire, accurately spaced by precision machines and wound under tension on a seasoned fibre strip so that the turns cannot come loose. Carrying capacity 1.5 amperes. Its operation is controlled by a beautiful 2⅛-inch dial with 100 point marking covering full sweep of contact arm. Diameter of base 2 5/32 inches. Made in resistance of 6½, 25, 40 and 60 Ohms.

Each $1.10

HOWARD MICROMETER RHEOSTAT WITH DIAL. ONE CONTROL. The HOWARD Micrometer Rheostat gives instantly that extremely fine and hair line adjustment so necessary for the successful operation of all gas content tubes, known as soft tubes. The micrometer adjustment does not have a separate control but is automatically carried along with the main contact arm and brought into play instantly when desired. Made in resistances of 6½, 25 and 40 Ohms. The micrometer attachment can be purchased separately and will fit any standard HOWARD Rheostat.

Dial Rheostat with Micrometer Attachment. Each $1.50
Micrometer Attachment separate. Each ..... .50

POTENTIOMETERS WITH DIAL. HOWARD Potentiometers are noted for that extremely close control of the potential in the plate and grid circuits so necessary to increase selectivity and obtain satisfactory results. The potential is kept under positive control at all times.

The HOWARD Potentiometer is the same size and matches the HOWARD Standard Rheostats. Furnished in resistance of 200 and 400 Ohms.

200 Ohms. Each $1.50
400 Ohms. Each 2.00

MIDGET RHEOSTATS. The HOWARD MIDGET RHEOSTAT was designed to meet the long-felt want for a high grade rheostat small enough to be used in portable sets where space is limited and a smaller instrument is desired. The same materials and workmanship will be found in this Rheostat as in the standard HOWARD Rheostats, the only difference being in the size. The base being 1⅝ inches as compared with 2 5/32 inches on the standard Rheostat. This Rheostat is not furnished with micrometer attachment. Made in resistances of 6½, 25, 40 and 60 Ohms.

Each $1.10

(Cut is ⅔ actual size)

Front view of HOWARD Dial. These dials are sold separately and may be placed on any HOWARD Rheostat or Potentiometer. Size, 2⅛ inches in diameter.

Each $0.25

Rear view of HOWARD Dial showing 3/16-inch shaft permanently anchored in dial. The length of this shaft is 1⅜ inches.

Each $0.25

The superiority of the HOWARD Socket lies in the "Sure Contact" which is made to the side of the tube pins and not to the ends. The contact arms have more than twice the spring value found in the average socket, as well as a full one-quarter-inch contact surface applied to the side of the pins. These contact arms cannot lose their spring tension and can be relied upon to make a permanent, perfect contact. The base of the Howard Socket is moulded from the highest grade bakelite.

Each $1.25

Upper Cut shows the Howard Socket and Lower Cut shows the construction of the "Sure Contact" springs.

THE HOWARD MULTI-TERMINAL PHONE PLUG is the most simple and efficient on the market. The patented feature provides instantly a positive connection for phones or loud speaker and will accommodate from one to six pairs of phones, all connected in at the same time, with maximum electrical efficiency. Slip in another pair of phones instantly without interfering with connections previously made. Merely insert the tips in the holes provided in the plug for that purpose.

Each $2.00

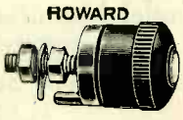
FIXED CONDENSERS. Nearly every radio set in existence makes use of small fixed condensers. They perform a very important part in the successful operation of the set. Defective or inaccurate condensers cause no end of trouble. When a circuit calls for a condenser of a "fixed" rated capacity, install a "HOWARD" for accuracy and permanency. Only the best grade of Indian Ruby Mica is used to separate the copper and brass conductors. No paraffin or similar substances form any part of the dielectric. They are all hand made, each tested on a capacity bridge and guaranteed to be noiseless and accurate. Made in capacities of .00025, .0005, .001 and .002.

Each $0.60

HOWARD INDUCTANCE SWITCH LEVER. This switch lever is made in two sizes, with small and large knob and having a blade radius of one inch and 1 9/32 inches respectively. The highly nickel plated phosphor bronze contact blade is securely keyed to the knob and will not turn or come loose under any condition.

Each $0.50

HOWARD BINDING POST. The special feature of this binding post is the holding device which positively prevents the binding post from turning after it has been mounted. The top is made of the same high-grade insulating material as used in the manufacture of other Howard products.



Each $0.20

21-22 — Large and small indicating pointers. .020 inch thick, 8-32 thread, 1 1/16 inch radius and 13/16 inch radius respectively. Highly nickel plated.

Each $0.08

23-24-25—Soldering Lugs with standard 6-32 hole, nickel plated.

Per dozen $0.10

26-27—Switch points and switch stops, highly nickel plated, 6-32 thread and equipped with nut.

Each $0.03

All Howard Products are sold with a Guarantee of "Satisfactory Performance or Money Back"

Ask your dealer to show you the Howard line of parts. If he cannot supply your wants, send his name to us with your order.

KODEL. Model C-14 Four Tube Receiver. Price $32.50. (Without battery cabinet, loud speaker or accessories.) Battery cabinet can be furnished with any KODEL set at slight additional cost.

KODEL

—An astonishing new receiver that will make radio history

KODEL is the name of a circuit discovered by an independent experimenter. So wonderful is the KODEL circuit that it picks up stations 1,000 miles away, using only one tube, and *no antenna*, when conditions are right. Add tubes and you increase distance and volume until you succeed in covering 3,000 miles on the loud speaker. All this with only a single dial to turn!

If you travel—KODEL Portable. If you cannot erect an antenna—KODEL. If you want distance and quality—KODEL. If you want simplicity—KODEL. If your pocketbook is limited—KODEL. Even if you want results regardless of cost—KODEL.

See the KODEL line at your dealer's. If he cannot supply you, send us his name and address with check or money order and we will ship direct to you. Money returned if any KODEL set does not more than satisfy you.

ALL KODEL sets use the unique KODEL circuit and may be operated from either storage or dry batteries at will, and without an outdoor antenna if desired.

FREE! Write for instructive KODEL Catalog, entitled, "Radio for Every Purpose and Any Purse." FREE!

DEALERS: the KODEL is a sensation wherever introduced. Write for terms.

Kodel Manufacturing Company

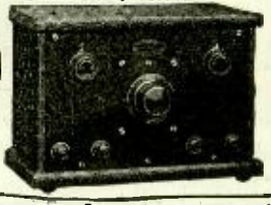
Under the same management that made the Homcharger famous

179 West Third Street, Cincinnati, Ohio

Complete line of Kodel Parts also available

Model P-12 Two Tube Portable. Model P-11 with amplifier tube added, which increases distance and volume many times. $22.50.

Model S-1 KODEL crystal set. Sensitive, selective, low priced. Only $5.00.



Model C-12 Two Tube Receiver — $18.00. A great distance getter; puts local stations on the horn; single dial tuning.

Model C-11 One Tube Receiver. The biggest value in a one tube radio set today. Price $10.00.

Radio for every purpose and any purse—$5 to $32.50

Anyone can use a storage battery now

CHARGING a storage battery ten years ago was a task needing expensive apparatus and the services of a specialist. To-day, anyone can do it in the home. No knowledge of electricity is needed. It can be done economically, simply, automatically, with

The New Silent GOLD SEAL HOMCHARGER

just as more than 200,000 satisfied users of Homchargers are doing right now.

If you are one of the many who envy the results of storage battery tubes but think you can't enjoy them unless you are a battery expert, go right out now and buy those tubes, a battery and a Gold Seal Homcharger.

Here's all you have to do to maintain a storage battery: add a little water once in a while (your eye will tell you when); charge it regularly. To use the Homcharger, screw a plug in any lamp socket, slip two spring clips over the battery terminals, go to bed and forget about it. Next morning the battery is charged. What could be easier?

The Gold Seal Homcharger—simple, efficient, dependable, quick. Cannot injure battery, furnishings, anything or anybody. Handsome, finished in mahogany-red and gold. Approved by Fire Insurance Underwriters. Unqualifiedly guaranteed. Only one moving part, replaceable for $1 after thousands of hours of use. Silent—its faint hum cannot be heard in the next room.

Popularly priced; but it at your dealer's for $18.50 complete; $25.00 in Canada. For radio at its best, use storage battery tubes, any good battery and the Gold Seal Homcharger.

FREE! Send for our interesting free booklet, "The Secret of Distance and Volume in Radio," containing valuable information on this subject and fully describing the GOLD SEAL HOMCHARGER.

The Automatic Electrical Devices Company

179 West Third Street

Cincinnati, Ohio

Largest Manufacturers of Vibrating Rectifiers in the World

Design and Construction Count in Results

Yaxley Approved Radio Products are fully guaranteed. You can depend upon the devices listed below to give you perfect satisfaction.

Radio Jacks

Patented Jan. 30, 1923.

The following features, many of them exclusively Yaxley, recommend these jacks:

One nut mounting. Drill one hole and mount on any standard thickness panel without use of spacer washers.

Springs of genuine phosphor bronze.

Pure silver self-cleaning contact rivets.

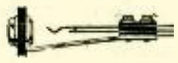
Firm contact pressure; high conductivity.

All bakelite insulation; low dielectric loss.

Fit any standard radio plug.

Code No. 1—Open Circuit $0.70

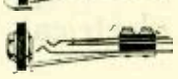
Code No. 2—Circuit Closing.....$0.80



Code No. 2A—Two Circuit.....$0.80

Code No. 3—Single Circuit Filament Control.....$0.90

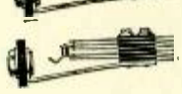
Code No. 3A—Circuit Reversing $0.90



Code No. 3C—Double Circuit.....$0.90

Code No. 4—Interstage $1.00

Code No. 4A—Two Circuit Filament Control $1.00



Code No. 5—Two Circuit Filament Lighting $1.10

Code No. 6—Interstage Filament Control $1.20

Code No. 7—Interstage Filament Lighting $1.30

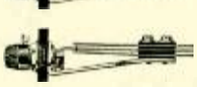
Radio Jack Switches

Insulated from frame; no body capacity.

Quick make and break contacts.

Carefully adjusted and tested; fully guaranteed.

Code No. 20—Battery Switch.....$1.00



Code No. 30—Two Circuit.....$1.15

Code No. 40—Double Circuit.....$1.25

Code No. 60—Two-Way Two Circuit $1.50

All cuts of Radio Jacks and Radio Jack Switches are ¼ size.

YAXLEY

Approved Radio Products

IMPORTANT ANNOUNCEMENT

You, as a radio man, are interested in the design and construction of the radio parts you use. You buy for results.

For this reason, you will be interested in Yaxley Approved Radio Products. As manufacturers, long experienced in the radio business and before that in the development and manufacture of telephone equipment, we appreciate the importance of correct design and materials as well as extreme care to every detail in the manufacture of radio products. The Yaxley factory is planned and equipped to manufacture radio products of the highest quality.

Hundreds of thousands of Yaxley made radio parts are in use today giving satisfaction. Original and correct design and superior construction have won for them the approval of leading manufacturers of high class radio equipment as well as builders of their own sets.

We are pleased to give you herewith a brief description of some Yaxley Approved Radio Products. Each is fully guaranteed.

Use this list in making your selection of radio devices and be sure of satisfaction. You can procure these parts from your dealer—or write direct, giving his name.

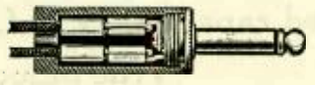
Duplex Plug

Connects to two or more phones by means of screw terminals.

Each

Code No. 75.....$0.75

One Phone Plug



Heavy bronze springs grip cord tips full length. Phones instantly connected without use of tools. Cords cannot be disconnected until handle is removed. All bakelite insulation prevents current leakage. The short length handle makes this plug particularly desirable for compact portable sets.

Each

Code No. 50.....$0.50

Midget Battery Switch

An actual necessity for every tube set. Very compact. One nut mounting in single panel hole. Hard rolled bronze springs. Pure silver contacts. Insulated from metal frame. Quick snap-break contact.

Each

Code No. 10.....$0.60

Midget Plug

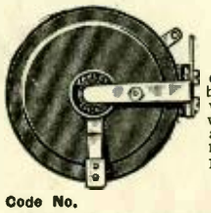
Has binding post method of connecting either flexible cord or wire.

Each

Code No. 15.....$0.15

Yaxley Approved Radio Products are original and correct in design and of superior construction. We will be pleased to send you a more detailed description of these and other Yaxley Approved Radio Products.

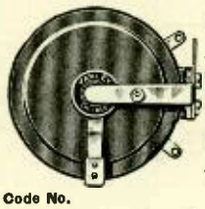
Rheostat



The resistance element closely wound with special high resistance chrom-alloy wire, assures sharp tuning without the use of Vernier attachments. Has single nut mounting in ½" panel hole.

Code No.		Price
16-K—	6 ohm Rheostat with knob	$1.35
16-D—	6 ohm Rheostat with dial	1.60
120-K—	20 ohm Rheostat with knob	1.35
120-D—	20 ohm Rheostat with dial	1.60
130-K—	30 ohm Rheostat with knob	1.35
130-D—	30 ohm Rheostat with dial	1.60

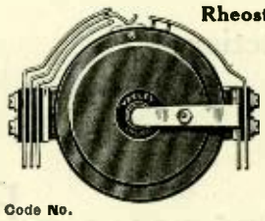
Potentiometer



Resistance unit has 900 turns of special high resistance chrom-alloy wire, which provides for extremely fine voltage adjustment. Smooth and noiseless in operation. Has single nut mounting in ½" panel hole. Provided with dial No. 368.

Code No.		Price
200—	200 ohm Potentiometer	$1.85
400—	400 ohm Potentiometer	1.85

Rheostat Interstage Control



Automatically controls plate circuit without use of 1st and 2nd stage jacks. Resistance element same as that used in regular Rheostat. Has single nut mounting in ½" panel hole.

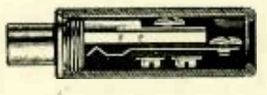
Code No.		Price
36-K—	6 ohm Rheostat with knob	$1.85
36-D—	6 ohm Rheostat with dial	2.10
320-K—	20 ohm Rheostat with knob	1.85
320-D—	20 ohm Rheostat with dial	2.10
330-K—	30 ohm Rheostat with knob	1.85
330-D—	30 ohm Rheostat with dial	2.10

Inductance Switch

Mounts back of panel; no front contacts. Coil wires solder direct to one-piece terminal. Graduated dial eliminates panel marking. Copper ribbon pigtail prevents loose connections. Has single nut mounting in ½" panel hole. Provided with dial No. 363.

Code No.		Price
70—	7 Point Inductance Switch	$1.25
90—	9 Point Inductance Switch	1.35
150—	15 Point Inductance Switch	1.50
	Double Contact Arm, extra	.10

Extension Jack



Connects to extension cord or wire so that loud speaker or head phones may be plugged in at distant point.

Each

Code No. 100.....$1.00

Midget Jack

Better than binding posts. Easy to mount. Fits cord tips or Midget Plug.

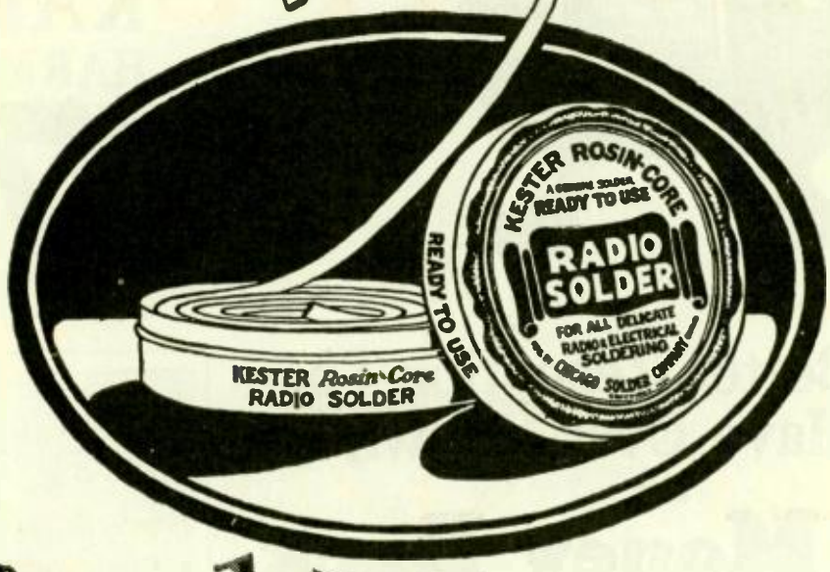
Each

Code No. 16.....$0.30

YAXLEY MFG. CO., Dept. C., 217 North Desplaines Street, Chicago

KESTER Radio SOLDER

ROSIN-CORE



Oh boy! it sure is Safe & Simple

Here's the solder that contains the flux recommended by radio engineers! The pure rosin core inside of Kester Radio Solder is a *natural* flux and can leave no harmful chemical or electrical action on delicate parts or joints.

In developing radio frequency it proved that all fluxes, except rosin, spatter, fume and run over delicate parts and joints. *This causes high leakage and reduces resistance to like values as grid leaks!*

Solder with Kester Radio Solder. It requires only heat. You will have no need to go over and wipe away surplus flux. Leave what rosin may remain—it is a good insulator!

Get a handy can of Kester Radio Solder from your dealer today and know that your valuable parts are *easily, safely, neatly* and *substantially* soldered.

CHICAGO SOLDER COMPANY

Look for this carton on your dealer's counter!

IF YOUR DEALER CAN NOT SUPPLY YOU,

R. C. B.

Chicago Solder Company
4226 Wrightwood Ave., Chicago, Ill.

Gentlemen: Send me one can Kester Radio Solder, for which I enclose 25c in stamps.
(*Postpaid anywhere in U. S. A.*)

Name.....

Address.....

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

Dealer.....

KARAS HARMONIK $7.00

Far, Far Better Reception Than You Have Ever Known

Or

Your Money Back Immediately

MAIL THE COUPON AT ONCE for a pair of the Marvelous, New, Karas Harmonik Audio Frequency Transformers. Put them in that new radio set you are building or put them in your old set in place of the transformers you are now using. Try them out—test them thoroughly for 60 days.

If YOU don't enthusiastically agree that they give you the most delightful radio reception you have ever heard send them back and we will return your money immediately without question or quibble.

That's our special introductory offer.

Those who are now using Karas Harmonik Transformers in their radio sets are so pleased with the surprisingly better reception they are enioying that they tell us if we could REALLY describe to all radio enthusiasts the exquisite pleasure of hearing this wonderful reception they would all want Karas Harmoniks in their sets, at once.

But we don't know how to adequately describe the delightfully rich, round, full, clear-as-a-bell tones of Karas Harmoniks. The only way to fully realize what a vast improvement they make in ANY radio set is to actually hear their surprising reception. That is why we make you this unprecedented trial offer.

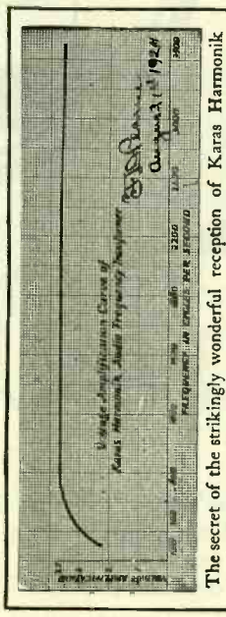
We are stocking the dealers with Karas Harmoniks just as fast as we can. In the meanwhile we are making this "Proof By Trial" offer direct to those radio enthusiasts who are keen to enjoy radio reception at its very best. If your dealer already has secured his allotment of Karas Harmoniks he is authorized to make you this offer.

We might give pages to telling you WHY Karas Harmonik Transformers give purer, sweeter, more natural music than any transformer ever built before. But you had much rather hear and enjoy their actual performance than to just read about how and why they are so wonderful.

That's why we simply say "Try a pair of Karas Harmoniks at our expense and hear with your own ears the beautiful musical tones they deliver. Judge from their performance whether they give Far Better Reception Than You Have Ever Known."

Mail the coupon today. Please write your name and address very plainly.

KARAS ELECTRIC CO., 4040 N. ROCKWELL ST. DEPT. 58-61 CHICAGO



The secret of the strikingly wonderful reception of Karas Harmonik Audio Frequency Transformers is disclosed by this Scientific Laboratory "Curve" of their actual performance.

Low frequencies represent low notes. High frequencies represent high notes and the harmonics of low notes. The bulk of musical sound is made up of many high frequency harmonics and overtones. It is the combination of these harmonics forming a single note that makes it a beautiful, pleasing, musical sound. The absence of fully amplified harmonics causes distortion and unnatural sounding tones.

The "Curve" shows that Karas Harmonik Transformers amplify all tones equally delivering pure, natural musical reception that is a delightful pleasure to listen to.

To Jobbers and Dealers

Distribution of Karas Harmonik Transformers through regular jobber and dealer channels is being carried out as rapidly as the output of our factory permits. In the meantime mail applications will be taken care of in the order they are received, on an allotment basis. Write us for test records, discounts, etc.

To Set Manufacturers

We positively prove that Karas Harmonik Audio Frequency Transformers will vastly improve the musical quality of your set by any form of test you wish to impose. When you are convinced of this you will naturally want to use them. Write or wire us and arrangements for tests will be made promptly.

Send No Money With this Coupon

Karas Electric Co., Dept. 58-61
4040 N. Rockwell Street, Chicago, Ill.

Please send me.....pair of Karas Harmonik All Stage Ratio Audio Frequency Transformers. I will pay the postman $7 apiece, plus postage, on delivery. It is understood that I am privileged to return the transformers any time within 60 days if they do not prove entirely satisfactory to me, and my money will be refunded at once.

Name.....

Address.....

City.....

Dealer's Name.....

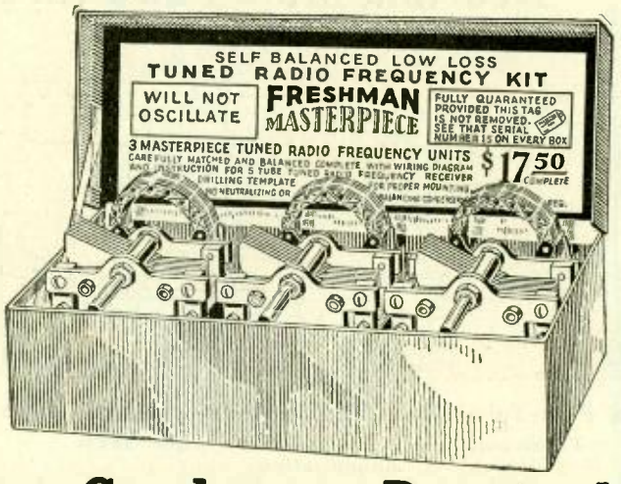
Dealer's Address.....

If you send cash with order we'll send transformers postpaid.

It's Results that Count!

When you build a 5-tube tuned radio frequency receiver you want a set that does not oscillate and does not require laboratory testing before it can be of service.

FRESHMAN MASTERPIECE

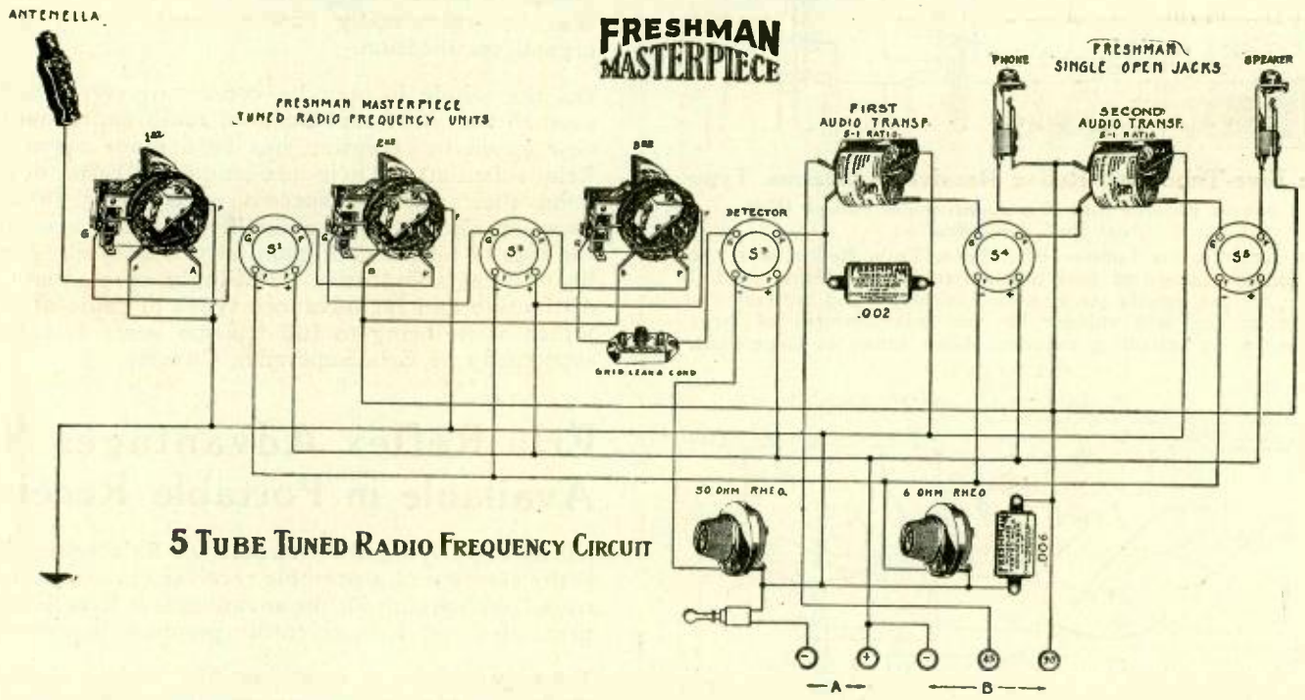


No Neutralizing or Balancing Condensers Required

With these marvelous units you can easily build a five-tube tuned Radio Frequency Receiver that will be highly selective as well as a remarkable distance getter, bringing in all stations with pleasing clarity and volume.

Kit consists of 3 Masterpiece Tuned Radio Frequency Units carefully matched and balanced. Complete with wiring diagram and instructions for building any 5-tube tuned radio frequency receiver and also drilling template for proper mounting..... $17.50

HERE'S THE IDEAL CIRCUIT TO BUILD



5 TUBE TUNED RADIO FREQUENCY CIRCUIT

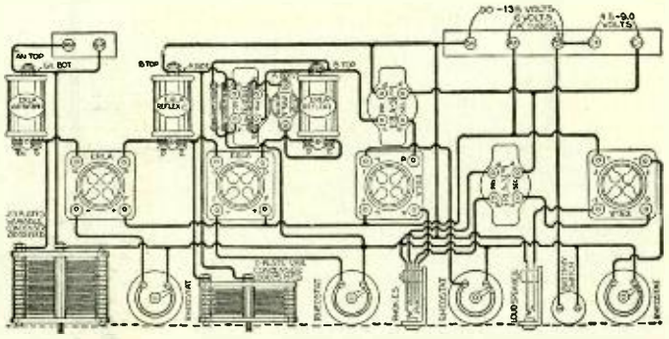
This is the circuit used in the wonderful FRESHMAN MASTERPIECE RECEIVER which has made such remarkable records for distance, volume and selectivity. In building, use FRESHMAN parts to be sure of the best possible results. They are built especially for this circuit.

Freshman Products can be had at dealers everywhere. Ask your dealer for our new catalogue—or write to us for it. It's interesting.

CHAS. FRESHMAN CO., INC., 106 Seventh Avenue, New York City

New Erla Supereflex Circuits

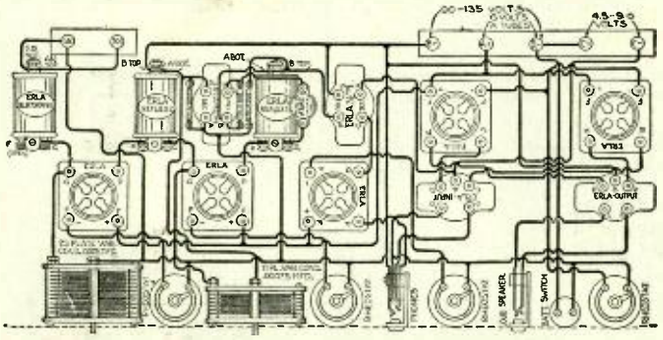
New and More Powerful Members of the Reflex Family



Erla Four-Tube Supereflex Receiver—Antenna Type

Transcontinental Reception With Triple Audio Amplification

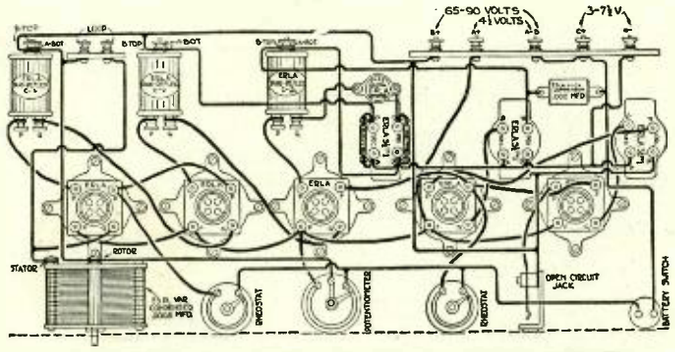
The famous Erla Three-Tube Reflex Receiver with an added stage of audio amplification permits the reception of the most distant stations with full loud speaker volume, while retaining the ease of tuning, simplicity, economy, and beautifully pure tone, which are notably characteristic of Erla Reflex amplification.



Erla Five-Tube-Duo-Reflex Receiver—Antenna Type

Concert Volume and Transcontinental Range With Push-Pull Amplification

This circuit is the famous Erla Three-Tube Reflex with the addition of a stage of push-pull amplification. Using its full power, distant signals are amplified faithfully and without distortion to sufficient volume for the entertainment of large groups, or for providing excellent dance music in large halls.



Erla Five-Tube Supereflex Receiver—Loop 199 Type

Combining Complete Portability With Extreme Range and Volume

A practical circuit for use with dry cell tubes, giving range and volume of reception rivalling that of the larger storage battery tubes. By means of special transformers, an efficiency of about 85% of that of the larger tubes is attained, a remarkable result. Designed for loop operation to give complete portability.

EXPERIMENTERS will find illustrated on this page the very latest developments in reflex amplification, consistently regarded by many foremost scientists and investigators as the principle offering greatest practical promise for ultimate radio perfection.

Acknowledged as the highest expression of reflex principles, because of their many original and unduplicated contributions to the art, are Erla Supereflex Circuits, most powerful ever built, tube for tube, and now developed and refined beyond all previous excellence.

Typifying Erla advancement are the new four and five tube Erla circuits illustrated.

The four-tube circuit incorporates one additional stage of audio-frequency amplification, combined with the celebrated Erla three-tube circuit, which has always been known to surpass all normal limits of performance for similar tube equipment.

Also based on this supreme efficiency is the new Erla five-tube circuit which adds a stage of push-pull amplification, thus providing every advantage of the most delicate and temperamental multi-stage circuits, while affording comparatively great simplicity, stability, economy and ease of control.

Joined to power, range and selectivity so extreme, is the characteristically flawless tonal purity of Erla crystal rectification.

On the whole it may be conservatively stated that even to the most sophisticated radio experimenters a new epoch in reception has been made apparent by Erla scientists. Their pre-eminence rests not only upon their peculiar success in evolving inherently superior circuits whose finality may be accepted in the face of all the confusion on this subject. But also have Erla laboratories unfailingly created all those distinctive and far advanced types of radio apparatus which alone bring to full fruition every fundamental superiority of Erla Supereflex Circuits.

Erla Reflex Advantages Now Available in Portable Receivers

Further typifying the character of Erla achievements is the creation of a portable receiver circuit, here illustrated, embodying all the advantages of Erla Supereflex principles and Erla scientific precision apparatus.

Consequently it is now possible, with a receiver of truly portable type, to surpass the purity, range, volume and selectivity of many of the most elaborate receivers not boasting Erla efficiency.

The Erla portable receiver circuit operates on a small loop aerial, without ground, using dry cells and UV-199 tubes. Full description is available in a supplement to Erla Bulletin No. 21, obtainable upon request to the Electrical Research Laboratories.

Erla Precision Apparatus

Expressly Designed for Highest Efficiency in Erla Circuits

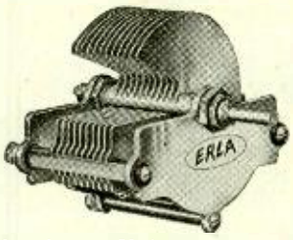
Erla Audio Transformers

Unique and supreme in their ability to meet the high test of distortionless three-stage amplification, Erla audio transformers manifestly assure tone purity, fidelity of reproduction, and simplicity not otherwise obtainable. Yielding results made possible only by the most perfect design and fabrication, Erla audio transformers are of the costliest construction known. Yet their superiority permits a volume of output which brings this true laboratory instrument within reach of everyone.

Erla Reflex Transformers

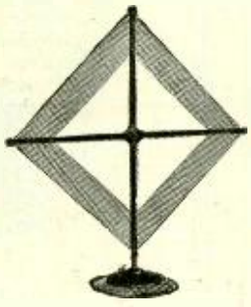
A basic factor in the matchless efficiency of Erla Supereflex Circuits, Erla Synchronizing Transformers procure distortionless amplification, and a degree of selectivity which make them indispensable for maximum results in reflex work. Responsible is the exclusive design by which these transformers, sharply tuned to the desired wave-length, exclude all interference, providing an unparalleled degree of selectivity, while the greatest ease of control is made possible, two vital factors typifying Erla superiority.

Erla Miniloss Variable Condenser



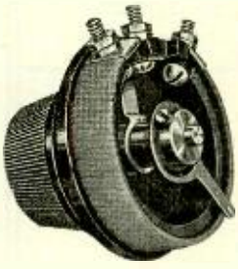
Notable scientific refinements and exquisitely accurate construction create new standards of efficiency in Erla Miniloss Condensers. Exclusive Erla construction reduces dielectric losses to the lowest ever known. Resistance is similarly lowered through positive locking of plates in slotted posts, and use of grounded rotor, fitted with adjustable, oversize lifetime cone bearings. Unique compensating plate form provides improved straight line tuning throughout the entire wavelength range.

Erla Collapsible Loop Aerial



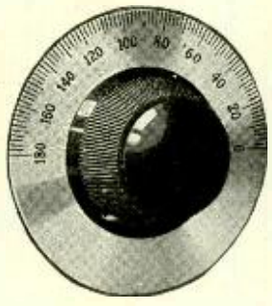
Highest in technical efficiency of reception, the Erla Loop Aerial at the same time represents a combination of ideal construction characteristics never before available. The winding is silk covered, best grade stranded copper wire. The nickeled brass hinge is of piano type. Original lock design assures instantaneous erection with absolute rigidity, although absolutely free rotation is obtained with low-resistance swivel plug base connection. Collapsed, the Erla loop aerial is the most compact ever designed. Rich appearance is achieved in the walnut arms base.

Erla Precision Rheostat



The silky "feel" of Erla Precision Rheostats is one of many indications of marked advancement. The factory-adjusted tension of the special spring arm is undisturbed by installation, because the novel single-hole mounting eliminates disassembling. Genuine Bakelite is used throughout, with special oversize alloy wire of excess radiating and carrying capacity. The minute, sensitive control, free from adjustment noises, is a notable Erla characteristic.

Erla Metal Dials



Handsomely finished in frosted, silver or gold, with artistic calibration, Erla dials nevertheless have infinitely more significance than mere fine appearance. The extra heavy brass which is used assures permanent true running. The scientifically proportioned Bakelite knob affords utmost delicacy of touch. Made to fit ¼" shaft, locked with set screw. A real dial improvement.

Erla Precision Potentiometer

Like the Erla Precision Rheostat, the Precision Potentiometer is truly remarkable for its smooth-running adjustment, accurate over a wide range of resistance. Like all Erla panel-mounting apparatus, provision is made for single-hole mounting of the instrument, not only reducing the amount of labor needed in preparing the panel, but preserving the factory-set tension on the contact arm. Made of genuine Bakelite, with Erla engraved Bakelite knob.

Erla Autogrip Phone Plug

Necessarily departing from conventional construction, Erla succeeded in incorporating the many desired phone plug characteristics into the new Erla Autogrip Phone Plug. Instant positive grip of phone tips without the aid of tools is a remarkable attribute. Head phones or loud speaker are connected instantly merely by inserting the phone tips. The thorough-going quality is indicated by the heavy nickel finish and the grip of genuine Bakelite, milled finish.

Warranty: All Erla products are guaranteed unconditionally against defects in materials or workmanship, and are warranted to give absolute satisfaction when properly installed.

ELECTRICAL RESEARCH LABORATORIES

Dept. L, 2500 Cottage Grove Ave., Chicago

Bristol "AUDIOPHONE" Loud Speakers

Years of research in sound reproduction, in the laboratories of an established engineering concern, have made the AUDIOPHONE what it is—have given it its round, full tone, its ample carrying power, its distinctive freedom from blurring and distortion. You forget the instrument, in your enjoyment of the entertainment it brings to you.

No adjustments are necessary, no additional batteries are required for magnetizing. The Audiophone is complete and ready to use on connecting to your set.

2099

SENIOR AUDIOPHONE

15-inch diameter Bell, Finish dull gold bronze. Weight complete, 10 lbs.

Price $30.00

2102

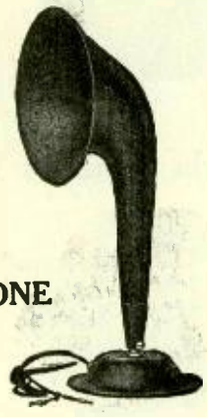
JUNIOR AUDIOPHONE

With 11-inch diameter metal Bell, Finish dull gold bronze.

Price $22.50

With Fibre Horn similar to that illustrated on the Baby Model.

Price $20.00



2162

BABY AUDIOPHONE

This is regularly furnished with Fibre Horn as illustrated. It can be used on two or three stages of amplification, and gives excellent results. The Fibre Horn is a bronze color matching the finish of the metal base.

Price $12.50

Bristol One Stage Power Amplifier

Needs No "C" Battery

1901

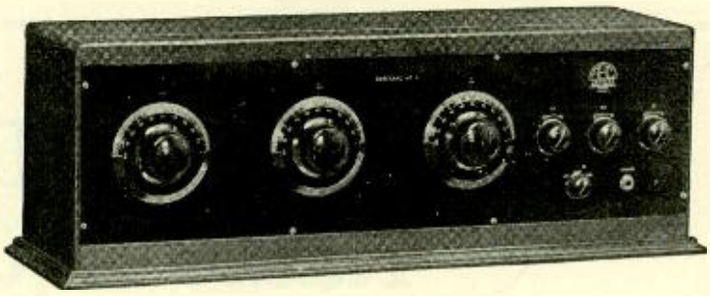
This amplifier has been carefully worked out to avoid the distortions of speech and music which are apt to mar the performance of amplifiers with improper grid control and transformers of inferior design. When used with Loud Speakers of the better class and particularly with Bristol Audiophone, music and speech are reproduced without any distortion that the ear can detect.

The Bristol Power Amplifier can be used with the Detector and One or Two Stage Amplifiers now on the market. Any desired amplification can be had by connecting several Bristol One Stage Power Amplifiers together. Price $25.00.

Made by

The Bristol Company

Waterbury, Conn.



The Andrews Deresnadyne

is the only set using the principle of the *Balanced Plate Circuit.* It successfully combines tone quality and selectivity with distance and volume

Hitherto it has been possible to purchase in a radio set one of two groups of qualities—tone quality and selectivity on the one hand, and distance and volume on the other—but not both. Now the Andrews Deresnadyne, using the new and exclusive principle of the *Balanced Plate Circuit,* for the first time successfully combines the two. It secures the finest tone and high selectivity *with increased distance and volume.*

The *Balanced Plate Circuit* is the only circuit which stops the oscillation that produces whistling and distortion at its source—the plate circuit—where it can be easily and efficiently controlled. It does away with the use of special suppressing devices in the grid, where all adjustments are very critical, and where the suppression of excessive energy which produces oscillation results in distortion and cutting down of signal strength. By balancing the plate circuit the generation of this excessive energy is prevented while the signal strength is allowed to build up to a maximum. *The result is a tone quality which in our belief has never been equalled by any radio set on the market.*

In volume the Deresnadyne will give anything from a mute tone to a volume that fills a large hall. A special feature is the Plate Balancer, which enables you, by simply turning a knob, to accentuate either tone quality or distance, as you wish. The Deresnadyne is highly selective. It will go through a powerful local station to reach a distant station with only a few meters difference in wave length. One of the factors in securing this high selectivity is the remarkably low losses of the condensers and transformers. Great distance is secured by conserving signal strength through unusually close transformer coupling.

The Deresnadyne is extremely simple in operation and construction. It is easy to log. You can change from first to second stage or turn off the set by simply turning the switch knob, eliminating jacks and plugs. The case is of solid hand-rubbed mahogany, with large handsome dials.

Price
without accessories
$150

Few Sets have ever received the enthusiastic comments of radio authorities given the Deresnadyne. Robert J. Casey, head of the Chicago Daily News Laboratory, says about it: "*The circuit combines selectivity, range and quality in a degree that will astonish the old experimenter.*" Hear the Deresnadyne at your dealer's. If he does not carry it, write to us.

DEALERS: *Order through your jobber*
JOBBERS: *Exclusive rights in open territory may be secured by aggressive jobbers of high standing*

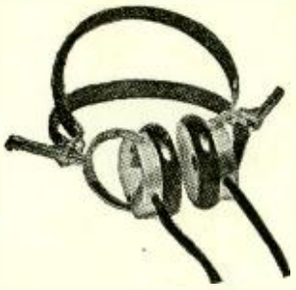
ANDREWS RADIO COMPANY . 327 S. LA SALLE STREET . CHICAGO

Andrews
Deresnadyne
DĒ-RĒS'-NÀ-DĪNE • PATENTS PENDING
Radio Receiving Set

Why buy DYMAC Radio Equipment?

We have been making telephone and radio equipment to meet the most exacting requirements of other manufacturers, for years.

Our DYMAC line of radio accessories and parts represents our highest production achievement in radio equipment —and, therefore, bears our own individual brand.



Type A "Supreme" DYMAC Headset

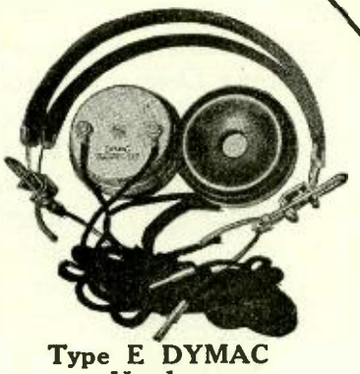
Clearest reception, mellowest tone. Hard rubber caps; aluminum cases; ferrotype diaphragms; 6-foot, 18-strand Dymac tinsel cord; self-adjusting and detachable headbands; permanent magnets of tungsten steel. Resistance 2,200 ohms; Impedance, 22,000 ohms.

Price, $6.00

Type F "Popular" DYMAC Headset

A Quality set at a low price. Molded caps; aluminum cases; ferrotype diaphragms; standard 5-foot DYMAC tinsel cord; comfortable headbands; tungsten steel magnets, DYMAC electro magnets. Resistance 2,200 ohms. (Furnished with 3,000 ohms resistance at no extra cost).

Price, $3.50



Type E DYMAC Headset

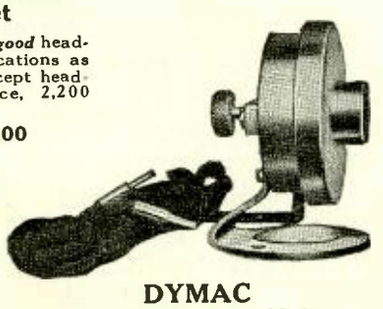
The lowest priced *good* headset. Same specifications as Type F above, except headband. Resistance, 2,200 ohms.

Price, $3.00

No unit of the DYMAC line is an assembled product. Each one is made complete by us in our modern plant, under the most rigid inspection, from superior materials selected from the best raw material markets.

Only units so made, that can meet such tests, bear the DYMAC label. Every DYMAC product has behind it our ***guarantee*** for one year.

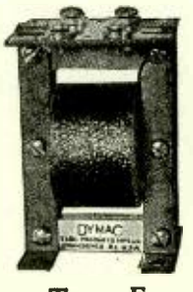
Send for booklet descriptive of the entire line of *guaranteed* DYMAC radio accessories and parts, or ask your radio dealer to show you DYMAC products.



DYMAC Loud Speaker Unit

May be fitted to all standard phonographs. Gives sufficient tone volume for home or small hall. Excellent for sets with one or two stages of audio amplification. Finished in black enamel and polished nickel; 5-foot, 18-strand DYMAC tinsel cord with standard tips.

Price, $4.00



Type E DYMAC Transformer

A good audio transformer at a low price. Ratio, 3 to 1. Terminals conveniently located and properly marked. Bakelite panel.

Price, $2.50

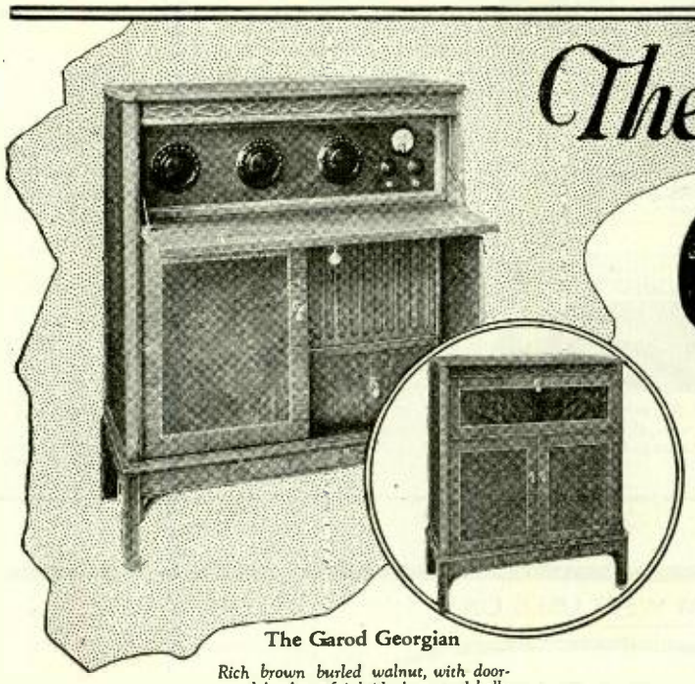
Electrical Products Manufacturing Co.

Sole Makers of DYMAC Radio Equipment

69 Sprague Street **Providence, R. I.**

GAROD

ANNOUNCES THEIR NEW POWERFUL NEUTRODYNE MODELS THE GEORGIAN AND THE V



The public wants Power

Power—to produce great volume.

Power—to bring in distant stations.

Power—to work through local stations.

Power—to moderate or intensify volume.

Power—to render the original quality of tone transmitted.

Power—to select programs.

Power—to get the best out of the program.

The Garod Georgian

Rich brown burled walnut, with door-panel borders of inlaid ebony and holly —5 tube model—built-in loud speaker—battery compartments and accessory drawer. Will grace the finest drawing room—provide the best in radio reception. Size 35½" long—16⅝" deep—42½" high.

$400.00

The Garod V

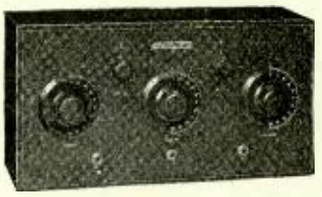
Genuine mahogany highly finished cabinet—graceful 15° sloped genuine mahogany panel—carved feet—five inch dials—double reading Westan volt-meter — 5 tube model. Size 34⅜" long—13¾" deep—11⅜" high.

$195.00

The Garod RAF

The receiver that made GAROD famous. Added mechanical improvements — 4 tube model — with which you are familiar. Size 19½" long—7⅜" deep—10" high.

$135.00



These models have power plus—and then more power. They are full voiced—with tonal quality of exquisite timbre. They can be controlled to meet the capacity of the small living room, or manipulated to take full advantage of the acoustic possibilities of the large hall.

In every respect, they are worthy of bearing the name GAROD.

We are now ready to enter orders, and grant jobbers of standing, exclusive non-conflicting territories, where open.

GAROD LICENSED INDEPENDENT RADIO MANUFACTURERS IN NEUTRODYNE U.S.A. HAZELTINE PATENTS NOS. 1450,080 AND 1492,218 OTHER PATENTS PENDING TRADE MARK REG. U.S. PAT. OFF.

Canadian Distributors:
Continental Equipment Company, Ltd.
357 St. Catherine Street, West
Montreal, Canada

The GAROD *Corp.*
120 Pacific Street, Newark, N. J.

AJAX
ST. LOUIS

No. 18—A Multi Connector, $1.00 Each

For use with receiving sets equipped with binding posts, only 1, 2, 3, 4. Always in series.

No. 18—Multi Plug, $1.00 Each

Fits all standard jacks. Always in series. Gives equal results on all head phones or loud speakers.

No. 19—Round Handle, 40c Each

Double phone plug. No screws to unloosen to reach terminals.

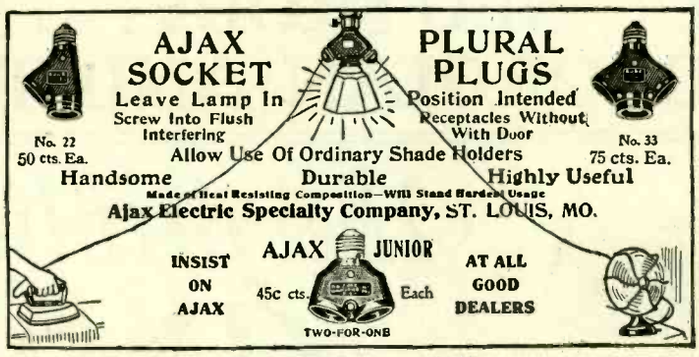
No. 17—Flat Handle, 40c Each

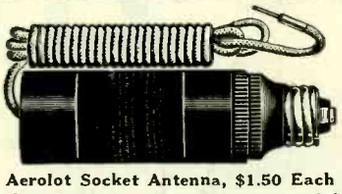
Double phone plug. Takes two sets, any type of terminals.

AJAX-St. Louis Radio Specialties cover most items in the parts line in GUARANTEED MERCHANDISE, backed by 29 YEARS EXPERIENCE in manufacture of TELEPHONE and ELECTRICAL SPECIALTIES. Insist on Ajax-St. Louis parts for satisfaction.

LIBERAL DISCOUNTS TO TRADE

Users at List Price From Your Dealer or Direct. Write for Complete Price Sheets.





Aerolot Socket Antenna, $1.50 Each

Complete with cord and tip for connecting to receiving set. Equal or superior to any this type.

A. C. S. Crystal Set, $5 Each

Range 200 to 600 meters. Best in material or workmanship.

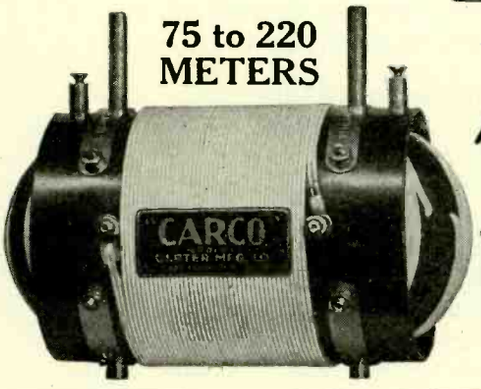
Plain, Each .07½. Initialed 10c Each.

B. P. B. S. accommodates two cord tips, any type.

$18.00 Each.

Marvel tone, brass horn crystal, block 26 inches high, 14-inch belt. Biggest and best.

"ASK THE HAM WHO USES ONE"



75 to 220 METERS

"CARCO"
HAM SPECIAL
SHORTWAVE-LOW LOSS COUPLER

DESIGNED BY A HAM FOR HAMS
PRICE $8.00 EACH
SPECIAL PRICE TO HAMS ONLY, $5.00
This Special Price is **NET.** *No Discount to Dealers*
Sent C.O.D. A Postal with name address will bring it.
Not on sale at Dealers.

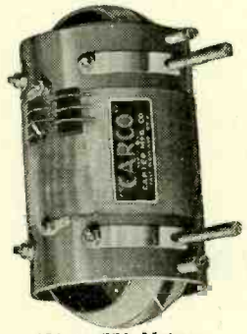
A compact unit in a space of only 3"x5½".

Antenna Rotor and secondary Stator designed for "Low Loss" and "Low Resistance."

Our special single layer, **multiple wound** inductance does the trick.

A "Low Loss" Condenser for secondary is the only addition required for a complete tuning unit.

DX work requires a "Low Loss" tuner. Rebuild your set with a "CARCO" Ham Special. An increase in efficiency will result.



220 to 550 Meters
"CARCO" No. 3
$6.75
Send for "CARCO" Catalog

"CARCO" No. 3 P. S. T. LOW LOSS COUPLER

This coupler consists of a single unit in which is contained a **"low loss"** Stator or secondary winding and two rotors, one of which is the antenna inductance and wound with **"low loss"** coarse wire; the other coil is wound with finer wire and its use depends on the circuit. The entire unit occupies a space of only 3" by 5½" yet has the performance of a 3-circuit variometer set with even greater efficiency. By turning the antenna rotor a very high degree of selectivity is possible, due to the fact that the coupling at minimum is very close to zero. The coupler is strongly recommended for use in **congested districts** where interference is bad. The signal strength is as great as the best type single circuit regenerative with the additional advantage of maximum selectivity, all due to the **"low loss"** windings for both Primary and Secondary. The operation of the coupler is very simple, in fact as simple as the single circuit. The antenna circuit is partially aperiodic and therefore requires very little adjusting in picking up a station. The coupling needs no attention in the process of finding a station and is only adjusted in the final process of tuning out an unwanted station. The general construction of the coupler lends itself to flexibility and a variety of different hook-ups. The best of materials are used in its construction. **"Low loss"** Bakelite tubing, Hard Rubber Rotors, DC. Cotton covered wire.

THE CARTER MANUFACTURING CO.
1728 Coit Ave., East Cleveland, O., U. S. A.

Dealers: Your Jobber carries "CARCO" Couplers.

HANDY CHARGER

$18.00
F. O. B.
St. Louis

Charges them all

2 Volts to 48 Volts

NOW you can charge all of your radio and automobile batteries with the same charger. The Ultra Handy Charger makes this possible. Charges any battery from 2 volts to 48 volts. Easy to operate. Simply connect cord and plug to lamp socket.

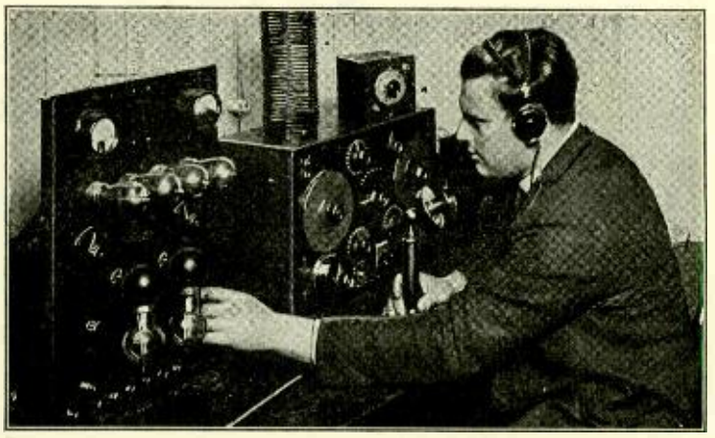
Will not overcharge or harm your battery—even if left attached for days. Gives a taper charge. This reduces the amount of charging current as the battery becomes full.

Contacts absolutely cannot stick and give trouble. No breakable glass. No bulbs. No acid to spill. No fast wearing parts. No frequent adjustments. No auxiliaries necessary.

Only best material used. A precision WESTON AMMETER—the best—tells accurately the rate at which battery is being charged. Porcelain base. Rubber covered acid proof battery leads, approved plugs, clips, etc., assure satisfaction. Place beautiful Mahogany finished sheet metal case anywhere.

Ask your dealer for a demonstration. Or write us for free illustrated descriptive folder

INTERSTATE ELECTRIC CO.
of St. Louis
4339 Duncan Ave. St. Louis, Mo.



More Money For You in RADIO

THE amazing expansion of Radio has opened up hundreds of wonderful new positions on land and sea. Big salaries, fascinating, easy work, short hours, and a wonderful future are offered to ambitious men who get into Radio now.

Take advantage of these wonderful opportunities to step into a big paying position in this great new field. Radio offers you an opportunity to travel and see the world, with all expenses paid, and a fine salary besides. Or you can stay at home and work up to a position paying up to $10,000 a year. One of our recent graduates secured a position one week after graduating, paying a salary of $300 per month. Hundreds of others report equal success.

Easy to Learn Radio at Home

Hundreds of men are already earning handsome incomes in this wonder science. If you want to get into a profession where opportunities are unlimited make Radio your career—become a Certified Radio-trician.

Thousands of Certified Radio-tricians are wanted to design Radio sets; to make new Radio improvements; to manufacture Radio equipment and to install it; to maintain and operate great broadcasting stations and home Radio sets; to repair and sell Radio apparatus; to go into business for themselves; to operate aboard ship and at land stations.

You can easily and quickly qualify in your spare time at home through the help of the National Radio Institute, first school to teach radio successfully by mail, established 1914. No previous experience or training needed. Prominent Radio experts will help you in every problem, giving you personal attention.

You learn by actually doing, as we furnish free with the course circuits and parts for building latest receiving sets, making the work thoroughly practical. You learn quickly and easily—right at home.

This is the absolutely complete course which qualifies you for the real "big pay job" in Radio.

Send for FREE BOOK

No other field today offers such great opportunities as Radio. Take your choice of the many wonderful openings everywhere. Prepare now to step into the most interesting and best paid profession today. Read about the opportunities open now—the different kinds of work—the salaries paid. Write today for the 32-page book that tells how America's first and biggest Radio school (government recognized) can teach you to become a Certified Radio-trician in your spare time and also Special Offer to those who act at once! Mail the coupon or write a letter NOW.

NATIONAL RADIO INSTITUTE
Dept. 85A **Washington, D. C.**

NATIONAL RADIO INSTITUTE, Dept. 85A
Washington, D. C.

Without obligation send me your book, "Rich Rewards in Radio," which tells all about the opportunities in Radio, how spare time study at home will qualify me quickly as a Certified Radio-trician so I can get one of these splendid positions, and how your Employment Service helps me to secure a big pay job. (Please write plainly.)

*Name*_____*Age*_____

*Street*_____*Occupation*_____

*City*_____*State*_____

M-B-G

RADIO CABINETS Are Convenient

Radio cabinets—large ones—small ones, just the kind you want—the kind that finish off your set, make it look better and work better—because it's always protected. They're made of Oregon Fir selected for its perfect grain. That's why thousands of fans are ordering them each day.

Send Your Order

Select the model and size you need and just send your order direct to us—or ask your radio dealer. We will forward it to you promptly. FREE with every cabinet comes complete and fascinating instruction on how to stain to harmonize with any color scheme or furniture. You finish M-B-G Cabinets to suit your taste—that makes them especially convenient.

Every M-B-G Radio Cabinet is guaranteed to give satisfaction or money will be cheerfully refunded.

Radio Cabinet Dept.

EXPRESS BODY CORPORATION

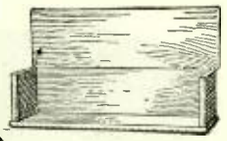
43 Lake St., Crystal Lake, Ill.

Cabinet No. 29

Open back with shelf compartment for "B" batteries, also, ample room for "A" battery. Total opening 10x11x29". Panel front to conceal all batteries, wires, etc. Size 11½x32x29" set up complete. Packed one each in carton **$7.50**

Cabinet No. 37

Exceptional design—panel size 7x28, 11" deep. Outside measure 11½x32x37" high. Top is hinged to open, supported by standard desk leaf support, making set workings accessible. Set up complete, packed one each in carton, $11.50. For $3.25 net extra, we will furnish Bakelite panel with base board, making our No. 37 cabinet suitable for most any radio set; or, we can furnish a laminated wood panel for this cabinet with base board at $0.75. Extension panels shorter than 28" designed to complete your present panel and to fit this cabinet, can also be furnished. Prices on request.



Neat Fit K.D. Cabinets Shipped knocked down, holes bored and everything furnished complete. Very easily assembled. Ends grooved to receive panels. Packed one each in carton.

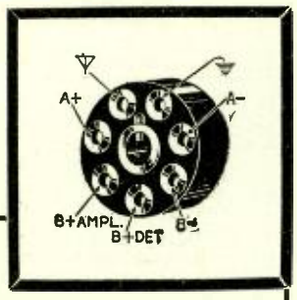
Panel 7x 9",	7" deep,	$1.50
Panel 7x12",	7" deep,	1.80
Panel 7x14",	7" deep,	2.00
Panel 7x16",	7" deep,	2.00
Panel 7x18",	7" deep,	2.10
Panel 7x21",	7" deep,	2.20
Panel 7x24",	7" deep,	2.30
Panel 7x26",	7" deep,	2.40
Panel 7x28",	7" deep,	2.50

Other sizes carried in stock. Prices on request.

Table No. 31

Size 15x31,29" high. A rigid substantial table at a very low price. Packed one each in carton..... **$3.50**

Jones Multi-Plugs are supplied for panel or bracket mounting. Also (as illustrated below) with seven leads coded for attaching to binding posts of any set.



Complete $5

One Pull—

On the Jones MULTI-PLUG instantly disconnects antenna, ground, "A" and "B" batteries from your set! One push reconnects! Long cable permits placing batteries out of way—in basement, closet or elsewhere. All leads coded.

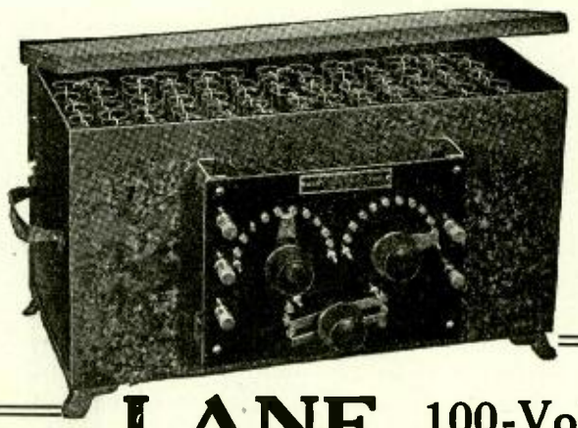
Jones MULTI-PLUG

Can't be plugged in wrong. Prevents burning out tubes or shorting batteries. 100 percent fool-proof. Enables anyone to connect your set with safety. Standard on Zenith, WorkRite and many other leading sets. Jones Multi-Plugs, complete for panel mounting, $4; for bracket mounting $4.50. Binding Post type, $5.00. Carried by all jobbers. If your dealer isn't supplied, state his name when ordering. Folder free.

Pat. Applied for

HOWARD B. JONES

618 South Canal St. Chicago



LANE 100-Volt

Non-Acid Storage "B" Battery

Makes a wonderful improvement in your radio set. Gives it more life and pep. Makes listening in a real pleasure. Gives a clearer reception than you have ever experienced. Brings in more stations louder and clearer, takes the guesswork out of distance reception,

LIFE OF BATTERY UNLIMITED

No deterioration—easiest, quickest to charge—will operate a 3 tube set continually for over 50 hrs. Ordinary use one to four months without recharging.

PANEL SWITCHES

Gives Instant and Correct Voltage

A great and necessary improvement on batteries. Gives instantly correct voltage at all times and perfect reception. Allows for charging in two equal parts.

Comes in handsome indestructible case, **$25** At your dealer's or direct, 150V. $37.50.

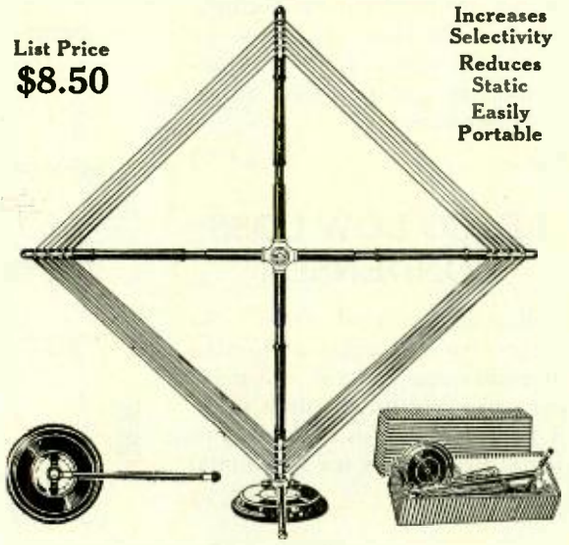
Attractive Proposition to Dealers and Jobbers

LANE MFG. CO., Dept. 13, 2941 W. Lake St., Chicago

Duo-Spiral
Folding Loop

List Price
$8.50

Increases Selectivity
Reduces Static
Easily Portable



Patents Pending

It Spans the Continent

The Duo-Spiral Folding Loop brings in stations from coast to coast. Provides better reception than the ordinary aerial. Reduces static to a minimum. Can be used anywhere—in the home, when touring, or in the camp. Folds neatly in small box when not in use.

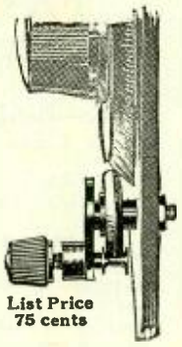
The Loop proper is about two feet square and is made of stranded copper wire with heavy silk insulation. The patented Duo-Spiral winding is an exclusive feature. Connection made direct from antenna to receiver. Wire always taut. Swivel base dial is graduated in degrees for calibration. Convenient handle permits adjustment without body capacity effects.

Each loop packed in individual box. *Write for descriptive folder.*

Tiny-Turn
Vernier Control

Tiny-Turn increases range and volume—improves tone quality through perfect tuning. It has a gear ratio of 30 to 1. Rotates in same direction as dial. Can be disengaged quickly when exact adjustment is not needed. Fits any standard panel.

Handsome nickel and ebony black finish. Packed in individual cartons. *Folder on request.*

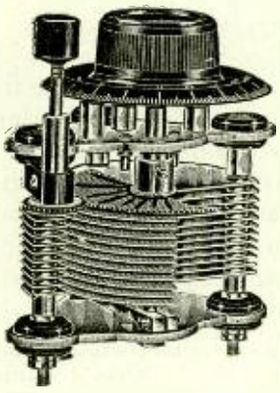


List Price
75 cents

Radio Units Inc.
Maywood, Illinois
1302 First Avenue

The *New* HEATH NON-DIELECTRIC CONDENSERS

OLD fashioned dielectric end plates (insulating material) which waste condenser efficiency completely discarded in the new HEATH CONDENSERS. End plates of aluminum entirely do away with dielectric loss, warping of plates and make shielding unnecessary. All metal, except for the small pieces of hard rubber which insulate the rotor from the stator plates. Extraordinarily rigid.



Permanently FLAT Plates

The well-known Heath process of stamping rotor plates makes the new HEATH an instrument of lasting accuracy.

Micrometer Geared Vernier

Ordinary adjustments reduced by separate geared adjustment to hair-breadth distinction. The most highly perfected vernier so far developed.

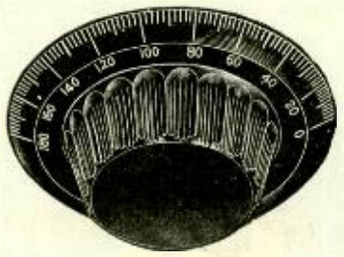
Prices of Model "A" Vernier Type with Dial

No. 12 A.V.	12 plate	$5.00
No. 24 A.V.	24 plate	5.50
No. 44 A.V.	44 plate	6.50

PLAIN TYPES in all sizes

Two New HEATH Products

HEATH Bakelite Dial



Specially designed easy grip-knob, beautifully proportioned, highly polished and clearly incised. Brass bushing centered by precision machinery to positive accuracy for perfect balance. Made in two (2) inch, three (3) inch and four (4) inch diameters. A typical HEATH product.

Prices

No. 101—2″ dial for ¼″ shaft	50 cents
No. 103—3″ dial for ¼″ shaft	65 cents
No. 105—4″ dial for ¼″ shaft	80 cents

HEATH Sockets with the Exclusive Shock Absorber Feature

Bakelite base into which reenforced phosphor bronze, self cleaning contacts are securely embedded. Binding posts are slotted hexagon nuts. HEATH Standards of material and workmanship .....Price 75c

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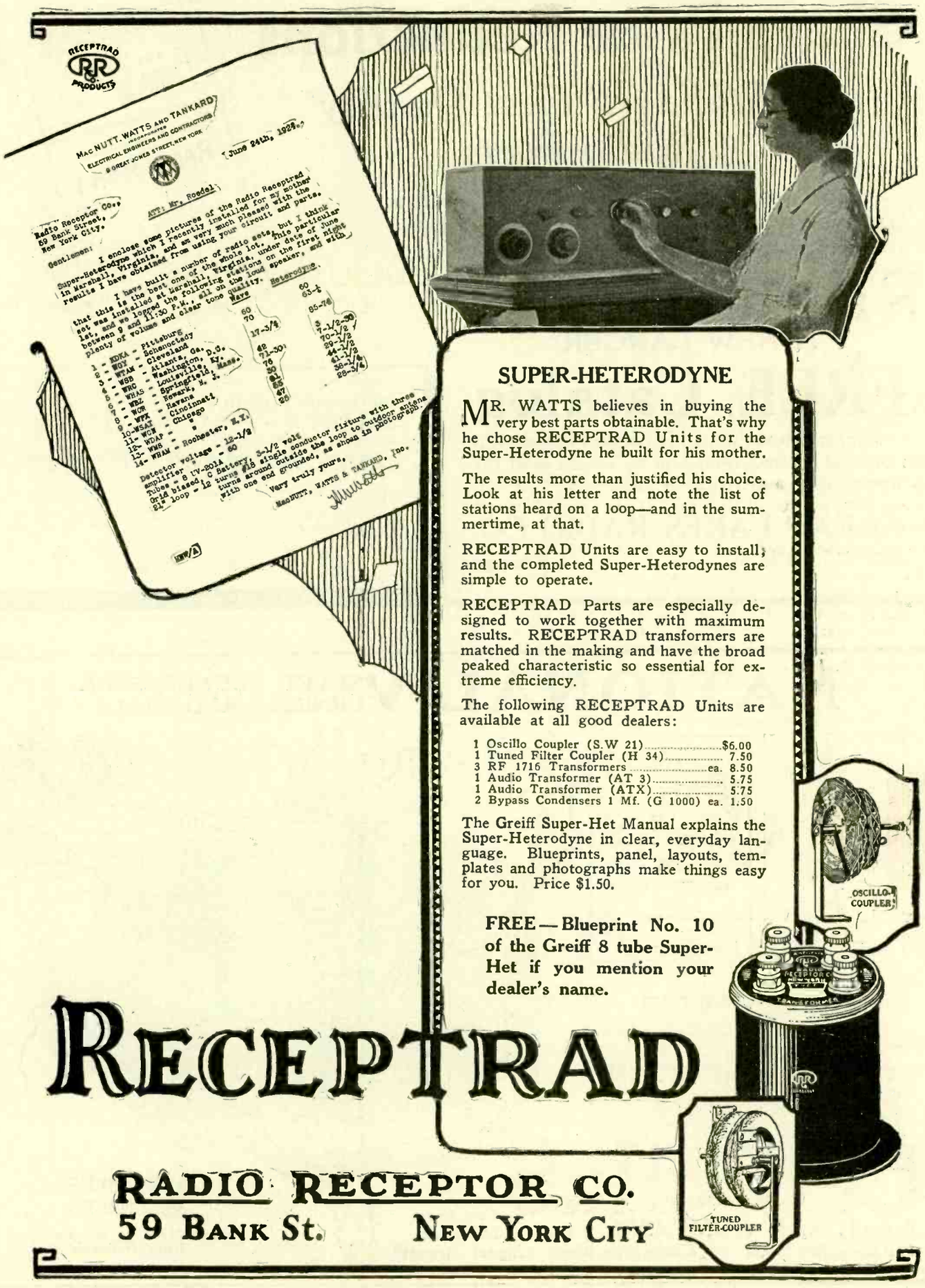

SUPER-HETERODYNE

MR. WATTS believes in buying the very best parts obtainable. That's why he chose RECEPTRAD Units for the Super-Heterodyne he built for his mother.

The results more than justified his choice. Look at his letter and note the list of stations heard on a loop—and in the summertime, at that.

RECEPTRAD Units are easy to install, and the completed Super-Heterodynes are simple to operate.

RECEPTRAD Parts are especially designed to work together with maximum results. RECEPTRAD transformers are matched in the making and have the broad peaked characteristic so essential for extreme efficiency.

The following RECEPTRAD Units are available at all good dealers:

1 Oscillo Coupler (S.W 21)	$6.00
1 Tuned Filter Coupler (H 34)	7.50
3 RF 1716 Transformers	ea. 8.50
1 Audio Transformer (AT 3)	5.75
1 Audio Transformer (ATX)	5.75
2 Bypass Condensers 1 Mf. (G 1000)	ea. 1.50

The Greiff Super-Het Manual explains the Super-Heterodyne in clear, everyday language. Blueprints, panel, layouts, templates and photographs make things easy for you. Price $1.50.

FREE—Blueprint No. 10 of the Greiff 8 tube Super-Het if you mention your dealer's name.

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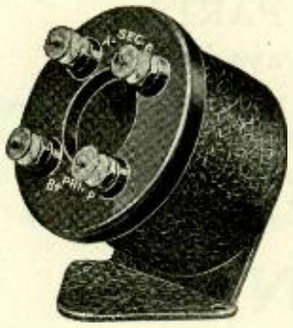
LATEST TRIUMPH

Announcing the

"MAXUM" Long Wave Transformer

RADIO AUDIO
—THE MAXUM TWINS—



"Maxum" Intermediate Frequency Transformer
Note the angle of mounting

A problem confronted our research department—the problem of designing a long wave (super-heterodyne) transformers retaining all the desirable features of the early types yet excluding all the objectionable characteristics. We have solved this problem and have added other refinements until the completed instrument stands alone—supreme. To enumerate all the details of its superior construction and to eulogize its operation would require too great space. Here are, however, a few of the outstanding points:

1. **Shielded—no "body capacity" effects and no extraneous noises.**
2. **Genuine moulded bakelite top—insulation of the highest order.**
3. **Assembled and mounted at the angle of zero coupling making it possible to:**
4. **Operate *without* the use of a potentiometer and *without* self-oscillation in the intermediate frequency amplifier.**

MADE IN BOTH IRON AND AIR CORE

TYPE 1001—100 Kilo-cycle Air Core Interstage.
TYPE 1012—100 Kilo-cycle Filter Transformer.
TYPE 501— 50 Kilo-cycle Iron Core Interstage.
TYPE 512— 50 Kilo-cycle Filter Transformer.

Price, all TYPES.....$6.00 each

"Maxum" Audio Frequency Transformers are rapidly gaining favor with set manufacturers as well as the man who "builds his own." Maxum Audio Transformers are made in the following types and ratios:

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AF312	3½ to 1	
AF41	4 to 1	
AF412	4½ to 1	
AF51	5 to 1	
AF61	6 to 1	
AF91	9 to 1	
AF101	10 to 1	
Cat. Nos.	Multi-ratio	Price
MR6	2 to 1— 5 to 1 3 to 1— 6 to 1 4 to 1—10 to 1	$6.00 Each
PP1	Push-Pull	$6.00 Each
PP2	Push-Pull	$12.00 per pr.

"Maxum" Radio Frequency Transformers

"Maxum" Radio Frequency Transformers are made in three types to fit all tubes and meet all requirements.

RF11, RF25, Reflex ..... **$4.00 Each**

"Maxum" Audio Frequency Transformers

MAXUM ELECTRIC COMPANY

Successors to
The Radio Division of the

FAIRMOUNT ELECTRIC & MFG. CO.

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MA-15

Mu-Rad MA 15—3 Stages of Radio Frequency Amplification, Detector and 2 Stages Audio Frequency Amplification (set alone—no accessories), List $180.00

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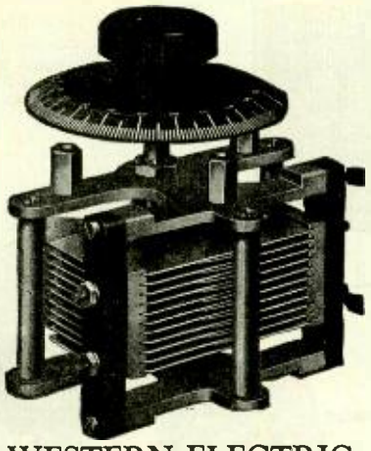

523 AW

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We carry a complete line of Western Electric Radio Products among which are listed the following:

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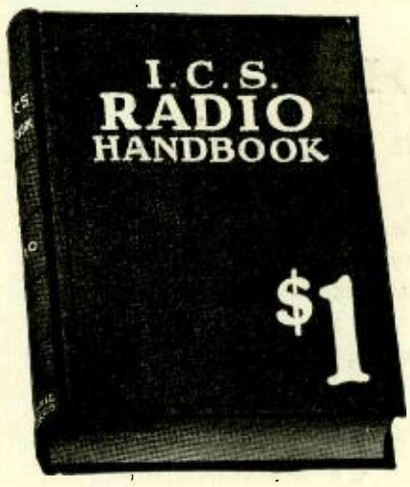
Contains complete information on the following lines (besides those mentioned above) for which we are distributors or jobbers: Acme Apparatus Co., French Battery & Carbon, Carter Radio Co., General Radio Co., Remler Radio Mfg. Co.. National Co., Inc., Vesta Battery Co., Como Apparatus Co., Stevens & Co., E. T. Cunningham, Inc., Kellogg S. & S. Co., Weston Elec. Instr. Co.



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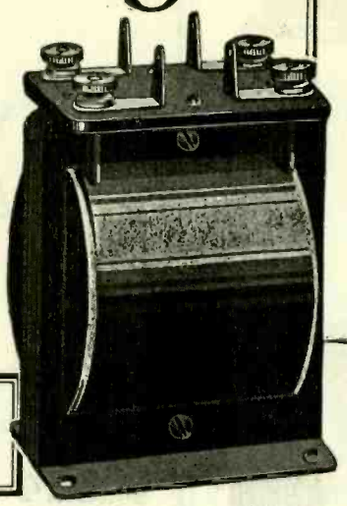
THE Massachusetts Institute of Technology is one of the world's largest and most famous scientific schools. Its laboratories are fitted with the latest, most sensitive, most accurate instruments.

In a comparative test conducted there by experts, the SAMSON HW-A2 audio frequency Transformer showed the highest efficiency and the least distortion.

Whether building or buying a receiving set, insist on Samson Helical Wound Transformers—most efficient because of the exclusive Helical Wound Coils. Write for Bulletin C6 proving SAMSON Transformer superiority.

Samson
HW-A2
AUDIO FREQUENCY
Transformer
TWO RATIOS 3:1 and 6:1
Now $5 was $7



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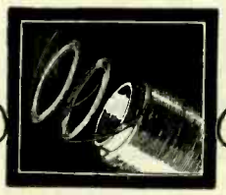
Manufacturers Since 1882
Factory Canton, Mass.
Sales Offices in principal cities of U. S. and Canada



H. W.
stands for Helical Winding

Patented machines, used only by us, wind the wire in both primary and secondary *in coils at right angles* instead of in layers parallel to the core. This makes adjacent turns of wire in Samson Transformers but about 80 turns apart instead of 800 to 1200 turns apart as in others. That is why Samson HW Transformers have almost no capacity effect and greater amplifying powers.

Ask your dealer for these Helical Wound Samson Transformers:

HW-A2 for Audio Frequency
HW-A2-I Input Transformer } for Pushpull
HW-A2-T Output Transformer } amplification
HW-R1 for Radio Frequency
(Made for three wave lengths: 3000, 5000 and 10,000 metres)

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We specialize on
BUILDING TO ORDER
THE "BEST" SUPER
The finest receiver yet developed

HALLOCK & WATSON RADIO SERVICE
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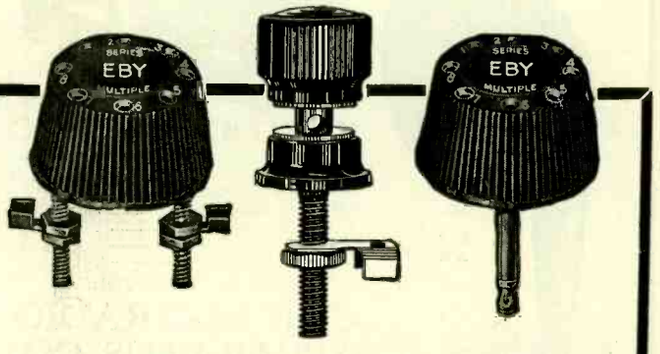

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EBY binding posts are ***scientifically accurate.*** They are ***beautifully finished.*** Their ***price is right.***

They are furnished either plain or with engraved tops in twenty-five different markings. And the ***tops don't come off.***

EBY "Tip Top" Posts and Plugs will take four sets of phones in either parallel or series.

EBY service is swift and reliable.

Insist upon and get genuine EBY posts!

H. H. EBY MFG. COMPANY
Philadelphia, Pa.

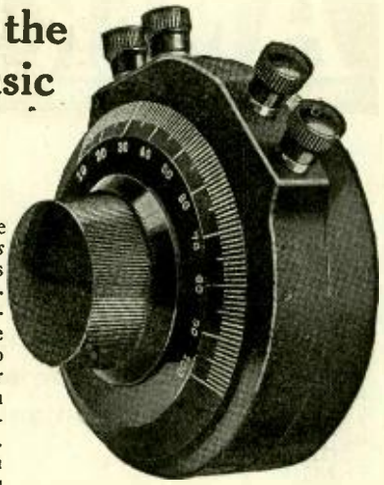
Build Any and All Sets With This Remarkable Unit

FIFTY or more circuits built with *De Roy Phusiformers* without discarding any parts. From the simple crystal set, right on up through the reflex, inverse duplex, neutrodyne, ultra audion circuits to the famous 5 Tube Phusiformer Circuit —all can be made with *DeRoy "No-Los" Phusiformer Units.* The easiest and most economical way to increase the range and efficiency of your set. Eliminates use of condensers, variometers, couplers and radio frequency transformers.

DeRoy Phusiformer "NO-LOS"

Manufactured Under License Agreement

Reproduces the Original Music and Speech Perfectly



The fundamental principle of *DeRoy Phusiformers* is a self-supporting series of coils telescopically arranged, lying in a non-inductive field. Far more sensitive than any radio tuning instrument ever perfected, bringing in programs from great distances clear and natural. Distortion is unknown in any circuit using *DeRoy Phusiformers.* The original music and speech is the *only* real rival of the DeRoy re-PRODUCTION. Highly selective, positive as a micrometer. Stations can be logged—always found at the same points on the dials. Non-radiating and non-oscillating.

A set that can be built free from all external noises, squeals, howls, and whistles is worth your consideration. We guarantee you these advantages.

List Price, $9
Complete with Dial

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Watch for Announcement of the New DeRoy "No-Los" Phusiformer Receiver

DE ROY RADIO CORPORATION

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from us with the least loss of time. Don't lose time writing manufacturers who, after some delay, will only refer you to some dealer who may not have what you want in stock. **SAVE TIME AND SEND YOUR ORDERS TO US,** and they will be filled from the most complete line of **NATIONALLY ADVERTISED RADIO GOODS** in the Middle West. Our stock and other stocks we have access to enables us to supply everything from a contact point or a binding post to a complete set with all supplies within 24 hours after receipt of your order, no matter how large or varied.

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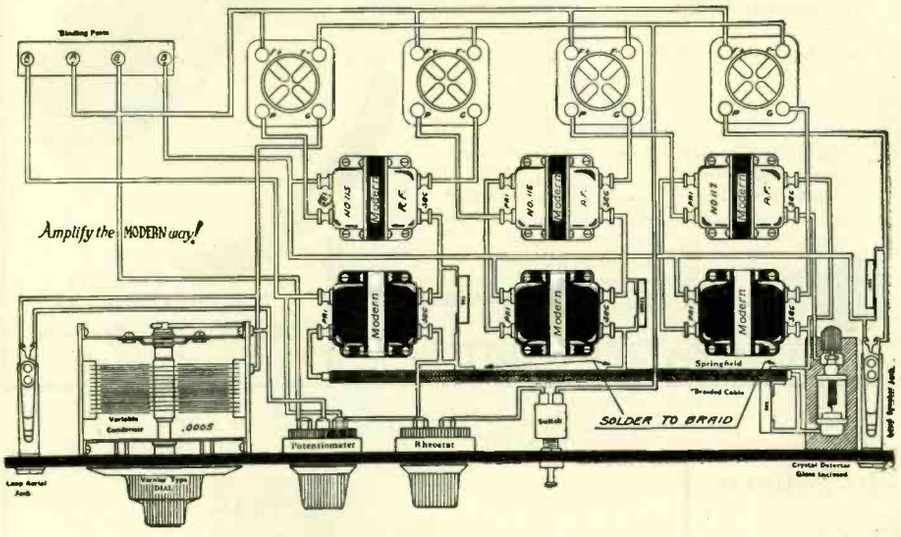
Amplify the MODERN *way!*

THE MODERN factory builds nothing but Transformers. MODERN engineers devote their entire time to the advancement of power Amplification. Those are the reasons for the unparalleled success of Modern Transformers.

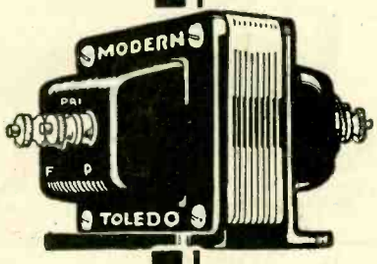
MODERN *Super-Six Reflex*



This is the peer of all Reflex circuits. IT WORKS ON A LOOP. Months of laboratory tests were made by MODERN engineers before the MODERN Radio Frequency Transformers used in the Super-Six circuit reproduced above were offered to the radio world. Its success and acceptance have been instantaneous. Large size wiring diagram mailed on receipt of 4c in stamps.

MODERN

TRANSFORMERS



MODERN "Push-Pull"

The perfect balance of Modern "Push-Pull" Transformers, plus their ability to provide the greatest possible amplification with clarity and volume and a minimum of distortion, has made them the last word in "push-pull" amplification. Price, per matched pair, $12.50.

MODERN Reflex

This is the transformer that makes one tube do the work of three in the Rasla Reflex. Distance, selectivity, and volume sufficient for a loud speaker. All these features are yours on one tube. Price, each, $5.50.

MODERN Standard Audio

This Transformer provides the utmost amplification with practically imperceptible distortion at all audio frequencies, Like other MODERN Transformers it has the endorsement of radio authorities and is used by numerous manufacturers of receiving sets. Price each, $5.00.

MODERN Long-Wave

The use of these MODERN 30 K. C. Transformers in Super-Heterodyne and Ultradyne circuits insures better-than-ordinary results. They provide the utmost of intermediate stage amplication. Price, each, $5.00.

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Most good dealers sell MODERN Transformers or will get them for you. Insist on getting the MODERN Transformers you need on our guarantee of satisfaction.

The Modern Electric Mfg. Co.

TOLEDO, OHIO

Tell 'Em You Saw It in the Citizens Radio Call Book

REMLER SUPER PARTS

For Gerald M. Best's 45,000 Cycle Super Circuit

Type 600
Transformer, $6.00

For building a super set using Gerald M. Best's 45,000 Cycle Circuit Remler Super Parts are recommended by Mr. Best. They operate at maximum efficiency at a frequency of 45,000 cycles—are built of finest materials, and receive an individual test before leaving the factory.

The Type 600 Intermediate Frequency Remler Transformer gives a practically uniform amplification between 45,000 and 50,000 cycles, with a maximum point at 45,000. It is an iron core transformer, housed in a bakelite casting. Terminals are brought out at the top; they are provided with nickel plated binding posts; are plainly marked to designate their association with other parts of the circuit.

Type 610
Transformer, $5.00

The Type 610 Tuned Stage Remler Transformer is a special air core type that prevents distortion of the voice frequency component of the 45,000 cycle carrier wave. When any standard .00025 mfd. condenser is shunted across the secondary, using the clips provided for that purpose, the Type 610 is tuned to 45,000 cycles. Handsomely made, and mounted in Bakelite casting, with marked terminal binding posts and condenser clips.

The use of a Remler Type 620 Coupling Unit in the Super Circuit as an oscillator coil system provides a uniform output over the entire broadcast wave length range. The split stator has balanced windings. Pigtail connections are provided. Note that this coupler is of the 180 degree type. Panel or table mounting.

The Remler Type 399 Dry Battery Tube Socket has self-cleaning contact springs, so that the tube prongs are automatically cleaned when tube is inserted in the socket. Fits only C-299 or UV-199 tubes. Special design insures compact wiring and short leads, a big factor in multi-tube sets using several stages of amplification. One of the finest dry cell tube sockets on the market.

Type 620 Coupling Unit, $3.00

Type C-399 Remler Dry Battery Tube Socket. List.....$ .75
Type 600 Remler Intermediate Frequency Transformer. List 6.00
Type 610 Remler Tuned Stage Transformer. List..... 5.00
Type 620 Remler Coupling Unit. List..... 3.00

TAYLOR ELECTRIC COMPANY
Madison, Wisconsin
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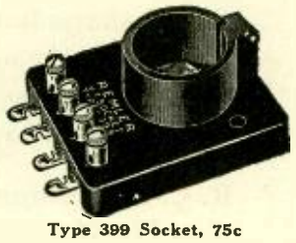
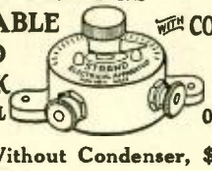


Type 399 Socket, 75c

If you have had difficulty in finding a good variable grid leak and condenser (as most every radio fan has) buy a

STRAND SUPERIOR

UNIVERSAL VARIABLE GRID LEAK FOR PANEL WITH CONDENSER $1.25 OR TABLE



Without Condenser, $1

When you install a STRAND SUPERIOR GRID LEAK AND CONDENSER, it will not be necessary for you to draw upon your imagination to detect improvements in your receiving set, and these are the reasons why:

Hand capacity effects are reduced to a minimum, permitting accurate adjustment.

Accurate adjustment of the STRAND SUPERIOR GRID LEAK will remain the same indefinitely, except when manually varied, and the adjustment for best reception is sharply defined. Its resistance range is 0.5 to 10 megohms.

Correct design of the brass and mica condenser used in the STRAND SUPERIOR results in an unchanging capacity of .00025 mf with direct and positive connections to the terminal posts.

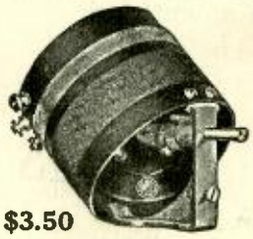
The excellent and unique construction of the STRAND SUPERIOR GRID LEAK AND CONDENSER unit insures quietness and smoothness of operation with a freedom from "hisses" and "crackles" that you will appreciate.

Every unit is tested in a broadcast receiver.

For sale at the better radio stores or by mail.

STRAND ELECTRICAL APPARATUS
Malden, Massachusetts

DEPENDABLE SIMPLEX **RADIO PRODUCTS**



$3.50

DX Tuner

With Spiral Wound Moulded Rotor. Strong signals, sharp tuning, highly selective. Specially designed for DX work.

$1.50

Lightning Arrester

Approved Air-Gap Type. Made of fine brown glazed porcelain. Easily installed. No fuse or vacuum.

SIMPLEX Receiving Set—Type RX

4 Dry-Cell Tubes. Simple and very selective. Great volume and distance. Dials can be logged for receiving stations each night. Handsome mahogany finish cabinet. Operates loud speaker.

$80.00

Price Without Accessories

Ask Your Dealer. Write Us for Catalog and Hook-Up

Simplex Radio Co. (Mfrs.), Philadelphia, Pa.

Index to Advertisers

AMATEURS ATTENTION!

OWING to the large amount of space devoted to amateur radio calls, the Board of Directors decided to publish a list of all the amateurs in the world in a complete book under one cover.

CONTENTS

U. S. AMATEURS
Complete fresh lists from the nine Radio Supervisors' offices, containing all new calls assigned and changes of addresses.

CANADIAN AMATEURS
Includes all Canada compiled by the Bureau of Marine and Fisheries, at Ottawa.

ENGLISH AMATEURS
Gives call letter, name and address of every amateur in England, carefully compiled from several different sources.

AUSTRALIAN AMATEUR STATIONS
Gives call letters, name and complete address of amateurs in all provinces of Australia.

NEW ZEALAND AMATEUR STATIONS
Shows call letter, name, address, power and wave length of all stations in New Zealand.

FRENCH AMATEUR STATIONS
Complete and up-to-date list just received from France.

LAND RADIO STATIONS OF THE WORLD
Shows all commercial and high powered transmitting stations giving call letters and wave length in every country of the world.

COMMERCIAL LAND AND SHIP STATIONS
Complete list corrected right up to date of all American ships and American commercial land stations.

FOR ONLY 40 CENTS

HOW TO OBTAIN

Tear out the enclosed coupon and send us 40c in stamps or money order.

Published by

CITIZENS RADIO SERVICE BUREAU
508 South Dearborn Street **Chicago, Ill.**

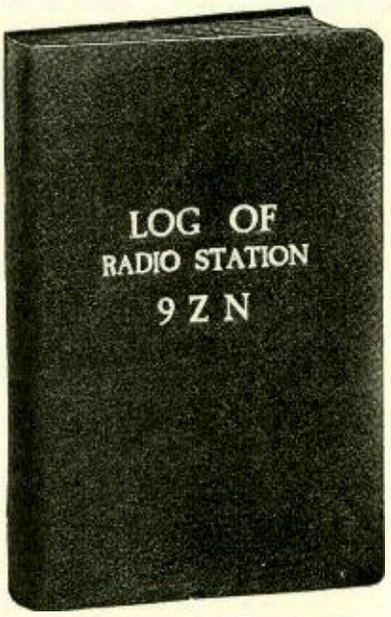
NOTICE TO DEALERS
Owing to the fact that there are a limited number of operators desiring this information and as we are furnishing this book at cost, we are not burdening the dealers with the sale of this publication. WE WILL NOT furnish Amateur Section separate, or without coupon.

Citizens Radio Service Bureau,
508 So. Dearborn St., Chicago, Illinois.
Gentlemen:—
Please find enclosed 40c for which send me your complete and up to date CALL BOOK.

(Name).....

(Address).....

(City and State).....



No Radio Station is Complete Without a

RADIO LOG

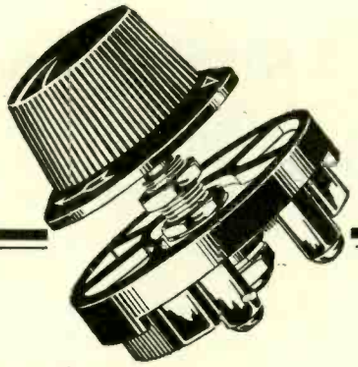
RADIO STATION LOG

Date	Station	Time	Q S S	Q R N	Char	Tone	Remarks

THE Citizens Radio Service Bureau has made arrangements to furnish at cost, a genuine Art Leather, 6x9½ inch, double snap ring, loose leaf cover, with your name stamped in gold, containing 100 log sheets. These log sheets are so arranged that you can record the position of all adjustments on your receiver, where the different stations are heard.

Sent upon receipt of $1.85, include 15c for postage. Please print your name plainly.

CITIZENS RADIO SERVICE BUREAU
508 South Dearborn Street **CHICAGO, ILL.**



DeJur RHEOSTATS

One Hole
Genuine Bakelite

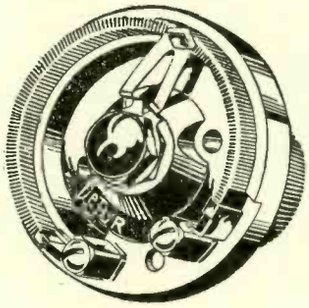
EMBODYING

Exclusive Features, Yet Costs No More

Smooth and easy running, yet maintaining perfect electrical contact. Shaft carrying the slide contact is set at the factory and permanently adjusted by experts, eliminating the possibility of future trouble.

No back panel adjustment necessary—merely fasten the knob or dial on the front of the panel—thus avoiding the possibility of leaving the sliding contact loose or having screwdriver slip and ruin the resistance element of the rheostat.

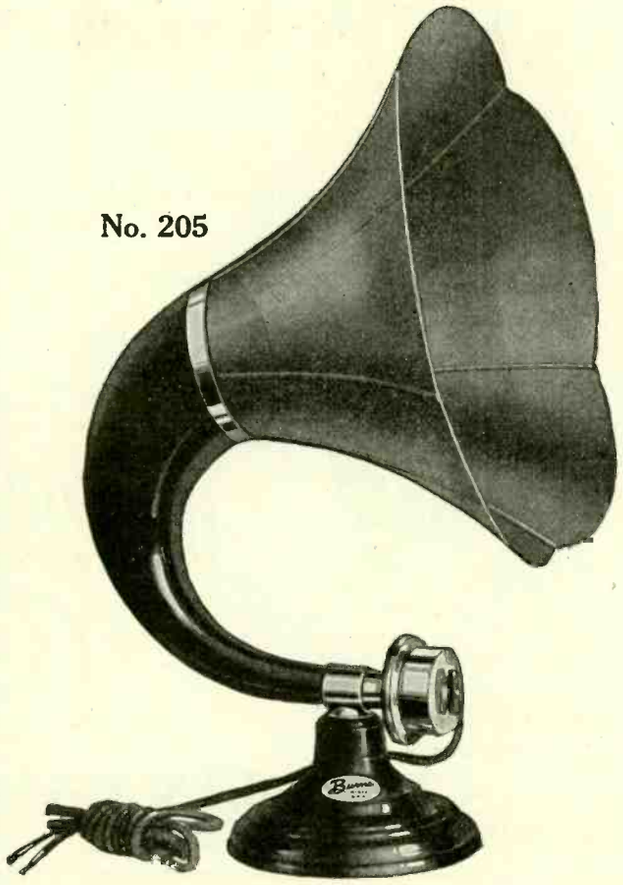
A Rheostat Without an Equal



At dealers everywhere.
Jobbers Write for Catalog

DeJur Products Co.
199 Lafayette Street New York

No. 205



Burns

A Reproducer of Distinction, Volume, Clarity, and Beauty

Tone quality is of a surprising clearness and naturalness that instantly attracts attention.

The generous size and correct design of this horn assures best acoustic results and remarkable volume of tone. The flare of the bell—14 inches in diameter—is of polished black pyralin, practically unbreakable and of a rich distinctive appearance. Sound column is of aluminum.

Equipped with the well-known Burns Speaker Unit which has convenient adjuster for regulating the tone. No separate batteries required.

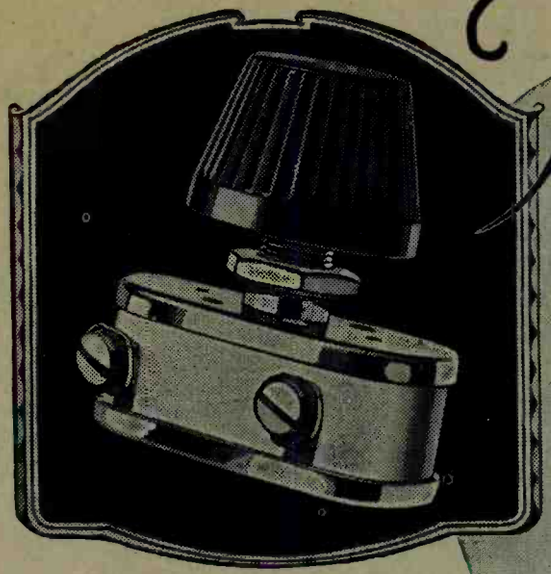
Also made up in a more elaborate style with the flare of bell of handsome shell finish pyralin, semi-transparent.

No. 205B—With polished black bell.....$22.50
No. 205D—With shell pyralin bell..... 25.00

Ask for data on our complete line of Radio products. Designed and built by telephone experts.

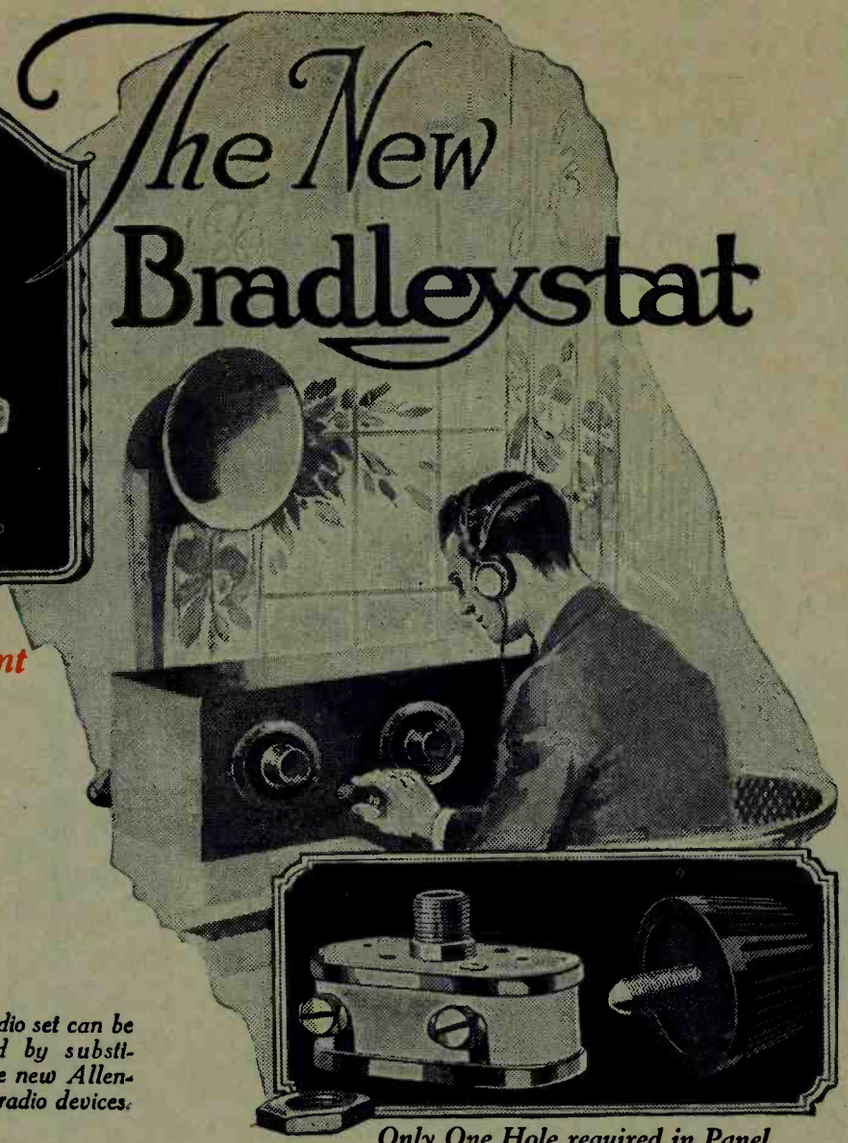
American Electric Company
State & 64th Streets
CHICAGO, U. S. A.

The New Bradleystat



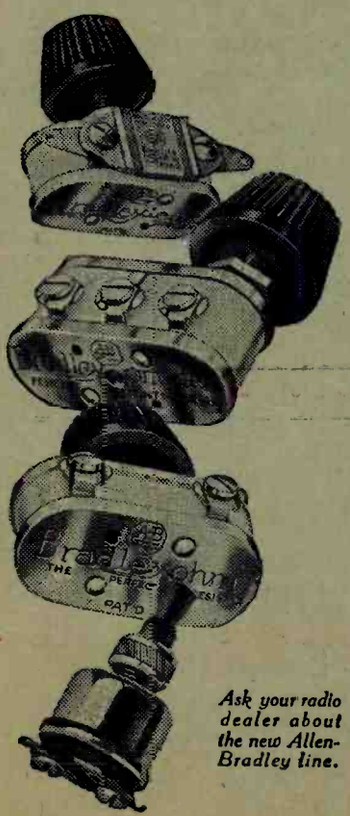
A Remarkable Achievement

Many refinements are embodied in the new Bradleystat. The graphite disc columns are enclosed in a *smaller* container; *two* terminals suffice for ALL tubes; a *new mounting* simplifies installation; the *knob* is of a daintier pattern. And the noiseless, stepless control of the old Bradleystat remains, unchanged. Such a combination of advantages can be found in no other filament rheostat.



Only One Hole required in Panel

Every radio set can be improved by substituting the new Allen-Bradley radio devices.



Ask your radio dealer about the new Allen-Bradley line.

A ***DISTINCTLY new and valuable contribution to radio!*** That is the verdict of all radio engineers and designers who have seen the new Allen-Bradley radio devices and have witnessed their amazing performance. The new "one-hole mounting," which replaces the older clip mounting, makes for marvelous compactness and simplicity of installation. The new Bradleystat, Bradleyleak and Bradleyohm require only a 11/16-inch space behind the panel, and the Bradleyometer only 7/8-inch. Thus, the new models can replace inferior wire rheostats and potentiometers without disturbing the arrangement of the set. Our new literature is ready. Send for it, today!

Allen-Bradley Co.

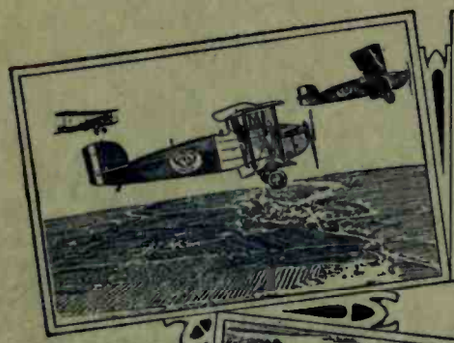
Electric Controlling Apparatus

488 Clinton St. — Milwaukee, Wis.

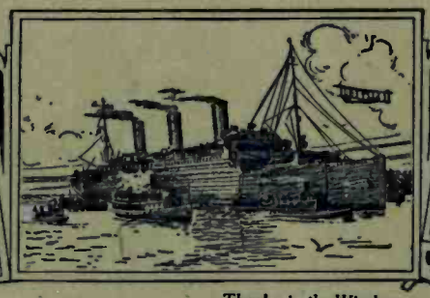
Baltimore	Buffalo	Cleveland	Knoxville	Philadelphia	Saint Paul
Birmingham	Chicago	Denver	Los Angeles	Pittsburgh	San Francisco
Boston	Cincinnati	Detroit	New York	Saint Louis	Seattle

Just a Few Adventures of

BURGESS
RADIO BATTERIES

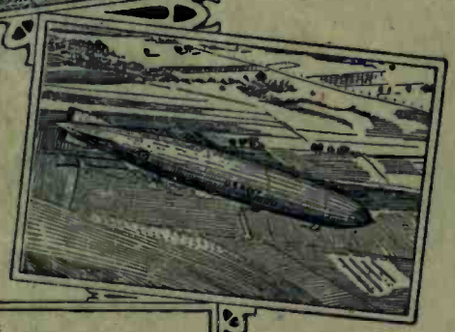


The World Flyers carried Burgess



They're in the Wireless Room of the Leviathan

Standard Equipment of United States Submarines



From U. S. G. Photos

The Shenandoah is Equipped with Burgess Batteries and MacMillan carried them to the Arctic.

If the quality of any product may be judged in part by the standing of its users, surely Burgess quality must be considered unusually high.

Burgess Radio Batteries are found where there's need for the most efficient batteries made—in emergencies where failure brings disaster—with explorers in far-off lands—with the unsung heroes of the air service—beneath the seas with the crew of the submarines.

"ASK ANY RADIO ENGINEER"

Send for the Burgess Radio Compass. Surprising —amusing and interesting to the entire family. Sent free of charge from 171 Burgess Engineering Building, Madison, Wisconsin. Write for it.

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