Summer Edition

Radio Listeners' Guide and Call Book

A Quarterly Magazine

Edited by
S. Gernsback

Fifty Cents

SETTING-UP EXERCISES
Posed by
Marceline Day
(Metro-Goldwyn-Mayer)

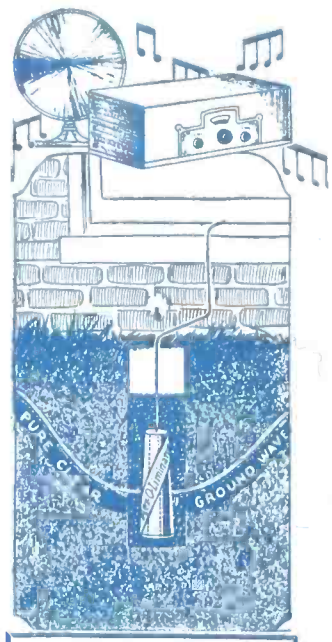
In This Issue ~ Experimental Television and Telephoto

Astounding

Successful

GROUND ANTENNA

Gets Winter Reception in Summer!



EASY TO INSTALL
Just dig a small hole about 6 inches in diameter and drop Aer-O-Liminator into it.

Clearer Ground Wave Reception Allows Greater Distance

Hundreds of satisfied users of the sensational Ground Antenna — Aer-O-Liminator — are wondering how they ever got along without it. All over the country radio owners are finding marvelous satisfaction in freedom from static and noise interference. This revolutionary improvement of reception comes from hooking your receiver to Ground Wave Reception. Radio engineers tell you that the broadcast wave through the ground is in most cases almost static-free and with rare exception carries no noise interference.

The rapidly increasing army of Aer-O-Liminator owners also enjoy and appreciate the natural human tone and clarity of this Ground Wave Reception. If you haven't tried it you can't imagine the difference!

Another advantage users have found with Aer-O-Liminator is the surprising DX they get. Distant stations formerly drowned out by static or noise interference of air waves now come in clear as a bell. Selectivity is improved because, with pure, clear Ground Wave Reception, you can pick up and log signals that before were lost in the jumble of shrieks and howls so common in DX reception through air waves.

You shouldn't deprive yourself of the new thrill of pure, clear ground wave reception a day longer than necessary. We let you prove it for yourself.

FREE TRIAL

Make this thrilling test at our risk!

Install an Aer-O-Liminator (Ground Antenna). Leave your old overhead aerial up. Try out on a night when static is bad. If you do not get a wonderful improvement in freedom from static, greater selectivity and clear, sweet tone without interfering noises, if you can't get good reception on stations that are drowned out by static on your old aerial, you need not pay us a red cent for this test! Send coupon at once for scientific explanation of Aer-O-Liminator (Ground Antenna), proof of performance and our conclusive iron-bound guarantee, and remarkable Free Trial Offer—Mail Coupon TODAY!

Read this Proof

From 208 Golf Terrace
Wilmette, Ill.

"Your Aer-O-Liminator works fine. You could hardly believe what a difference it makes in the clearness and tone of my set. It certainly seems to take out nearly all the static and power noises that have been bothering me, too.

"Mine is only a three tube set, but with the Aer-O-Liminator I can pick up outside stations every night, clear and with volume. You must be right about the static-free ground waves."

L. Beauvais.

From Kimberly Radio Corp.,
328 N. Michigan Ave., Chicago.

"We have used the Aer-O-Liminator with great satisfaction. It removes the necessity of the unsightly outside aerial and improves reception materially. It reduces static and outside interference, and produces very clear tones on distant stations, with good volume. It increases selectivity greatly. We would recommend it to anyone for the best results on his set."

P. R. Kimberly, President.

Rush This Important Coupon

Curtan Mfg. Company,
154 E. Erie St., Dept. 585-H, Chicago, Ill.

Please send me at once complete description of Aer-O-Liminator, with details of guarantee, Scientific Proof, and Free Trial Offer.

Name .....

Address .....

City .....

State .....

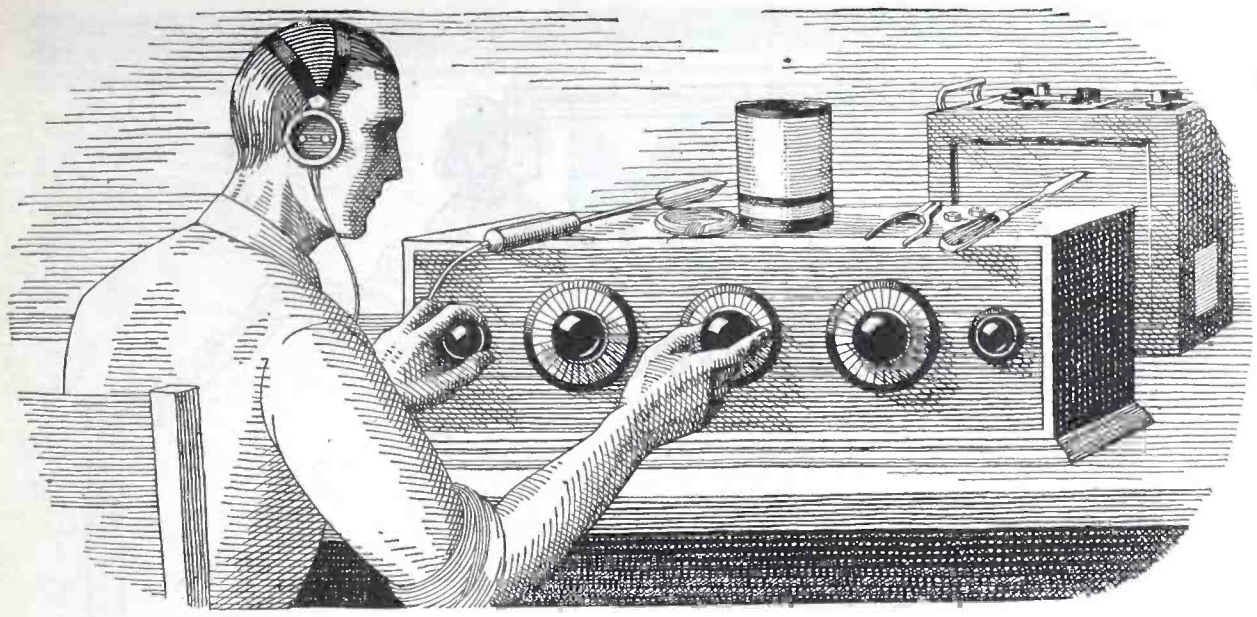
Aer-O-Liminator
(Ground Antenna)

Passed by the National Board of Fire Underwriters. Meets requirements of the National Electrical Code.

Endorsed by Foremost Engineers and Dealers.

CURTAN MFG. COMPANY

Dept. 585-H, 154 E. Erie Street, Chicago, Ill.



If all the Radio sets I've "fooled" with in my time were piled on top of each other, they'd reach about half-way to Mars. The trouble with me was that I thought I knew so much about Radio that I really didn't know the first thing. I thought Radio was a plaything—that was all I could see in it for me.

I Thought Radio Was a Plaything

But Now My Eyes Are Opened, And I'm Making Over $100 a Week!

$50 a week! Man alive, just one year ago a salary that big would have been the height of my ambition.

Twelve months ago I was scrimping along on starvation wages just barely making both ends meet. It was the same old story—a little job, a salary just as small as the job—while I myself had been dragging along in the rut so long I couldn't see over the sides.

If you'd told me a year ago that in twelve months' time I would be making $100 and more every week in the Radio business—whew! I know I'd have thought you were crazy. But that's the sort of money I'm pulling down right now—and in the future I expect even more. Why only today—

But I'm getting ahead of my story. I was hard up a year ago because I was kidding myself, that's all—not because I had to be. I could have been holding then the same sort of job I'm holding now, if I'd only been wise to myself. If you've fooled around with Radio, but never thought of it as a serious business, maybe you're in just the same boat I was. If so, you'll want to read how my eyes were opened for me.

When broadcasting first became the rage, several years ago, I first began my dabbling with the new art of Radio. I was "nuts" about the subject, like many thousands of other fellows all over the country. And no wonder! There's a fascination — something that grabs hold of a fellow—about twirling a little knob and suddenly listening to a voice speaking a thousand miles away! Twirling it a little more and listening to the mysterious dots and dashes of steamers far at sea. Even today I get a thrill from this strange force. In those days, many times I stayed up almost the whole night trying for DX. Many times I missed supper because I couldn't be dragged away from the latest circuit I was trying out.

I never seemed to get very far with it, though. I used to read the Radio magazines and occasionally a Radio book, but I never understood the subject very clearly, and lots of things I didn't see through at all.

So, up to a year ago, I was just a dabbler—I thought Radio was a plaything. I never realized what an enormous, fast growing industry Radio had come to be—employing thousands and thousands of trained men. I usually stayed home in the evenings after work, because I didn't make enough money to go out very much. And generally during the evening I'd tinker a little with Radio—a set of my own or some friend's. I even made a little spare change this way, which helped a lot, but I didn't know enough to go very far with such work.

And as for the idea that a splendid Radio job might be mine, if I made a little effort to prepare for it—such an idea never entered my mind. When a friend suggested it to me one year ago, I laughed at him.

"You're kidding me," I said.

"I'm not," he replied. "Take a look at this ad."

He pointed to a page ad in a magazine, an advertisement I'd seen many times but just passed up without thinking, never dreaming it applied to me. This time I read the ad carefully. It told of many big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. Well, it was a revelation to me. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, I've had a Radio business of my own. At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

Now I'm making, as I told you before, over $100 a week. And I know the future holds even more, for Radio is one of the most progressive, fastest growing business in the world to-day. And it's work that I like—work a man can get interested in.

Here's a real tip. You may not be as bad off as I was. But think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years—making the same money? If not, you'd better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free, and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. 5Q, Washington D. C.

J. E. SMITH, *President*,
NATIONAL RADIO INSTITUTE,
DEPT. 5Q, WASHINGTON, D. C.

Dear Mr. Smith:
Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation and that no salesman will call on me.

Name .....

Address .....

Town ..... State .....

Radio Listeners' Guide and Call Book

A Quarterly Magazine

Volume III — Number 1

JUNE, 1928

Contents of This Issue

RADIO LISTENERS' GUIDE AND CALL BOOK

A Quarterly Magazine

VOL. III, No. 1 — JUNE, 1928

Published quarterly by The Consrad Co., Inc., 230 Fifth Ave., New York, N. Y., telephone number Ashland 9344; H. Gernsback, President; S. Gernsback, Vice-President and Treasurer; C. E. Rosenfelt, Secretary. Price 50c a copy; subscriptions $1.75 a year in the United States of America, Canada and all countries within the domestic postal zone: elsewhere $2.00 a year, payable in advance. Subscriptions only acceptable in U. S. currency or stamps. No foreign currency or stamps. Checks and money orders should be drawn to the order of THE CONSRAD CO., Inc.

When subscribing to RADIO LISTENERS' GUIDE AND CALL BOOK, send your name and remittance to The Consrad Company, Inc., 230 Fifth Ave., New York, N. Y. Mention that you desire to subscribe to same. We also publish and distribute CONSRAD PATTERNS, E. I. COMPANY BOOKS, etc. Write clearly.

Entered as second class matter, March 10, 1925, at the Post Office at New York, N. Y. under the Act of March 3, 1879. Additional entry at the Post Office at Dunellen, N. J.

Published by the Same Management:

RADIO NEWS — SCIENCE AND INVENTION — AMAZING STORIES — FRENCH HUMOR

General Advertising Dept., 230 Fifth Ave., New York City

ADVERTISING REPRESENTATIVES

S. B. Darmstader, 326 W. Madison St., Chicago, Ill.
Harry E. Hyde, 548 Drexel Bldg., Philadelphia, Pa.
A. J. Norris Hill Co., 5 Third St., San Francisco, Calif.
412 West 6th St., Los Angeles, Calif.
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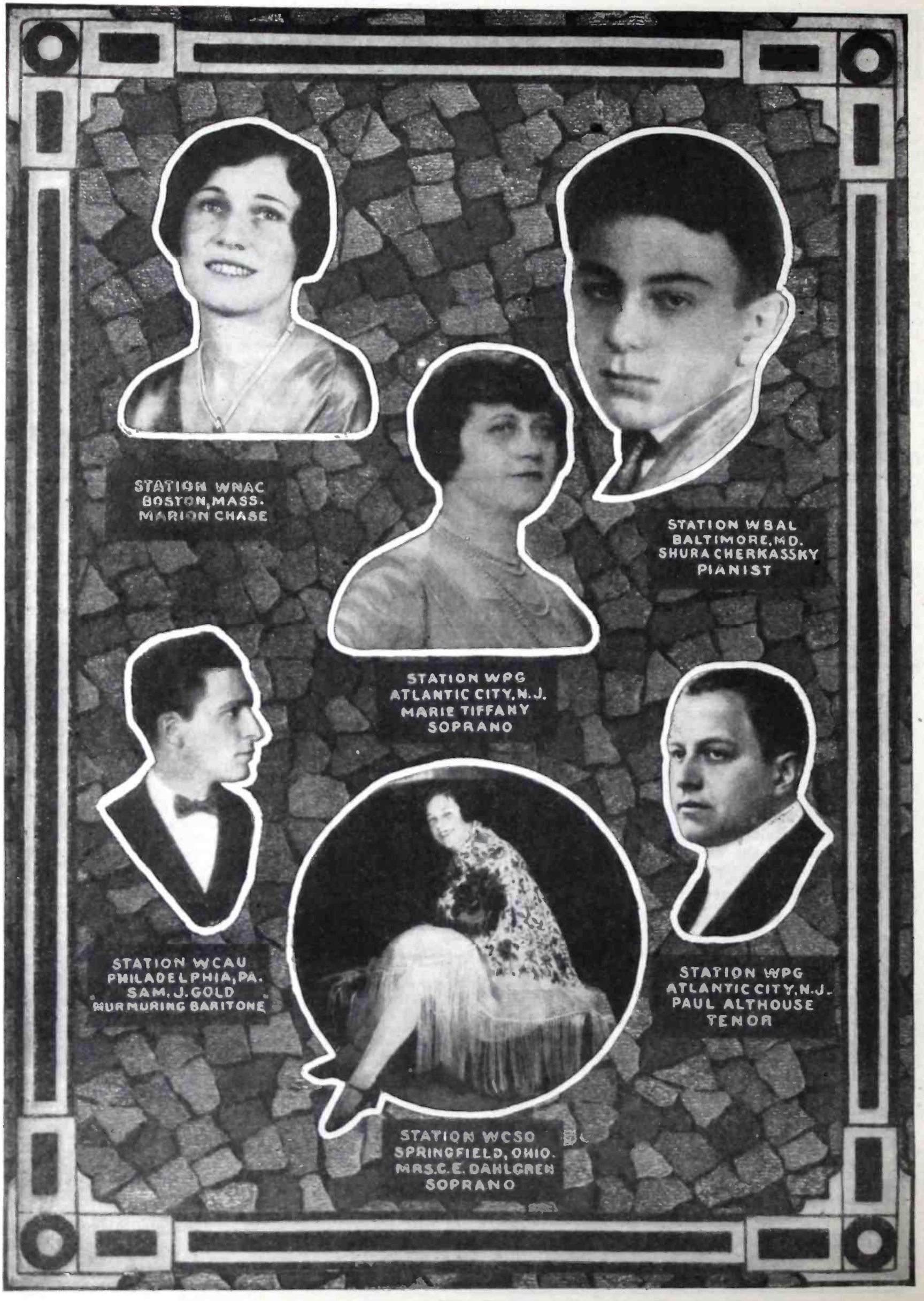
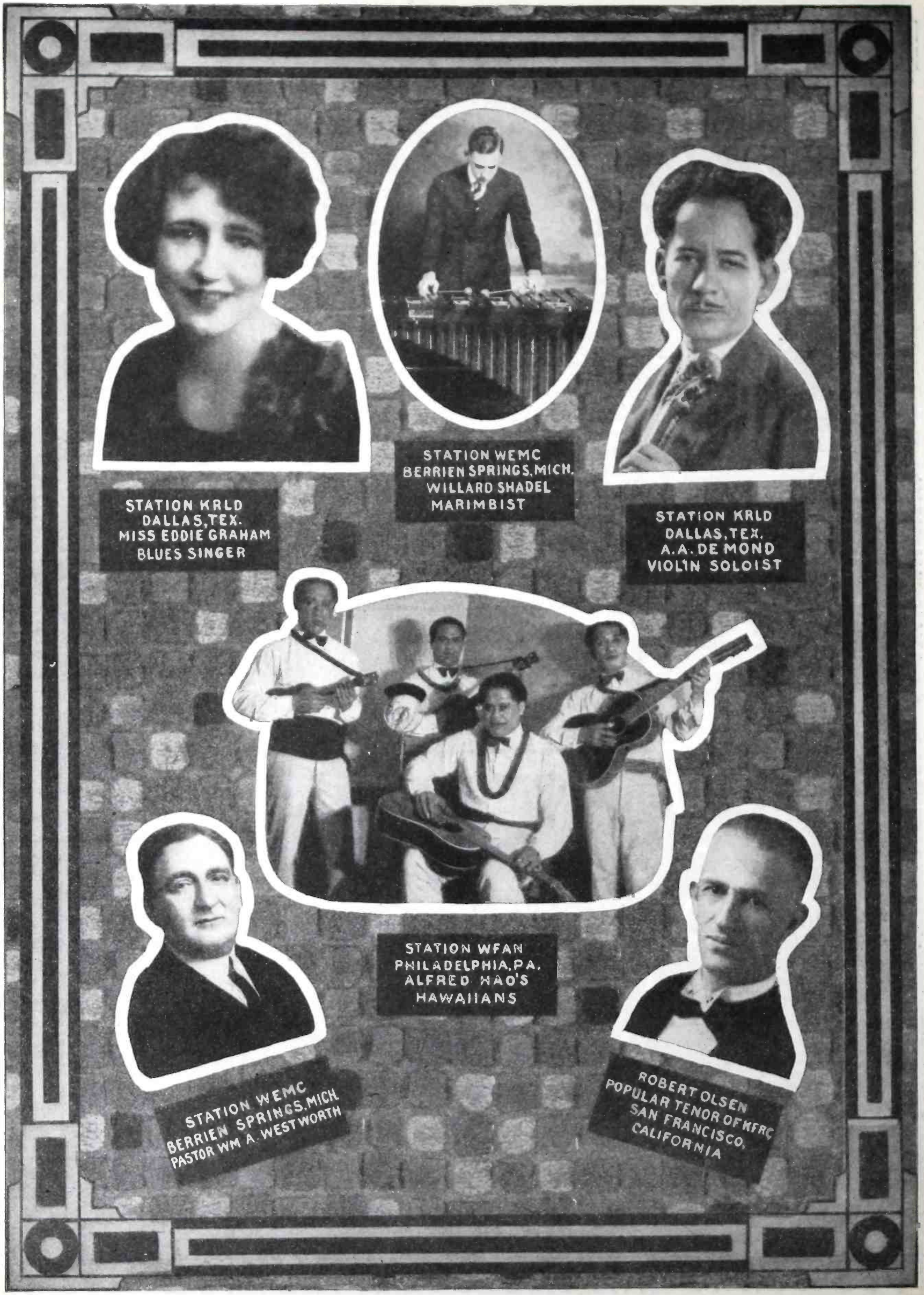
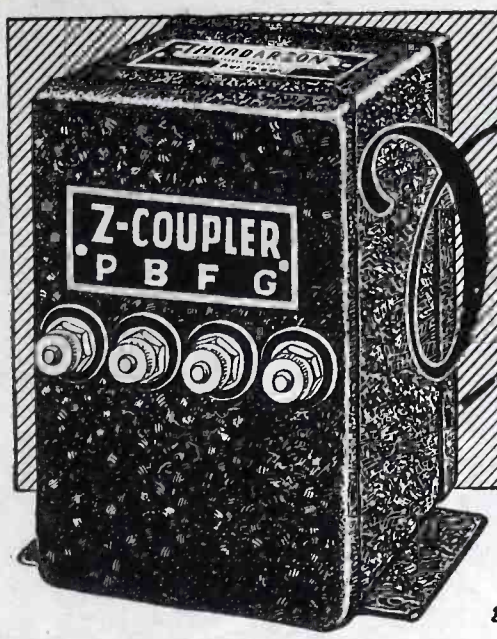






The Thordarson Z-Coupler, a special audio impedance coupler for use with screen grid tubes; price each, $12.

New! SCREEN-GRID Audio Amplification

Screen grid audio amplification, most revolutionary development in audio systems since the introduction of the power tube, is now an established fact.

The Thordarson Z-Coupler is a special audio coupling device designed for use with the screen grid tube UX-222. With the remarkable amplification thus obtained a mere whisper from the detector is stepped up to a point that gives the power tube all it can handle in the way of signal voltage. In fact, one stage Z-Coupled audio has the amplification equivalent of two, or even three, stages of ordinary coupling. Signals barely audible before may now be heard at normal room volume.

In tone quality, too, the Z-Coupler is unexcelled. Despite the high amplification the tonal reproduction is as nearly perfect as any audio amplifier yet developed. Both high and low notes come through with the same volume increase. Even at 60 cycles the amplification is over 95% of maximum.

Regardless of the type of your receiver you can vastly improve its performance by including this new system of amplification. The Z-Coupler replaces the second audio transformer, with very few changes in the wiring. The screen grid tube is used in the first audio stage. No shielding is required.

THORDARSON Z-COUPLER

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill. U.S.A.

Write To-Day for Complete Information

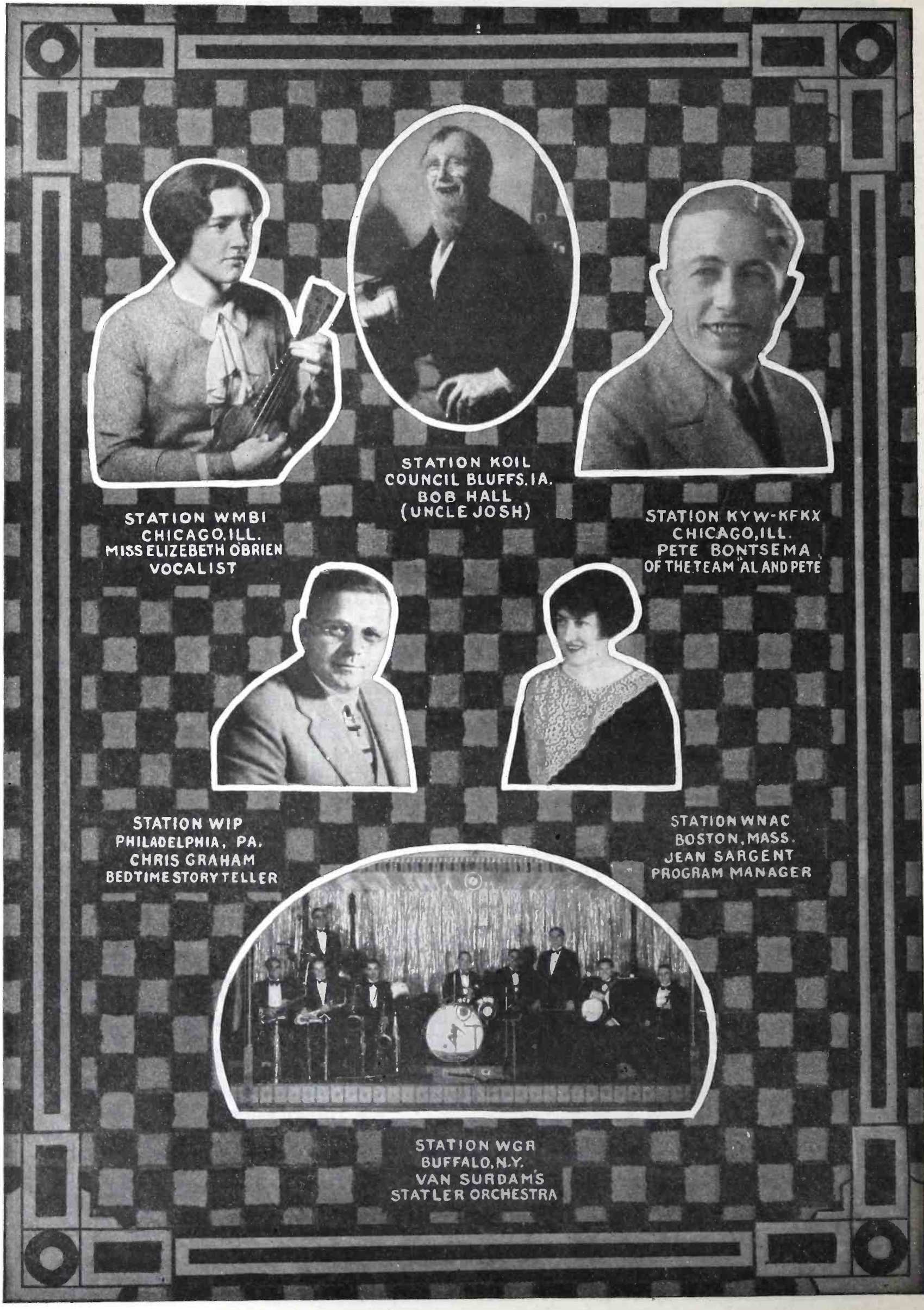
THORDARSON ELECTRIC MFG. CO.
Huron and Kingsbury Sts., Chicago, Ill.
Gentlemen:

Without obligation on my part, please send me complete information on screen grid audio amplifiers using your new Z-Coupler. (3578-N)

*Name*_____

*Street and No.*_____

*Town*_____ *State*_____



30 Up-to-Date Selections

With This Portable Phonograph

$1.00 down

A sensational offer. Only $1.00 with coupon below brings this Portable Phonograph with a special assortment of up-to-date high-grade 75c records—30 selections in all, 15 double face records. These records are made by the wonderful **new electric process**—more life like, more volume, less surface noise than ever. And they play longer. Very latest selections, popular songs, dance music, band and instrumental pieces — $11.25 worth of brand new records included with this outfit. We've picked out just the kind of records to please you most. And besides we give you

30 Days Trial

Yes, we'll send this Puritone portable phonograph outfit, with 30 high-grade selections, 15 double face 75c records, to your home on 30 days trial for only $1.00 with the coupon. Use it as your own and see what a wonderful convenience it is to have a phonograph that you can carry from room to room, from place to place, wherever and whenever you want it.

We Guarantee: that you get everything in this phonograph so far as concerns music reproduction that a $250 phonograph can give you. True, you don't get the big furniture, but you do get **(and we guarantee it)** the exact reproducer, the exact style of tone arm and the same grade of records you get in the most expensive phonograph ever made. That's why you get, on this wonderful offer, **absolutely the best** in music that any phonograph ever gave.

$2.60 a Month

If within 30 days you decide not to keep the outfit, send it back and we'll refund your $1.00 plus all transportation charges. If you keep it, pay only $2.60 a month until you have paid that sensational price on this special sale—only $26.85. Think of it, a first class high grade phonograph and 15 high grade, up-to-date, double face records—[30 selections] a complete outfit, ready to play, only **$26.85**! Seize this opportunity on this special sale, while it lasts. Send the coupon NOW!

FREE Catalog of home furnishings sent on request with or without order. See coupon.

Send Coupon NOW!

Straus & Schram, Dept. A356 Chicago, Ill.

Folds Like a Suitcase

with snap locks and carrying handle. So light and convenient — easily carried wherever you want it. Take it along to parties where you want to dance and sing, or listen to good music. Take it with you on trips.

It plays any make of standard 10-inch disc records and plays two ten-inch records with one winding. Weighs 17 lbs. Waterproof imitation leather case, with hinged lid. Measures 14½ x 12 x 7½ in. Records placed inside of lid and secured so they will not rattle or break. Holds 15 records. Has quiet spring motor, tone arm and reproducer with indestructible diaphragm and wide throat for full sound volume. Outfit includes 15 double face 75c *New Electric Process* records —30 selections. A complete record library without buying a single one! Shipping weight packed about 25 lbs.

Order by No. W8824JA—only $1.00 with coupon, $2.60 monthly. Total price, $26.85.

Straus & Schram, Dept. A356 Chicago, Ill.

Enclosed find $1. Ship special advertised Puritone Portable Phonograph with 15 Double Face 75c *New Electric Process* records —30 selections. I am to have 30 days free trial. If I keep the outfit, I will pay you $2.60 monthly. If not satisfied, I am to return the phonograph and records within 30 days and you are to refund my dollar and express charges I paid.

Puritone Portable Phonograph and 15 Double Face Records, W8824JA, $26.85

Name _____

Street, R.F.D. or Box No. _____

Shipping Point _____

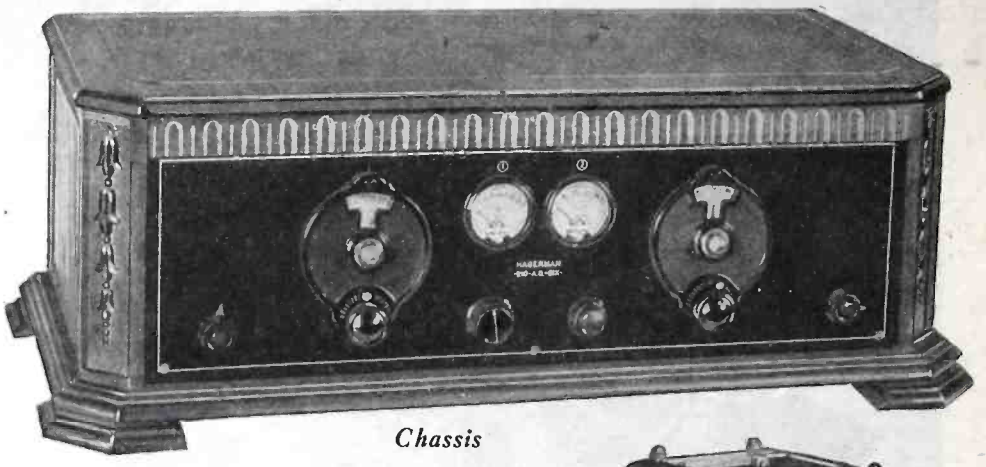
Post Office _____ *State* _____

Married or Single _____ *Nationality or Color* _____

If you want only our free catalog of home furnishings, mark X here ☐

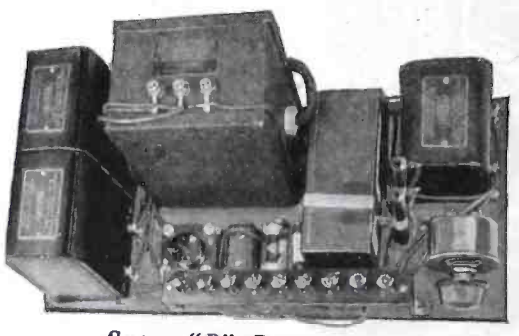
HAGERMAN ENSE

The Perfect Custom-Built Ensemble!



Chassis

Molded Wood Speaker Tone Chamber



Super "B" Power Supply

"A" Supply

These Leading Manufacturers Make This

MUTER

Power Condensers—Resistances, Etc.

The filter condensers of a power circuit are its most critical constants. Muter precision manufacturing methods assure the custom set builder, when he uses Muter Power Condensers, as well as chokes, resistances, transformers, etc., that the set he builds will be perfect in every detail.—Leslie F. Muter Co., 76th and Greenwood Ave., Chicago

JEWELL

Voltmeters

In the Hagerman 210-A.C.-Six Ensemble, Jewell instruments were chosen because of the years of experience of the manufacturer and because of the special fitness of these instruments for adaption to this circuit; Jewell instruments are accurate, sturdy and good looking, and will give untold satisfaction in their use.—Jewell Electrical Instrument Co., 1650 Walnut St., Chicago.

THORDARSON

Power Compact

"Transformers" and "Thordarson" are almost synonymous. The reliability and efficiency of the radio set or power supply is directly in ratio to the theoretical and mechanical perfection of the voltage supply or amplifying transformers. The R-171 and R-210 Power Compacts are the heart of any power amplifier or "B" supply.—Thordarson Electric Mfg. Co., 500 W. Huron St., Chicago.

MOLDED WOOD

Speaker Tone Chamber

The finest type of loud speaker as acknowledged by such great authorities as Dr. Lee De Forest. A natural choice for use in conjunction with the powerful 210-A.C.-Six. Equally as adaptable to any set with or without power amplification. Ready mounted for installation in any console or speaker table.—Moided Wood Products Company, 219 West Chicago Avenue, Chicago.

STATION KOA
DENVER, COLORADO
FREEMAN H. TALBOT
STUDIO DIRECTOR

STATION WJAX
JACKSONVILLE, FLA.
BOB MITCHELL
ORGANIST

STATION WPSC
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PENNSYLVANIA STATE COLLEGE VARSITY QUARTETTE

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BLUES SINGER

STATION WFIW
HOPKINSVILLE, KY.
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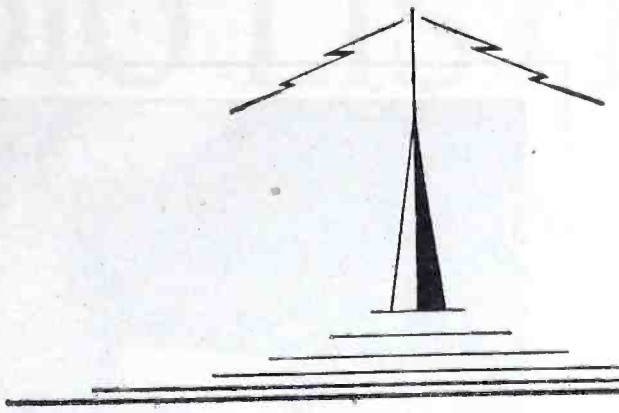
DIRECTOR



ANNOUNCEMENT

The new Balkite AC set will retail in the table model at a price between $175 and $200 without tubes. A complete line of console cabinets will be available. Showing will be made at an early date. The set will be worthy of the name Balkite, and well worth waiting for.

For your present radio set Balkite Radio Power Units furnish all power from the light socket and convert it into an electric receiver

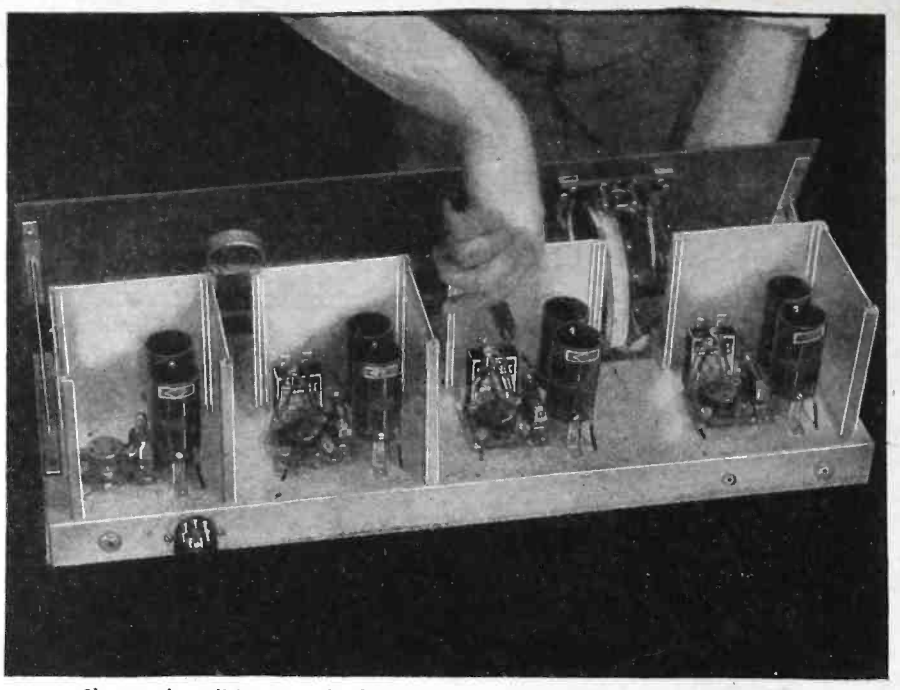
FANSTEEL

Balkite RADIO

FANSTEEL PRODUCTS COMPANY, Inc., *North Chicago, Illinois*

"I have used ACME PARVOLT *Condensers for many years and have never had one break down."*

E. W. Ackerday



Showing the well-known L. C. 28 wired for A. C. power supply. Only the finest parts are specified in this high class set, including PARVOLT *By-Pass Condensers.* ACME PARVOLT *Filter Condensers are also recommended for use in the power end.*

Whether You Buy or Build

a Power Supply Unit for Your Radio

PLAY SAFE WITH PARVOLTS!

WHEN you buy an electrified radio or power supply unit for your receiver, look for ACME PARVOLT Condensers; they are your guide to quality in all other parts. They cost the manufacturer a trifle more, but they are both his and your guarantee against costly condenser break-down.

Should you build your own power supply, be sure to use ACME PARVOLT Condensers and be safeguarded against the possibility of break down. Remember that poor filter condensers have caused untold thousands of dollars worth of loss in the past year or two, for blown out condensers mean blown tubes, burned out transformers and frequently the ruination of speaker units.

Just as PARVOLT By-Pass Condensers have been used for years in high grade receivers, so are PARVOLT Filter Condensers rapidly replacing ordinary condensers in electrified radio. These condensers are wound with the very finest insulating papers combined with highest grade foils. Every detail produced in one of America's most modern plants and under the supervision of experts in condenser design and manufacture.

Uniformity of capacity and uniformity of sizes are two big features. Accuracy of all ratings, based upon the R.M.A. standards, is another guarantee of uninterrupted service. Play safe with PARVOLTS!

Made by THE ACME WIRE CO., New Haven, Conn., manufacturers of magnet and enameled wire, varnished insulations, coil windings, insulated tubing and radio cables.

ACME PARVOLT FILTER CONDENSERS
In all required mfd. capacities for 200, 400, 600, 800, 1000, and 1500 Volt D C requirements. Supplied singly or in complete wired blocks for the important power supply units.

ACME PARVOLT BY-PASS CONDENSERS
Supplied in all required mfd. capacities and for all standard working voltages.

ACME PARVOLT CONDENSERS

Made by the Manufacturers of

ACME CELATSITE WIRE

ENAMELED AERIAL WIRE
Enameled copper wire in both stranded and solid types. Also Acme Lead-ins, Battery Cables, Indoor and Loop Aerial Wire.

CELATSITE FLEXIBLE and SOLID
For all types of radio wiring. High insulation value; non-inflammable. 10 colors.

ACME SPAGHETTI
A superior cambric tubing for all practical radio and other electrical requirements. Supplied in 10 colors.

RADIO LISTENERS' GUIDE and CALL BOOK

A Quarterly Magazine

Sidney Gernsback, Editor — *W. G. Many, Managing Editor*

RADIO BROADCAST STATIONS OF THE UNITED STATES

Indexed Alphabetically by Call Letters

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
KDKA	**E. Pittsburgh, Pa.** —Westinghouse Elec. & Mfg. Co.	50000	315.6	950	Eastern
KDLR	**Devils Lake, N. Dak.**— Radio Elec. Co.	15	230.6	1300	Central
KDYL	**Salt Lake City, Utah** —Intermountain Brdcast. Corp. 1009 Ezra Thompson Bldg.	500	234.2	1280	Mountain
KEJK	**Los Angeles, Cal.**— Macmillan Petroleum Co. 218 N. Larchmont Blvd. (Divides time with KGER)	250	252	1190	Pacific
KELW	**— Burbank, Calif.** — Earl L. White, 3702 Magnolia Ave. (Divides time with KPPC) (1000 watts Daytime)	500	228.9	1310	Pacific
KEX	**—Portland, Ore.**—Western Broadcasting Co.	2500	277.6	1080	Pacific
KFAB	**—Lincoln, Nebr.**—Nebraska Buick Auto Co. (Divides time with KOIL)	5000	319	940	Central
KFAD	**—Phoenix, Ariz.** — Electrical Equipment Co.	500	322.4	930	Mountain
KFAU	**—Boise, Idaho**—Independent School, Dist. of Boise (4000 watts Daytime)	2000	285.5	1050	Mountain
KFBB	**—Havre, Mont.**—F. A. Buttrey Co.	50	275.1	1090	Mountain
KFBI	**—San Francisco, Cal.**— (Airplane) Flying Broadcasters, Inc., 6138 Fulton St.	50	204	1470	Pacific
KFBK	**—Sacramento, Calif.**— Kimball-Upson Co., 610 California St.	100	275.1	1090	Pacific
KFBL	**—Everett, Wash.**—Leese Bros., 2814 Rucker Ave.	50	223.7	1340	Pacific
KFBU	**—Laramie, Wyo.**—St. Mathews Cathedral, Bishop N. S. Thomas.	500	483.6	620	Mountain
KFCB	**—Phoenix, Ariz.** — Nielson Radio & Sporting Goods Co., Central Ave. at Pierce.	125	243.8	1230	Mountain
KFCR	**—Santa Barbara, Cal.** —Santa Barbara Broadcasting Co., 1200 Anacapa St.	100	211.1	1420	Pacific
KFDM	**—Beaumont, Tex.** — Magnolia Petroleum Co.	500	483.6	620	Central
KFDX	**—Shreveport, La.** — 1st Baptist Church	250	236.1	1270	Central
KFDY	**—Brookings, S. Dak.**— South Dakota State College (Divides time with WDAY)	1000	545.1	550	Central
KFDZ	**—Minneapolis, Minn.**— H. O. Iverson, 2510 Thomas Ave., South.	10	215.7	1390	Central
KFEC	**—Portland, Ore.**—Meier & Frank Co. (Divides time with KFIF).	50	214.2	1400	Pacific
KFEL	**—Denver, Colo.**—Eugene P. O'Fallon, Argonaut Hotel.	250	227.1	1320	Mountain
KFEQ	**—St. Joseph, Mo.** — Scroggin & Co. Bank, Hotel Robidoux (2000 watts Daytime).	1000	230.6	1300	Central
KFEY	**—Kellogg, Idaho**—Bunker Hill & Sullivan Mining and Concentrating Co., 834 McKinley Ave.	10	232.4	1290	Pacific
KFGQ	**—Boone, Iowa** — Boone Biblical College, 924 W. Second St.	10	209.7	1430	Central
KFH	**—Wichita, Kans.**—Rigby-Gray Hotel Co., Hotel Lassen, First and Market Sts.	500	245.8	1220	Central
KFHA	**—Gunnison, Colo.** — Western State College of Colorado.	50	249.9	1200	Mountain
KFHL	**—Oskaloosa, Iowa** — Penn College.	10	212.6	1410	Central
KFI	**—Los Angeles, Calif.** — Earle C. Anthony, Inc., 1000 So. Hope St.	5000	468.5	640	Pacific

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
KFIF	**— Portland, Ore.** — Benson Polytechnic School (Divides time with KFEC).	50	228.9	1310	Pacific
KFIO	**—Spokane, Wash.** — North Central High School (Divides time with KFPY).	100	245.8	1220	Pacific
KFIZ	**—Fond du Lac, Wis.**— Fond du Lac Commonwealth Reporter, 22 Forest Ave.	100	267.7	1120	Central
KFJB	**—Marshalltown, Iowa**— Marshalltown Electric Co., 1603 W. Main St. (250 watts Daytime).	100	247.8	1210	Central
KFJF	**—Oklahoma City, Okla.** —National Radio Mfg. Co., Security Bldg. (1000 watts Daytime).	750	272.6	1100	Central
KFJI	**—Astoria, Ore.** — Liberty Theatre (Geo. Kincaid) (Divides time with KMED).	50	249.9	1200	Pacific
KFJM	**—Grand Forks, N. D.**— University of North Dakota.	100	333.1	900	Central
KFJR	**—Portland, Ore.**—Ashley C. Dixon & Son, Fifth and Stark, Lumbermen's Bldg.	500	239.9	1250	Pacific
KFJY	**—Fort Dodge, Iowa** — Tunwall Radio Co., 1004 Central (Divides time with KFMR).	100	232.4	1290	Central
KFJZ	**—Fort Worth, Tex.** — Henry C. Allison, 2121 Refugio St.	50	249.9	1200	Central
KFKA	**—Greeley, Colo.**—Colorado State Teachers College (1000 watts Daytime).	500	249.9	1200	Mountain
KFKB	**—Milford, Kans.**—J. R. Brinkley, M.D. (2500 watts Daytime).	1500	241.8	1240	Central
KFKU	**—Lawrence, Kans.** — University of Kansas (Divides time with WREN).	500	254.1	1180	Central
KFKX	**—Chicago, Ill.** —Westinghouse Elec. & Mfg. Co., 508 Michigan Ave. (Divides time with KYW) (5000 watts after 10 P.M.).	2500	526	570	Central
KFKZ	**—Kirksville, Mo.**—State Teachers College.	15	225.4	1330	Central
KFLV	**—Rockford, Ill.**—Swedish Evangelical Mission Church.	100	267.7	1120	Central
KFLX	**—Galveston, Tex.**—Geo. R. Clough, 3327 Avenue P.	100	270.1	1110	Central
KFMR	**—Sioux City, Iowa** — Morningside College (Divides time with KFJY).	100	232.4	1290	Central
KFMX	**—Northfield, Minn.** — Carleton College.	500	236.1	1270	Central
KFNF	**—Shenandoah, Iowa** — Henry Field Seed & Nursery Co.	2000	461.3	650	Central
KFOA	**—Seattle, Wash.** — Rhodes Department Store.	1000	447.5	670	Pacific
KFON	**—Long Beach, Calif.** — Nichols & Warinner, Inc., Jergins Trust Bldg.	500	241.8	1240	Pacific
KFOR	**—Lincoln, Nebr.**—Howard A. Shuman.	100	217.3	1380	Central
KFOX	**— Omaha, Nebr.** — Board of Education, Technical High School.	100	258.5	1160	Central
KFPL	**—Dublin, Tex.**—C. C. Baxter, 205 Grafton St.	15	275.1	1090	Central
KFPM	**—Greenville, Tex.**—The New Furniture Co.	15	230.6	1300	Central
KFPR	**—Los Angeles, Calif.** — Los Angeles County Forestry Dept. (Divides time with KFQZ).	250	232.4	1290	Pacific
KFPW	**—Carterville, Mo.** — St. Johns M. E. Church, 120 W. Main St.	50	263	1140	Central
KFPY	**—Spokane, Wash.**—Symons Investment Co. (Divides time with KFIO).	250	245.8	1220	Pacific
KFQA	**—St. Louis, Mo.**—The Principia, 5539 Page Ave. (Divides time with WMAY and KWK).	1000	234.2	1280	Central
KFQB	**—Fort Worth, Tex.**—W. B. Fishborn, Inc., 205 Worth Bldg.	1000	333.1	900	Central
KFQU	**—Holy City, Calif.**—W. E. Riker.	100	220.4	1360	Pacific
KFQW	**—Seattle, Wash.** — KFQW Inc., Continental Hotel.	100	217.3	1380	Pacific
KFQZ	**—Hollywood, Calif.** — Taft Radio & Broadcasting Co., Inc., 1641 N. Argyle (Divides time with KFPR).	250	232.4	1290	Pacific
KFRC	**—San Francisco, Calif.** —Don Lee, Inc.	1000	454.3	660	Pacific
KFRU	**—Columbia, Mo.** — Stephens College, Administration Bldg.	500	249.9	1200	Central
KFSD	**—San Diego, Calif.**—Airfan Radio Corp., U. S. Grant Hotel.	500	440.9	680	Pacific
KFSG	**—Los Angeles, Calif.**— Echo Park Evangelistic Ass'n, Angelus Temple.	500	252	1190	Pacific
KFUL	**—Galveston, Tex.**—Thos. Goggan & Bros. Music Co., 2126 Market St.	500	258.5	1160	Central
KFUM	**—Colorado Springs, Colo.**—Corley Mountain Highway, Mining Exchange Bldg.	1000	483.6	620	Mountain
KFUO	**—St. Louis, Mo.**—(Transmitter in Clayton)—Lutheran Church of the Missouri Synod, Concordia Theological Seminary (Divides time with KSD) (1500 watts Daytime).	1000	545.1	550	Central
KFUP	**—Denver, Colo.** — Fitzsimons General Hospital, Red Cross Bldg., Educational and Recreational Dept., U. S. Army.	100	227.1	1320	Mountain
KFUR	**—Ogden, Utah** — Peery Building Co., 420 Twenty-fifth St.	50	225.4	1330	Pacific

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
KFUS	**Oakland, Cal.**—Louis L. Sherman, 529 Twenty-eighth St. (Divides time with KRE).	50	208.2	1440	Pacific
KFUT	**Salt Lake City, Utah**—University of Utah.	50	249.9	1200	Mountain
KFVD	**Venice, Calif.** — McWhinnie Elec. Co., 1825 So. Pacific Ave. (Divides time with KGFJ).	250	215.7	1390	Pacific
KFVG	**Independence, Kans.**—First Methodist Episcopal Church.	50	225.4	1330	Central
KFVI	**Houston, Tex.**—Headquarters Troop 56th Cavalry.	50	238	1260	Central
KFVS	**Cape Girardeau, Mo.**—Hirsch Battery & Radio Co., 312 S. Frederick St.	50	223.7	1340	Central
KFWB	**Los Angeles, Calif.**—Warner Bros. Pictures (Inc.), 5842 Sunset Blvd.	1000	352.7	850	Pacific
KFWC	**San Bernardino, Calif.**—(Transmitter in Ontario)—L. E. Wall, Valley Blvd.	100	247.8	1210	Pacific
KFWF	**St. Louis, Mo.**—St. Louis Truth Center, 4030 Lindell Blvd.	250	214.2	1400	Central
KFWI	**San Francisco, Calif.**—(Transmitter in So. San Francisco)—Radio Entertainments, Inc., 1182 Market St.	500	267.7	1120	Pacific
KFWM	**Oakland, Calif.** — Oakland Educational Society, 1520—8th Ave. (1000 watts Daytime).	500	236.1	1270	Pacific
KFWO	**Avalon, Catalina Island, Calif.**—Major Lawrence Mott, Signal Corps, U. S. Army.	250	299.8	1000	Pacific
KFXD	**Jerome, Idaho** — The Service Radio Co., Main St. (50 watts Daytime).	15	204	1470	Mountain
KFXF	**Denver, Colo.** — Pikes Peak Broadcasting Co., Brown Palace Hotel.	250	282.8	1060	Mountain
KFXJ	**Edgewater, Colo.**—R. G. Howell.	50	209.7	1430	Mountain
KFXR	**Oklahoma City, Okla.**—Exchange Avenue Baptist Church, 416 W. Grand St.	50	223.7	1340	Central
KFXY	**Flagstaff, Ariz.**—Mary M. Costigan, Orpheum Theater.	25	205.4	1460	Mountain
KFYO	**Breckenridge, Tex.** — Kirksey Bros. Battery, Electric & Radio Service.	15	211.1	1420	Central
KFYR	**Bismarck, N. Dak.**—Hoskins Meyer, Inc., 200 Fourth St. (500 watts Daytime).	250	249.9	1200	Central
KGA	**Spokane, Wash.** — Northwest Radio Service Co., 325 E. Rowan Ave.	2000	260.7	1150	Pacific
KGAR	**Tucson, Ariz.**—Tucson Citizen, 80 South Stone St.	100	234.2	1280	Mountain
KGB	**San Diego, Calif.**—Dr. A. W. Yale, Electric Bldg.	100	247.8	1210	Pacific
KGBZ	**St. Joseph, Mo.**—Foster-Hall Tire Co., 1221 Fred. Av.	100	288.3	1040	Central
KGBY	**Shelby, Nebr.** — (Transmitter in Columbus) — Dunning & Taddiken.	50	222.1	1350	Central
KGBZ	**York, Nebr.** — Federal Live Stock Remedy Co., 715 Grand Ave.	250	212.6	1410	Central
KGCA	**Decorah, Iowa**—Chas. W. Greenley (Divides time with KWLC).	10	247.8	1210	Central
KGCB	**Oklahoma City, Okla.**—Wallace Radio Inst., 103 W. 13th St. (Divides time with KGFG).	50	215.7	1390	Central
KGCH	**Wayne, Nebr.**—Wayne Hospital.	250	293.9	1020	Central
KGCI	**San Antonio, Tex.**—Liberto Radio Sales, 409 So. Flores St. (Divides time with KGRC).	100	220.4	1360	Central
KGCL	**Seattle, Wash.**—Louis Wasmer and Archie Taft, 1107 2nd Ave. (Divides time with KPCB).	100	230.6	1300	Pacific
KGCN	**Concordia, Kans.** — Concordia Broadcasting Co., 105 E. 5th St.	50	208.2	1440	Central
KGCR	**Brookings, S. Dak.**—Cutler's Radio Broadcasting Service (Inc.), 415 Main St.	15	208.2	1440	Central
KGCU	**Mandan, N. Dak.** — Mandan Radio Association, 320 Main Street.	100	239.9	1250	Mountain
KGCX	**Vida, Mont.** — First State Bank of Vida.	10	243.8	1230	Mountain
KGDA	**Dell Rapids, S. Dak.**—Home Auto Co. (Daytime only).	15	254.1	1180	Central
KGDE	**Barrett, Minn.**—Jaren Drug Co.	50	205.4	1460	Central
KGDM	**Stockton, Calif.** — E. F. Peffer, 42 S. California St.	10	217.3	1380	Pacific
KGDP	**Pueblo, Colo.**—Boy Scouts of America.	10	223.7	1340	Mountain
KGDR	**San Antonio, Tex.**—Joe B. McShane (30 watts Daytime).	15	206.8	1450	Central
KGDW	**Humboldt, Nebr.** — Frank J. Rist.	100	293.9	1020	Central
KGDY	**Oldham, S. Dak.**—J. Albert Loesch.	15	206.8	1450	Central
KGEF	**Los Angeles, Calif.**—Trinity Methodist Church, 1201 So. Flower St.	1000	263	1140	Pacific
KGEK	**Yuma, Colo.**—Beehler Electrical Equipment Co., 109 W. Second Ave.	10	263	1140	Mountain

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
KGEN	**El Centro, Cal.**—E. R. Irey & F. M. Bowels, Chamber of Commerce Bldg.	100	225.4	1330	Pacific
KGEO	**Grand Island, Nebr.**—Hotel Yancey, 116 N. Locust St.	100	205.4	1460	Central
KGEQ	**Minneapolis, Minn.**—Fred W. Herrmann, 920 Fifth Ave., N.	50	204	1470	Central
KGER	**Long Beach, Calif.**—C. Merwin Dobyns, 435 Pine Ave., (Divides time with KRLO).	100	215.7	1390	Pacific
KGES	**Central City, Nebr.**—Central Radio Elec. Co.	10	204	1470	Central
KGEW	**Fort Morgan, Colo.**—City of Fort Morgan, City Hall Bldg. (200 watts Daytime).	100	218.8	1370	Mountain
KGEZ	**Kalispell, Mont.** — Flathead Broadcasting Assoc.	100	293.9	1020	Mountain
KGFB	**Iowa City, Iowa**—A. C. Dunckle.	10	223.7	1340	Central
KGFF	**Alva, Okla.**—Earl E. Hampshire, 718—5th St.	25	205.4	1460	Central
KGFG	**Oklahoma City, Okla.**—Full Gospel Church (Divides time with KGCB).	50	215.7	1390	Central
KGFH	**La Crescenta, Calif.**—Frederick Robinson, Box 163 (Divides time with KMIC).	250	263	1140	Pacific
KGFI	**San Angelo, Tex.** — Ragsdale Auto Co., 20 W. Concho Ave.	15	220.4	1360	Central
KGFJ	**Los Angeles, Calif.** — Ben S. McGlashan, 2333 W. Twenty-first St. (Divides time with KFVD).	100	212.6	1410	Pacific
KGFK	**Hallock, Minn.**—Kittson County Enterprise.	50	223.7	1340	Central
KGFL	**Trinidad, Colo.**—Transmitter in Raton, N. M.—Norbert L. Cotter, 219 W. Main St.	50	222.1	1350	Mountain
KGFM	**Yuba City, Calif.**—Geo. W. Johnson, 336 Plumas St.	15	211.1	1420	Pacific
KGFN	**Aneta, N. Dak.**—Haraldson & Thingstad.	15	199.9	1500	Central
KGFO	**Terre Haute, Ind.**—(Portable) Brandt Radio Power Co.	100	204	1470	
KGFW	**Ravenna, Nebr.**—Otto F. Sothman, 318 Grand Ave.	10	296.9	1010	Central
KGFX	**Pierre, S. Dak.**—Dana McNeil, 510 Summit Ave.	200	254.1	1180	Central
KGGF	**Picher, Okla.**—Dr. D. L. Connell.	100	206.8	1450	Central
KGGH	**Cedar Grove, La.**—Bates Radio & Elec. Co.	50	212.6	1410	Central
KGGM	**Inglewood, Calif.** — (Portable)—Jay Peters.	100	204	1470	
KGHA	**Pueblo, Colo.**—Geo. H. Sweeney and N. S. Walpole.	500	209.7	1430	Pacific
KGHC	**Slayton, Minn.**—Hegsted Radio Co.	15	209.7	1430	Central
KGHD	**Missoula, Mont.**—Raymond S. Nash, 542 So. 3rd St. W.	5	232.4	1290	Mountain
KGHF	**Pueblo, Colo.**—Philip Curtis P. Ritchie and Joe E. Finch.	250	209.7	1430	Mountain
KGHG	**McGehee, Ark.**—Chas. W. McCallum.	50	——	——	Central
KGHI	**Little Rock, Ark.**—Berean Bible Class, 1201 Louisiana St.	15	——	——	Central
KGHL	**Billings, Mont.**—Northwestern Auto Supply Co., Fifth Ave. and No. Broadway.	250	222.1	1350	Mountain
KGHO	**Fort Stockton, Tex.**—John M. Baldwin.	50	——	——	Central
KGHP	**Hardin, Mont.**—Hardin Post No. 8 American Legion.	50	263	1140	Mountain
KGHX	**Richmond, Texas** — Fort Bend County School Board	50	——	——	Central
KGJF	**Little Rock, Ark.**—First Church of the Nazarene.	250	——	——	Central
KGKB	**Goldthwaite, Tex.**—Eagle Pub. Co.	50	——	——	Central
KGKL	**Georgetown, Tex.**—M. L. Cates, 1263 Brushy St.	100	——	——	Central
KGKO	**Wichita Falls, Tex.**—Highland Heights Christian Church, 2146 Avenue H.	250	——	——	Central
KGO	**Oakland, Calif.**—General Electric Co.	5000	384.4	780	Pacific
KGRC	**San Antonio, Tex.**—Paramount Radio Co., 103 San Pedro Ave. (Divides time with KGCI).	100	220.4	1360	Central
KGRS	**Amarillo, Tex.**—Gish Radio Service, 108 E. 8th St. (500 watts Daytime).	250	243.8	1230	Central
KGTT	**San Francisco, Calif.** Glad Tidings Temple and Bible Inst.	50	220.4	1360	Pacific
KGW	**Portland, Ore.** — The Oregonian Pub. Co., 806 Oregonian Bldg.	1000	491.5	610	Pacific
KGY	**Lacey, Wash.**—St. Martin's College.	50	245.8	1220	Pacific
KHJ	**Los Angeles, Calif.**—Don Lee (Inc.)	500	399.8	750	Pacific
KHMC	**Harlingen, Tex.** — Harlingen Music Co.	100	236.1	1270	Central
KHQ	**Spokane, Wash.**—Louis Wasmer, Davenport Hotel.	1000	370.2	810	Pacific
KICK	**Atlantic, Iowa** — (Transmitter in Red Oak)—Red Oak Radio Corp. (Divides time with WIAS) (Daytime only).	100	322.4	930	Central

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
KJBS	**San Francisco, Calif.**—Julius Brunton & Sons Co., 1380 Bush St.	100	245.8	1220	Pacific
KJR	**Seattle, Wash.**—Northwest Radio Service Co., 604 Home Savings Bldg.	2500	348.6	860	Pacific
KKP	**Seattle, Wash.**—City of Seattle, Harbor Dept.	15	272.6	1100	Pacific
KLCN	**Blytheville, Ark.**—Daily Courier News.	50	285.5	1050	Central
KLDS	**Independence, Mo.**—Midland Broadcasting Co. and Reorganized Church of Jesus Christ of Latter Day Saints.	1500	270.1	1110	Central
KLS	**Oakland, Calif.**—Warner Bros. Radio Supplies Co., 2201 Telegraph Ave. (Divides time with KZM).	250	245.8	1220	Pacific
KLX	**Oakland, Calif.**—The Oakland Tribune.	500	508.2	590	Pacific
KLZ	**Denver, Colo.**—(Transmitter in Dupont) Reynolds Radio Co., Shirley Savoy Hotel.	1000	352.7	850	Mountain
KMA	**Shenandoah, Ia.**—May Seed & Nursery Co. (Divides time with KWKH).	1000	394.5	760	Central
KMBC	**Kansas City, Mo.**—Midland Broadcasting Co.	1500	270.1	1110	Central
KMED	**Medford, Ore.**—W. J. Virgin (Divides time with KFJI).	50	270.1	1110	Pacific
KMIC	**Inglewood, Calif.**—J. R. Fouch, 219 N. Market St. (Divides time with KGFH).	250	223.7	1340	Pacific
KMJ	**Fresno, Calif.**—Fresno Bee.	50	365.6	820	Pacific
KMMJ	**Clay Center, Nebr.**—M. M. Johnson Co. (Divides time with WCAJ) (250 watts at Night).	500	285.5	1050	Central
KMO	**Tacoma, Wash.**—KMO, Inc., Hotel Winthrop.	500	254.1	1180	Pacific
KMOX	**St. Louis, Mo.**—Transmitter in Kirkwood—The Voice of St. Louis, Inc., Mayfair Hotel.	5000	299.8	1000	Central
KMTR	**Hollywood, Calif.**—KMTR Radio Corp., 1025 N. Highland Ave.	500	516.9	580	Pacific
KNRC	**Santa Monica, Calif.**—C. B. Juneau.	500	374.8	800	Pacific
KNX	**Los Angeles, Calif.**—Western Broadcast Co., 6116 Hollywood Blvd.	500	336.9	890	Pacific
KOA	**Denver, Colo.**—General Electric Co., 1370 Krameria St. (500 watts until 8 P.M.).	5000	325.9	920	Mountain
KOAC	**Corvallis, Ore.**—Oregon Agricultural College.	500	270.1	1110	Pacific
KOB	**State College, N. Mex.**—New Mexico College of Agriculture and Mechanic Arts (Divides time with KWSC and KTW). (7500 watts Daytime).	5000	394.5	760	Mountain
KOCH	**Omaha, Nebr.**—C. H. Thompson.	250	258.5	1160	Central
KOCW	**Chickasha, Okla.**—Oklahoma College for Women.	250	252	1190	Central
KOIL	**Council Bluffs, Iowa**—Mona Motor Oil Co. (Divides time with KFAB).	5000	319	940	Central
KOIN	**Portland, Ore.**—Transmitter in Sylvan—KOIN, Inc.	1000	319	940	Pacific
KOOS	**Marshfield, Ore.**—KOOS Radio Sales and Service Inc., 432 W. E. Miner Bldg.	50	206.8	1450	Pacific
KOMO	**Seattle, Wash.**—Fisher's Blend Station, Inc., Metropolitan Center.	1000	309.1	970	Pacific
KORE	**Eugene, Ore.**—Eugene Broadcast Station, 475-21st St.	50	199.9	1500	Pacific
KOW	**Denver, Colo.**—Associated Industries, Inc., 1429 Champa St.	250	218.8	1370	Mountain
KPCB	**Seattle, Wash.**—Pacific Coast Biscuit Co., 505 Central Bldg. (Divides time with KGCL).	100	230.6	1300	Pacific
KPJM	**Prescott, Ariz.**—Frank Wilburn, Journal Miner Bldg.	15	214.2	1400	Mountain
KPLA	**Los Angeles, Calif.**—Pacific Development Radio Co.	500	288.3	1040	Pacific
KPNP	**Muscatine, Iowa**—Central Radio Co., East Second St.	100	211.1	1420	Central
KPO	**San Francisco, Calif.**—Hale Bros. and the San Francisco Chronicle.	1000	422.3	710	Pacific
KPOF	**Denver, Colo.**—Pillar of Fire, Inc., Belleview College, 1631 California St.	500	201.2	1490	Mountain
KPPC	**Pasadena, Calif.**—Pasadena Presbyterian Church (Divides time with KELW).	50	315.6	950	Pacific
KPRC	**Houston, Tex.**—Houston Post Dispatch.	500	293.9	1020	Central
KPSN	**Pasadena, Calif.**—The Star-News.	1000	315.6	950	Pacific
KQV	**Pittsburgh, Pa.**—Doubleday-Hill Electric Co., 719 Liberty Ave. (Divides time with WJAS).	500	270.1	1110	Eastern
KQW	**San Jose, Calif.**—Fred J. Hart, Sherman Clay & Co. Bldg.	500	296.9	1010	Pacific

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
KRAC	**Shreveport, La.** — Caddo Radio Club, Fair Grounds.	50	220.4	1360	Central
KRE	**Berkeley, Calif.** — First Congregational Church of Berkeley and Pacific School of Religion (Divides time with KFUS).	100	230.6	1300	Pacific
KRLD	**Dallas, Tex.** — Dallas Radio Laboratories, 208 North St. Paul Street.	500	461.3	650	Central
KRSC	**Seattle, Wash.**—Radio Sales Corporation, 1202 Fifth Avenue.	50	272.6	1100	Pacific
KSAC	**Manhattan, Kans.** —Kansas State Agricultural College.	500	333.1	900	Central
KSBA	**Shreveport, La.** — Shreveport Broadcasting Corp.	1000	267.7	1120	Central
KSCJ	**Sioux City, Iowa** — Perkin Bros. Co. (Divides time with KWUC) (1000 watts Daytime).	500	243.8	1230	Central
KSD	**St. Louis, Mo.**—Pulitzer Publishing Co., 12th and Olive Sts.	500	545.1	550	Central
KSEI	**Pocatello, Idaho** — KSEI Broadcasting Association.	250	333.1	900	Mountain
KSL	**Salt Lake City, Utah**— Radio Service Corp. of Utah, Vermont Bldg.	1000	302.8	990	Mountain
KSMR	**Santa Maria, Calif.**— Santa Maria Valley R. R. Co.	100	272.6	1100	Pacific
KSO	**Clarinda, Iowa** — Berry Seed Co.	500	227.1	1320	Central
KSOO	**Sioux Falls, S. Dak.**— Sioux Falls Broadcast Assoc., 609 Minnehaha Bldg.	250	209.7	1430	Central
KSTP	**St. Paul, Minn.**— (Transmitter in Wescott) National Battery Broadcasting Co.	2000	220.4	1360	Central
KTAB	**Oakland, Calif.** — The Associated Broadcasters, 1410 Tenth Ave.	500	280.2	1070	Pacific
KTAP	**San Antonio, Tex.**— Alamo Broadcasting Co., Robert B. Bridge, 822 W. Mulberry St.	250	228.9	1310	Central
KTBI	**Los Angeles, Calif.** — Bible Institute of Los Angeles, 536 So. Hope St.	1000	275.1	1090	Pacific
KTBR	**Portland, Ore.**—M. E. Brown, 525 Morrison St. (Divides time with KFJR)	500	228.9	1310	Pacific
KTHS	**Hot Springs National Park, Ark.**—Arlington Hotel Co.	1000	499.7	600	Central
KTNT	**Muscatine, Iowa** — Norman Baker.	2000	256.3	1170	Central
KTSA	**San Antonio, Tex.**— Alamo Broadcasting Co.	2000	265.3	1130	Central
KTUE	**Houston, Tex.** — Uhalt Electric Co., 614 Fannin St.	5	212.6	1410	Central
KTW	**Seattle, Wash.** — The First Presbyterian Church of Seattle.	1000	394.5	760	Pacific
KUJ	**Seattle, Wash.**—Puget Sound Radio Broadcasting Co., 5811 Fifth Ave., N. E.	10	199.9	1500	Pacific
KUOA	**Fayetteville, Ark.** — University of Arkansas.	1000	296.9	1010	Central
KUOM	**Missoula, Mont.** — State University of Montana.	500	461.3	650	Mountain
KUSD	**Vermillion, S. Dak.**— University of South Dakota.	250	483.6	620	Central
KUT	**Austin, Tex.**—University of Texas.	500	232.4	1290	Central
KVI	**Tacoma, Wash.**—Puget Sound Radio Broadcasting Co., 15 No. Tacoma Ave.	250	282.8	1060	Pacific
KVL	**Seattle, Wash.** — A. C. Dailey, 844 East 58th St.	100	272.6	1100	Pacific
KVOO	**Tulsa, Okla.** — Southwestern Sales Corp., Tulsa & Bristow.	1000	348.6	860	Central
KVOS	**Bellingham, Wash.** — L. Kessler, Henry Hotel.	250	209.7	1430	Pacific
KWBS	**Portland, Ore.** — Schaeffer Manufacturing Co., 226 E. Forty-first St.	15	199.9	1500	Pacific
KWCR	**Cedar Rapids, Iowa**— H. F. Paar, Cedar Rapids Broadcasting Corp., 1444 Second Ave., E. (Divides time with WJAM).	250	239.9	1250	Central
KWEA	**Shreveport, La.**—Wm. E. Anthony (Divides time with KGGH)	250	212.6	1410	Central
KWG	**Stockton, Calif.**—Portable Wireless Telephone Co., Commercial & Savings Bank Bldg.	100	344.6	870	Pacific
KWJJ	**Portland, Ore.**—Wilbur Jerman, 220 Broadway.	50	249.9	1200	Pacific
KWK	**St. Louis, Mo.**—Greater St. Louis Broadcasting Co., Hotel Chase (Divides with KFQA and WMAY Sunday Only) (2000 watts Daytime).	1000	234.2	1280	Central
KWKC	**Kansas City, Mo.**— Wilson Duncan Broadcasting Studios, Werby Building.	100	222.1	1350	Central
KWKH	**Shreveport, La.**—W. K. Henderson.	3500	394.5	760	Central
KWLC	**Decorah, Ia.** — Luther College.	50	247.8	1210	Central
KWSC	**Pullman, Wash.** — State College of Washington, Mechanic Arts Bldg. (Divides time with KTW and KOB).	500	394.5	760	Pacific

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
KWTC	**Santa Ana, Calif.**—Dr. John W. Hancock, 1101 North Ross Street (Divides time with KFWC).	100	272.6	1100	Pacific
KWUC	**Le Mars, Iowa**—Western Union College (Daytime only) (Divides time with KSCJ).	1500	243.8	1230	Central
KWWG	**Brownsville, Tex.** — Chamber of Commerce.	500	277.6	1080	Central
KXA	**Seattle, Wash.** — American Radio Tel. Co.	500	535.4	560	Pacific
KXL	**Portland, Ore.** — KXL Broadcasters, 719 Bedell Bldg.	250	220.4	1360	Pacific
KYA	**San Francisco, Calif.** —Pacific Broadcasting Co.	1000	361.2	830	Pacific
KYW	**Chicago, Ill.**—Westinghouse Electric & Mfg. Co., 508 S. Michigan Ave. (Divides time with KFKX) (500 watts after 10 P.M.).	2500	526	570	Central
KZM	**Oakland, Calif.** — (Transmitter in Hayward) Leon P. Tenney, 13th and Harrison Sts. (Divides time with KLS).	100	230.6	1300	Pacific
NAA	**Arlington, Va.** — United States Navy.	1000	434.5	690	Eastern
WAAD	**Cincinnati, Ohio**—Ohio Mechanics Institute.	25	230.6	1300	Eastern
WAAF	**Chicago, Ill.**—Chicago Daily Drovers Journal (Divides time with WBBM and WJBT).	500	389.4	770	Central
WAAM	**Newark, N. J.**—I. R. Nelson, 1 Bond St., Studio at 626 Central Ave., East Orange (Divides time with WNJ and WGCP) (500 watts Daytime).	250	267.7	1120	Eastern
WAAT	**Jersey City, N. J.**—Bremer Broadcasting Corp., 210 Jackson Ave. (Divides time with WGBB and WSOM).	300	245.8	1220	Eastern
WAAW	**Omaha, Nebr.**—Omaha Grain Exchange (Before 6 P.M. only).	500	440.9	680	Central
WABC	**New York, N. Y.**—Atlantic Broadcasting Corp., 113 W. 57th St. (Divides time with WBOQ) (5000 watts Daytime).	2500	309.1	970	Eastern
WABF	**Kingston, Pa.**—Markle Broadcasting Corp., 294 Wyoming Ave.	250	205.4	1460	Eastern
WABI	**Bangor, Me.** — First Universalist Church, Park St.	100	389.4	770	Eastern
WABO	**Rochester, N. Y.**—Hickson Elec. Co. (Divides time with WHEC).	500	254.1	1180	Eastern
WABW	**Wooster, Ohio**—College of Wooster.	50	247.8	1210	Eastern
WABY	**Philadelphia, Pa.**—John Magaldi, Jr.	50	247.8	1210	Eastern
WABZ	**New Orleans, La.** — Colis Place Baptist Church, 1376 Camp St.	50	238	1260	Central
WADC	**Akron, Ohio**—Allen T. Simmons, Towell-Cadillac Bldg.	1000	223	1260	Eastern
WAFD	**Detroit, Mich.**—Albert B. Parfet Co., Charlotte St. and Woodward Ave. (Divides time with WRAV).	100	230.6	1300	Eastern
WAGM	**Royal Oak, Mich.**—Robert L. Miller, 309 So. Main St.	50	225.4	1330	Eastern
WAIT	**Taunton, Mass.**—A. H. Waite & Co., Inc., 32 Weir St.	10	214.2	1400	Eastern
WAIU	**Columbus, Ohio** — American Insurance Union, Deshler-Walleck Hotel (Divides time with WEAO).	5000	282.8	1060	Eastern
WAIZ	**Omro, Wis.**—Transmitter in Appleton—Irving Zuelke Music Studio.	100	227.1	1320	Central
WALK	**Willow Grove, Pa.** — Albert A. Walker.	50	201.2	1490	Eastern
WAPI	**Auburn, Ala.** — Alabama Polytechnic Institute (Divides time with WJAX).	1000	340.7	880	Central
WASH	**Grand Rapids, Mich.** —Baxter Laundries, Inc.	250	256.3	1170	Eastern
WATT	**Boston, Mass.**—(Portable)—Edison Elec. Illuminating Co.	100	201.2	1490	
WBAA	**West Lafayette, Ind.**—Purdue University (Divides time with WRM).	500	272.6	1100	Central
WBAK	**Harrisburg, Pa.** — Pennsylvania State Police (Divides time with WPSC) (Daytime only).	500	299.8	1000	Eastern
WBAL	**Baltimore, Md.** — Transmitter in Glen Morris—Consolidated Gas, Elec. Light & Power Co.	5000	285.5	1050	Eastern
WBAO	**Decatur, Ill.** — James Millikin University.	100	267.7	1120	Central
WBAP	**Fort Worth, Tex.** — Carter Publishing Co., Inc. (Divides time with WOAI).	5000	499.7	600	Central
WBAW	**Nashville, Tenn.** — Waldrum Drug Co.	5000	239.9	1250	Central
WBAX	**Wilkes-Barre, Pa.** — John H. Stenger, Jr., 66 Gildersleeve St. (Divides time with WBRE).	100	249.9	1200	Eastern
WBBC	**Brooklyn, N. Y.** — Brooklyn Broadcasting Corp., 16 Court St. (Divides time with WSDA).	500	227.1	1320	Eastern
WBBL	**Richmond, Va.** — Grace-Covenant Presbyterian Church, 1627 Monument Ave.	100	234.2	1280	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WBBM	**—Chicago, Ill.**—Transmitter in Glenview—Atlass Investment Co., 728 Kimball Bldg. (Divides time with WJBT and WAAF).	5000	389.4	770	Central
WBBP	**—Petoskey, Mich.**—Petoskey High School.	100	239.9	1250	Central
WBBR	**—Rossville, N. Y.**—Peoples Pulpit Ass'n, 117 Adams St., Brooklyn (Divides time one-half with WLTH-WEBJ).	1000	256.3	1170	Eastern
WBBW	**—Norfolk, Va.**—Ruffner Junior High School.	100	236.1	1270	Eastern
WBBY	**—Charleston, So. Car.**—Washington Light Infantry.	75	249.9	1200	Eastern
WBBZ	**—Chicago, Ill.** — (Portable)—C. L. Carrell, 1506 No. American Bldg.	100	204	1470	
WBCN	**—Chicago, Ill.** — Great Lakes Broadcasting Co., Straus Bldg. (5000 watts Daytime; Consolidated with WENR).	500	288.3	1040	Central
WBES	**—Takoma Park, Md.**—Bliss Electrical School.	100	265.3	1130	Eastern
WBET	**—Boston, Mass.**—(Transmitter at Medford) Boston Transcript.	500	288.3	1040	Eastern
WBIS	**—Boston, Mass.** — The Shepard Stores.	500	461.3	650	Eastern
WBMH	**—Detroit, Mich.**—Braun's Music House, 13214 East Jefferson Ave.	100	211.1	1420	Central
WBMS	**—Union City, N. J.** — Geo. W. Schowerer, 837-34th St. (Divides time with WBKN, WWRL and WIBI).	100	199.9	1500	Eastern
WBNY	**—New York, N. Y.**—Baruchrome Corp., 400 E. 139th St. (Divides time with WHAP and WMSG).	500	236.1	1270	Eastern
WBOQ	**—New York, N. Y.**—Transmitter in Richmond Hill—Atlantic Broadcasting Corp., 113 W. 57th St. (Divides time with WABC).	500	309.1	970	Eastern
WBOW	**—Terre Haute, Ind.**—Banks of Wabash Broadcasting Assoc.	100	208.2	1440	Central
WBRC	**—Birmingham, Ala.** — Birmingham Broadcasting Corp., Loew's Temple Theatre.	250	302.8	990	Central
WBRE	**—Wilkes-Barre, Pa.**—L. G. Baltimore, 16 N. Main St. (Divides time with WBAX).	100	249.9	1200	Eastern
WBRL	**—Tilton, N. H.**—Booth Radio Laboratories, 23 Summer St.	500	232.4	1290	Eastern
WBRS	**— Greenville, N. Y.** — Westchester Broadcasting Corp. (Divides time with WCGU and WRST)	250	211.1	1420	Eastern
WBSO	**—WellesleyHills,Mass.** — (Transmitter in Babson Park) Babson Statistical Organization.	100	384.4	780	Eastern
WBT	**—Charlotte, N. C.**—C. C. Coddington, 500 West Trade St.	1000	258.5	1160	Eastern
WBZ	**—Springfield, Mass.** — Transmitter in East Springfield—Westinghouse Elec. & Mfg. Co., Hotel Kimball.	15000	333.1	900	Eastern
WBZA	**—Boston, Mass.**—Westinghouse Elec. & Mfg. Co., Hotel Statler.	500	333.1	900	Eastern
WCAC	**—Mansfield, Conn.**—Connecticut Agricultural College (Divides time with WTIC).	500	535.4	560	Eastern
WCAD	**—Canton, N. Y.**—St. Lawrence University (1000 watts Daytime).	500	243.8	1230	Eastern
WCAE	**—Pittsburgh, Pa.** — Kaufmann & Baer Co., Sixth and Smithfield Sts.	500	461.3	650	Eastern
WCAH	**—Columbus, Ohio** — Studio at Fort Hayes Hotel—Commercial Radio Service Co.	250	234.2	1280	Eastern
WCAJ	**— Lincoln, Nebr.** — Nebraska Wesleyan University (Daytime only).	500	379.5	790	Central
WCAL	**—Northfield, Minn.**—St. Olaf College (Divides time with WDGY).	500	285.5	1050	Central
WCAM	**—Camden, N. J.**—City of Camden, Civic Centre.	500	223.7	1340	Eastern
WCAO	**—Baltimore, Md.** — Monumental Radio, Inc., 848 N. Howard St. (Divides time with WFBR).	250	243.8	1230	Eastern
WCAP	**—Asbury Park, N. J.**—Municipality of Asbury Park.	500	239.9	1250	Eastern
WCAT	**—Rapid City, S. Dak.**—South Dakota State School of Mines.	100	247.8	1210	Mountain
WCAU	**—Philadelphia, Pa.** — Transmitter at Byberry — Universal Broadcasting Co.	1000	260.7	1150	Eastern
WCAX	**—Burlington, Vt.**—University of Vermont.	100	254.1	1180	Eastern
WCAZ	**—Carthage, Ill.**—Carthage College.	50	249.9	1200	Central
WCBA	**—Allentown, Pa.**—Chas. W. Heimbach, 1015 Allen St. (Divides time with WSAN).	100	222.1	1350	Eastern
WCBD	**—Zion, Ill.**—Wilbur G. Voliva (Divides time with WLS).	5000	344.6	870	Central
WCBE	**—New Orleans, La.** — Uhalt Bros., Hotel De Soto.	5	227.1	1320	Central
WCBM	**—Baltimore, Md.**—Hotel Chateau, Charles St. and North Ave.	100	225.4	1330	Eastern
WCBR	**—Providence, R. I.** — (Portable)—Chas. H. Messter, 42 Doyle Ave.	100	201.2	1490	

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WCBS	**Springfield, Ill.** — Harold L. Dewing and Charles H. Messter, St. Nicholas Hotel.	250	209.7	1430	Central
WCCO	**Minneapolis-St. Paul, Minn.**—Transmitter in Anoka—Washburn-Crosby Co. (7500 watts Daytime).	5000	405.2	740	Central
WCDA	**New York, N. Y.**—Transmitter in Cliffside Park, N. J. — Italian Educational Broadcasting Co., Inc., 27 Cleveland Place (Divides time with WRST).	250	212.6	1410	Eastern
WCFL	**Chicago, Ill.**—Chicago Federation of Labor, 623 S. Wabash Ave. (Divides time with WLTS).	1500	483.6	620	Central
WCGU	**Brooklyn, N. Y.**—U. S. Broadcast Corp. (Divides time with WKBO and WKBQ).	500	218.8	1370	Eastern
WCLB	**Brooklyn, N. Y.**—Arthur Faske, 1515 Eastern Parkway (Divides time with WWRL, WIBI and WBMS).	100	199.9	1500	Eastern
WCLO	**Kenosha, Wis.**—C. E. Whitmore.	100	227.1	1320	Central
WCLS	**Joliet, Ill.**—M. A. Felman Co., 301 E. Jefferson St. (Divides time with WKBB).	150	215.7	1390	Central
WCMA	**Culver, Ind.** — Culver Military Academy.	500	260.7	1150	Central
WCOA	**Pensacola, Fla.**—City of Pensacola, City Hall.	500	249.9	1200	Central
WCOC	**Columbus, Miss.** — Crystal Oil Co.	500	230.6	1300	Central
WCON	**Danbury, Conn.** — Danbury Broadcasting Co.	100	265.3	1130	Eastern
WCOT	**Providence, R. I.**—(Transmitter in Olneyville) Jacob Conn, 1849 Westminster St.	100	225.4	1330	Eastern
WCRW	**Chicago, Ill.** — Clinton R. White, 2756 Pine Grove Ave., Embassy Hotel (Divides time with WPCC).	500	223.7	1340	Central
WCSH	**Portland, Me.**—Henry P. Rines, Congress Square Hotel Co.	500	365.6	820	Eastern
WCSO	**Springfield, Ohio** — Wittenberg College.	500	256.3	1170	Eastern
WCWK	**Fort Wayne, Ind.** — Chester W. Keen, 1729 Lafayette St.	500	214.2	1400	Central
WCX	**Detroit, Mich.**—Transmitter in Pontiac—Detroit Free Press.	5000	440.9	680	Eastern
WDAD	**Nashville, Tenn.**—Dad's Auto Accessory & Radio Store, 171 Eighth Ave., North	1000	225.4	1330	Central
WDAE	**Tampa, Fla.**—Tampa Daily Times.	500	267.7	1120	Eastern
WDAF	**Kansas City, Mo.**—Kansas City Star, 18th and Grand Ave.	1000	370.2	810	Central
WDAG	**Amarillo, Tex.** — J. Laurance Martin, 605 E. 4th St.	250	263	1140	Central
WDAH	**El Paso, Tex.**—Trinity Methodist Church, Cor. Blvd. and Mesa Ave.	100	234.2	1280	Mountain
WDAY	**Fargo, N. Dak.**—Radio Equipment Corp., 119 Broadway (Divides time with KFDY) (500 watts Daytime).	250	545.1	550	Central
WDBJ	**Roanoke, Va.** — Richardson-Wayland Elec. Corp., 106 Church Ave., S. W.	250	230.6	1300	Eastern
WDBO	**Orlando, Fla.**—Orlando Broadcasting Co., Fort Gatlin Hotel (1000 watts Daytime).	500	288.3	1040	Eastern
WDEL	**Wilmington, Del.** — WDEL, Inc., 405 Delaware Ave.	100	296.9	1010	Eastern
WDGY	**Minneapolis, Minn.**—Geo. W. Young, Falvey Cross Rd., Superior Blvd., Studio at 217 Loeb Arcade.	500	285.5	1050	Central
WDOD	**Chattanooga, Tenn.**—Chattanooga Radio Co., Inc., 615 Market St.	500	243.8	1230	Central
WDRC	**New Haven, Conn.**—Doolittle Radio Corporation, 70 College St. (Divides time with WCAC).	500	282.8	1060	Eastern
WDWF	**Cranston, R. I.** — Dutee W. Flint and Lincoln Studios (Inc.), 335 Westminster St., Providence.	250	247.8	1210	Eastern
WDZ	**Tuscola, Ill.**—Jas. L. Bush (Daytime only).	100	277.6	1080	Central
WEAF	**New York, N. Y.**—Transmitter at Bellmore, L. I.—National Broadcasting Co., Inc., 711—5th Ave.	50000	491.5	610	Eastern
WEAM	**North Plainfield, N. J.**—Borough of North Plainfield (Divides time with WJBI).	250	263	1140	Eastern
WEAN	**Providence, R. I.**—The Shepard Co., 122 Mathewson St. (Divides time with WNAC).	500	275.1	1090	Eastern
WEAO	**Columbus, Ohio**—The Ohio State University (Divides time with WAIU).	750	282.8	1060	Eastern
WEAR	**Cleveland, Ohio**—Willard Storage Battery Co., 1100 Chester Ave. (Divides time with WTAM).	1000	399.8	750	Eastern
WEBC	**Superior, Wis.**—Head of the Lakes Broadcasting Co. (1000 watts Daytime).	250	241.8	1240	Central
WEBE	**Cambridge, Ohio** — Roy W. Waller, 319 Wall Ave.	10	247.8	1210	Eastern
WEBH	**Chicago, Ill.** — Edgewater Beach Hotel Co., 5300 Sheridan Rd. (Divides time with WJJD).	2000	365.6	820	Central
WEBJ	**New York, N. Y.** — Third Ave. Railway Co., 2396 Third Ave. (Divides time [one-quarter] with WJBI & WBBR).	500	256.3	1170	Eastern
WEBQ	**Harrisburg, Ill.**—Tate Radio Co., 1 N. Main St.	15	223.7	1340	Central
WEBR	**Buffalo, N. Y.**—Howell Broadcasting Co., Inc., 50 W. Eagle.	200	241.8	1240	Eastern

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WEBW	**Beloit, Wis.**—Beloit College.	500	258.5	1160	Central
WEDC	**Chicago, Ill.** — Emil Denemark Broadcasting Station, 3860 Ogden Avenue (Divides time with WGES).	500	241.8	1240	Central
WEDH	**Erie, Pa.**—Erie Dispatch Herald.	30	208.2	1440	Eastern
WEEI	**Boston, Mass.** — The Edison Electric Illuminating Co.	500	508.2	590	Eastern
WEHS	**Evanston, Ill.**—A. T. Becker, 1318 Elmwood Ave.	100	215.7	1390	Central
WEMC	**Berrien Springs, Mich.**—Emmanuel Missionary College (Divides time with WCFL and WLTS).	1000	483.6	620	Central
WENR	**Chicago, Ill.** — Great Lakes Radio Broadcasting Co., 310 S. Michigan Ave. 5000 Watts Daytime (Consolidated with WBCN).	500	288.3	1040	Central
WEPS	**Gloucester, Mass.** — Matheson Radio Co., 209 Main St.	100	296.9	1010	Eastern
WEVD	**New York, N. Y.** — (Transmitter in Woodhaven) Union Course Labs. Debs Memorial Radio Fund (Divides time with WGBB and WAAT).	500	245.8	1220	Eastern
WEW	**St. Louis, Mo.** — St. Louis University.	1000	352.7	850	Central
WFAA	**Dallas, Tex.**—Dallas News and Sears, Roebuck & Co., Baker Hotel.	500	545.1	550	Central
WFAM	**St. Cloud, Minn.** — Times Publishing Co., 18—6th Ave., N.	10	252	1190	Central
WFAN	**Philadelphia, Pa.** — Keystone Broadcasting Co., Hotel Lorraine.	500	223.7	1340	Eastern
WFBC	**Knoxville, Tenn.** — First Baptist Church.	50	234.2	1280	Central
WFBE	**Cincinnati, Ohio** — Park View Hotel.	250	245.8	1220	Eastern
WFBG	**Altoona, Pa.** — The William F. Gable Co.	100	267.7	1120	Eastern
WFBJ	**Collegeville, Minn.** — St. John's University.	100	272.6	1100	Central
WFBL	**Syracuse, N. Y.**—The Onondaga Co.	750	258.5	1160	Eastern
WFBM	**Indianapolis, Ind.** — (Transmitter in Perry Township) Indianapolis Power & Light Co.	1000	275.1	1090	Central
WFBR	**Baltimore, Md.**—Baltimore Radio Show, Inc., Hoffman and Bolton Sts. (500 watts Daytime).	250	243.8	1230	Eastern
WFBZ	**Galesburg, Ill.** — Knox College (Divides time with WRAM).	50	247.8	1210	Central
WFCI	**Pawtucket, R. I.**—Frank Crook Inc., 103 Exchange St.	100	241.8	1240	Eastern
WFDF	**Flint, Mich.** — Frank D. Fallain, 513 So. Saginaw St.	100	272.6	1100	Eastern
WFI	**Philadelphia, Pa.** — Strawbridge & Clothier (Divides time with WLIT).	500	405.2	740	Eastern
WFIW	**Hopkinsville, Ky.** — Acme Mills, Inc.	1000	260.7	1150	Central
WFJC	**Akron, Ohio**—W. F. Jones Broadcasting, Inc.	500	227.1	1320	Eastern
WFKB	**Chicago, Ill.**—Francis K. Bridgman, Inc., 4536 Woodlawn Ave. (Divides time with WCRW).	500	223.7	1340	Central
WFKD	**Philadelphia, Pa.** — Foulkrod Radio Engineering Co.	10	247.8	1210	Eastern
WFLA	**Clearwater, Fla.** — Transmitter in City Park at Causeway— Chamber of Commerce.	750	516.9	580	Eastern
WGAL	**Lancaster, Pa.** — Lancaster Elec. Supply & Construction Co., 23 E. Orange St.	15	252	1190	Eastern
WGBB	**Freeport, N. Y.** — Harry H. Carman, 217 Bedell St. (Divides time with WAAT and WSOM).	400	245.8	1220	Eastern
WGBC	**Memphis, Tenn.** — First Baptist Church, Linden and Lauderdale Sts.	15	228.9	1310	Central
WGBF	**Evansville, Ind.** — Finke Furniture Co., 307 South Seventh St.	250	236.1	1270	Central
WGBI	**Scranton, Pa.**—Scranton Broadcasters, Inc., 318 Adams Ave. (Divides time with WQAN).	250	230.6	1300	Eastern
WGBS	**New York, N. Y.** — Transmitter in Astoria, L. I.— Gimbel Bros., 33rd St. and Broadway (Divides time with WIP and WOO).	500	348.6	860	Eastern
WGCM	**Gulfport, Miss.**— Gulf Coast Music Co., 1319-26th Ave.	15	222.1	1350	Central
WGCP	**Newark, N. J.**—Paramount Broadcasting & Artists' Service, 591 Broad St. (Divides time with WNJ and WAAM).	250	267.7	1120	Eastern
WGES	**Chicago, Ill.**—Transmitter in Oak Park—Oakleaves Broadcasting Corp., 128 N. Crawford Ave. (Divides time with WEDC).	500	241.8	1240	Central
WGHP	**Mount Clemens, Mich.**—(Transmitter at Fraser) Geo. H. Phelps, Studio, 1408 Moccabee Bldg., Detroit, (Divides time with WKAR).	750	277.6	1080	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WGL	**—New York, N. Y.**—Transmitter in Secaucus, N. J. International Broadcast Corp., 485—5th Ave. (Divides time with WODA).	1000	293.9	1020	Eastern
WGM	**—Jeannette, Pa.**—Verne & Elton Spencer, 501 Cowan Ave.	50	208.2	1440	Eastern
WGMU	**—New York, N. Y.**—Portable (Transmitter in Richmond Hill)—Mobile Station of A. H. Grebe & Co., Inc., 109 West 57th St.	100	201.2	1490	
WGN	**—Chicago, Ill.**—The Chicago Tribune, Drake Hotel (Divides time with WLIB).	15000	416.4	720	Central
WGOP	**—Flushing, N. Y.** — Frederick B. Zittell, Jr., 369 Amity St. (Divides time with WBKN, WWRL and WBMS).	100	199.9	1500	Eastern
WGR	**—Buffalo, N. Y.**—Federal Radio Corp., Hotel Statler.	750	302.8	990	Eastern
WGST	**—Atlanta, Ga.**—Georgia School of Technology (Divides time with WMAZ).	500	270.1	1110	Central
WGWB	**—Milwaukee, Wis.** — Evening Wisconsin Co., 467 Jackson St.	250	270.1	1110	Central
WGY	**—Schenectady, N. Y.**— General Electric Co.	50000	379.5	790	Eastern
WHA	**—Madison, Wis.**—University of Wisconsin (Divides time with WLBL).	750	333.1	900	Central
WHAD	**—Milwaukee, Wis.** — Marquette University (Divides time with WTMJ).	500	270.1	1110	Central
WHAM	**—Rochester, N. Y.** — Transmitter in Victor Township—Stromberg-Carlson Telephone Mfg. Co.	5000	280.2	1070	Eastern
WHAP	**—New York, N. Y.** — Transmitter in Carlstadt, N. J. —Defenders of Truth Society, Inc., 9 W. 96th St. (Divides time with WBNY and WMSG).	1000	236.1	1270	Eastern
WHAR	**—Atlantic City, N. J.**— F. P. Cook's Sons, Inc., Seaside Hotel.	750	272.6	1100	Eastern
WHAS	**—Louisville, Ky.**—Courier-Journal and Louisville Times, 3rd and Liberty Sts.	500	322.4	930	Central
WHAZ	**—Troy, N. Y.** —Rensselaer Polytechnic Institute (Divides time [Mondays only] with WIBO and WHT).	500	305.9	980	Eastern
WHB	**—Kansas City, Mo.** — Sweeney Automotive & Elec. School, Sweeney Bldg. (Divides time with WOQ).	500	340.7	880	Central
WHBC	**—Canton, Ohio** — St. John's Catholic Church, 627 McKinley Ave., N. W.	10	254.1	1180	Eastern
WHBD	**—Bellefontaine, Ohio** —First Presbyterian Church.	100	222.1	1350	Eastern
WHBF	**—Rock Island, Ill.** — Beardsley Specialty Co., 217 Eighteenth St.	100	222.1	1350	Central
WHBL	**—Sheboygan, Wis.**— (Portable)—Press Pub. Co. and C. L. Carrell, 1506 No. American Bldg. (500 watts Daytime).	250	204	1470	
WHBM	**—Chicago, Ill.**—(Portable)—C. L. Carrell, 1506 N. American Bldg.	100	201.2	1490	
WHBP	**—Johnstown, Pa.** — Johnstown Automobile Co., 101 Main St. (500 watts Daytime).	250	228.9	1310	Eastern
WHBQ	**—Memphis, Tenn.** — WHBQ, Inc., Dermon Bldg.	100	232.4	1290	Central
WHBU	**—Anderson, Ind.**—Citizens Bank, 1101 Meridian St.	15	220.4	1360	Central
WHBW	**—Philadelphia, Pa.** — D. R. Kienzle, 4916 Chestnut St.	100	220.4	1360	Eastern
WHBY	**—West De Pere, Wis.**— St. Norbert's College.	50	249.9	1200	Central
WHDI	**—Minneapolis, Minn.**— Wm. Hood Dunwoody Industrial Inst., 818 Superior Blvd. (Divides time with WLB).	500	245.8	1220	Central
WHEC	**—Rochester, N. Y.** — Hickson Electric Co., 36 South Ave. (Consolidated with WABO, Lake Ave. Baptist Church).	500	254.1	1180	Eastern
WHFC	**—Chicago, Ill.**—Goodson & Wilson, Inc., Hotel Flanders, 4145 Broadway (Divides time with WKBI).	200	215.7	1390	Central
WHK	**—Cleveland, Ohio**—Radio Air Service Corp., 1116 Carnegie Hall, (1000 watts Daytime).	500	265.3	1130	Eastern
WHN	**—New York, N. Y.**—Marcus Loew Booking Agency, Inc., 1540 Broadway (Divides time with WQAO and WPAP).	500	394.5	760	Eastern
WHO	**—Des Moines, Ia.**—Bankers Life Co., 1110 Liberty Bldg.	5000	535.4	560	Central
WHPP	**—New York, N. Y.** — (Transmitter in Englewood Cliff, N. J.) Bronx Broadcasting Co., 958 St. Nicholas Ave.	10	206.8	1450	Eastern
WHT	**—Chicago, Ill.**—Transmitter in Deerfield—Radiophone Broadcasting Corp., 410 N. Michigan Blvd. (Divides time with WIBO and WHAZ).	5000	305.9	980	Central
WIAD	**—Philadelphia, Pa.**— Howard R. Miller, Hotel Vendig (Divides time with WNAT).	100	288.3	1040	Eastern
WIAS	**—Ottumwa, Iowa**—Poling Electric Co., 107 E. 2nd St.	100	475.9	630	Central
WIBA	**—Madison, Wis.**—Capital Times Studio & Strand Theatre Corp., 14 E. Mifflin St.	100	239.9	1250	Central

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WIBG	**Elkins Park, Pa.**—St. Paul's Protestant Episcopal Church (Sunday's, 11 A.M. and 4 P.M.).	50	440.9	680	Eastern
WIBJ	**Chicago, Ill.** —(Portable)—C. L. Carrell, 1506 No. American Bldg.	100	201.2	1490	
WIBM	**Chicago, Ill.** — (Portable)—C. L. Carrell, 1506 No. American Bldg.	100	201.2	1490	
WIBO	**Chicago, Ill.** — Transmitter in Desplaines—WIBO Broadcasters, Inc., 6312 Broadway (Divides time with WHT and WHAZ).	5000	305.9	980	Central
WIBR	**Steubenville, Ohio** — Thurman A. Owings.	50	249.9	1200	Eastern
WIBS	**Elizabeth, N. J.**—New Jersey Broadcasting Corp., 80 Broad St. (Divides time with WMBQ and WLBX).	250	204	1470	Eastern
WIBU	**Poynette, Wis.** — Wisconsin State Journal.	20	217.3	1380	Central
WIBW	**Topeka, Kans.**—C. L. Carrell, 901 National Reserve Life Ins. Co. Bldg.	250	204	1470	Central
WIBX	**Utica, N. Y.**—WIBX, Inc., Hotel Utica.	150	238	1260	Eastern
WIBZ	**Montgomery, Ala.**—A. D. Trum, 217 Catoma St.	15	230.6	1300	Central
WICC	**Bridgeport, Conn.** — Bridgeport Broadcasting Co., Inc.	500	265.3	1130	Eastern
WIL	**St. Louis, Mo.**—Benson Radio Broadcasting Co. (Divides time with WSBF).	250	258.5	1160	Central
WIOD	**Miami Beach, Fla.** — Carl G. Fisher Company.	1000	247.8	1210	Eastern
WIP	**Philadelphia, Pa.**—Gimbel Bros., Market St. Bldg. (Divides time with WOO and WGBS).	500	348.6	860	Eastern
WINR	**Bay Shore, N. Y.** — Radiotel Mfg. Co., Carleton Hall (Divides time with WCDA and WBRS).	150	211.1	1420	Eastern
WISN	**Milwaukee, Wis.**—Wisconsin News, 115 Michigan St.	250	270.1	1110	Central
WIVA	**Norfolk, Va.** — Radio Corp. of Virginia.	100	209.7	1430	Eastern
WJAD	**Waco, Tex.** — Frank P. Jackson, 801 Austin Ave.	500	333.1	900	Central
WJAG	**Norfolk, Nebr.** — Norfolk Daily News, Hotel Norfolk (500 watts Daytime).	250	285.5	1050	Central
WJAK	**Kokomo, Ind.**—J. A. Kautz, Y. M. C. A. Bldg.	50	234.2	1280	Central
WJAM	**Cedar Rapids, Ia.** — D. M. Perham, 322 Third Ave., W. (Divides time with KWCR).	250	239.9	1250	Central
WJAR	**Providence, R. I.**—The Outlet Co.	500	483.6	620	Eastern
WJAS	**Pittsburgh, Pa.**—M. H. Pickering Furniture Co. (Divides time with KQV).	500	270.1	1110	Eastern
WJAX	**Jacksonville, Fla.**—City of Jacksonville, Waterworks Park, 1st and Main Sts. (Divides time with WAPI).	1000	340.7	880	Eastern
WJAY	**Cleveland, Ohio** — Cleveland Radio Broadcasting Corp., Hotel Hollenden.	500	227.1	1320	Eastern
WJAZ	**Chicago, Ill.** — Transmitter in Mount Prospect — Zenith Radio Corporation, 3620 Iron St. (Divides time with WMBI).	5000	263	1140	Central
WJBA	**Joliet, Ill.** — D. H. Lentz, Jr., 301 Whitley Ave.	50	247.8	1210	Central
WJBB	**St. Petersburg, Fla.**—Transmitter in Sarasota—Financial Journal, 126—13th St., N.	250	238	1260	Eastern
WJBC	**La Salle, Ill.**—Hummer Furniture Co., 2nd and Joliet Sts.	100	227.1	1320	Central
WJBI	**Red Bank, N. J.**—Robt. S. Johnson, 63 Broad St.	250	263	1140	Eastern
WJBK	**Ypsilanti, Mich.**—Ernest F. Goodwin, 803 Congress St.	15	220.4	1360	Central
WJBL	**Decatur, Ill.** — Wm. Gushard Dry Goods Co., 301 N. Water St.	250	212.6	1410	Central
WJBO	**New Orleans, La.** — Valdemar Jensen, 119 S. St. Patrick St.	100	263	1140	Central
WJBT	**Chicago, Ill.**—John S. Boyd, Kimball Bldg. (Divides time with WBBM and WAAF).	500	389.4	770	Central
WJBU	**Lewisburg, Pa.** — Bucknell University, Engineering Bldg.	100	214.2	1400	Eastern
WJBW	**New Orleans, La.**—C. Carlson, Jr., 2743 Dumaine St.	30	238	1260	Central
WJBY	**Gadsden, Ala.**—Electric Construction Co., 517 Broad St.	50	234.2	1280	Central
WJBZ	**Chicago Heights, Ill.**—Roland G. Palmer & A. Coppotelli, 144 East Sixteenth St.	100	208.2	1440	Central
WJJD	**Mooseheart, Ill.** — Supreme Lodge, Loyal Order of Moose (Divides time with WEBH).	1000	365.6	820	Central
WJKS	**Gary, Ind.** — Johnson Kennedy Radio Corp., 540 Lake St.	500	232.4	1290	Central
WJR	**Detroit, Mich.** — Transmitter in Pontiac—Good Will Station WJR, Inc. & Detroit Free Press, General Motors Bldg. and Book Cadillac Hotel.	5000	440.9	680	Eastern
WJZ	**New York, N. Y.** — Transmitter in Bound Brook, N. J.—National Broadcasting Co., 711—5th Ave.	40000	454.3	660	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WKAR	**East Lansing, Mich.**—Michigan State College (1000 watts Daytime).	500	277.6	1080	Central
WKAV	**Laconia, N. H.**—Laconia Radio Club, Auditorium, Public Service Co. of N. H.	50	223.7	1340	Eastern
WKBB	**Joliet, Ill.** — Sanders Bros., 607 Jefferson St. (Divides time with WCLS).	150	215.7	1390	Central
WKBC	**Birmingham, Ala.** — H. L. Ansley, 1428 North Twelfth Ave.	10	218.8	1370	Central
WKBE	**Webster, Mass.**—K. & B. Electric Co., 59 Emerald Ave.	100	228.9	1310	Eastern
WKBF	**Indianapolis, Ind.** — Noble B. Watson, Hoosier Athletic Club.	250	252	1190	Central
WKBG	**Chicago, Ill.** — (Portable)—C. L. Carrell, 36 So. State Street.	100	201.2	1490	
WKBH	**La Crosse, Wis.**—Callaway Music Co., 221 Main St.	500	230.6	1300	Central
WKBI	**Chicago, Ill.**—Fred L. Schoenwolf, Lincoln Trust & Savings Bank Bldg. (Divides time with WHFC).	50	215.7	1390	Central
WKBL	**Monroe, Mich.**—Monrona Radio Mfg. Co., 16 S. Monroe St.	15	205.4	1460	Eastern
WKBN	**Youngstown, Ohio** — Radio Electric Service, Y. M. C. A. (Divides time with WMBW).	50	214.2	1400	Eastern
WKBO	**Jersey City, N. J.** — Camith Corporation, 2866 Boulevard (Divides time with WKBQ and WCGU).	500	218.8	1370	Eastern
WKBP	**Battle Creek, Mich.**— Battle Creek Enquirer & News.	50	212.6	1410	Eastern
WKBQ	**New York, N. Y.** — Standard Cahill Co., Inc., 1100 East 177th St. (Divides time with WKBO and WCGU).	500	218.8	1370	Eastern
WKBS	**Galesburg, Ill.** — P. N. Nelson, 227 Duffield Ave. (Divides time with WLBO).	100	217.3	1380	Central
WKBT	**New Orleans, La.** — First Baptist Church.	50	252	1190	Central
WKBV	**Brookville, Ind.** — Knox Battery & Electric Co., 1058 Main St.	100	218.8	1370	Central
WKBW	**Buffalo, N. Y.** — (Transmitter in Amherst) Churchill Evangelistic Assoc., 1420-1428 Main St.	5000	217.3	1380	Eastern
WKBZ	**Ludington, Mich.** — Karl L. Ashbacker, First National Bank Bldg.	15	199.9	1500	Eastern
WKDR	**Kenosha, Wis.** — Edward A. Dato, 936 N. Michigan Ave., Chicago, Ill.	15	247.8	1210	Central
WKEN	**Buffalo, N. Y.**—Transmitter in Kenmore—WKEN Inc., 2 E. Hazeltine Ave. (Divides time with WSVS).	250	204	1470	Eastern
WKJC	**Lancaster, Pa.**—Kirk Johnson & Co., 16 West King St. (Divides time with WGAL).	50	252	1190	Eastern
WKRC	**Cincinnati, Ohio** — Kodel Radio Corp., 507 E. Pearl St.	500	245.8	1220	Central
WKY	**Oklahoma City, Okla.** — WKY Radiophone Co., Huckins Hotel.	150	288.3	1040	Central
WLAC	**Nashville, Tenn.** — Dad's Auto Accessory & Radio Store and The Life & Casualty Insurance Co.	1000	225.4	1330	Central
WLAP	**Louisville, Ky.** — Virginia Avenue Baptist Church, 2600 Virginia Ave. (100 watts Daytime).	500	267.7	1120	Central
WLB	**Minneapolis, Minn.** — University of Minnesota (Divides time with WHDI).	500	245.8	1220	Central
WLBC	**Muncie, Ind.** — D. A. Burton, 2224 So. Jefferson St.	50	209.7	1430	Central
WLBF	**Kansas City, Mo.** — Everett L. Dillard, 32nd and Main Sts.	50	209.7	1430	Central
WLBG	**Petersburg, Va.** — R. A. Gamble.	100	214.2	1400	Eastern
WLBH	**Farmingdale, N. Y.**— Joseph J. Lombardi.	30	232.4	1290	Eastern
WLBI	**Wenona, Ill.**—Wenona Legion Broadcasters, Inc.	250	238	1260	Central
WLBL	**Stevens Point, Wis.** —Wisconsin Department of Markets (Divides time with WHA).	2000	333.1	900	Central
WLBM	**Boston, Mass.** — (Transmitter in Cambridge) Browning - Drake Corp., 353 Washington St.	50	230.6	1300	Eastern
WLBN	**Little Rock, Ark.**— (Portable) — Arkansas Broadcasting Co., 210 Center St.	50	204	1470	
WLBO	**Galesburg, Ill.**—Frederick Trebbe, Jr. (Divides time with WKBS).	100	217.3	1380	Central
WLBQ	**Atwood, Ill.**—E. Dale Trout.	25	218.8	1370	Central
WLBR	**Belvidere, Ill.**—Transmitter in Rockford—Rockford Broadcasting Corp.	15	247.8	1210	Central
WLBT	**Crown Point, Ind.** — Harold Wendell.	50	247.8	1210	Central
WLBV	**Mansfield, Ohio** — Mansfield Broadcasting Assoc., Chamber of Commerce Bldg.	50	206.8	1450	Eastern
WLBW	**Oil City, Pa.**—Petroleum Telephone Co.	500	272.6	1100	Eastern
WLBX	**Long Island City, N. Y.**—John N. Brahy, 283 Crescent St. (Divides time with WIBS and WMBQ).	250	204	1470	Eastern
WLBY	**Iron Mountain, Mich.** —Aimone Electric.	50	209.7	1430	Central

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WLBZ	—Dover-Foxcroft, Me. —Thompson L. Guernsey.	250	208.2	1440	Eastern
WLCI	—Ithaca, N. Y.—Lutheran Assoc. of Ithaca.	50	247.8	1210	Eastern
WLEX	—Lexington, Mass.—The Lexington Air Station, 131 Willow Ave.	50	215.7	1390	Eastern
WLIB	—Chicago, Ill. — Liberty Weekly.	500	416.4	720	Central
WLIT	—Philadelphia, Pa.—Lit Bros., 8th and Market Sts. (Divides time with WFI).	500	405.2	740	Eastern
WLOE	—Chelsea, Mass.—New England Broadcasting Co., 56 Washington Ave.	100	211.1	1420	Eastern
WLS	—Chicago, Ill.—Transmitter in Crete—Sears, Roebuck & Co. (Divides time with WCBD).	5000	344.6	870	Central
WLSI	—Cranston, R. I.—Dutee W. Flint and Lincoln Studios, Inc., 335 Westminster St., Providence (Divides time with WBSO).	250	247.8	1210	Eastern
WLTH	—Brooklyn, N. Y. — Flatbush Radio Labs., 1421 E. 10th St. (Divides time with WKDQ and WKBO).	250	256.3	1170	Eastern
WLTS	—Chicago, Ill. — Lane Technical High School (Divides time with WCFL).	100	483.6	620	Central
WLW	—Cincinnati, Ohio — Transmitter in Harrison—Crosley Radio Corp.	5000	428.3	700	Central
WLWL	—New York, N. Y. — (Transmitter in Kearney, N. J.) Paulist Fathers, 415 W. 59th St. (Divides time with WMCA).	5000	370.2	810	Eastern
WMAC	—Cazenovia, N. Y.— Clive B. Meredith (Divides time with WSYR).	500	225.4	1330	Eastern
WMAF	—South Dartmouth, Mass. — Round Hills Radio Corp.	500	428.3	700	Eastern
WMAK	—Buffalo, N. Y., (Transmitter in Martinsville) WMAK Broadcast Station.	1000	545.1	550	Eastern
WMAL	—Washington, D. C.— M. A. Leese Radio Co., 720 Eleventh St., N. W.	500	241.8	1240	Eastern
WMAN	—Columbus, Ohio—W. E. Heskett Radio Station, 507 N. High St.	50	234.2	1280	Eastern
WMAQ	—Chicago, Ill. — Chicago Daily News, 15 North Wells St. (Divides time with WQJ).	1000	447.5	670	Central
WMAY	—St. Louis, Mo.—Kings Highway Presbyterian Church (Divides time with KFQA).	100	234.2	1280	Central
WMAZ	—Macon, Ga. — Mercer University (Divides time with WGST).	500	270.1	1110	Eastern
WMBA	—Newport, R. I. — LeRoy Joseph Beebe, 19 B'way.	100	204	1470	Eastern
WMBB	—Chicago, Ill.— Transmitter in Homewood — American Bond & Mortgage Co., 6201 Cottage Grove Ave. (Divides time with WOK).	5000	252	1190	Central
WMBC	—Detroit, Mich. — Michigan Broadcasting Co., Savoy Hotel.	100	243.8	1230	Eastern
WMBD	—Peoria Heights, Ill.— Peoria Heights Radio Laboratory, 107 E. Glen Ave.	250	205.4	1460	Central
WMBE	—St. Paul, Minn. — (Transmitter in White Bear Lake) Dr. C. S. Stevens, 2018 Grand Ave.	10	208.2	1440	Central
WMBF	—Miami Beach, Fla.— Fleetwood Hotel Corporation, (Divides time with WQAM).	500	384.4	780	Eastern
WMBG	—Richmond, Va.—Havens & Martin, 914 West Broad St.	15	220.4	1360	Eastern
WMBH	—Joplin, Mo. — Edwin Dudley Aber, 1526 E. Fifty-third St.	100	204	1470	Central
WMBI	—Chicago, Ill. — Transmitter in Addison — Moody Bible Institute of Chicago, 153 Institute Place (Divides time with WJAZ).	5000	263	1140	Central
WMBJ	—Monessen, Pa. — Wm. Roy McShaffrey.	50	232.4	1290	Eastern
WMBL	—Lakeland, Fla. — Benford Radio Studios, 121 No. Kentucky Ave.	100	228.9	1310	Eastern
WMBM	—Memphis, Tenn. — Seventh Day Adventist Church,	10	209.7	1430	Central
WMBO	—Auburn, N. Y.—Radio Service Laboratories, 17 South St.	100	220.4	1360	Eastern
WMBQ	—Brooklyn, N. Y. — Paul J. Gollhofer, 95 Leonard St. (Divides time with WIBS and WLBX).	100	204	1470	Eastern
WMBR	—Tampa, Fla. — F. J. Reynolds.	100	252	1190	Eastern
WMBS	—Harrisburg, Pa. — Transmitter in Lemoyne — Mack Battery Co.	250	234.2	1280	Eastern
WMBW	—Youngstown, Ohio— Youngstown Broadcasting Co., 647 Market St. (Divides time with WKBN).	50	214.2	1400	Eastern
WMC	—Memphis, Tenn. — Memphis Commercial Appeal, Inc., Commercial Appeal Bldg.	5000	516.9	580	Central
WMCA	—New York, N. Y. — Transmitter in Hoboken, N. J. —Associated Broadcasters, Inc., Hotel McAlpin (Divides time with WLWL).	500	370.2	810	Eastern
WMCO	—Detroit, Mich. — Transmitter in Saginaw—W. T. Thomas Radio Co., Whittier Hotel (Divides time with WAFD).	250	272.6	1100	Eastern

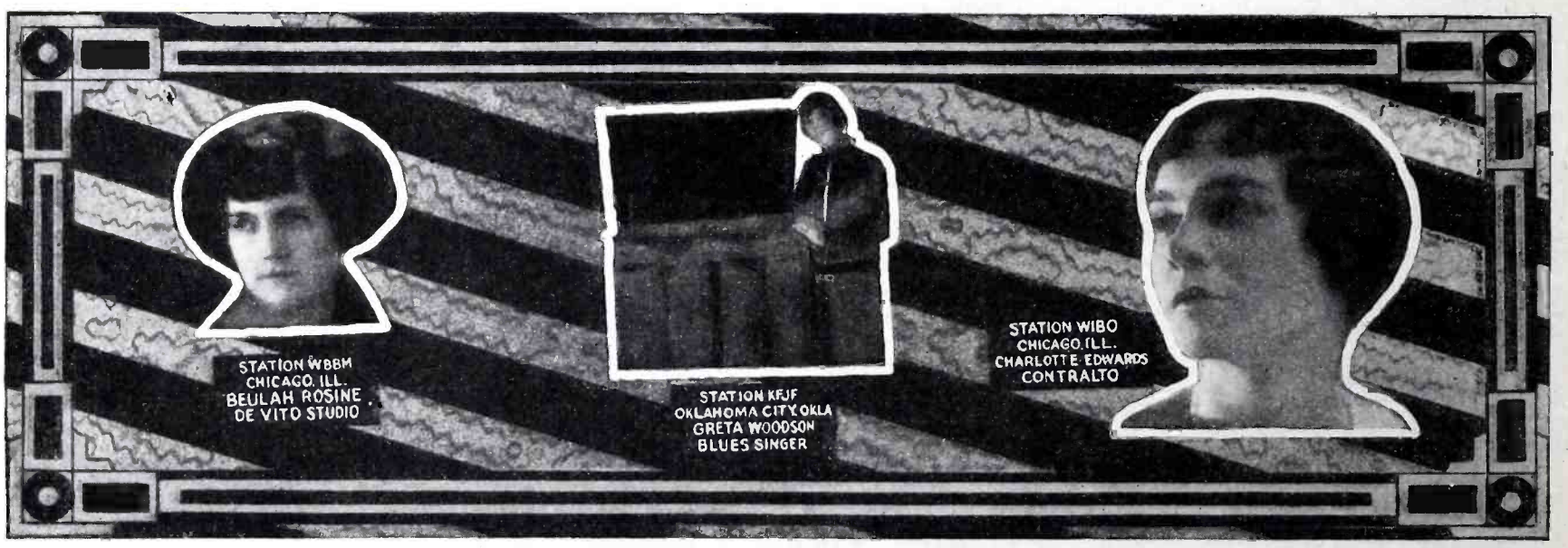
Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WMES	**Boston, Mass.** — Educational Society, Barristers Hall.	50	211.1	1420	Eastern
WMPC	**Lapeer, Mich.**—First Methodist Protestant Church.	30	234.2	1280	Eastern
WMRJ	**Jamaica, N. Y.**—Peter J. Prinz, 10 New York Blvd. (Divides time with WTRL and WHPP).	10	206.8	1450	Eastern
WMSG	**New York, N. Y.** — Madison Square Garden Broadcasting Corp., 319 W. 49th St. (Divides time with WBNY and WHAP).	500	236.1	1270	Eastern
WNAC	**Boston, Mass.** — The Shepard Stores.	500	461.3	650	Eastern
WNAD	**Norman, Okla.**—University of Oklahoma.	500	239.9	1250	Central
WNAL	**Omaha, Nebr.**— R. J. Rockwell, 5019 Capital Ave. (Divides time with KOCH and KFOX).	250	258.5	1160	Central
WNAT	**Philadelphia, Pa.** — Lennig Bros. Co., Spring Garden and 9th Sts. (Divides time with WIAD).	100	288.3	1040	Eastern
WNAX	**Yankton, S. Dak.** — Gurney Seed and Nursery Co. (Daytime only).	1000	302.8	990	Central
WNBA	**Forest Park, Ill.**—M. T. Rafferty, 810 Desplaines Ave.	200	208.2	1440	Central
WNBF	**Endicott, N. Y.**—Howitt-Wood Radio Co., Inc., 117 W. Main St., Hotel Frederick.	50	206.8	1450	Eastern
WNBH	**New Bedford, Mass.** —New Bedford Broadcasting Co., New Bedford Hotel.	250	260.7	1150	Eastern
WNBJ	**Knoxville, Tenn.** — Lonsdale Baptist Church, 122 W. Conn. Ave.	50	206.8	1450	Central
WNBO	**Washington, Pa.** — John B. Spriggs, So. Main St.	15	211.1	1420	Eastern
WNBQ	**Rochester, N. Y.** — Gordon P. Brown, 192 S. Goodman St.	15	205.4	1460	Eastern
WNBR	**Memphis, Tenn.** — Popular Radio Shop, 883 Poplar Ave.	100	228.9	1310	Central
WNBW	**Carbondale, Pa.** — Home Cut Glass & China Co., 21 Salem Ave.	5	199.9	1500	Eastern
WNBX	**Springfield, Vt.**—First Congregational Church.	10	241.8	1240	Eastern
WNBZ	**Saranac Lake, N. Y.**—	10	232.4	1290	Eastern
WNJ	**Newark, N. J.**—Radio Investment Co., 89 Lehigh Ave. (Divides time with WGCP and WAAM).	250	267.7	1120	Eastern
WNOX	**Knoxville, Tenn.** — People's Telephone & Telegraph Co., 313 Commerce Ave.	1000	265.3	1130	Central
WNRC	**Greensboro, N. C.**— Wayne M. Nelson.	250	223.7	1340	Eastern
WNYC	**New York, N. Y.** — Department of Plants and Structures, Municipal Bldg.	500	526	570	Eastern
WOAI	**San Antonio, Tex.** — Southern Equipment Co., 1031 Navarro St. (Divides time with WBAP).	5000	280.2	1070	Central
WOAN	**Lawrenceburg, Tenn.** —Church of the Nazarene and Vaughan School of Music.	500	239.9	1250	Central
WOAX	**Trenton, N. J.** — Franklyn J. Wolff, The Monument Pottery Co. (Divides time with WCAP).	500	239.9	1250	Eastern
WOBR	**Shelby, Ohio**—(Portable)—Harl Smith.	10	204	1470	
WOBT	**Union City, Tenn.** — Tittsworth's Radio & Music Shop, 114 South First St.	15	205.4	1460	Central
WOBU	**Charleston, W. Va.**— Charleston Radio Broadcasting Co., 1026 Quarier St.	250	267.7	1120	Eastern
WOC	**Davenport, Iowa** — The Palmer School of Chiropractic, 1002 Brady St.	5000	374.8	800	Central
WOCL	**Jamestown, N. Y.** — A. E. Newton.	25	223.7	1340	Eastern
WODA	**Paterson, N. J.** — James K. O'Dea, Inc., 115 Ellison St. (Divides time with WGL).	1000	293.9	1020	Eastern
WOI	**Ames, Iowa**—Iowa State College (5000 watts Daytime 6 to 6).	2500	265.3	1130	Central
WOK	**Chicago, Ill.** — Transmitter in Homewood—Trianon, Inc. (Divides time with WMBB).	5000	252	1190	Central
WOKO	**Poughkeepsie, N. Y.** (Transmitter at Mt. Beacon Summit) — Harold E. Smith, Hotel Windsor.	500	215.7	1390	Eastern
WOKT	**Rochester, N. Y.** — Titus-Ets. Corp.	500	209.7	1430	Eastern
WOMT	**Manitowoc, Wis.** — Mikadow Theatre.	50	222.1	1350	Central
WOO	**Philadelphia, Pa.** — John Wanamaker (Divides time with WIP and WGBS).	500	348.6	860	Eastern
WOOD	**Grand Rapids, Mich.** Transmitter in Furnwood — Walter B. Stiles, Inc., Hotel Rowe.	500	260.7	1150	Central
WOQ	**Kansas City, Mo.**—Unity School of Christianity (Divides time with WHB).	500	340.7	880	Central
WOR	**Newark, N. J.**—Transmitter in Kearney—L. Bamberger & Co.	5000	422.3	710	Eastern

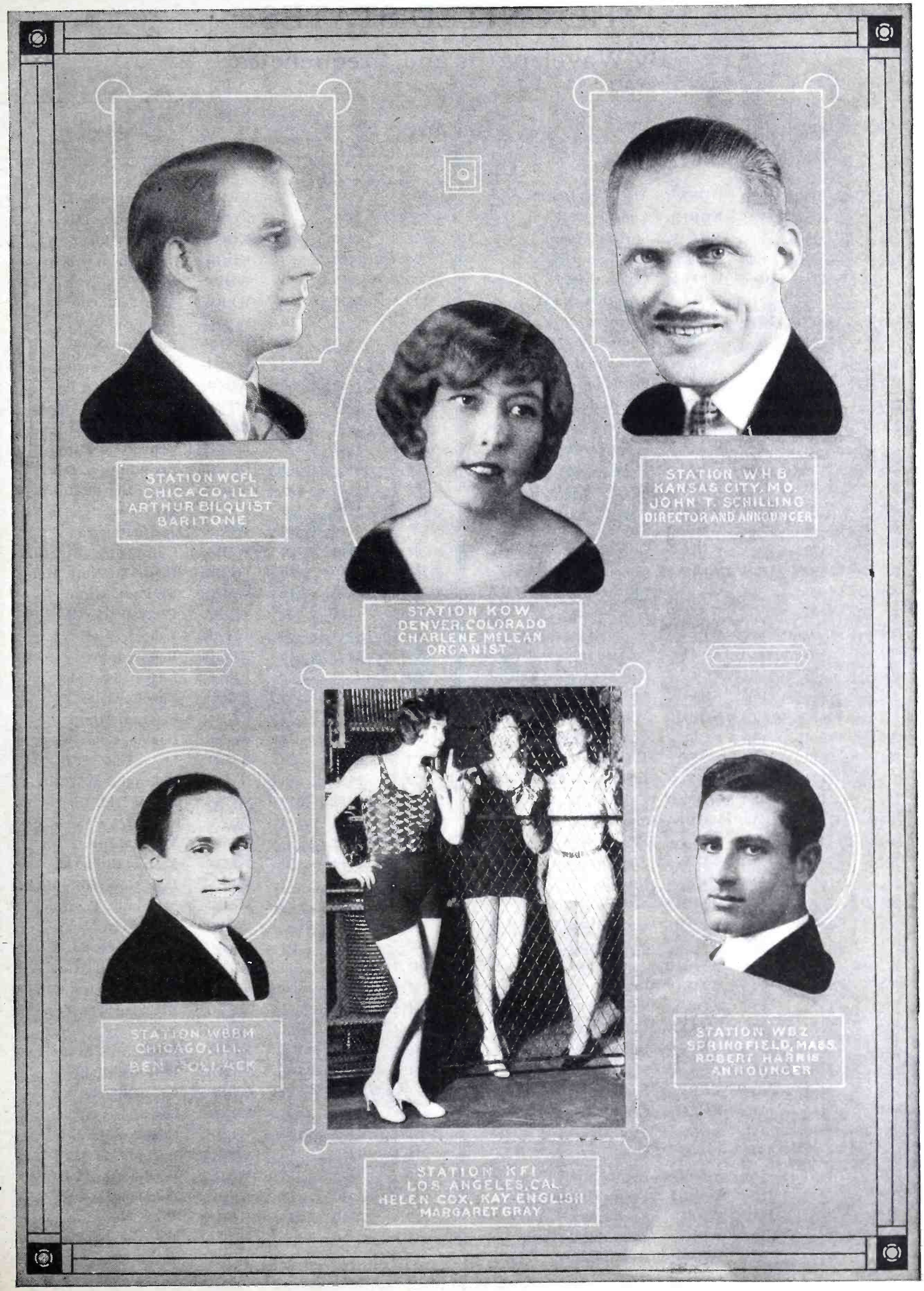
Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WORD	**—Chicago, Ill.**—Transmitter in Batavia — People's Pulpit Ass'n, 124 Columbia Heights, Brooklyn, N. Y. (Divides time with WHT and WIBO).	5000	252	1190	Central
WOS	**—Jefferson City, Mo.** — Missouri State Marketing Bureau (Divides time with WSAI).	500	361.2	830	Central
WOW	**—Omaha, Nebr.**—Woodmen of the World Life Insurance Association.	1000	508.2	590	Central
WOWO	**—Fort Wayne, Ind.** — The Main Auto Supply Co., 213 West Main St. (5000 watts Daytime).	2500	228.9	1310	Central
WPAP	**—New York, N. Y.**—(Transmitter in Cliffside, N. J.) —Palisades Amusement Park 1540 Bway. (Divides time with WHN).	500	394.5	760	Eastern
WPCC	**—Chicago, Ill.** — North Shore Congregational Church.	500	223.7	1340	Central
WPCH	**—New York, N. Y.** — Transmitter in Hoboken, N. J. —Concourse Radio Corp., Hotel McAlpin, B'way and 34th St. (Divides time with WRNY).	500	325.9	920	Eastern
WPEP	**—Waukegan, Ill.**—Maurice Mayer, 140 Hazel Court.	250	215.7	1390	Central
WPG	**—Atlantic City, N. J.** — Municipality of Atlantic City.	5000	272.6	1100	Eastern
WPOR	**—Norfolk, Va.**—Reliance Electric Co., 519 W. 21st St.	500	236.1	1270	Eastern
WPRC	**—Harrisburg, Pa.**—Wilson Printing & Radio Co., Fifth and Kelker Streets.	100	209.7	1430	Eastern
WPSC	**—State College, Pa.** — Pennsylvania State College (Divides time with WBAK) (Daytime only).	500	299.8	1000	Eastern
WPSW	**—Philadelphia, Pa.** — Philadelphia School of Wireless Telegraphy, 1533 Pine St.	50	206.8	1450	Eastern
WPTF	**—Raleigh, N. C.**—Durham Life Ins. Co., 226½ Fayetteville St.	1000	545.1	550	Eastern
WQAM	**—Miami, Fla.**—Electrical Equipment Co., 42 Northwest Fourth St. (Divides time with WMBF).	750	384.4	780	Eastern
WQAN	**—Scranton, Pa.** — Scranton Times, Penn Ave. and Spruce St. (Divides time with WGBI).	250	230.6	1300	Eastern
WQAO	**—Cliffside, N. J.**—Calvary Baptist Church, 123 W. 57th St., N. Y. C. (Divides time with WHN).	500	394.5	760	Eastern
WQBA	**—Tampa, Fla.** — Amroc College.	250	238	1260	Eastern
WQBC	**—Utica, Miss.** — I. R. Jones.	225	215.7	1390	Central
WQBJ	**—Clarksburg, W. Va.** —John Raikes, Willow Beach Club.	65	239.9	1250	Eastern
WQBZ	**—Weirton, W. Va.**— J. H. Thompson, 3337 Elm St.	60	249.9	1200	Eastern
WQJ	**—Chicago, Ill.**—Calumet Broadcasting Co. (Divides time with WMAQ).	500	447.5	670	Central
WRAF	**—Laport, Ind.** — The Radio Club, Inc., 719 Michigan Ave.	100	208.2	1440	Central
WRAH	**—Providence, R. I.** — Stanley N. Read, 191 Alabama Ave.	250	199.9	1500	Eastern
WRAK	**—Erie, Pa.**—C. R. Cummins, 1931 State St.	30	218.8	1370	Eastern
WRAM	**—Galesburg, Ill.**—Lombard College (Divides time with WFBZ).	50	247.8	1210	Central
WRAW	**—Reading, Pa.** — Avenue Radio & Electric Shop, 460 Schuylkill Ave.	100	238	1260	Eastern
WRAX	**—Philadelphia, Pa.** — Berachah Church, Inc., 1608 Alleghany Ave.	250	212.6	1410	Eastern
WRBC	**—Valparaiso, Ind.**—Immanuel Lutheran Church.	250	238	1260	Central
WRBH	**—Manchester, N. H.**— New Hampshire Broadcasting Co., 33 Kimball St.	500	——	——	Eastern
WRBI	**— Tifton, Ga. —** Kent's Furniture and Music Store.	20	——	——	Eastern
WRBJ	**—Hattiesburg, Miss.**— Woodruff Furniture Co., 119 W. Pine St.	10	——	——	Central
WRBL	**—Columbus, Ga.**—R. E. Martin.	50	——	——	Eastern
WRBQ	**—Greenville, Miss.**—J. Pat Scully.	100	——	——	Central
WRBT	**—Wilmington, N. C.**— Wilmington Radio Assn., 720 N. Fourth St.	50	——	——	Eastern
WRBU	**—Gastonia, N. C.**—A. J. Kirby Music Co., 221 E. Main St.	50	——	——	Eastern
WRBW	**—Columbia, S. C.**—Paul S. Pearce, 2011 Green St.	15	——	——	Eastern
WRBX	**—Richmond, Va.**—Richmond Development Corp., 20 Salem Ave., S.E.	250	——	——	Eastern
WRC	**—Washington, D. C.** — Radio Corporation of America.	500	468.5	640	Eastern
WREC	**—Memphis, Tenn.** — WREC, Inc.	500	249.9	1200	Central
WREN	**—Lawrence, Kans.** — Jenny Wren, Inc. (Divides time with KFKU).	750	254.1	1180	Central
WRES	**—Quincy, Mass.**—Harry L. Sawyer, 335A Newport Ave.	50	217.3	1380	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WRHF	**Washington, D. C.** —Washington Radio Hospital Fund, Hotel Annapolis (9 A.M. to 7 P.M.).	150	322.4	930	Eastern
WRHM	**Minneapolis, Minn.** —Rosedale Hospital Co., Inc., Andrews Hotel.	1000	260.7	1150	Central
WRJN	**Racine, Wis.**—Racine Broadcasting Corp., Hotel Racine.	50	247.8	1210	Central
WRK	**Hamilton, Ohio**—Doron Bros. Electrical Co., 325-329 North "B".	100	205.4	1460	Eastern
WRM	**Urbana, Ill.**—University of Illinois (Divides time with WBAA) (1000 watts before 6 P.M.).	500	272.6	1100	Central
WRMU	**New York, N. Y.** — (Portable) — (Transmitter in Richmond Hill)—Marine Station of A. H. Grebe & Co., 109 W. 57th St.	100	201.2	1490	
WRNY	**New York, N. Y.** — Transmitter in Coytesville, N. J.—Experimenter Publishing Co., 230—5th Ave. (Divides time with WPCH).	500	325.9	920	Eastern
WRR	**Dallas, Tex.** — City of Dallas, Police and Fire Signal Department.	500	461.3	650	Central
WRUF	**St. Petersburg, Fla.**— (Transmitter in Gainesville)— University of Florida.	5000	202.6	1480	Eastern
WRVA	**Richmond, Va.**—Larus & Brother Co., Inc., 22nd and Cary Sts.	1000	254.1	1180	Eastern
WSAI	**Cincinnati, Ohio** — Transmitter in Mason—United States Playing Card Co. (Divides time with WOS).	5000	361.2	830	Central
WSAJ	**Grove City, Pa.** — Grove City College.	250	223.7	1340	Eastern
WSAN	**Allentown, Pa.**—Allentown Call Publishing Co. (Divides time with WCBA).	100	222.1	1350	Eastern
WSAR	**Portsmouth, R. I.** — Transmitter in Fall River, Mass. —Doughty & Welch Electric Co., 46 N. Main St.	250	212.6	1410	Eastern
WSAX	**Chicago, Ill.** — Zenith Radio Corp., 3620 S. Iron St.	100	204	1470	Central
WSAZ	**Huntington, W. Va.**— McKellar Elec. Co., 1143—4th Ave.	100	249.9	1200	Eastern
WSB	**Atlanta, Ga.** — The Atlanta Journal.	1000	475.9	630	Central
WSBC	**Chicago, Ill.** — World Battery Co., 1219 South Wabash Ave. (Divides time with WJKS).	500	232.4	1290	Central
WSBF	**St. Louis, Mo.**—Mississippi Valley Broadcasting Co., 6th and Washington Sts. (Divides time with WIL).	250	258.5	1160	Central
WSBT	**South Bend, Ind.** — South Bend Tribune, 225 W. Colfax Ave.	500	399.8	750	Central
WSDA	**Brooklyn, N. Y.** — Amateur Radio Specialty Co., 77 Cortlandt St., N. Y. C. (Divides time with WSGH and WBBC).	500	227.1	1320	Eastern
WSEA	**Virginia Beach, Va.**— (Transmitter at Portsmouth) Virginia Beach Broadcasting Co., Cavalier Hotel, Main Studio at Norfolk.	500	263	1140	Eastern
WSGH	**Brooklyn, N. Y.**—Amateur Radio Specialty Co., 77 Cortlandt St., N. Y. C. (Divides time with WSDA and WBBC).	500	227.1	1320	Eastern
WSIX	**Springfield, Tenn.** — 638 Tire & Vulcanizing Co.	150	249.9	1200	Central
WSKC	**Bay City, Mich.** — World's Star Knitting Co.	250	272.6	1100	Eastern
WSM	**Nashville, Tenn.** — The National Life & Accident Ins. Co., National Bldg.	5000	336.9	890	Central
WSMB	**New Orleans, La.** — Saenger Amusement Co. and Maison Blanche Co.	750	296.9	1010	Central
WSMK	**Dayton, Ohio** — S.M.K. Radio Corporation, 39 East Third St.	200	296.9	1010	Eastern
WSPD	**Toledo, Ohio**—Toledo Broadcasting Co.	250	239.9	1250	Eastern
WSRO	**Middletown, Ohio** — Middletown Broadcasting Co., Central and Canal Sts.	100	236.1	1270	Central
WSSH	**Boston, Mass.** — Tremont Temple Baptist Church.	100	288.3	1040	Eastern
WSUI	**Iowa City, Iowa**—State University of Iowa.	500	475.9	630	Central
WSUN	**St. Petersburg, Fla.**— Transmitter in City Hall Park at Causeway — Chamber of Commerce (Divides time with WFLA).	750	516.9	580	Eastern
WSVS	**Buffalo, N. Y.**—Seneca Vocational School, 666 E. Delavan Ave. (Divides time with WKEN).	50	204	1470	Eastern
WSYR	**Syracuse, N. Y.**—Clive B. Meredith, Hotel Syracuse (Divides time with WMAC).	500	293.9	1020	Eastern
WTAD	**Quincy, Ill.** — Illinois Stock Medicine Broadcasting Corp.	250	236.1	1270	Central
WTAG	**Worcester, Mass.** — Worcester Telegram Pub. Co., 18 Franklin St.	250	516.9	580	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WTAM	**—Cleveland, Ohio**— Willard Storage Battery Co., 1100 Chester Ave. (Divides time with WEAR) (5000 watts Daytime).	3500	399.8	750	Eastern
WTAQ	**—Eau Claire, Wis.** — Gillette Rubber Co.	500	254.1	1180	Central
WTAR	**—Norfolk, Va.** — Reliance Electric Co., 519 W. 21st St.	500	236.1	1270	Eastern
WTAS	**—Batavia, Ill.** — Illinois Broadcasting Corp.	3500	275.1	1090	Central
WTAW	**—College Station, Tex.** —Agricultural and Mechanical College of Texas.	500	483.6	620	Central
WTAX	**—Streator, Ill.** — Williams Hardware Co., 115 So. Vermillion St.	50	247.8	1210	Central
WTAZ	**—Richmond, Va.**—Thos. J. McGuire.	15	220.4	1360	Eastern
WTFF	**—Washington, D. C.**— Independent Publishing Co., 339 Pennsylvania Ave., N.W.	10000	202.6	1480	Eastern
WTFI	**—Toccoa Falls, Ga.** — Toccoa Falls Inst.	500	209.7	1430	Eastern
WTHS	**—Atlanta, Ga.**—Atlanta Technological High School.	200	227.1	1320	Central
WTIC	**—Hartford, Conn.** — Travelers Insurance Co.	500	535.4	560	Eastern
WTMJ	**—Milwaukee, Wis.** — Transmitter in Brookfield — Milwaukee Journal.	1000	293.9	1020	Central
WTRL	**—Midland Park, N. J.**— Technical Radio Labs. (Divides time with WMRJ and WHPP).	15	206.8	1450	Eastern
WWAE	**—Chicago, Ill.**—Dr. Geo. F. Courrier, 2024 So. Wabash Ave. (Divides time with WSBC).	500	227.1	1320	Central
WWJ	**—Detroit, Mich.** — Evening News Assoc.	1000	352.7	850	Eastern
WWL	**—New Orleans, La.** — Loyola University.	500	245.8	1220	Central
WWNC	**—Asheville, N. C.** — Asheville Chamber of Commerce, 101 Patton Ave.	1000	296.9	1010	Central
WWRL	**—Woodside, N. Y.** — W. H. Reuman (Divides time with WBKN, WIBI and WBMS).	100	199.9	1500	Eastern
WWVA	**—Wheeling, West Va.**— John C. Stroebel, Jr., 1229 Main St.	250	516.9	580	Eastern

This list has been corrected up to and including May 15th, 1928





RADIO BROADCAST STATIONS OF THE UNITED STATES

By Wavelengths and Frequencies

Meters	Kilocycles	Power	Call Letters	Location
199.9	1500	15	KGFN	Aneta, N. Dak.
199.9	1500	50	KORE	Eugene, Ore.
199.9	1500	10	KUJ	Seattle, Wash.
199.9	1500	15	KWBS	Portland, Ore.
199.9	1500	100	WBMS	Union City, N. J.
199.9	1500	100	WCLB	Brooklyn, N. Y.
199.9	1500	100	WGOP	Flushing, N. Y.
199.9	1500	15	WKBZ	Ludington, Mich.
199.9	1500	5	WNBW	Carbondale, Pa.
199.9	1500	250	WRAH	Providence, R. I.
199.9	1500	100	WWRL	Woodside, N. Y.
201.2	1490	500	KPOF	Denver, Colo.
201.2	1490	50	WALK	Willow Grove, Pa.
201.2	1490	100	WATT	Boston, Mass.
201.2	1490	100	WCBR	Providence, R. I.
201.2	1490	100	WGMU	New York, N. Y.
201.2	1490	100	WHBM	Chicago, Ill.
201.2	1490	100	WIBJ	Chicago, Ill.
201.2	1490	100	WIBM	Chicago, Ill.
201.2	1490	100	WKBG	Chicago, Ill.
201.2	1490	100	WRMU	New York, N. Y.
202.6	1480	5000	WRUF	St. Petersburg, Fla.
202.6	1480	10000	WTFF	Washington, D. C.
204	1470	50	KFBI	San Francisco, Calif.
204	1470	15	KFXD	Jerome, Idaho
204	1470	50	KGEQ	Minneapolis, Minn.
204	1470	10	KGES	Central City, Nebr.
204	1470	100	KGFO	Terre Haute, Ind.
204	1470	100	KGGM	Inglewood, Calif.
204	1470	100	WBBZ	Chicago, Ill.
204	1470	250	WHBL	Sheboygan, Wis.
204	1470	250	WIBS	Elizabeth, N. J.
204	1470	250	WIBW	Topeka, Kans.
204	1470	250	WKEN	Buffalo, N. Y.
204	1470	50	WLBN	Little Rock, Ark.
204	1470	250	WLBX	Long Island City, N. Y.
204	1470	100	WMBA	Newport, R. I.
204	1470	100	WMBH	Joplin, Mo.
204	1470	100	WMBQ	Brooklyn, N. Y.
204	1470	10	WOBR	Shelby, Ohio
204	1470	100	WSAX	Chicago, Ill.
204	1470	50	WSVS	Buffalo, N. Y.
205.4	1460	25	KFXY	Flagstaff, Ariz.
205.4	1460	50	KGDE	Barrett, Minn.
205.4	1460	100	KGEO	Grand Island, Nebr.
205.4	1460	25	KGFF	Alva, Okla.
205.4	1460	250	WABF	Kingston, Pa.
205.4	1460	15	WKBL	Monroe, Mich.
205.4	1460	250	WMBD	Peoria Heights, Ill.
205.4	1460	15	WNBQ	Rochester, N. Y.
205.4	1460	15	WOBT	Union City, Tenn.
205.4	1460	100	WRK	Hamilton, O.
206.8	1450	15	KGDR	San Antonio, Tex.
206.8	1450	15	KGDY	Oldham, S. Dak.
206.8	1450	100	KGGF	Picher, Okla.
206.8	1450	50	KOOS	Marshfield, Ore.
206.8	1450	10	WHPP	New York, N. Y.
206.8	1450	50	WLBV	Mansfield, Ohio
206.8	1450	10	WMRJ	Jamaica, N. Y.
206.8	1450	50	WNBF	Endicott, N. Y.
206.8	1450	50	WNBJ	Knoxville, Tenn.
206.8	1450	50	WPSW	Philadelphia, Pa.
206.8	1450	15	WTRL	Midland Park, N. J.
208.2	1440	50	KFUS	Oakland, Calif.
208.2	1440	50	KGCN	Concordia, Kans.
208.2	1440	15	KGCR	Brookings, S. Dak.
208.2	1440	100	WBOW	Terre Haute, Ind.
208.2	1440	30	WEDH	Erie. Pa,
208.2	1440	50	WGM	Jeannette, Pa.
208.2	1440	100	WJBZ	Chicago Heights, Ill.
208.2	1440	250	WLBZ	Dover-Foxcroft, Me.
208.2	1440	10	WMBE	St. Paul, Minn.
208.2	1440	200	WNBA	Forest Park, Ill.
208.2	1440	100	WRAF	Laporte, Ind.
209.7	1430	10	KFGQ	Boone, Iowa
209.7	1430	50	KFXJ	Edgewater, Colo.
209.7	1430	500	KGHA	Pueblo, Colo.
209.7	1430	15	KGHC	Slayton, Minn.
209.7	1430	250	KGHF	Pueblo, Colo.
209.7	1430	250	KSOO	Sioux Falls, S. D.
209.7	1430	250	KVOS	Bellingham, Wash.
209.7	1430	250	WCBS	Springfield, Ill.
209.7	1430	100	WIVA	Norfolk, Va.
209.7	1430	50	WLBC	Muncie, Ind.
209.7	1430	50	WLBF	Kansas City, Mo.
209.7	1430	50	WLBY	Iron Mountain, Mich.
209.7	1430	10	WMBM	Memphis, Tenn.
209.7	1430	500	WOKT	Rochester, N. Y.
209.7	1430	100	WPRC	Harrisburg, Pa.
209.7	1430	500	WTFI	Toccoa Falls, Ga.
211.1	1420	100	KFCR	Santa Barbara, Cal.
211.1	1420	15	KFYO	Breckenridge, Tex.
211.1	1420	15	KGFM	Yuba City, Calif.
211.1	1420	100	KPNP	Muscatine, Iowa
211.1	1420	100	WBMH	Detroit, Mich.
211.1	1420	250	WBRS	Greenville, N. Y.
211.1	1420	150	WINR	Bay Shore, N. Y.
211.1	1420	100	WLOE	Chelsea, Mass.
211.1	1420	50	WMES	Boston, Mass.
211.1	1420	15	WNBO	Washington, Pa.
212.6	1410	10	KFHL	Oskaloosa, Iowa
212.6	1410	250	KGBZ	York, Nebr.
212.6	1410	100	KGFJ	Los Angeles, Calif.
212.6	1410	50	KGGH	Cedar Grove, La.

Meters	Kilocycles	Power	Call Letters	Location
212.6	1410	5	KTUE	Houston, Tex.
212.6	1410	250	KWEA	Shreveport, La.
212.6	1410	250	WCDA	New York, N. Y.
212.6	1410	250	WJBL	Decatur, Ill.
212.6	1410	50	WKBP	Battle Creek, Mich.
212.6	1410	250	WRAX	Philadelphia, Pa.
212.6	1410	250	WSAR	Portsmouth, R. I.
214.2	1400	50	KFEC	Portland, Ore.
214.2	1400	250	KFWF	St. Louis, Mo.
214.2	1400	15	KPJM	Prescott, Ariz.
214.2	1400	10	WAIT	Taunton, Mass.
214.2	1400	500	WCWK	Fort Wayne, Ind.
214.2	1400	100	WJBU	Lewisburg, Pa.
214.2	1400	50	WKBN	Youngstown, Ohio
214.2	1400	100	WLBG	Petersburg, Va.
214.2	1400	50	WMBW	Youngstown, Ohio
215.7	1390	10	KFDZ	Minneapolis, Minn.
215.7	1390	250	KFVD	Venice, Calif.
215.7	1390	50	KGCB	Oklahoma City, Okla.
215.7	1390	100	KGER	Long Beach, Calif.
215.7	1390	50	KGFG	Oklahoma City, Okla.
215.7	1390	150	WCLS	Joliet, Ill.
215.7	1390	100	WEHS	Evanston, Ill.
215.7	1390	200	WHFC	Chicago, Ill.
215.7	1390	150	WKBB	Joliet, Ill.
215.7	1390	50	WKBI	Chicago, Ill.
215.7	1390	50	WLEX	Lexington, Mass.
215.7	1390	500	WOKO	Poughkeepsie, N. Y.
215.7	1390	250	WPEP	Waukegan, Ill.
215.7	1390	225	WQBC	Utica, Miss.
217.3	1380	100	KFOR	Lincoln, Nebr.
217.3	1380	100	KFQW	Seattle, Wash.
217.3	1380	10	KGDM	Stockton, Calif.
217.3	1380	20	WIBU	Poynette, Wis.
217.3	1380	100	WKBS	Galesburg, Ill.
217.3	1380	5000	WKBW	Buffalo, N. Y.
217.3	1380	100	WLBO	Galesburg, Ill.
217.3	1380	50	WRES	Quincy, Mass.
218.8	1370	100	KGEW	Fort Morgan, Colo.
218.8	1370	250	KOW	Denver, Colo.
218.8	1370	500	WCGU	Brooklyn, N. Y.
218.8	1370	10	WKBC	Birmingham, Ala.
218.8	1370	500	WKBO	Jersey City, N. J.
218.8	1370	500	WKBQ	New York, N. Y.
218.8	1370	100	WKBV	Brookville, Ind.
218.8	1370	25	WLBQ	Atwood, Ill.
218.8	1370	30	WRAK	Erie, Pa.
220.4	1360	100	KFQU	Holy City, Calif.
220.4	1360	100	KGCI	San Antonio, Tex.
220.4	1360	15	KGFI	San Angelo, Tex.
220.4	1360	100	KGRC	San Antonio, Tex.
220.4	1360	50	KGTT	San Francisco, Calif.
220.4	1360	50	KRAC	Shreveport, La.
220.4	1360	2000	KSTP	St. Paul, Minn.
220.4	1360	250	KXL	Portland, Ore.
220.4	1360	15	WHBU	Anderson, Ind.
220.4	1360	100	WHBW	Philadelphia, Pa.
220.4	1360	15	WJBK	Ypsilanti, Mich.
220.4	1360	15	WMBG	Richmond, Va.
220.4	1360	100	WMBO	Auburn, N. Y.
220.4	1360	15	WTAZ	Richmond, Va.
222.1	1350	50	KGBY	Shelby, Nebr.
222.1	1350	50	KGFL	Trinidad, Colo.
222.1	1350	250	KGHL	Billings, Mont.
222.1	1350	100	KWKC	Kansas City, Mo.
222.1	1350	100	WCBA	Allentown, Pa.
222.1	1350	15	WGCM	Gulfport, Miss.
222.1	1350	100	WHBD	Bellefontaine, O.
222.1	1350	100	WHBF	Rock Island, Ill.
222.1	1350	50	WOMT	Manitowoc, Wis.
222.1	1350	100	WSAN	Allentown, Pa.
223.7	1340	50	KFBL	Everett, Wash.
223.7	1340	50	KFVS	Cape Girardeau, Mo.
223.7	1340	50	KFXR	Oklahoma City, Okla.
223.7	1340	10	KGDP	Pueblo, Colo.
223.7	1340	10	KGFB	Iowa City, Iowa
223.7	1340	50	KGFK	Hallock, Minn.
223.7	1340	250	KMIC	Inglewood, Calif.
223.7	1340	500	WCAM	Camden, N. J.
223.7	1340	500	WCRW	Chicago, Ill.
223.7	1340	15	WEBQ	Harrisburg, Ill.
223.7	1340	500	WFAN	Philadelphia, Pa.
223.7	1340	500	WFKB	Chicago, Ill.
223.7	1340	50	WKAV	Laconia, N. H.
223.7	1340	250	WNRC	Greensboro, N. C.
223.7	1340	25	WOCL	Jamestown, N. Y.
223.7	1340	500	WPCC	Chicago, Ill.
223.7	1340	250	WSAJ	Grove City, Pa.
225.4	1330	15	KFKZ	Kirksville, Mo.
225.4	1330	500	KFUR	Ogden, Utah
225.4	1330	50	KFVG	Independence, Kans.
225.4	1330	100	KGEN	El Centro, Calif.
225.4	1330	50	WAGM	Royal Oak, Mich.
225.4	1330	100	WCBM	Baltimore, Md.
225.4	1330	100	WCOT	Providence, R. I.
225.4	1330	1000	WDAD	Nashville, Tenn.
225.4	1330	1000	WLAC	Nashville, Tenn.
225.4	1330	500	WMAC	Cazenovia, N. Y.
227.1	1320	250	KFEL	Denver, Colo.
227.1	1320	100	KFUP	Denver, Colo.
227.1	1320	500	KSO	Clarinda, Iowa
227.1	1320	100	WAIZ	Omro, Wis.
227.1	1320	500	WBBC	Brooklyn, N. Y.
227.1	1320	5	WCBE	New Orleans, La.
227.1	1320	100	WCLO	Kenosha, Wis.
227.1	1320	500	WFJC	Akron, O.
227.1	1320	500	WJAY	Cleveland, Ohio
227.1	1320	100	WJBC	LaSalle, Ill.
227.1	1320	500	WSDA	Brooklyn, N. Y.
227.1	1320	500	WSGH	Brooklyn, N. Y.
227.1	1320	200	WTHS	Atlanta, Ga.
227.1	1320	500	WWAE	Chicago, Ill.
228.9	1310	500	KELW	Burbank, Calif.
228.9	1310	50	KFIF	Portland, Ore.
228.9	1310	250	KTAP	San Antonio, Tex.
228.9	1310	500	KTBR	Portland, Ore.
228.9	1310	15	WGBC	Memphis, Tenn.
228.9	1310	250	WHBP	Johnstown, Pa.

Meters	Kilocycles	Power	Call Letters	Location
228.9	1310	100	WKBE	Webster, Mass.
228.9	1310	100	WMBL	Lakeland, Fla.
228.9	1310	100	WNBR	Memphis, Tenn.
228.9	1310	2500	WOWO	Ft. Wayne, Ind.
230.6	1300	15	KDLR	Devils Lake, N. D.
230.6	1300	1000	KFEQ	St. Joseph, Mo.
230.6	1300	15	KFPM	Greenville, Tex.
230.6	1300	100	KGCL	Seattle, Wash.
230.6	1300	100	KPCB	Seattle, Wash.
230.6	1300	100	KRE	Berkeley, Calif.
230.6	1300	100	KZM	Oakland, Calif.
230.6	1300	25	WAAD	Cincinnati, O.
230.6	1300	100	WAFD	Detroit, Mich.
230.6	1300	500	WCOC	Columbus, Miss.
230.6	1300	250	WDBJ	Roanoke, Va.
230.6	1300	250	WGBI	Scranton, Pa.
230.6	1300	15	WIBZ	Montgomery, Ala.
230.6	1300	500	WKBH	La Crosse, Wis.
230.6	1300	50	WLBM	Boston, Mass.
230.6	1300	250	WQAN	Scranton, Pa.
232.4	1290	10	KFEY	Kellogg, Idaho
232.4	1290	100	KFJY	Fort Dodge, Ia.
232.4	1290	100	KFMR	Sioux City, Ia.
232.4	1290	250	KFPR	Los Angeles, Cal.
232.4	1290	250	KFQZ	Hollywood, Cal.
232.4	1290	5	KGHD	Missoula, Mont.
232.4	1290	500	KUT	Austin, Tex.
232.4	1290	500	WBRL	Tilton, N. H.
232.4	1290	100	WHBQ	Memphis, Tenn.
232.4	1290	500	WJKS	Gary, Ind.
232.4	1290	30	WLBH	Farmingdale, N. Y.
232.4	1290	50	WMBJ	Monessen, Pa.
232.4	1290	10	WNBZ	Saranac Lake, N. Y.
232.4	1290	500	WSBC	Chicago, Ill.
234.2	1280	500	KDYL	Salt Lake City, Utah
234.2	1280	1000	KFQA	St. Louis, Mo.
234.2	1280	100	KGAR	Tucson, Ariz.
234.2	1280	1000	KWK	St. Louis, Mo.
234.2	1280	100	WBBL	Richmond, Va.
234.2	1280	250	WCAH	Columbus, O.
234.2	1280	100	WDAH	El Paso, Tex.
234.2	1280	50	WFBC	Knoxville, Tenn.
234.2	1280	50	WJAK	Kokomo, Ind.
234.2	1280	50	WJBY	Gadsden, Ala.
234.2	1280	50	WMAN	Columbus, O.
234.2	1280	100	WMAY	St. Louis, Mo.
234.2	1280	250	WMBS	Harrisburg, Pa.
234.2	1280	30	WMPC	Lapeer, Mich.
236.1	1270	250	KFDX	Shreveport, La.
236.1	1270	500	KFMX	Northfield, Minn.
236.1	1270	500	KFWM	Oakland, Calif.
236.1	1270	100	KHMC	Harlingen, Tex.
236.1	1270	100	WBBW	Norfolk, Va.
236.1	1270	500	WBNY	New York, N. Y.
236.1	1270	250	WGBF	Evansville, Ind.
236.1	1270	1000	WHAP	New York, N. Y.
236.1	1270	500	WMSG	New York, N. Y.
236.1	1270	500	WPOR	Norfolk, Va.
236.1	1270	100	WSRO	Middletown, O.
236.1	1270	250	WTAD	Quincy, Ill.
236.1	1270	500	WTAR	Norfolk, Va.
238	1260	50	KFVI	Houston, Tex.
238	1260	50	WABZ	New Orleans, La.
238	1260	1000	WADC	Akron, O.
238	1260	150	WIBX	Utica, N. Y.
238	1260	250	WJBB	St. Petersburg, Fla.
238	1260	30	WJBW	New Orleans, La.
238	1260	250	WLBI	Wenona, Ill.
238	1260	250	WQBA	Tampa, Fla.
238	1260	100	WRAW	Reading, Pa.
238	1260	250	WRBC	Valparaiso, Ind.
239.9	1250	500	KFJR	Portland, Ore.
239.9	1250	100	KGCU	Mandan, N. Dak.
239.9	1250	250	KWCR	Cedar Rapids, Ia.
239.9	1250	5000	WBAW	Nashville, Tenn.
239.9	1250	100	WBDP	Petoskey, Mich.
239.9	1250	500	WCAP	Asbury Park, N. J
239.9	1250	100	WIBA	Madison, Wis.
239.9	1250	250	WJAM	Cedar Rapids, Ia.
239.9	1250	500	WNAD	Norman, Okla.
239.9	1250	500	WOAN	Lawrenceburg, Tenn.
239.9	1250	500	WOAX	Trenton, N. J.
239.9	1250	65	WQBJ	Clarksburg, W. Va.
239.9	1250	250	WSPD	Toledo, Ohio.
241.8	1240	1500	KFKB	Milford, Kans.
241.8	1240	500	KFON	Long Beach, Calif.
241.8	1240	250	WEBC	Superior, Wis.
241.8	1240	200	WEBR	Buffalo, N. Y.
241.8	1240	500	WEDC	Chicago, Ill.
241.8	1240	100	WFCI	Pawtucket, R. I.
241.8	1240	500	WGES	Chicago, Ill.
241.8	1240	500	WMAL	Washington, D. C.
241.8	1240	10	WNBX	Springfield, Vt.
243.8	1230	125	KFCB	Phoenix, Ariz.
243.8	1230	10	KGCX	Vida, Mont.
243.8	1230	250	KGRS	Amarillo, Tex.
243.8	1230	500	KSCJ	Sioux City, Iowa
243.8	1230	1500	KWUC	Le Mars, Iowa
243.8	1230	500	WCAD	Canton, N. Y.
243.8	1230	250	WCAO	Baltimore, Md.
243.8	1230	500	WDOD	Chattanooga, Tenn.
243.8	1230	250	WFBR	Baltimore, Md.
243.8	1230	100	WMBC	Detroit, Mich.
245.8	1220	500	KFH	Wichita, Kans.
245.8	1220	100	KFIO	Spokane, Wash.
245.8	1220	250	KFPY	Spokane, Wash.
245.8	1220	50	KGY	Lacey, Wash.
245.8	1220	100	KJBS	San Francisco, Calif.
245.8	1220	250	KLS	Oakland, Calif.
245.8	1220	300	WAAT	Jersey City, N. J.
245.8	1220	500	WEVD	New York, N. Y.
245.8	1220	250	WFBE	Cincinnati, Ohio
245.8	1220	400	WGBB	Freeport, N. Y.
245.8	1220	500	WHDI	Minneapolis, Minn.
245.8	1220	500	WKRC	Cincinnati, Ohio
245.8	1220	500	WLB	Minneapolis, Minn.
245.8	1220	500	WWL	New Orleans, La.
247.8	1210	100	KFJB	Marshalltown, Ia.

Meters	Kilocycles	Power	Call Letters	Location
247.8	1210	100	KFWC	San Bernardino, Calif.
247.8	1210	100	KGB	San Diego, Cal.
247.8	1210	10	KGCA	Decorah, Iowa
247.8	1210	50	KWLC	Decorah, Iowa
247.8	1210	50	WABW	Wooster, Ohio
247.8	1210	50	WABY	Philadelphia, Pa.
247.8	1210	100	WCAT	Rapid City, S. D.
247.8	1210	250	WDWF	Cranston, R. I.
247.8	1210	10	WEBE	Cambridge, Ohio
247.8	1210	50	WFBZ	Galesburg, Ill.
247.8	1210	50	WFKD	Philadelphia, Pa.
247.8	1210	1000	WIOD	Miami Beach, Fla.
247.8	1210	50	WJBA	Joliet, Ill.
247.8	1210	15	WKDR	Kenosha, Wis.
247.8	1210	15	WLBR	Belvidere, Ill.
247.8	1210	50	WLBT	Crown Point, Ind.
247.8	1210	50	WLCI	Ithaca, N. Y.
247.8	1210	250	WLSI	Cranston, R. I.
247.8	1210	50	WRAM	Galesburg, Ill.
247.8	1210	50	WRJN	Racine, Wis.
247.8	1210	50	WTAX	Streator, Ill.
249.9	1200	50	KFHA	Gunnison, Colo.
249.9	1200	50	KFJI	Astoria, Ore.
249.9	1200	50	KFJZ	Fort Worth, Tex.
249.9	1200	500	KFKA	Greeley, Colo.
249.9	1200	500	KFRU	Columbia, Mo.
249.9	1200	50	KFUT	Salt Lake City, Utah
249.9	1200	250	KFYR	Bismarck, N. D.
249.9	1200	50	KWJJ	Portland, Ore.
249.9	1200	100	WBAX	Wilkes-Barre, Pa.
249.9	1200	75	WBBY	Charleston, S. C.
249.9	1200	100	WBRE	Wilkes-Barre, Pa.
249.9	1200	50	WCAZ	Carthage, Ill.
249.9	1200	500	WCOA	Pensacola, Fla.
249.9	1200	50	WHBY	West De Pere, Wis.
249.9	1200	50	WIBR	Steubenville, Ohio
249.9	1200	60	WQBZ	Weirton, W. Va.
249.9	1200	500	WREC	Memphis, Tenn.
249.9	1200	100	WSAZ	Huntington, W. Va.
249.9	1200	150	WSIX	Springfield, Tenn.
252	1190	250	KEJK	Los Angeles, Calif.
252	1190	500	KFSG	Los Angeles, Calif.
252	1190	250	KOCW	Chickasha, Okla.
252	1190	10	WFAM	St. Cloud, Minn.
252	1190	15	WGAL	Lancaster, Pa.
252	1190	250	WKBF	Indianapolis, Ind.
252	1190	50	WKBT	New Orleans, La.
252	1190	50	WKJC	Lancaster, Pa.
252	1190	5000	WMBB	Chicago, Ill.
252	1190	100	WMBR	Tampa, Fla.
252	1190	5000	WOK	Chicago, Ill.
252	1190	5000	WORD	Chicago, Ill.
254.1	1180	500	KFKU	Lawrence, Kans.
254.1	1180	15	KGDA	Dell Rapids, S. Dak.
254.1	1180	200	KGFX	Pierre, S. Dak.
254.1	1180	500	KMO	Tacoma, Wash.
254.1	1180	500	WABO	Rochester, N. Y.
254.1	1180	100	WCAX	Burlington, Vt.
254.1	1180	10	WHBC	Canton, O.
254.1	1180	500	WHEC	Rochester, N. Y.
254.1	1180	750	WREN	Lawrence, Kans.
254.1	1180	1000	WRVA	Richmond, Va.
254.1	1180	500	WTAQ	Eau Claire, Wis.
256.3	1170	2000	KTNT	Muscatine, Iowa
256.3	1170	250	WASH	Grand Rapids, Mich.
256.3	1170	1000	WBBR	Rossville, N. Y.
256.3	1170	500	WCSO	Springfield, Ohio
256.3	1170	500	WEBJ	New York, N. Y.
256.3	1170	250	WLTH	Brooklyn, N. Y.
258.5	1160	100	KFOX	Omaha, Neb.
258.5	1160	500	KFUL	Galveston, Tex.
258.5	1160	250	KOCH	Omaha, Neb.
258.5	1160	1000	WBT	Charlotte, N. C.
258.5	1160	500	WEBW	Beloit, Wis.
258.5	1160	750	WFBL	Syracuse, N. Y.
258.5	1160	250	WIL	St. Louis, Mo.
258.5	1160	250	WNAL	Omaha, Neb.
258.5	1160	250	WSBF	St. Louis, Mo.
260.7	1150	2000	KGA	Spokane, Wash.
260.7	1150	1000	WCAU	Philadelphia, Pa.
260.7	1150	500	WCMA	Culver, Ind.
260.7	1150	1000	WFIW	Hopkinsville, Ky.
260.7	1150	250	WNBH	New Bedford, Mass.
260.7	1150	500	WOOD	Grand Rapids, Mich.
260.7	1150	1000	WRHM	Minneapolis, Minn.
263	1140	50	KFPW	Carterville, Mo.
263	1140	100	KGEF	Los Angeles, Calif.
263	1140	10	KGEK	Yuma, Colo.
263	1140	250	KGFH	La Crescenta, Calif.
263	1140	50	KGHP	Hardin, Mont.
263	1140	250	WDAG	Amarillo, Tex.
263	1140	250	WEAM	No. Plainfield, N. J.
263	1140	5000	WJAZ	Chicago, Ill.
263	1140	250	WJBI	Red Bank, N. J.
263	1140	100	WJBO	New Orleans, La.
263	1140	5000	WMBI	Chicago, Ill.
263	1140	500	WSEA	Virginia Beach, Va.
265.3	1130	2000	KTSA	San Antonio, Tex.
265.3	1130	100	WBES	Takoma Park, Md.
265.3	1130	100	WCON	Danbury, Conn.
265.3	1130	500	WHK	Cleveland, Ohio
265.3	1130	500	WICC	Bridgeport, Conn.
265.3	1130	1000	WNOX	Knoxville, Tenn.
265.3	1130	2500	WOI	Ames, Iowa
267.7	1120	100	KFIZ	Fond du Lac, Wis.
267.7	1120	100	KFLV	Rockford, Ill.
267.7	1120	500	KFWI	San Francisco, Calif.
267.7	1120	1000	KSBA	Shreveport, La.
267.7	1120	250	WAAM	Newark, N. J.
267.7	1120	100	WBAO	Decatur, Ill.
267.7	1120	500	WDAE	Tampa, Fla.
267.7	1120	100	WFBG	Altoona, Pa.
267.7	1120	250	WGCP	Newark, N. J.
267.7	1120	500	WLAP	Louisville, Ky.
267.7	1120	250	WNJ	Newark, N. J.
267.7	1120	250	WOBU	Charleston, W. Va.
270.1	1110	100	KFLX	Galveston, Tex.
270.1	1110	1500	KLDS	Independence, Mo.

Meters	Kilocycles	Power	Call Letters	Location
270.1	1110	1500	KMBC	Kansas City, Mo.
270.1	1110	50	KMED	Medford, Ore.
270.1	1110	500	KOAC	Corvallis, Ore.
270.1	1110	500	KQV	Pittsburgh, Pa.
270.1	1110	500	WGST	Atlanta, Ga.
270.1	1110	250	WGWB	Milwaukee, Wis.
270.1	1110	500	WHAD	Milwaukee, Wis.
270.1	1110	250	WISN	Milwaukee, Wis.
270.1	1110	500	WJAS	Pittsburgh, Pa.
270.1	1110	500	WMAZ	Macon, Ga.
272.6	1100	750	KFJF	Oklahoma City, Okla.
272.6	1100	15	KKP	Seattle, Wash.
272.6	1100	50	KRSC	Seattle, Wash.
272.6	1100	100	KSMR	Santa Maria, Cal.
272.6	1100	100	KVL	Seattle, Wash.
272.6	1100	100	KWTC	Santa Ana, Calif.
272.6	1100	500	WBAA	West Lafayette, Ind.
272.6	1100	100	WFBJ	Collegeville, Minn.
272.6	1100	100	WFDF	Flint, Mich.
272.6	1100	750	WHAR	Atlantic City, N. J.
272.6	1100	500	WLBW	Oil City, Pa.
272.6	1100	250	WMCO	Detroit, Mich.
272.6	1100	5000	WPG	Atlantic City, N. J.
272.6	1100	500	WRM	Urbana, Ill.
272.6	1100	250	WSKC	Bay City, Mich.
275.1	1090	50	KFBB	Havre, Mont.
275.1	1090	100	KFBK	Sacramento, Calif.
275.1	1090	15	KFPL	Dublin, Tex.
275.1	1090	1000	KTBI	Los Angeles, Calif.
275.1	1090	500	WEAN	Providence, R. I.
275.1	1090	1000	WFBM	Indianapolis, Ind.
275.1	1090	3500	WTAS	Batavia, Ill.
277.6	1080	2500	KEX	Portland, Ore.
277.6	1080	500	KWWG	Brownsville, Tex.
277.6	1080	100	WDZ	Tuscola, Ill.
277.6	1080	750	WGHP	Mt. Clemens, Mich.
277.6	1080	500	WKAR	East Lansing, Mich.
280.2	1070	500	KTAB	Oakland, Calif.
280.2	1070	5000	WHAM	Rochester, N. Y.
280.2	1070	5000	WOAI	San Antonio, Tex.
282.8	1060	250	KFXF	Denver, Colo.
282.8	1060	250	KVI	Tacoma, Wash.
282.8	1060	5000	WAIU	Columbus, Ohio
282.8	1060	500	WDRC	New Haven, Conn.
282.8	1060	750	WEAO	Columbus, Ohio
285.5	1050	2000	KFAU	Boise, Idaho
285.5	1050	50	KLCN	Blytheville, Ark.
285.5	1050	500	KMMJ	Clay Center, Nebr.
285.5	1050	5000	WBAL	Baltimore, Md.
285.5	1050	500	WCAL	Northfield, Minn.
285.5	1050	500	WDGY	Minneapolis, Minn.
285.5	1050	250	WJAG	Norfolk, Nebr.
288.3	1040	100	KGBX	St. Joseph, Mo.
288.3	1040	500	KPLA	Los Angeles, Calif.
288.3	1040	500	WBCN	Chicago, Ill.
288.3	1040	500	WBET	Boston, Mass.
288.3	1040	500	WDBO	Orlando, Fla.
288.3	1040	500	WENR	Chicago, Ill.
288.3	1040	100	WIAD	Philadelphia, Pa.
288.3	1040	150	WKY	Oklahoma City, Okla.
288.3	1040	100	WNAT	Philadelphia, Pa.
288.3	1040	100	WSSH	Boston, Mass.
293.9	1020	250	KGCH	Wayne, Nebr.
293.9	1020	100	KGDW	Humboldt, Nebr.
293.9	1020	100	KGEZ	Kalispell, Mont.
293.9	1020	500	KPRC	Houston, Tex.
293.9	1020	1000	WGL	New York, N. Y.
293.9	1020	1000	WODA	Paterson, N. J.
293.9	1020	500	WSYR	Syracuse, N. Y.
293.9	1020	1000	WTMJ	Milwaukee, Wis.
296.9	1010	10	KGFW	Ravenna, Nebr.
296.9	1010	500	KQW	San Jose, Cal.
296.9	1010	1000	KUOA	Fayetteville, Ark.
296.9	1010	100	WDEL	Wilmington, Del.
296.9	1010	100	WEPS	Gloucester, Mass.
296.9	1010	750	WSMB	New Orleans, La.
296.9	1010	200	WSMK	Dayton, Ohio
296.9	1010	1000	WWNC	Asheville, N. C.
299.8	1000	250	KFWO	Avalon, Catalina Is., Cal.
299.8	1000	5000	KMOX	St. Louis, Mo.
299.8	1000	500	WBAK	Harrisburg, Pa.
299.8	1000	500	WPSC	State College, Pa.
302.8	990	1000	KSL	Salt Lake City, Utah
302.8	990	250	WBRC	Birmingham, Ala.
302.8	990	750	WGR	Buffalo, N. Y.
302.8	990	1000	WNAX	Yankton, S. Dak.
305.9	980	500	WHAZ	Troy, N. Y.
305.9	980	5000	WHT	Chicago, Ill.
305.9	980	5000	WIBO	Chicago, Ill.
309.1	970	1000	KOMO	Seattle, Wash.
309.1	970	2500	WABC	New York, N. Y.
309.1	970	500	WBOQ	New York, N. Y.
315.6	950	50000	KDKA	East Pittsburgh, Pa.
315.6	950	50	KPPC	Pasadena, Calif.
315.6	950	1000	KPSN	Pasadena, Calif.
319	940	5000	KFAB	Lincoln, Nebr.
319	940	5000	KOIL	Council Bluffs, Ia.
319	940	1000	KOIN	Portland, Ore.
322.4	930	500	KFAD	Phoenix, Ariz.
322.4	930	100	KICK	Atlantic, Iowa
322.4	930	500	WHAS	Louisville, Ky.
322.4	930	150	WRHF	Washington, D. C.
325.9	920	5000	KOA	Denver, Colo.
325.9	920	500	WPCH	New York, N. Y.
325.9	920	500	WRNY	New York, N. Y.
333.1	900	100	KFJM	Grand Forks, N. D.
333.1	900	1000	KFQB	Fort Worth, Tex.
333.1	900	500	KSAC	Manhattan, Kans.
333.1	900	250	KSEI	Pocatello, Idaho
333.1	900	15000	WBZ	Springfield, Mass.
333.1	900	500	WBZA	Boston, Mass.
333.1	900	750	WHA	Madison, Wis.
333.1	900	500	WJAD	Waco, Tex.
333.1	900	2000	WLBL	Stevens Point, Wis.
336.9	890	500	KNX	Los. Angeles, Calif.
336.9	890	5000	WSM	Nashville, Tenn.
340.7	880	1000	WAPI	Auburn, Ala.
340.7	880	500	WHB	Kansas City, Mo.

Meter	Kilocycles	Power	Call Letters	Location
340.7	880	1000	WJAX	Jacksonville, Fla.
340.7	880	500	WOQ	Kansas City, Mo.
344.6	870	100	KWG	Stockton, Calif.
344.6	870	5000	WCBD	Zion, Ill.
344.6	870	5000	WLS	Chicago, Ill.
348.6	860	2500	KJR	Seattle, Wash.
348.6	860	1000	KVOO	Tulsa, Okla.
348.6	860	500	WGBS	New York, N. Y.
348.6	860	500	WIP	Philadelphia, Pa.
348.6	860	500	WOO	Philadelphia, Pa.
352.7	850	1000	KLZ	Denver, Colo.
352.7	850	1000	WEW	St. Louis, Mo.
352.7	850	1000	WWJ	Detroit, Mich.
352.7	850	1000	KFWB	Los Angeles, Calif.
361.2	830	1000	KYA	San Francisco, Calif.
361.2	830	500	WOS	Jefferson City,. Mo
361.2	830	5000	WSAI	Cincinnati, Ohio
365.6	820	50	KMJ	Fresno, Calif.
365.6	820	500	WCSH	Portland, Me.
365.6	820	2000	WEBH	Chicago, Ill.
365.6	820	1000	WJJD	Mooseheart, Ill.
370.2	810	1000	KHQ	Spokane, Wash.
370.2	810	1000	WDAF	Kansas City, Mo.
370.2	810	5000	WLWL	New York, N. Y.
370.2	810	500	WMCA	New York, N. Y.
374.8	800	500	KNRC	Santa Monica, Calif.
374.8	800	5000	WOC	Davenport, Iowa
379.5	790	500	WCAJ	Lincoln, Nebr.
379.5	790	50000	WGY	Schenectady, N. Y.
384.4	780	5000	KGO	Oakland, Calif.
384.4	780	100	WBSO	Wellesley Hills, Mass.
384.4	780	500	WMBF	Miami Beach, Fla.
384.4	780	750	WQAM	Miami, Fla.
389.4	770	500	WAAF	Chicago, Ill.
389.4	770	100	WABI	Bangor, Me.
389.4	770	5000	WBBM	Chicago, Ill.
389.4	770	500	WJBT	Chicago, Ill.
394.5	760	1000	KMA	Shenandoah, Iowa
394.5	760	5000	KOB	State College, N. Mex.
394.5	760	1000	KTW	Seattle, Wash.
394.5	760	3500	KWKH	Shreveport, La.
394.5	760	500	KWSC	Pullman, Wash.
394.5	760	500	WHN	New York, N. Y.
394.5	760	500	WPAP	New York, N. Y.
394.5	760	500	WQAO	Cliffside, N. J.
399.8	750	500	KHJ	Los Angeles, Calif.
399.8	750	1000	WEAR	Cleveland, Ohio
399.8	750	500	WSBT	South Bend, Ind.
399.8	750	3500	WTAM	Cleveland, Ohio
405.2	740	5000	WCCO	Minneap.-St. Paul, Minn.
405.2	740	500	WFI	Philadelphia, Pa.
405.2	740	500	WLIT	Philadelphia, Pa.
416.4	720	15000	WGN	Chicago, Ill.
416.4	720	500	WLIB	Chicago, Ill.
422.3	710	1000	KPO	San Francisco, Calif.
422.3	710	5000	WOR	Newark, N. J.
428.3	700	5000	WLW	Cincinnati Ohio.
428.3	700	500	WMAF	South Dartmouth Mass.
434.5	690	1000	NAA	Arlington, Va.
440.9	680	500	KFSD	San Diego, Calif.
440.9	680	500	WAAW	Omaha, Nebr.
440.9	680	5000	WCX	Detroit, Mich.
440.9	680	50	WIBG	Elkins Park, Pa.
440.9	680	5000	WJR	Detroit, Mich.
447.5	670	1000	KFOA	Seattle, Wash.
447.5	670	1000	WMAQ	Chicago, Ill.
447.5	670	500	WQJ	Chicago, Ill.
454.3	660	1000	KFRC	San Francisco, Calif.
454.3	660	40000	WJZ	New York, N. Y.
461.3	650	2000	KFNF	Shenandoah, Io wa
461.3	650	500	KRLD	Dallas, Tex.
461.3	650	500	KUOM	Missoula, Mont.
461.3	650	500	WBIS	Boston, Mass.
461.3	650	500	WCAE	Pittsburgh, Pa.
461.3	650	500	WNAC	Boston, Mass.
461.3	650	500	WRR	Dallas, Texas
468.5	640	5000	KFI	Los Angeles, Calif.
468.5	640	500	WRC	Washington, D. C.
475.9	630	100	WIAS	Ottumwa, Iowa
475.9	630	1000	WSB	Atlanta, Ga.
475.9	630	500	WSUI	Iowa City, Ia.
483.6	620	500	KFBU	Laramie, Wyo.
483.6	620	500	KFDM	Beaumont, Tex.
483.6	620	1000	KFUM	Colorado Springs, Colo.
483.6	620	250	KUSD	Vermillion, S. D.
483.6	620	1500	WCFL	Chicago, Ill.
483.6	620	1000	WEMC	Berrien Springs, Mich.
483.6	620	500	WJAR	Providence, R. I.
483.6	620	100	WLTS	Chicago, Ill.
483.6	620	500	WTAW	College Station, Tex.
491.5	610	1000	KGW	Portland, Ore.
491.5	610	50000	WEAF	New York, N. Y.
499.7	600	1000	KTHS	Hot Spgs. Natl. Pk., Ark.
499.7	600	5000	WBAP	Fort Worth, Tex.
508.2	590	500	KLX	Oakland, Calif.
508.2	590	500	WEEI	Boston, Mass.
508.2	590	1000	WOW	Omaha, Nebr.
516.9	580	500	KMTR	Hollywood, Calif.
516.9	580	750	WFLA	Clearwater, Fla.
516.9	580	5000	WMC	Memphis, Tenn.
516.9	580	750	WSUN	St. Petersburg, Fla.
516.9	580	250	WTAG	Worcester, Mass.
516.9	580	250	WWVA	Wheeling, W. Va.
526	570	2500	KFKX	Chicago, Ill.
526	570	2500	KYW	Chicago, Ill.
526	570	500	WNYC	New York, N. Y.
535.4	560	500	KXA	Seattle, Wash.
535.4	560	500	WCAC	Mansfield, Conn.
535.4	560	5000	WHO	Des Moines, Iowa
535.4	560	500	WTIC	Hartford, Conn.
545.1	550	1000	KFDY	Brookings, S. D.
545.1	550	1000	KFUO	St. Louis, Mo.
545.1	550	500	KSD	St. Louis, Mo.
545.1	550	250	WDAY	Fargo, N. D.
545.1	550	500	WFAA	Dallas, Tex.
545.1	550	1000	WMAK	Buffalo, N Y.
545.1	550	1000	WPTF	Raleigh, N. C.

This list has been corrected up to and including May 15th, 1928

STATION KGFI
SAN ANGELO, TEXAS
RAINBOW MALE QUARTETTE

STATION KFRC
SAN FRANCISCO, CAL.
HARRISON HOLLIWAY
MANAGER

STATION WPG
ATLANTIC CITY, N.J.
EDWIN FRANKO GOLDMAN
BAND CONDUCTOR

STATION KPO
SAN FRANCISCO, CAL.
MISS OLGA STEFFANI
SOPRANO

STATION WGBS
NEW YORK, N.Y.
DAILEY PASKMAN
DIRECTOR

STATION WIP
PHILADELPHIA, PA.
EDWARD A. DAVIES
DIRECTOR AND ANNOUNCER

RADIO BROADCAST STATIONS OF THE UNITED STATES

By States and Cities

State and City	Call Letters	Wave Length
ALABAMA		
Auburn	WAPI	340.7
Birmingham	WBRC	302.8
Birmingham	WKBC	218.8
Gadsden	WJBY	234.2
Montgomery	WIBZ	230.6
ARIZONA		
Flagstaff	KFXY	205.4
Phoenix	KFAD	322.4
Phoenix	KFCB	243.8
Prescott	KPJM	214.2
Tucson	KGAR	234.2
ARKANSAS		
Blytheville	KLCN	285.5
Fayetteville	KUOA	296.9
Hot Springs Nat'l Pk.	KTHS	499.7
Little Rock	KGHI	.....
Little Rock	KGJF	.....
Little Rock	WLBN	204
McGehee	KGHG	.....
CALIFORNIA		
Avalon, Catalina Is.	KFWO	299.8
Berkeley	KRE	230.6
Burbank	KELW	228.9
El Centro	KGEN	225.4
Fresno	KMJ	365.6
Hollywood	KFQZ	232.4
Hollywood	KMTR	516.9
Holy City	KFQU	220.4
Inglewood	KGGM	204
Inglewood	KMIC	223.7
La Crescenta	KGFH	263
Long Beach	KFON	241.8
Long Beach	KGER	215.7
Los Angeles	KFI	468.5
Los Angeles	KEJK	252
Los Angeles	KFPR	232.4
Los Angeles	KFSG	252
Los Angeles	KFWB	352.7
Los Angeles	KGEF	263
Los Angeles	KGFJ	212.6
Los Angeles	KHJ	399.8
Los Angeles	KNX	336.9
Los Angeles	KPLA	288.3
Los Angeles	KTBI	275.1
Oakland	KFUS	208.2
Oakland	KFWM	236.1
Oakland	KGO	384.4
Oakland	KLS	245.8
Oakland	KLX	508.2
Oakland	KTAB	280.2
Oakland	KZM	230.6
Pasadena	KPPC	315.6
Pasadena	KPSN	315.6
Sacramento	KFBK	275.1
San Bernardino	KFWC	247.8
San Diego	KFSD	440.9
San Diego	KGB	247.8
San Francsico	KFBI	204
San Francisco	KFRC	454.3
San Francisco	KFWI	267.7
San Francisco	KGTT	220.4
San Francisco	KJBS	245.8
San Francisco	KPO	422.3
San Francisco	KYA	361.2
San Jose	KQW	296.9
Santa Ana	KWTC	272.6
Santa Barbara	KFCR	211.1
Santa Maria	KSMR	272.6
Santa Monica	KNRC	374.8
Stockton	KGDM	217.3
Stockton	KWG	344.6
Venice	KFVD	215.7
Yuba City	KGFM	211.1
COLORADO		
Colorado Springs	KFUM	483.6
Denver	KFEL	227.1
Denver	KFUP	227.1
Denver	KFXF	282.8
Denver	KLZ	352.7
Denver	KOA	325.9
Denver	KOW	218.8
Denver	KPOF	201.2
Edgewater	KFXJ	209.7
Fort Morgan	KGEW	218.8
Greeley	KFKA	249.9
Gunnison	KFHA	249.9
Pueblo	KGDP	223.7
Pueblo	KGHA	209.7
Pueblo	KGHF	209.7
Trinidad	KGFL	222.1
Yuma	KGEK	263
CONNECTICUT		
Bridgeport	WICC	265.3
Danbury	WCON	265.3
Hartford	WTIC	535.4
Mansfield	WCAC	535.4
New Haven	WDRC	282.8
DELAWARE		
Wilmington	WDEL	296.9
DIST. OF COLUMBIA		
Washington	WMAL	241.8
Washington	WRC	468.5
Washington	WRHF	322.4
Washington	WTFF	202.6
FLORIDA		
Clearwater	WFLA	516.9
Jacksonville	WJAX	340.7
Lakeland	WMBL	228.9
Miami	WQAM	384.4
Miami Beach	WIOD	247.8
Miami Beach	WMBF	384.4
Orlando	WDBO	288.3
Pensacola	WCOA	249.9
St. Petersburg	WJBB	238
St. Petersburg	WRUF	202.6
St. Petersburg	WSUN	516.9
Tampa	WDAE	267.7
Tampa	WMBR	252
Tampa	WQBA	238
GEORGIA		
Atlanta	WGST	270.1
Atlanta	WSB	475.9
Atlanta	WTHS	227.1
Columbus	WRBL	.....
Macon	WMAZ	270.1
Tifton	WRBI	.....
Toccoa Falls	WTFI	209.7
IDAHO		
Boise	KFAU	285.5
Jerome	KFXD	204
Kellogg	KFEY	232.4
Pocatello	KSEI	333.1
ILLINOIS		
Atwood	WLBQ	218.8
Batavia	WTAS	275.1
Belvidere	WLBR	247.8
Carthage	WCAZ	249.9
Chicago	KFKX	526
Chicago	KYW	526
Chicago	WAAF	389.4
Chicago	WBBM	389.4
Chicago	WBBZ	204
Chicago	WBCN	288.3
Chicago	WCFL	483.6
Chicago	WCRW	223.7
Chicago	WEBH	365.6
Chicago	WEDC	241.8
Chicago	WENR	288.3
Chicago	WFKB	223.7
Chicago	WGES	241.8
Chicago	WGN	416.4
Chicago	WHBM	201.2
Chicago	WHFC	215.7
Chicago	WHT	305.9
Chicago	WIBJ	201.2
Chicago	WIBM	201.2
Chicago	WIBO	305.9
Chicago	WJAZ	263
Chicago	WJBT	389.4
Chicago	WKBG	201.2
Chicago	WKBI	215.7
Chicago	WLIB	416.4
Chicago	WLS	344.6
Chicago	WLTS	483.6
Chicago	WMAQ	447.5
Chicago	WMBB	252
Chicago	WMBI	263
Chicago	WOK	252
Chicago	WORD	252
Chicago	WPCC	223.7
Chicago	WQJ	447.5
Chicago	WSAX	204
Chicago	WSBC	232.4
Chicago	WWAE	227.1
Chicago Heights	WJBZ	208.2
Decatur	WBAO	267.7

State and City	Call Letters	Wave Length
ILLINOIS		
Decatur	WJBL	212.6
Evanston	WEHS	215.7
Forest Park	WNBA	208.2
Galesburg	WFBZ	247.8
Galesburg	WKBS	217.3
Galesburg	WLBO	217.3
Galesburg	WRAM	247.8
Harrisburg	WEBQ	223.7
Joliet	WCLS	215.7
Joliet	WJBA	247.8
Joliet	WKBB	215.7
LaSalle	WJBC	227.1
Mooseheart	WJJD	365.6
Peoria Heights	WMBD	205.4
Quincy	WTAD	236.1
Rockford	KFLV	267.7
Rock Island	WHBF	222.1
Springfield	WCBS	209.7
Streator	WTAX	247.8
Tuscola	WDZ	277.6
Urbana	WRM	272.6
Waukegan	WPEP	215.7
Wenona	WLBI	238
Zion	WCBD	344.6
INDIANA		
Anderson	WHBU	220.4
Brookville	WKBV	218.8
Crown Point	WLBT	247.8
Culver	WCMA	260.7
Evansville	WGBF	236.1
Fort Wayne	WCWK	214.2
Fort Wayne	WOWO	228.9
Gary	WJKS	232.4
Indianapolis	WFBM	275.1
Indianapolis	WKBF	252
Kokomo	WJAK	234.2
Laport	WRAF	208.2
Muncie	WLBC	209.7
South Bend	WSBT	399.8
Terre Haute	KGFO	204
Terre Haute	WBOW	208.2
Valparaiso	WRBC	238
West Lafayette	WBAA	272.6
IOWA		
Ames	WOI	265.3
Atlantic	KICK	322.4
Boone	KFGQ	209.7
Cedar Rapids	KWCR	239.9
Cedar Rapids	WJAM	239.9
Clarinda	KSO	227.1
Council Bluffs	KOIL	319
Davenport	WOC	374.8
Decorah	KGCA	247.8
Decorah	KWLC	247.8
Des Moines	WHO	535.4
Fort Dodge	KFJY	232.4
Iowa City	KGFB	223.7
Iowa City	WSUI	475.9
Le Mars	KWUC	243.8
Marshalltown	KFJB	247.8
Muscatine	KPNP	211.1
Muscatine	KTNT	256.3
Oskaloosa	KFHL	212.6
Ottumwa	WIAS	475.9
Shenandoah	KFNF	461.3
Shenandoah	KMA	394.5
Sioux City	KFMR	232.4
Sioux City	KSCJ	243.8
KANSAS		
Concordia	KGCN	208.2
Independence	KFVG	225.4
Lawrence	KFKU	254.1
Lawrence	WREN	254.1
Manhattan	KSAC	333.1
Milford	KFKB	241.8
Topeka	WIBW	204
Wichita	KFH	245.8
KENTUCKY		
Hopkinsville	WFIW	260.7
Louisville	WHAS	322.4
Louisville	WLAP	267.7
LOUISIANA		
Cedar Grove	KGGH	212.6
New Orleans	WABZ	238
New Orleans	WCBE	227.1
New Orleans	WJBO	263
New Orleans	WJBW	238
New Orleans	WKBT	252
New Orleans	WSMB	296.9
New Orleans	WWL	245.8
Shreveport	KFDX	236.1
Shreveport	KRAC	220.4
Shreveport	KSBA	267.7
Shreveport	KWEA	212.6
Shreveport	KWKH	394.5
MAINE		
Bangor	WABI	389.4
Dover-Foxcroft	WLBZ	208.2
Portland	WCSH	365.6
MARYLAND		
Baltimore	WBAL	285.5
Baltimore	WCAO	243.8
Baltimore	WCBM	225.4
Baltimore	WFBR	243.8
Tokoma Park	WBES	265.3
MASSACHUSETTS		
Boston	WATT	201.2
Boston	WBET	288.3
Boston	WBIS	461.3
Boston	WBZA	333.1
Boston	WEEI	508.2
Boston	WLBM	230.6
Boston	WMES	211.1
Boston	WNAC	461.3
Boston	WSSH	288.3
Chelsea	WLOE	211.1
Gloucester	WEPS	296.9
Lexington	WLEX	215.7
New Bedford	WNBH	260.7
Quincy	WRES	217.3
South Dartmouth	WMAF	428.3
Springfield	WBZ	333.1
Taunton	WAIT	214.2
Webster	WKBE	228.9
Wellesley Hills	WBSO	384.4
Worcester	WTAG	516.9
MICHIGAN		
Battle Creek	WKBP	212.6
Bay City	WSKC	272.6
Berrien Springs	WEMC	483.6
Detroit	WAFD	230.6
Detroit	WBMH	211.1
Detroit	WJR	440.9
Detroit	WMBC	243.8
Detroit	WMCO	272.6
Detroit	WWJ	352.7
East Lansing	WKAR	277.6
Flint	WFDF	272.6
Grand Rapids	WASH	256.3
Grand Rapids	WOOD	260.7
Iron Mountain	WLBY	209.7
Lapeer	WMPC	234.2
Ludington	WKBZ	199.9
Monroe	WKBL	205.4
Mt. Clemens	WGHP	277.6
Petoskey	WBBP	239.9
Pontiac	WCX	440.9
Royal Oak	WAGM	225.4
Ypsilanti	WJBK	220.4
MINNESOTA		
Barrett	KGDE	205.4
Collegeville	WFBJ	272.6
Hallock	KGFK	223.7
Minneapolis	KFDZ	215.7
Minneapolis	KGEQ	204
Minneapolis	WDGY	285.5
Minneapolis	WHDI	245.8
Minneapolis	WLB	245.8
Minneapolis	WRHM	260.7
Northfield	KFMX	236.1
Northfield	WCAL	285.5
St. Cloud	WFAM	252
St. Paul	KSTP	220.4
St. Paul	WMBE	208.2
St. Paul-Minneapolis	WCCO	405.2
Slayton	KGHC	209.7
MISSISSIPPI		
Columbus	WCOC	230.6
Greenville	WRBQ	.....
Gulfport	WGCM	222.1
Hattiesburg	WRBJ	.....
Utica	WQBC	215.7
MISSOURI		
Cape Girardeau	KFVS	223.7
Carterville	KFPW	263
Columbia	KFRU	249.9
Independence	KLDS	270.1
Jefferson City	WOS	361.2
Joplin	WMBH	204
Kansas City	KMBC	270.1
Kansas City	KWKC	222.1
Kansas City	WDAF	370.2
Kansas City	WHB	340.7
Kansas City	WLBF	209.7
Kansas City	WOQ	340.7
Kirksville	KFKZ	225.4
St. Joseph	KFEQ	230.6
St. Joseph	KGBX	288.3
St. Louis	KFQA	234.2
St. Louis	KFUO	545.1
St. Louis	KFWF	214.2
St. Louis	KMOX	299.8
St. Louis	KSD	545.1
St. Louis	KWK	234.2
St. Louis	WEW	352.7
St. Louis	WIL	258.5
St. Louis	WMAY	234.2
St. Louis	WSBF	258.5

State and City	Call Letters	Wave Length
MONTANA		
Billings	KGHL	222.1
Hardin	KGHP	263
Havre	KFBB	275.1
Kalispell	KGEZ	293.9
Missoula	KGHD	232.4
Missoula	KUOM	461.3
Vida	KGCX	243.8
NEBRASKA		
Central City	KGES	204
Clay Center	KMMJ	285.5
Grand Island	KGEO	205.4
Humboldt	KGDW	293.9
Lincoln	KFAB	319
Lincoln	KFOR	217.3
Lincoln	WCAJ	379.5
Norfolk	WJAG	285.5
Omaha	KFOX	258.5
Omaha	KOCH	258.5
Omaha	WAAW	440.9
Omaha	WNAL	258.5
Omaha	WOW	508.2
Ravenna	KGFW	296.9
Shelby	KGBY	222.1
Wayne	KGCH	293.9
York	KGBZ	212.6
NEW HAMPSHIRE		
Laconia	WKAV	223.7
Manchester	WRBH	.....
Tilton	WBRL	232.4
NEW JERSEY		
Asbury Park	WCAP	239.9
Atlantic City	WHAR	272.6
Atlantic City	WPG	272.6
Camden	WCAM	223.7
Cliffside	WQAO	394.5
Elizabeth	WIBS	204
Jersey City	WAAT	245.8
Jersey City	WKBO	218.8
Midland Park	WTRL	206.8
Newark	WAAM	267.7
Newark	WGCP	267.7
Newark	WNJ	267.7
Newark	WOR	422.3
North Plainfield	WEAM	263
Paterson	WODA	293.9
Red Bank	WJBI	263
Trenton	WOAX	239.9
Union City	WBMS	199.9
NEW MEXICO		
State College	KOB	394.5
NEW YORK		
Auburn	WMBO	220.4
Bay Shore	WINR	211.1
Brooklyn	WBBC	227.1
Brooklyn	WCGU	218.8
Brooklyn	WCLB	199.9
Brooklyn	WLTH	256.3
Brooklyn	WMBQ	204
Brooklyn	WSDA	227.1
Brooklyn	WSGH	227.1
Buffalo	WEBR	241.8
Buffalo	WGR	302.8
Buffalo	WKBW	217.3
Buffalo	WKEN	204
Buffalo	WMAK	545.1
Buffalo	WSVS	204
Canton	WCAD	243.8
Cazenovia	WMAC	225.4
Endicott	WNBF	206.8
Farmingdale	WLBH	232.4
Flushing	WGOP	199.9
Freeport	WGBB	245.8
Greenville	WBRS	211.1
Ithaca	WLCI	247.8
Jamaica	WMRJ	206.8
Jamestown	WOCL	223.7
Long Island City	WLBX	204
New York	WABC	309.1
New York	WBNY	236.1
New York	WBOQ	309.1
New York	WCDA	212.6
New York	WEAF	491.5
New York	WEBJ	256.3
New York	WEVD	245.8
New York	WGBS	348.6
New York	WGL	293.9
New York	WGMU	201.2
New York	WHAP	236.1
New York	WHN	394.5
New York	WHPP	206.8
New York	WJZ	454.3
New York	WKBQ	218.8
New York	WLWL	370.2
New York	WMCA	370.2
New York	WMSG	236.1
New York	WNYC	526
New York	WPAP	394.5
New York	WPCH	325.9
New York	WRMU	201.2
New York	WRNY	325.9
Poughkeepsie	WOKO	215.7
Rochester	WABO	254.1
Rochester	WHAM	280.2
Rochester	WHEC	254.1
Rochester	WNBQ	205.4
Rochester	WOKT	209.7
Rossville	WBBR	256.3
Saranac Lake	WNBZ	232.4
Schenectady	WGY	379.5
Syracuse	WFBL	258.5
Syracuse	WSYR	293.9
Troy	WHAZ	305.9
Utica	WIBX	238
Woodside	WWRL	199.9
NORTH CAROLINA		
Asheville	WWNC	296.9
Charlotte	WBT	258.5
Gastonia	WRBU	.....
Greensboro	WNRC	223.7
Raleigh	WPTF	545.1
Wilmington	WRBT	.....
NORTH DAKOTA		
Aneta	KGFN	199.9
Bismarck	KFYR	249.9
Devils Lake	KDLR	230.6
Fargo	WDAY	545.1
Grand Forks	KFJM	333.1
Mandan	KGCU	239.9
OHIO		
Akron	WADC	238
Akron	WFJC	227.1
Belle fontaine	WHBD	222.1
Cambridge	WEBE	247.8
Canton	WHBC	254.1
Cincinnati	WAAD	230.6
Cincinnati	WFBE	245.8
Cincinnati	WKRC	245.8
Cincinnati	WLW	428.3
Cincinnati	WSAI	361.2
Cleveland	WEAR	399.8
Cleveland	WHK	265.3
Cleveland	WJAY	227.1
Cleveland	WTAM	399.8
Columbus	WAIU	282.8
Columbus	WCAH	234.2
Columbus	WEAO	282.8
Columbus	WMAN	234.2
Dayton	WSMK	296.9
Hamilton	WRK	205.4
Mansfield	WLBV	206.8
Middletown	WSRO	236.1
Shelby	WOBR	204
Springfield	WCSO	256.3
Steubenville	WIBR	249.9
Toledo	WSPD	239.9
Wooster	WABW	247.8
Youngstown	WKBN	214.2
Youngstown	WMBW	214.2
OKLAHOMA		
Alva	KGFF	205.4
Chickasha	KOCW	252
Norman	WNAD	239.9
Oklahoma City	KFJF	272.6
Oklahoma City	KFXR	223.7
Oklahoma City	KGCB	215.7
Oklahoma City	KGFG	215.7
Oklahoma City	WKY	288.3
Picher	KGGF	206.8
Tulsa	KVOO	348.6
OREGON		
Astoria	KFJI	249.9
Corvallis	KOAC	270.1
Eugene	KORE	199.9
Marshfield	KOOS	206.8
Medford	KMED	270.1
Portland	KEX	277.6
Portland	KFEC	214.2
Portland	KFIF	228.9
Portland	KFJR	239.9
Portland	KGW	491.5
Portland	KOIN	319
Portland	KTBR	228.9
Portland	KWBS	199.9
Portland	KWJJ	249.9
Portland	KXL	220.4
PENNSYLVANIA		
Allentown	WCBA	222.1
Allentown	WSAN	222.1
Altoona	WFBG	267.7
Carbondale	WNBW	199.9
E. Pittsburgh	KDKA	315.6
Elkins Park	WIBG	440.9
Erie	WEDH	208.2
Erie	WRAK	218.8
Grove City	WSAJ	223.7
Harrisburg	WBAK	299.8
Harrisburg	WMBS	234.2
Harrisburg	WPRC	209.7

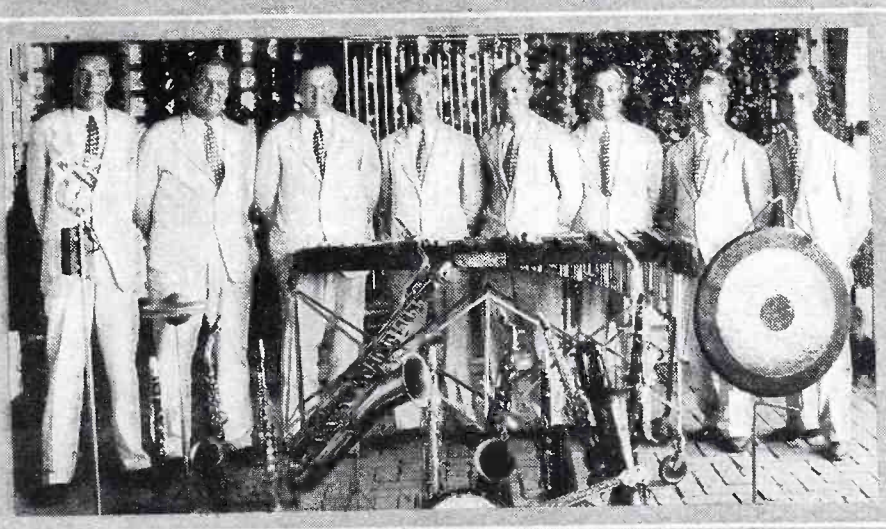
This list has been corrected up to and including May 15th, 1928

State and City	Call Letters	Wave Length
PENNSYLVANIA		
Jeanette	WGM	208.2
Johnstown	WHBP	228.9
Kingston	WABF	205.4
Lancaster	WGAL	252
La ncaster	WKJC	252
Lewisburg	WJBU	214.2
Monessen	WMBJ	232.4
Oil City	WLBW	272.6
Philadelphia	WABY	247.8
Philadelphia	WCAU	260.7
Philadelphia	WFAN	223.7
Philadelphia	WFI	405.2
Philadelphia	WFKD	247.8
Philadelphia	WHBW	220.4
Philadelphia	WIAD	288.3
Philadelphia	WIP	348.6
Philadelphia	WLIT	405.2
Philadelphia	WNAT	288.3
Philadelphia	WOO	348.6
Philadelphia	WPSW	206.8
Philadelphia	WRAX	212.6
Pittsburgh	KQV	270.1
Pittsburgh	WCAE	461.3
Pittsburgh	WJAS	270.1
Reading	WRAW	238
Scranton	WGBI	230.6
Scranton	WQAN	230.6
State College	WPSC	299.8
Washington	WNBO	211.1
Wilkes-Barre	WBAX	249.9
Wilkes-Barre	WBRE	249.9
Willow Grove	WALK	201.2
RHODE ISLAND		
Cranston	WDWF	247.8
Cranston	WLSI	247.8
Newport	WMBA	204
Pawtucket	WFCI	241.8
Portsmouth	WSAR	212.6
Providence	WCOT	225.4
Providence	WCBR	201.2
Providence	WEAN	275.1
Providence	WJAR	483.6
Providence	WRAH	199.9
SOUTH CAROLINA		
Charleston	WBBY	249.9
Columbia	WRBW	.....
SOUTH DAKOTA		
Brookings	KFDY	545.1
Brookings	KGCR	208.2
Dell Rapids	KGDA	254.1
Oldham	KGDY	206.8
Pierre	KGFX	254.1
Rapid City	WCAT	247.8
Sioux Falls	KSOO	209.7
Vermillion	KUSD	483.6
Yankton	WNAX	302.8
TENNESSEE		
Chattanooga	WDOD	243.8
Knoxville	WFBC	234.2
Knoxville	WNBJ	206.8
Knoxville	WNOX	265.3
Lawrenceburg	WOAN	239.9
Memphis	WGBC	228.9
Memphis	WHBQ	232.4
Memphis	WMBM	209.7
Memphis	WMC	516.9
Memphis	WNBR	228.9
Memphis	WREC	249.9
Nashville	WBAW	239.9
Nashville	WDAD	225.4
Nashville	WLAC	225.4
Nashville	WSM	336.9
Springfield	WSIX	249.9
Union City	WOBT	205.4
TEXAS		
Amarillo	KGRS	243.8
Amarillo	WDAG	263
Austin	KUT	232.4
Beaumont	KFDM	483.6
Breckenridge	KFYO	211.1
Brownsville	KWWG	277.6
College Station	WTAW	483.6
Dallas	KRLD	461.3
Dallas	WFAA	545.1
Dallas	WRR	461.3
Dublin	KFPL	275.1
El Paso	WDAH	234.2
Fort Stockton	KGHO	.....
Fort Worth	KFJZ	249.9
Fort Worth	KFQB	333.1
Fort Worth	WBAP	499.7
Galveston	KFLX	270.1
Galveston	KFUL	258.5
Georgetown	KGKL	.....
Goldthwaite	KGKB	.....
Greenville	KFPM	230.6
Harlingen	KHMC	236.1
Houston	KFVI	238
Houston	KPRC	293.9
Houston	KTUE	212.6
Richmond	KGHX	.....
San Angelo	KGFI	220.4
San Antonio	KGCI	220.4
San Antonio	KGDR	206.8
San Antonio	KGRC	220.4
San Antonio	KTAP	228.9
San Antonio	KTSA	265.3
San Antonio	WOAI	280.2
Waco	WJAD	333.1
Wichita Falls	KGKO	.....
UTAH		
Ogden	KFUR	225.4
Salt Lake City	KDYL	234.2
Salt Lake City	KFUT	249.9
Salt Lake City	KSL	302.8
VERMONT		
Burlington	WCAX	254.1
Springfield	WNBX	241.8
VIRGINIA		
Arlington	NAA	434.5
Norfolk	WBBW	236.1
Norfolk	WIVA	209.7
Norfolk	WPOR	236.1
Norfolk	WTAR	236.1
Petersburg	WLBG	214.2
Richmond	WBBL	234.2
Richmond	WMBG	220.4
Richmond	WRBX	.....
Richmond	WRVA	254.1
Richmond	WTAZ	220.4
Roanoke	WDBJ	230.6
Virginia Beach	WSEA	263
WASHINGTON		
Bellingham	KVOS	209.7
Everett	KFBL	223.7
Lacey	KGY	245.8
Pullman	KWSC	394.5
Seattle	KFOA	447.5
Seattle	KFQW	217.3
Seattle	KGCL	230.6
Seattle	KJR	348.6
Seattle	KKP	272.6
Seattle	KOMO	309.1
Seattle	KPCB	230.6
Seattle	KRSC	272.6
Seattle	KTW	394.5
Seattle	KUJ	199.9
Seattle	KVL	272.6
Seattle	KXA	535.4
Spokane	KFIO	245.8
Spokane	KFPY	245.8
Spokane	KGA	260.7
Spokane	KHQ	370.2
Tacoma	KMO	254.1
Tacoma	KVI	282.8
WEST VIRGINIA		
Charleston	WOBU	267.7
Clarksburg	WQBJ	239.9
Huntington	WSAZ	249.9
Weirton	WQBZ	249.9
Wheeling	WWVA	516.9
WISCONSIN		
Beloit	WEBW	258.5
Eau Claire	WTAQ	254.1
Fond du Lac	KFIZ	267.7
Kenosha	WCLO	227.1
Kenosha	WKDR	247.8
La Crosse	WKBH	230.6
Madison	WHA	333.1
Madison	WIBA	239.9
Manitowoc	WOMT	222.1
Milwaukee	WGWB	270.1
Milwaukee	WHAD	270.1
Milwaukee	WISN	270.1
Milwaukee	WTMJ	293.9
Omro	WAIZ	227.1
Poynette	WIBU	217.3
Racine	WRJN	247.8
Sheboygan	WHBL	204
Stevens Point	WLBL	333.1
Superior	WEBC	241.8
West De Pere	WHBY	249.9
WYOMING		
Laramie	KFBU	483.6

STATION KSO
CLARINDA, IOWA
JOE FAASSEN
ANNOUNCER

STATION WMCA
NEW YORK, N.Y.
GEORGE KELTING, NORMAN PIERCE, MISS [illegible] EDOM

STATION WEMC
BERRIEN SPRINGS, MICH.
PROF. T. H. MADISON
DIRECTOR



STATION WSEA
VIRGINIA BEACH, VA.
EDDIE McNIGHTS
SILVER SLIPPER ORCH.

STATION WBAL
BALTIMORE, MD.
MISS EDNA BERHENIN
SOPRANO

STATION KGW
PORTLAND, ORE.
DOROTHY LEWIS
CONTRALTO

Canadian Radio Broadcast Stations

Indexed Alphabetically by Call Letters

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
CFAC	**Calgary, Alberta** — The Calgary Herald, Herald Bldg.	500	434.5	690	Mountain
CFBO	**St. John, N. B.**—C. A. Munro, Ltd., Imperial Theatre, King Square.	100	336.9	890	Atlantic
CFCA	**Toronto, Ont.** — Star Publishing & Printing Co., S. W. Cor. Yonge St. and St. Clair Ave.	100	356.9	840	Eastern
CFCF	**Montreal, Que.**—Canadian Marconi Co., Mount Royal Hotel.	1650	410.7	730	Eastern
CFCH	**Iroquois Falls, Ont.**—Abitibi Power & Paper Co., Ltd.	250	499.7	600	Eastern
CFCN	**Calgary, Alberta** — W. W. Grant (Ltd.), 708 Crescent Rd., N. W.	1800	434.5	690	Mountain
CFCQ	**Vancouver, B. C.** — Sprott-Shaw Radio Co., Room 1604, Bekin Bldg.	50	410.7	730	Pacific
CFCT	**Victoria, B. C.**—G. W. Deaville, 1405 Douglas St.	500	475.9	630	Pacific
CFCY	**Charlettetown, P. E. Island**—Island Radio Company, 176 Kent St.	100	312.3	960	Atlantic
CFGC	**Brantford, Ont.** — The Wentworth Radio Supply Co., Ltd., 90 Colborne St.	50	296.9	1010	Eastern
CFJC	**Kamloops, B. C.**—N. S. Dalgleish & Sons and Weller & Weller, 186 Victoria St.	15	267.7	1120	Pacific
CFLC	**Prescott, Ont.** — Radio Association of Prescott, Victoria Hall.	50	296.9	1010	Eastern
CFMC	**Kingston, Ont.**—Monarch Battery Co., Montreal St.	20	267.7	1120	Eastern
CFNB	**Fredericton, N. B.** — James S. Neill & Sons, Limited, 212 Waterloo Row.	25	247.8	1210	Atlantic
CFQC	**Saskatoon, Sask.**—The Electric Shop, Ltd., 1322 Osler St.	500	329.5	910	Mountain
CFRB	**York Co., Ont.** — Standard Radio Mfg. Corp., Ltd., Township of King.	1000	516.9	580	Eastern
CFRC	**Kingston, Ont.** — Queens University, Dept. of Electrical Engineering, Fleming Hall.	500	267.7	1120	Eastern
CFYC	**Burnaby, B. C.** — International Bible Students Assoc., 2243 Royal Oak Ave.	500	410.7	730	Pacific
CHCA	**Calgary, Alberta** — The Albertan Publishing Co., Ltd. (Uses Station CJCJ).	250	434.5	690	Mountain
CHCS	**Hamilton, Ont.** — The Hamilton Spectator, Spectator Bldg.	10	340.7	880	Eastern
CHCT	**Red Deer, Alberta**— G. F. Tull & Ardern, Ltd. (Uses Station CKLC).	1000	356.9	840	Mountain
CHCY	**Edmonton, Alberta**— International Bible Students Assoc., King Edward Park.	250	516.9	580	Mountain
CHGS	**Summerside, P. E. I.**— R. T. Holman, Ltd., Holman Bldg.	25	267.7	1120	Atlantic
CHIC	**Toronto, Ont.**—Northern Electric Co., Ltd., Hillcrest Park (Uses Station CKNC).	500	356.9	840	Eastern
CHMA	**Edmonton, Alberta**— Christian and Missionary Alliance, 9618—106A Ave.	250	516.9	580	Mountain
CHML	**Mt. Hamilton, Ont.**— Maple Leaf Radio Co., Ltd., Yale Ave.	50	340.7	880	Eastern
CHNC	**Toronto, Ont.** — Toronto Radio Research Society, Hillcrest Park (Uses Station CKNC).	500	356.9	840	Eastern
CHNS	**Halifax, Nova Scotia**— Northern Electric Co., Carleton Hotel, Cor. Prince and Argyle Sts.	100	322.4	930	Atlantic
CHPC	**Vancouver, B. C.** — Central Presbyterian Church (Uses Station CKCD).	1000	410.7	730	Pacific
CHRC	**Quebec, Que.** — E. Fontaine, 120 Dolbeau St.	5	340.7	880	Eastern
CHSC	**Unity, Sask.** — H. N. Stovin & Radio Sales, Main St.	50	267.7	1120	Mountain
CHUC	**Saskatoon, Sask.**—International Bible Students Assoc., Cor. Ave. D and 26th St.	500	329.5	910	Mountain
CHWC	**Regina, Sask.**—R. H. Williams & Sons, Ltd., Cor. Hamilton St. and 11th Ave.	15	312.3	960	Mountain
CHWK	**Chilliwack, B. C.** — Chilliwack Broadcasting Co., Ltd., Wellington Ave.	5	247.8	1210	Pacific
CHYC	**Montreal, Que.** — Northern Electric Co., Ltd., 121 Shearer St.	750	410.7	730	Eastern
CJBC	**Toronto, Ont.**—Jarvis Street Baptist Church (Uses one of the stations in Toronto City or District).	500	516.9 356.9	580 840	Eastern
CJBR	**Regina, Sask.** — Saskatchewan Co-Operative Wheat Producers, Ltd. (Uses Station CKCK).	500	312.3	960	Mountain
CJCA	**Edmonton, Alberta** — The Edmonton Journal, Ltd., Journal Bldg.	500	516.9	580	Mountain

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power (Watts)	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
CJCJ	**Calgary, Alberta**—Radio Service and Repair Shop, 18th Ave. and 7th St., E.	250	434.5	690	Mountain
CJCR	**Red Deer, Alberta** — The North American Collieries, Ltd. (Uses Station CKLC).	1000	356.9	840	Mountain
CJGC	**London, Ont.** — London Free Press Printing Co., Ltd., 430 Richmond St.	500	329.5	910	Eastern
CJGX	**Yorkton, Sask.** — The Winnipeg Grain Exchange.	500	475.9	630	Mountain
CJOC	**Lethbridge, Alberta** — J. Palmer, 1235—5th Ave. A, South.	50	267.7	1120	Mountain
CJOR	**Sea Island, B. C.** — Geo. C. Chandler.	50	291.1	1030	Pacific
CJRM	**Moose Jaw, Sask.** — Jas. Richardson & Sons, Ltd., 337 Coteau St., W.	500	296.9	1010	Mountain
CJSC	**Toronto, Ont.** — The Evening Telegram (Uses station CKCL).	500	356.9	840	Eastern
CJWC	**Saskatoon, Sask.**—The Wheaton Elec. Co, Ltd., 33d St. and Ave. "C", N.	250	329.5	910	Mountain
CJYC	**Scarboro Station, Ont.** —Universal Radio of Canada, Ltd.	500	516.9	580	Eastern
CKAC	**Montreal, Que.**—La Presse Publishing Co., Ltd., Cor. St. James St. and St. Lawrence Blvd.	1200	410.7	730	Eastern
CKCD	**Vancouver, B. C.** — Vancouver Daily Province, 142 Hastings St., W.	1000	410.7	730	Pacific
CKCI	**Quebec, Que.** — Le "Soleil", Ltd., 120 Dolbeau St.	22½	340.7	880	Eastern
CKCK	**Regina, Sask.** — Leader Publishing Co., Ltd.	500	312.3	960	Mountain
CKCL	**Toronto, Ont.** — Dominion Battery Co., Ltd., 20 Trinity St.	500	356.9	840	Eastern
CKCO	**Ottawa, Ont.** — Dr. G. M. Geldert (for Ottawa Radio Assoc.), 282 Somerset St., W.	100	434.5	690	Eastern
CKCR	**St. George, Ont.** — John Patterson, Main St.	25	257.7	1120	Eastern
CKCV	**Quebec, Que.** — G. A. Vandry, 66 St. Joseph St.	50	340.7	880	Eastern
CKCX	**Scarboro Station, Ont.**—International Bible Students Assoc. (Uses Station CJYC).	500	516.9	580	Eastern
CKFC	**Vancouver, B. C.** — United Church of Canada, Cor. Thurlow and Pendrell Sts.	50	410.7	730	Pacific
CKGW	**Bowmanville, Ont.**—Gooderham & Worts (Under Construction).	5000	312.3	960	Eastern
CKLC	**Red Deer, Alberta** — Alberta Pacific Grain Co., Ltd.	1000	356.9	840	Mountain
CKMC	**Cobalt (East Side), Ont.**—R. L. MacAdam.	5	247.8	1210	Eastern
CKNC	**Toronto, Ont.**—Canadian National Carbon Co., Ltd., Hillcrest Park.	500	356.9	840	Eastern
CKOC	**Hamilton, Ont.**—Wentworth Radio Supply Co., Ltd., Royal Connaught Hotel	100	340.7	880	Eastern
CKOW	**Scarboro Station, Ont.**—Nestle's Food Co. of Canada.	500	516.9	580	Eastern
CKPC	**Preston, Ont.**—Wallace Russ, 40 Russ Ave.	7½	247.8	1210	Eastern
CKPR	**Midland, Ont.**—E. O Swan.	50	267.7	1120	Eastern
CKSH	**St. Hyacinthe, Que.**—City of St. Hyacinthe, Que., Mondor and Cascades St.	50	296.9	1010	Eastern
CKSM	**Toronto, Ont.** — St. Michael's Cathedral (Uses Station CFRB).	1000	516.9	580	Eastern
CKUA	**Edmonton, Alberta** — University of Alberta.	500	516.9	580	Mountain
CKWX	**Vancouver, B. C.** — A. Holstead & W. Hanlon, 1220 Seymour St.	50	410.7	730	Pacific
CKY	**Winnipeg, Manitoba** — Manitoba Telephone System, Sherbrooke St.	500	384.4	780	Central
CNRA	**Moncton, N. B.** — Canadian National Railways.	500	475.9	630	Atlantic
CNRC	**Calgary, Alberta** — Canadian National Railways (Uses station CFAC).	500	434.5	690	Mountain
CNRE	**Edmonton, Alberta** — Canadian National Railways (Uses station CJCA).	500	516.9	580	Mountain
CNRM	**Montreal, Que.**—Canadian National Railways (Uses stations, CHYC, CKAC and CFCF).	1000-1650	410.7	730	Eastern
CNRO	**Ottawa, Ont.** — Canadian National Railways.	500	434.5	690	Eastern
CNRQ	**Quebec, Que.** — Canadian National Railways (Uses station CKCV).	50	340.7	880	Eastern
CNRR	**Regina, Sask.** — Canadian National Railways (Uses station CKCK).	500	312.3	960	Mountain
CNRS	**Saskatoon, Sask.** — Canadian National Railways (Uses station CFQC).	500	329.5	910	Mountain
CNRT	**Toronto, Ont.** — Canadian National Railways (Uses station CFCA).	500	356.9	840	Eastern
CNRV	**Vancouver, B. C.** — Transmitter is on Lulu Island, B. C.—Canadian National Railways.	500	291.1	1030	Pacific
CNRW	**Winnipeg, Manitoba** —Canadian National Railways (Uses station CKY).	500	384.4	780	Central

Canadian Radio Broadcast Stations

By Provinces and Cities

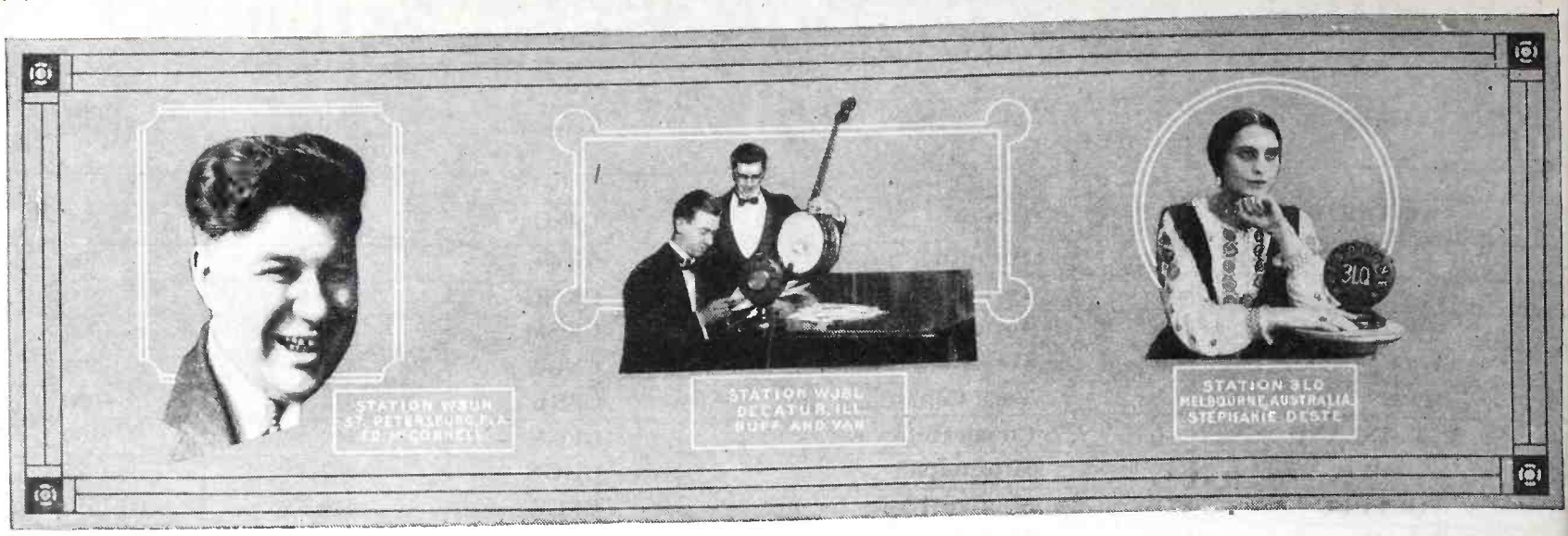
Provinces	Cities	Call Letters	Wave Length (Meters)	Power (Watts)
ALBERTA	Calgary	CFAC	434.5	500
"	Calgary	CFCN	434.5	1800
"	Calgary	CHCA	434.5	250
"	Calgary	CJCJ	434.5	250
"	Calgary	CNRC	434.5	500
"	Edmonton	CHMA	516.9	250
"	Edmonton	CJCA	516.9	500
"	Edmonton	CKUA	516.9	500
"	Edmonton	CNRE	516.9	500
"	Lethbridge	CJCC	267.7	50
"	Red Deer	CHCT	356.9	1000
"	Red Deer	CJCR	356.9	1000
"	Red Deer	CKLC	356.9	1000
BRITISH COLUMBIA	Burnaby	CFYC	410.7	500
"	Chilliwack	CHWK	247.8	5
"	Kamloops	CFJC	267.7	15
"	Sea Island	CJOR	291.1	50
"	Vancouver	CFCQ	410.7	50
"	Vancouver	CHPC	410.7	1000
"	Vancouver	CKCD	410.7	1000
"	Vancouver	CKFC	410.7	50
"	Vancouver	CKWX	410.7	50
"	Vancouver	CNRV	291.1	500
"	Victoria	CFCT	475.9	500
MANITOBA	Winnipeg	CKY	384.4	500
"	Winnipeg	CNRW	384.4	500
NEW BRUNSWICK	Fredericton	CFNB	247.8	25
"	Moncton	CNRA	475.9	500
"	St. John	CFBO	337	100
NOVA SCOTIA	Halifax	CHNS	322.4	100
ONTARIO	Bowmanville	CKGW	312.3	5000
"	Brantford	CFGC	296.9	50
"	Cobalt	CKMC	247.8	5
"	Hamilton	CHCS	340.7	10
"	Hamilton	CKOC	340.7	100
"	Iroquois Falls	CFCH	499.7	250
"	Kingston	CFMC	267.7	20
"	Kingston	CFRC	267.7	500
"	London	CJGC	329.5	500
"	Midland	CKPR	267.7	50
"	Mt. Hamilton	CHML	340.7	50
"	Ottawa	CKCO	434.5	100
"	Ottawa	CNRO	434.5	500
"	Prescott	CFLC	296.9	50
"	Preston	CKPC	247.8	7½
"	St. George	CKCR	257.7	25
"	Scarboro Station	CJYC	516.9	500
"	Scarboro Station	CKCX	516.9	500
"	Scarboro Station	CKOW	516.9	500
"	Toronto	CFCA	356.9	500
"	Toronto	CHIC	356.9	500
"	Toronto	CHNC	356.9	500
"	Toronto	CJBC	516.9–356.9	500

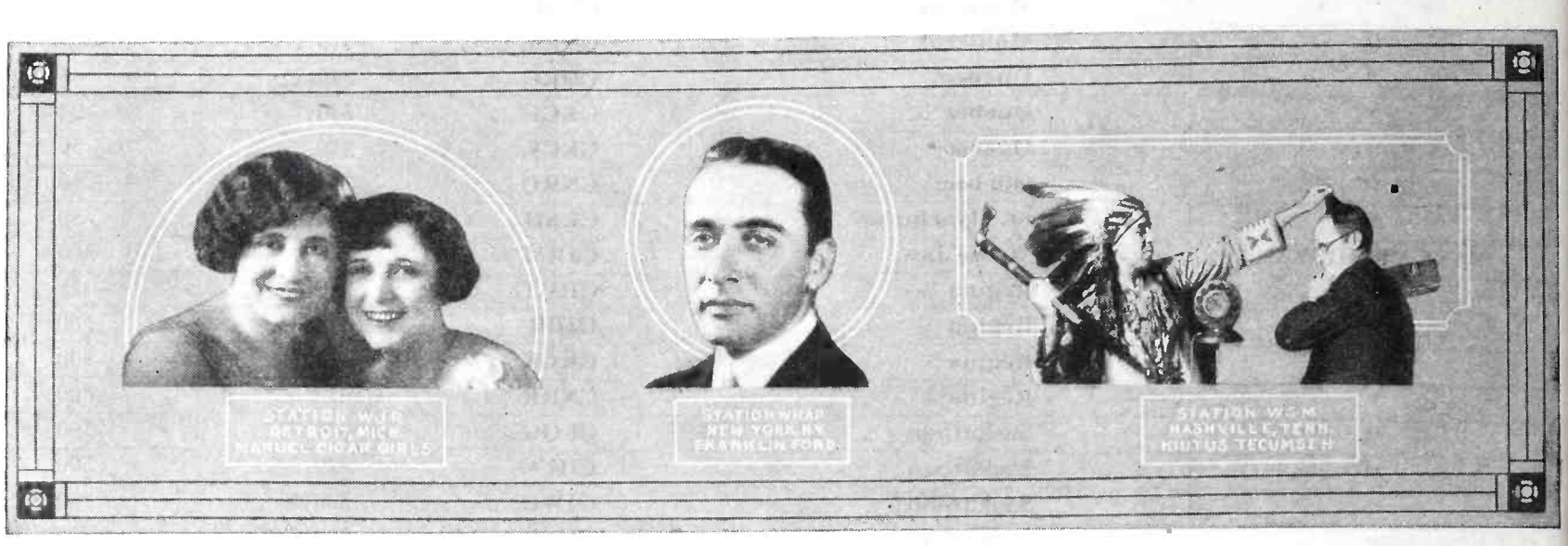
Provinces	Cities	Call Letters	Wave Length (Meters)	Power (Watts)
ONTARIO	Toronto	CJSC	356.9	500
"	Toronto	CKCL	356.9	500
"	Toronto	CKNC	356.9	500
"	Toronto	CKSM	516.9	1000
"	Toronto	CNRT	356.9	500
"	York Co.	CFRB	516.9	1000
P. E. ISLAND	Charlottetown	CFCY	312.3	100
"	Summerside	CHGS	267.7	25
QUEBEC	Montreal	CFCF	410.7	1650
"	Montreal	CHYC	410.7	750
"	Montreal	CKAC	410.7	1200
"	Montreal	CNRM	410.7	1000-1650
"	Quebec	CHRC	340.7	5
"	Quebec	CKCI	340.7	22½
"	Quebec	CKCV	340.7	50
"	Quebec	CNRQ	340.7	50
"	St. Hyacinthe	CKSH	296.9	50
SASKATCHEWAN	Moose Jaw	CJRM	296.9	500
"	Regina	CHWC	312.3	15
"	Regina	CJBR	312.3	500
"	Regina	CKCK	312.3	500
"	Regina	CNRR	312.3	500
"	Saskatoon	CFQC	329.5	500
"	Saskatoon	CHUC	329.5	500
"	Saskatoon	CJWC	329.5	250
"	Saskatoon	CNRS	329.5	500
"	Unity	CHSC	267.7	50
"	Yorkton	CJGX	475.9	500

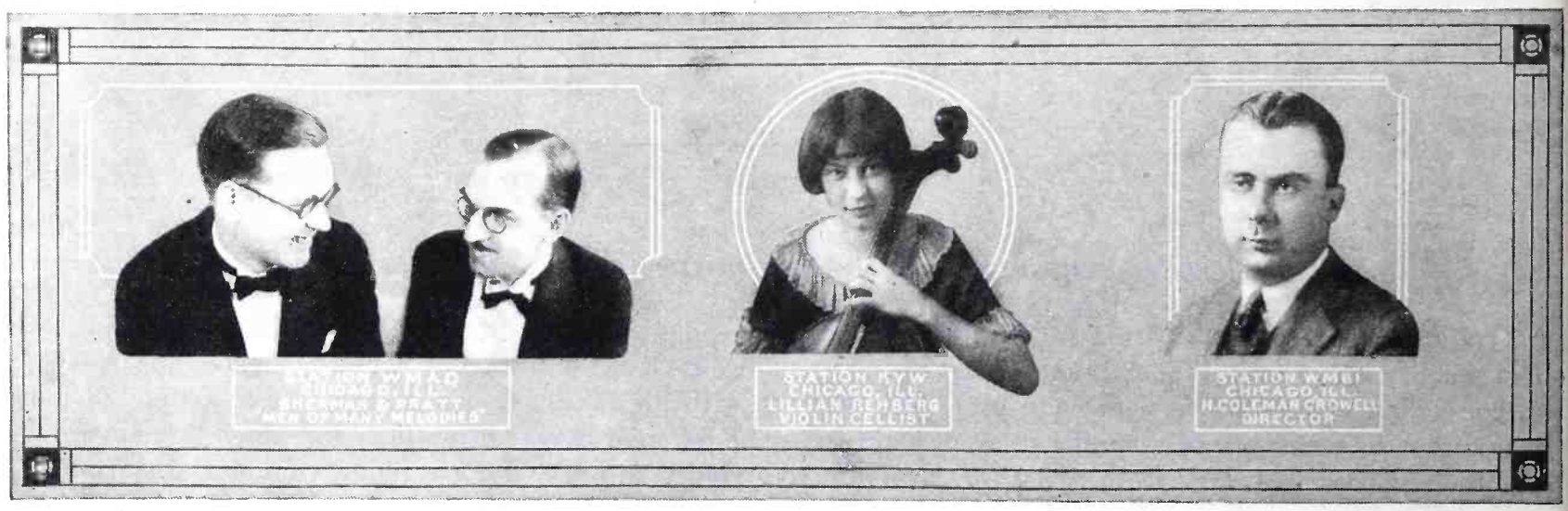
Licenses Required for Both Transmitters and Receivers in Canada

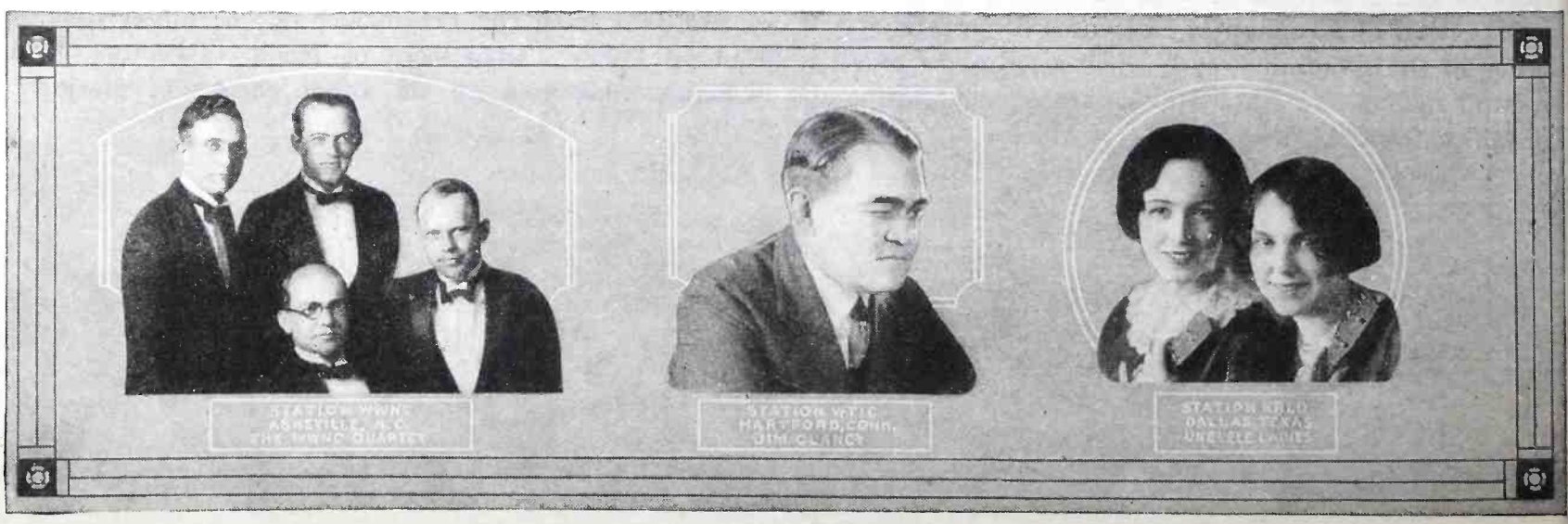
All radio stations, whether used for transmitting or receiving purposes are required to be licensed in Canada The penalty on summary conviction for operating an unlicensed radio station is a fine not exceeding $50.00, and on conviction or indictment a fine not exceeding $500.00, with imprisonment for a term not exceeding 12 months. in addition to forfeiture of all unlicensed apparatus. The different classes of stations for which licenses are issued and their license fees vary from $1.00 for a private receiving set to $50.00 for a public commercial station.

The issue of licenses for transmitting stations is limited to British subjects or to companies incorporated under the laws of the Dominion of Canada or its provinces. Licenses for private receiving sets are issued to any person irrespective of nationality. Licenses for receiving sets are obtained from the Postmaster of the larger towns and cities in the Dominion, radio dealers, Royal Canadian Mounted Police, Department of Radio Inspectors, Departmental Agencies or from the Department of Marine and Fisheries. Licenses for all other classes of stations are obtained from the Department of Marine and Fisheries at Ottawa.









Foreign Radio Broadcast Stations

Including U S. Possessions

Countries, Cities and Owners	Call Letters	Wave Length (Meters)	Power (Watts)
ALASKA			
Anchorage—Anchorage Radio Club	**KFQD**	300	100
Juneau—Alaska Elec. Light & Power Co.	**KFIU**	226	10
Ketchikan—Alaska Radio & Service Co.	**KGBU**	229	500
ALGERIA			
Algiers—Colin & Fils	**8DB**	310	2000
ARGENTINE			
Buenos Aires	**LOJ**	270	1000
Buenos Aires—Radio America	**LOL**	236	2000
Buenos Aires—Radio Fenix	**LON**	210	5000
Buenos Aires—Radio Prieto	**LOO**	252	1000
Buenos Aires—Radio Buenos Aires	**LOQ**	261	500
Buenos Aires—Sociedad Radio Argentina	**LOR**	344.8	1000
Buenos Aires—Municipality of Buenos Aires	**LOS**	291.2	5000
Buenos Aires—Radio Broadcasting	**LOT**	400	1000
Buenos Aires—Francisco J. Brusa	**LOV**	361.5	1000
Buenos Aires—Grand Splendid	**LOW**	303	1000
Buenos Aires—Radio Cultura	**LOX**	380	1000
Buenos Aires—Sociedad Radio Nacional	**LOY**	315.8	1000
Buenos Aires—"La Nacion"	**LOZ**	330	1000
Buenos Aires—Gino Bocci y Hno.	**B2**	275	100
Buenos Aires	**D3**	253.3	100
Cordoba—Antonio Vanelli	**H5**	275	100
Cordoba—Diario "Los Principios"	**H6**	250	20
La Plata, FCS.—Universidad Nacional	**LOP**	425	1000
Mendoza—Ministerio de Obras Publicas	**LOU**	380	500
Rosario—Manuel Fugardo	**F2**	270	100
Santa Fe—Jose Roca Soler	**F1**	279	20
AUSTRALIA			
Adelaide—Central Broadcasters Ltd.	**5CL**	395	5000
Adelaide—5 DN Pty. Ltd.	**5DN**	313	500
Adelaide—Sports Radio Broadcasting Station	**5KA**	250	1000
Adelaide—Millswood Auto & Radio Co.	**5MA**		
Adelaide—Marshall & Co.	**5MC**	273	500
Bathurst—Mockler Bros.	**2MK**	275	250
Brighton	**3PB**		
Brisbane—Dr. V. McDowell	**4CM**	278	250
Brisbane—Radio Manufacturers Ltd.	**4MB**	337	250
Brisbane—Queensland Radio Service	**4QG**	385	5000
Hobart—Tasmanian Broadcasting Pty.	**7ZL**	516	3000
Melbourne—Associated Radio Co.	**3AR**	481	3000
Melbourne—Druleigh Business & Technical College	**3DB**	225	500
Melbourne—Broadcasting Co. Australia	**3LO**	371	5000
Melbourne—O. J. Nilson & Co.	**3UZ**	319	100
Melbourne—L. J. Hellier	**3WR**	303	100
Mildura—R. J. Egge	**3EO**	286	100
Newcastle—H. A. Douglas	**2HD**	288	100
Northbridge—Otto Sandel	**2UW**	263	500
Perth—Westralian Farmers, Ltd.	**6WF**	1250	3000
Rockhampton—Queensland Gov't	**4RN**	323	500
Sydney—The Electrical Utilities Supply Co.	**2UE**	293	250
Sydney—Burgin Electric Co.	**2BE**	316	100
Sydney—Theosophical Broadcasting Service	**2GB**	316	3000
Sydney—Trades Hall Broadcasting Station	**2KY**	280	1500
Sydney—Farmer & Co., Ltd.	**2FC**	442	5000
Sydney	**2WA**	462	100
Sydney—Broadcasters Sydney Ltd.	**2BL**	358	5000
Sydney—Otto Sandel	**2UW**	267	500
Toowomba—Gold Radio Elec. Service	**4GR**	294	100
Wagga—Otto Sandel	**2UX**	300	500
AUSTRIA			
Graz—Oesterreichische Radio-verkehrs Gesellschaft		357.1	500
Innsbruck		294.1	500
Klagenfurt		272.7	1500
Vienna—Oesterreichische Radio-verkehrs Gesellschaft	**ORV**	577	1500
Vienna		517.2	7000
BELGIUM			
Brussels—Radio Belgique Co.	**BAV**	508.5	1500
Brussels—Radio Belgique Co.	**SBR**	481	1500
BOLIVIA			
La Paz		175–300	50
La Paz		300	50
BRAZIL			
Bahia—Radio Sociedade de Bahia	**SQAD**	350	50
Bello Horizonte—Radio Sociedade de Mina Geraes		400	500
Ceare—Radio Club Cearense			50
Curytiba—Livio Moreira			
Fortazela—Radio Club			300
Goyanna—Benedicto Ravello			
Juiz de Fora	**SQAY**	380	200
Matto Grosso—Radio Club de Campo Grande			
Minas Geraes—Luiz de Fora			100
Para—Radio Club de Para			100
Parana		370	300
Parahyba—Radio Sociedade de Parahyba			
Pelotas—Radio Sociedade Pelotense			
Penedo—A. G. Oliveira			
Pernambuco—Radio Club de Pernambuco		310	1000
Pernambuco—Cia Radiotelegrafica Brasileira		250–380	500
Pernambuco—Radio Sociedade de Jader de Andrada			
Pernambuco—Radio Sociedade de Garanhuns			
Petropolis—Radio Club de Petropolis			
Porto Alegre—Radio Sociedade Riograndense	**RSR**	381	80
Praia Vermelha—Radio Club do Brasil	**SQIB**	320	500
Rio de Janeiro—Radio Sociedade de Rio de Janeiro	**SQAA**	400	2000
Rio de Janeiro	**SQAB**	320	500
Rio de Janeiro	**SQAJ**	260	250
Sao Paulo	**SQAG**	365	1000
Sao Paulo	**SQBO**	225.4	1000
Sorocaba		425	....

Countries, Cities and Owners	Call Letters	Wave Length (Meters)	Power (Watts)
CANARY ISLANDS			
La Laguna—Servando Ortoll Delmotte	EAJ5	280	50
Las Palmas—Canary Islands Radio Club		300	6
Teneriffe—Servando Ortoll Delmotte	EAR5	350	200
CEYLON			
Colombo		800	1500
CHILE			
Antofagasta—Sr. J. Pedreny	CHAO		
Concepcion	CMAI	345	1500
Santiago—"El Mercurio"	CMAC	360	1200
Santiago—Castagneto Felli	CMAD	320	1000
Santiago—Radio Comercial	CMAE	280	100
Santiago—Sociedad Broadcasting de Chile	CRC	385	350
Tacna—Ministerio de Relaciones Exteriores	CMAT	550	200
Tacna—Chilean Government	CRCT	550	200
Temuco	CMAK	245	100
Valparaiso		400	50
CHINA			
Hong Kong	VPS3	800	1500
Kharbin—Eastern Manchurian Broadcasting Station	XOH	340	50
Mukden	COMK	425	2000
Shanghai—Kellogg Switchboard & Supply Co.	KRC	335	150
Shanghai—The Shanghai Shimbun Ltd.	KSMS	277	50
Shanghai—Shinsho Co.	NKS	318	50
Shanghai—Radio Supply Co. of Nanking Road	RSC	235	10
Tientsin—Gisho Electric Co.	GEC	288	50
Tientsin—Tientsin Broadcasting Station	XOL	480	500
Victoria (Hongkong)—Hongkong Radio Society	5HK	475	150
CHOSEN			
Seoul	JODK	345	1000
COSTA RICA			
San Jose—Government			
CUBA			
Caibarien—Maria J. Alvarez	6EV	250	50
Caibarien—Manuel A. Alvarez	6LO	325	250
Camaguey—Pedro Nogueras	7AZ	225	10
Camaguey Armanda Vaquer	7GT	195	5
Camaguey—Melchor Aguero	7KP	300	15
Camajuani—Diego Iborra	6YR	200	20
Caney—Juan Fdez. de Castro	8KP	30	100
Caney	8LO	300	100
Central Elia—Salvador Rionda	7SR	350	500
Central Tuinucu—Frank H. Jones	6KW	368	100
Central Tuinucu—Frank H. Jones	6JK	272	100
Ciego de Avila—Eduardo V. Figueroa	7BY	235	20
Ciego de Avila—Feliciano Isaac	7FU	200	15
Ciego de Avila—Porfirio de la Cruz	7HS	192	15
Florida—Leonard B. Fox	7JQ	42	5
Cienfuegos—Jose Ganduxe	6BY	260	200
Cienfuegos—Eduardo Terry	6DW	225	10
Cienfuegos—Gustavo Rodriguez	6GR	150	10
Cienfuegos—Juan Pablo Ros	6GT	190	50
Colon—Leopoldo V. Figueroa	5EV	360	100
Guanajay—Antonio Zarazola	1AZ	275	30
Havana—Ulpiano Muniz	2MU	265	10
Havana—Casimiro Pujadas	2CP	280	10
Havana—Cristina W. Vda. de Crucet	2HP	205	200
Havana—Julio Power	2JP	312	30
Havana—Frederick W. Borton	2CX	320	10
Havana—Alberto S. Bustamante	2AB	250	10
Havana—Cuban Telephone Co.	PWX	400	500
Havana—Jose Leiro	2JL	275	5
Havana—Alvara Daza	2K	200	20
Havana—E. Sanchez de Fuentes	2KD	350	50
Havana—"El Pais"	2EP	355	400
Havana—Bernardo Barrie	2BB	250	15
Havana—Frederick W. Borton	2BY	260	100
Havana—Jose Lara	2LR	215	15
Havana—Manuel y Guillermo Salas	2MG	284	15
Havana—R. B. Waters	2MK	32	100
Havana—Mario Garcia Velez	2OK	360	100
Havana—Oscar Collado	2OL	257	100
Havana—Roberto E. Ramirez	2TW	270	30
Havana—Benito Veita Ferro	2UF	265	20
Havana—Raul Karman	2RK	315	100
Havana—Homero Sanchez	2SZ	180	10
Havana—Miguel Troncoso	2WX	340	150
Havana—Lecuona Music Co.	2XA	230	200
Havana—Raul Perez Falcon	2JD	105	20
Havana—Heraldo de Cuba	2HC	275	500
Hershey—Alberto Alvarez	2FG	200	20
Marianao—Jose L. Ferriol	2JF	245	5
Marianao—Jose Leiro	2JL	294	5
Marianao—Modesto Alvarez	2MA	215	50
Marianao—Samuel I. Wheeldon	2WD	274	7½
Mariano—Antonio A. Genard	2XX	225	5
Nueva Gerona—Isle of Pines Telephone Co.	8JQ	130	20
Sagua la Grande—Santiago Ventura	6HS	200	10
Sancti Spiritus-Antonio Galguera	6KP	250	20
Santiago—Alfredo Vinnet	8FU	225	15
Santiago—Pedro C. Anduz	8DW	275	50
Santiago—Alfredo Broock Galo	8AZ	240	50
Santiago—Ceferino Ramos	8IR	190	20
Santiago—Alberto Ravelo	8BY	250	20
Santiago—Guillermo Polanco	8HS	200	30
Tuinucu—Frank H. Jones	6XJ	20	100
CZECHOSLOVAKIA			
Bratislava	OKR	300	500
Brunn—Radio Journal	OKB	441.2	3000
Kbely		1100	1000
Koszice (Kassa)		1870	5000
Prague—Radio Journal	OKP	348.9	5000
DANZIG			
Danzig		272.7	750
DENMARK			
Copenhagen—Copenhagen Radio Broadcasting Station		337	1000
Kalundborg		1153.8	7000
Ryvang		1150	1500
Soro—Ministry of War		1153.8	1500
EGYPT			
Cairo	SRE	255	
ESTONIA			
Tallinn		408	2200
Tallinn		1200	100
FINLAND			
Bjorneborg—Nuoren Voiman Liiton Radiohydistys		311	200
Hango—Nuoren Voiman Liiton Radiohydistys		260	250

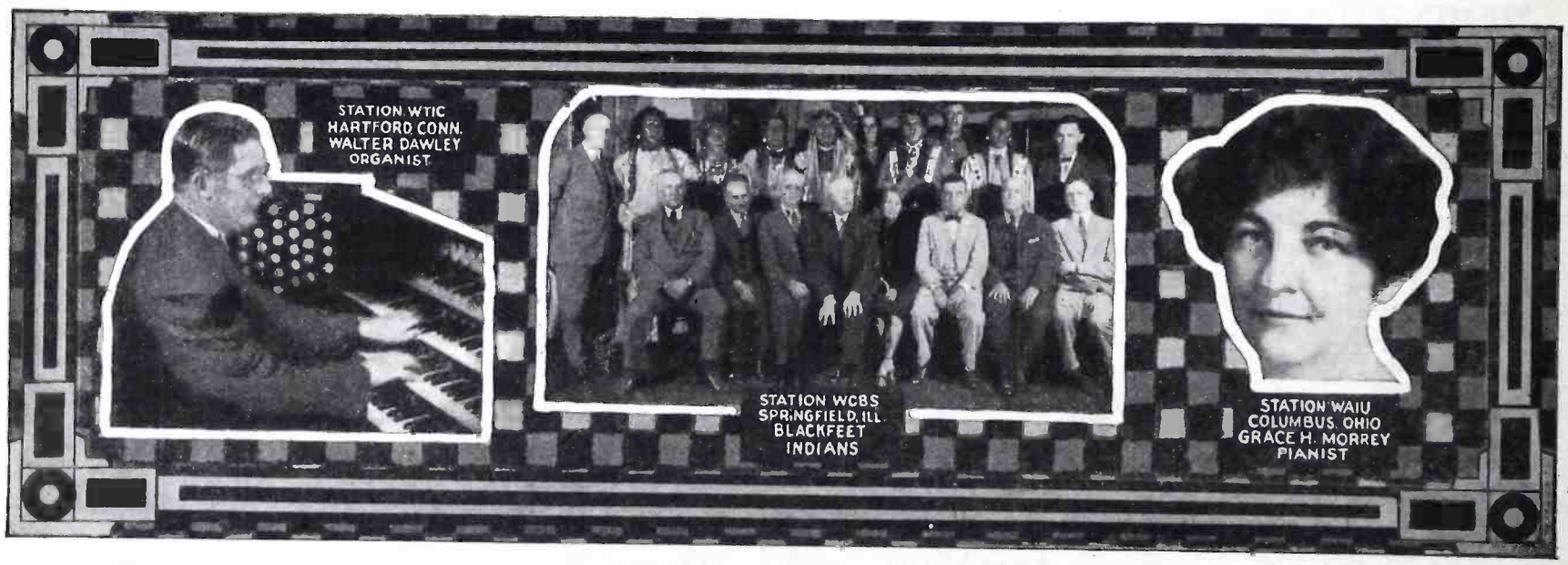
Countries, Cities and Owners	Call Letters	Wave Length (Meters)	Power (Watts)
FINLAND			
Helsingfors—Civil Guards of Finland		375	1200
Jacobstad		275.2	200
Jyvaskyla—Nuoren Voiman Liiton Radiohydistys		297	250
Lahtis		318	180
Mikkeli—Nuoren Voiman Liiton Radiohydistys		566	250
Pori—Nuoren Voiman Liiton Radiohydistys		255.3	100
Skatudden—Military Station Radio-Div		318	750
St. Michel—Nuoren Voiman Liiton Radiohydistys		566	250
Tammerfors—Nuoren Voiman Liiton Radiohydistys	3NB	400	250
Tampere		373	250
Uleaborg		250	250
Viborg		214.3	750
FRANCE			
Agen—Dept. of Lot et Garonne	2BD	297	250
Angers—Radio Anjou		275.2	500
Beziers		158	500
Biarritz—Cote d'Argent		200	250
Bordeaux		275	1000
Bordeaux		238.1	1500
Dijon		207.5	1000
Grenoble—Ministry of P. T. T.		588.2	1500
Issy-les-Moulineaux—Ministry of War	QGA	1800	500
Juan-les-Pins		230	500
Lille		287	500
Limoges		273	500
Lyon—Ministry of P. T. T	YN	476	1000
Lyon—Radio Lyon		291.3	1500
Marseilles—Ministry of P. T. T.		309	500
Mont-de-Marsan—Radio Club Landrais		400	4000
Montpelier—Societe Languedocienne de T. S. F.		252.1	250
Paris—Ecole Superieure de P. T. T.	FPTT	464	500
Paris—Eiffel Tower, Army	FL	2650	5000
Paris—Societe Francaise Radioelectrique	8AJ	1780	100
Paris—Lucien Levy		350	250
Paris—Petit Parisien	5NG	340.9	500
Paris—Cie. Francaise de Radiophone		1750	6000
Paris—Radio Paris	CFR	1750	3000
Paris—Radio Vitus		308	1000
Pic du Midi		350	
Reims		204.1	500
Reziers		178	500
St. Etienne—Radio Club Forezien		220	50
Strasbourg—Military Station Radio Club	8GF	222.2	250
Toulouse—Aerodrome	MRD	260	1000
Toulouse—La Radio		391	3000
GERMANY			
Aix-la-Chapelle		401	750
Augsburg		566	1500
Berlin—Koenigswusterhausen Deutsche Welle A. G.	AFP	4000–2900	8000
Berlin—Koenigswusterhausen Station	AFT	1250	35000
Berlin—Vox Haus Funkstunde	AB	566	2000
Berlin—Witzleben Funkstunde A. G.		483.9	4000
Berlin—Wolff's Bureau		2525	5000
Bremen—Nordischer Rundfunk	BMN	400	1500
Breslau—Schlessische Funkstunde		322.6	5000
Cologne	SMXQ	283	4000
Dortmund—Westdeutsche Funkstunde		283	750
Dresden—Mitteldeutscher Rundfunk		275.2	700
Elberfeld—Westdeutsche Funkstunde		468.8	750
Frankfort-on-the-Main — Sudwestdeutscher Rundfunkdienst	LP	428.6	4000
Freiburg im Breisgau—Suddeutscher Rundfunk		573.6	750
Gleiwitz—Schlesische Funkstunde		250	750
Hamburg—Nordischer Rundfunk	HA	394.7	4000
Hanover—Nordischer Rundfunk		297	750
Kassel—Sudwestdeutscher Rundfunk		272	750
Kiel—Nordicher Rundfunk		254.2	750
Koenigsberg—Ostmarken Rundfunk		329.7	4000
Langenberg	LA	468.8	25000
Leipzig—Mitteldeutscher Rundfunk	MR	365.8	4000
Munich—Deutsche Stunde in Bayern		535.7	4000
Muenster—Westdeutsche Funkstunde	MS	241.9	1500
Norddeich	KAV	1829	
Nuremberg—Deutsche Stunde in Bayern		303	4000
Stettin—Funkstunde A. G.		236.2	500
Stuttgart—Suddeutscher Rundfunk	OKP	379.7	4000
HAITI			
Port-au-Prince—Haitien Government	HHK	361.2	1000
HAWAII			
Honolulu	KGHB	227	250
Honolulu—Honolulu Advertiser	KGU	270	500
HUNGARY			
Budapest—Hungarian States' Post and Telegraph	MTI	555.6	3000
Budapest—Magyar Tavirati Iroda		1050	2000
ICELAND			
Reykjavik		333.3	1000
INDIA			
Bangalore—Indian Broadcasting Co.			
Bombay—Walter Rogers & Co.	2AX	226	
Bombay	7BY	357.1	3000
Bombay—Bombay Residency Radio Club	2FV	375	220
Calcutta—Radio Club of Bengal	2BZ	800	500
Calcutta—Indian States & Eastern Agency	5AF	425	1500
Calcutta	7CA	370.4	3000
Karachi—Karachi Radio Club		425	40
Madras—Crampton Elec. Co.		220	120
Madras—Madras Presidency Club	2GR	400	200
Rangoon—Radio Club of Burmah	2HZ	350	350
IRISH FREE STATE			
Cork	6CK	400	1500
Dublin—Government	2RN	319.1	1500
ITALY			
Milan		541	7000
Milan—Unione Radiofonica Italiana	IMI	315.8	1500
Naples—Unione Radiofonica Italiana	INA	333.3	1500
Nice		362	1000
Rome—Unione Radiofonica Italiana	IRO	450	3000
JAPAN			
Hiroshima—Broadcasting Corp. of Japan	JOFK	353	10000
Keijo—Keijo Broadcasting Associaton	JODK	366	1000

Countries, Cities and Owners	Call Letters	Wave Length (Meters)	Power (Watts)
JAPAN			
Kumamoto — Broadcasting Corp. of Japan	**JOGK**	380	10000
Nagoya—Broadcasting Corp. of Japan	**JOCK**	370	1000
Osaka—Broadcasting Corp. of Japan	**JOBK**	385-400	10000
Sapporo—Broadcasting Corp. of Japan	**JOIK**	361	10000
Sendai—Broadcasting Corp. of Japan	**JOHK**	396	10000
Tokyo—Broadcasting Corp. of Japan	**JOAK**	345-375	10000
JAVA			
Batavia—Bataviasche Radio Vereening-ing	**JFC**	220	40
KWANTUNG			
Dairen—Government Bureau of Communications	**JQAK**	395	5000
LATVIA			
Riga	**KCX**	526.3	2000
LITHUANIA			
Kovno		2000	15000
LUXEMBURG			
Luxemburg	**LOAA**	217.4	250
MEXICO			
Chihuahua—Federal Government	**CZF**	310	250
Guadalajara—Federal Military Command	**FAM**	490	1000
Mazatlan—Castulo Llamas	**CYR**	475	250
Merida—Partido Socialista del Surestan	**CYY**	549	100
Mexico City—Efran R. Gomez	**CYA**	300	500
Mexico City—Jose J. Reynosa (El Buen Tono)	**CYB**	275	500
Mexico City—Miguel S. Castro (La High Life)	**CYH**	375	100
Mexico City—General Electric Co.	**CYJ**	400	2000
Mexico City—"El Universal"	**CYL**	400	500
Mexico City—Martinez y Zetina	**CYO**	425	100
Mexico City—Excelsior Compania Editorial	**CYX**	325	500
Mexico City—Departamento de Educacio	**CZE**	350	500
Monterey—D. Constantino de Tarnava, Jr.	**CYH**		
Monterey—Constantino de Tarnava	**CYS**	311	250
Oaxaca—Federico Zonilla	**CYF**	265	100
Puebla—Augustin del P. Saenz	**CYU**	312	100
Tampico	**CYQ**	322	100
Torreon	**CYM**	225	1500
Vera Cruz—Ministerio de Comunicacaciones	**CYC**	337	50
Vera Cruz	**CYD**		
MOROCCO			
Casablanca—Radio Club de Moroc	**CNO**	305	2500
NETHERLANDS			
Amsterdam		760	
Bloemendaal		566	
De Bilt	**PCFF**	1100	1250
Eindhoven—Phillips Lamp Works	**PCJJ**	30.2	
Huizen			1950
Hilversum—Nederlandische Seintoellen Fabriek	**HDO**	1060	5000
Scheveningen		1950	2500
NETHERLANDS EAST INDIES			
Soe abaya—Radiotelegraph Club		90	

Countries, Cities and Owners	Call Letters	Wave Length (Meters)	Power (Watts)
NEW ZEALAND			
Auckland—Newcomb (Ltd.)	**1YL**	260	500
Auckland—The Radio Broadcasting Co. of New Zealand	**1YA**	333	500
Auckland—La Gloria Gramophone Co.	**1YB**	275	50
Auckland—L. R. Keith	**1ZO**	330	50
Christchurch—Radio Broadcasting Co. of New Zealand	**3AC**	240	10
Christchurch—Radio Broadcasting Co. of New Zealand	**3YA**	306	500
Dunedin—Otago University	**4XO**	140	
Dunedin—Radio Broadcasting Co. of New Zealand	**4YA**	463	750
Dunedin—Radio Supply Co.	**4YO**	370	500
Dunedin—Radio Broadcasting Co.	**VLDN**	380	750
Gisborne—Gisborne Radio Co.	**2YM**	260	500
Napier—B. C. Spackman	**2YL**	190	100
Wellington—Broadcastings Ltd.	**2YB**	275	15
Wellington—Radio Broadcasting Co. of New Zealand	**2YA**	420	5000
Whangerei—N. C. Shepherd	**1YC**	250	15
NORWAY			
Bergen—Bergen Broadcasters		370.4	1500
Fredrikstad—Broadcasting Co. A. S.		434.8	750
Hamar—Broadcasting Co. A. S.		566	750
Natodden—Broadcasting Co. A. S.		423	700
Oslo—Broadcasting Co. A. S.	**OSLO**	461.5	1500
Porsgrund—Broadcasting Co. A. S.		524	1000
Rjuken—Broadcasting Co. A. S.		443	250
Stavanger		277.8	250
Tromso—Tromso Broadcasters		500	
Trondhjem		243.9	
PARAGUAY			
Asuncion			12
PERU			
Lima—Peruvian Broadcasting Co.	**OAX**	360	1500
PHILIPPINE ISLANDS			
Baguio	**KZUY**	359.9	500
Iloilo	**KPM**	400	500
Manila—Radio Corp. of the Philippines	**KZIB**	260	500
Manila—Radio Corp. of the Philippines	**KZKZ**	270	500
Manila—Radio Corp. of the Philippines	**KZRM**	413	1000
Manila—Radio Corp. of the Philippines	**KZRQ**	400	1000
POLAND			
Cracow		422	1500
Kattowitz		422	10000
Posen		344.8	1500
Vilna		435	500
Warsaw—Government	**PTR**	380	700
Warsaw	**AXO**	1111.1	10000
PORTO RICO			
San Juan—Radio Corp. of Porto Rico	**WKAQ**	340.7	500
PORTUGAL			
Lisbon—Grandes Armazens do Chiado	**PIAA**	267.8	500
Montesanto—Government Wireless Station	**CTV**	2450	1500
SAN SALVADOR			
San Salvador—Government of el Salvador	**AQM**	482	500
SENEGAL			
St. Louis—Senegal Radio Club		300	100

Countries, Cities and Owners	Call Letters	Wave Length (Meters)	Power (Watts)
SIBERIA			
Tomsk	RA21	300	250
SPAIN			
Almeria	EAJ18	323.8	1000
Barcelona—Radio Barcelona (Hotel Colon)	EAJ1	344.8	1500
Barcelona—Radio Catalana	EAJ13	462	1000
Bilbao—Radio Club Vizcaina	EAJ9	436	1000
Bilbao—Radio Vizcaya	EAJ11	418	2000
Bilbao—Armando de Otera		383	200
Cadiz—Radio Cadiz	EAJ3	400	500
Cadiz—Radio Lahera	EAJ10	297	1000
Cartagena—Enrique de Orbe	EAJ16	335	1000
Cartagena	EBX	1200	1000
Madrid—Radio Espana	EAJ2	393	3000
Madrid—Escuela Superior	PTT	458	1000
Madrid—Antonio Castilla	EAJ4	375	6000
Madrid—Radio Iberica	EAJ6	392	1000
Madrid—Union Radio	EAJ7	373	1500
Madrid	EAJ12	306	2000
Madrid—Radio Espanola	EAJ15	490	1000
Madrid	EGC	1650–2200	2000
Malaga—Spanish Telecommunication Co.	EAJ25	325	1000
Malaga—Alfonso Villota		325	200
Oviedo (Cima)—Arturo Cima Fernandez	EAJ19	340	100
Salamanca	EAJ22	405	1000
San Sebastian—Sabino Ucelayeta	EAJ8	335	500
Sevilla—Manuel Garcia Ballesta	EAJ17	400	1000
Sevilla—Jorge la Riva	EAJ21	300	1000
Sevilla—Radio Club Sevillano	EAJ5	344.8	1000
Valencia	EAJ24	360	1000
Valencia—Jose Lopez Aznar	EAJ14	500	500
Zaragoza	EAJ23	325	1500
STRAITS SETTLEMENTS			
Singapore—Malaya Amateur Wireless Society		330	150
SWEDEN			
Boden—Radiotjanst	SASE	1200	1000
Boras	SMBY	230.8	1000
Eskilstuna—Radio Club	SMUC	250	250
Falun—Radiotjanst	SMZK	357	2000
Gaevle—Radio Club	SMXF	204.1	250
Goteborg—Radiotjanst	SASB	416.7	1000
Halmstad	SMSB	215.8	250
Helsingborg	SMYE	229	250
Hudiksvall	SMSL	272.7	250
Jonkopings—Jonkopings Rundradiostation	SMZD	201.3	500
Kalmar	SMSD	254.2	250
Kalmar	SMSW	252.1	250
Karlsborg—Radiotjanst	SASF	1350	50
Karlsborg	SAJ	1365	5000
Karlskrona	SMSM	196	250
Karlstadt—Radio Club of Karlstad	SMXG	221	250
Karlstadt	SMXZ	221	250
Kiruna		238.1	250
Kristinehamm	SMTY	202.7	250
Linkoeping—Radio Club	SMUV	588.2	250
Linkoeping	SMUW	497.5	250
Malmo—Radiotjanst	SASC	260.9	1000
Motala		1320	30000
Norrkoeping—Radio Club	SMVV	275.2	250
Orebro	SMTI	236.2	250
Ostersund		720	2000
Saffle	SMTS	252.1	500
Stockholm—The Swedish Broadcasting Co.	SASA	454.5	1500
Sundsvall—Radiotjanst	SASD	545.6	1000
Trolhattan — Trolhattans Rundradiostation	SMXQ	277.8	1000
Uddevalla	SMZP	294.1	250
Umea	SMSN	229	250
Uppsala		500	250
Varborg	SMSO	297	250
SWITZERLAND			
Basle	HB3	1100	250
Berne—Radio—Genossenschaft	HBA	411	1500
Geneva—Radio Broadcasting Soc. of Geneva	HBI	760	500
Lausanne—Lausanne Radio Society	HB2	680	600
Zurich—Zurich University	RGZ	515–650	500
Zurich—Zurich Radio Genossenschaft	HBZ	500	1000
TUNISIA			
Carthage	TNV	1850	5000
Carthage		1840	4000
Tunis—French Army	OCTU-TUA	1450–45	500
TURKEY			
Angora		1800	6000
Osmanieh—Broadcasting Co.		1200	6000
Stamboul		1800	15000
UNION OF SO. AFRICA			
Cape Town—African Broadcasting Assn.	WAMG	375	1500
Durban—Town Council		400	1500
Johannesburg — African Broadcasting Co.	JB	450	500
UNION OF SOVIET SOCIALIST REPUBLICS (formerly Russia)			
Astrakhan	RA26	700	1000
Baku	RA45	760	1250
Bogorodsk	RA8	750	
Ekaterinburg	RA15	750	250
Homel	RA39	925	1250
Irkutsk		1300	
Ivanovo Voznesensk	RA7	800	1000
Kharkov	RA43	640	4000
Kharkov	RA24	475	4000
Kiev	RA5	775	1000
Kniepropetrovsk		560	1000
Krasnodar	RA38	513	1000
Leningrad	RA6	940	2000
Leningrad	RA42	1000	10000
Minsk	RA18	950	1250
Moscow—Sokolniki		1010	2000
Moscow—Trade Union	KAZ	450	2000
Moscow—Lubovitch		365	
Moscow	MSK	650	2000
Moscow—Union of Soviet Workers	RA4	675	500
Moscow—Kominern	RDW	1450	40000
Moscow—Radio-Peredatcha	RAI	420	2000
Niji-Novgorod	RA13	1400	1500
Novosibirsk	RA33	700	4000
Odessa	RA40	1000	1250
Rostov-on-Don	RA14	820	1250
Saratoff		700	1000
Sevastopol	RA9	800	1000
Stavropol	RA20	655	1250
Tashkent	RA27	800	4000
Tiflis		870	4000

Countries, Cities and Owners	Call Letters	Wave Length (Meters)	Power (Watts)
UNION OF SOVIET SOCIALIST REPUBLICS (formerly Russia)			
Tver	**RA44**	965	1250
Ust-Syssolsk	**REG**	1000	1250
Veliky-Ustjuk	**RA16**	1010	1250
Vladivostok	**RA17**	456	1250
Vladivostok—Union of Soviet Worker's Radio Club	**RL20**	480	1500
Voronesh	**RA12**	950	1250
UNITED KINGDOM			
Aberdeen—British Broadcasting Co.	**2BE**	306.1	1500
Belfast—British Broadcasting Co.	**2BD**	500	1500
Birmingham—British Broadcasting Co.	**5IT**	326.1	1500
Bournemouth—British Broadcasting Co.	**6BM**	326.1	1500
Bradford	**2LS**	252.1	200
Cardiff—British Broadcasting Co.	**5WA**	353	1500
Chelmsford—British Broadcasting Co.	**2BR**		
Daventry (Experimental)	**5GB**	491.8	25000
Daventry—British Broadcasting Co	**5XX**	1604.8	25000
Dundee—British Broadcasting Co.	**2DE**	294.1	200
Edinburgh—British Broadcasting Co.	**2EH**	288.5	200
Glasgow—British Broadcasting Co.	**5SC**	405.4	1500
Hull—British Broadcasting Co.	**6KH**	294.1	200
Leeds—British Broadcasting Co.	**2LS**	277.8	200
Liverpool—British Broadcasting Co.	**6LV**	297	200
London—British Broadcasting Co.	**2LO**	361.4	3000
Manchester—British Broadcasting Co.	**2ZY**	384.6	1500
Newcastle—British Broadcasting Co.	**5NO**	312.5	1500
Nottingham—British Broadcasting Co	**5NG**	275.2	200
Plymouth—British Broadcasting Co.	**5PY**	400	200
Poldhu—British Broadcasting Co.	**2YT**		
Sheffield—British Broadcasting Co.	**6FL**	272.7	200
Stoke-on-Trent—British Broadcasting Co.	**6ST**	294.1	200
Swansea—British Broadcasting Co.	**5SX**	294.1	200
URUGUAY			
Montevideo—Diario "El Dia"	**CWOR**	350	500
Montevideo—Danree & Cia	**CWOF**	300	100
Montevideo—Templo Metodista	**CWOG**	280	10
Montevideo—General Electric Co. of Uruguay	**CWOS**	380	500
VENEZUELA			
Caracas—Empresa Venezolana de Radio-telefonia	**AYRE**	375	1000
YUGOSLAVIA			
Agram (Zagreb)		310	350
Belgrade—Cie. Generalle De T.S.F.	**HFF**	225.6	1000



SHORT-WAVE RADIO STATIONS OF THE WORLD

Operating on Wavelengths Below 100 Meters

Stations by Call Letters

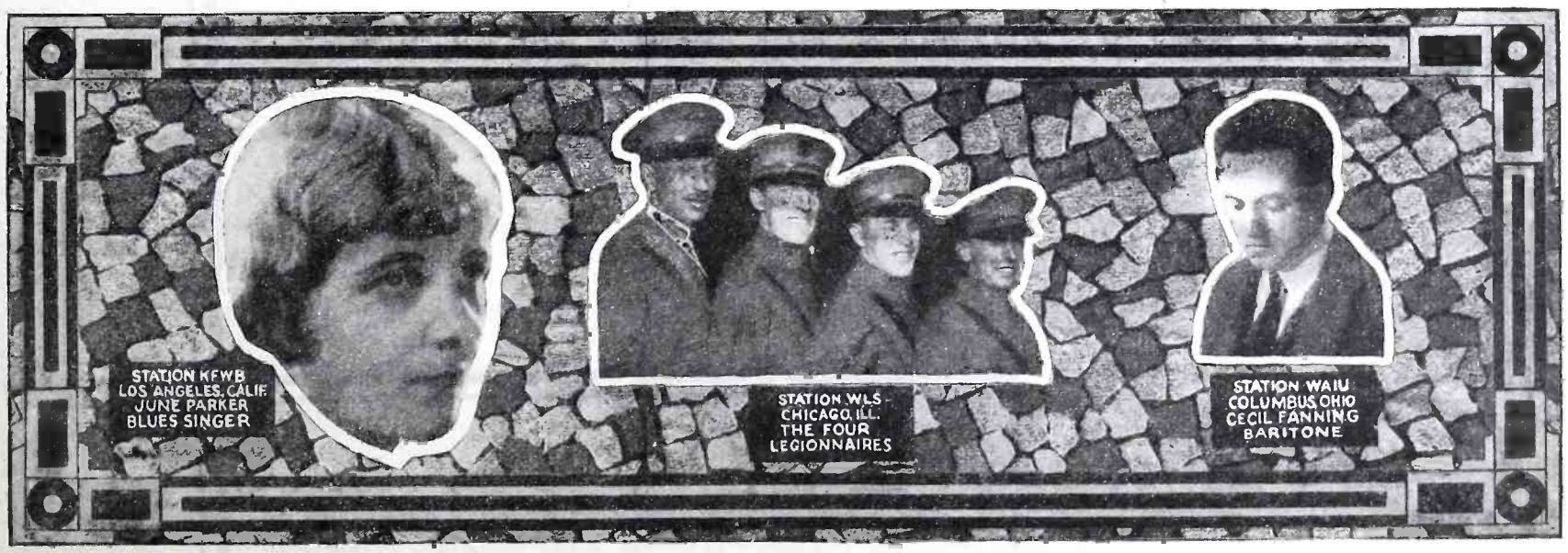
Call Letters	Stations and Location	Wave Length (Meters)	Remarks
AFI	Konigswusterhausen	26.3	
AFJ	Konigswusterhausen	53.5	
AFU	Konigswusterhausen	39.7	
AGA	Nauen	14.9, 12.25, 13.5, 14.25, 16.0, 26.0	
AGB	Nauen	25.5, 26.6, 27.0	
AGC	Nauen	17.2, 26.0, 39.8, 40.2	Phone occasionally.
AGJ	Nauen	56.7	Phone after 1800 G.M.T.
AGK	Nauen	11.0, 20.0 (2 kw.)	
AIN	Casablanca, Ain Bordja	51.0	Weather reports, 0830 & 1930 G.M.T.
AKA	German Naval Vessel, M.81.	54.0	
AKB	German Naval Vessel, M.82.	54.0	
ANC	Tjililin, Java	26.2, 40.2	Code
AND	Tjililin, Java	18.8, 28.8, 37.5	Code
ANDIR	Malabar, Java (Military Aerodrome)	38.5	
ANE	Bandoeng, Java	17.4	Code and Phone
ANF	Tjililin, Java	20.3, 36.5	Code
ANH	Malabar, Java	17.4, 27.0, 32.0	Code. Phone Sat. 1200-1700G.M.T.
ANK	Malabar, Java	19.4, 30.20	Exp. Tests
AQE	SS. Sir James Clark Ross	33.5	
ARCX	Norwegian Whaler Nielsen Alonso	30.5	After 0700 G.M.T.
ARDI	SS. C. A. Larsen	32.0	
AYG	Guayra, Venezuela	31.8	
A 2FC	Sydney, N. S. W.	32.0	Phone
A 2ME	Sydney, Australia	28.50	Phone Sun., 1830–2000 G.M.T.
A 3LO	Melbourne	29.8, 32 or 36	Phone Sun., 1830–2030 G.M.T.
BAM	Tahiti	40.0	
BVJ	R. N. College, Dartmouth	46.0	
BWW	Gibraltar, North Front (Naval Station)	35.0	
BXW	Seletar, Singapore (Naval)	35.0	
BXY	Stonecutters Island, Hong-Kong	35.0	
BYB	Whitehall R. C. (Naval)	35.0	
BYC	Horsea (Naval)	35.0	
BYZ	Rinella, Malta (Naval)	35.0	
BZC	Portsmouth Signal School	35.5	
BZE	Matara, Ceylon (Naval)	35.0	
BZF	Aden (Naval)	35.0	
B82	Uccle, Belgium	40.0	
CF	Drummondville, Montreal (Beam Station)	32.0	Temporary
CG	Drummondville, Montreal	16.501, 32.128	
CH	Quilicura, Chile	15–20	
CRHA	Lourenco Marques, Portuguese East Africa	18.360	
CRHB	Praia, Cape Verde Islands	18.094	
CRHC	Loanda, Angola	18.182	
DCP	SS. Cap Polonio (German)	25.0, 34.0	
DNSC	Royal Danish Dockyard Copenhagen	47.0	
DS	H.M.S. Renown	36.0	
EAM	Madrid	30.7	
FAMJ	French SS. Jeane d'Arc (French Navy)	26–60	
FL	Eiffel Tower	32.0, 75.0	
FTJ	SS. Jacques Cartier (France)	75.0	
FW	St. Assize, Cie. Radio, France	14.28, 23.25, 25.0, 41.95, 43.0	Traffic with Buenos Aires
FUA	Bizerta-Sidi-Abdallah, Tunis	42.5, 56.0, 73.0	
FUE	Mengam, France	38.5	
FUL	Beyrouth-Djedeide, Lebanon	28.0, 80.0	
FUM	Montebourg (Air Station)	37.0	
FUT	Toulon-Mourillon, France	36.5	
F 8GA	Clichy	30.0	
F 8GB	St. Assize, Paris (S.F.R.)	75.0	S.F.R. Bulletins
F 8GC	Radio LL, Paris	60.0	Phone
GBH	Grimsby (Beam Station)	25.906	
GBI	Grimsby (Beam, Indian Circuit)	16.216, 34.168	
GBJ	Bodmin (Beam, S. Africa Circuit)	16.146, 34.013	
GBK	Bodmin (Beam Station)	16.574, 32.397	
GBL	Leafield (P. O. Station)	17.5, 21.5, 24.0, 30.0, 56.0	
GBM	Leafield (P. O. Station)	17.5, 21.5, 24.0, 30.0, 56.0	
GBO	Leafield (P. O. Station)	17.5, 21.5, 24.0, 30.0, 56.0	
GDKB	SS. Dorsetshire	24.0, 41.7	
GFA	Air Ministry, London	44.0	
GFR	Winchester (R.A.F. School)	20.0	
GFY	Royal Air Force, Henlow	76.0	
GLG	Royal Air Force, Henlow	15.740, 15.707	
GLH	Dorchester (Beam Station)	22.091	U.S. Circuit
GLQ	Ongar (for communication with New York, Buenos Aires, and Rio de Janeiro)	24.5	
GLS	Ongar	15.0	
GLSQ	SS. Olympic	20.0	
GLW	Dorchester (Beam Station, South American Circuit)	15.707	
GLYX	SS. Derbyshire	37.0	
G 2BR	Chelmsford	15.0, 17.0	
G 2NM	G. Marcuse, Caterham	32.5	Phone Tues., Thurs., Sat., Sun., 0600–0700, and Sun., 1600–1800 G.M.T.
G 2YT	Poldhu	25.0, 32.0, 60.0, 92.0, 94.0	
G 5DH	Dollis Hill (P. O. Station)	21.7, 27.6, 35.3, 47.0	
G 5SW	Chelmsford (B.B.C. Exp.)	24.0	Phone 1330, 1430, and 1930 onwards
HBC	Berne, Switzerland	34.2	
HJG	Bogotá, Colombia	22.0	
HVA	Hanoi, Tonkin	32.0	
HZA	Saigon	25.0	
H 90C	Telegraphic and Radio Service, Case No. 63, Poste Transit, Berne	32.0	Relays, Berne, Mon., Thurs. and Sat., 2000–2100
H 9XD	Radio Club of Zurich	32.0, 85.0	
ICC	Coltano	18.0	
ICD	Rome (Cento Celle)	63.0	
ICF	Messina, Sicily	49.0	
ICJ	Bengasi, Cyrenaica	26.0, 53.0	
ICK	Tripoli	45.0	
ICO	Derna, Cyrenaica	54.0	

Call Letters	Stations and Location	Wave Length (Meters)	Remarks
ICU	Tobruk, Cyrenaica	54.0	
ICX	Massawa	47.0	
IDO	Rome, San Paulo	33.0–37.5	
IDX	Amara, Erythrea	32.5, 64.0	
IHF	Catania, Italy	53.5	
IST	Chisimaio, It. Somaliland	38.0	
I 1AX	Rome, Via Savoia 80	45.0	Phone occasionally
I 1FC	Royal Frederico Cesi School, Rome	33.0, 34.0	
I 1MA	Rome, Via Bramante 3	43	Sun., 1700–1930 G.M.T.
I 1RG	"Radiogiornale," Lake Como	10.0, 18.0, 35.0 65.0	
JB	Johannesburg	32.0	Phone
JBK	Kagoshima, Japan	30.0, 40.5, 70.0	
JES	Osaka, Japan	24–71	
JEW	Osaka, Japan	24–71	
JFAB	Taipeh, Formosa	39.5	0900 G.M.T.
JHL	Hiroshima, Japan	32.0, 58.0, 74.0	
JKV	Kanasawa, Japan	37.5	Temporary
JKZB	Tokyo Electric Co.	20.5	
JOC	Otchishi, Japan	43.0	
JPP	Tokyo, Japan	16–73	
JPS	Sapporo, Japan	29.0, 38.0, 60.0	
JYB	Tokyo, Japan	16–73	
JYZ	Tokyo, Japan	16–73	
J 1AA	Iwatsuki, Japan	40.5	
J 1PP	Tokyo	20.0, 21.5, 35.0	
KAV	Norddeich	39.0, 68.0	
KDKA	East Pittsburgh, Pa. (Westinghouse E. & M. Co.)	26.3, 42.95, 62.5	Phone from 2300 G.M.T.
KDO	SS. Esparta (United Fruit Co. U. S. A.)	33.0	
KDZ	Point Barrow, Alaska	21.4, 42.08, 74.77	
KEB	Oakland, Calif. (G. E. Co.)	18.62, 21.8	
KEG	Vancouver, Washington (Pacific Air Transport)	45.0	
KEL	Bolinas, Calif. (R.C.A.)	14.1, 29.3, 95.0	
KEMM	Bolinas, Calif. (R.C.A.)	14.29, 28.58	
KESS	Bolinas, Calif. (R.C.A.)	14.40, 28.80	
KET	Bolinas, Calif. (R.C.A.)	99.0	
KEU	Los Angeles, Calif. (Pacific Air Transport)	45.02	
KEUN	Bolinas, Calif. (R.C.A.)	14.08, 38.38	
KEWE	Bolinas, Calif. (R.C.A.)	14.08, 28.15	
KFD	Denver, Colo. (G. E. Co.)	17.7, 24.3	
KFHW	SY. Poinsettia	40.0	
KFQU	Holy City, Calif.	31.0, 53.0, 63.0	
KFVM	SS. Idalia	17.0, 37.0, 74.0	
KFWB	Los Angeles, Calif.	40.0	
KFY	Poinciana, Florida	68.4	
KFZG	Port Barrow	45.32, 69.25	
KFZH	Fairbanks, Alaska	44.71, 68.32	
KFZQ	SS. Robador	37.5	
KGBB	U. S. SS. Ungava (R. B. Metcalf)	22.0, 37.0	
KGDU	SS. Four Winds	35.03	
KGE	Medford, Oregon (Pacific Air Transport)	46.06	
KGFT	Portable Station, Texas	50.0	
KGH	Hillsbro', Oregon (Fed. Telegraphic Co.)	36.52, 46.99	
KGT	Fresno, Calif. (Pacific Air Transport)	46.06	
KIO	Kahuku, Hawaii (R.C.A.)	90.04	
KKC	Palo Alto, Calif. (Fed. Telegraphic Co.)	17.0, 27.5	
KLL	Bolinas, Calif. (R.C.A.)	21.85	
KMM	Bolinas, Calif. (R.C.A.)	14.29, 28.58	
KMV	Bandini, Calif. (Western Air Express, Inc., Morse)	49.5	
KNN	Honolulu (Mackay, R. & T. Co.)	17.2, 23.0, 23.7, 28.0, 34.4, 46.0, 47.4, 56.0	
KNR	Clearwater, Calif. (Fed. Telegraphic Co.)	29.5, 49.15	
KNW	Palo Alto, Calif. (Mackay, R. & T. Co.)	16.7, 17.0, 24.0, 33.4, 34.0, 48.0, 51.0	

Call Letters	Stations and Location	Wave Length (Meters)	Remarks
KQS	Lone Pine, Calif. (City of Los Angeles)	45.77	
KQT	Los Angeles, Calif. (City of Los Angeles)	45.77	
KRP	Salt Lake City, Utah (Western Air Express, Inc.)	49.5	
KSS	Bolinas, Calif. (R.C.A.)	14.40, 28.80	
KSZ	McCamey, Texas	48.05	
KTA	Guam (Mackay R. & T. Co.)	18.0, 21.8, 22.0, 23.5, 36.0, 43.6, 44.0, 47.0	
KTF	Midway Island (Mackay R. & T. Co.)	21.6, 33.2, 43.2, 66.4	
KUN	Bolinas, Calif. (R.C.A.)	16.93, 33.88	
KUY	Bear Creek, Alaska	82.0	
KVR	Las Vegas, Nev. (Western Air Express, Inc.)	49.5	
KWE	Bolinas, Calif. (R.C.A.)	14.08, 28.15	
KWJJ	Portland, Ore.	53.54	¼ kw.
KWT	Palo Alto, Calif. (Fed. Telegraphic Co.)	34.86, 48.05, 49.97, 58.10	
KWV	Bakersfield (Pacific Air Transport)	66.48	
——	Lyons, Radio Lyon	39.5	Phone 1700–1800 G.M.T. except Sun.
LA1E	Meteorological Hut, Bergen	43.0	
LA 1M	Meteorological Inst., Oslo	45.0	
LCHO	Telegraph Administration, Oslo	33.0	
LPI	Buenos Aires	34.0	
LPZ	Buenos Aires	36.0, 75.0	
LY	Bordeaux, Lafayette	32.0	
——	Matagora (Spain), Cie. Transatlantic Espagnola	70.0	
NAA	Washington	24.9, 37.4, 74.7	
NAJ	Great Lakes, Illinois	40.0, 76.0, 34.0	
NAL	Navy Yard, Washington, D. C.	20.0, 30.6	
NAS	Pensacola, Florida	40.0	
NBA	Balboa, Canal Zone	54.0	
NEL	Lakehurst, N. J.	80.0	
NEPQ	U. S. SS. Relief	20.0	
NERM	U. S. SS. Los Angeles	70.0–84.5	
NFV	U. S. Marine Corps, Quantico, Va.	77.4, 77.5	
NIRX	U. S. SS. Canopus	75.0	
NKF	Naval Lab., Bellevue, Anacostia	16.0, 17.0, 20.8, 21.0, 25.5, 41.3, 54.4, 61.0, 71.3, 81.5	
NKL	Arlington	29.0, 37.4, 74.7	
NOSN	U. S. Submarine Base, Coco Solo, Panama	40.0	
NPC	Puget Sound, Washington	37.0	
NPG	San Francisco, Calif.	16.49, 32.98	
NPL	U. S. Training Ship, San Diego, Calif.	71.7	
NPM	Honolulu, Hawaii	35.0 and 36.8	
NPO	Cavite, Philippine Islands	68.0, 70.0	
NPU	Tutuila, Samoa	37.0–40.0, 53.0	
NQC	San Diego, Calif.	75.0, 86.0	
NQW	U. S. SS. Mexico	40.0	
NRRG	Winter Park, Florida	39.5, 82.0	
NRRL	U. S. SS. Seattle	40.0	
NUQB	U. S. SS. Pope	75.0	
OCBA	Bamako (Soudan)	41.50	
OCBV	French Military Station at Beyreuth	58.0	
OCCO	Conakry (French W. Africa)	33.0	
OCDA	Dakar (French W. Africa)	35.0	
OCDB	Djibouti	72.0	
OCDJ	Issy-les-Moulins	33.0	1008–1028 G.M.T., Corresponding with OCDB
		65.0	
		32.0	Time Signal 0756 and 0955

Call Letters	Stations and Location	Wave Length (Meters)	Remarks
OCMV	French Military Station, Mont Valerien, Suresnes (Seine)	39.0, 44.0, 46.0	At 1000, 1100 1230, 1330, 1600, 1900, 2000, 2100 and 2200 G.M.T. on either 600 cycles or D.C.
OCNG	Nogent-le-Rotrou	29.0, 32.0, 45.0, 48.0, 72.0	
OCRB	Rinck, Meteo Aviation, Rabat, Morocco	36.0	
OCRF	Reggu, Morocco	74.0	2130–2145 G.M.T.
OCRU	Rufisque (French W. Africa)	39.0	
OCTN	Mourillon, Toulon	20.0	Series of "a" from 1530–1540 G.M.T.
		33.0	Series of "b" from 1545–1555 G.M.T.
		57.0	Series of "c" from 1600–1610 G.M.T. daily, except Sun.
OCTP	The Military Station of Nogent-le-Rotrou.		
OCTU	Tunis la Casbah	48.0, 50.0	
OHK	Vienna	39.5, 40.6	
OLQ	SS. Slamat	19.0, 22.5, 37.0	
——	Paris, Radio LL	61.0	Phone
——	Paris, Radio Vitus	37.0	Phone Wed., Fri., Sun., 2100 – 2245 G.M.T.
PCA	Amsterdam	33.33	
PCG	Malabar, Java	17.0	
PCH	Scheveningen Port	20.0, 20.6, 20.69, 21.127, 28.800, 29.226, 29.283	
PCJJ	Hilversum, Holland (Philips Lamp Works)	30.2	
PCLL	Kootwijk, Holland	46.0, 32.0, 18.0	Phone Wed., 1400–1600 G.M.T. and occasionally on Mon. and Fri., and other wavelengths below 60 meters (40 kw.)
PCMM	Ministry of Posts and Telegraphs, Kootwijk	25.0, 27.5, 36.0	and other wavelengths below 60 meters
PCPP	Kootwijk, Holland	27.0	and other wavelengths below 60 meters
PCRR	Kootwijk, Holland	20.0, 25.0, 37.0	and other waveledgths below 60 meters
PCTT	Kootwijk, Holland	21.0, 29.5	and other wavelengths below 60 meters (10 kw.)
PCUU	Dutch Colonial Ministry, The Hague	34.0	
PKD	Koebang	32.0	
PKE	Amboina	24.0	
PKH	Soerabaja, Java (D. E. Indies)	23.0	
PKP	Medan	21.5, 31.5	
PKX	Java	27.0, 32.0	
POF	Nauen	13.5, 18.0	
POX	Nauen	20.0	
POY	Nauen	25.0	
POZ	Nauen	47.0	
POS	Alfragidi, Lisbon (Beam)	18.270	
PQW	Alfragidi, Lisbon (Beam)	15.641	
PTQ	Quartel-General, Brazil	30.5	
PVC	Curacao	15.0–20.0	
RABL	Habarousk	22.0	
RAU	Tashkent	23.0, 34.0	
RCRL	Central Lab., Leningrad	27.0	
RCT	Sebastopol	64.0	
RDI	Petrozavadosk	34.2	
RDRL	Leningrad	28.5	
RDW	Moscow	83.0	
RKV	Moscow	21.0, 34.0	
RLT	Tommot	23.0	
RRP	Nijni Novgorod	20.0–42.0	
RTRL	Tiflis	22.0–42.0	
SAA	Karlskrona	44.0	
SAB	Goteborg	36.5	
SAD	Flottads Stations, Stockholm	31.0–51.0	
SAJ	Karlesborg, Sweden	50.0	
SDK	SS. Kiruna	54.0	
SFR	Paris	75.0, 85.0	
SGT	Motorship Suecia	42.0, 50.0	
SIC	SS. Masilia	42.0, 51.5	
SKB	Motorship Gripsholm	37.5	
SMHA	Stockholm	41.0	
SOJ	Brazilian SS. Jaquarao	100.0	
SOK	Moskwa Sokoleniki Radio	37.0	
SPM	Radio Laboratory, Ministry of Posts, Helsingfors	47.0	
SPR	Sepetiva, Rio de Janeiro, Brazil	22.180	Meteorological reports, 1530 local time
SPU	Santa Cruz (Beam)	15.576	
SPW	Rio de Janeiro	29.3	
SPX	Rio de Janeiro	40.5	
SP 1	Rio de Janeiro	17.0, 44.5, 47.0	
SUC 2	Abuzabal (Cairo)	47.0	
TFA	Reykjavik, Iceland	42.5, 49.5	
TSB	Norwegian SS. Helder	46.5, 51.0	
TUK	Tomsk, Siberia	20.0	
TVE	SS. Solderijk	31.1	
U1XAO	Belfast, Maine	40.0, 56.0, 60.0, 70.0	
U 1XAB	Portland, Maine (Congress Square Hotel Co.)	63.79	250 watts
U 1XR	Manila, Philippine Islands	30.0	
U 2XAA	Houlton, Maine	22.99	Phone after 2300 G.M.T,
U 2XAC	G. E. Co., Schenectady, N. Y.	50.0	
U 2XAD	G. E. Co., Schenectady, N. Y.	21.96	Phone, Mon. Wed., Fri., 2300; Sat., 1900 – 2200 G.M.T.
U 2XAF	G. E. Co., Schenectady, N. Y. transmitting program from WGY	32.7	Phone Tues., Thurs., and Sat., 2300 G.M.T.
2XAI	Newark, N. J. (Westinghouse Electric Co.)	43.0	
2XAL	New York, short-wave transmitter of WRNY (Experimenter Publ. Co.)	30.91	
U 2XAO	Belfast, Maine	40.0, 56.0, 60.0, 70.0	
U 2XAP	New York (Bull Insular Line)	18.3, 18.7, 36.6, 37.5	
U 2XAW	G. E. Co., Schenectady, N. Y.	3.0–20.0, 15.0	
U 2XBA	Newark, N. J. (Short-wave Station of WAAM)	65.18	Phone Mon., Wed., Fri., 2355 – 0500 G.M.T.
U 2XBB	New York (R.C.A.)	1–5	1 kw.
U 2XBC	Rocky Point, N. J. (R.C.A.)	14.09 and 5.35–18.74	
U 2XBI	Rocky Point, N. Y. (R.C.A.)	1–15	10 kw.

Call Letters	Stations and Location	Wave Length (Meters)	Remarks
U2XE	Richmond Hill, N. Y. (Short-wave of WABC)	22.1	Phone after 2300 G.M.T.
U 2XG	Rocky Point, N. J. (Western Electric Co.)	16.02	Phone Mon. and Fri. after 1700 G.M.T.
U 2XH	Schenectady, N. Y.	50.0	
U 2XI	Schenectady, N. Y.	30.0, 35.0, 38.0	
U 2XK	South Schenectady, N. Y. (General Electric Co.)	65.5	
U 2XN	Rocky Point (R.C.A.)	5–80	150 watts
U 2XS	Rocky Point (R.C.A.)	14.93	80 kw.
U 2XT	Rocky Point, N. Y. (R.C.A.)	16.17	80 kw.
U 3XL	Bound Brook, N. J.	60.0	30 kw.
U 3XQ	Mountain Lakes, N. J.	37.95, 75.9	
U 4XK	San Juan, Porto Rico (Bull Insular Line)	18.3, 18.7, 36.6, 37.5	
U 5XH	New Orleans (Tropical Radio Telegraphic Co.)	42.0	
U 6XAI	Inglewood, Calif.	66.04	Phone 2400 G.M.T. onwards
U 6XAR	San Francisco, Calif.	33.00	Phone 2400 G.M.T. onwards
U 6XI	Bolinas, Calif.	29.3	
U 6XO	Kahuhu, Hawaii	90.0	
U 8XJ	Columbus, Ohio	54.02	
U 8XK	East Pittsburgh (Westinghouse Co.)	26.8	Mon. and Fri. 1900–2100 G.M.T.
U 8XS	East Pittsburgh, Pa.	67.0, 96.0	
U 9XU	Council Bluffs, Iowa	61.06	Phone
VAS	Louisburg, Nova Scotia	52.0	Press reports
VGJL	SS. Canadian Commander	43.0	
VIS	Sydney	22.0, 26.0, 32.0, 42.0, 51.5	
VIT	Townsville, Queensland	22.0, 42.0	
VIZ	Ballan, Melbourne (Beam Station)	25.728	
VJZ	Rabaul, New Britain	22.0, 26.0, 32.0, 42.0	
VKQ	Garden Island, Sydney	35.0	
VNB	Klipheuval, South Africa (Beam)	16.077, 33.708	
VQF	Kuching, Sarawak	32–38	
VWZ	Kirkee, Bombay (Beam)	16.286, 34.483	
VZDK	SS. Jervis Bay	33.0	
WABC	Richmond Hill, N. Y. (Atlantic Broadcasting Cpn.)	64.0	
WAJ	Rocky Point, N. Y. (R.C.A.)	22.24, 44.48	
WAQ	Newark, N. J. (Westinghouse Elec. & Mfg. Co.)	44.03	
WBO	Dearborn, Mich. (Ford Motor Co.)	44.62	
WBU	Rocky Point, N. Y. (R.C.A.)	14.09	
WBZ	Springfield, Mass. (Westinghouse E. & M. Co.)	50.0, 70.0	20 kw.
WCFL	Chicago, Ill. (Fed. of Labor)	37.24	
WCGB	Brooklyn, N. Y.	54.0	½ kw.
WCSH	Portland, Maine	63.79	½ kw.
WDJ	Harrison, Ohio (Crosley Radio Corporation)	21.4, 26.3	
WDS	Rocky Point, N. Y. (R.C.A.)	15.86, 31.73	
WEAJ	Rocky Point, N. Y. (R.C.A.)	22.24, 44.48	
WEAO	Columbus, Ohio (Ohio State University)	54.02	
WEDS	Rocky Point, N. Y. (R.C.A.)	15.86, 31.73	
WEEM	Rocky Point, N. Y. (R.C.A.)	16.41, 32.84	
WEFX	Rocky Point, N. Y. (R.C.A.)	15.79, 31.39	
WEGT	S. Juan, Porto Rico (R.C.A.)	21.75, 65.3	
WEHR	Rocky Point, N. Y. (R.C.A.)	15.93, 31.96	
WEM	Rocky Point, N. Y. (R.C.A.)	16.41, 32.84	
WEOP	Rocky Point, N. Y. (R.C.A.)	21.57, 43.14	
WEP	Cape Charles, Virginia (Norfolk Cape Charles Radio Telegraph Co.)	99.9	
WEPE	Rocky Point, N. Y. (R.C.A.)	21.63, 43.33	
WEQA	Rocky Point, N. Y. (R.C.A.)	14.13, 28.26	
WEQB	Rocky Point, N. Y. (R.C.A.)	16.71, 33.42	
WEQC	Rocky Point, N. Y. (R.C.A.)	16.78, 33.37	
WEQX	Rocky Point, N. Y. (R.C.A.)	14.85, 29.71	
WEQY	Rocky Point, N. Y. (R.C.A.)	14.91, 29.83	
WFV	Poinciana, Florida (Florida RT Co.)	70.54	
WFX	Rocky Point, N. Y. (R.C.A.)	15.70, 31.59	
WGI	Alpena, Mich. (Alpena Marine Radio Service)	98.3	
WGT	S. Juan, Porto Rica (R.C.A.)	21.75, 65.3	
WGW	Vieques, Porto Rico (Bureau of Insular Telegraphs)	52.0	
WGY	Schenectady, N. Y. (G. E. Co.)	35.0	
WHD	Sharon, Pa. (Westinghouse Co.)	49.0	
WHK	Cleveland, Ohio	66.04	½ kw.
WHR	Rocky Point, N. Y. (R.C.A.)	15.93, 31.96	
WHW	Highland Park, Ill. (Wireless Telegraph & Communication Co.)	45.02	
WIK	New Brunswick, N. J.	21.48, 21.5	
WIR	New Brunswick, N. J. (R.C.A.)	74.0	20 kw.
WIZ	New Brunswick, N. J. (R.C.A.)	43.35	Phone occasionally from 2300 G.M.T.
WJD	New York International News Service	37.01	
WJZ	Boundbrook, N. J. (R.C.A.)	18.17	
WKC	Newark, N. J.	17.5, 27.9	
WKI	Newark, N. J. (Fed. Telegr. Co.)	17.3, 27.9	
WKK	Cuba, Porto Rico (Bureau of Insular Telegraphs)	52.0	
WLL	Rocky Point, N. Y. (R.C.A.)	16.57	
WLW	Cincinnati, Ohio (Crosley Radio Corporation)	52.02	2200 – 0400 G.M.T. except Fri.
WNBT	Elgin, Ill.	33.5	Special Time Signals
WND	Ocean Township, N. J. (American Telephone & Telegraph Co.)	13.88, 16.35, 22.38, 32.69, 46.48	
WNU	New Orleans, La.	26.0, 40.0	Press reports
WOBD	SS. Radio	37.0, 43.74, 77.0	
WOBV	U. S. SS. Nippekontu	36.2, 72.4	
WOP	Rocky Point, N. Y. (R.C.A.)	21.57, 43.14	
WOWO	Fort Wayne, Ind. (Main Auto Supply Co.)	22.80	1 kw. Phone after 2300 G.M.T.
WPE	Rocky Point, N. Y. (R.C.A.)	21.63, 43.14	
WQA	Rocky Point, N. Y. (R.C.A.)	14.13, 28.26	
WQB	Rocky Point, N. Y. (R.C.A.)	16.71, 33.42	
WQC	Rocky Point, N. Y. (R.C.A.)	16.78, 33.57	
WQN	Rocky Point, N. Y. (R.C.A.)	51.5, 54.5, 57.0	
WQO	Rocky Point, N. Y. (R.C.A.)	35.03, 44.0	
WQQ	Rocky Point, N. Y. (R.C.A.)	14.8	
WQX	Rocky Point, N. Y. (R.C.A.)	14.85, 29.71	
WQY	Rocky Point, N. Y. (R.C.A.)	14.91, 29.83	
WRB	Miami, Florida (Florida Radio Telegraph Co.)	70.74	
WRNY	Coytesville, N. J. ("Radio News")	30.91	Phone Mon., Wed., Fri., 1930 – 2215 G.M.T.; other days, 2355 –0500
WSS	Rocky Point, N. Y. (R.C.A.)	16.0, 20.0	
WTT	Rocky Point, N. Y. (R.C.A.)	16.02	
XDA	Mexico City, Mex.	34.0	Press reports 0500 G.M.T.
XEK 4AP	German Aeroplane	42.5	
YZ	Fort d'Issy, France	45–47	
ZWT	Bremerhaven	53.0	
ZZ	Fort d'Issy (Portable)	45–47	



ARE YOU REPRESENTED IN THE RADIO MARKET

Custom Setbuilders! RADIO LISTENERS' GUIDE and CALL BOOK has inaugurated a new service to help you increase your sale of radio receivers. The Spring issue carried the first of a series of articles the purpose of which was to acquaint our readers with your work and to show you an easy way to start in business for yourself. To this end we offered the service of the RADIO LISTENERS' GUIDE and CALL BOOK to you. In our effort to co-operate further we have opened a section of our magazine in which we carry in geographical order the advertisements of as many setbuilders as wish to avail themselves of this service. Your ad will be inserted at no cost and it is our hope that it will prove a big help in boosting your sales and in making more money for you.

CONDITIONS

Each advertisement will be keyed and listed geographically in the "RADIO SET MARKET" section as seen on page 136.

No advertisement more than fifty words. Each must be clearly written on a piece of white paper and attached to the coupon herewith. No request will be considered without the coupon.

No ad will be accepted from persons merely desiring to sell a set and who are not bonafide custom setbuilders.

We invite you to take advantage of this service. Fill in the coupon and mail it to us with your ad.

Radio Listeners' Guide and Call Book
230 Fifth Avenue, N. Y. C., N. Y.

Radio Listeners' Guide and Call Book,
230 Fifth Avenue, New York, N. Y.

Gentlemen:—Without cost or obligation to me kindly insert the attached custom made set offer in your next issue.

Name .....

Address .....

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

From Radio Amateur to Custom Set Builder

TWENTY years ago, H. G. Horneij started as a radio amateur. Today he is at the head of a prosperous concern, Schneider-Horneij Radio Research Laboratories, Inc., New York, that produces custom-built receivers and radio apparatus for laboratories, and sells service for home radio outfits.

Mr. Horneij lays no claim to being a radio wizard, although he has a national reputation. He was merely one of those young men with a natural liking for mechanical and experimental work. There are thousands of such men, all wishing that they could get away from routine jobs where they are but cogs in the wheels of industry, and longing to be independent business men, free to do the kind of work that they like best and able to make a good living at it. The main difference between them and Mr. Horneij is that he went ahead and did the things which the others only think about.

Any man who looks back over his past must realize that the path of opportunity always has been right in front of him, but that he often was too blind to see it. A lot of us are like pigs and somebody has to hold a board on each side of us to make us think that we are going up the right alley. The trouble with that arrangement is that the fellow who holds the boards brings home the bacon.

We are like the radio operator who wrote a bitter letter criticizing an article because it had stated that there were good opportunities in radio. He said he had been an operator for three long years and all the opportunity he had, was to make monotonous trips on a bad smelling tanker and lie for days in a hot harbor surrounded by mosquito-breeding marshes. A bird like that would sit all the evening in a bunch of old maids without seeing a chance to get married!

The story of this man Horneij appeals to the average man more, we believe, than accounts of men such as Dubilier and Sarnoff. Most of us would like their positions and incomes but we could not stand the work they do. They were good radio men, but either they liked executive work better than construction and experiment or else they went into it merely because there was more money in it.

The born mechanic and experimenter does not enjoy executive work as a rule. He may get a thrill out of it the first few times that he sits at the head of a conference table and steers a board of directors, but after a few weeks of it the mention of a conference is likely to make him sick enough to lose his lunch.

Mr. Horneij became interested in radio—wireless it was called then—in 1908. He says that he built what was then a receiver. Old-timers will remember what that was, with a "coherer" that served as a detector, when it cohered. He also built a coil transmitter, one of those old "rock crushers" that would drown out hundreds of broadcast, ship and shore stations if it should open up today, but would shoot only a few miles.

As the various types of magnetic and crystal detectors came along, Horneij tried them out. Then came the vacuum tube receiver and transmitter. By that time he was ready

for a commercial operator's job and he joined the Marconi Company.

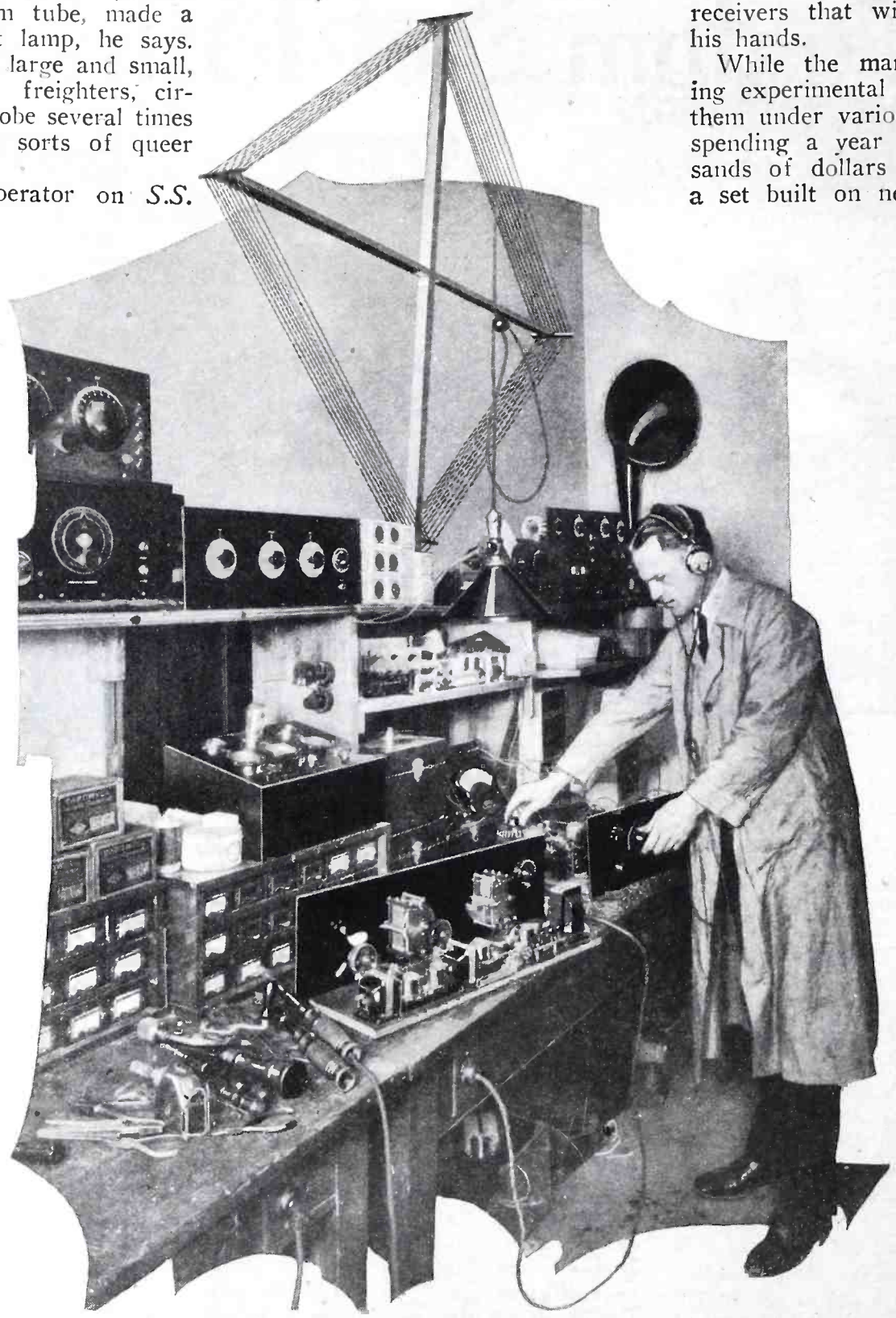
He sailed the Seven Seas, as thousands of men would like to do, with all expenses paid and a fair salary to put in the bank or spend on shore trips. His experience increased as he worked all types of transmitters and receivers. The old Fleming valve, the forerunner of the present three-element vacuum tube, made a perfectly good night lamp, he says. He sailed on vessels large and small, passenger ships and freighters, circumnavigating the globe several times and poking into all sorts of queer places.

He was chief operator on *S.S. New York* of the American Line, call letters KSN, when she was mined off the coast of England. Admiral Sims was on board, en route to England to take command of the American Navy in British waters. Horneij was on watch when the mine exploded, and he broadcast his first and only SOS.

While at sea, Mr. Horneij always was experimenting with different circuits. He carried a trunk full of apparatus and this helped him to pass the time and also laid the foundation for his present thorough knowledge of radio. He read books, too, all the radio books he could find. He still has the reading habit.

He resigned from the Marconi Company in 1920 and was elected secretary and organizer of the Commercial Radio Operators' Association. During the two years that he served this organization he started building high wave receivers and amplifiers to be used on shipboard, and relays to be used with "bug" transmitting keys. He found ready sale for these among the operators.

During the same period he built a tube transmitter at home and began to broadcast "canned" music. He was one of the first amateurs to do this. Then broadcasting suddenly captured the attention of the public and he started to build complete receivers. He met with fair success, but partnership troubles interfered with the business. He had learned that there were certain classes of radio buyers who preferred custom built receivers, just as there are men who buy only custom made clothes no matter how good the factory-made product may be, so he decided to go into the business of building radio sets to order.



Mr. Horneij, the aggressive custom set builder, continually experiments on up-to-date developments and new receivers in order to keep ahead of the manufactured sets.

As a builder of custom sets, Mr. Horneij found that he could keep a year ahead of manufactured sets. The reasons are easy to see. Every day new ideas are presented to manufacturers. However good an idea may be, a manufacturer cannot afford to put it into his product until he has tested it thoroughly. He is working on a mass production basis. He must produce sets that will give average results under average conditions. He cannot adapt sets to the peculiar conditions of certain localities and certain homes. Therefore, he must acquire a considerable volume of experience or he runs a chance of putting out thousands of receivers that will come back onto his hands.

While the manufacturer is making experimental models and testing them under various conditions, often spending a year or more and thousands of dollars before he can sell a set built on new lines, Mr. Horneij and other custom set builders can be making and selling sets that embody every new idea. He builds a set in his shop, tests it in his home, demonstrates it in the home of a customer and sells it, possibly all within a week. If it gives satisfaction in that home, that is all that is necessary. If conditions in the next home are against it, some other type can be installed there.

The manufacturers raise no objections. Where there are patent rights involved, of course they are respected. The custom set builder's volume of sales is as small, compared with the manufacturer's volume, as the custom tailor's output is beside the output of the great clothing factory. No manufacturer fears his competition. On the other hand, the manufacturer reaps the benefit of the experience of the custom set builder, who can tell him what results are obtained with new hook-ups and new types of apparatus right in the homes of the ultimate consumers.

The manufacturers of radio parts welcome the custom set builder and give him wholesale prices. Their business grows as his grows.

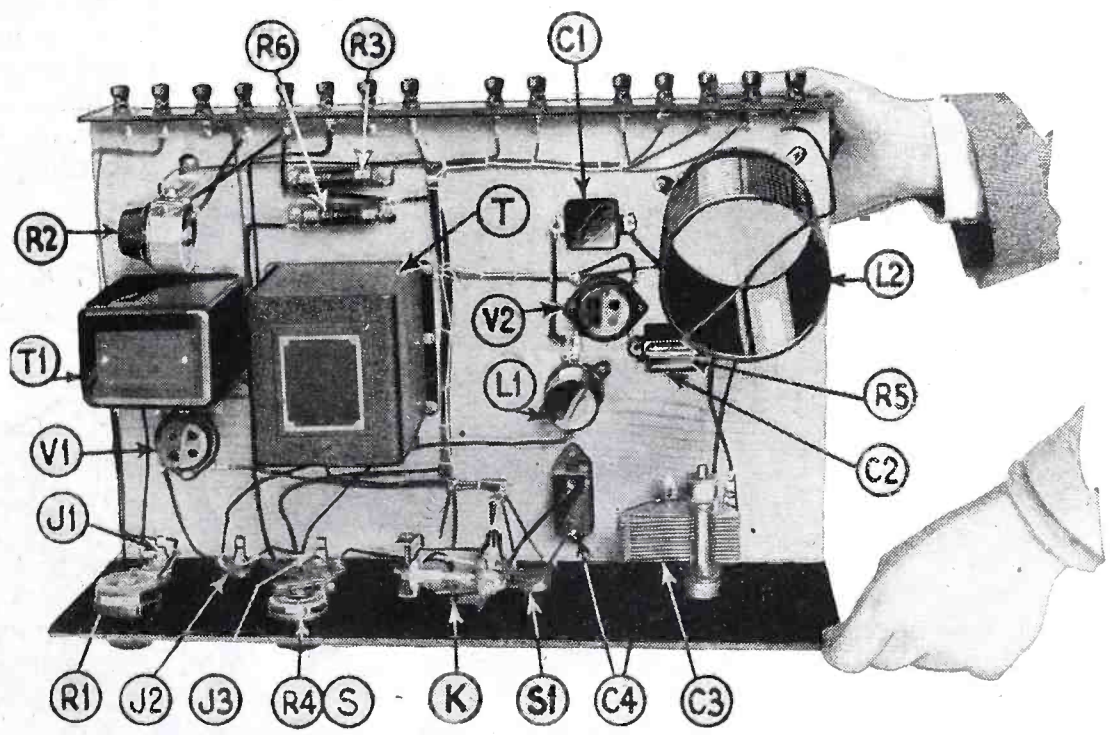
In the early days of his business venture, Mr. Horneij confided his

(*Continued on page* 152)

Building a Radio Picture Receiver

IF, some day while tuning idly around, you pick up peculiar signals that sound like a badly greased grinding stone turning over at a fairly rapid rate, let your curiosity find out what it is all about. The chances are that you accidentally tuned in a radio photograph transmission broadcast. There are several stations, in the United States and in Canada, that are "on the air" with radio pictures. Now, the sport is building a special set that will pick these up, and enable the amateur to receive his own radio-photos in his home.

Radio pictures are being broadcast within the wave bands assigned by the Government for program and entertainment use. This means that the receiving set now ordinarily employed for the reception of broadcast programs can be used to pick up picture impulses without any change. To operate various devices that make it possible to record the picture transmitted, some additional material, to be described further on, will be needed.



This photo shows a top view of the radio picture receiver. All parts are indicated to correspond with components listed in the text of this article.

Receiving a radio picture is practically reversing the process of transmission. At the sending station, an original photograph is wrapped around a cylinder that turns over at a very definite rate of speed, say 100 revolutions per minute. A beam of light is made to strike the surface of the photograph, the reflected ray being directed against the aperture of a photo-electric system, connecting to the transmitting apparatus. The mechanism is so arranged that the entire photograph will be scanned by this narrow beam, revolving and progressing axially before it.

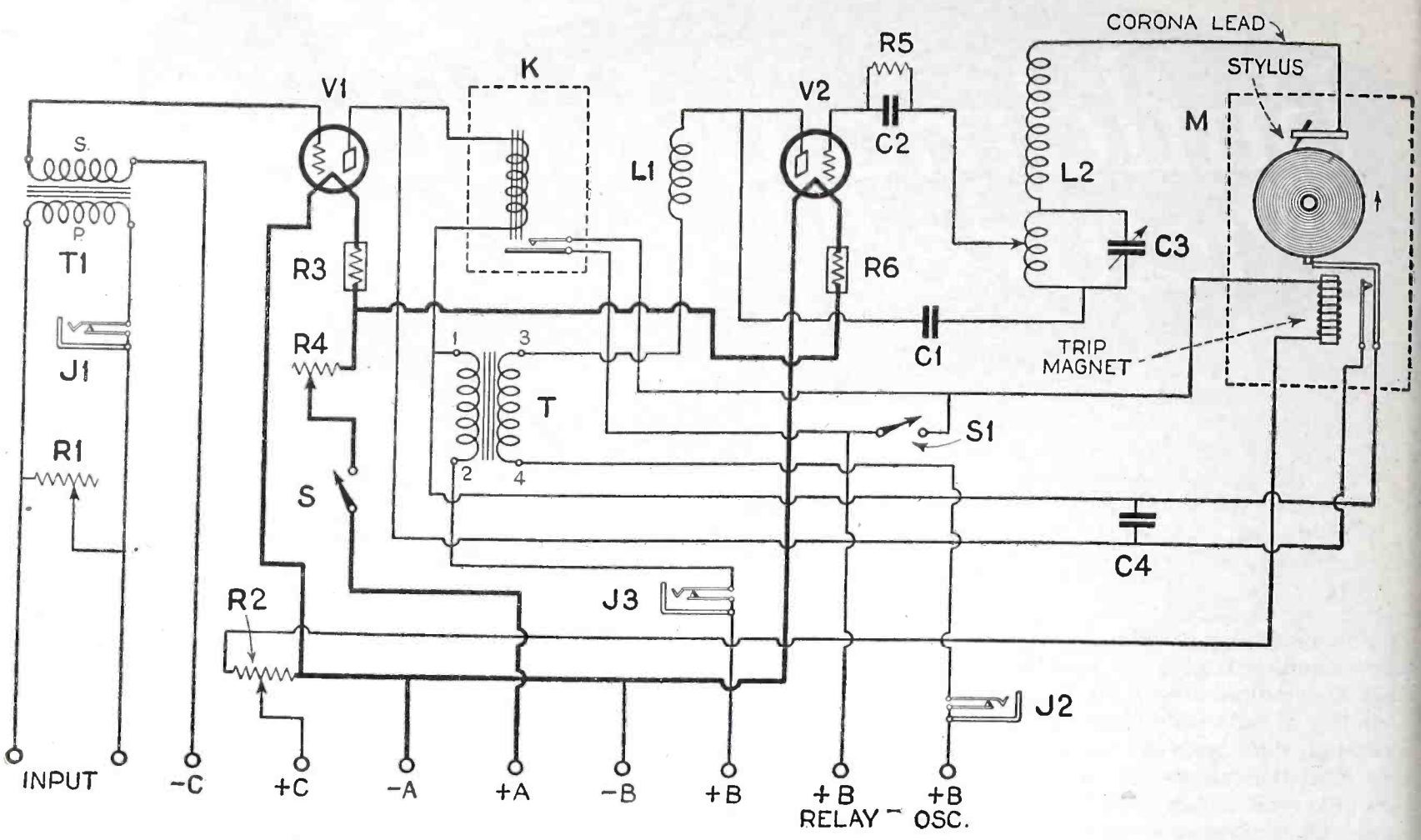
As the beam meets different values of light and shade on the photograph, a greater or lesser amount of light will be reflected to the photo-electric cell. This device, in turn, regulates the intensity of the picture impulse sent.

At the receiving end, the wave is tuned in, and the impulses amplified as though they were ordinary broadcast signals. Then, they are fed into a special amplifying and oscillating arrangement, and after reaching high voltages, are led to a stylus, or recording point on a travelling carriage that is part of a recording cylinder mechanism.

One of the most important considerations in picture transmission and reception is that the both systems operate in absolute synchronism. In this case, it is necessary to have the receiving cylinder turn over at the same rate of speed as the sending one, i.e.—100 revolution per minute.

This may seem an impossible feat, when it is considered that the receiving and sending stations are probably hundreds of miles apart, and with no connecting circuits, except the radio channel. Enginers have, a number of years ago, solved this problem in a more or less satisfactory way. It is called the "stop-start" method, and was used by an Englishman nearly twenty years ago for picture telegraph work between Paris and London. It is the simplest and most practical perhaps, for amateur picture work, and is the idea worked into this system to be described.

The method is simply to have the receiving cylinder travel at a slightly higher rate of speed than that of the sending station. A spring stops the receiving cylinder automatically at the end of each revolution, and a separate but distinct impulse from the transmitter reacts on a relay that permits the receiving cylinder to begin its next revolution at exactly the same time that it does. Thus, the two cylinders begin each



Schematic wiring diagram of the radio picture apparatus described in the article.

revolution on exactly the same instant, and the receiving cylinder is synchronized at every revolution.

Putting together the mechanism that will enable any amateur that can tune in to a picture broadcast to record his own photographs by radio is not complicated. In fact, anyone that can build any of the standard types of multi-tube sets can construct a radio picture receiver.

Standard parts are used throughout. With the exception of the special recorder, and one or two additional parts, all of the apparatus may be purchased from your local radio dealer. The character of parts needed are given as follows:

- 1 Variable gain control resistance, 10,000 ohms, R1.
- 1 Potentiometer, 200 ohms, high current capacity, R2.
- 1 Filament rheostat, 10 ohms, high current, with filament switch, R4, S.
- 1 Fixed condenser 0.1 mfd., C4.
- 2 Fixed condensers 0.0005 mfd., C1, C2.
- 1 Variable condenser 0.0005 mfd., C3.
- 1 R.F. choke, 85 millihenries, L1.
- 1 Switch, filament circuit type, S1.
- 3 Jacks short circuiting short jacks, double contacts, J1, J2, J3.
- 2 Filament ballast resistances, R3, R6.
- 1 Phone plug, P.
- 1 Milliameter 0 to 25 mils, MA.
- 2 Tube sockets, V1, V2.
- 14 Binding posts.
- 1 Panel 16½x7 in.
- 1 Binding post strip 16½x2 in.
- 1 Wood Baseboard 10½x16½ in.
- 1 Grid leak.
- 1 Corona coil, L2.
- 1 Low ratio audio amplifying transformer, T1.
- 1 Modulation transformer, T.
- 1 Relay, K.
- 1 Recording machine, M.

The radio picture set receiving a photograph with the aid of a victrola motor as the driving device. Experiments are being conducted daily with radio picture sets such as described in this article.

With a view to minimizing as much as possible any bad feed-back effects that are most undesirable in this machine, and also, to give maximum room for adjustment, wiring, and replacement, a large board is used for the base. The panel is of standard size, and will accommodate all of the controls that are of immediate importance in the working of the machine.

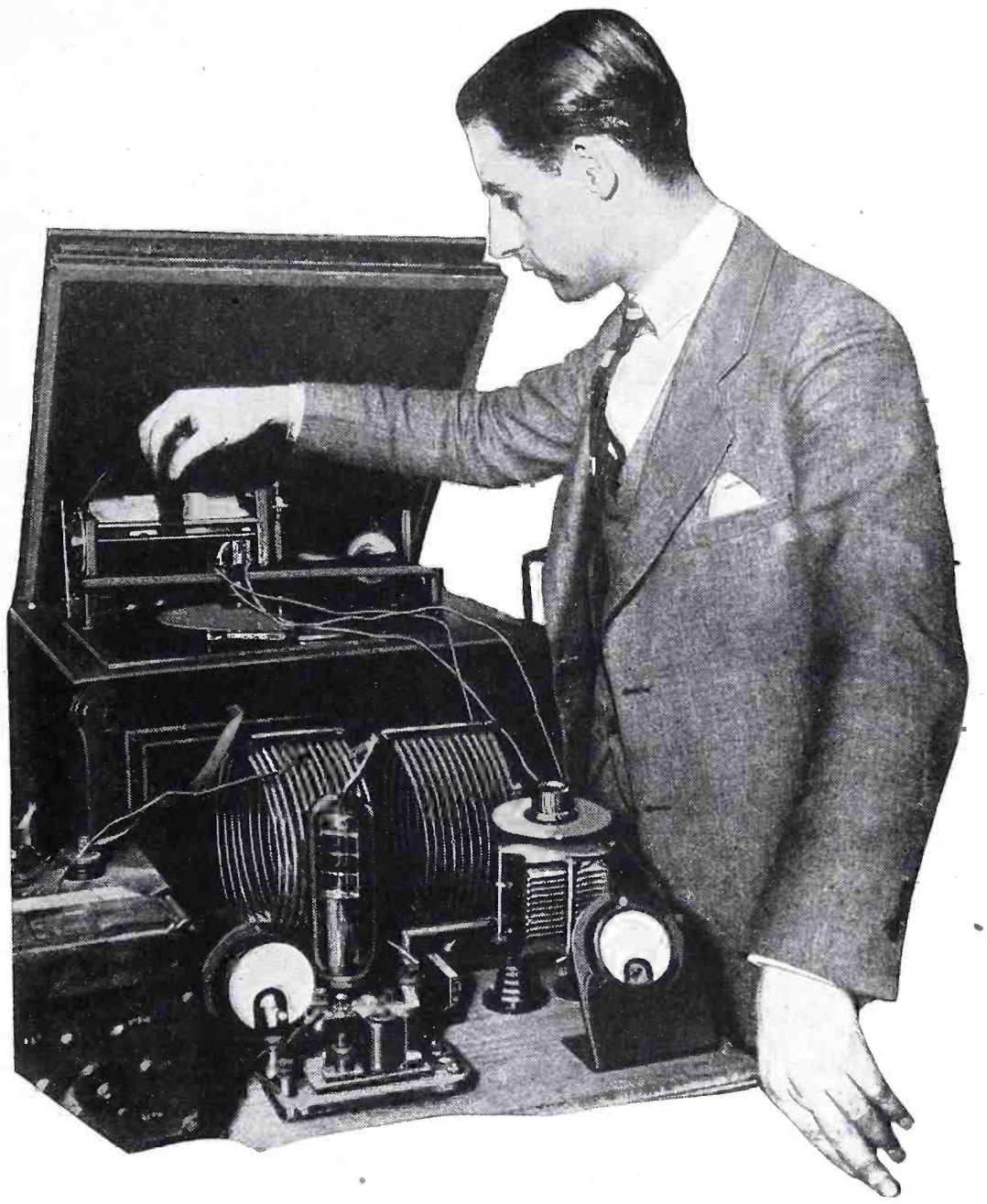
Much of the success of the picture set will depend on the way it is assembled. First, the audio and modulation transformers are located and fastened down with large screws. Then, the sockets, fixed condensers, choke, filament controls, and the coil. The suggested layout can be followed. Experienced amateurs only will attempt to change it greatly.

Work on the panel can now be started. On it are placed the filament and gain controls, several jacks, the special relay, and a variable condenser. Any symetrical arrangement can be designed for the panel. A convenient and practical layout is the one suggested here in the model.

A binding post strip, with the binding posts readily accessible is screwed on the rear end of the baseboard. The preliminary wiring can now proceed.

First, it is suggested that the filament circuits be tackled. The grid, and then, the plate circuits can be done in succession. Before this is done, the front panel should be mounted on the front edge of the baseboard with wood screws.

Every circuit should be checked over carefully. Specially is it important that the relay circuit be watched. Notice the numbers on the transformer terminals, and connect them to the correct jack, relay, and other points in the modulation and oscillating circuits.



Above is the picture transmitter showing simplicity of equipment, hooked up to ordinary victrola. A short wave transmitter is used in conjunction with a photo pick-up device. Experimental tests are being conducted daily over a broadcast station in New York.

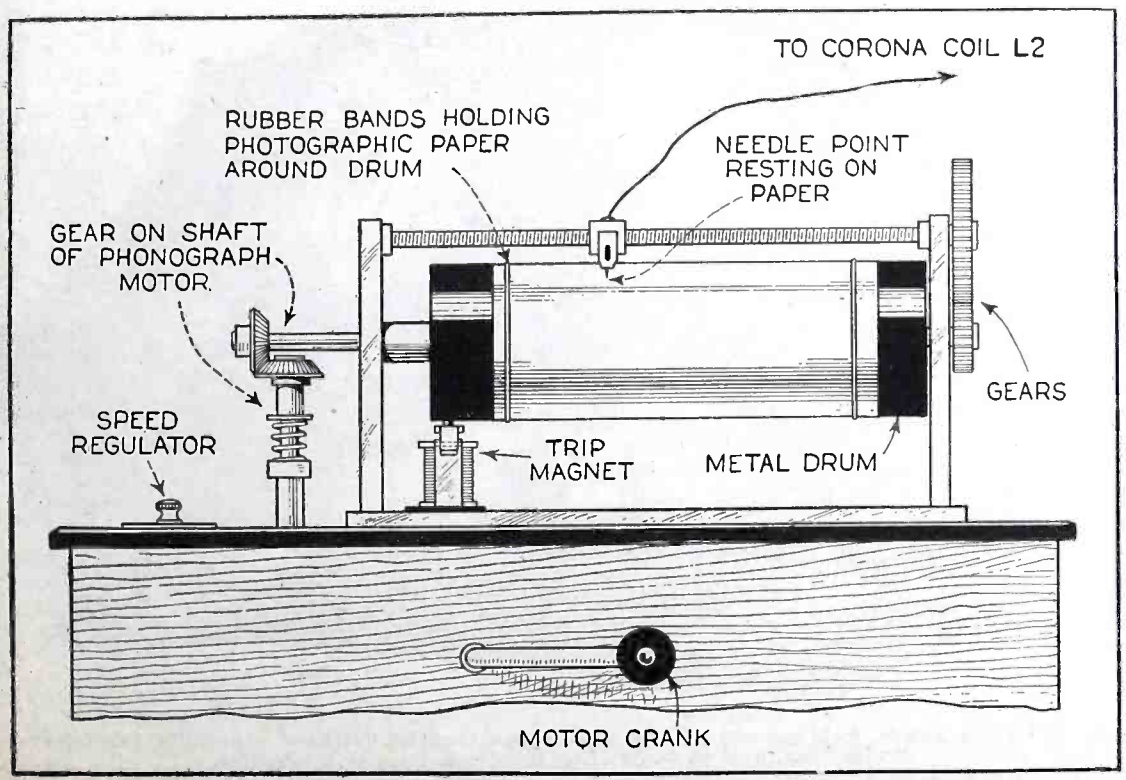
Modulation transformer posts are numbered 1, 2, 3 and 4 in the accompanying schematic diagram. The input goes to terminals 1 and 2. The first terminal connects with the winding of the relay, which in turn, goes to the plate of the first tube. The second post connects with a jack, and to the B plus post on the rear strip.

Then, secondary connections are made, for post three, to the choke coil feeding to the plate of the oscillator; post four goes to high plate voltage terminal on the strip, through a jack. Although the connections from the receiving set into the input transformer are not of prime importance as to direction, they may be reversed if necessary.

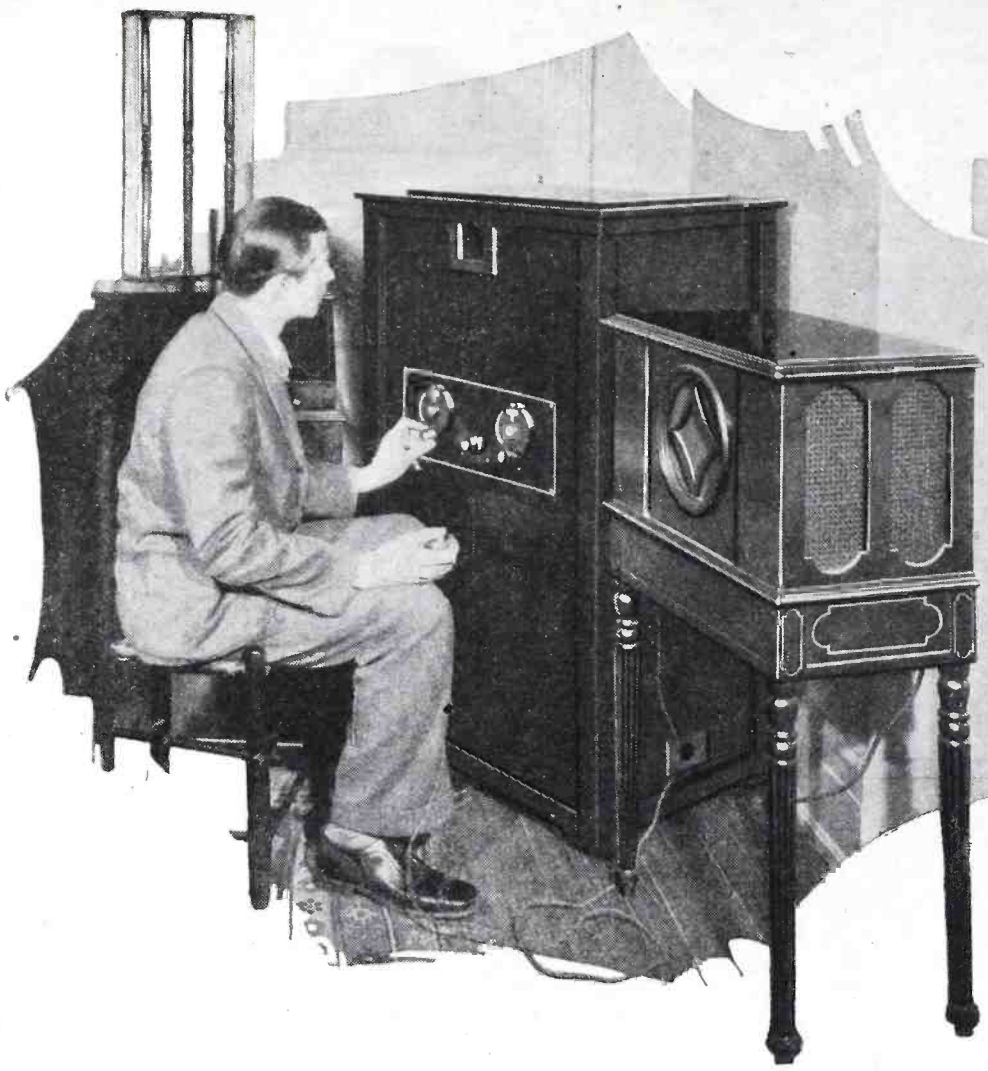
To produce a neat wiring job, wires may be cabled, in the telephone manner, and carefully tied together. Needless to say, all connections should be soldered, and individually tested. All parts should be inspected before using in the circuits. This work may save hours of time later, when it is found that trouble has developed.

Attention may now be given the recorder shown in a sketch herewith. It consists of a cylinder, about two inches in diameter, and six inches long. It is driven, through

(*Continued on page* 144)



Details of the recorder. A device of this type is available completely assembled, or it can be built by the experienced machinist.



EXPERIMENTAL TELEVISION

ALTHOUGH the art of television is not a new one, as compared with its sister science, radio telephony, it has been dormant for many years. while radio telephony has increased in scope with leaps and bounds. Television in the laboratry was an established fact many years ago, but the physical, electrical and mechanical difficulties of bringing it out of that stage were so many, and so seemingly unsurmountable, that it was only recently that several improvements in the art were announced, and interest in television received a great impetus.

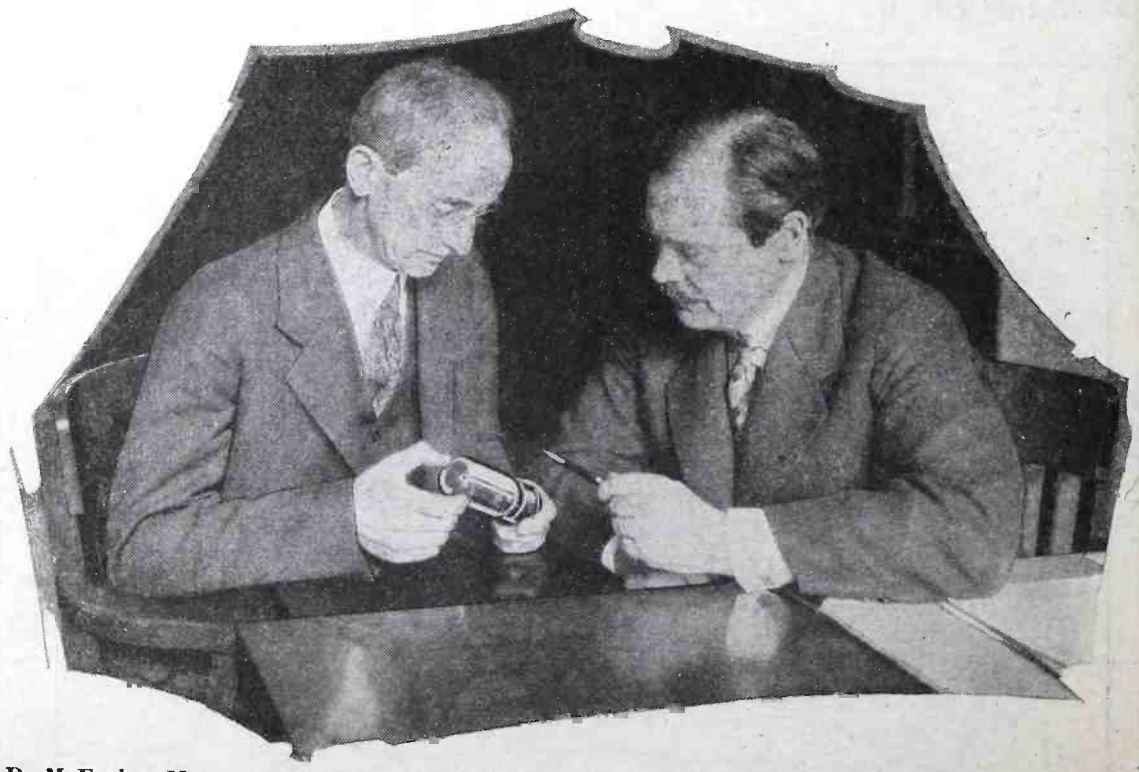
Recently the Bell Laboratories, and then the General Electric Company, have come forth with television systems that have been exhibited and pronounced successful. Baird, a British experimenter, has received much publicity for his method of transmission and reception, and it is quite popular on the other side of the ocean. Even in this country, a demonstration was given recently of the Baird instruments, and the favored few who witnessed it declared hat the results were quite satisfactory. And we could go on and on, telling of this and of that experiment, all backed by money—some of the large companies interested in the work have spent fortunes in research.

But the reader is undoubtedly more interested in what *he* can do with television. The purpose, therefore, of this article is to put before the amateur the simple facts of television transmission and reception, and to give to him some basis for his own work, so that he can, in his own laboratory, and with a minimum of apparatus, learn something of the mysteries of television, and even demonstrate it to his friends.

Before entering into a discussion of the actual construction of the instruments themselves, it will be well to review the theory of the perforated disk system of television. Reverting to a familiar subject, we should bear in mind the motion picture. Here we all know that a series of individaul photographs are projected on a screen at a speed of approximately 16 per second, and that the ability of the eye to retain vision for a fraction of a second makes the pictures blend together. Thus we get the effect of continuous motion.

In television, if we are apparently to see motion, we must produce a series of individual pictures or images, and transmit them to the eye with about the same rapidity that motion pictures are thrown on the screen. Just how this is done will be made plain by the illustrations in Figures 1 and 2. The process consists of picking up the light reflected from the image to be transmitted, taking the light from only a small area at a time, and allowing that light to affect a photo-electric cell.

Let us consider the photo-electric cell for a moment. It is a delicate



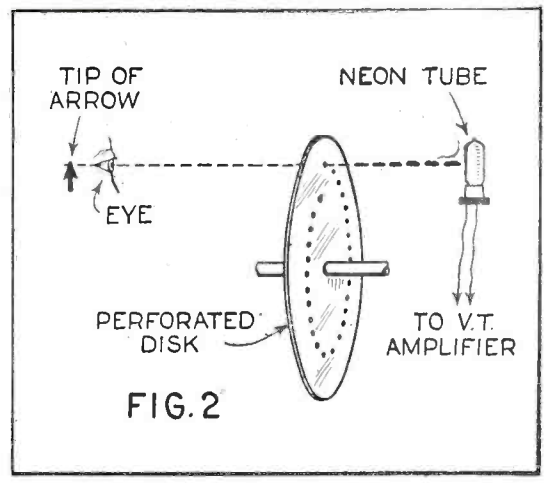
D. McFarlan Moore, holding one of the neon tubes that he designed especially for television reception, and E. F. W. Alexanderson, television inventor.

piece of apparatus, the electrical resistance of which is changed by the action of light. When a powerful light falls on one of these cells that is connected in a circuit, the resistance of the cell falls, and the current in the circuit rises.

Referring specifically to Figure 1, we find a much simplified diagrammatic sketch of a television transmitter. The object to be "televised" is placed in front of a revolving disk, which is pierced with a series of holes, arranged in a spiral, as will be more fully described later. The object, shown here as an arrow for the sake of simplicity, is illuminated by a powerful source of light. This light is, of course, reflected from all parts of the object, in amounts varying with the shade of the particular part of the object that is being considered. These reflected beams, concentrated by a short-focus lens, strike the revolving disk, and when they pass through the holes, they affect the photo-electric cell. The holes in the disk are so arranged that light from only a small portion of the object can reach the cell at one time, and so it will be plain that as the disk revolves, light from each part of the object will reach the cell in its turn, and change the resistance of the cell in a degree governed by the shade of the part.

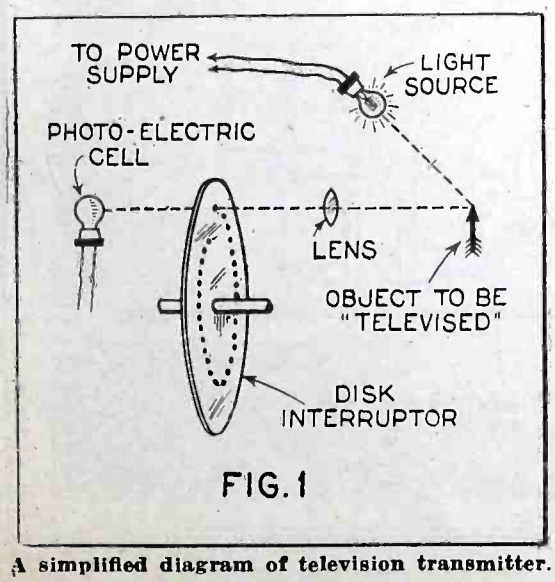
These rapid changes of resistance on the part of the photo-electric cell will set up a current that will fluctuate in accord with the shades of the object. This current is then amplified and used to operate a radio transmitter in much the same way that the voice current in a radio telephone transmitter is employed.

It will be obvious that this system is capable of being worked in the opposite manner. That is, the light source may be in back of the revolving, perforated disk, whereupon the object to be "televised" will be "painted" or "scanned" with a moving beam of light. This light will then be reflected from the object, and this reflected light will be picked up by one or more photo-electric cells. However, for experimental purposes, it is the writer's opinion that the system outlined first will be the best. For commercial work on a large scale, the latter method is probably to be preferred, because more than one photo-electric cell may be employed.



The principle of the television receiver.

Dr. Alexanderson is shown here tuning the television receiver: the image is seen through the small square opening on a level with the operator's eyes. Notice the broadcast receiver and loud speaker.

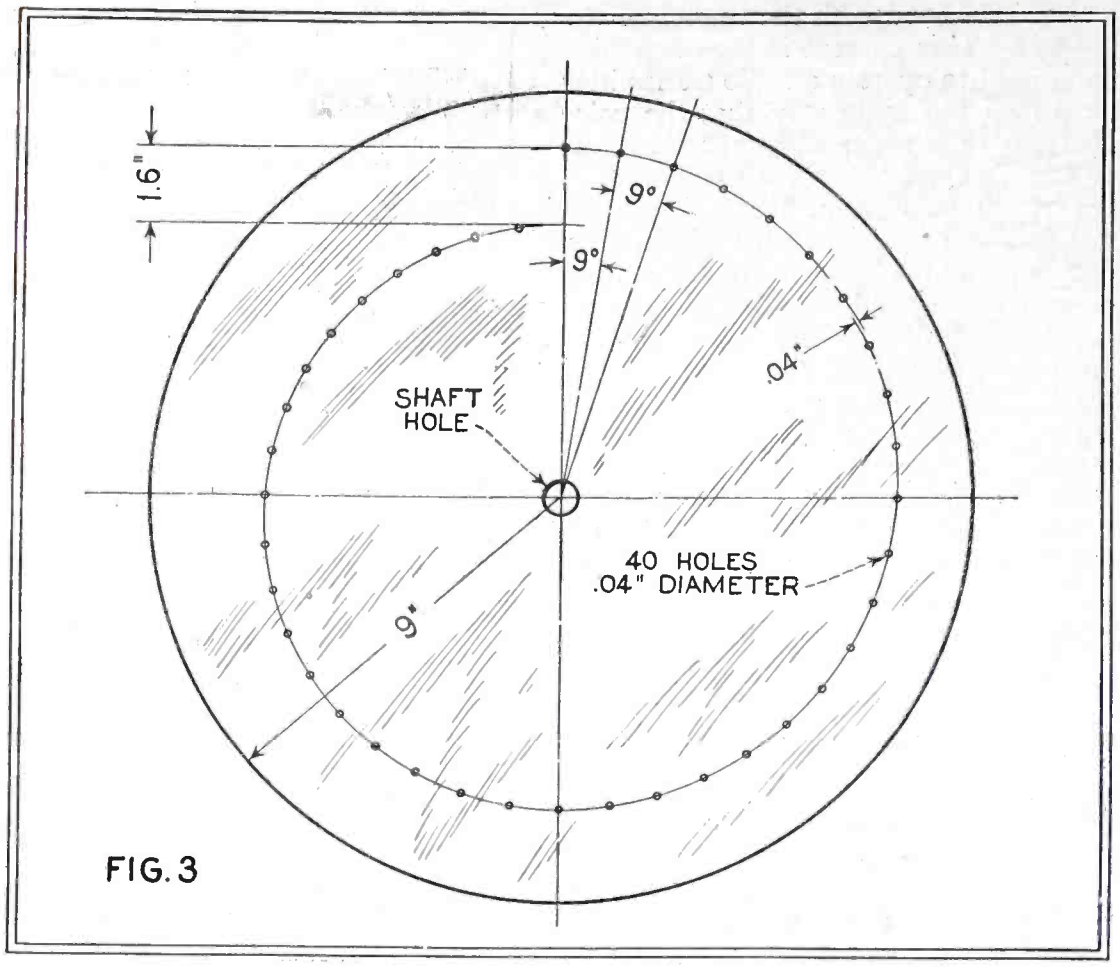


A simplified diagram of television transmitter.

Now, turning to the receiving end, shown diagrammatically in Figure 2, we find another revolving disk, identical with the one used in the transmitter. On one side of this disk is a neon tube of special construction. On the other side is the eye of the observer, or a screen. The current received from the transmitter is rectified and amplified in the usual manner, whereupon the picture current is fed to the neon tube. The latter must be capable of responding rapidly and accurately to a fluctuating current—that is, it must vary quickly in its emitted light when the current fed to it varies.

Let us now follow the sequence of operations through from beginning to end. At the transmitter the illuminated arrow reflects light to the disk. The latter is in such a position that the beam from only the tip of the arrow enters and strikes the photo-electric cell. The latter therefore causes a current to flow, the value of which will correspond with the shade of the tip of the arrow. This current will be transmitted and received and the neon tube will be illuminated to a brightness that was determined at the transmitter by the picture current. Therefore the eye of the observer will record a light intensity from the neon tube that will correspond with the relative shade of the arrow tip. The light will reach the eye through one of the holes in the perforated disk, and therefore the location of the tip will be fixed relatively. Due to the speed of the disk, the received images follow each other so rapidly that the observer sees the image of the entire object, seemingly all at the same time, although actually in series of small portions of the complete object.

The two disks, one at the tansmitter and the other at the receiver, must rotate in absolute synchronism, and here is one of the stumbling blocks that television has always had. For example, they must be rotated so that



Layout of holes in the revolving disc.

the hole that is at the top of the disk at the transmitter will be in the same portion of the spiral series as the hole in the receiver disk that is at the top at the same instant. Any variation of this will destroy the entire system, and if any picture is produced at all, it will be distorted beyond recognition.

Since synchronism of the two disks is a difficult mechanical and electrical problem, the experimenter will be better off if he starts his work with a combination transmitter and receiver working from the same driving motor, and disregards, for the time being, the actual radio transmission and reception. In this way, he will not have to struggle with synchronization and can concentrate his energies on the building of a good, distortionless amplifier, and the rest of the necessary apparatus. Such a combination unit is illustrated in Figure 4, and more will be said of it later.

The first parts of the apparatus that should receive consideration are the revolving disks, two of which will be required for the combination unit. A suitable disk is shown in detail in Figure 3. It may be made of any stiff sheet metal, or even of fibre. The metal is preferable, as the fibre will tend to warp. However, for a temporary installation, fibre will be satisfactory for a time.

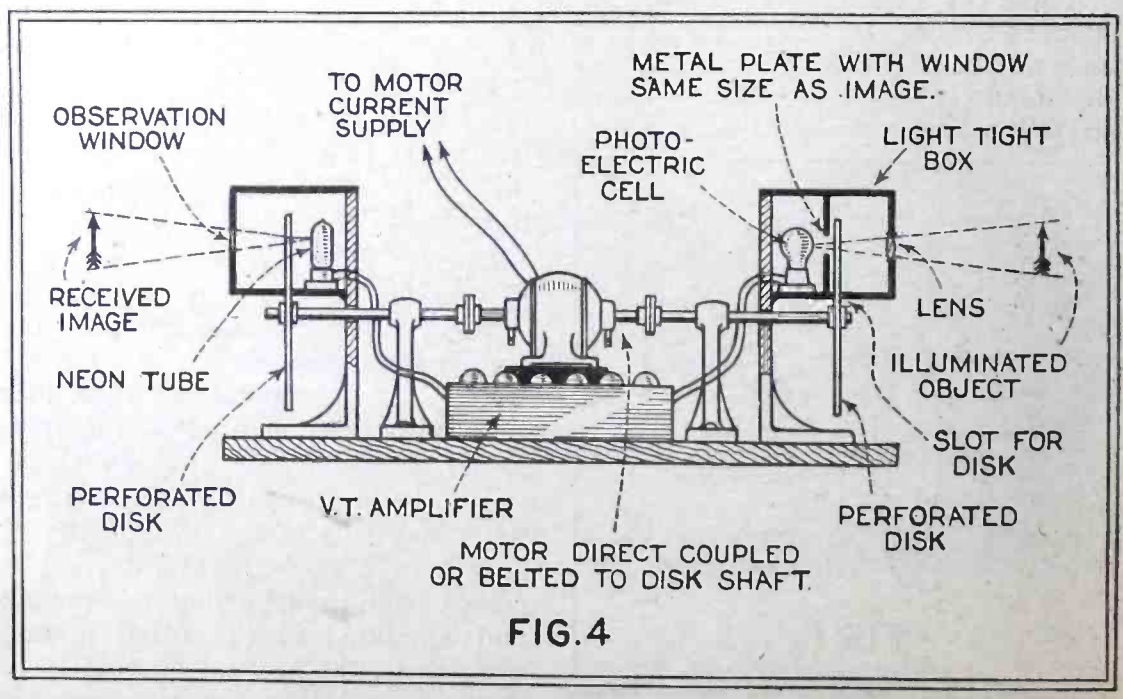
The disk as illustrated, is 18 inches in diameter, and is pierced with a series of 40 holes, each .04 inches in diameter. These dimensions are for a received image of about 1 by .6 inches. The first part of the job is to lay the disk out with 40 equal radii. These will be nine degrees apart. Draw them from the center to the circumference, and drill the first hole on one of them, about ½ inch from the edge. The second hole is drilled on the next radius line, but is .04 inches farther from the edge of the disk than the first. The third hole comes next, and is .04 inches farther in than the second, and so on, until the 40 holes are drilled.

The drilling must be done carefully, with a medium or low-speed drill, and the holes must be true. The drill must not "wobble" during the drilling, and it must be held at right angles to the face of the disk. If the holes are not clean cut, they should be carefully reamed out, and the ends smoothed off with a fine file or abrasive stone. These cleaning operations should be repeated until each hole is perfectly clean, and free from fuzzy edges.

The next step is to procure a motor suitable for rotating the two disks. This should be about ¼ horsepower, and so wound that on the current available, it will turn over at about 1,000 R.P.M. One method of driving the disks from this motor is shown in Figure 4, wherein extension shafts from each end of the motor shaft have the disks fastened to them. However, with most commercial types of motors, this is not possible, so alternative methods are to drive, by a belt or gears from the motor, a solid shaft that connects the disks.

The disks, regardless of the method of driving that is used, must be fastened solidly to the shaft. This can best be done by procuring or making two flanges, and bolting or riveting them fast to the disks. These can then be fastened solidly to the shaft by pins or bolts. Before fastening the disks to the shafts, be very sure that they are in register—that is, that the outer hole in one disk is in the same position in relation to the shaft as the outer hole in the other disk. Thus, the disks will rotate in synchronism and the hole corresponding to the one opposite the object at the transmitting end will be opposite the neon tube in the receiving end at the same instant.

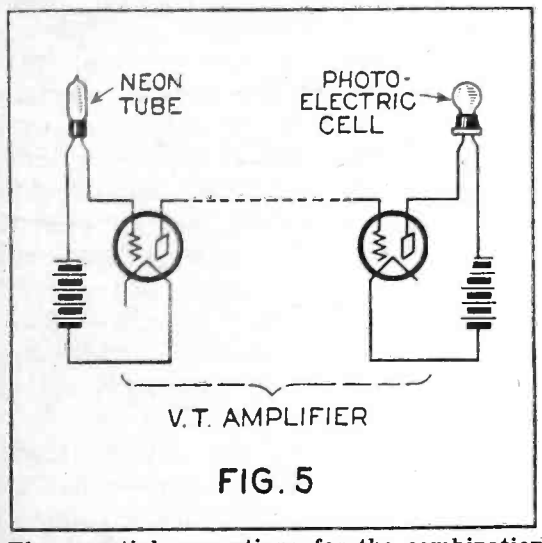
The rest of the details will be obvious from Figure 4. The photo-electric cell and the neon tube are mounted behind their respective disks as shown, and a rectangular hole 1 by 1.6 inches is cut in the face of the receiving enclosures. This window must be placed so that the upper edge is exactly in line with the outer hole in the disk, when this hole is in its



The experimental television apparatus can be arranged as shown above.

upper-most position. Then, of course, the same will be true of the lower edges and the inner-most holes. In the transmitter enclosure a short-focus line is placed in the front, and a metal shield is situated between the disk and the photo-electric cell. In this is cut a 1 by 1.6 inch hole, and it is lined up with the holes in the disk as described for the receiver window.

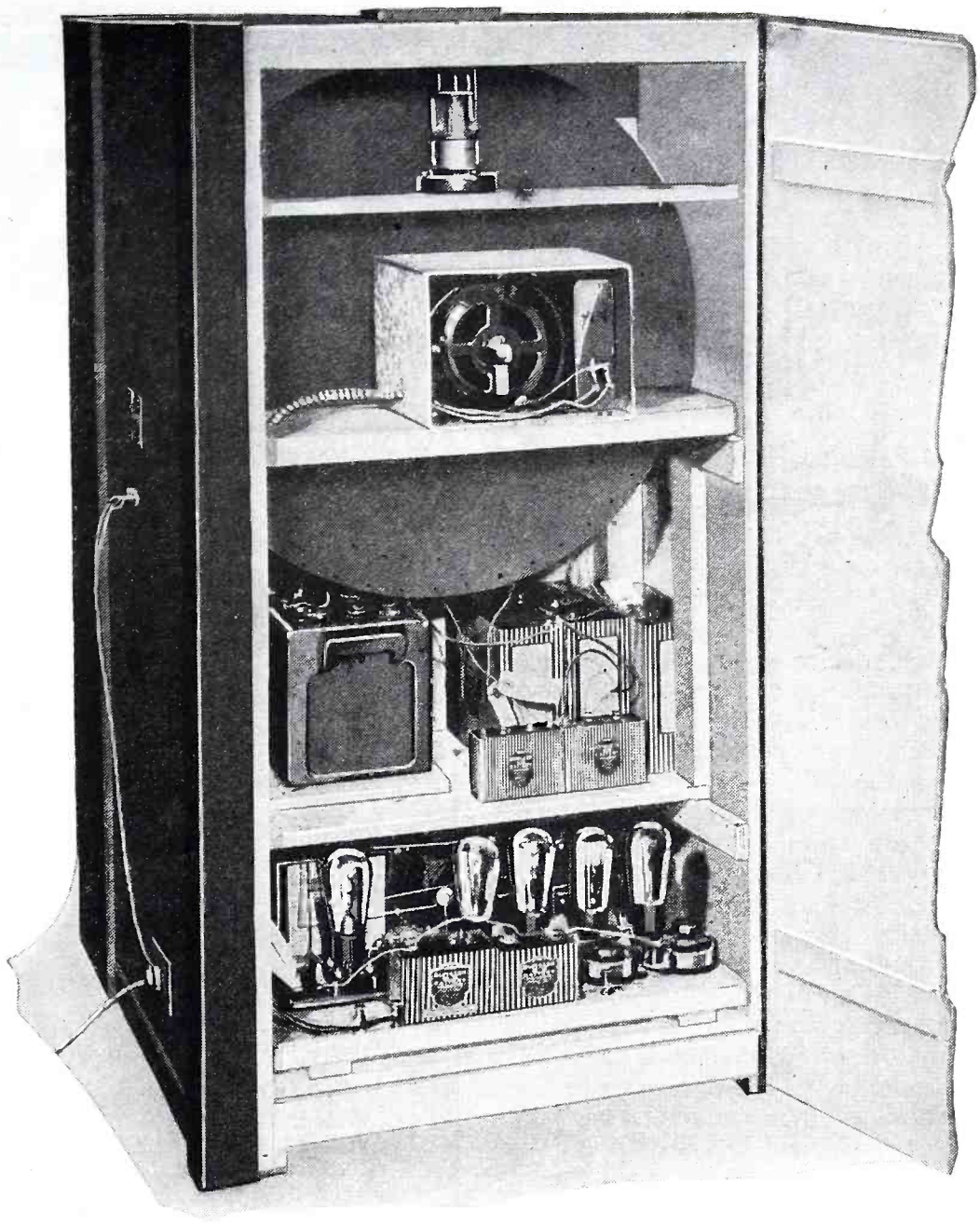
The amplifier in a television outfit is a very important factor. If it distorts the picture currents, the resulting received image will be distorted.



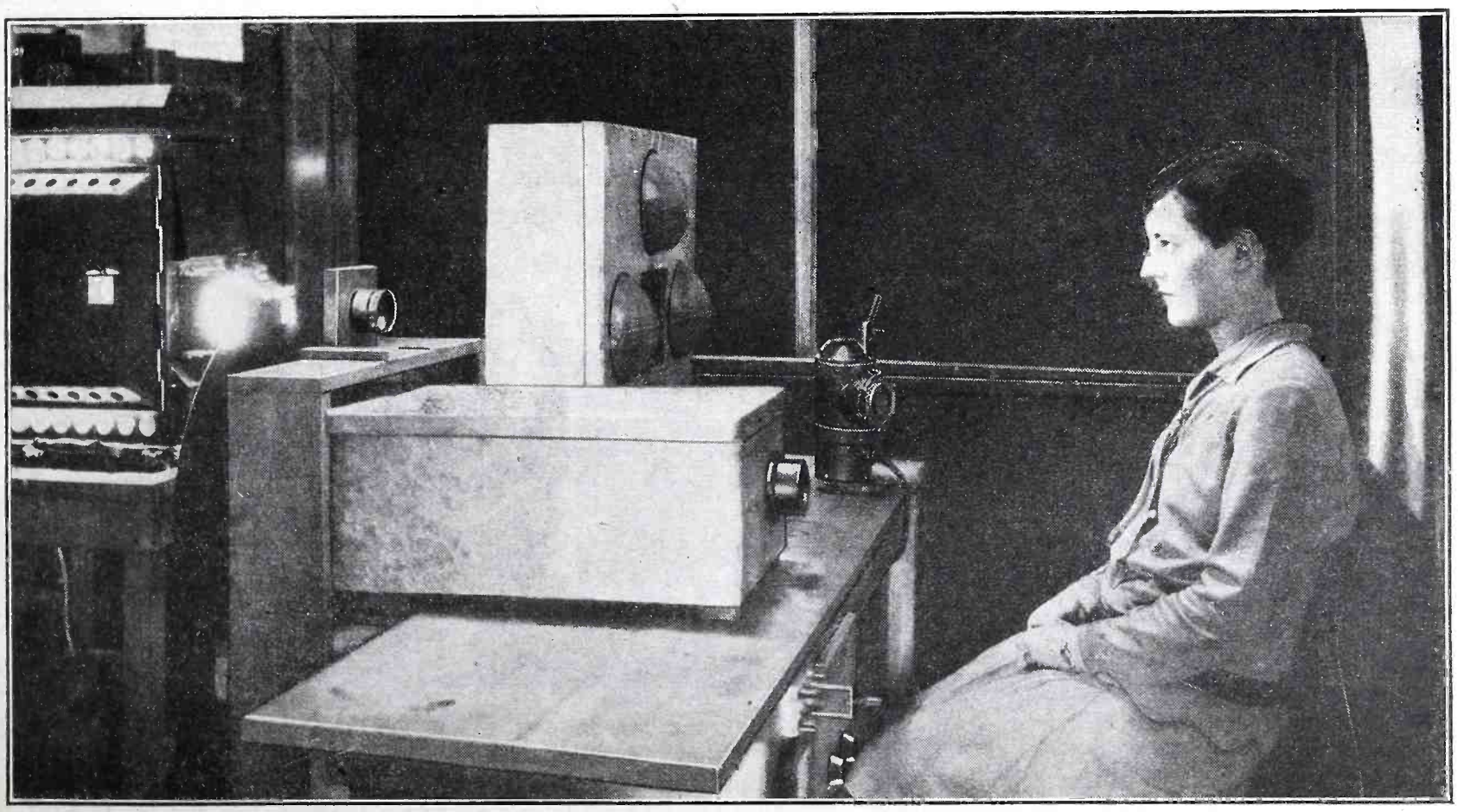
The essential connections for the combination television unit described in this article.

Even an amplifier that seems to give perfect reproduction when amplifying voice currents, will not always be good enough for television work. Therefore, build your amplifier with a generous leeway. Five or six stages of resistance or impedance-coupled amplification will be necessary. Using

(*Continued on page* 151)



A rear view of the television receiver showing the universal motor which drives the scanning disc. Above the motor is the Moore neon lamp. On the lower shelves are batteries and the amplifier and rectifier tubes.



Above shows the relative position of the apparatus used in transmitting by radio. The grouping of the photoelectric cells is shown, three being visible and a fourth behind the amplifier boxes. Note the microphone at the right and the lines of light and shadow on the girl's face.

THE HAGERMAN 210-A-C-SIX

THE desire for something better in radio reception, which is one of the chief incentives for extensive research, has been richly gratified during the last year.

Three far-reaching improvements have been applied to radio reception that will have a very lasting and beneficial effect. These are: the long tone chamber speaker; the super-power amplifier, utilizing the new power tubes of the 210 type; and distinct improvements in mechanical design of all parts used in radio construction. This latter is rather general, but is nevertheless very important and includes features that have been badly needed since the inception of radio.

To detail just what effect these will have on the radio industry as a whole, would be rather complicated. Two things have been definitely accomplished. The radio set has evolved from a mechanical reproducer of sound into a true musical instrument, and the custom-built receiver is now the finest example of radio receiver from every standpoint; mechanically, theoretically, and from a standpoint of dollars and cents value for money invested.

The Hagerman 210-A. C.-Six was created for the express purpose of providing for the custom builder and home builder, a radio receiver that incorporates every desirable new feature and can be built at a cost much less than a manufactured set capable of producing even comparable results.

It was found that to obtain satisfactory results from any radio circuit it was essential that the power supply and speaker be of a type fully adapted to the characteristics of the set. A great percentage of the difficulty experienced by custom and home builders can be directly traced to ineffeciencies in the power or speaker circuits. This does not necessarily mean that they were defective, but that they were not designed to operate the set to which they were attached.

Therefore, a special power supply and speaker circuit were designed for the 210-A. C.-Six. The complete receiver should preferably be employed in conjunction with these for best results. This eliminates the gamble in selecting power supplies and further insures the builder against failure.

LIST OF PARTS

- 4 Benjamin 2¼-in. R. F. transformers, L1, L2, L3, L4.
- 6 Benjamin base mounting sockets, V1, V2, V3, V4, V5, V6.
- 4 Karas .00037 mfd. SLF condensers, type 17, C1, C2, C3, C4.
- 2 Karas audio transformers, type 28, T1, T2.
- 1 Set Karas brackets.
- 1 Jewell 0-8 D. C. voltmeter type 135, M1.
- 1 Jewell 0-100 D. C. voltmeter type 135 M2.
- 3 Carter .5 mfd. by-pass condensers, C10, C11, C12.
- 1 Muter .002 mfd. fixed condenser, C14.
- 1 Muter .00025 mfd. condenser and clips, C13.
- 1 Muter .0005 mfd. fixed condenser, C15.
- 1 Muter 6 ohm rheostat, R4.
- 2 Muter ¼ amp. tubestats, R2,. R3.
- 4 Aluminum Co. of America box shields 5x9x6 inches.
- 1 Celoron 7x24x3/16 inch front panel.
- 1 Celoron 10x23x3/16 inch sub-panel.
- 4 Hammarlund 85 m.h. R. F. chokes, L5, L6, L7, L8.
- 2 Hammarlund midget condensers, C8, C9.
- 3 X-L variodensers, Model N, C5, C6, C7.
- 1 Midget Clarostat, R5.
- 1 Muter 3 megohm grid leak, R1.
- 2 National illuminated vernier dials.
- 1 Belden 7-wire cable.
- 1 Belden indoor or outdoor antenna kit.
- 1 Roll Belden colorubber wire.
- 1 Molded wood tone chamber with Fidelity Speaker Unit.
- 2 Brass ¼ inch shafts 10 inches long.
- 1 X-L binding post.
- 1 Pkg. Kester rosin core solder.

The chassis of the set is a six-tube radio frequency circuit, consisting of three stages of radio frequency amplification, detector, one stage of simple audio amplification and a stage of super-power amplification using the type 210 tube.

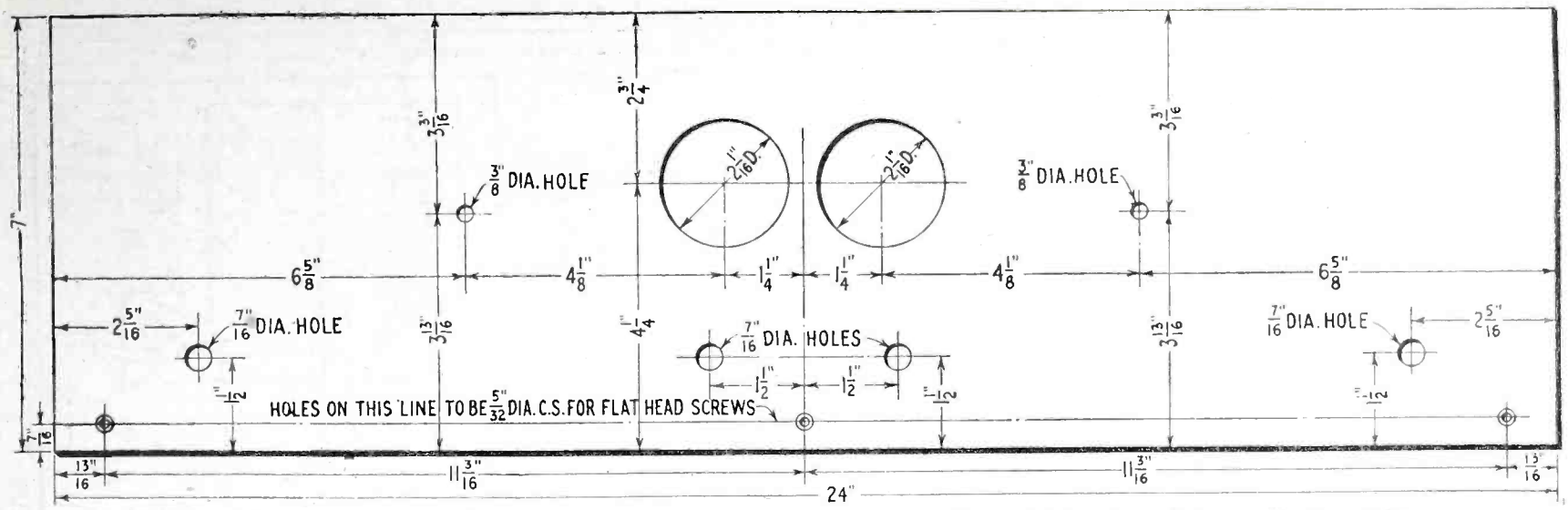
The circuit is not new in principle, but decidedly new in mechanical design and in the control of oscillation. This latter is the greatest problem of the radio set designer. Developing a circuit that is selective and sensitive and still not over critical is simple enough, but to find one that can be built by anyone with limited facilities, and still retain these all essential features is really an accomplishment.

The circuit of the 210-A. C.-Six is shown in the accompanying diagrams. Each individual stage is completely shielded and individually balanced with variable controls. This allows the builder to peak each stage so that it exactly matches the others. The result is a tremendous increase in overall amplification and selectivity. No attempt is made at lining up the dual variable condensers. Trimmers are provided allowing instant hair-line adjustment that is absolutely necessary in the reception of far distant or weak signals. These are critical but positive and need only be made once. They do not enter into the everyday operation of the set.

Attention is called to the audio circuit employed in this set. The 210-power tube is built into the set itself. The "B" power supply is strictly a source of plate voltage. The alternating current filament voltage and direct current grid bias and plate potential are brought to the set through the common power cable. This isolates every circuit in the set from the power supply, reducing the possibility of audio frequency regeneration to a minimum.

There may be some question as to the desirability of the new 250-type tube over the 210. It is not advisable to substitute. The 210 is fully capable of handling the entire output and will give results equally as good as the 250.

Using the 210 tube built into the set necessitated the designing of a power supply of special design. The voltages required are approximately 450 volts on the plate of the 210 tube, 40 volts on the grid, and 7½



Front panel layout for the receiver giving all dimensions for holes to be drilled. The two large holes are for the meters.

volts A. C. on the filament. The power unit for the 210-A. C.-Six supplies these voltages, as well as the intermediate voltages for the set itself.

In it is also incorporated a special condenser-choke output arrangement using a choke capable of handling over 85 milliamperes, and a condenser rated at 600 volts working voltage. This latter is very important. Should this condenser break down, the speaker unit will be burnt out and possible injury result to the set and power supply. There is no danger if the specified condenser is used.

The rectifier tube employed is the 281 type, a very sturdy and reliable tube. Filament voltage is supplied by the Thordarson power pack.

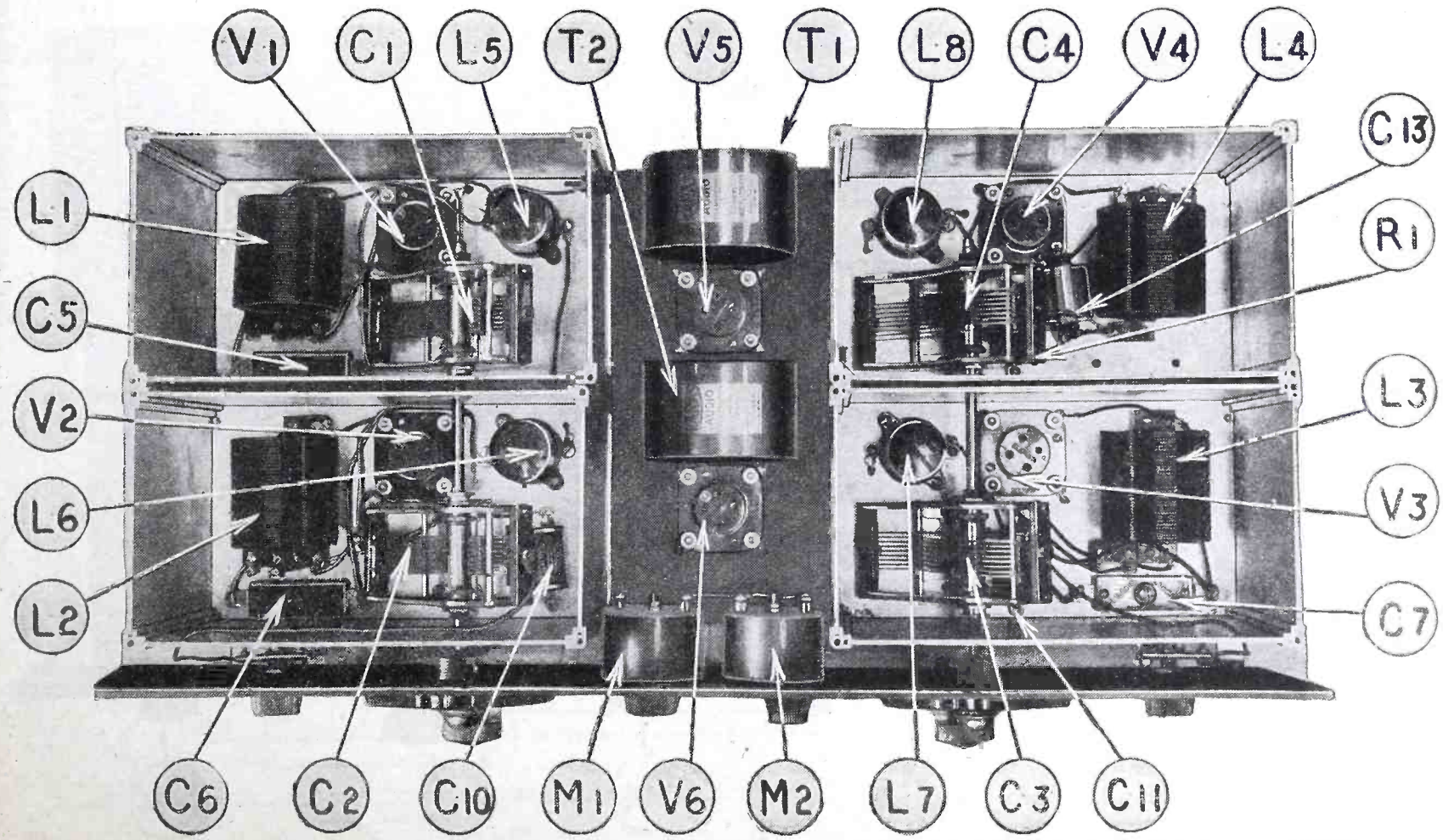
Considerable attention was given the question of the type tubes to be employed. There are three ways of obtaining complete A. C. operation: by the use of A. C. tubes; standard tubes with the filaments in series operated from a rectifier tube with high output; or standard tubes hooked up in the customary manner with filaments in parallel, deriving filament voltages from an A. C. converter.

The latter method was selected as being the most satisfactory from a custom-builder's standpoint. The results obtained with standard tubes are equally as good, if not better than with A. C. types. The original cost is much less, and all possibility of an A. C. hum, which is very objectionable with super-power amplification, is eliminated.

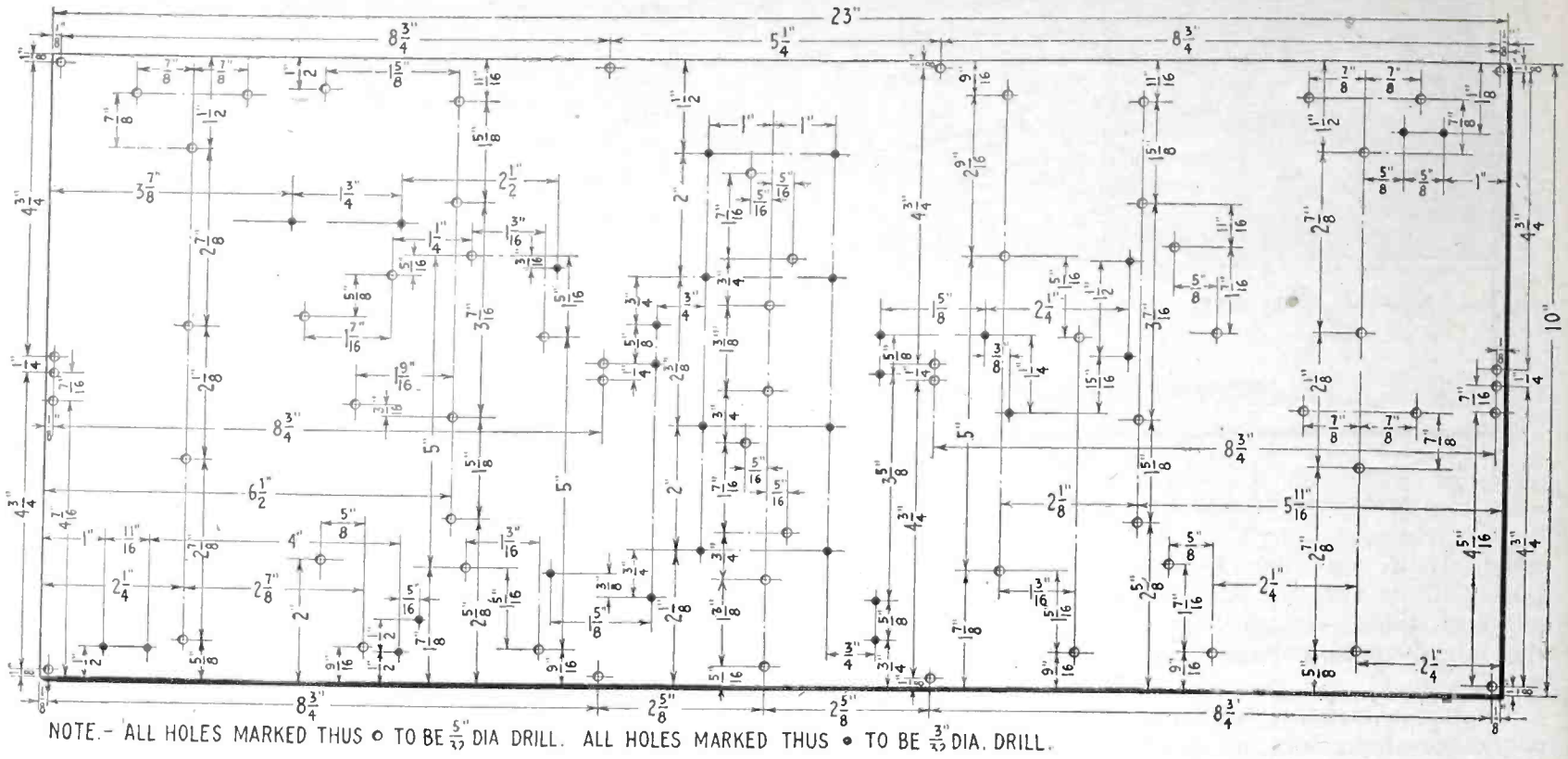
The A. C. converter specified was selected because of its extremely high capacity filter as "A" supply. This unit lights the filaments of the tubes directly from the A. C. line by changing alternating current into pulsating current and smoothing this into pure, hum-free direct current by means of a filter having two condensers with a capacity of over 200,000 microfarads.

The speaker employed is of the new long tone chamber type and is equipped with a special speaker unit which was specially designed to work with it. Many variations and inflections of tone that are inaudible to the human ear are brought out with this combination horn and unit.

The speaker chamber shown in a photo accompanying this article is preferably constructed in a box, ready for mounting in a console or speaker table. This depends on the desire and pocketbook of the constructor and is left to his selection.



A top view of the Hagerman 210-A.C.-Six Receiver showing the arrangement of parts within the four shielded compartments.



Sub-panel drilling layout of the Hagerman receiver described herewith.

The general assembly, wiring, etc., is comparatively simple. There is surprisingly little wiring, and as the circuits in the radio frequency end of the set are almost identical to one another, the set is very easily hooked up.

The chassis assembly is self explanatory from the layout herewith. There are several precautions to be taken. The holes for mounting the Variodensers should be larger in the aluminum shields than in the sub-panel. This is to prevent the mounting screws from shorting the condensers.

Wherever possible, the shields are used as wiring connections to the negative filament circuit. The variable condensers are mounted directly on the aluminum, which automatically connects them to the negative filament. The by-pass condensers are connected in the same way. One end of these is mounted on a short stilt, raising the other end so that it can be wired to the plate circuit.

It should be noted that the power leads are conducted to the set by means of a seven-wire cable that

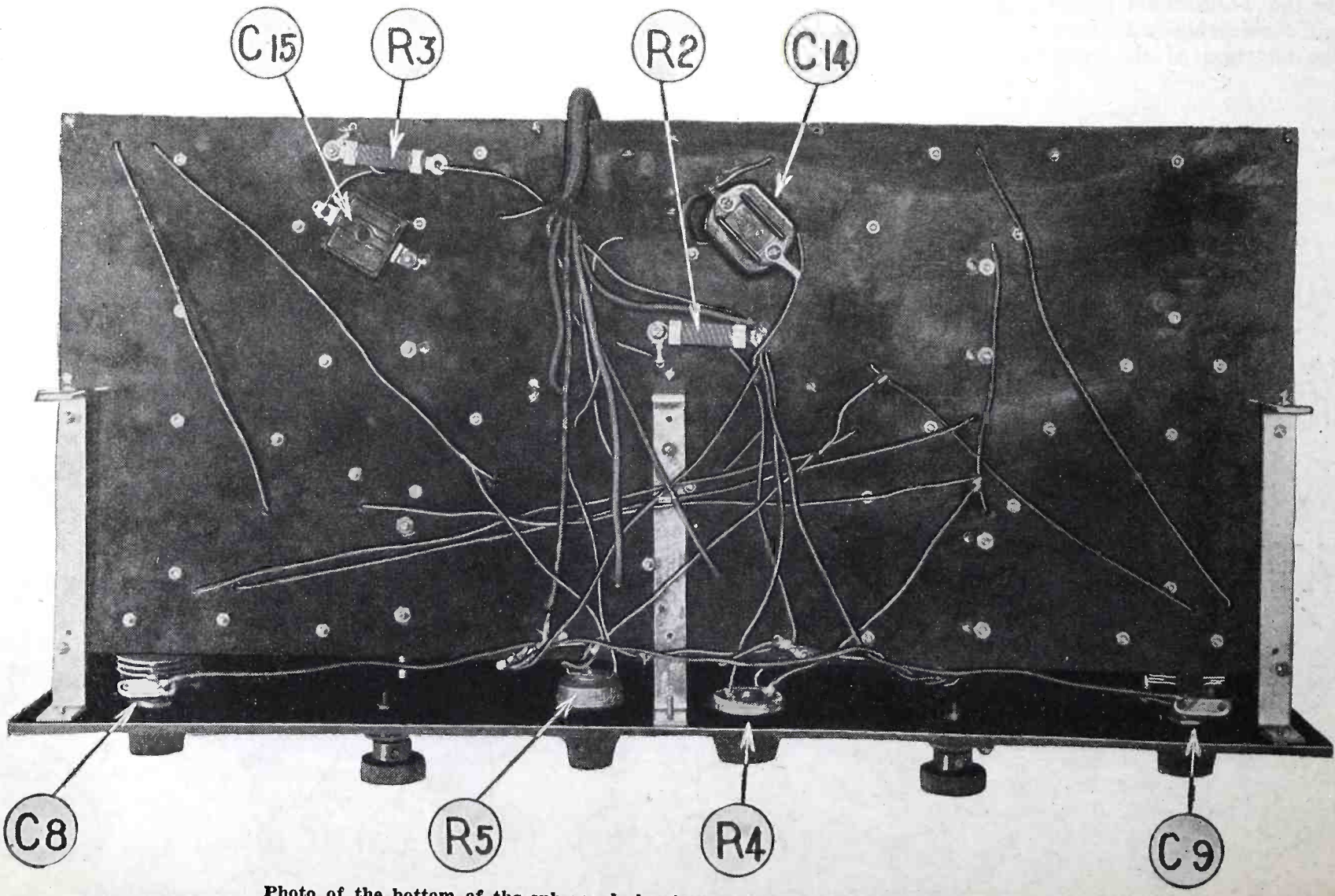
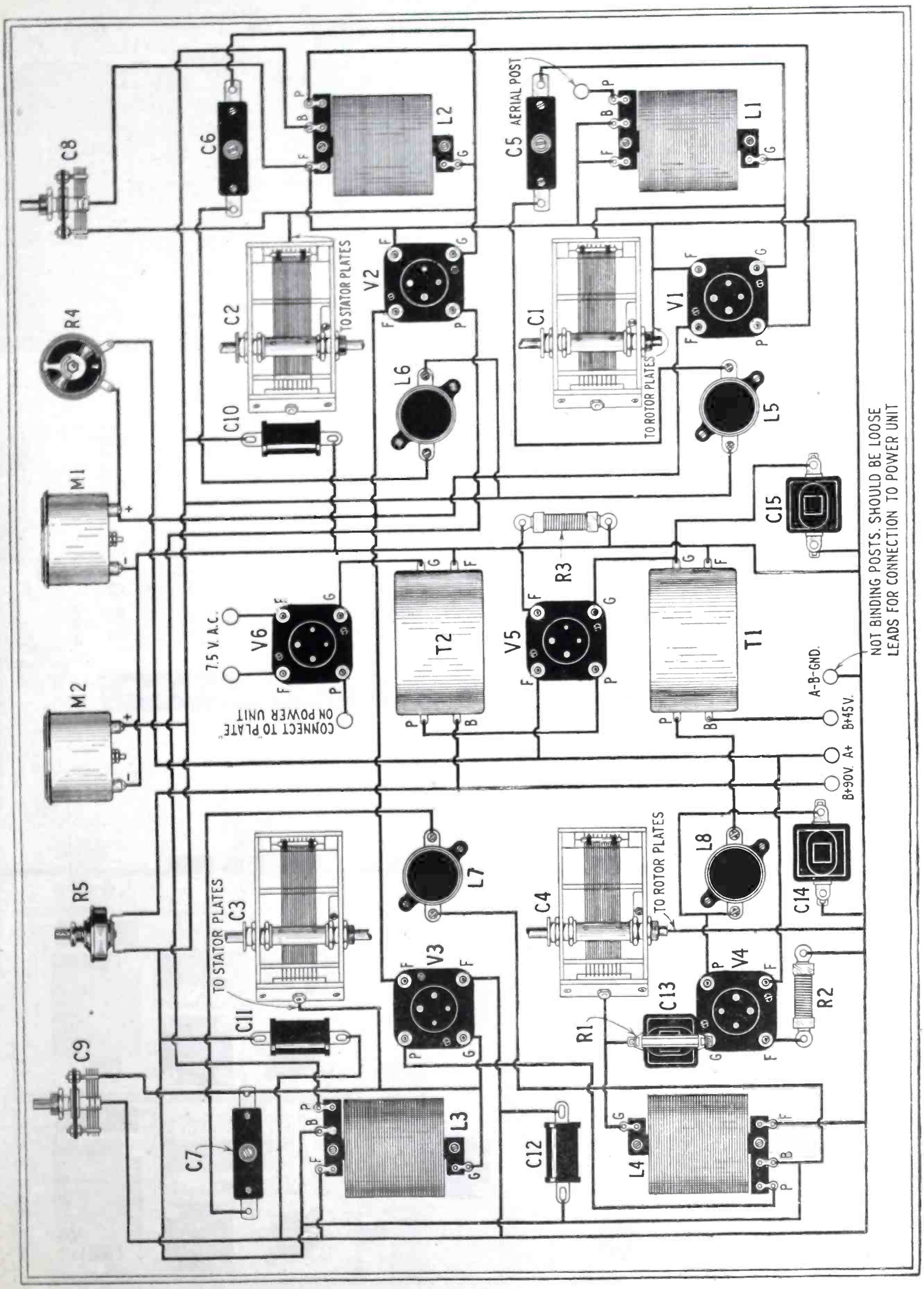
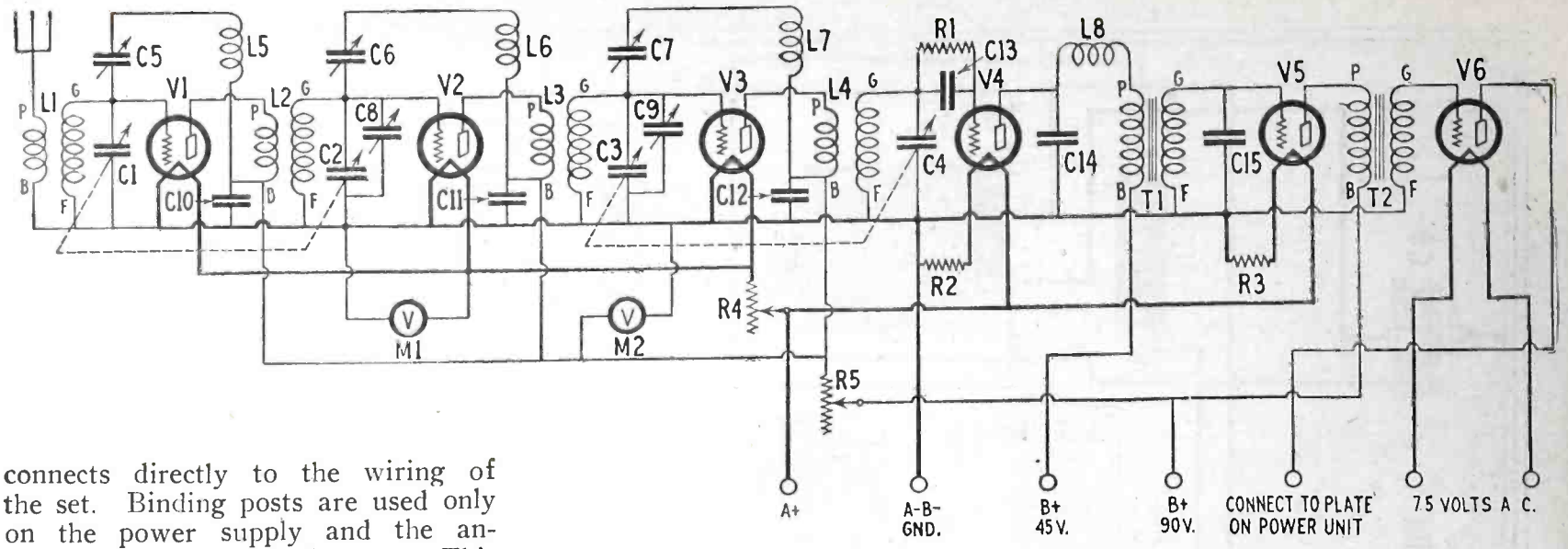


Photo of the bottom of the sub-panel showing condensers, fixed resistors and wiring.





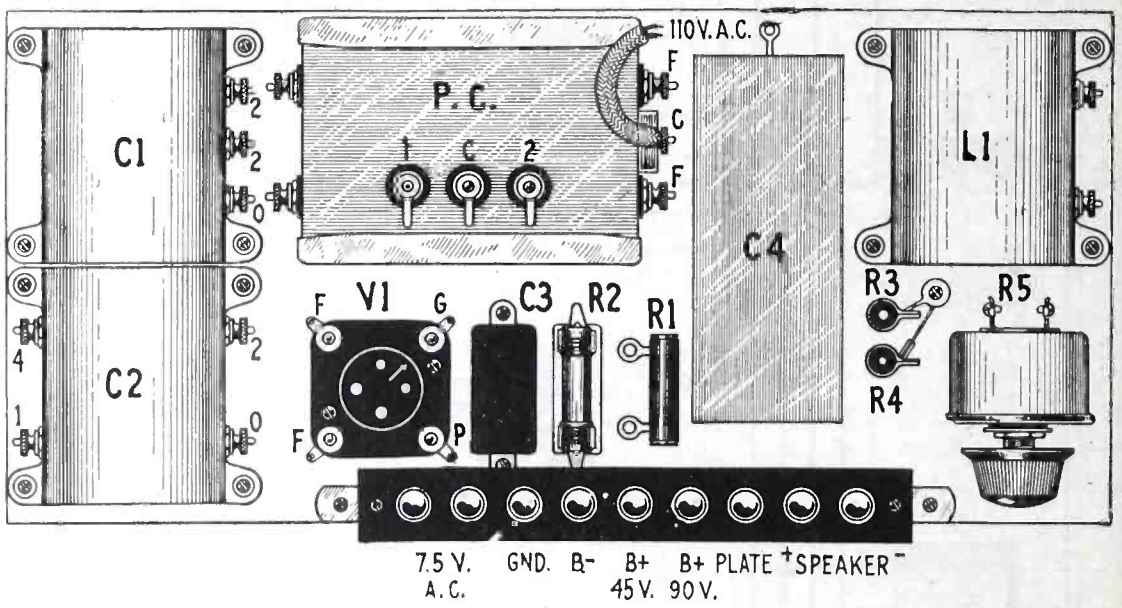
Schematic wiring diagram of the six tube A.C. operated receiver described herewith. Variable condensers C1 and C2 are operated on one shaft and condensers C3 and C4 on another shaft.

connects directly to the wiring of the set. Binding posts are used only on the power supply and the antenna connection to the set. This cable connection simplifies wiring the set to the power unit and prevents to a great extent the possibility of making an error in hooking up.

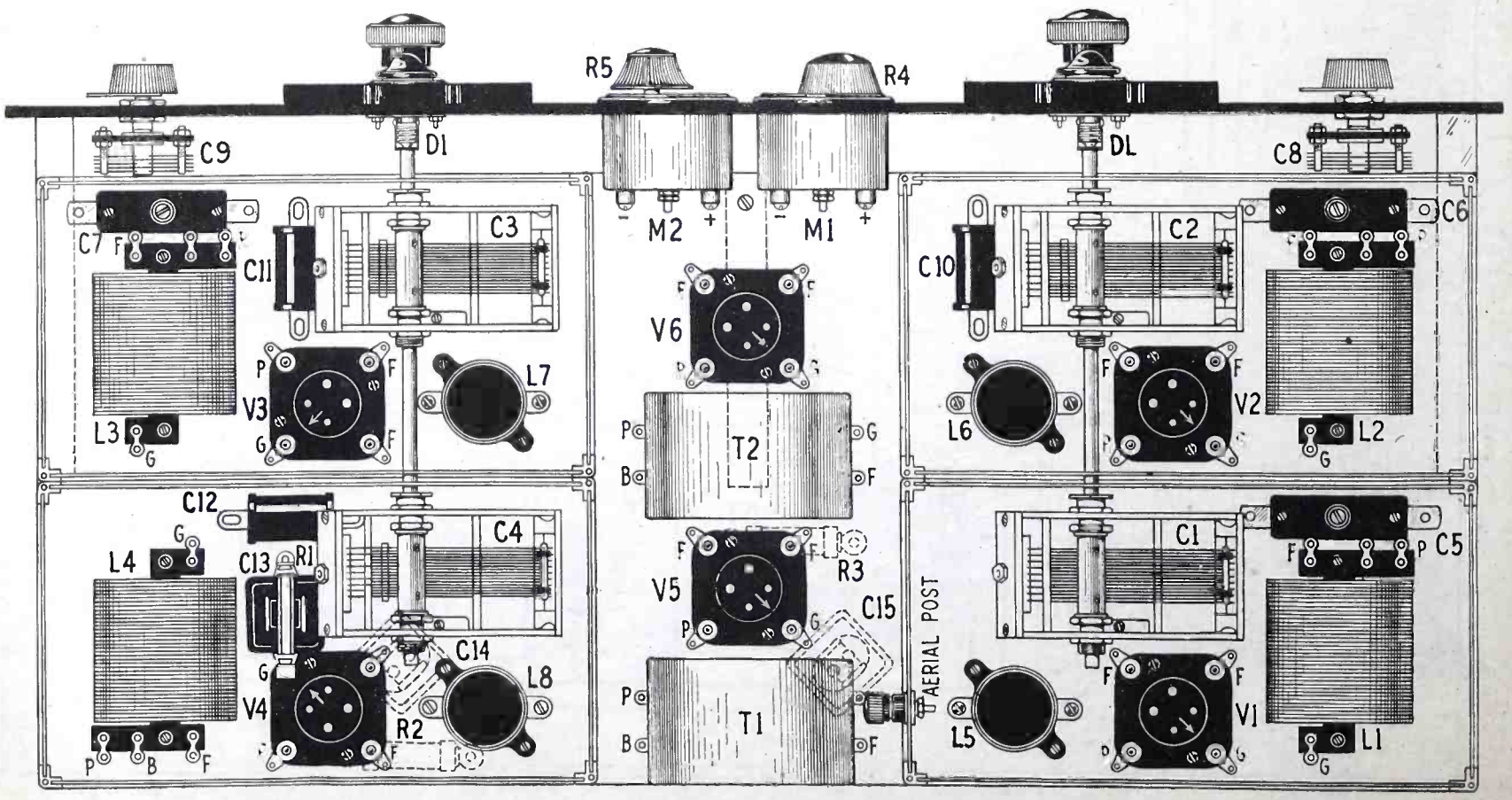
The wiring of the power supply is not like any other power unit. If there are connections that do not seem exactly in accordance with your previous experience, make them as shown. The diagrams explain the circuit.

The Hagerman 210-A. C.-Six operates on either an indoor or outdoor antenna. This should be given every consideration. For an indoor antenna, a length of wire fifty to seventy-five feet in length around the molding or rug is sufficient. The outdoor antenna, which is much to be desired, should be from thirty-five to fifty feet in length in congested localities, and longer where there are few nearby stations.

Putting the set into operation merely consists of connecting the



Layout of parts for the power unit employed in conjunction with the Hagerman 210-A.C. Six Receiver. Parts are indicated in symbols to correspond with diagrams.



Instrument layout of the receiver indicating the exact location of all components. Parts mounted beneath the sub-panel are shown in dotted lines.

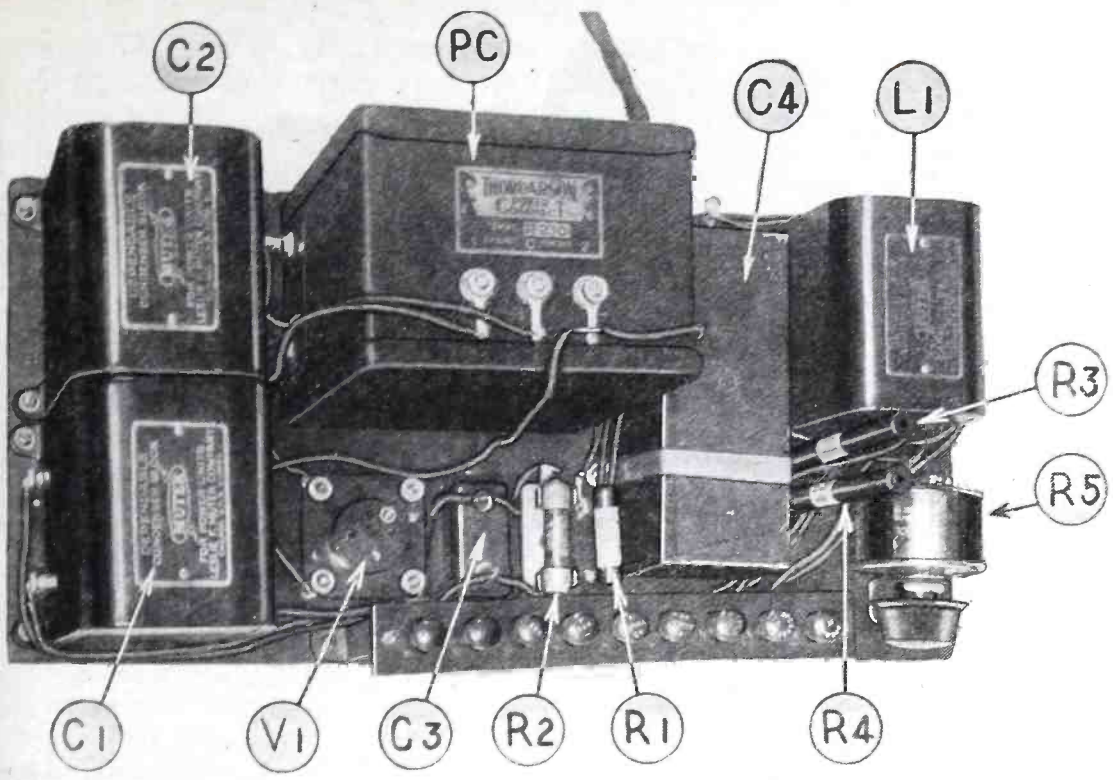


Photo of the power unit. All parts are indicated to correspond with wiring diagrams.

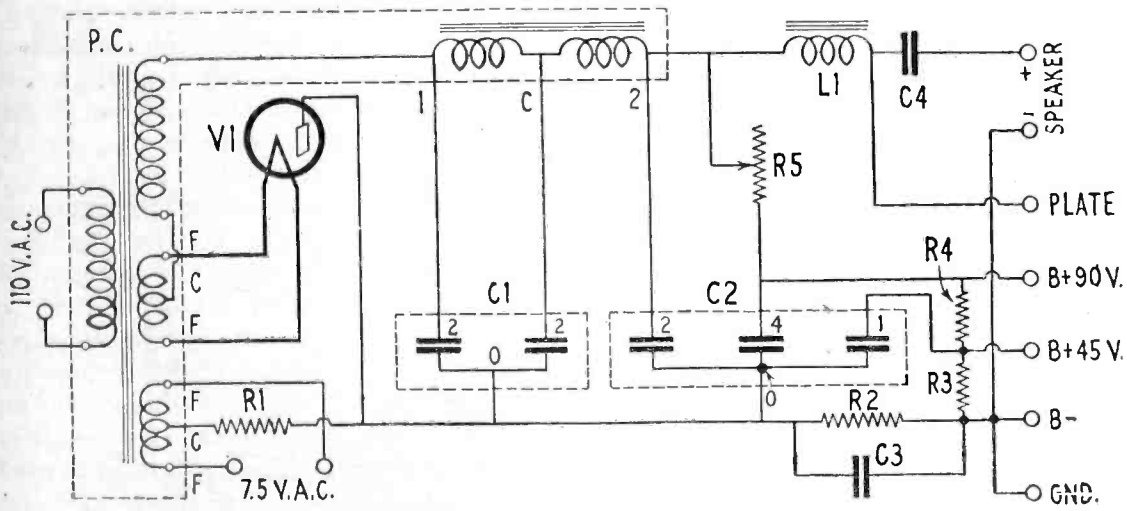
cable to the power supply, attaching the loud speaker, inserting the tubes and plugging into the light socket. Be sure that the power Clarostat in the power supply is screwed all the way out.

When the set is turned on, the meters on the panels should show a deflection. Adjust the rheostat so that the 0-8 voltmeter reads about 4 volts and screw the knob of the power supply Clarostat in until the reading with the volume control all the way in is about 100 volts. Then decrease it with the volume control to about 50 volts.

Turning the dials should now bring in a station. Adjust the trimmer and the volume controls for best results. Do not use the rheostat or filament control constantly. The ideal setting for this will vary for different tubes, but once determined, should be fairly constant.

If the set has good volume, tunes fairly sharp and shows the customary response to superficial tuning, with a long screw driver or, better yet, a pointed stick, screw the Variodensers all the way down.

Now, using the trimmers carefully, tune in a distant station. Adjust the Variodensers in the first stage so as to bring in the station with the greatest volume, and so on through the entire group. Do this with several stations and the best adjustments will be found.



Schematic wiring diagram of the power unit.

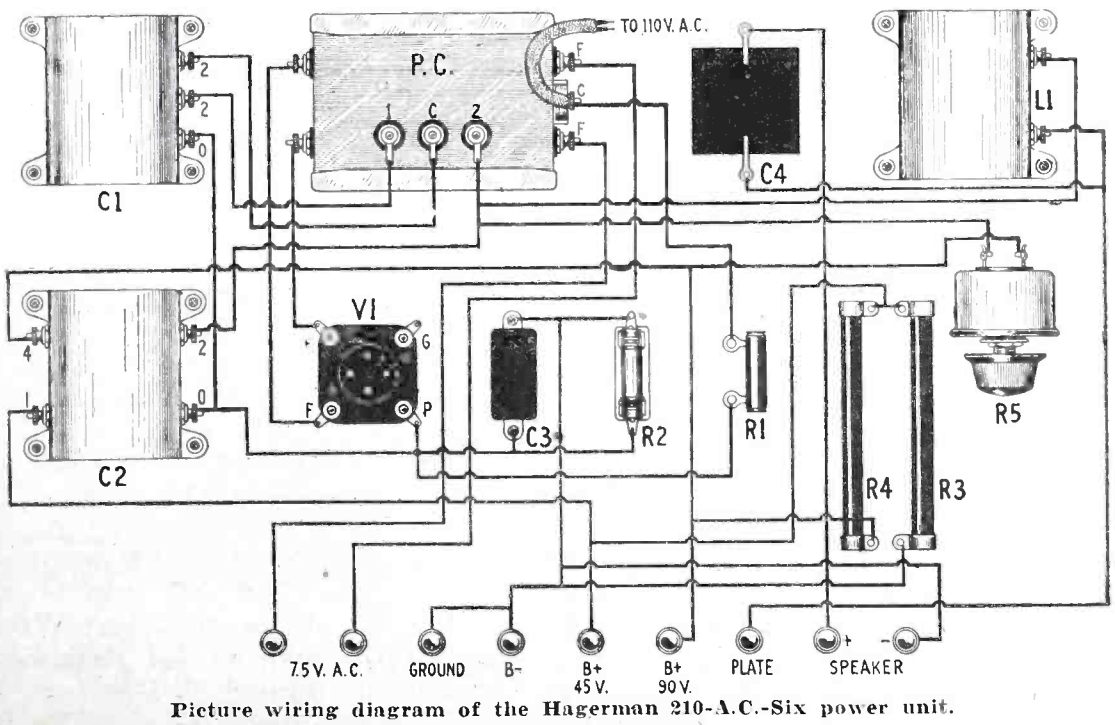
The 0-100 voltmeter can be used as a very valuable adjunct to tuning. The setting of the volume control can be recorded as well as the dial setting, by jotting down the voltage reading at which the set was most sensitive to receive a certain station on a certain frequency. This is very valuable in logging new stations that you had before, because you know not only the dial readings on which they should be received, but also the proper voltage setting of the volume control.

It might be noted that this voltmeter is a standard type; not a high-resistance meter, even though it is used to measure the output of a "B" supply. Being constantly in the circuit, the small amount of energy it consumes is of no consequence to the "B" supply, which has an output quite in excess of that required, and the small drain means a drop of but about 2 per cent of the total output.

(*Continued on page* 143)

PARTS FOR POWER SUPPLY

- 2 Muter power condenser blocks No. 598, C1, C2.
- 2 Muter 10,000 ohm resistors No. 2910, R3, R4.
- 1 Muter 1000 ohm resistor No. 2901, R1.
- 1 Muter audio power choke No. 3130, L1.
- 1 Muter 2 mfd. power condenser 600 volt, C4.
- 1 Benjamin base mounting socket, V1.
- 1 Thordarson power compact, type R210, PC.
- 1 Heavy duty high range Clarostat, R5.
- 9 X-L binding posts.
- 1 Amsco 100 ohm resistor and mounting, R2.
- 1 Muter ½ mfd. condenser No. 507, C3.
- 1 Abox 6 volt A unit.
- 1 Celoron strip 1x9x¾ inches.



Picture wiring diagram of the Hagerman 210-A.C.-Six power unit.

The Four-Tube Roberts A-C Receiver

THE Four-Tube Roberts A. C. Receiver was designed for that large class of people who do not care to spend more than a hundred dollars for a complete "all-electric" installation. It was designed to permit easy assembly for both the novice and the custom set builder. The simplicity of its layout and the inclusion of everything necessary for operation in one unit, is bound to appeal to those who do not care to be troubled by such annoyances as recharging "A" batteries, replacing "B" and "C" batteries or the knowledge required to connect innumerable wires from a receiver to the proper terminals of batteries or "A" and "B" eliminators.

All that is necessary to put the Four-Tube Roberts A. C. set in operation is to insert the plug of the unit into an electric light socket, connect up antenna, ground and speaker and tune the set.

In spite of the fact that both receiver and power pack are included in a single unit, careful design and placement of parts have made possible a compact unit with a panel size of 7 inches by 21 inches with a depth of 12 inches. This size will fit into most of the standard table cabinets or consoles and is easily adaptable for mounting in desks, secretaries, bookcases and other odd pieces of furniture.

Although the list price of the parts for making the combined receiver and power pack has been kept under $100.00, no attempt was made to skimp on the quality of parts employed. A glance at the list of parts will attest to the high quality of the parts selected.

Economy, both in first cost and in operating expense was achieved through the design of a really efficient circuit and by trimming off all non-essentials.

It is impossible, of course, to make any guarantees regarding the receiving range or operating efficiency of a receiver under unknown conditions, but a brief statement of the performance of this receiver in New York City, a test location which is as trying to the best radio receivers as Pike's Peak is to the best automobiles, should prove interesting.

In a test during the early evening between eight and ten o'clock when the local stations were on full blast, KDKA, Pittsbugh on 315 meters was brought in through the local stations WABC on 309 meters and WRNY on 325 meters. Soon after, WSM, Nashville, Tenn., on 337 meters was brought in through stations WRNY on 325 meters and WGBS on 348 meters. Next WSAI, Cincinnati, Ohio, on 361 meters was brought in through WGBS on 348 meters and WMCA on 370 meters. Finally WGY, Schenectady, N. Y., on 379 meters and station WBBM, Chicago, Ill., on 389 meters were brought in through WMCA on 370 meters and WPAP on 394 meters.

LIST OF PARTS

2 Hammarlund .0005 mfd. Midline condensers, .0005 mfd., C1, C2.
1 Aerovox .00025 mfd. molded condenser with grid leak clips.
1 Aerovox .001 mfd. molded condenser, C4.
2 Acme Parvolt 1 mfd. condenser, series A, C5, C6.
1 Acme Parvolt, No. R-171 condenser block, CB.
1 Electrad type F, Royalty variable resistance, 0-2,000 ohms, R1.
1 Durham metalized grid leak, 2 megohms, R2.
1 Electrad type B-1, Truvolt fixed resistance, 100 ohms, R3.
1 Electrad type C-130-S Truvolt tapped resistor, R4.
1 Set of Hammarlund HR-23 coils, T1, T2.
2 Thordarson R-200 audio frequency transformers, T3, T4.
1 Thordarson R-76 output transformer, T5.
1 Thordarson type T-2504 transformer, T6.
1 Thordarson type R-171 power compact, T7.
3 Amperites, No. 227, or Elkay Equalizers for A.C. tubes.
3 Eby 5-prong sockets, VT1, VT2, VT3.
2 Eby standard 4-prong sockets, VT4, RT.
1 Hammarlund illuminated drum dial, model DD-2.
1 Formica or Micarta panel 7x21x 3/16".
4 X-L binding posts for Ant., Ground, and Loud Speaker.
1 Pkg. Acme Celatsite wire.
1 Pkg. Kester rosin core solder.

The remarkable part of the whole performance was the fact that these distant stations came pounding in so strongly that it was necessary to turn down the volume control. Such performance might well be the envy of many six- and seven-tube sets under the same difficult conditions of reception as are found in the New York City locality in which the Four-Tube Roberts A. C. Receiver was tested.

A casual study of the circuit will reveal the reasons for its really remarkable performance. A very efficient non-radiating and non-interfering circuit is employed, making possible the utilization of the tremendous sensitivity of the regenerative circuit without any interference to neighboring receivers. The circuit is a modification of the old tried and true Roberts Circuit consisting of a stage of tuned radio frequency amplification, a regenerative detector and two stages of transformer-coupled audio frequency amplification.

To simplify the transformer requirements and the wiring, A. C. heater type tubes such as the UY-227 and C-327 tubes are used in all except the last audio stage. This arrangement eliminates the necessity for a large and comparatively expensive heater transformer. In its place a standard power transformer designed to supply a secondary voltage of 3 volts is employed. A 100-ohm fixed resistor is connected in the primary circuit of this transformer to cut down the seconday voltage to the proper value.

A variable resistance, having a resistance range of from 0 to 2,000 ohms, connected across the primary

winding of the R. F. transformer serves the double purpose of a very efficient volume and oscillation control.

One of the most common sources of trouble when using A. C. tubes is that resulting from the application of excessive voltages to the filaments of the tubes. Such overloading of the filaments usually results in shortening the life of the tubes and impaired reception during the time that the tubes are used.

In the Four-Tube Roberts A. C. set special automatic filament controls are used in the filament circuit of each A. C. tube to prevent any possiblity of harm to the tubes when the line voltage becomes excessive. This means of regulating the filament voltage applied to the tubes increases the useful life of the tubes and the overall efficiency of the receiver.

Two stages of high grade transformer-coupled audio frequency amplification, complete the circuit itself. An output transformer is used to keep the heavy direct current in the plate circuit of the last tube out of the loud speaker. This serves both to improve tone quality and prevent damage to the loud speaker windings.

The plate current supply for the unit is obtained very efficiently without taking up undue space, by using the power compact and condenser specified in the accompanying list of parts. The power compact contains, in a single unit, the power transformer winding which supplies the high voltage to the rectifier electrodes and the 5-volt winding required for the filament of the UX-171A or CX-371A tube of the last audio stage. It also includes the two choke coils necessary for the filter system and the two buffer condensers which are required across each half of the high voltage winding.

The condenser block includes the three filter condensers required for the filter system and two additional 1-mfd. by-pass condensers for use across the resistances of the voltage divider system.

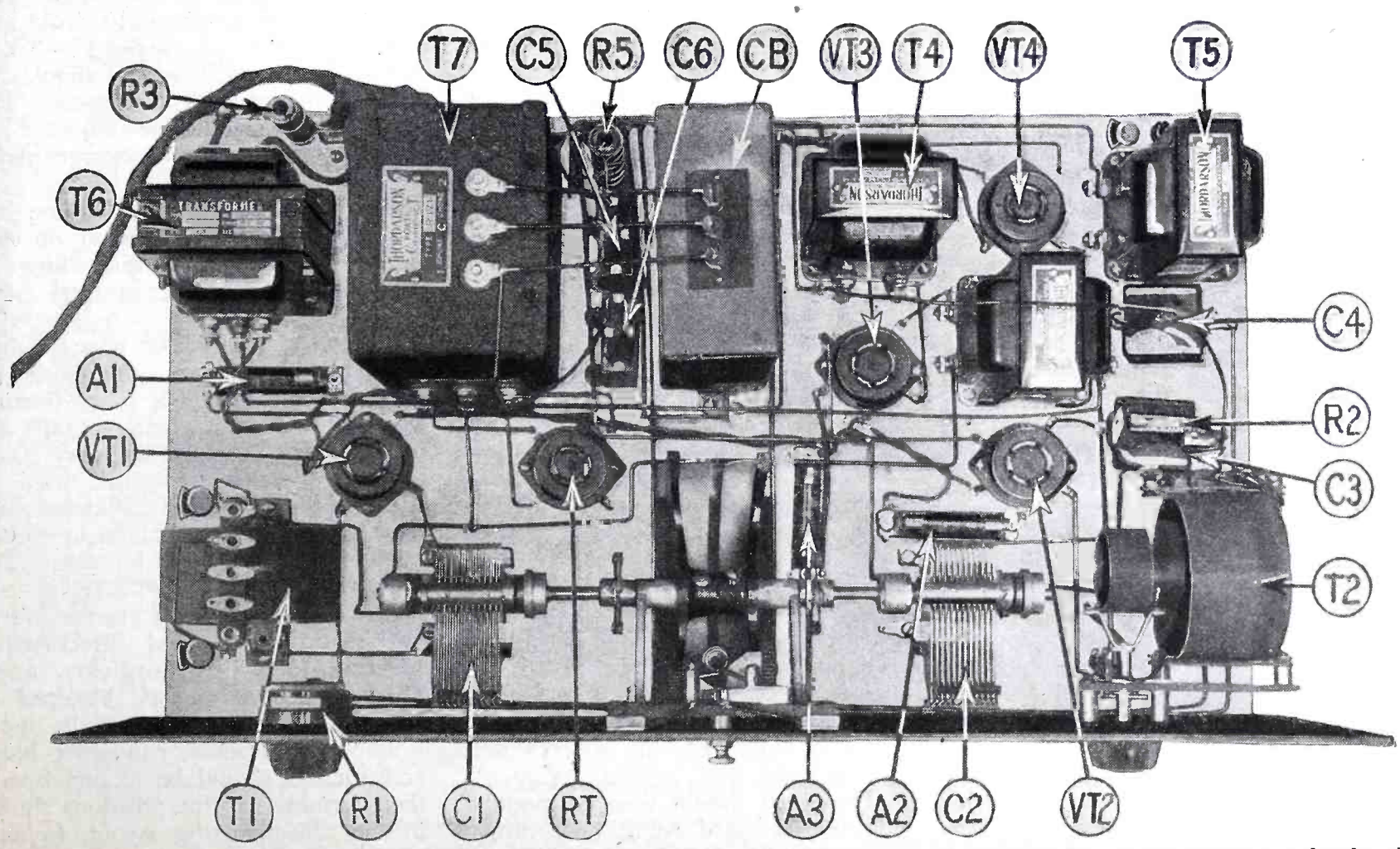
Simplified operation has been attained by using only two tuning controls which are centralized so that both controls may be operated together as a single control. The knob at the left of the panel is used simply to adjust the volume to the amount desired while the knob at the right is used to set the regeneration control at the required position for maximum sensitivity and selectivity.

To avoid any possibility of confusion regarding the proper terminals to be connected together, each instrument has been assigned a distinctive symbol such as C1, T1, etc., and the same symbol has been used to designate the corresponding parts on both the schematic and the pictorial wiring diagrams. In addition, where there would be any likelihood of confusion between the terminals on any particular part, the letters or numbers stamped on those terminals ae shown on both wiring diagrams. Where no numbers or letters are given on the parts themselves, numbers or letters have been assigned to those terminals on the drawings so that corresponding terminals on both diagrams and photos may be located without trouble.

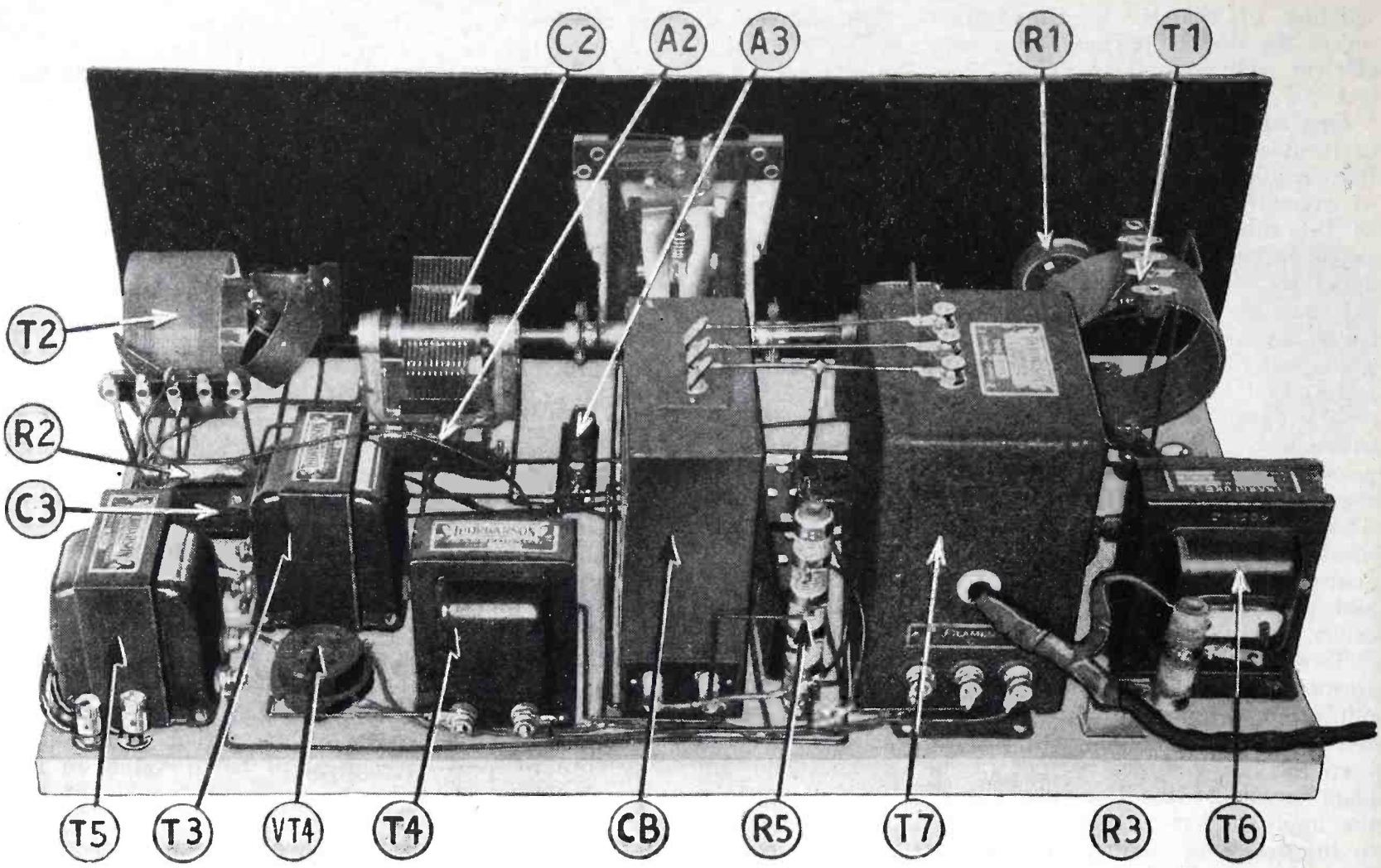
The exact relative location of the parts on the panel and baseboard are shown in the rear view photograph of the receiver. While the pictorial wiring diagram shows the relative location of the parts, it was necessary for the sake of clearness and to avoid confusion where lack of space would otherwise have necessitated crowding of the wiring, to show the spaces between the parts out of true proportion to permit the wiring to show clearly.

The first step, after gathering all the parts together is to mount them on the panel and baseboard. The mounting of the parts is a comparatively simple matter but a few suggestions gathered from the experience of the author in building the receiver will be of value, in lessening the time and trouble of assembling the receiver.

Much trouble and annoyance will be spared if the proper number of screws necessary to mount the parts are obtained when purchasing the rest of the material. The screws required for mounting the transformers, sockets and fixed condenses to the baseboard should be ¾"—No. 6 round head wood screws. In all, 36 of these screws will be required.



How the set appears looking down on the baseboard from top. Note that complete parts for the "B" supply are also mounted on baseboard.



A rear view of the set showing the "B" supply condenser block, CB, power compact, T7, filament transformer, T6 and resistors, R3, R5, as well as other parts of the set.

To fasten the variable condensers and the antenna coupler to the baseboard, four 1"—No. 6 round head wood screws should be provided. Four, 1"—No. 6 flat head wood screws will be necessary to fasten the front panel to the baseboard.

If the ready-drilled panel is used, no trouble at all will be experienced in mounting the double drum dial, the R. F. transformer, T2, and the variable resistance R1.

If a plain panel is employed, the first step will be to drill the panel for the dial, R. F. transformer and the volume control mounting holes and provide also, four holes at the bottom of the panel for use in fastening the panel to the baseboard.

In drilling the panel, use the template provided with the drum dial to lay out the dial cut out and necessary mounting holes. The holes for the dial, the R. F. transformer T2, the volume control R1 and the holes for use in mounting the panel on the baseboard should be laid out to correspond with the measurements given on the panel drilling template given herewith.

A baseboard 20 inches long and 11½ inches deep is required in building the receiver. A well-seasoned board, not more than three-quarters of an inch thick, should be used for this purpose. A board exactly three-quarters of an inch thick will bring the shafts of the variable condensers to the proper height to fit the drum dial bushings. If a thinner board is used the top surface of the board should be brought to a distance of three-quarters of an inch from the bottom edge of the panel before fastening the panel to the baseboard.

This can be done by building up the thickness of the board by gluing cardboard of the required thickness to the bottom of the baseboard or by using a wood screw at each corner of the bottom side of the baseboard with the head allowed to project just far enough to bring the height of the top surface of the baseboard to three-quarters of an inch.

No matter what method is used, it is important that the distance from the surface on which the condensers are mounted and the axis of the drum dial bushings be kept to exactly 2-1/16 inches to prevent any strain on the dial or the condensers.

A notch 2⅛ inches wide and 4 inches deep should be cut in the front edge of the baseboard to allow clearance for the drums of the dial.

The next step is to mount the dial in accordance with the instructions furnished with it, being careful to use the two spacers provided if the dial is to be used with a one-eighth inch panel. If a three-sixteenths inch panel is employed, the spacers need not be used.

The panel should then be mounted on the baseboard being very careful that the distance between the top surface of the baseboard and the axis of the drum dial bushings is exactly 2-1/16 inches before fastening the panel and sub-panel together.

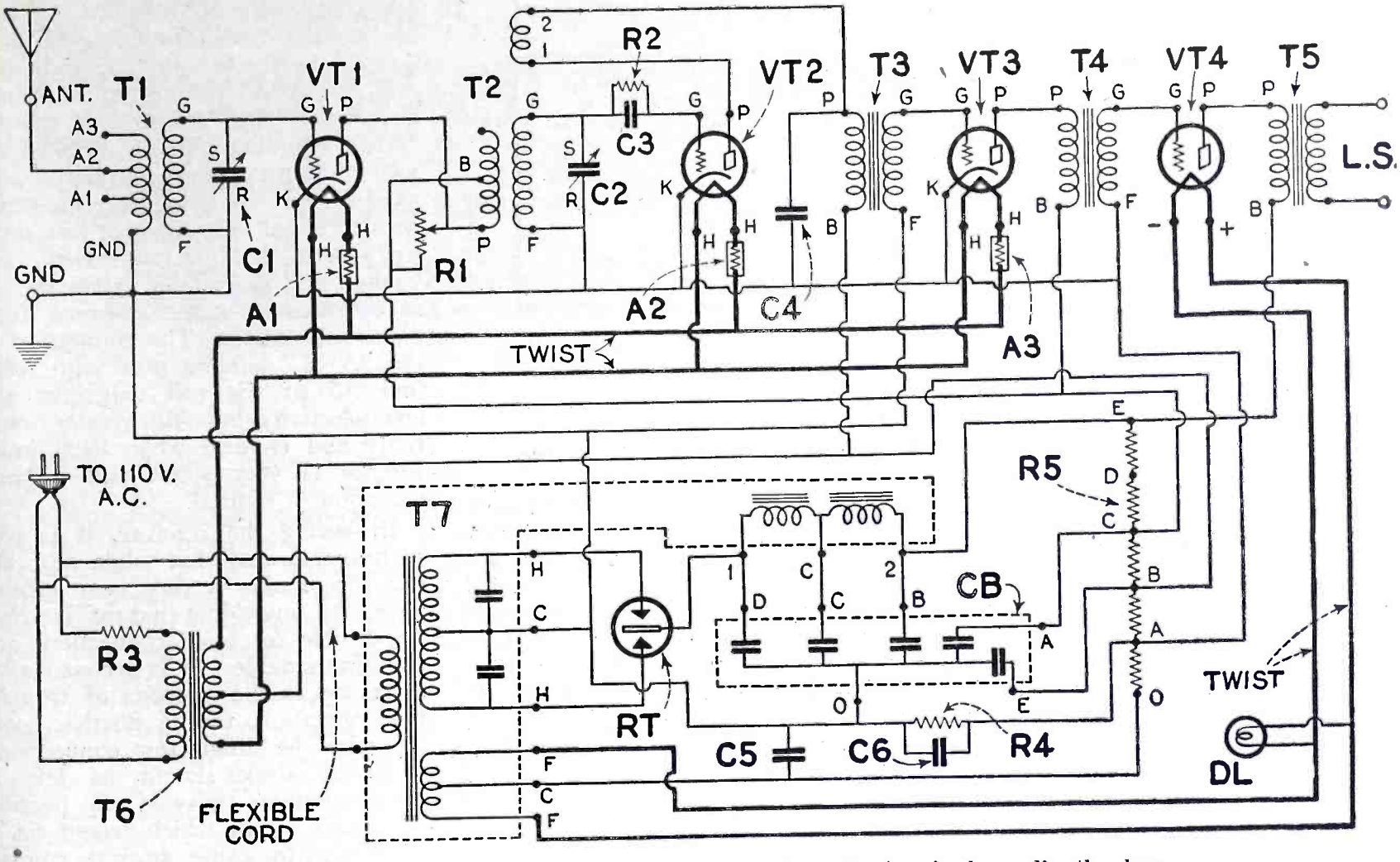
Care should be used in mounting the condensers to make sure that their shafts are in alignment with the dial couplings so as to avoid any possible strain. A single, 1"—No. 6 round head wood screw should be used to mount each condenser. The dial drums should be adjusted to read 100 when the condenser plates are all in mesh.

The two by-pass condensers, C5 and C6 should be mounted on end by bending the mounting lugs at right angles to their original positions.

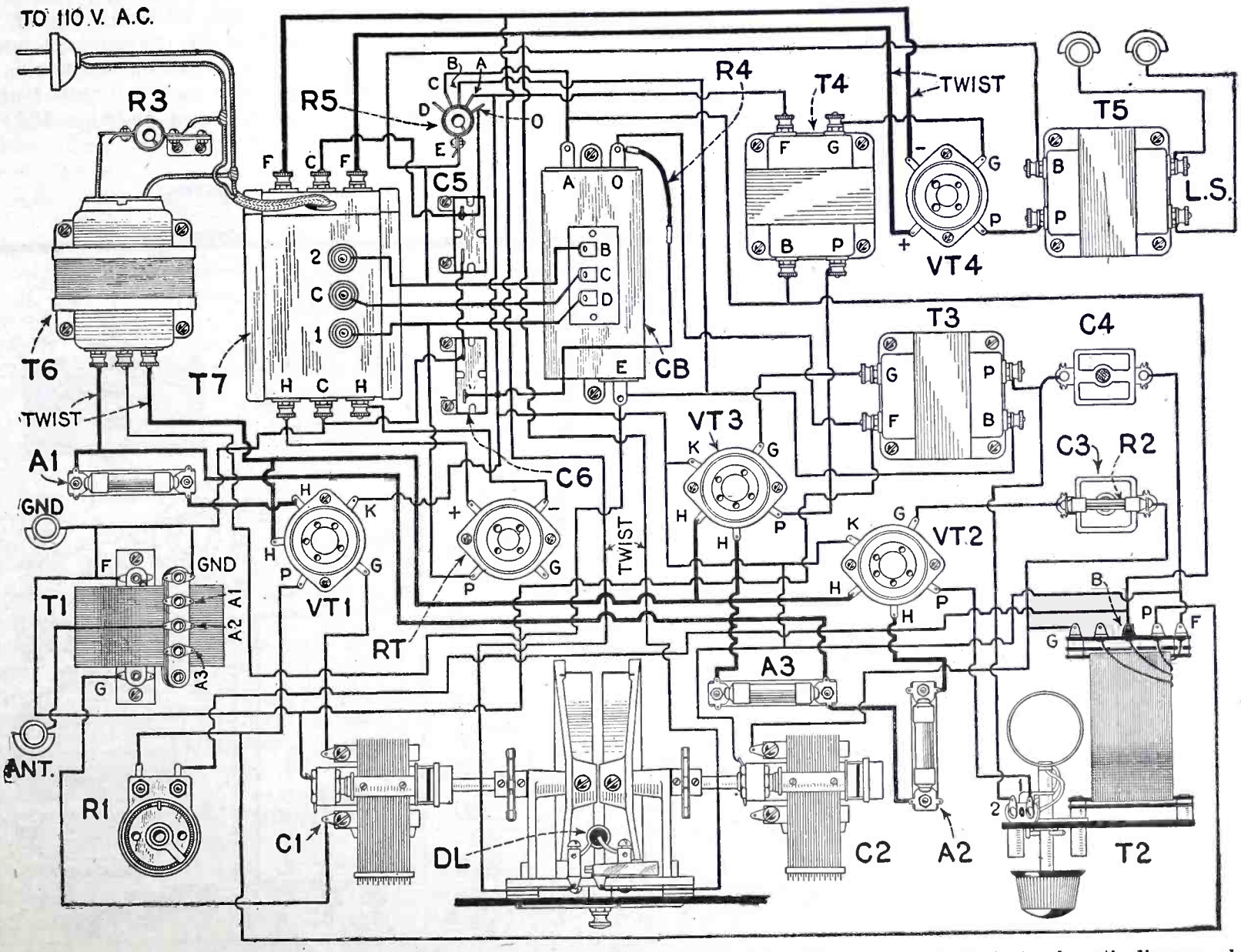
The tapped resistance unit R5 may be mounted on end. It makes no difference which end is down because the resistance units between taps are of the same values either way.

The resistance unit R3, used in the primary lead of the filament supply transformer is mounted by means of a small mounting bracket. The required mounting bracket is not generally available at radio stores but may be obtained direct from Electrad, Inc. An ordinary angle bracket such as can be obtained at most hardware stores may be used.

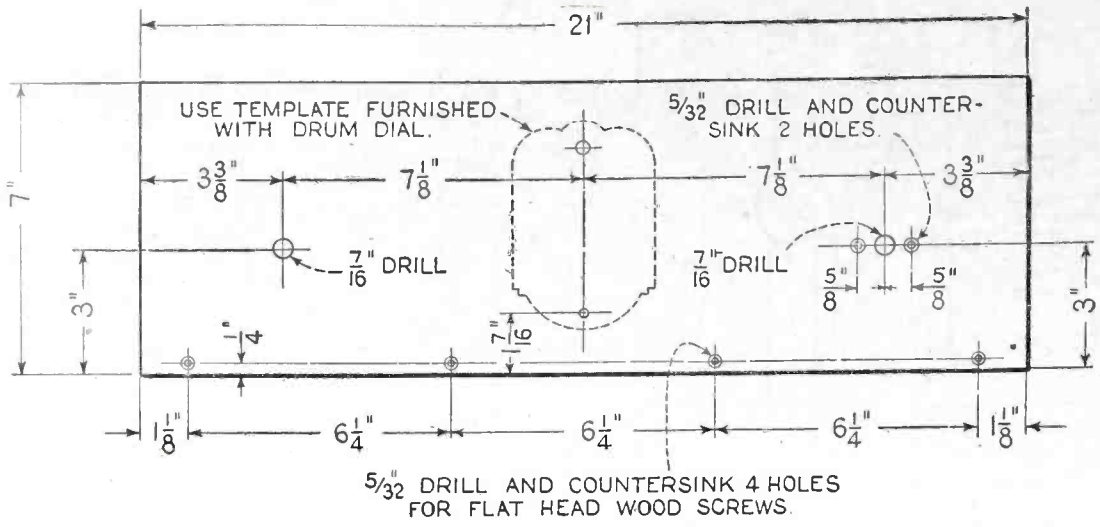
The transformers, condenser block and sockets should be mounted with their terminals in the positions shown in the accompanying layout, to simplify connections.



Schematic wiring diagram of the Four-Tube Roberts A. C. Receiver is shown directly above.



Picture wiring diagram for the Roberts A. C. set. All parts are indicated to correspond with references in the text, schematic diagram, photos, instrument layout and list of parts.



Dimensions for drilling the front panel of the Four-Tube Roberts A. C. Receiver.

Practically all of the wiring is so self-evident from the schematic wiring diagram, and the pictorial wiring diagram, that detailed instructions or step-by-step wiring instructions are unnecessary.

In the case of the antenna coupler T1, the R. F. transformer T2 and the resistance unit R5, the positions of the terminals have been altered slightly so as to bring all of them into view. In the resistance unit for instance, the bottom terminal or zero point is marked "O." The taps from that point up are marked respectively "A", "B", "C", "D" and "E" in order. Tap "D" is not used as shown in both the schematic diagram and the pictorial diagram.

In the R. F. transformer T2, the terminal between the terminals marked "G" and "B" is not used. The tickler coil connections must be made with the proper polarity to produce results. The tickler coil terminals are shown marked 1 and 2, the terminal nearest the baseboard being number 2 and that towards the top of the panel being number 1.

When the coil is mounted in the position shown, the upper terminal, number 1 should be connected to the "P" terminal of socket VT2 while the lower terminal, number 2 goes to the "P" terminal of transformer T3.

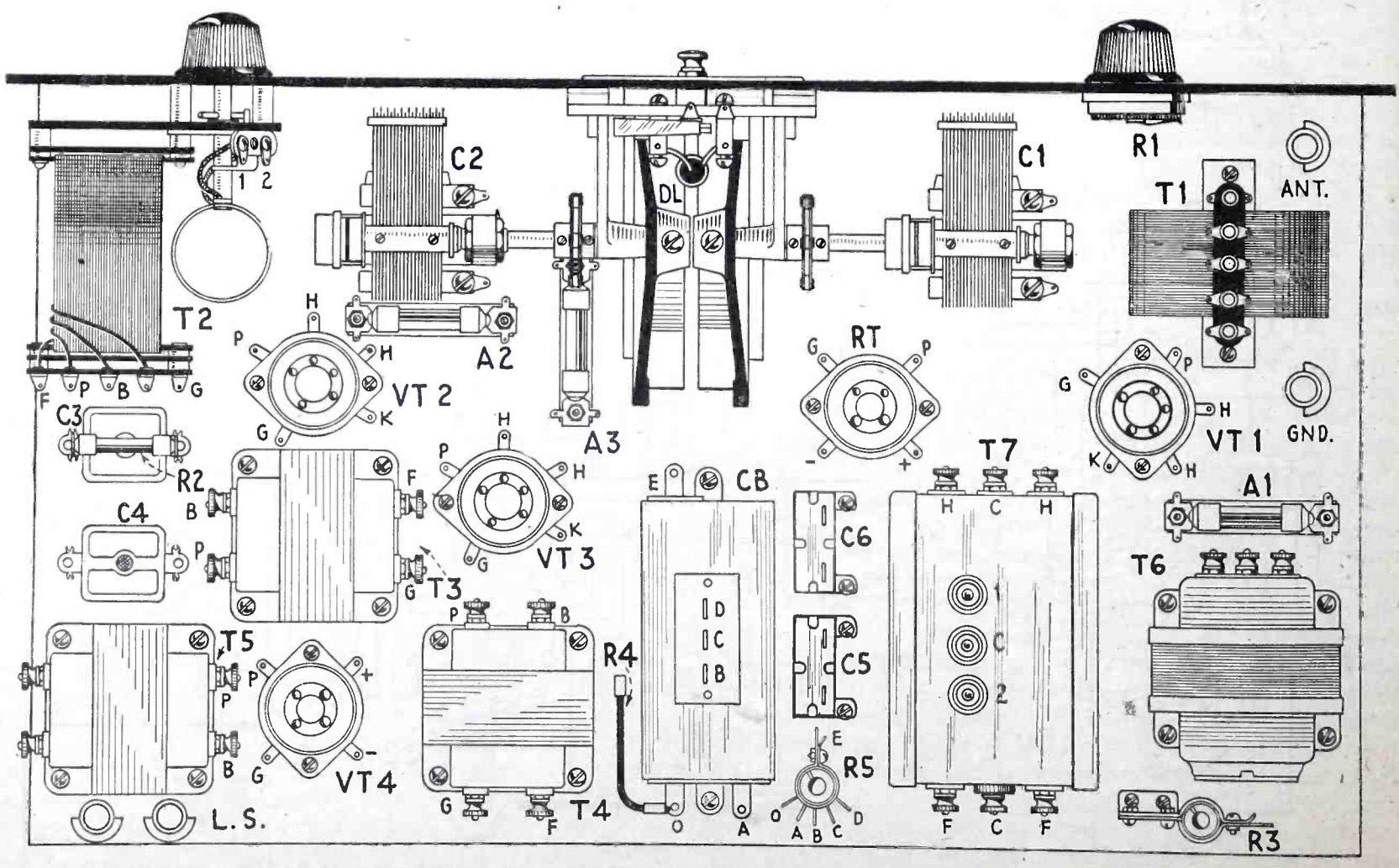
Be sure that the antenna coupler, T1, is mounted so that its primary coil is towards the back of the receiver. In this position, the terminal at the end of the top strip is in the position shown, marked "GND."

Various degrees of selectivity and sensitivity may be obtained by connecting the "ANT" binding posts to one of the three remaining terminals, A1, A2, or A3 of the antenna coupler, T1. The connection of the "ANT" binding post to terminal A1 will give maximum selectivity with good signal strength. Its connection with terminal A2 will give less selectivity but greater sensitivity and volume and is suitable when the set is operated at some distance from powerful stations. The connection of the "ANT" binding post with terminal A3 of the coil will give still less selectivity but still greater sensitivity and is ideal when local interference is very slight and distance reception is desired.

In wiring the receiver, it is well to bear in mind that while stiff bus bar wire makes a very neat appearance, its unyielding nature is often responsible for loose connections and resulting trouble. It is recommended therefore, in the interests of trouble-free operation, that a flexible hook-up wire be used for connections. Sufficient slack should be left in the connections to avoid any possible chance of strain which would be at all likely to cause broken connections.

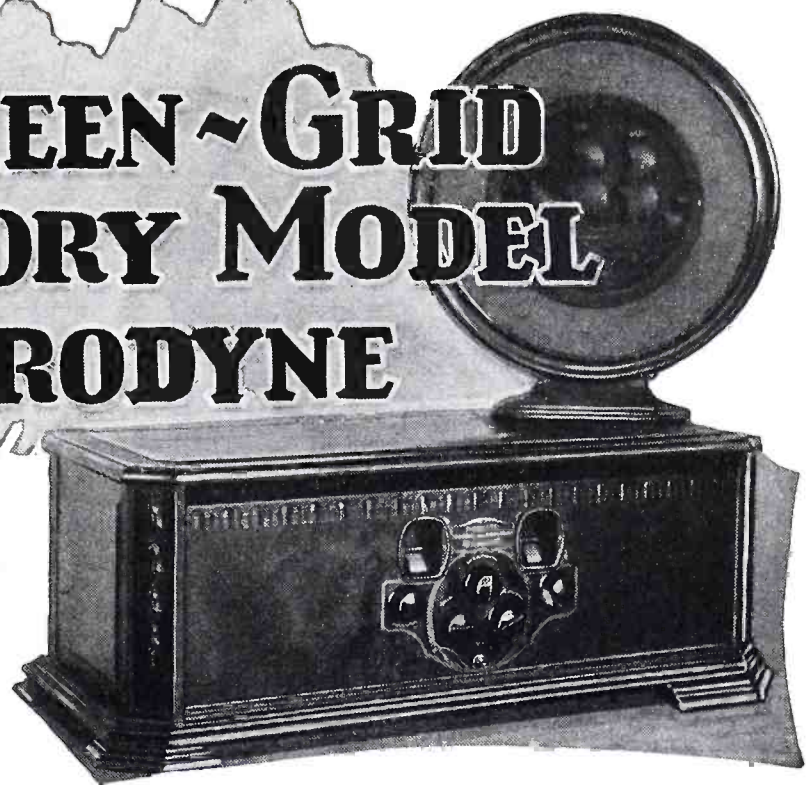
By using flexible insulated wire and by threading the end of the wire into the soldering lug or twisting the end of the wire around any other wire to which connection is to be made, the main source of possible

(*Continued on page* 163)



Instrument layout showing the placement of all parts on the baseboard and front panel.

The Improved Screen-Grid Laboratory Model Super-Heterodyne



THE receiver pictured and described herewith is an eight-tube superheterodyne employing three of the new screen-grid R. F. amplifier tubes in the intermediate-frequency amplifier, which is a laboratory-assembled and tested shielded unit, and which effectively eliminates all possibility of anything less than peak performance in the hands of even the most inexperienced builder.

The real value of the screen-grid tubes in this receiver can best be realized from the statement that the amplification factor in the three-stage 112-kc. intermediate amplifier approaches 40 per stage, as compared to about 20 per stage for 201A-type tubes. Thus, for the three R. F. stages, the amplification when using screen-grid tubes is approximately 40x40x40, or 64,000, as against 20x20x20, or 8,000 gain for the same amplifier using 201A-type tubes. These values of amplification were obtained under conditions of equal *apparent* selectivity; for it must be borne in mind that, as the sensitivity or amplification of a radio set is increased, the selectivity must go up far faster to maintain the same apparent selectivity in tuning the set. Actually, if the receiving range is doubled, selectivity must go up four times, merely to hold the apparent selectivity constant. Therefore, in designing a screen-grid amplifier, great care must be used to prevent the loss of selectivity from accompanying the increased amplification.

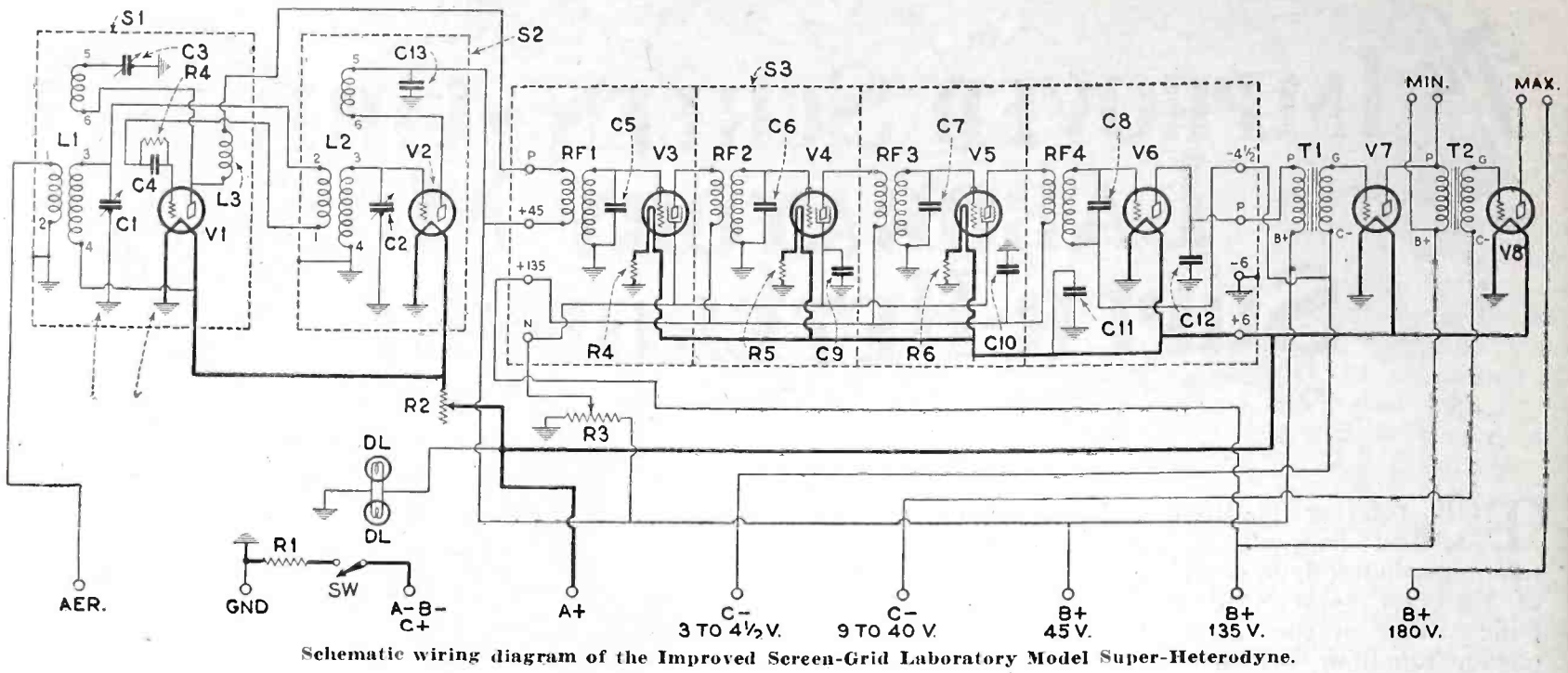
In the receiver described herewith, not only have the factors of increased amplification and increased selectivity been given careful consideration, but also that of tone quality, so generally neglected or, of necessity, slighted in very sensitive superheterodynes. Through the use of an intermediate frequency of 112 kilocycles, high amplifier selectivity has been obtained and the cutting of side bands is brought entirely within the operator's control. Either he may have medium range, ultra-high-quality reception or, by sacrificing tone slightly, he can boost the sensitivity of the set to a point where local noise and static, ordinarily very weak, comes in as a roar, and stations not ordinarily heard come in loudly

Another advantageous feature of the 112-kc. intermediate frequency is that, for all stations below 215 meters or above 455 meters, the receiver is a "one-spot" set; that is, stations outside of the 215—455-meter range are tuned in at but one point on the oscillator drum dial. Though stations between 215 and 455 meters can be tuned in at two points on the oscillator dial, by taking 25 grid turns off a standard oscillator coil, the set is made "one-spot" for all stations outside the 215-390-meter band. A further advantage of the 112-kc. intermediate frequency is that the two oscillator dial readings, for those stations that do come in at two dial settings, are widely separated; so that, with the sharp tuning of the regenerative first detector, the set is in operation practically "one-spot." Of course, all stations are received at but one setting of the antenna dial, and either a loop or a short antenna may be used. It is also possible to cut out one of the intermediate amplifier stages and one of the audio stages at will, if desired.

The set employs a regenerative first-detector circuit (S1) using a 201A- or 200A-type first detector tube (V1), with a plug-in antenna coil (L1), or loop, tuned by a .00035-mf. variable condenser (C1) which is controlled by an illuminated drum dial. Regeneration is effected thorugh a small .000075-mf. midget condenser (C3) adjusted by the "sensitivity" knob on the panel. The second tube (V2) is the oscillator, also using a plug-in coil (L2) and a .00035-mf. variable condenser (C2). The oscillator is coupled to the first-detector grid circuit. The use of plug-in coils allow different sizes of standard oscillator and antenna coils to be plugged into the set, thus covering all waves from about 30 to 3,000 meters. Following the first detector and oscillator, which may be shielded as shown at S1 and S2 or not, as desired (depending upon

LIST OF PARTS

2	S-M .00035 mfd. variable condensers, C1, C2.
1	S-M .000075 mfd. midget condenser, C3.
2	S-M type 111A plug-in coils, L1, L2.
1	S-M R. F. choke coil, 2.5 millihenries, L3.
2	S-M A. F. transformers, 3 to 1 ratio, T1, T2.
2	S-M aluminum stage shields, 7¾x3¾x5 in., S1, S2.
1	S-M Time amplifier, S3.
2	S-M vernier action, single type drum dials.
2	S-M 6-contact type coil sockets.
4	S-M UX type tube sockets.
1	Carter fixed resistor, .57 ohms, R1.
1	Carter 6 ohm rheostat, R2.
1	Yaxley 5000 ohm potentiometer, R3.
1	Carter fixed condenser, .00015 mfd., C4.
1	Polymet by-pass condenser, C13.
1	Carter battery switch, SW.
4	Carter tip jacks.
1	Polymet grid leak, 2 megohms, R4.
2	CeCo vacuum tubes, 200A type, V1, V6.
2	CeCo vacuum tubes, 201A type, V2, V7.
3	CeCo vacuum tubes, 222 type, V3, V4, V5.
1	CeCo vacuum tube, 171 type, V8.
1	Van Doorn steel chassis, pierced, with hardware.
1	Van Doorn front panel, pierced and engraved.
9	X-L binding posts.
1	Pkg. Acme Celatsite hook-up wire.
1	Pkg. Kester rosin core solder.

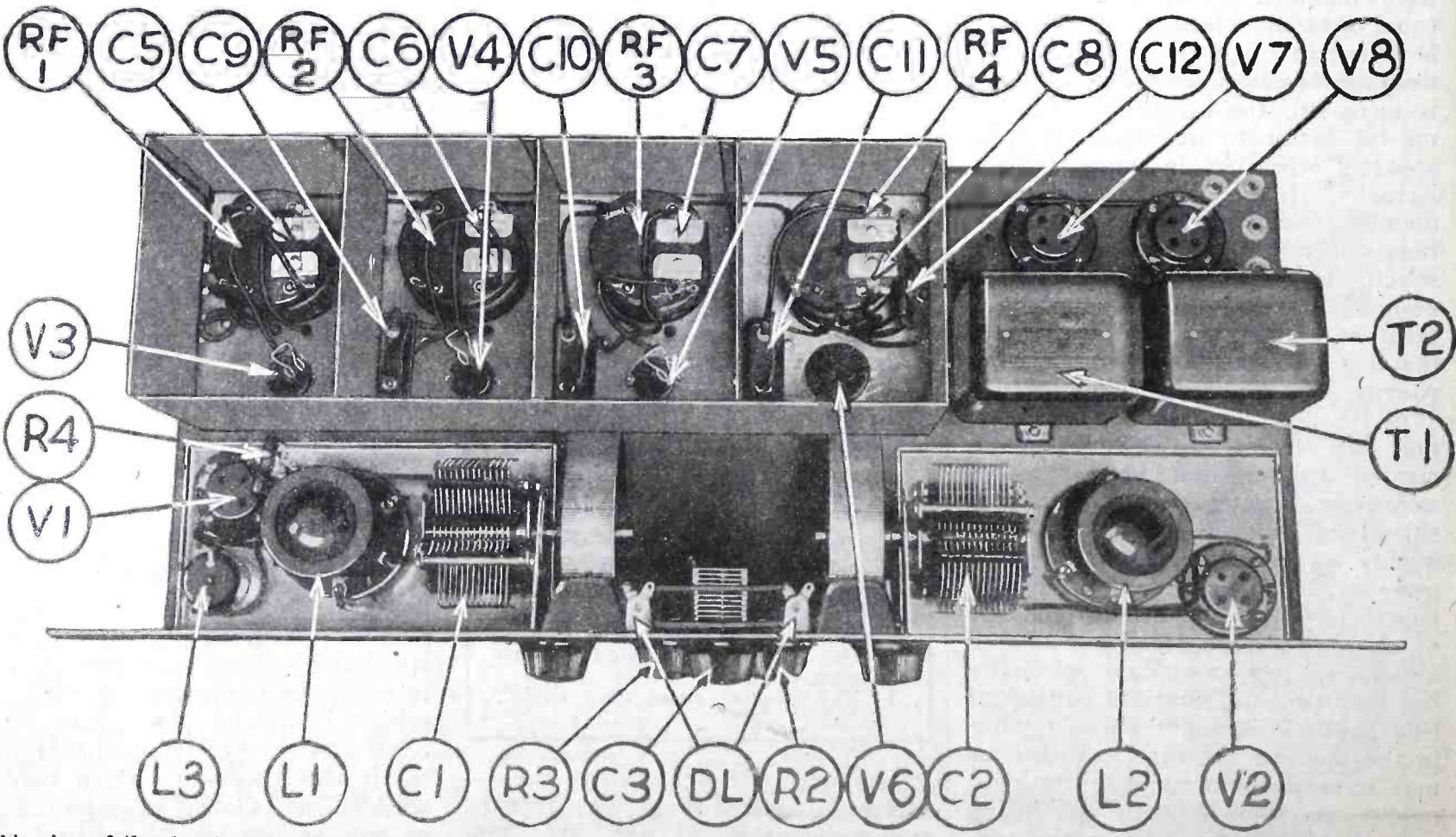


Schematic wiring diagram of the Improved Screen-Grid Laboratory Model Super-Heterodyne.

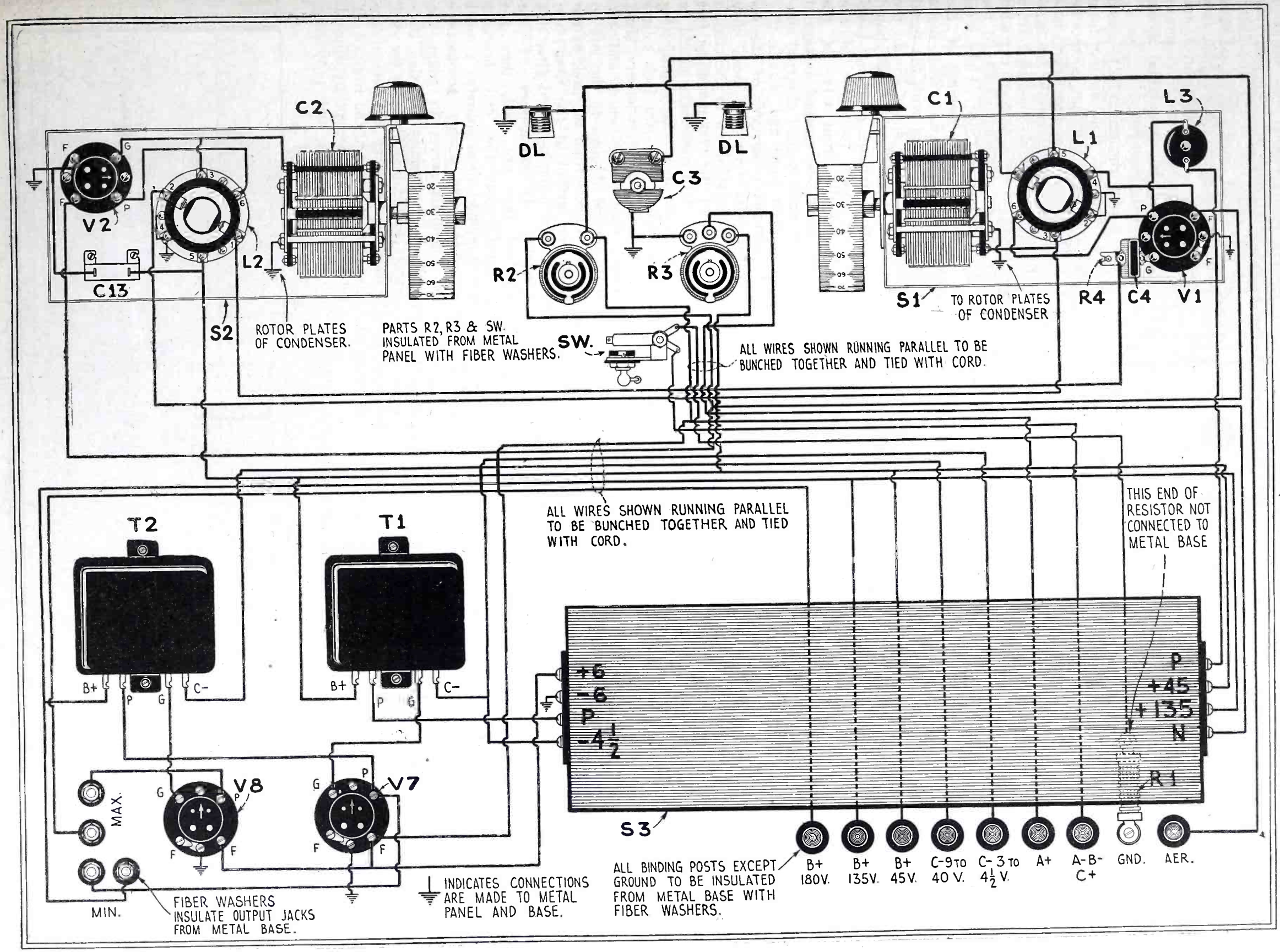
whether the set is to be operated in a congested broadcasting center or in the country) is the four-tube long-wave amplifier (S3) containing the three 112-kc. amplifier circuits and screen-grid tubes (V3, V4 and V5) and the second detector circuit and tube (V6). Each transformer and tube is in a separate compartment in the copper shielding, which is 15 inches long, 5 inches wide, and 5½ inches high, with a cover removable to allow tube insertion and removal. To the right of this I. F. unit (which is actually a complete amplifier for time-signal reception), is the two-stage audio amplifier, using a pair of high quality audio transformers (T1 and T2). This amplifier gives uniform amplification to all frequencies between 30 and 5,000 cycles. Above the highest frequency it cuts off to keep down background noise and the all-too-prevalent heterodyne squeals which are caused by over 600 broadcasting stations being crowded into channels, which would adequately accommodate 95 stations without interference.

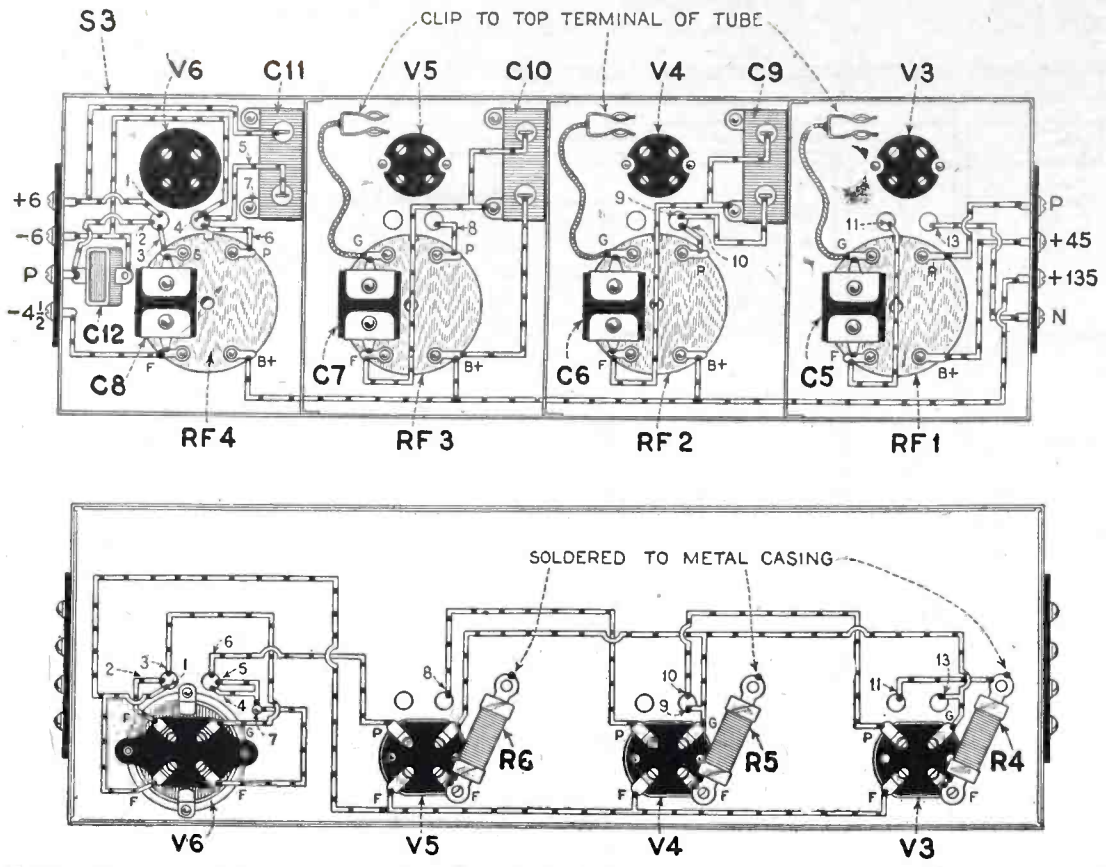
The entire set is mounted on a pierced steel chassis 10 inches wide, 1½ inches high, and 23 inches long, to which is attached a 7x24-inch metal panel carrying the control knobs. The actual controls are the vernier knobs actuating the two drum dials; an "On-Off" switch (Sw); a regeneration control (C3) for the first detector (the "Sensitivity" knob); a "Gain" control potentiometer (R3) regulating volume of the screen-grid amplifiers; and a filament rheostat (R2) for the first detector and oscillator.

In a number of tests the Improved Screen-Grid Laboratory Model receiver has been found to have no equal for DX ability; for it will reach out from Chicago on a small ten or twenty-foot aerial, bringing in with loud-speaker volume stations on the east and west coasts that many other receivers will not bring in at all. One I. F. amplifier stage can be dropped from the eight-tube



This view of the chassis, with stage shields removed, clearly shows the location of all apparatus: C1 and C2, variable condensers; L1 and L2, R.F. coils; R2, rheostat; R3, potentiometer; C3, midget condenser; L3, R.F. choke coil; T1 and T2, A.F. transformers; V1, V2, V7 and V8, tube sockets; DL, dial lights; R4, grid condenser. The remaining parts shown are located inside the intermediate-amplifier unit S3. By-pass condenser, C13 is not shown in this photo but is placed in the bottom of the shield at the right in back of socket, V2. See instrument layout.





Wiring diagram of the top and under side of the long-wave shielded time amplifier, S3. V3, V4 and V5 are screen-grid tubes. This amplifier is available only as a complete, ready-wired unit. Its wiring is shown as a matter of technical interest.

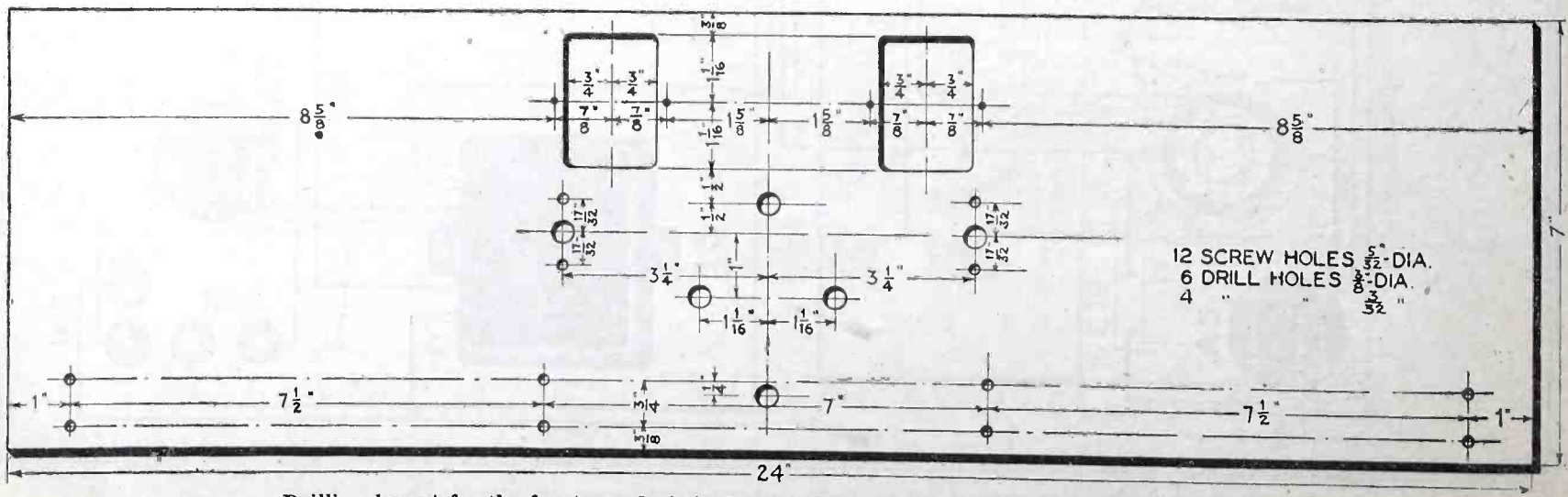
circuit by simply pulling the grid lead from the left compartment of the amplifier (S3) over the partition and clipping it to the top cap of the second tube (V4), whose clip lead is ignored. So connected and using but two I. F. amplifier stages, the set will produce results for distance, tone quality, and selectivity that will equal those obtained from other nine- and ten-tube supers. Even using only seven tubes the set will bring east and west coast stations into Chicago almost like locals on a twenty foot length of wire. Truly, the set is one fully deserving of the name "superheterodyne," for even in the hands of a novice, it tunes in distant station after distant station through a maze of locals with a simplicity that is delightful, while an expert can make it run rings around ordinary sets.

The parts used for the Improved Screen-Grid Laboratory receiver are named in the list of apparatus which accompanies this article and are all of standard manufacture. It will be found that the different parts bear the same symbols as in the drawings and photographs. The two aluminum stage shields (S1 and S2) are not absolutely necessary, but should be used to house the detector and oscillator circuits if the set is to be operated near any powerful broadcast stations. Brass-plate variable condensers of the more expensive type are illustrated in the set, as these allow the dials to turn in the same direction for simultaneous capacity increase or decrease by means of removable shafts. Though the cheaper type made by the same manufacturer are equally satsifactory, the dials turn in opposite directions for simultaneous oscillator and antenna increase or decrease of wavelengths.

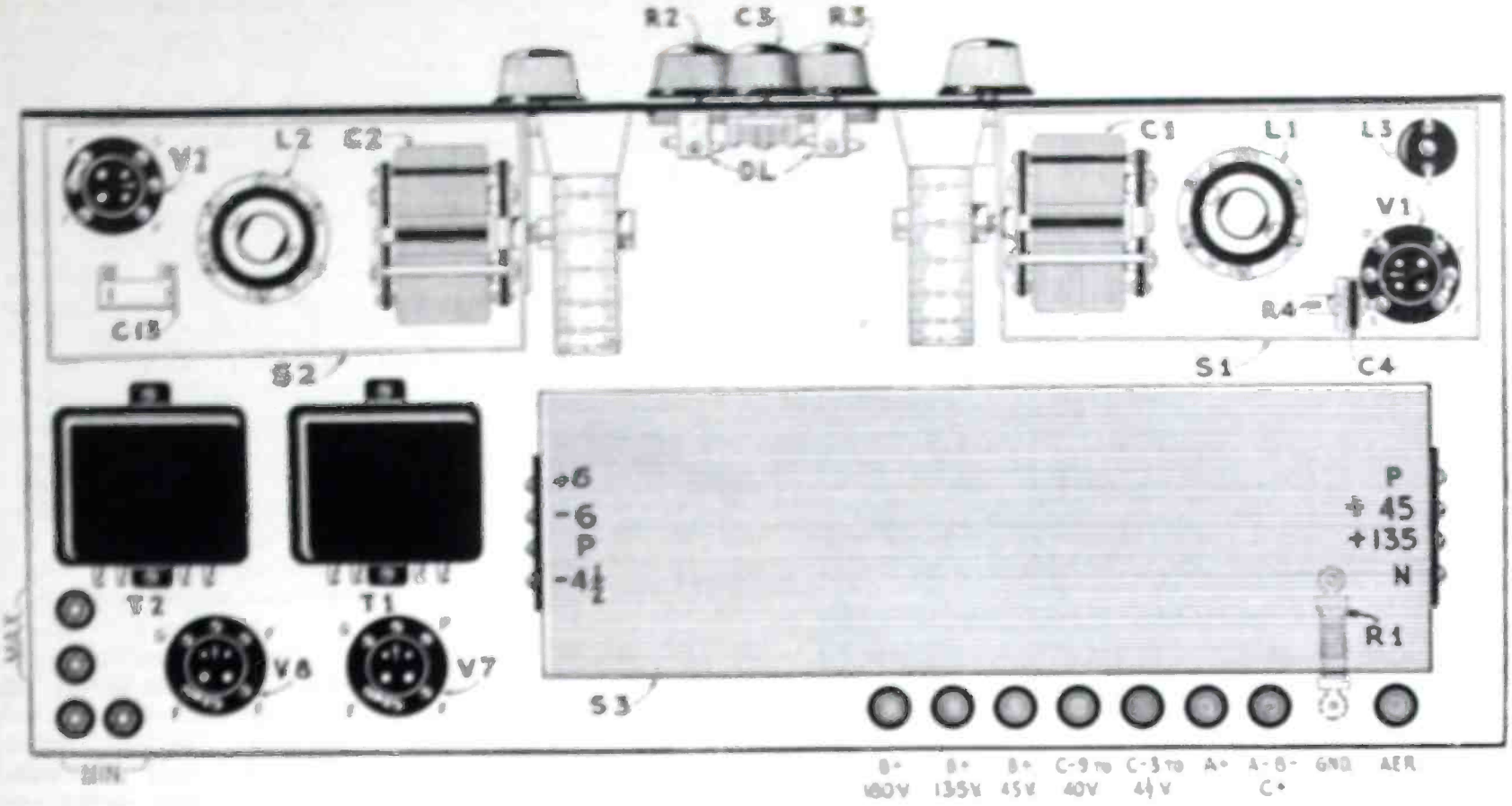
The construction of the Improved Screen-Grid Laboratory receiver is a simple task, indeed; for the steel chassis and panel are completely and accurately pierced so that the different parts need simply be placed upon them, in the positions in which they appear in the different pictures, and bolted down with machine screws and nuts. A few precautions should be observed, however.

The 6-ohm rheostat (R2) placed in the "filament" hole of the front panel and the 5000 ohm potentiometer (R3) placed in the "gain" hole of the front panel should be carefully and thoroughly insulated from the panel, using a pair of extruded fiber washers for each as should the "On-Off" switch (Sw), while it is desirable that the bushing of the midget condenser (C3) shall make good, positive contact with the metal panel and a small space around the "sensitivity" hole in the panel should be scraped free of enamel. Likewise, the lower rear side of the panel and the front edge of the chassis should be scraped at several points to make a good electrical contact between panel and chassis.

If variable condensers of the removable-shaft type are used, they may be screwed down to the chassis by means of the two mounting feet provided. Both condensers should be put in with their shafts projecting to the right. The two lock collars on the oscillator-condenser shaft should then be loosened and the shaft pushed through to the left so that it projects from the back of the condenser instead of the front; the lock collars being tightened after this operation. If condensers of the standard type are used, they are mounted upon the dial brackets which support them entirely; a small extruded brass washer accompanying the dials serves to adapt the small shaft bushing of the condensers to the large hole in the dial brackets. The dial brackets themselves are fastened to the front panel with the drive mechanism slipped into their bushings and projecting



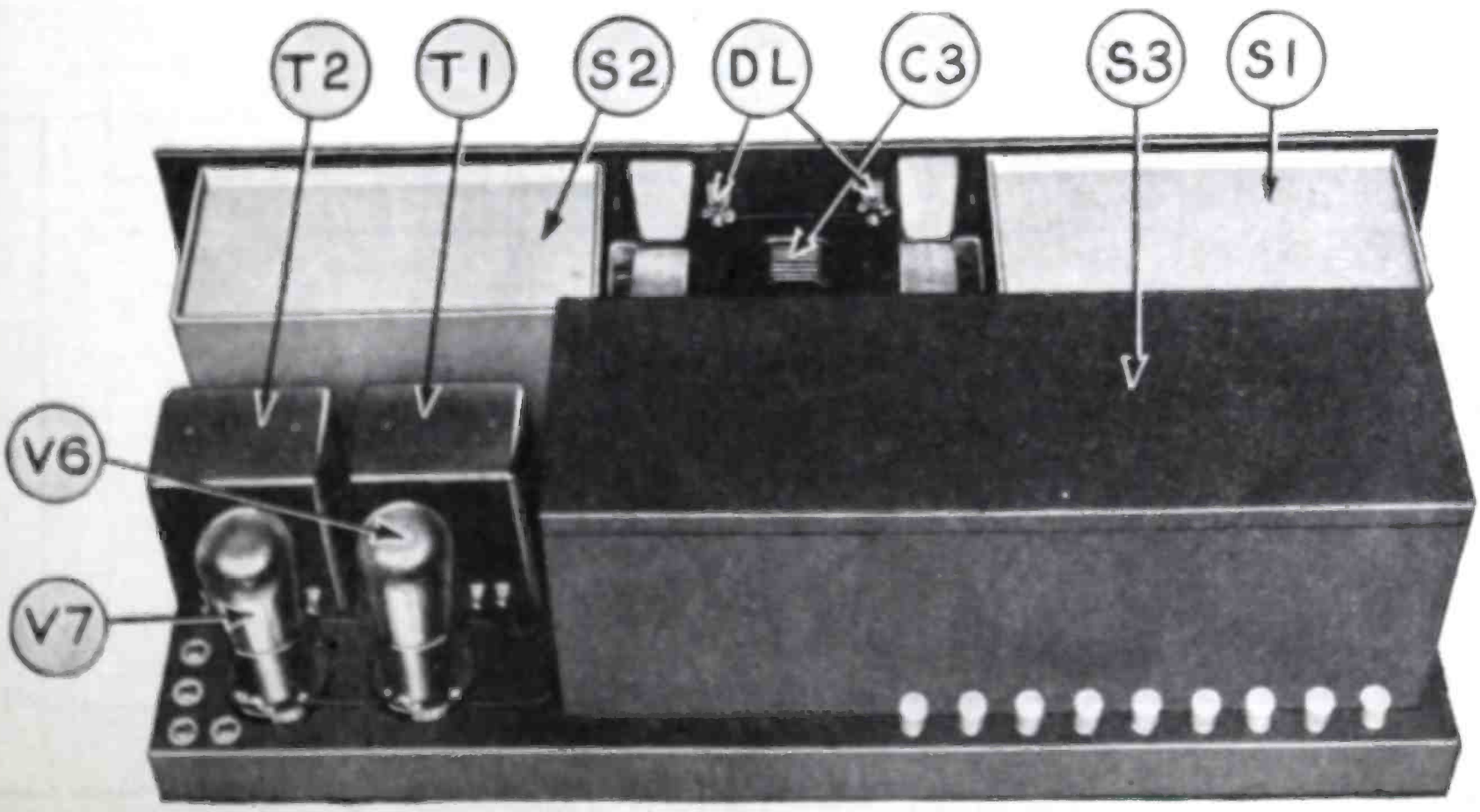
Drilling layout for the front panel of the Improved Screen-Grid Laboratory Super-Heterodyne.



Instrument layout of parts for the set. All binding posts are insulated from the metal chassis with the exception of the ground terminal. Note how parts are mounted within the two stage shields.

through the front panel. The drum scales should be fitted on the condenser shafts to read 100 when the condensers are entirely interleaved, so that readings will increase with the wavelength.

The location of the different parts upon the chassis is very clearly illustrated in the layout accompanying this article. If oscillator and first-detector stage shields (S1 and S2) are used, they are held to the chassis by the different parts mounted in them. It is important to elevate the coil sockets for L1 and L2 above the chassis by means of the ½-inch hollow brass studs slipped over the mounting screws. Terminal 3 of the antenna coil (L1) socket should be to the rear; and terminal 3 of the oscillator coil (L2) socket to the front. The positions of the four tube sockets are clearly illustrated in the top view photo and instrument layout, and the "A—" connection of each tube socket is grounded to the chasis by means of a lug under the head of the nearest socket mounting screw. The positions of the audio transformers (T1 and T2), choke coil (L3), and time-signal amplifier (S3) are clearly illustrated and their mounting needs little explanation, other than to state that the amplifier is held to the chassis by four long 8/32 screws tapped into the corners of its chasis. Each binding post should be mounted, using a pair of extruded fiber washers to insulate it thoroughly from the chassis, with the exception only of the "ground"



A rear view of the set with the covers of shields, S1 and S2 closed.

binding post, which should be grounded to the chassis. The simplest way of doing this is to use one lug of the the 0.57-ohm filament resistor (R1) as a washer for the "ground" binding post, the binding-post screw going through the resistor lug, up through the chassis, and into the binding post. This connection serves to ground one end of the resistor, the other end being connected directly to the "A—" binding post (this connection can be seen in the schematic diagram—the resistor should be mounted, not as in the under-view picture, but as explained above.)

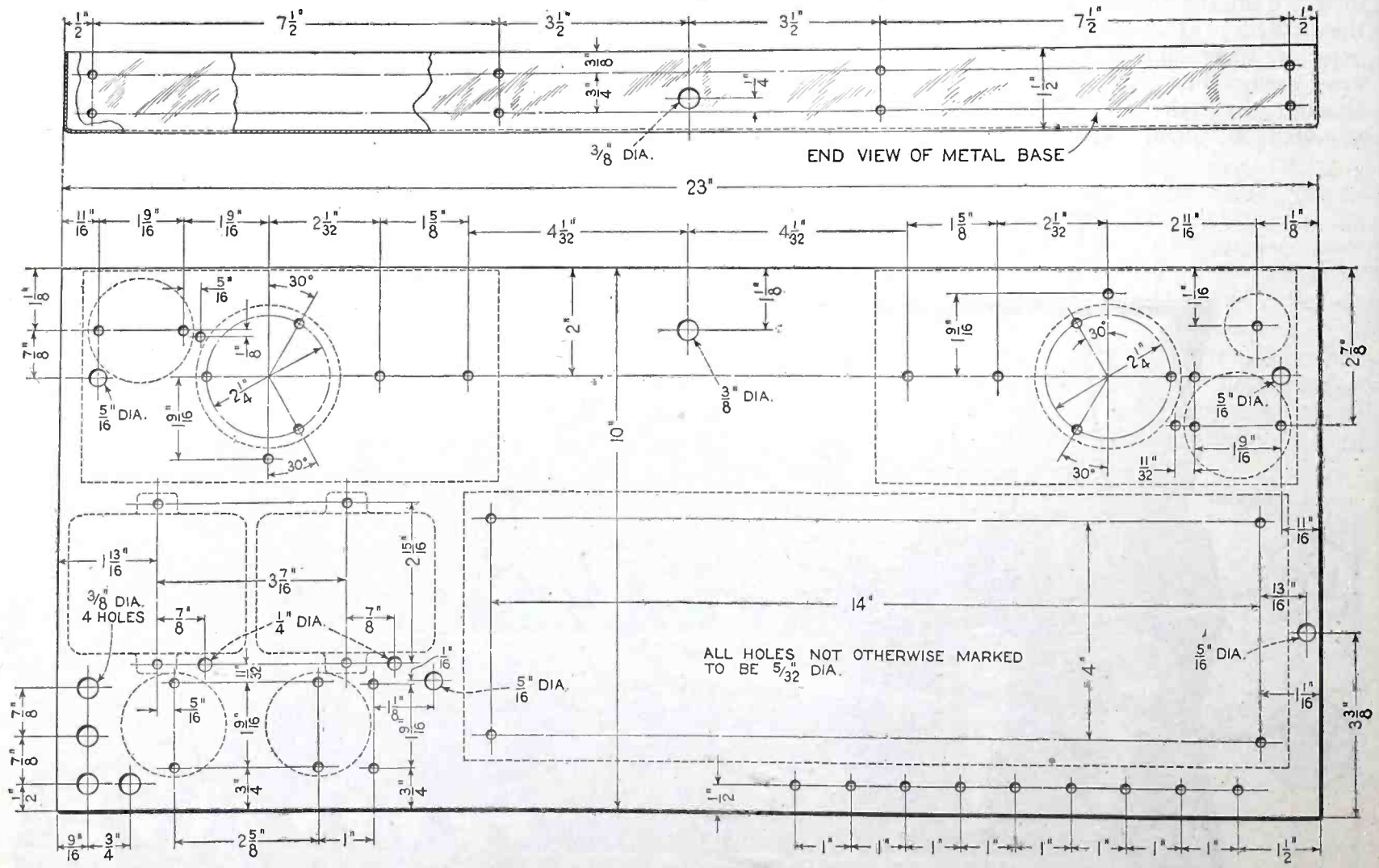
The wiring of the receiver is done entirely with flexible fabric-insulated hook-up switch-board wire, with the exception of the three leads, which are put in with bus-bar in spaghetti. One of these bus-bar leads serves to connect post 5 of the antenna coil socket (4) to the stator lug of the midget "sensitivity" condenser (C3); while the other two leads serve to connect posts 1 and 2 of the oscillator coil socket (L2) to post 3 of the antenna coil socket (L1) and the first-detector grid condenser (C4). All three of these leads should be made of bus-bar in spaghetti, put in in such a way that they are at least ¾-inch away from the metal chassis or receiver assembly at any point where they run parallel. All the rest of the wiring, with the exception only of grid and plate leads, should be bunched together as far as possible and, after final assembly and testing, may be laced or cabled, using heavy waxed shoemaker's thread, thus providing a very neat and workmanlike job, as seen in the pictures. The receiver can, of course, be wired with bus-bar in spaghetti throughout, if desired.

The wiring and assembly of the receiver having been completed, all previous operations should be very carefully checked, and the wiring compared with the schematic and pictorial diagrams to make absolutely sure that no errors, which might result in tube burn-out, or other damage, have been allowed to creep in. This done, the set is ready for operation.

The necessary accessories should be connected to the receiver in accordance with the markings on the binding posts, and all tubes placed in the set. With both filament rheostats (R2 and R3) turned to the left or "Off" position, and the "On-Off" switch turned on, the two audio amplifier tubes (V7 and V8) and the detector tube (V6) in the time-signal amplifier should light. With the filament rheostat (R2) turned slowly to the right, the first detector and oscillator tubes (V1 and V2) should light; and with the "Gain" knob to the right, the three 222-type tubes in the screen-grid amplifier should light. The three flexible leads with clips should, of course, be attached to the top caps of the 222-type tubes in the amplifier.

To operate the receiver, the filament rheostat (R2) should be turned half-way on, the "Sensitivity" knob of the midget condenser (C3) should be turned absolutely all the way out, and the "Gain" or potentiometer knob (R3) turned in a central position. If the oscillator dial is now rotated, no squeals should be heard; should they be, it will indicate oscillation of the intermediate amplifier. This would possibly be correct in the case of certain individual tube variations, in which event the "Gain" knob should be turned slightly to the left or right, until oscillation stops and rotation of the oscillator drum produces no squeals. The receiver may now be tuned as a regular superheterodyne, the Antenna and Oscillator dials serving to select stations. As mentioned previously, stations between approximately 215 and 455 meters will be heard at two points upon the oscillator dial. In preliminary testing, some station between 440 and 460 meters should be tuned in for best response on both dials. It will be observed that while the station can be heard at two points on the Oscillator dial, one point will be stronger than the other. Which of these points is strongest is de-

(*Continued on page* 158)



Drilling layout for the steel chassis as used for the Improved Screen-Grid Laboratory Model Super-Heterodyne. Dotted lines indicate location of apparatus to be mounted on the chassis.

The Supreme A.C. Six Receiver

IT seems as if every important development is preceded by an enormous public demand, and the batteryless radio receiver is no exception to this rule. Even in the early days of radio, the set owners grumbled about battery troubles. As a result, "B" eliminators were introduced and perfected, but the storage "A" battery still remained to cause bother and annoyance. Trickle chargers helped the situation somewhat, but the advent of the new A. C. tubes has now made it possible to operate the radio receiver direct from the lamp socket without the help, or one might say the hindrance, of any batteries at all.

While it has been the purpose of the tube manufacturer to design the A. C. tubes with characteristics similar to those of the battery operated tubes, it is natural to assume that a circuit planned to take advantage of the peculiarities of the new tubes would give especially good results. This happens to be the case with the set described herewith. The fundamental circuit of this receiver consists of two stages of balanced tuned radio frequency amplification, a detector, one stage of transformer coupled amplification and a push-pull amplifier in the last stage. Standard apparatus is used throughout and parts have been selected especially for their adaptability for use in connection with the A. C. tubes. Slight differences between stages may be compensated for by the three small compensating condensers. A phasatrol is used in each R. F. stage to eliminate any tendency to radio frequency oscillation or distortion. Volume is controlled by means of a 75-ohm rheostat shunted around a portion of the primary of the first R. F. coil.

The combination of transformer, and 171 push-pull amplifier in the last audio stage, gives the receiver plenty of volume, while the superior tone quality furnishes another reason for naming this set. "The Supreme A. C. Six."

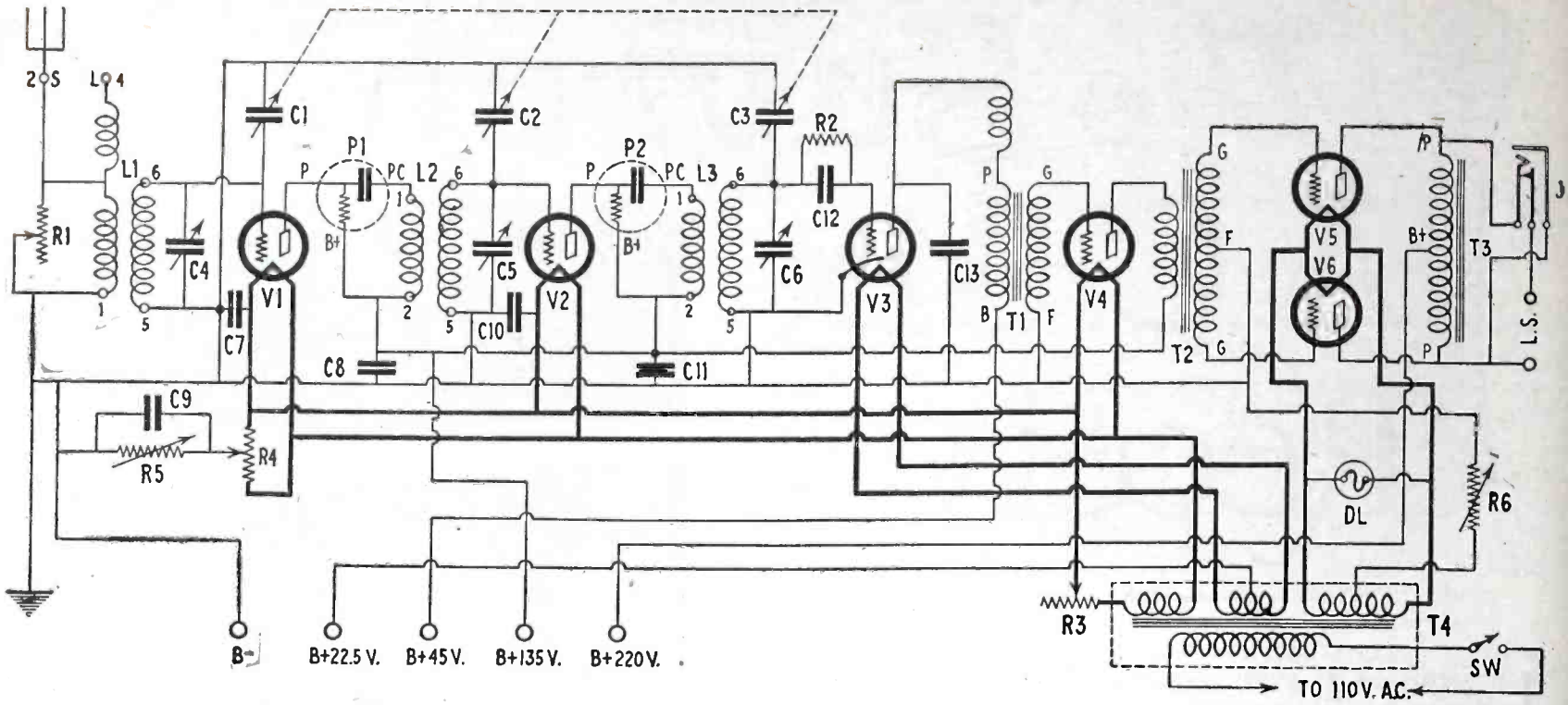
LIST OF PARTS

- 3 Aero R. F. coils, type U-12, L1, L2, L3.
- 1 Hammarlund Mid-Line condenser, .0005 mfd., C1.
- 1 Hammarlund Dual Mid-Line condenser, .0005 mfd., C2, C3.
- 1 National or Mar-Co vernier dial.
- 3 X-L variodensers, model "N," C4, C5, C6.
- 1 Thordarson, type R-200 transformer, T.
- 1 Thordarson input transformer, type T-2408, T2.
- 1 Thordarson output choke, type T-2420, T3.
- 1 Thordarson A. C. tube filament transformer, type T-2445, T4.
- 2 Electrad Phasatrols, P1, P2.
- 2 Electrad variable resistors, type "F," R5, R6.
- 5 Acme by-pass condensers, ½ mfd., C7, C8, C9, C10, C11.
- 1 Polymet by-pass condenser, .001 mfd., C13.
- 1 Samson R. F. choke, No. 85, L4.
- 1 Polymet grid condenser, .00025 mfd., C12.
- 1 Durham metallized grid leak with mounting, 2 meg., R2.
- 1 Yaxley 10 ohm rheostat, type 110-K used as potentiometer, R4.
- 1 Yaxley 2-circuit jack, No. 2-A, J.
- 2 Yaxley Pup jacks.
- 5 Eby tube sockets UX type.
- 1 Eby tube socket, UY type.
- 2 Rolls Acme Celatsite wire.
- 1 Carter ½ ohm rheostat type IR-X5, R3.
- 1 Carter 75 ohm rheostat type IR-75, R1.
- 1 Carter power switch, SW.
- 3 X-L binding posts.
- 6 Ft. Cornish 5-wire cable.
- 1 Can Kester rosin core solder.
- 1 Formica panel, 7x26x3/16 in.
- 1 Formica sub-panel, 10x24½x3/16 in.
- 4 Benjamin or Karas brackets.

A special filament supply transformer furnishes correct voltages to the various tubes. Since the 227 detector tube is not critical as to filament voltage, no variable resistance is used in this portion of the circuit for voltage control. Due to the separate heater element, the grid return is not critical, so that a center tap on the transformer winding is used for this purpose.

A ½-ohm rheostat is placed in series with the 1½-volt winding to compensate for line voltage differences, since the 226 tubes are quite critical as to filament voltage. Grid return for these tubes must be brought to the point of exact potential balance of the filament voltage, thus necessitating the use of the 10-ohm potentiometer. Negative grid bias for the 226 tubes is secured by means of a 2,000-ohm variable resistance connected between the mid-tap of the potentiometer and "B" minus. A negative grid bias of 40 volts is obtained for the 171 tubes by means of the 2,000-ohm variable resistance, R6, connected between the center tap of the input transformer and the center tap of the 5-volt winding supplying the filaments of the 171 tubes. With 220 volts applied to the plates of the 171 tubes, the net voltage across plate and filament of these tubes will be 180 volts.

A power switch is connected in series in the primary circuit of the



Schematic wiring diagram of the set. Variable condensers, C1, C2 and C3 operate on the one shaft, making the set uni-controlled.

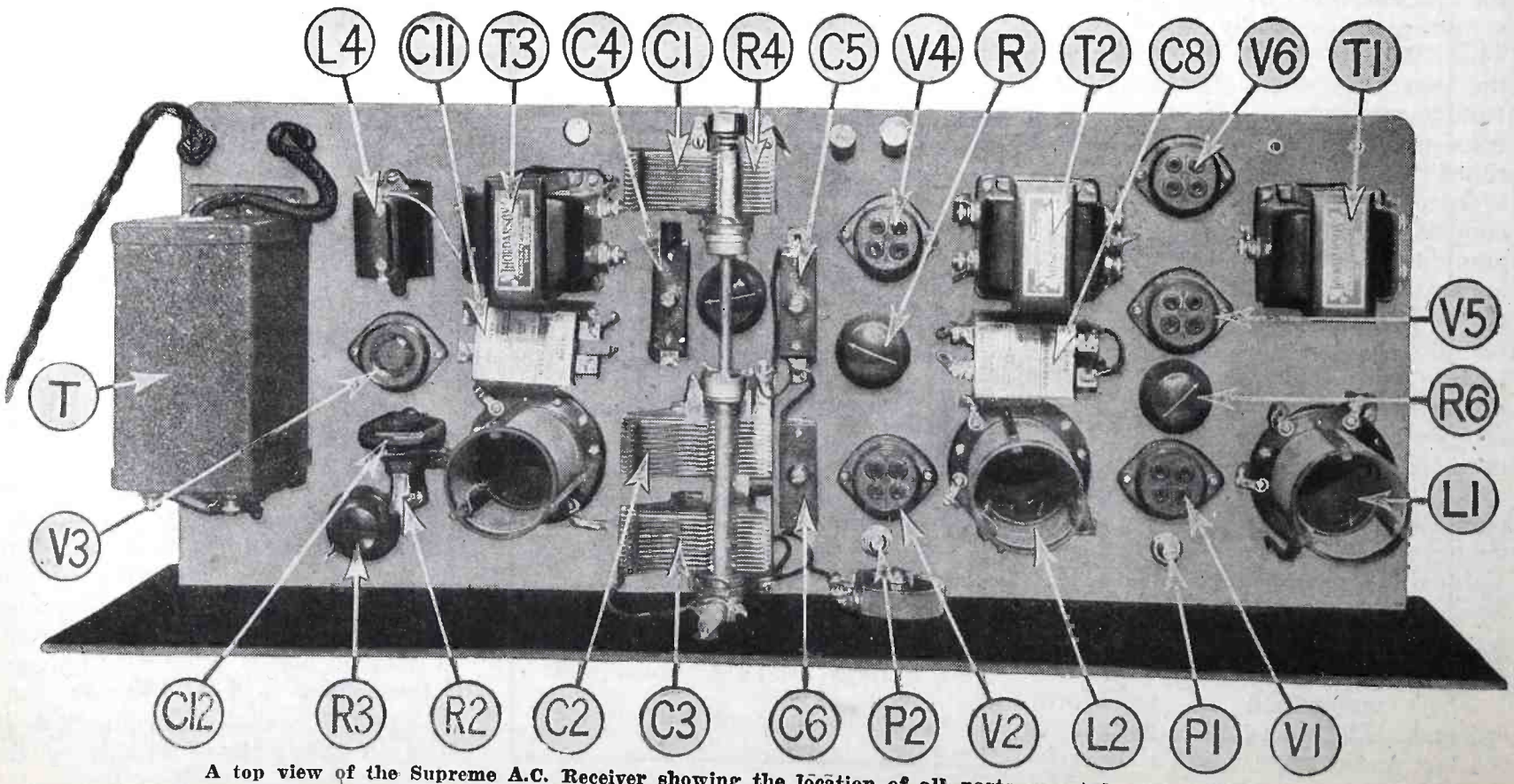
filament supply transformer. Filament leads are twisted separately and it is desirable to use a heavier gauge wire for these leads to prevent voltage drop, due to the resistance of small diameter wire.

The first step in assembling the Supreme A. C. Six, is to cut the sub-panel to the correct length of 24½ inches. The four low brackets are next fastened to the sub-panel. Two of the brackets are placed at the ends of the sub-panel (at a distance of approximately 1¼ inches from each end), while the other two are located 7¾ inches from each end, respectively.

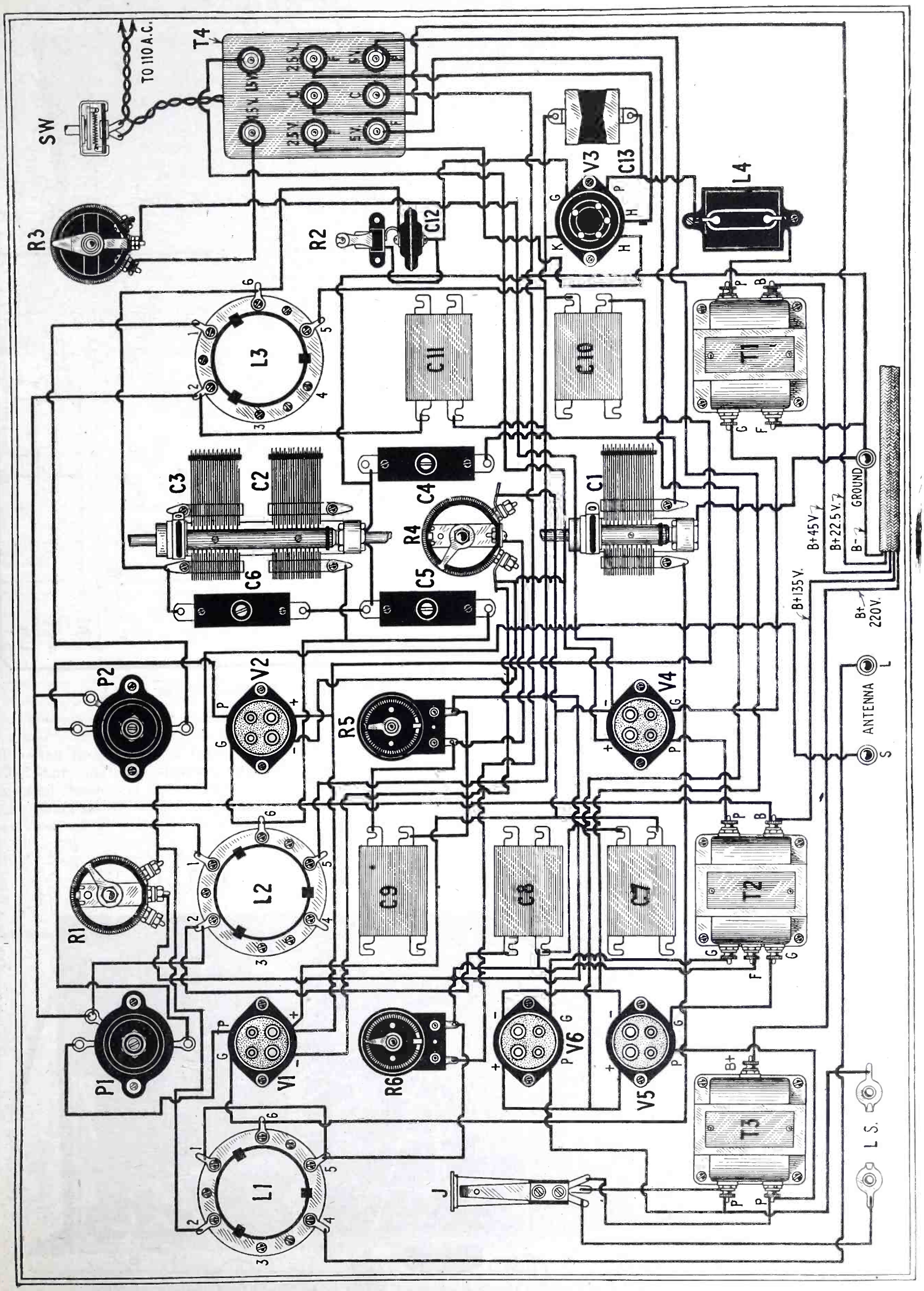
The variable condensers are then mounted with the shaft centers on a line 11½ inches from the right edge of the sub-panel (facing rear of panel). The dual condenser is located with its front bearing flush with the (panel) edge of the sub-panel, while the single condenser is mounted with its rear bearing flush with the rear edge of the sub-panel. This leaves a distance of about 2⅜ inches between the condensers. The shaft of the dual condenser is moved forward, while the shaft of the single condenser is replaced by a longer shaft, which is rigidly attached to the dual condenser by means of the rear shaft set screw on the dual condenser. In this way the condensers are "ganged" for single dial control.

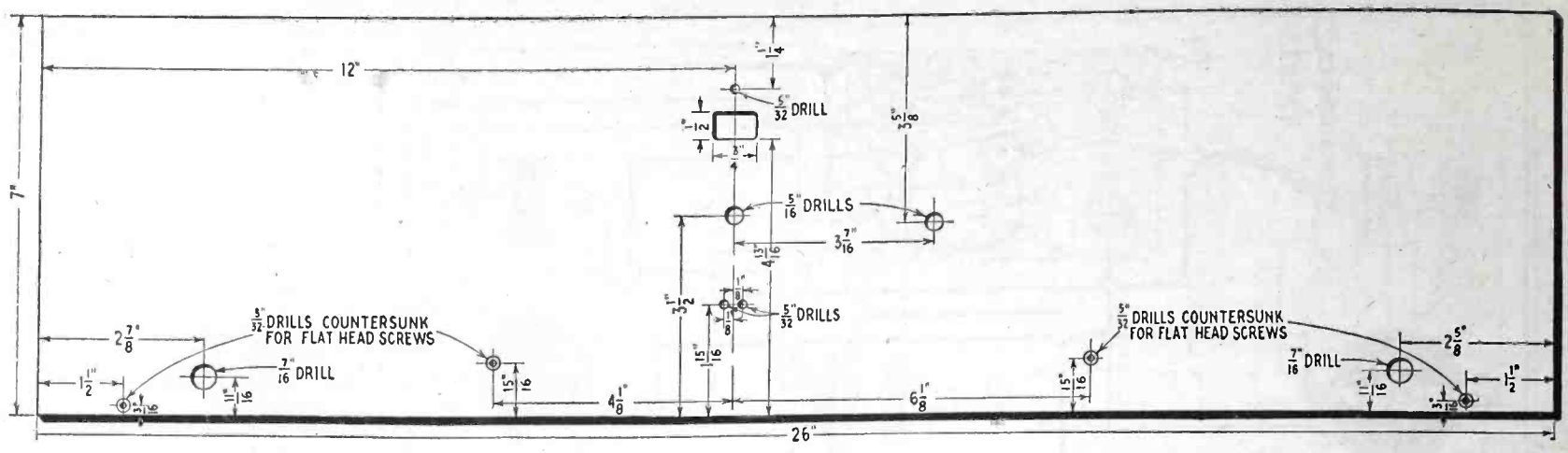
The tube sockets and the two phasatrols are mounted as shown in the photo and diagram of the top view. The audio transformer, the input transformer and the output choke are mounted in a row at the rear of the sub-panel, about 1⅜ inches from the rear edge. The compensating condensers are placed at each side of the variable condensers, as shown.

The four by-pass condensers are next mounted. Condenser, C8 is placed directly on top of C7, while C11 is placed on top of C10. Next a R. F. choke may be mounted between transformer, T and choke, T3, as seen in the photo. The single resistor mounting for the grid leak, R2, is then mounted. The by-pass grid condenser, C12, is fastened to the mounting.

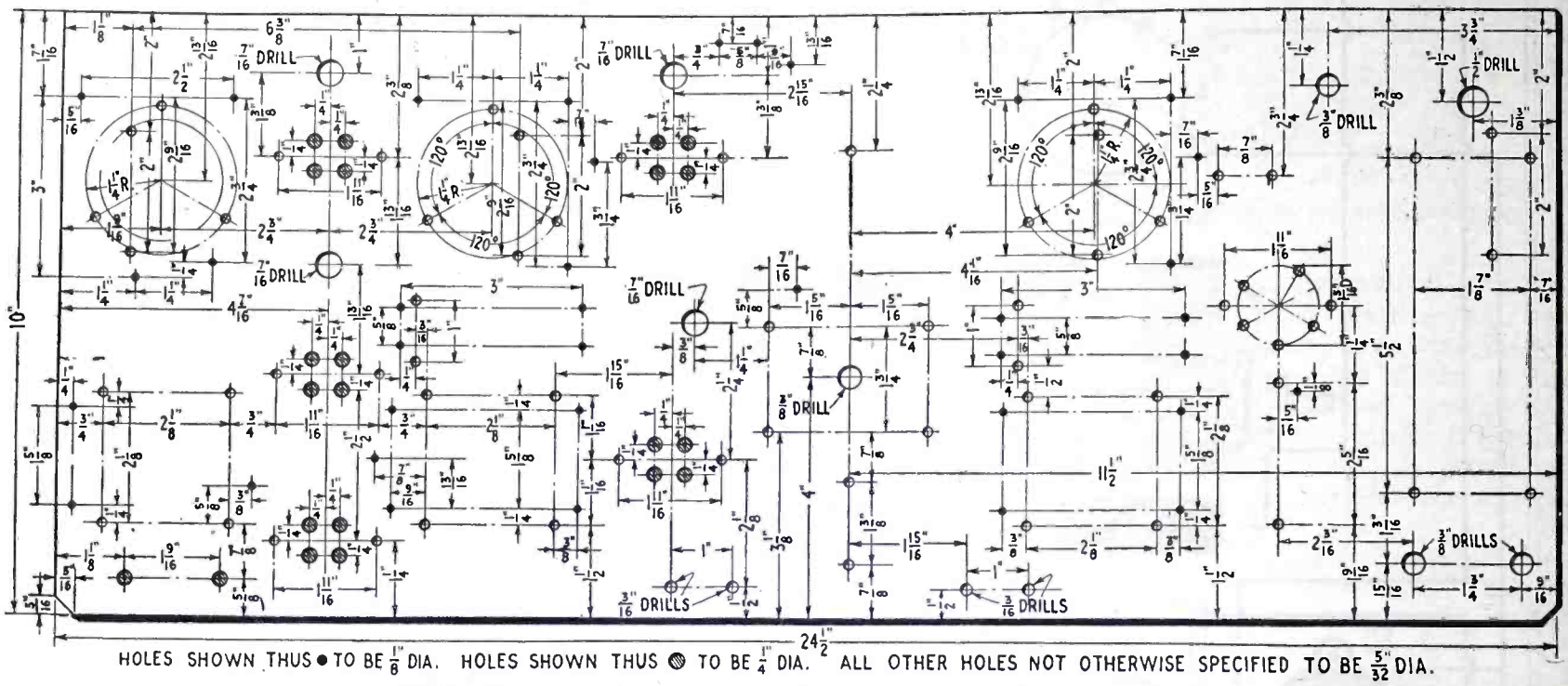


A top view of the Supreme A.C. Receiver showing the location of all parts mounted on the sub-panel.





Directly above is the layout for drilling the front panel.



HOLES SHOWN THUS ● TO BE 1/8" DIA. HOLES SHOWN THUS ⊘ TO BE 1/4" DIA. ALL OTHER HOLES NOT OTHERWISE SPECIFIED TO BE 5/32" DIA.

Drilling layout for the sub-panel of the Supreme A. C. Six Receiver.

Holes are now drilled for resistances and potentiometer and these parts are then mounted. Holes for the binding posts are also drilled at this time and posts are mounted. Next the holes are drilled for the filament supply transformer. The two fixed condensers are fastened beneath the sub-panel as shown by the dotted lines on layout herewith.

The panel is then placed flat, with the sub-panel in position, and holes are drilled for fastening brackets to panels, and also for fastening dual condenser to panel. Holes are also

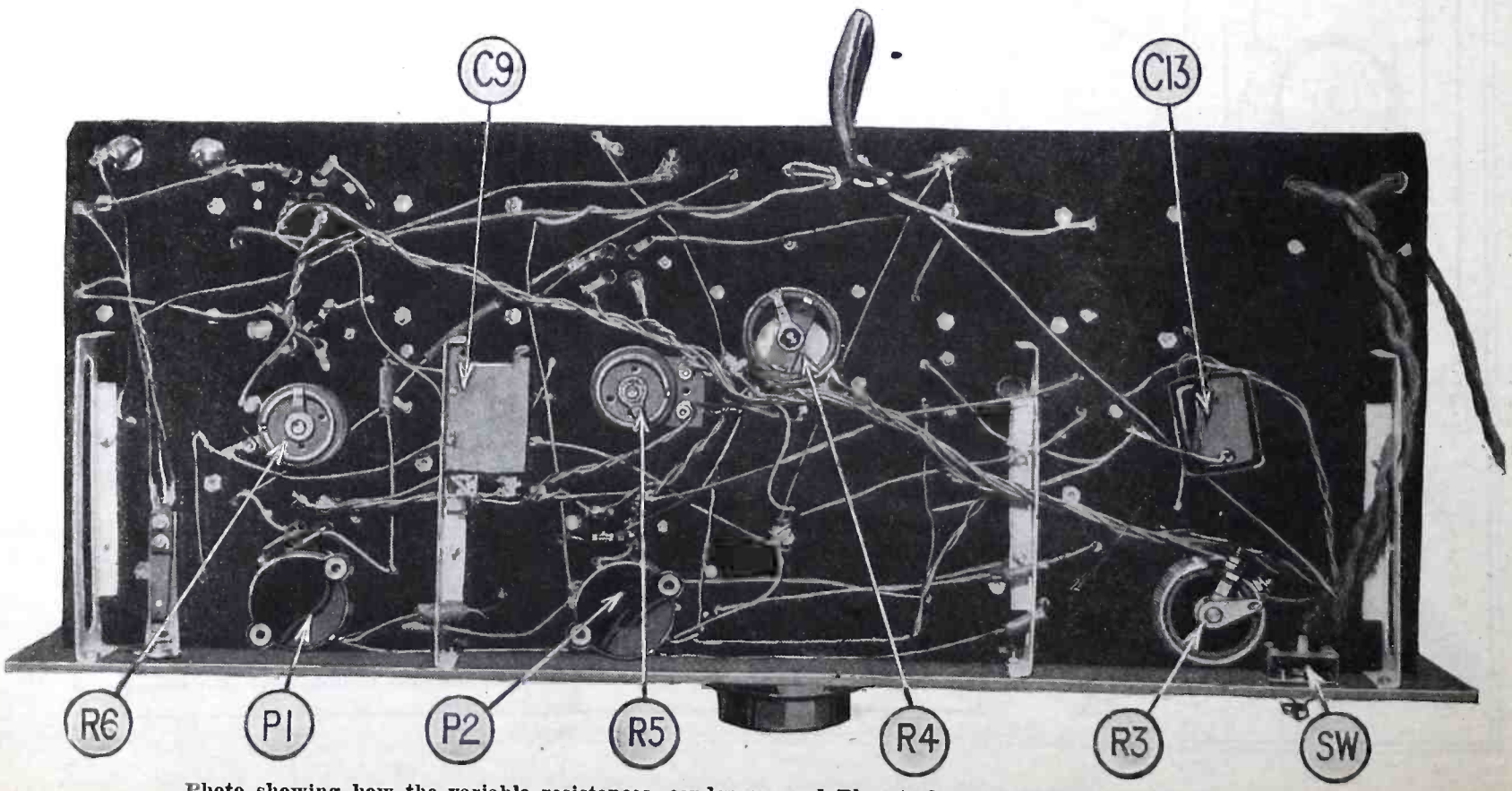
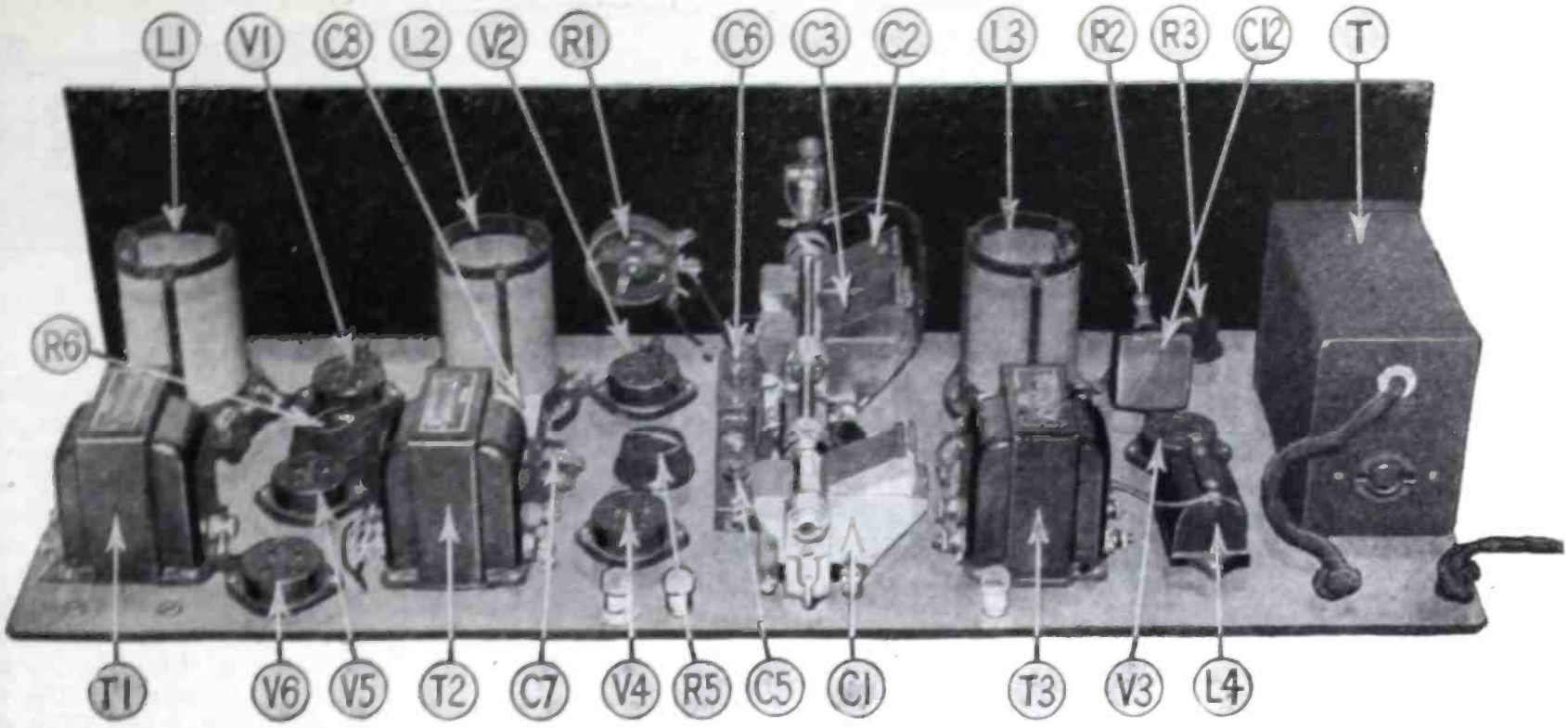


Photo showing how the variable resistances, condensers and Phasatrols are mounted beneath the sub-panel.



A rear view of the set. All parts are lettered to correspond with diagrams and list of parts.

drilled in the panel for the volume control rheostat, the power switch and jack. The volume control is located at 3½ inches to the right of the dial center line.

The three R. F. coils, L1, L2 and L3 are mounted on the sub-panel as shown. Holes are then drilled for the phone tip jacks and these are mounted. Holes are also drilled for the power cord and filament leads.

The panel is fastened to the sub-panel and the filament transformer is mounted on the sub-panel. Holes are drilled in the panel for the panel light and for the dial fastening screw and the dial is fastened to the panel. Practically any well made dial can be used on the set providing it gives vernier adjustment.

The wiring should be performed with flexible hook-up wire, using rosin core solder in making joints. The following sequence should be followed:

First: Wire all grid circuits, up to negative return.

Second: Wire all plate circuits to "B" plus terminals of apparatus.

Third: Wire "B" minus and all negative returns.

Fourth: Connect the twisted 1.5 volt filament leads to the first and second R. F. and first audio sockets.

Fifth: Connect the twisted 3-volt lead to the detector socket.

Sixth: Wire in the twisted filament leads to sockets V5 and V6.

Seventh: Wire all the "B" plus leads from apparatus terminals to the cable mounting.

Eighth: Connect the by-pass condensers in the circuit.

Ninth: Wire in the jack and phone tip jacks.

Tenth: Wire in the antenna circuit, with volume control and ground binding post.

Eleventh: Wire in the panel light with twisted leads.

It should be noted that the small figures shown at coil terminals of L1, L2 and L3 correspond to the same markings on the R. F. coils.

To place the Supreme A. C. Six in adjustment, first tighten up the compensating condensers C4, C5, C6, as much as possible. Then unscrew all of them four turns each. Turn all the phasatrols all the way to the right. Set the potentiometer, R4 to approximately mid-point. Turn bias resistor R5 to about mid-point. Next, turn the power switch "on" and rotate the dial until a station is heard. A hum may be present. If there is no hum, turn the R. F. bias resistance, R5, until hum is heard.

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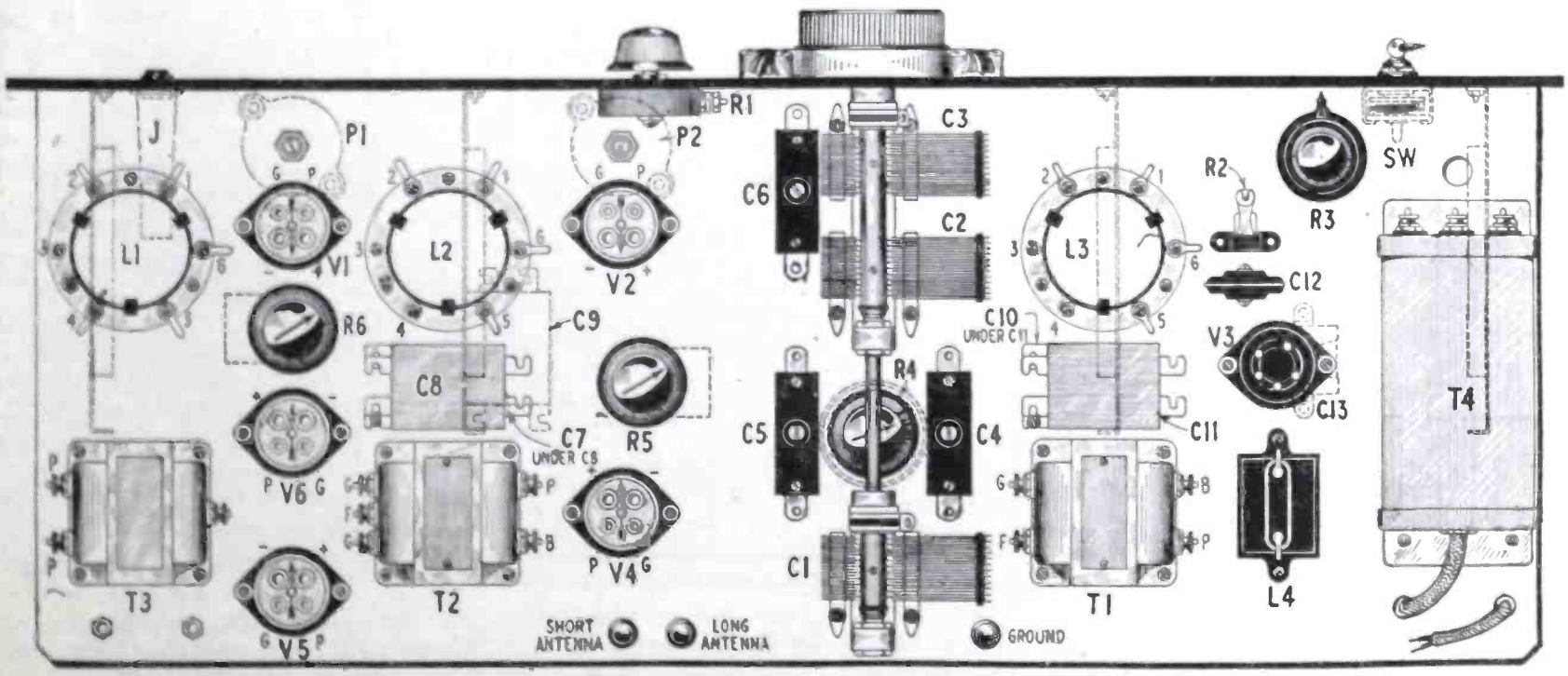
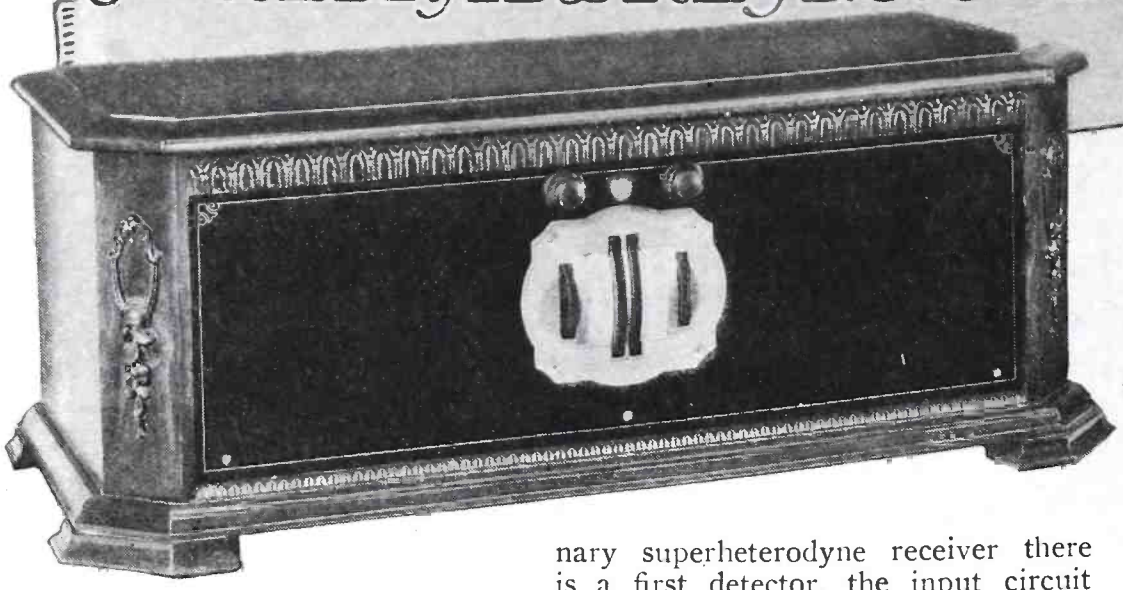


Layout indicating the exact location of all parts. Instruments shown in dotted lines are mounted beneath the sub-panel.

The ULTRADYNE A.C. COMMANDER



ONE of the greatest tests of a radio receiving circuit is that of time. Those readers who have been in the game since the beginning of broadcasting will remember the deluge of new circuits that were continually forthcoming, but how many of those circuits are remembered today, and furthermore, how many of the remembered circuits are being used? You could count them on the fingers of your hands.

As has been said this matter of time is an important one by which a circuit can be judged. If a circuit or a principle has remained in use when the field has been flooded with new circuits and principles, then that old timer must be something of real worth. And that is exactly the case with the set described in this article. The principle underlying the whole thing is good and having been proved good has been in use for four or five years, which incidentally is a long time for such a thing in the realm of radio.

The circuit in this set has as its underlying principle the superimposition of one frequency upon another —the superheterodyne. However, there are some features of this receiver not found in the usual run of superheterodyne sets. For example, instead of feeding the signals from the antenna directly to the first detector, there is a stage of tuned radio-frequency amplification in the input circuit. This increases the efficiency greatly. Then, too, the "modulation" system is employed, replacing the first detector. Above all this, though, the set has been adapted to the use of alternating-current tubes, which fact in itself is a boost for any set.

Let us examine this system of modulation more closely. In the ordinary superheterodyne receiver there is a first detector, the input circuit of which is coupled directly to the antenna circuit and whose plate circuit is connected to the input of the intermediate-frequency amplifier. To this tube is coupled the oscillator tube through a pick-up coil or some other means. Now the frequency of the oscillator circuit must be such that when it is beat with the incoming signal-frequency, the result will be a frequency for which the intermediate transformers have been especially designed, i.e., they operate most efficiently at that frequency or rather band of frequencies. The first detector tube has to fulfill more than one function; it must mix, as it were, the signal frequency with that of the oscillator, rectify the resulting beat note and then transfer it to the intermediate-frequency amplifier.

The modulation system employed in this receiver operates differently and more efficiently. It will be seen upon reference to the circuit diagram of the receiver that the plate of the modulator tube is not connected to a "B" battery but to the grid circuit of the oscillator tube through the primary of the first intermediate-frequency transformer. Therefore the frequency of the oscillator is impressed directly on the plate of the modulator. Now the signal frequency after being first amplified in the radio-frequency tube modulates the oscillator frequency and produces a band of frequencies for which the intermediate transformers are designed. Therefore, it can be seen that no rectification occurs in the modulator tube. By this system a very minute amount of current will cause the system to function and therefore the set will respond to distant signals, which an ordinary superheterodyne receiver would never detect.

Another interesting fact is that the sensitivity is greatly increased by the use of the stage of tuned radio-frequency amplification. Also the selectivity is increased.

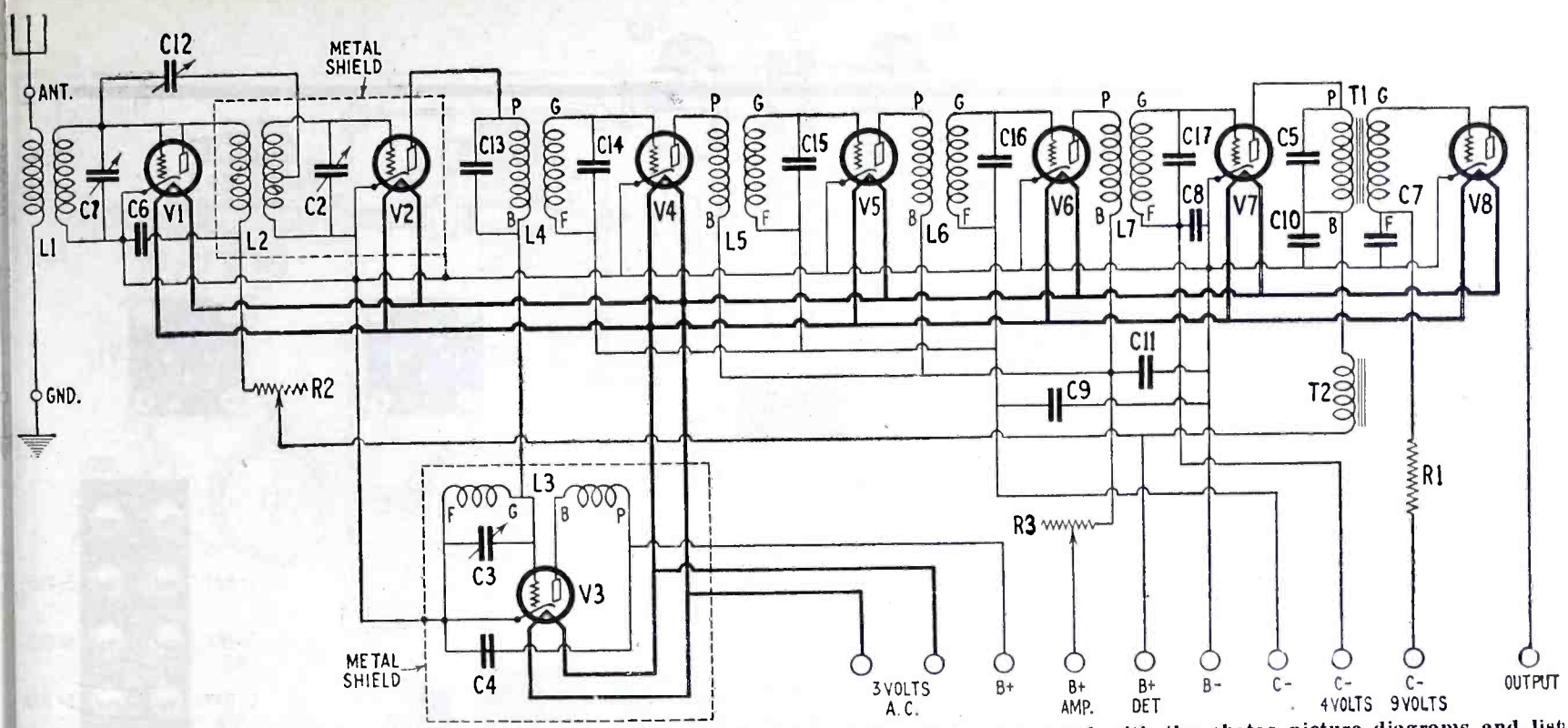
The intermediate-frequency amplifier is designed to function at 113 kilocycles (2650 meters). The intermediate-frequency transformers (Ultraformers) are of the air-core type, having their secondaries tuned to the designated frequency by small condensers.

The first thing to do when laying out the receiver is to drill the sides of the aluminum shields for the mounting of the variable condensers. The greatest care should be exer-

LIST OF PARTS

- 3 Hammarlund type ML17 .00035 mfd. variable condensers, C1, C2, C3.
- 1 Sangamo .001 mfd. fixed condenser, C4.
- 1 Sangamo .002 mfd. fixed condenser, C5.
- 4 Acme Parvolt ½ mfd. by-pass condensers, C6, C7, C8, C9.
- 2 Acme Parvolt 1 mfd. by-pass condensers, C10, C11.
- 1 Hammarlund balancing condenser, C12.
- 1 Hammarlund R. F. coil No. 40, L1.
- 1 Hammarlund R. F. coil, No. 41, L2.
- 1 Hammarlund R. F. coil, No. 42, L3.
- 3 Ultradyne Ultraformers, type B, L4, L5, L6.
- 1 Ultradyne Ultraformer, type A, L7.
- 1 Sangamo audio transformer, T1.
- 1 Thordarson autoformer, T2.
- 1 Lynch 100,000 ohm fixed resistor and mounting, R1.
- 2 Clarostat variable resistances, R2, R3.
- 1 Front Panel, 8x24x3/16 inches.
- 1 Terminal Strip.
- 1 Birnbach 10-ft. battery cable.
- 10 Eby binding posts.
- 8 Benjamin sockets, No. 9044.
- 5 Special matched fixed condensers (with coils) C13, C14, C15, C16, C17.
- 1 Tyrman drum dial.
- 2 Hammarlund shields.
- 25 Feet Acme Celatsite wire.
- 2 Hammarlund extension shafts.
- 1 Hammarlund flexible shaft coupling.
- 1 Wooden baseboard, 12x25½ in.
- 1 Carter switch No. 110, S.
- 8 Sovereign A. C. tubes, V1, V2, V3, V4, V5, V6, V7, V8.

Miscellaneous lugs, nuts, screws, bolts.

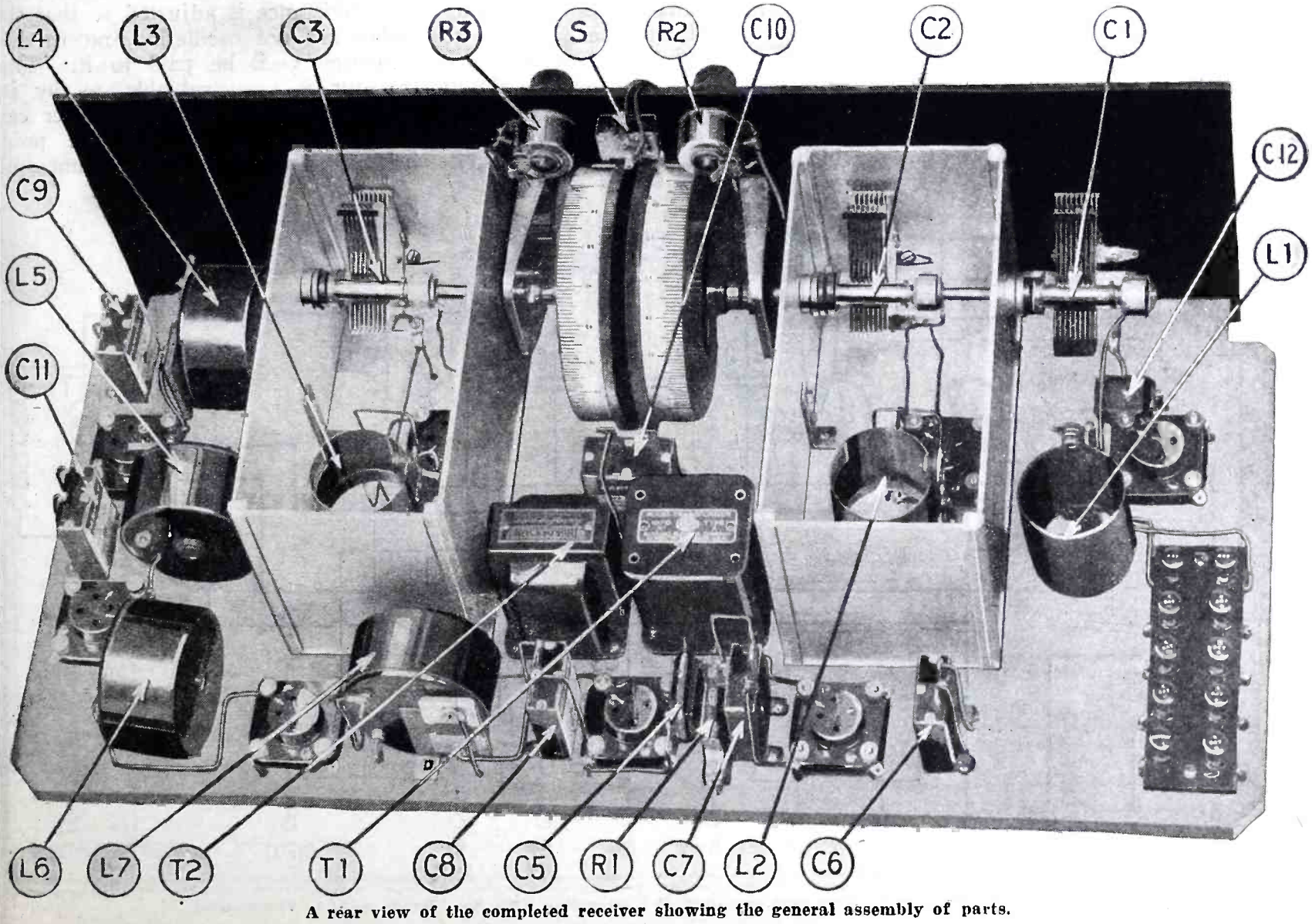


Schematic wiring diagram of the Ultradyne A. C. Commander. All parts are indicated to correspond with the photos picture diagrams and list of parts for the set.

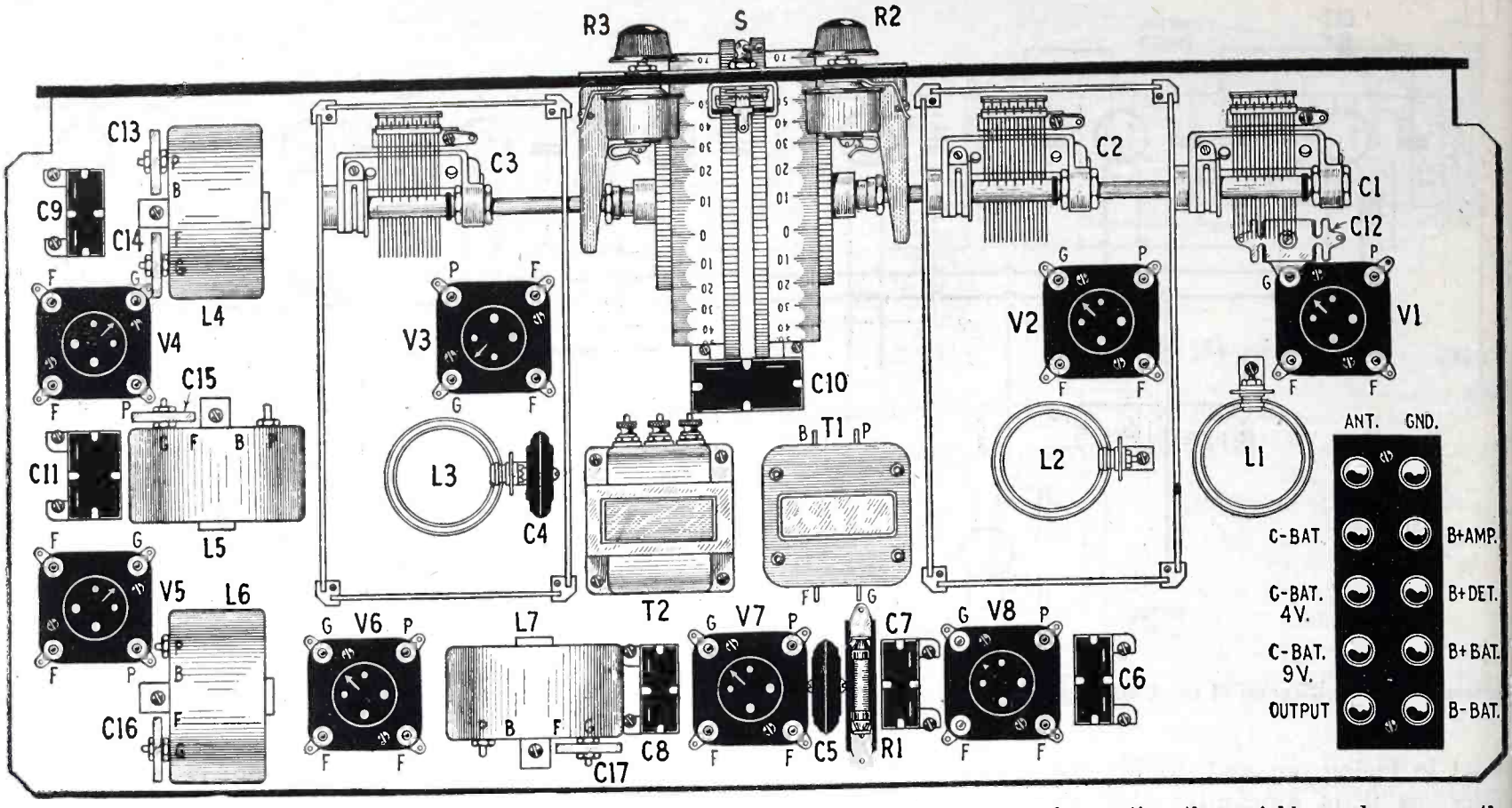
cised in laying out and drilling these holes, as it is imperative that they line up exactly. Use an accurate scale when measuring the distances, for if these holes are not aligned accurately the condensers' shaft will not fit into the drum dial.

The next step is to drill the front panel, but this is not difficult as there are comparatively few holes. The hole for the drum dials, if no "fly cutter" is available, may be made by drilling a series of small holes around a circle inscribed on the panel and then cutting out with a small saw the remaining spaces between them. The hole can be trued up by using a half round file. The various pieces of apparatus are next placed on the wooden baseboard and mounted in place by means of wood screws. The baseboard should be one-half inch thick.

The apparatus that is mounted on the front panel should be fastened to it after the panel has been mounted on the wooden baseboard which should be at least one-half inch thick. Care must be taken in the mounting of the condensers and



A rear view of the completed receiver showing the general assembly of parts.



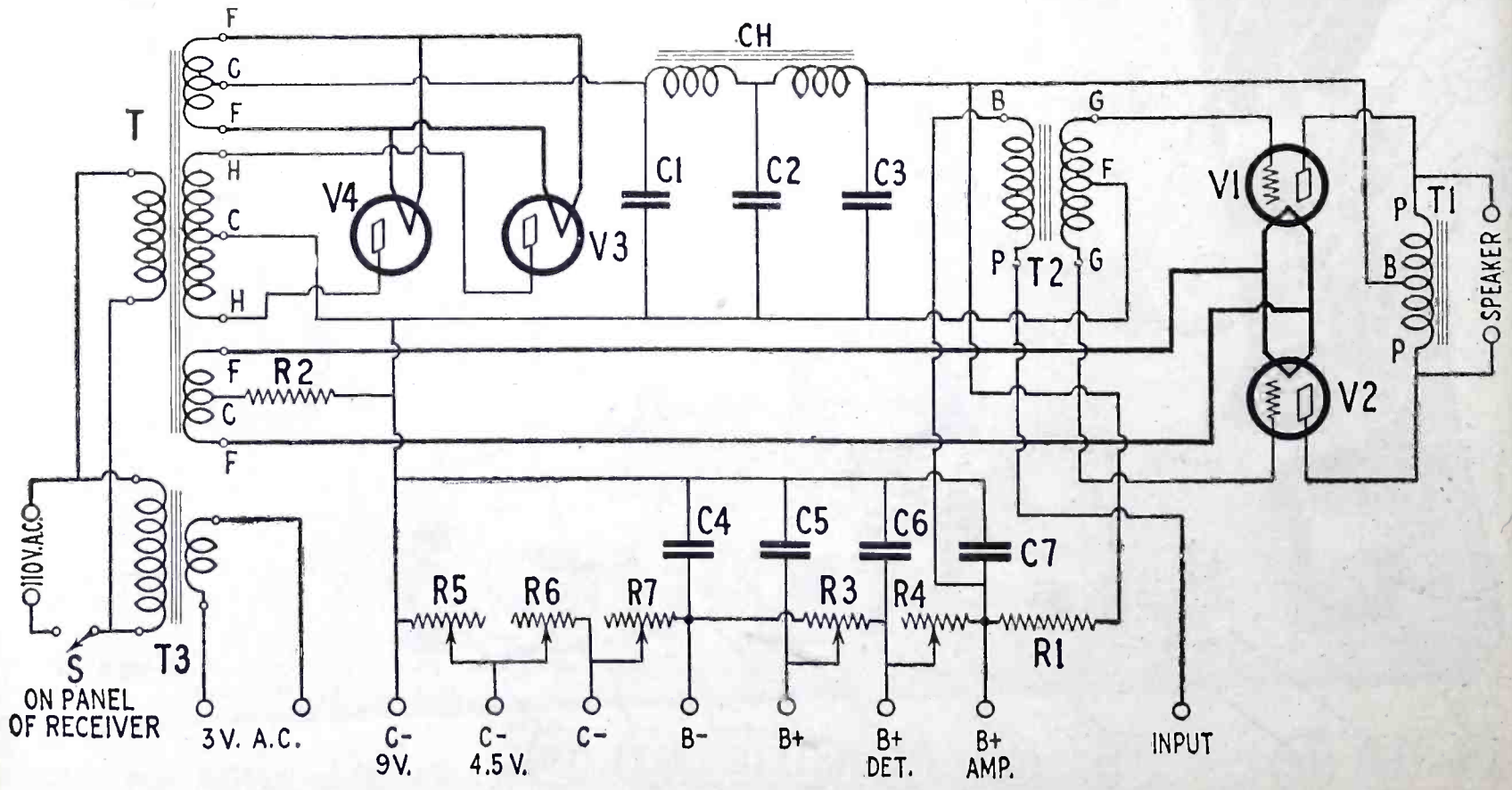
The above layout shows how all parts are mounted on the baseboard and panel. Note the method of mounting the variable condensers on the walls of the aluminum shields.

drum dials so that they line up perfectly and therefore will operate smoothly. Next the other apparatus is mounted by means of wood screws to the baseboard, following the layout that is shown herewith. As may be seen some of the wiring is run under the baseboard and therefore holes have to be drilled at the proper places to permit this.

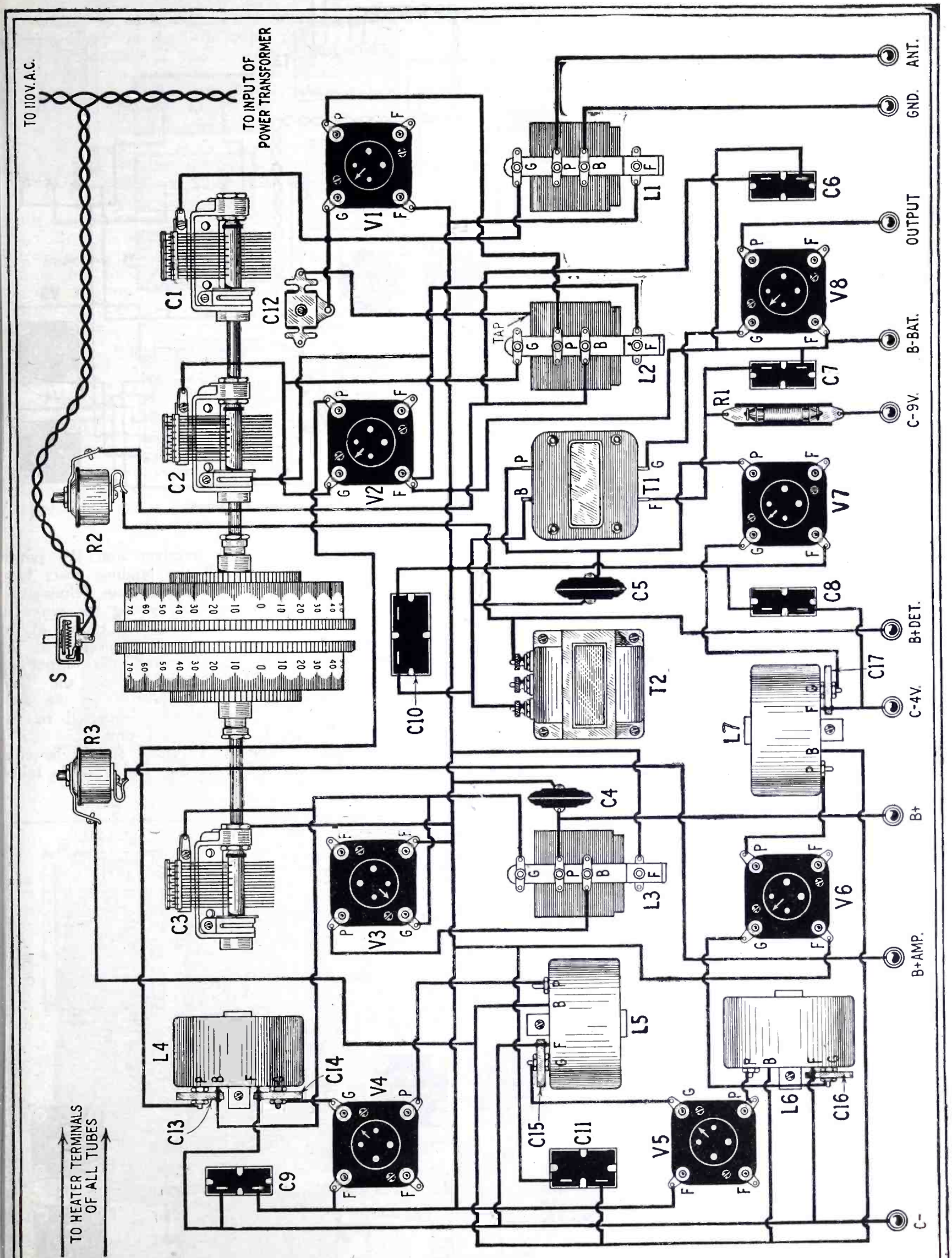
The constructor will find that the wiring diagram given is a great aid. When the set was designed and built thought was given as to just how each wire should be run in order to get the best results. Therefore the constructor is advised to follow this diagram as closely as possible.

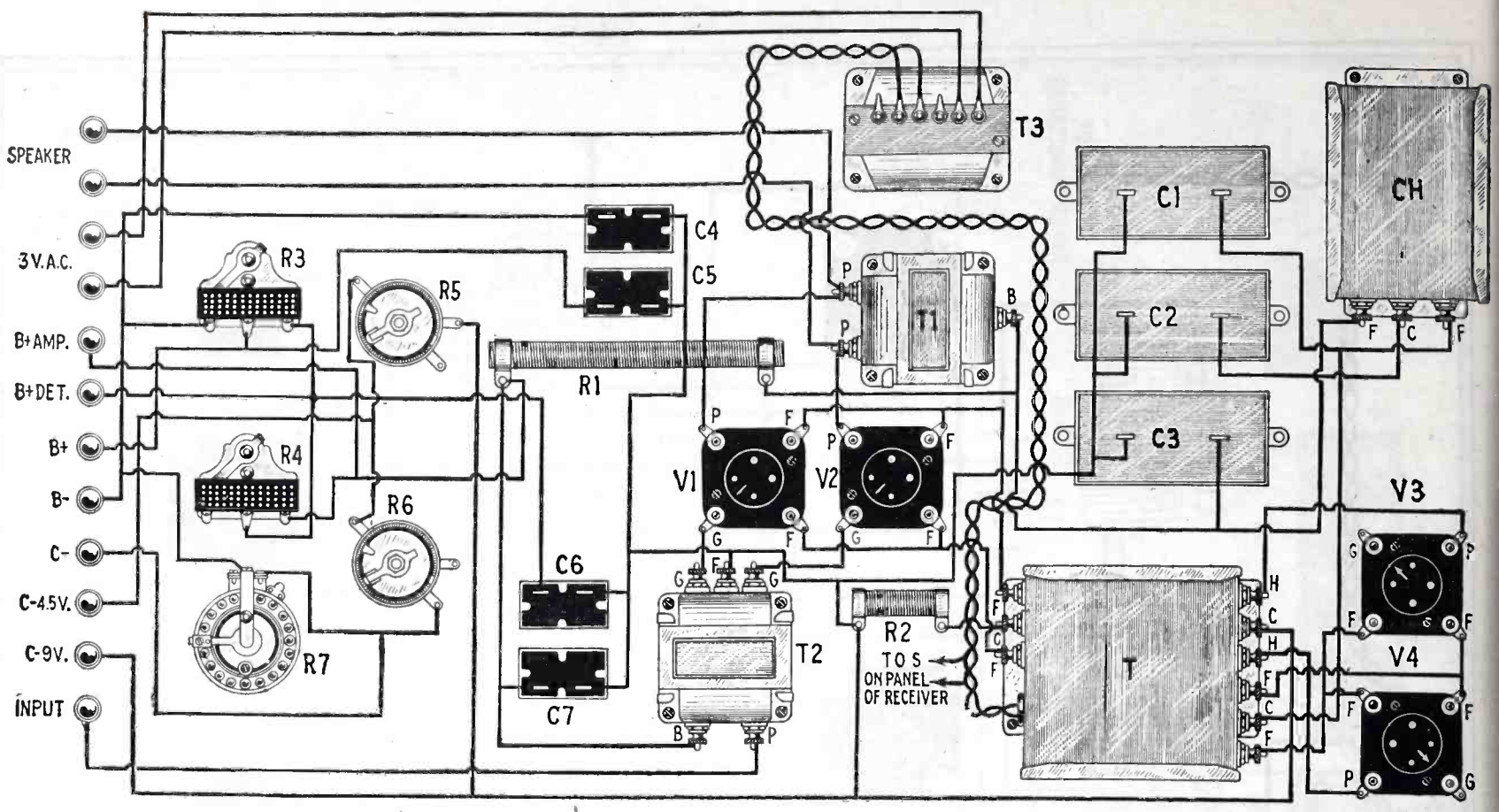
Since the volume cannot be varied by changing the filament current of the tubes, a variable resistor is placed in the plate circuit of the radio-frequency amplifier tube. This is an ideal position for the control as it cuts down the signal energy almost at the very start and so does not overload any of the following tubes, which might be the case when listening to a local station, and thereby cause distortion.

In order to eliminate all chance of the tubes in the intermediate amplifier oscillating, another variable resistor is incorporated in the plate circuit of these tubes. When once this resistance is adjusted so that the tubes are not oscillating, no further attention need be paid to it. This resistor is very valuable, as by its means the tubes in the amplifier can be brought right up to the point of oscillation, but they will not spill



Schematic diagram of the power unit employed in conjunction with the Ultradyne A. C. Commander.





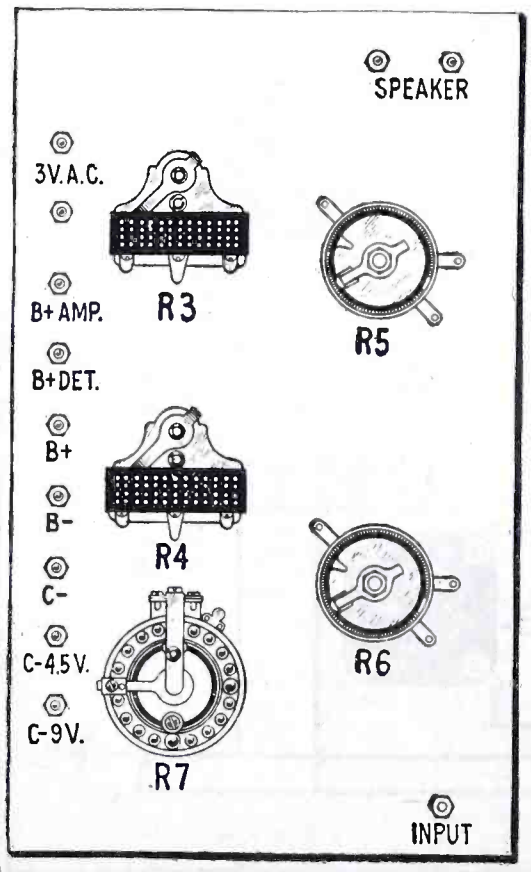
The diagram above shows in picture form how parts of the power unit are wired.

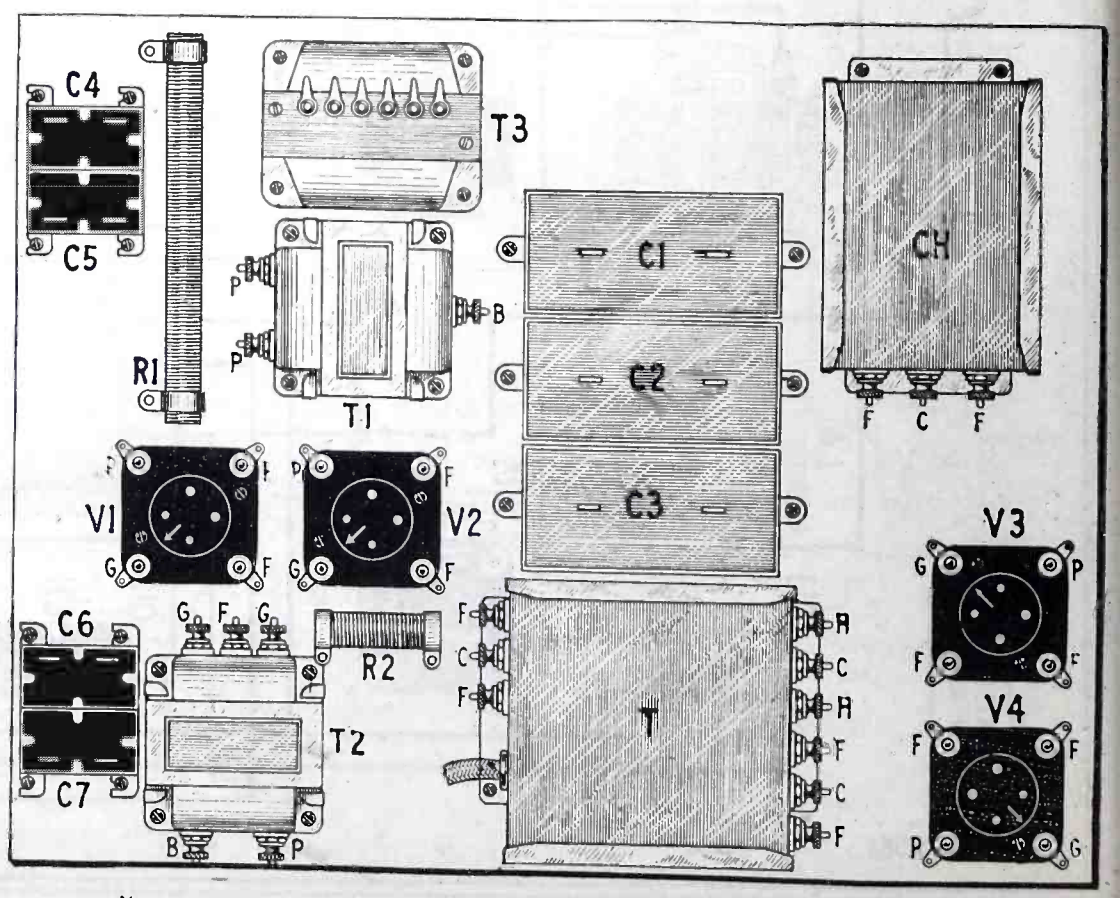
over. As this will aid greatly when hunting for DX stations this is really a sensitivity control.

The first step in building the power unit for operating this receiver is to drill the front panel on which are mounted the resistors and binding posts. This panel is then mounted on a wooden baseboard on which the rest of the apparatus is placed. Here none of the wiring need be run beneath the baseboard, as there is comparatively little to do. Follow carefully the layout plans shown, as in this way the wires carrying the power will be in the best place.

It is a good idea to use busbar when wiring the unit as it is stiff and will therefore stay in place. Also connections carrying high voltage should be covered with spaghetti tubing, eliminating any danger of getting a shock if they should be touched accidentally. There is little work in making the connections between the receiver and the power unit as all the binding posts have similar markings, thus eliminating any chance of getting the wires in the wrong place. The output of the set is of course connected to the input of the unit, the output of which is connected to the loud speaker. The heaters of the set's A. C. tubes are connected to the A. C. posts on the unit.

The A. C. tubes should be connected with the supply leads taken





At the left shows how the variable resistors of the power unit are mounted on the panel while at the right shows the arrangement of parts on on the baseboard.

in the center so that four tubes are connected to each side of the main leads. This is done in order that the distribution of the current can be evened up along these leads.

To operate the set, all the resistors on the power unit are adjusted so that the arm is about in the middle of each one. This should permit the set to operate at first. When the tubes are functioning correctly then the resistors can be readjusted in accordance with the voltage on the line. This can be determined by the quality of the music coming from the loud speaker.

On the set itself the upper left knob controls the volume and also the sensitivity of the radio-frequency amplifier. It is advantageous to readjust this knob when trying for weak stations, so that this amplifier will function at the highest possible efficiency. The other control is in the intermediate amplifier circuit and should be adjusted until the signals are loudest and clearest. Then the rheostat on the power unit panel should be reset for optimum results.

PARTS FOR POWER UNIT

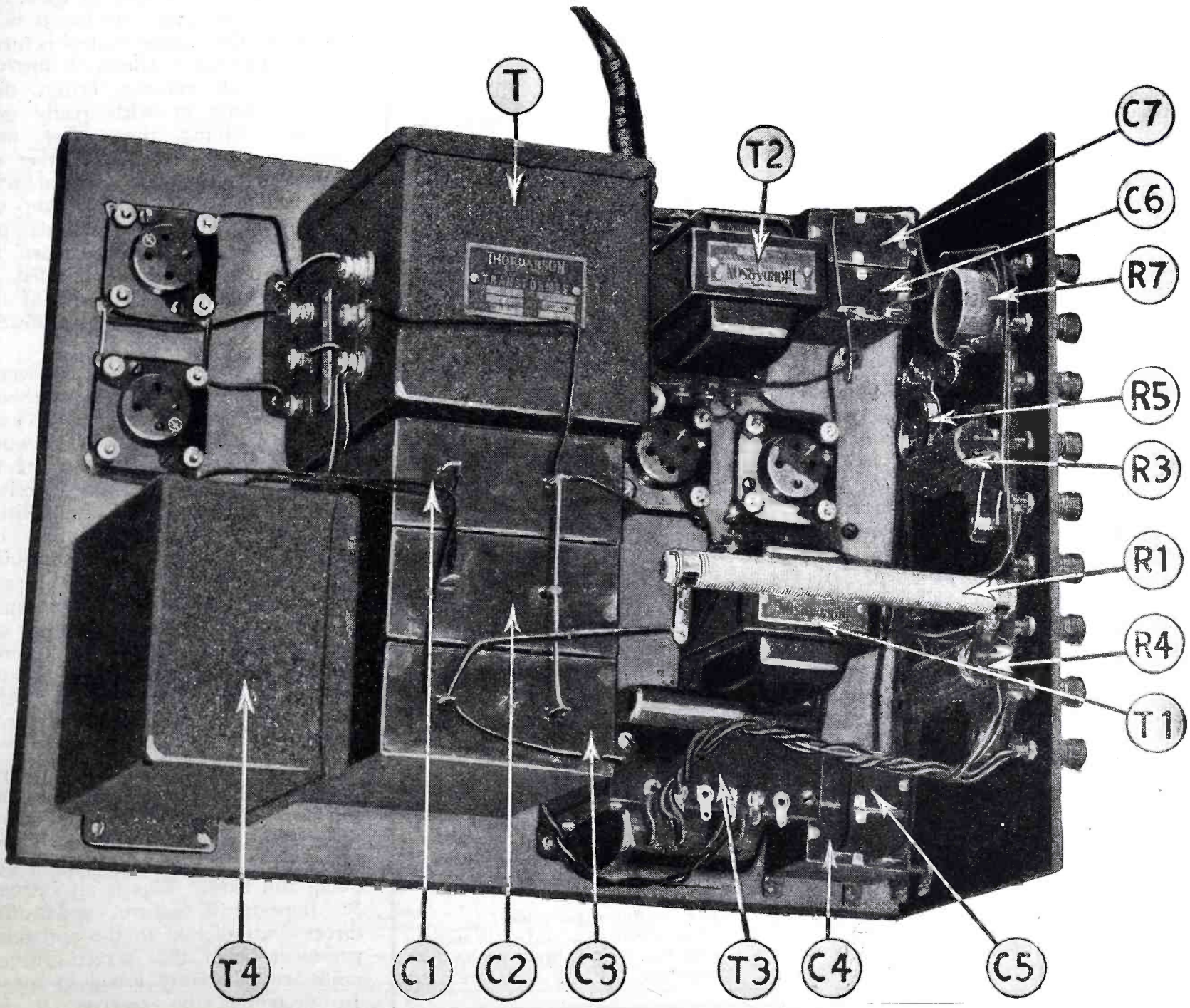
- 4 Acme Parvolt type A, 1 mfd. by-pass condensers, C4, V5, C6, C7.
- 3 Acme Parvolt type C, 2 mfd. by-pass condensers, 1,000 volts, C1, C2, C3.
- 1 Thordarson push-pull transformer, type T2408, T2.
- 1 Thordarson output choke, type T2420, T1.
- 1 Thordarson high voltage transformer type T2098, T.
- 1 Transformer Co. of America A. C. heater transformer. T3.
- 1 Thordarson double choke coil, type T2099, CH.
- 1 Eelectrad Truvolt fixed resistor, type D70, R1.
- 1 Electrad Truvolt fixed resistor, type B7.5, R2.
- 2 Electrad Truvolt variable resistors, type T50, R3, R4.
- 2 Carter 200 ohm potentiometers, R5, R6.
- 1 Carter 50 ohm rheostat, R7.
- 12 Eby engraved binding posts.
- 1 Panel 7x12x3/16 inches.
- 1 Wood baseboard, 12x15 inches.
- 20 Feet Acme Celatsite wire.
- 2 CeCo tubes, type L10, V1, V2.
- 2 CeCo tubes, type R81, V3, V4.
- 4 Benjamin spring sockets.

This receiver will operate on any type of antenna, either indoor or outdoor, but it almost goes without saying that the best results will be from an outdoor antenna. Any single wire between 75 and 120 feet long will be sufficient. Be sure that you have a good ground connection on either a water pipe or a radiator.

A word of caution should be added here. Before trying this out or better yet before building this set, be sure that you have 60-cycle alternating current in your home. This set will operate only on that.

In order to get the full benefit of the high-quality audio amplifier and push-pull second stage, a good loud speaker must be used; because quite a few loud speakers will rattle or distort and will not do justice to the quality of the amplifier.

In tests conducted at our laboratory, a dynamic type speaker was used which gave exceptionally good results. However, the constructor has a wide variety of good speakers to choose from, but is advised to select a high grade product.



A photographic view of the power unit showing the layout of parts and wiring.

How to Build The Cosmopolitan Screen-Grid Receiver

IN designing this receiver, the collaboration was obtained of a Research Engineer who has not only spent many years in developing receivers but who has also made exhaustive tests with screen-grid tubes. There is probably no engineer today who has had more practical experience with or first-hand information on this tube and the circuits employing it. It was a privilege indeed to be able to call upon his vast store of information on the peculiarities of this tube in working out the design for this receiver. While his affiliations in the radio industry make it impossible to give him due credit by divulging his name, we wish to take this opportunity of acknowledging indebtedness to his kindly interest and helpful suggestions.

The outstanding feature of this receiver of course, is its sensitivity. During a demonstration recently staged in New York City between the hours of 8 and 9:30 P. M., stations at Schenectady, N. Y., Pittsburgh, Pa., and Nashville, Tenn., were brought in using only a four-foot wire for an an antenna. These stations came pounding in with sufficient volume to make conversation in the same room difficult. With a 30-foot antenna, the volume was so great, on stations up to 1,000 miles away, as to overload the tube in the last audio stage when the volume control was turned up.

In tests covering several evenings, KFI, Los Angeles, has been brought in regularly on a 30-foot antenna. On a 75-foot antenna, KFI has been brought in with sufficient volume to be heard several rooms away. Such reception was not a matter of unusually favorable conditions but a night after night reception in the hours after WRC, Washington, D. C., which operated on the same wavelength has signed off.

The receiver is so thoroughly shielded that there is no signal pick-up without an antenna except on two or three of the low-wave stations. Even in the case of these low-wave stations signals are barely heard only when the volume control is turned all the way on. Adding a one-foot wire for an antenna brings these same stations in with really good volume. Adding three feet more brings in all the locals and other stations up to several hundred miles distant with good loud-speaker volume. This really remarkable performance on extremely short antennae of a perfectly shielded receiver is conclusive proof of the high degree of R. F. amplification attained in the design.

The construction of the receiver is by no means complicated although somewhat greater care must be exercised in its construction than would be given to the construction of the ordinary type of five-tube receiver. Tuning is simple, being accomplished with two main controls and one auxilliary control. The auxilliary control however, is used only to provide exact resonance when tuning in distant stations, when maximum sensitivity and selectivity are required. For normal reception this control need not be used. The only other adjustment is that for volume control.

Through careful design, adequate selectiviity has been obtained to permit bringing in innumerable out of town stations during the early evening when the local stations are going full blast. This is an extremely important feature and offers direct contradiction to the apparently prevalent belief that screen-grid circuits are inherently broad in tuning. In designing the receiver it was

LIST OF PARTS

- 3 Hammarlund No. ML-17. .00035 mfd. Midline variable condensers, C1, C2, C3.
- 1 General Radio, type 368, .000015 mfd. variable condenser, C4.
- 1 Hammarlund No. EC, Equalizer adjustable condenser, C5.
- 4 Aerovox .02 mfd. fixed condensers, C6, C7, C8, C9.
- 1 Aerovox .5 mfd. by-pass condenser, C10.
- 1 Aerovox .001 mfd. fixed condenser, C11.
- 2 National or Marco vernier dials, D1, D2.
- 1 Yaxley or Jones 7 wire cable plug, MP.
- 1 Frost 500,000 ohm variable high resistance with filament switch, R1, SW.
- 1 Carter type H-4 or RU-4 resistance, 4 ohms, R2.
- 2 Carter type H-10 resistances, 10 ohms, R3, R4.
- 1 Carter type H-20 fixed resistance, 20 ohms, R5.
- 1 Amperite, No. 112, R6.
- 3 Hammarlund No. RFC-85 radio frequency chokes, RFC1, RFC2, RFC3.
- 3 Aluminum Co. of America standard box shields, 9x5x6 inches, S1, S2, S3.
- 2 Carter screen-grid tube shields, S3, S4.
- 1 Precision No. 41 Diamond Cut antenna coupling transformer, T1.
- 2 Precision No. 4M Diamond Cut screen grid coupling transformers, T2, T3.
- 2 Thordarson R-200 audio transformers, T4, T5.
- 1 National tone filter, T6.
- 3 Carter No. 10 tip jacks and Carter Imp plugs to match, TJ1, TJ2.
- 5 Benjamin No. 9040, sockets, VT1, VT2, VT3, VT4, VT5.
- 2 CX-322 screen-grid tubes, in sockets VT1 and VT2.
- 1 CX-299 tube in socket VT3.
- 1 CX-310A tube in socket VT4.
- 1 CX-371A tube in socket VT5.
- 1 Formica or Lignole panel, 7x21 inches.
- 1 Wood baseboard 20x12x½ inches.
- 1 Pkg. Acme Celatsite flexible hook-up wire.
- 1 Pkg. Kester radio solder.
- 1 Composition strip, 4x1x3/16 inches with two 1 inch brass angles for mounting.

found necessary to design special coils because none of the coils on the market would supply either the maximum amplification or maximum selectivity made possible by the tubes. Therefore it is of vital importance that the coils specified be used in the construction of this set. In preliminary test circuits a voltage amplification (average at all broadcast frequencies) of 39 per stage and running as high as 49 per stage at 1,500 kilocycles was obtained when employing these coils, much higher than any of the other coils available for use with these tubes.

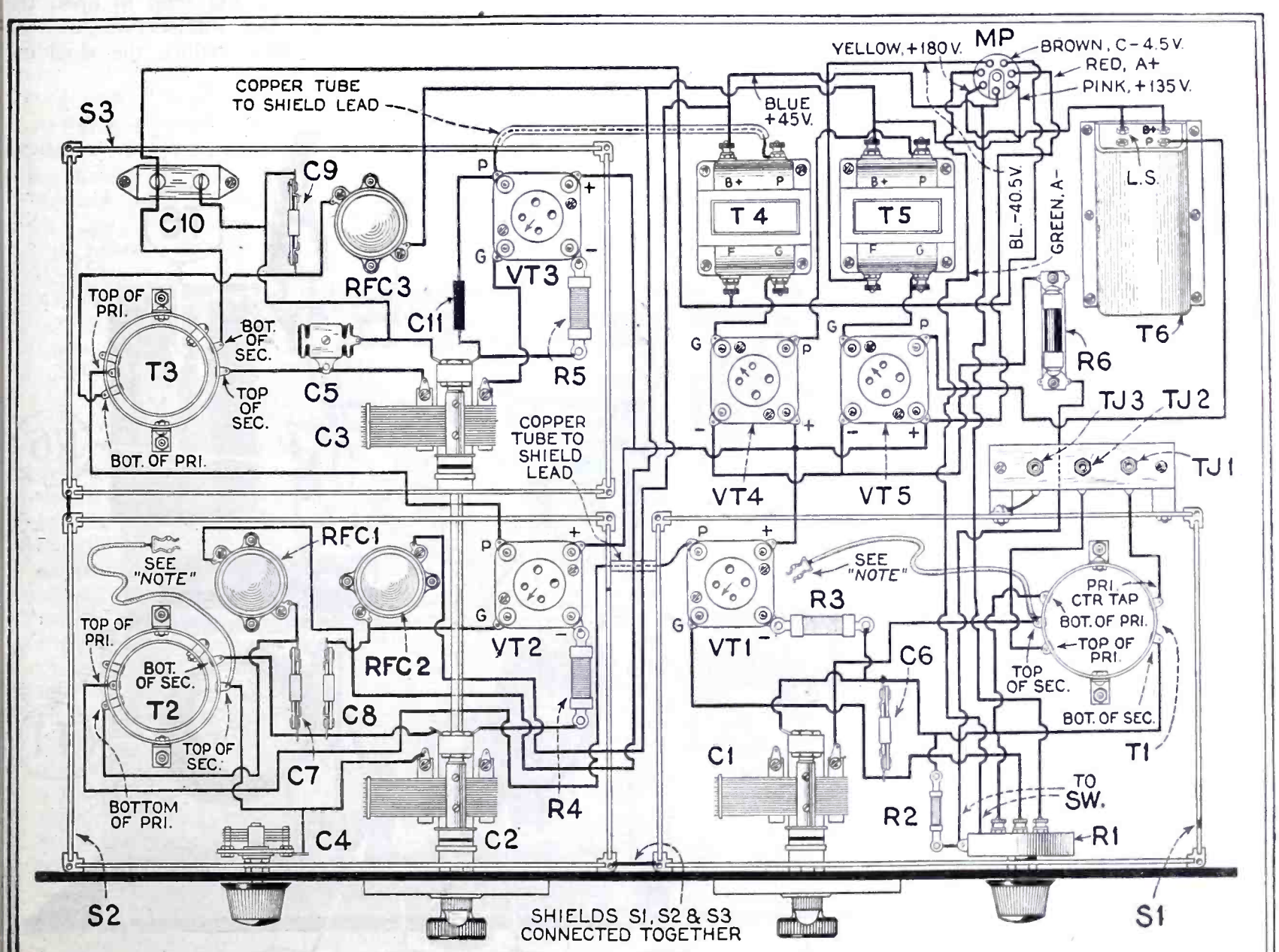
The turn ratio of the R. F. coupling transformers is approximately 1 to 1, yet the receiver cannot be made to oscillate except on the very low wavelengths and there the oscillation is under absolute control by means of the volume control knob. This stability is accomplished through proper coil and circuit design and not through the usual lesser methods. Had the coils been made slightly less efficient it would have been possible to completely eliminate the possibility of making the receiver oscillate even on the low wavelengths, but this would have meant a sacrifice of amplification, especially at the long waves. This would not be desirable, especially as it is never necessary to turn up the volume control to a point where the amplifier will oscillate.

Needless to say, careful attention has been given to the matter of tone quality. The stability of the R. F. amplifier prevents any tendency toward distortion in that portion of the circuit and high grade transformers in the audio stages insure quality reproduction at that end.

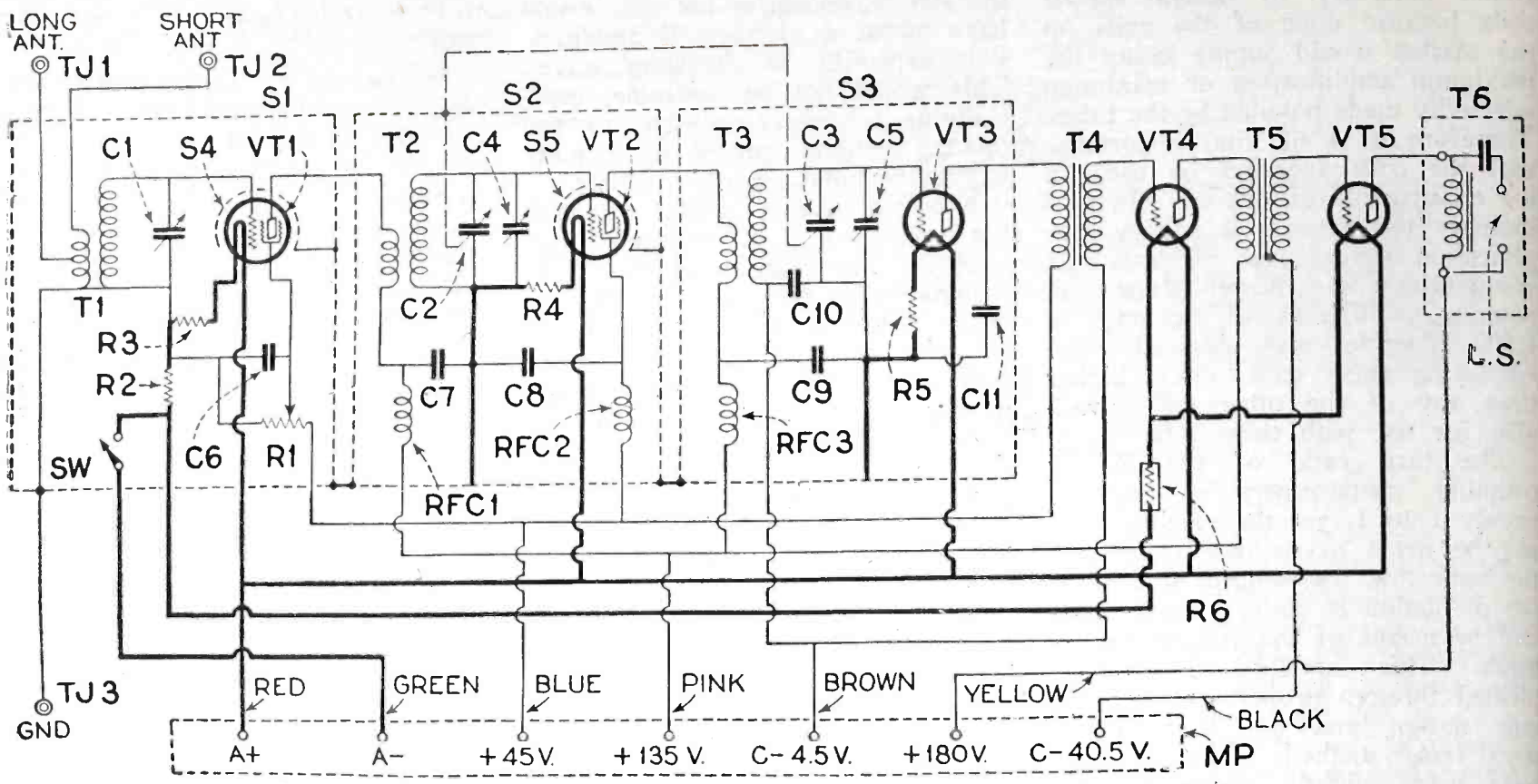
A study of the illustrations will disclose that extensive precautions have been taken to avoid any undesirable coupling between stages. The two R. F. stages and the detector stage are individually enclosed in aluminum box shields to reduce electro-static and electro-magnetic coupling. Direct coupling through the leads and batteries or "B" eliminator is reduced through the use of chokes and by-pass condensers. The two screen-grid tubes are shielded from their circuits by the use of individual tube shields of copper. These shields are provided with removable caps and shielded connectors.

The method of volume control employed is unique and has the advantage that it neither broadens tuning nor causes microphonic disturbance as would be the case with shunt resistances or filament rheostats respectively. Neither of these older methods has any place in circuits employing screen-grid tubes.

The "C" bias for the screen-grid tubes is obtained through the drop in the 10-ohm resistors inserted in the negative side of the individual filament circuits. This arrangement has the advantage that the "C" bias varies with the tube plate current which in turn varies with the tube plate voltage. In this way, the correct bias is automatically maintained regardless of the amount of plate voltage applied to the tubes. In the case of the detector tube, a bias is also used but this is obtained from an external "C" battery or from the battery eliminator as the case may be. The grid bias method was used for several reasons. The most obvious was to prevent over-



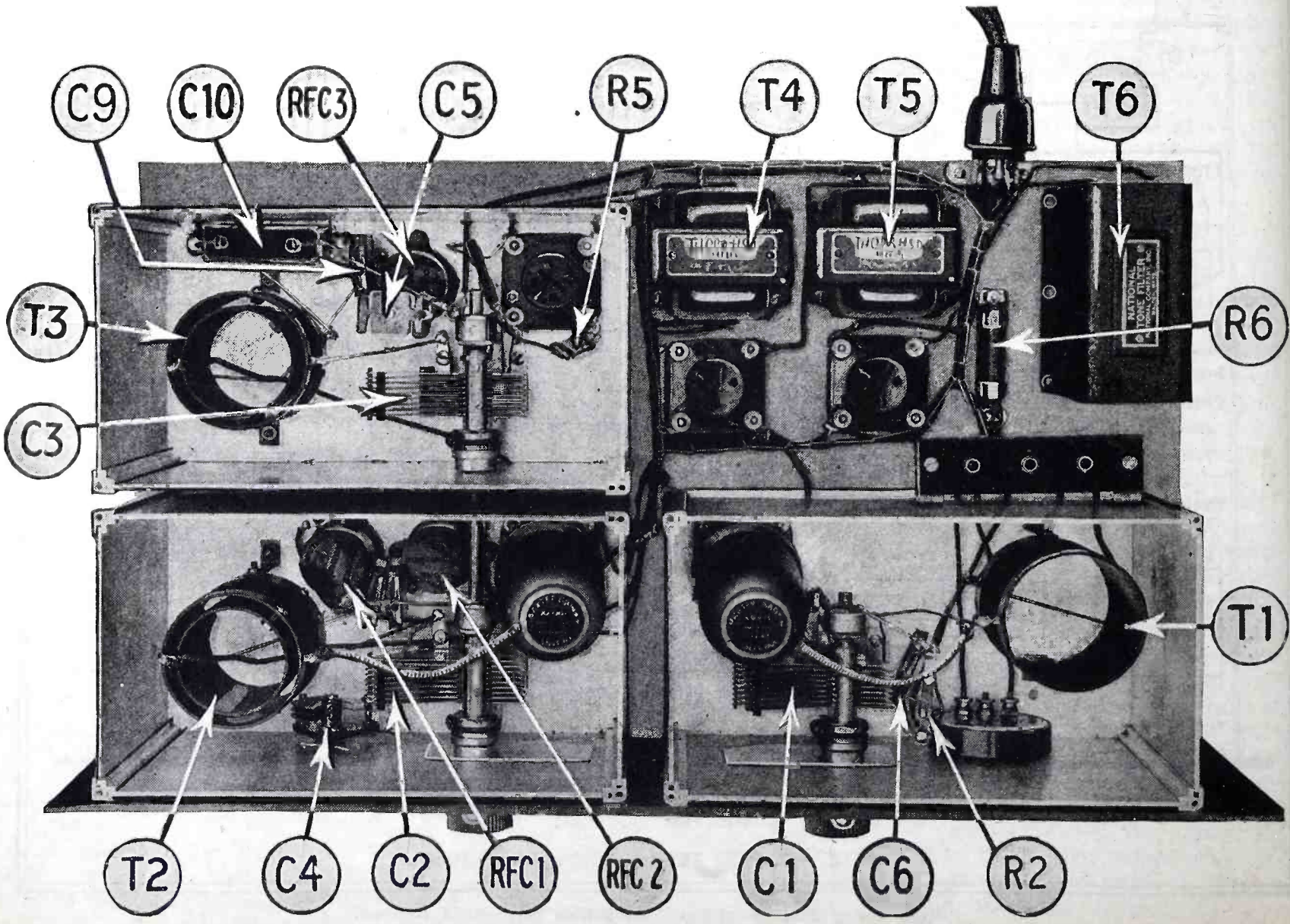
Picture wiring diagram of the Cosmopolitan Screen-Grid Receiver.



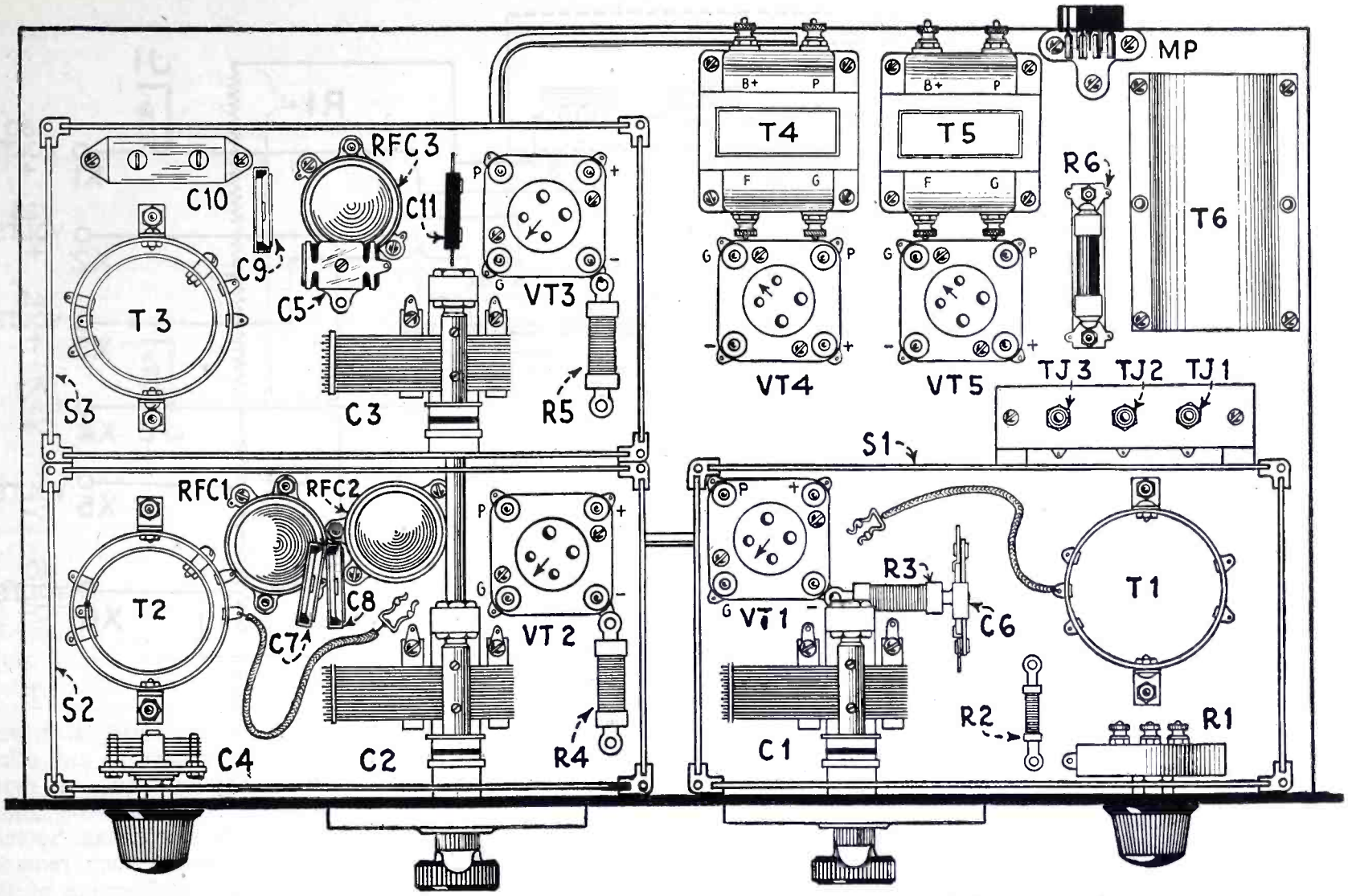
Schematic diagram of the wiring. All parts within dotted lines are enclosed in shields.

loading the detector—a precaution made necessary by the high amplification of the R. F. amplifier system.

In assembling the receiver shown in the illustrations, the sheilds were mounted with ¼ inch bushing between baseboard and shield bases and were attached to the baseboard at only three corners of each shield. This precaution was taken to prevent warping of the shield bases in case the baseboard is not absolutely flat. If this is not done, any warping of the baseboard and of the shield bases would tend to open the shields at the intersection of the edges and thus reduce the shielding effect.



A top view of the set showing how the screen-grid tube shields are mounted and connected.



Instrument layout of the set showing the placement and position of all parts.

Contact with the grid terminal stem of the screen-grid tubes is made by means of small caps of the connectors provided with shields which fits snugly over the brass ferrule of the tubes. Special insulating bushings are provided to prevent any possibility of contact between the caps and shields after connecting the leads to the terminals on top of the tubes, the caps may be placed on the tube shields and the flexible shields slipped over the leads.

In order to gang the tuning condensers of the second R. F. and detector stages on a single shaft, it is necessary to use a small, extra balancing capacity if exact resonance is to be obtained. The second R. F. stage requires slightly higher capacity than the detector stage and the amount of this extra capacity increases with the wavelength. At the low wavelengths the capacity difference is less than the minimum capacity of a midget condenser, whereas at the highest broadcast wavelengths a balancing capacity of approximately half that of the balancing condenser "C4" is needed. Inasmuch as a midget type of movable plate condenser is required in the second stage for control from the panel, and inasmuch as the minimum capacity of such a condenser is too high to obtain resonance at the low wavelengths, it has been found necessary to add a very small capacity across the tuning condenser of the detector stage. This is a small spring type neutarilizing condenser "C5" which need be adjusted only once.

This receiver will function very well with either "B" batteries or a "B" eliminator. A very desirable type of eliminator designed especially for this set will be described in detail later in this article.

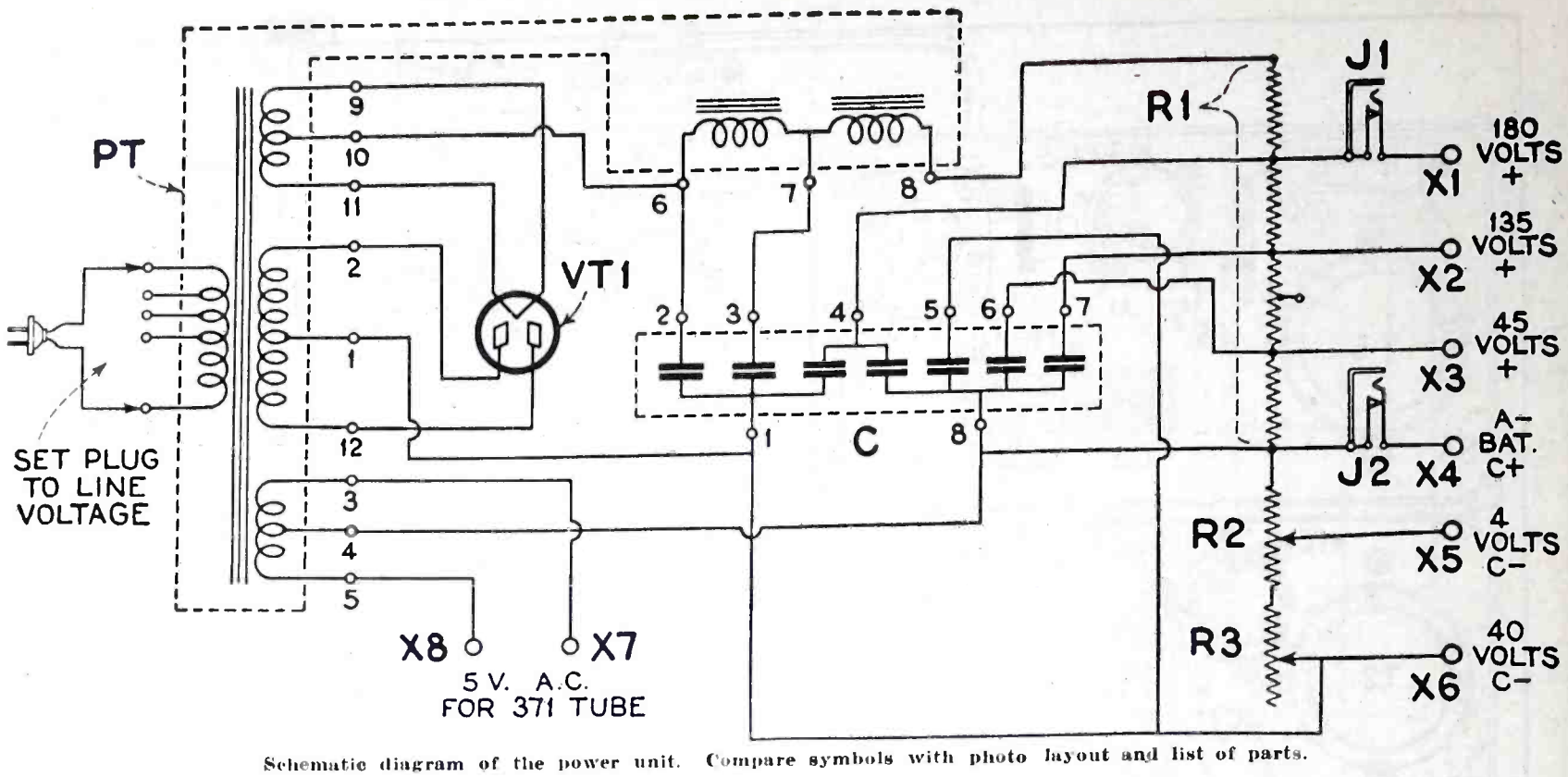
PARTS FOR POWER UNIT

1 Aerovox No. BC-280 condenser block, C.
2 Carter No. 2-A short jacks, J1, J2.
1 Samson No. 713 power block, PT.
1 Electrad type C-130-S "Truvolt" tapped resistance unit, R1.
1 Electrad type T-5 "Thruovlt." 500 ohm variable resistor, R2.
1 Electrad type T-10 "Truvolt," 1000 ohm variable resistor, R3.
1 Benjamin vacuum tube socket.
8 Eby binding posts, X1, X2, X3, X4, X5, X6, X7, X8.
1 CX-380, rectifier tube, VT1.
1 Composition panel, 10x4x3/16 inches.
1 Wood baseboard, 10x11½x¾ inches.
1 Pkg. Acme Celatsite flexible hookup wire.

It will be noted that the volume control potentiometer is connected directly across the detector plate supply source, whether the receiver is turned on or off. This would seem, at first glance to be wasteful of current when "B" batteries are used. Actually it provides no cause for worry because the current drain through this resistance is only about one-tenth of a milliampee and probably would not reduce the useful life of a set of batteries by one per cent.

In putting the receiver into operation, the usual practices are followed, except in the adjustment of the balancing condensers C4 and C5. This is therefore the only point that requires discussion. The adjustment is made with the covers of shields S2 and S3 removed.

The first step is to adjust the knob of C4 so that its arrow is in a horizontal position, pointing to the left when the plates are entirely unmeshed. Then turn the screw of C5 all the way in and then back one full turn. Next put the receiver into operation and tune in a low wave station at around 10 on the tuning dials, the left-hand tuning dial is then readjusted with different settings of the balancing condenser C4 until the best position for the balancing condenser is found for that particular station. If the condenser C5 is properly adjusted, the best position for C4 at this wavelength should be with the head of the arrow on the knob about ¼ inch above the horizontal. If it is less than this, turn the screw of C5 one-

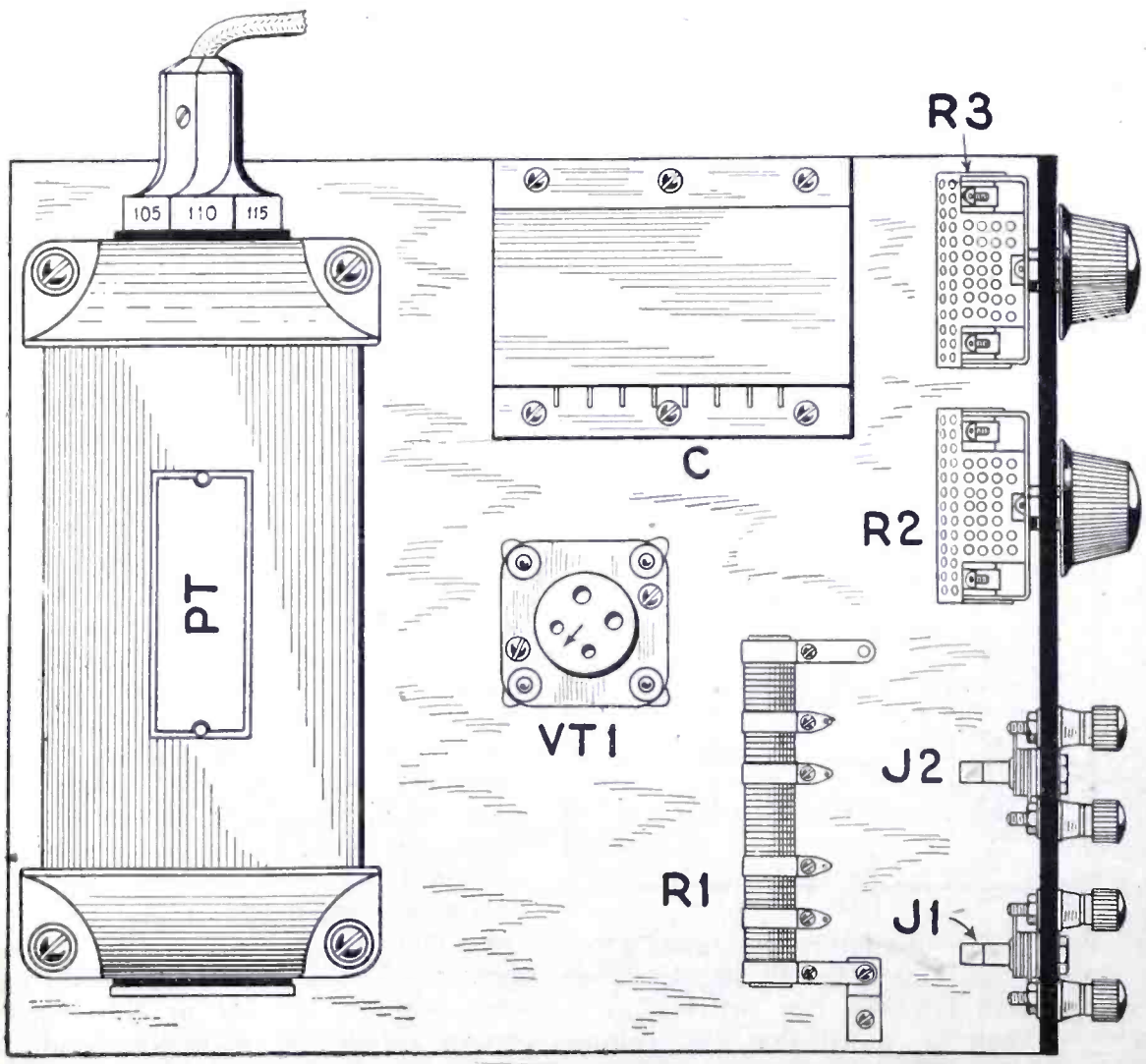


Schematic diagram of the power unit. Compare symbols with photo layout and list of parts.

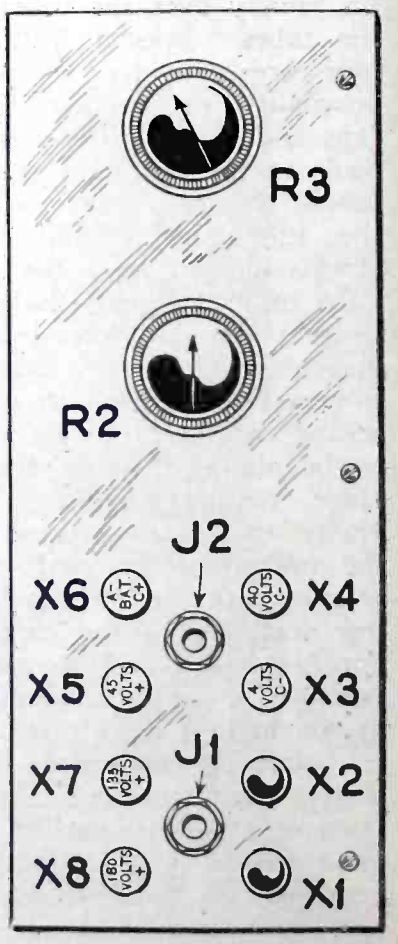
quarter turn to the right (clockwise) and repeat the process.

When the proper adjustment of C5 has thus been found, it need not be changed again. When maximum sensitivity and selectivity are desired on distant stations, C5 should be adjusted. For 200 meter stations, its adjustment will be about horizontal with the arrow pointing to the left (minimum capacity) while for 545 meter stations, the arrow will point almost directly up. Its useful range therefore represents only a a quarter turn of the knob and its adjustment is therefore not critical and adds very little complication to the tuning.

The eliminator illustrated was designed particularly for use with the Cosmopolitan Screen-Grid Receiver, but is equally applicable to any other receiver that employs one or more 371-type power tubes in the audio amplifier. The Cosmopolitan Screen-Grid set is capable of such remarkable results that it is deseving of the best of power supply units as a run ning mate and it is for that reason that this, the present unit, was de-



TOP VIEW-



- FRONT VIEW-

Layout of parts on the baseboard of the power unit is shown at the left. At the right is given a layout of the small bakelite panel on which the variable resistors, jacks and binding posts are mounted.

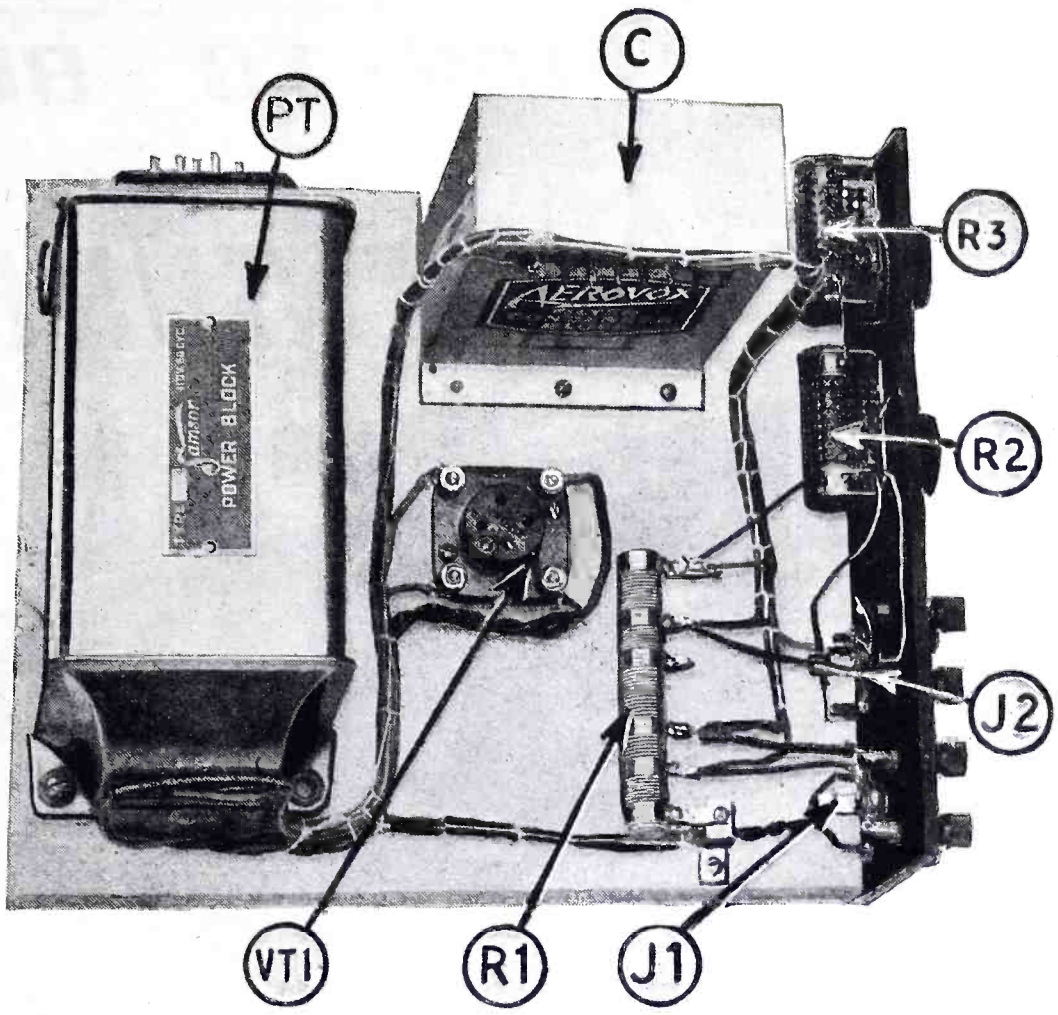
signed and is being described here.

This power pack is small in size, consists of few parts and is easy to construct and wire. While the parts employed are all standard and are of the highest possible standard, the cost of the whole job is little if any higher than the cost of the "B" batteries that would be required to do the same work over a period of one year.

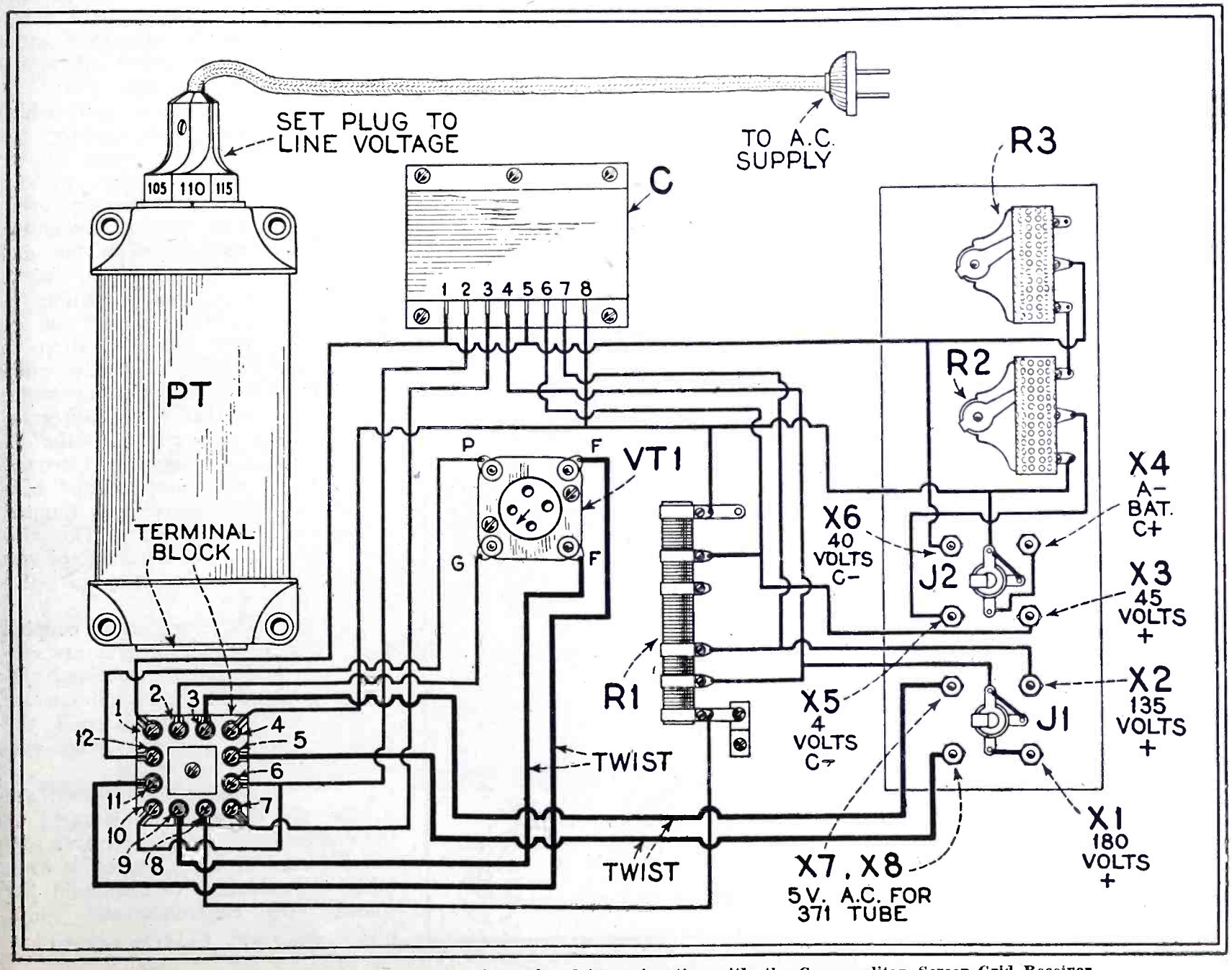
The transformer employed provides secondary voltages of 300 for each side of the full wave rectifier circuit; a five-volt, center-tapped winding for the filament supply for the CX-380 type full wave rectifier tube; and another five-volt center-tapped winding for operation of the filament of one or two CX-371 type tubes used in the last audio stage of the receiver with which this power unit is to be used.

A unique feature of the transformer is the primary plug connection by means of which the transformer primary is matched up with the pevailing local line voltage by the position of the plug. This scheme eliminates the necessity for voltage adjusting rheostats, switches, etc.,

(*Continued on page* 165)

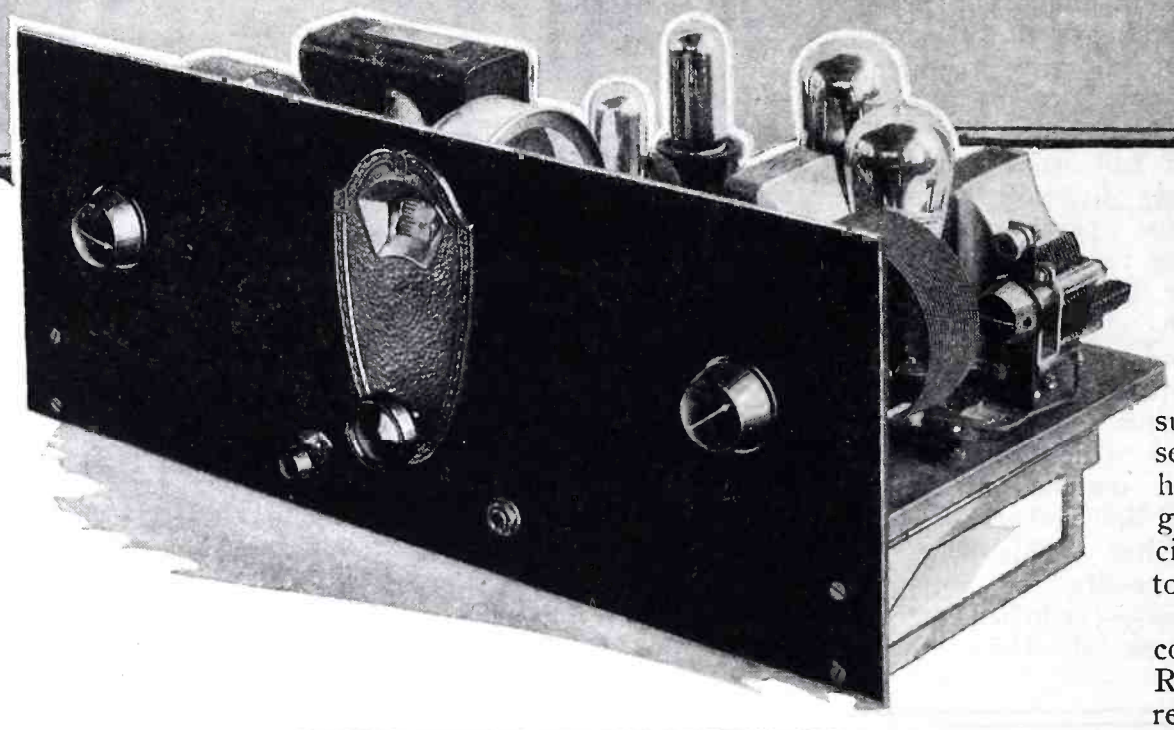


A photo of the power unit showing wiring.



Picture wiring diagram of the power unit employed in conjunction with the Cosmopolitan Screen-Grid Receiver.

HOW · TO · BUILD
THE · ADVENTURER · FOUR



IT has long been the desire on the part of those interested in short-wave work to evolve a circuit wherein it was possible to employ satisfactorily a stage of radio frequency amplification. Efforts to incorporate in the circuit a regular tuned stage of R. F. amplification ahead of the detector have not been very successful, due largely to uncontrollable oscillation in the R. F. stage and the extreme difficulty often encountered in satisfactorily tuning an exceedingly sharp or selective circuit.

The circuit featured in the design of the receiver described in this article has none of these drawbacks and in fact is so flexible in operation as to allow of the ganging together of the two tuning condensers.

Referring to the accompanying schematic diagram, the first tube, V1, is the radio frequency amplifier, the antenna being coupled to the tuned circuit L2-C3 through the midget condenser C1. Another condenser, C6 is employed to feed energy from the plate of the R. F. tube to the grid circuit of the detector tube. When C6 is correctly adjusted a very easy control of oscillation is thereby obtained. Capacity feedback is employed in the detector circuit thereby eliminating the necessity for a separate tickler coil. If the capacity of C6 is fairly large in comparison to the feedback condenser C5 then the R. F. amplifier will oscillate strongly and the detector only feebly, a condition which is rather undesirable. However, if the capacity of C5 be made large and C6 be made small in comparison a desirable condition results and it will be seen that what we have is a tuned grid-tuned plate circuit in the detector circuit.

Since the circuit comprises a good R. F. amplifier and regenerative detector, the receiver is extremely satisfactory in the reception of short-wave broadcast programs.

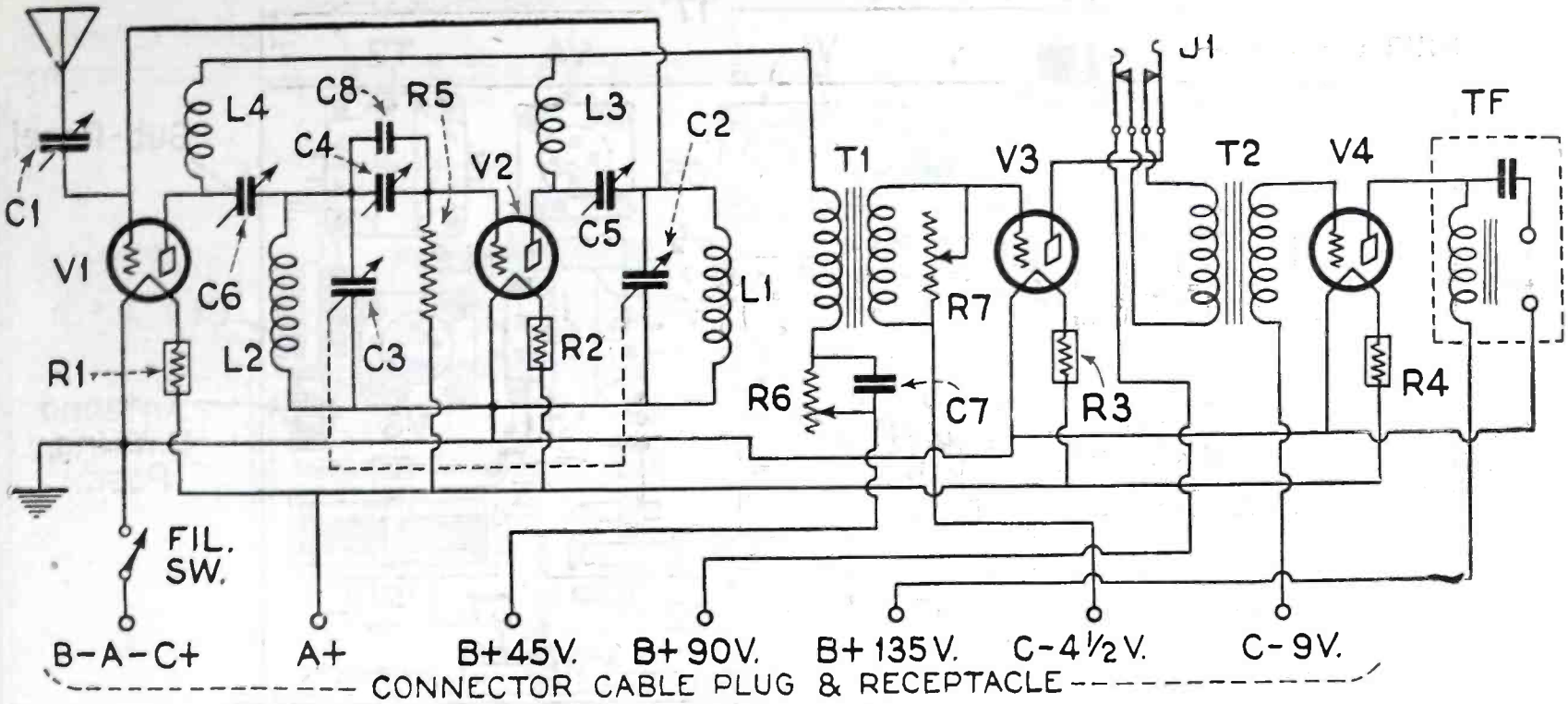
L3 and L4 are choke coils which provide a means for applying the plate potential to the plates of the R. F. and detector tubes without detriment to their satisfactory operation. The two tuning condensers C2 and C3 are actuated by one dial of the drum type and which, due to the natural sharpness of tuning at the short wavelengths must be of the vernier type. Regeneration in the detector circuit is controlled quite smoothly by a variable resistance unit, R6. So that the audio component in the plate circuit of the detector tube may be by-passed around this variable resistance a fixed condenser of 1 mfd. capacity is shunted across the resistance unit. This also helps to reduce the tendency of the resistance unit to be noisy in operation.

Two stages of transformer coupled audio frequecy amplification are employed to build up the received signal to a point where it will operate a loud speaker. The last of the audio stages is a power stage employing a 112 type of tube.

The tuning inductances which are of the plug-in type are situated at the extreme ends of the receiver and are mounted at right angles to each other to reduce to a minimum the chances for electromagnetic coupling.

LIST OF PARTS

1 Hammarlund midget condenser, 100 mmfd., C1.
2 Hammarlund midline condensers, .0001 mfd., C2, C3.
2 Hammarlund equalizer condensers, 35 mmfd., C4, C5.
1 Hammarlund midget condenser, 35 mmfd., C6.
1 Tobe by-pass condenser, 1 mfd., type 301, C7.
1 Tobe fixed condenser, .0001 mfd., C8.
2 Aero interchangeable coils, type INT-2 (for 30 to 70 meters), L1, L2.
2 Samson choke coils, No. 85.
2 Amperites, type 6V-199, or Elkay Equalizors, type No. 50, R1, R2.
2 Amperites, type 1A and 112, or Elkay Equalizors types Nos. 4 and 2, R3, R4.
3 Durham grid leaks, 8, 9 and 10 megohms, R5.
1 Electrad royalty variable resistance, 0-200,000 ohms, R6.
1 Electrad tonatrol, R7.
1 Durham grid leak mount.
1 National drum dial.
1 National tone filter, TF.
4 Eby or Benjamin UX type tube sockets.
2 Benjamin sub-panel brackets, type 8629.
1 Yaxley battery switch, No. 10.
1 Yaxley interstage junior jack, type 704.
1 Yaxley connector cable plug.
2 Samson audio transformers.
1 Formica panel. 7x18x3/16 in.
1 Sub-base, 9x17x3/8 in.
1 Pkg. Kester rosin core solder.
3 Rolls Corwico Braidite wire.

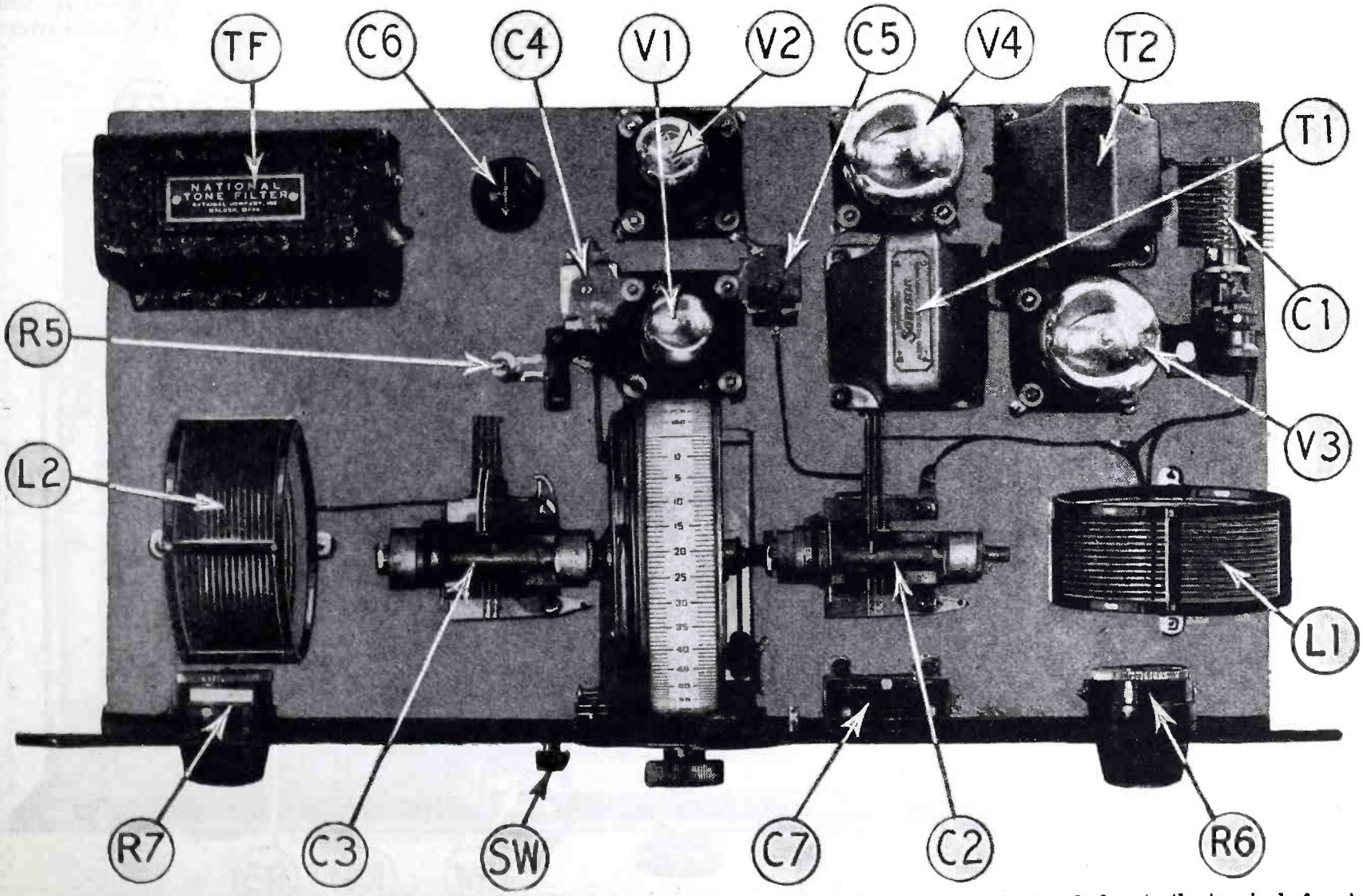


Schematic diagram of the Adventurer Four receiver. Variable condensers C2 and C3 are operated on the single control drum dial.

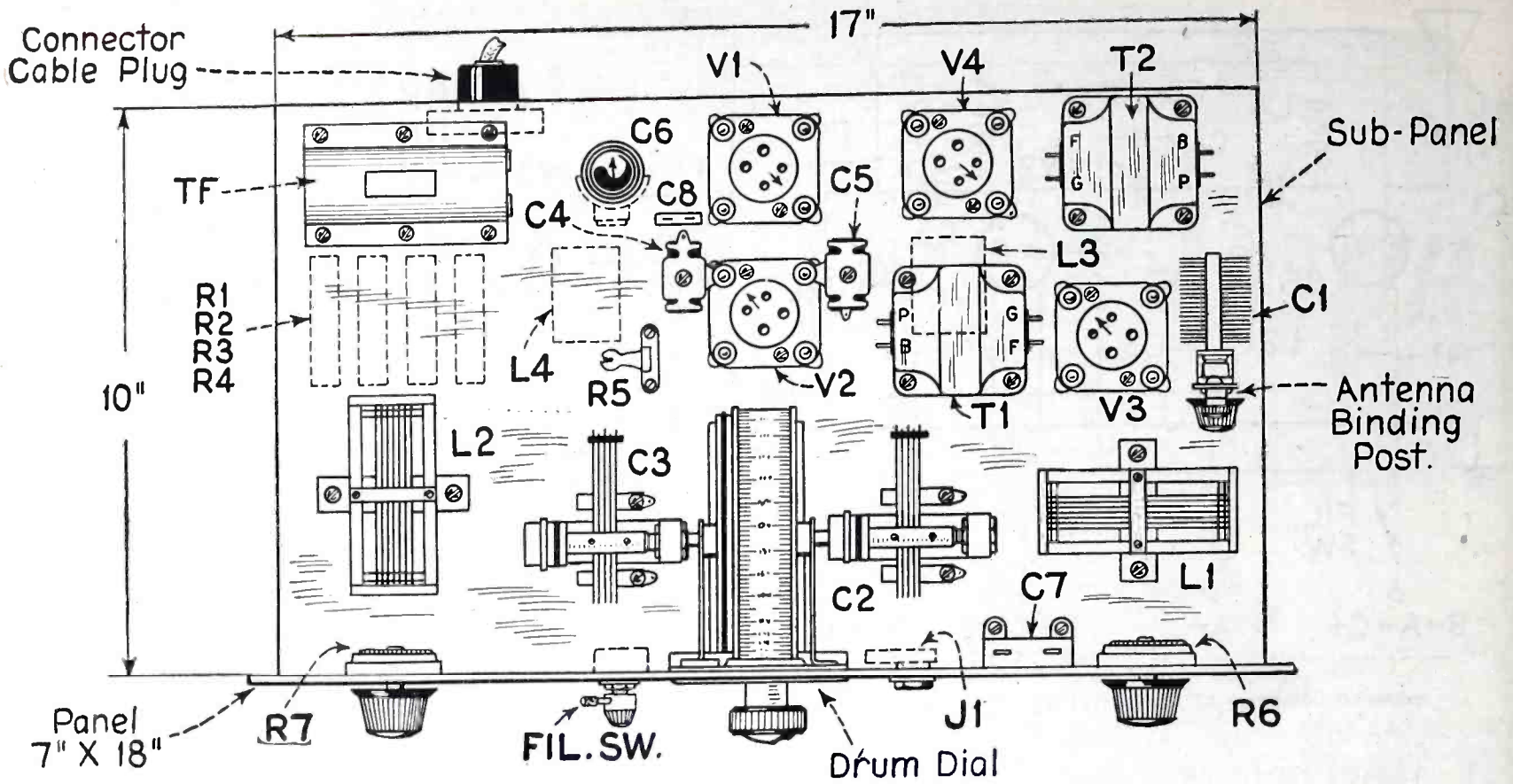
A variable resistance shunted across the secondary of the first audio transformer permits a ready control of the volume obtainable. A double circuit jack in the output of this stage makes possible the reception of a signal suitable for headphones.

In the receiver shown home-made coils were first used, but were later replaced by manufactured coils. Those who wish to make their own coils may do so, but it is far preferable to use the manufactured product as specified in the accompanying list of parts. Home-made coils can be wound on three-inch forms using No. 16 D. C. C. wire separated by the width of the wire. Both coils consist of the same number of turns and for the 20 meter band 4 turns should be wound. For the 30-55 meter band 7 tubes are required. For the 80 meter band 15 turns are required.

If it were merely the intention of the experimenter to play with this circuit it might be quite all right to hastily throw the necessary parts together on any old baseboard. However, if it is desired to build a receiver which will be patterned along sound constructional lines it



A top view of the set. The best part of the wiring is beneath the baseboard. Holes are drilled in the baseboard close to the terminal of parts and wires are passed through the board to the underneath side.

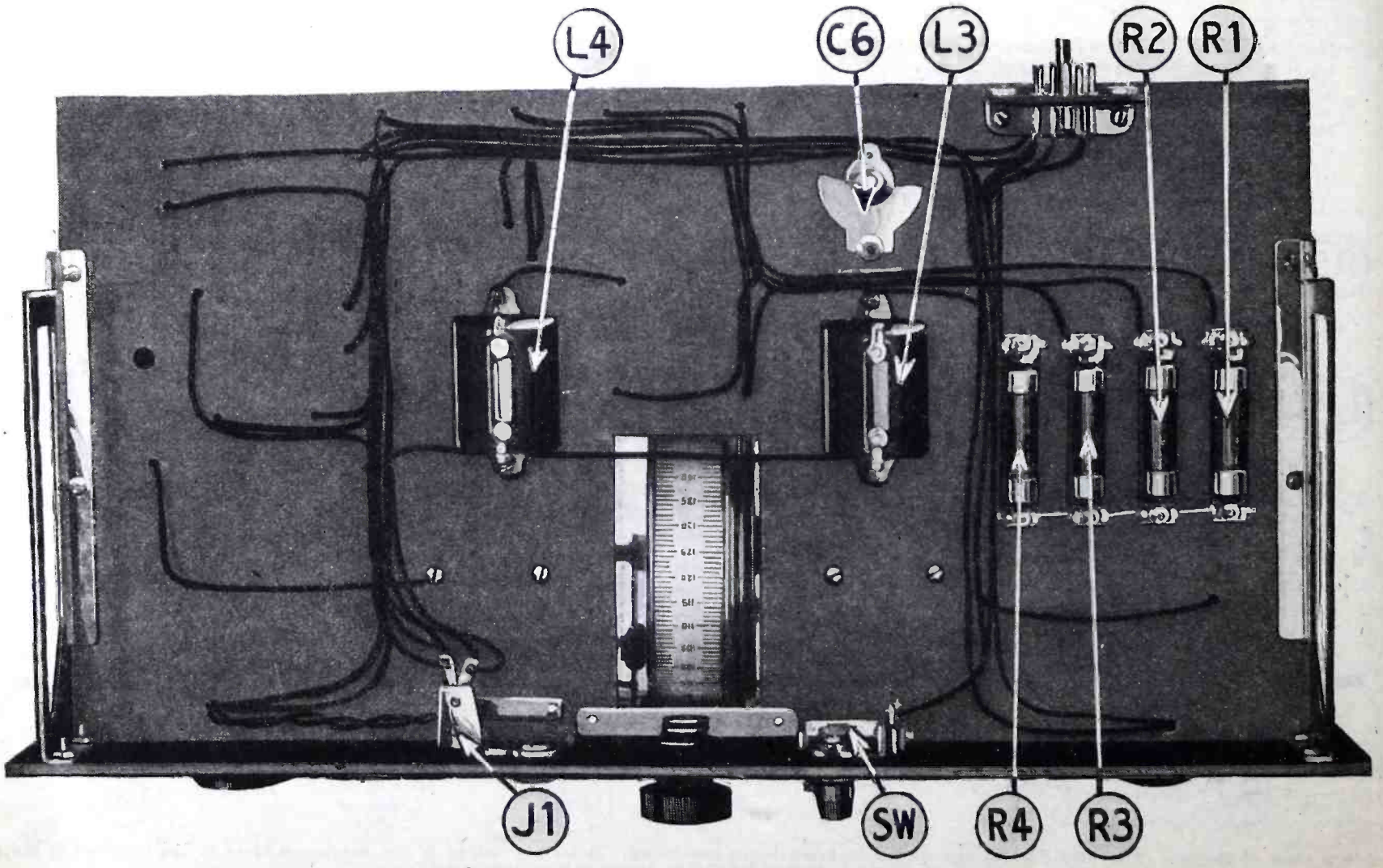


Instrument layout of the set. Parts to be mounted beneath the baseboard are indicated in dotted lines.

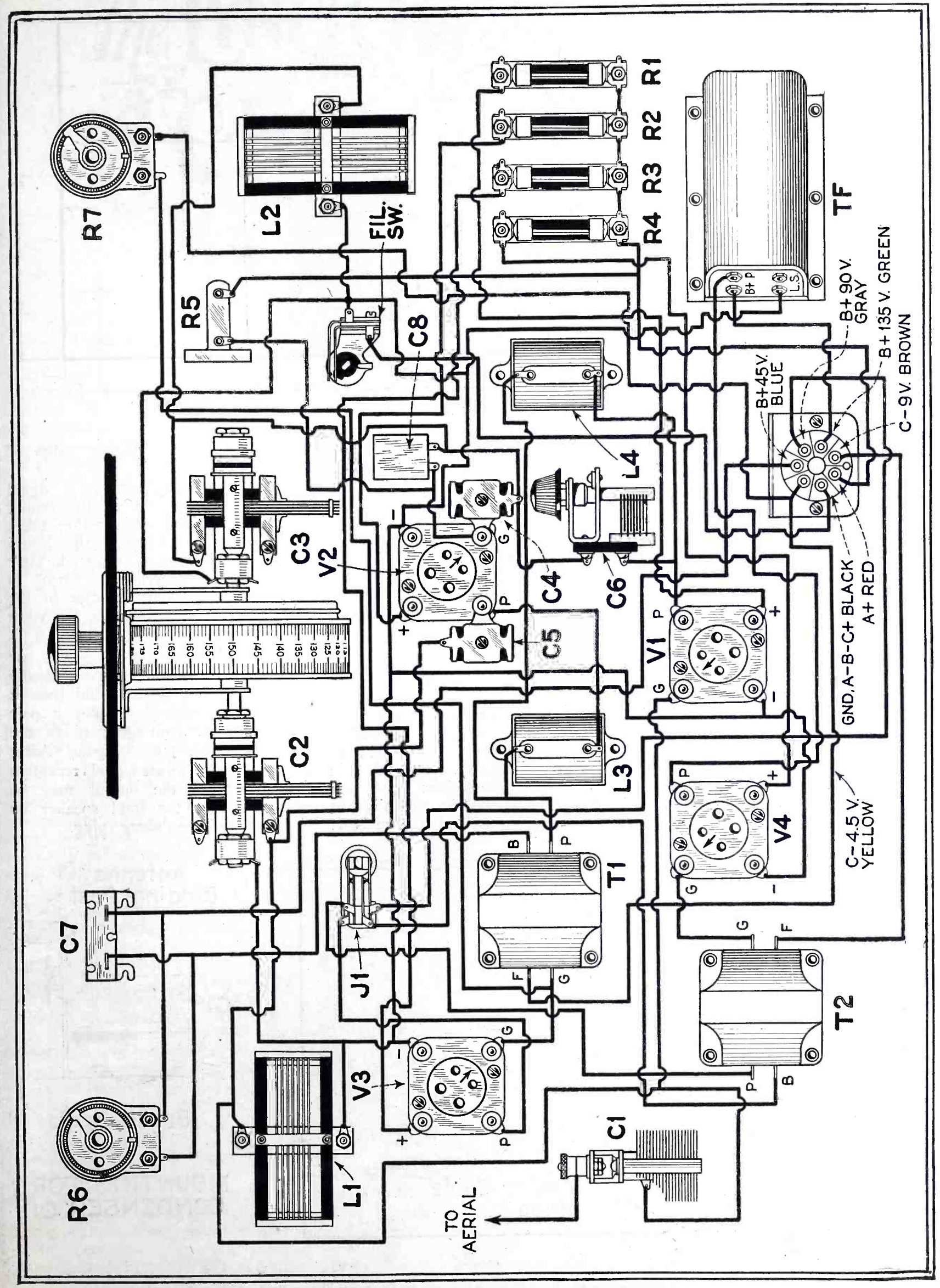
is well for the constructor to heed the instructions given here as to the particular placement of parts. Deviation of the list of parts as listed herein will naturally result in a necessary deviation form the proper placement of these individual parts to the ultimate detriment and inferior operation of the receiver.

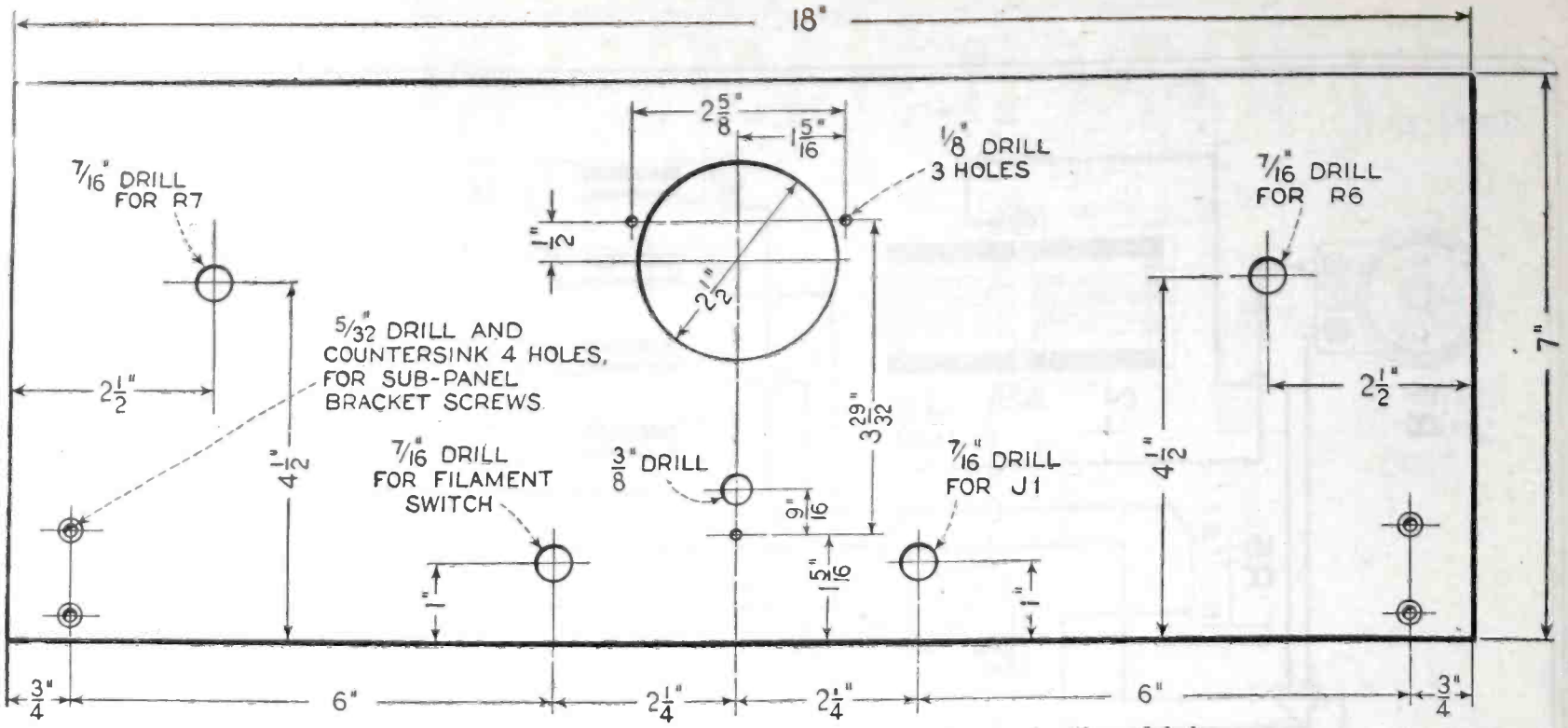
Practically all of the apparatus employed in the construction, with the exception of the two variable resistances, the filament switch and the interstage jack are mounted directly on the sub-base. The actual layout of the parts is shown in the accompanying illustration. The choke coils, cable connector receptacle and amperites are mounted below the sub-base as shown in the sub-base layout. The dotted line outlined in layout show the relative positions of these pieces of apparatus in respect to the placement of the others above the baseboard.

Perhaps the most difficult operation in the whole construction is the placement and mounting of the two tuning condensers and the drum dial. After the sub-base has been cut away to take the drum dial it should be temporarily placed in position and the mount holes for the condensers



A photographic view of the set from beneath the baseboard showing parts and wiring.





The front panel drilling layout giving all dimensions for the location of holes.

marked off and drilled. Then the condensers may be fastened in place after which the mounting of the dial may be accomplished.

The accompanying panel drilling layout gives the dimensions for laying out the mounting holes for the various panel controls.

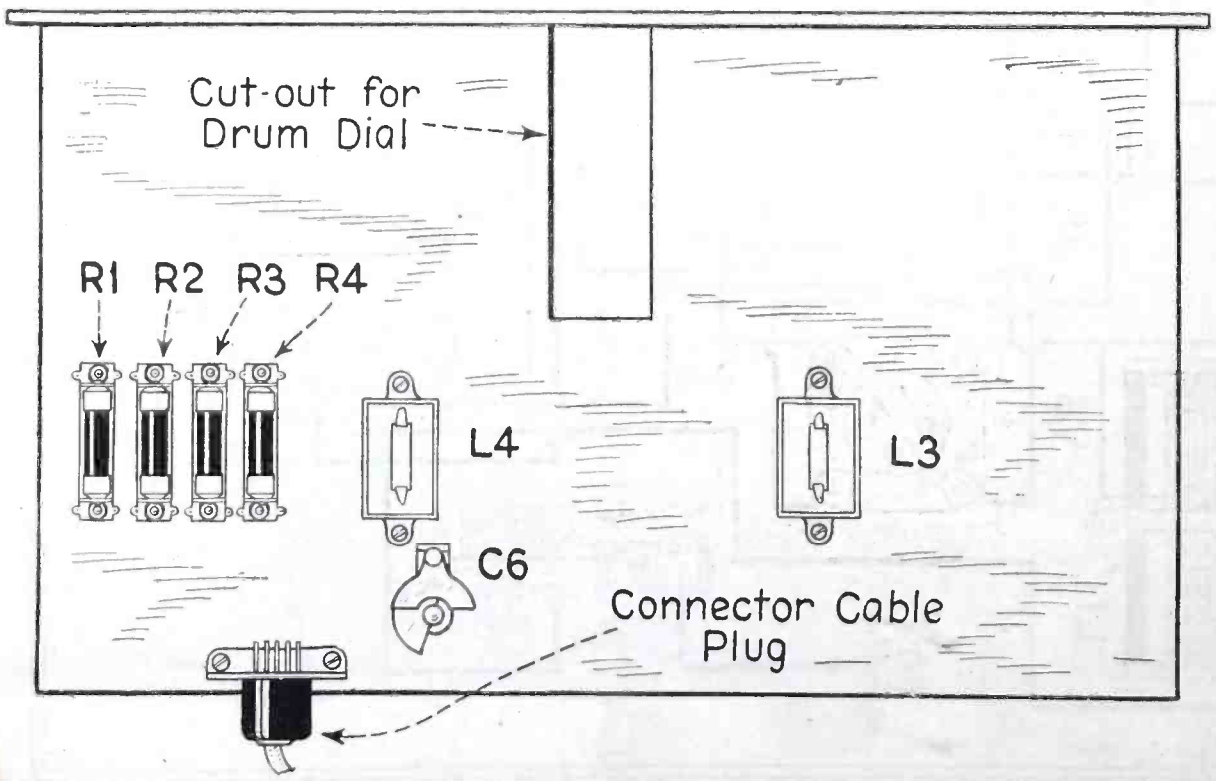
In the wiring of any short-wave receiver it is well to dispense with pretty right angle bus bar wiring and employ instead flexible hook-np wire which will allow of short, direct point-to-point wiring. This is especially true of the tuning circuits.

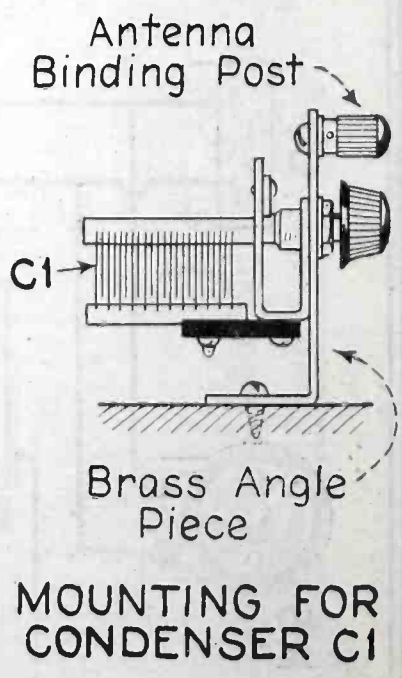
It has been found that for most suitable operation the grid condenser should be variable over a small range and therefore the equalizer condenser, C4, is shunted by a fixed condenser of .0001 mfd. This condenser is soldered in place, its terminals directly shunting those of the equalizer condenser.

After the receiver is completely wired in accordance with the picture or schematic diagram the batteries, antenna-ground and loud speaker may be connected to their respective terminals and the filament switch thrown to the "on" position. The capacity of C5 and C6 should be varied, making that of C5 quite large in comparison to C6. When operating on the wavelengths between 20 and 40 or 50 meters it may be found necessary to adjust the grid condenser C4 to a comparatively low value while for the higher wavelengths a larger value will be found more suitable. Several grid leaks between the values of 8 and 10 megohms should be available, as better reception of weak signals is obtained when the higher value of resistance is used.

To satisfactorily tune in a signal the regeneration control R6 should be adjusted until regeneration takes place—then by turning the drum dial a signal may be received, after which the regeneration control is retarded until, as in the case of the reception of 'phone signals, the voice or music is clearly received.

For the reception of code, or where the operator must actually find the station on the dial then it is most advisable to employ a pair of headphones, plugging in to the jack on the front of the panel. After the station is located and reception is satisfactory the output may be transferred to the loud speaker by withdrawing the 'phone plug.





The above sketches show how parts are mounted under the baseboard and at the right shows the method of mounting variable condensers C1.

The LYNCH-HAMMARLUND A-C-FIVE RECEIVER

THE battery operated Lynch-Hammarlund Five receiver was described in the preceding number of this publication. The remarkable popularity of this receiver following its introduction to the radio enthusiast has more than justified a revision of the circuit to adapt it to the use of alternating current tubes.

The general acclaim accorded this receiver may be credited to its electrical efficiency and mechanical convenience. The electrical characteristics of the set, as far as the radio frequency channel is concerned, are practically identical with those of the original Roberts circuit which remains today probably the only receiving system introduced during the hey-dey of circuit production that has maintained its popularity for almost five years.

The Roberts receiver has always been controlled by two dials tuning one stage of radio frequency amplification and a regenerative detector. It may be remarked in passing, that no really efficient receiver has ever been produced that did not owe its efficiency to the combination of radio frequency amplification and regeneration. The Roberts receiver effects with a minimum of tubes the requirements and specifications of an ideally selective and sensitive receiver.

The mechanical convenience of the Lynch-Hammarlund design is the result of the chassis or "deck" arrangement in which practically all the components of the audio and detecting systems are premounted on a simple sub-panel eliminating at least 50% of the mechanical effort generally associated with receiver construction.

The conversion of the Lynch-Hammarlund Five to A.C. operation is a relatively simple matter necessitating comparitively few and elementary variations from the direct current procedure. However, this article is not written merely for the enthusiast who has already constructed the battery operated model and who now desires to convert it to A.C. operation. The general excellence of the receiver is such as to justify a complete new construction on an A.C. basis by thousands of interested fans who at present are in ignorance of the excellencies of this general arrangement. However, the electrical features of the A.C. model are best illustrated in a description of the steps necessary to alter the D.C. set to A.C. operation.

The conversion has been accomplished by the use of Arcturus A.C. tubes. While it is possible to convert a Lynch-Hammarlund receiver to the use of alternating current tubes of other manufacture, Arcturus tubes have been chosen for this particular set, in consideration of the mechanical and electrical characteristics which particularly recommend them for conversion purposes. The Arcturus A.C. tubes are all of the relatively humless heater type and plug into the standard UX sockets without adaptors of any kind. A common cathode heater connection makes this possible. This particular feature holds for all types of Arcturus tubes, including the detector. Also, Arcturus tubes are made in a hi-mu type "the A.C. 32" inch which particularly recommends them for use in resistance coupled circuits. The A.C. 32 tube has an amplification constant of 30 and is comparable in its electrical characteristics with the R.C.A. and Cunningham hi-mu tubes.

Assuming that the reader has a battery operated model of the Lynch-Hammarlund Five receiver, the following additional parts will be required in effecting the conversion:

1 volume control Clarostat, R5

1 Arcturus type A.C 28 amplifying tube

1 Arcturus type A.C. 26 detector tube

1 Arcturus type A.C. 32 hi-mu tube

1 Arcturus type A.C. 30 power tube

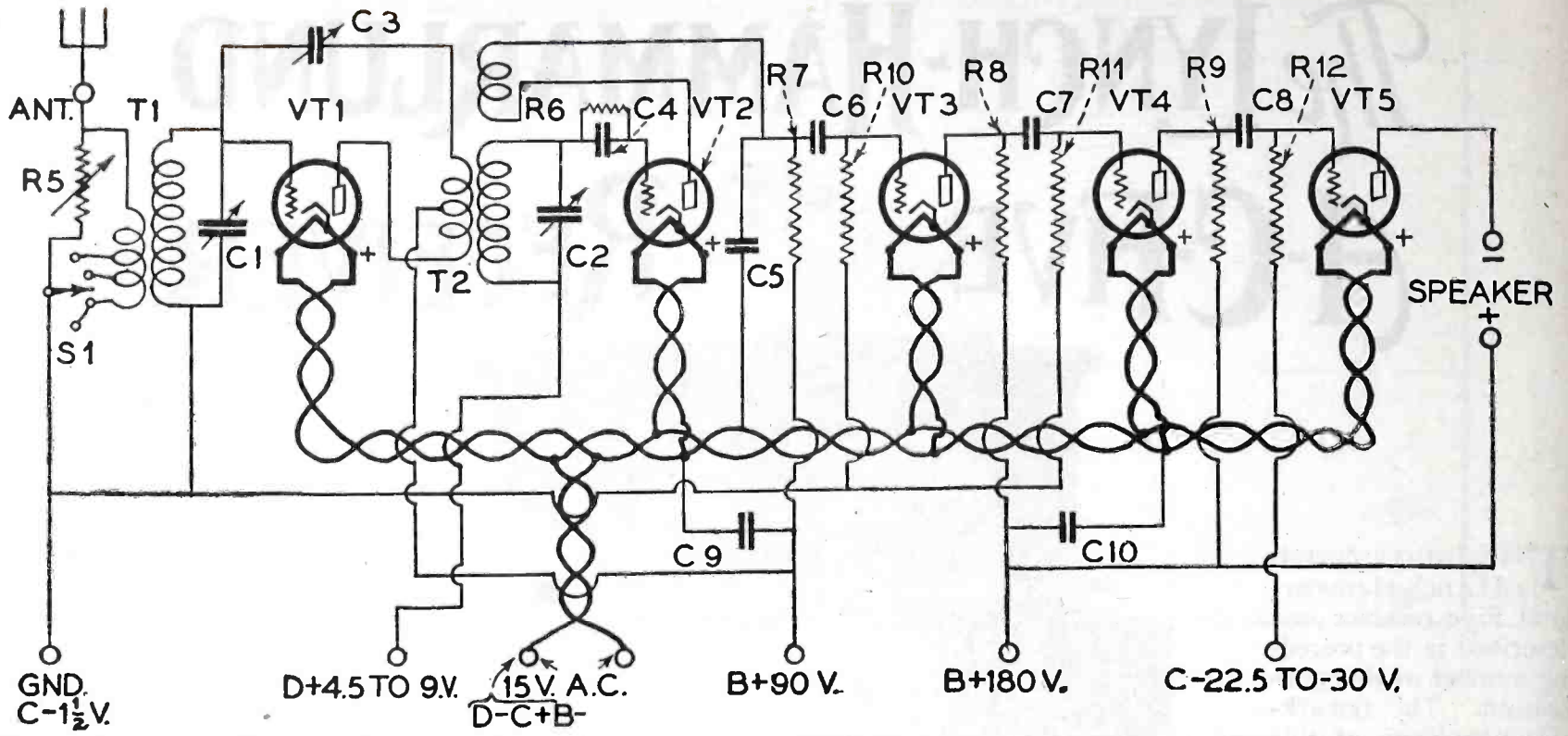
(Arcturus type 28 amplifier tubes may also be used in place of the hi-mu tubes with satisfactory results.)

2 Polymet 2. mfd. by-pass condensers, C10, C11

1 Filament lighting transformer with a 15 volt secondary such as the Thordarson type TY 121.

The mechanical appearance of the A.C. receiver converted from the battery set remains identical with that of the original design as will be observed from the accompanying photographs. The circuit changes are as follows resulting in the arrangement shown in the accompanying diagrams.

Turn the receiver upside down and clip all wires running to the filament terminals of the sockets at the point

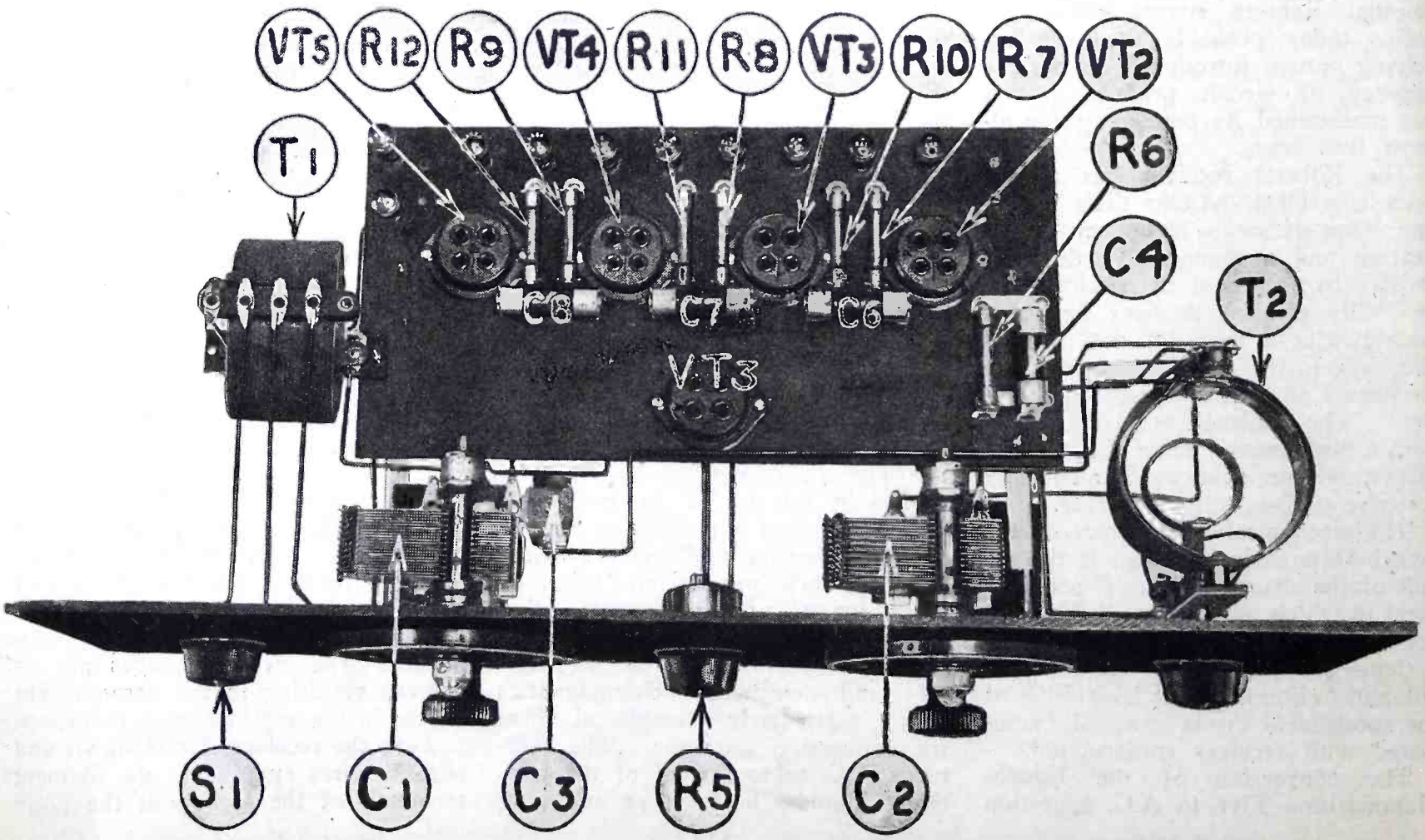


Above shows a schematic wiring diagram of the Lynch-Hammarlund set wired for A.C. operation. All parts of the circuit are indicated to correspond with photos, picture wiring diagram and list of parts.

where they connect to the lugs on the socket. Also disconnect the lead running to the A plus B minus post and likewise the lead running to the A minus C plus post at the posts. Short circuit all connections at the terminals of the 20 ohm rheostat and filament switch. Run a wire from this short circuited connection to the wire running from the ground post to the inductance switch. Now rewire the filament or heater circuit with twisted flexible cable. Twisted red and black Celatsite is recommended for this purpose as the coding facilitates the correct connections. As a matter of consistency connect the red wire to the plus filament post of all sockets. The twisted heater conductor is then led to the posts originally marked A plus and A minus. Coding is immaterial at this point. The effect of these alterations is such that the filament or heater circuit is now completely isolated from the rest of the receiver while the two radio frequency secondaries are grounded on the low potential sides.

Remove the grid leak in the detector circuit from its clip mounting. Replace it so that only side makes contact with the clip nearest to the socket, that is, the clip that is electrically wired to the grid terminal of the socket. The grid leak will now stick out past the detector socket being held in position only by one clip, the free terminal being unsupported. A wire is easily connected, by mechanical pressure, in the groove on this free end. This wire provides an extra lead to the receiver and is designated on the wiring diagram as "plus D 4.5 to 9 volts."

The grid returns from the first two



A top view of the set showing all parts mounted on the "deck" and front panel. The Clarostat, R5 is mounted directly in the center of the front panel and is connected in the antenna circuit of the set as shown in the diagrams accompanying this article.

audio frequency tubes have automatically been grounded by the connection effected between the 20 ohm rheostat (which has been shorted out of the electrical significance) and the ground post. No additional changes are made in the audio frequency amplifier.

With A. C. tubes the volume control or regenerative control of volume is seldom adequate on local stations. To provide satisfactory variations of signal intensity the Clarostat volume control is connected to antenna and ground posts. This has not been indicated on the circuit diagram. The volume control Clarostat is a table mounting device requiring no mechanical or electrical alterations in the receiver itself

It is desirable that two additional by-pass condensers be used in the A.C. job. The Polymet type C905 are particularly well suited mechanically and electrically to the designated use in the Lynch-Hammarlund receiver. These are connected between ground and plus 90 and 180 volts potential points. They are designated as "C" on the wiring diagram.

An additional lead is wired to the plus filament prong on the detector socket (which, incidentally, is the cathode to the detector tube) through which the B return is effected. This extra lead is designated on the wiring diagram as "minus B, minus D and plus C." It is important that an extra lead be wired for this purpose rather than use the red coded heater wire. An amplification plate potential of 180 is supplied to the post marked "B plus 135 volts" on the battery operated receiver. Plus 90 volts is tapped off to the indicated post and likewise, 45 volts for the detector circuit. The minus side of the B battery is connected to the special lead designated on the diagram. If it is possible to tap the B battery between 4.5 to 9 volts, this tap may be connected to the special lead designated as "plus D." If, however, it is impracticable to secure this special potential from the B battery, an extra battery may be connected between the D minus lead and the D plus lead. A "C" potential of 1.5 volts is connected between the B minus lead and the ground post—negative to the ground. If convenient and practicable this may be tapped off from a larger C. battery supplying from 22.5 to 30 volts to the grid of the power tube, (the C minus 9 volt post on the battery operated set.) Fifteen volts A.C. potential are applied to the heaters for the Arcturus tubes. The tubes may be turned on and off by a switch placed in the primary circuit of the heater lighting transformer.

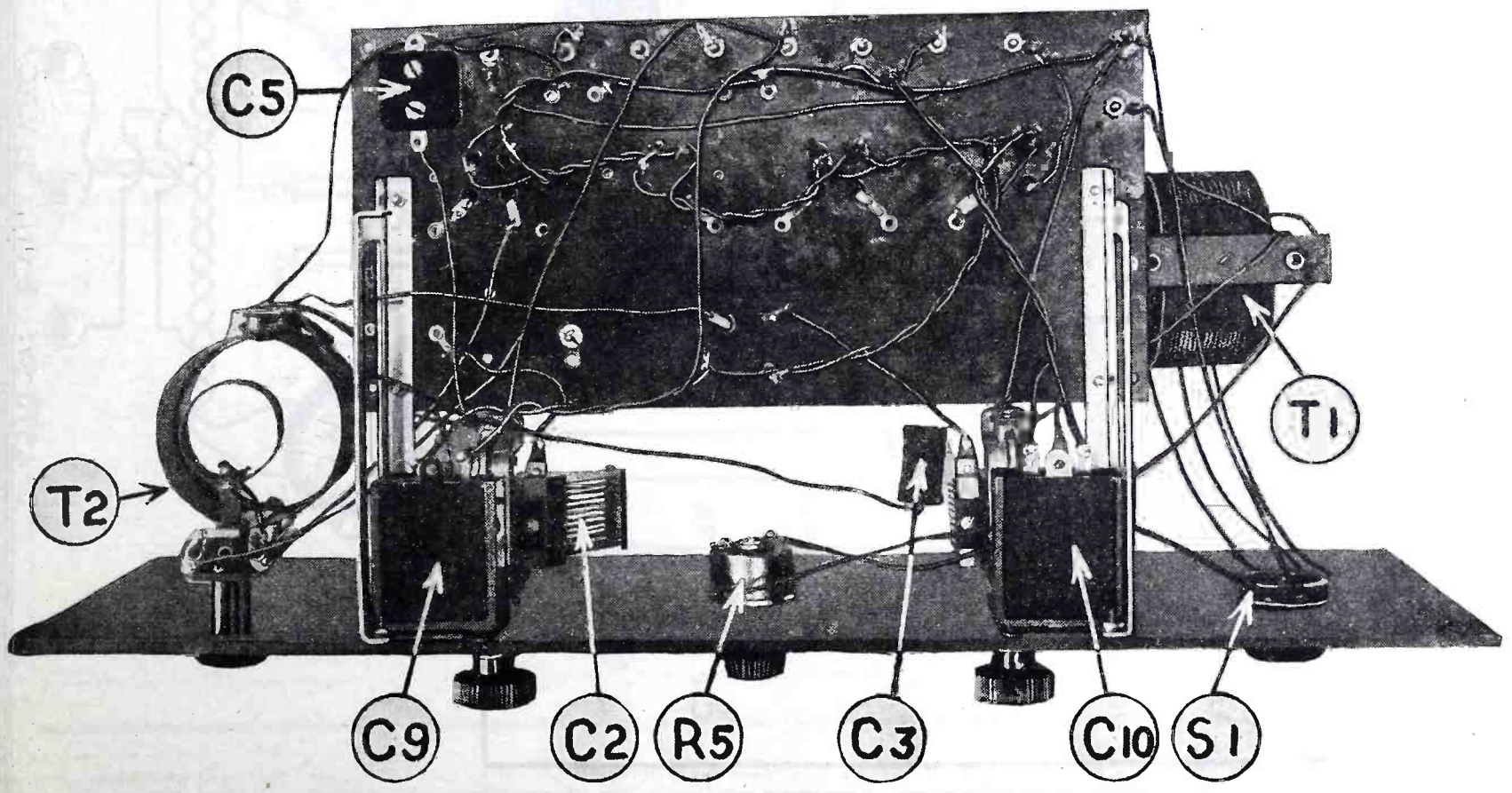
Any efficient eliminator, such as can be found advertised in this publication, supplying the necessary potentials, can be used in place of the batteries.

If it is desired to build a complete receiver of the Lynch-Hammarlund A.C. Five design rather than converting an already existing battery operated set, the accompanying list of parts will be required in addition to the parts listed previously.

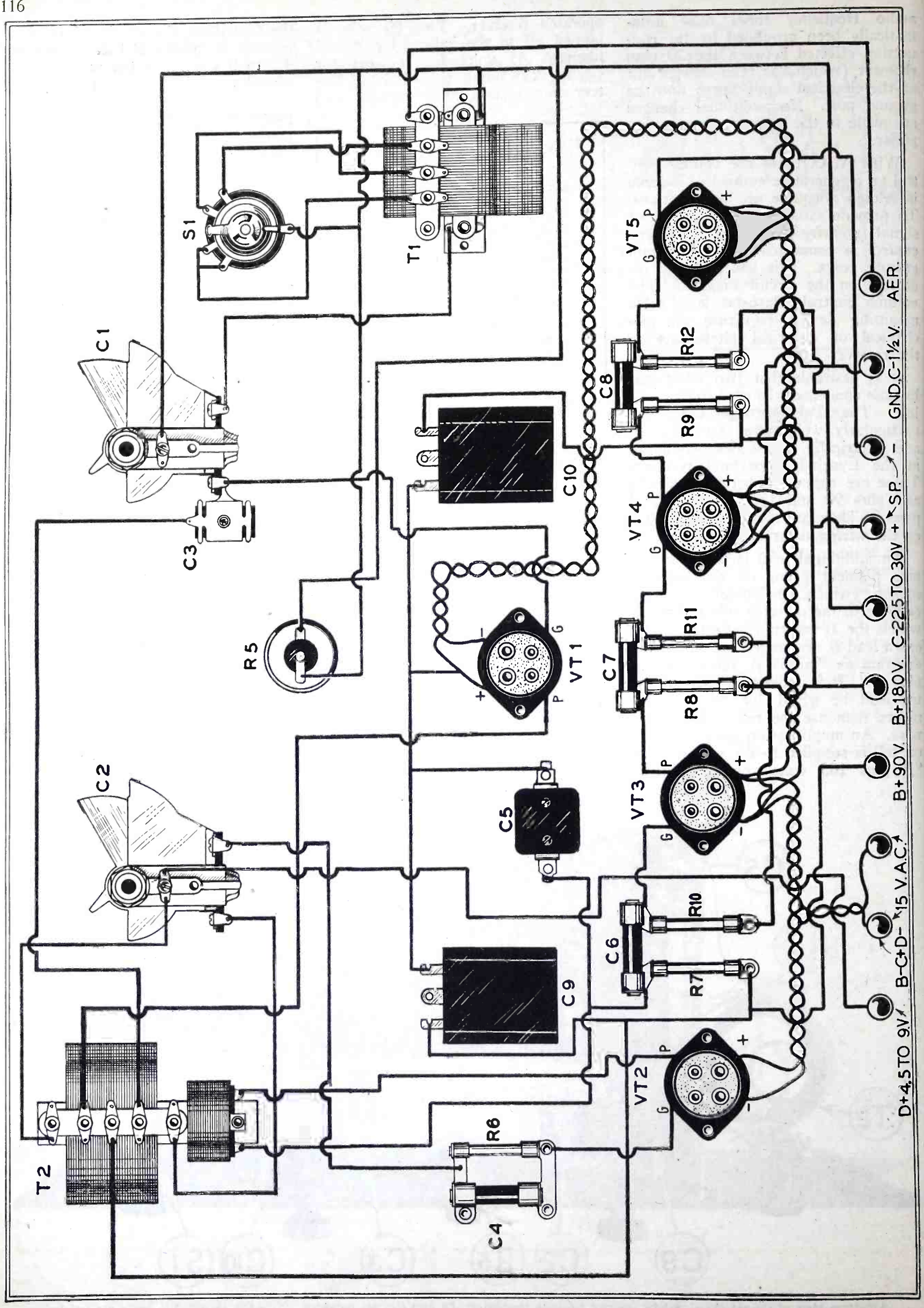
The operation of the Lynch-Hammarlund A.C. Five receiver is identical with that of the battery operated model. A slight readjustment of the neutralizing condenser may be necessary. While the design of the heaters on the Arcturus tubes is such as to provide for reasonable variations

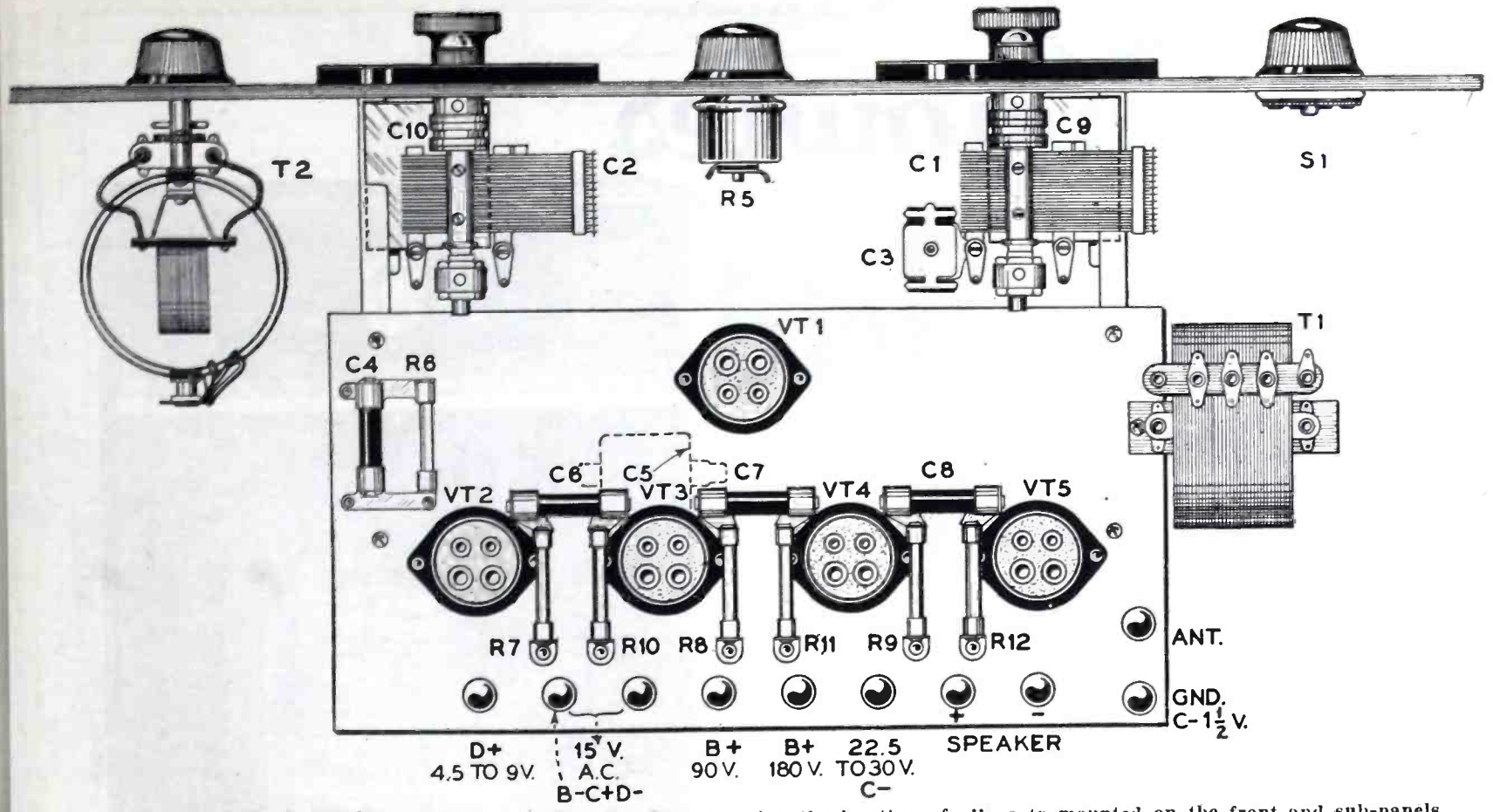
LIST OF PARTS

1 Lynch five tube DeLuxe kit which includes the following:
1 Lynch .00025 mfd. cartridge type fixed condenser, C4
3 Lynch .006 mfd. cartridge type fixed condensers, C6, C7, C8
1 Lynch 2.5 megohm metallized resistor, R6
3 Lynch .1 megohm metallized resistors, R7, R8, R9
3 Lynch .5 megohm metallized resistors, R10, R11, R12
5 Eby universal sockets, VT1, VT2, VT3, VT4, VT5
1 Formica or Micarta 6x12 3/16-inch sub-panel
4 Sets special mountings
All of the above material is completely assembled on the sub-panel ready for wiring.
2 Hammarlund ML-23 .0005 mfd. variable condensers, C1, C2
1 Hammarlund EC. equalizing balancing condenser, C3
1 Polymet .001 mfd. fixed condenser, C5
2 Polymet 2. mfd. by-pass condensers, C9, C10
1 Carter inductance switch No. 404, S1
1 Hammarlund antenna coupler HR-23, T1.
1 Hammarlund coupler coil, TCT-23, T2
1 Formica panel 7x21x3/16 inch
2 Benjamin sub-panel brackets
2 Marco vernier dials
10 X-L or Eby binding posts
1 Can of Kester radio solder
1 Package of Acme Celatsite hook-up wire



A bottom view of the set showing how the two by-pass condensers, C9 and C10 are mounted. Note the 15-volt A.C. leads are twisted.





Instrument layout of the Lynch-Hammarlund A.C. Five Receiver, showing the location of all parts mounted on the front and sub-panels.

in line voltage, it is desirable that the heaters be lighted across a potential of 15 volts. This assurance is best effected by using a Jewell A. C. voltmeter. However, if such an instrument is not available, the proper adjustment to the transformer voltage (generally effected by variable taps) can be achieved by noting the length of time it requires for the cold filaments to heat to normal operation. At 15 volts it will require exactly 30 seconds from the time the current is turned on to when satisfactory reception is secured.

One of the most important details in the construction of the home-built or custom-made receiver is the installation of the completed ensemble in a suitable cabinet to fill the requirements of home surroundings as well as the convenience of installing incidental equipment. The cabinet to the radio set is therefore just as important as the body of an automobile is to the chassis.

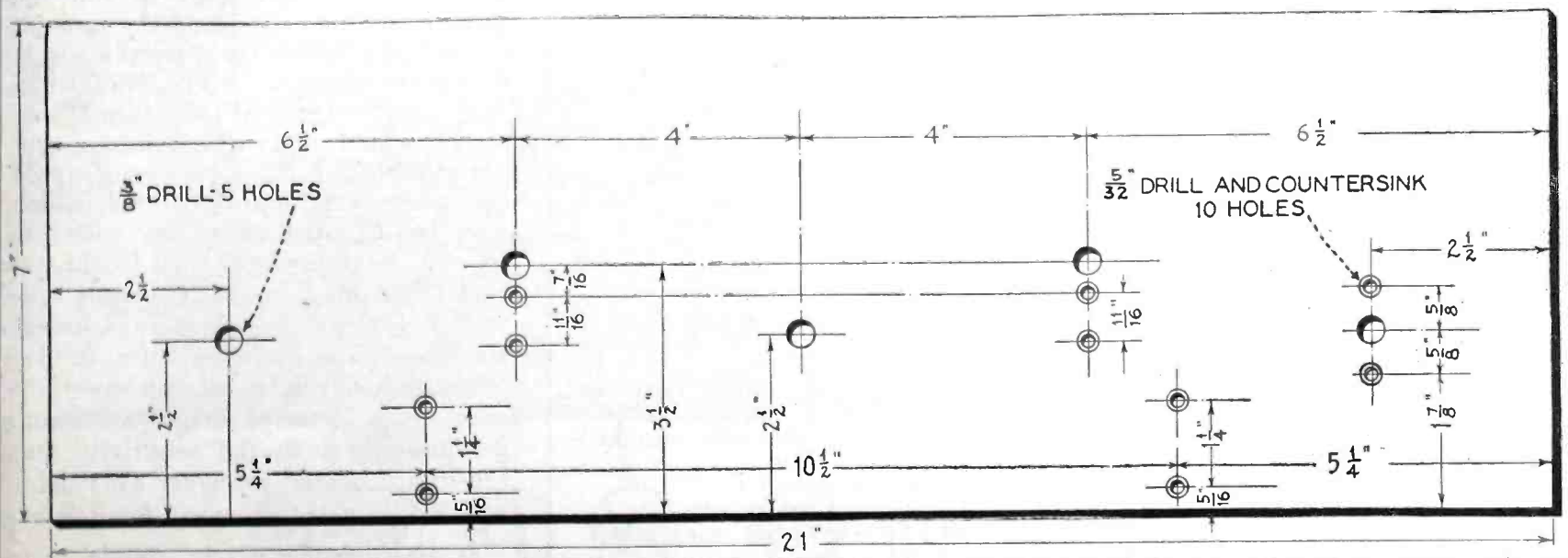
For this reason we cannot recommend too highly the advisability of installing the set in a cabinet or console which will be in keeping with the furnishings of the home.

The Lynch-Hammarlund A.C. Five as described in the preceding paragraphs is shown in the heading of this article installed in an Excello wall type console. This particular type of cabinet is available in various designs. The upper portion of the cabinet into which the set is placed also provides ample space for installing other incidental equipment employed with the set. The lower portion is fitted with a decorative grill backed with a silken mesh fabric, and a cone or aeroplane cloth speaker can easily be installed in this part of the cabinet.

There are several types of loud speaker kits and speaker units available on the market, but if the constructor hopes to be repaid for his time and efforts as well as expense, it would be well to select a speaker unit which will handle all that this receiver will deliver and exercise care in the construction of the cone or aeroplane cloth diaphragm.

Among the most efficient types of speaker units recommended in connection with the construction of a loud speaker suitable for installing in the lower portion of the Excello console are the Ensco, Accusti-cone, Fan-speaker or the G.R.P. units.

The "B" eliminator unit to be used in connection with the Lynch-Hammarlund A.C. receiver can also be installed in the lower portion of the cabinet just behind the speaker diaphragm.



Layout for drilling the front panel. The hole at the extreme left is for mounting switch, S1 and hole at the extreme right for coupler coil, T2, either side are for mounting the variable condensers, C1 and C2. The hole directly in the center of the panel is for the Clarostat variable resistor, R5, and holes on either side are for mounting the variable condensers, C1 and C2.

The Knowles Screen-Grid Four

WE are continually told that the radio industry is "in its infancy" and that things in radio quickly become obsolete. While this would seem to be true, judging from the "new" and "revolutionary" designs that appear from time to time, there are numerous exceptions. Probably the most outstanding exception to this tendency, in circuit combinations, is that of a stage of tuned-radio-frequency amplification with a regenerative detector and an audio-frequency amplifier. This type of circuit has appeared under numerous different names—each variation calling for a new name.

The fact that this circuit arrangement is still very popular, although it has been in common use for four years or more, indicates that it has definite survival value. With the advent of the screen-grid (222-type) tube, which promises to mark a new era in radio-frequency amplification, it is very natural to ask whether this popular circuit arrangement can still be used advantageously and, if so, just what modifications are necessary. Because of the very different characteristics of this new tube it is important to modify the circuit, and not merely to insert the new tube in the old circuit with the expectation of getting greatly-improved results.

The receiver we are about to discuss is one which combines the features of this well-known circuit arrangement with the modifications made necessary by the use of the 222 tube. The merits which have been carried over may be summed up in the word "performance." This is due to the fact that each tube is made to operate at its maximum efficiency — a thing which is much more difficult in a receiver using five or more tubes.

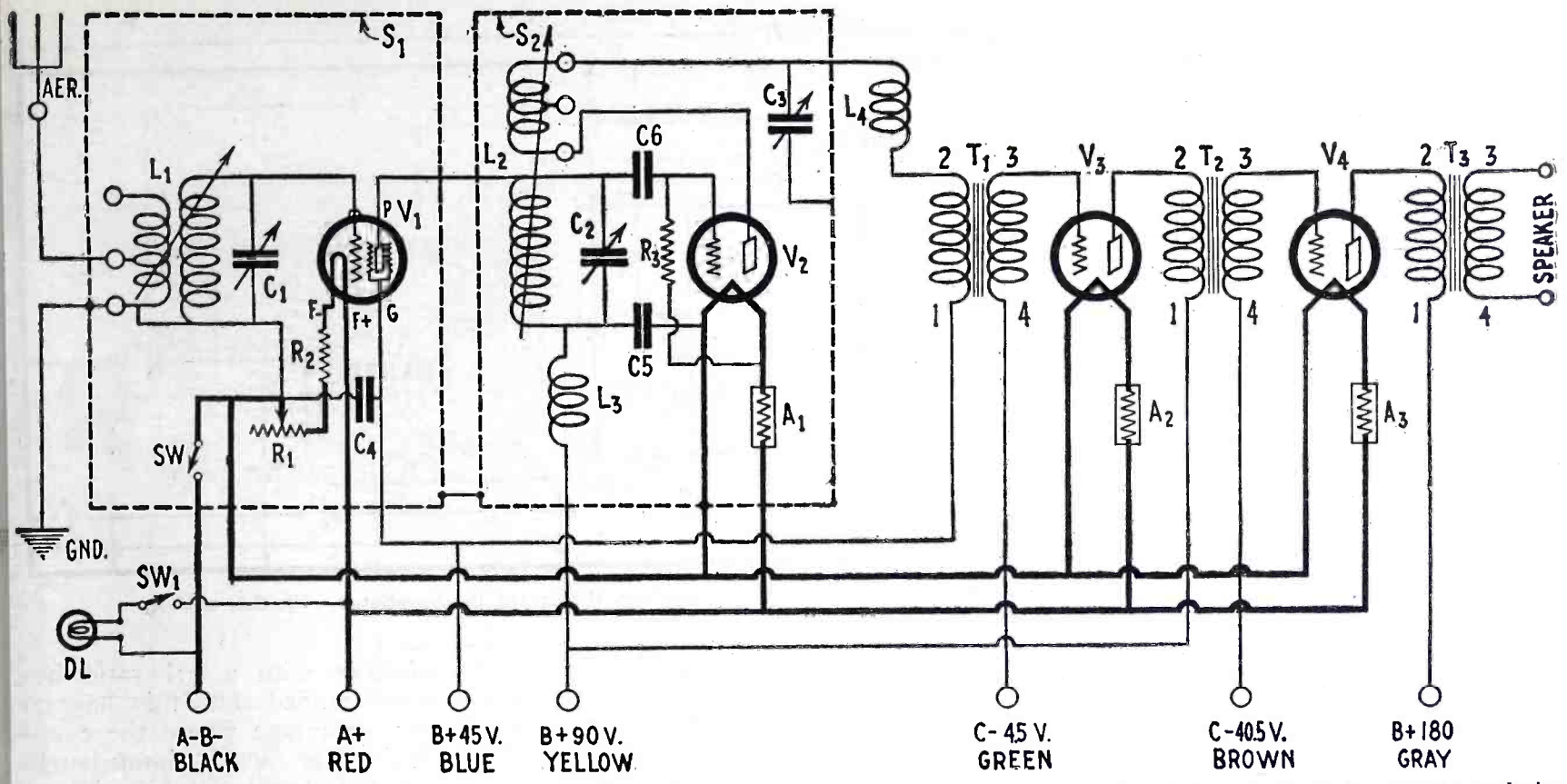
LIST OF PARTS

2 Hammarlund .00035 mfd. variable condensers, C1, C2.
1 Hammarlund 65 mmfd. midget condenser, C3.
2 Polymet or Tobe 0.5 mfd. bypass condensers, C4, C5.
1 Polymet .00025 mfd. grid condensers, C6.
2 S-M audio frequency transformers, 3 to 1 ratio, T1, T2.
1 S-M output transformer, 1 to 1 ratio, T3.
2 Hammarlund coupling coils, L1, L2.
2 Hammarlund R. F. choke coils, 85 millihenry, L3, L4.
2 Amperites, 5 volt, ¼ ampere type, A1, A2.
1 Amperite, ½ ampere type, A3.
1 Yaxley switch-rheostat, 40 ohms, R1, SW.
1 Yaxley fixed resistor, 15 ohms, R2.
1 Polymet or Durham grid leak, 8 megohms, R3.
1 Screen-grid tube, type 222, V1.
1 CeCo type H special detector tube, V2.
1 CeCo type A tube, V3.
1 CeCo type 171 tube, V4.
2 Hammarlund aluminum stage shields, S1, S2.
1 Yaxley 7 wire cable plug P.
1 Hammarlund double type drum dial.
1 Polymet grid leak mounting.
3 X-L binding posts.
4 Benjamin UX type sockets.
1 Formica or Micarta front panel, 7x21x½ in.
1 Formica or Micarta terminal strip, 3x¾x⅛ in.
1 Wood baseboard.
1 Pkg. Acme Celatsite wire.
1 Pkg. Kester rosin core solder.

In performance the receiver combines the features that have made the sets using the 201A-type tube popular, and those that are made possible only by the use of the new 222-type tube. It combines simplicity of operation on local stations with a flexibility of control which permits the more experienced operator to get remarkable results on distant stations. The 222-type tube has made greater radio-frequency amplification possible; with the result that this set's sensitivity is equal to that of the average five- or even six-tube receiver in which controlled regeneration and individual-stage control are not used.

The antenna coupling may be varied (in the coil L1) to suit the type of antenna used and the amount of interference that prevails in a particular locality. The radio-frefrequency stage (S1) is tuned separately; which insures maximum amplification. The detector circuit (S2) has a separate tunning control, which may be operated in unison with the R. F. stage control on local stations, but may be more closely adjusted for the reception of distant stations. The judicious use of regeneration by means of condenser C3 makes the detector stage contribute its quota to both the selectivity and sensitivity of the receiver. This point will be discussed in more detail later.

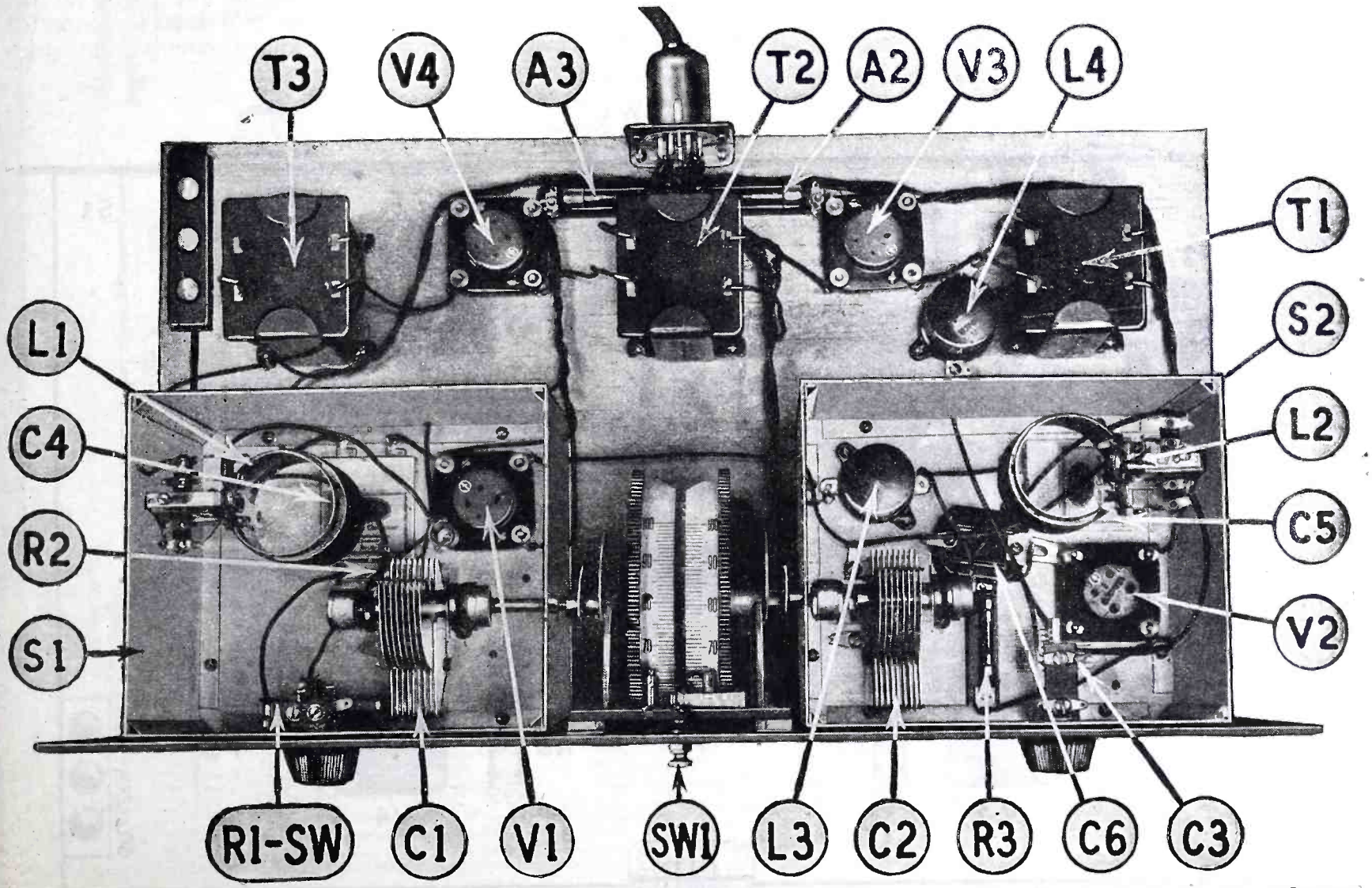
It is a comparatively simple matter to make one laboratory model of



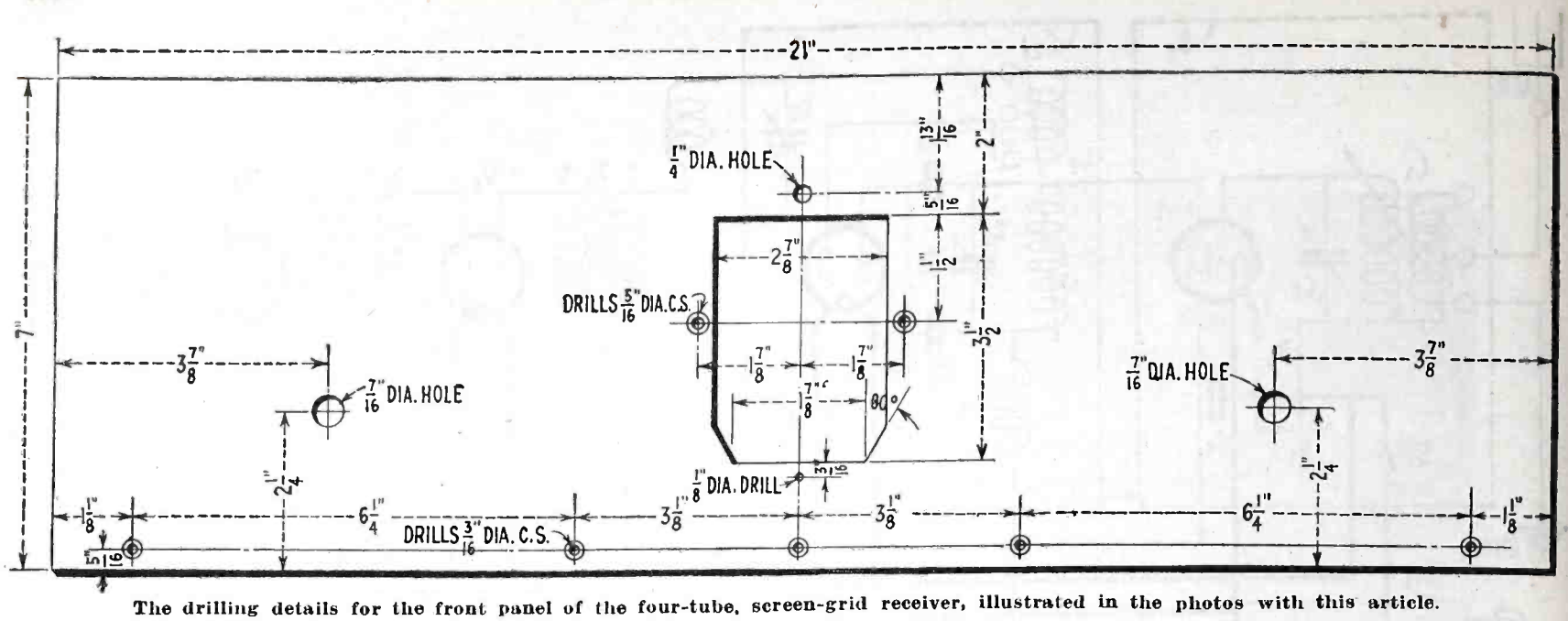
The schematic diagram of the Knowles screen-grid receiver described in the article herewith. The dotted lines indicate the shields enclosing R. F. portions of the circuit.

a receiver which has exceptional performance; but it is a very different thing to build a receiver which may be duplicated by the thousands in the homes of set constructors, not only in parts of appearance, but in performance as well. When this is considered we have a clue to the popularity of the R. F.-stage, regenerative detector combination. Such a circuit normally has no component parts which have critical values; in other words, it is a *production receiver* in the sense that it is easy to duplicate and can be relied upon for excellent results consistently.

One of the most important motives in building a receiver is the economic one. Since the set builder is usually willing to use only the best parts obtainable, to insure corresponding performance, it is important to build a receiver which is simple and which uses as few com-



C1, C2, .00035-mf. condensers; L1, L2, coupling coils; V1, socket for 222-type tube; R2, 15-ohm resistor; R3, grid leak; C4, C5, by-pass condensers; C6, grid condenser; R1-SW, switch and rheostat.



The drilling details for the front panel of the four-tube, screen-grid receiver, illustrated in the photos with this article.

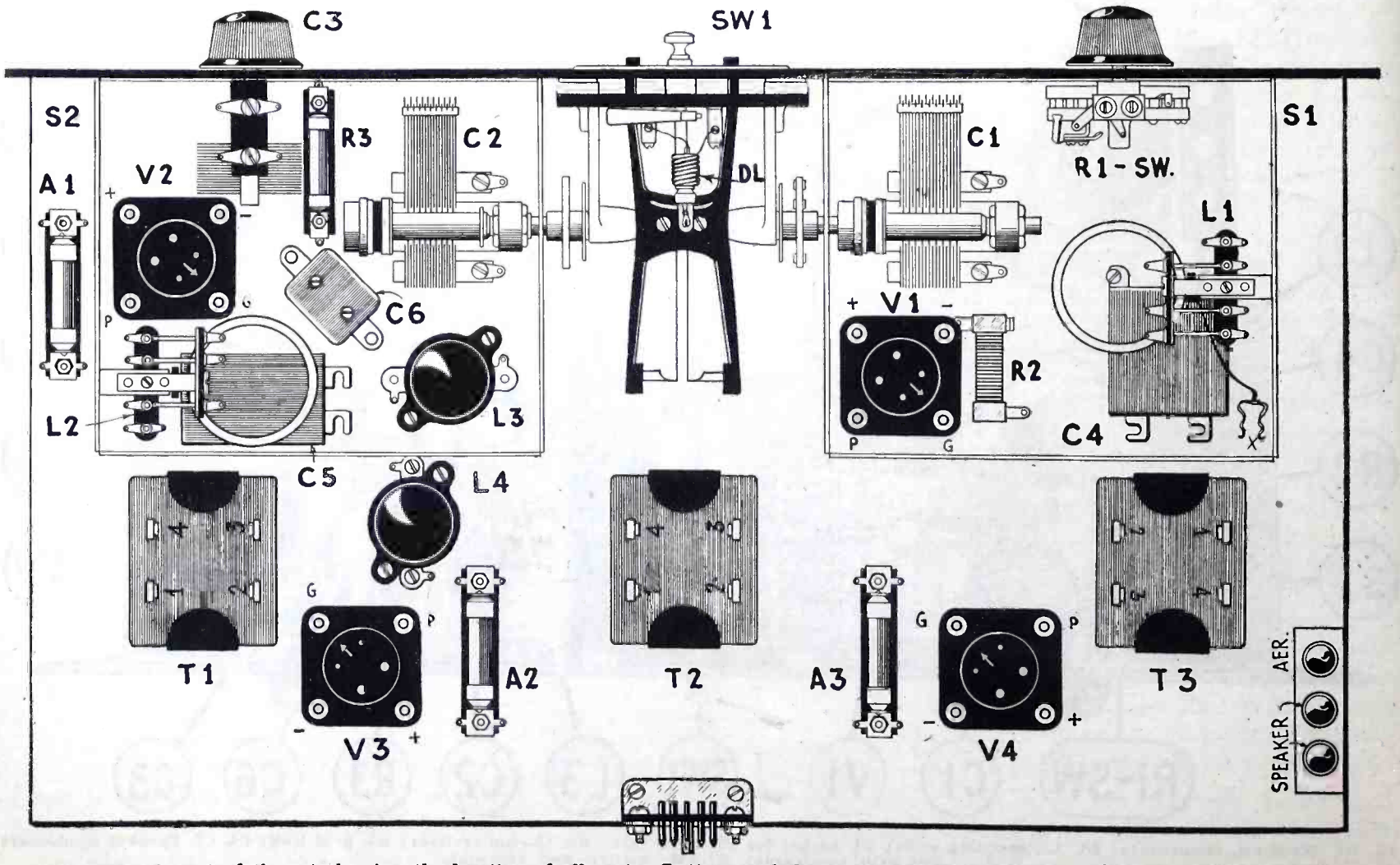
ponents and tubes as possible. This is another important reason for the survival and popularity of the circuit combination we have in mind.

An inspection of the wiring diagram of the receiver will show that two principal changes are made necessary by the use of the new screen-grid tube, V1. These are the omission of the balancing circuit, which is a distinct advantage resulting from the low inter-electrode capacity (from control grid to plate) in this tube; and the use of a tuned circuit instead of a transformer to couple the radio-frequency stage to the detector.

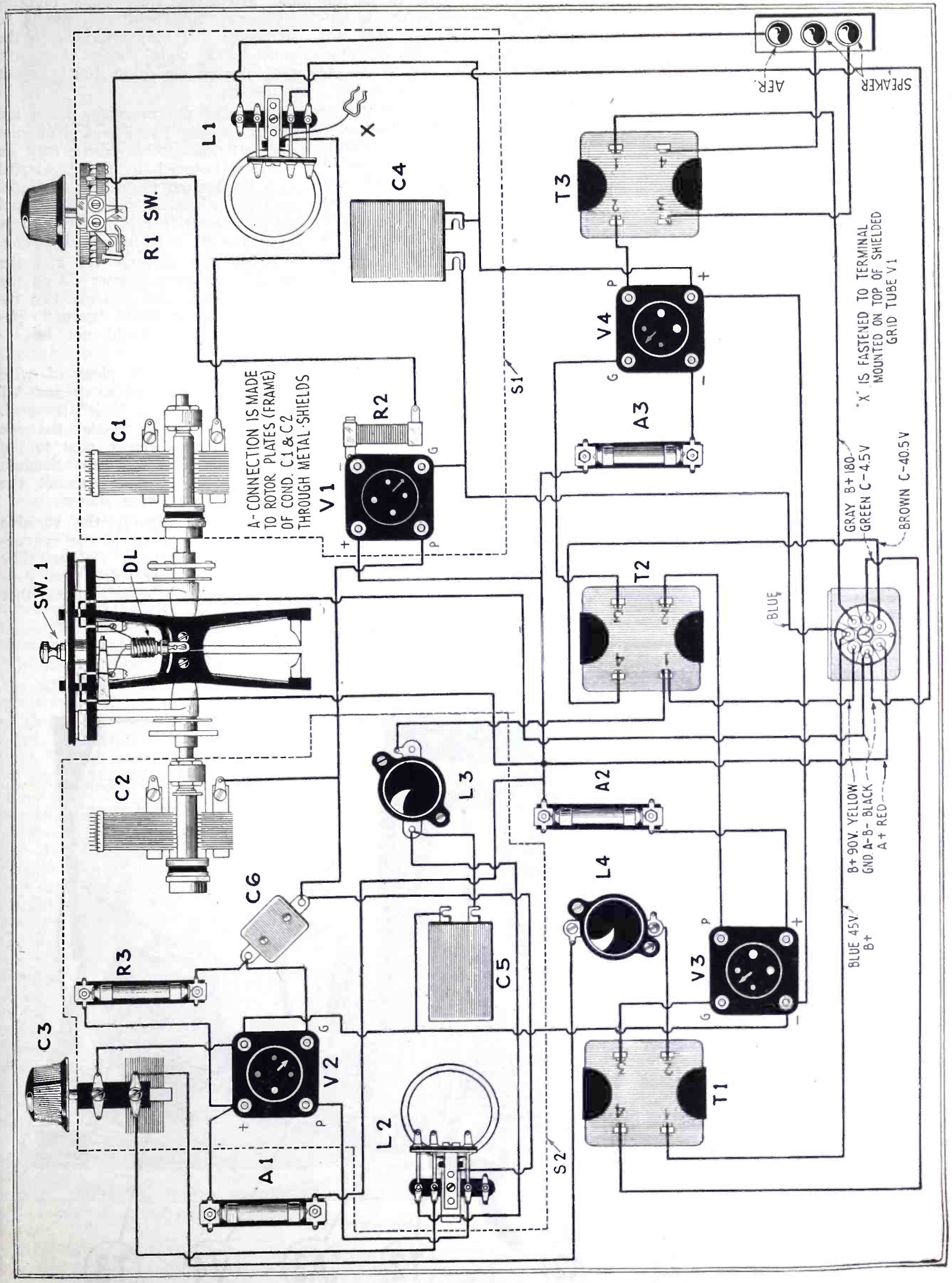
Although no balancing circuit is used, certain precautions must be observed. It is important to minimize the capacity between the plate of the screen-grid tube and the control-grid. In this arrangement, it will be seen that the plate lead leaves the shield compartment within half an inch of the terminal. To prevent any coupling through the common battery, or through the battery leads, a radio-frequency choke and a by-pass condenser are used.

Because of the high plate impedance of the 222-type tube it is important to use a coupling device of high impedance. This is most readily obtainable, without the use of a special coil, by using a tuned circuit such as recommended by the manufacturer of the tube. In some cases a transformer with a 1:1 ratio has been recommended, but this has no particular advantage where the coupling device is used immediately ahead of the detector tube. When such a transformer gives perfect coupling between the primary and secondary, it is similar to the tuned-impedance stage. When increased selectivity is obtained, it is due to looser coupling or to the omission of the grid leak; and this cannot be omitted in the detector stage without making the detector itself much less efficient.

This circuit normally tunes very broadly. This is due partly to the fact that the grid leak is connected across the tuned circuit; but prin-



Instrument layout of the set showing the location of all parts. Letter symbols correspond with diagrams, photos and list of parts.



cipally to the fact that the 201A-type tube must be operated with a positive bias on the grid to secure efficient rectification in the grid circuit (that is, with a condenser-leak arrangement). This positive bias is obtained by connecting the leak (R3) to the positive A filament terminal. Under these conditions the grid attracts electrons and this greatly decreases the grid-to-filament resistance, resulting in loss of sensitivity and selectivity.

To insure good quality reproduction the radio-frequency circuits need not pass more than about ten kilocycles. When the tuned circuit "looks into" the detector, the band it will pass depends on the frequency but is from 30 to 60 kilocycles wide; indicating that it contributes little or nothing to the selectivity. Furthermore what is known as the "dynamic" resistance of the circuit is decreased to such a low value that the 222-type tube gives only moderate amplification.

To offset these effects regeneration has been used. The effect of regeneration is to decrease the losses in the circuit or to increase the resistance across the circuit. When used in moderation it results merely in bringing this stage up to par without impairing the quality. In other words, sufficient regeneration may be used to increase the amplification considerably and to narrow the band the circuit passes to approximately 10 kilocycles. The adjustment is made by the operator, who can regulate it until he detects no appreciable distortion.

When the radio-frequency stages are adjusted so they do not discriminate against the higher audio frequencies, then the problem of good reproduction rests with the audio-frequency amplifier and speaker. A high quality audio-frequency amplifier has been used together with an output transformer, which makes it possible to use the 171 or 171A-type tube in the last stage.

The receiver may very easily be constructed by following the instrument layout, picture and schematic wiring diagrams.

A few general precautions will permit the constructor to duplicate the receiver quite easily. If three hours are available in which to assemble the receiver, one of them will be well spent in considering the sequence that is to be followed in the assembly, and in becoming familiar with the various parts and leads.

Partially assemble the two shields by holding the sides together and forcing the corner pieces down about half way. Place the bottom of the shield in what seems to be the proper position and then hold the assembled side walls immediately over it. The shields should be so placed that they are next to the panel and their sides clear the couplings on the drum dial by about 3/16-inch.

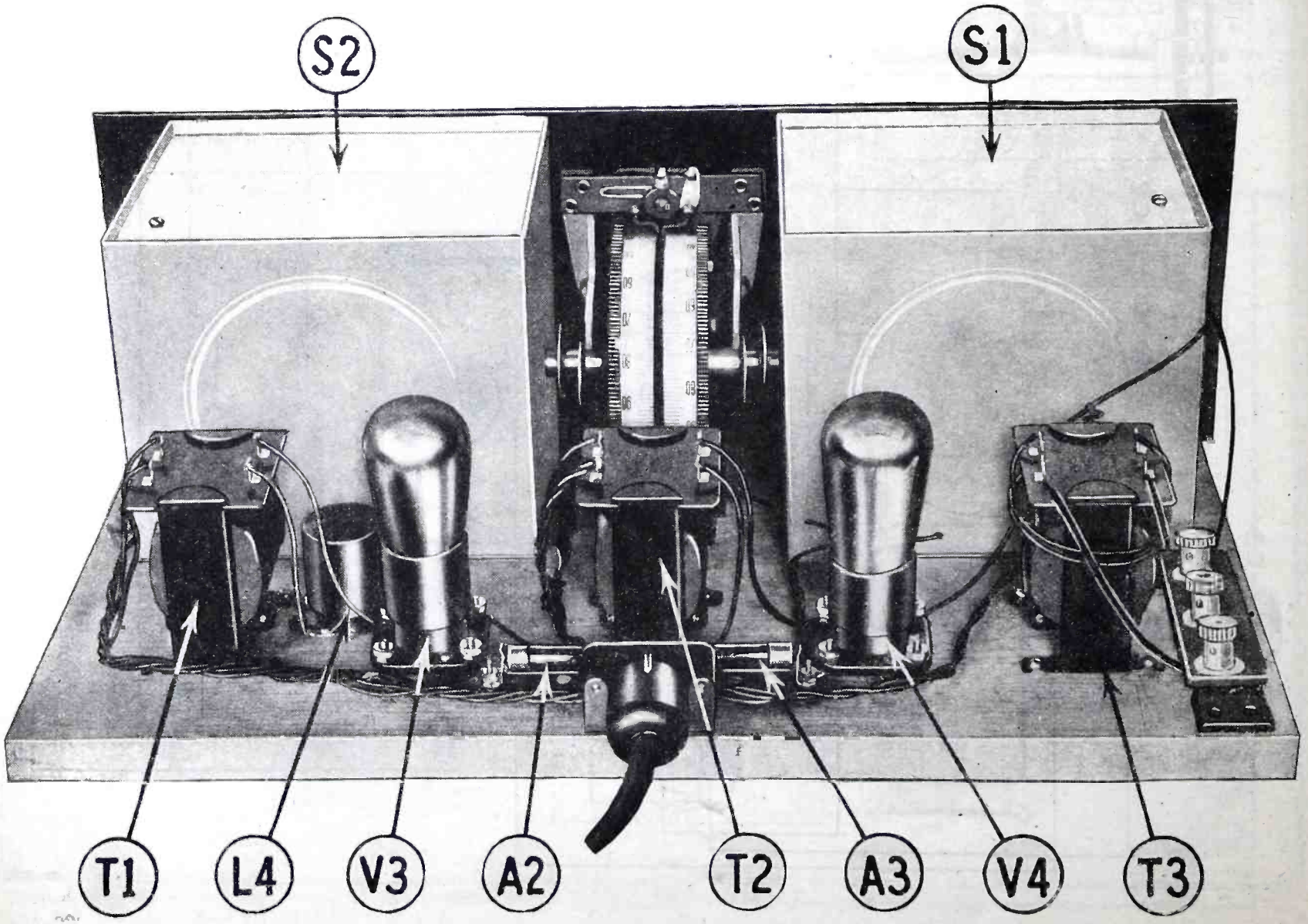
After all the necessary holes are drilled in the panel and drum-dial sides of the shields, these may be securely fastened to the baseboard with the bottom piece in place. An ice pick or similar tool may be used very conveniently to locate the screw holes and to start the wood screws.

Mount the rheostat R1 and the variable midget condenser C3 on the panel. The shafts of these two instruments are at shield (ground) potential so they should not be insulated.

Solder an 18-inch piece of wire to the "P" terminal of socket V1 and another to the "F+" terminal. These two leads go through the side of the left-hand shield, next to the drum dial. Thread them through the holes provided and mount the socket in the position shown.

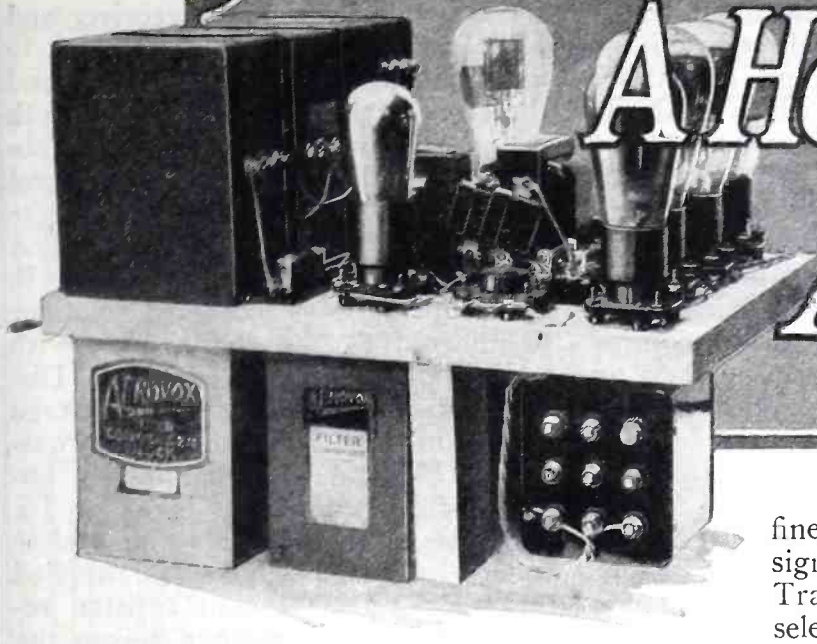
Details for aligning the variable condensers are given in the instructions with the drum dial so they need not be repeated. The condenser C1 should be so mounted that

(*Continued on page* 147)



S1, S2, shields; A2, A3, amperites; V4, power tube; T1, T2, A. F. transformers; T3, output transformer; L4, R. F. choke coil.

A Home Concert Amplifier



THE last two years have seen greater advances in the perfection of broadcast reception equipment than any other like period since the inception of broadcasting. It is less than two years since we thought that a push-pull amplifier utilizing two 201A tubes with 90 volts of B battery gave us real good reproduction. Perhaps it did, but when the first of the power tubes were brought out there was no question as to their superiority. The 71 followed the 112 and finally the old 5-watt transmitting tube was dressed up into the 7½-watt amplifier and seemed the culmination of amplification effort.

The last of these tubes drew from 20 to 30 milliamperes each, which, in consideration of the voltage required for their operation, absolutely prohibited the continuance of batteries except by millionaires; and eliminators became the order of the day.

Ever progressing, however, the last three months or so have seen the announcement of a new amplifier tube which dwarfs the 210—we now have available tubes of the UX-250 type. These tubes require no higher voltage than did the 210 and have at last enabled us to reproduce music on a scale which makes it possible to imagine that we have the singer or orchestra in our own home. In the past we have not been able to bring in the full performance of a symphony orchestra with real fidelity—in fact, even the base notes of the piano have betrayed the burring dissonance which is a sure sign of overloading. The new tubes change all this. They will reproduce all the volume which can be desired for home entertainment without any distortion whatever and we can now listen to the whispering notes of the upper register or the deep boom of a tuba with equal pleasure.

Owing to the much larger amounts of power required for the operation of the new valves, a great many refinements in circuit design prove necessary. Transformers must be selected which will carry the greater drain. Filter chokes which were all right for 35 M.A. have no reactance at all at 135. Filter systems must be designed with a view towards much improved regulation even with the heavier load. Amplifiers must be designed with greater care, for we no longer can be helped by corrective distortion.

LIST OF PARTS

1 Thordarson power transformer, type T-2098, T1
1 Karas A.C. Former, T2
1 Aerovox Pyrohm type 992-900, R1
1 Aerovox Pyrohm type 992-750, R2
2 Aerovox condensers type 202, 1 mfd., C1, C2
2 Thordarson chokes type 2099, L1, L2
2 Aerovox condensers type 1002, 2 mfd., C3, C6
2 Aerovox condensers, type 1002, 4 mfd., C4, C5
1 Aerovox Pyrohm type 992-10,000, C7
3 Aerovox condensers type 202, 4 mfd., C8, C9, C10
1 Aerovox Lavite resistor, 100,000 ohms with mounting, R3
1 Aerovox Pyrohm type 992-15000, R4
1 Aerovox Pyrohm type 992-8000, R5
1 Aerovox Pyrohm type 992-10000, R6
1 Aerovox Pyrohm type 992-250, R7
1 Thordarson output impedance type 2420, L3
1 Thordarson push-pull transformer type 2408, L4
2 Aerovox moulded mica condensers, .006 mfd., C11, C12
2 Aerovox Metalohms, 2 megohm, R8, R9
2 Aerovox Lavites, 500,000 ohms with mounting, R10, R11
1 Aerovox Lavite, 100,000 ohms with mounting, R12
8 Benjamin sockets
1 Yaxley plug and cable
1 Wood baseboard 12x15x1"
2 CeCo rectifying tubes, type R-81
2 CeCo amplifying tubes, type G
2 CeCo amplifying tubes, type L-250
1 Voltage regulator, type CX-374
1 Pkg. Kester rosin core solder
50 Ft. Corwico rubber covered hook-up wire.

The combined power unit and amplifier which will be described in the following paragraphs has been worked out with an eye to all these conditions and if instructions are followed carefully, the result will be a power block supplying up to 140 M.A. at 475 volts at the rectifier output.

The non-motor-boating voltage divider system cut this down to 45 and 90 volts for the receiver and 100 volts for the external first stage audio amplifier tube, which energizes the 4 tube power amplifier.

The voltage regulator tube, without which the unit nonoperative, protects the tubes and condensers from dangerous surges. The simplicity of construction is obvious, all parts except the filter condensers and resistances being mounted on the upper side of the foundation board while the condensers and power resistances are underneath. All wiring from one to the other is carried through one large hole and two small ones in the wooden baseboard.

To simplify construction of the functions of the various parts, we shall divide our description of the unit into the following sections. 1.—Power Converter; 2.—Filter and, 3.—Amplifier.

Mount the transformer, Lavite resistors and grid-leaks with the tube sockets on one side of the board taking care to locate them carefully as in the illustrations. Then turn the board over and mount the condensers and Pyrohm resistors with the Karas A.C. Former on the lower side of the board.

The .006 mfd. coupling condensers are mounted directly on the ends of the ½-megohm Lavite resistors.

The 110 volt A.C. Leads from the glow tube are carried around the outside of the board, twisted together and well away from all parts of the set; finally being led up directly to their terminals at the glow tube through a hole alongside of the socket. The same hole can be used to conduct the A.C. filament lead from the 5-volt section of the A.C. Former to the high-mu tube sockets.

All D.C. leads should be cabled to-

gether wherever possible and each pair or triplet of A.C. leads should be twisted separately. A.C. and D.C. leads should be as far apart as possible and the loud speaker leads from L3 to the Yaxley plug should also be twisted and can be somewhat separated from the other leads. All cases of transformers and condensers must be grounded in order to prevent any possible 120 cycle pick-up.

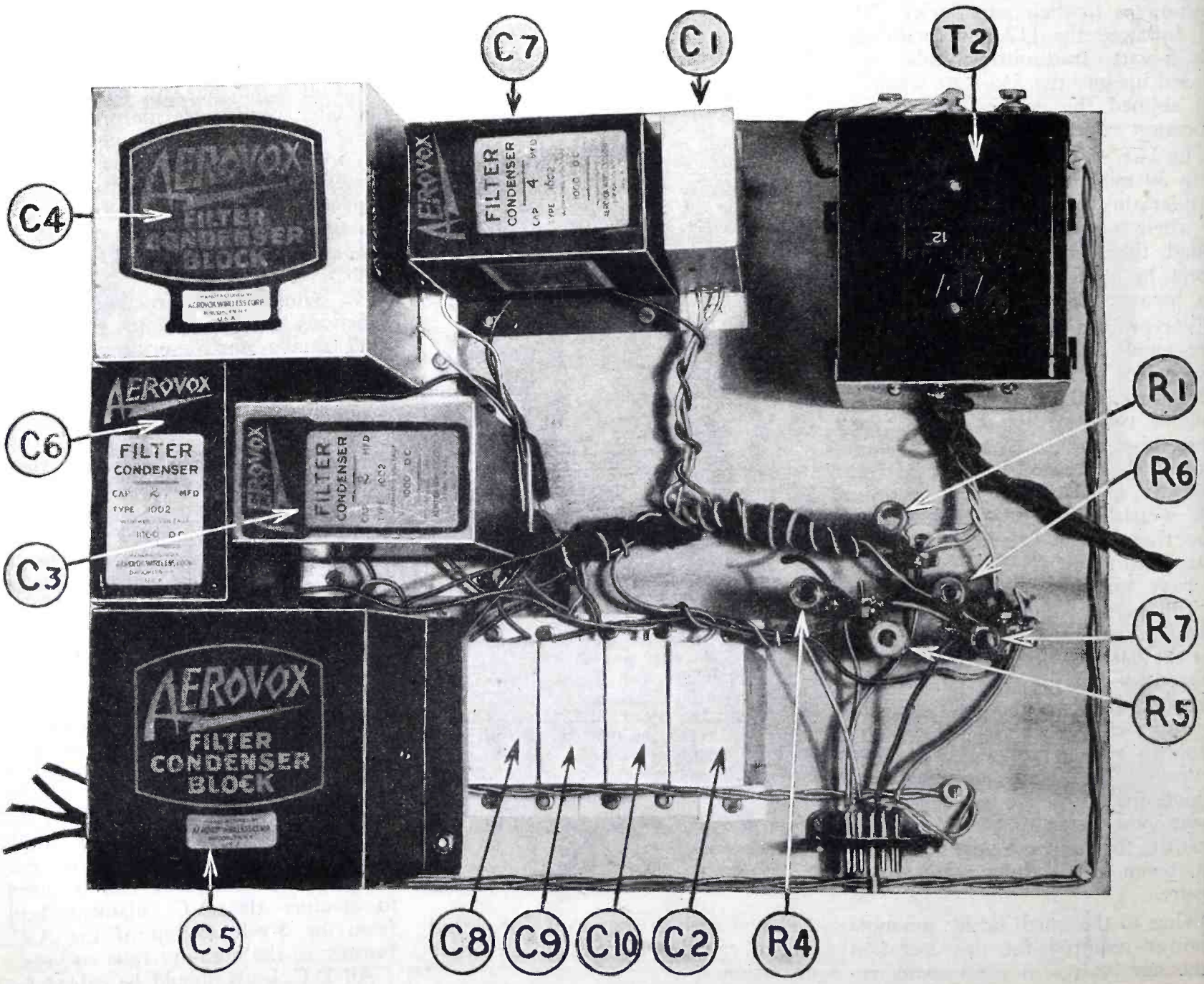
A reference to the circuit diagram will show a number of unusual features. For example, a great deal of care has been taken in designing the unit to prevent any possible audio frequency feed-back to plate supply taps, for all taps of more than 90-volts are taken direct from the maximum plus "B" terminal. The first sections of the double chokes are connected in parallel in order to increase their current carrying capacity and keep the voltage drop in them to a minimum. The plate supply for the two high-mu tubes is carried through a filter choke system which is separate from the supply for the balance of the tubes and isolates any possible trouble from reactance here.

The plate lead to the input transformer is also tapped directly off the major plus "B" through a 100,000 ohm Lavite resistor, which with its by-pass condenser forms an isolator circuit for the audio frequency component of the input tube plate current.

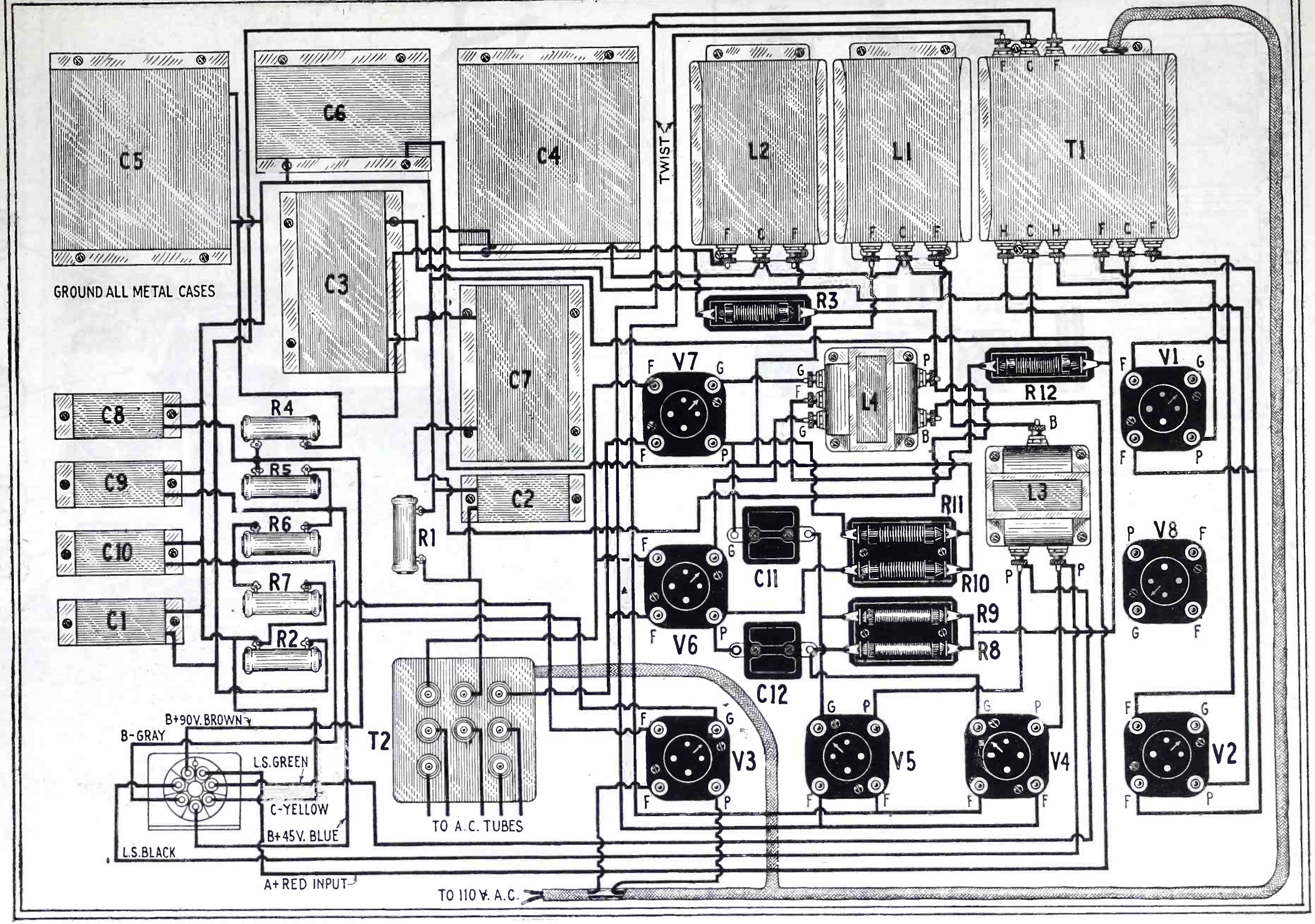
The glow tube holds the voltages for the detector and amplifying tubes in the receiver to their exact requirements regardless of the number of tubes used in the receiver and also serves as a protection for the by-pass condensers if the amplifier is turned on without any load, but if any other tube is by accident inserted in the socket of the glow tube, the cut-off will not function and power will not be applied to the transformer primaries, thus protecting the user against burning out tubes if he accidentally gets them in the wrong sockets.

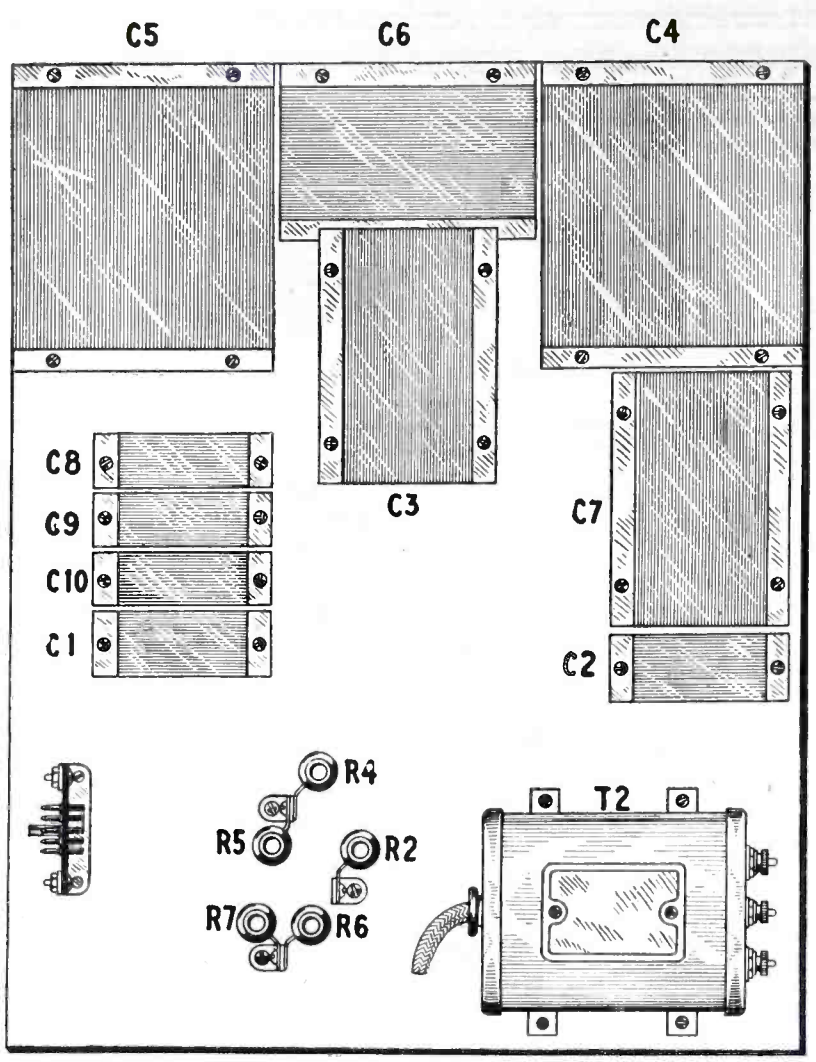
The system of amplification (push-pull input to two high-mu voltage amplifier tubes, each operating one type L-250 amplifier) has several reasons. In the first place in order to get the proper amounts of current for best operation of the receiver and 350's, we are working very close to the limit of the rectifier tubes and therefore if equal amplification both in quality and quantity can be ob-obtained with tubes drawing a total of 1.6 M.A. to that which can be gotten with 7 or 8 M.A. we have made a perceptable gain. It is customary in the ordinary resistor coupled amplifier to utilize 135-volts plate supply with resistor of about 200,000 ohms. Under this condition, the D.C. voltage across the tube terminals is approximately 118 and the amplification obtained from one stage is about 16. We have available in this unit a plate voltage of 425. This is applied through a 500,000 ohm resistor resulting in a D.C. voltage across the tube of about 170 volts and an overall amplification of about 26 which is better than can be obtained with an ordinary tube and a 3 to 1 transformer; besides which the distortion which a transformer might possibly introduce is avoided.

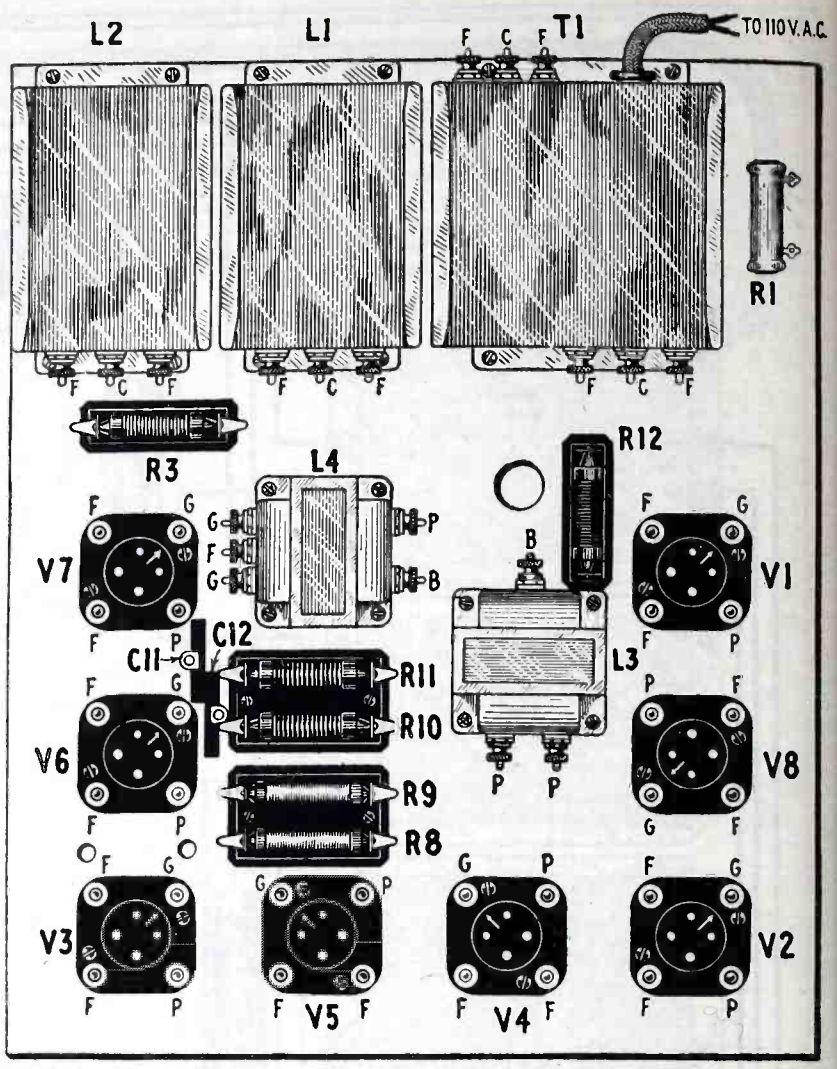
The output impedance selected to couple the CX-350 to the loud speaker has been carefully checked as to its



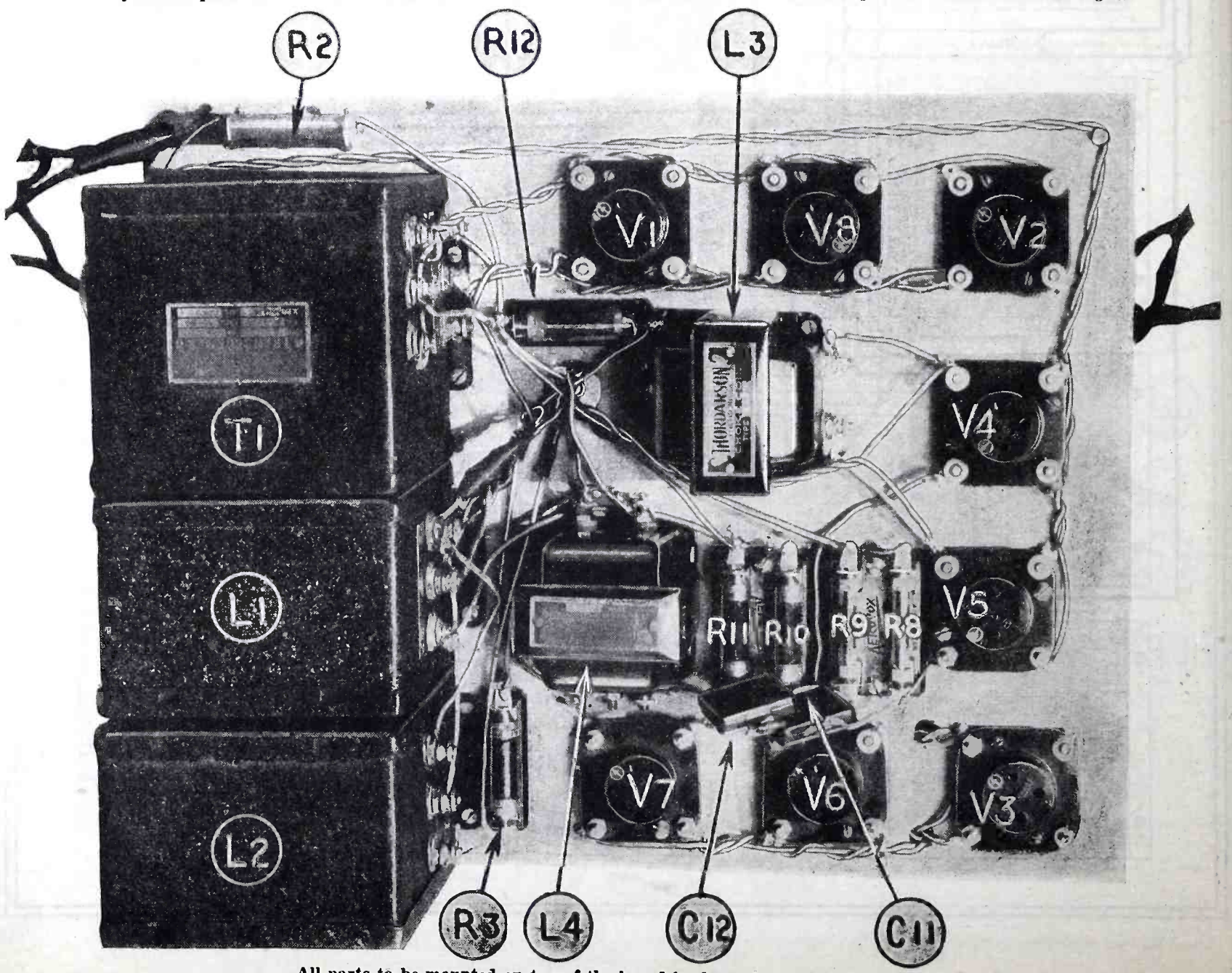
A bottom view of the completed Home Concert Amplifier showing how the condensers, fixed resistors and cable-plug connector are mounted and wired.







Layout for parts on the bottom of the board is shown at the left and layout for the top of the board is at the right.



All parts to be mounted on top of the board is shown in the above photo.

mpedance in combination with that f the average loud speaker and it will roduce in most tases the optimum oad at sonic frequencies.

The whole unit may be expected to ive an overall amplification of about 00 to 325 and its undistorted power utput should be in the neighborhood f seven and a half watts.

In operation with a receiver the econd audio tube should be left out nd the input lead of the Yaxley able should be connected to the plate erminal of the first audio amplifying ube. When used with a phonograph, special impedance mating transormer should be used between the honograph pick-up and the amplifier. The secondary of the latter should e connected on one side to the inut lead and the other side through 4 mfd. filter condenser to the minus B" lead.

Under no circumstances should the nit be operated with less than its ull complement of tubes as the reistances have been calculated to give he proper bias when all the tubes re in their sockets and if it is operted under other conditions serious lamages may result.

Attention is called to the fact that there are no knobs to turn. All voltages have been arranged exactly to give the best operation with existing receivers and variable resistors can do very little to improve and a great deal to harm the operation of the unit as an eliminator.

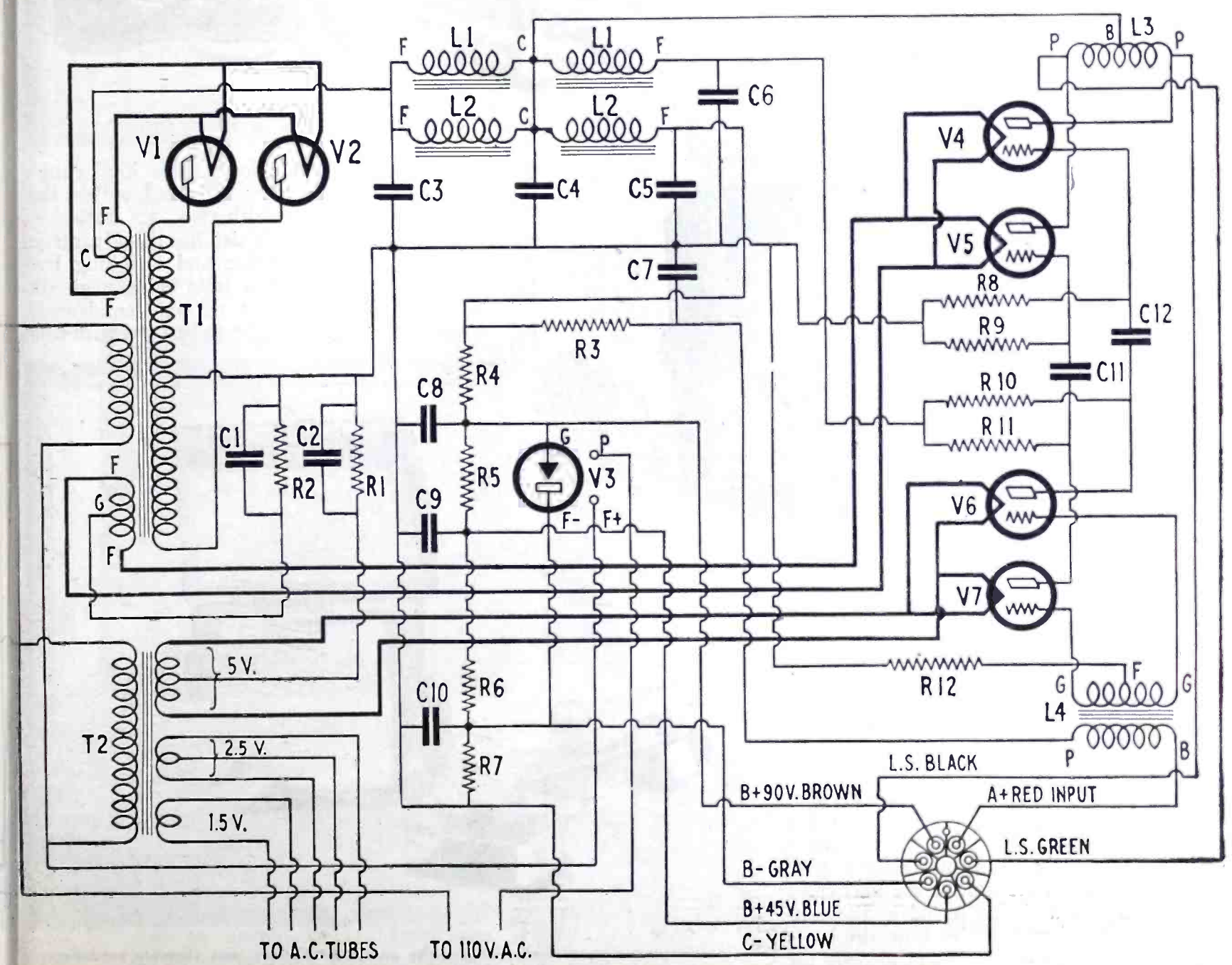
If the unit is to be used with an A.C. receiver or if it is desired to convert a battery set to complete A.C. operation, filament windings are provided on the Karas A.C. Former for type 226 and 227 tubes. The Carter A.C. Adapter will simplify the conversion of existing sets.

After completing the assembly of the unit it may be encased in a metal container both for appearance sake and general convenience in handling. Practically any local tinsmith will make a metal box to fit this unit at a reasonable cost.

The metal box should cover the over-all size of the unit allowing from one to one and a half inches in height above the top of the L-250 tube, and large ventilating holes should be made in a removable cover for the top of the box. If the box is made so that the wood board fits flush with the inside, two chest handles can be screwed to either side of the box. The box may then be given a few coats of lacquer and the finished product will have every appearance of a fine factory-made job.

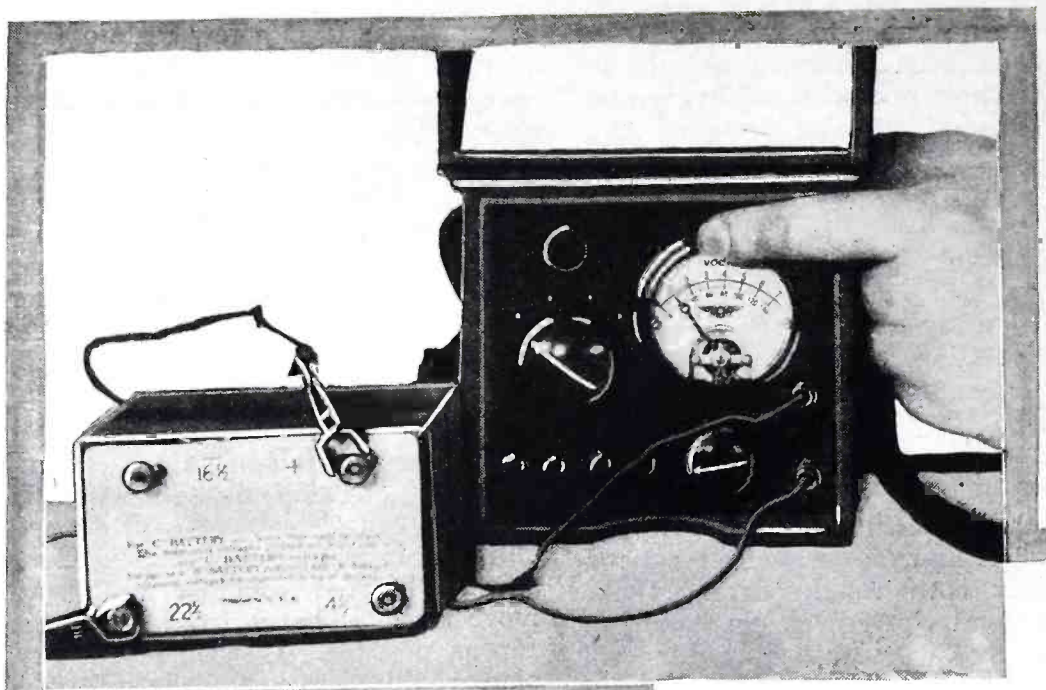
This unit is particularly effective when used in conjunction with aeroplane cloth speakers such as the Dynatone speaker, Accousti-cone, or an aeroplane cloth diaphragm speaker using the Brielle B-A motor. These speakers are specially designed to handle a heavy output and give exceptionally natural tone reproduction.

The completed Home Concert Amplifier can conveniently be installed in the radio console cabinet with the set, although if trouble is experienced by an A.C. hum, it would be well to remove the unit away from the set as far as possible. Of course the best plan would be to install the unit in a separate cabinet with the loud speaker. Thus, if a dynamic type speaker is employed a cabinet can be so constructed as to allow for a suitable baffle for the speaker unit. The amplifier can then be installed in the cabinet either above or below the speaker, and leads for the power supply can be connected to the set by means of the cable and twisted lamp cord for the A.C. tube leads.

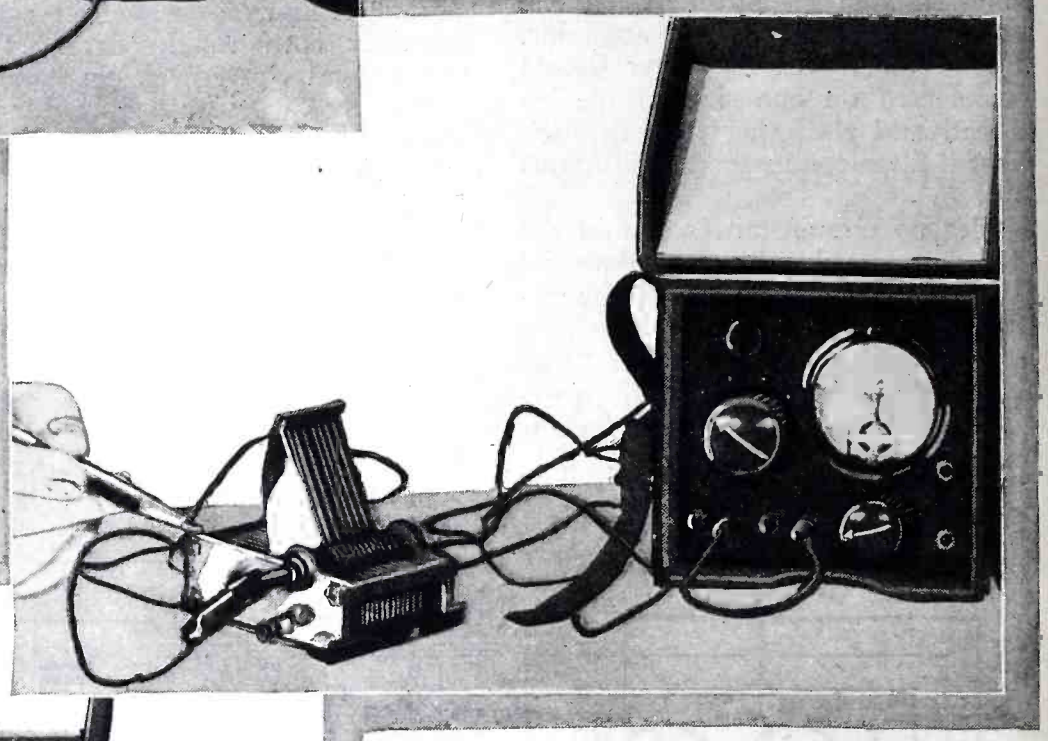


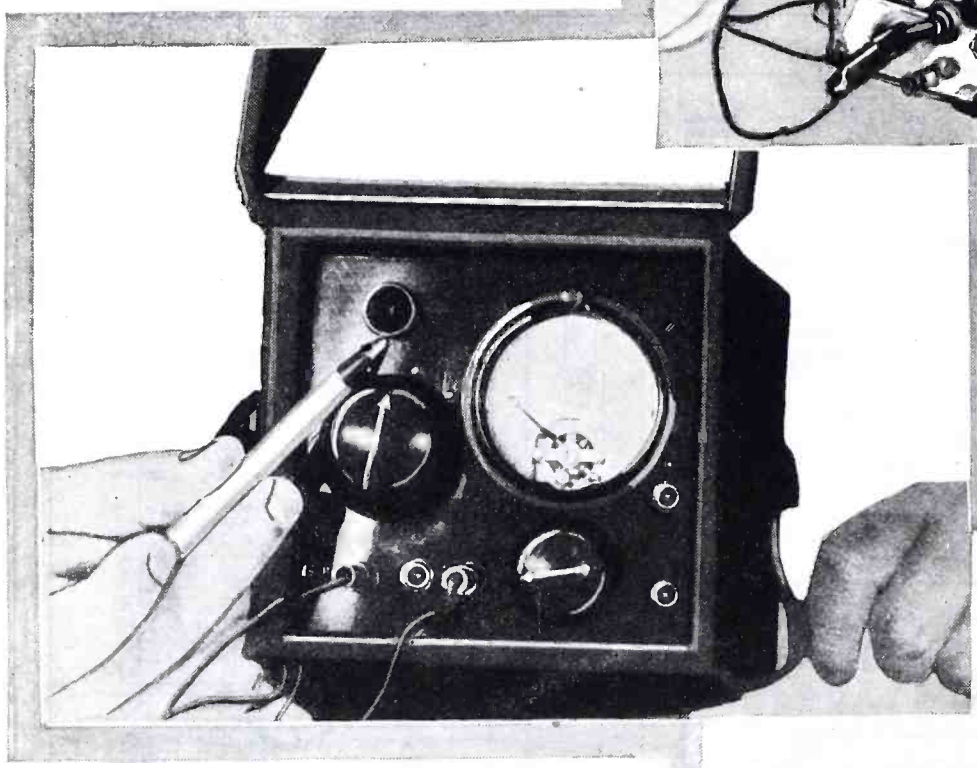
Schematic wiring diagram of the Home Concert Amplifier.

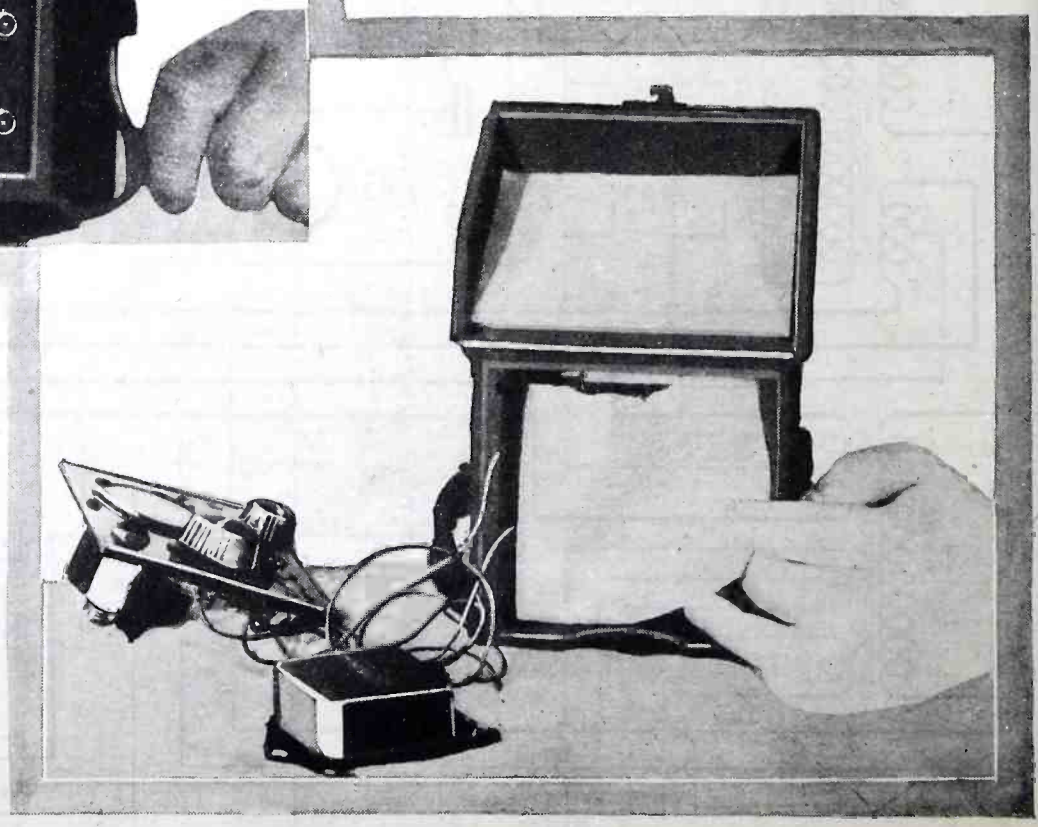
A COMPACT TEST SET



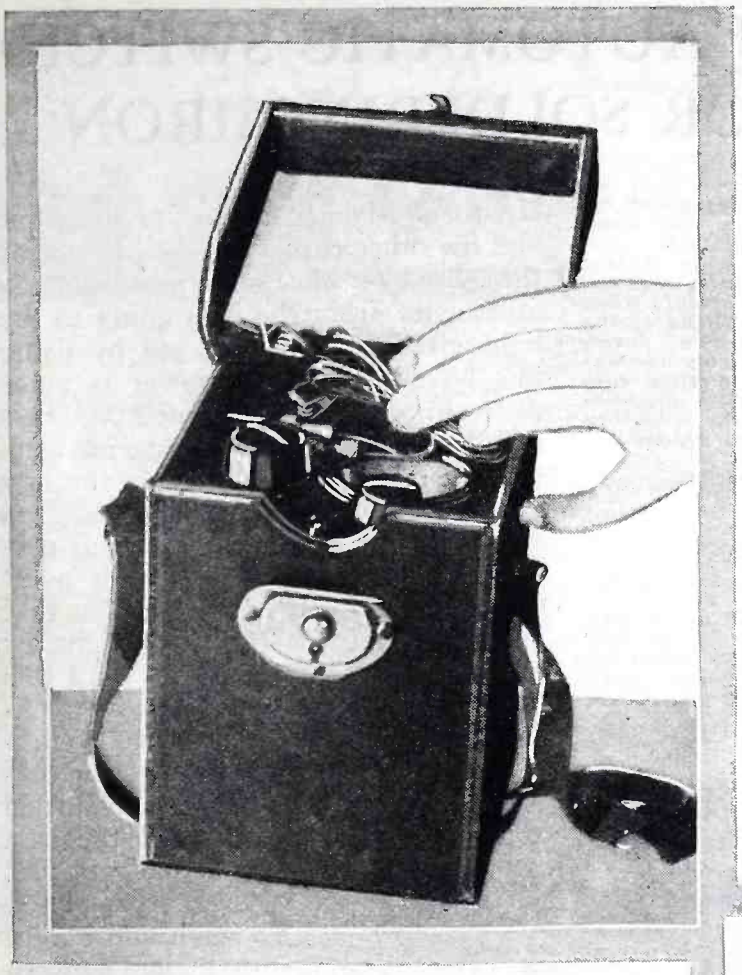
THIS compact radio set tester is exceptionally useful for measuring the various voltages of batteries at the battery terminals of the tube sockets in a radio set when trouble occurs. It may also be used for testing the continuity of the various circuits and the condition of the various components used in radio set construction. By means of a multi-pointed switch, a buzzer voltmeter or test lamp may be used as an indicator. The completed instrument is readily portable, as it is housed in a discarded camera case. Two "C" batteries are also included with the testing outfit and furnish the necessary current for testing radio circuits and parts. As may be seen from the photos, the potentiometer, voltmeter, four point switch, tip jacks and test lamp are mounted on the panel. A voltmeter giving a double range reading should be used. By means of the four point switch, the buzzer, test lamp or voltmeter may be cut into the circuit and used to give indication of the condition of the particular piece of apparatus being tested or the continuity of the circuit. The four tip jacks arranged on the panel as shown, provide for the insertion of the two test leads. Various combinations can be obtained by simply plugging-in the test leads in the different tip jacks. The circuit diagram of the meter is also given here. A 2,000 ohm potentiometer is used as the rheostat. The tip jacks numbered 1, 2, 3 and 4 are used for ordinary testing, and numbers 5 and 6 are used when testing "B" batteries or higher voltages as they connect with the high reading portion of the dual range voltmeter. The buzzer is placed within the meter case together with two "C" batteries. This small testing outfit also has the advantage of being readily portable and weighing but little. The photos show tests being made on a "B" battery and on a variable condenser. The best type of test light to be used with this



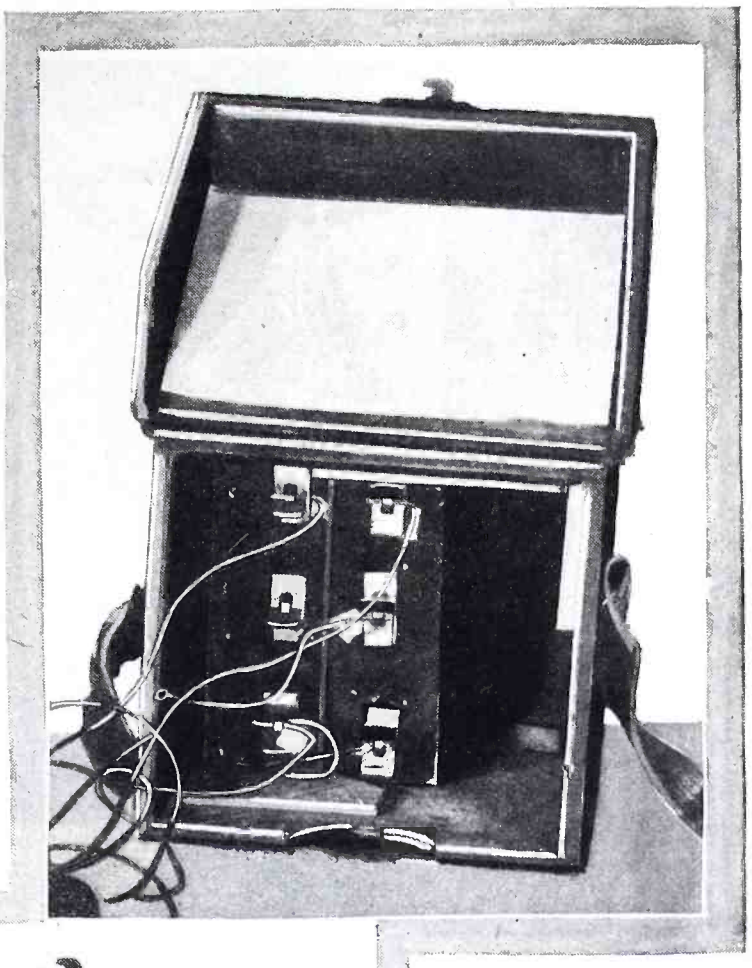


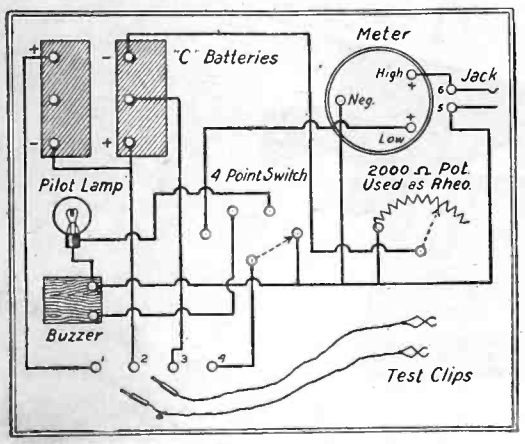


Above photos show tests being made on a "B" battery and variable condenser. The lower photo shows the parts removed from camera case.

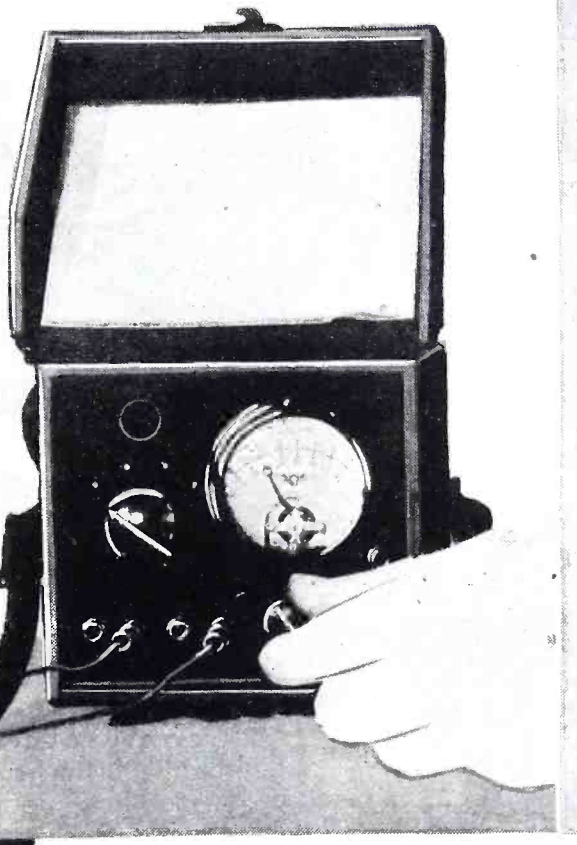


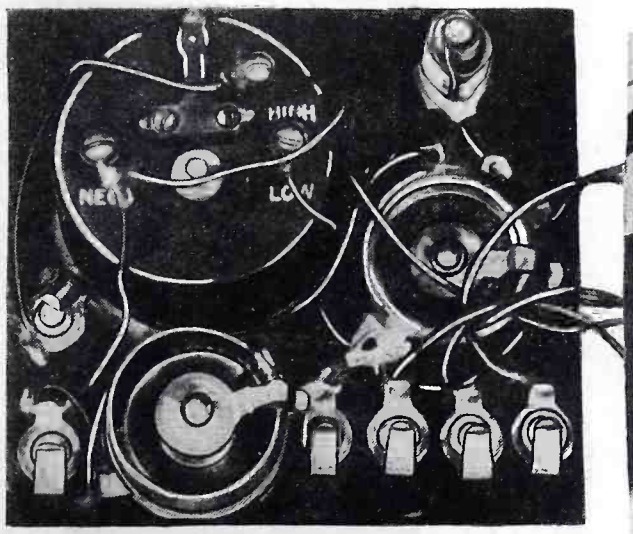
The photos on this page show various details of the radio test set. At the left is complete test set with test cords placed in the top of the camera carrying case. At the right shows how the two "C" batteries are placed in the bottom of the carrying case. The three photos directly below show a top view, a rear view of the panel, and the lower right hand photo indicates the location of the small pilot light.

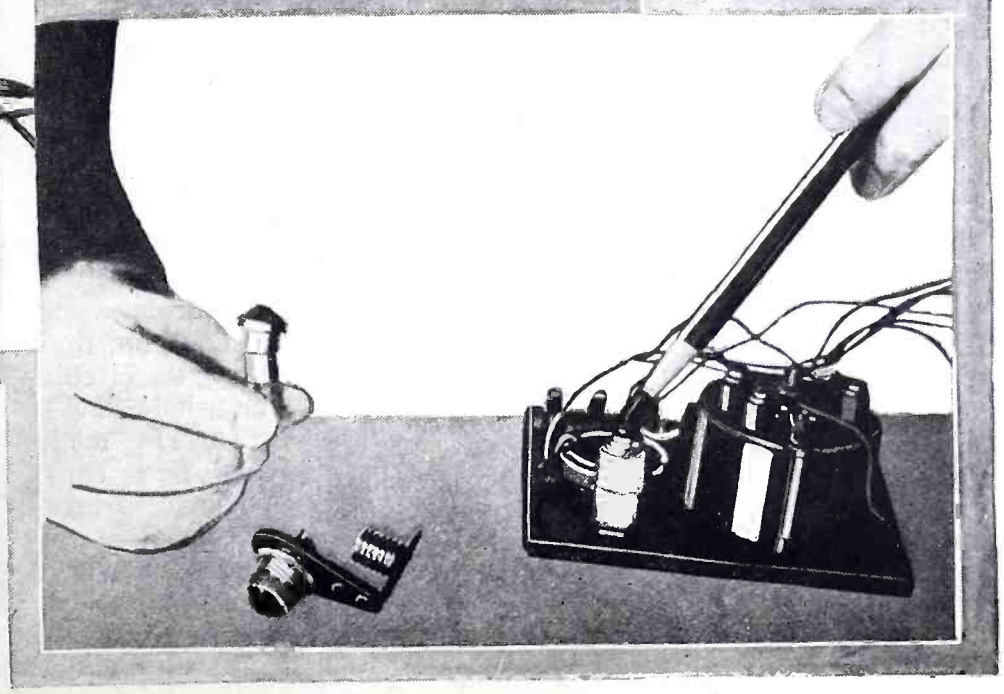




Wiring diagram of the testing set.



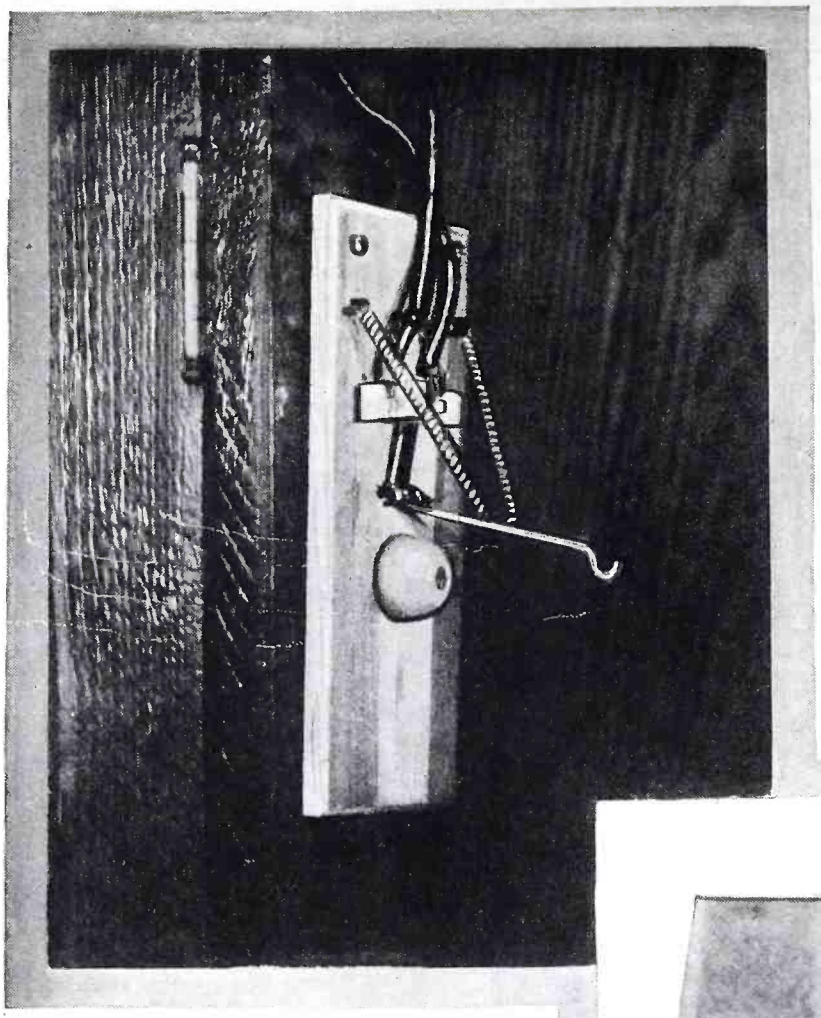




outfit is also shown. This light has a colored glass front with the small electric bulb placed in an upright position in back of it. A testing device of this nature is particularly helpful to the builder while making tests of a receiver on the work bench, since it is possible to immediately ascertain which circuit is faulty or incomplete. The testing outfit is also valuable in determining wheth-

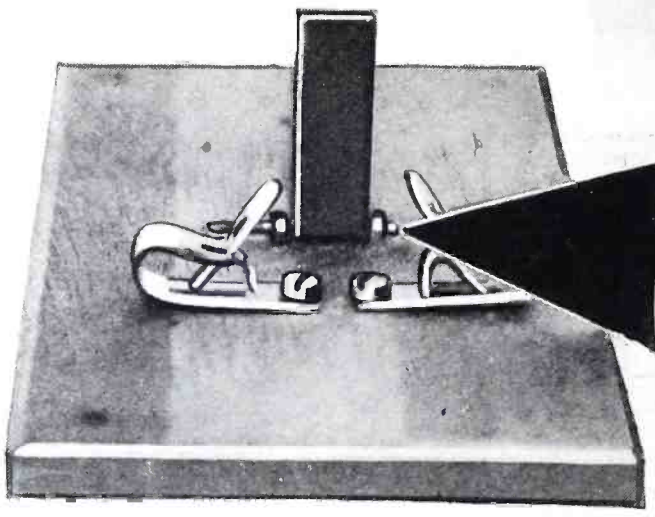
er condensers have been short circuited or broken down, or if the windings on transformers and coils have become broken or injured in any way. The cost of the outfit is really low compared to the valuable service which it renders and is particularly valuable to the custom setbuilder or service man who does not have the money to invest in a more elaborate outfit.

AN AUTOMATIC SWITCH FOR SOLDERING IRON

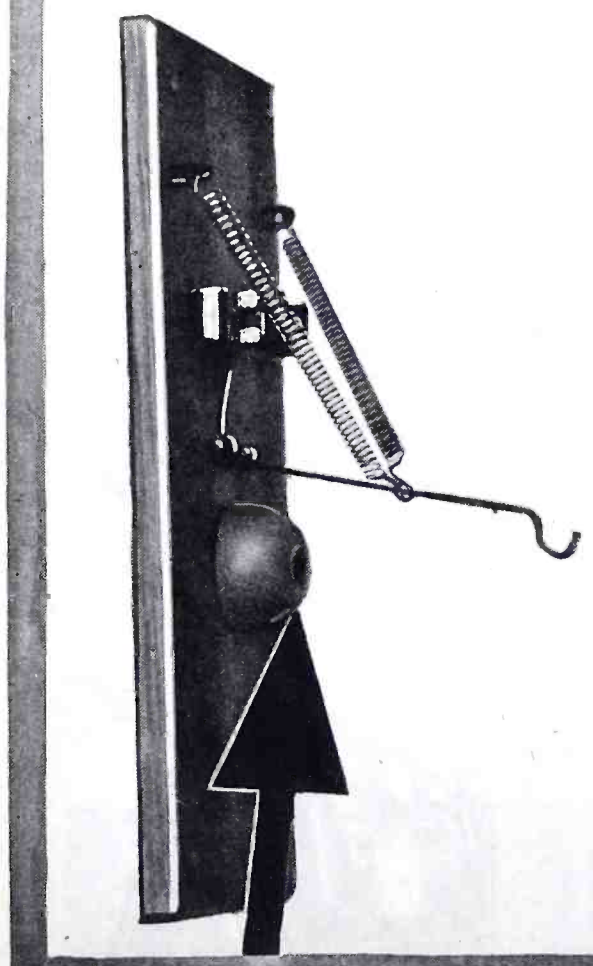


The photograph at the left shows the completed automatic soldering iron holder which shuts off the electric current when the iron is hung on the hook. This device saves not only the expense of electric current but also prevents the electric soldering iron from oxidizing.

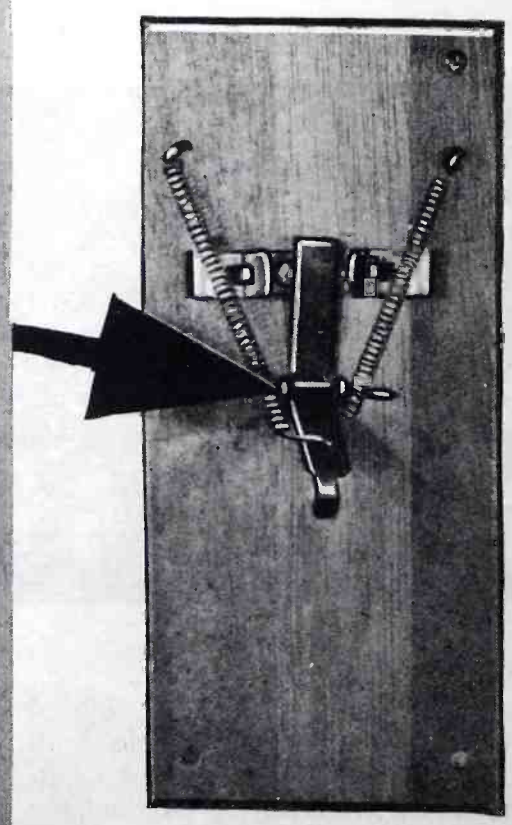
Directly below an arrow points to the contacts which are merely the heads of the two wood screws fastening the spring terminals to the baseboard.



THE soldering iron holder shown in the photographs should find much use in the laboratory and radio workshop, inasmuch as it is automatic in its action. When the iron is taken from the holder, the current is automatically turned on, and when it is hung up, the switch shuts off the supply. The construction is simple and the completed arrangement may be mounted upon a wooden base as shown. The hook for the iron also acts as the switch. The weight of the iron keeps this switch in an off position, but when the iron is lifted, the springs pull the hook up, thus closing the circuit. The whole device is easily made from two clips, two small springs, and a piece of metal upon which the iron is hooked. One of the wires from the light circuit is attached to one of the clips, and the other clip is attached to one of the wires on the soldering iron, the other wire from the iron going to the light circuit. Thus we see by using this novel device, the power is automatically shut off and turned on. This will do much to save the soldering iron, for when the iron is left on for any length of time the tip becomes oxidized and encrusted with scales which prevent the heat from reaching the point to be soldered. It often happens that the iron is left attached overnight, or for a long period of time. With this device described here, the above mentioned troubles will be entirely eliminated, as the current is only turned on when the iron is actually in use. The completed switch and holder may be conveniently mounted on the wall near the work bench. This simple device serves very nicely in the workshop of the custom set-builder and will save expense on the electric bill.



A rubber bumper stop is fastened below the hook.



The arrow points to the hinge of the hook arm.

Remote Volume Control For Speakers, Etc.

PROVIDING precise variable resistance in the form of an accessory rather than as a radio part, together with sufficient current-handling capacity for reliable and long-life operation, the device shown in the photo herewith has a wide range of applications in radio and laboratory work.

Photo by courtesy American Mechanical Labs.
This device can be placed on the tea table or any remote location for control of tone.

Briefly, the device comprises a micrometric variable resistor or from zero to 500,000 ohm range, mounted in a neat metal stand, together with two flexible conducting cords provided with standard cord tips as well as a connection block to take the usual loud speaker cord tips. The metal case is handsomely finished in nickel and bronze, with a neat bakelite knob to complete the attractive appearance of this accessory. The bottom is provided with a soft felt pad to protect the finest furniture.

There are various ways in which this device may be employed. First of all, it may be employed as a through connection, with one cord to the receiver and the other, by means of the connection block, to the loud speaker. Again, it may be employed to cut in resistance in any given circuit, by using just one cord, since the resistance is shunted across the cords. It provides an ideal volume control for the usual loud speaker, either alongside or as a remote control. It may be employed as a volume control for electric phonographs. It may be used in connection with A. C. tube harness. It may be applied in many experimental and laboratory set-ups.

A Full Automatic Power Control

THREE systems are now available to the set owner who wishes to operate the filament circuits of his radio receiver with power obtained from the light socket. The first method employs a storage battery, a battery charger and an automatic power-control switch; and the battery is automatically charged while the receiver is not in use. The second system uses an "A" power-supply unit which converts the 110-volt A. C. into pure 6-volt D.C., which may be used for heating the filaments of the tubes. The third way is to use special A.C. tubes, which have electrical characteristics similar to standard tubes, but are designed for operation with a low-voltage source of A.C., which may be obtained from a transformer. It is possible to operate a receiver at high efficiency with any one of these systems; but each has features which render it unsuitable under certain conditions.

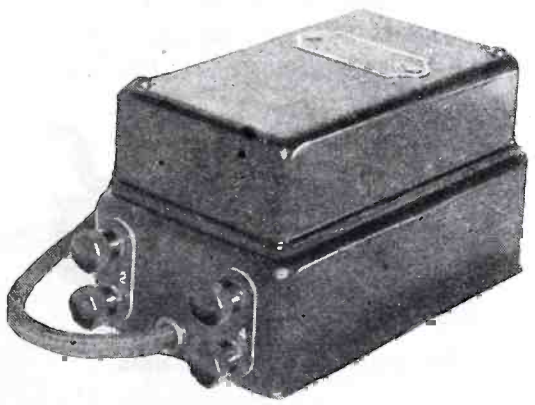


Photo by courtesy Yaxley Mfg. Co.
The full automatic power control is completely encased in metal and fool-proof in every way.

In a properly-designed receiver A.C. tubes are capable of giving excellent performance, and the characteristic A.C. hum may be reduced to a very low minimum. However, the receiver must be designed especially for these tubes or, if originally D.C. operated it must be rewired before these tubes may be used. Also, the characteristics of the A.C. supply must be good, or line noises will be heard in the receiver. "A" power supply units also give excellent satisfaction; but they necessitate discarding the storage battery and purchasing a unit which is as expensive as a battery and a charger. As in the case of A.C. tubes, these units may be used only where a good A.C. supply is available.

There are a large number of radio fans, who already own an "A" battery, to whom the use of a charger with an automatic power-control relay strongly appeals; as this is a very inexpensive method of electrifiying a receiver. With this system the "trickle" type of charger is most commonly used, and this supplies the battery with current at a very slow rate. In twenty hours, chargers of this type replace approximately the same amount of current that is consumed by the average receiver during an evening's operation. Therefore, where a receiver is used consistently, this method keeps the battery in good condition at all times.

There are also two classes of listeners who wish to use a trickle charger, but find it unsuitable for their needs. The first use the receiver a great deal and, as a result, are constantly discharging the battery; the second class use the set very little and therefore overcharge the battery. This problem may be solved by a new type of power-control relay recently placed on the market. With this relay a full-rate charger is used; the relay turns on the charger when the set is turned off, and turns off the charger when the battery is fully charged. If the set is used a great many hours during the day the full-rate charger is able to bring the battery back to full charge before the set is used the next time. When the set is seldom used, the charger does not operate after the battery has been charged. In other words, the charger keeps the battery fully charged at all times, but never overcharges it. Also, the battery requires practically no attention; as it is necessary only to add water to the cells, at very infrequent intervals.

In construction, the new relay is the same as a previous model, but with an extra coil added. The schematic wiring diagram will be found on this page and shows that the device really comprises two relays, A and B. Relay A, connected in series with the "A" battery lead to the set, causes the

"B" power unit to be turned on when the set is in use, and connects the charger when the set is turned off. Relay B is connected in shunt with the battery at all times and turns off the charger when the battery is charged.

"A" Power With Charger and Filter Unit

THE photo herewith shows a new dry "A" filter unit which can be employed in conjunction with practically any type of battery charger to furnish the filament lighting current of battery operated receivers. In this way the efficiency of direct current type tubes or the newer screen-grid tubes can be had along with the advantage of A. C. operation.

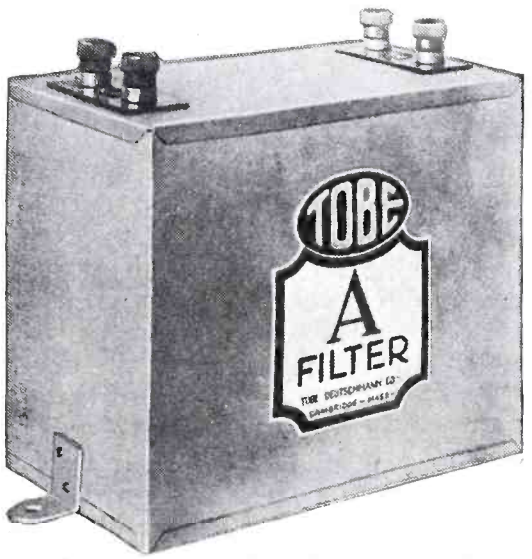


Photo by courtesy Tobe Deutschmann Co.

This device can be connected to the battery charger as a filter for the "A" battery supply from the A.C. line.

The major difficulty with a number of "A" battery eliminators has been primarily that of an efficient high capacity condenser or filter system. The unit herewith employs a dry type condenser of the usual construction which has a capacity of 3,600 mfd., and with it two specially designed choke coils are combined in a metal casing.

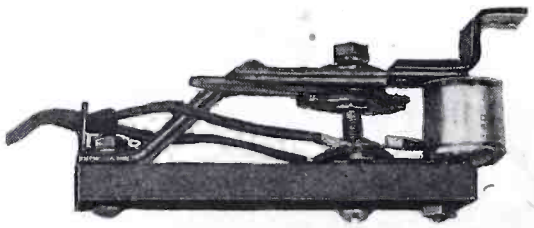
All that is necessary to complete the "A" battery eliminator is a charger of the two ampere type to which this unit is connected as though it were a battery. The radio set owner who does not have a charger needs only a rectifier, transformer and a high voltage rheostat, and in a few minutes can assemble an efficient "A" eliminator, as practically all the wiring is made within the filter unit. A 10 ohm heavy duty variable resistor is connected to the positive lead of the set in order to control the voltage from the eliminator to compensate for the line voltage variations. The transformers tested in connection with this unit and which have been found to be most efficient were those of the 75-watt types with a secondary output of 10 to 14 volts. A voltmeter is recommended to be employed in conjunction with this unit to keep accurate check on the current flow, as line voltage variations are common in most A. C. current sources.

The Piano As a Radio Loud Speaker

A FUNDAMENTAL fact in the musical production of tones is the naturalness and beauty of wood as a reproducing medium. The two instruments that play an indespensable role in musical creation are the violin and piano.

The manufacturers of the unit pictured in an accompanying photo have taken advantage of this fact in the development of this simple device which can be readily attached to the sound-board of the piano with the resultant production or reproduction of broadcast music of astonishing quality. The pole-piece or armature of the unit is flat and fairly rigid, allowing no free vibration and responding only to the impressed vibrations from the radio receiver. In order to do away with the distortion inherent in the average cone unit or driving mechanism, the motion here is direct. There is no side-sway. The air gap being in the center of the flux field there is practically no loss of flux and no great loss of energy.

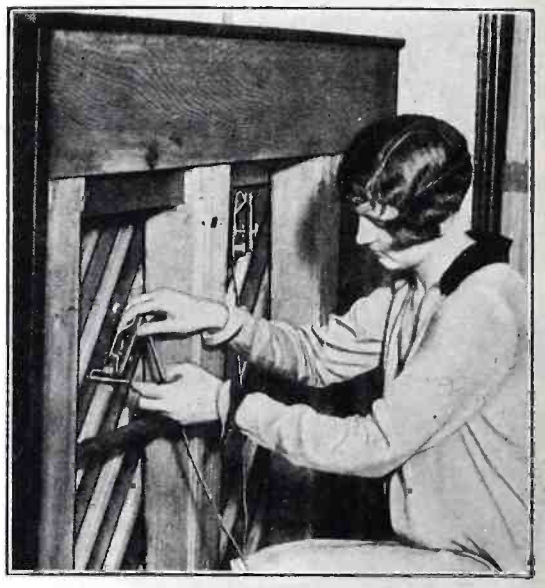
Another photo herewith shows how the unit is attached to the sound-board of an upright piano. The vibrating portion of the upper



The piano loud speaker unit.

armature is fitted with a bracket which is fastened to a cross rib of the sound-board by means of two screws. The unit is self-supported on its own armature and consequently there is no loss of energy, every impulse being transmitted direct to the vibrating medium or sound-board.

In operation the unit is adjusted to the right point for the particular set and in the exact location on the sound-board to give the pitch and range you individually prefer. By means of a small pin attached to the bracket it is possible to test for the best location before mounting the unit. The unit is merely connected to the set and the pin pressed against the sound-board at various points. In this manner the proper point can readily be determined. This will vary with different conditions but for general use and in the case of the average set and piano, about the middle of the sound-board will be found best. This allows a novel feature in that one can make the loud speaker suit his ear. If extreme bass accentuation is preferred, the unit is placed low down at right rear, over the bass strings of the



Photos by courtesy Engineers Service Co.

Method of fastening the unit to the sound board of an upright type piano.

piano. If a higher pitch is preferred it can be placed to the left rear over the high strings, or if an average pitch is desired, which will give a wide range of tone over the entire scale of audible frequencies, it is placed about the center of the sound-board.

A Socket-Power Unit For Four-Volt Tube Sets

THE "A" power unit illustrated in the photo herewith was designed especially for use in the battery compartment of a popular superheterodyne receiver, which employs tubes of the 199 type; but it may be used to advantage for electrifying any receiver using 4-volt dry-cell-type tubes.

A large majority of the receivers using 199-type tubes obtain their filament power from three No. 6 dry-cell batteries connected in series; and these batteries are usually located in the receiver cabinet. Therefore, an "A" power unit for sets of this type should be small in size, in

order that it may fit in the space formerly occupied by the batteries. The "A" power unit under discussion answers this requirement. It is housed in a metal case 4 by 9 inches by 6 inches high and weighs only 11½ pounds. It will provide pure direct current of 0.6 amperes at 4 volts, which is ample for the operation of any receiver using 10 tubes or fewer.

There are on the power unit no knobs or dials which require adjustment. Two binding posts are provided, for connecting wires to the battery posts of the set, and there is a filler hole where distilled water is added at rare intervals; in addition, there is the wire and plug which connects with the lamp socket. To install the unit it is necessary only to connect two wires to the posts and insert the plug in the socket. After it has been installed it is necessary to add water to the filler hole on an average of only once every six months. It should also be remembered that the unit is

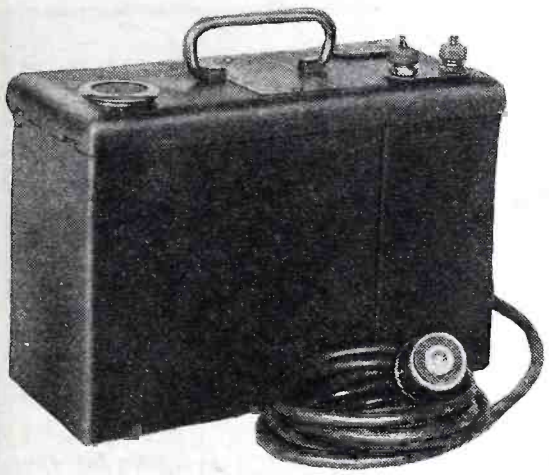


Photo by courtesy the Abox Co.

This compact unit may be used to provide filament power for sets using up to ten 199-type receiving tubes. It supplies 0.6 amperes at 4 volts D.C.

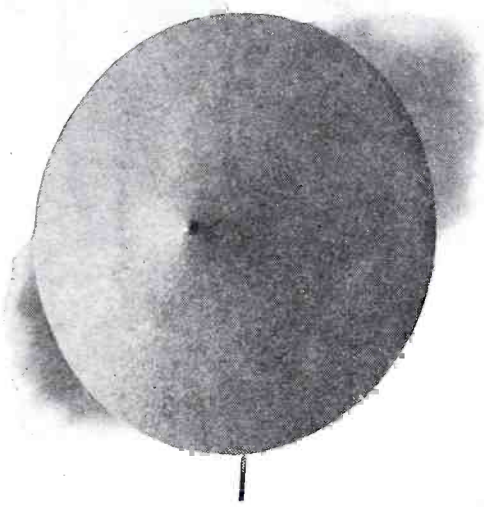
turned on and off at the lamp socket and *not* by the filament switch on the panel of the receiving set.

Electrically, the unit consists of a stepdown transformer, a rectifier of the electrolytic type, and a filter system consisting of a heavy-duty choke coil and a high-capacity electrolytic condenser bank. Power units of this type, which were designed to supply filament current to receivers using 6-volt tubes, have been described previously in the "Listeners' Accessory Guide" section of RADIO LISTENERS' GUIDE AND CALL BOOK.

It should be explained that this unit does not supersede *all* batteries. It provides filament power for 4-volt tubes and replaces the "A" battery; but "B" batteries or a "B" power unit are still required. It should also be pointed out that the unit may be operated only with 110-volt, 60-cycle house current.

A Double-Cone Loud Speaker Kit

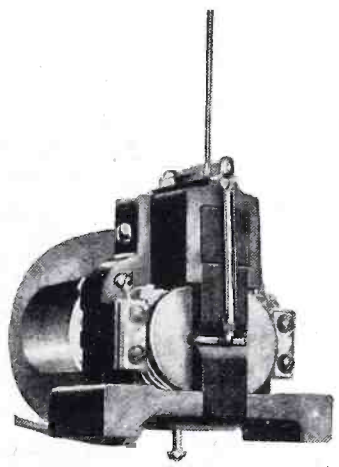
THE loud speaker shown in a photo herewith is of the double cone type and is furnished in kit form for home assembly. The unit employed in this speaker is shown in another photo and is of the balanced-armature type. It has laminated pole pieces made of silicon steel and are cast into an iluminum frame.



The completely assembled double-cone loud speaker.

A heavy horseshoe permanent magnet, which has one side 5/8" longer than the other, is held in position with regard to the pole pieces by set screws in the aluminum frame; so that drilling the magnet is not required. The two coils, which are of eliptical section, are relatively large and are clamped into the pole pieces; two special holes in the frame allow easy mounting of this unit on the mounting piece provided with the kit.

The kit consists of the unit as described; two large sheets of special paper for the front and back cone which are marked and can be cut for three sizes up to 36 inches in diameter; two aluminum back



Photos by courtsy G. R. Penn Mfg. Co.

A special speaker unit is used in the construction of the speaker.

rings; a bridge piece for mounting the unit; bolts, nuts, tube of cement; apex fittings, etc.

The process of assembling this speaker is remarkably simple as instructions furnished with each kit are easily understood and each step in assembly is illustrated. The usual method of cutting out the two cones is followed and the assembly of the cones as well as mounting of unit can be accomplished by practically untrained hands.

The tone qualities of this speaker are excellent; the reproduction has naturalness and great volume.

An "A" Power Unit For Rural Sections

WHEN designing accessories for radio receivers, a large percentage of the manufacturers in this country have considered only the demands of the broadcast listeners who reside in the cities and towns, and have ignored almost entirely the needs of the farmers, who wish also to enjoy radio programs. In more than nine cases out of ten the socket-power units, chargers, automatic relays, etc., designed for the benefit of the city user are of no value to the farmer whose house is not supplied

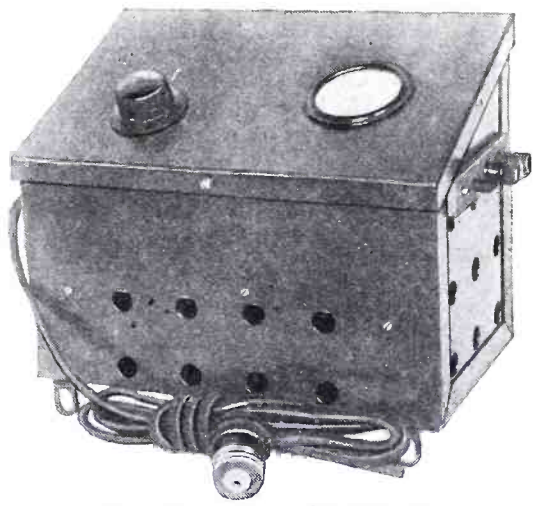


Photo by courtesy the Kato Co.

General view of farm "A" power unit housed in a compact metal case.

with electricity from the city power stations.

In a large number of modern farm and rural houses electric power is obtained fom a 32-volt farm-lighting plant; this consists of a bank of storage batteries, which are charged each day with current from a small electric generator driven by a gasoline motor. Such an outfit provides an ideal source of filament power for a radio receiver, and recently a manufacturer has placed on the market an "A" current-supply unit which, when connected to a 32-volt D. C. supply, reduces the voltage to the 6 required for operating the average set. The unit will be found pictured in the photo herewith.

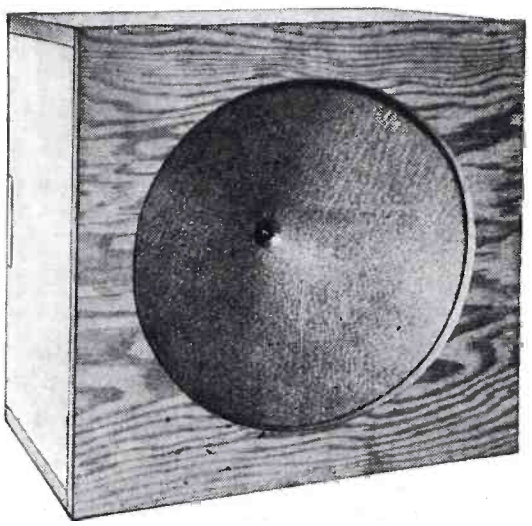
Essentially this unit consists of a bank of resistance units, a multi-point switch, a voltmeter and a cir-

cuit-breaker. The resistors are connected in series and reduce to a suitable amount the voltage applied to the filament. A switch connects various portions of the resistance bank into the circuit and in this way adjusts the output voltage to the required value. A voltmeter registers accurately the exact voltage at all times; and a circuit-breaker prevents the possibility of applying accidentally an excessively high voltage to the tubes, as it is so adjusted that it opens the circuit when the potential difference is over 6½ volts between the output terminals.

The voltage control knob and the voltmeter are mounted on the top. The plug is connected into the 32-volt supply circuit, and the binding posts on the side provide the 6-volt supply to the receiver. An adjustment knob on the side with the binding posts may be used to prevent the circuit-breaker from operating.

Loud-Speaker Unit Employs Powerful Electro-Magnetic Field

THE speaker illustrated in the accompanying photographs is a new type of power unit especially designed for operation from the "A" battery source of the radio set. It is also designed to match the new power tubes and faithfully reproduces natural tones over the entire range of the musical scale.



The assembled speaker can be housed in a wood box as shown above.

The outstanding feature of the unit which differs from the usual run of speaker units, is in the use of an electromagnet instead of a permanent magnet for polarization.

This unit is designed for cone speaker operation and is not adapted for use with the exponential horn type of speaker. It weighs about 4 pounds and is so shaped that it will fit into and 18-inch double cone speaker. The electromagnet draws about .4 of an ampere from the 6-volt "A" battery, or a little less than that required to light a power tube, which is not enough current

Photos by courtesy the Fanspeaker Radio Co.

The assembly of the cone showing the electro-magnetic power unit.

to be alarmed at. Where an "A" battery is not available, a trickle charger connected to the 110-volt A. C. lighting line may be used to supply the low voltage direct current needed. No filter is required. Under 200 volts "B" battery, no protective device is required between set and speaker.

A unit of this type will operate large and small cones, wood, airplane cloth, and other types of large diaphragm speakers. However, the most practical type of speaker seems to be the one shown in the illustration using a small cone mounted in a baffle box or chamber. This construction gives us a small sized speaker having a wide frequency response curve that may be placed in the average console cabinet.

This box may be constructed out of a good grade of wood at least ½-inch thick having a 11-inch diameter opening in the front to accommodate the 12-inch cone. The back of the box is open with the exception of the 3-inch strip of hard wood across the center for supporting the unit. The rim of the cone should be covered with felt; it is merely pressed against the front of the box behind the opening as shown. For the 12-inch cone the box must measure at least 12x12x6 inches deep inside. In building this speaker it is advisable to make the box as large as is possible to fit within a console cabinet or other space alloted for it.

In operation, it is possible to feed the speaker all that the set will deliver, whether using 100 volts or 700 volts, and rest assured that the speaker will stand the full blaze of the set without blasting or choking or otherwise distorting the musical tones.

Adapter Harness Converts Battery Sets For A.C. Operation

THE adapter harness shown in the accompanying photograph has recently been introduced to the radio public and makes it possible to convert practically any type of battery operated set to A. C. tube operation. When the conversion is made, no alterations in the wiring of the set is necessary.

The method of connecting the harness in standard battery operated sets is as follows:

The battery type tubes are removed from the A and C batteries disconnected. The tube adapters are then placed in the tube sockets of the set and the A. C. tubes are inserted in the adapters. The leads of the harness are connected to the binding post of a filament transformer designed for the A. C. tubes employed. All leads of the harness

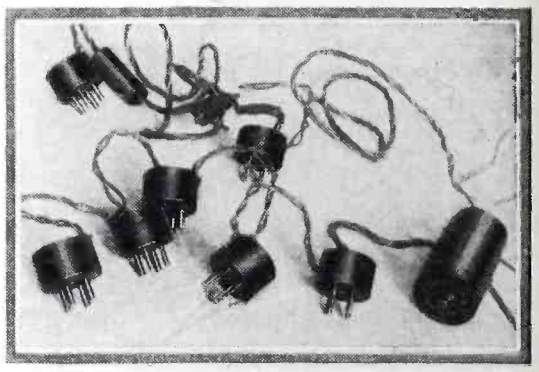


Photo by courtesy Carter Radio Co.

The A.C. adapter harness is made for four, five, six and seven tube sets. The seven tube harness is pictured above.

are clearly marked and there is little possibility of making error. Since the A and C batteries were disconnected from the set, the A battery terminals are of course not used. The C— binding post of the receiver should then be connected to the C+ binding post with a short piece of wire. The receiver is then ready to operate without batteries.

After the set is thus converted for A. C. operation, the old volume control usually becomes inoperative and an auxiliary volume control or variable resistor is connected across the aerial and ground terminals of the receiver which serves most effectively for the purpose.

Standard harnesses of this type are available for five, six and seven tube sets, both with or without power tubes. No tools are required to install this harness and the wiring of the set itself is not disturbed or altered in any way.

(*Continued on page* 169)

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All advertisements of custom set-builders appearing in the radio set market are published without cost or obligation. However, the publishers reserve the right to reject any advertisement which in their opinion appears illegitimate or cases where concerns merchandising parts would take advantage of this offer to custom set-builders. No more than fifty words to each advertisement and only one advertisement is allowed to each party or concern. Each request must be written on a separate sheet of paper to which must be attached the special coupon given in the notice appearing on another page preceding the feature articles in this issue.

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No. 203—Custom setbuilder in Dumont, N. J., has five and six tube radio frequency sets for sale. Specializes in this kind of set. Will build any kind of receiver to order. Prices reasonable.

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No. 236—Custom setbuilder in Maplewood, N. J., builds Hammarlund-Roberts Hi-Q Six and other popular sets to order during summer months. Inquire for estimate on set to suit your requirements, or on converting sets to A.C. operation. Appointments arranged.

No. 116—Setbuilder in Newark, N. J., specializes in Hammarlund-Roberts Hi-Q 6 and Everyman 4 sets. Built to your specifications. Expert service on all sets. References and particulars on request.

No. 172—Setbuilder in Passaic, N. J., specializes in A.C. sets, "B" eliminators, and special step-up or step-down transformers. All work guaranteed.

No. 156—Setbuilder in Phillipsburg, N. J., specializes in Scott's World's Record Super 10, Shielded Grid Six, A.C. Shielded Six, A.C. Nine-in-Line and any other sets described in Radio Listeners' Guide and Call Book. Prices on request. Quick service.

No. 217—Setbuilder in Crafton, Pa., has custom built Browning-Drake 4-tube sets for sale. Will also build any make of set to order.

No. 144—Setbuilder in Irwin, Pa., specializes in Browning-Drake and Silver-Marshall 4-tube Shielded Grid sets. All types of sets custom built.

No. 245—Custom setbuilder in Manon, Pa., owing to business transaction just completed several extra fine 5-tube table model sets to offer at good prices with or without accessories. Special prices during the summer months on building and repairs.

No. 264—Custom setbuilder in Philadelphia, Pa., has 5-tube, one-dial DX Shielded T.R.F. sets for sale with walnut cabinet. Specializes in this type of set. Can build any make of set to order, also socket power amplifiers and eliminators.

No. 191—Setbuilder in Philadelphia, Pa., specializes in A.C. sets. Will build to order any type of set.

No. 149—Setbuilder in Philadelphia, Pa., builds high-grade receivers and power packs. Specializes in Super-Hilodyne, Tyrman 70, Hammarlund Hi-Q, Continental, H.F.L. Model 28, World's Record Super, and sets using screen grid tubes.

No. 155—Setbuilder in Philadelphia, Pa., has six and seven-tube sets for sale. Specializes in Aero Seven and Harkness Counterfonic. Can build any make set or "B" supply unit to order.

No. 101—Setbuilder in Philadelphia, Pa., has on demonstration the latest Browning-Drake receiver. Will also build any set to order. Best material, workmanship and results at lowest prices.

No. 102—Setbuilder in Philadelphia, Pa., specializes in Tyrman "70" receiver employing shielded grid tubes. A set you can be proud of. Send today for descriptive literature.

No. 106—Modern up-to-date sets constructed and serviced by a setbuilder in Philadelphia, Pa. Tuned Radio Frequency, Browning-Drake and Neutrodynes a specialty. Power Amplifiers.

No. 123—Setbuilder in Philadelphia, Pa., specializes in Hammarulnd-Roberts Hi-Q sets.

No. 141—Setbuilder in Philadelphia, Pa., has 6-tube Hammarlund-Roberts and Aerodyne sets for sale. Can build any make of set to order.

No. 152—Authorized radio-trician in Pittsburgh, Pa., has Hammarlund-Roberts Hi-Q 6 and Tyrman "70" radios for sale. Demonstration at your request. Sets built to your order.

No. 241—Setbuilder in Reading, Pa., has guaranteed custom-built radio receivers and short wave sets for sale.

No. 205—Setbuilder in Scranton, Pa., has Tyrman "70" for sale, $95. Others accordingly. Write for our low prices on custom built sets. Repairing, designing and building any set on market.

No. 146—Setbuilder in Sharon Hill, Pa., is authorized Cardwell builder. My responsibility extends beyond ordinary guarantees and all designs are far in advance of commercial types.

NEW ENGLAND STATES
Connecticut, Massachusetts, New Hampshire, Rhode Island

No. 129—Setbuilder in E. Norwalk, Conn., has on display and ready for demonstration the Silver-Marshall Shielded Grid Six and Hammarlund-Roberts Hi-Q Six. Old radios rewired, electrified and brought up-to-date.

No. 232—Setbuilder in New Haven, Conn., has Ultradyne L2 for sale with or without AmerTran A. B. C. 2-stage power unit. Specializes in custom built sets.

No. 122—Setbuilder in New London, Conn., with years of experience in radio business, has custom made sets for sale. Can build any make of set to order. Prompt service.

No. 242—Radiotrician and custom setbuilder in Staffordville, Conn., has the late model 6-tube single control Standardyne set for sale. Will build and repair all makes of sets and guarantee all work.

No. 127—Custom made sets built to order by a setbuilder in West Haven, Conn. No set too small, none too large. Also repairing and remodeling of all kinds. Have your old set made up-to-date. Tyrman "70", all electric, for sale.

No. 139—Setbuilder in Medford, Mass., has 5-tube Browning-Drake for sale $39.50. Sets built to order. Repairing and service work done at very reasonable prices.

No. 258—Setbuilder in Medford, Mass., has Browning-Drake sets for sale. Any type of radio set and power unit built to order. Official parts used. Write for particulars.

No. 114—Hammarlund-Roberts radiotrician in Natick, Mass., will inspect any set in trouble without cost. Will assemble any circuit. Hammarlund-Roberts specialty. Tubes, batteries and all other accessories for any radio for sale on order.

No. 107—Professional setbuilder and radio expert in Quincy, Mass., will build any make of set to order. Workmanship and results guaranteed, using materials as specified in Radio Listeners' Guide and Call Book.

No. 195—Setbuilder in Worcester, Mass., has facilities to build on order any type set in sizes for homes or large halls. Factory built sets and accessories supplied where preferred. Builder and engineering graduate with seven years' experience. Personal service.

No. 243—Custom setbuilder in Chesham, N. H., builds any of the popular sets. Specializes in the new Two-Dial Karas Equamatic receiver and Karas Knickerbocker Four.

No. 263—Setbuilder in Pawtucket, R. I., has Everyman 4 sets for sale. Specializes in this kind of set. Can build any make of set to order.

CENTRAL STATES
Minnesota, Wisconsin, Missouri, Illinois, Indiana, Ohio, Texas, Virginia, Florida, Louisiana, Washington, D. C., Michigan, South Dakota, Arkansas, North Dakota, Kansas, West Virginia, Iowa, Tennessee.

No. 229—Setbuilder in Eureka Springs, Ark., can build any make of set to order. Send schematic or preferably picture diagram for estimate. Workmanship guaranteed.

No. 126—Setbuilder in Bradentown, Fla., can save you money on a custom built radio set and build it to suit you and your furniture. Will guarantee good reception and great distance.

No. 112—Setbuilder in Daytona Beach, Fla., will build any type of the latest custom-made sets to order. Specializes in short wave receivers and transmitters. Service on all types of sets.

No. 140—Custom made radio receiving sets employing such circuits as Remler, Browning-Drake and other high grade receivers built by setbuilder in Champaign, Ill. Lowest prices for quality merchandise. For sale, 5-tube radio frequency receiver, coast to coast reception, complete with accessories, less than $50.00.

No. 120—Custom setbuilder in Chicago, Ill., will build any make of set using only specified parts, or using quality parts that you choose. Also will rewire or repair any set indorsed by National Radio Institute, Washington, D. C. All work guaranteed. Prices on all work gladly furnished.

No. 246—Professional setbuilder in Chicago, Ill., will build World's Record Super 10, 9, 8 sets to order, or regular models at list prices. All workmanship guaranteed. Free installation and two-year service. Will build, repair or service any other type or make of set. Prices are reasonable.

No. 248—Setbuilder in Chicago, Ill., will build Super-Heterodynes of all makes and styles, also Hammarlund-Roberts, Silver-Marshall, Karas, Scott and Browning-Drake sets. Any others made to order, including power packs. Workmanship guaranteed. Installations on work free.

No. 259—Setbuilders in Chicago, Ill., have for sale the following sets and amplifiers: Hammarlund-Roberts Hi-Q, Silver-Marshall, Madison-Moore, Remler, Victoreen, Camfield, and Karas A.C. Prices on application.

No. 142—Any make radio built to order by a setbuilder in Chicago, Ill. Only well-known and advertised parts used. Specializes in the Quadjur Six, Silver Laboratory Super and the Quadraformer Five and Six.

No. 162—Setbuilder in Chicago, Ill., specializes in Bremer-Tully Counterphase, Hammarlund-Roberts Hi-Q, short wave sets, and can build any other make of set to order. "A" and "B" eliminators also built. Guaranteed radio service on repairing, remodeling and designing.

No. 167—Setbuilder in Chicago, Ill., takes second-hand sets in trade on his wonder set, the "King Kustombilt 10," cheap. Several supers as low as $35.00; others from $5.00 up. We are pioneers in the radio business, having started as wireless operators in 1907.

No. 204—Setbuilder in Forest Park, Ill., will build for residents of Chicago, Oak Park, Maywood and other western suburbs of Chicago, any make of set to order. Specializes in the Everyman Four and Hammarlund-Roberts Hi-Q. Best results guaranteed.

No. 169—Setbuilder in Moline, Ill., will build to order any type set for the price of parts and cabinet. No charge for assembling and wiring. Set shipped to you as a finished product and guaranteed to be as represented. State if you wish set accessories also.

No. 209—Setbuilder in Springfield, Ill., will build to order from practically all standard kits, both sets and power packs.

No. 137—Setbuilder in Stockton, Ill., has five, six and seven-tube sets that have the promised ten kilocycle sharpness with the new shielded grid tubes. Silver-Marshall Shielded Grid Six specialty. Can build any make of set to order. Last word in up-to-minute reproducers.

No. 145—Setbuilder in Elkhart, Ind., wants to build your next set for you. Madison-Moore and Diamond of the Air are specialties. Will guarantee you more for your money. Also expert repairing and rebuilding. Prices are very reasonable.

No. 143—Setbuilder and radio doctor in Emison, Ind., specializes in Karas Equamatic sets, but will build any type of reliable set desired. Results guaranteed. Write for prices stating make and type of sets interested in.

No. 181—Setbuilder in Indianapolis, Ind., is specialist on A.C. and shielded grid tube sets. Will build to your order a set from any nationally advertised kits with parts specified by designer of circuit. Guaranteed workmanship at reasonable prices.

No. 186—Setbuilder in Muncie, Ind., specializes in Silver-Marshall Six with the new shield-grid tubes and 210 power tube. Highest quality workmanship only. Special reduced building prices during summer season until Sept. 1st.

No. 166—Setbuilder in Richmond, Ind., has the improved Silver-Marshall Shielded Laboratory receiver for sale, employing eight standard tubes and unconditionally guaranteed to outperform any other eight tube receiver, under similar and fair operating conditions. Can build any make set to order. Lowest prices.

No. 261—Setbuilder in Burlington, Iowa, will rebuild and make any set to order. Specializes in building four and five tube sets employing regeneration. Satisfaction guaranteed.

No. 208—Setbuilder in Council Bluffs, Iowa, has Bremer-Tully Power Six and World's Record Super 10 sets for sale with or without accessories. One to fourteen tube sets, any make, built to your order.

No. 257—Setbuilder in Dubuque, Iowa, has the Custom Built Hammarlund-Roberts Hi-Q Six, the Tyrman 70, Air Scout Four, and the Official one-dial Browning-Drake 5-tube kit set for sale.

No. 233—Professional setbuilder in McGregor, Iowa, will build sets to your specifications, using any circuit, and to fit any console or cabinet. Hammarlund-Roberts Hi-Q Six a specialty.

No. 183—Setbuilder in Newton, Iowa, offers some 5-tube T.R.F. radio sets without cabinets, wired for power tube and "C" battery. These are real volume and distance getting sets and are priced at about one-half parts price alone. Also offer complete 5-tube kits comparitively low priced.

No. 117—Setbuilder in Red Oak, Iowa, builds and rebuilds any make of radio set from 1-tube to 14-tube to order. Five years' experience. Specializes in Bremer-Tully Power Six. A real set for the farmers.

No. 252—Seven years' radio experience enables custom setbuilder in Kansas City, Kans., to offer custom built sets that will surprise you in their marvelous operation regardless of their low prices. We specialize in Shielded Grid receivers. Shielded Grid 7, $60; 4-tube, $40. We quote prices on any set.

No. 128—Setbuilder in Shreveport, La., will build any set. Specializes in 5 and 6 tube circuits. Estimates given. We guarantee results.

No. 111—Setbuilder in Battle Creek, Mich., authorized Hammarlund-Roberts representative, will build or service any type of set. Reasonable results guaranteed. Specializes in Hammarlund-Roberts and Silver-Marshall circuits, but can build nearly anything client desires.

No. 184—Setbuilder in Detroit, Mich., has for sale a 9-tube Lincoln Super complete. Specializes in any Super. Guarantee satisfaction or money refunded. $200 in bank your protection.

No. 190—Setbuilder in Detroit, Mich., will build any set described in Radio Listeners' Guide and Call Book. Six years' experience. Specialist on Scott's World's Record Supers 8-9-10, Nine-in-Line, Shielded Grid Six and Hi-Q Six. All work guaranteed. Any set tailored to your order.

No. 244—Setbuilder in Detroit, Mich., has 6-tube Superphonic sets for sale. Complete line of tubes and accessories. Sets built to order. Sets repaired, altered and serviced. Prompt service.

No. 239—Sets, power packs, cones, constructed to order by custom setbuilder in Kalamazoo, Mich. Sets rewired for A.C. Also repaired and tested. Specializes in Hammarlund-Roberts Hi-Q Six.

No. 223—Setbuilder in Manton, Mich., specializes in Silver shielded grid sets. The prices complete with cabinets are as follows: 4-tube, $47.50; 6-tube loop, $91.50; 6-tube regular, $97.00; 8-tube Super-Heterodyne, $82.90. Can make any other kind of set to order.

No. 158—Setbuilder in Cloquet, Minn., specializes in Silver-Marshall sets, Tyrman 70 Shielded Grid Amplimax and other Super-Heterodynes. Reasonable prices. Can build any circuit desired. Also convert and service radios.

No. 189—Setbuilder in Minneapolis, Minn., specializes in Norden-Hauck Shielded Super 10 custom built receiver. Five type UX-222 screen grid tubes are used in this ultra-powerful broadcast receiver increasing the radio frequency amplification and sensitivity over 500 times. Installation on this receiver in any part of the country.

No. 121—Setbuilder in Stanchfield, Minn., has seven years' experience in custom setbuilding and will build your favorite set for you. Fast, modern assembly equipment used and price will please you. Correspondence invited.

No. 224—Setbuilder in Denton, Mo., will build Victoreen Super and any other sets to order.

No. 136—Setbuilder in Memphis, Mo., has three-tube coast-to-coast receivers for sale, and specializes in this type of set. Full loud speaker volume. Can build any type of set. My best reference is satisfied customers.

No. 267—Setbuilder in St. Louis, Mo., popular radio expert and custom setbuilder will build any type set you desire. Get my price to make a Panathrope combination from your radio set and your phonograph. Can also change your D.C. battery type set to use the new A.C. type tubes. All work guaranteed.

No. 230—Custom setbuilder in St. Louis, Mo., will gladly furnish estimate of cost of constructing any type radio of recognized merit, four to fourteen tubes; also power packs and short wave receivers. Workmanship unsurpassed. Have Victoreen 8-tube super for sale.

No. 182—Setbuilder in Minot, N. Dak., will build any popular circuit to fit your requirements. Variety as to appearance offered. Buy a custom set adapted to the locality.

No. 201—Setbuilder in Alliance, Ohio, with three years experience, will build any make of set to order. Specializes on Magnaformer 9-8 receivers.

No. 206—Custom setbuilder in Canton, Ohio, specializes in Aero-Dyne Six and Seven. Will construct any standard custom set. All work guaranteed.

No. 211—Setbuilder in Cleveland, Ohio, has for sale 4, 5 and 6-tube sets for 1, 2 or 3-dial control. Can also build any set to order.

No. 153—Setbuilder in Cleveland, Ohio, will build to order and repair any Silver-Marshall Shielded Grid Super-Heterodyne and Shielded Grid Sixes.

No. 160—Setbuilder in Cleveland, Ohio, will build to order the new Browning-Drake sets. Specializes in completing the factory made kits. Satisfaction guaranteed. Moderate prices.

No. 247—Custom setbuilder in Columbiana, Ohio, specializes in Super-Heterodynes, Browning-Drake, Hammarlund-Roberts, etc. Am capable of building any other set when ordered. I build custom built sets which give custom built results.

No. 170—Setbuilder in Columbus, Ohio, will build all latest circuits, Hi-Q Six, Hot-Spot, 14, Nine-in-Line, etc. Sets made A.C. or D.C.

No. 177—Custom setbuilder in Fostoria, Ohio, is authorized Hammarlund-Roberts radio-trician. The best in radio must be custom built. Write for literature or demonstration. Any receiver, in any furniture, built to your order.

No. 105—Setbuilder in Malvern, Ohio, assembles, wires and constructs any make of set to order. Specializes in Silver-Marshall line. Thoroughly experienced.

No. 216—Custom setbuilder in Mansfield, Ohio, can build any set to order. Specializes in Silver-Marshall and Tyrman receivers. Have experimented with practically every type of circuit and speaker. Will also build any type power supply for radio sets. All work guaranteed. Reasonable charge for producing the best.

No. 255—Custom setbuilder in Steubenville, Ohio, builds any make of set to order, either battery or electric operated.

No. 202—Custom setbuilders and radio trouble shooters in Yankton, S. Dak., will build S-M Shield-Grid Sixes or any type of set to order.

No. 168—Setbuilder in Chattanooga, Tenn., builds any kind of set or eliminator. Old sets rebuilt or brought up-to-date; adaptation from battery to light socket operation.

No. 130—Any set described in popular radio magazines built to order by custom setbuilder in Baumont, Texas. Also power ampliers. Local installation free.

No. 161—Setbuilder in Fort Worth, Texas, has 5-tube resistance coupled Radio Broadcast Universal receiving set for sale. Can build any make of set to order. Specialize in Browning-Drake receivers.

No. 150—Short wave tuners and receivers built to order by a setbuilder in Houston, Texas. Specializes in Silver-Marshall Shielded Grid Six and Laboratory Super. Satisfaction guaranteed or no pay. Lowest possible prices consistent with good work.

No. 218—Setbuilder in Richmond, Va., offers exceptional service in designing and building special sets to suit individual needs. All types of sets serviced and repaired. Specialist on Super-Hets. Let's get together and build that DX set you've always wanted.

No. 157—Setbuilder in St. Charles, Va., has 6-tube Bremer-Tully Power Six receivers for sale. Will build any set from one to fourteen tubes on order. All work first-class and guaranteed. Six years' experience in building radio receivers.

No. 108—Setbuilder in Washington, D. C., builds the famous Hot-Spot receiver. Will guarantee all parts and workmanship. Super thoroughly tested before shipping. Will furnish the complete kit or assemble all parts and you can do the wiring or we will do both at a reasonable figure.

No. 215—Setbuilder in Hollidays Cove, W. Va., has Hammarlund-Roberts Hi-Q Six receivers for sale. Will also build or repair any other make of set.

No. 234—Setbuilder in Hustisford, Wis., specializes and has for sale 4 and 6-tube one-dial radio frequency sets. Will also build any other type of set to order.

No. 238—Custombuilt is invariably the reply when you ask what set have you that enables you to get such phenomenal results? Setbuilder in Milwaukee, Wis., will bring the world to your fireside with a custom built receiver placed in the type of cabinet or console you like best. Installation and service in and near Milwaukee.

No. 171—Setbuilders in Milwaukee, Wis., will build any set to suit individual taste. Specializing in Hammarlund-Roberts Hi-Q Six, Browning-Drake, Tyrman Amplimax 70, Nine-in-Line and radio cabinets and consoles, satisfaction guaranteed. Correspondence solicited.

No. 188—Setbuilder in Milwaukee, Wis., has 5-tube Karas Equamatic for sale. Will build any make of set (preferably of the neutrodyne type).

No. 222—Setbuilder in Milwaukee, Wis., will construct any set desired from one to fourteen tubes and build it into any cabinet console or desk you wish. Specialize in Silver-Marshall's latest and most efficient circuits from one to seven tubes.

No. 266—Setbuilder in Milwaukee, Wis., specializes in building Silver-Marshall sets and has same for sale. Any make of set built to order. Expert work in rebuilding and repairing custom built sets and also service work.

No. 135—Setbuilder in Monomonie, Wis., will build any set with 10% cash discount. Each set carries a guarantee for one year free service, express prepaid. Laboratory tested Super-Heterodynes our specialty.

PACIFIC STATES
Washington, California, Arizona, Utah, Colorado, Nebraska

No. 212—Custom setbuilder in Ajo, Ariz., will build any make radio receiver. All work satisfactory.

No. 260—Community setbuilder in Phoenix, Ariz., has eight radio sets for sale, including Browning-Drake, Mar-Co-Dinis, Diamond of the Air, and tuned radio frequency sets. The tuned radio frequency sets are equipped with or without regeneration.

No. 256—Custom setbuilder in Glendale, Calif., specializes in Bremer-Tully, Silver-Marshall and Browning-Drake receivers. Official Arcturus service station. Inquiries gladly answered without cost or obligation. Let us help you with your problems.

No. 228—Setbuilder in Hollywood, Calif., has Silver-Marshall Shielded Grid Six sets for sale. Is equipped to balance and service any make of sets. Will also build to order any and all makes of sets.

No. 220—Setbuilder in Huntington Park, Calif., will build to order Hammarlund-Roberts Hi-Q Six, H. F. L. 9, Scott's World's Record Super, Silver-Marshall Shielded Six, Tyrman 70, and any others. Sets built for quality and distance, and only the best of parts used. 24 karat gold plated wire used for bus bar wiring.

No. 185—Professional setbuilder in Los Angeles, Calif., has 6-tube Silver-Marshall Shielded Six and Shielded Grid Six sets for sale. Specializing in this kind of set. Can build any kind of set to order. Can design cabinets or consoles to match.

No. 210—Setbuilder in Oakland, Calif., will build to order Silver-Marshall Shielded Grid Six, Silver-Marshall Laboratory Super, power packs, Infradyne, Best's 115 K.C. 10-tube Super and C.R. Leutz's C7 and C10 Supers. All the above sets are laboratory tested and guaranteed.

No. 227—Setbuilder in Oildale, Calif., has Aerodyne Sixes for sale. Also make Magnaformer 9-8, and any other radio set you may wish. Mounted in any type cabinet you prefer.

No. 198—Custom setbuilder in Roseville, Calif., specializes in Browning-Drake and World's Record Supers. Will build any make of custom built receiver. Shop equipped with Jewell instruments assuring satisfactory service on all receivers.

No. 231—Setbuilder in Whittier, Calif., will build and repair any make of set.

No. 174—Setbuilder in Durango, Colo., specializes in short wave sets. Will build any type short wave set and any other type of sets.

No. 173—Setbuilder in Upland, Nebr., will build any set and also repair sets of all kinds.

No. 131—Setbuilder in Price, Utah, specializes on Infradyne and S-M Shielded Grid Six. Can build any make of set to order. Prices reasonable and all work fully guaranteed.

No. 214—Setbuilder in Salt Lake City, Utah, will build any make of broadcast receiver or amateur short-wave receivers and transmitters to order. Will also build eliminators, cone speakers, or cabinets.

No. 159—Setbuilder in Oak Harbor, Wash., will build custom radio sets free. My only charge is list price for parts. Any type of set built to your order. I also design and rebuild them for any need. No set too small or too large. Free consultation.

No. 196—Setbuilder in Seattle, Wash., builds practically any type of set. Workmanship guaranteed.

No. 200—Setbuilder in Seattle, Wash., has radio sets that bring in the stations you want. Up-to-date sets installed in your old cabinet or console.

No. 213—Setbuilder in So. Tacoma, Wash., has for sale all Silver-Marshall sets and power units. Any set built to order.

CANADA
Alberta, British Columbia, Saskatchewan, Manitoba, Ontario

No. 225—Setbuilder in Nanaimo, B. C., Canada, will build any type of receiver from complete kits for $3.00 per tube. Expert work. Five years' experience. Satisfaction assured. Distance no obstacle. If you propose buying write for information and unbiased advice on how you can have a better receiver for less money.

No. 235—Setbuilder in New Dayton, Alta., Canada, has long distance, one, two, three, four, five, six and ten-tube sets for sale. Any make built to order. Dry or wet cell equipped. Sets installed and repaired. Work guaranteed.

No. 176—Setbuilder in Regina, Sask., Canada, has for sale a 4-Tube Bremer-Tully receiver and 2-tube Bremer-Tully short wave receiver (12½-200). Specializes in Bremer-Tully and Silver-Marshall sets. Any make of set built to order.

No. 226—Setbuilder in Regina, Sask., Canada, specializes in 5 and 6 tube receivers, Super-Heterodynes, power suppliers and amplifiers. Estimates gladly given on the above to suit purse, taste and location.

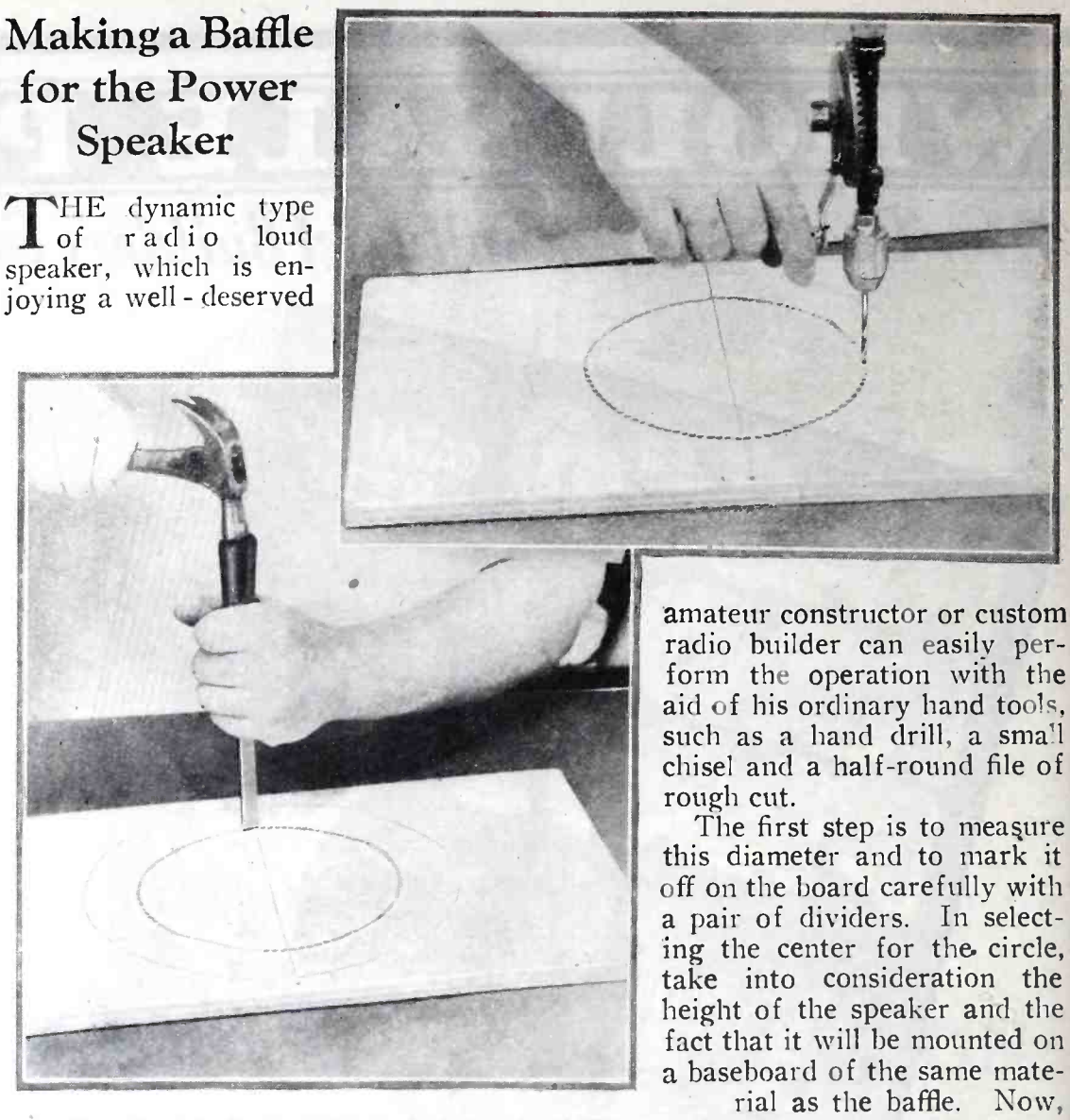
No. 254—Setbuilder in Saskatoon, Sask., Canada, will build radio sets with any number of tubes to order. Prices reasonable showing great saving in cost to purchaser. Will install complete ready for operation anywhere within 100 miles of Saskatoon. Satisfaction guaranteed.

No. 193—Setbuilder in Toronto, Canada, builds all popular circuits, more sensitive, selective, powerful and cheaper than equivalent circuit in manufactured set. Specializes in 5-tube receiver which has received verifications from Cuba, Mexico and Pacific Coast.

Making a Baffle for the Power Speaker

THE dynamic type of radio loud speaker, which is enjoying a well-deserved popularity, requires a baffle board for its most satisfactory operation. This baffle is merely a plain board about three times the area of the mouth of the speaker, with a hole cut in it to accommodate the latter.

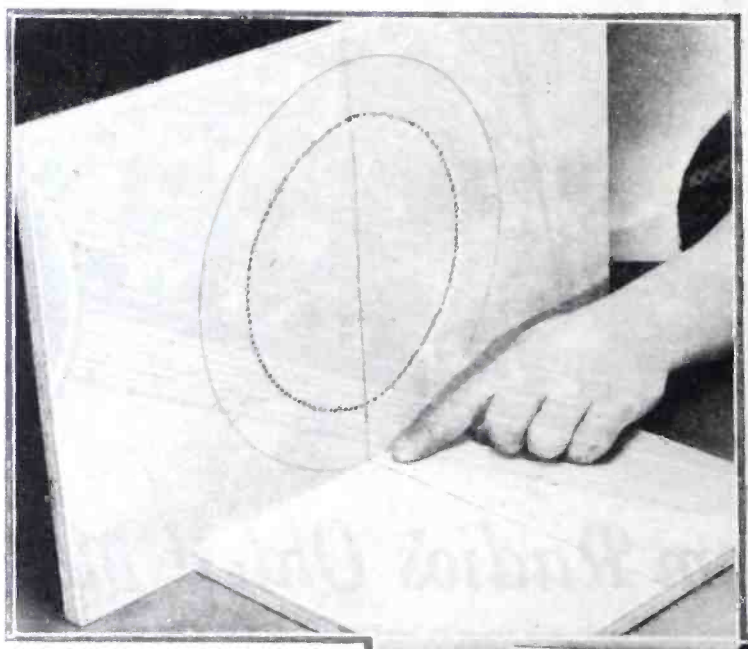
The main job in making such a baffle is the cutting of the large hole, which must be of the same diameter as the speaker opening. The amateur constructor or custom radio builder can easily perform the operation with the aid of his ordinary hand tools, such as a hand drill, a small chisel and a half-round file of rough cut.

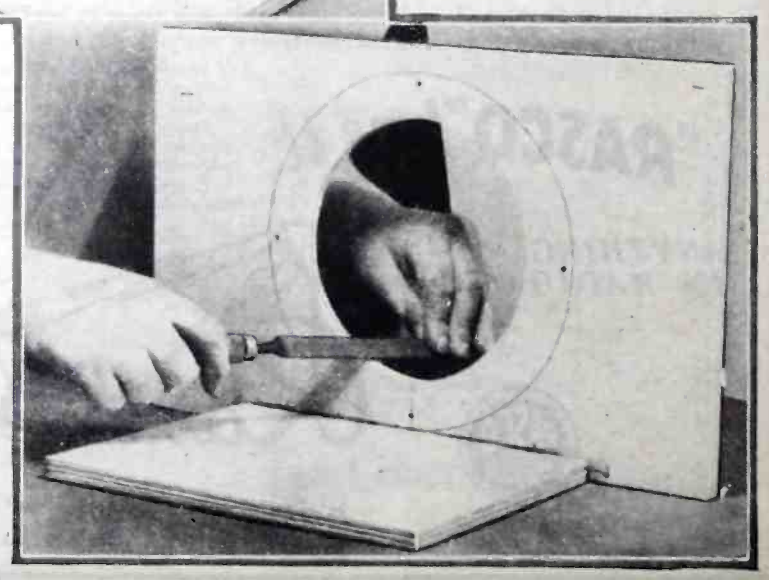


How the hole in the baffle is drilled and cut out.

The first step is to measure this diameter and to mark it off on the board carefully with a pair of dividers. In selecting the center for the circle, take into consideration the height of the speaker and the fact that it will be mounted on a baseboard of the same material as the baffle. Now, with a hand drill and a drill about 3/16 inch in diameter, drill a circle of closely-spaced holes just inside the circle you have marked. Work slowly and carefully, and allow the drill to cool after every eight or ten holes.

Then take the chisel, and working it with a hammer, carefully cut through the small spaces between the drilled holes, so that a rough disc will eventually fall out. Now clamp the baffle in a vise, and smooth off the big hole with the half-round





Fitting and filing the hole in the baffle.

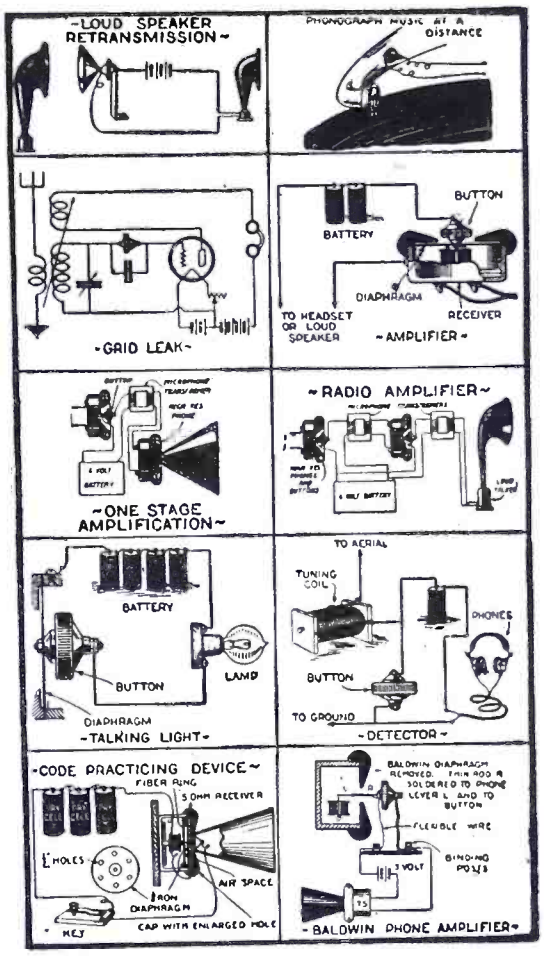
Thousands Use The *SKINDERVIKEN TRANSMITTER UNIT*

95c Or Two for $1.75

This famous and popular unit has been adapted to hundreds of different uses. Its application to radio, to electrical phenomena and to many unusual and practical household uses is limitless. It is essentially a very powerful amplifier as well as an efficient and dependable transmitter.

The Skinderviken transmitter units are, at the present time, used in numerous radio circuits, they are used for radio transmission, for radio amplification permitting the operation of a loud speaker from a crystal receiver, for phonograph and loud speaker amplification, for stethescopes, detectaphones, telephone transmission, etc., etc. Every amateur should have two or three of these units in his laboratory.

A FEW USES FOR THESE UNITS



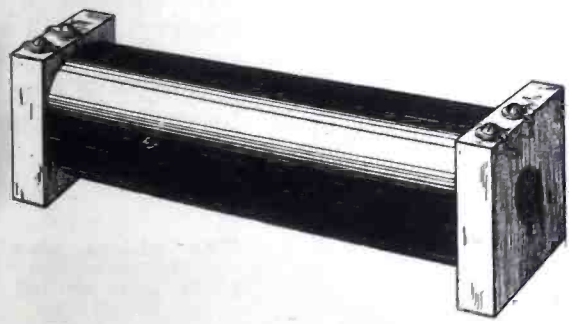
12 Page Instruction Booklet Furnished with Each Unit

With each unit is furnished a twelve-page instruction booklet, containing suggestions and diagrams for innumerable uses. Each use in the booklet is explained carefully and illustrated with clear diagrams. The booklet alone is worth the price of the unit.

We Pay $5.00 In Cash

for every new use developed for this unit and accepted and published by us. There is no limit to the uses to which the Skinderviken Transmitter Unit can be put. Experimenters are always finding new ones. There still remains hundreds of undiscovered applications that can be developed by a little experimentation. Here is your chance to make some money.

P.G. MICROPHONE TRANSFORMER



A microphone transformer (*modulation transformer*) specially designed for use with the Skinderviken Transmitter. These transformers are used for stepping up the low voltage high-frequency currents from the transmitter circuit, to a slightly higher voltage which will permit transmission over greater distances. The coils have many other uses for experimenters, such as for making small medical coils, etc. Primary resistance 1¼ ohms.

$2.00

The 12-page instruction booklet furnished with each Unit gives details and diagrams for a large number of special uses of the Transformer in conjunction with the unit.

Skinderviken Transmitter Units Are For Sale at Following Dealers

The W. T. Grant Stores
J. Belmuth, 198 Broadway, New York City
Chicago Salvage Stock Store, 509 S. State St., Chicago
Metropolitan Radio Supply, 134 W. 7th St., Los Angeles
Radio Centre Corp., 329 W. Baltimore St., Baltimore
Radio Specialty Co., 98 Park Place, New York City
Conrad Richter, 1284 Market Street, San Francisco
Ben's Tremont Elec. Sup. Co., 228 Tremont St. & 70 Stuart St., Boston
Washington Elec. Sup. Co., 24 Stuart St., Boston
Wedel Co., 520-2nd Ave., Seattle

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Address .....

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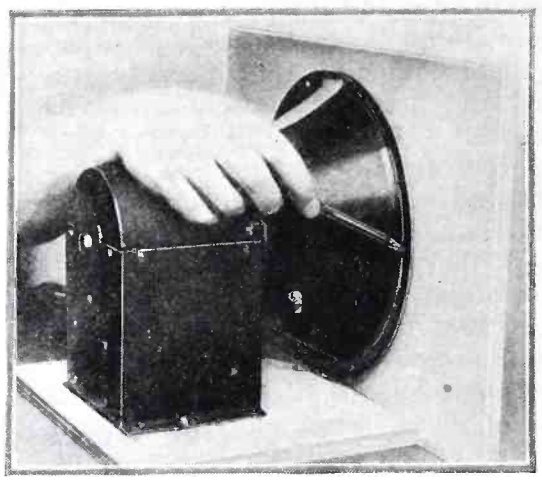
file. Use light strokes and rock the file around so that it will not tend to dig beyond the marked circle. Finish the hole by smoothing off the edge with fine sandpaper.

The rest of the operation consists merely of drilling four holes for the mounting screws of the speaker frame, and of fastening the baffle to the baseboard. With the two boards thus joined, the speaker can be screwed in place permanently.



Fastening the baffle to the baseboard.

One length of dowel stick, one-quarter inch in diameter and about a foot long; two smaller pieces of dowel, one-half or five-eighth inch in diameter and each two inches long; a small brass hinge, not over one-quarter inch wide; and a small oil can.

Drill a one-quarter-inch hole in the side of one of the short dowels, so that the long, thin stick will fit tightly in it, forming a sort of little hammer. Then fasten the clamp of the pick-up unit around the end of the thick dowel, and tape the other end, as shown in the picture.

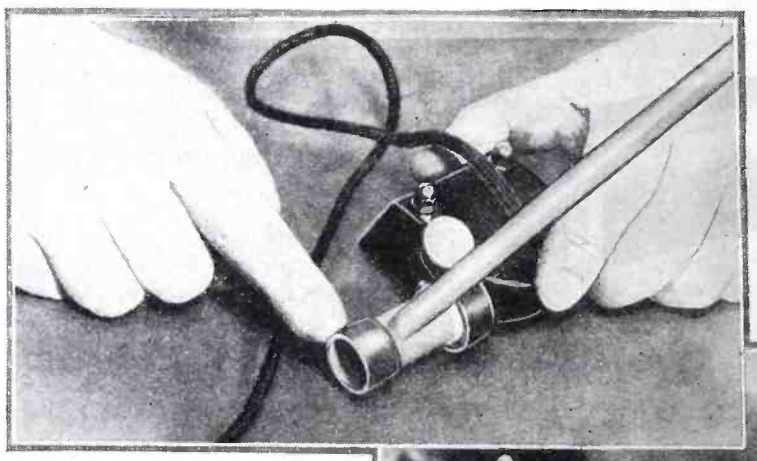
The other illustration shows the arrangement of the end support so clearly that little explanation is necessary. Cut off about half of the nose of the oil can, and drill a hole in the end of the second thick dowel to accommodate the short piece that remains. The hole should be a trifle oversize, so that the stick is free to turn. Screw the hinge to the top of the thick dowel and to the end of the thin one, so that the pick-up unit may be raised off the turn-table when not in use. Then drill two holes through the body of the oil can and screw the latter down to the turntable box in one of its corners.

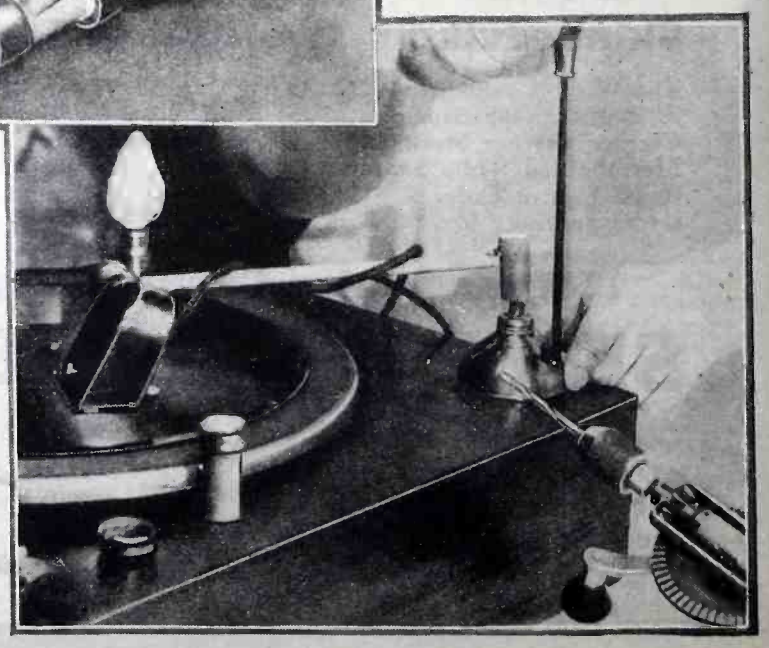
A complete phonograph motor-turntable device can easily be assembled at home as the only parts required are a phonograph motor and record turntable which can be often purchased from a second-hand dealer. The motor is merely mounted in a suitable wooden box with speed regulator and crank handle projecting at the side. Then when the whole unit is mounted in a cabinet all the controls will be readily accessible. The method of connecting the pick-up device to a suitable amplifier is furnished by the manufacturers.

Constructing a "Tone Arm" for the Phonograph Pick-Up Unit

THE man who has built the simple phonograph turntable described in the previous number of RADIO LISTENERS' GUIDE will be interested in this description of a "tone arm" designed to support the electrical pick-up unit in the same manner that the tone arm on a regular phonograph holds the mechanical pick-up device. The two accompanying illustrations make the nature of the device clear.

The parts required are as follows:



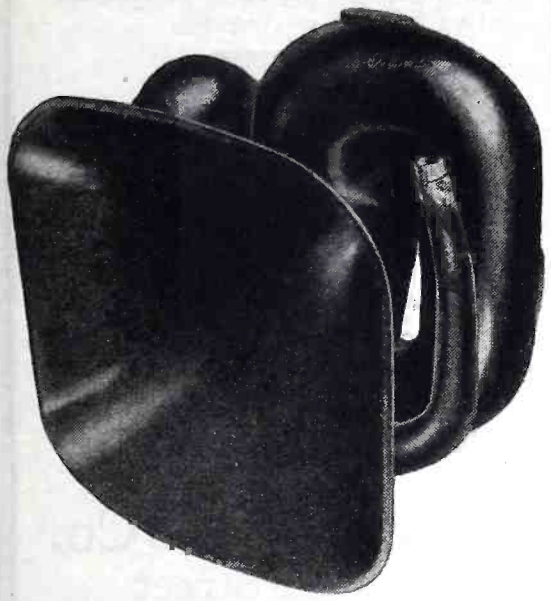


Two photos showing a close-up of the arm piece and method of mounting.

The Hagerman 210-A.C. Six

(*Continued from page 79*)

The success of this set or any other set can be traced directly to the efficiency of the parts employed. Those used in this set were selected after extensive experimentation as to

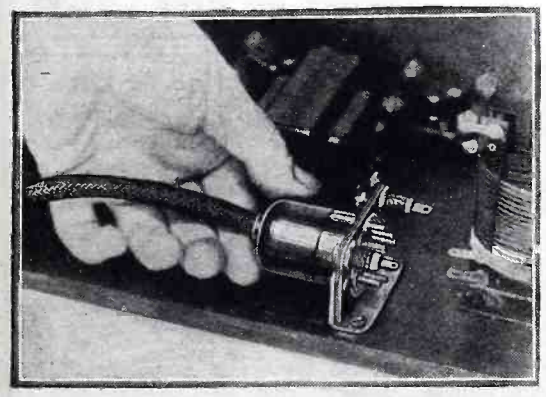


The molded wood horn recommended for use in conjunction with the set.

their electrical and mechanical characteristics. They all work perfectly in the circuit and are of exactly the correct values and physical size to conform to the base and panel layout and theoretical circuit. It is therefore not advisable to substitute any parts for those as specified.

Mounting Cable Connector

MOST radio set builders mount cable connectors on baseboards in such a manner that the multi-point plug, when inserted in the con-



Mount the cable connector at right angles with the edge of the baseboard.

nector itself, protrudes at right angles over the edge of the board. In this position it sometimes proves to be very awkward and inconvenient, as allowance must always be made for the distance the plug hangs over the baseboard.

With some sets and power-supply devices it is a better idea to mount the receptor end of the connector at right angles to the edge of the baseboard, so that the plug, when inserted, will lie *inside* the edge and parallel to it. In this position, the pins of the connector are more accessible for soldering than they were before, and the markings on them can be distinguished with less trouble.

Building a Radio Picture Receiver

(*Continued from page 69*)

a gear arrangement, by a spring motor. An ordinary phonograph motor, or an electric one that has the same speed can be used. A commercial recorder is made so that it can be placed in a standard phonograph for driving.

By means of a train of gears, a carriage moves along the cylinder axially at the rate of about 80 lines to the inch. A sharp stylus, such as a phonograph steel needle is attached to it. This is the terminal electrode of the high voltage corona coil. At this point, a brush discharge of varying intensity takes place, which records the picture on a photographic paper wrapped around the metal cylinder.

There is a stop-start spring arrangement, together with a release magnet, which stops, and again starts the cylinder, according to impulses received and directed through the relay, as explained above for the synchronization process.

The entire recording mechanism looks very much like an old cylinder phonograph, except that it has in addition the synchronizing apparatus. It would be possible to convert such a device into a recorder, by providing the synchronizing means, as in the commercial product. It would, however, be necessary for the amateur to have an elaborate machine shop equipment to do this.

Nevertheless, in a subsequent edition of RADIO LISTENERS' GUIDE AND CALL BOOK we shall make every effort to give our readers complete mechanical details for making a recorder and relay as well as other constructional information on the subject of telephoto reception.

After the final assembly of the picture machine, and the good working of the recorder, either spring or electrically driven, the picture set should be tried out. Tubes of the usual amplifier type are placed in the sockets, the V1, V2, and batteries connected, and a milliameter handy. It is very desirable to use individual batteries for this appara-

tus. Eliminators are best used with the receiving set to be connected to the picture machine. Of course, the ideal experimental set-up is where the entire arrangement is operated from individual sources of current supply.

Certain adjustments will have to be made to the picture set before it will be ready for operation. There is apparatus adjustment, and a bit of tuning. The relay contacts will have to be carefully brought into place, and the tension on the armature regulated to a nicety. Every time this relay trips, it will actuate the magnet of the recorder machine. It must be balanced so that only the synchronizing signal, which precedes each picture impulse once a revolution will trip it.

Then, the biasing resistance R2, must be judged best, so as to give the right amount of negative bias on the amplifier tube grid in order to swing the plate current to the operating point of the relay winding. The best way to adjust this resistance value is by means of a milliameter reading, when the relay and recorder magnets are energized. A reading of 15 mils in the plate circuit of the amplifier tube show a healthy operating condition.

This relay, as explained previously, will cause the recording cylinder magnet to stop its revolving once a revolution, in synchronism with the sending impulse. There may be some sparking at the contacts, which may be minimized by placing a large fixed condenser across them, or by increasing the space between contacts. The relay will trip at approximately 100 or more times a minute. The speed of the phonograph motor, governing that of the recording cylinder will have to be adjusted to strictly that of the sending station, plus a little advance. The revolutions can be readily counted by the tick produced by the trip magnet when it works.

To receive a picture, it will be necessary to see that a corona discharge is actually taking place at the stylus end. The oscillating circuit must perforce be working. A milliameter reading in its plate circuit will determine this. The recorder depends upon the voltage generated in the step-up radio frequency transformer for the spark discharge.

By darkening the room, and placing the stylus on a dark piece of paper, its glow may be seen. By adjusting various parts of the circuits, such as the variable condenser, the intensity of the spark can be regulated. A better method would be to insert a piece of photographic paper on the cylinder, and "expose" it to the spark. After developing, dark spots will indicate the action of the spark.

See page 135 for full information on Gernsback's Radio Encyclopedia.

The oscillating circuit should be regulated so that there is just a visible discharge when there is no modulated picture signal coming through. The intensity of the discharge will vary with that of the picture impulse.

Ordinary photographic paper can be used with the recorder. Azo No. 2 has been suggested, but Velox, or any of the other standard makes can be used. Simply wrap the sheet, which should be about 5 by 7 inches around the cylinder, holding it in place by means of rubber bands, or, if desired, paste along the long edge.

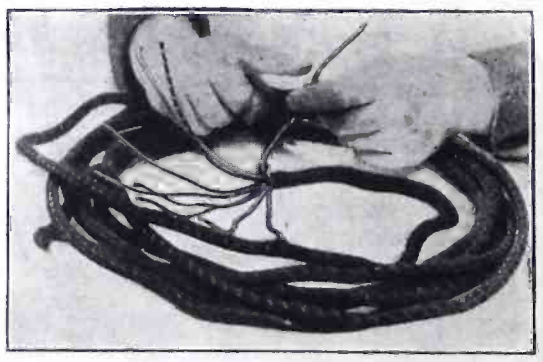
After the picture is run off, it should be developed in the regular way, with a developing and fixing bath. As skill is gained with the apparatus, more sensitive or contrasty papers can be tried, until the best combination is discovered. If the pictures are too dark, it is because the spark discharge is too strong, or the paper too rapid. Adjust the input resistance of the picture set to the amount given above, or use a slower grade of paper, or, again, readjust the oscillating condenser so that the discharge will be smaller.

If the pictures are weak, boost the signal, or use faster paper. Careful adjustment of the oscillating circuit should be made also.

Static and other interference may cause some difficulties in the manipulation of the picture machine. These generally show up in the shape of streaks in the photographs. The skill of the amateur constructor will enter here, to eliminate much of the troubles, and to obtain the finest picture.

Tracing Colors In Connector Cables

CONNECTOR cables which are used between the radio receiver proper and the batteries or socket-power units consist of from five to ten individual wires, covered by a single fabric sleeve. If these wires are examined closely, it will be seen



Each wire is of a distinct color.

hat they are all colored differently. Two or three of them may have their nsulation in solid colors, such as red, rown, yellow and green, while the thers will have vari-colored tracer trings woven into the material. A color scheme of some kind is necesary to enable the set owner to identify the wires and to connect them to the proper binding posts.

The colors used vary greatly. The solid red wires invariably represent the "A" plus leads, the solid black the "A" minus. The experimenter will have to adopt an identifying code of his own f the wires of any particular cable he has on hand do not conform to any standard code. It makes absolutely no difference which wire is selected for any service, as long as the code is adhered to.

If you are "shooting" trouble in a set equipped with an old cable, and find that the colors of the wires faded, merely slice off some of the outer fabric sleeve, so as to reveal an unfaded section of the wire.

The Knowles Screen-Grid Four

(*Continued from page* 122)

its stator plates clear the side of the rheostat R1 by about 3/16-inch. The condenser C2 should be mounted so the frame is ⅛-inch from the side of the shield.

The location of C2 is quite important, since its frame and rotor plates must be insulated from the shield. They are connected to the "B+90" lead. The frame may be insulated from the bottom of the shield by using a thin piece of varnished cambric or empire tape; or two or three pieces of paraffined paper may be used. The holes in the shield bottom should be quite large and the hole through the insulating strip just large enough to clear the screws. The hole in the side of the shield, through which the shaft goes, should be large enough to clear the shaft by 1/16-inch unless a short piece of bakelite shaft is available.

After C2 has been mounted, a test may be made from its frame to the shield by using a battery with a voltmeter, head-set or speaker. There should be no "click" or deflection of the voltmeter.

The sockets and by-pass condensers may then be mounted. A long lead should be soldered to one terminal of the choke L3. This should be threaded through the hole in the shield, after which the two mounting screws may be inserted. The two machine screws on the soldering lugs

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should be removed, to prevent the possibility of one's touching the shield bottom.

Flexible rubber-covered wire is used throughout for the wiring. This, together with the use of "bee" or direct-line wiring and cabled battery leads, makes the wiring very simple. Long leads should be soldered to the terminals which are difficult to reach with a soldering iron after the apparatus is mounted. The grid-leak mount is an example of this; after it has been screwed in place the leads may be cut to the proper length and soldered to the grid condenser and to the filament terminal. If a 201A-type detector is to be used the filament connection of the leak should be made to the "A+" terminal. If the 200A-type is used, it should be connected to the "A—" terminal.

The wiring should progress with a view to completing the coil connections just before the shield is to be assembled. No parts are mounted on the rear side of the shields and these may be added after all the connections have been made. This makes it possible to solder the leads to the coils and other parts more easily.

After the wiring in both shielded compartments has been completed the three A. F. transformers (T1, T2 and T3), the A. F. sockets (V3 and V4), and the amperites (A1, A2 and A3) should be mounted. The left-hand shield should have five long leads, which are to be connected externally. They are the following: "A—" lead, which goes to the cable terminal; aerial lead from the primary of L1, which goes to the aerial binding post; plate lead from V1, which goes to the stator of C2; screen-grid lead, which is attached to the "G" terminal of V1 and goes to the "B+45" terminal (blue) on the cable connector, and the "A+" lead, which goes to the red cable terminal.

The right-hand shield should have the following external leads: one from the stator plates of condenser C3 to the choke L4; "A+" battery lead, which goes to A1 (to the right-hand side of the detector shield and not visible in the pictures); from the choke L3 to the yellow terminal on the cable connector; and that which goes across to the other shield and connects the stator plates of C2 with the "P" terminal of V1.

After these leads have been checked, the audio-frequency amplifier may be wired. The bottom leads to the cable terminal should be wired first to simplify the soldering.

There is ample room on the baseboard to permit the use of any type of audio-frequency amplification. If the constructor prefers push-pull amplification a pair of push-pull trans-

formers may be substituted for T2 and T3, and another socket and amperite added.

The amperite used in the last stage will depend on the power tube. The 1A type should be used for all ¼-ampere and the 112 type for all ½-ampere tubes.

To place the receiver in operation, connect the two "A" battery leads to the cable. Insert the 222-type tube in V1, 201A tubes in V2 and V3 (unless a special detector is used in V2), and the power tube on V4. The filament switch (R1-Sw) should break the connection to all the filaments and should control the brilliancy of the 222-type tube. If the rheostat seems to work satisfactorily complete the battery connections. The small initial spark on the blue and yellow leads is due to the current which charges the by-pass condensers. There should be no second spark when it is disconnected and quickly reconnected.

All of the cable markers are correct except that on the yellow lead. This lead should be connected to the "B+90" terminal instead of the "B—."

Connect the aerial, ground and loud speaker and tune in a local station. If the aerial is quite long, the position of the primary of L1 should be adjusted by turning the primary screw (which protrudes through a small hole in the top of the shield) until the primary is near the top of the shield; that is, until the coupling is very loose. If a small indoor aerial is used, the primary should be adjusted so that it is near the secondary. If a very short wire, having a total length of not over 30 feet, is used the connection should be changed so that all of the primary, instead of half of it, is used. The adjustment of the primary will depend on the selectivity and sensitivity wanted. It may be adjusted, while listening to a station, until the desired selectivity is obtained on the left-hand drum.

The right-hand drum will be found to tune broadly, for the reasons previously mentioned. To sharpen up this circuit, the regeneration control must be adjusted. Turn the rotor of the midget condenser (C3) until the plates are fully meshed. Set the rotor knob with the arrow pointing downward, so that thisp osition may be determined after the shield top is replaced. Set both drums at 100 and adjust the regeneration or tickler coil, just as the primary coil was adjusted, until the set begins to make a hissing noise or otherwise shows signs of oscillating.

When short-wave stations are tuned in it will be found that the capacity of the midget condenser must be decreased to stop oscillations.

The tuning is done as follows: move both dials, keeping them in the same relative positions and with about the same setting. When a station is found, tune the left-hand drum, which should be quite sharp, until maximum intensity is found. This should be done with the volume control in the "on" position; that is, with no resistance in the rheostat circuit. If the station is a local, the volume control may be turned to the left until the volume is moderate. Adjust the right-hand dial and gradually increase the capacity of the midget condenser C3 (make the plates intermesh more completely). It will be found that the setting of the drum must be changed slightly to secure maximum volume, and that the tuning becomes sharper. If the regeneration control is tuned too far, the quality becomes poor and there is a piercing whistle which varies in frequency as the drum is rotated. At some intermediate position good volume may be secured without any loss in the quality of the reproduction.

The selectivity of the detector circuit, in all such circuit arrangements, seems particularly poor because no other tuning control is operated from the same drum. If another tuned circuit were operated from the same control and sharply tuned, the "apparent" selectivity would be much better; although the actual selectivity might be the same. The important measure of selectivity is the distance to which *all* frequency controls must be moved in unison to tune out a station; this gives a measure of the over-all selectivity.

In this receiver the overall sensitivity and selectivity are quite high and both may be controlled largely by the regeneration control. In adjusting the receiver *both controls should be rotated together,* before judging that the selectivity is inadequate. If it must be increased, either more regeneration may be used or the aerial coupling may be decreased as explained before.

Both the selectivity and the sensitivity may be increased when this is necessary by employing the 200A-type detector tube; this may be used with an "A—" return or with the filament end of the leak connected to this terminal. This greatly increases the grid-to-filament resistance of the detector tube and results in sharper tuning and increased sensitivity.

After completing the set it can be installed in a suitable cabinet either of the table type variety or a wall type console. The latter is preferable as it contributes to the furnishings of the home.

Experimental Television

(*Continued from page 73*)

this number of tubes, and power tubes in the last stages, the individual tubes will not be overloaded, and there will be little chance of distortion. Run the tubes at their rated plate and grid voltages, and do not try to force them. Then there will be less chance of trouble with the amplifier unit. Use batteries, not eliminators.

In Figure 5 give the essential connections for the combination television unit described above. The photo-electric cell feeds into the first tube of the vacuum-tube amplifier, and the last tube feeds the neon tube. The voltages in the first grid and last plate circuits will depend on the type and make of photoelectric cell and neon tube that you employ. The manufacturers will supply the necessary data.

In presenting the design detailed in Figure 4, dimensions of the various parts are purposely omitted. The builder of a similar unit will have to change the layout to suit the parts available, and he will undoubtedly want to incorporate some of his own ideas in the construction of the apparatus.

When all of the parts have been constructed and assembled, the testing begins. First, start the motor and allow it to gain speed until it is turning the disks at a rate of about 1,000 R.P.M. If the photo-electric cell and the neon tube are "fast" enough, the disks may turn even faster than this, with a consequent increase in the quality of reprodution. A speed of about 960 R.P.M. with the disks built as described, will give about the equivalent of motion-picture speed, as the object to be transmitted will send beams of light from all its parts in succession through the disk to the photo-electric cell 16 times every second.

When the motor is running smoothly, turn on the amplifier and the light at the transmitting end. The latter may be an arc, or one or two 1,000-watt incandescent bulbs. Place an object before the window of the transmitter, and if everything is working properly, an image of the object, more or less perfect, will appear to the observer as he looks directly into the window at the receiving end through the revolving disk, to the neon tube. The position of the lens in the transmitter may have to be varied for best results.

The above description is presented to the amateur more as a series of constructive suggestions than as a definite set of rules that must be followed to the last period. Much still remains to be done before television

will have reached as high a stage of perfection as, say, radio telephone broadcasting.

However, with the experience gained with a combination outfit such as that outlined, the ambitious experimenter will soon be ready to tackle actual radio television. The necessary steps will be obvious to every transmitting "ham" and there is no need to go into details. Furthermore, in a very short time, we may expect to have some of our more prominent broadcasters equipped to transmit television programs. Then the experience gained with this outfit will stand you in good stead, and you will be far advanced toward good television reception.

The problem of synchronization has been but lightly touched upon in the foregoing paragraphs. When television broadcasting is ready for the public, and programs are transmitted, the synchronizing process will undoubtedly be govened by that used by the broadcaster, and this information will then be made public. There is no use of entering into a lengthy discussion of it here, as when the work is started, there is no telling just what system will be employed.

From Radio Amateur To Custom Set Builder

(Continued from page 66)

plans to the editors of several radio magazines. They invited him to submit for publication new circuits and new ideas in set building. When these were published, all inquiries concerning them were turned over to Mr. Horneij. He followed up the inquiries and in many cases turned them into sales.

Soon he had a national reputation for fine work and good receivers at fair prices. He did some national and local advertising, with good results. The early customers recommended him to their friends and satisfied customers gained in this way still keep the business growing. It would be easy in most cases for local set builders to secure co-operation from local papers as Mr. Horneij did from magazines, and the magazine ediotors always like to have a look at good radio stuff.

Mr. Horneij believes that his sets outdo in performance any of the factory sets of similar types. He has tested them against manufactured sets many times, with results favorable to the custom built set. One reason for the success of the

custom set builder is that he goes out among the manufacturers of the best parts, selects the materials for his sets and tests each part before putting a set together.

When a set is finished, he tests it several times before he is satisfied that it is perfect. If it satisfies him, he can be sure that the customer will be satisfied for, with his experience, he can discover defects that the average radio user would overlook.

One thing that is losing money for radio dealers, Mr. Horneij says, is service. He says that his sets require practically no service. He has never had to visit a customer more than once to inspect a set. When tubes or batteries cause trouble the customer may call up, but all needed information can be given over the phone.

The customer pays for the service call, unless inspection proves that the set is at fault. Mr. Horneij points out the cause of the trouble to the customer, and he does not try to duck any responsibility that belongs to him.

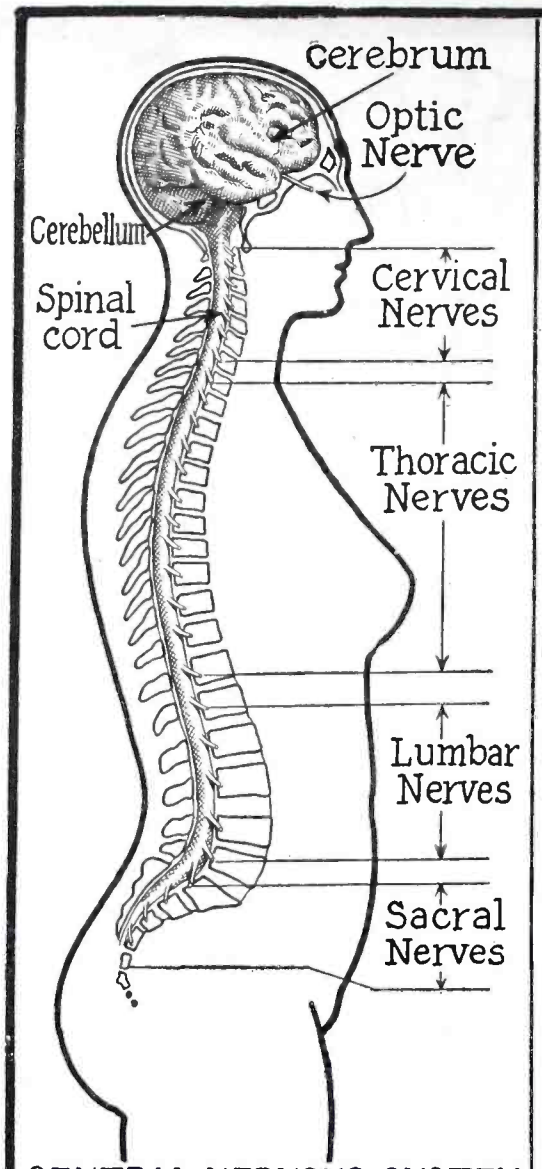
As each set is finally tested after installation in the place where it is to be used, and is adjusted for best results in that location, the customer knows what it will do before he accepts it.

Sometimes a prospective customer wants to try a set of a certain type but is not sure that he wishes to purchase one. He is told that there will be a moderate charge for this service, unless he buys a set.

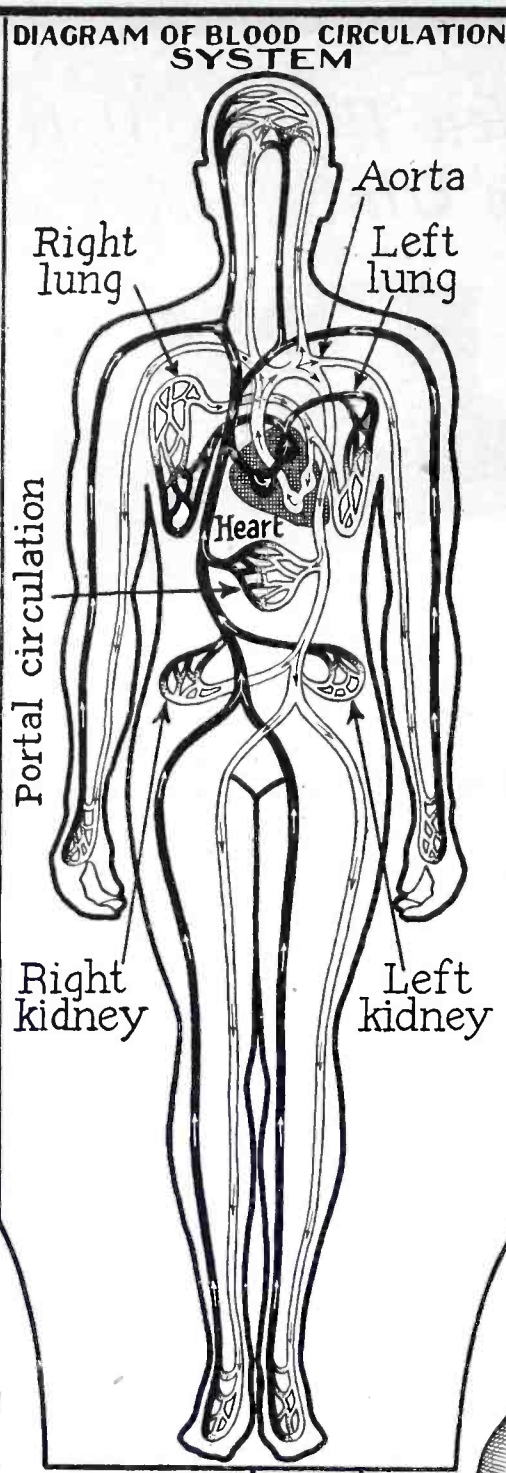
Knowing his field as he does, and having had years of experience in installing receivers in many places, Mr. Horneij can tell what circuits will work best in different localities. If he is not sure what circuit will be best for a certain home, he takes a test set there and makes a reception test in room where the set that is ordered will be used. This eliminates guess work, and is one of the things that make customers. No customer buys a set that will work only half way.

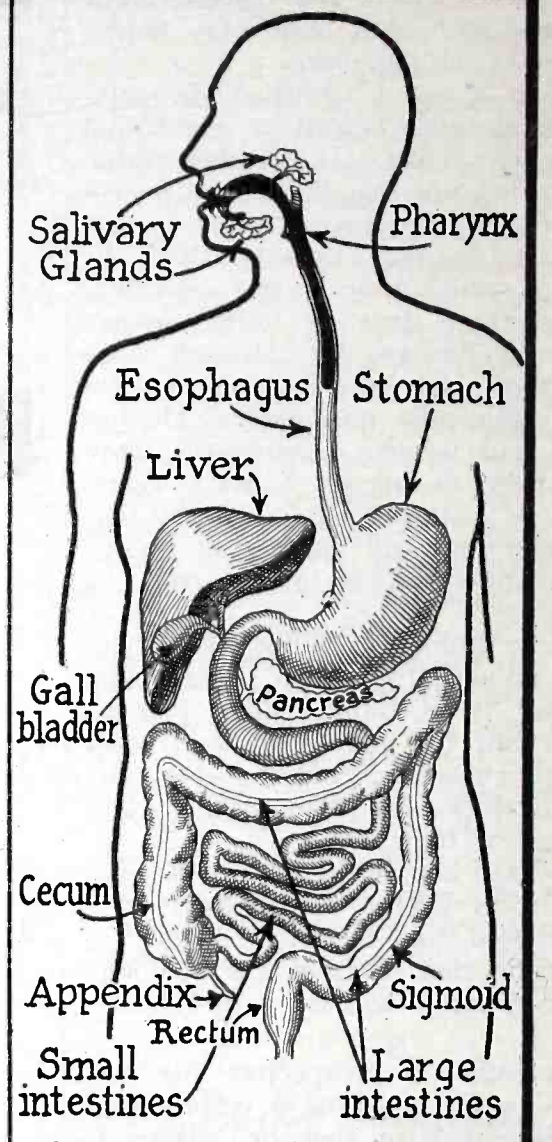
Schneider-Horneij Radio Research Laboratories, Inc., which is the latest development of Mr. Horneij's business, was the first concern, he believes, to be appointed as an authorized service station for radio kits. Home set builders sometimes encounter problems that they cannot solve alone, even with the plans and instructions furnished with the kits, because they know so little of the principles of radio. A number of kit manufacturers were glad to turn such customers over to Schneider-Horneij, who give the necessary help for a reasonable fee.

This concern has no trouble about prices. Its price on a set usually is about the same as that of a similar

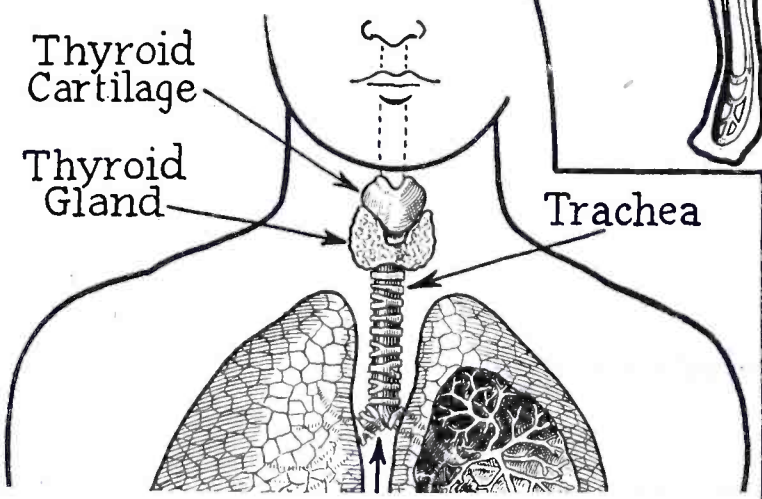


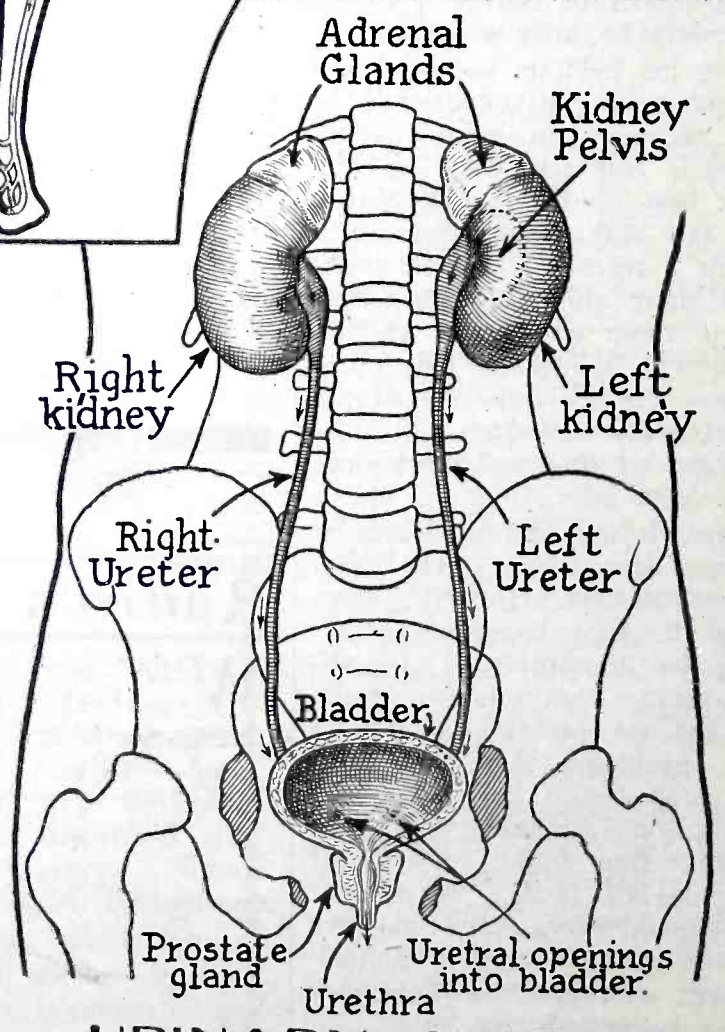
CENTRAL NERVOUS SYSTEM





DIGESTIVE SYSTEM





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factory built set. Sometimes it is lower. In any case, the customer receives a better set than one built under factory conditions because it is built of the best parts obtainable and under the eye of the man who is ultimately responsible for its performance.

Mr. Horneij, whose knowledge of human nature has increased with his radio experience, says that in every case where there is an argument about price, he has found a customer ready to pay a little more if he could get a better outfit. That is a good point for set builders to remember.

Besides building sets, Schneider-Horneij have constructed laboratory apparatus for manufacturers. They build and install transmitters and broadcast receivers for pleasure boats of all types. They were the first to put out a tube tester, several years ago. This type now is being used by the Radio Corporation of America.

In the busy season they employ several men to build sets, but Mr. Horneij does all the testing and has the contact with customers. His personal interest in the success of every set, and his desire to make a friend of every customer, are so strong that he will not delegate this important work to anyone else.

It is improbable that any reader has come this far unless he is the kind of man who would like to build up a business as Mr. Horneij has. Why not do it?

It is not necessary to have twenty years of radio experience to start with. Mr. Horneij acquired his a day at a time. Today there is experience available, in printed form and in apparatus, that enables a man to start building sets without personal experience and with reasonable assurance of success.

I have known novices, who never read a radio book or handled a piece of apparatus, who bought parts, built sets and sold them at a profit. Even before kits were on the market they did it. With a kit, a set of plans, an instruction book and a reasonable amount of common sense, any man who is handy with tools can put together a set tha twill bring in broadcast programs.

It would be unfortunate to raise false hopes. I have known men who were fine mechanics but who could not sell $5 gold pieces at a nickel apiece, because they had not learned the simple rudiments of salesmanship. But unless a man's personality is hopelessly weak, he can install a radio set in a home, school or club house and let it sell itself.

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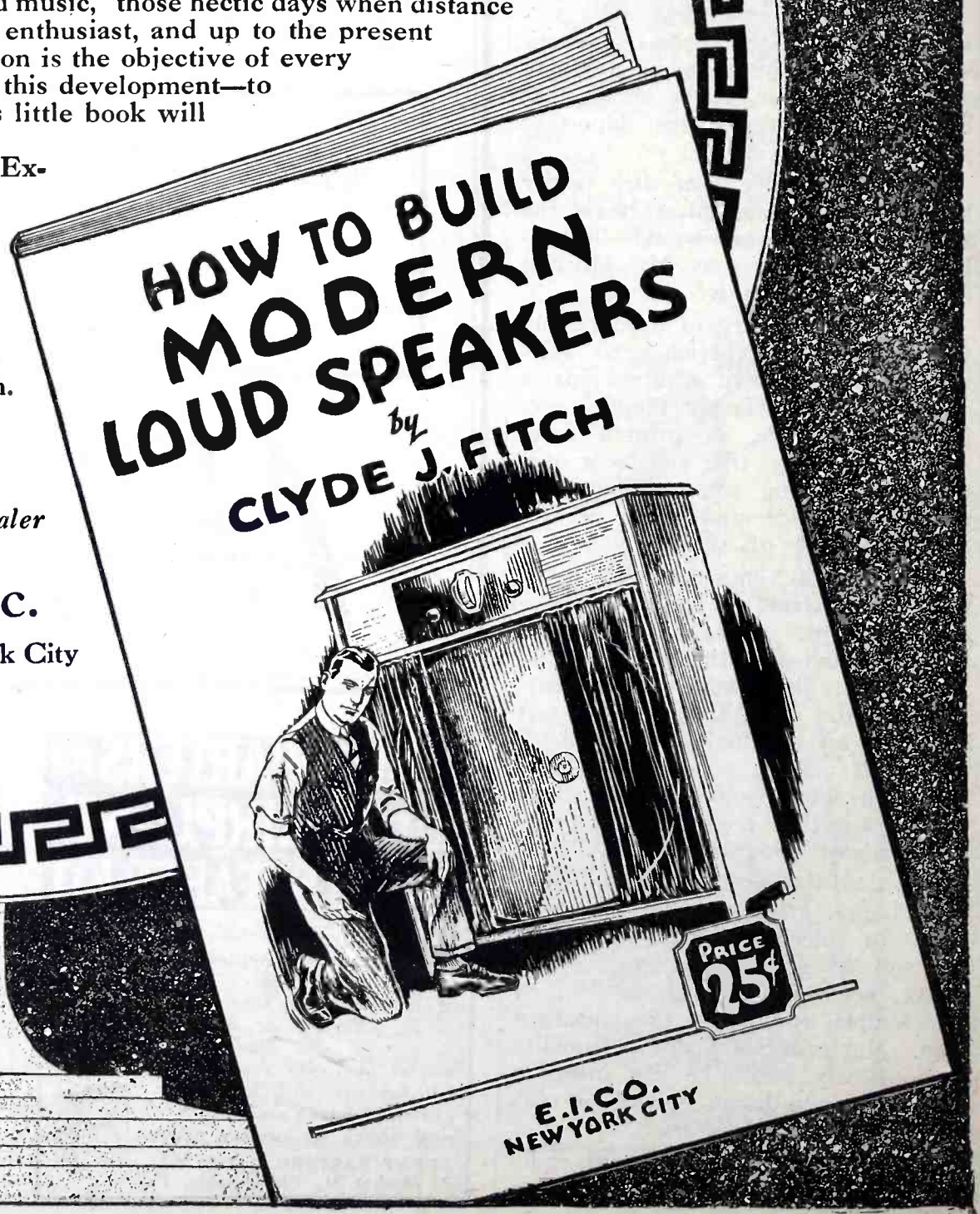

any salesman I ever saw. He has a force of salesmen and he has taught them to keep still, too. He started by hunting up a good prospect and asking her if she would like to have a radio set in her home for a few days, for a demonstration. She was delighted. He went to the house, placed the set where she wanted it, ran a ground wire to the radiator, placed a short length of antenna wire somewhere out of the way, plugged into a light socket and—

After the lady had finished her enthusiastic exclamations about how she never knew it was so easy to put in a radio, and how she always thought it was hard to tune one, and so on, she began giving him names of her friends whom she knew would like to have demonstrations. He sold them, too, and they gave him more names. So many names were given to him that he started putting on salesmen. In a short time he had six men trained and at work.

Little capital is needed for a start in set building, just enough to buy the first outfit of parts. The work can be done at home—no factory or office rent to pay. The selling can be done in the evening hours, if a man is busy during the day. It is one of the few kinds of business that a man can start with little money and in his spare time, and find a market for his products in any community.

The Supreme A.C. Six Receiver

(*Continued from page 95*)

Now reduce with this control until the hum just disappears, or nearly does. Next adjust the bias of the power tubes, R6. The next step is to adjust all compensating condensers in turn until the set howls on a station about 50 on the dial. The phasatrols are turned to the left until howl ceases. Begin with phasatrol, P1. The set should then be tuned to a wave length station near 200 meters. Howling will probably be noted again. This can be eliminated by reducing the phasatrols a little. The compensating condensers should again be adjusted to a finer degree. If this makes the set oscillate again, reduce the phasatrols still further to remove the howl. Readjust grid bias of all tubes. If a slight A. C. hum is present, adjust the 1.5 volt power rheostat and readjust the potentiometer.

The Improved Screen-Grid Laboratory Model Super-Heterodyne

(*Continued from page* 90)

termined by the position of the oscillator-coil rotor, which should be turned about 180 degrees in order to make the lower wavelength point (with oscillator-condenser plates least engaged) strongest, and this oscillator-coil rotor should be left set at about 45 degrees with respect to the stator coil. The selectivity of the Antenna dial is determined by the position of the antenna coil rotor; greatest selectivity at least volume being obtained with the antenna rotor at right angles to the stator coil. Antenna selectivity and the sensitivity of the receiver are further affected by the position of the "Sensitivity knob"; this, through the midget regeneration condenser, controls regeneration and oscillation in the first detector and if turned too far in, will naturally cause first-detector oscillation, so that a large number of squeals will be heard in operation. Care should be taken never to use this condenser except on very weak stations, when, after the station is tuned in, it should be turned up gradually to increase signal strength with slight readjustment of the Antenna dial to compensate for the variations in tuning caused by the Sensitivity condenser.

If it is desired to operate the receiver as a seven-tube set, omitting one intermediate stage—and this is really desirable, except for extreme long-range reception—the first R. F. amplifier stage can very easily be dropped by simply pulling the clip lead in the left-hand compartment of the time-signal amplifier over into the next compartment to the right and clipping it on to the top lead of the second 222-type tube. The clip in the second compartment, ordinarily going to the second tube, should be ignored. Thus the first transformer in the intermediate amplifier feeds the second tube, which, in turn, feeds the third transformer; so that the tube in the first compartment and the transformer in the second compartment (from the left) are simply dropped out of the circuit. It will be found in operation that the tone quality will be somewhat better when using only two intermediate stages than when using three; but the sensitivity in the receiver will be greatest using three stages, and, of course, greater sensitivity means greater noise and stronger signals. The last audio-amplifier stage can also be dropped

very easily by simply moving the loud-speaker cord tips from the two "maximum" tip-jacks to the two "minimum" tip-jacks; although this course is not recommended except where an external power amplifier is used, in which case it is best to leave off the second audio stage altogether. An output transformer should be used connected between the output jacks of the set and the loud speaker.

It will be observed in tuning the set that, when using the lower-wavelength heterodyne point of the Oscillator for all signals, both dials will not track. This condition can be remedied by tuning in (say, KYW or KSD) a very high-wave station, and removing turns from the top end of the oscillator coil until the Oscillator dial reading for this high-wave station coincides with that of the Antenna dial. Actually, it may be desirable to remove turns from both oscillator and antenna coils so that KYW or any other 535-meter station will come in with both Oscillator and Antenna condensers interleaved to within all but five degrees of their maximum position. If this stripping of oscillator and antenna coils, which is done in steps of two or three turns at a time, is carried out, it is possible to extend the range of the receiver down so that it will actually go a little below 200 meters. In stripping the coils, only the enamel wire winding at the top end of the stator forms should be touched, the rotors and slot windings being O. K. Generally 10 turns may be removed from the antenna and 25 turns from the oscillator coil.

The receiver will, of course, cover other than the regular broadcast wavelength range, a pair of 111B coils allowing it to tune from about 70 to 210 meters, and a pair of 111C coils covering the range of about 30 to 90 meters. Two type 111D coils will cover the range of 500 to 1,500 meters; while the addition of one 111E coil for the antenna socket (using a 111D oscillator) will allow the set to tune up to about 3,000 meters. All of these coils are interchangeable plug-in types fitting the standard coil socket.

For short wavelength a three-tube regenerative receiver will generally give entire satisfactory results, or even for medium range broadcast reception. It is a simple matter to add a three-contact switch, with all contacts insulated from the frame, on the front panel of the receiver under the detector stage assembly. The lead from post P on the left end of the intermediate amplifier to the R. F. choke coil (L3) should be broken, and the wire from the choke coil led to the blade of the switch. One contact to the switch

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should go to post P on the left of the intermediate amplifier and the other contact should connect to post P on the right of the intermediate amplifier. The switch then serves to throw the output of the regenerative first detector either directly into the audio amplifier or into the intermediate amplifier. Naturally, when the detector output is connected directly to the audio amplifier, the oscillator tube and all tubes in the intermediate amplifier are unused and may be turned out by an extra pair of contacts on the throw-over switch; or the tubes may be removed from the set, if desired.

If any difficulty is experienced in getting the set to function properly in the matter of sensitivity, selectivity, or tone quality, the change above suggested should be made and the lead from the choke (L3) connected directly to terminal P on the right end of the I. F. amplifier. The set should then be operated as a three-tube regenerator, and the results carefully observed, in order that the operator may familiarize himself with the operation of the first detector circuit and the nature of the regeneration control of the "Sensitivity" knob. Naturally, when the intermediate amplifier is added to the circuit, volume, sensitivity and selectivity should increase very much and the oscillator dial would then come into play. In tuning, the oscillator dial should be extremely sharp, requiring only a degree or two at the outside to eliminate practically any station, local or distant. The antenna dial will be broad comparatively, local stations covering as much as 20 to 30 degrees of the Antenna dial when it is rotated alone, and out-of-town stations from 5 to 10 degrees or more.

The real test of the receiver's performance, however, is a comparison against any other standard set—the Improved Screen-Grid Laboratory Model receiver should give greater selectivity and far greater distance range than any other set on the American market, and the tone quality, when using but two intermediate stages, should be on a par with that of the very best T. R. F. receivers. When using three intermediate stages for extreme sensitivity, it should be equal or better than that of practically all other superheterodyne. A loop may be used, connected to antenna coil socket posts 3 and 4, with the antenna coil removed from the set.

It is suggested that a high grade speaker be employed in conjunction with this set if best tone quality is expected. Among the types recommended for use with this set are the Accusti-cone, Ensco, Dynatone and G. R. Penn speakers.

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The Four-Tube Roberts A.C. Receiver

(*Continued from page* 84)

trouble, that of loose connections, can be eliminated.

A little extra care spent in making sure that the binding post connections are good and tight and that the soldered connections are really fast will be more than repaid by freedom from trouble.

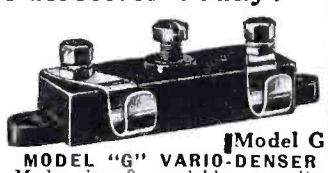
If the parts specified are employed and ordinary care is taken in the construction of the receiver, the resulting job will be one of which any professional set builder or radio experimenter may well be proud and the receiver may be counted upon to put many much more expensive receivers to shame.

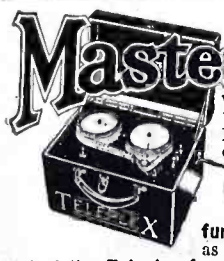
A good idea in wiring up the set is to put in the filament wiring to the tubes first. The leads for making the filament connections to the power tube, in socket VT4 and to the heater ("H") terminals of sockets VT1, VT2 and VT3 should be twisted pair wire or parallel leads twisted together. This twisting is important in avoiding troublesome hum through interacting fields around the wires.

The next step in the wiring is to make the connections to the cathode ("K") terminals of sockets VT1, VT2 and VT3 and to the terminals of the other instruments which are joined with the "K" terminals of the sockets.

The rest of the wiring can then be done, following the scheme of connections as shown in the schematic and pictorial diagrams.

In making the connections to the primary of the power transformers, T6 and T7, cut the braid which covers the twisted pair leads which come out of the porcelain outlet, just above the filament terminals of transformer T7, so as to separate the two leads. These two leads should then be bared (a short distance apart as shown in the pictorial diagram, to avoid any possibility of short circuit). One of the leads from transformer T6 should be connected with one of the bared leads of transformer T7, shown in pictorial wiring diagram. The other lead from transformer T6 should be connected with one of the terminals of resistor R3 as shown. The other terminal of resistor R3 should be connected with the other bared lead of transformer T7. After the connections have been made, the joints to the leads from transformer T7 should be taped up to insulate them.





This scheme of connections connects the primary of transformer T7 directly across the A. C. line but connects the primary of transformer T6 across the A. C. line with the resistance R3 in series with the primary of transformer T6 to cut down the voltage to the required value.

Binding posts should be mounted on the baseboard and connected to the output terminals of the output transformer T5 for connections to the cord tips of the loud speaker.

While the possibilities of trouble have been reduced down to an absolute minimum in this receiver by the selection of high grade parts and by careful design of the circuit and layout, a few hints and cautions on how to avoid trouble or eliminate it will prove helpful.

Regardless of the care taken in the mounting the parts and wiring the receiver, there is always a chance that even the most experienced set-builder might make an error in connecting the terminals.

If after careful checking the set fails to work, it is a good plan to check up each portion of the circuit. The audio unit can be tested out step by step by connecting the loud speaker terminals first across the primary of the first audio transformer, T3 to see whether the signal comes through on the detector stage. If the signal comes through, then proceed to connect the loud speaker across the primary terminals of the second audio transformer T4, to determine whether the first audio stage is functioning. Finally connect the loud speaker across the primary terminals of the output transformer T5 to see whether the last audio stage is operating. If the signal comes through at each stage it indicates that the trouble is farther along in the circuit, until a point is found where the signal does not come through indicating a defective part, tube or connection.

If the signal does not come through on the detector stage, take out the R. F. tube from socket VT1 and connect the antenna to the stator plates terminal of the tuning condenser C2. If signals come through on this connection, the detector stage is all right and the trouble may be located in the R. F. stage.

It is well to keep in mind also, that the volume is increased when the volume control knob is turned in a counterclockwise direction and not in a clockwise direction as is the case with many other sets. Do not therefore expect to hear loud signals if your volume control is turned as far as it will go in a clockwise direction. If these simple precautions are taken excellent results will be obtained.

How to Build the Cosmopolitan Screen-Grid Receiver

(*Continued on page* 107)

and insures best operation of the power unit at all times and in any location.

The filter and by-pass condensers are all enclosed in a single block or "can." These condensers have an ample safety factor in their voltage ratings thus eliminating any possible chance of breakdown. The output resistor network has been the subject of careful consideration and was selected for use only after thorough investigation as to its fitness for inclusion in this job. These resistors are capable of carrying several times the current placed upon them in this circuit, their resistance remains constant and they are capable of providing exactly the output voltages required—to an accuracy of better than five per cent. In fact, with a little care in the first adjustment the output voltages can be brought within one per cent of the receiver requirements.

Binding posts are provided for each required output voltage and jacks are included on the terminal panel so that a milliammeter with a scale range of 0-50 milliamperes may be plugged in by means of an ordinary phone plug to obtain current readings on the plate supply to the power amplifier tube in the receiver and on the total current drain of the receiver.

The fine voltage regulation, by means of which the output voltages are maintained at almost absolute constancy regardless of heavy loads imposed by strong reproduction of low notes is obtained through the use of a power transformer with excellent regulation, a properrly proportioned filter, a rectifier tube capable of handling much geater loads than are imposed upon it in this eliminator—and particularly by the use of an output resistance network of comparatively low resistance. The regulation is so good in fact that the rectifier output varies only 7 per cent when the load of the Cosmopolitan receiver is applied to the output of the eliminator. If the total voltage variation from no load to full load is only 7 per cent it is obvious that the variation with small variations in the load are negligible. The low output resistance also has the advantage that with the receiver disconnected from the eliminator, in other words with no load, the volt-

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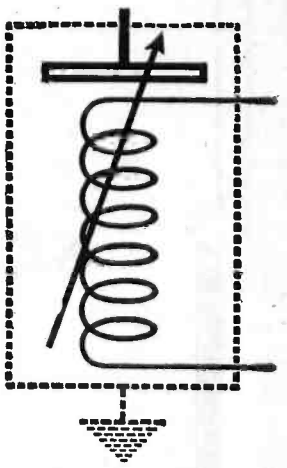

A great deal of valuable time and money has been spent in the last few years in an effort to facilitate the operation of radio receivers by cutting down to a minimum the number of controls required to operate a set efficiently. In this effort many manufacturers have attained a degree of perfection quite laudable but until the development, by Hugo Gernsback, of the PERIDYNE—one-dial radio receiver—each new method, although accomplishing its purpose, did so at the sacrifice of some necessary feature in construction. In the PERIDYNE the solution to the question of efficient operation has been found. THE PERIDYNE IS THE IDEAL ONE-DIAL RECEIVER.

Previous to the PERIDYNE it was impossible to build a one-dial radio receiver that was selective. With the advent of the PERIDYNE, however, not only was selectivity preserved, but all other features required for the successful operation of the receiver did not suffer in the least from the elimination of what previously had been considered necessary controls. Those desiring maximum efficiency and simplicity of operation could find no radio circuit better fitted for their requirements than the PERIDYNE.

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age increase at the filter is so small as to eliminate surges and strains which would otherwise endanger filter condensers and rectifier.

The total available voltage at the output of the eliminator is 300 volts at a drain of 40 milliamperes. The voltage drop in the first section of resistor "R1" drops this to 220 volts which provides 180 volts for the plate supply of the power tube and 40 volts for the grid bias for this tube. The next resistor tap provides a plate voltage of 135 which is the value used for both the R. F. and first A. F. tubes in the Cosmopolitan receiver. The 45-volt supply for the screen grids and for the detector plate are obtained from the next to the bottom tap on the resistor "R1" and the junction between "R1" and "R2" provides the "B—" terminal. The slider arm of "R2" provides the —4.5-volt tap for the first A. F. and detector grid bias and the slider of "R3" provides the —40-volt grid bias for the power tube.

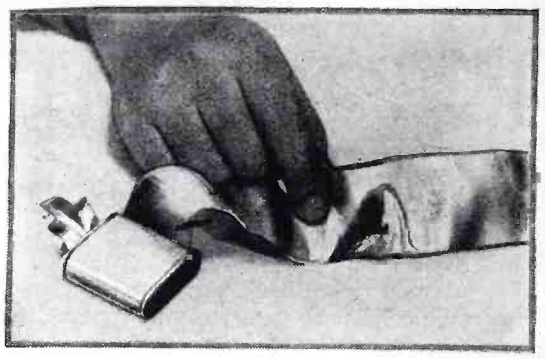
The taps on the resistor "R1" are all adjustable. When the power-pack is first put into operation the taps that provide the 135- and 45-volt terminals (and also the 90-volt terminal if this voltage is required) should be adjusted until they provide exactly the desired voltages. This can only be done with the assistance of a high resistance volt meter which may be borrowed for the occasion inasmuch as it is not required after the adjustment has once been made. Adjustment is made by loosening the screw in the terminal clamp and shifting the clamp band toward the high voltage end of the resistor to secure higher voltage and toward the low end to secure lower voltage.

At first glance the necessity for adjusting the taps of "R1" would seem to be a nuisance but this scheme has the advantage over fixed resistors that the output voltages can be made to exactly fit the requirements of the receiver with which the unit is to be used. It also has the advantage over ordinary variable resistors that it eliminates the tendency to make constant readjustments with resulting doubt as to correct adjustment. In other words the schemes employed here has the advantages of both the fixed and variable resistors but without the outstanding disadvantages of either.

This eliminator is highly recommended to anyone who desires a plate supply source which approaches the ideal, at a moderate investment of money, time and skill. It can be used to maximum advantage with any receiver, using a CX-371A type of tube in the last audio stage, requires no upkeep attention and has an indefinite life.

Effects of a Blown Out Condenser

AT one time or another you probably have asked yourself: "What happens inside a fixed condenser when it blows out?" If you are curious to find out without deliberately blowing a few and disembowelling them, look at the accompanying picture. The black spotch



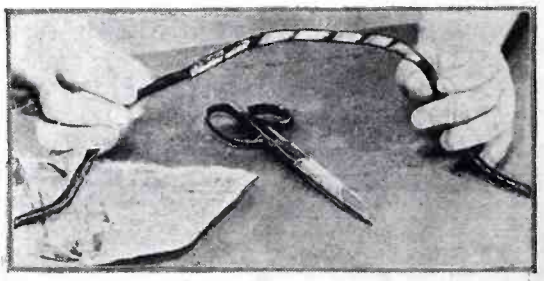
The effect of a blown out by-pass condenser.

indicates the spot where the paper dielectric of the condenser broke down and was burned by the current as it arced between the tinfoil sheets.

Keep this picture in mind the next time you debate the advisability of using a condenser rated at 180 volts in a power circuit carrying 400.

Shielding the Battery Cable With Foil

WITH certain types of sets, it is necessary to shield every exposed part of the equipment, including even the battery cable, which may act as a pick-up of stray R.F. current to a troublesome degree. Receivers employing the 222 (screen-grid tube) are especially critical in this respect.



The foil is wrapped around the battery cable.

Shielded battery cables are not readily obtainable, and if they were, they probably would be very expensive. Fortunately, it is a very simple matter to shield an ordinary cable. Simply cut strips about an inch wide from a sheet of heavy tin or lead foil, and wrap them around the wires in exactly the same manner that you would apply ordinary friction tape. When the job is completed, connect the foil to the ground post of the set.

The Listeners' Accessory Guide

(*Continued from page* 134)

A Short Wave Adapter

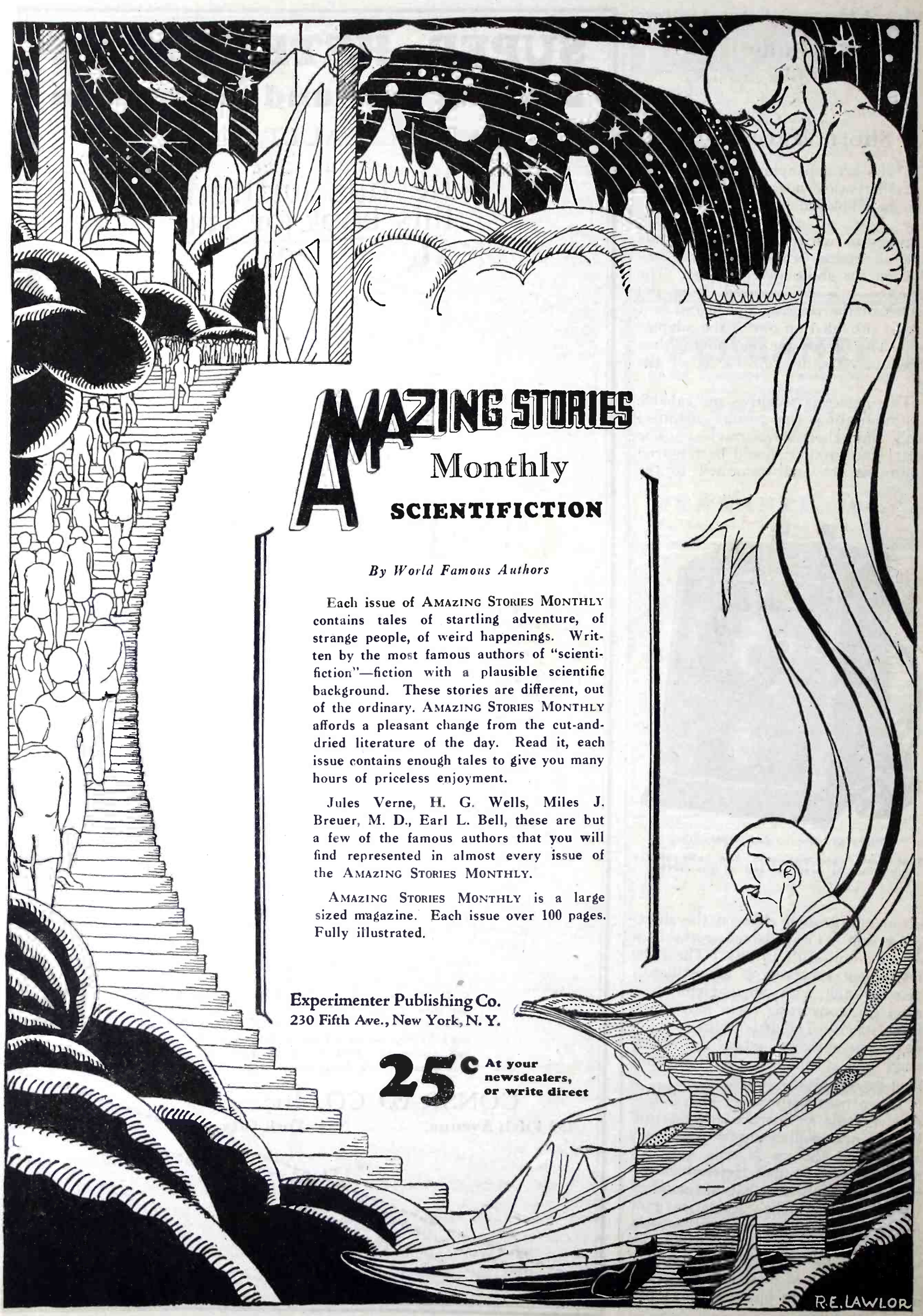
THE accompanying photo shows a short-wave adaptor device which can be employed in conjunction with any type of radio receiver. No changes in wiring have to be made and all tuning is done with the one dial on the short-wave adapter. The detector tube is removed from the socket of the receiver and placed in a socket provided on top of the adapter unit. The short-wave unit plug is then fitted into the detector socket of the set.

This device is sensitive and capable of duplicating the results obtained with any short-wave receiver. The aerial and ground should be removed from the set and connected to the aerial and ground clips on the short-wave unit. This adapter works as a detector unit with all sets. The same instrument functions as an oscillator-detector unit with Super-Heterodyne receivers, converting them into short-wave supers. The dials of the set have no effect in tuning when the short-wave unit is attached, therefore, they may be left at any setting.

Photo by courtesy J-M-P Mfg. Co.

The short wave adapter. The tube socket holes can be seen on top of the device.

When used with Super-Heterodyne receivers the short-wave adapter utilizes all intermediate radio frequency stages and the set is then vertually a short wave Super-Heterodyne receiver with only one dial on the adapter to tune. The device is now available in four additional models, namely: one with interchangeable coils and three for the different type of A.C. tubes. All of these models are exactly the same in appearance as pictured herewith.



An "A. B. and C." Power Supply Unit For A. C. Sets

FOR receivers wired for 226, 227 and 171 or 112 power tubes, the power supply unit shown in the accompanying photograph can be installed without the necessity of adding mid-tap resistors, C bias resistors or filament by-pass condensers. All such connections are provided for in the power unit itself. Where a filament switch and volume control are employed in the set, with which this unit is to be employed, a rheostat of 50,000 ohms can be used in the plate circuit of the radio frequency tubes or a 200,000 ohm potentiometer connected in the aerial circuit. Single switch operation is made automatic by connection to the receiver filament switch, or by external switch, depending on the receiver design. Thus only minimum changes of the set are necessary.

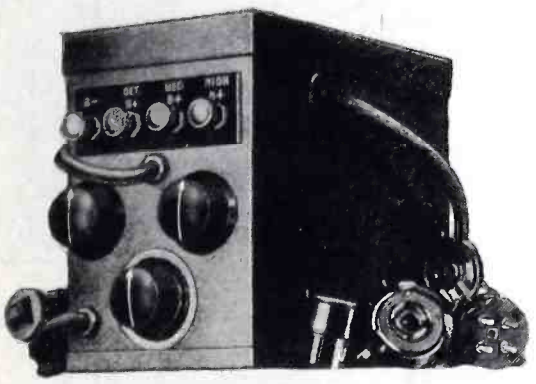
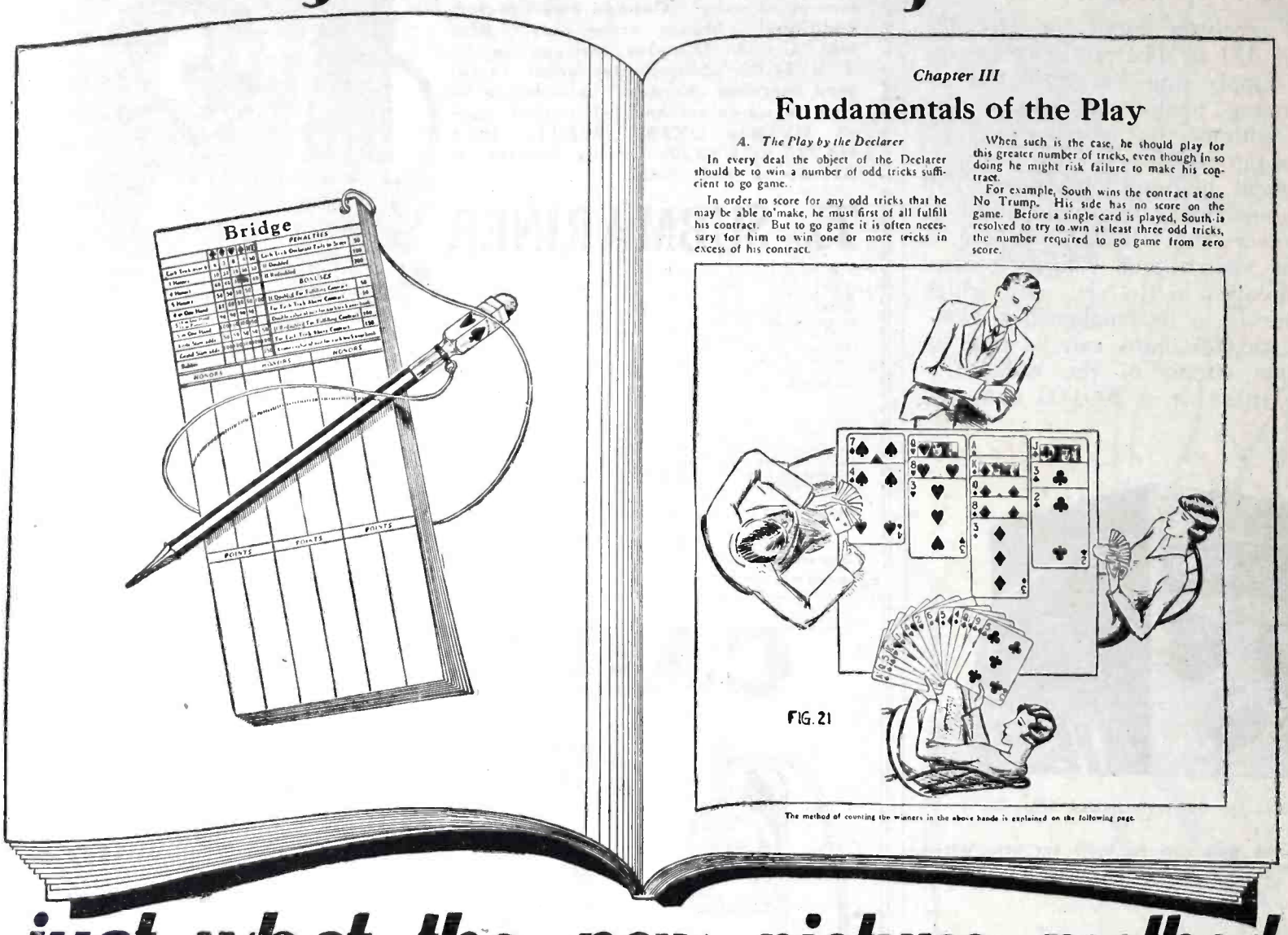


Photo by courtesy Sterling Mfg. Co.

This power unit can be used for sets wired for A.C. tubes. The A.C. adapter harness is also shown in the photo.

Battery operated sets can be converted for A. C. tube operation by means of a special harness which is manufactured by the same concern who makes the unit. This harness also shown in the photograph herewith is especially designed for use in connection with the power unit. The 6-tube adapter is provided with removable grid resistors for the R. F. tubes to prevent execessive oscillation. Special harnesses are also provided for five, seven and eight tube receivers. This power supply unit consists of vacuum tube rectifier system and high voltage condenser filters, the output voltage of which is regulated by means of carbon pressure type variable resistors. The C bias voltage is also furnished within the unit. The entire unit is housed in a metal casing finished in a dark green lacquer, size 7½x4½x5½ inches and is equipped with screw clamps for attaching permanently in a console or radio table.

Bridge —/ —/ —/ —/ by Whitehead



Chapter III

Fundamentals of the Play

A. The Play by the Declarer

In every deal the object of the Declarer should be to win a number of odd tricks sufficient to go game.

In order to score for any odd tricks that he may be able to make, he must first of all fulfill his contract. But to go game it is often necessary for him to win one or more tricks in excess of his contract.

When such is the case, he should play for this greater number of tricks, even though in so doing he might risk failure to make his contract.

For example, South wins the contract at one No Trump. His side has no score on the game. Before a single card is played, South is resolved to try to win at least three odd tricks, the number required to go game from zero score.

FIG. 21

The method of counting the winners in the above hands is explained on the following page.

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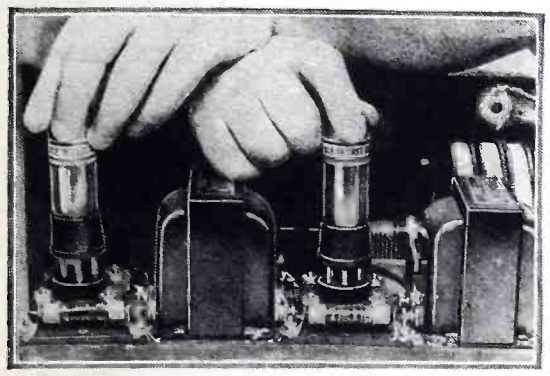
Switching Tubes in the A.F. Amplifier

THE oft-repeated advice about switching tubes back and forth in the radio-frequency sockets of a broadcast receiver applies just as well to the audio portion of the receiver, although, of course, the tubes in this position are not quite as critical.

Application of the advice may be especially helpful if the audio amplifier uses a final stage of the popular push-pull type. After you have tuned in a station put one hand on each of the push-pull tubes, remove them quickly and switch them around. Don't expect any *marked* increase



If the tubes are changed around in the sockets of the set better results are often obtained.

in volume or any *decided* improvement in tone quality; you simply may obtain a little better results. But if the effect of the change is not as good as before the tubes can easily be changed around to their original position.

In switching tubes around, be careful to not interchange tubes of different kinds. For instance, the first stage or first two stages of the A. F. amplifier may use 201A's or high mu's, and the last stage a 112A, 171A or 210. You can exchange the 201A's for each other in the first two sockets, but you must leave the last tube alone.

STATEMENT

Of the ownership, Management, Circulation, Etc., required by the Act of Congress of August 24, 1912, of RADIO LISTENERS' GUIDE AND CALL BOOK, a quarterly published at New York, N. Y., for April 1, 1928.

State of New York,
County of New York, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared S. Gernsback, who having been duly sworn according to law, deposes and says that he is the Editor of the RADIO LISTENERS' GUIDE AND CALL BOOK, a quarterly magazine, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Consrad Co., Inc., 230 Fifth Avenue; Editor, S. Gernsback, 230 Fifth Avenue; Managing Editor, W. G. Many, 230 Fifth Avenue; Business Manager, C. E. Rosenfelt, 230 Fifth Avenue.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual members, must be given.) The Consrad Co., Inc., 230 Fifth Avenue; Hugo Gernsback, President, 230 Fifth Avenue; Sidney Gernsback, Vice-President, 230 Fifth Avenue; R. W. DeMott, 230 Fifth Avenue.

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

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

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

S. GERNSBACK, Editor.

Sworn to and subscribed before me this 31st day of March, 1928.

[SEAL.] JOSEPH H. KRAUS.

Notary Public, Queens Clerk's No. 985, Queens County Register's No. 2903, New York County Register's No. 9257, New York County Clerk's No. 317. (My commission expires March 30, 1929.)

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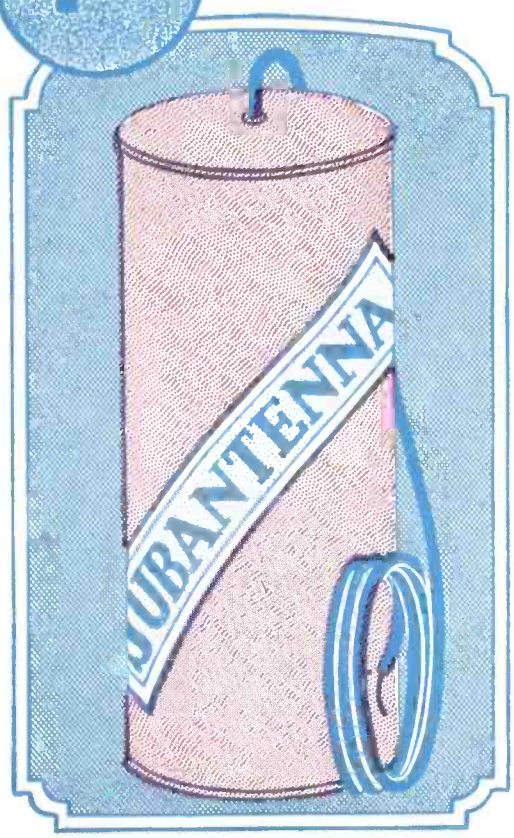

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