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RADIO REVIEW

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Edited by S. Gernsback

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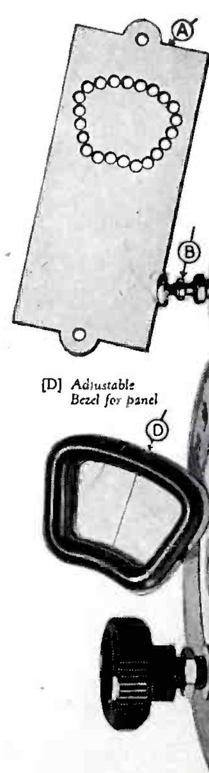

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The set you enter in the Radio Review prize contest should have MAR-CO *controls. Their advanced design may be just the thing that wins you a prize.*

Radio Listeners' Guide and Call Book

Combined With

Radio Review

Volume I

Number 11

DECEMBER, 1926

Contents *of* This Issue

RADIO LISTENERS' GUIDE AND CALL BOOK, Combined with RADIO REVIEW

VOLUME I, NUMBER 11 DECEMBER, 1926

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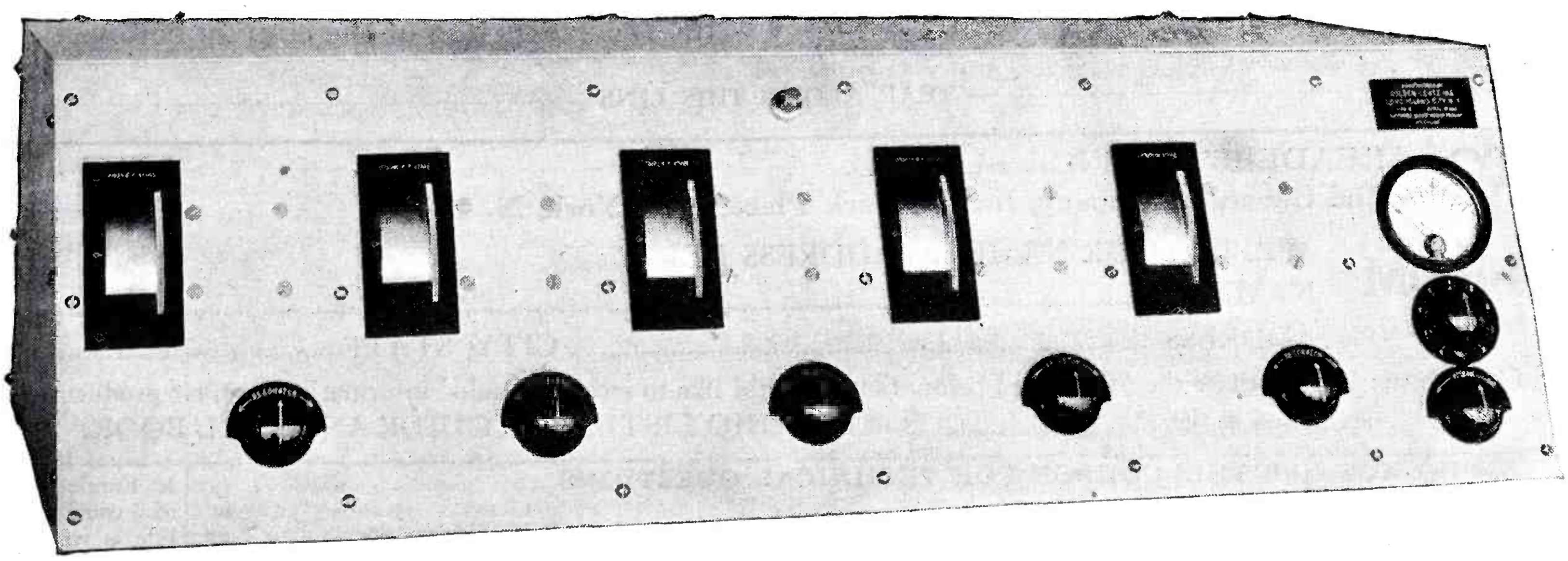

UNIVERSAL TRANSOCEANIC "NEW PHANTOM"

Item	Quan.	DESCRIPTION	Price
1	1	Universal Transoceanic "New Phantom" Broadcast Receiver, 7 tubes, 2 tuned radio, detector, three audio and power audio amplifier. Including "A" Transformers for 200 to 560 meters tuning range. (No accessories included.)	$220.00
		EXTRAS	
2	1	Set selected tubes including detector and 210 power tube	21.50
3	1	Set "B" Transformers for tuning 80 to 210 meters	15.00
4	1	Set "C" Transformers for tuning 35 to 90 meters	15.00
5	1	Set "AA" Transformers for tuning 500 to 1500 meters	15.00
6	1	Set "BB" Transformers for tuning 1200 to 3600 meters	15.00
7	1	6 volt 120 A.H. Storage Battery	24.00
8	1	New Type Farrand Senior Loud Speaker, Cone Type	32.50
9	1	Golden-Leutz Special Current Supply for 110 volts 50/60 cycle A.C.	135.00
10	1	Antennae Equipment	4.00
		Total all accessories	$497.00
11	1	Complete Knocked down Kit of all Transoceanic "New Phantom" Parts ready for assembly including constructional Drawings (no accessories) "A" Type transformers for 200 to 560 meters included	$190.00
12	1	Complete set of Constructional Drawings and Operating Data on Transoceanic "New Phantom" only	2.00

Special Quotation for Dry "B" Battery Operation Will Be Made on Request

UNIVERSAL TRANSOCEANIC "PHANTOM"

Item	Quan.	DESCRIPTION	Price
1	1	Universal Transoceanic "Phantom" Broadcast Receiver, 9 tubes, 4 tuned radio, detector, three audio and power audio amplifier. Including "A" Transformers for 200 to 560 meters tuning range. (No accessories included.)	$250.00
		EXTRAS	
2	1	Set selected tubes including detector and 210 power amplifier	25.50
3	1	Set "B" Transformers for tuning 80 to 210 meters	25.00
4	1	Set "C" Transformers for tuning 35 to 90 meters	25.00
5	1	Set "AA" Transformers for tuning 500 to 1500 meters	25.00
6	1	Set "BB" Transformers for tuning 1200 to 3600 meters	25.00
7	1	6 volt 120 A.H. Storage Battery	24.00
8	1	New Type Farrand Senior Loud Speaker, Cone Type	32.50
9	1	Golden-Leutz Special Current Supply for 110 volts 50/60 cycle A.C.	135.00
10	1	Antennae Equipment	4.00
		Total all accessories	$571.00
11	1	Complete Knocked down Kit of all Transoceanic "Phantom" Parts, ready for assembly including constructional drawings (no accessories). "A" Transformers for 200 to 560 meters included	$220.00
12	1	Complete set of Constructional Drawings and Operating Data for Transoceanic "Phantom" only	2.00

Special Quotation for Dry "B" Battery Operation Will Be Made on Requ-

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Radio Listeners' Guide and Call Book

Combined With

Radio Review

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

RADIO BROADCAST STATIONS OF THE UNITED STATES

with Time Table

Indexed Alphabetically by Call Letters

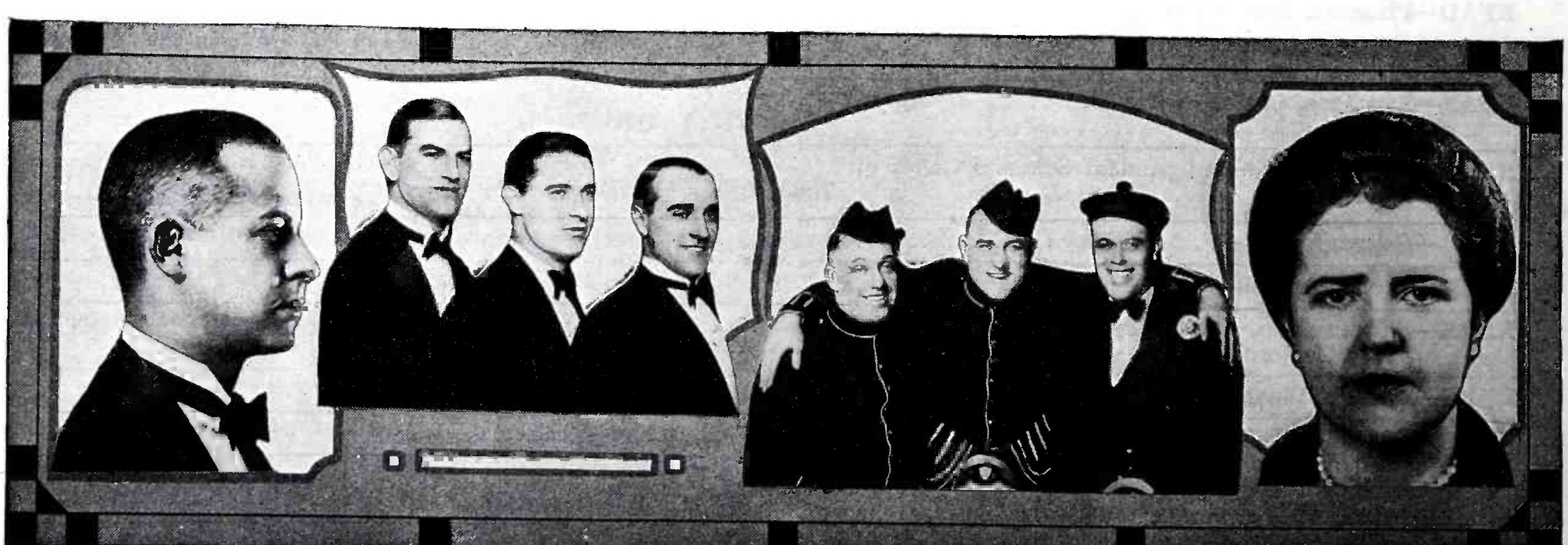
The following list of stations has been so arranged that it can be readily referred to in finding the location, name, power, wave length, frequency and time of a station, providing the call letters are known.

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
KD	**KDKA—Pittsburgh, Pa.** (Transmitter is in East Pittsburgh)—Westinghouse Elec. & Mfg. Co......	Var.	309.1	970	Eastern	Mon., 7:15 to 8; 9:45; 11:55 am; 12 am; 4:20; 5:45; 6:30; 8; 8:15; 9:55 pm; Tue., 7:15 to 8 am; 9:45; 10; 11:55 am; 12 am; 4:20; 5:45; 6:30; 8; 8:15; 8:30; 9:55; 11:35 pm; Wed., 7:15; 8; 9:45; 11:55 am; 12 am: 4:20; 5:45; 6:30; 8; 8:15; 9; 9:55 pm; Thu., 7:15; 9:45; 11:55 am; 12 am; 4:20; 5:45; 6:30; 8; 8:15; 8:30; 9; 9:55; 11 pm; Fri., 7:15; 9:45; 10; 11:55 am; 12 am; 12:20; 4:20; 5:45; 6:30; 8; 8:15; 9; 9:30; 9:55; 10:10 pm; Sat., 11:55 am; 12 am; 5:45; 6:39; 8; 8:30; 9:55 pm. Sun.: 11 am; 4; 4:45; 6:10; 6:30; 7:15; 7:45 pm.
	KDLR—Devils Lake, N. D.—Radio Elec. Co..........	5	231	1300	Central	Daily: 12:10 am and 6:15; 9:30 to 12 pm Mon. Sun. and Holidays: 11 am; 4 pm.
	KDYL—Salt Lake City, Utah—Intermountain Broadcasting Corp., 1009 Ezra Thompson Bldg.....	100	246	1220	Pacific	
KF	**KFAB—Lincoln, Nebr.**—Nebraska Buick Auto Co.....	5000	340.7	880	Central	Daily: 3:15 to 3:45; 5:30 to 6:30; 8:30 to 10:30 Thu., silent; 12 to 2 am Sat. Sun. and Holidays: 4 to 5 pm; 9 to 11 pm.
	KFAD—Phoenix, Ariz.—Electrical Equipment Co......	100	272.6	1100	Mountain	Mon.. silent; Tue., 6 to 7 pm; 8 to 9 pm; Wed.. 6 to 7 pm; 8 to 9 pm; 9 to 11 pm; Thu., 6 to 7 pm; 8 to 9 pm; Fri., 6 to 7 pm; 8 to 9 pm; Sat., 6 to 7 pm; 8 to 9 pm. Sun.: 11 am to 12:30 pm.
	KFAF—San Jose, Calif.—Alfred E. Fowler, Montgomery Hotel................................	50	217.3	1380	Pacific	
	KFAU—Boise, Idaho—Independent School District of Boise....................................	2000	280	1070	Mountain	Mon., Wed., Fri., 12:30 to 1 pm; Tue., 12:30 to 1 pm; 7:30 to 9:30 pm; Thu., 12:30 to 1 pm; 8 to 10 pm; Sat., 12:30 to 1 pm; 7:30 to 9 pm.
	KFBB—Havre, Mont.—F. A. Buttrey Co............	50	275	1090	Mountain	Daily: 12:45 to 1:30 pm only.
	KFBC—San Diego, Cal.—W. K. Azbill, 5038 Cliff Place.	50	215.7	1390	Pacific	
	KFBK—Sacramento, Calif.—Bee-Kimball Upson Co., 610 California St..........................	100	248	1210	Pacific	Mon., 6 tg 7 pm; Thu., 7:30 to 10 pm; Sat., 7:30 to 10 pm.
	KFBL—Everett, Wash.—Leese Bros., 2814 Rucker Ave.	100	224	1340	Pacific	Daily: 7:30 to 8:30 pm.
	KFBS—Trinidad, Colo.—School Dist. No. 1..........	15	238	1260	Mountain	
	KFBU—Laramie, Wyo.—The Cathedral, Bishop N. S. Thomas.................................	500	374.8	800	Mountain	
	KFCB—Phoenix, Ariz.—Nielsen Radio Supply Co., 311 N. Central Ave.......................	100	238	1260	Mountain	Mon., 7:30 to 8:30 pm; Wed., 8 to 9 pm; Sat 7 to 8 pm and 11 pm to 1 am. Sun. and Holida· 9:30 to 10:30 am.

KF

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
KFDD	Boise, Idaho—St. Michaels Episcopal Cathedral	50	278.6	1080	Mountain	Sun.: 11 am to 12:30 pm; 7:30 pm to 9:15 pm.
KFDM	Beaumont, Tex.—Magnolia Petroleum Co...	500	315.6	950	Central	
KFDX	Shreveport, La.—1st Baptist Church........	100	250	1200	Central	
KFDY	Brookings, S. Dakota—South Dakota State College..................................	100	305.9	980	Central	Daily: 12:15 pm; Tue., 11 am; Thu., 7:30 pm.
KFDZ	Minneapolis, Minn.—H. O. Iverson, 2510 Thomas Ave. South.......................	10	231	1300	Central	Tue., 9 pm. Sun.; 5:45 pm.
KFEC	Portland, Oregon—Meier & Frank Co........	50	248	1210	Pacific	Daily: 12 am; 4 to 5 pm.
KFEL	Denver, Colo.—Eugene P. O'Fallon..........	250	254	1180	Mountain	Mon., 11 am; 2 pm; 5 pm; Tue., 11 am; 2 pm; 5 pm; 9 pm; 10 pm; Wed., 11 am; 2 pm; 5 pm; Thu., 11 am; 2 pm; 5 pm; 8 pm; 9 pm; 10 pm; Fri., 11 am; 2 pm; 5 pm; Sat., 11 am; 2 pm; 5 pm. Sun. and Holidays: 9 am only.
KFEQ	Oak, Nebr.—John L. Scroggin...............	500	268	1120	Central	Daily: 2 to 3:15 pm. Sun. and Holidays: 4 to 6 pm; 8:30 to 10 pm.
KFEY	Kellogg, Idaho—Bunker Hill & Sullivan Mining & Concentrating Co.......................	100	233	1290	Pacific	Mon. and Wed., 8 pm. Sun.; 7:30 pm; 11 am.
KFFP	Moberly, Mo.—First Baptist Church..........	50	242	1240	Central	Alternate Thu., at 8 pm. Sun.: 9:45 am; 10:45 am; 7:30 pm.
KFGQ	Boone, Iowa—Crary Hardware Co............	10	226	1330	Central	Tues., 10 to 11 pm; 8:30 to 9:30 pm, Fri.
KFH	Wichita, Kans.—Hotel Lassen................	500	268	1120	Central	Daily: 9 am; 10 am; 11 am; 12 am; 1 pm; 2 pm; 10 to 11 pm. Sun.: 9:40 to 10:40 am; 10 to 11 pm.
KFHA	Gunnison, Colo.—Western State College of Colo....................................	50	252	1190	Mountain	Tue. and Fri., 7:30 to 9:30.
KFHL	Oskaloosa, Iowa—Penn College..............	10	240	1250	Central	Mon., 9:45 am; Tue., 9:45 am and 7:15 pm; Wed., silent; Thu., 9:45 am; Fri., 9:45 am and 7:15 pm; Sat., silent. Sun.: 4 pm.
KFI	Los Angeles, Calif.—Earle C. Anthony, Inc., Packard Motor Car Bldg....................	5000	467	640	Pacific	Mon., 10:45 and 11:05 am; Wed. and Fri., 10:45 am; 5:30 pm to 11 pm daily and to 2 am on Sat. Sun., 10 am and 4 pm; 5:30 to 11 pm.
KFIF	Portland, Ore.—Benson Polytechnic School.....	100	248	1210	Pacific	Tue., 8:15 to 9:15 pm.
KFIO	Spokane, Wash.—North Central Radio Club, North Central High School.................	500	273	1100	Pacific	Fri., 8 to 9:30 pm.
KFIQ	Yakima, Wash.—I. M. Miller................	500	256	1170	Pacific	Wed., 7 pm; Sat., 7 pm. Sun.: 11 am; 3:30 pm; 7:30 pm.
KFIZ	Fond du Lac, Wis.—Daily Commonwealth & Wis. Radio Sales, 22 Forest Ave.............	100	273	1100	Central	
KFJB	Marshalltown, Iowa—Marshall Electric Co....	10	248	1210	Central	
KFJC	Junction City, Kans.—Episcopal Church......	10	218.8	1370	Central	
KFJF	Oklahoma, Okla.—National Radio Mfg. Co....	500	261	1150	Central	Mon., 9:40 am; 12:15 pm; 2:15 pm; 6 pm; 6:30 to 7:30 pm and 8:15 to 10:45 pm. First Mon. of each month, 8 pm. Tue., 9:40 am; 12:15 pm; 2 15 pm; 6 pm; 6:30 to 7:30 pm; 10 pm. Wed., 9:40 am; 12:15 pm; 2:15 pm; 6 pm; 6:30 to 7:30 pm; 7.40 pm; 8:15 to 10:30 pm; and 11 to 12 pm; Thu. Fri. and Sat., 9:40 am; 12:15 pm; 2:15 pm; 6 pm; 6:30 to 7:30 pm; 8:15 to 10:45 pm. Sun.: 6:40 am; 10 am; 11 am; 12:15 pm; 7:30 pm; 10 pm.

Radio Broadcast Station WJZ—New York, N. Y.

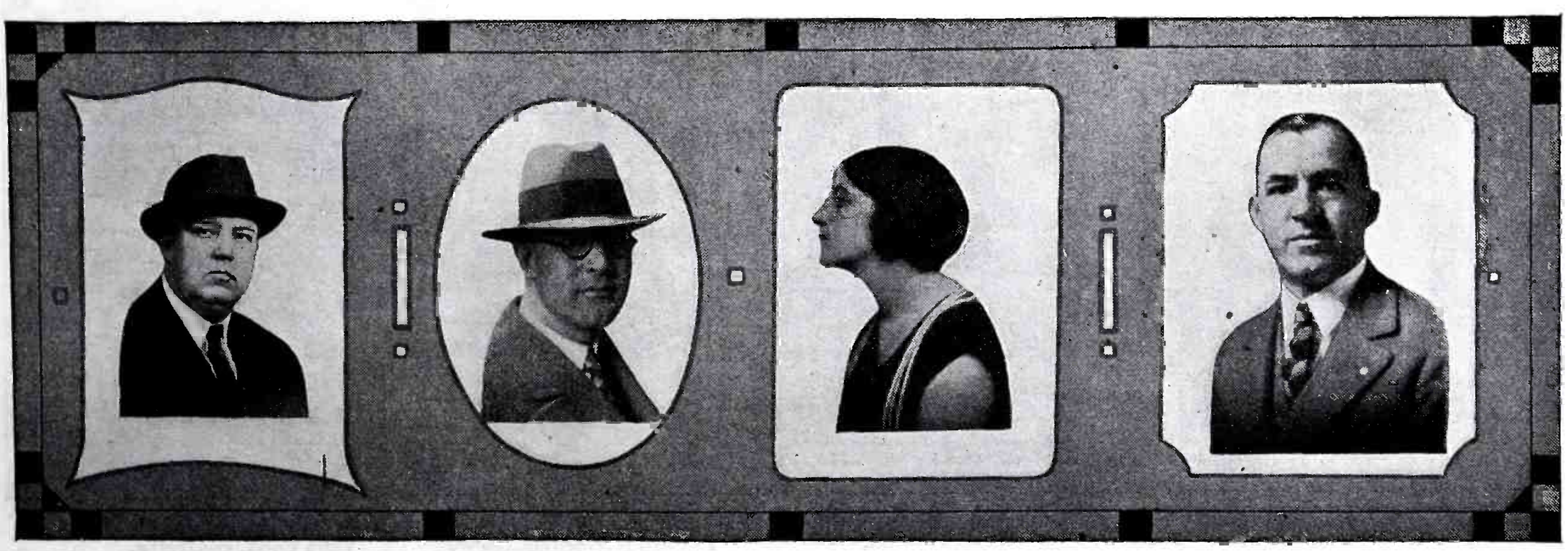


E. Boardman Sanchez. The Record Boys. Bonnie Laddies. Erva Giles.

KF

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
KFJI	**Astoria, Ore.**—Liberty Theatre (E. E. Marsh)...	10	246	1220	Pacific	
KFJM	**Grand Forks, N. D.**—University of N. D......	100	278	1080	Central	Mon., 6 to 7 pm; Tue., 6 to 7 pm; Wed., 6 to 7 pm; Thu., 8:45 to 10 pm; Fri., 6 to 7 pm; Sat., 6 to 7 pm. Sun.: 6 to 7 pm.
KFJR	**Portland, Ore.**—Ashley C. Dixon & Son (Associated with Ralph Schneeloch Co.), 95–5th St.	120	263	1140	Pacific	Mon., 7:30 to 8:45 pm; Tue., 7:15 to 8:15 pm; 9 to 10:30 pm; Wed., 7:30 to 8:30 pm; Thu., 7:30 to 8:30 pm; 9 to 10:30 pm; Sat., 1:30 to 3 pm.
KFJY	**Fort Dodge, Iowa**—Tunwall Radio Co., 13 N. 10th St..................................	50	246	1220	Central	Mon., 5:45 pm; Tue., 5:45 pm; Wed., 5:45 pm; Thu., 5:45 pm; 6 pm; 7 pm; Fri., 5:45 pm; 6 pm; Sat., 5:45 pm; 11 pm.
KFJZ	**Fort Worth, Tex.**—W. E. Branch............	50	254	1180	Central	
KFKA	**Greeley, Colo.**—Colorado State Teachers College..................................	50	273	1100	Mountain	Tue., 8 to 9 pm; Thu., 8 to 9 pm; Wed., 10 to 11 am.
KFKU	**Lawrence, Kans.**—University of Kansas......	500	275	1090	Central	Mon., 12:30 to 1:30 pm.
KFKX	**Hastings, Neb.**—Westinghouse Elec. & Mfg. Co....................................	5000	288.3	1040	Central	
KFKZ	**Kirksville, Mo.**—Chamber of Commerce......	10	226	1330	Central	
KFLR	**Albuquerque, N. Mex.**—University of New Mexico................................	100	254	1180	Mountain	
KFLU	**San Benito, Tex.**—San Benito Radio Club....	20	236	1270	Central	Mon. Thu. Sat., 8 to 9 pm.
KFLV	**Rockford, Ill.**—Swedish Evangelical Mission Church................................	100	229	1310	Central	
KFLX	**Galveston, Tex.**—Geo. R. Clough, 3327 Ave. P.	250	240	1250	Central	
KFLZ	**Anita, Iowa**—Walnut Grove Co.............	100	273	1100	Central	Daily: 11:50 am and 12:30 pm. Sun. and Holidays: 8:30 pm to 10 pm.
KFMR	**Sioux City, Iowa**—Morningside College......	100	261	1150	Central	
KFMX	**Northfield, Minn.**—Carleton College........	500	336.9	890	Central	Daily time signals: 10:25 to 10:30 am; Tue., 9:30 to 10 pm; Wed., 9 to 10 pm; Fri., 10 to 11 pm. Sun.: 7 to 8 pm.
KFNF	**Shenandoah, Iowa.**—Henry Field Seed & Nursery Co..............................	2500	461.3	650	Central	Daily: 7 to 8 am; 10 to 11 am; 12:15 to 1:35 pm; 2:45 to 4 pm; 7 to 9 pm. Sun.: 10:45 to 12:15 pm; 2:30 to 4 pm; 6:30 to 8:30 pm.
KFOA	**Seattle, Wash.**—Rhodes Department Store....	1000	454.3	660	Pacific	Daily: 10 am to 10:45 am; 12:30 pm to 1:30 pm; 3 to 4 pm; 4:15 to 5 pm; 6 to 6:30 pm; 6:45 to 8:15 pm; 8:15 to 10 pm; 10 to 11 pm. No Sun. broadcast. Holidays same as regular schedule.
KFOB	**Burlingame, Calif.**—KFOB Inc...............	50	226	1330	Pacific	Tue., 8 to 12 pm; Thu., 8 to 12 pm; Sat., 5:30 to 6 pm.; 8 to 12 pm.
KFON	**Long Beach, Calif.**—Nichols & Warinner, Inc., Jergins Trust Bldg.........................	500	233	1290	Pacific	Daily: 2:30 to 4:30 pm; 6:30 to 11 pm. Sun. and Holidays: 2:30 to 4 pm; 7:45 to 11 pm.
KFOR	**David City, Neb.**—David City Tire & Elec. Co.	100	226	1330	Central	Mon., 7 to 8 pm; Thu., 7 to 9 pm. Sun.: 3:30 to 4 pm.
KFOT	**Witchita, Kans.**—College Hill Radio Club (College Hill Methodist Church)................	50	231	1300	Central	Fri., 12 to 2 am; Sat., 11:15 pm to 1:30 am. Sun.: 11 to 1 pm and 7:30 to 9 pm.
KFOX	**Omaha, Neb.**—Technical High School (Board of Education)............................	100	248	1210	Central	No regular schedule.

Radio Broadcast Station KUOA—Fayetteville, Ark.

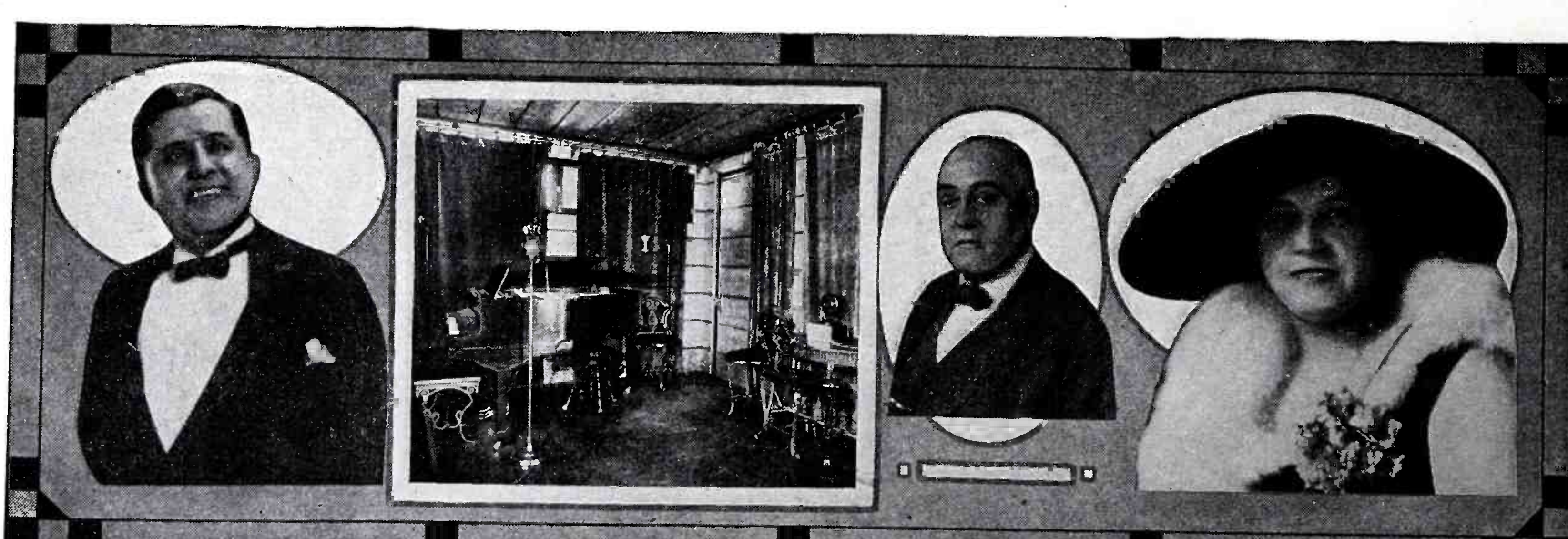


Henry D. Tovey, pianist. Harry E. Shultz, baritone. Alberta McAdams Stone, soprano. A. M. Harding, manager.

KF

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
KFOY	**St. Paul, Minn.**—Beacon Radio Service (M. G. Goldberg), 376 Robert St.	50	252	1190	Central	
KFPL	**Dublin, Tex.**—C. C. Baxter, 205 Grafton St.	20	252	1190	Central	
KFPM	**Greenville, Tex.**—The New Furniture Co.	10	242	1240	Central	Mon.,1 pm and 9 pm; Tue., 1 pm; Wed., 1 pm and 8 pm; Thu., 1 pm; Fri., 1 pm and 9 pm; Sat., 1 pm. Sun.: 11 am.
KFPR	**Los Angeles, Calif.**—Los Angeles County Forestry Dept.	500	230.6	1300	Pacific	
KFPW	**Carterville, Mo.**—St. Johns M. E. Church, South. (L. E. Stewart)	20	258	1160	Central	Tue., 8 to 9 pm; Fri. 8 to 9 pm. Sun.: 1 to 2 pm.
KFPY	**Spokane, Wash.**—Symons Investment Co.	100	266	1130	Pacific	Mon., 7 to 8 pm; 9:30 to 10:30 pm; Wed., 7 to 8 pm; 9 to 12 midnight; Thu., 7 to 8 pm; 10 to 11 pm; Fri., 7 to 8 pm; Sat., 7 to 8 pm; 11 pm to 12 midnight. Sun.: 9:55 to 10:40 am; 9 to 10 pm.
KFQA	**St. Louis, Mo.**—The Principia, 5539 Page Ave. * (KFQA and KMOX sharing use of same transmitter. Not yet permitted to use full power.)	*5000	280.2	1070	Central	Sun.: 8 pm.
KFQB	**Fort Worth, Tex.**—Searchlight Publishing Co., 408 Throckmorton St., Broadcasting from First Baptist Church	2500	410.7	730	Central	Sundays only: 8:30 to 9:30; 10 to 11 am; 3 to 5; 6:30 to 9:30; 11 to 12 pm.
KFQP	**Iowa City, Iowa.**—Geo. S. Carson, Jr., 906 E. College St.	10	223.7	1340	Central	Wed., 8 to 9 pm.
KFQU	**Alma (Holy City), Calif.**—W. E. Riker	250	231	1300	Pacific	Daily: 9 to 10 pm. Sun. and Holidays: 11 am to to 12 am; 9 to 10 pm.
KFQW	**North Bend, Wash.**—Carl F. Knierim	50	215.7	1390	Pacific	
KFQZ	**Hollywood, Calif.**—Taft Radio & Broadcasting Co., Inc., 1641 N. Argyle	500	226	1330	Pacific	Daily: 8 to 11 pm. Sun. and Holidays: 8 to 11 pm.
KFRB	**Beeville, Tex.**—Hall Bros.	250	248	1210	Central	
KFRC	**San Francisco, Calif.**—City of Paris Dry Goods Co.	50	267.7	1120	Pacific	Mon., 10 to 11 am; 5:30 to 10 pm; Tue., 11 to 12:30 pm; 5:30 to 11 pm; Wed., 10 to 12 am; 5:30 to 12 pm; Thu., 11 to 12 am; 4 to 10 pm; Fri., 12 to 12:30 pm; 4 to 11 pm; Sat., 11 to 11:30 am; 4 pm to 1 am. No change for holidays. Sun.: 6:30 to 12 pm.
KFRU	**Columbia, Mo.**—Stephens College. A Junior College for Women	500	499.7	600	Central	Mon., 4:30pm; 6:15 pm., Tue., 8:45 am; 4:30 pm; 6:15 pm; Wed., 4:30 pm; 6:30 pm; 9pm; Thu. 8:45 am; 4:30 pm; 6:15 pm; Fri., 4:30 pm; 6:15 pm; 12 midnight; Sat., 4:30pm. Sun., 7:30 am. 9:30 am; 4 pm; 7:30 pm.
KFRW	**Olympia, Wash.**—Western Broadcasting Co.	50	218.8	1370	Pacific	
KFSD	**San Diego, Calif.**—Airfan Radio Corp., 402 B. St.	1000	245.8	1220	Pacific	Daily: 9 pm to 1 am.
KFSG	**Los Angeles, Calif.**—Echo Park Evangelistic Assn., 1100 Glendale Blvd.	500	275	1090	Pacific	
KFUL	**Galveston, Texas**—Thos. Groggan and Bros. Music Co., 2126 Market St.	500	258	1160	Central	
KFUM	**Colorado Springs, Colo.**—Corley Mountain Highway	100	239.9	1250	Mountain	Mon., 8 to 10 pm; Thu., 8 to 10 pm. Sun.: 11 am and 9 pm.

Radio Broadcast Station WCFL—Chicago, Ill.



Little Joe Warner, character singer and comedian, — View of the studio. — Edward N. Nockels, Sec'y. Chicago Federation of Labor. — Vella Cook, contralto.

KF

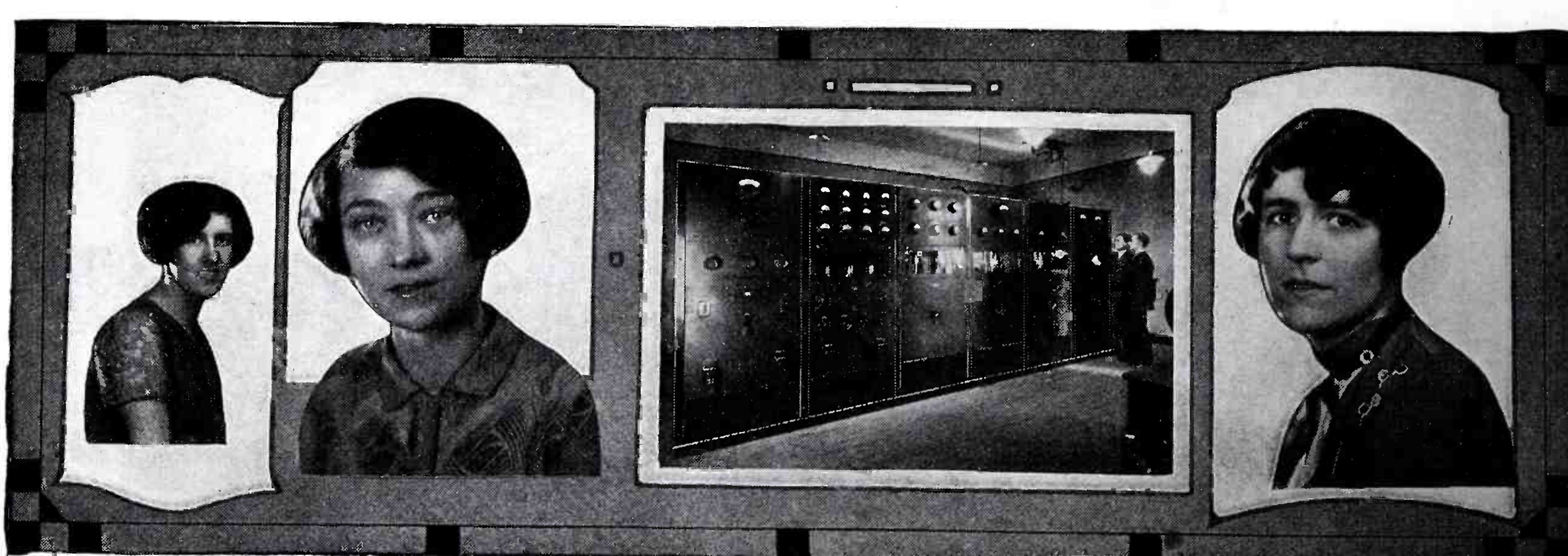
Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
KFUO	**St. Louis, Mo.**—Concordia Theological Seminary	1000	545.1	550	Central	Mon., 3 pm and 8 pm; Tue., 3 pm and 6:30 pm; Wed., 3 pm and 9:15 pm; Thu., 3 pm; Fri., 3 pm and 9:30 pm; Sat., 7:45 pm. Sun.: 4 pm and 9:15 pm.
KFUP	**Denver, Colo.**—Fitzsimons General Hospital	50	234	1280	Mountain	
KFUR	**Ogden, Utah**—Peery Building Co., 420 Twenty-fifth St	50	224	1340	Pacific	
KFUS	**Oakland, Calif.**—Louis L. Sherman, 529 Twenty-eighth St	50	256	1170	Pacific	Daily: 6:30 to 7:30 pm. Sun.: 9 am; 2:30 to 3:30 pm; 3:30 to 4:30 pm.
KFUT	**Salt Lake City, Utah**—University of Utah	100	261	1150	Pacific	Tue., 12 to 1 pm; Thu., 12 to 1 pm.
KFUU	**Oakland, Calif.**—H. C. Colburn and E. L. Mathewson, Flint Motor Car Building	100	220	1360	Pacific	Daily: 10:45 am to 11:45 am; 6:30 to 7:30 pm; 8 to 10:30 pm. Sun.: 8 to 10 pm.
KFVD	**Venice, Calif.** — McWhinnie Elec. Co., 1825 So. Pacific Ave	50	205.4	1460	Pacific	
KFVE	**St. Louis, Mo.**—Benson Broadcasting Corp., 1111 Olive St	5000	240	1250	Central	
KFVG	**Independence, Kans.**—First Methodist Episcopal Church	15	236	1270	Central	
KFVI	**Houston, Texas**—Dunlap, Wilkes, Hills & Hjorth	50	240	1250	Central	
KFVN	**Fairmont, Minn.**—Carl E. Bagley	50	227	1320	Central	Mon. Wed. and Fri., 9 pm. Sun.: 3 pm.
KFVR	**Denver, Colo.**—The Olinger Corp	50	244	1230	Mountain	
KFVS	**Cape Girardeau, Mo.**—Hirsch Battery and Radio Co	50	224	1340	Central	Daily: 12:15 pm; Thu., 7 pm. Sun.: 11 am and 7 pm.
KFVY	**Albuquerque, N. Mexico**—Radio Supply Co., 407 West Central Ave	10	250	1200	Mountain	
KFWB	**Hollywood, Calif.**—Warner Bros. Pictures (Inc.), 5842 Sunset Blvd	500	252	1190	Pacific	
KFWC	**San Bernardino, Calif.**—L. E. Wall	200	211.1	1420	Pacific	Mon., silent; Tue., 8 am to 12 am; 1 pm to 1 am; Thu., 8 am to 12 am; 1 pm to 1 am; Fri., 8 to 12 pm; Sat., 8 to 12 am. Sun.: 8 am to 1 pm.; 7 pm to 2 am.
KFWF	**St. Louis, Mo.**—St. Louis Truth Center, Rev. Emil C. Hartmann, 4030 Lindell Blvd	250	214.2	1400	Central	Tue., 7 pm; 8 pm; Thu., 10:45 am; 12 am; 7:45 pm; 9 pm. Sun.: 10:45; 7:45; 9 pm.
KFWH	**Eureka, Calif.**—F. Wellington Morse, Jr., 522 Grand Ave., Oakland, Calif	100	254	1180	Pacific	
KFWI	**San Francisco Calif.** (Transmitter is in So. San Francisco, Calif.)—Tom Catton	500	250	1200	Pacific	Mon., 10:45 to 11:30 am; 1 to 2; 6:30 pm to 1 am; Tue., 11 to 1 am; Wed., 10:45 to 11:30 am; 1 to 2; 6:30 pm to 1 am; Thu., Silent; Fri., 10:45 to 11:30 am; 6:30 pm to 1 am; Sat., 1:30 to 3:30 am. Sun.: 1 to 2; 8 to 12:30 pm.
KFWM	**Oakland, Calif.**—Oakland Educational Society, 1520 8th Ave	500	315.6	950	Pacific	Mon., 8 to 10; Tue., 2 to 2:30; Wed., 2 to 2:30; Thu., 8 to 10; Fri., 2 to 2:30; Sat., 8 to 10. Sun. 9:30 to 11 am; 1 to 2 pm.
KFWO	**Avalon, Catalina Island, Calif.**—Major Lawrence Mott, Signal Corps, U. S. Army	250	211.1	1420	Pacific	Mon., 12:30 to 1:30 pm; 6 to 10 pm; Tue., 12:30 to 1:30 pm; 5 to 9 pm; Wed., 12:30 to 1:30 pm; 6 to 10 pm; Thu., 12:30 to 1:30 pm; 6 to 9 pm; Fri., 12:30 to 1:30 pm; 6 to 11 pm; Sat., 12:30 to 1:30 pm; 6 to 9 pm. Sun.: 12:30 to 1:30 pm; 5 to 10 pm.

Radio Broadcast Station KGW—Portland, Oregon

Dorothy Lewis, contralto. **Ivy Lilly, entertainer.** **Merle McIntre Rice, program director.** **Gladys Johnson, violinist.**

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
KF	KFWU—Pineville, La.—Louisiana College	100	238	1260	Central	
	KFWV—Portland, Ore.—Wilbur Jerman, 385 East Fifty-eighth St., So	50	212.6	1410	Pacific	
	KFXB—Big Bear Lake, Calif.—Bertram O. Heller	500	202.6	1480	Pacific	Daily: 5 to 5:30 pm; 8 to 8:30 pm. Sun.: silent.
	KFXD—Logan, Utah—Service Radio Company	10	205.4	1460	Mountain	
	KFXF—Colorado Springs, Colo.—Pikes Peak Broadcasting Co., 226 Hagerman Bld.	500	250	1200	Mountain	
	KFXH—El Paso, Texas—Bledsoe Radio Co., 115 S. El Paso St	50	242	1240	Central	
	KFXJ—Edgewater, Colo.—R. G. Howell	15	215.7	1390	Mountain	Daily: 9 to 11 am; 5:30 to 6:30 pm. Night programs pending.
	KFXR—Oklahoma, Okla.—Classen Film Finishing Co., 132½ W. Main Street	15	214.2	1400	Central	
	KFXY—Flagstaff, Ariz.—Mary M. Costigan (Orpheum Theatre)	50	205.4	1460	Mountain	
	KFYF—Oxnard, Calif.—Carl's Radio Den, 207—5th St.	10	205.4	1460	Pacific	Daily: 5:05 to 6 pm; 9 to 11 pm on 2nd and 4th Thu. each month. Programs on Tue. and Thu. by special announcement.
	KFYJ—Houston, Texas—(Portable) Houston Chronicle Pub. Co.	10	238	1260		
	KFYO—Texarkana, Texas—Buchanan-Vaughan Co.	10	209.7	1430	Central	
	KFYR—Bismark, N.D.—Hoskins Meyer, 200 Fourth St.	10	248	1210	Central	Daily: 6:30 to 7:30 pm. Extra hours on extra programs. Sun.: 3 to 5 pm.
KG	KGAR—Tucson, Ariz.—Tucson Citizen, 80 South Stone St	100	243.8	1230	Mountain	
	KGBS—Seattle, Wash.—A. C. Dailey, 844 E. 58 St.	50	227	1320	Pacific	Wed., 7 to 8 pm.; Fr., 7:30 to 8:30 pm.
	KGBW—Joplin, Mo.—Martin Brotherson, 112 W. Sixth St	250	282.8	1060	Central	
	KGBX—St. Joseph, Mo.—Julius B. Abercrombie, 1221 Fred Ave	60	347.8	862	Central	Tues. and Fri. from 8 to 10 pm.
	KGBY—Shelby, Nebr.—Albert C. Dunning	50	202.6	1480	Central	
	KGBZ—York, Nebr.—Federal Live Stock Remedy Co., 303 W. Fifth St.	100	333.1	905	Central	Daily, except Tue. and Sun.; 10 to 12 am.; 7:30 to 9:30 pm.
	KGCA—Decorah, Iowa—Chas. W. Greenley	10	280.2	1070	Central	Irregular.
	KGCB—Oklahoma, Okla.—Wallace Radio Inst., 105 W. 13 St	100	331	905	Central	
	KGCG—Newark, Ark.—Moore Motor Co.	100	234.2	1280	Central	Wed., 9 to 10 pm.; Sat. 10 to 11 pm. Sun.: 2:30 to 3:30 pm.
	KGCH—Wayne, Nebr.—Wayne Hospital (S. A. Lutgen)	500	434	690	Central	Daily: 8 am.; 6 to 7 pm. except Sat. and Mon.
	KGCI—San Antonio, Texas—International Radio Co., 100 West Commerce St	15	239.9	1250	Central	

Radio Broadcast Station WLWL—New York, N. Y.



Marion Loughlin, hostess. Margaret Mahon, hostess. The 5,000 watt transmitter of WLWL. Miss Gertrude Lunt.

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
KG	**KGCL—Seattle, Wash.**—Louis Wasmer, 609 Washington Blvd	10	230.6	1300	Pacific	
	KGO—Oakland, Calif.—General Electric Co	5000	361.2	830	Pacific	Mon., 7:15; 7:45; 8:15; 8:30; 10:40; 11:30 am; 1:30; 3; 4 to 5:30; 5:30 to 6; 6 to 6:55; 8 to 10 pm; Tue., 7:15; 7:45; 8:15; 8:30; 11:30 am; 1:30; 4 to 5:30; 6 to 6:55; 8 to 10 pm; Wed., 7:15; 7:45; 8:15; 8:30; 11:30 am; 1:30; 3; 4 to 5:30; 6 to 6:55 pm; Thu., 7:15; 7:45; 8:15; 8:30; 10:40; 11:30 am; 1:30; 4 to 5:30; 8 to 10 pm; Fri., 7:15; 7:45; 8:15; 8:30; 11:30 am; 1:30; 3; 4 to 5:30; 5:30 to 6; 6 to 6:55 pm; Sat., 7:15; 7:45; 8:15; 8:30; 11:30 am; 12:30; 4 to 5:30; 8 to 10 pm. Sun.: 11 am; 3:30 to 5 pm; 7:45 pm.
	KGTT—San Francisco, Calif.—Glad Tidings Temple and Bible Inst	50	207	1450	Pacific	Tue., 2:30 to 3:30 pm; 8 to 10 pm; Wed., 2:30 to 3:30 pm; 8 to 10 pm; Thu., 2:30 to 3:30 pm; Fri., 2:30 to 3:30 pm; 8 to 10 pm. Sun.: 2:30 to 5 pm; 8 to 10 pm.
	KGW—Portland, Ore.—The Oregonian Pub. Co	1000	492.5	609	Pacific	Mon., 6 to 10 pm; Tue., 6 to 12 pm; Wed., 6 to 11 pm; Thu., 6 to 10 pm; Fri., 6 to 12 pm; Sat., 6 to 12 pm. Sun.: 7 to 10 pm.
	KGY—Lacey, Wash.—St. Martins College	50	278	1080	Pacific	Tue., 8:30 to 9:30 pm; Thu., 8:30 to 9:30 pm. Sun.: 8:30 to 9:30 pm.
KH	**KHJ—Los Angeles, Calif.**—Times Mirror Co., 100 N. Broadway	500	405.2	740	Pacific	Daily: 12:30 to 1:30 pm; 6:30 to 10 pm; Wed., same only 2:30 to 3:30 pm. Sun. and Holidays: 4 to 5 pm; 8 to 10 pm; also Sun.: 10 am to 12 am.
	KHQ—Spokane, Wash.—Louis Wasmer, Davenport Hotel	1000	394.5	760	Pacific	
KJ	**KJBS—San Francisco, Calif.**—Julius Brunton and Son Co., 1380 Bush St	5	220	1360	Pacific	Daily: 9 to 10:40 am; 2 to 2:30 pm; Mon. and Wed., 8 to 10 pm; Fri., 8 to 11:30 pm. Sun.: 5 to 6:30 pm.
	KJR—Seattle, Wash.—Northwest Radio Service Co	1000	384.4	780	Pacific	Daily: 10:30 to 11:30 am; 11:30 to 12; 5 to 6 7 to 8:30; 8:30 to 10; Thu., 10 to 12 pm. Sun. 11 to 12:30; 7 to 9; 9 to 10:30.
KL	**KLDS—Kansas City, Mo.**—Reorganized Church of Jesus Christ of Latter Day Saints	1000	440.9	680	Central	Mon., 12:15 to 11 pm; Tue., 6:30 am; 12:15; 2:30; 8 pm; Wed., 12:15; 6 pm; Thu., 12:15; 2:30; 8 pm; Fri., 6:30 am; 12:15; 2:30 pm; Sat., 8 pm. Sun.: 11 am; 3; 6:30; 9:15 pm.
	KLS—Oakland, Calif.—Warner Bros. Radio Supplies Co., 2201 Telegraph Ave	250	250	1200	Pacific	Sun.: 10 am and 11 am.
	KLX—Oakland, Calif.—The Oakland Tribune	500	508	590	Pacific	Mon., 6:30 to 7:30 pm and 8 to 10:30 pm; Tue., 3 to 5 pm; 7 to 7:30 pm; Wed., 3 to 5 pm; 6:30 to 7:30 pm; 8 to 10:30 pm; Thu., 3 to 5 pm; 7 to 7:30 pm; Fri., 3 to 5 pm; 7 to 7:30 pm; 8 to 10:30 pm; Sat., 3 to 5 pm; 7 to 7:30 pm. No Sun. broadcasting. Holidays same as usual.
	KLZ—Denver, Colo.—Reynolds Radio Co., 1534 Glenarm Street	500	384.4	780	Mountain	Mon., 3 to 4 pm; 6 to 7 pm; 8 to 1 am; Tue., 6:30 to 9 pm; 10 to 11 pm; Wed., 3 to 4 pm; 6 to 7 pm; 8 to 10 pm; Thu. Silent; Fri., 6 to 7 pm; 8 to 10 pm; Sat., 3 to 4 pm; 6:30 pm to 1 am. Sun.: 5 to 6 pm; 6:30 to 8 pm; 9 to 10:30 pm.
KM	**KMA—Shenandoah, Iowa**—May Seed and Nursery Co	500	461	650	Central	Mon., 5:30 to 7; 9; 11:30 am to 12:30 pm; 6 to 7; 9 to 11 pm; Tue., 5:30 to 7; 9; 11:30 am to 12:30 pm; 2; 6 to 7; 9 to 11 pm; Wed., 5:30 to 7; 9; 11:30 am to 12:30 pm; 2; 6 to 7; 9 to 11 pm; Thu., 5:30 to 7; 9; 11:30 am to 12:30 pm; 2 to 3; 4 to 5; 6 to 7; 9 to 11 pm; Fri., 5:30 to 7; 9; 11:30 am to 12:30 pm; 2 to 3; 6 to 7; 9 to 11 pm; Sat., 5:30 to 7; 9; 11:30 am to 12:30 pm; 2; 6 to 7; 9 to 11 pm. Sun.: 12:15; 4 to 5; 5 to 6 pm.

Radio Broadcast Station KYW—Chicago, Ill.

Lawrence Salerno, baritone. **Harold A. "Shorty" Fall, asst. director and football announcer.** **Mary L. Casey, program editor.** **Lillian Rehberg, cellist.** **Lewis Meehan, Irish Tenor**

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
KM	**KMJ—Fresno, Calif.**—Fresno Bee	50	234	1280	Pacific	
	KMJP—Kansas City, Mo.—Kansas City Journal-Post	1000	440.9	680	Central	
	KMMJ—Clay Center, Nebr.—M. M. Johnson Co	1000	229	1310	Central	
	KMO—Tacoma, Wash.—KMO Incorporated	500	250	1200	Pacific	
	KMOX—St. Louis, Mo. (Transmitter is in Kirkwood, Mo.)—Voice of St. Louis, Inc	1500	280.2	1070	Central	Daily: 8:40 to 12:40, Market Reports at Half Hour Intervals; 12:30 to 1:30; 3 to 5 pm; 6 to 11:30 pm; Thu., Silent after 5 pm. Sun.: 9 to 10:30 pm.
	KMTR—Hollywood, Calif.—Echophone Mfg. Co., 1025 N. Highland Ave	500	370.2	810	Pacific	Daily: 9 am; 2:30 pm; 5 pm; 6 pm; 8 to 10 pm; Tue. Thu. Sat., 9:30 pm; Mon. Wed. Fri., 10 to 11 pm. No regular broadcast on Sun.
KN	**KNRC—Los Angeles, Calif.**—Kierulff and Ravenscroft, 1630 So. Los Angeles St	500	208	1440	Pacific	Mon., 1 to 3 pm; 5:45 to 10 pm; Tue., 1 to 3 pm; 5:45 to 10 pm; Wed., 1 to 3 pm; 5:45 to 10 pm; Thu., 2 to 3 pm; 5:45 to 10 pm; Fri., 2 to 3 pm; 5:45 to 10 pm; Sat., 2 to 3 pm; 5:45 to 11 pm.
	KNX—Los Angeles, Calif.—Los Angeles Evening Express, 6116 Hollywood Blvd	500	336.9	890	Pacific	
KO	**KOA—Denver, Colo.**—General Electric Co., 1370 Krameria St	5000	322.4	930	Mountain	Mon., 11:45 am to 1:15 pm; 6 to 10 pm; Tue., 11:45 am to 1:15 pm; 3:15 to 4:30; 6 to 8:30 pm; Wed., 11:45 am to 1:15 pm; 6 pm to 12 pm; Thu., 11-45 to 1:15 pm; 3:15 to 4:30; 6 to 8 pm; Fri., 11:45 to 1:15 pm; 3:15 to 4:30; 6 to 10 pm; Sat., 11:45 to 1:15 pm; 9 pm to 12 pm. Sun.: App. 11 am; 4; 7:30 pm.
	KOAC—Corvallis, Ore.—Oregon Agricultural College	500	280.2	1070	Pacific	Mon., 12:15 to 12:45 pm; 7 to 8:30 pm; Wed., 2 to 3 pm; 7:20 to 8:15 pm; Thu., 2 to 3 pm; Fri., 7:30 to 9 pm.
	KOB—State College, N. Mex.—New Mexico College of Agriculture and Mechanic Arts	5000	348.6	860	Mountain	Daily: 11:55 am to 12:30 pm; 9:55 pm to 10:10 pm; Mon., 7:30 to 8:30 pm; Fri., 7:30 to 8:30 pm.
	KOCH—Omaha, Nebr.—Central High School	250	258	1160	Central	Mon., 8:30 to 10; Tue., 8-30 to 10; Thu., 8:30 to 10. Sun.: 3:30 pm.
	KOCW—Chickasha, Okla.—Oklahoma College for Women	200	252	1190	Central	
	KOIL—Council Bluffs, Iowa—Mona Motor Oil Co	500	305.9	980	Central	Mon., 6 pm to midnight; Tue., Thu., Fri., 6 to 9 pm; 11 to 12 pm; Wed., Silent; Sat., 6 to 9 pm; 11 to 1 am. Sun.: 11 am; 4; 7 to 9 pm; 11 to 12 pm.
	KOIN—Sylvan, Ore.—KOIN, Inc	1000	319	940	Pacific	
	KOMO—Seattle, Wash.—Birt F. Fisher	1000	305.9	980	Pacific	
	KOWW—Walla Walla, Wash.—Blue Mountain Radio Association. (Frank A. Moore)	500	285	1050	Pacific	
KP	**KPO—San Francisco, Calif.**—Hale Bros. and the San Francisco Chronicle	1000	428.3	700	Pacific	Mon., 7 to 8:30 am; 1 to 2; 2:30 to 4:30; 5:15 to 7:30; 8 to 11 pm; Tue. Wed. and Thu., same as Mon.; Fri., 7 to 8:30 am; 12:45 to 2 pm; 4 to 7:30 and 8 to 11 pm; Sat., 7 to 8:30 am; 2:30 to 5:30; 6 to 7:30 and 8 to 12 pm. Sun.: 9:45 to 10:45 am; 5 to 10 pm.
	KPPC—Pasadena, Calif.—Pasadena Presbyterian Church	50	229	1310	Pacific	Wed., 7:15 to 9 pm. Special broadcasts as announced. Sun.: 10:30 am to 12:30 pm; 6:45 pm to 9 pm.

Radio Broadcast Station WSAI—Cincinnati, Ohio

Sigmund Culo, violinist. Carl Wunderele, Viola Ernest Pack, violinist. Grace Raine, musical directress. Paul A. Greene, manager, announcer and radio engineer. Walter Heerman, cellist.

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
KP	**KPRC—Houston, Texas**—Houston Post Dispatch......	500	296.9	1010	Central	Daily: Fri., silent 10:55 am; 11 am; 12 am; 5:30 pm; 7:30 pm; 8 pm; 8:30 pm; 9 pm; 9:30 pm. Daily and Sun.: 11 pm Wed. and Sat. only. Sun.: 10:45 am; 7 pm; 9:30 pm.
	KPSN—Pasadena, Calif.—The Star-News............	1000	315.6	950	Pacific	Mon., Silent; Tue., 8 to 9 pm; Wed., silent; Thu; 8 to 9 pm; Fri., silent; Sat., 8 to 10 pm. Sun.: 8:45 to 9:45 pm.
KQ	**KQV—Pittsburgh, Pa.**—Doubleday-Hill Electric Co., 719 Liberty Ave..........................	500	275	1090	Eastern	Mon., 10:30 to 11 am; 3 to 4:30 pm; Tue., 10:30 to 11 am; 3 to 4:30 pm; 6:30 to 7:30; Wed., 10:30 to 11 am; 3 to 4:30 pm; Thu., 10:30 to 11 am; 3 to 4:30 pm; Fri., 10:30 to 11 am; 3 to 4:30 pm; Sat., 10:30 to 11 am; 3 to 4:30 pm.
	KQW—San Jose, Calif.—First Baptist Church of San Jose, Montevina Ave......................	500	331.1	905	Pacific	Mon. Tue. Wed. Thu. Fri. 6:30; 7. Sun.: 9:40 to 12:30; 7:30 to 9:30.
KR	**KRE—Berkeley, Calif.**—Berkeley Daily Gazette.......	100	256	1170	Pacific	Daily: 11:15 am to 11:45 am; 5:30 pm to 6 pm; Mon. and Thu., 8 to 10 pm; Tue., 9 to 10; Fri., 9 pm to 1 am; Sat., 8 pm to 1 am. Sun. and Holidays: 10 to 11 am; 6:30 to 7:30 pm; 8 to 9 pm.
KS	**KSAC—Manhattan, Kans.**—Kansas State Agricultural College..................................	500	340.7	880	Central	
	KSBA—Shreveport, La.—Shreveport Broadcasting Co..	1000	312.6	960	Central	
	KSD—St. Louis, Mo.—Pulitzer Publishing Co.—The St. Louis Post Dispatch....................	500	545.1	550	Central	Mon., 9:40; 10:40; 11:40; 12:40 pm; 1:40; 2:40; 3:40 pm; 7; 9 to 10:30 pm; Tue., 7 to 11 pm; Wed., 7 to 9:15 pm; Thu., 7 to 11 pm; Fri., 7 to 9:20; 10 to 11 pm; Sat., 7 to 7:45; 8 to 11 pm. Mon., Wed. and Fri., 10 am and 11 am. Sun.: 6:15 to 9:15 pm.
	KSL—Salt Lake City, Utah—Radio Service Corp. of Utah, 505 Templeton Bldg..................	1000	299.8	1000	Mountain	Mon., 7:30 am; 6 pm to 11 pm; Tue., 7 pm to 11 pm; Wed., 7:30 am; 10 am; 6 to 11:30 pm; Thu., 7 pm to 11 pm; Fri., 7:30 am; 10 am; 6 pm to 11 pm; Sat., 7:15 pm to 11 pm. Sun.: 11 am; 4 pm to 11 pm.
	KSMR—Santa Maria, Calif.—Santa Maria Valley R. R. Co....................................	100	282.8	1060	Pacific	Mon. Wed. and Fri., 7:45 to 8:15 pm; Tue., Thu. and Sat., 7 to 10 pm.
	KSO—Clarinda, Iowa—A. A. Berry Seed Co..........	500	242	1240	Central	Mon., 12:30 pm to 7 pm; Tue., 12:30 pm to 7 pm; Wed., 12:30 pm to 7 pm; Thu., 12:30 pm; 3 pm to 4:30; 7 pm; Fri., 12:30 pm; 7pm; Sat., 12:30 pm.
KT	**KTAB—Oakland, Calif.**—The Associated Broadcasters.	1000	302.8	990	Pacific	Daily: 9 to 9:30 am; 12 to 1 pm; 8 to 10 pm. Sun.: 9:45 to 10:45 am; 11 am to 12:30; 7:45 to 9:15 pm; 9:30 to 11 pm.
	KTBI—Los Angeles, Calif.—Bible Institute of Los Angeles..................................	750	293.9	1020	Pacific	
	KTBR—Portland, Ore.—Brown's Radio Shop, 172 Tenth St................................	50	263	1140	Pacific	Mon., 1:30 to 2:30 pm; 8:45 to 9:45 pm; Tue., 1:30 to 2:30 pm; 8:30 to 9 pm; Wed., 1:30 to 2:30 pm; 8:30 to 10:30 pm; Thu., 1:30 to 2:30 pm; 6:15 to 7:15 pm; Fri., 1:30 to 2:30 pm; 6 to 10 pm; Sat., 3 to 4 pm; 11:30 to 1:30 am. Sun.: 3 to 4 pm.
	KTHS—Hot Springs Nat'l Park, Ark.—New Arlington Hotel Co................................	1000	374.8	800	Central	Mon., 12:30 to 1 pm; 9 to 11:30 pm; Tue., 9 to 11:30 pm; Wed., 12:30 to 1 pm; 9 to 11:30 pm; Thu., 12:30 to 1 pm; 9 to 11:30 pm; Fri., 12:30 to 1:30 pm; 9 to 11:30 pm; Sat., 12:30 to 1:30 pm; 9 to 11:30 pm. Sun.: 11 am to 12:15 pm; 9 pm to 12:45 am.
	KTNT—Muscatine, Iowa—Norman Baker............	1000	333.1	905	Central	Daily: 12 to 12:30 pm; 6:45 to 7:45 pm; 9 to 10:30 pm; 11 to 12 pm; Sat., silent; 9:30 each Mon Night "Common Sense Talks," by N. Baker Sun.: 9 to 10:30 pm.

Radio Broadcast Station KOA—Denver, Colo.

Ralph Freese, announcer and lyric tenor. **Iris Ruth Gilmore, director of dramatics.** **Hulda Helen Edwards, dramatic soprano.** **Freeman H. Talbot, program manager and studio director.**

	Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
KT	KTUE	**Houston, Texas**—Uhalt Electric, 614 Fannin St.	5	263	1140	Central	
	KTW	**Seattle, Wash.**—The First Presbyterian Church of Seattle, Wash.	1500	454.3	660	Pacific	Sun.: 11 am to 12:30 pm; 3 to 4:30 pm; 7:30 pm. to 10 pm.
KU	KUOA	**Fayetteville, Ark.**—University of Arkansas	750	299.8	1000	Central	Mon., 7:30 to 9; Tue., 8 to 10; Thu., 8 to 10.
	KUOM	**Missoula, Mont.**—State University of Montana	500	244	1230	Mountain	Daily: 6:30 pm; Mon. and Thu., 8 pm. Sun.: 9:15 pm.
	KUSD	**Vermillion, S. D.**—University of South Dakota	100	278	1080	Central	Wed., 8 to 10 pm. Sun.: 3:30 pm; 9 pm.
	KUT	**Austin, Texas**—University of Texas	500	231	1300	Central	Mon., 8 pm; Wed., 8 pm. Sun.: 11 am; 3:30 pm
KV	KVOO	**Bristow, Okla.**—Southwestern Sales Corp., Tulsa and Bristow, Okla.	500	375	800	Central	Daily: 7 to 9 am; 11:30 to 12:30 pm; 3 to 4; 6 to 9 pm. Sun.: 12:30 to 7 pm (continuous); 7:30 to 9 pm.
KW	KWCR	**Cedar Rapids, Iowa**—H. F. Paar, 1444 Second Ave., E.	500	278	1080	Central	Mon., 9 to 10:30; Wed., 9 to 10:30; Fri., 9 to 10:30; Afternoon programs, 4:15 pm; Mon. Wed. and Fri. Sun.: 11 am; 5:15 pm; 9:30 pm.
	KWG	**Stockton, Calif.**—Portable Wireless Telephone Co., 530 East Market St.	50	248	1210	Pacific	
	KWKC	**Kansas City, Mo.**—Wilson Duncan Broadcasting Studios, Werby Building	100	236	1270	Central	Tue., 7 and 9 pm; Wed., 7 and 9 pm; Thu., 7 and 9 pm; Fri., 7 and 9.
	KWSC	**Pullman, Wash.**—State College of Washington	500	348.6	860	Pacific	
	KWUC	**Le Mars, Iowa**—Western Union College	50	252	1190	Central	Mon., 7:30 to 9 pm Wed., 8 to 9 pm; Fri., 7 to 8 pm. Sun.: 3 to 4 pm.
	KWWG	**Brownsville, Texas**—Chamber of Commerce	500	278	1080	Central	Daily: 12 noon; 6 pm; Mon. and Thu., 8:30 pm; Tue. and Fri., 12:01 am. Sun.: 11 am.
KY	KYW	**Chicago, Ill.**—Westinghouse Electric and Mfg. Co.	2000	536	560	Central	Daily: 11 am; 12 am; 1 pm; 2:35 to 4 pm; Tue., Thu. and Sat., 5:45 to 6; 6:30 to 7 pm; 8 to 12 pm. Sun. and Holidays: 11 am; 2:30; 4:30; 7 and 9:30 pm.
KZ	KZM	**Oakland, Calif.**—Preston D. Allen, 13th and Harrison Streets	100	240	1250	Pacific	Daily except Sunday: 6:30 to 7 pm.
NA	NAA	**Arlington, Va.**—United States Navy	1000	434.5	690	Eastern	Daily: 10:05 to 10:20; 11:55 to noon; 3:45 to 4; 9:55 to 10; 10:05 to 10:20 pm; Wed., 7:45 to 8 pm; 8:45 to 9:20 pm; Fri., 8:45 to 9:20 pm.
WA	WAAD	**Cincinnati, Ohio**—Ohio Mechanics Institute	25	258	1160	Central	
	WAAF	**Chicago, Ill.**—Chicago Daily Drovers Journal	500	278	1080	Central	
	WAAM	**Newark, N. J.**—I. R. Nelson, 1 Bond St.	500	263	1140	Eastern	Mon., 11 to 12 am; 6 to 11 pm; Tue., 10:15 to 12 am; 6 to 11 pm; Wed., 11 to 12 am; 6 to 11 pm; Thu., 11 to 12 am; 6 to 7:30 pm; Fri., 10:15 to 12 am; 6 to 11 pm; Sat., 6 to 11 pm. Sun.: 11 am to 12:30 pm.
	WAAT	**Jersey City, N. J.**—Frank V. Bremer, 210 Jackson Ave.		235	1280	Eastern	
	WAAW	**Omaha Neb.**—Omaha Grain Exchange	500	384.4	780	Central	Daily except Sat., 9:30 am; 9:45 every half hour to 1:15 pm. Last Broadcast on Sat., 12:45 pm. Evenings at 8 pm. Broadcast only market reports.
	WABB	**Harrisburg, Pa.**—Harrisburg Radio Co.	10	204	1470	Eastern	
	WABC	**Asheville, N. C.**—Asheville Battery Co., 101 Patton Ave.	100	254	1180	Central	
	WABI	**Bangor, Me.**—First Universalist Church	100	240	1250	Eastern	Sun.: 10:30 to 12 am; 7:30 to 9:30 pm.

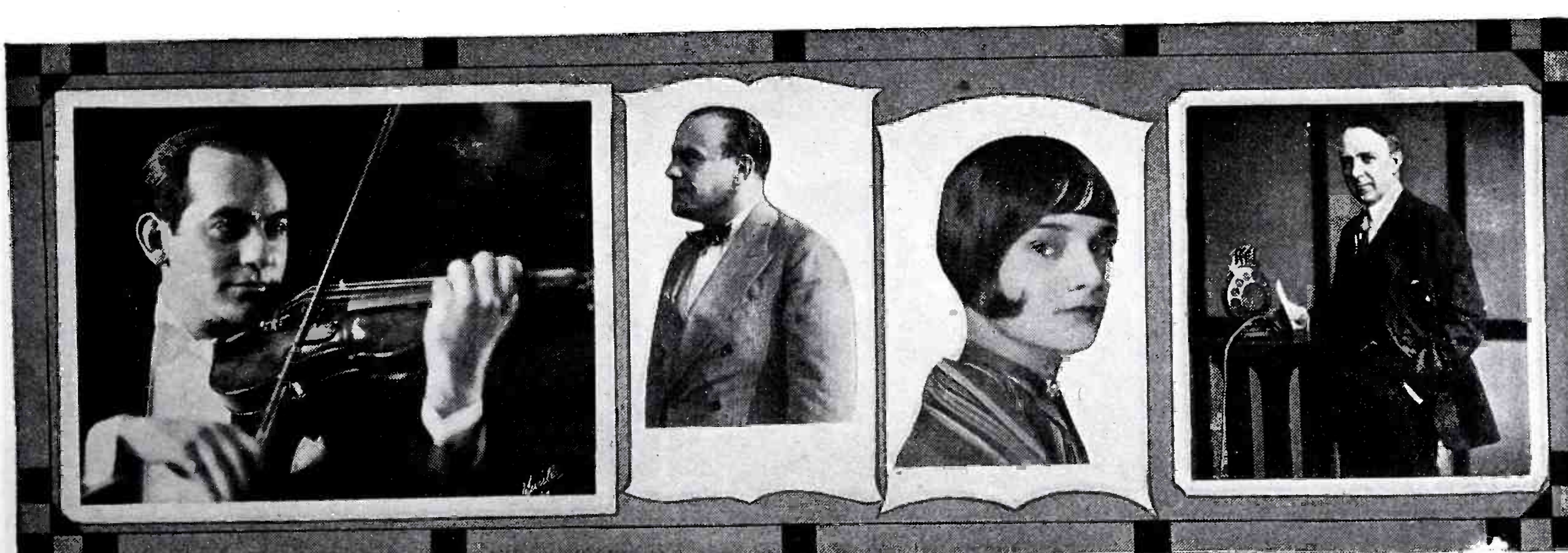
Radio Broadcast Station WHK—Cleveland, Ohio

Geraldine Kirby, soprano. Dr. Phillip Robert Linsey, tenor. Gladys Dante Beddoe, soprano. Gertrude Lance, concert pianist.

WA

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WABO	**Rochester, N. Y.**—Lake Ave. Baptist Church	100	258	1160	Eastern	Sun.: 10:30 to 12 am; 7:30 am to 9 pm.
WABQ	**Haverford, Pa.**—Haverford College Radio Club	1000	365.7	820	Eastern	Mon., 7:30 pm. to 12:30 am; Fri., 7:30 pm. to 12:30 am.
WABR	**Toledo, Ohio**—Scott High School	50	263	1140	Eastern	Program variable, depending upon the activities in and about school.
WABW	**Wooster, Ohio**—College of Wooster	50	206.8	1450	Eastern	9:30 to 10 on Tue., Wed. and Thu. Otherwise very irregular as broadcast college programs.
WABX	**Mount Clemens, Mich.**(near)—Henry B. Joy, 1830 Penobscot Bldg., Detroit, Mich	500	246	1220	Central	
WABY	**Philadelphia, Pa.**—John Magaldi, Jr., 815 Kimball St	50	242	1240	Eastern	
WABZ	**New Orleans, La.**—Coliseum Place Baptist Church	50	275	1090	Central	Sun.: 11 to 12:30 pm; 7:30 to 9 pm.
WADC	**Akron, Ohio**—Allen T. Simmons	500	258	1160	Eastern	Mon., 11 am to 12 am; 6:30 to 7:30 pm; Tue., 1 am to 3 am; 11 am to 12 am; 6:30 to 7:30 pm; 8 to 11 pm; Wed., 11 to 12 am; 6:30 to 7:30 pm; Thu., 11 am to 12 am; 6:30 to 7:30 pm; 9:30 to 11 pm; Fri., 11 am to 12 am; 6:30 to 7:30 pm; 8 to 11 pm; Sat., 11 am to 12 am; 6:30 to 7:30 pm. Sun.: 12:30 to 1:30 pm; 6:30 to 7:30 pm.
WAFD	**Port Huron, Mich.**—Albert B. Parfet Co., 1432 Military Road	500	275	1090	Eastern	Mon., 8 to 10 pm; Wed., 8 to 10 pm; Fri., 8 to 10 pm; Sat., 8 to 10 pm. Sun. and Holidays: 12:30 am to 2 am; 10 am to 12 am; 7:30 pm to 9:15 pm.
WAGM	**Royal Oak, Mich.**—Robert L. Miller	50	225.4	1330	Eastern	Mon., 7:30 pm to 12:30 am; Wed., 7:30 pm to 10:30 pm; Fri., 7:30 pm to 10:30 pm.
WAHG	**Richmond Hill, N. Y.**—A. H. Grebe and Co.	500	315.6	950	Eastern	Mon., 11:50 am; 12:02; 8; 9:45; 9:55; 10:15; 10:30; 12 pm; Tue., 11:55 am; 12:02 pm; Wed., 11:50 am; 12:02; 8:45; 9:20; 9:55; 10:02; 10:30 pm; Thu., 11:55 am; 12:02 pm; Fri., 11:50 am; 12:02; 8; 9; 9:55; 10:02; 10:30 pm; Sat., 11:55 am; 12:10 pm. Sun.: Silent.
WAIT	**Taunton, Mass.**—A. H. Waite and Co., Inc., 32 Weir St	10	229	1310	Eastern	Wed., 7 to 8 pm; Fri., 7 to 8 pm.
WAIU	**Columbus, Ohio**—American Insurance Union	750	293.9	1020	Eastern	Mon., 11:55 am to 4 pm; 6 pm to 7:15 pm; 8 pm to 9:30 pm; 10 pm to 12 pm; Tue., 11:55 am to 1 pm; 2 pm to 4 pm; 6 to 7 pm; 9:15 pm to 1 am; Wed., 11:55 am to 1 pm; 2 to 4 pm; 6 to 7 pm; Thu., 11:55 am to 1 pm; 2 to 4 pm; 6 to 7 pm; Fri., 11:55 am to 1 pm; 2 to 4 pm; 6 to 7 pm; 8 to 9:30 pm; 10 pm to 1 am; Sat., 11:55 am to 1 pm; 2 to 4 pm; 9:15 pm to 1 am. Sun. 2 pm to 4 pm; 6 pm to 7 pm.
WAMD	**Minneapolis, Minn.**—Hubbard and Company and Radisson Radio Corp	5000	243.8	1230	Central	Daily: 12 am to 12:15 pm; 6:15 pm; 6:55 pm; 7 pm; 7:05 pm; 7:10 pm; 8 pm; 11 pm. Sun.: 10:30 am; 3 pm; 6:15 pm; 6:45 pm; 9:30 pm.
WAPI	**Auburn, Ala.**—Extension Service Alabama Polytechnic Institute	1000	461	650	Central	Mon., 7 to 8:30 pm; Tue., 7 to 8:30 pm; Wed., silent; Thu., 7 to 8:30 pm; Fri., 8 to 11 pm; Sat., 6:30 to 10 pm. Sun.: Irregular.
WARC	**Medford Hillside, Mass.**—The Amrad Corp.	100	261	1150	Eastern	
WATT	**Boston, Mass.** (Portable)—Edison Electric Illuminating Company of Boston	100	243.8	1230		

Radio Broadcast Station KFI—Los Angeles, Calif.



Morris Stoloff, concert violinist. **Robert Hurd, tenor.** **Dolly McDonald, Blue Singer** **Earl C. Anthony, owner**

WB

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WBAA	**Lafayette, Ind.**—Purdue University	250	273	1100	Central	Daily: 9:50 am; Mon. and Fri., 7:15 pm.
WBAK	**Harrisburg, Pa.**—Pennsylvania State Police	500	275	1090	Eastern	Daily except Sun.: 10 to 1:30 to 5:45; 7:30; 12 am.
WBAL	**Glen Morris, Md. (near)**—Consolidated Gas, Electric Light and Power Co.	5000	246	1220	Eastern	Mon., 6 pm to 8 pm; Tue., 7:30 pm to 10 pm; Wed., Silent; Thu., 6 pm to 8 pm; Fri., 7:30 pm to 10 pm; Sat., Silent. Sun.: 6:30 to 7:30 pm.
WBAO	**Decatur, Ill.**—James Millikin University	100	270	1110	Central	
WBAP	**Fort Worth, Texas**—Carter Publishing Co., Inc.	1500	475.9	630	Central	Daily: 6; 7:30; 9:30; 11 pm; Wed., Silent. Sun.: 11 am; 5; 9:30 pm.
WBAW	**Nashville, Tenn.**—Braid Elec. Co. and Waldrum Drug Co.	100	236.1	1270	Central	
WBAX	**Wilkes-Barre, Pa.**—John H. Stenger, Jr., 66 Gildersleeve St.	100	256	1170	Eastern	
WBBC	**Brooklyn, N. Y.**—Peter J. Testan, 2123 Troy Ave.	100	249.9	1200	Eastern	
WBBL	**Richmond, Va.**—Grace-Covenant Presbyterian Church	50	229	1310	Eastern	Tue., 8 pm to 10 pm. Sun.: 11 am and 7:45 pm.
WBBM	**Chicago, Ill.**—Atlass Investment Co., 1554 Howard St.	1500	225.4	1330	Central	Mon., 4 to 7 pm; Tue., 4 to 6 pm; 8 to 12 pm.; Wed., 4 to 6 pm; 8 to 10 pm; 12 pm to 2 am.; Thu., 4 to 6 pm; 8 to 12 pm; Fri., 4 to 6 pm; 8 to 10 pm; Sat., 4 to 6 pm; 8 pm to 2 am; Sun.: 12:30 to 2 pm; 4 to 6 pm; 8 to 10 pm; 12 to 3 am.
WBBP	**Petoskey, Mich.**—Petoskey High School	200	238	1260	Central	Tue., 9 to 10:30 pm; Fri., 8 to 9:30 pm. Sun. and Holidays: 10:30 to 12 am; 3 to 4 pm.
WBBR	**Rossville, N. Y.**—People's Pulpit Assn., 124 Columbia Heights, Brooklyn, N. Y.	500	416.4	720	Eastern	Mon., 8 to 9 pm; Thu., 8 to 9 pm; Fri., 8 to 9 pm Sun.: 10 am to 12:30 pm; 2 to 4 pm; 9 to 10:30 pm.
WBBS	**New Orleans, La.**—First Baptist Church	50	252	1190	Central	Sun.: 11 am and 7:45 pm.
WBBW	**Norfolk, Va.**—Ruffner Junior High School	50	222	1350	Eastern	
WBBY	**Charleston, S. C.**—Washington Light Infantry	10	267.9	1120	Eastern	Community furnishes artists about once a week.
WBBZ	**Chicago, Ill.** (Portable)—C. L. Carrell, 1506 No. American Building	50	215.7	1390		
WBCN	**Chicago, Ill.**—Foster and McDonnell, 728 West Sixty-fifth St.	500	266	1130	Central	Daily: 9:45 to 11 am; 12 am to 1 pm; 3 to 6 pm; 7 to 8 pm; 10 to 12 pm. Sun.: 10:45 am to 12:30 pm; 4 to 6; 7:30 to 9:15 pm.
WBDC	**Grand Rapids, Mich.**—The Baxter Laundry Company	500	256.4	1170	Eastern	Mon., 12:30 pm to 1:30 pm; 5:30 to 6 pm; 7 to 8 pm; Tue., 12:30 to 1:30 pm; 5:30 to 6 pm; 7 to 8 pm; Wed., 12:30 pm to 1:30 pm; 5:30 pm to 6 pm. 7 to 8 pm; Thu., 12:30 pm to 1:30 pm; 5:30 pm to 6:30 pm; Fri., 12:30 pm to 1:30 pm; 5:30 pm to 6 pm; 7 to 8 pm; Sat., 5:30 pm to 6 pm; 7 to 7:40 pm; 7:50 to 8 pm. Sun.: 11 to 12:15 pm.
WBES	**Takoma Park, Md.**—Bliss Electrical School	100	222	1350	Eastern	
WBNY	**New York, N. Y.**—Baruchrome Corp., 145 W. 45th St.	1000	322	930	Eastern	Mon., 7 pm to 11 pm; Tue., 7 pm to 11 pm; Wed. 7pm to 11 pm; Thu., 7 pm to 11 pm; Fri., 7 pm to 11 pm; Sat., Silent. Sun.: 2:30 pm to 6 pm.
WBOQ	**Richmond Hill, N. Y.**—A. H. Grebe & Co., 70 Van Wyck Boulevard	100	236	1270	Eastern	
WBRC	**Birmingham, Ala.**—Birmingham Broadcasting Corp., Age-Herald Bldg.	50	248	1210	Central	Mon., 8 to 10 pm; Wed., 8 to 10 pm; Sat., 9 pm to midnight.

Radio Broadcast Station WBZ—Springfield, Mass.

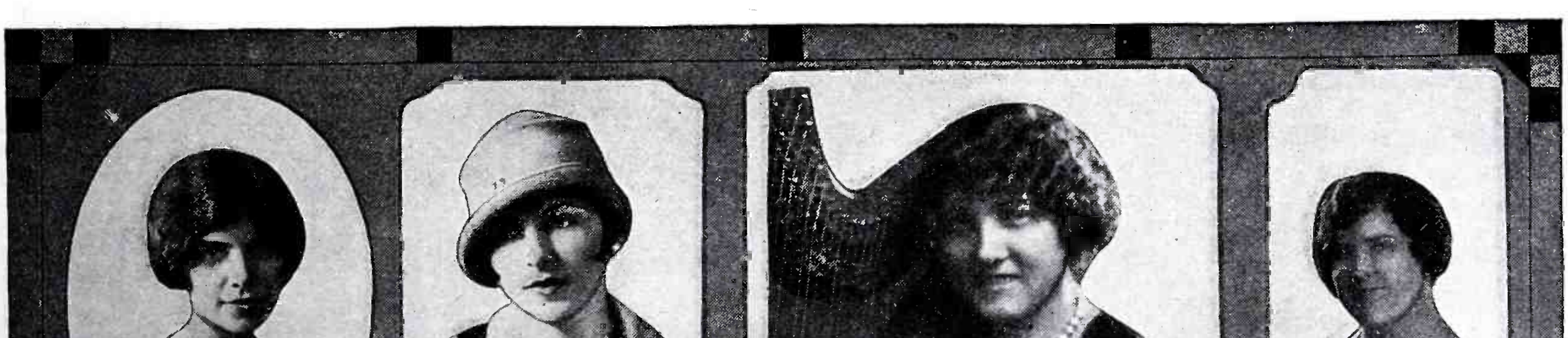
Eleven members of Aleppo Temple Band.

W. Gordon Swan, announcer.

Leo Reisman and his Hotel Brunswick Orchestra.

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WB	**WBRE—Wilkes-Barre, Pa.**—Baltimore Radio Exchange, 17 West Northampton St.	100	231	1300	Eastern	Mon., 2 to 3:30 pm; Tue., 2 to 4 pm; Wed., 2 to 3:30 pm; 8:30 to 11:30 pm; Thu., 2 to 4 pm; Fri. 2 to 3:30 pm; 8:30 to 12 midnight; Sat., 2 to 4:30 pm; Sun: 9 to 12 Midnight
	WBRL—Tilton, N. H.—Booth Radio Lab.	500	365	820	Eastern	
	WBRS—Brooklyn, N. Y.—Universal Radio Mfg. Co., 1062 Broadway	100	394	760	Eastern	
	WBT—Charlotte, N. C.—Charlotte Chamber of Commerce	250	275	1090	Eastern	Daily 6 to 7 and 9 to 11 pm. Sun.: 11 am and 7:30 pm.
	WBZ—Springfield, Mass. (Transmitter is in East Springfield)—Westinghouse Elec. and Mfg. Co.	2000	331.1	905	Eastern	Daily: 6:25 to 10 pm and sometimes to 10:30 pm. Sun. and Holidays: 10:50 am and 7 to 10 pm.
	WBZA—Boston, Mass.—Westinghouse Electric and Mfg. Co.	250	242	1240	Eastern	
WC	**WCAC—Storrs, Conn.**—Connecticut Agricultural College	500	275	1090	Eastern	Mon., 8 to 9 pm; Wed., 8 to 9 pm; Fri., 8 to 9 pm.
	WCAD—Canton, N. Y.—St. Lawrence University	250	263	1140	Eastern	Mon., 11 am to 11:20 am; Tue., 11 am to 11:20 am Wed., 11 am to 11:20 am; 8 pm to 11 pm; Thu. 11 am to 11:20 am; 7:30 to 11 pm; Fri., 11 am to 11:20 am; 7:30 to 11 pm; Sat., 11 am to 11:20 am.
	WCAE—Pittsburgh, Pa.—Pittsburgh Press and Kaufmann and Baer Co., 6th and Smithfield Streets	500	461.3	650	Eastern	Mon., 10:45 am; 12:30 pm; 4:30 pm; 6, 7, 8, 9, 10, 11 pm; Tue., 12:30 pm; 4:30, 6, 7, 8, 9, 10, 11 pm; Wed., 10:45 am; 12:30 pm; 4:30 pm; 6, 7, 8, 9, 10, 11 pm; Thu., 12:30 pm; 4:30, 6, 7, 8, 9, 10, 11 pm; Fri., 10:45 am; 12:30 pm; 4:30 pm; 6, 7, 8, 9, 10, 11 pm; Sat., 12:30 pm; 4:30 pm; 6, 7, 8, 9, 10, 11 pm. Sun.: 10:45 am; 4 pm; 6:30 pm; 7:20 pm; 9:15 pm.
	WCAJ—University Place, Neb.—Nebraska Wesleyan University	500	254	1180	Central	Mon., 4:30 pm; Tue., 4:30 pm; Wed., 4:30 pm; 8 pm; Thu., 4:30 pm; Fri., 4:30 pm; 7 pm. Occasionally Chapel talks, 10 am.
	WCAL—Northfield, Minn.—St. Olaf College	500	336.9	890	Central	Mon., 9:45 am; 8:30 pm; Tue., 9:45 am; Wed., 9:45 am; Thu., 7 pm; Fri., 9:45 am; 7:30 pm; 8:30 pm; Sat., 9:45 am. Sun.: 8:30 am; 9:15 pm.
	WCAM—Camden, N. J.—City of Camden	250	236	1270	Eastern	
	WCAO—Baltimore, Md.—Albert A. and A. Stanley Brager, 842 N. Howard St.	100	275	1090	Eastern	
	WCAR—San Antonio, Texas—Southern Radio Corp. of Texas, 101 West Pecan St.	2000	263	1140	Central	Daily (except Sun.): 8 to 10 pm.
	WCAT—Rapid City, S. D.—South Dakota State School of Mines	50	240	1250	Mountain	
	WCAU—Philadelphia, Pa.—Universal Broadcasting Co. (Durham and Co.)	500	276.6	1080	Eastern	Mon., 6:30 to 12 midnight; Tue., 6:30 to 12 midnight; Wed., 6:30 pm to 1 am; Thu., 6:30 to 12 midnight; Fri., 6:30 to 12 midnight; Sat., Silent. Sun.: 11 am to 12:30 pm; 5 pm to 11 pm.
	WCAX—Burlington, Vt.—Extension Service, University of Vermont	100	252	1190	Eastern	Fri., 7 to 8 pm.
	WCBA—Allentown, Pa.—Charles W. Heimbach, 1015 Allen St.	150	254	1180	Eastern	Mon., 2 am to 3 am; 7:30 pm to 9 pm; Wed., 2 am to 3 am; 7:30 pm to 11 pm; Fri., 6:45 pm to 11 pm; Sat., 9 pm to 12 midnight. Sun.: 10 am; 5:30 pm; 7 pm; 9 pm.

Radio Broadcast Station KMOX—St. Louis, Mo.



Alice Maslin, studio director — Agnes Griffin, Jazz organist and pianist. — Jacquinot Jules, program director, organist and accompanist. — Helen Musick, lyric soprano.

WC

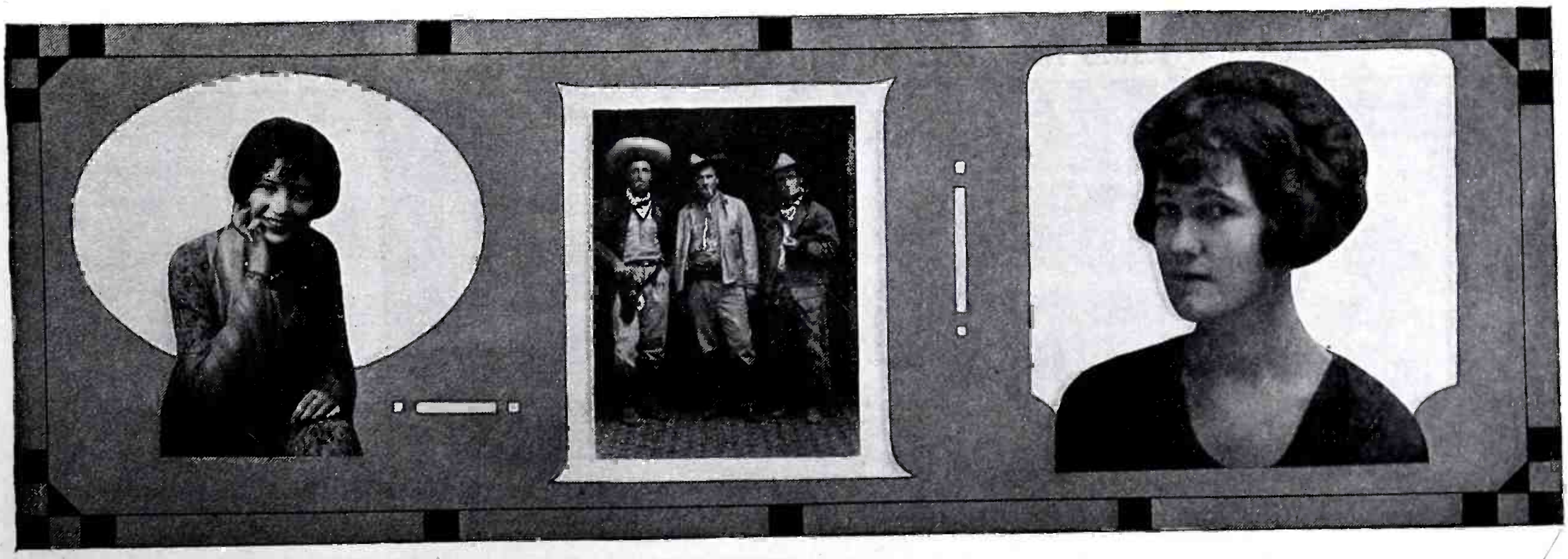
Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WCBD	**Zion, Ill.**—Wilbur G. Voliva	5000	344.6	870	Central	Tue., 8 to 10:30 pm; Wed., 12:30 to 1 pm; Thu., 2:30 to 3:45; 8 to 10:30 pm. Sun.: 9 to 10:45 am. 8 to 10:30 pm.
WCBE	**New Orleans, La.**—Uhalt Bros., 1219 No. Rampart St	5	263	1140	Central	Daily: 10:30 am to 11:30 am; 7:30 pm to 8:30 pm. Sun., and Holidays: 12:30 pm to 2:30 pm; 8 pm to 9 pm; 9:30 pm to 11:30 pm.
WCBH	**Oxford, Miss.** (near)—University of Mississippi	50	242	1240	Central	Tue., 9 pm; Thu., 9 pm; Sat., 9 pm.
WCBM	**Baltimore, Md.**—Hotel Chateau, Charles St. and North Ave	100	229	1310	Eastern	Mon., 10 pm; Thu., 10 pm. Sun.: 9:45 pm.
WCBR	**Providence, R. I.** (portable)—Chas. H. Messter, 42 Doyle Ave	100	209.7	1430		Daily: 4 to 5 pm; 8 to 10 pm. Sun.: 3 to 5 pm.
WCBS	**Providence, R. I.**—(Portable) Harold L. Dewing and Chas. H. Messter, 6 N. Main St. M	250	242.5	1240		
WCCO	**St. Paul - Minneapolis, Minn.**—Washburn - Crosby Co	5000	416.4	720	Central	Mon., 9:30 am; 10:30 am; 10:45 am; 11:30 am; 12 am; 1:30 pm; 2 pm; 2:30 pm; 3 pm; 4 pm; 5:30 pm; 6:30 pm; 7:45 pm; 8 pm; 9 pm; 10 pm; Tue., 9:30 am; 10:30 am; 11:30 am; 1:30 pm; 2 pm; 2:30 pm; 3 pm; 3:30 pm; 4 pm; 5:30 pm; 6:15 pm; 7:30 pm; 9:30 pm; 10 pm; Wed., 9:30 am; 10:30 am; 10:45 am; 11:30 am; 1:30 pm; 2 pm; 2:30 pm; 3 pm; 4 pm; 5:30 pm; 6:30 pm; 7:30 pm; 9 pm; 10 pm; 10:05 pm; 11:30 pm; Thu., 9:30 am; 10:30 am; 11:30 am; 12 am; 1:30 pm; 2 pm; 3 pm; 4 pm; 5:30 pm; 7 pm; 10 pm; 10:05 pm; 10:30 pm; Fri., 9:30 am; 10:30 am; 10:45 am; 11:30 am; 1:30 pm; 2 pm; 3 pm; 4 pm; 5:30 pm; 6 pm; 6:15 pm; 7:45 pm; 8 pm; 8:15 pm; 9 pm; 10 pm; 10:05 pm; Sat., 9:30 am; 10:30 am; 11:30 am; 12:30 pm; 1:30 pm; 2:30 pm; 6:15 pm; 8 pm; 8:15 pm; 10 pm; 10:05 pm; Sun.: 10:50 am; 3 pm; 4:10 pm; 6:20 pm; 8:15 pm; 9:15 pm.
WCFL	**Chicago, Ill.**—Chicago Federation of Labor	500	491.5	610	Central	
WCFT	**Tullahoma, Tenn.**—Knights of Pythias Home	10	252	1190	Central	
WCLO	**Camp Lake, Wis.**—C. E. Whitmore	50	230.6	1300	Central	Daily except Sun.: 3:30 to 5 pm; 7:39 to midnight.
WCLS	**Joliet, Ill.**—Harold M. Couch	150	214.2	1400	Central	Tue., 11 am; 7 pm to 8 pm; 8:30 pm to 12 midnight; Wed., 8:30 pm to 12 midnight; Thu., 11 am; 7 to 8 pm; Fri., 8:30 pm to 12 midnight; Sat., 11 am; 7 to 8 pm; and 9 pm to 12 midnight. Sun.: 11 am; 2:30 pm; 10 pm to 12 midnight.
WCMA	**Culver, Ind.**—Culver Military Academy	500	258.5	1160	Central	
WCOA	**Pensacola, Fla.**—City of Pensacola	500	222	1350	Central	Mon., Wed. and Fri., 10:30 am; 12:30 pm; 7 pm to 11 pm. Sun.: 12:30 pm.
WCRW	**Chicago, Ill.**—Clinton R. White, 650 Waveland Ave	50	416.4	720	Central	
WCSH	**Portland, Me.**—Henry P. Rines, Congress Square Hotel Co	500	256.3	1170	Eastern	Mon., 12 am to 1:30 pm; 6:15 to 7:30 pm; 8:30 pm to 9:15 pm; Tue., 10:30 to 11:15 am; 12 am to 1:30, pm; 3 to 5 pm; 6 to 7:45 pm; 8 to 10:30 pm; Wed., 12 am to 1:30 pm; 6:15 to 7:30 pm; 9 to 11:30 pm; Thu., 10:30 am; 11:15 am; 12 am to 1:30 pm; 4 to 5 pm; 6:15 to 7:45 pm; 9 to 9:30 pm; Fri., 12 am to 1:30 pm; 3 to 4:30 pm; 6 to 7:30 pm; 9 to 10 pm; Sat., 12 am to 1 pm; 6:15 to 11:30 pm. Sun., 10:30 am to 12 am; 1:30 to 2:30 pm; 4 to 5:30 pm; 6 to 7 pm; 7:20 to 10 pm.
WCSO	**Springfield, Ohio**—Wittenberg College	100	248	1210	Central	

Radio Broadcast Station WCBD—Zion, Ill.

J. H. DePew, chief announcer and manager. **Mrs. H. E. Mayfield, soprano.** **Mrs. Glen R. Sparrow, contralto.** **Mrs. P. M. LaRose, contralto.**

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WC WCWK	**Fort Wayne, Ind.**—Chester W. Keen, 2315 South Calhoun St.	50	234.4	1280	Central	Tue., 6 to 6:30 pm; 8 pm to 12 pm; Wed., 6 to 6:30 pm; Thu., 6 to 6:30 pm; Fri., 6 to 6:30 pm; 8 to 12 pm; Sat., 6 to 6:30 pm. Sun.: 4 to 5 pm; 7 to 8 pm.
WCWS	**Bridgeport, Conn.**—Chas. W. Selen and Harold D. Feuer, 1188 Main St.	500	282.8	1060	Eastern	Mon., 8 to 9 pm; Tue., 8 to 9 pm; Wed., 8 to 10 pm; Thu., Silent night; Fri., 7:30 to 10:30 pm; Sat., 8 to 9 pm. Sun.: Silent.
WCX	**Pontiac, Mich.**—Detroit Free Press	5000	516.9	580	Eastern	Mon., 4 pm; 6 to 7 pm; 8 to 9 pm; Tue., 4 pm; 6 to 7 pm; 8 to 9 pm; 10 pm; Wed., 4 pm; 6 to 7 pm; 8 to 9 pm; Thu., 4 pm; 6 to 7 pm; 8 to 9 pm; Fri., 4 pm; 6 to 7 pm; 8 to 9 pm; 10 to 11 pm. Sun.: 7:15 pm.
WD WDAD	**Nashville, Tenn.**—Dad's Auto Accessory and Radio Store, 160 Eighth Ave., North	150	226	1330	Central	Daily except Thu.: 11:45 am to 1 pm; 3:30 pm to 5 pm; 8 pm to 10 pm; Thu., Silent. Sun.: 3 to 5 pm.
WDAE	**Tampa, Fla.**—Tampa Daily Times	1000	273	1100	Eastern	
WDAF	**Kansas City, Mo.**— The Kansas City Star	1000	365.6	820	Central	Mon., 10:45 am to 11:05 am; 6 to 7 pm; 8 to 10 pm. 11:45 pm to 1 am; Tue., 3:30 to 4:30 pm; 6 to 7 pm; 11:45 pm to 1 am; Wed., same as Mon.; Thu., same as Tue.; Fri., same as Mon.; Sat., same as Tue. Sun.: 3 to 4 pm; 4 to 4:45 pm.
WDAG	**Amarillo, Texas**—J. Laurance Martin, 605 East Fourth Street	100	263	1140	Central	
WDAH	**El Paso, Texas**—Trinity Methodist Church	50	267.7	1120	Mountain	Wed., 8:30 to 10 pm. Sun. Morning and Evening Church Services.
WDAY	**Fargo, N. D.**—Radio Equipment Corp., 119 Broadway	50	261	1150	Central	
WDBE	**Atlanta, Ga.**—Gilham-Schoen Elec. Co., 35 Cone St.	100	270	1110	Central	Tue., 7 to 8 pm; Fri., 7 to 8 pm.
WDBJ	**Roanoke, Va.**—Richardson-Wayland Electric Corp., 106 Church Ave., S. W.	50	229	1310	Eastern	Daily: 12 to 1 pm; 5:30 to 6 pm; Wed. and Sat.: 9 to 11 pm; Mon., 8 to 9 pm. Sun.: 7:30 to 9 pm.
WDBK	**Cleveland, Ohio**—S. J. Broz, Mgr. of Broz Furniture, Hardware and Radio Store, 13920 Union Ave.	50	327	917	Eastern	Tue., 8:30 pm to midnight; Fri., 8:30 pm to midnight.
WDBO	**Winter Park, Fla.**—Central Florida Broadcast Station, Inc.	500	240	1250	Eastern	Daily: 7; 7:10; 7:30; 9 pm (except Wed.); Wed. only, 8 pm; Fri. only, 7:45 pm. Sun.: 11 am; 7:30 pm.
WDBZ	**Kingston, N. Y.**—Kingston Radio Club (Boy Scouts of America, Ulster County Council)	10	233	1290	Eastern	
WDEL	**Wilmington, Del.**—Wilmington Elec. Specialty Co., 405 Delaware Ave.	100	266	1130	Eastern	Daily: 7 to 9 pm.
WDGY	**Minneapolis, Minn.**—Geo. W. Young, 909 West Broadway	500	263	1140	Central	Mon., 6 to 8; Wed., 7 to 9; Thu., 6 to 7; 9 to 10; Fri., 8 to 9. Sun.: 1 to 3; 7 to 8.
WDOD	**Chattanooga, Tenn.**—Chattanooga Radio Co., Inc., 615 Market St.	500	256	1170	Central	Mon., 6:30 to 10 pm; Tue., 9 to 9:30 pm; Wed., 6:30 to 10 pm; Fri., 6:30 to 10 pm. Sun.: 11 to 12 noon; 4 to 5:15 pm; 7:30 to 9 pm; 9:15 pm to 10:15 pm.
WDRC	**New Haven, Conn.**—Doolittle Radio Corporation, 115 Crown St.	100	268	1120	Eastern	
WDWF	**Cranston, R. I.**—Dutee W. Flint and Lincoln Studios, Inc.	500	440.9	680	Eastern	Sun.; 9:45 am; 4:45 pm (Oct. to May).
WDZ	**Tuscola, Ill.**—Jas. L. Bush	100	278	1080	Central	Mon. to Sat., incl: 9 am Markets every half hour to 1 pm; 1:15 pm; 2:40 pm. No regular hours for musical programs.

Radio Broadcast Station KWWG—Brownsville, Texas



Winifred Heath, pianist. "Los Rancheros." Florine Pierce, asst. program director.

WE

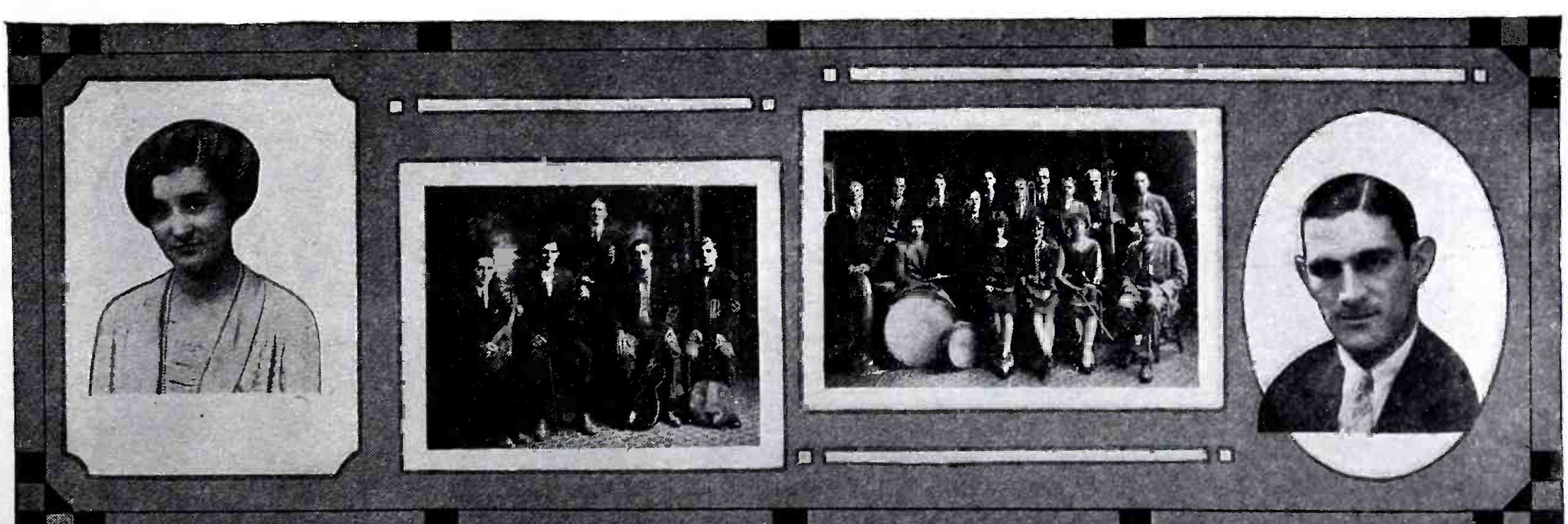
Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WEAF	**New York, N. Y.**—Broadcasting Co. of America, Inc., 195 Broadway	5000	491.5	610	Eastern	Mon., 6:45 to 8; 10:45 am to 12:20 pm; 4 to 6, 6 to 12 pm; Tue., 6:45 to 8; 11 am to 12 am; 4 to 6; 6 to 12 pm; Wed., 6:45 to 8; 10:45 am to 12:20 pm; 4 to 6; 6 to 12 pm; Thu., 6:45 to 8; 11 am to 12 am; 4 to 6; 6 to 12 pm; Fri., 6:45 to 8; 10:45 am to 12:20 pm; 4 to 6; 6 to 12 pm; Sat., 6:45 to 8; 4 to 6; 6 to 12 pm. Sun.: 2 to 10:15 pm.
WEAI	**Ithaca, N. Y.**—Cornell University	500	254	1180	Eastern	
WEAM	**North Plainfield, N. J.**—Borough of North Plainfield (W. G. Buttfield)	250	261	1150	Eastern	
WEAN	**Providence, R. I.**—The Shepard Co	500	367	817	Eastern	Daily: 11:45 am to 10 pm. Sun.: 10:45 am; 1:30 pm; 7:30 pm.
WEAO	**Columbus, Ohio**—The Ohio State University	750	293.9	1020	Eastern	Mon., 9 am; 9:45 am; 11 am; 1 pm; 4 pm; Tue.; 9 am; 9:45 am; 11 am; 1 pm; 4 pm; 7 pm; Wed.. 9 am; 9:45 am; 11 am; 1 pm; 4 pm; 4:10 pm, 8 pm; Thu., 9 am; 9:45 am; 11 am; 1 pm; 4 pm; 8 pm; Fri., 9 am; 9:45 am; 11 am; 1 pm; 4 pm; Sat., 9 am; 9:45 am; 11 am; 1 pm; 4 pm.
WEAR	**Cleveland, Ohio**—Willard Storage Battery Co.	1000	389.4	770	Eastern	Mon., 11 to 12:15 pm; 3:30 to 4:15 pm; 7 to 8 pm Tue., 11 to 12:15 pm· 3:30 to 4:15 pm; 7 to 11 pm; Wed., 11 to 12:15 pm, 3:30 to 4:15 pm; 7 to 8 pm; Thu., 11 to 12:15 pm; 3:30 to 4:15 pm; 7 to 11 pm; Fri., 11 to 12:15 pm; 3:30 to 4:15 pm; 7 to 12 pm; Sat., 11 to 12:15 pm; 7 to 8 pm. Sun.: 3:30 to 5 pm; 7 to 10 pm.
WEAU	**Sioux City, Iowa**—Davidson Bros. Co.	100	275	1090	Central	Daily: 9:35 am; 10:35 am; 11:35 am; 12:20 pm; 1:20 pm; 5 pm.
WEBC	**Superior, Wis.**—Superior Telegram-Ross Elec. Co., 1225 Tower St	100	242	1240	Central	Mon., 6:15 to 8 pm; Tue., Silent; Wed., 8 to 10 pm; Thu., Silent; Fri., 6:15 to 8 pm; Sat., 10 to 12 pm. Sun.: 10:30 to 12 am; 3 to 4:30 pm.
WEBH	**Chicago, Ill.**—Edgewater Beach Hotel Co., 5300 Sheridan Road	2000	370	810	Central	Daily except Mon.: 7 pm to 8 pm, 9 pm to 10 pm; 11 pm to 12 midnight. Sun.: 5 pm to 9 pm.
WEBJ	**New York, N. Y.**—Third Ave. Railway Co., 2396 Third Ave	500	272.6	1100	Eastern	Tue. and Fri., 7 to 9 pm; Wed., 8 to 10 pm.
WEBL	United States (Portable) Radio Corp. of America	100	226	1330		
WEBQ	**Harrisburg, Ill.**—Tate Radio Co., 700 West Robinson St	100	225.4	1330	Central	Daily: 7:15 pm. Sun.: 3 to 4 pm.
WEBR	**Buffalo, N. Y.**—Howell Broadcasting Co., Inc., 54 Niagara St	100	244	1230	Eastern	Mon., 6:15 to 11:30 pm; Tue., 6:15 to 7:30 pm; Wed., 6:15 to 11:30 pm; Thu., 6:15 to 7:30 pm; Fri., 6:15 to 11:30 pm; Sat., 6:15 to 7:30 pm. Sun.: 10:15 am to 11 pm.
WEBW	**Beloit, Wis.**—Beloit College	500	268	1120	Central	Mon., 8 to 9:30 pm. Sun.: 4:30 to 5:30 pm.
WEBZ	**Savannah, Ga.**—Savannah Radio Corp., 11 East York St	50	263	1140	Eastern	Mon., 2 pm; 6 pm; 8 pm; Tue., 2 pm; 6 pm; Wed., 2 pm; 6 pm; 8 pm; Thu., 2 pm; 6 pm; Fri., 2 pm; 6 pm; 8 pm; Sat., 2 pm; 6 pm.
WEEI	**Boston, Mass.**— The Edison Electric Illuminating Co. of Boston	500	348.6	860	Eastern	Daily: 6:45 am to 8 am; 10:15 am to 11:20 am; 2 pm to 5 pm; 6 pm to 11 pm. Sun.: 10:50 am to 10:15 pm.
WEHS	**Evanston, Ill.**—Robert E. Hughes	10	202.6	1480	Central	
WEMC	**Berrien Springs, Mich.**—Emmanuel College	4000	315.6	950	Central	Mon., 8 am; 8:15 pm; Tue., 8 am; Wed., 8 am; 8:15 pm; Thu., 8 am; Fri., 8 am; 9 pm. Sun.: 11 am; 8:15 pm.
WENR	**Chicago, Ill.**—All American Radio Corporation, 4201 Belmont Ave	1000	266	1130	Central	Mon., Silent; Tue., 1 to 3 pm; 6 to 7 pm; 8 to 9 pm; 9 to 10 pm; Wed., 1 to 3 pm; 6 to 7 pm; 8 to 10 pm; 12 pm to 1 am; Thu., 1 to 3 pm; 6 to 7 pm; 8 to 10 pm; Fri., 11 am to 12 am; 1 to 3 pm; 6 to 7 pm; 8 to 10 pm; 12 pm to 2 am; Sat., 1 to 3 pm; 6 to 7 pm; 8 to 10 pm; 12 pm to 2 am; Sun.: 2 to 3 pm; 3 to 4 pm; 6 to 7 pm; 9:30 to 12 pm.

Radio Broadcast Station WEBQ—Harrisburg, Ill.

Harry Reed, pianist. **Skaggs Snappy Serenaders.** **View of the main studio.** **The Towers of the station.**

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WE	**WEW—St. Louis, Mo.**—St. Louis University	1000	360	833	Central	Mon., 9 am; 10 am; 2 pm; 5 pm; Tue., 9 am; 10 am; 2 pm; 5 pm; 7 pm; Wed., 9 am; 10 am; 2 pm; 5 pm; Thu., 9 am; 10 am; 2 pm; 5 pm; 7 pm; Fri., 9 am; 10 am; 2 pm; 5 pm; Sat., 9 am; 10 am; 2 pm; 5 pm. Sun.: 2 pm; 7:15 pm to 7:45 pm.
WF	**WFAA—Dallas, Texas**—Dallas News and Dallas Journal	500	475.9	630	Central	
	WFAM—St. Cloud, Minn.—Times Publishing Co., Inc.	10	273	1100	Central	No definite days. Mostly Mon., 8 to 10 pm.
	WFAV—Lincoln, Neb.—University of Nebraska, Dept. of Electrical Engineering	500	275	1090	Central	
	WFBC—Knoxville, Tenn.—First Baptist Church	50	250	1200	Central	
	WFBE—Seymour, Ind.—Van DeWalle Music and Radio Co., 208 West Second St.	10	226	1330	Central	
	WFBG—Altoona, Pa.—The William F. Gable Co.	100	277.8	1080	Eastern	Daily: 11:45 to 12:45 pm; 3:30 pm to 4:15 pm; 6:30 to 7:30 pm; 7:45 pm to 8 pm; 8:30 to 10:30 pm; Thu. and Fri., special, 11:15 pm to 1:30 am. Sun.: 10:45 am to 12:30 pm; 3, 4, 5, 6, 7:30 and 9:15 pm.
	WFBH—New York, N. Y.—Concourse Radio Corporation, Hotel Majestic	500	272.6	1100	Eastern	Mon., 2 to 7 pm; 11:30 pm to 2 am; Tue., 2 to 7 pm; 11:30 pm to 2 am; Wed., 2 to 8 pm; 11:30 to 2 am; Thu., 2 to 8 pm; 11:30 pm; Fri., 2 to 7 pm; 11:30 pm; Sat., 2 to 8 pm; 11:30 pm.
	WFBJ—Collegeville, Minn.—St. John's University	100	236	1270	Central	Sun.: 5 to 5:45 pm.
	WFBL—Syracuse, N. Y.—Onondaga Hotel	500	252	1190	Eastern	Mon., 12 to 1; 3 to 4; 6 to 8; Tue., 12 to 1; 3 to 4; 6 to 11; Wed., 12 to 1; 3 to 4; 6 to 8; Thu., 12 to 1; 3 to 4; 6 to 12:30 am; Fri., 12 to 1; 3 to 4; 6 to 11; Sat., 6 to 8; 10 to 11. Sun.: 3 to 9.
	WFBM—Indianapolis, Ind.—Merchants Heat and Light Co.	250	268	1120	Central	Mon., 6 pm to 12 pm; Tue., 6 pm to 10:30 pm; Wed., 6 pm to 12 pm; Thu., 6 pm to 10:30 pm; Fri., 6 pm to 12 pm. Sun. and Holidays: 9:30 am to 12:30 pm; 2 to 5 pm; 7:30 to 9 pm.
	WFBR—Baltimore, Md.—Fifth Infantry Maryland National Guard, Fifth Regt. Armory	100	254	1180	Eastern	Mon., 12 to 2 pm; Tue., 12 to 3 pm; 8 to 12 pm; Wed., 12 to 3 pm; Thu., 12 to 3 pm; 8 to 12 pm; Fri., 12 to 3 pm; Sat., 12 to 2 pm; 8 to 12 pm. Sun.: 11 am to 12:30 pm; 2 to 3:30 pm; 9 to 10:30 pm.
	WFBZ—Galesburg, Ill.—Knox College	20	254	1180	Central	
	WFCI—Pawtucket, R. I.—Frank Crook, Inc., 103 Exchange St.	100	229	1310	Eastern	
	WFDF—Flint, Mich.—Frank D. Fallain, Police Building	100	234	1280	Eastern	Mon., Wed. and Fri., 8 pm.
	WFI—Philadelphia, Pa.—Strawbridge & Clothier	500	394.5	760	Eastern	Daily: am., 10 to 11; pm, 1 to 2; 3 to 4:30; 6 to 7:30; Tue. Thu. Sat., 8 pm to mid. Sun.: 4:30 to 6 pm; 9:30; or alternating 10:30 am to noon; 7:30 to 9:30 pm.
	WFKB—Chicago, Ill.—Francis K. Bridgman, 4536 Woodlawn Ave.	500	217.3	1380	Central	Mon., Silent; Tue., 7 to 10 pm; Wed., 7 to 10 pm; Thu., 7 to 10 pm; Fri., 7 to 10 pm; Sat., 7 to 10 pm.
	WFRL—Brooklyn, N. Y.—Robt. M. Lacey and Jas. A. Bergner (Flatbush Radio Labs.), 1421 E. 10th St.	100	205.4	1460	Eastern	On the Air every day but hours subject to change until after completion of new studios.

Radio Broadcast Station KSO—Clarinda, Iowa



Doris Samuels, asst. program director. **Hay Mow Five.** **Berry's Radio Orchestra.** **Henry Anderson, program director.**

WG

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WGAL	**Lancaster, Pa.**—Lancaster Elec. Supply & Construction Co., 23 East Orange St	10	248	1210	Eastern	
WGBB	**Freeport, N. Y.**, Harry H. Carman, 217 Bedell St	100	244	1230	Eastern	Mon., 8 to 11 pm; Wed. and Fri., same as Mon. Sun.: 10:40 am.
WGBC	**Memphis, Tenn.**—Radio Bible Class, First Baptist Church	10	278	1080	Central	Sun.: 9:30 to 10:30 am; 7:30 to 8:45 pm.
WGBF	**Evansville, Ind.**—Finke Furniture Co., 307 South Seventh St	500	236	1270	Central	Mon., 7:15 am; 12:10 pm; Tue., 7:15 am; 12:10 pm; 7:15 pm to 10 pm; Wed., 7:15 am; 12:10 pm; Thu., 7:15 am; 12:10 pm; Fri., 7:15 am; 12:10 pm; 8 to 10 pm; 11 pm to 2 am; Sat., 7:15 am; 12:10. pm.
WGBI	**Scranton, Pa.**—Scranton Broadcasters, Inc., 608 Linden St	100	240	1250	Eastern	Mon., 5:15 to 6:30 pm; Tue., 5:15 to 6:30 pm; Wed., 5:15 to 6:30 pm; 8 to 12 pm; Thu., 5:15 to 6:30 pm; 8 to 12 pm; Fri., 5:15 to 6:30 pm; Sat., 5:15 to 6:30 pm; 8 to 11 pm. Sun.: 3 to 5 pm; 7 to 9 pm.
WGBR	**Marshfield, Wis.**—Geo. S. Ives, 731 West Fifth St	10	229	1310	Central	
WGBS	**New York, N. Y.**—(Transmitter is in Astoria, L. I.), Gimbel Bros	500	315.6	950	Eastern	Mon., 10 to 11 am; 1:30 to 2:30 pm; 3 to 4 pm; 6 to 7:30 pm; Tue., 10 to 11 am; 1:30 to 2:30 pm; 3 to 4 pm; 6 to 11:30 pm; Wed., same as Mon.; Thu., same as Tue.; Fri., same as Mon.; Sat., same as Tue. Sun.: 3:30 to 4:30 pm; 9:30 to 11:30 pm.
WGBU	**Fulford-by-the-Sea, Fla.**—Florida Cities Finance Co	500	278	1080	Eastern	
WGBX	**Orono, Me.**—University of Maine	500	234.2	1280	Eastern	Wed., 7:30 to 9 pm. Sun.: 2 to 3 pm.
WGCP	**Newark, N. J.**—May Radio Broadcast Corp. 380 Central Ave	500	252	1190	Eastern	Mon., 6; 6:15; 6:30; 8:30; 8:45; 9:45; 11; 11:15; 11:30; 11:45 pm; Tue., 7; 7:30; 7:45; 8; 8:15 pm; Wed., 7; 8; 8:30; 9; 9:30; 12 pm; 12:15; 12:30; 12:45; 1:15 am; Fri., 7; 7:15; 7:30; 7:45; 8; 8:15; 12 pm. Sun.: 5; 5:15; 7; 8; 8:30; 8:45; 9 pm.
WGES	**Chicago, Ill.**—(Transmitter is in Oak Park, Ill.), Coyne Electrical School	500	250	1200	Central	Mon., 5 pm; Tue., 5 to 7 pm; 8 to 9 pm; Wed., 11 pm to 1 am; Thu. Fri. Sat., same as Tue. Sun.: 10:15 am to 12 am; 5 to 7:40 pm; 11 pm to 12 p.m
WGHB	**Clearwater, Fla.**—Fort Harrison Hotel (Ed. A. Haley)	500	266	1130	Eastern	Mon., 6:30 to 7:30 pm; 8:30 to 10 pm; 11:45 to 1 am; Tue. Wed. Thu. Fri. Sat., same as Mon.
WGHP	**Detroit, Mich.**—Geo. H. Phelps, 110 Rowena St	1500	270	1110	Central	
WGM	**Jeanette, Pa.**—Verne & Elton Spencer, 501 Cowan Ave	150	372	806	Eastern	Daily: 7 to 10:30 pm. Silent Sun.
•WGMU	**Richmond Hill, N. Y.**—(portable), A. H. Grebe & Co	100	236	1270		
WGN	**Chicago, Ill.**—The Chicago Tribune (Drake Hotel)	1000	303	990	Central	Mon. to Sat., incl., 9 am to 12 am; 12 am to 5 pm, Mon., 6 to 7 pm; Tue., to Sat., inc., 6 to 7 pm; 8 to 11 pm. Sun.: 12 m to 5 pm and 6:15 to 11 pm.
WGR	**Buffalo, N. Y.**—Federal Radio Corp., 1738 Elmwood Ave	750	319	940	Eastern	Mon., 10:45 am to 1 am; Tue., 10:45 am to 11 pm; Wed., 10:45 am to 11 pm; Thu., 10:45 am to 11 pm; Fri., 10:45 am to 1 am; Sat., 10:45 am to 11 pm; Sun.: 10:45 am to 12 am; 7:45 to 10:15 pm.
WGST	**Atlanta, Ga.**—Georgia School of Technology	500	270	1110	Central	Mon., 9 to 1 pm; Thu., 7 to 8 pm.
WGY	**Schenectady, N. Y.**—General Electric Co	10000	379.5	790	Eastern	Mon., 2 to 3 pm; 6 to 9 pm; Tue., 2 to 3 pm; 6 to 11 pm; Wed., 6 to 10 pm; Thu., 2 to 3 pm; 6 to 11 pm; Fri., 2 to 3 pm; 6 to 11:30 pm; Sat., 9 to 12 pm. Sun.: 10:30 am to 12 am; 7:30 pm to 10 pm.

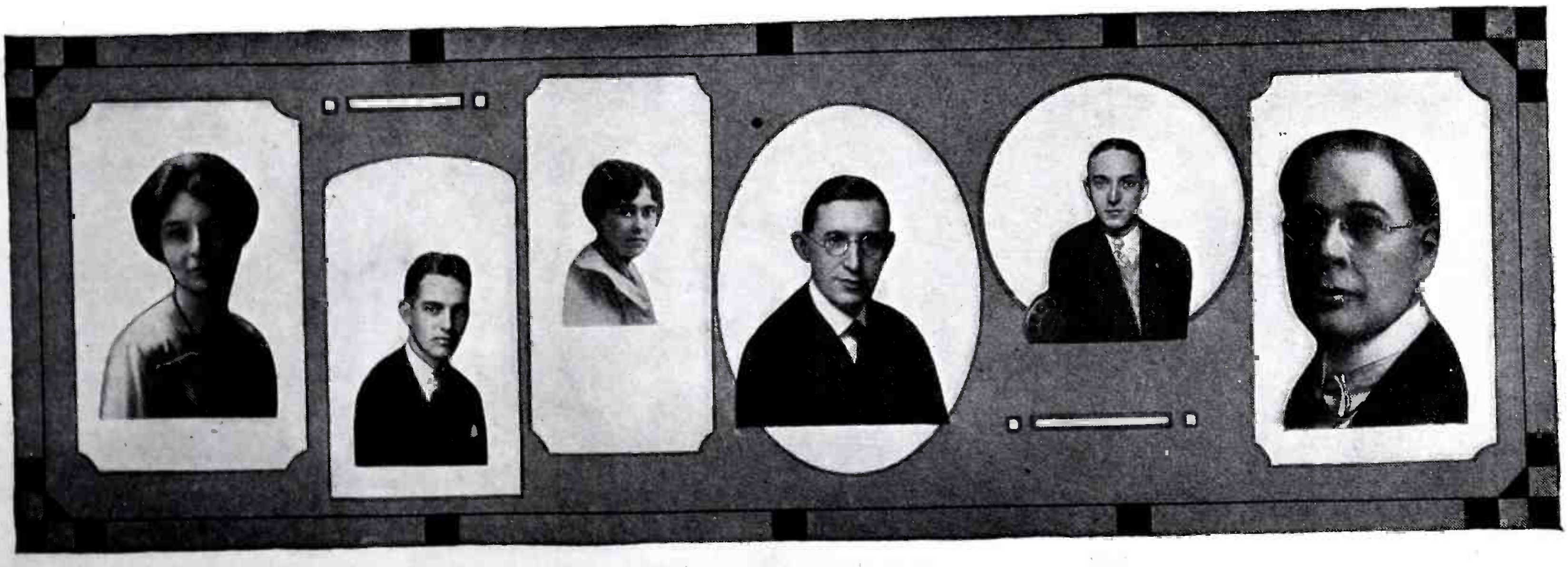
Radio Broadcast Station WHT—Chicago, Ill.

Pat Barnes, director-announcer. **Billy Allen Huff, popular singer.** **Al Carney, organist.** **Helen Rauh, asst. program director.**

WH

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WHA	**Madison, Wis.**—University of Wisconsin	750	535.4	560	Central	Mon., 8 to 9 pm; Wed., 8 to 9 pm; Fri., 8 to 9 pm.
WHAD	**Milwaukee, Wis.**—Marquette University and Milwaukee Journal	500	275	1090	Central	Mon. and Tue., 12 am; 4; 6; 6:15; 8:30 pm; Wed., 12 am; 4; 6; 6:15; 10:30; 11:30 pm; Thu. and Fri., 12 am; 4; 6; 6:15; 8:30 pm; Sat., 12 am; 4; 6; 6:15 pm. Sun.: 3:30 pm.
WHAM	**Rochester, N. Y.**—University of Rochester (Eastman School of Music)	100	278	1080	Eastern	
WHAP	**New York, N. Y.**—W. H. Taylor Finance Corp., 426 West 31st St	500	431	695	Eastern	Mon., 6:30 to 11 pm; Wed., 6:30 to 11 pm; Fri. 6:30 to 11 pm. Sun.: 2:30 to 4 pm.
WHAR	**Atlantic City, N. J.**—F. B. Cook's Sons, Owners, Seaside Hotel	500	275	1090	Eastern	Mon., 2 pm; 7:30 pm; 8 pm; 11 pm; Tue., 2 pm; 7:30 pm; 8 pm; Wed., Silent; Thu., 2 pm; 7:30 pm; 8 pm; 11 pm; Fri., 2 pm; 7:30 pm; 8 pm. Sat., 2 pm; 7:30 pm; 8 pm. Sun.: 10:45 am; 2:15 pm; 2:45 pm; 7:50 pm; 9 pm.
WHAS	**Louisville, Ky.**—Courier-Journal and Louisville Times	500	399.8	750	Central	Daily except Mon.: 7:30 to 9 pm. Sun.: 10 am; 4:30 to 5:30 pm.
WHAZ	**Troy, N. Y.**—Rensselaer Polytechnic Institute	500	379.5	790	Eastern	Mon., 9 to 12 pm; 2nd Mon. of each month from 12 pm to 1:30 am Tue.
WHB	**Kansas City, Mo.**—Sweeney Automotive and Elec. School, Sweeney Building	500	365.6	820	Central	Mon., 2 to 3 pm; 7 pm; 8 pm; Tue., 7 pm; 10 pm. Wed., 7 pm; 8 pm; Thu., 7 pm; 10 pm; Fri., 7 pm. 8 pm; Sat., Silent night. Sun.: 9:40 am; 12:30 pm; 8 pm; 9:15 pm; 11:15 pm; 1 am.
WHBA	**Oil City, Pa.**—Shaffer Music House	10	250	1200	Eastern	
WHBC	**Canton, Ohio**—Rev. E. P. Graham, 627 McKinley Ave., N. W	10	254	1180	Eastern	Mon., 8 to 8:30 pm.
WHBD	**Bellefontaine, Ohio**—Chamber of Commerce	100	222	1350	Central	
WHBF	**Rock Island, Ill.**—Beardsley Specialty Co., 217 Eighteenth St	100	222	1350	Central	Mon., 7 to 9 pm; Wed., 7 to 9 pm; Sat., 2 to 4 pm and 7 to 9 pm.
WHBG	**Harrisburg, Pa.**—John S. Skane, 1810 North Fourth St	20	231	1300	Eastern	Tue., Thu. and Sat., 12:01 to 1 pm; 5:30 to 11 pm; Sun.: 10:20 am to 12:01 pm; 1 to 2; 6:15 to 9 pm.
WHBL	**Chicago, Ill.**—(Portable), C. L. Carrell	50	215.7	1390		
WHBM	**Chicago, Ill.**—(Portable), C. L. Carrell, 1536 South State St	20	215.7	1390		
WHBN	**St. Petersburg, Fla.**—First Ave. Methodist Church	10	238	1260	Eastern	
WHBP	**Johnstown, Pa.**—Johnstown Automobile Co., 101 Main St	100	256	1170	Eastern	Mon., 12:30 pm to 1:30 pm; Tue., 12:30 pm to 1:30 pm; Wed., 12:30 pm to 1:30 pm; Thu., 12:30 pm to 1:30 pm; Fri., 12:30 pm to 1:30 pm; Sat., 12:30 pm to 1:30 pm; 10 pm to 12 pm. Sun.: 2:30 to 4 pm.
WHBQ	**Memphis, Tenn.**—Men's Fellowship Class of St. Johns Methodist Episcopal Church South	50	233	1290	Central	
WHBR	**Cincinnati, Ohio**—United Research Lab., 2317 Gilbert Ave	300	215.7	1390	Central	
WHBU	**Anderson, Ind.**—Rivera Theatre and Bing's Clothing Store, 1002 Meridian St	10	218.8	1370	Central	Daily: 9 to 9:30 am; Wed., 7 to 9 pm; Fri., 7 to 9 pm. Sun.: 7 to 9 pm.

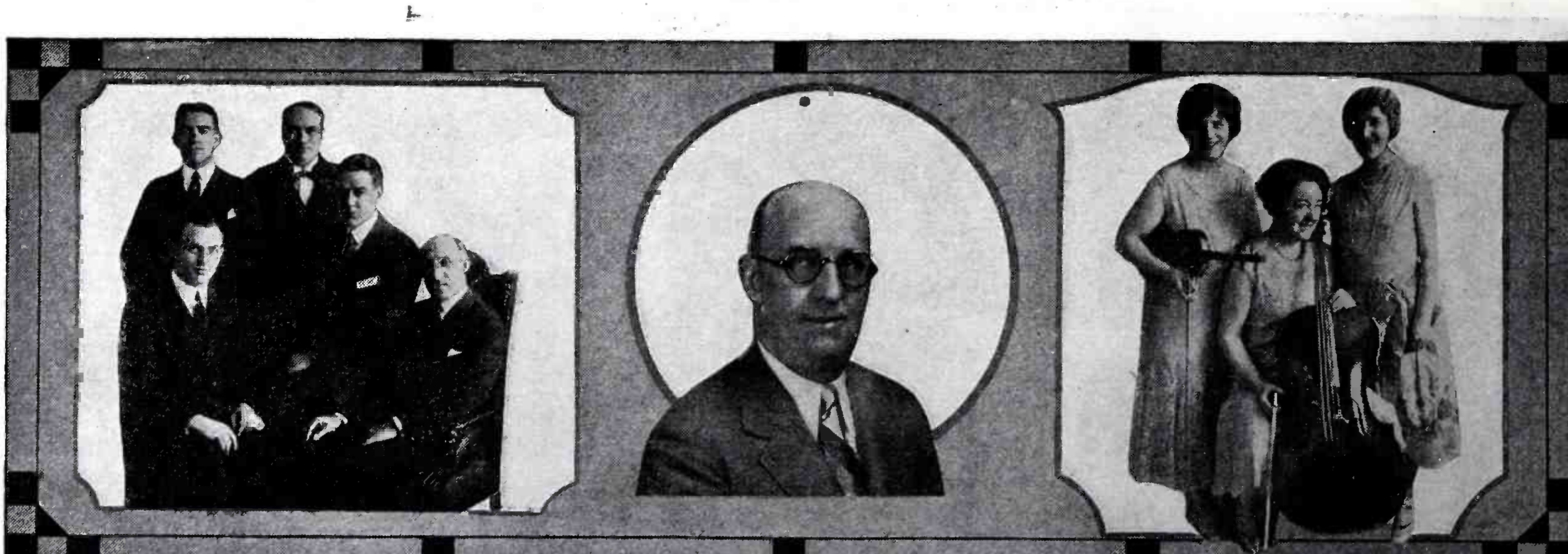
Radio Broadcast Station KFRU—Columbia, Mo.



Jessie Logan Burrall. Kenneth I. Brown, lecturer. Eva Winegarden, soloist and accompanist. Basil Deane Gauntlett, musical director. Gale H. Curtright, chief announcer and manager. Ernest L. Cox, bass.

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WH WHBW	**Philadelphia, Pa.**—D. R. Kienzle, 4916 Chestnut St.	100	216	1390	Eastern	Mon., 8:30 to 10:30 pm and 11:15 pm to 12:15 am. Thu., 8:30 to 11 pm; Sat., 7:45 to 10 pm.
WHBY	**West De Pere, Wis.**—St. Norbert's College	50	250	1200	Central	Daily: 5 to 6 pm; Mon., 8 to 10 pm; other nights irregular.
WHDI	**Minneapolis, Minn.**—Wm. Hood Dunwoody Industrial Institute	500	278	1080	Central	Mon., 8 to 9 pm; Wed., 9 to 10 pm; Fri., 9 to 10 pm.
WHEC	**Rochester, N. Y.**—Hickson Electric Co., 36 South Ave.	100	258	1160	Eastern	
WHFC	**Chicago, Ill.**—Hotel Flanders (Stanley Ehrmann) 4145 Broadway	150	258.5	1160	Central	Daiy: 6 to 7 pm.; 10 to 12 pm.; Sat. until 1 am. Sun., silent.
WHK	**Cleveland, Ohio**—Radio Air Service Corp., 1116 Carnegie Hall	1000	272.6	1100	Eastern	Daily except Fri.: 6:30 pm to 10:30 pm. Sun.: 9:30 am to 11 am; 6:30 pm to 10:30 pm.
WHN	**New York, N. Y.**—George Schubel, 1540 B'way	500	361.2	830	Eastern	Daily: 2:15 pm to 5:30 pm; 7 pm to 12 pm. Sun. and Holidays: 11:30 to 12:30 pm; 12:30 to 1 pm; 2 to 3 pm; 3 to 4:30 pm; 5 to 5:30 pm; 7:30 to mid.
WHO	**Des Moines, Ia.**—Bankers Life Co., 1110 Liberty Building	5000	526	570	Central	Mon., 9:45 am; 12 am; 2 pm; 7:30 pm; 11 pm; Tue., 9:45 am; 12 am; 2 pm; 7:30 pm; 11 pm; Wed., 9:45 am; 12 am; 2 pm; 3:30 pm; 7:30 pm; 11 pm; Thu., 9:45 am; 12 am; 2 pm; 7:30 pm; 11 pm; Fri., 9:45 am; 12 am; 2 pm; 3:30 pm; 7:30 pm; 11 pm; Sat., 9:45 am; 12 am; 2 pm; 7:30 pm; 11 pm. Sun.: 11 am; 4 pm; 7:30 pm; 11 pm. Holidays generally same as week days.
WHT	**Chicago, Ill.**—(Transmitter is in Deerfield, Ill.) Radiophone Broadcasting Corp., 410 North Michigan Blvd., Chicago, Ill.	3500	400	750	Central	Mon., 10; 10:45; 11:15; 11:40; 11:50 am; 12 am; 12:45; 6; 7 pm; Tue., 10; 10:20; 10:45; 11; 11:40; 11:50 am; 12 am; 12:45; 6; 6:40; 6:50; 7:45; 9:15; 9:35; 9:50; 10:10; 11:30; 12 pm; Wed., 10; 10:45; 11:15; 11:40; 11:50 am; 12 am; 12:45; 6; 6:50; 7:54; 9:15; 9:30; 10:05; 11:15; 11:30; 12 pm; Thu., 10; 10:15; 10:45; 10:50; 11:40; 11:50 am; 12 am; 12:45; 6; 6:30; 6:45; 9:15; 9:30; 10:10; 11:30; 12 pm; Fri., 10; 10:45; 11; 11:40; 11:50 am; 12 am; 12:45; 6; 6:50; 7:45; 9:15; 9:30; 10:05; 11:30; 12 pm; Sat., 10; 10:45; 11; 11:40; 11:50 am; 12 am; 6; 6:50; 7:45; 9:15; 9:30; 9:50; 10; 11:30; 12 mid. Sun.: 12 am; 12:45; 1:15; 1:30; 1:45; 2; 2:30; 2:45; 5:30; 6; 6:30; 9:30; 10:30 pm.
WI WIAD	**Philadelphia, Pa.**—Howard R. Miller, 6318 North Park Ave.	100	250	1200	Eastern	Tue., 9 pm; Fri., 9 pm.
WIAS	**Burlington, Iowa**—Home Electric Co.	100	254	1180	Central	Mon., 8 to 9 pm; Fri., 8 to 9 pm. Sun.: 10:30 to 12 am.
WIBA	**Madison, Wis.**—Capital Times Studio, and Strand Theatre Corp., 14 E. Mifflin St.	100	236.1	1430	Eastern	Mon., 8:45 to 10:30 pm; Wed., 8:45 to 10:30 pm, Fri., 9 to 10:30 pm; Sat., 10:45 to 12 pm.
WIBG	**Elkins Park, Pa.**—St. Paul's Protestant Episcopal Church	50	222	1350	Eastern	
WIBH	**New Bedford, Mass.**—Elite Radio Stores, 55 Hillman St.	30	209.7	1430	Eastern	
WIBI	**Flushing, N. Y.**—Frederick B. Zittell, Jr., 49 Boerum Ave.	50	218.8	1370	Eastern	
WIBJ	**Chicago, Ill.**—(Portable), C. L. Carrell, 1506 N. American Bldg.	50	215.7	1390		

Radio Broadcast Station WNAC—Boston, Mass.



The Knickerbocker Club **John Shepard.** **The Three Red Heads.**

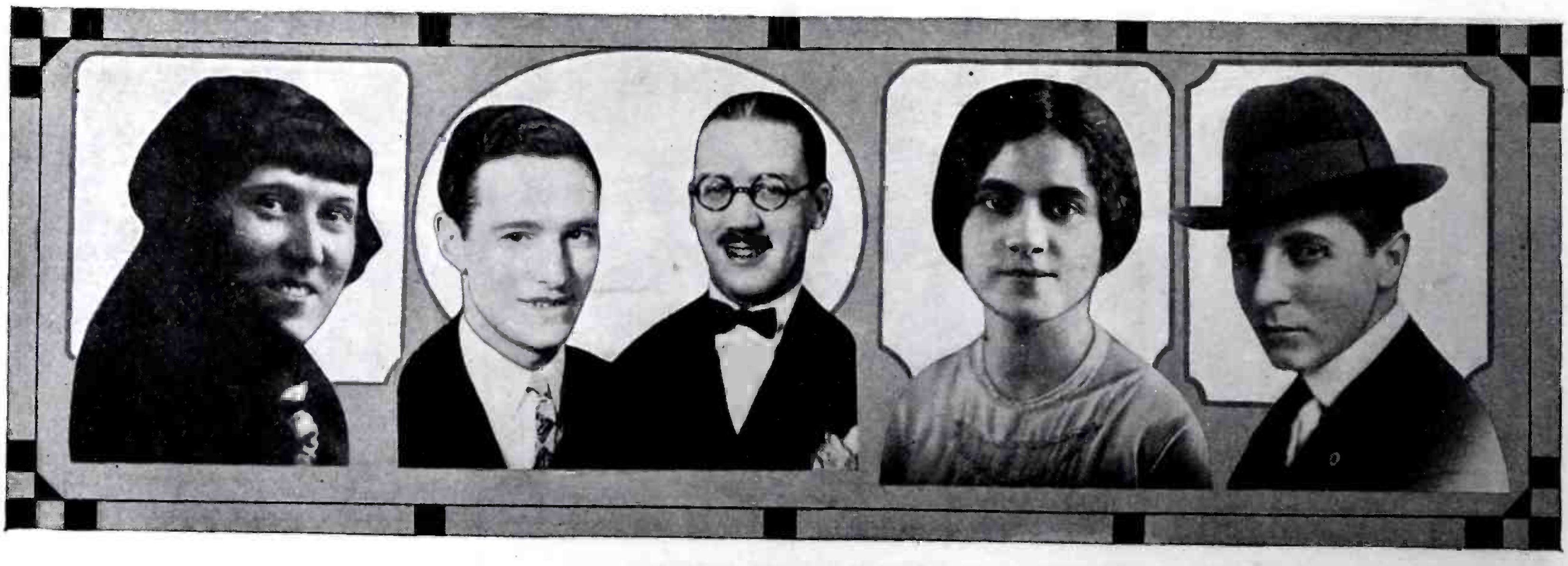
Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WI	**WIBM—Chicago, Ill.**—(Portable), Billy Maine, 36 West Randolph St.	10	215.7	1390		Daily: 2:30 to 4:30 pm; 8 to 10 pm.
	WIBO—Chicago, Ill.—Nelson Bros. Russo & Fiorito	1000	226	1330	Central	Mon., 2 to 4 pm; Tue., 2 to 4 pm; 6 to 8 pm; mid. to 3 am; Wed., 2 to 4 pm; 6 to 8 pm; 10 pm to 12 pm; Thu., 2 to 4 pm; 6 to 8 pm; mid. to 3 am; Fri., 2 to 4 pm; 6 to 8 pm; 10 pm to 2 am; Sat., 2 to 4 pm; 6 to 8 pm. Sun.: 10:15 am; 2 to 4 pm; 6 to 8 pm; 10 pm to 12 pm.
	WIBR—Steubenville, Ohio—Thurman A. Owings	50	246	1220	Eastern	
	WIBS—Elizabeth, N. J.—(Portable), Lieut. Thos. F. Hunter	.10	202.6	1480		
	WIBU—Poynette, Wis.—The Electric Farm	20	222	1350	Central	
	WIBW—Logansport, Ind.—Dr. L. L. Dill, Barnes Bldg.	100	220	1360	Central	Mon., 4:15 to 5:15 pm; Tue., 4:15 to 5:15; 6 to 7 pm; Wed., 4:15 to 5:15 pm; Thu., 4:15 to 5:15; 8 to 9 pm; Fri., 4:15 to 5:15; 6 to 7 pm; Sat., 4:15 to 5:15 pm. Sun.: 7:30 to 8:30 pm.
	WIBX—Utica, N. Y.—WIBX (Inc.), 236 Genesee St.	150	234.2	1280	Eastern	Tue., 12 am to 1 pm; 6:30 to 9 pm; Thu., same as Tue.; Fri., same as Tue. Sun.: 10:30 to 12 am; 3 to 4 pm; 7 to 8 pm.
	WIBZ—Montgomery, Ala.—A. D. Trum, 217 Catoma St.	10	230.6	1300	Central	Tue., 8:30 to 9:30; Wed., 9 to 10; Thu., 11 to 12. Sun.: 9:30 to 10:30.
	WIL—St. Louis, Mo.—St. Louis Star & Benson Radio Co.	250	273	1100	Central	Mon., 10 to 12 pm; Tue., 4 to 5 pm; Wed., 9 to 11 pm; Thu., 4 to 5; 8 to 10 pm; Fri., 9 to 11 pm; Sat., 4 to 5; 10 to 12 pm.
	WIOD—Miami Beach, Fla.—Carl G. Fisher Co.	1000	247.8	1210	Eastern	Daily: 8:30 to 12:30 am; Tue., Silent. Sun.: 11 am to 12:15 pm; 8:45 to 9:45 pm.
	WIP—Philadelphia, Pa.—Gimbel Bros.	500	508.2	590	Eastern	Daily: 6:45 am to 7:30 am; 10 am to 11 am; 1 to 2 pm; 3 to 4:30 pm; 6 to 7:30 pm; Tue., Thu. and Sat. also 8 pm to 12 pm. Sun.: 10:45 pm. to 12:30 pm; 4 pm to 5:30 pm. Alternate Sun.: 7:15 to 12 pm.
WJ	**WJAD—Waco, Tex.**—Frank P. Jackson	500	352.7	850	Central	
	WJAF—Ferndale, Mich.—J. A. Fenburg Radio Co. & W. J. Thomas, 187 E. Woodland Ave.	500	407	737	Eastern	Daily: 9 to 11 pm., Sun. included.
	WJAG—Norfolk, Neb.—Norfolk Daily News	200	270	1110	Central	Daily: 12:15 pm. Evenings by special arrangement. Sun.: Special programs only by arrangement.
	WJAK—Kokomo, Ind.—J. A. Kautz, Kokomo Tribune, 1531 Washington St.	50	254	1180	Central	Daily: 11:45 pm; Mon., 7:30 pm.
	WJAM—Cedar Rapids, Ia.—D. M. Perham, 322 Third Ave. W.	100	268	1120	Central	
	WJAR—Providence, R. I.—The Outlet Co.	500	305.9	980	Eastern	Mon., Wed. and Fri., 10 to 11 am; Daily: 11:05 pm; Mon., 7:45 to 11 pm; Tue., 7:30 to 10 pm; Wed., 7:30 to 11 pm; Thu., 7:45 to 11 pm; Fri., 7:45 to 10:30 pm; 11 to 12. Sun.: 6 pm to 10:15 pm.
	WJAS—Pittsburgh, Pa.—Pittsburgh Radio Supply House, 963 Liberty Ave.	500	275	1090	Eastern	Daily: 2 pm; 7:45 pm; 8 pm to 12 pm.
	WJAX—Jacksonville, Fla.—City of Jacksonville	1000	336.9	890	Eastern	
	WJAZ—Chicago, Ill.—(Transmitter is in Mount Prospect, Ill.), Zenith Radio Corp., 312 South Michigan Ave.	10000	329.8	910	Central	Mon., Silent; Tue., 9 pm to 1 am; Wed., 9 pm to 1 am; Thu., 9 pm to 12 pm; Fri., 9 pm to 1 am; Sat., 9 pm to 2 am. Sun.: 7 to 9 pm.

Radio Broadcast Station KFWB—Hollywood, Calif.

The Court of Grauman's Egyptian Theatre. Charlie Wellman, announcer. Western premier of John Barrymore's "Don Juan."

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WJ	WJBA—**Joliet, Ill.**—D. H. Lentz, Jr., 301 Whitley Ave.	50	206.8	1450	Central	
	WJBB—**St. Petersburg, Fla.**—Financial Journal, J. E. Dadsure, Publisher, 126 13th St. N.	250	254	1180	Eastern	Daily: 2 to 4 pm; 7 pm to 12 pm.
	WJBC—**LaSalle, Ill.**—Hummer Furniture Co., 2nd & Joliet Sts.	100	234.2	1280	Central	Daily: 12:30 to 1:30 pm; Mon., 8 to 10 pm. Sun.: 7 to 10 pm.
	WJBI—**Red Bank, N. J.**—Robt. S. Johnson, 63 Broad St.	250	218.8	1370	Eastern	
	WJBK—**Ypsilanti, Mich.**—Ernest F. Goodwin, 803 Congress St.	10	233	1290	Central	
	WJBL—**Decatur, Ill.**—Wm. Gushard Dry Goods Co., 301 N. Water St.	500	270	1110	Central	Mon., 9:30 to 11 pm; Wed., 9 to 10:30 pm; Sat., 9:30 to 11 pm. Sun.: 10:45 am; 3 to 4:30 pm.
	WJBO—**New Orleans, La.**—Valdemar Jensen, 119 S. St. Patrick St.	100	268	1120	Central	Fri., 8 to 11 pm. Sun.: 2:30 to 4:30 pm; 12 pm to 1 am.
	WJBR—**Omro, Wis.**—Gensch & Stearns.	50	227.1	1320	Central	Mon., 8 to 10:30 pm; Thu., 8 to 10:30 pm. Sun.: 2 to 4 pm; 8 to 10:30 pm.
	WJBT—**Chicago, Ill.**—John S. Boyd, 7421 Sheridan St.	500	238	1260	Central	
	WJBU—**Lewisburg, Pa.**—Bucknell University.	100	211.1	1420	Eastern	
	WJBV—**Woodhaven, N. Y.**—Union Course Laboratories, 9024-78th St.	500	469.9	640	Eastern	
	WJBW—**New Orleans, La.**—C. Carlson, Jr., 2743 Dumaine St.	30	340.7	880	Central	
	WJBX—**Osterville, Mass.**—Henderson & Ross, Seapuit Golf Club.	100	280	1070	Eastern	
	WJBY—**Gadsden, Ala.**—Electric Const. Co. (T. G. Erwin), 517 Broad St.	15	270.1	1110	Central	
	WJJD—**Mooseheart, Ill.**—Supreme Lodge, Loyal Order of Moose.	1000	370.2	810	Central	Daily: 12 to 1 pm; 2 to 3 pm; 4 to 5 pm; 5:30 to 7 pm; 8 to 9 pm; 10 to 11 pm; 12:30 to 2 am Sun. and Holidays: 7:45 am; 9:40 am; 2:30 to 5 pm.
	WJR—**Detroit, Mich.**—(Transmitter is in Pontiac, Mich.), Jewett Radio & Phonograph Co.	5000	516.9	580	Central	
	WJUG—**New York, N. Y.**—Uda Benjamin Ross, 30 Park Place.	250	516.9	580	Eastern	
	WJY—**New York, N. Y.**—Radio Corp. of America.	1000	405.2	740	Eastern	
	WJZ—**New York, N. Y.**—(Transmitter is in Bound Brook, N. J.), Radio Corp. of America.	50,000	455	660	Eastern	Daily: 1 to 2 pm; 4 to 6 pm; 7 to 12 pm. Sun.: 9 to 12 am; 2 to 6 pm; 7 to 10:30 pm.
WK	WKAF—**Milwaukee, Wis.**—Kesselman O'Driscoll-Hotel Antlers Co., 130 Second St.	1000	261	1150	Central	Mon., 10 to 11 pm; Wed., 10 to 11 pm; Thu., 2 to 3 pm; 8:30 to 9:45 pm; Fri., 7 to 7:30 pm; 10 to 11 pm; Sat., 8:30 to 9:45 pm. Sun.: 4 to 6 pm.
	WKAR—**East Lansing, Mich.**—Michigan State College	1000	285.5	1050	Central	Mon., 12 to 12:30 pm; 8 to 9 pm; Tue., 12 to 12:30 pm; Wed., 12 to 12:30 pm; 7:45 to 9 pm; Thu., 12 to 12:30 pm; Fri., 12 to 12:30 pm; 7:45 to 9 pm; Sat., 12 to 12:30 pm. Sun.: Silent.
	WKAV—**Laconia, N. H.**—Laconia Radio Club.	50	224	1340	Eastern	Fri., 7 pm. Sun.: Church Services.
	WKBA—**Chicago, Ill.**—Arrow Battery Co. (Jos. Silverstein), 1217 Wabash Ave.	200	209.7	1430	Central	
	WKBB—**Joliet, Ill.**—Sanders Bros., 607 Jefferson St.	100	282.8	1060	Central	
	WKBC—**Birmingham, Ala.**—H. L. Ansley, 1428 North Twelfth Ave.	50	225	1330	Central	
	WKBE—**Webster, Mass**—K. & B. Electric Co., 59 Emerald Ave.	100	270.1	1110	Eastern	Mon., 8 to 11 pm.

Radio Broadcast Station WOR—Newark, N. J.



Marion Newland Adams, soprano. Ballin & Race, duo piano artists. Rosa Calvaris, soprano. Ted Cole, pianist.

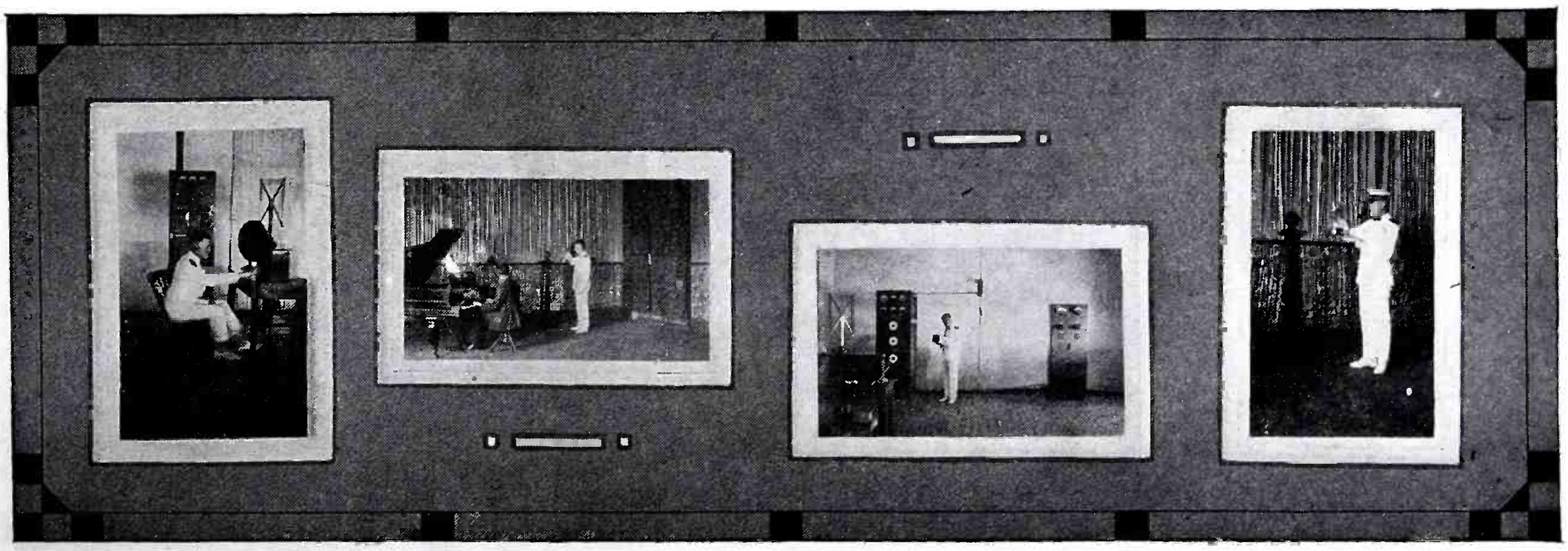
WK

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WKBF	**Indianapolis, Ind.**—Noble B. Watson, 233 Iowa St.	100	244	1230	Central	
WKBG	**Chicago, Ill.**—(Portable), C. L. Carrell, 36 So. State St.	100	215.7	1390		
WKBH	**La Crosse, Wis.**—Callaway Music Co., 221 Main St.	500	249.9	1200	Central	
WKBI	**Chicago, Ill.**—Fred L. Schoenwolf, 1917 Warner Ave.	500	220.4	1360	Central	Daily: 8 to 10 pm., except Sun. and Mon.
WKBJ	**St. Petersburg, Fla.**—Gospel Tabernacle, Inc., 5th Ave. and 10th St.	250	280	1070	Eastern	
WKBQ	**New York, N. Y.**—Starlight Amusement Park, Inc., 1,100 E. 177 St.	8	285	1050	Eastern	
WKDR	**Kenosha, Wis.**—Edward A. Dato, 936 N. Michigan Ave.	10	428.3	700	Central	
WKJC	**Lancaster, Pa.**—Kirk Johnson Co., 16 West King St.	50	258	1160	Eastern	
WKRC	**Cincinnati, Ohio**—Kodel Radio Corp., 507 E. Pearl St.	1500	325.9 422.3	920 710	Central	Mon., 6 to 7 pm; 8 to 10 pm; 12 pm. to 2 am. Tue., 10 to 12 pm; Wed., same as Mon.; Thu.; 10 to 12 pm; Fri., Silent; Sat., 10 to 12 pm, Sun.: 6:45 to 7:30 pm; 10 pm to 1 am.
WKY	**Ojlahoma, Okla.**—WKY Radio Co. (Huckins Hotel)	100	275	1090	Central	

WL

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WLAL	**Tulsa, Okla.**—W. & E. Radio Service Co.	100	250	1200	Central	
WLAP	**Louisville, Ky.**—Virginia Avenue Baptist Church, 2600 Virginia Ave.	20	275	1090	Central	
WLB	**Minneapolis, Minn.**—University of Minnesota	500	277.6	1080	Central	
WLBL	**Madison, Wis.**—(Transmitter is in Stevens Point, Wis.), Wisconsin Department of Markets	750	278	1080	Central	Mon., 8:45 am; 9:45 am; 10:45 am; 11:45 am; 12:30 pm; 1:45 pm; 6 to 7 pm; Tue., 9:45 am; 10:45 am; 11:45 am; 12:30 pm; 1:45 pm; 8 pm; Wed., 8:45 am; 9:45 am; 10:45 am; 11:45 am; 12:30 pm; 1:45 pm; Thu., same as Wed.; Fri., same as Mon.; Sat., same as Wed.; also 8 pm to 12 pm.
WLIB	**Chicago, Ill.**—Liberty Weekly	4000	303	990	Central	Mon., Silent; Tue., 7 pm to 8 pm; 11 pm to 12:30 pm; Wed., 7 pm to 8 pm; 11 pm to 12:30 pm; Thu., 7 pm to 8 pm; 11 pm to 12:30 pm; Fri., 7 pm to 8 pm; 11 pm to 12:30 pm; Sat., 7 pm to 8 pm; 11 pm to 12:30 pm. Sun.: 5 to 6:15 pm.
WLIT	**Philadelphia, Pa.**—Lit Bros.	500	394.5	760	Eastern	Daily: 12 am to 1 pm; 2 pm to 3 pm; 4:30 to 5:30 pm; 7:30 to 11 pm Mon., Wed. and Fri.; 7:30 to 8 pm; Tue., Thu. and Sat. Sun.: 2 to 4 pm, also from 6:30 to 9:30 pm on alternate Sun.
WLS	**Chicago, Ill.**—(Transmitter is in Crete, Ill.), Sears Roebuck & Co.	5000	345	870	Central	Mon., 9 to 7; Tue., 6:30 to 8:30; Wed., 6:30 to 1 am; Thu., 6:30 to 8:30 pm; Fri., 6:30 am to 1 am; Sat., 7:30 am to 12 pm. Sun.: 6 to 8 pm.
WLSI	**Cranston, R. I.**—Dutee W. Flint & Lincoln Studios, Inc.	500	440.9	6[illegible]0	Eastern	Daily: 5 to 6 pm; 8 to 10 pm; Sat., Silent. Sun.: 9:45 am a d 4:45 pm.
WLTS	**Chicago, Ill.**—Lane Technical High School, Hotel Flanders	100	258.5	1160	Central	Mon., 1 to 2 pm; 6 to 7 pm; Tue., 7 to 8 pm; 10 pm to 2 am; Wed., 1 to 2 pm; 6:30 to 7 pm; 10 pm to 12 pm; Thu., 7 to 8 pm; 10 pm to 2 am; Fri., 1 to 2 pm; 6:30 to 7 pm; 10 pm to 12 pm; Sat., 7 to 8 pm; 10 pm to 12 pm. Sun.: 12 pm to 3 am.

Radio Broadcast Station AQM—San Salvador, Central America



J. Fred Mejia listening in. **View of the studio.** **J. Fred Mejia, chief engineer, checking wavelength.** **Announcer holding mechanical bird up to the "Mike."**

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WL WLW	**Cincinnati, Ohio**—(Transmitter is in Harrison, Ohio), Crosley Radio Corp., Cincinnati, Ohio	5000	422.3	710	Central	Mon., 7:30 am; 8 am; 10 am; 11 am; 11:55 am; 12:05 pm; 1.30 pm; 1:40 pm; 3 pm; 4 pm; 4:30 pm; 6:50 pm; 7 pm; 7:30 pm; 7:40 pm; 10 pm; Tue., 7:30 am; 8 am; 10 am; 11 am; 11:55 am; 12:10 pm; 1:30 pm; 1:40 pm; 3 pm; 4 pm; 4:10 pm; 4:30 pm; 6 pm; 6:30 pm; 7 pm; 7:20 pm; 7:30 pm; 7:50 pm; 8 pm; 8:50 pm; 9 pm; Wed., 7:30 am; 8 am; 10 am; 11 am; 11:55 am; 12:05 pm; 1:30 pm; 1:40 pm; 3 pm; 3:30 pm; 4 pm; 4:30 pm; 4:45 pm; 6:50 pm; 7 pm; 7:30 pm; 7:40 pm; 10 pm; 11 pm; 11:15 pm; Thu., 7:30 am; 8 am; 10 am; 11 am; 11:55 am; 12:05 pm; 12:30 pm; 1:30 pm; 1:40 pm; 2 pm; 3 pm; 4 pm; 4:30 pm; 5 pm; 6:15 pm; 6:45 pm; 6:50 pm; 7 pm; 7:30 pm; 7:40 pm; 10 pm; 10:03 pm; 10:40 pm; 11 pm; 11:30 pm; 12:15 am; Fri., 7:30 am; 8 am; 10 am; 11 am; 11:55 am; 12:10 pm; Sat., 10 am; 11:55 am; 1:30 pm; 1:30 pm; 6:50 pm; 7 pm; 7:30 pm; 8 pm; 8:30 pm; 9 pm. Sun.: 9:30 am; 10:30 am; 11 am; 5 pm; 7:30 pm; 8:30 pm.
WLWL	**New York, N. Y.**—Universal Broadcasting Corp., 415 West 59th St.	5000	384.4	780	Eastern	Mon., 9 to 11 pm; Tue., 9 to 11 pm; Wed., 9 to 11 pm; Thu., 8:30 to 11 pm. Sun.: 8 pm.
WM WMAC	**Cazenovia, N. Y.**—Clive B. Meredith	100	275	1090	Eastern	
WMAF	**Dartmouth, Mass.**—Round Hills Radio Corp.	1000	440.9	680	Eastern	
WMAK	**Lockport, N. Y.**—Norton Laboratories	1000	266	1130	Eastern	
WMAL	**Washington, D. C.**—M. A. Leese Co., 720 Eleventh St., N. W.	100	290	1030	Eastern	Tue., Thu. and Sat.
WMAN	**Columbus, Ohio**—W. E. Heskett, 507 North High St.	50	286	1050	Eastern	Sun.: 10:30 am; 7:30 pm.
WMAQ	**Chicago, Ill.**—Chicago Daily News	1000	447 5	670	Central	Mon., 12 am to 3 pm; 4 to 7 pm; Tue., 12 am to 3 pm; 4 to 7 pm; 8 to 10 pm; Wed., 12 am to 3 pm; 4 to 7 pm; 8 to 10 pm; Thu., 12 am to 3 pm; 4 to 7 pm; 8 to 10 pm; Fri., 12 am to 3 pm; 4 to 7 pm; 8 to 10 pm; Sat., 12 am to 3 pm; 4 to 7 pm; 8 to 10 pm.
WMAY	**St. Louis, Mo.**—Kingshighway Presbyterian Church	100	248	1210	Central	
WMAZ	**Macon, Ga.**—Mercer University	500	261	1150	Eastern	Mon., 9 to 11 pm; Wed., 10 to 12 pm; Fri., 9 to 11 pm.
WMBB	**Chicago, Ill.**—American Bond & Mortgage Co., 6201 Cottage Grove Ave.	500	250	1200	Central	Daily: 7 to 8 pm and 9 to 11 pm; Mon., Silent Sun.: 3 to 5 pm; 7:40 to 9 pm; 9 to 11 pm.
WMBC	**Detroit, Mich.**—Mich. Broadcasting Co.	100	256.4	1170	Eastern	
WMBF	**Miami Beach, Fla.**—Fleetwood Hotel Corp.	500	384.4	780	Eastern	Daily: 7 to 8 pm; 8 to 9 pm; 10 pm to 1 am; Tue., Silent.
WMBI	**Chicago, Ill.**—Moody Bible Institute of Chicago 153 Institute Place	500	288.3	1040	Central	Sun.,3:30 to 5 pm.; 7 to 9 pm.; Mon., 7 to 7:30 am.; 10:30 to 11:30 am. All other days: 7 to 7:30 am.; 10:30 to 11:30 am.; 8:30 to 9:30 pm.
WMC	**Memphis, Tenn.**—The Commercial Appeal	500	499.7	600	Central	Mon., 9:45 am; 11:30 am; 2:30 pm; 7:15 to 8 pm; 8:30 to 10 pm; Tue., same as Mon.; also 11 to 12 pm; Wed., silent; Thu., same as Mon.; Fri., same as Tue.; Sat., same as Mon. Sun.: 11 am to 12:30 pm.
WMCA	**New York, N. Y.** (Transmitter is in Hoboken, N. J.)—Associated Broadcasters, Inc.	500	341	880	Eastern	Daiy: 10:30 to 5 pm; 6 pm to 12:15 am. Sun.: 11 to 12 :15 am; 2:50 to 10 pm.
WMRJ	**Jamaica, N. J.**—Peter J. Prinz, 10 New York Ave.	5	227.1	1320	Eastern	
WMSG	**New York, N. Y.**—Madison Square Garden Broadcasting Corp.	500	302.8	990	Eastern	

Radio Broadcast Station WTAM—Cleveland, Ohio

Leona Brown Woodcock, asst. program director.

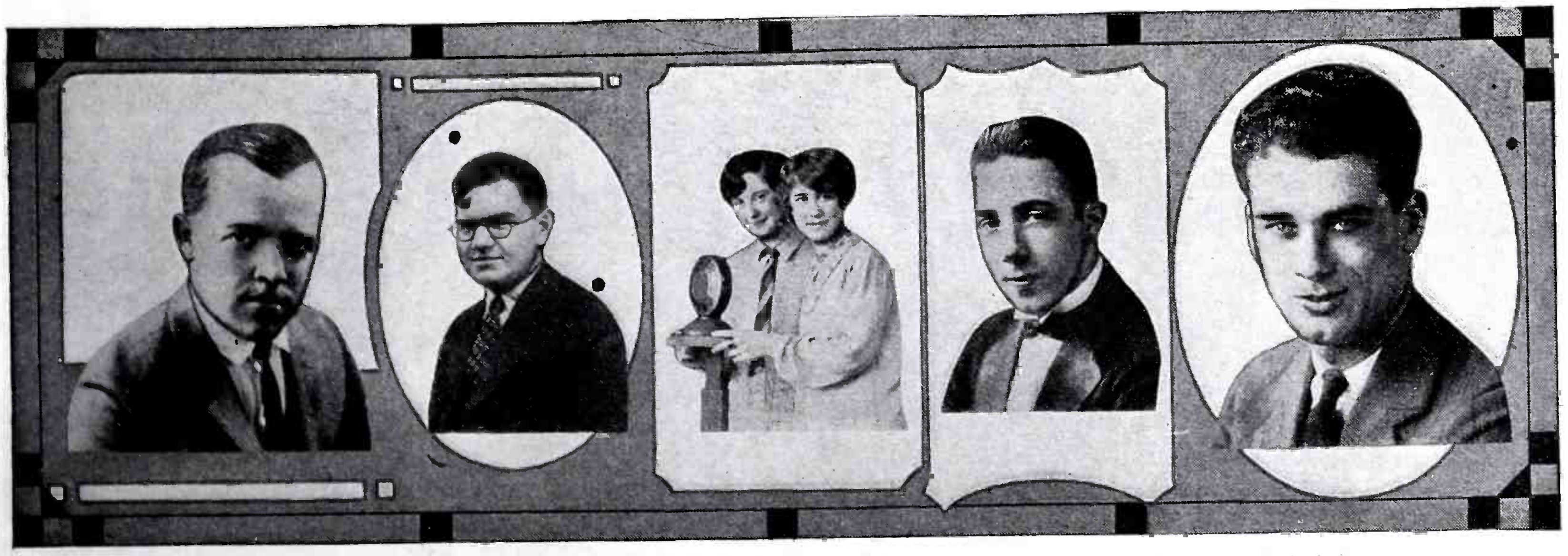
Emerson Gill and his orchestra.

Emerson Gill, violinist.

Ralph Humphrey, chief announcer

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WN	**WNAB—Boston, Mass.**—The Shepard Stores..........	100	280.2	1070	Eastern	Daily: 3 to 4 pm; Special.
	WNAC—Boston, Mass.—The Shepard Stores..........	500	430.1	697	Eastern	Daily: 10:30 to 11:30 am; 1 to 2 pm; 4 pm; 5 pm; 6 pm; 7:35 pm; 8 to 10 pm or later. Sun.: 11 am; 1:30 to 2:30 pm; 6:45 to 8:30 pm.
	WNAD—Norman, Okla.—University of Oklahoma.....	500	254	1180	Central	Mon., 12:50 to 1:20; 7 to 11 pm; Tue., 12:50 to 1:20; 7 to 8 pm; Wed., 12:50 to 1:20; 7 to 8 pm; Thu., 12:50 to 1:20 pm; Fri., 12:50 to 1:20 pm. Sun.: 9:30 pm.
	WNAL—Omaha, Neb.—R. J. Rockwell, 5019 Capital Ave.	50	258	1160	Central	Fri., 9 pm; Sat., 9 pm.
	WNAT—Philadelphia, Pa.—Lennig Bros. Co., Spring Garden and 9th Sts........................	500	250	1200	Eastern	Wed., 6:50 pm to mid; Sat., 7:30 pm to mid. Sun.: 4:30 to 7:30 pm.
	WNAX—Yankton, S. D.—Dakota Radio Apparatus Co.	100	244	1230	Central	
	WNBH—New Bedford, Mass.—New Bedford Hotel (Irving J. Vermilya)........................	250	248	1210	Eastern	Mon., Wed. and Fri., 6 to 10 pm; Tues., Thu. and Sat., Silent. Sun.: 11 am to 12:15 pm; 2 to 3 pm; 4:30 to 5:30 pm; 7 to 9 pm,
	WNJ—Newark, N. J.—Radio Shop of Newark (Herman Lubinsky), 89 Lehigh Ave..................	150	348.6	860	Eastern	
	WNOX—Knoxville, Tenn.—People's Telephone and Telegraph Co..........................	100	268	1120	Central	
	WNRC—Greensboro, N. C.—Wayne M. Nelson.......	10	224	1340	Eastern	
	WNYC—New York, N. Y.—City of New York, Dept. of Plants and Structures......................	1000	526	570	Eastern	Daily: 6 to 11 pm. Sun.: Irregular.
WO	**WOAI—San Antonio, Texas**—Southern Equipment Co.	2000	394.5	760	Central	Daily: 10 am; 12:15 pm, [illegible]:30 pm; 3 pm; 6:10 pm; 8:30 pm. Sun. and Holidays: 11 am; 7:35 pm; 9:30 pm.
	WOAN—Lawrenceburg, Tenn.—Jas. D. Vaughn......	500	282.8	1060	Central	Daily except Sat.
	WOAW—Omaha, Neb.—Woodmen of the World.......	1000	526	570	Central	Daily: 6 pm to 7:30 pm; 9 to 11 pm (except Wed.); Sat., 6 to 12 pm. Sun. and Holidays: 9 to 11 am; 1:30 to 4 pm; 6 to 7 pm; 9 to 11 pm.
	WOAX—Trenton, N. J.—Franklyn J. Wolff, Top of the Monument Pottery Co.....................	500	240	1250	Eastern	Daily: Noon, 12:15 pm; 6 to 7 pm; Tue. and Fri., special 8:30 to 10:30 pm; Sat., 9:30 to 11 pm. Sun.: 9:30 pm to 11 pm.
	WOC—Davenport, Iowa—The Palmer School of Chiropractic..................................	5000	483.6	620	Central	Mon., 12:15; 1:55; 2; 3; 6; Tue., 12:15; 1:55; 2; 3; 6; 6:30; 7; 9; Wed., 12:15; 1:55; 2; 3; 4; 5:45; 6; 6:30; 9; Thu., 12:15; 1:55; 2; 3; 6; 6:30; 7; 11; Fri., 12:15; 1:55; 2; 3; 4; 5:45; 6; 6:30; 8; 9; Sat., 12:15; 1; 5:45; 6; 6:30; 9; 11. Sun.: 1; 6:30; 8:15; 9:45.
	WOCL—Jamestown, N. Y.—A. E. Newton, for the Jamestown Furniture Market Assn..........	15	275.2	1090	Eastern	Mon., 9 to 12 pm. Sun.: 10:30 am and 7:30 pm.
	WODA—Paterson, N. J.—O'Dea Temple of Music.....	500	391.5	765	Eastern	
	WOI—Ames, Iowa—Iowa State College...............	750	270	1110	Central	Daily: 9:30 am; 10:30 am; 12:30 pm; 12:45 pm, Mon. and Thu., 7:30 and 7:50 pm; Tue. and Thu; 10:30 am. Sun.: 10:45 am to 11; 11 am to 12 am.
	WOK—Chicago, Ill. (Transmitter is in Homewood, Ill.) Neutrowound Radio Mfg. Co., 1721 Prairie Ave.....................................	20,000	217.3	1380	Central	
	WOKO—Peekskill, N. Y.—Harold E. Smith.........	50	233	1290	Eastern	Daily: 8 to 12 pm.
	WOO—Philadelphia, Pa.—John Wanamaker..........	500	508.2	590	Eastern	Daily: 11 am; 12 to 1 pm; 4:45 pm; 7:30 pm; Mon., Wed. and Fri., 8 to 11. Sun.: Alternate Sun. Morning and Evening, 10:30 am and 7:30 pm. Every Sun, 6 to 7 pm; every other Sun., 9:15 to 10:15 pm.

Radio Broadcast Station WHAD—Milwaukee, Wis.



Les Hoadley, organist. **Andy Hertel, pianist.** **Marcella Schuldes and Viola Schroeder, Duo Songsters** **Cliff Borchardt, baritone.** **Dave Miller, orchestra director.**

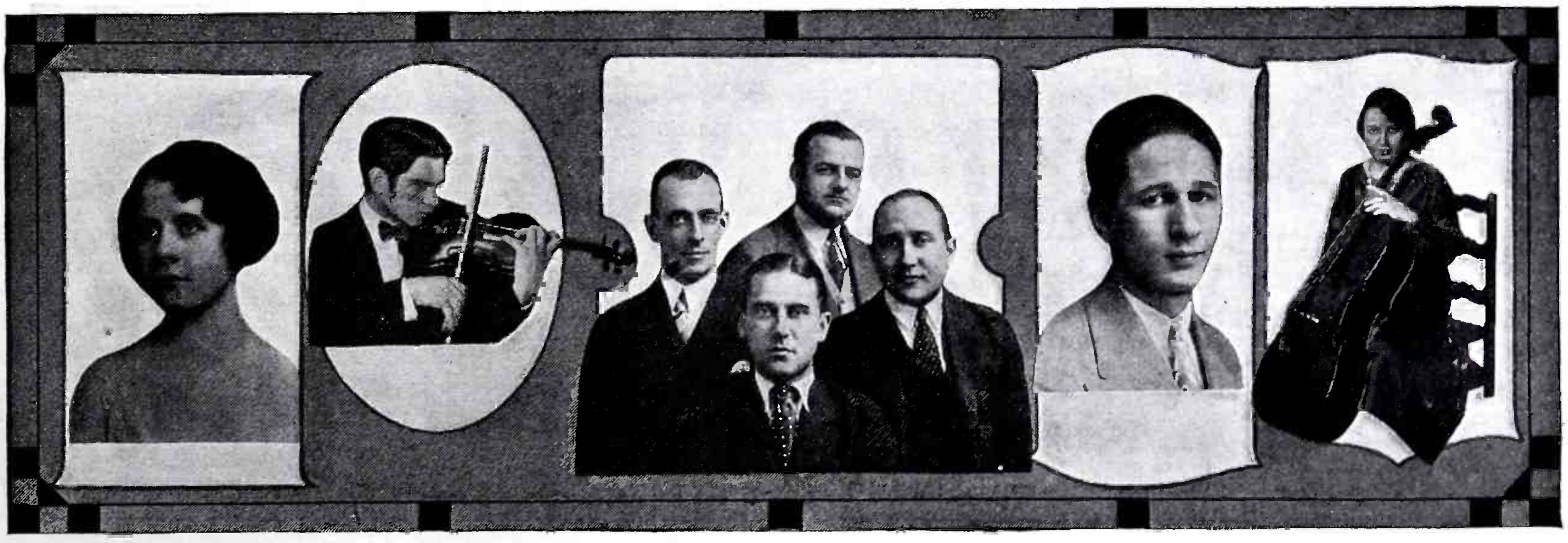
Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WO	**WOOD—Grand Rapids, Mich.**—Hotel Rowe	1000	242	1240	Central	Daily: 10 am; 9 pm to mid.; Thu., Silent.
	WOQ—Kansas City, Mo.—Unity School of Christianity.	1000	278	1080	Central	Mon., 11 am; Tue., 11 am; 8 to 9:30 pm; Thu. 11 am; 7 to 10 pm; Sat., 11 am; 8 pm to 12 pm Sun.: 11 am to 12:30 pm; 7 to 7:45 pm; 7:45 pm to 9:30 pm.
	WOR—Newark, N. J.—L. Bamberger and Co	500	405	740	Eastern	Daily: 6:45 am; 2:30 to 4 pm; 6:15 to 7:30 pm; Mon., Wed. and Sat., until 12 pm. Not on Sun. but every holiday.
	WORD—Batavia, Ill.—Peope's Pulpit Assn., 18 Concord St., Brooklyn, N. Y	5000	275	1090	Central	Tue., 7 to 7:45 pm; 9 to 10 and 11 to 12 pm; Wed., 7 to 8 pm and 9 to 10 pm; Thu., 8 to 10 pm; Fri., 7 to 8; 9 to 10 pm; Sat., 7 to 8; 9 to 10 pm. Sun., 10 to 11 am; 2:30 to 4 pm; 6 to 7 pm; 9 to 10:30 pm.
	WOS—Jefferson City, Mo.—Missouri State Marketing Bureau	500	440.9	680	Central	
	WOWO—Fort Wayne, Ind.—The Main Auto Supply Co., 213 West Main St	500	227	1320	Central	Mon., 8 to 12 pm; Wed., 8 to 12 pm; Thu., 8 to 12 pm. Every noon except Sat. and Sun.
WP	**WPAK—Fargo, N. D.**—North Dakota Agricultural College	50	275	1090	Central	Mon., 7:30 pm; Wed., 7:30 pm; Fri., 7:30 pm.
	WPAP—Cliffside, N. J.—Palisades Amusement Park	100	361.2	830	Eastern	
	WPCC—Chicago, Ill.—North Shore Congregational Church	500	258	1160	Central	Wed., 7 to 8 pm; Fri., 7 to 8 pm. Sun.: 11 am; 3:30 pm; 8 pm.
	WPDQ—Buffalo, N. Y.—Hiram L. Turner, 121 Norwood Ave	50	205.4	1460	Eastern	
	WPG—Atlantic City, N. J.—Municipality of Atlantic City	5000	299.8	1000	Eastern	Daily: 6:30 to mid. with occasional luncheon and tea music at 1:30 and 4:30 pm. Sun.: 3:15 to 5 pm; 9 to 11 pm.
	WPRC—Harrisburg, Pa.—W. Arthur Wilson, Prop., Wilson Printing and Radio Co., Fifth and Kelker Streets	100	215.6	1390	Eastern	Mon., 9 to 11 pm; Wed., 9 to 11 pm. Sun.: 7:20 to 10:30 pm.
	WPSC—State College, Pa.—Pennsylvania State College, Dept. of Elec. Engineering	500	282.8	1060	Eastern	Mon., 7:30 to 10:30 pm; Wed., 7:30 to 10:30 pm; Fri., 7:30 to 10:30 pm.
WQ	**WQAA—Parkersburg, Pa.**—Horace A. Beale, Jr	500	220	1360	Eastern	
	WQAC—Amarillo, Texas—Gish Radio Service	125	234	1280	Central	Mon. to Sat., incl.: Sunrise; Sunset; 10 am; 11 am; noon and 8 pm. Sun.: Sunrise; Sunset; 11 am and 8 pm.
	WQAE—Springfield, Vt.—Moore Radio News Station	50	246	1220	Eastern	
	WQAM—Miami, Fla.—Electrical Equipment Co., 42 Northwest Fourth St	750	285.5	1050	Eastern	Daily: 6 to 6:30 pm; 7:30 to 9 pm; 10:30 to 12:30 pm. Sun. and Holidays: 10:30 to 12 am; 7:30 to 9 pm.
	WQAN—Scranton, Pa.—Scranton Times	100	250	1200	Eastern	Daily: 12:30 to 1:30; 4:30 to 5:30 pm; except Sun., Fri. and Tue. nights, 8 to 11 pm; Sat. night 11 to 12 pm.
	WQAO—Cliffside, N. J.—Calvary Baptist Church	100	361.2	830	Eastern	
	WQJ—Chicago, Ill.—Calumet Baking Powder Co. and Rainbo Gardens	500	447.5	670	Central	Daily: 11 am to 12 am; 3 to 4 pm; 7 to 8 (except Mon.); 10 pm to 2 am (except Sat.); Sat., 10 to 3 am. Sun.: 10 to 12 am; 3 to 4 pm; 8 to 10 pm
WR	**WRAF—Laport, Ind.**—The Radio Club, Inc	100	223.8	1340	Central	Mon. and Thu., 8 to 10 pm. Sun.: 10:45 am to 12:15 pm; 7:30 pm to 9 pm.
	WRAH—Providence, R. I.—Stanley N. Read, 191 Alabama Ave	450	235	1280	Eastern	

Radio Broadcast Station WLW—Cincinnati, Ohio

Norinne Gibbons & Priscilla Holbrook (piano) entertainers. **Madam Ida Tcimpidis, French teacher.** **"The Pups," Kay Nye organist, Big Barker violinist and announcer.** **Marcian Thalberg, pianist.**

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WR	**WRAK—Escanaba, Mich.**—Economy Light Co., 1105 Ludington St.	100	256.3	1170	Central	
	WRAL—Ithaca, N. Y.—Eclipse Studio, 317 Elm St.	25	365	820	Eastern	
	WRAM—Galesburg, Ill.—Lombard College	100	243.8	1230	Central	Mon., 7 pm; 8 pm; 9 pm.
	WRAV—Yellow Springs, Ohio—Antioch College	100	263	1140	Central	
	WRAW—Reading, Pa.—Avenue Radio and Electric Shop, 460 Schuylkill Ave.	10	238	1260	Eastern	Tue., 9 pm; Thu., 10 pm.
	WRAX—Philadelphia, Pa.—Berachach Church, Inc., 1608 Alleghany Ave.	500	268	1120	Eastern	
	WRBC—Valparaiso, Ind.—Immanuel Lutheran Church	500	278	1080	Central	Mon., 7:30 pm. Sun.: 7:30 pm. During July, Aug. and Sept., 10:30 am.
	WRC—Washington, D. C.—Radio Corporation of America	1000	468.5	640	Eastern	
	WRCO—Raleigh, N. C.—Wynne Radio Co., 226½ Fayetteville St.	100	252	1190	Eastern	
	WREC—Whitehaven, Tenn.—Wooten's Radio and Electric Co.	10	254	1180	Central	
	WREO—Lansing, Mich.—Reo Motor Car Co.	500	285.5	1050	Eastern	Daily except Sun.: 6 to 7 pm; Tue., 8:15 pm; Thu., 8:15 pm; Sat., 10 to 12 pm. Sun.: 10; 10:30 am; 7:30 pm.
	WRHF—Washington, D. C.—Washington Radio Hospital Fund, 525 Eleventh St., N. W.	50	256	1170	Eastern	Tue., Thu. and Sat., 6 to 7 pm.
	WRHM—Minneapolis, Minn.—Rosedale Hospital Co., Inc.	50	252	1190	Central	Mon., 1:15 pm; Tue., 11 pm; Wed., 9 pm; Thu., Silent; Fri., 1:15 pm; Sat., Silent. Sun.: 9:30 am; 2 pm; 9 pm.
	WRK—Hamilton, Ohio—Doron Bros. Electrical Co.	100	270	1110	Central	
	WRM—Urbana, Ill.—University of Illinois	500	273	1100	Central	
	WRMU—Richmond Hill, N. Y. MU-1 (Yacht)—A. H. Grebe and Co., Inc.	100	236	1270		No fixed schedule.
	WRNY—New York, N. Y.—Experimenter Publishing Co., 53 Park Place	500	374	802	Eastern	Mon., 11 am to 1 pm; 6:50 to 11:45 pm; Tue., 11 am to 1 pm; 6:45 to 11:45 pm; Wed., 11 am to 1 pm; 6:15 to 10:45 pm; Thu., 11 am to 1 pm; 6:45 to 12 pm; Fri., 11 am to 1 pm; 5:20 to 12 pm; Sat., 11 am to 1:15 pm; 1 to 2 am. Sun.: 2:30 to 6 pm.
	WRR—Dallas, Tex.—City of Dallas, Police and Fire Signal Department	500	246	1220	Central	
	WRST—Bay Shore, N.Y.—Radiotel Mfg. Co., 5 First Ave.	150	215.7	1390	Eastern	
	WRVA—Richmond, Va.—Larus & Brother Co., Inc., 22nd & Cary Strs.	1000	256	1170	Eastern	Mon., 8 to 11 pm; Tue., 11 to 1 am; Wed., 8 to 11 pm; Thu., 8 to 11 pm; Fri., 7 to 11 pm; Sat., Silent. Sun.: Silent.
WS	**WSAI—Cincinnati, Ohio**—(Transmitter is in Mason, Ohio), United States Playing Card Co., Cincinnati, Ohio	5000	325.9	920	Central	Mon., 8 to 9 pm (alternate months Feb., etc.); 10 to 12 pm; Tue., 5:30 to 10 pm; Wed., 6:45 to 8 pm; 10 to 12 pm; Thu., 7 to 10 pm; Fri., Silent; Sat., 6:40 to 10 pm; 12 pm to 1 am. Sun.: 3 to 4:30 pm and 7:45 to 10:15 pm.
	WSAJ—Grove City, Pa.—Grove City College	250	229	1310	Eastern	Irregular schedule.

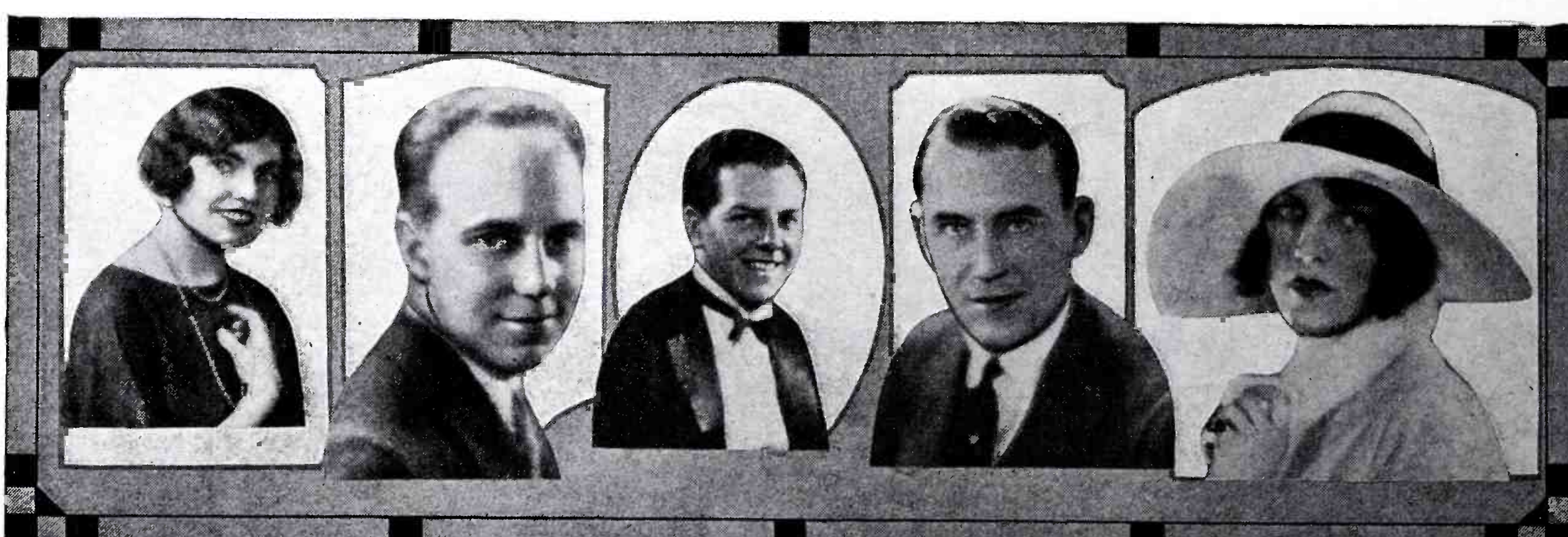
Radio Broadcast Station WBAL—Glen Morris, Md.



Margaret Cobb, program supervisor. **Michael Weiner, violinist.** **Male Quartet.** **Sol Sax, pianist.** **Helene Broemer, cellist.**

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WS	**WSAN—Allentown, Pa.**—Allentown Call Publishing Co.	100	229	1310	Eastern	
	WSAR—Fall River, Mass.—Doughty & Welch Electric Co., Inc., 46 N. Main St.	100	254	1180	Eastern	Daily: 12:05 pm to 1 pm; 5 to 6 pm. Sun.: 10:30 am to 12:15 pm.
	WSAX—Chicago, Ill.—(Portable), Zenith Radio Corp., 332 South Michigan Ave	100	268	1120		
	WSAZ—Pomeroy, Ohio—Chase Electric Shop	50	244	1230	Eastern	
	WSB—Atlanta, Ga.—The Atlanta Journal	1000	428.3	700	Central	Daily: 12 am to 1 pm; 5 pm to 6 pm; 8 to 9 pm; 10:45 pm; 3 pm baseball. Sun.: 9:30 am; 10:45 am; 5 to 6 pm; 7:30 pm.
	WSBC—Chicago, Ill.—World Battery Co., 1219 South Wabash Ave	1500	288.3	1040	Central	Tue. to Sun., incl., 6:30 pm to 8:30 pm and 10 pm 1 am. Sun.: Special. Own Program, 2 am to 4 am; Mon., 5:30 pm to 7 pm.
	WSBF—St. Louis, Mo.—Stix, Baer & Fuller Dept. Store	250	273	1100	Central	Daily: Noon to 1 pm to 3 to 4 pm; Mon., Wed. and Fri., 7:30 to 9 pm; Wed., 11 pm to 1 am. Sun.: 9 pm to 10:30 pm.
	WSBT—South Bend, Ind.—South Bend Tribune	500	275	1090	Central	Mon., 7 to 10 pm; Wed., 7 to 9; 11:45 to 1 am; Fri., 7 to 10 pm.
	WSDA—New York, N. Y.—The City Temple (Seventh Day Adventist Church, 120th St. Lenox)	250	263	1140	Eastern	
	WSKC—Bay City, Mich.—World's Star Knitting Co.	100	261	1150	Eastern	Mon., 8 to 11 pm; Wed., 9 to 11 pm; Sat., 9 pm to 2 am. Sun.: 10:30 to 12.
	WSM—Nashville, Tenn.—The National Life & Accident Ins. Co.	1000	282.8	1060	Central	Mon., 6:30 to 9; 10 to 11 pm; Tue., 10 to 12 pm; Wed., 6:30 to 9; 10 to 11 pm; Thu., Silent; Fri., 6:30 to 9; 10 to 11 pm; Sat., 6:30 to 12 pm. Sun.: Alternate morning and Evening Church Services.
	WSMB—New Orleans, La.—Saenger Theatres, Inc. & Maison Blanche Co.	500	319	940	Central	Daily: 12:30 to 1:30 pm; 6:30 to 7:30 pm; Mon., Wed., Thu., Sat., 8:30 pm.
	WSMH—Owosso, Mich.—Shattuck Music House, 207 Washington St.	20	240	1250	Eastern	Wed., 8 to 10 pm; Sat., 10 to 12 pm. Sun.: 10 to 11:30 am.
	WSMK—Dayton, Ohio—S. M. K. Radio Corporation, 39 East Third St.	500	275	1090	Eastern	
	WSOE—Milwaukee, Wis.—School of Engineering of Milwaukee, 415 Marshall St.	500	246	1220	Central	
	WSRO—Hamilton, Ohio—The Radio Co., 421 High St.	100	252	1190	Central	Tue., 8 to 10 pm; Fri., 8 to 10 pm. Sun.: 2 to 4 pm.
	WSSH—Boston, Mass.—Tremont Temple Baptist Church	100	261	1150	Eastern	Mon. and Fri., 7:30 to 9 pm. Sun.: 10:30 am to 12 am; 6:30 pm to 9 pm.
	WSUI—Iowa City, Iowa—State University of Iowa	500	484	620	Central	Daily except Sat. and Sun.: 12:30 pm; Mon. of alternate weeks 4 pm; Mon., 7:30 to 8:30 pm; Wed., 9 to 9:30 am; 7:30 to 8:30 pm. Occasional programs are broadcast Sat. at 7:30 pm. Sun.: 9:30 pm to 10 pm. About once a month a Vesper Service program is broadcast at 4 pm.
	WSVS—Buffalo, N. Y.—Seneca Vocational School, Seneca & Hydraulic Sts.	50	219	1370	Eastern	Mon., Wed. and Fri., 9 pm.
	WSWS—Wooddale, Ill.—Bligh-Whittington Co.	1000	275	1090	Central	
WT	**WTAB—Fall River, Mass.**—Fall River Daily Herald	100	266	1130	Eastern	
	WTAD—Carthage, Ill.—Robt. E. Compton	50	236	1270	Central	
	WTAG—Worcester, Mass.—Worcester Telegram Pub. Co.	500	545.1	550	Eastern	

Radio Broadcast Station WBBM—Chicago, Ill.



Hazel McBroom, contralto. **Nate Caldwell, chief announcer.** **Fred L. Jesko, baritone.** **Lee Sims, pianist.** **Eunice Hoeffer, Studio Sunshine Girl.**

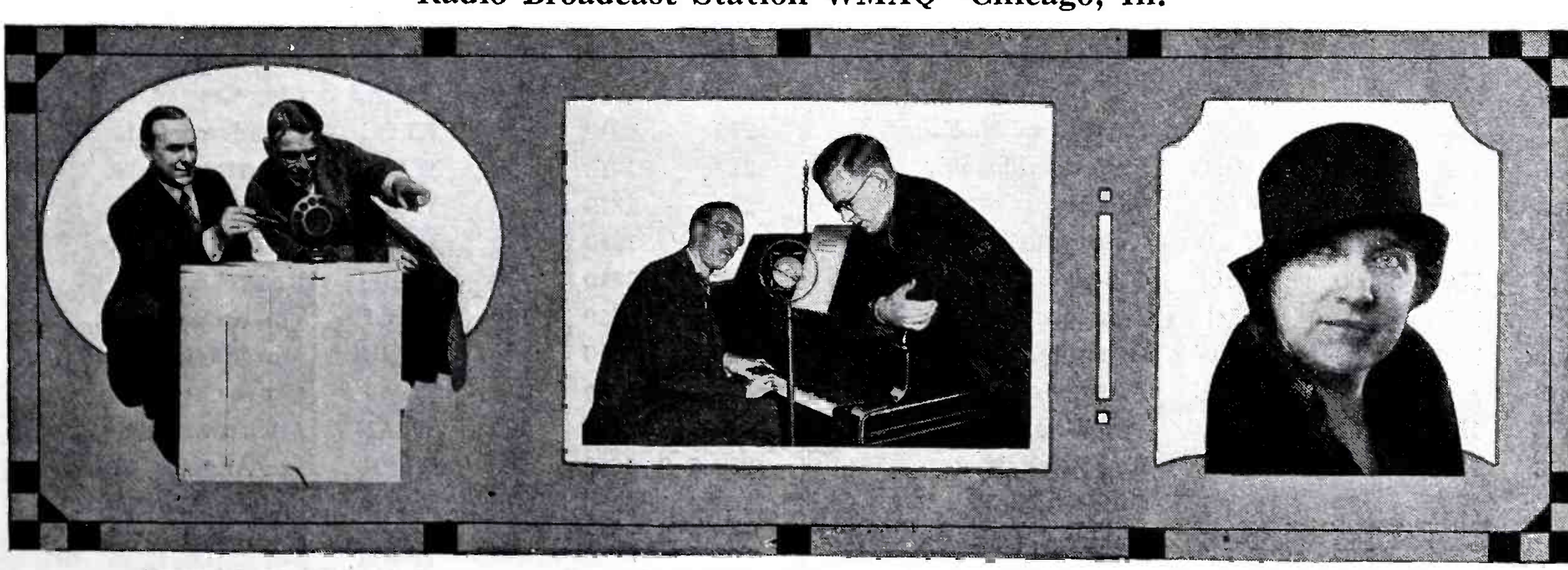
Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
WT	**WTAL—Toledo, Ohio**—Toledo Broadcasting Co. (Hotel Waldorf)	100	252	1190	Eastern	Mon., 7:30 to 10:30 pm; Tue., 7:30 to 9 pm; Wed. 7:30 to 10:30 pm; Thu., 7:30 to 9 pm; Fri., 7:3, to 10:30 pm; Sat., 7:30 to 9 pm. Sun.: 4 to 6 pm.
	WTAM—Cleveland, Ohio—Willard Storage Battery Co.	1000	389.4	770	Eastern	Mon., 6; 8; 10 pm; Wed., 6; 8; 11 pm; Sat., 6; 8 pm.
	WTAQ—Eau Claire, Wis.—S. H. Van Gorden	1000	254	1180	Central	
	WTAR—Norfolk, Va.—Reliance Electric Co., 519 West 21st St.	100	261	1150	Eastern	Mon., 6:15 pm; Tue. 8 to 9 pm; Wed., 6:15 pm; Thu., 6:15 pm; Fri., 6:15 pm; Sat., 6:15 pm.
	WTAW—College Station, Tex.—Agricultural & Mechanical College of Texas	500	270	1110	Central	Wed. and Fri., 8 to 9:30 pm. Sun.: 11 to 12 am.
	WTAX—Streator, Ill.—Williams Hardware Co., 115 So. Vermillion St.	50	231	1300	Central	Thu., 8 to 12 pm.
	WTAZ—Lambertville, N. J.—Thos. J. McGuire	15	261	1150	Eastern	
	WTIC—Hartford, Conn.—Travelers Insurance Co.	500	475.9	630	Eastern	Mon., 11 am to 12 am and 5:30 to 11 pm; Tue., Silent; Wed., 5:30 to 9 pm; Thu., 5:30 to 6:30 pm; Fri., 11 am to 12 am and 5:30 to 11 pm; Sat., 5:30 to 10:30 pm.
	WTRC—Brooklyn, N. Y.—Twentieth Assembly District Regular Republican Club, Inc., 62 Woodbine St.	50	239.9	1250	Eastern	
WW	**WWAE—Plainfield, Ill.**—Lawrence J. Crowley	500	242.2	1240	Central	Mon., Silent; Tue., Wed. and Thu., 9 to 12 pm; Fri., 9 pm to 3 am; Sat., 9 pm to 12 pm. Sun.; 9 pm to 12 pm.
	WWJ—Detroit, Mich.—Detroit News	1000	352.7	850	Eastern	Daily: 7:30 to 8:30 am; 9:30 to 9:50 am; 12 to 12:45 pm; 3 to 4 pm; 4 to 5:30 pm; 6 to 7 pm; 8 to 11 pm. Sun.: 11 am to 12:30 pm.
	WWL—New Orleans, La.—Loyola University	100	275	1090	Central	
	WWRL—Woodside, N. Y.—Woodside Radio Labs., 41-30 Fifth-Eighth Street	100	258.5	1160	Eastern	Mon., 8 to 12 pm.; Wed., 2to 3 pm.; Fri., 2 to 3 pm. Sun.: 2 to 4 pm.

This list has been corrected up to and including November 1, 1926.

Radio Broadcasting Station WSM—Nashville, Tenn.

Mrs. Daisy Hoffman, pianist. **Vito Pellettieri, violinist.** **Beasley Smith, director of Andrew Jackson Hotel Orchestra.** **Mrs. M. H. Goldschein dramatic soprano.** **Aleda Waggoner, coloratura soprano.**

Radio Broadcast Station WMAQ—Chicago, Ill.



Harry (left) and Hal (right) **Russel Pratt (left) and Ransom Sherman (right)** **Miss Judith C. Waller, director.**

RADIO BROADCAST STATIONS OF THE UNITED STATES

By Wavelengths and Frequencies

Meters	Kilocycles	Power	Call Letters	Location
202.6	1480	500	KFXB	Big Bear Lake, Cal.
202.6	1480	50	KGBY	Shelby, Neb.
202.6	1480	10	WEHS	Evanston, Ill.
202.6	1480	10	WIBS	Elizabeth, N. J.
204	1470	10	WABB	Harrisburg, Pa.
205.4	1460	50	KFVD	Venice, Cal.
205.4	1460	10	KFXD	Logan, Utah
205.4	1460	50	KFXY	Flagstaff, Ariz.
205.4	1460	10	KFYF	Oxnard, Cal.
205.4	1460	100	WFRL	Brooklyn, N. Y.
205.4	1460	50	WPDQ	Buffalo, N. Y.
206.8	1450	50	WABW	Wooster, Ohio
206.8	1450	50	WJBA	Joliet, Ill.
207	1450	50	KGTT	San Francisco, Cal.
208	1440	500	KNRC	Los Angeles, Cal.
209.7	1430	10	KFYO	Texarkana, Tex.
209.7	1430	100	WCBR	Providence, R. I.
209.7	1430	30	WIBH	New Bedford, Mass.
209.7	1430	200	WKBA	Chicago, Ill.
211.1	1420	200	KFWC	San Bernardino, Cal.
211.1	1420	250	KFWO	Avalon, Catalina Is., Cal.
211.1	1420	100	WJBU	Lewisburg, Pa.
212.6	1410	50	KFWV	Portland, Ore.
212.6	1410	100	WMAL	Washington, D. C.
214.2	1400	250	KFWF	St. Louis, Mo.
214.2	1400	15	KFXR	Oklahoma, Okla.
214.2	1400	150	WCLS	Joliet, Ill.
215.6	1390	100	WPRC	Harrisburg, Pa.
215.7	1390	50	KFBC	San Diego, Cal.
215.7	1390	50	KFQW	North Bend, Wash.
215.7	1390	15	KFXJ	Edgewater, Colo.
215.7	1390	50	WBBZ	Chicago, Ill.
215.7	1390	50	WHBL	Chicago, Ill.
215.7	1390	20	WHBM	Chicago, Ill.
215.7	1390	300	WHBR	Cincinnati, Ohio
215.7	1390	50	WIBJ	Chicago, Ill.
215.7	1390	10	WIBM	Chicago, Ill.
215.7	1390	100	WKBG	Chicago, Ill.
215.7	1390	150	WRST	Bay Shore, N. Y.
216	1390	100	WHBW	Philadelphia, Pa.
217.3	1380	50	KFAF	San Jose, Cal.
217.3	1380	500	WFKB	Chicago, Ill.
217.3	1380	20000	WOK	Chicago, Ill.
218.8	1370	10	KFJC	Junction City, Kans.
218.8	1370	50	KFRW	Olympia, Wash.
218.8	1370	10	WHBU	Anderson, Ind.
218.8	1370	50	WIBI	Flushing, N. Y.
218.8	1370	250	WJBI	Red Bank, N. J.
219	1370	50	WSVS	Buffalo, N. Y.
220	1360	100	KFUU	Oakland, Cal.
220	1360	5	KJBS	San Francisco, Cal.
220	1360	100	WIBW	Logansport, Ind.
220	1360	500	WQAA	Parkersburg, Pa.
220.4	1360	500	WKBI	Chicago, Ill.
222	1350	50	WBBW	Norfolk, Va.
222	1350	100	WBES	Takoma Park, Md.
222	1350	500	WCOA	Pensacola, Fla.
222	1350	20	WHBD	Bellefontaine, Ohio
222	1350	100	WHBF	Rock Island, Ill.
222	1350	50	WIBG	Elkins Park, Pa.
222	1350	20	WIBU	Poynette, Wis.
223.7	1340	10	KFQP	Iowa City, Ia.
223.8	1340	100	WRAF	Laport, Ind.
224	1340	100	KFBL	Everett, Wash.
224	1340	50	KFUR	Ogden, Utah
224	1340	50	KFVS	Cape Girardeau, Mo.
224	1340	50	WKAV	Laconia, N. H.
224	1340	10	WNRC	Greensboro, N. C.
225	1330	50	WKBC	Birmingham, Ala.
225.4	1330	50	WAGM	Royal Oak, Mich.
225.4	1330	100	WEBQ	Harrisburg, Ill.
226	1330	10	KFGQ	Boone, Iowa
226	1330	10	KFKZ	Kirksville, Mo.
226	1330	50	KFOB	Burlingame, Cal.
226	1330	100	KFOR	David City, Neb.
226	1330	500	KFQZ	Hollywood, Cal.
226	1330	1500	WBBM	Chicago, Ill.
226	1330	150	WDAD	Nashville, Tenn.
226	1330	100	WEBL	U. S. (Portable)
226	1330	10	WFBE	Seymour, Ind.
226	1330	1000	WIBO	Chicago, Ill.
227	1320	50	KFVN	Fairmont, Minn.
227	1320	50	KGBS	Seattle, Wash.
227	1320	500	WOWO	Ft. Wayne, Ind.
227.1	1320	50	WJBR	Omro, Wis.
227.1	1320	10	WMRJ	Jamaica, N. J.
229	1310	100	KFLV	Rockford, Ill.
229	1310	1000	KMMJ	Clay Center, Nebr.
229	1310	50	KPPC	Pasadena, Cal.
229	1310	10	WAIT	Taunton, Mass.
229	1310	50	WBBL	Richmond, Va.
229	1310	100	WCBM	Baltimore, Md.
229	1310	50	WDBJ	Roanoke, Va.
229	1310	100	WFCI	Pawtucket, R. I.
229	1310	10	WGBR	Marshfield, Wis.
229	1310	250	WSAJ	Grove City, Pa.
229	1310	100	WSAN	Allentown, Pa.
230.6	1300	500	KFPR	Los Angeles, Cal.
230.6	1300	10	KGCL	Seattle, Wash.
230.6	1300	50	WCLO	Camp Lake, Wis.

Meters	Kilocycles	Power	Call Letters	Location	Meters	Kilocycles	Power	Call Letters	Location
230.6	1300	10	WIBZ	Montgomery, Ala.	240	1250	500	WOAX	Trenton, N. J.
231	1300	5	KDLR	Devils Lake, N. D.	240	1250	20	WSMH	Owosso, Mich.
231	1300	10	KFDZ	Minneapolis, Minn.	242	1240	50	KFFP	Moberly, Mo.
231	1300	50	KFOT	Wichita, Kans.	242	1240	10	KFPM	Greenville, Tex.
231	1300	250	KFQU	Alma (Holy City), Cal.	242	1240	50	KFXH	El Paso, Tex.
231	1300	500	KUT	Austin, Tex.	242	1240	500	KSO	Clarinda, Iowa
231	1300	100	WBRE	Wilkes-Barre, Pa.	242	1240	50	WABY	Philadelphia, Pa.
231	1300	20	WHBG	Harrisburg, Pa.	242	1240	250	WBZA	Boston, Mass.
231	1300	50	WTAX	Streator, Ill.	242	1240	50	WCBH	Oxford, Miss.
233	1290	100	KFEY	Kellogg, Idaho	242	1240	100	WEBC	Superior, Wis.
233	1290	500	KFON	Long Beach, Cal.	242	1240	1000	WOOD	Grand Rapids, Mich.
233	1290	10	WDBZ	Kingston, N. Y.	242.2	1240	500	WWAE	Plainfield, Ill.
233	1290	50	WHBQ	Memphis, Tenn.	242.5	1240	250	WCBS	Providence, R. I. (P'ble.)
233	1290	10	WJBK	Ypsilanti, Mich.	243.8	1230	100	KGAR	Tucson, Ariz.
233	1290	50	WOKO	Peekskill, N. Y.	243.8	1230	5000	WAMD	Minneapolis, Minn.
234	1280	50	KFUP	Denver, Colo.	243.8	1230	100	WATT	Boston, Mass.
234	1280	50	KMJ	Fresno, Cal.	243.8	1230	100	WRAM	Galesburg, Ill.
234	1280	100	WFDF	Flint, Mich.	244	1230	50	KFVR	Denver, Colo.
234	1280	125	WQAC	Amarillo, Tex.	244	1230	500	KUOM	Missoula, Mont.
234.2	1280	100	KGCG	Newark, Ark.	244	1230	100	WEBR	Buffalo, N. Y.
234.2	1280	500	WGBX	Orono, Me.	244	1230	100	WGBB	Freeport, N. Y.
234.2	1280	150	WIBX	Utica, N. Y.	244	1230	100	WKBF	Indianapolis, Ind.
234.2	1280	100	WJBC	La Salle, Ill.	244	1230	100	WNAX	Yankton, S. D.
234.4	1280	50	WCWK	Fort Wayne, Ind.	244	1230	50	WSAZ	Pomeroy, Ohio
235	1280	...	WAAT	Jersey City, N. J.	245.8	1220	1000	KFSD	San Diego, Calif.
235	1280	450	WRAH	Providence, R. I.	246	1220	100	KDYL	Salt Lake City, Utah
236	1270	20	KFLU	San Benito, Tex.	246	1220	10	KFJI	Astoria, Ore.
236	1270	15	KFVG	Independence, Kans.	246	1220	50	KFJY	Fort Dodge, Ia.
236	1270	100	KWKC	Kansas City, Mo.	246	1220	500	WABX	Mount Clemens, Mich.
236	1270	100	WBOQ	Richmond Hill, N. Y.	246	1220	5000	WBAL	Glen Morris, Md. (Near)
236	1270	250	WCAM	Camden, N. J.	246	1220	50	WIBR	Weirton, W. Va.
236	1270	100	WFBJ	Collegeville, Minn.	246	1220	50	WQAE	Springfield, Vt.
236	1270	500	WGBF	Evansville, Ind.	246	1220	500	WRR	Dallas, Tex.
236	1270	100	WGMU	Richmond Hill, N. Y.	246	1220	500	WSOE	Milwaukee, Wis.
236	1270	100	WRMU	Richmond Hill, N.Y.	247.8	1210	1000	WIOD	Miami Beach, Fla.
236	1270	50	WTAD	Carthage, Ill.	248	1210	100	WFBK	Sacramento, Cal.
236.1	1270	100	WBAW	Nashville, Tenn.	248	1210	50	KFEC	Portland, Oregon
236.1	1270	100	WIBA	Madison, Wis.	248	1210	100	KFIF	Portland, Oregon
238	1260	15	KFBS	Trinidad, Colo.	248	1210	10	KFJB	Marshalltown, Ia.
238	1260	100	KFCB	Phoenix, Ariz.	248	1210	100	KFOX	Omaha, Neb.
238	1260	100	KFWU	Pineville, La.	248	1210	250	KFRB	Beeville, Tex.
238	1260	10	KFYJ	Houston, Tex.	248	1210	10	KFYR	Bismark, N. D.
238	1260	200	WBBP	Petoskey, Mich.	248	1210	50	KWG	Stockton, Cal.
238	1260	10	WHBN	St. Petersburg, Fla.	248	1210	1000	WAPI	Auburn, Ala.
238	1260	500	WJBT	Chicago, Ill.	248	1210	50	WBRC	Birmingham, Ala.
238	1260	10	WRAW	Reading, Pa.	248	1210	100	WCSO	Springfield, Ohio
239.9	1250	100	KFUM	Colorado Springs, Colo.	248	1210	10	WGAL	Lancaster, Pa.
239.9	1250	15	KGCI	San Antonio, Tex.	248	1210	100	WMAY	St. Louis, Mo.
239.9	1250	50	WTRC	Brooklyn, N. Y.	248	1210	250	WNBH	New Bedford, Mass.
240	1250	10	KFHL	Oskaloosa, Iowa	249.9	1200	100	WBBC	Brooklyn, N. Y.
240	1250	250	KFLX	Galveston, Tex.	249.9	1200	500	WKBH	LaCrosse, Wis.
240	1250	5000	KFVE	St. Louis, Mo.	250	1200	100	KFDX	Shreveport, La.
240	1250	50	KFVI	Houston, Tex.	250	1200	10	KFVY	Alburquerque, N. Mex.
240	1250	100	KZM	Oakland, Cal.	250	1200	500	KFWI	San Francisco, Calif.
240	1250	100	WABI	Bangor, Me.	250	1200	500	KFXF	Colorado Springs, Colo.
240	1250	50	WCAT	Rapid City, S. D.	250	1200	250	KLS	Oakland, Cal.
240	1250	500	WDBO	Winter Park, Fla.	250	1200	500	KMO	Tacoma, Wash.
240	1250	100	WGBI	Scranton, Pa.	250	1200	50	WFBC	Knoxville, Tenn.

Meters	Kilocycles	Power	Call Letters	Location
250	1200	500	WGES	Chicago, Ill.
250	1200	10	WHBA	Oil City, Pa.
250	1200	50	WHBY	West De Pere, Wis.
250	1200	100	WIAD	Philadelphia, Pa.
250	1200	100	WLAL	Tulsa, Okla.
250	1200	500	WMBB	Chicago, Ill.
250	1200	500	WNAT	Philadelphia, Pa.
250	1200	100	WQAN	Scranton, Pa.
252	1190	50	KFHA	Gunnison, Colo.
252	1190	50	KFOY	St. Paul, Minn.
252	1190	20	KFPL	Dublin, Tex.
252	1190	500	KFWB	Hollywood, Cal.
252	1190	200	KOCW	Chickasha, Okla.
252	1190	50	KWUC	Le Mars, Iowa
252	1190	50	WBBS	New Orleans, La.
252	1190	100	WCAX	Burlington, Vt.
252	1190	10	WCFT	Tullahoma, Tenn.
252	1190	500	WFBL	Syracuse, N. Y.
252	1190	500	WGCP	Newark, N. J.
252	1190	100	WRCO	Raleigh, N. C.
252	1190	50	WRHM	Minneapolis, Minn.
252	1190	100	WSRO	Hamilton, Ohio
252	1190	100	WTAL	Toledo, Ohio
254	1180	250	KFEL	Denver, Colo.
254	1180	50	KFJZ	Fort Worth, Tex.
254	1180	100	KFLR	Albuquerque, N. M.
254	1180	100	KFWH	Eureka, Cal.
254	1180	100	WABC	Asheville, N. C.
254	1180	500	WCAJ	University Place, Neb.
254	1180	150	WCBA	Allentown, Pa.
254	1180	500	WEAI	Ithaca, N. Y.
254	1180	100	WFBR	Baltimore, Md.
254	1180	20	WFBZ	Galesburg, Ill.
254	1180	10	WHBC	Canton, Ohio
254	1180	100	WIAS	Burlington, Ia.
254	1180	50	WJAK	Kokomo, Ind.
254	1180	250	WJBB	St. Petersburg, Fla.
254	1180	500	WNAD	Norman, Okla.
254	1180	10	WREC	Whitehaven, Tenn.
254	1180	100	WSAR	Fall River, Mass.
254	1180	1000	WTAQ	Eau Claire, Wis.
256	1170	500	KFIQ	Yakima, Wash.
256	1170	50	KFUS	Oakland, Cal.
256	1170	100	KRE	Berkeley, Cal.
256	1170	100	WBAX	Wilkes-Barre, Pa.
256	1170	500	WDOD	Chattanooga, Tenn.
256	1170	100	WHBP	Johnstown, Pa.
256	1170	50	WRHF	Washington, D. C.
256	1170	1000	WRVA	Richmond, Va.
256.3	1170	500	WCSH	Portland, Me.
256.3	1170	100	WRAK	Escanaba, Mich.
256.4	1170	500	WBDC	Grand Rapids, Mich.
256.4	1170	100	WMBC	Detroit, Mich.
258	1160	20	KFPW	Carterville, Mo.
258	1160	500	KFUL	Galveston, Tex.
258	1160	250	KOCH	Omaha, Neb.
258	1160	25	WAAD	Cincinnati, Ohio
258	1160	100	WABO	Rochester, N. Y.
258	1160	500	WADC	Akron, Ohio
258	1160	100	WHEC	Rochester, N. Y.
258	1160	50	WKJC	Lancaster, Pa.
258	1160	50	WNAL	Omaha, Neb.
258	1160	500	WPCC	Chicago, Ill.
258.5	1160	500	WCMA	Culver, Ind.
258.5	1160	150	WHFC	Chicago, Ill.
258.5	1160	109	WLTS	Chicago, Ill.
258.5	1160	100	WWRL	Woodside, N. Y.
261	1150	500	KFJF	Oklahoma, Okla.
261	1150	100	KFMR	Sioux City, Ia.
261	1150	100	KFUT	Salt Lake City, Utah
261	1150	100	WARC	Medford Hillside, Mass.
261	1150	50	WDAY	Fargo, N. D.
261	1150	250	WEAM	No. Plainfield, N. J.
261	1150	1000	WKAF	Milwaukee, Wis.
261	1150	500	WMAZ	Macon, Ga.
261	1150	100	WSKC	Bay City, Mich.
261	1150	100	WSSH	Boston, Mass.
261	1150	100	WTAR	Norfolk, Va.
261	1150	15	WTAZ	Lambertville, N. J.
263	1140	120	KFJR	Portland, Oregon
263	1140	50	KTBR	Portland, Oregon
263	1140	5	KTUE	Houston, Tex.
263	1140	500	WAAM	Newark, N. J.
263	1140	50	WABR	Toledo, Ohio
263	1140	250	WCAD	Canton, N. Y.
263	1140	2000	WCAR	San Antonio, Texas
263	1140	5	WCBE	New Orleans, La.
263	1140	100	WDAG	Amarillo, Tex.
263	1140	500	WDGY	Minneapolis, Minn.
263	1140	50	WEBZ	Savannah, Ga.
263	1140	100	WRAV	Yellow Springs, Ohio
263	1140	250	WSDA	New York, N. Y.
266	1130	100	KFPY	Spokane, Wash.
266	1130	500	WBCN	Chicago, Ill.
266	1130	100	WDEL	Wilmington, Del.
266	1130	1000	WENR	Chicago, Ill.
266	1130	500	WGHB	Clearwater, Fla.
266	1130	1000	WMAK	Lockport, N. Y.
266	1130	100	WTAB	Fall River, Mass.
267.7	1120	50	KFRC	San Francisco, Cal.
267.7	1120	50	WDAH	El Paso, Texas
267.9	1120	10	WBBY	Charleston, S. C.
268	1120	500	KFEQ	Oak, Nebr.
268	1120	500	KFH	Wichita, Kans.
268	1120	100	WDRC	New Haven, Conn.
268	1120	500	WEBW	Beloit, Wis.
268	1120	250	WFBM	Indianapolis, Ind.
268	1120	100	WJAM	Cedar Rapids, Ia.
268	1120	100	WJBO	New Orleans, La.
268	1120	100	WNOX	Knoxville, Tenn.
268	1120	500	WRAX	Philadelphia, Pa.
268	1120	100	WSAX	Chicago, Ill.
270	1110	100	WBAO	Decatur, Ill.
270	1110	100	WDBE	Atlanta, Ga.
270	1110	1500	WGHP	Detroit, Mich.
270	1110	500	WGST	Atlanta, Ga.

Meters	Kilocycles	Power	Call Letters	Location
270	1110	200	WJAG	Norfolk, Nebr.
270	1110	500	WJBL	Decatur, Ill.
270	1110	750	WOI	Ames, Ia.
270	1110	100	WRK	Hamilton, Ohio
270	1110	500	WTAW	College Station, Tex.
270.1	1110	15	WJBY	Gadsden, Ala.
270.1	1110	100	WKBE	Webster, Mass.
272.6	1100	100	KFAD	Phoenix, Ariz.
272.6	1100	500	WEBJ	New York, N. Y.
272.6	1100	500	WFBH	New York, N. Y.
272.6	1100	1000	WHK	Cleveland, Ohio
273	1100	500	KFIO	Spokane, Wash.
273	1100	100	KFIZ	Fond du lac, Wis.
273	1100	50	KFKA	Greeley, Colo.
273	1100	100	KFLZ	Anita, Ia.
273	1100	250	WBAA	Lafayette, Ind.
273	1100	1000	WDAE	Tampa, Fla.
273	1100	10	WFAM	St. Cloud, Minn.
273	1100	250	WIL	St. Louis, Mo.
273	1100	500	WRM	Urbana, Ill.
273	1100	250	WSBF	St. Louis, Mo.
275	1090	50	KFBB	Havre, Mont.
275	1090	500	KFKU	Lawrence, Kans.
275	1090	500	KFSG	Los Angeles, Cal.
275	1090	500	KQV	Pittsburgh, Pa.
275	1090	50	WABZ	New Orleans, La.
275	1090	500	WAFD	Port Huron, Mich.
275	1090	500	WBAK	Harrisburg, Pa.
275	1090	250	WBT	Charlotte, N. C.
275	1090	500	WCAC	Storrs, Conn.
275	1090	100	WCAO	Baltimore, Md.
275	1090	100	WEAU	Sioux City, Ia.
275	1090	500	WFAV	Lincoln, Neb.
275	1090	500	WHAD	Milwaukee, Wis.
275	1090	500	WHAR	Atlantic City, N. J.
275	1090	500	WJAS	Pittsburgh, Pa.
275	1090	100	WKY	Oklahoma, Okla.
275	1090	20	WLAP	Louisville, Ky.
275	1090	100	WMAC	Cazenovia, N. Y.
275	1090	5000	WORD	Batavia, Ill.
275	1090	100	WPAK	Fargo, N. D.
275	1090	500	WSBT	South Bend, Ind.
275	1090	500	WSMK	Dayton, Ohio
275	1090	1000	WSWS	Wooddale, Ill.
275	1090	100	WWL	New Orleans, La.
275.2	1090	15	WOCL	Jamestown, N. Y.
276.6	1080	500	WCAU	Philadelphia, Pa.
277.6	1080	500	WLB	Minneapolis, Minn.
277.8	1080	100	WFBG	Altoona, Pa.
278	1080	100	KFJM	Grand Forks, N. D.
278	1080	50	KGY	Lacey, Wash.
278	1080	100	KUSD	Vermillion, S. D.
278	1080	500	KWCR	Cedar Rapids, Ia.
278	1080	500	KWWG	Brownsville, Tex.
278	1080	500	WAAF	Chicago, Ill.
278	1080	100	WDZ	Tuscola, Ill.
278	1080	10	WGBC	Memphis, Tenn.
278	1080	500	WGBU	Fulford-by-the-Sea, Fla.
278	1080	100	WHAM	Rochester, N. Y.
278	1080	500	WHDI	Minneapolis, Minn.
278	1080	750	WLBL	Madison, Wis.
278	1080	1000	WOQ	Kansas City, Mo.
278	1080	500	WRBC	Valparaiso, Ind.
278.6	1080	50	KFDD	Boise, Idaho
280	1070	2000	KFAU	Boise, Idaho
280	1070	100	WJBX	Osterville, Mass.
280	1070	250	WKBJ	St. Petersburg, Fla.
280.2	1070	5000	KFQA	St. Louis, Mo.
280.2	1070	10	KGCA	Decorah, Iowa
280.2	1070	1500	KMOX	St. Louis, Mo.
280.2	1070	500	KOAC	Corvallis, Oregon
280.2	1070	100	WNAB	Boston, Mass.
282.8	1060	250	KGBW	Joplin, Mo.
282.8	1060		KSMR	Santa Maria, Cal.
282.8	1060	500	WCWS	Bridgeport, Conn.
282.8	1060	100	WKBB	Joliet, Ill.
282.8	1060	500	WOAN	Lawrenceburg, Tenn.
282.8	1060	500	WPSC	State College, Pa.
282.8	1060	1000	WSM	Nashville, Tenn.
285	1050	500	KOWW	Walla Walla, Wash.
285	1050	8	WKBQ	New York, N. Y.
285.5	1050	1000	WKAR	East Lansing, Mich.
285.5	1050	750	WQAM	Miami, Fla.
285.5	1050	500	WREO	Lansing, Mich.
286	1050	50	WMAN	Columbus, Ohio
288.3	1040	5000	KFKX	Hastings, Neb.
288.3	1040	500	WMBI	Chicago, Ill.
288.3	1040	1500	WSBC	Chicago, Ill.
293.9	1020	750	KTBI	Los Angeles, Cal.
293.9	1020	750	WAIU	Columbus, Ohio
293.9	1020	750	WEAO	Columbus, Ohio
296.9	1010	500	KPRC	Houston, Tex.
299.8	1000	1000	KSL	Salt Lake City, Utah
299.8	1000	750	KUOA	Fayetteville, Ark.
299.8	1000	5000	WPG	Atlantic City, N. J.
302.8	990	1000	KTAB	Oakland, Cal.
302.8	990	500	WMSG	New York, N. Y.
303	990	1000	WGN	Chicago, Ill.
303	990	4000	WLIB	Chicago, Ill.
305.9	980	100	KFDY	Brookings, S. Dak.
305.9	980	500	KOIL	Council Bluffs, Ia.
305.9	980	1000	KOMO	Seattle, Wash.
305.9	980	500	WJAR	Providence, R. I.
309.1	970	Var	KDKA	Pittsburgh, Pa.
312.6	960	1000	KSBA	Shreveport, La.
315.6	950	500	KFDM	Beaumont, Tex.
315.6	950	500	KFWM	Oakland, Cal.
315.6	950	1000	KPSN	Pasadena, Cal.
315.6	950	500	WAHG	Richmond Hill, N. Y.
315.6	950	4000	WEMC	Berrien Springs, Mich.
315.6	950	500	WGBS	New York, N. Y.
319	940	1000	KOIN	Sylvan, Oregon
319	940	750	WGR	Buffalo, N. Y.
319	940	500	WSMB	New Orleans, La.
322	930	1000	WBNY	New York, N. Y.
322.4	930	5000	KOA	Denver, Colo.

Meters	Kilocycles	Power	Call Letters	Location
325.9	920	1500	WKRC	Cincinnati, Ohio
325.9	920	5000	WSAI	Cincinnati, Ohio
327	917	50	WDBK	Cleveland, Ohio
329.8	910	10000	WJAZ	Chicago, Ill.
331	905	100	KGCB	Oklahoma, Okla.
331.1	905	2000	WBZ	Springfield, Mass.
333.1	905	100	KGBZ	York, Nebr.
333.1	905	500	KQW	San Jose, Cal.
333.1	905	1000	KTNT	Muscatine, Iowa
336.9	890	500	KFMX	Northfield, Minn.
336.9	890	500	KNX	Los Angeles, Cal.
336.9	890	500	WCAL	Northfield, Minn.
336.9	890	1000	WJAX	Jacksonville, Fla.
340.7	880	5000	KFAB	Lincoln, Nebr.
340.7	880	500	KSAC	Manhattan, Kans.
340.7	880	30	WJBW	New Orleans, La.
341	880	500	WMCA	New York, N. Y.
344.6	870	5000	WCBD	Zion, Ill.
345	870	5000	WLS	Chicago, Ill.
347.8	862	60	KGBX	St. Joseph, Mo.
348.6	860	5000	KOB	State College, N. Mex.
348.6	860	500	KWSC	Pullman, Wash.
348.6	860	500	WEEI	Boston, Mass.
348.6	860	150	WNJ	Newark, N. J.
352.7	850	500	WJAD	Waco, Tex.
352.7	850	1000	WWJ	Detroit, Mich.
360	833	1000	WEW	St. Louis, Mo.
361.2	830	5000	KGO	Oakland, Cal.
361.2	830	500	WHN	New York, N. Y.
361.2	830	100	WPAP	Cliffside, N. J.
361.2	830	100	WQAO	Cliffside, N. J.
365	820	500	WBRL	Tilton, N. H.
365	820	25	WRAL	Ithaca, N. Y.
365.6	820	1000	WDAF	Kansas City, Mo.
365.6	820	500	WHB	Kansas City, Mo.
365.7	820	1000	WABQ	Haverford, Pa.
367	817	500	WEAN	Providence, R. I.
370	810	2000	WEBH	Chicago, Ill.
370.2	810	500	KMTR	Hollywood, Calif.
370.2	810	1000	WJJD	Mooseheart, Ill.
372	806	150	WGM	Jeanette, Pa.
374	802	500	WRNY	New York, N. Y.
374.8	800	500	KFBU	Laramie, Wyo.
374.8	800	1000	KTHS	Hot Springs Nat. Pk., Ark
375	800	500	KVOO	Bristow, Okla.
379.5	790	10000	WGY	Schenectady, N. Y.
379.5	790	500	WHAZ	Troy, N. Y.
384.4	780	1000	KJR	Seattle, Wash.
384.4	780	500	KLZ	Denver, Colo.
384.4	780	500	WAAW	Omaha, Neb.
384.4	780	5000	WLWL	New York, N. Y.
384.4	780	500	WMBF	Miami Beach, Fla.
389.4	770	1000	WEAR	Cleveland, Ohio
389.4	770	1000	WTAM	Cleveland, Ohio
391.5	765	500	WODA	Paterson, N. J.
394	760	100	WBRS	Brooklyn, N. Y.
394.5	760	1000	KHQ	Spokane, Wash.
394.5	760	500	WFI	Philadelphia, Pa.
394.5	760	500	WLIT	Philadelphia, Pa.
394.5	760	2000	WOAI	San Antonio, Tex.
399.8	750	500	WHAS	Louisville, Ky.
400	750	3500	WHT	Chicago, Ill.
405	740	500	WOR	Newark, N. J.
405.2	740	500	KHJ	Los Angeles, Cal.
405.2	740	1000	WJY	New York, N. Y.
407	737	100	WJAF	Ferndale, Mich.
410.7	730	2500	KFQB	Fort Worth, Tex.
416.4	720	500	WBBR	Rossville, N. Y.
416.4	720	5000	WCCO	St. Paul, Minn.
416.4	720	50	WCRW	Chicago, Ill.
422.3	710	1500	WKRC	Cincinnati, Ohio
422.3	710	5000	WLW	Cincinnati, Ohio
428.3	700	1000	KPO	San Francisco, Cal.
428.3	700	10	WKDR	Kenosha, Wis.
428.3	700	1000	WSB	Atlanta, Ga.
430.1	697	500	WNAC	Boston, Mass.
431	695	500	WHAP	New York, N. Y.
434	690	500	KGCH	Wayne, Nebr.
434.5	690	1000	NAA	Arlington, Va.
440.9	680	1000	KLDS	Kansas City, Mo.
440.9	680	1000	KMJP	Kansas City, Mo.
440.9	680	500	WDWF-WLSI	Cranston, R. I.
440.9	680	1000	WMAF	Dartmouth, Mass.
440.9	680	500	WOS	Jefferson City, Mo.
447.5	670	1000	WMAQ	Chicago, Ill.
447.5	670	500	WQJ	Chicago, Ill.
454.3	660	1000	KFOA	Seattle, Wash.
454.3	660	1500	KTW	Seattle, Wash.
455	660	50000	WJZ	New York, N. Y.
461	650	500	KMA	Shenandoah, Ia.
461.3	650	1000-2500	KFNF	Shenandoah, Ia.
461.3	650	500	WCAE	Pittsburgh, Pa.
467	640	5000	KFI	Los Angeles, Cal.
468.5	640	1000	WRC	Washington, D. C.
469.9	640	500	WJBV	Woodhaven, N. Y.
475.9	630	1500	WBAP	Fort Worth, Tex.
475.9	630	500	WFAA	Dallas, Tex.
475.9	630	500	WTIC	Hartford, Conn.
483.6	620	5000	WOC	Davenport, Ia.
484	620	500	WSUI	Iowa City, Ia.
491.5	610	500	WCFL	Chicago, Ill.
491.5	610	5000	WEAF	New York, N. Y.
492.5	609.5	1000	KGW	Portland, Oregon
499.7	600	500	KFRU	Columbia, Mo.
499.7	600	500	WMC	Memphis, Tenn.
508	590	500	KLX	Oakland, Cal.
508.2	590	500	WIP	Philadelphia, Pa.
508.2	590	500	WOO	Philadelphia, Pa.
516.9	580	5000	WCX	Pontiac, Mich.
516.9	580	5000	WJR	Detroit, Mich.
516.9	580	250	WJUG	New York, N. Y.
526	570	5000	WHO	Des Moines, Iowa
526	570	1000	WNYC	New York, N. Y.
526	570	1000	WOAW	Omaha, Nebr.
535.4	560	750	WHA	Madison, Wis.
536	560	2000	KYW	Chicago, Ill.
545.1	550	1000	KFUO	St. Louis, Mo.
545.1	550	500	KSD	St. Louis, Mo.
545.1	550	500	WTAG	Worcester, Mass.

This list has been corrected up to and including November 1, 1926.

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	Sending Hours
CF	**CFAC—Calgary, Alberta**—The Calgary Herald, Herald Bldg	500	434.5	690	Mountain	Mon., 1 pm to 9 pm; Tue., 1 pm to 8 pm; Wed., 1 pm; 5 pm to 8 pm; Thu., 1 pm; 7 pm to 9 pm (under call CNRC); Fri., 1 pm to 7 pm; Sat., 12 am to 1 pm; Silent; Sun.: 11 am to 7:30 pm alternating.
	CFCA—Toronto, Ont.—Star Publishing & Printing Co., S. W. Cor. Yonge St. and St. Clair Ave	500	356.9	840	Eastern	Daily except Sun.: 12 am to 1 pm; 5 to 6:30 pm; Mon., 6:30 to 8 pm; Wed., 6:30 pm to 2 am; alternate Thu. and Sat., 8 pm to 2 am; alternate Thu., 7 to 9 pm; alternate Sat., 8 to 9 pm. Sun.: 10 am to 1 pm; 6 to 9 pm.
	CFCF—Montreal, Que.—Canadian Marconi Co., Canada Cement Bldg	1650	410.7	730	Eastern	Daily except Sun.: 12:40 to 1 pm; Tue. and Sat., 4:45 to 5:45 pm (except in June, July and August). Mon. and Fri., 7 to 11:30 pm.
	CFCH—Iroquois Falls, Ont.—Abitibi Power & Paper Co., Ltd	250	499.7	600	Eastern	
	CFCK—Edmonton, Alberta—Radio Supply Co., Ltd., Royal George Hotel	50	516.9	580	Mountain	Daily except Sun.: 4 to 5 pm; 9 to 11:30 pm.
	CFCN—Calgary, Alberta—W. W. Grant (Ltd.), 708 Crescent Rd., N. W	1800	434.5	690	Mountain	Daily except Sun.: 8:45 to 9 pm; Tue. and Wed., 9 to 10 pm; Thu., 8 to 9; Tue., 11:30 to 1 pm to am; Fri., 10 to 1 pm to am.
	CFCQ—Vancouver, B. C.—Sprott-Shaw Radio Co., 153 Pender St., W	10	410.7	730	Pacific	Daily except Sun.: 7:30 to 8:30 pm.
	CFCT—Victoria, B. C.—G. W. Deaville, 1405 Douglas St	500	329.5	910	Pacific	Mon., Silent; Tue., Silent; Wed., 8 pm; Thu. 10:30 pm alternating; Fri., 8 pm; Sat., 10 pm; Sun.: 11 am and 7:30 pm; 9 pm.
	CFCY—Charlottetown, P. E. Island—Island Radio Co., Upper Hillsboro St	50	312.3	960	Atlantic	Wed. and Thu., 7:30 to 9:30 pm; Sun.: 11 am and 7 pm.
	CFDC—Vancouver, B. C.—Arthur Holstead & Wm. Hanlon, 1006 Granville St	10	410.7	730	Pacific	Daily except Sun.: 6 to 7 pm; Mon. and Wed., 9:30 to 11:30 pm; Thu., 10:30 to 11:30 pm. Sun.: 10 to 12 pm.
	CFGC—Brantford, Ont.—The Brant Radio Supply Co., 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 Assoc. of Prescott, Victoria Hall	50	296.9	1010	Eastern	
	CFCM—Kingston, Ont.—Monarch Battery Co., Montreal St	20	267.7	1120	Eastern	
	CFQC—Saskatoon, Sask.—The Electric Shop, Ltd., 1322 Osler St	500	329.5	910	Mountain	Daily: 9 to 10; 1 to 2; Wed., 8 to 10 pm; Fri., 9 to 12 pm; Sun.: 11 to 12; 7 to 8:30.
	CFRC—Kingston, Ont.—Queens University, Dept. of Electrical Engineering	500	267.7	1120	Eastern	
	CFYC—Burnaby, B. C.—International Bible Students Assoc., 2243 Royal Oak Ave	500	410.7	730	Pacific	Daily except Sun.: 12 to 1:30 pm; 2:30 to 3:30 pm. Daily except Sun. and Wed.: 4:30 to 5:30 pm. Daily except Sun. and Mon.: 6:30 to 7:30; Mon., 6:30 to 8:30; 9:30 to 11:30; Thu., Sat., 7:30 to 8:30; Sat., 10:30 to 11:30. Sun.: 7 to 7:30 pm; 9 to 10 pm.

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
CH						
CHCO	**Huntsville, Ont.**—A. Staples, Ginsburg Blk., Main St.	5	247.8	1210	Eastern	
CHCS	**Hamilton, Ont.**—The Hamilton Spectator, Spectator Bldg.	10	340.7	880	Eastern	
CHCY	**Edmonton, Alberta**—Int'l Bible Students Assoc., King Edward Park	250	516.9	580	Mountain	
CHIC	**Toronto, Ontario**—Northern Electric Co., Ltd., Hillcrest Park. (Uses Station CKNC, Canadian Nat'l Carbon Co., Toronto, Ontario)	500	356.9	840	Eastern	Mon., 8 to 9 pm; Sat., 10:30 to 11:30 am; 10:00 to 12 pm; Sun.: 5 to 6 pm.
CHLC	**Summerside, P. E. I.**—R. L. Holman, Ltd., Holman Bldg.	25	267.7	1120	Atlantic	
CHNC	**Toronto, Ont.**—Toronto Radio Research Soc., Hillcrest Park. (Uses Station CKCN, Canadian Nat'l Carbon Co., Toronto, Ont)	500	356.9	840	Eastern	No regular schedule.
CHNS	**Halifax, N. S.**—Northern Elec. Co., Carleton Hotel, Cor. Prince and Argyle Sts.	100	322.4	930	Atlantic	
CHRC	**Quebec, Que.**—E. Fountaine, 11 Fifth St.	5	340.7	880	Eastern	
CHUC	**Saskatoon, Sask.**—The International Bible Students Assoc., Cor. Ave. D and 26th St.	500	329.5	910	Mountain	Tue. and Thu., 8 to 9:30 pm. Sun.: 1 to 2 pm 7 to 9:30 pm.
CHWC	**Regina, Sask.**—R. H. Williams & Sons, Ltd., Cor. Hamilton St. and 11th Ave.	15	312.3	960	Mountain	
CHXC	**Ottawa, Ont.**—J. R. Booth, 28 Range Rd.	250	434.5	690	Eastern	Fri., 8:30 to 10 pm. Sun.: 2 to 3 pm.
CHYC	**Montreal, Que.**—Northern Electric Co., Ltd., 121 Shearer St.	750	410.7	730	Eastern	Wed., 7 to 12:30 pm; Sun.: 11 to 1 2 am; 7 to 11 pm
CJ						
CJBC	**Toronto, Ont.**—Jarvis St. Baptist Church. (Uses one of the stations in Toronto City or District.)	500	291.1 356.9	1030 840	Eastern	
CJCA	**Edmonton, Alberta**—The Edmonton Journal, Ltd., Journal Bldg.	500	516.9	580	Mountain	Daily except Sun.: 12:30 pm; Mon., 7:30 to 8 pm; 8:30 to 10 pm; Tue., 7:30 to 8 pm; Wed., 8:45 to 9 pm; 9 to 12 pm; mid to 1; Thu., 6 to 8 pm; Fri., 7:30 to 8 pm; 8:30 to 10:30 pm; Sat., 7:30 to 8 pm; 10 to 12 pm; mid. to 1; Sun.: 7:30 to 9 pm.
CJCF	**Kitchener, Ont.**—O. Rumpel, 39 S. Cameron St.	25	247.8	1210	Eastern	
CJCI	**Toronto, Ont.**—Loyal Order of Moose		291.1	1030	Eastern	
CJCQ	**York Co., Ont.**—Standard Radio Mfg. Corp., Ltd.	1000	291.1	1030	Eastern	
CJGC	**London, Ont.**—London Free Press Printing Co., Ltd. 430 Richmond St.	500	329.5	910	Eastern	Daily except Sun. and Mon.: 1 to 2 pm; 7 to 9 pm. Sun.: 11 am and 7 pm. Alternate Sun.: 2:30 to 3:30 pm.
CJOC	**Lethbridge, Alberta**—J. E. Palmer, 1235–5 Avenue A, South	50	267.7	1120	Mountain	
CJOR	**Sea Island, B. C.**—H. C. Chandler	50	291.1	1030		
CJRM	**Moose Jaw, Sask.**—Jas. Richardson & Sons, Ltd., 337 Coteau St. W.	50	296.9	1010		
CJSC	**Toronto, Ont.**—The Evening Telegram. (Uses station CKCL, the Dominion Battery Co., 20 Trinity St., Toronto, Ont.)	500	356.9	840	Eastern	No regular program schedule.
CJWC	**Saskatoon, Sask.**—The Wheaton Electric Co., Ltd., 33rd St. and Ave. C, North	250	329.5	910	Mountain	Mon., 12 to 1; 8 to 10 pm; Tue. and Thu., 12 to 1; 5 to 6; 6 to 7 pm; Sun.: 3:45 to 5 pm.
CJYC	**Scarboro Station, Ont.**—Universal Radio of Canada, Ltd.	500	291.1	1030	Eastern	
CK						
CKAC	**Montreal, Que.**—La Presse Publishing Co., Ltd., Cor. St. James St. & St. Lawrence Blvd.	1200	410.7	730	Eastern	Daily except Sat.: 4 pm 4:30 pm; Mon., Wed. and Fri., 1:45; 4:30 pm; Tue., Thu. and Sat., 7; 7:30; 8:30; 10:30 pm. Midnight Frolics, first and third Thu. of each month, at 11:30 pm; Sun., 2:45 pm.
CKCD	**Vancouver, B. C.**—Vancouver Daily Province, 142 Hastings St. W.	1000	410.7	730	Pacific	Wed. and Sat., 8:30 to 9:30 pm; Tues. and Fri., 8:30 to 8:50 pm; Mon., 8 to 9 pm; Thu., 8:30 to 10:30 pm.
CKCK	**Regina, Sask.**—Leader Publishing Co., Ltd.	500	312.3	960	Mountain	Daily except Sun.: 9:45 to 10:30 am; 1 to 2 pm. Tue., 7:30 to 8:15 pm. Sun.: 9 to 10 pm.

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station	Sending Hours
CK	**CKCL—Toronto, Ont.**—Dominion Battery Co., Ltd., 20 Trinity Street	500	356.9	840	Eastern	Daily except Sat.: 10:30 to 11:30 am; 3 to 4:30 pm; Mon., Wed. and Fri., 7 to 8 am; Tue., 7 to 12 pm; alternate Thu., 7 to 8; Sat., 7 to 8 pm; Sun.: 3 to 4:55 pm.
	CKCO—Ottawa, Ont.—Dr. G. M. Geldert, 282 Somerset St. W.	100	434.5	690	Eastern	Tue., 7 to 10 pm. Sun.: 7 to 10 pm.
	CKCV—Quebec, Que.—G. A. Vandry, 66 St. Joseph St.	50	340.7	880		
	CKCW—Burketon Jct., Durham Co., Ont.—Canadian Broadcasting Corp.	5000	329.5	910	Eastern	
	CKCX—Toronto, Ont.—International Bible Students Assoc. (Uses station CJYC, Universal Radio Co. of Canada, Ltd., Scarboro Station, Ont.).	500	291.1	1030	Eastern	
	CKFC—Vancouver, B. C.—United Church of Canada, Cor. Thurlow and Pendrell Sts.	50	410.7	730	Pacific	Sun.: 11 am to 1 pm; 3 pm to 5:30 pm; Alternate Sun.: 7:30 to 9 pm.
	CKMC—Cobalt, Ont.—R. L. Mac Adam	5	247.8	1210		
	CKNC—Toronto, Ont.—Canadian National Carbon Co.	500	356.9	840	Eastern	Mon., 8; 9 to 11 pm (alternate); Sat., 4; 8 pm.
	CKOC—Hamilton, Ont.—Wentworth Radio Supply Co., Ltd., Royal Connaught Hotel	50	340.7	880	Eastern	Mon., 6:15 to 7:15 pm; Thu., 5 to 6 pm; Fri., 6 to 7 pm; Sat., 2:30 to 6:30 pm; Sun.: 11 am to 12:30 pm; 6:30 to 8:30 pm.
	CKPC—Preston, Ont.—Wallace Russ, 40 Russ Ave., Eagle St	7½	247.8	1210	Eastern	
	CKSH—St. Hyacinthe, Que.—City of St. Hyacinthe, Que., Mondor and Cascades Sts.	50	312.3	960		
	CKY—Winnipeg, Manitoba—Manitoba Telephone System, Sherbrooke St.	500	384.4	780	Central	Mon., 10:50; 11 am; 12:30; 12:40 to 12:45; 1:15; 1:30; 2:15; 2:35; 4; 4:25; 4:45; 4:50; 5; 8; 8:30; 10:30; 11; 12 pm; Tue., 10:50; 11 am; 12:30; 12:40; 12:45; 1:15; 1:30; 2:15; 2:35; 4; 4:25; 4:45; 4:50; 5 pm (evening usually silent); Wed., 10:50; 11 am; 12:30; 12:40; 12:45; 1:15; 1:30; 2:15; 2:35; 4; 4:25; 4:45; 4:50; 5; 7:30; 11 pm; Thu., 10:50; 11 am; 12:30; 12:40; 12:45; 1:15; 1:30; 2:15; 2:35; 4; 4:25; 4:45; 4:50; 5; 8:30; 10; 11 pm; Fri., 10:50; 11 am; 12:30; 12:40; 12:45; 1:15; 1:30; 2:15; 2:35; 4; 4:25; 5 pm (evenings usually silent); Sat., 10:50; 11 am; 12:30; 12:40; 12:45; 1; 1:15; 1:30; 8; 8:30; 11 pm; Sun., 7; 9; 10 pm.
CN	**CNRA—Moncton, N. B.**—Canadian National Railways.	500	322.4	930	Atlantic	Daily: 2:45 to 3:45; Tue., 7:30 to 12; Fri., 9 to 12 pm.
	CNRC—Calgary, Alberta—Canadian National Railways (Uses station CFAC, Calgary Herald, Calgary, or station CFCN, W. W. Grant, Lt., Calgary).	500	434.5	690	Mountain	Wed. and Thu., 9 to 11 pm.
	CNRE—Edmonton, Alberta—Canadian National Railways. (Uses station CJCA, Edmonton Journal Ltd., Edmonton, Alberta)	500	516.9	580	Mountain	Fri., 7:30 to 8 pm; 8:30 to 10:30 pm.
	CNRM—Montreal, Que.—Canadian National Railways. (Uses station CHYC, Northern Elec. Co., Ltd., Montreal; CKAC, LaPresse Pub. Co., Ltd., Montreal; CFCF, Canadian Marconi Co., Montreal, P. Q.)	1000-1650	410.7	730	Eastern	4th Wed. of each month, 8:30 to 10:30 pm; 1st, 2nd and 3rd Thu. of each month, 8:30 to 10:30 pm; 5th Fri. of each month (when any), 8:30 to 10:30 pm.
	CNRO—Ottawa, Ont.—Canadian National Railways	500	434.5	690	Eastern	Wed., 7 to 7:30 pm; 7:30 to 8; 8 to 8:30; 8:57 to 10:15; 11 to 12:30 pm; Sat., 7:30 to 8; 8 to 8:30; 8:57 to 10:15; 11 to 12:30 pm.
	CNRR—Regina, Sask.—Canadian National Railways. (Uses station CKCK, Leader Pub. Co., Ltd., Regina, Sask.	500	312.3	960	Mountain	Tue., 8 to 10 pm.
	CNRS—Saskatoon, Sask.—Canadian National Railways. (Uses station CFQC, Elec. Shop, Ltd., Saskatoon, Sask.)	500	329.5	910	Mountain	Daily: 2:30 to 3:30 pm.
	CNRT—Toronto, Ont.—Canadian National Railways. (Uses station CFCA, Star Printing & Pub. Co., Toronto, Ont.)	500	356.9	840	Eastern	Fri., 6:30 pm to 2 am.
	CNRV—Vancouver, B. C.—Canadian National Railways, (Transmitter is on Lulu Island, B. C.)	500	291.1	1030	Pacific	Tue., 3:30 to 11:30 pm; Fri., 3:30 to 11:30 pm.
	CNRW—Winnipeg, Manitoba—Canadian National Railways. (Uses station CKY, Manitoba Tel. System, Winnipeg, Manitoba.)	500	384.4	780	Central	Wed., 8:30 to 11 pm.

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	CNRC	434.5	500
"	Edmonton	CFCK	516.9	50
"	Edmonton	CHCY	516.9	250
"	Edmonton	CJCA	516.9	500
"	Edmonton	CNRE	516.9	500
"	Lethbridge	CJOC	267.7	50
BRITISH COLUMBIA	Burnaby	CFYC	410.7	500
"	Kamloops	CFJC	267.7	15
"	Sea Island	CJOR	291.1	50
"	Vancouver	CFCQ	410.7	10
"	Vancouver	CFDC	410.7	10
"	Vancouver	CKCD	410.7	1000
"	Vancouver	CKFC	410.7	50
"	Vancouver	CNRV	291.1	500
"	Victoria	CFCT	329.5	500
MANITOBA	Winnipeg	CKY	384.4	500
"	Winnipeg	CNRW	384.4	500
NEW BRUNSWICK	Moncton	CNRA	322.4	500
NOVA SCOTIA	Halifax	CHNS	322.4	100
ONTARIO	Brantford	CFGC	296.9	50
"	Burketon Jct., Durham Co.	CKCW	329.5	5000
"	Cobalt	CKMC	247.8	5
"	Hamilton	CHCS	340.7	10
"	Hamilton	CKOC	340.7	50
"	Huntsville	CHCO	247.8	5
"	Iroquois Falls	CFCH	499.7	250
"	Kingston	CFMC	267.7	20
"	Kingston	CFRC	267.7	500
"	Kitchener	CJCF	247.8	25
"	London	CJGC	329.5	500
"	Ottawa	CHXC	434.5	250
"	Ottawa	CKCO	434.5	100
"	Ottawa	CNRO	434.5	500
"	Prescott	CFLC	296.9	50
"	Preston	CKPC	247.8	7½
"	Scarboro Station	CJYC	291.1	500
"	Toronto	CFCA	356.9	500
"	Toronto	CHIC	356.9	500
"	Toronto	CHNC	356.9	500
"	Toronto	CJBC	291.1–356.9	500
"	Toronto	CJCI	291.1	
"	Toronto	CJSC	356.9	500
"	Toronto	CKCL	356.9	500
"	Toronto	CKCX	291.1	500
"	Toronto	CKNC	356.9	500
"	Toronto	CNRT	356.9	500
"	York Co.	CJCQ	291.1	1000

Provinces	Cities	Call Letters	Wave Length (Meters)	Power (Watts)
P. E. ISLAND	**Charlottetown**	**CFCY**	312.3	50
"	**Summerside**	**CHLC**	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**	**CKCV**	340.7	50
"	**St. Hyacinthe**	**CKSH**	312.3	50
SASKATCHEWAN	**Moose Jaw**	**CJRM**	296.9	50
"	**Regina**	**CHWC**	312.3	15
"	**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

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.

All About Standard Time

The United States adopted standard time in 1883, on the initiative of the American Railway Association, and at noon of November 18th, 1883, the telegraphic time signals sent out daily from the Naval Observatory at Washington were changed to the new system, according to which the meridians of 75°, 90°, 105°, and 120° west from Greenwich became the time meridians of Eastern, Central, Mountain, and Pacific standard time respectively.

United States standard Eastern time is used from the Atlantic Ocean to a line through Toledo, Monroeville, Mansfield and Newark, O.; thence through Huntington, W. Va.; Norton, Va.; Johnson City, Tenn.; Asheville, N. C.; Atlanta and Macon, Ga.; and Apalachicola, Fla. U. S. standard Central time is used from this first line to a line through Mandan, N. D.; Pierre, S. D.; McCook, Neb.; Dodge City, Kans., and along west line of Okla., and Tex.; standard Mountain time is used from the second ine to a line that forms the western boundary of Mont,. thence follows the Salmon River westward, the western boundary of Idaho southward, the southern boundary of Idaho eastward, and thence passes southward through Ogden and Salt Lake City, Utah; Parker and Yuma, Ariz. U. S. standard Pacific time is used from the third line to the Pacific Ocean.

Almost all countries throughout the world use standard time that differs from Greenwich time by a whole number of hours or half-hours; a few countries, however, use standard time based on the longitude of their national observatories.

Table for Making Time Transitions

Eastern Standard Time..............	1	2	3	4	5	6	7	8	9	10	11	12
Central Standard Time..............	12	1	2	3	4	5	6	7	8	9	10	11
Mountain Standard Time..............	11	12	1	2	3	4	5	6	7	8	9	10
Pacific Standard Time..............	10	11	12	1	2	3	4	5	6	7	8	9

HOW TO USE TIME TRANSITION TABLE

If a station is giving a program at 8 o'clock Mountain time and you wish to find what this is equivalent to in Central time, find 8 o'clock in the third or Mountain time row. Then immediately above it in the same vertical column will be found the figure 9 in the Central time row. This indicates that the program would be heard at 9 o'clock Central time.

Foreign Radio Broadcast Stations

Including U. S. Possessions

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
ALASKA				
Juneau	Alaska Elec. Light & Power Co.	**KFIU**	226	10
Ketchikan	Roy R. Thornton, Sunset Manor	**KGBU**	229	500
ALGERIA				
Algiers	Colin & Fils	**8DB**	180	100
ARGENTINE				
Buenos Aires	Radio Titanic	**LON**	206.9	500
" "	Radio Prieto	**LOO**	250	1000
" "	Tomas Torres	**LOQ**	206.8	1000
" "	Diario "Critica"	**LOR**	222	1000
" "	Municipality of Buenos Aires	**LOS**	285.7	5000
" "	Francisco J. Brusa	**LOV**	352.9	1000
" "	Grand Splendid	**LOW**	300	1000
" "	Radio Cultura	**LOX**	375	500
" "	Sociedad Radio Nacional	**LOY**	315.8	1000
" "	"La Nacion" Soc. A. B. C.	**LOZ**	333.3	1000
" "	Gino Bocci Hnos.	**B2**	275	100
" "	Circ Bocci Hnos.	**A11**		
" "	Sociedad Radiotelefonica	**A1**		
" "	Francisco J. Brusa	**B1**		1000
" "	Facultad de Ciencias Medicas	**C1**		
" "	Departmento Nacional de Higiene	**C2**		
Cordoba	Antonio Vanelli	**H4**	275	20
"	Sociedad Radio Comercial de Cordoba		381	100
"	Jorge Coen	**HA8**	255	50
"	Diario "Los Principios"	**H6**	250	20
Hurlingham, FCP.	Felix Gunther	**DA-1**		
La Plata, FCS.	Universidad Nacional	**LOP**	425	1000
Mendoza	Ministerio de Obras Publicas	**LOU**	380	500
"	Pedro B. Baldasarre	**M6**	348	100
Monte Grande, FCS.	Argentine Broadcasting Assn.			
Olivos, FCCA.	Eugenio A. Vautier	**LOT**	272.7	1000
Rio Cuarto	Arturo Rodriguez	**H5**	275	100
Rosario	Manuel Fugardo	**F4**	260	100
San Fernando, FCCA.	Americo Liberti	**D3**	235.3	100
Santa Fe	Jose Roca Soler	**F1**	279	20
" "	Sociedad Rural de Cerealistas	**F2**	270	100
AUSTRALIA				
Adelaide	Central Broadcasting Co.	**5CL**	395	5000
"	F. J. Hume	**5DN**	313	500
"	Millswood Auto & Radio Co.	**5MA**		
"	Marshall & Co.	**5MC**	273	500
Bathurst		**2MK**		
Brighton		**3PB**		
Brisbane	Dr. V. McDowell	**4CM**	278	250
"	Radio Manufacturers Ltd.	**3MB**	337	250
"	Queensland Government	**4QG**	385	5000
Hobart	Associated Radio Co.	**7ZL**	525	250
Melbourne	Associated Radio Co.	**3AR**	484	1600
"	Broadcasting Co. of Australia	**3LO**	371	5000

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
AUSTRALIA				
Melbourne	O. J. Nilson & Co.	**3UZ**	319	100
"	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	5000
Rockhampton	Queensland Government	**4RN**	323	500
Sydney	The Electrical Utilities Supply Co.	**2UE**	297	250
"	Burgin Electric Co.	**2BE**	326	100
"	Farmer & Co., Ltd.	**2FC**	1100	10000
"	Broadcastings Sydney Ltd.	**2BL**	353	5000
Toowoomba	Gold Radio Elec. Service	**4GR**	294	100
AUSTRIA				
Graz	Oesterreichische Radio-verkehrs Gesellschaft		404	500
Vienna	Oesterreichische Radio-verkehrs Gesellschaft	**ORV**	530	1500
BELGIUM				
Brussels	Radio Belgique Co.	**BAV**	265	1500
BOLIVIA				
Oruro	Radio Club Boliviano	**CPM**	50—200	50
BRAZIL				
Bahia	Radio Sociedade de Bahia		250—450	500
Bello Horizonte	Radio Sociedade de Mina Geraes		400	500
Ceare	Radio Club Cearense			50
Curytiba	Livio Moreira			
Fortaleza	Radio Club			300
Goyanna	Benedicto Ravello			
Matto Grosso	Radio Club de Campo Grande			
Minas Geraes	Juiz 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
"	Cia Radiotelegrafica Brasileira		250—380	500
"	Radio Sociedade de Jader de Andrada			
"	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		381	1000
" " "	Radio Club do Brasil	**SPE**	312	500
" " "	National Telegraph Service		450	500
Sao Paulo	Sociedade Radio Educadora		310	1000
" "	Sociedade Radio Educadora Paulista	**SQIG**	450	1000
" "	Radio Club de Sao Paulo		350	100
" "	Radio Bandeirantes		370	50
" "	Dias Carneiro & Cia.		380—420	100
CANARY ISLANDS				
La Laguna	Servando Ortoll Delmotte	**EAJ5**	280	50
Las Palmas	Canary Islands Radio Club		300	6
CHILE				
Antofagasta	Oficina Jose Santos Ossa	**CLAC**		50
"	Oficina Jose Francisco Vergara	**CLAD**		50
Iquique	Gildemeister & Cia.	**CLAE**		100
"	Oficina San Pedro	**CLAF**		100
"	Oficina Pena Chica	**CLAG**		100

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
CHILE				
San Eugenio	Rene Doneaud		230	25
Santiago	Radio Corporation of Chile	CBC	400—600	250
"	Chilean Radiophone Club	CHAC	300	200
"	Ferrocarril Transandino Chileno	CLAA		200
"	Carlos Buin Walsen	CMAA	240	20
"	Sociedad Radio Chileana	CMAB	480	1500
"	Castagneto Felli	CMAD	320	100
"	Ministerio de Higiene	CMAF	400	1350
"	Sociedad Broadcasting de Chile	CRC	385	350
"	"El Mercurio"	CMAC	360	1000
"	Radio Comercial	CMAE	280	500
"	Pedro Arroyo	CMAG	250	250
"	Cia Radio Transandino	CMAI	260	100
"	Universidad de Chile	CMAU	440	100
"		ORC	430	
"		RC	350	50
"	Harvey Diamond	CNAA		
"	Jose Bellalta	CNAC		
Tacna	Ministerio de Relaciones Exteriores	CMAT	365	1000
Valparaiso	Cia Radio Transandina	CNAD	265	500
"	Cia de Salitres de Antofagasta	CLAB		50
Vilna del Mar	Antonio Cornish Besa	ACB	400	50
" " "	Antonio Cornish Besa	CNAB		
CHINA				
Shanghai	Kellogg Switchboard & Supply Co.	KRC	365	100
Tientsin	Gisho Electric Co.	GEC	288	50
Victoria (Hongkong)	Government			1500
COSTA RICA				
San Jose	Government			
CUBA				
Caibarien	Maria J. Alvarez	6EV	250	50
Camaguey	Pedro Nogueras	7AZ	225	10
"	Salvador Rionda	7SR	350	500
Camajuani	Diego Ibarra	6YR	200	20
Central Tuinicu	Frank H. Jones	6KW	340	100
" "	Frank H. Jones	6KJ	275	100
Ciego de Avila	Eduardo V. Figueroa	7BY	235	20
Cienfuegos	Jose Ganduxe	6BY	260	200
"	Antonio T. Figueroa	6CX	170	20
"	Eduardo Terry	6DW	225	10
"	Luis Del Castillo	6GR	250	10
"	Juan Pablo Ros	6GF	190	50
"	Eligio Cobelo Ramirez	6JQ	275	10
"	Valentin Ullivarri	16AZ	200	20
Havana	Credito y Construcciones Cia.	2HP	295	100
"	Julio Power	2JP	270	20
"	Frederick W. Borton	2CX	320	10
"	Alberto S. Bustamante	2AB	235	10
"	Cuban Telephone Co.	PWX	400	500
"	Jose Leiro	2JL	275	50
"	Alvara Daza	2K	200	20
"	E. Sanchez de Fuentes	2KD	350	50
"	Fausto Simon	2MN	270	30
"	"El Pais"	2EP	355	400
"	Humberto Giquel	2CG	350	15
"	Bernardo Barrie	2BB	255	15
"	Frederick W. Borton	2BY	260	100
"	Luis Casas	2LC	250	30

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
CUBA				
Havana	Westinghouse Elec. Co.	**2EV**	220	100
"	Julio Power	**2HS**	180	50
"	Jose Lara	**2LR**	235	50
"	Manuel y Guillermo Salas	**2MG**	280	20
"	R. B. Waters	**2MK**	85	20
"	Maria Garcia Velez	**2OK**	360	100
"	Oscar Collar Orta	**2OL**	300	100
"	Roberto E. Ramirez	**2TW**	230	20
"	Roberto E. Ramirez	**2UF**	265	10
"	Manuel Karman	**2RK**	310	20
"	Raul Karman	**2RY**	275	10
"	Homero Sanchez	**2SZ**	180	10
"	Amadeo Saenz	**2WW**	210	20
"	Antonio A. Ginard	**2XX**	150	50
"	Raul Perez Falcon	**2JD**	105	20
"	Heraldo de Cuba	**2HC**	275	500
Matanzas	Leopoldo T. Figueroa	**5EV**	360	10
"	Ernesto V. Figueroa	**5AZ**	200	50
"	Leon Gonzalez Velez	**5BY**	190	10
Nueva Gerona	Isle of Pines Telephone Co.	**8JQ**	225	20
Puerto del Rio	Antonio Sarasola	**1AZ**	275	50
Sagua la Grande	Santiago Ventura	**6HS**	200	10
Santiago	Alfredo Vinnet	**8FU**	225	15
"	Pedro C. Anduz	**8DW**	275	50
"	Alfredo Brooks	**8AZ**	240	20
"	Ceferino Ramos	**8IR**	190	20
"	Alberto Ravelo	**8BY**	250	100
"	Guillermo Polanco	**8HS**	200	20
Tuinicu	Frank H. Jones	**6XJ**	275	50
CZECHOSLOVAKIA				
Brunn	Radio Journal	**OKB**	750	1000
Prague	Radio Journal	**OKP**	513	5000
DENMARK				
Copenhagen	Copenhagen Radio Broadcasting Station		348	500
Soro	Ministry of War		1150—2400	1000
EQUADOR				
Guayaquil	J. Puig Verdaguer			
FINLAND				
Hango	Nuoren Voiman Liiton Radiohydistys		259.6	200
Helsingfors	Civil Guards of Finland		522	500
Jyvaskyla	Nuoren Voiman Liiton Radiohydistys		301.5	100
Mikkeli	Nuoren Voiman Liiton Radiohydistys		561	100
Pori	Nuoren Voiman Liiton Radiohydistys		255.3	100
Skatudden	Military Station Radio Div.		318	750
St. Michel	Nuoren Voiman Liiton Radioyhdistys		561	500
Tammerfors	Nuoren Voiman Liiton Radiohydistys	**3NB**	393	250
Tampere			373	250
Uleaborg			233	100
FRANCE				
Agen	Dept. of Lot et Garonne	**2BD**	318	250
Grenoble	Ministry of P. T. T.		380	150
Issy-les-Moulineaux	Ministry of War	**QGA**	1800	500
Lyon	Ministry of P. T. T.	**YN**	482.3	500
"	Radio Lyon		280	2000
Marseilles	Ministry of P. T. T.		340.1	300
Mont-de-Marsen			366	300
Montpellier	Societe Languedocienne de T. S. F.		168	100

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
FRANCE				
Paris	Ecole Superieure de P. T. T.	FPTT	459.4	500
"	Eiffel Tower, Army	FL	2200	4000
"	Societe Francaise Radioelectrique	8AJ	1780	100
"	Petit Parisien		345	500
"	Cie. Francaise de Radiophone		1750	4000
Pic du Midi			350	
St. Etienne	Radio Club Forezien		220	50
Toulouse	Aerodrome	MRD	315	2000
"	La Radio		435.1	2000
GERMANY				
Berlin	Koenigswusterhausen Deutsche Welle A. G.	AFP	1300	5000
"	Vox Haus Funkstunde	AB	571	2250
"	Witzleben Funkstunde A. G.		504	
Bremen	Nordische Rundfunk		277	1500
Breslau	Schlessische Funkstunde		418	4000
Dortmund	Westdeutsche Funkstunde		283	
Dresden	Mitteldeutscher Rundfunk		294	750
Elberfeld	Westdeutsche Funkstunde		259	
Frankfort-on-the-Main	Sudwestdeutscher Rundfunkdienst	LP	470.4	750
Freiburg-Brsg.	Suddeutsche Rundfunk		446	
Gleiwitz	Schlesische Funkstunde		251	1500
Hamburg	Nordische Rundfunk	EG	392	750
Hanover	Nordische Rundfunk		297	1500
Kassel	Sudwestdeutscher Rundfunkdienst		273	750
Kiel	Nordiche Rundfunk		233	
Koenigsberg	Ostmarken Rundfunk		462	750
Leipzig	Mitteldeutscher Rundfunk	MR	452	750
Munich	Deutsche Stunde in Bayern	WM	488	750
Munster	Westdeutsche Funkstunde		412	750
Nuremberg	Deutsche Stunde in Bayern		340	750
Stettin	Funkstunde A. G.		241	
Stuttgart	Suddeutscher Rundfunk	OKP	446	1500
HAWAII				
Honolulu	Honolulu Advertiser	KGU	270	500
HUNGARY				
Budapest	Muegyetemi Radio Club	MTI	546	1000
"	Magyar Tavirati Iroda		1050	2000
ICELAND				
Reykjavik			430	500
INDIA				
Bangalore	Indian Broadcasting Co.			
Bombay	Walter Rogers & Co.	2AX	226	
"	Bombay Presidency Radio Club	2FV	387	220
Calcutta	Indian States & Eastern Agency	5AF	425	1500
Karachi	Karachi Radio Club		425	40
Madras	Crampton Elec. Co.		220	120
Rangoon	Radio & Wireless Club of Burma		450	40
IRISH FREE STATE				
Dublin	Government	2RN	390.9	1500
ITALY				
Milan	Unione Radiofonica Italiana	IMT	308	1280
Rome	Unione Radiofonica Italiana	IRO	434	1200
JAPAN				
Nagoya	Nagoya Radio Broadcasting Co.	JOCK	360	1500
Osaka	Osaka Radio Broadcasting Co.	JOBK	385	500
Tokyo	Tokyo Radio Broadcasting Co.	JOAK	375	1000
LATVIA				
Riga			480	2000

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
MEXICO				
Chihuahua	Federal Government	**CZF**	325	250
"	Telefonos Del Gobierno del Estado de Chihuahua	**ZCF**	310	250
"	Compania Telefonica	**XICE**	500	500
Guadelajara	Radio Club—Degollado Theatre		280	10
"	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
" "	Jose J. Reynosa (El Buen Tono)	**CYB**	275	500
" "	Miguel S. Castro (La High Life)	**CYH**	375	100
" "	"El Universal"	**CYL**	400	500
" "	Martinez y Zetina	**CYO**	425	100
" "	Excelsior Parker	**CYX**	325	500
" "	La Liga del Radio	**CYZ**	400	100
" "	Departmento de Educacion	**CZE**	350	500
" "		**CZI**	450	100
" "	Fabrica Nacional de Vestuario	**IJ**		500
" "	F. C. Stephenex	**IR**	250	100
Monterrey	Roberto Reyes	**CYM**	275	100
Oaxaca	Federico Zonilla	**CYF**	265	100
Puebla	Augustin del P. Saenz	**CYU**	312	100
Saltillo	Colegio Ateneo Fuente		450	135
Tampico		**CYE**	360	100
"	Alberto Isaak	**CYQ**	322	100
Vera Cruz	Ministerio de Communicaciones	**CYC**	300	500
" "		**CYD**	250	500
MOROCCO				
Casablanca	Radio Club de Moroc	**CNO**	250	500
NETHERLANDS				
Hilversum	Nederlandische Seintoellen Fabriek	**HDO**	1050	1000
NETHERLANDS EAST INDIES				
Soerabaya	Radiotelegraph Club		90	
NEW ZEALAND				
Auckland	Newcomb (Ltd.)	**1YL**	260	500
"	The Radio Broadcasting Co. of New Zealand	**1YA**	330	200
"	La Gloria Gramophone Co.	**1YB**	275	50
"	L. R. Keith	**IYD**	330	50
Christchurch	Radio Broadcasting Co.	**3AC**	240	10
Dunedin	Otago University	**4XO**	140	
"	British Electrical & Engineering Co.	**4YA**	310	500
"	Radio Supply Co.	**4YO**	370	500
"	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
"	Radio Broadcasting Co.	**2YK**	295	120
Whangarei	N. C. Shepherd	**1YC**	250	15
NORWAY				
Bergen	Bergen Broadcasters		358	500
Oslo	Broadcasting Co. A. S.	**OSLO**	381.2	1500
PERU				
Lima	Peruvian Broadcasting Co.	**OAX**	380	1500
"	German Gallo	**5OA**	250	20
"	Enrique Perez	**4OA**	250	20
"	Augusto Gilardi	**3OA**	250	20
PHILIPPINE ISLANDS				
Iloilo		**KPM**	400	500
Manila	I. Beck, Inc.	**KZIB**	260	20

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
PHILIPPINE ISLANDS				
Manila	Radio Corp. of the Philippines	**KZKZ**	270	500
"	Far Eastern Radio, Inc.	**KZRQ**	222	500
POLAND				
Warsaw	Government	**PTR**	380	700
PORTO RICO				
San Juan	Radio Corp. of Porto Rico	**WKAQ**	340	500
PORTUGAL				
Lisboa	Grandes Armazeins do Chiado	**PIAA**	320	500
Montesanto	Government Wireless Station	**CTV**	2450	1500
RUSSIA				
Moscow	Sokolniki		1010	2000
"	Trade Union		450	2000
"	Lubovitch		365	
"	Union of Soviet Workers		675	
"	Comintern	**RDW**	1450	12000
"	Radio-Peredatcha		400	2000
Leningrad			310–240	2000
Niji-Novgorod			253	1000
Kiev			1000	2500
SAN SALVADOR				
San Salvador	Government of Salvador	**AQM**	452	500
SENEGAL				
St. Louis	Senegal Radio Club		300	100
SPAIN				
Barcelona	Radio Barcelona (Hotel Colon)	**EAJ1**	325	1000
"	Radio Catalana	**EAJ13**	460	1000
Bilbao	Radio Club Vizcaina	**EAJ9**	415	200
"	Radio Vizcaya	**EAJ11**	418	200
"	Armando de Otera		383	200
Cadiz	Radio Cadiz	**EAJ3**	360	200
"	Juan Iaborra-Iahera	**EAJ10**	330	1000
Cartagena	Enrique de Orbe	**EAJ16**	335	150
"		**EBX**	1200	1000
Madrid	Radio Espana	**EAJ2**	334	300
"	Escuela Superior	**PTT**	458	1000
"	Antonio Castilla	**EAJ4**	305	1000
"	Radio Iberica	**EAJ6**	392	1000
"	Union Radio	**EAJ7**	372.4	1000
"	Radio Espanola	**EAJ15**	490	1000
"		**EGC**	1650–2200	2000
Malaga	Spanish Telecommunication Co.	**EAJ25**	325	2000
"	Alfonso Villota		325	200
Oviedo (Cima)	Arturo Cima	**EAJ19**	340	1000
"		**EAJ12**	345	1000
Salamanca		**EAJ22**	290	1000
San Sebastian	Sabino Ucelayeta	**EAJ8**	344.6	500
Sevilla	Manuel Garcia Ballesta	**EAJ17**	330	100
"	Jorge la Riva	**EAJ21**	300	1000
"	Radio Club Sevillano	**EAJ5**	350	150
Valencia		**EAJ24**	360	1000
"	Jose Lopes Azcar	**EAJ14**	400	500
Zaragoza		**EAJ23**	325	1000
STRAIGHTS SETTLEMENTS				
Singapore	Amateur Wireless Soc. of Malaya		270	100
SWEDEN				
Boden	Radiotjanst	**SASE**	1350	500
Eskilstuna	Radio Club	**SMUC**	243	150

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
SWEDEN				
Falun	Radiotjanst	**SMZK**	370	40
Gaevle	Radio Club	**SMXF**	325	200
Goteborg	Radiotjanst	**SASB**	290	500
Jonkopings	Jonkopings Rundradiostation	**SMZD**	265	200
Karlsborg	Radiotjanst	**SASF**	1350	50
Karlskrona			196	200
Karlstad	Karlstad Rundradiostation	**SMXG**	355	80
Linkoeping	Radio Club	**SMUV**	467	25
Malmo	Radiotjanst	**SASC**	270	500
Norrkoeping	Radio Club	**SMVV**	260	175
Stockholm	Radiotjanst	**SASA**	427	100
Sundsvall	Radiotjanst	**SASD**	545	500
Trollhattan	Trollhattans Rundradiostation	**SMXQ**	345	50
SWITZERLAND				
Berne	Gen. Post & Telegraph Office		302	1500
Geneva	Radio Broadcasting Soc. of Geneva		760	500
Lausanne	Lausanne Radio Society	**HB-2**	318	500
Zurich	Zurich University	**RGZ**	515–650	500
"	Zurich Radio Genossenschaft		514.1	500
TUNISIA				
Tunis	French Army	**OCTU—TUA**	1450--45	500
UNION OF SO. AFRICA				
Cape Town	Cape Publicity Assn.	**WAMG**	375	1200
Durban	Town Council		400	1200
Johannesburg	Associated Scientific & Technical Societies	**JB**	438	1000
UNITED KINGDOM				
Aberdeen	British Broadcasting Co.	**2BD**	497.1	1500
Belfast	British Broadcasting Co.	**2BE**	438.7	1500
Birmingham	British Broadcasting Co.	**5IT**	476.6	1500
Bournemouth	British Broadcasting Co.	**6BM**	385	1500
Cardiff	British Broadcasting Co.	**5WA**	351.6	1500
Daventry	British Broadcasting Co.	**5XX**	1600	16000
Dundee	British Broadcasting Co.	**2DE**	330.5	200
Edinburgh	British Broadcasting Co.	**2EH**	328	200
Glasgow	British Broadcasting Co.	**5SC**	421.6	1500
Hull	British Broadcasting Co.	**6KH**	335	200
Leeds-Bradford	British Broadcasting Co.	**2LS**	343.5—310	
Liverpool	British Broadcasting Co.	**6LV**	313	200
London	British Broadcasting Co.	**2LO**	362	3000
Manchester	British Broadcasting Co.	**2ZY**	376.8	1500
Newcastle	British Broadcasting Co.	**5NO**	403.9	1500
Nottingham	British Broadcasting Co.	**5NG**	326	1500
Plymouth	British Broadcasting Co.	**5PY**	338	200
Sheffield	British Broadcasting Co.	**6FL**	303.5	200
Stoke-on-Trent	British Broadcasting Co.	**6ST**	306	200
Swansea	British Broadcasting Co.	**5SX**	482	200
URUGUAY				
Montevideo	Radio Sudamericano	**CWOZ**	320	500
"	Diario "El Dia"	**CWOR**	375	500
"	Danree & Cia	**CWOF**	300	200
"	Templo Metodista	**CWOG**	325	100
"	Instituto Metereologico	**CWOB**	240	500
"	General Electric Co. of Uruguay	**CWOS**		500
VENEZUELA				
Caracas	Empresa Venezolana de Radiotelefonia	**AYRE**	374	1000
YUGOSLAVIA				
Belgrade	Cie. Generalle De T. S. F.	**HFF**	1650	2000

Capt. Renee Fonck, French Ace.

Lena Abarbanell, opera singer.

Chas. D. Isaacson, program director.

Vincento Ballaster.

Caroline Lee "The Virginia Girl.'

Dr. Sigmund Spaeth.

Olive Wyndham.

Jessie Tarbox Beal.

David Putterman, cantor.

Virginia Howell.

The Edison Ensemble.

A Message from WRNY to the Radio Folks

By CHARLES D. ISAACSON

Program Director, WRNY

YOU and I and all of us, in radio have such wonderful, perfect opportunities.

To do big things for America, for civilization, for progress, I would be loathe to go to my desk or our microphone if I thought the only occupation we had was sending out entertainment —even the very best.

I dream of the service of radio for great and good causes.

The other night, Dr. Stephen Wise (the eminent divine and the man whom the late William Jennings Bryan characterized as the most eloquent man in America) was our guest at WRNY and gave a beautiful thrilling message. He was so amiable, so generous, that I was touched by it. He listened to my thanks, and leaning over half whispered in my ear, "It was for a good cause. That's the thing that appeals to me—a cause. I'll do anything for a—Cause!"

Radio has the opportunity to work for great causes.

Not for propaganda. Not for slippery, sly, sneaky side-alley schemes.

But the great human vital causes.

For America, and all demands of the nation. For God, and all godly enterprises.

For enlightenment. For broad, free, sweeter thinking. For taste. For good taste. For better taste.

So over in our studio, we are trying to keep ourselves attuned to the call letters of the divine and human transmitters which appeal for right and order. We miss so much. We are not sufficiently sensitized yet to catch everything. There are interferences, many. And there are as you can well imagine, many material things which are calling for their place. We are not compromising. But we are finding the best way we can to keep the ideal and the practical in intimate and friendly relations.

But we need you.

We need your help, and your suggestions.

WRNY invites the radio folk in stations everywhere to set up an Exchange of Ideas.

I will make a proposal to you now, clearly and any or all of you, who write to me, I will carry my promise through to the letter.

WRNY will exchange a letter of ideas with any other station anywhere.

Tell us the different things you are trying to do which are constructive, and WRNY will tell you of its fine plans. Tell us what you have found needs and deserves support, and WRNY will do as much with you.

Go further: Tell us the novel ideas you have attempted in straight program making, and we will send you the outline of WRNY'S attempts.

Chronicle your account of the good and bad things in announcing in singing, playing, ensemble work—and let us in on your discoveries. We'll do the same.

Out of this there may come something more than good for us, and our individual audience, or good for you and your individual audience.

There may be born a real Fraternity of Radio, developed from the angle of Service to Great Causes.

And that is what I am coming to now.

WRNY will be glad to lend its aid to the organization of the Radio International Mutual Service Association. That sounds important. It doesn't really explain itself. Perhaps many better names will occur to you.

The membership will be amongst all who serve in radio and are interested through radio, to serve Great Causes.

The purposes will be to create an Exchange of Ideas, and to band together strength for campaigns, offenses, emergencies. At the present time, there is no banded army of radio. There are chains of stations, yes.

But if it seems desirous that all radio get behind a plan for America, or for God, or for any great need—there is no central channel for meeting all the strategic spots.

WRNY invites correspondence from all in radio work. Particularly from executives, program directors, studio managers, announcers, and the like.

WRNY invites suggestions.

WRNY invites an exchange of ideas.

But principally we should like to leave in this little message, one tiny, tremendous thought.

Radio used to destroy or malign is vicious.

Radio used to create and develop and sow seeds of beauty and worth is noble.

Let us all together strive to use our strategic positions to lead radio in the direction of service to mankind.

Christmas with Modern Improvements

By L. W. HATRY

THE red-hot mysteries of the writer's profession have gradually seeped out to an unsuspecting public. Consequently when I say this is written in hot August the logic thereof is readily understandable. At worst that fact can only cause the supposition that I have been affected by the heat. No other reason could convince anyone just why a technical writer should drop from his dignified realm into outlands of less *fascinating* writing.

The reason is an altruistic one—and yet not *so* altruistic, as will be divulged. So be it:—

Christmases come and go, and amid a job-lot of rejoicing and happiness there always creeps one chill figure. Momentarily, merely for the sake of argument, let's grant that some of the fun of the holiday is due to the gifts and that not a small part of the pleasure they deliver lies in the element of surprise, particularly when the surprise is over a bigger or a better gift. All granted; if we observe this chill figure we find "he" is symbolic and "he" represents the men of the family. Is "he" surprised or is "he" likely to be? It is improbable. Last Christmas "he" received a pair of socks, two handkerchiefs, a tie, two more handkerchiefs, another tie. Christmas before—but why go back that far? No one else will. Everybody will remember last Christmas and the result will be a surplus of socks to balance the previous handkerchiefs unless a birthday or unexpected splurge has disturbed the balance already. For this creature the faintest trace of thought prevents surprise; for that matter instinct does. This symbolic man and his sunless Christmas are my reason. I would come to his assistance and hence to the assistance of the men of all families—and hence the man in my own family whereby I become less altruistic, aye, I even approach the practical.

Let me plead. I assume the proper posture; left foot forward, right hand up. No— right foot— no— left hand— no, oh well, no matter, the posture is assumed. I beg that all families, especially the women-folk (why is that hyphenate more polite than plain "women"—parenthetically, again—I don't mean homely—) will make this Christmas one for the exercise of the ingenuity to the purpose of surprising that indubitably necessary device, the husband, by *not* buying him socks, ties or handkerchiefs. He will appreciate the spending of his money for his present much more if the present is something he may want but which he might deny himself. Nor after giving all this advice will I wander off satisfied with the theory and unable to propound and plan the practice as well. NO, SIR! At the same time, this being designed for a radio magazine, I being one of that

If he is a DX hound, nothing could please him more than parts for a set which can get distance.

category labeled "radio-bug" and my knowledge specialized in radio, this tirade will keep within the limits thus automatically acquiesced to.

The fan has one of three prominent bents which his folk can sift out for themselves. He has a bent for DX or distance, new circuits and apparatus; or, he likes most about radio that which occurs at the work-bench and he is a connoisseur of tools; or, much rarer, he aches for knowledge of radio and reads his idiotic head off. The material to be mentioned will follow a similar categorical arrangement and most of it is too technical and mysterious for anyone to remember so it will only be necessary to carry the article along and get the clerk to read the name of the particular thing wanted.

Now then, to get to the matter of the moment. There are, you know, set kits—or kit sets, have it as you will. These either contain the complete set of parts, from the smallest nut to the panel, or else they contain merely the essentials such as coils and condensers. There are super-heterodyne set kits, four-tube set kits, six-tube set kits and so on. One of the popular ones for this winter is for the construction of a short-wave receiver or a multi-wave-band affair. It is the former in particular, though, that makes many a fan's heart beat faster because he has probably tried many of the standard things and now he wants to play with impractical and the "ads" or an inadvertently dropped word will put one on the right track.

Father's enthusiasm becomes demonstrative over a battery eliminator for his radio set.

The automobile accessory-fiend has his counterpart in the apparatus-hound who loves his set accessories.

the short waves. Silver-Marshall makes a set of cute short-wave coils and the condensers to fit—a kit. So do several others, Bremer-Tully, Aero Coil, Hammarlund, etc. Look at the radio magazine ads for "short-wave coils and kits." Standard set kits are made by so many manufacturers that a list is

The automobile accessory-fiend has his counterpart in the apparatus-hound who loves his set accessories. This fellow wants meters—ammeters, voltmeters, milliammeters, wavemeters, three-reading meters, any meters at all. Any good standard meter is generally satisfactory and your "ads" can form your judgment in that line. Jewell Weston, Hoyt and Sterling are the names of a few manufacturers of standard instruments. For most, a double scale voltmeter is a very useful piece of equipment. This is a meter designed for table or other flat use which is arranged to measure the voltage of the "A" battery and, by means of correct wiring, of the "B" batteries as well. There is a combination ammeter and voltmeter for use with dry-cells and "B" batteries: this is extremely useful. Three-reading or three-scale instruments read three different voltages, each higher than the other. The wavemeter is an instrument for measuring the wave-length of incoming signal. A good one is made by General Radio and the device will serve as a wavetrap as well—and be it mentioned that a wavetrap helps reduce interference. The Hanscom wavemeter is a handy little device which acts as a miniature broadcasting station—hint to a "bug" about that!

And there are a thousand varieties of loudspeakers, a dozen breeds of headsets, many, many brands of dials from slow motion to hardy creepers, with all modern improvements including electric illumination and we wouldn't be surprised to learn of running water, showers, low center of gravity and a new 90 degree.

Let's not forget the "B" eliminator. Women as well as men want that. They like the idea of light-socket attachments in place of batteries. The fan simply hungers for one and there are gobs of good ones ready-made as well as kits to permit home assembly. The latter particularly are as varied as the year is long. The ads will help, they are generous that way, oh! how well they will help.

Tools

For the fellow who likes best the construction work, who loves to tinker with tools among the fascinations of radio, I have much sympathy; for families have a deliberate way, not intentionally insulting, of not thinking much of this sort of thing, of saying so and of remaining abysmally ignorant of it all.

Take a little device such as a screw-driver. It graduates from the watchmaker's tiny point to the browny blade of the machinist—extremes always are used to illustrate. While the radio-bug deals with neither extreme, neither is his hobby something to limit the choice

What most men can find in a fine collection of tools seems a mystery—but they can rave more about a cross-cut saw that rings true than the natural beauty shows.

simply to *a* screw-driver. He must have a short screw-driver with a not very wide blade, and certainly a thin one, which has a handle large enough to be gripped firmly. This is his general utility tool, doing nearly all the regular work. One screw-driver is too plebeian a present, though, and that's where a treatise like this comes in. He needs as well at least two others. One is comparatively short, but the blade must be very narrow and should be thin. This is used for getting at tiny set-screws. And he needs one with a blade no narrower than the utility one but the length of which is at least twice as much, and then he can get as far down into things as necessary for recalcitrant screws. Similarly a fourth screw-driver might be added by having another long-bladed one whose blade is narrow enough to cope with the tiny set screws. The four, of good quality, would make an attractive set. These plain screw-drivers are not the limit by any means. There are purchasable sets consisting of a handle and various sizes of screw-driver blades. There are ratchet screw-drivers, the handle of which will turn at choice, in either direction free from the blade so that the hand need not be loosened nor removed and which often make screwing a one-hand job instead of two. These all come in various grades at various prices.

And pliers! A fellow can make a set with no more than a satisfactory pair of these and a couple of good screw-drivers. There are three kinds that every set-constructor likes to have. He likes to have a side-cutter in a small size, one pair of very long-nose pliers and a wire-former. He can then do practically anything he wants to with facility. Yet these are hardly enough. For heavier work a larger size of the side-cutters is valuable; and for the same kind of work a plier normal to the automobile is useful. Then for cutting in corners and other odd places he needs a diagonal pair of pliers. This last plier has merely two cutting blades coming somewhat to a point and set at an angle.

The drill is a third utility tool. It is useless without drill-bits; the latter being the points that make the holes. These come in various styles. The radio man needs a fairly high-speed one and it is better to stick to some standard brand in this line.

Drill-bits come in sets. The type to buy for radio work, which generally deals with wood, composition and metal indiscriminately, is the high-speed drill-bit. The cost is only a trifle more per drill and the lasting power is much greater than the more normal types.

Saws have a variety positively astounding to the unwarned. However, the radio-bug's need is limited. He should have two. He should have a hack-saw with a thin blade and a dozen extra blades to fit. This is used for cutting metal or similar purposes where it will be handy. His other saw should be one of the familiar hand type in cross-cut style.

A more useful device than the vise is unlikely where much work and tinkering is done. A small one is very valuable, and if the equipment is increased it should be with another and much larger one for taking care of extreme sizes. These come in sufficient varieties to make a connoisseur go into raptures.

This is becoming over long, yet there remain rulers, rules, squares, dividers, scribers, and the small rethreading tools, taps and dies, and so on. And yet I've failed to mention files, one of the most varied of small tools. Well let's stop anyhow. There have certainly been suggestions enough in the space used already to provide any bug with a satisfactory Christmas, devoid of socks, ties and handkerchiefs.

The Man with the Ache to Learn

He has an incurable disease. It can be submerged under necessity but unless it has been dulled thoroughly by a long stretch of years (then is his true spirit broken) it will bob up ever irritating or compelling. For him the present of a wanted book, or a subscription or two to some coveted magazines will be manna from heaven. The newsdealer can provide the addresses of the magazines and the names of them, but don't depend on him as to suggestions regarding their worthiness. When in doubt about anything try to go to a man that knows something about it, be frank as to the case and then ask your questions. A good radio man interested in the technical side of things can offer the most accurate assistance; go to one or write to one. Radio magazines, most of them, run book review departments that can help in the choice of the book. But it is from the victim himself that the best suggestions come with a little diplomacy dangled around as a line to catch them with.

L'Envoi

I want to exit with a graceful bow but I really have nothing to say (another mixed metaphor). So, I say it, and look at you with pleading eyes that cry: "Now, do the right thing."

TRAINING FUTURE RADIO EXPERTS

By H. G. Cisin, M.E.

Photo by courtesy of Radio Institute of America

ECRETARY HOOVER has estimated that more than 5,000,000 nerican homes are equipped with io sets. Practically every set needs vicing at one time or another so it ı readily be seen that expert radio n are bound to be in great demand. odern sets, while simple to operate : more or less complicated in nstruction. Haphazard knowledge ked up by the "cut and try" method no longer adequate. The radio set this present day and age with its ee or four stages of radio frequency plification and three stages of audio plification, operating on a loop, ect from the light socket, is a far · from the simple crystal set of sev-l years ago. Many a so-called "ex-t" with knowledge sufficient to fix : old style sets finds himself de-edly up against it when it comes to 27 models. He finds that he needs ecial training and in answer to this eat need, schools have been estab-ned which supply the authentic owledge about radio necessary to ep the vast army of radio fans satis-d. Classroom instruction is pro-led for those able to attend either y or night classes, while a home ıdy course is furnished those whose cumstances prevent them from tually attending the classes.

The work in the classes is divided to lectures on electrical and radio eory and actual laboratory work on mmercial radio sets. The practical ork includes modern receiving set nstruction, trouble finding, assembly ıd adjustment.

A number of graduates of radio ome study courses have done remark-ble work as a direct result of the instructions received. One of the illustrations shows the interior of the transmitter house of WEMC at Berrien Springs, Mich. This station, which uses 5000 watts and cost $100,000, was built by Mr. John Fetzer, shown standing. Mr. Fetzer, who is only 26 years old, is a graduate of a well-known radio home study course. He designed and built this station without assistance.

The demand for men able to service radio receivers, is not the only one being met by the special radio schools. Operators are being trained for ship and shore commercial stations and engineers are turned out, capable of installing and operating broadcast stations.

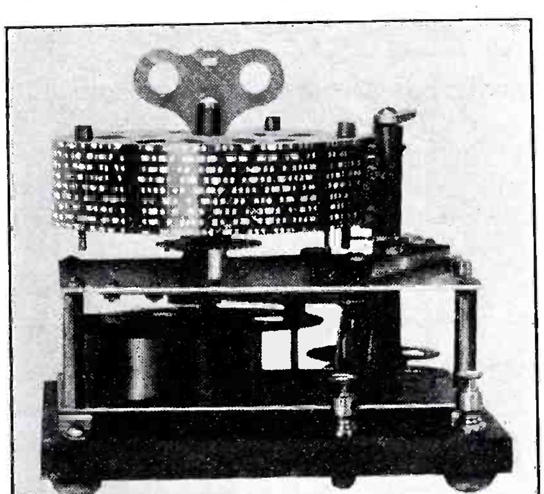


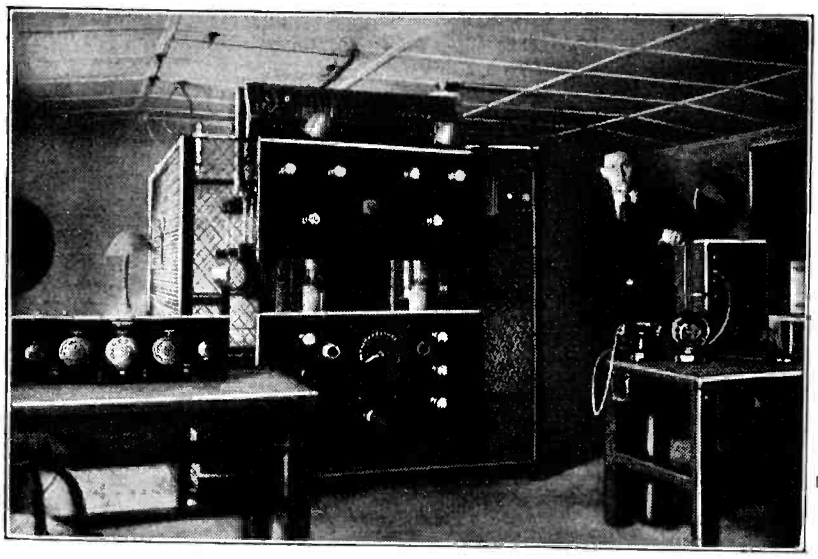
Photo by courtesy of National Radio Institute

The Natrometer is a mechanical code sending device. It is very useful for home-study of the radio code.

One of the illustrations shows a device known as a Natrometer, used for teaching students the code at home without the assistance of a human instructor. It gets excellent results and also is considered by many to be more efficient than a human code instructor. Another similar machine is known as the Omnigraph.

It is unlawful to operate a radio transmitting station of any kind without a government radio license. These licenses are divided into eleven classifications, ranging from commercial extra first class to amateur second grade. To pass the commercial extra first class examination, the operator is required to have 18 months' experience on a first class, first grade license, pass a technical examination with a grade of 85%, and a code examination of 30 words per minute in Continental code and 25 words per minute in American Morse Code. A radio broadcast license requires a code speed of 12 words per minute and a grade of 75% in the technical examination. To obtain an amateur first grade license, the applicant must have a satisfactory knowledge of the apparatus he wishes to operate and of the regulations of the International Radio Convention and Acts of Congress relating to interference with other radio communication and of the duties of all operators. He must be able to transmit and receive at least 10 words per minute in the Continental code and be able to recognize distress and official "keep out" signals. The second grade amateur license is issued only when the applicant satisfies the inspector in writing that he has the ability to pass the first grade license but cannot report for examination. The inspector may, at his discretion, waive examination.

The code test for operator's examinations consists of messages with call



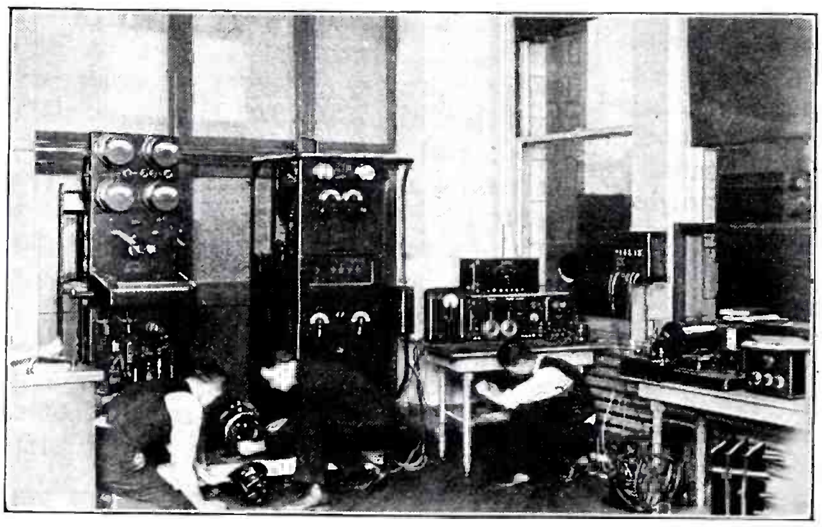
The illustration at the left shows the interior of broadcasting station WEMC built by Mr. John Fetzer, a graduate of a radio home study course. This station is located at Berrien Springs, Mich. It uses 5000 watts and cost $100,000.

Photograph by courtesy of National Radio Institute

letters and regular preambles, conventional signals, abbreviations and odd phrases. In no case does it consist of simple reading matter. The test is conducted by automatic transmitters. The applicant is required to receive perfectly for one minute out of five minutes' transmission at the speed required for the class of license he desires to obtain. Applicants are always given credit for the maximum speed attained. A sending test is given as well as a receiving test. The technical examinations call for a diagram of transmitting and receiving apparatus, knowledge of transmitting apparatus, knowledge of receiving apparatus, knowledge of care and operation of motors and generators, knowledge of storage batteries, of International Regulations and U. S. Radio Laws and Regulations and actual operating experience.

Those interested in radio operating are broadly classified as follows: First, young men who see in it a profitable life career. These men usually remain in the capacity of radio operators from two to five years and then get positions as chief radio operators aboard ship or as radio operators on trans-Atlantic liners or as engineers of broadcasting stations. Second, young men who need money for college courses or for similar purposes. These men stay at the job during the summer season and return to college with a world of experience from their travels and with money enough to see them through the following semester—since the minimum wage for radio operators is $85 a month, plus board and sleeping quarters. A third class of young men are those who go into radio operating for a year or two to see the world and to gather a familiarity with foreign customs that will be broadening to them in future life.

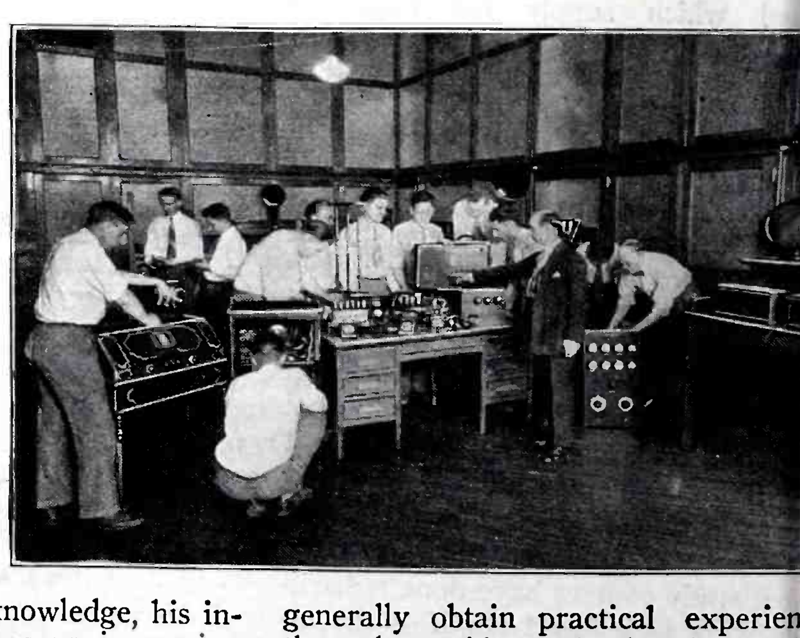
Promotions that occur in the ranks and the large proportion of operators who leave shortly after they take up this work, make for great opportunities in radio operating. It may be recalled that the present Vice-President and General Manager of the Radio Corporation of America was a former operator. Conditions aboard ship are generally good, operators being classed as petty officers. Inasmuch as there is generally little communication when a ship is in foreign ports, the operator



Students learn by act[i] practice how to install a[nd] operate intricate radio a[nd] electrical apparatus.

Photo by courtesy of Ra[dio] Institute of Amer[ica]

usually has a chance to go ashore and see the country. Radio operating is one field where a man must "know his stuff." If he has managed to crawl through the government examinations



Modern receiving sets are studied thoroughly so that the students will have first-hand knowledge of set servicing.

Photo by courtesy of Radio Institute of America

with a minimum of knowledge, his incompetency soon shows up in service.

The vastness and importance which radio has assumed in these last f[ew] years is almost unbelievable. From inventor's dream it has become international force which is shapi[ng] the progress and habits of nations.

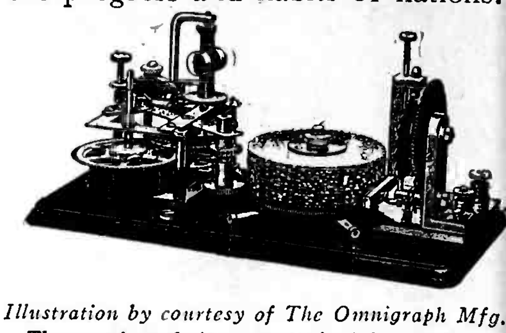


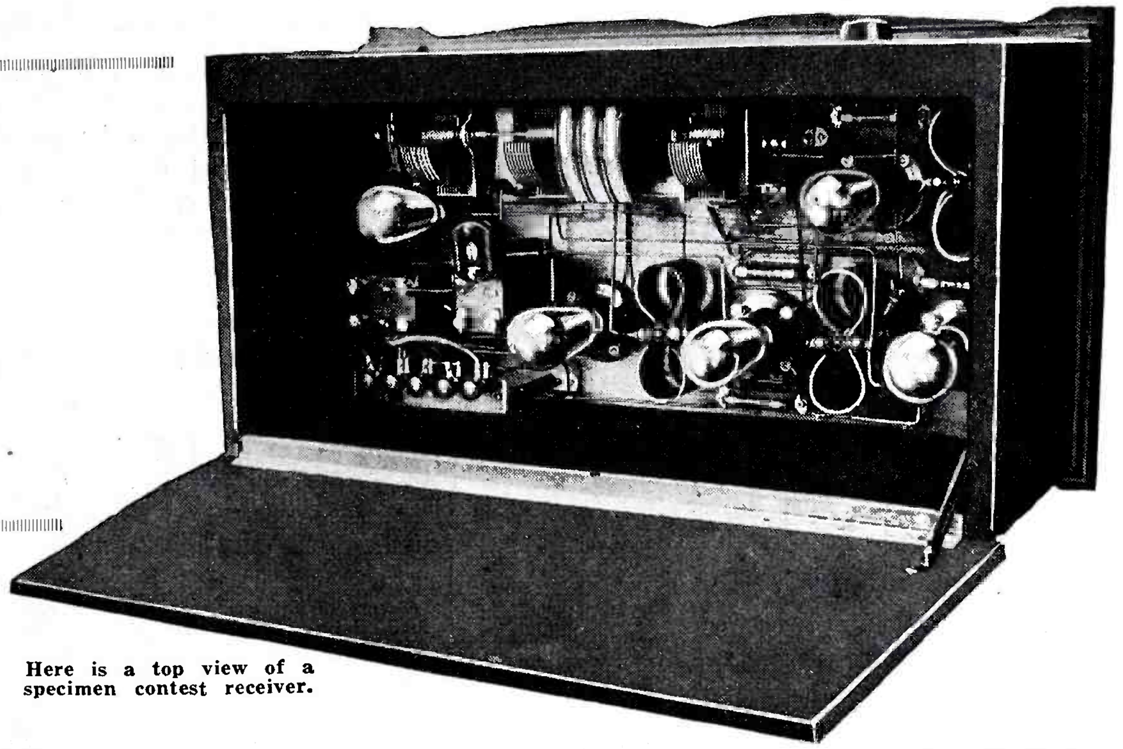
Illustration by courtesy of The Omnigraph Mfg.
The omnigraph is a convenient instrument fo[r] teaching the embryo radio operator the cod[e]

It takes an army of men to supp[ly] and maintain the radio sets now [in] operation. Not only because of t[he] tremendous size which the radio i[n]dustry has already attained, but al[so] because of its constant developme[nt] and growth, radio more than any oth[er] industry, calls persistently for mo[re] and more new men. Promotions [in] the ranks and installations of ne[w] equipment are continually opening [up] responsible and well-paying positio[ns] for operators, mechanics, salesme[n] engineers and executives. But t[he] most important requisite of all is thorough knowledge of radio—and th[is] is the knowledge which the mode[rn] radio schools and institutes are pr[e]pared to impart.

Students taking home-study cours[es] generally obtain practical experien[ce] through outside work, thus being al[e] to earn while they learn.

$200.00 Set Building Contest

Seven Best Sets Will Receive Cash Prizes



Here is a top view of a specimen contest receiver.

WE are constantly in receipt of letters from our readers telling us of the wonderful success they have had in building the sets described in the *Radio Listeners' Guide & Call Book*. Many of the set builders, although following instructions, as regards the circuit described, change the layout or add certain refinements which result in better tone quality, increased selectiveness or sensitiveness or sensitivity or in some way improve the operation. In some cases this improvement is the result of exhaustive experimentation, while in others it is purely accidental.

No matter how arrived at, we want to know what you have accomplished along these lines, so that other readers and set builders can take advantage of this knowledge and improve their sets also.

To make the matter more interesting, we are offering $200.00 in prizes for photographs and descriptions of the best sets built according to instructions in this and the Fall (1926) issues of *Radio Listeners' Guide & Call Book* which incorporate additional worthwhile refinements or improvements made by you. The conditions of the contest are given below. Photos and descriptions of prize-winning sets will be published in the next issue of this magazine.

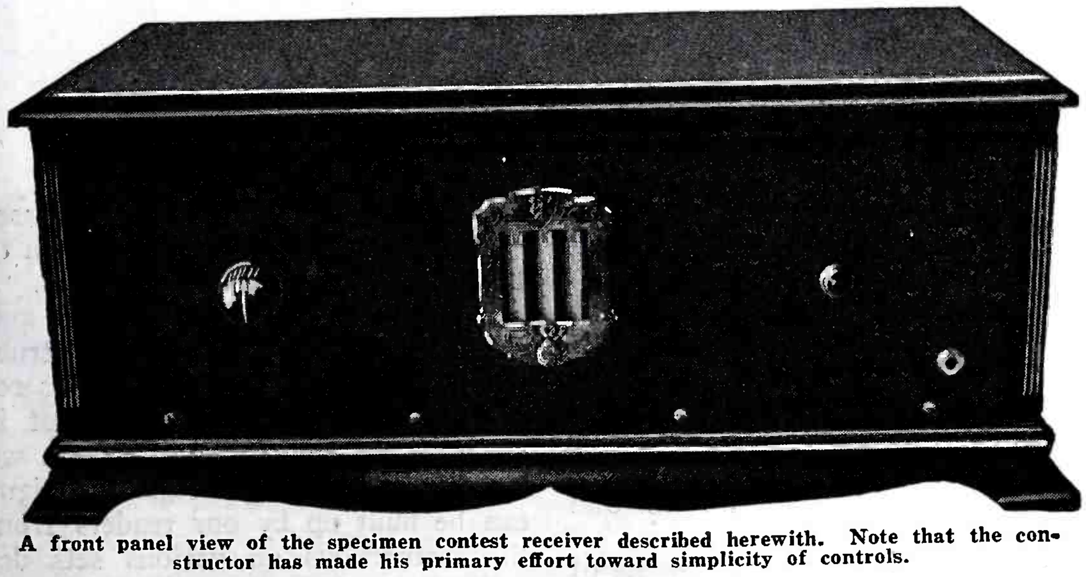
In order to give an example of what is expected, the photographs and descriptions herewith show a set which was built according to data for the Bodine Radio Frequency Set given in the June, 1926, issue of *Radio Listeners' Guide & Call Book*. The builder has introduced several interesting improvements in the layout and construction. These are fully described, and photographs show exactly how the work has been done.

$200.00 in Prizes

for description and photographs of the best sets built from instructions and circuits given in this or the Fall (1926) issues of the *Radio Listeners' Guide & Call Book*. This contest is open to all and will be decided strictly on the merits of the set which you build and describe. It will not be necessary for you to send in the set itself. You can win the prize and enjoy the set at the same time. The rules of the contest are given below. Read them carefully, but remember that this contest closes at noon, February 15th, 1927, and that all entries must be in our hands at that time.

PRIZES

First Prize	$100.00
Second Prize	50.00
Third Prize	25.00
Fourth Prize	10.00
Fifth, Sixth and Seventh Prizes, each	$5.00—$15.00
	$200.00



A front panel view of the specimen contest receiver described herewith. Note that the constructor has made his primary effort toward simplicity of controls.

Conditions and Rules of $200.00 Set Building Contest

1. Sets entered in this contest must be built according to some hook-up described in this issue or in the last issue (Fall, 1926) of *Radio Listeners' Guide & Call Book*.

2. To win a prize, a set must contain some improvement or refinement which will result in better operation.

3. No one shall be eligible for a prize unless the set has actually been constructed for this contest.

4. At least two photographs and complete description of the set must be submitted. No sets are to be submitted. Prize winning sets remain the property of the constructor.

5. Do not use pencil in writing the description of your set. Use typewriter or pen and ink.

6. Rolled manuscripts or photographs are excluded. All photographs and manuscripts must be submitted flat.

7. Anyone is eligible to enter this contest with the exception of employees of this magazine or their immediate families.

8. Name and address must be printed clearly on every sheet of paper and on every photograph.

9. The Editor reserves the right to publish any manuscript or photograph submitted for this contest.

10. This contest closes at noon February 15th, 1927, by which time all answers must have been received at this office. Announcement of the prize winners will be made in the Spring, 1927, issue of *Radio Listeners' Guide & Call Book*, upon publication of which the prizes will be awarded.

11. If, in the opinion of the Judges, two contestants send descriptions of sets possessing equal merit, they will each be awarded the identical prize.

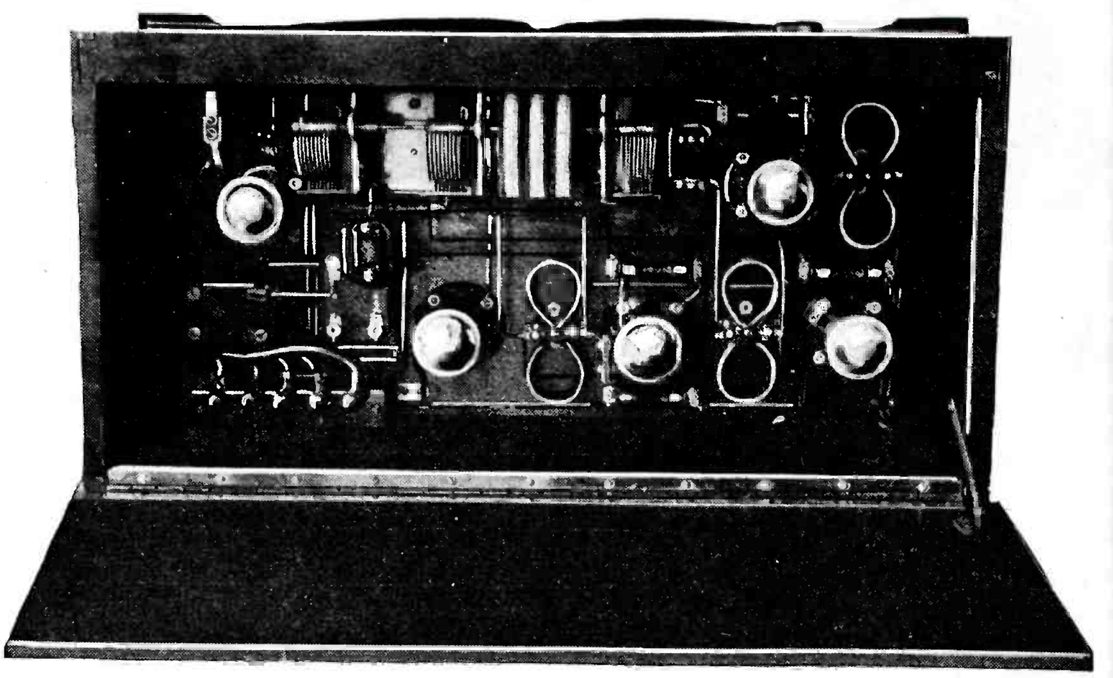
12. All entries should be addressed to Contest Editor, *Radio Listeners' Guide & Call Book*, 53 Park Place, New York City.

The prizes of this contest will be awarded to those persons submitting the most useful and interesting refinements or improvements on sets described in this and the Fall (1926) issues, in the opinion of the Judges.

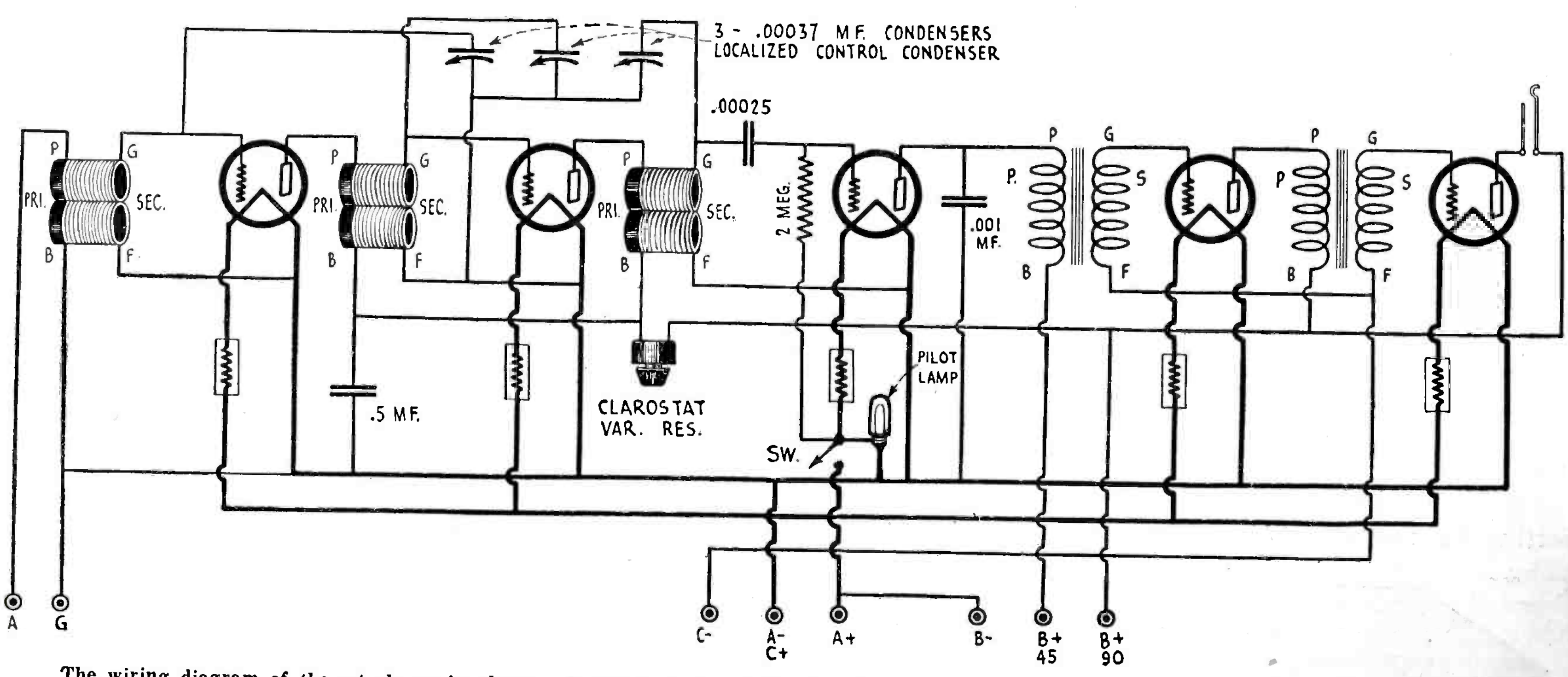
The Judges of the contest will be the Editors of this magazine. Their findings will be final.

Description of Contest Set Given for Example

The reader will find herewith photos of a 5-Tube Tuned Radio Frequency set which was built according to the instructions on "The Bodine Radio Frequency Set" given in the June, 1926, issue of *Radio Review combined with Radio Listeners' Guide & Call Book.* Although the identical hook-up as shown in the article was followed, a few modifications in design served to simplify controls and make the set more compact, to mention the least that they also made a better-looking panel arrangement. The set is built in a handsome walnut cabinet, size 7" x 21" (10" deep) which is fitted with an "Ace" crackle surface front panel. On a hard wood baseboard,



Another top view of the specimen contest receiver looking directly down into the set. Similar photos of contest sets are desirable.



The wiring diagram of the set shown in photos. A pencil sketch of the circuit may be sent in with photos of your set, but is not required.

which fits in the cabinet close around the inner sides, are mounted the Bodine radio frequency coils, Alden sockets, Amperites, Sampson audio frequency transformers, Electrad, .05 mfd. bypass condenser and Eby binding post strips on brackets and Alden localized control variable condenser unit. The latter is raised above the surface of the ½" baseboard by being mounted on a piece of 3/16" hard rubber cut from an old panel. This was done in order to bring the drums of the variable condenser unit up to the exact center of the front panel.

By eliminating the filament controls with Amperites as shown in the accompanying diagram, a Bruno panel light switch is used simply to turn the set on or off. A small pilot lamp illuminating through a small red glass, indicates when the tubes are lit. The only other control on the front panel besides this device and the localized drums which turn each condenser separately is a Clarostat variable resistance used to control volume.

This set operates most effectively and efficiently, having brought in Pacific coast stations under conditions which were far from ideal, in New York City.

The set is operated on a General Radio Company power amplifier and "B" supply unit made up from the regular kit as described in a recent issue of *Radio Listeners' Guide & Call Book.*

The "A" battery current consists of a small capacity 6 volt storage battery charged by means of a Balkite trickle charger.

A switching arrangement is provided so that when the set is not in use, the charger is building up the battery capacity.

The loud speaker used in conjunction with this set is of the three-foot cone type built up from the Engineers' Service Company's kit of parts. Despite the fact that this speaker is large in size it nicely serves the purpose of a cabinet on which to place the set. The front of the cone itself being hidden from view by silken drapery, consequently makes a handsome addition to the furnishings of the living room.

This receiver is merely shown and described in order to give the constructor who may care to enter in this set building contest an idea of what is expected in this contest, although we are sure that many original designs can be built up by our readers from the instructions on various sets described elsewhere throughout this and the Fall (1926) issue of *Radio Listeners' Guide & Call Book,* combined with *Radio Review.*

Read the rules on the preceding page carefully, select the set you are most interested in and start now to win a prize.

The Karas Equamatic Receiver

An Autobalanced Set Employing Automatically Coupled Radio Frequency Transformers

By A. M. POWERS

THE five-tube tuned radio frequency set is very popular for oadcast reception and justly so. hen one compares its many advanges with those of other types of sets, ere is little wonder that many other ts are completely outdistanced in eir race for popular approval. The rfect tuned radio frequency set is lective, non-radiating, operates efiently on both distant and local staons, is easily tuned and can be caliated or logged, and it introduces rtually no distortion in the reproiced music.

There is, however, one serious dislvantage in this type of set; it fails operate uniformly over the entire oadcast wave-band. You have probbly noticed, when tuning one of these ts that it is not quite sensitive enough the upper dial setting to receive DX, orks exceptionally well on the middle al settings (from, say, 30 to 60) and cillates or squeals incessantly on the wer dial settings. A set that behaves this manner is obviously unbalanced. is the problem of balancing the set at has baffled radio engineers in the ıst.

Hitherto the balancing schemes of erit have depended upon the electrical form amplification throughout the entire range, but in the set described below, mechanical and not electrical means are provided to balance the set

PARTS REQUIRED

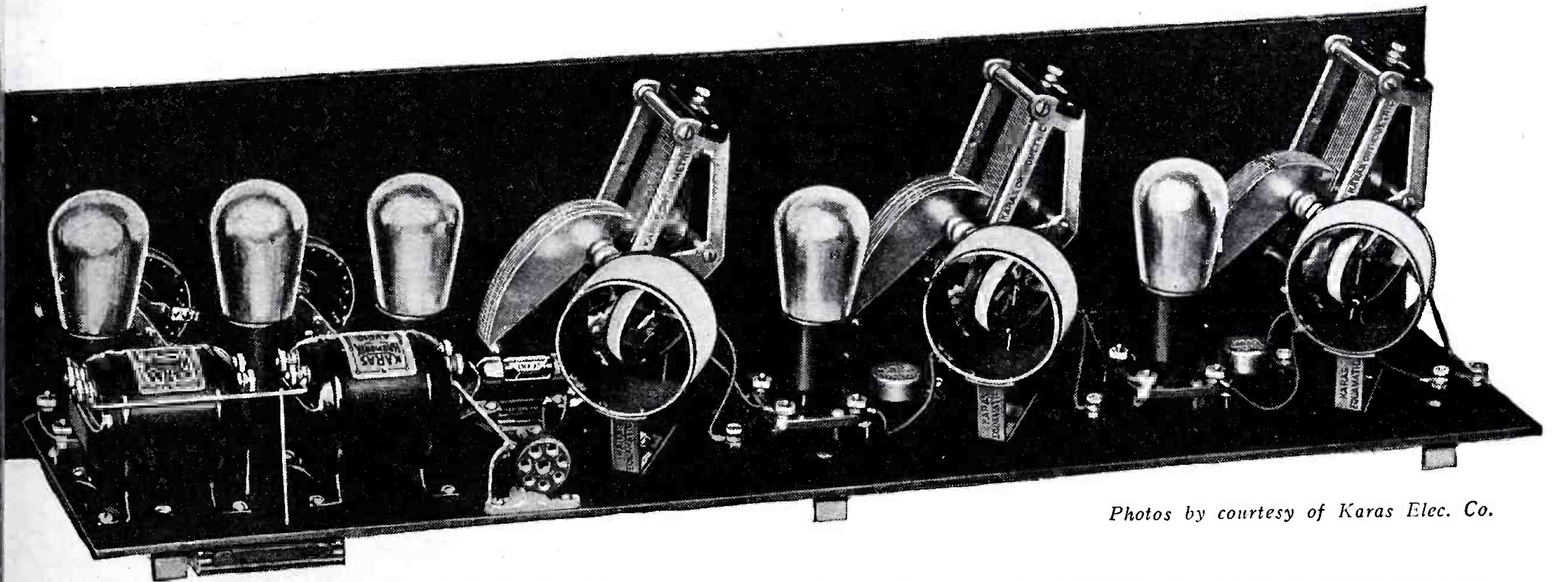
- 3 Karas Equamatic R.F. Transformers
- 3 Special Karas Orthometric Extended Shaft .00037 mfd. 17 plate variable Condensers
- 3 New Karas Micrometric Vernier Dials
- 2 Karas Harmonik Audio Transformers
- 2 Karas Equamatic Retard Coils
- 3 Karas Equamatic Sub-panel Brackets
- 1 Formica or Radion Panel 7" x 28"
- 1 Formica or Radion sub-panel 6" x 27"
- 1 Yaxley 10 ohm rheostat with dial
- 1 Yaxley 20 ohm rheostat with dial
- 1 Yaxley No. 4 interstage phone jack for first stage audio
- 1 Yaxley No. 1 open circuit phone jack for second stage audio
- 1 Yaxley filament switch
- 1 Sangamo .00025 mfd. fixed condenser with grid leak clips
- 1 Amsco 2 megohm grid gate
- 2 Radiall No. 1-A amperite 6 volt resistors with mountings
- 1 4½ volt C battery
- 1 Jones Multiplug with mounting and 8 ft. cable
- 5 Benjamin U.X. cushion sockets

and secondary of a radio frequency transformer at all wave-length settings between 200 and 600-meters,—the amount of energy to be transferred to be at all times the practical maximum. The merits and advantages of this system can best be explained by drawing attention to the inefficiency of existing methods of controlling oscillations in tuned radio frequency circuits.

It is acknowledged that the best broadcast reception occurs when the tubes are just under their oscillation point.

Let a straight line represent the oscillation point of a tube from 200 to 600 meters. Draw a parallel line underneath this line so that they are separated by about a thirty-second of an inch. The lower line will represent the point of highest efficiency of the tube—just under the oscillation point.

Let the left hand end of the line represent 200 meters. Let the right hand end represent 600 meters. Let the center represent 300 meters. Since the frequency of a 200 meter signal is 1500 kilocycles, and since the frequency of a 600 meter signal is only 500 kilocycles, and since impedance varies with frequency, and since the amount of energy transferred from



Photos by courtesy of Karas Elec. Co.

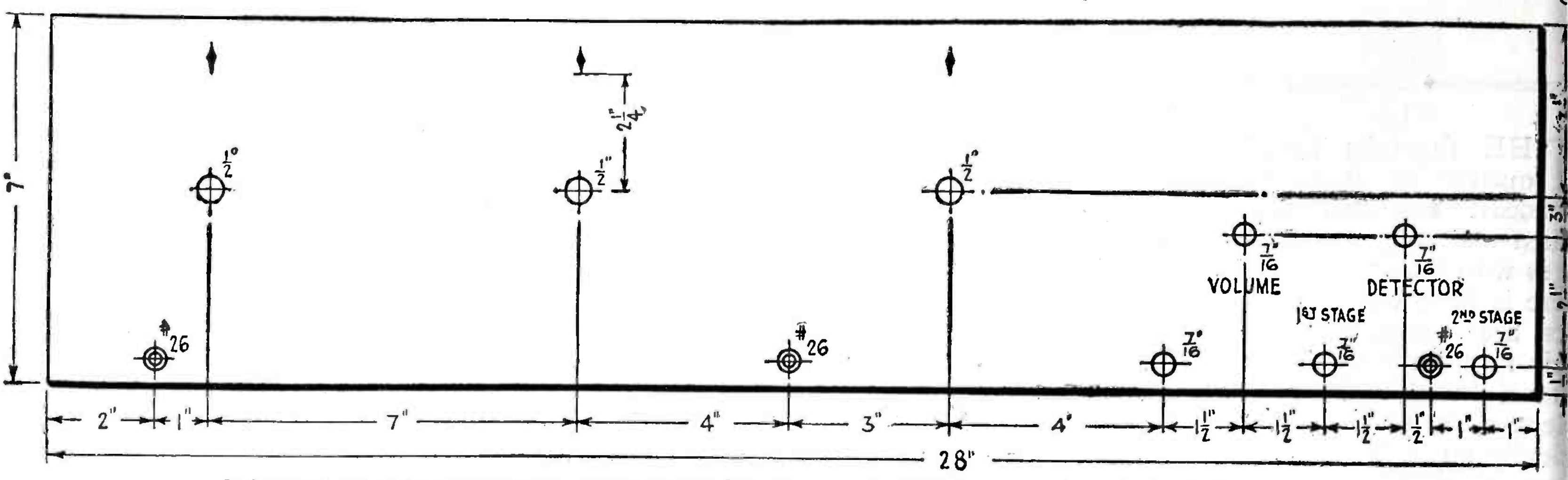
A rear view of the Karas Equamatic receiver. This shows the arrangement of the coils. A swivel arrangement permits the stationary coils to be adjusted in the exact position they are to stay permanently.

haracteristics of the circuits for their peration, as in the Isofarad, Neutroyne and others. A new method deeloped by E. H. Loftin and S. Y. White combines both electromagnetic nd electrostatic coupling between the adio frequency stages to obtain uniautomatically. The "Equamatic" System, developed by Louis G. King, is employed for automatically varying the coupling with the frequency.

The object of the Equamatic System is to provide a continuously equal transfer of energy between the primary primary to secondary varies with impedance, it is conceivable that we require a much greater inductance in a primary coil to tune to 600 meters than we require to tune to 200 meters.

It is also conceivable that in order to secure the practical maximum transfer of energy at every wave-length setting we require an increased primary for every ten kilocycle decrease in frequency, in other words, we would require an increased amount of primary for every successively longer wave-length setting.

Since there are 100 broadcasting

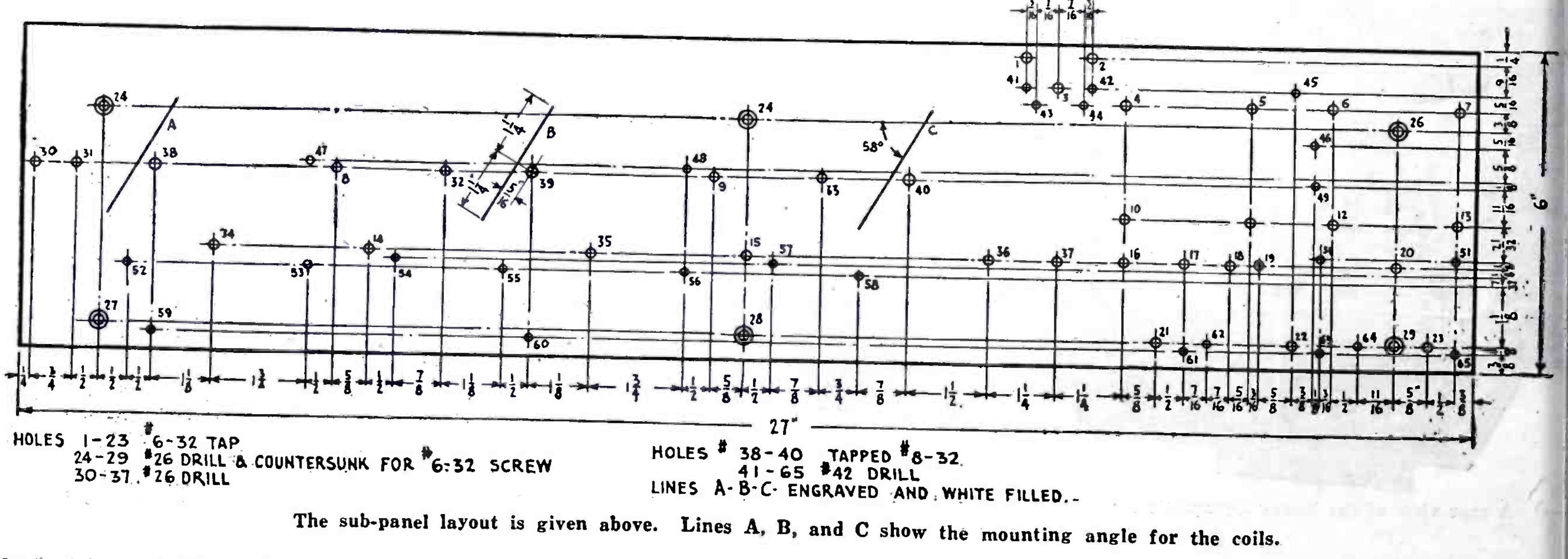


This shows the main panel layout. Holes marked No. 26 are to be drilled and countersunk for 6/32 in. screw.

channels between 200 and 600 meters we would require 100 separate primary coils, each having the exact number of turns, even to the fractional portion of a turn, if we were to secure the maximum transfer of energy between primary and secondary for every wave-length setting. Of course, it isn't practical to have 100 separate primary coils, or even 50, or 10, or 2. We must do the best we can with one primary coil.

It is conceivable that with a given secondary inductance tuned by the proper variable capacity that a primary coil that will fit comfortably inside the secondary coil would require, in order to tune to just under the oscillation point at 200 meters, a certain definite number of turns.

The exact number is not known, but for the sake of illustration let us say



The sub-panel layout is given above. Lines A, B, and C show the mounting angle for the coils.

3⅛ turns. The next longer wave-length, having a frequency of ten kilocycles less than 200 meters, would require a certain definite increased amount of wire on the primary, let us say 3½ turns, an increase of ⅜ of a turn. Then for the next longer wave-length, 20 kilocycles less than 200 meters, you might require four turns, or an increase of 4/8 of a turn.

These figures are in no wise actual. They are put down merely to illustrate the point that you require a continuously greater amount of inductance for each increased degree of 10 kilocycles of wave-length.

If we choose the coil of 3⅛ turns we will get the highest efficiency on a 200 meter signal. We will get successively lower efficiency on every successively longer wave-length. By the time we reach 600 meters in our tuning we have probably less than one-third of the energy transferred that we had at 200 meters.

Using 3⅛ turns is therefore quite impractical, so we have compromised by using anywhere from four to six turns. Let us consider for the sake of this argument that the compromise is on 6¼ turns, and let us consider that 6¼ turns is the proper number to tune to 300 meters. We now have high efficiency at 300 meters and a lower efficiency for every wave-length longer than 300 meters—poor efficiency at 600 meters.

Now let's see what happens at wave-lengths shorter than 300 meters. Having too much inductance for the increased frequency the consequence is that the tube "plops" into oscillation.

In order to keep the tubes from breaking into oscillation we have resorted to the so-called "losser" methods.

These methods have a decided broadening effect on tuning, causi the tubes to be less sensitive and le selective.

It is agreed, that the highest sensiti ity, highest selectivity and greate power occur simultaneously with th practical maximum transfer of energ between primary and secondary a every dial setting.

When anything is done to interfe with this practical maximum, either b providing too great a transfer o energy or too little a transfer o energy, we lose sensitivity, selectivit and volume.

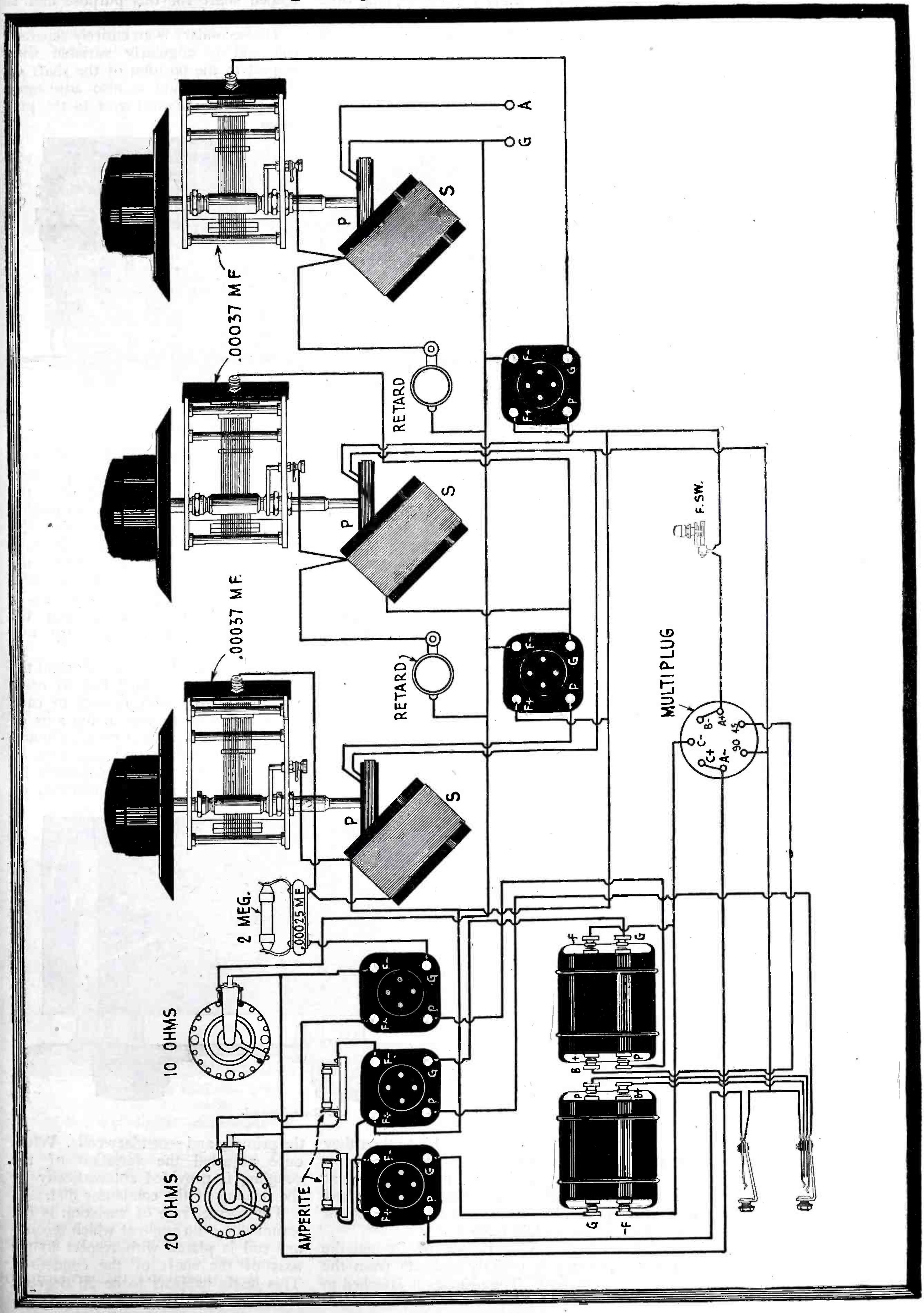
Referring back to our little diagra and our 6¼ turn primary for tunin with highest efficiency to 300 meter we find we have an ever increasing los of energy for all wave-lengths longe than 300 meters, and since, even wit the "losser" methods to control oscilla tions, we cannot control them auto matically at every dial setting, we hav in effect a dropping off of efficienc for even the wave-lengths shorter tha 300 meters.

As a matter of fact we have rea efficiency at one dial setting only, not a very enviable state of affairs.

The foregoing applies to the neutro dyne system the same as it does to any of the other present day "losser" methods of tuned radio frequency reception.

It is conceivable that requiring 3⅛

Picture Wiring Diagram of Karas Equamatic Receiver



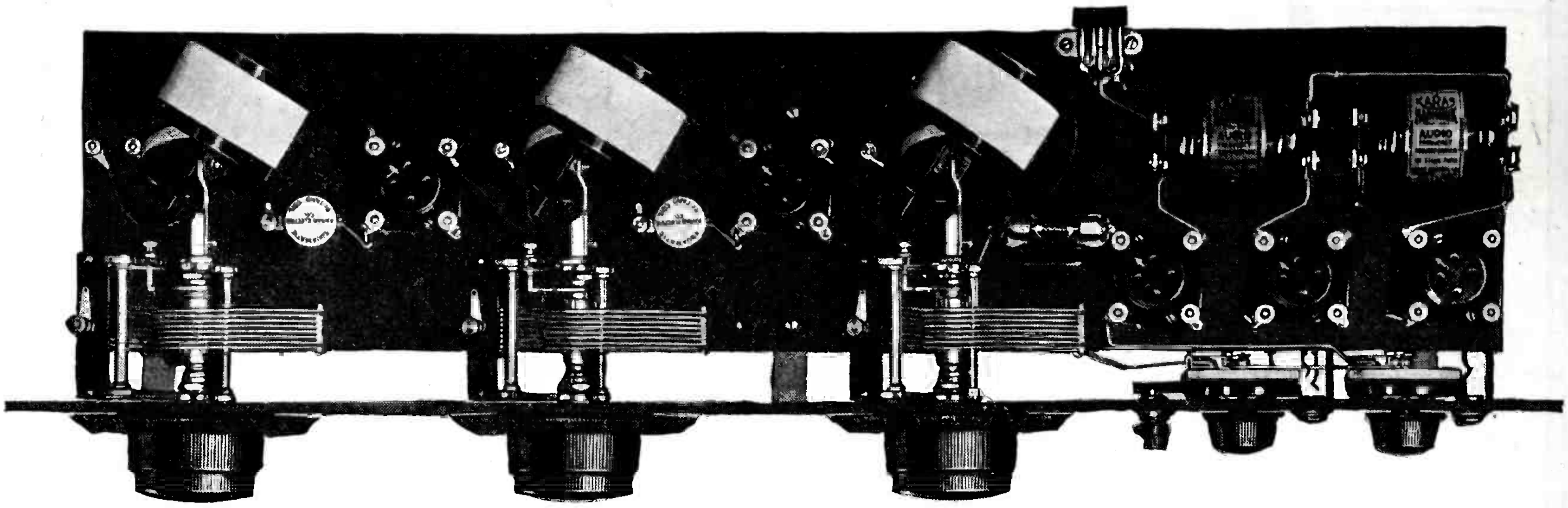
turns at 200 meters you would require in the neighborhood of 14 turns at 600 meters or 500 kilocycles. This variation in the number of turns required for each wave-length is of course based on a given degree of coupling.

Let us consider a tuned circuit having a 14 turn primary at close coupling with the secondary, and that this combination tunes to 600 meters with highest efficiency.

It is conceivable that if the 14 turn primary were drawn away from the secondary that at a certain distance from the secondary it would be the equivalent of 3⅛ turns at close coupling with the secondary.

If some mechanical means could be provided whereby the rate of separation between the primary and secondary coil could be kept in exact step at an ever-varying rate of variation, and that this variation could be accomplished automatically by the turning of the condenser knob so that the variation of the coupling between primary and secondary could always be exactly in proper step with the increase or decrease of the capacity of the condenser, you would have a system that would enable you to at all times automatically keep your tubes operating at a point just under the oscillation point without disturbing the rheostat or without resorting to any tuning device whatsoever other than the condenser knobs.

It has been realized by radio engineers generally for a long, long time that this sort of thing would be desirable. But it has been quite a different matter to work it out mechanically. Although there have been certain attempts to do this only one of them has been totally successful.



A top view of the finished receiver. The retard coils can be seen directly behind the two left-hand condensers.

Mr. King, the inventor of the Equamatic System, like all radio engineers, realized that in order to accomplish this equal transfer of energy at all wavelengths he would have to devise some means for varying the primary coil at a certain definite ever-changing rate of variation. His problem was to devise some mechanical means to do it.

He was aware of the various methods of varying the primary with the turning of the condenser shaft. But all of these methods lacked uniformity. They are better, of course, than fixed primaries, but since none of them provides for the variation of the entire primary at exactly the proper ratio to keep the tubes just under the oscillation point at a constant setting of the rheostat, they are considerably less efficient at certain dial settings than they are at others.

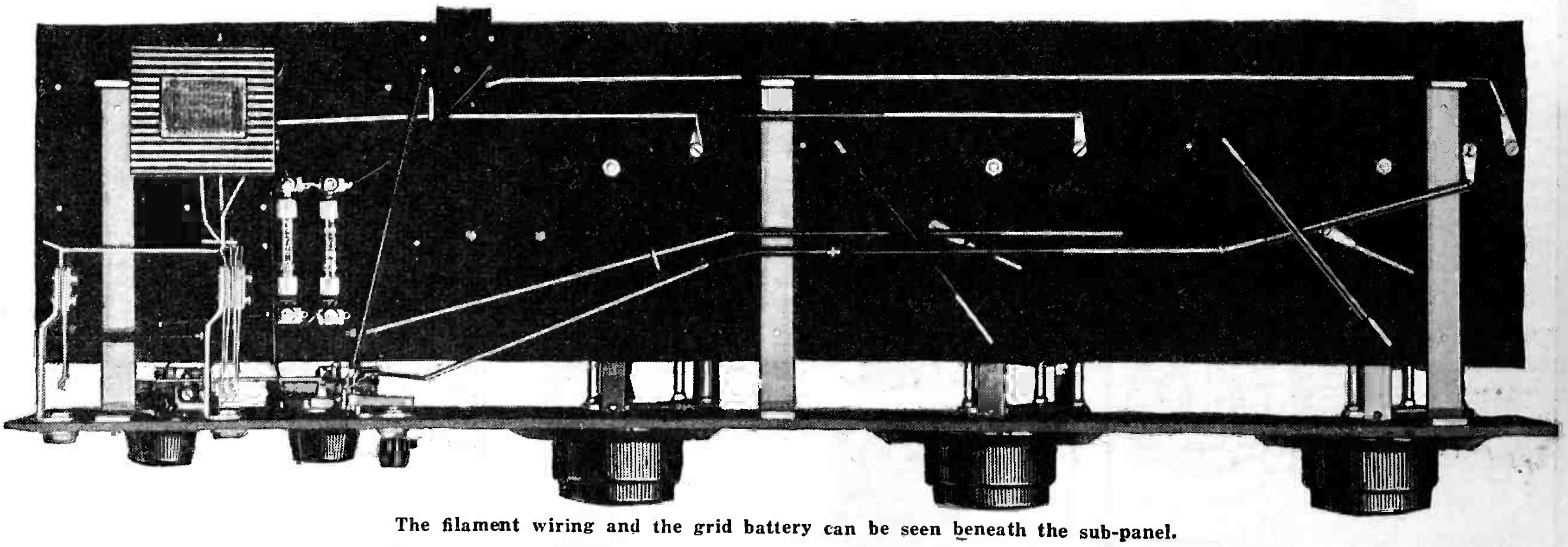
Generally they are rather efficient at the shortest waves and at the highest waves, but very considerably inefficient at the middle range.

In the King Equamatic System the primary is entirely separate from the secondary. The primary is attached to the shaft of a condenser having an extended shaft for this purpose and is angularly adjustable on this shaft.

The secondary is an entirely separate coil and is angularly variable with respect to the position of the shaft of the condenser and is also adjustable (by pushing forward over to the primary or backward away from the primary) so as to afford any practical useful degree of coupling with the primary. On account of tubes getting old and their electron emission decreasing and on account of "A" batteries running down, it is often desirable to compensate for these losses. In the Equamatic System all that it is necessary to do is to tighten the coupling between the primary and secondary.

In fact in the Equamatic System the primary and secondary are so completely variable with respect to each other and with respect to the axis of the condenser shaft that practically any degree of coupling and any rate of variation of coupling is obtainable by simple, quickly made adjustments of the primary and secondary coils. When once adjusted the variation of the coupling is provided automatically by the turning of the condenser dial.

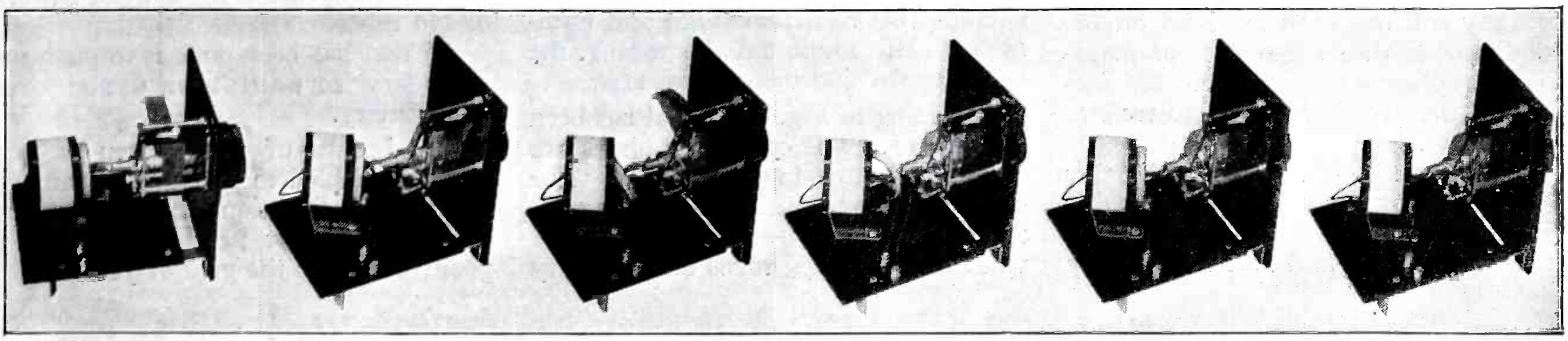
The correct rate of variation is determined by the angle at which secondary coil is placed with respect to the axis of the shaft of the condenser. This angle happens to be 58 degrees.



The filament wiring and the grid battery can be seen beneath the sub-panel.

This is also the proper angle at which to place the coils so as to eliminate the overlapping of their magnetic fields.

This absolutely correct rate of variation of coupling can be secured only



From left to right, Fig. 1 shows the primary and secondary coils parallel to each other and also to the faces of the condenser plates. In Fig. 2, the secondary has been set at the proper angle, about 58 degrees. The plates are all in, the dial being at 100, and the coils are at the proper position to tune to 600 meters. In Fig. 3 the dial has been turned to 50, in order to tune to 300 meters. In Fig. 4 the dial is set at zero with condenser plates all out, to tune to 200 meters. Fig. 5 is the same as Fig. 4 except that the primary coil has been turned from a minimum coupling to a maximum coupling. Fig. 6 is the same as Fig. 5, but illustrates how the coupling between primary and secondary can be tightened to compensate for a weak battery.

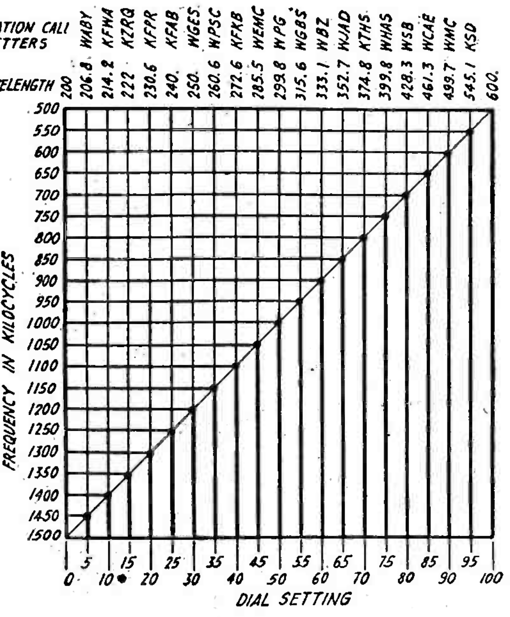
when the coil is used in connection with a 180 degree straight frequency line condenser. The system cannot be made to work with a straight line capacity or straight line wave-length condenser—it must be a straight frequency line condenser.

In the ordinary tuned radio frequency circuit, using fixed coupling between the primary and secondary windings of the radio frequency transformers, the transfer of energy between the primary and secondary varies with the wave-length to which the secondary is tuned. On the lower wave-lengths, the transfer is greater than on the upper wave-lengths. It is this effect that causes the set to oscillate on the lower settings and to amplify poorly on the higher settings. The problem, therefore, is to design the apparatus so that the transfer of energy is uniform throughout the entire wave-band. In the Equamatic System, this is accomplished by varying mechanically the coupling between the primaries and secondaries of the radio frequency transformers, simultaneously and in the proper proportion to the change in wave-length of the secondary circuits.

The Equamatic System does this very thing perfectly. Ten photographs are shown, six of them being photographs of a unit built for the purpose of illustrating the means and the method by which the Equamatic System accomplishes an equal transfer of energy at all wave-length settings.

Referring to Fig. 1 you will notice that the secondary coil is equipped with a foot having a slot which fits around a screw to which is attached a spring clip which keeps the secondary firmly in place at any angle at which it is put.

In Fig. 1 the primary and secondary coils are parallel to each other and also parallel with the faces of the condenser plates. With the coils in this position the arrangement is not materially different from any other primary and secondary. The turning of the condenser knob with the coils in this position would throw the condenser plates from maximum to minimum and from minimum to maximum without in the slightest changing the value of the energy transferred from the primary to the secondary coil.



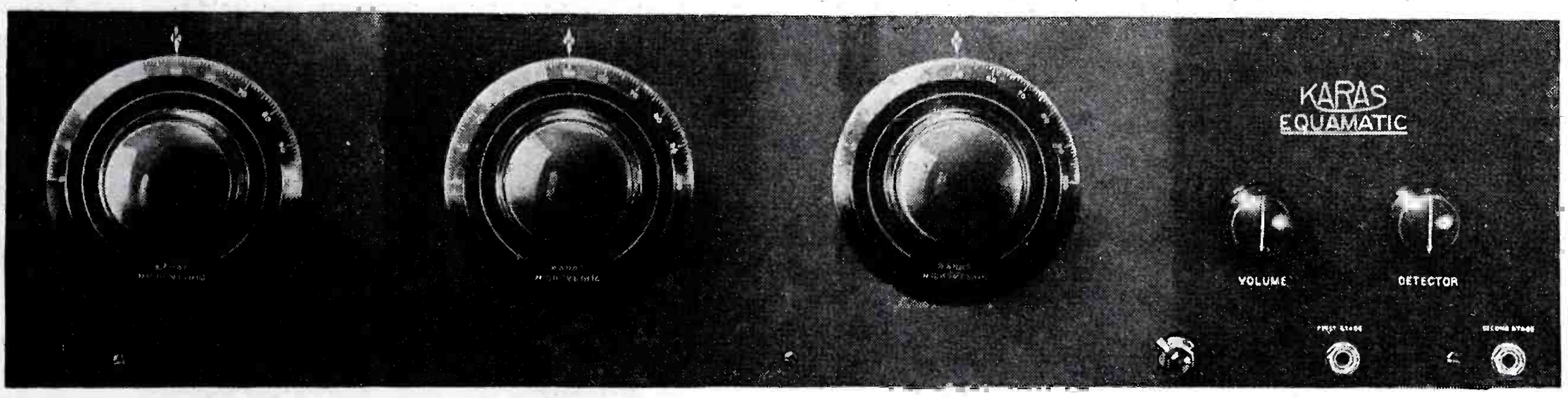
A tuning chart which will be found to be very accurate.

The coils in this position would be efficient at 600 meters, with the condenser plates all in. But the minute you would turn the condenser plates out in the slightest degree, the coupling between the primary and secondary would be too great for the increased frequency (shorter wave-length) to which you would be tuning. And the tube would break into oscillation.

By changing the angle of the secondary coil and leaving the primary coil just where it is, it would be possible to secure practically any constant degree of coupling desired that would be the equivalent of from 14 turns to no turns at all as desired. You could even turn the secondary around so that it would be at an angle of 45 degrees, which would give what is commonly referred to as zero coupling. You would have zero coupling at every dial setting.

By placing the secondary at various angles and then throwing the condenser plates all in and then adjusting the primary on the shaft of the condenser so that it is at maximum coupling with the secondary any rate of variation of coupling desired may be secured. You can secure a very slight variation by moving the secondary slightly or a maximum variation by placing the secondary and primary at angles of 45 degrees.

In order to tune from 200 to 600 meters with a straight frequency line condenser there is an exact angle at which the secondary must be placed in order to secure the continuously varying correct rate of coupling necessary to keep the tubes just under their oscillation points—and without any



A front view of the Equamatic receiver. The three condenser dials tune in consistent synchronism.

further adjustments of any kind. This angle happens to be about 58 degrees.

Next refer to Fig. 2. The secondary has been set at the proper angle, about 58 degrees. The plates of the condenser have been turned all in. The primary coil has been adjusted on the condenser shaft so that it is at maximum coupling with respect to the secondary, the proper coupling to tune to 600 meters.

The exact degree of coupling is arrived at by having all three dial settings alike, and then pushing the secondary toward and over the primary until the coupling is great enough to force the tubes to break into oscillation. Then the secondaries are pushed back just a trifle until the tubes do not oscillate. The rheostat controlling the radio frequency tubes should be adjusted so that the tubes are pulling about five volts of "A" battery. The exact amount of voltage will depend a great deal upon the efficiency or inefficiency of the tubes.

When the proper degree of coupling has been provided the turning of the condenser dial changes the coupling between the primary and secondary at exactly the rate of speed necessary to provide the practical maximum transfer of energy at every wave-length setting. The tubes will remain just under the oscillation point no matter what the dial setting.

This condition would not obtain if the secondary were placed at a lesser degree than 58 degrees. It also would not obtain if the secondary were placed at a greater degree than 58 degrees.

Should the secondary be placed at an angle of 45 degrees you would have what is called zero coupling when the condenser plates were all out. In this case you would be far under the oscillation point at 200 meters.

In Fig. 2 we have the dial set at 100. The plates are all in. The coils are placed at the proper angles to tune a 600 meter wave.

Now refer to Fig. 3. The dial has been turned to 50, throwing the condenser plates half way out—to tune to 300 meters—1000 kilocycles. The primary has been automatically turned so that it is at one-half of the degree of coupling between maximum and minimum. By minimum is meant the coupling for 200 meters, not zero.

Referring to Fig. 4, the dial has been set at zero. The condenser plates are all out—to tune to 200 meters. The coupling between primary and secondary is at minimum—the equivalent of what would be 3⅛ turns on a primary coupled in parallel as in Fig. 2. These four photographs will serve to illustrate the flexibility of Equamatic System coupling.

Another advantage of the Equamatic System is that it automatically compensates for any variation in the length of aerial. The ideal length of aerial is about 70 feet. But it does not make any difference how long the aerial is, the Equamatic System takes care of it. It is conceivable that with an exceptionally long aerial—an aerial having a natural wave-length of its own—that it might be efficient to have a maximum coupling between primary and secondary at 200 meters and a minimum coupling between primary and secondary at 600 meters.

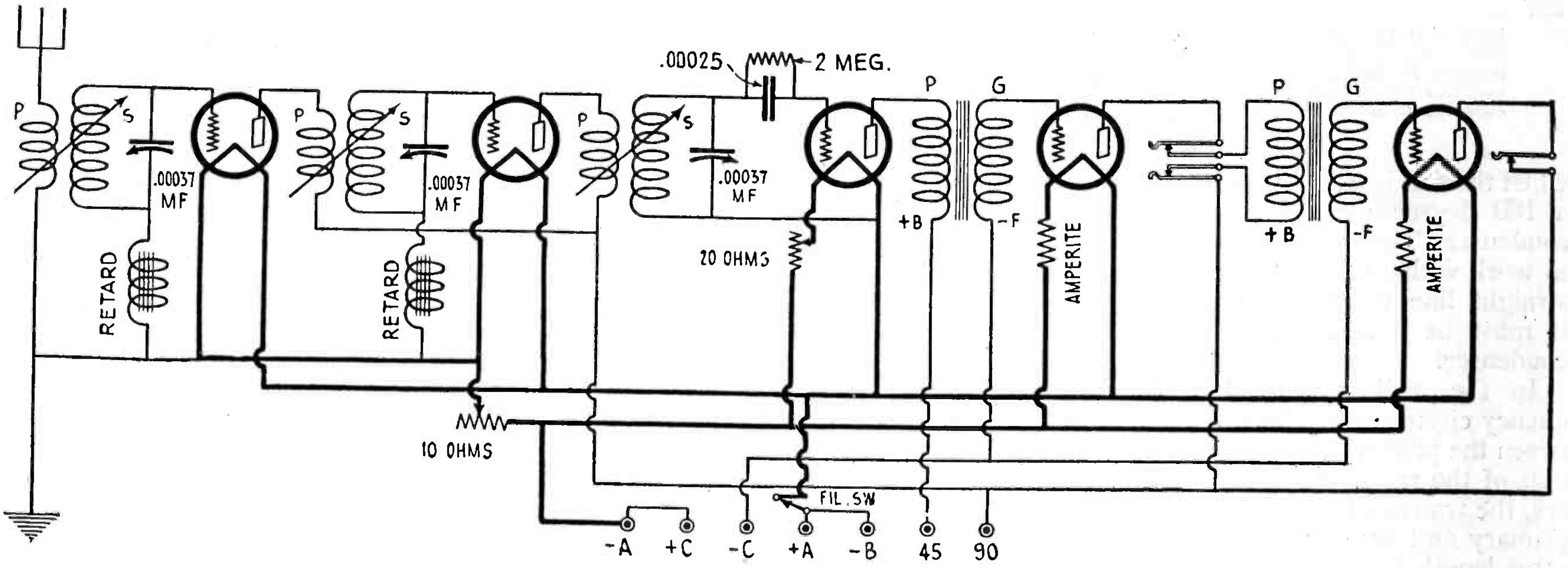
The Equamatic System accomplishes this in a very simple manner. This is shown in Fig. 5. This is the same photograph as Fig. 4 with the exception of the position of the primary angle. All that has been done is to turn the primary coil from a minimum coupling to a maximum coupling by adjusting it on the condenser shaft. It takes but a second to do this.

No matter what the length of your aerial is, you can adjust the primary coupling to compensate for it. It is not always necessary to change the coupling from minimum to maximum. It can be changed to any intermediate degree in accordance with the necessity provided by the length of aerial.

Fig. 6 is the same as Fig. 5, and illustrates how the coupling between primary and secondary can be tightened to compensate for a weak battery or old tubes.

All that has been done is to push the secondary forward toward and over the primary.

The beauty of this system is that you are enabled to take full advantage of the amplification factor of your tubes. It is not necessary to put a positive bias on the grid of your detector tube nor is it necessary to insert any resistance whatever in the plate circuit.



The circuit diagram of the Equamatic receiver. The coils subject to automatic coupling variation are indicated by the three arrows. The values for the various parts are given in the text.

The laboratory experiments with the Equamatic System indicated that the condenser shafts should be placed seven inches apart center to center as a minimum. With the condenser shafts seven inches apart and with the coils set at a 58 degree angle there is practically no intercoupling of electrostatic or electromagnetic fields.

The sleeve fixture attached to the primary and which fits over the extended shaft of the condenser is of sufficient length to preclude any undesirable overlapping of the electrostatic fields with the electromagnetic fields.

You may judge of the high efficiency resulting from the use of this system from the fact that it is naturally so sensitive that it will not pull more than 3½ volts "A" battery with 201A tubes. As a matter of fact the system is too sharp and too critical for the tubes.

In order to adapt the system so that it can be successfully and easily operated by any radio fan, it was necessary to introduce a retard coil in the grid circuit. The effect of this coil is to cause the tubes to operate higher on their characteristic curves, giving a greater latitude of play for the rheostat.

(*Continued on page* 130)

The "Varion" A. C. Receiver

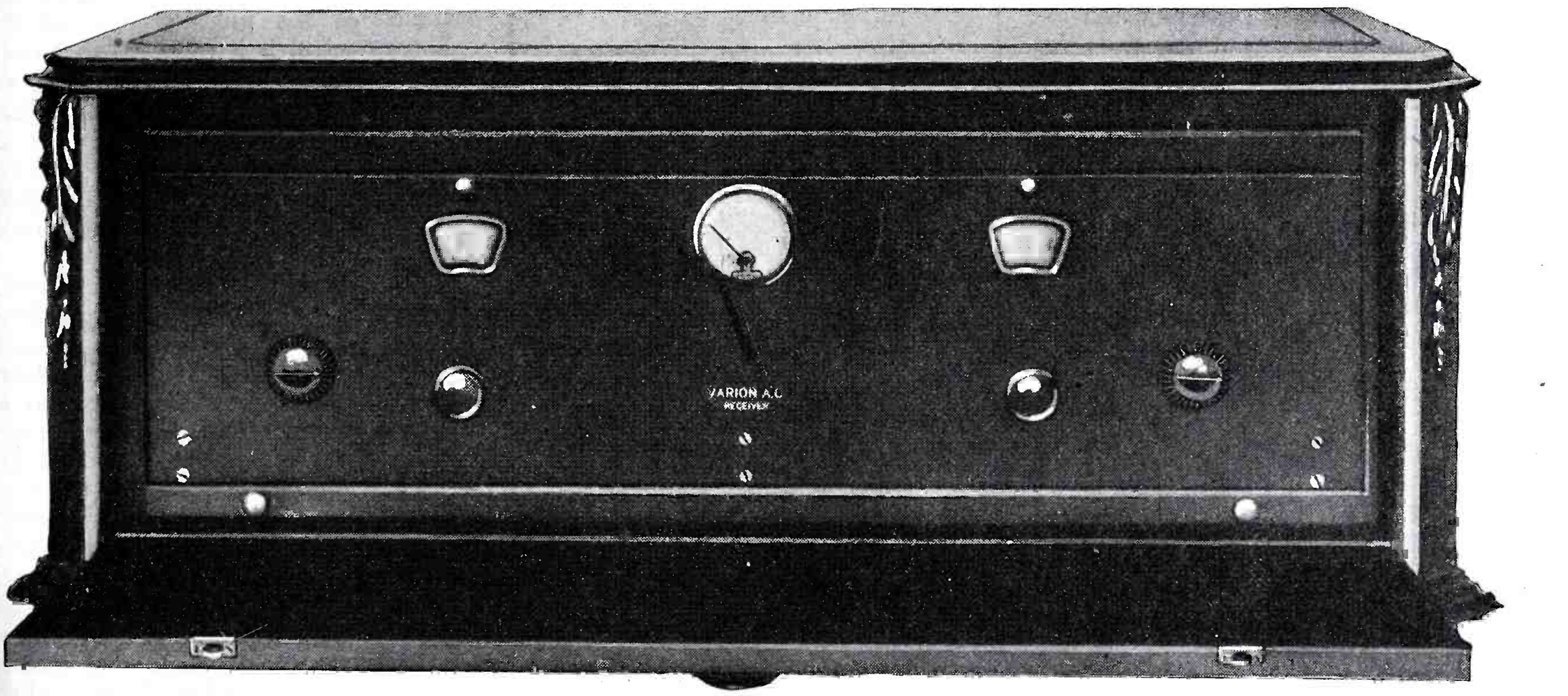
A Set Which Has No Battery Problems

By BERT E. SMITH

EVER since the dawn in Radio the bane of the experimenter's life has been—batteries. In the days when "Wireless" was still the only cognomen for the strangely assorted contraptions which bound a few earnest workers into a fraternity of effort, and vacuum tubes were a dream of a rather demented sort of person named DeForest, most of the attempts at communication were spark coils working from dry batteries obtainable at twenty-five cents each, and Oh! how those batteries did pass out.

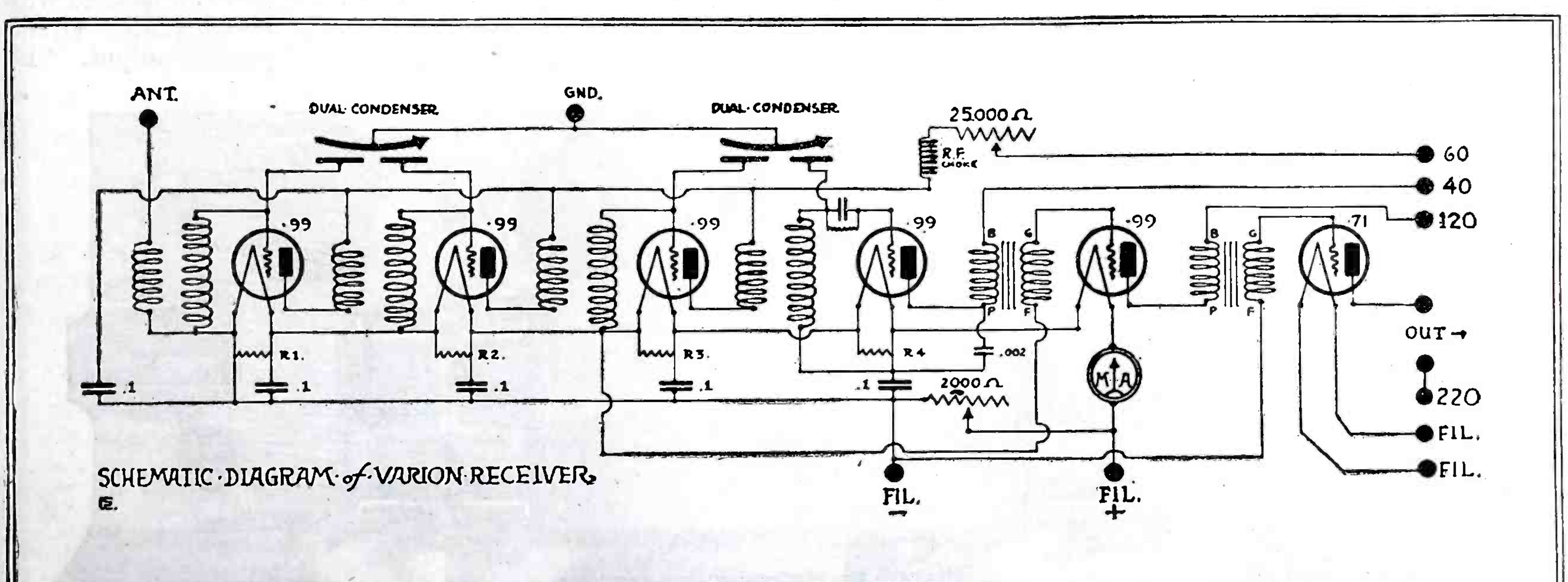
The elite used transformers working off the 60 cycle mains and delivering ungodly voltages to a multitude of spark gaps which didn't give a clean note no matter how carefully they were worked. For receiving, thank heaven, crystals didn't need batteries and the more varieties of crystal detector that could be assembled on a table, the more reputation the proud owner established!

Then came the forerunner of modern Radio. The vacuum tube became an accomplished thing. Expensive, true, and extremely critical, but nevertheless far better than the best of crystals. And with it "A" batteries, "B" batteries, "C" batteries and lots of other batteries. We had to have lots of current, and direct current at that, for the filament. We had to have lots of voltage, D. C. voltage for the plate, and as the modern form of "B" battery was unknown we got it by a flock of flashlight batteries which cost heavy jack; but we couldn't help that and so we struggled along, supported by a few manufacturers whose clearness of



Illustrations by courtesy of Allen D. Cardwell Mfg. Corp.

Front view of the completed Varion receiver.



The circuit wiring diagram of the "Varion" alternating current receiver.

vision and faith saw the miracle ahead.

And then the deluge! From two or three sources music was broadcast and the world turned to radio for its entertainment. Into the attic with the piano, over the fence for the phonograph—all the music anyone could want out of the electric bell and the oatmeal box—and some batteries. From that came the radio of the present, but even to this day with lots of cheap electricity in the electric light wires, the world continues to pay heavily for the current that supplies their radio set—from batteries.

For some time the efforts of engineers have been bent to using the electric light socket current for the operation of radio receivers. Many would like to have a radio, but will not be bothered with replacing and recharging batteries or do not want the unsightly mess which is their almost inevitable accompaniment.

First came schemes for "B" battery elimination, retaining the messy storage battery with its necessity for noisy recharging and the innocuous "C" battery whose only drawback was the necessity for its very occasional renewal.

The next stage of elimination was the "C" battery, but only in a very, very few of the extremely expensive manufactured sets has the necessity for an "A" battery been really and satisfactorily removed.

The man who builds his own has been long denied this boon; but realizing the potential need for this, a merchandiser of radio material enlisted the co-operation of a number of the highest grade manufacturers in the problem and the research of their engineers has resulted in an amazingly efficient broadcast receiver which requires no batteries, is simple to construct and operate, and will give better all around satisfaction than most sets, either home constructed or manufactured, which employ batteries.

The Varion receiver for alternating current operation contains six tubes of which five are regular amplifier tubes and the last is a power tube. In addition to this there is a Raytheon of the latest type and the set is necessarily divided into two units, one of which, the receiver, is mounted in a handsome cabinet of the usual type; and the eliminator, which may be either placed in the cabinet or with better results in the cellar or a closet. We will first proceed with a description of the eliminator.

LIST OF PARTS NEEDED

- 2 Cardwell Condensers, Type 217-C
- 1 Panel, Radion or bakelite, 17" x 3/16" x 28"
- 1 Sub-Panel, Radion or bakelite, 7" x 3/16" x 26"
- 6 Benjamin Sockets
- 2 Mar-Co Illuminated Controls
- 1 Centralab Radiohm, Type 25M.
- 1 Centralab Radiohm, Type 2M.
- 1 Weston Milliammeter, 2", 0/100 milliamperes
- 3 Benjamin Brackets
- 3 Aluminum Shields
- 4 "Varion" Coils
- 3 Eby "Ensign" Binding Posts
- 1 Sangamo Condenser, Capacity .001 mfd.
- 1 Sangamo Condenser, Capacity .00025 mfd.
- 5 Sangamo Condensers, Capacity .1 mfd.
- 1 Cardwell R.F. Choke, Type 198-C
- 1 Amertran DeLuxe 1st stage Transformers
- 1 Amertran DeLuxe 2nd stage Transformers
- 4 Ward-Leonard Filament Resistors
- 1 Daven Grid Leak, 3 megohms
- 1 6-Conductor Cable
- 1 2-Conductor Cable
- 25' Belden No. 18 Flexible Wire
- 4' Kester Rosin Core Solder
- Nuts, Machine Screws, Lugs, etc.

LIST OF PARTS FOR ELIMINATOR

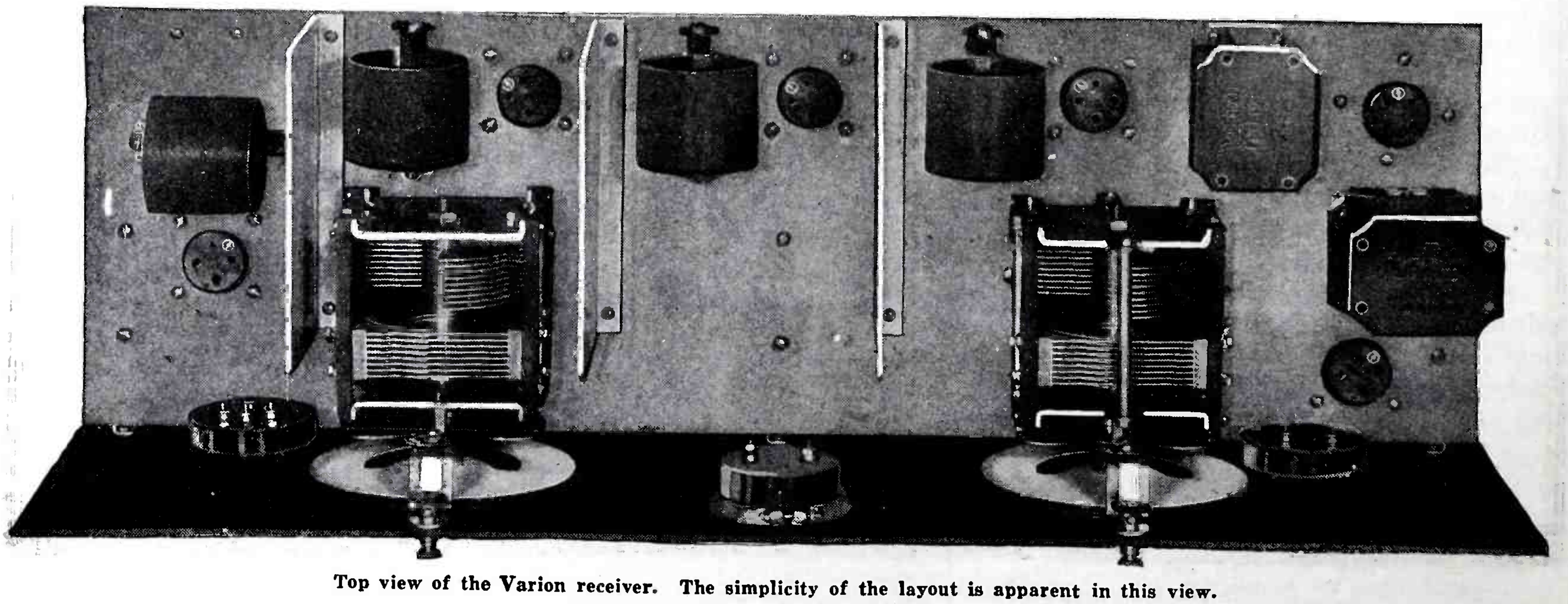
- 1 Metal Box 10" x 12" x 24"
- 1 Eby UX Socket
- 1 Sangamo Varion Condenser Block
- 1 Amertran Varion Transformer
- 8 Eby Ensign Binding Posts
- 2 Transformer Brackets
- 1 Strip Fish Paper
- 2 Socket Bushing, 1/8"
- 1 Attachment Cord and Plug
- 4 Ward-Leonard Mounting Feet
- 1 Raytheon BH Tube
- 1 Sangamo Condenser 2 MFD A
- 1 Ward-Leonard ABC Resistance
- 1 Ward-Leonard 2000 ohm Resistor
- 2 Amerchokes No. 854
- 1 Radion bakelite B.P. Strip, Drilled
- 8' Belden No. 18 Flexible Wire
- 2' Kester Rosin Core Solder
- Nuts, Bolts, Lugs, etc.

There are three types of current in common use today. By far the most common is 110 volt, 60 cycle alternating current. This amounts to about ninety percent of the service and the balance is about evenly divided between 110 volt direct current and 32 volt direct current as supplied by the majority of farm lighting systems.

Elimination of all batteries using 110 volt direct current is a simple matter. The circuit diagram in Fig. 1 shows how this may be accomplished, and table "A" gives the proper values of resistances to use for the various tubes. One word of caution seems necessary. Due to the fact that the resistance of the tubes is part of the voltage control it is essential that none of the tubes be removed from the set while the current is turned on, as such procedure will immediately result in the burning out of the remainder of the tubes. The table shown in "B" gives "B" battery voltages obtainable using this system.

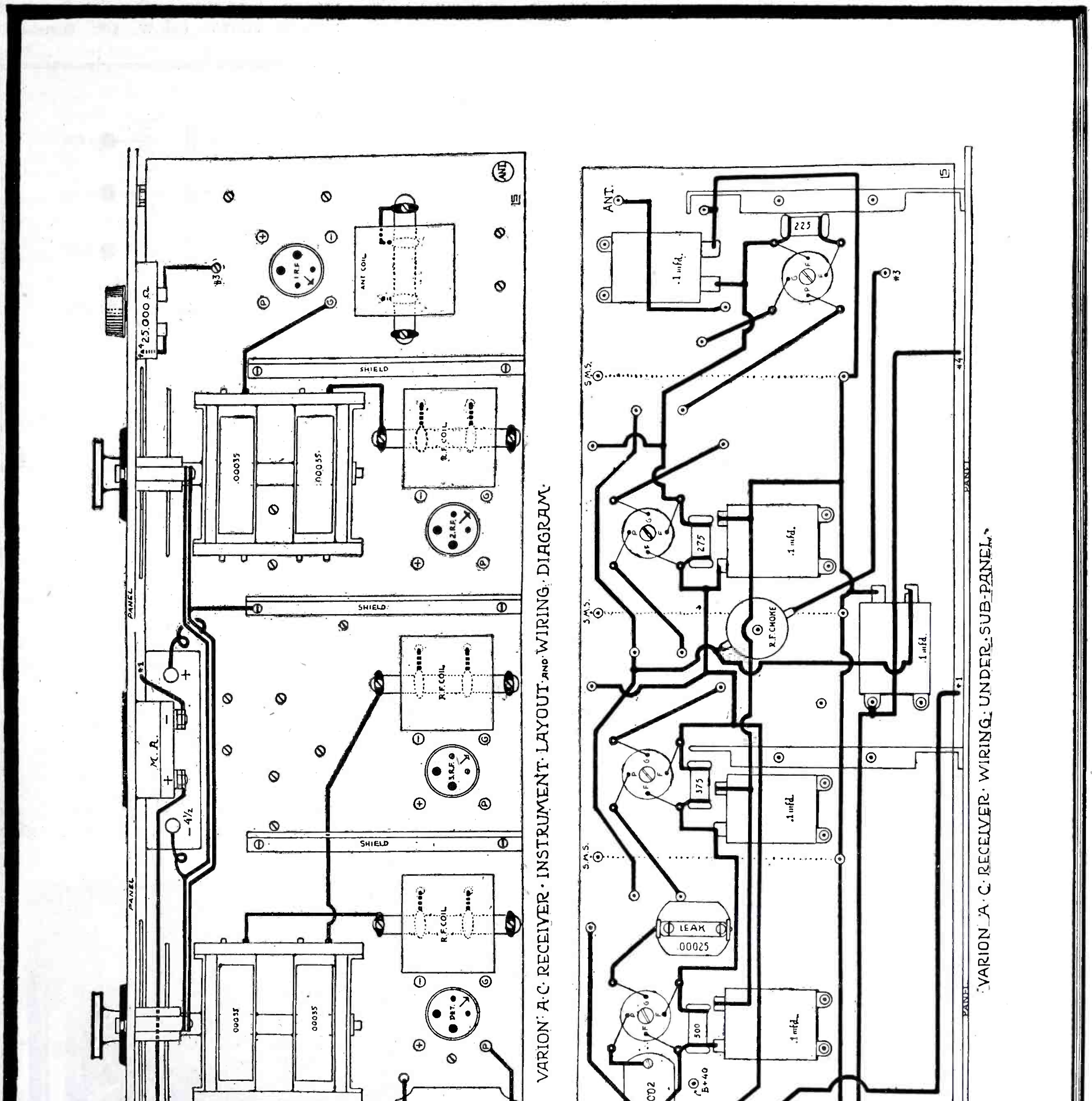
Major interest, of course, centres around complete operation direct from alternating current mains. The construction of a satisfactory "B" battery eliminator is simple, but operation of the filament has been considered a practically impossible job. To operate the ordinary radio set using six tubes of the 201-A type requires an absolutely smooth direct current of one and one-half to two amperes, and to obtain such current, apparatus costing into the hundreds of dollars is necessary.

There are many methods of obtaining partial or complete battery elimination. The most popular of these has been by means of tubes using no filament, but operating by means of an ionizing process which permits the flow of electrons in one direction only, as popularly used under the guise of the "Raytheon" tube. It gives full wave rectification, that is, all of the alternating current is utilized. This method is highly efficient, and can be used with a comparatively simple filter circuit giving an almost perfect output. "B"

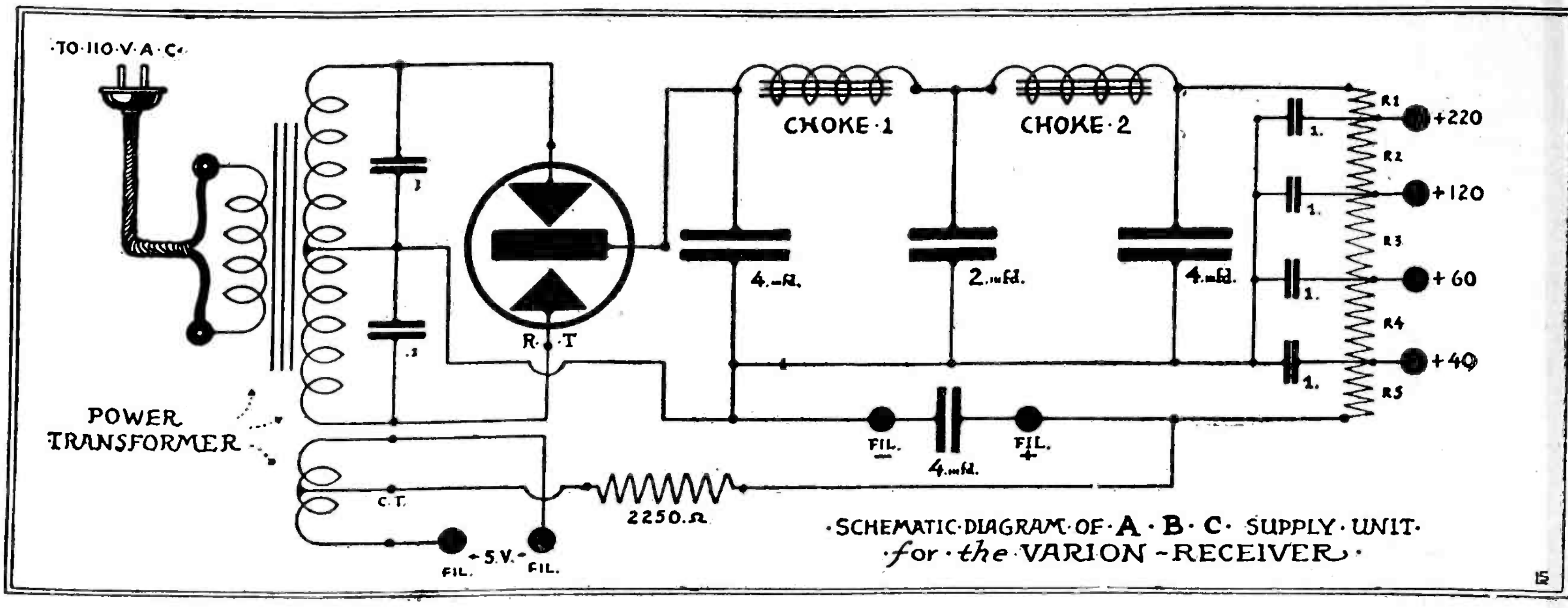


Top view of the Varion receiver. The simplicity of the layout is apparent in this view.

Layout Wiring Diagram of the "Varion" A.C. Receiver



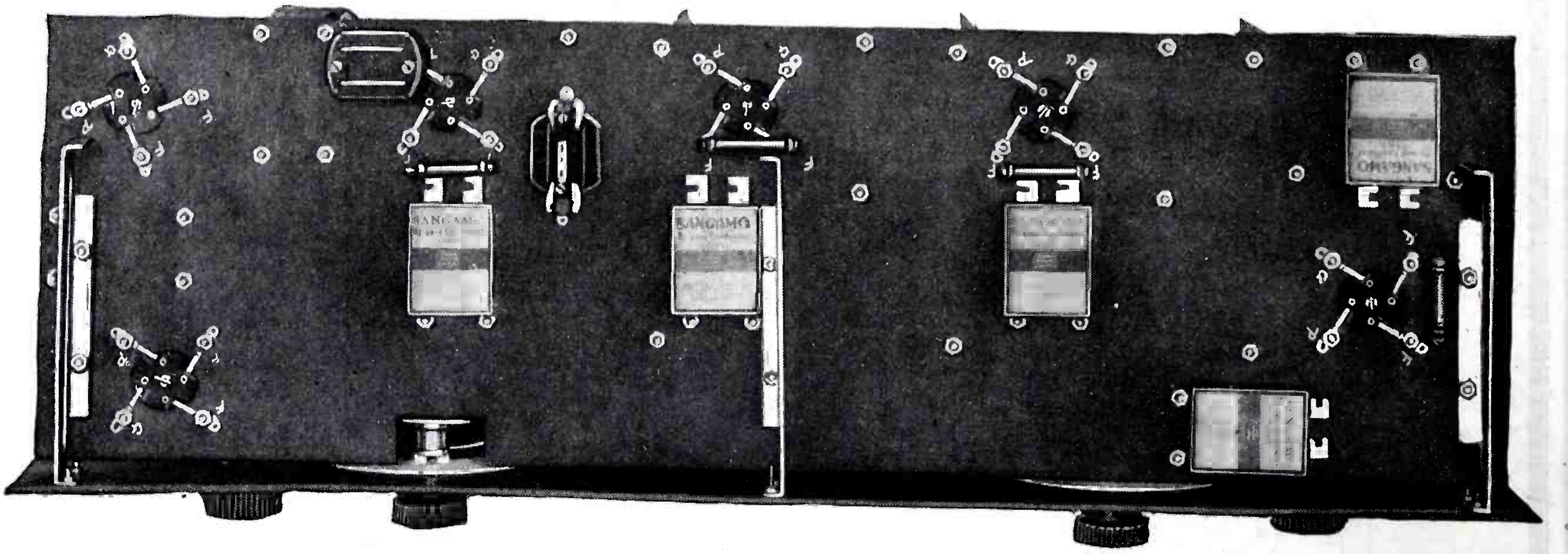
battery eliminators using the Raytheon tubes have been available for more than a year and have proved extremely popular and satisfactory. The new Raytheon tube will pass sufficient current to be used also for filament current in a properly designed circuit.



A schematic diagram showing the wiring of the battery eliminator unit.

The next method, gauged by popularity, has been the use of regular rectifier tubes having filaments. This has also been very satisfactory, but where this method is used to take care of filament current a large current capacity tube of the Tungar type must be employed and difficulty with filters is encountered.

A third method, and in fact, the only one which has been practical for complete elimination up to the present, is the use of trickle chargers in conjunction with storage batteries, which is really no elimination at all, although it removes the necessity for replacements and recharging.



Bottom view, showing the sub-panel layout.

Careful consideration of all these systems and others resulted in a decision to use the Raytheon method, as it requires no attention, is fool-proof, and highly satisfactory.

"A" battery elimination in the Varion is accomplished by means of a special circuit in the eliminator and receiver. As previously explained, the problem of "A" elimination depends entirely upon the *quantity* of current to be passed through the filter system. Referring to the diagram of the receiver, Fig. 4, it will be seen that five 199 tubes are employed before the final or output tube. These five tubes require approximately sixty milliamperes of current each at three volts to operate the filaments. If these five tubes were placed in a circuit with their filaments in parallel, a total of three hundred milliamperes current would be required and this would be more than an efficient filter could easily handle. However, if we were to place these tube filaments in series, it would then be necessary to have only sixty milliamperes of current available, but the voltage across the filament series terminals would have jumped to fifteen.

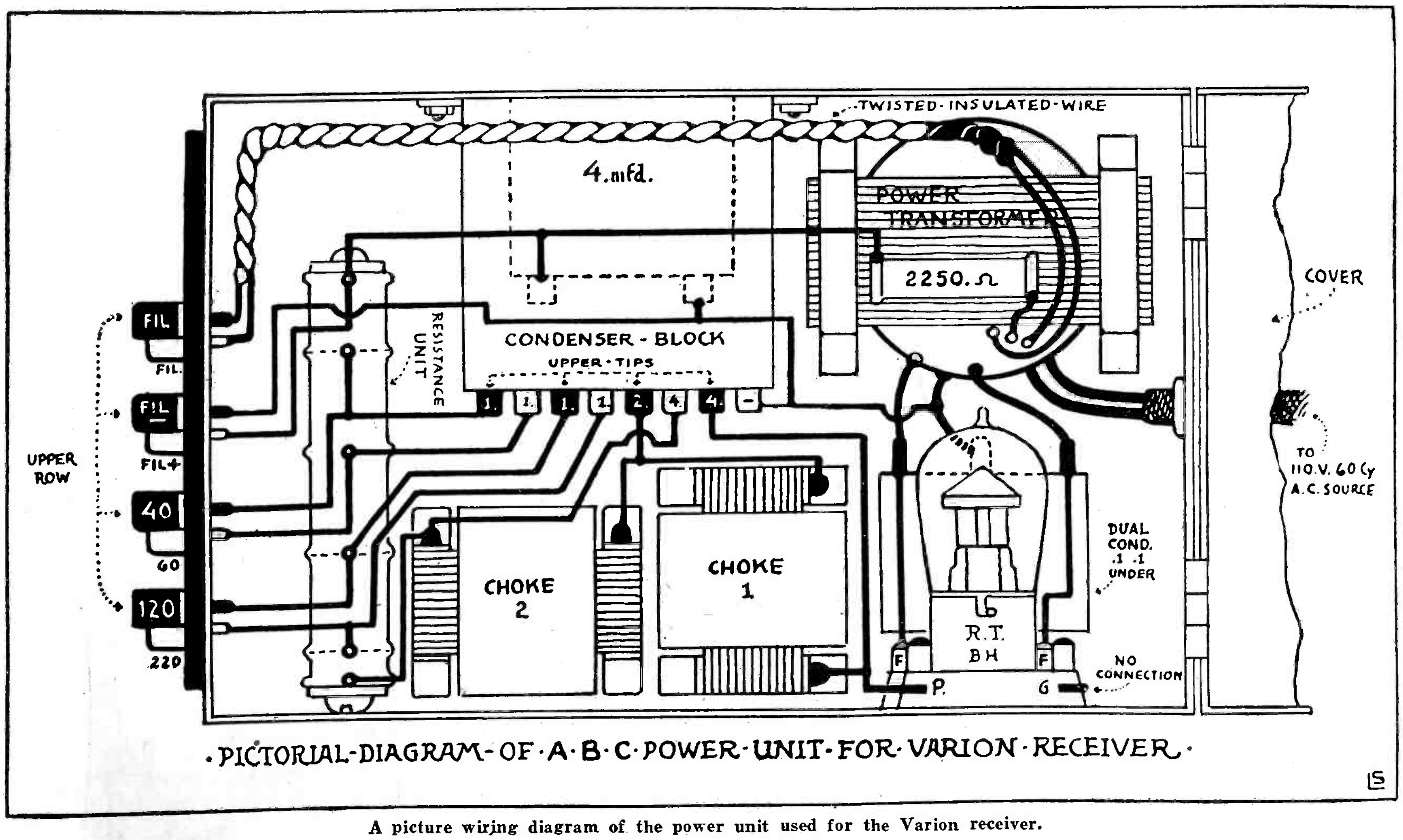
Obviously, since we have up to two hundred and fifty or more volts of pure direct current at our disposal with the Varion, and there are eighty-five milliamperes of current to back that up, it is only necessary to find some way to apply some of this excess current and voltage to the tube filaments. Glancing at the eliminator diagrams shown below, the resistance has been placed in shunt across the total output of the unit. Current will flow through this resistance, varying in quantity with the resistance across the circuit. Now, if we break the negative "B" line and insert our filament series connection, we shall have, assuming that the value of the shunt resistance is correct, the right amount of current flowing through each tube, and in doing this we have lost but fifteen volts from the maximum of our plate voltage supply. This, in effect, is what is done in the Varion. There are a number of other points to take into consideration, however, before actually building a receiver to operate in that manner. In the first place, the plate current of the tubes, including that of the power tube in the Varion circuit, is going to be added to the filament supply and this must be compensated for by raising the value of the shunt resistance so that the total of the two currents does not exceed sixty milliamperes. We also have the factor of line voltage fluctuation. This is easily taken care of by making all values in the eliminator proper for a minimum line voltage and then absorbing the excess current by means of an additional shunt resistance. The manner in which this is done is shown very clearly in the various receiver diagrams.

As has been explained before, the "C" bias voltage on the power tube is supplied by the voltage drop across the two thousand, two hundred and fifty ohm resistance. We still have, though, the problem of bias voltages for the balance of the tubes in the receiver. As we have already placed the tube filaments in series, we may readily utilize the fact that there is a three volt drop across the filament of each tube in the circuit. By properly posi- connection. If this extra filament current were not taken care of in some manner, the last tube in the line would be getting approximately ten milliamperes more current than the first tube. As the filament current is measured by the Western Milliammeter as the *total* of the current flowing through the circuit, it can readily be seen that half the tubes would be operating on less current than is needed and the balance of the tubes would be overloaded. This point has been neglected in almost all receivers using systems similar to the Varion, and accounts for the short life of the last two or three tubes in these circuits.

Reference to the circuit diagram of the eliminator, as shown herewith, will disclose that it is very similar to the standard Raytheon circuit. There are several refinements, however, type of power tube used the 2250 ohm resistance in series with the centre tap of the filament winding will give it a correct negative bias. The "C" bias voltage is obtained by the drop across this resistance. The heavier the current drawn through this resistance the greater the voltage drop will be and corresponding with heavier current drawn by the UX 171 the grid bias will increase corespondingly over its value when a 112 is used.

It cannot be emphasized too strongly that all of the units in the Varion have been coordinated for perfect operation. The complete eliminator combines the wide experince and radio knowledge of each of the companies whose product is included.

There is, we believe, no necessity of going into the actual wiring of the Varion eliminator in any great detail.



·PICTORIAL-DIAGRAM-OF·A·B·C·POWER-UNIT·FOR·VARION·RECEIVER·

A picture wiring diagram of the power unit used for the Varion receiver.

tioning the various tubes, we have the detector operating at a positive bias of one and one-half volts, the three radio frequency tubes at a negative bias of three volts, and the first audio tube at a negative bias of nine volts. These values, in respect to the particular plate voltage under which each of these various tubes operate, are exactly those called for by the tube manufacturers.

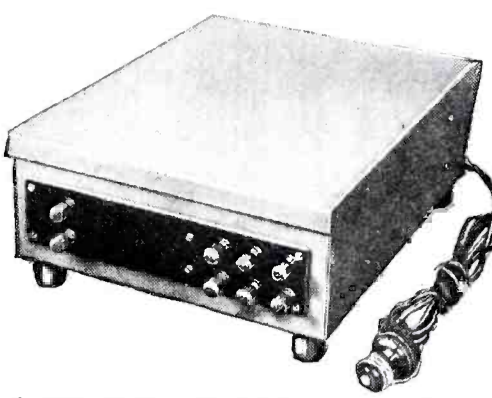
There is one point about the receiver circuit which many of you have probably noticed. That is the presence of resistances placed across all of the tubes in the series connection except the first tube. These resistances are placed at these points to compensate for the addition of the plate circuit to the filament supply by each tube in the which have not been heretofore included in eliminators, for example, experienced constructors will appreciate the fact that successful design and operation of the receiver is largely dependent upon the quality and design of the apparatus used throughout. In selecting parts for the Varion receiver, apparatus of the highest grade was used and in several cases where present apparatus was not satisfactory, special instruments have been designed and manufactured especially for the Varion.

The plate voltage supplied in sixty-seven volts for the radio frequency, forty-five for the detector, one hundred and thirty-five for the first amplifying tube and one hundred and thirty-five to one hundred and eighty for the power amplifying. Independent of the Either the schematic or pictorial diagrams may be used to wire by, and each is clear enough to prevent any danger of incorrect connections. The sole warning on the building or operation of this unit is—never make any repairs or adjustments on the eliminator while the house current is on. Damage to the eliminator and the possibility of a severe shock to yourself are bound to result.

Now we come to the receiver itself. The most careful attention has been paid to every detail of design in order to make this the most perfect broadcast receiver available and it is in every way a quality product giving reception which fully meets the admittedly exacting demands of the experienced listener. The result of this intensive research gives results which are equalled by few, if any, receivers on the market today.

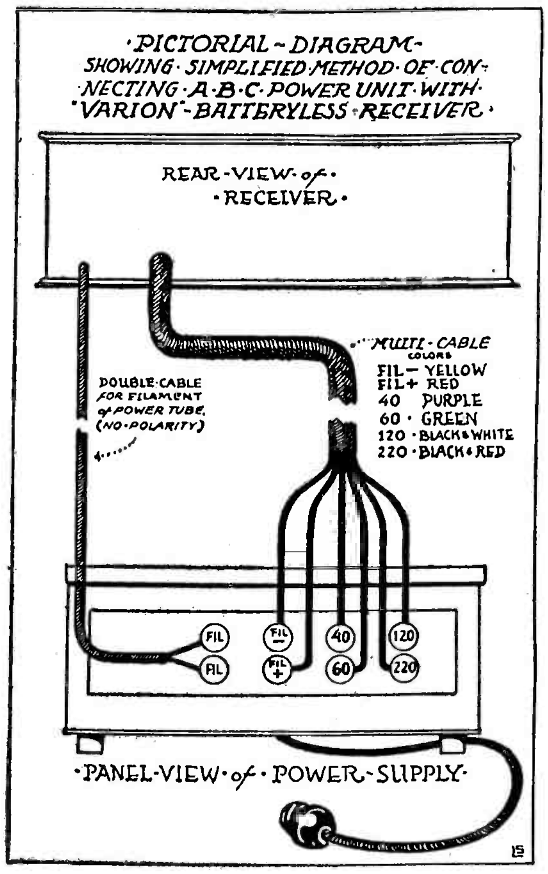
Let us diverge from theory and constructional details for a moment to consider the requirements of a broadcast receiver under present day conditions. Selectivity assumes greater importance all the time and with it sensitivity without critical control. Simplicity of operation is essential, and a fine quality of tone and range of reproduction has become the "sine qua non" of a good receiver. Economy of operation, of course, is the one thing we have been aiming at directly in the elimination of all batteries.

These five points then, were considered to be the essentials in the design of the Varion Receiver. Regeneration, always productive of distortion and trouble, has been dispensed with, while retaining a high degree of sensitivity and selectivity by the use of three stages of sharply tuned radio frequency amplification. Selectivity is such that no trouble will be experienced in "cutting through" the most powerful locals operating nightly in the congested centres, and there is ample sensitivity to


A view of the completed power supply unit, showing panel.

insure splendid distance reception. This is accomplished, with but two controls, by use of two Cardwell condensers in conjunction with specially designed coils manufactured by Hammarlund. These Cardwell condensers are of the dual type in which the sections are accurately matched at all points to a degree which completely removes the necessity for auxiliary tuning knobs. Outside of these condensers there are the two controls on the panel, one of which is used to keep the volume down to a point where it is agreeable for the average living room, and the other is to compensate for various voltages in the lighting wires. These both require almost no attention after adjustment and do not in any way effect the main tuning of the receiver.

The quality of reproduction when the Varion is used with a high grade speaker is equal to that of most expensive manufactured receivers. As in every other part of the receiver, nothing has been sacrificed, nor expense spared, in designing an audio frequency amplifier which would deliver irreproachable quality of tone. Engineers are practically unanimous, after trying many systems, in the opinion that transformer coupled amplification is the most efficient and logical method of securing the true tone range demanded by every radio owner today.



A diagram showing method of connecting the power unit to the receiver.

De Luxe Amertran transformers were selected after exhaustive tests as far ahead of all others available.

In mentioning again economy of operation the subject may be dismissed with the statement that the Varion receiver operates at a cost of less than two cents an hour while it is turned on and, of course, has no batteries to depreciate when the set is not in use. The satisfaction of being able at all times to turn your set on with full assurance that ample current is available is well worth a great deal of trouble in construction, but, as a matter of fact, the Varion receiver is simpler of construction than most battery operated sets.

Let us take up a slightly more detailed account of the separate circuits.

As previously mentioned, the radio frequency portion of the receiver employs three tuned stages feeding a non-regenerative detector. This requires four of the special Varion coils the arrangement of which is very clearly seen from both the wiring diagram and the photograph. Semi-shielding is accomplished by the new Aluminum Company of America Shields, which also appears very clearly in the photograph. The Cardwell Type 217-C dual Condensers mounted on the backs of the Marco Illuminated Dials are placed in such a position that a handsome and symmetrical panel arrangement is secured, while at the same time the leads are kept properly balanced. On the left is shown the 50,000 ohm Radiohm which is placed in series with the radio frequency plate lead and is in series with the radio frequency choke. On the right hand side is the 2,000 ohm Radiohm (R4) which controls the filament current of the whole receiver and is properly a portion of the eliminator circuit. In the centre of the panel is the Weston Milliammeter which is a great aid in keeping the filament current at a proper point. Looking at the under side of the sub-Panel in the other illustration we find the sockets, fixed condensers, and fixed resistances all laid out in such a way that wiring is almost unbelievably simple.

All the wiring is shown very clearly and the experimenter who follows these instructions carefully can hardly go wrong.

The detector circuit was made non-regenerative for two major reasons. In the first place quality of reproduction is, to a great extent, dependent on the detector. Much has been written about audio amplifiers but in the final analysis there is much more distortion occurring in the detectors of most receivers than in the audio amplifier. Another reason why regeneration has been abandoned to a great extent is that it is no longer necessary or even desirable as a volume control, and


Placement of apparatus within power supply unit.

ample selectivity and sensitivity can be secured through the use of a number of tuned stages without any of the drawbacks which are inherent when regeneration is used.

The audio frequency amplifier is all the conventional transformer coupled

(*Continued from page* 150)

The Hammarlund-Roberts Hi-Q Receiver

This New Set Incorporates Several Desirable Features in Up-to-Date Design

By V. T. BAIRD

THE new Hammarlund-Roberts Hi-Q is an entirely modern radio receiver, non-oscillating and incorporating the latest approved features. The most important of these includes dual tuning, stage shielding, automatic coupling variation, high detection efficiency and a high power output.

Tried and proven fundamentals have been adherred to; but they are applied in new and different ways that produce greater selectivity, clearer tone, simpler tuning. This new Hammarlund-Roberts is the united achievement of ten of the leading radio engineers in the country; all concentrating on producing a most advanced and efficient receiver.

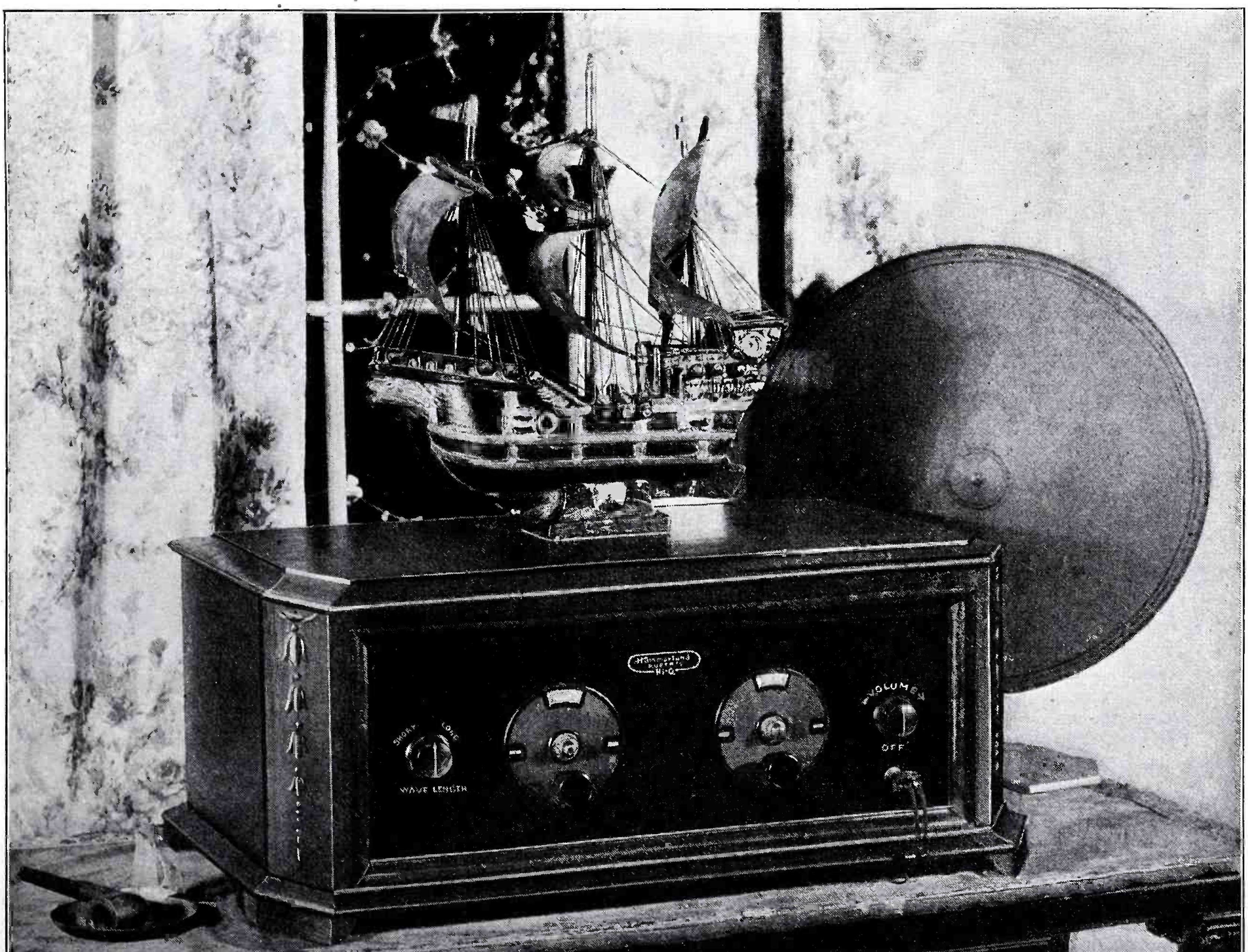
This new five-tube set employs two highly efficient stages of tuned radio amplification, a non-regenerative detector and two stages of high quality transformer coupled audio amplification, the second stage of which is so arranged that the new power tubes may be used.

Tuning has been held down to two major controls. Shielding of the radio frequency units produces a receiver of unusual selectivity, sensitivity, quality and volume.

Theory of the Circuit

In theory the Hammarlund-Roberts Hi-Q Receiver is comparatively simple. It combines the sensitivity and selectivity of two stages of radio frequency amplification with the inherent stability and distortionless characteristics of a non-regenerative detector. While it is admitted that a regenerative detector provides a considerable degree of radio frequency amplification it is well known that amplification secured in this manner has many drawbacks. Chief among these is the tendency to cut "side bands," a type of tone distortion which has a very disagreeable effect when passed on to the loud speaker. In order to avoid this and other types of "Regenerative" troubles without sacrificing sensitivity, the two radio frequency stages have been designed to insure an extremely high degree of amplification.

After providing for a high quality audio output from the detector a two



The new Hammarlund-Roberts Hi-Q receiver makes a handsome-looking set when completed.

stage transformer coupled audio amplifier is used to step up the signals to loud speaker intensity. The transformers used in the audio amplifier have a high primary impedance, insuring faithful reproduction of the lower musical and speech tones. The secondaries are wound by a special helical process which reduces distributed capacity to a minimum so that the higher audio frequencies and their harmonies are passed on to the loud speaker without loss. This results in the reproduction of the higher musical tones of such instruments as the violin with full "life" and "brilliance," and aids very materially in removing the "dull" and "muffled" effects so commonly associated with loud speaker reproduction.

Although the receiver has three radio frequency circuits the tuning controls have been reduced to two by placing the second and third variable condensers on the same shaft. A small compensating condenser in parallel with the third variable condenser has been provided to compensate for the small difference in circuit capacity of the third tuning circuit, chiefly due to the detector grid condenser. This compensator needs no adjustment after its setting has once been determined.

PARTS REQUIRED

- 2 Samson Transformers, type HW-A3 (3-1 ratio) (T)
- 3 Hammarlund .00035 mfd. Midline Condenser (C)
- 3 Hammarlund Auto-Couple Coils (set of 3 coils) (L, L_1)
- 1 Hammarlund Jr. Condenser, 9 plates, 32 mfd. (C_3)
- 2 Marco No. 192 Vernier Dials (D)
- 3 Benjamin No. 9040 Sockets (with bases) (S)
- 2 Benjamin No. 904 Sockets (without bases) (S_1)
- 2 Amperite No. 1A (R_3)
- 1 Amperite No. 112 (R_2)
- 1 Carter No. M-10-S Combined Rheostat and Filament Switch (10 ohm) (RS)
- 1 Carter No. 1 "Short" Jack (J)
- 1 Carter No. 12 "Imp" Aerial Switch (SW)
- 1 Sangamo .00025 mfd. Fixed Condenser (C_2)
- 1 Sangamo .001 mfd. Fixed Condenser (C_4)
- 1 pr. Sangamo Grid-Leak Clips
- 1 Durham Metallized Resistor 2 megohms (R_1)
- 10 Eby engraved Binding Posts (BP)
- 1 Hammarlund-Roberts Hi-Q Foundation Unit (containing: drilled and engraved panel, drilled sub-panel, two complete shields, two equalizers, extension shaft, resistance unit, wire, screws, nuts and all special hardware required to complete receiver.) (M)

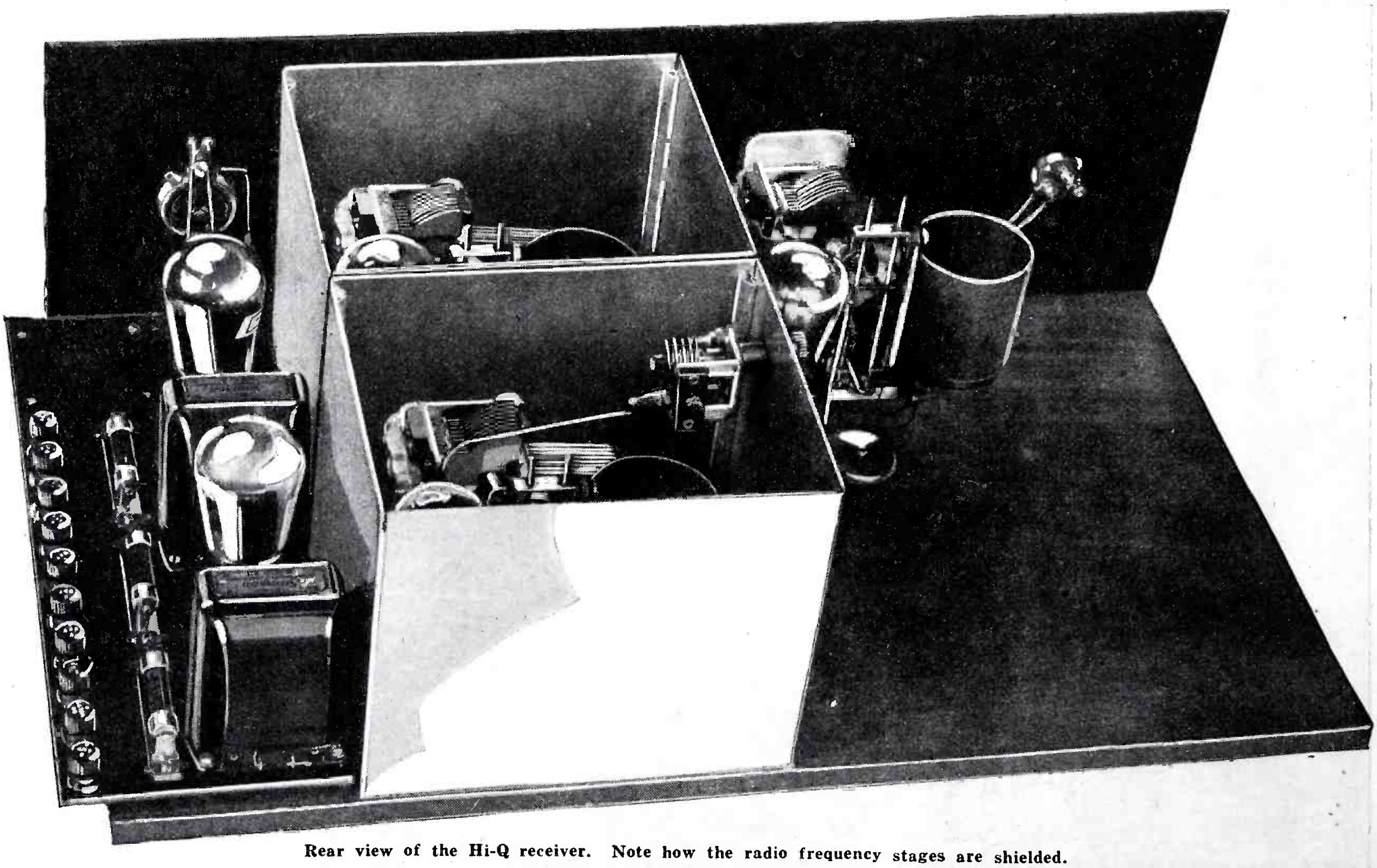
any interaction between circuits, thereby stabilizing the radio frequency amplifier and greatly increasing its overall efficiency.

No shield is necessary on the first radio frequency stage although the receiver is designed so that a shield can also be used for this stage if desired.

The output of the second radio frequency stage which is a highly amplified copy of the original signal picked up by the antenna, is then fed to the non-regenerative detector where it is demodulated or converted into audible frequencies. These audio currents or electric sound waves are then further increased in strength by the two stages of transformer coupled audio frequency amplification and passed on to the loud speaker.

The R. F. Amplifier

The two stages of radio frequency amplification used in the Hammarlund-Roberts Hi-Q Receiver present some rather new and novel features in the design of the antenna coupling coil and the interstage radio frequency transformers. The design of these coils is based on two fundamental laws of radio engineering that are as old as radio itself. The first of these laws is

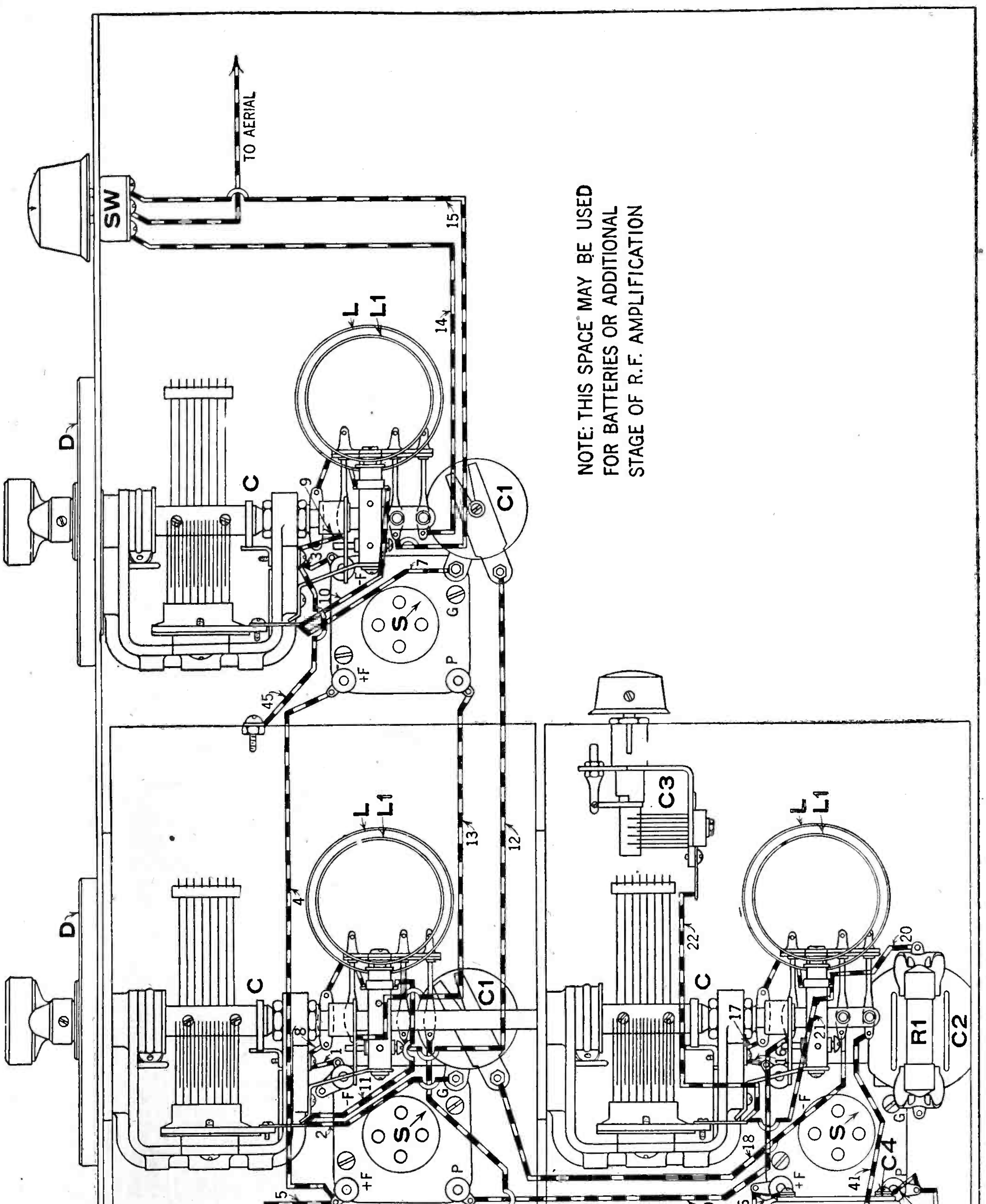


Rear view of the Hi-Q receiver. Note how the radio frequency stages are shielded.

A volume control has been provided which is exceptionally smooth and gradual, allowing the operator to adjust for a powerful local or a weak and distant station with equal facility. This volume control is a Carter 10 ohm rheostat regulating the filament brilliancy of the two radio frequency amplifier tubes. To eliminate the possibility of applying more than the rated voltage to the filaments of these tubes, a 2 ohm resistance unit is used in series with the radio frequency tubes and rheostat. The filaments of the remaining tubes are held at their proper operating temperature by separate amperites.

The use of stage shielding eliminates this: up to a certain point an increase in the coupling between two coils affords an increase in every transfer and a decrease in selectivity. The second law is this: the energy transfer between two coils such as the primary and secondary of any ordinary radio frequency transformer increases rapidly as the frequency increases. In

Layout Wiring Diagram of Hammarlund-Roberts Set



This layout scheme of the new Hammarlund-Roberts receiver is lettered to correspond with the list of parts given with this article: C indicates the variable condensers, two of which are so connected that they are controlled by the same dial; L and L1 are the inductances attached to the condensers; C1, equalizing condensers; C2 is the grid condenser; C3, the compensating condenser; C4 is a .001-mf. fixed condenser; S are the R.F. and detector sockets; S1, the A.F. sockets; RS is a combination filament switch and rheostat; SW is the antenna-correction switch; R1, the grid-leak; R2 and R3 are automatic filament controls; R is a 2-ohm resistance; and T indicates two 3:1-ratio A.F. transformers. The schematic circuit diagram is given on page 79.

other words the energy transfer is much greater at high frequencies (short wave-lengths) than at low frequencies (long wave-lengths) and the relative selectivity is less at high frequencies and greater at low frequencies. Conversely, a constant transfer of energy and constant selectivity can be maintained by loosening the coupling as the frequency is increased.

An ideal broadcast receiver must be capable of receiving wave-lengths from 200 meters (1500 kcy.) up to 545 meters (550 kcy.). This represents two extremes in frequency corresponding to a range of about three to one. These requirements together with the two laws stated above make it evident that some means of variable coupling must be provided if we are to obtain equal energy transfer and a selectivity throughout the broadcast spectrum. Since the trend in modern broadcast receivers is toward simplicity of tuning, the addition of variable coupling controls was not advisable. Therefore the engineer designers of the Hammarlund-Roberts Hi-Q Receiver developed a radio frequency transformer in which the coupling between the primary and secondary coils is automatically varied by the rotation of its associated tuning condenser. This variation in coupling is smooth and continuous and is accomplished by means of a cam on the variable condenser shaft. At the setting of zero on the condenser dial (which tunes the transformer to a wave-length slightly below 200 meters) the coupling between primary and secondary is minimum. As the tuning dial is advanced toward 100 the coupling increases gradually until it reaches maximum when the condenser dial reads 100, at which time the circuit is tuned to a wave-length of about 560 meters. The antenna coupler is designed to make use of this same efficient principle, and in addition, the antenna coil itself is tapped and a switch provided in order to afford a further coupling variation to suit different length antennas and to provide extremely loose coupling in very congested areas.

This automatic variable coupling feature made it possible to use a comparatively large number of turns in the primaries of the radio frequency transformers. This large primary allows great energy transfer and consequent loud signals on the longer wave-lengths where the coupling between primary and secondary is closest.

However, this large primary and close coupling would be totally unsuitable at the shorter wave-lengths. This difficulty is overcome by automatically loosening the coupling as the receiver is tuned to the shorter wave-lengths, thereby maintaining a high degree of selectivity without sacrificing signal strength. This is due to the fact that the same amount of energy transfer can be obtained with looser coupling at short wave-lengths than at long wave-lengths. Thus the Hammarlund-Roberts Hi-Q Receiver provides great signal strength and a high degree of selectivity throughout.

In most so called "self-balanced" circuits elimination of the tendency to oscillate has been attained at the sacrifice of efficiency. A method often used is to design the coils in such a way that the losses in the coils introduce enough resistance to prevent oscillation. This method is of course detrimental to efficiency. Some others make use of very low plate voltages in the radio frequency stages, thus reducing the tendency to oscillate, but again with a consequent lowering of efficiency.

In order to permit the use of more efficient interstage coupling coils, equalization of disturbing potentials has been incorporated in the Hammarlund-Roberts circuit, thereby allowing a higher degree of amplification with consequent louder signals and greater distance getting ability, without the usual troubles caused by self oscillation.

Both radio frequency stages are equalized utilizing the familiar Hammarlund-Roberts equalizing system.

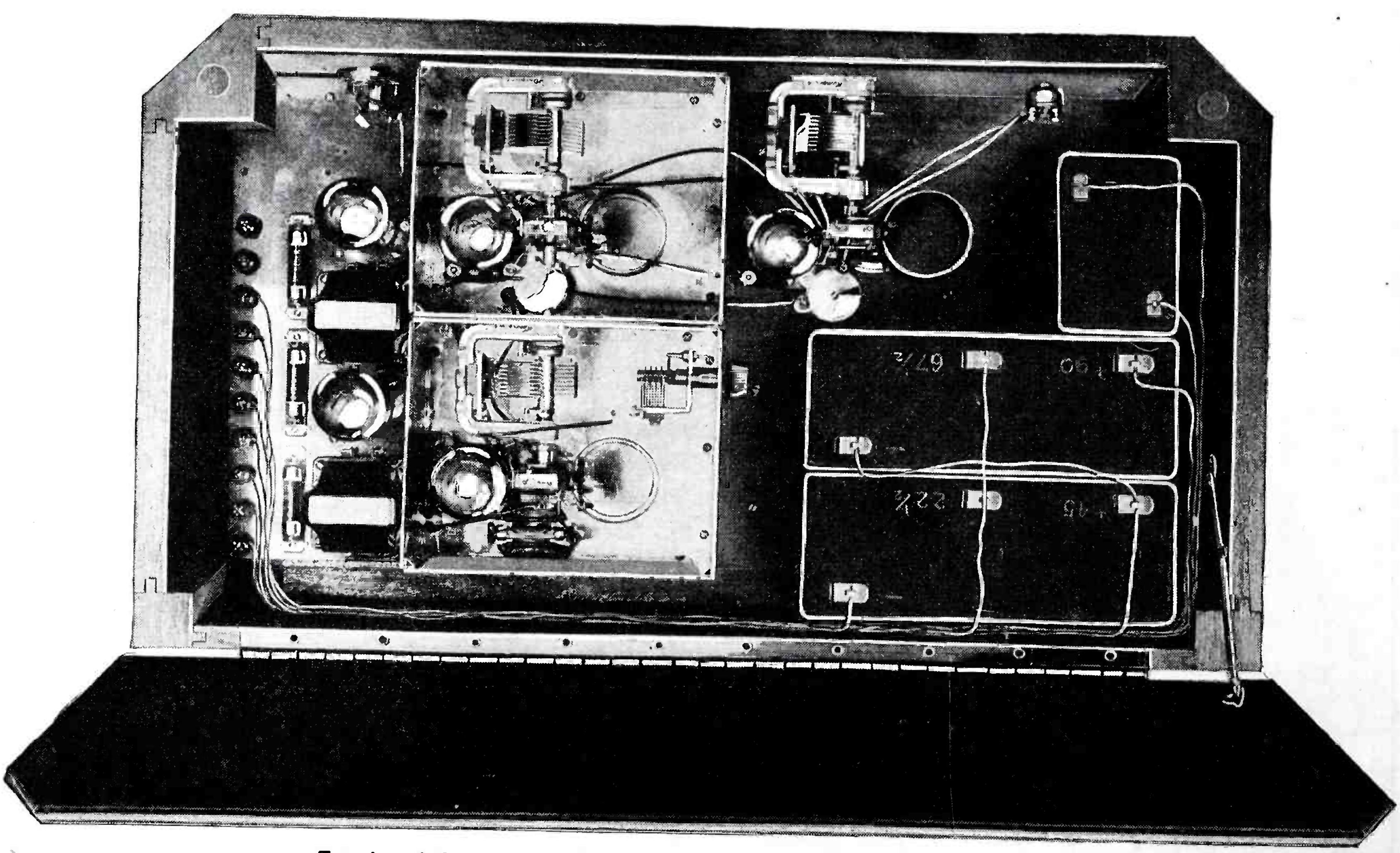
Constructional Details

Before attempting any actual work, it is advisable that you study the assembly and wiring diagrams so as to familiarize yourself with the layout and wiring of the set.

The first step in the construction of the receiver is to screw the front panel to the baseboard with five flat head wood screws.

Next mount the jack on the panel with the spring of the jack towards the baseboard.

Now mount the combination rheostat and switch with the terminals of



Top view of the completed receiver showing "B" and "C" batteries installed in case.

the instrument towards the top of the front panel.

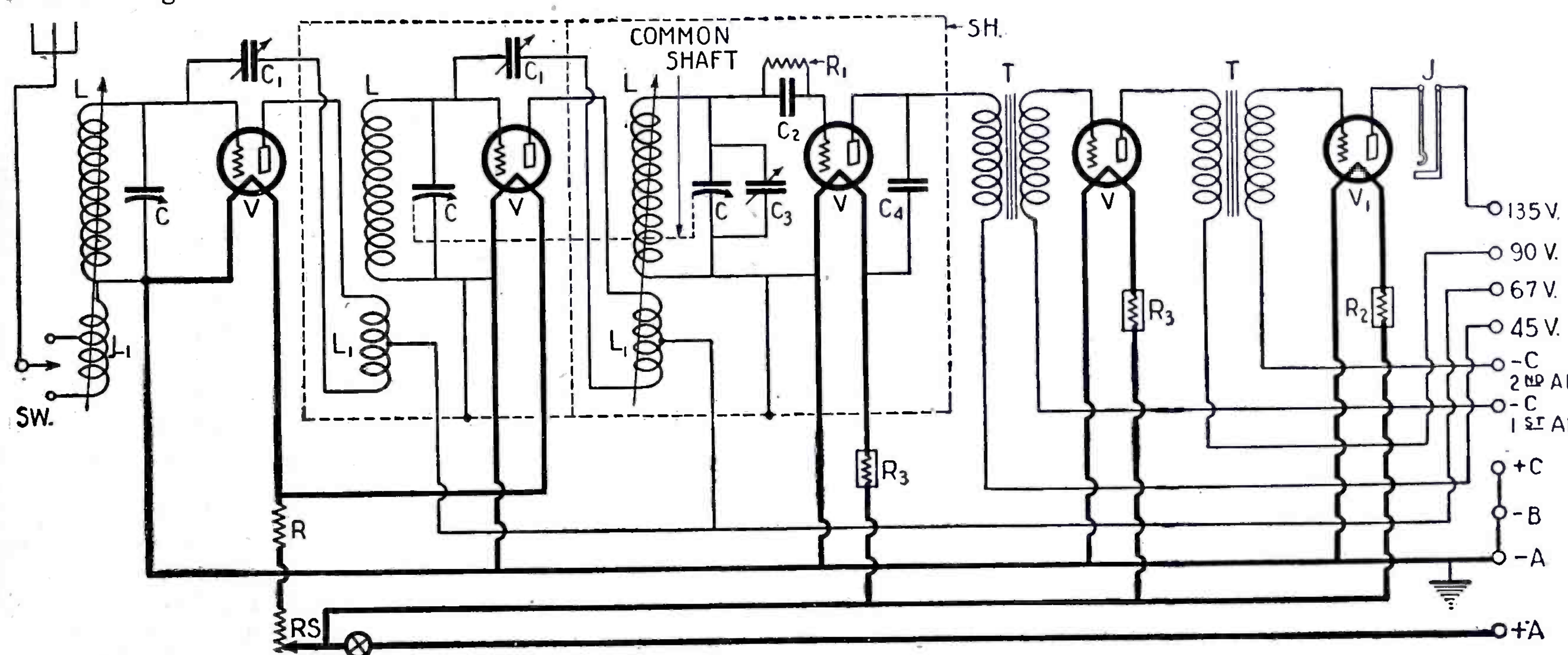
Then mount the aerial switch with the middle terminal towards the bottom of the panel, etc.

The bottom plates of the two shields and the second audio frequency and detector socket are mounted on two strips of 1½ x ⅛ inch metal, 12 inches long. These two strips which run from the front panel to the back edge of the baseboard serve as braces and supports for the bottoms of the shields. Holes properly spaced and tapped provide a means of lining up the shields and locating the sockets in their proper positions with respect to the other instruments.

The tube sockets (with bases) are mounted in place using the holes in the shield and the tapped holes in the strips under the shield bottoms.

A small strip of brass ⅜" wide and about 1" long with a hole at each end is used to mount the one end of the grid condenser to the "G" terminal of detector socket. One end is fastened to the underside of the grid condenser and the other end is slipped over and fastened to the "G" terminal of the detector socket. This socket is mounted on the bottom of the shield.

All other parts are mounted as shown in the photos and picture diagram, and if carefully followed the constructor will have little difficulty in assembling the set.



Schematic wiring diagram of the new Hammarlund-Roberts set.

The Wiring

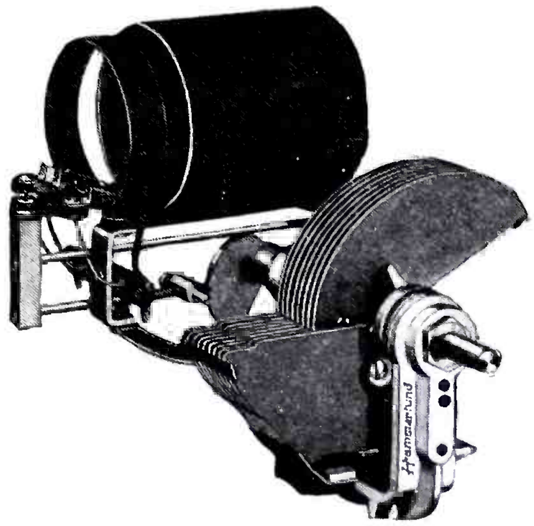
In soldering the connections of the set be careful to use a hot iron which is clean and properly tinned. A rosin-core solder will give best results. Where a stronger flux is necessary as for instance with nickle-plated terminals a touch of soldering paste may be used but be very careful to use as little paste as possible.

Begin the wiring by connecting the "A" battery leads; then connect the grid and plate circuits.

Proceed to assemble and wire the audio frequency unit. In mounting the sockets on the sub-panel of the audio unit be careful to assemble them so that the two halves fit together with the pin of the guide piece in the hole of the spring member.

Next mount the two audio transformers with their terminals in the positions as shown in the diagram.

A simple way to mount the amperites so that the terminals will be on the under side of the subpanel is to disassemble the clips and then use the ½" x 4/36 round head machine screws to fasten the mountings to the sub-panel with the screws projecting on the bottom side of the sub-panel. Soldering lugs can be fastened in place on the under side of the sub-panel, making the connection with the terminals of the amperites.



Midline condenser combined with auto-couple coil.

Next mount the binding posts in the following orders: "A Bat+"; "A Bat—"; "B Bat—"; "C Bat+"; "C Bat—"; "C Bat—"; "45 volts+"; "67 volts+"; "90 volts+", and "135 volts+".

The soldering lugs on all but the "A Bat+" binding post should be placed on the bottom side of the sub-panel. The soldering lug on the "A Bat+" binding post should be placed on the top side of the sub-panel between the binding post bottom and the sub-panel.

Terminals should be provided for anchoring connections from the bottom of the sub-panel so as to make connections to these terminals on the top side of the sub-panel after the audio unit is mounted on the baseboard. Begin wiring the audio unit as shown in the diagrams. In soldering to the transformer terminals be careful not to apply too much heat which would cause breakage of inside connections. Be sure that none of the connections on the under side of the sub-panel are close enough to interfere with the action of the spring sockets. Where it is necessary to cross over the sockets the wires should be carried at least a quarter of an inch away from the socket springs.

When the audio unit is completely wired it is mounted on the baseboard as shown in the photos.

Installing the Set

The connections for the ground, "A," "B" and "C" batteries are clearly indicated. A good way of making the ground connection is to connect the ground wire directly with the negative terminal of the "A" battery.

Now insert your loudspeaker into the jack and you are ready to proceed with the testing and adjustment of the set preparatory to actual operation.

While the selection of the parts that go into the construction of a receiver are important and their proper use essential to efficient operation, you must not lose sight of the fact that the kind of accessories you use with the set will determine in a large measure the degree of efficiency and pleasure you will get from your radio installation.

A good aerial installation is also absolutely necessary for most efficient operation. Because of the shielding in the set, the outside pickup is reduced to a minimum.

A Lamp-Socket-Operated Browning-Drake Set

A Set with An Automatic Control and a Power Amplifier

By ARTHUR H. LYNCH

THERE is no doubt, whatever, about the increasing popularity of receivers operated directly from the electric light lines. The author of the following article, which appeared in a recent issue of *Radio News*, is a man of wide experience in this field. He has taken the best of a number of new and interesting developments and combined them in a most satisfactory and scientific manner.

By following the instructions Mr. Lynch has prepared it is possible for the home constructor, in almost any part of the world, to provide himself, at reasonable cost, with the materials for building this very satisfactory combination.

The technical accuracy and easy readability of Mr. Lynch's articles have won him an enviable international reputation and the following article is one of the best which has come from his pen. Mr. Lynch's article is as follows:

Nearly three years ago Glen Browning and Frederick Drake developed after many months of mathematical and laboratory research work, a circuit which was enthusiastically received by the radio public. Unlike most other radio circuits, the Browning-Drake has become more popular each year until now it is almost the standard of home-built sets.

When the original circuit was developed, the coils and condensers available on the radio market were not of the same high quality as those being manufactured today. By space-winding the turns of the grid coils on thin high-insulating tubes and designing special low-loss condensers, Messrs. Browning and Drake have managed to so improve the results obtainable with their circuit that the theoretical optimum of performance is now very closely approached.

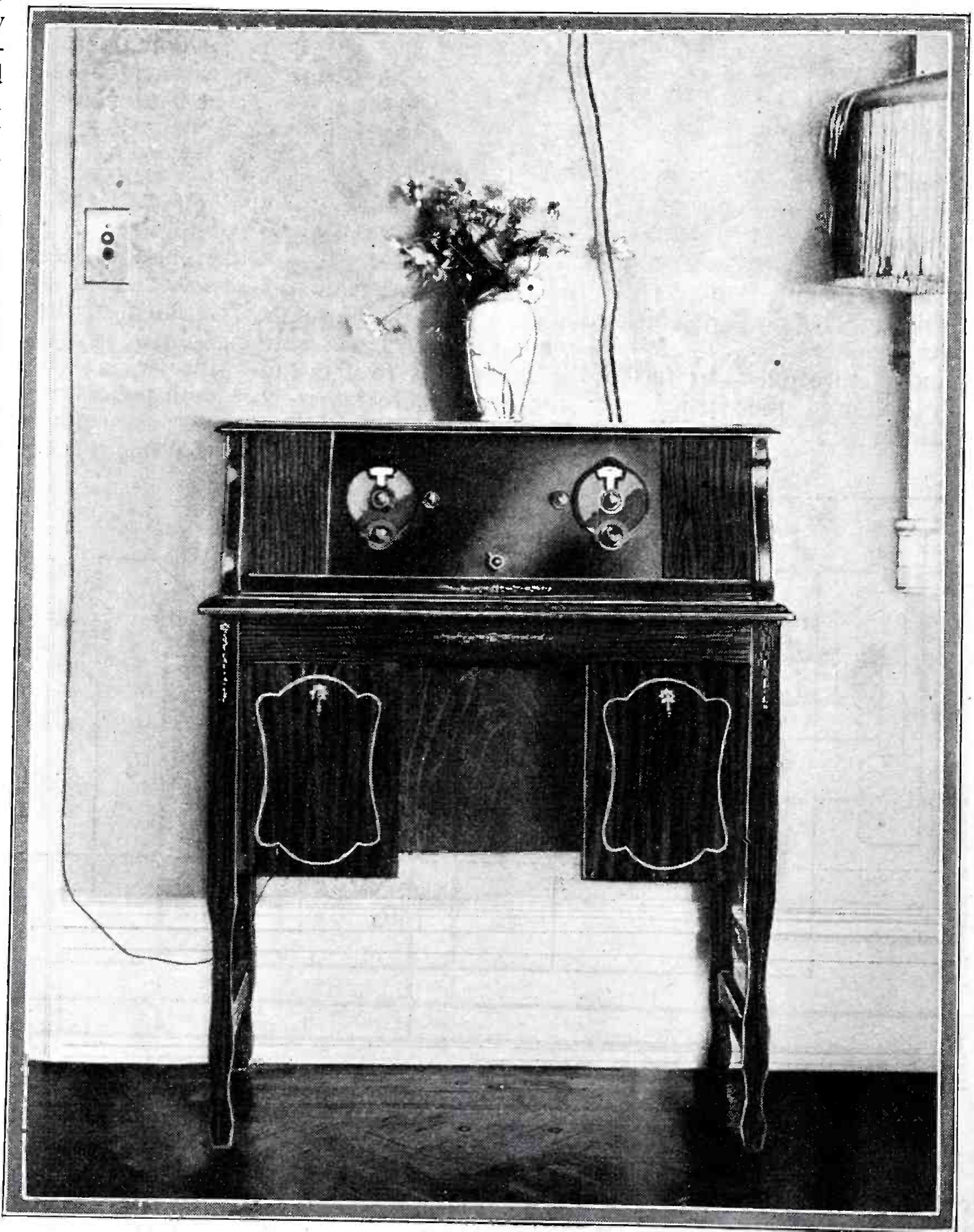
But while this progress in the field of radio-frequency amplification at broadcast frequencies was being made, the audio engineers were not entirely asleep.

Realizing that one way to perfect amplification was by inter-tube resistance coupling, a number of scientists in different parts of the country spent a great deal of time developing suitable resistors for such use. One of the outstanding results was the development of the metallized filament resistors which give noiseless and invariable results.

But a good coupling medium alone was not sufficient. New and different tubes from those of the past were also required, and they were not long in forthcoming. We have now special R.F. amplifier tubes, special detector tubes, voltage amplification, or "high-mu" tubes, and the so-called power tubes which are capable of delivering the power required to operate satisfactorily a loud-speaker without that most common form of distortion, "blasting."

With all of these essential components of a better amplifier available, it was not long before several engineers had brought them together into an amplifier that could deliver full volume with well-nigh perfect quality. Much credit for the development and design of high-grade lamp-socket amplifiers of the resistance-coupled type, such as described in this article, is due to James Millen.

And then, to complete the chain, the first models of the cone or disc speaker,



Illustrations by courtesy of Radio News

Fig. 1.—A view of the complete batteryless Browning-Drake receiver. The "A" and "B" power units and the audio amplifier are contained in the two compartments of the table.

vith its wide and uniform frequency haracteristic, were placed on the mar-et. This year practically all the better lass of manufacturers are making peakers which almost defy further nprovement.

Use of Power Units

By taking the best in the radio-fre-quency amplification field and combin-ng it with the best in the audio ampli-ication field, a truly fine receiver is obtained. But why stop here? Not only is practical lamp-socket operation an accomplished feat, but during the past year the shortcomings and imper-fections of the original devices have been overcome. In many ways, such as elimination of common plate-circuit coupling, supply of high voltage (so essential for good quality), saving in replacement and maintenance, and economy of operation, the power units have an advantage over batteries.

So far as the "A" battery is con-cerned, while it actually exists within the "A" power case, it to all intents and purposes, it too has been replaced; for who need know that it still exists, when it requires practically no maintenance? The automatically-controlled noiseless charger runs whenever the set is not in use, keeping the battery always fully charged and ready to give the best of service. The cell vents are vapor-proof, so that no corrosive acid fumes or spray can harm or corrode the in-terior of the cabinet; and large reserve water space is provided above the cells in order to make the addition of water more than once a year rarely necessary. And as for economy, a battery always kept fully charged need not be nearly as large as one which must have suffi-cient capacity to serve for several weeks at a time between the charging periods. Thus, the initial and final cost of the complete "A" power unit differs but little from that of a large storage battery.

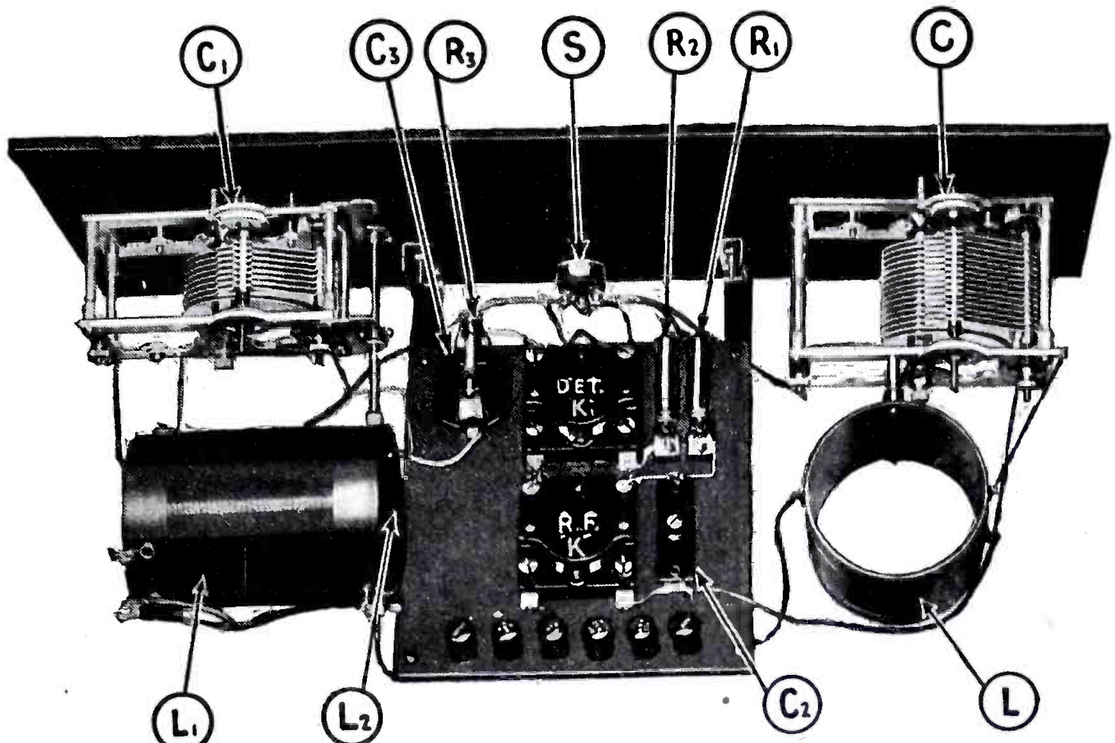


Fig. 3.—Interior view of the receiver. A 199 tube is employed in the R.F. socket and a 201-A in the detector socket. C_2 is the adjustable neutralizing condenser.

The result of a careful and harmoni-ous combination of the work of the best engineers in their own individual fields is the receiver shown in Fig. 1.

The panel is sloped at an angle of 25 degrees from the vertical in order to facilitate operation by preventing shadows from interfering with the dial readings. The dials are of the new station-recording type, on which the call letters of the different stations may be recorded in their proper places. This arrangement is of considerable advantage, as it enables any one to tune the set immediately to the wave of any desired station without consulting log books and graphs. As a further facil-ity to better tuning, the reduction ratio of the slow-motion vernier is variable. Thus, when tuning in local stations or going from one end of the dial to the other, the coarse adjustment saves both time and energy; yet, when fine adjust-ment is desired on a weak or distant station, it takes but an instant to bring the full slow-motion device into action.

Another aid to good tuning em-bodied in the set is the 270° variable condensers. The plate-shaping pre-vents congestion on the lower part of the dial. The 270° arc through which the plates may be rotated gives the same effect as further separation of the different stations. A still fur-ther, and rather unique, advantage is the way in which this arrangement per-mits sharp tuning with seemingly un-

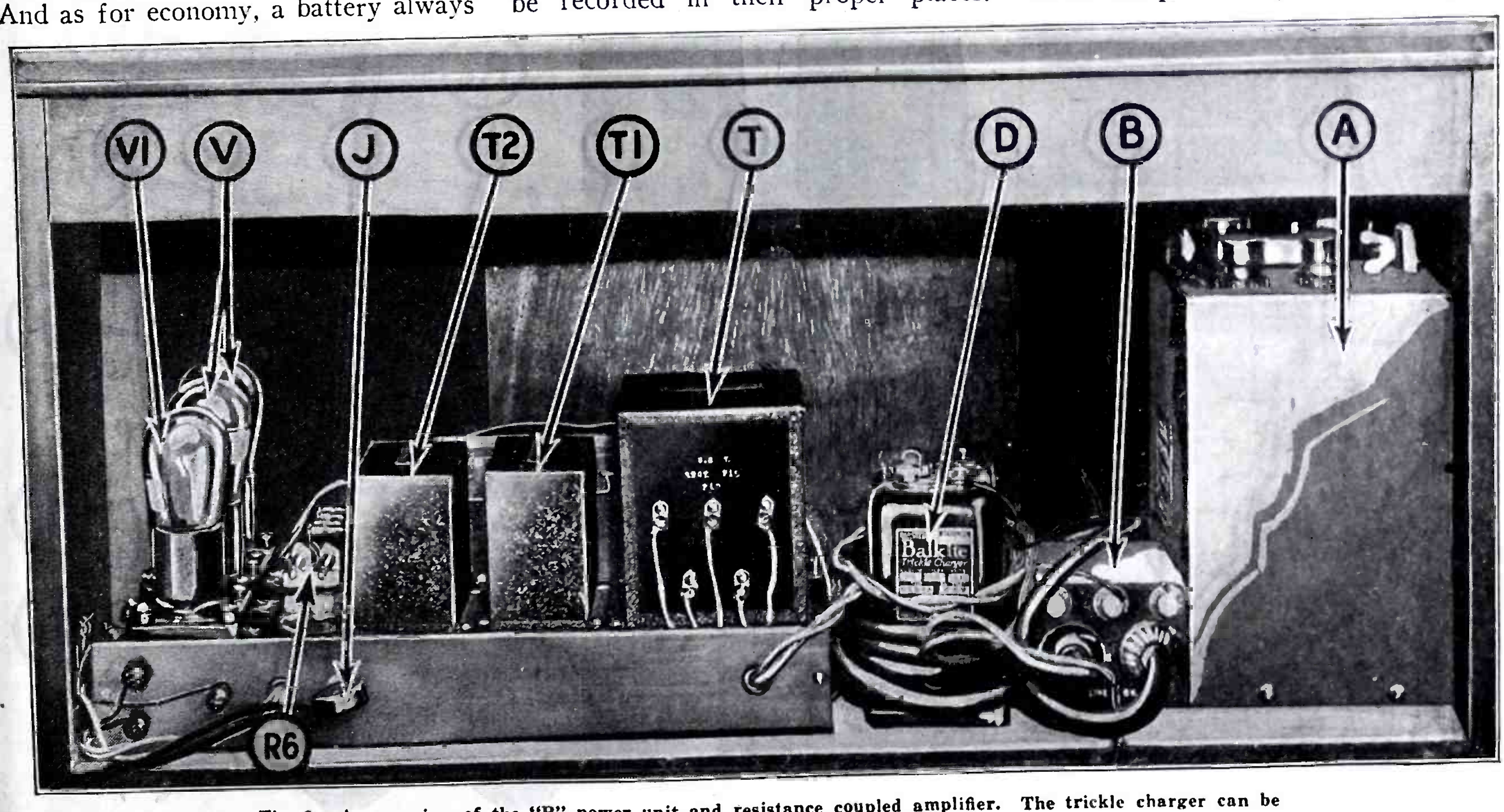


Fig. 2. A rear view of the "B" power unit and resistance coupled amplifier. The trickle charger can be seen at D. B is the automatic magnetic relay.

LIST OF PARTS FOR LAMP-SOCKET-OPERATED BROWNING-DRAKE SET

1 National Variable Condenser .0005 mfd. (C)
1 National Browning-Drake Aerial Inductance (L)
1 National Variable Condenser .0003 mfd. (CL)
1 National Browning-Drake R.F. Transformer (L1L2)
1 Yaxley Rheostat 30 ohms (R)
1 Amperite Self-adj. rheostat for 199 tube (R1)
1 Amperite Self-adj. rheostat for 201-A tube (R2)
1 Fixed Grid leak 2 meg. (R3)
1 Bruno Filament Switch with pilot light (S)
1 XL Vario-Denser Model N Neutralizing Condenser .00005 mf. (C2)
1 Sangamo Grid Condenser with grid leak mounting .00025 mf. (C3)
1 Precise Model 601 Variable Condenser, midget type .000025 mf. (SC)
2 Airgap Tube sockets (K, K1)
1 National Power Transformer with 5 volt fil. winding (T)
1 National Filter, double choke (T1)
1 National Tone Filter, choke and 4 mf. condenser (T2)
2 Ceco type G (High-Mu) tubes 5 volt fil. (V)
1 Type 171 tube, 5 volt fil. (V1)
1 Raytheon type B4 Rectifier tube (V2)
1 Ceco type E tube, 3 volt fil. (K)
1 Ceco type H tube, 5 volt fil. (K1)
1 Resistance Amp. (R4, 5, 6)
1 Electrad Royalty type Variable Resistance 5000 ohms (R7)
1 Electrad Royalty type Variable Resistance .5 meg. (R8)
1 Electrad Royalty type Variable Resistance 2500 ohms (R9)
2 Tobe-Deutschmann Filter condensers 4.0-mf. (C4)
6 Tobe-Deutschmann Fixed condensers 1.0-mf. (C5)
2 Tobe-Deutschmann Fixed condensers 2.0-mf. (C6)
2 Tobe-Deutschmann Fixed condensers 0.1-mf. (C7)
1 Resistor with mounting .05-meg. (R10)
1 Amperite Self-adj. rheostat (R11)
1 Yaxley Jack, short type open circuit (J)
1 Formica or Radion panel 7" x 18"
1 Formica or Radion panel 7" x 16"
1 Formica or Radion panel 7" x 14"
2 Formica or Radion panels 2" x 14"
4 Airgap tube sockets
2 Brackets for receiver
2 Brackets for amplifier
9 Eby Binding Posts
3 Bushings
Wire, Screws, etc.
1 Gould storage battery 6 volts (A)
1 Balkite Trickle Charger (D)
1 Brach Automatic Control (B)
1 Console Cabinet
1 Rola Loud speaker, cone type

critical control. In fact, the lack of necessity for critical adjustment of the tuning dials ofttimes tends to give one not familiar with the operation of the new Browning-Drake receiver the impression that it is not selective. This, is a mistake, however, as the layman will readily appreciate when he finds how completely the different stations are separated, and the engineer when he knows that the tuned-circuit resistance at 300 meters is less than 7 ohms. And last, but far from least, not more than two hands, which most of us possess, are required to tune the set.

Automatic Power Control

A unique and highly practical method of remote power control has been incorporated in this receiver. The red pilot lamp on the panel switch glows whenever the set is in use, and serves not only to control the filament circuits of the different tubes but, by means of an automatic magnetic relay (B in Figs. 2 and 6), to switch the lamp-socket power to either the trickle charger (D) in the "A" power unit or to the "B" power unit and the filament of the power tube in the set, as required.

The Amplifier

As will be readily seen from the list of parts accompanying this article, a

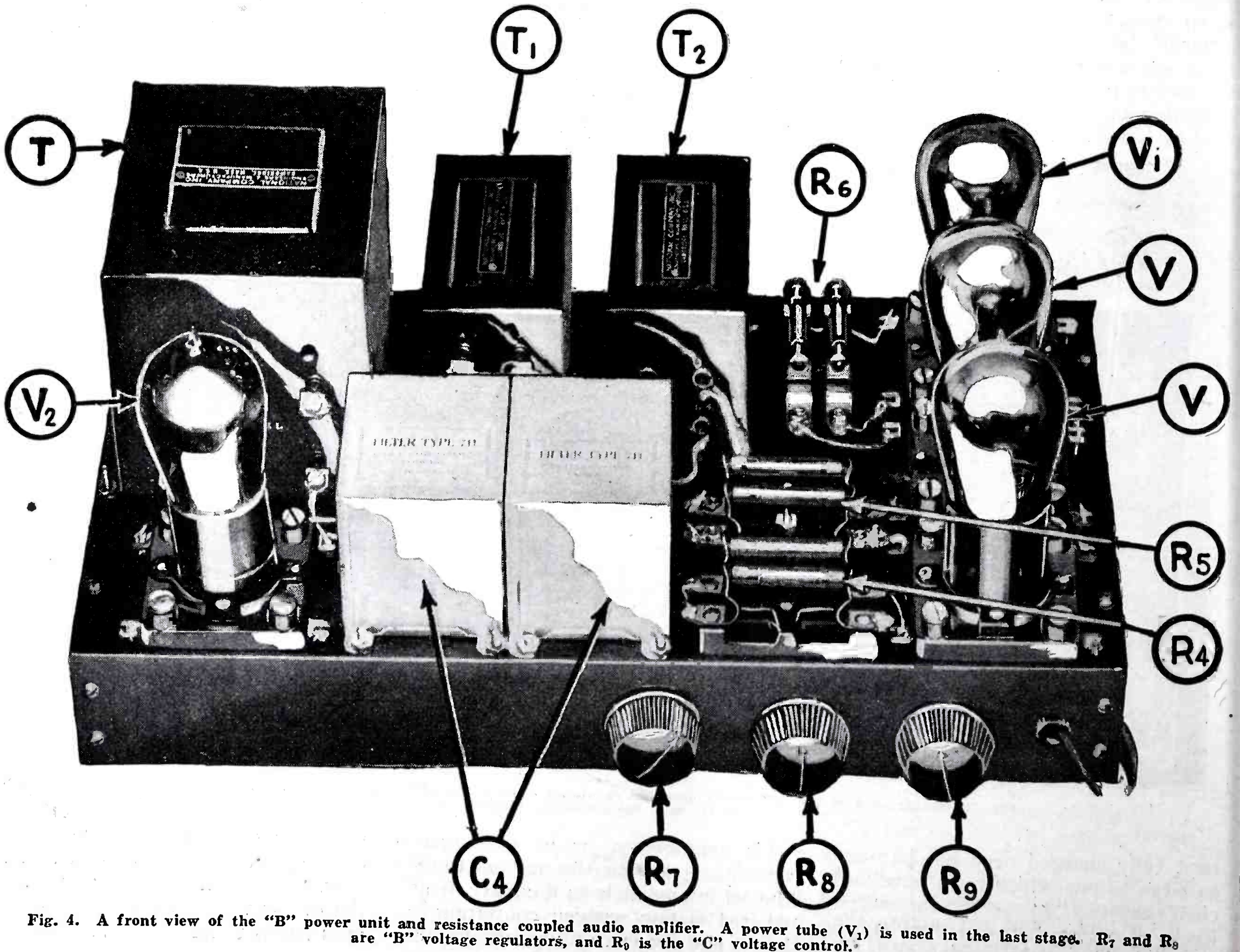


Fig. 4. A front view of the "B" power unit and resistance coupled audio amplifier. A power tube (V_1) is used in the last stage. R_7 and R_8 are "B" voltage regulators, and R_9 is the "C" voltage control.

umber of prominent manufacturers f high grade radio equipment are producing parts for the construction of ood audio amplifiers. A very comact set of parts is used in the conruction of the unusually small and eat three-stage lamp-socket-power restance-coupled amplifier shown in igs. 4 and 5.

While adaptable for use with any et, this amplifier unit was designed y the author in conjunction with ames Millen primarily for incorporaon in this Lynch-Browning-Drake reeiver, to supply, in addition, an adjustble "B" voltage to the plates of the adio-frequency-amplifier tube and the etector tube.

which are located the loud-speaker jack (J) and binding posts.

The circuit employs a power transformer which supplies the high voltage to the rectifier tube, which, by the way, is one of the new "BH" tubes. This tube, like its little brother, the "B," works on the gaseous-conduction principle; having no filament, it has an almost limitless life and will serve for thousands of hours without attention. Of course, the "B" tube may be used if desired; but as the different parts of the amplifier have been selected with the "BH" tube in mind, slightly better results will be obtained by its use.

But to get back to the amplifier circuit the power transformer has also a

"C" Voltage Supply

By a rather novel arrangement of audio-frequency filter and voltage-drop resistor, the high "C" voltage (approximately 90 volts negative) required for the grid of the last audio, or 171-type tube, is obtained from the "B" supply. If an attempt were made to secure the negative "C" voltage by utilizing the voltage drop across a resistor in the negative plate-supply lead, the result would be rather discouraging; as it would be found that very little amplification was being obtained. This phenomenon is due to the fact that not only would the D.C. component of the space current of the last tube be passing through this resistor,

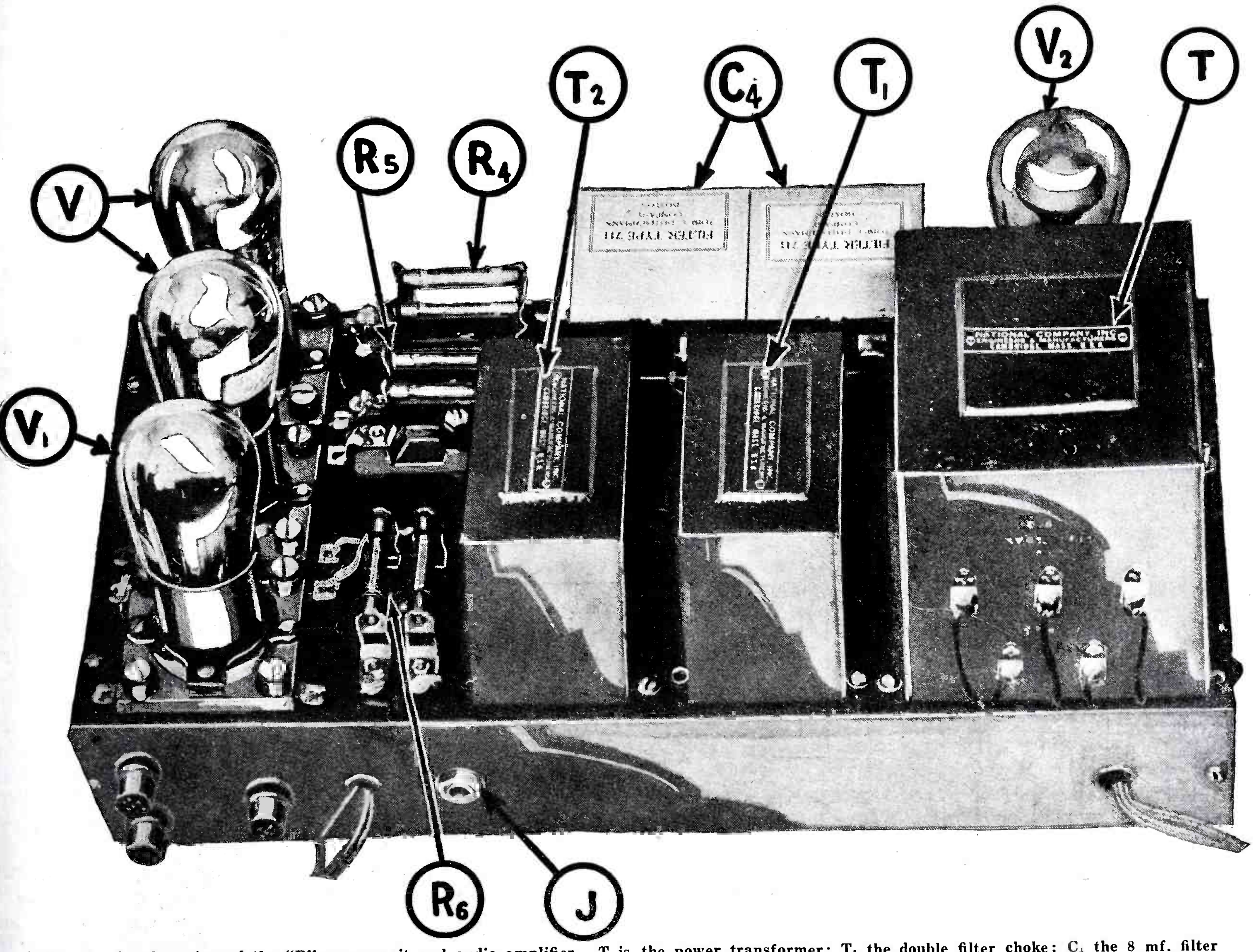


Fig. 5. Another view of the "B"-power unit and audio amplifier. T is the power transformer; T_1 the double filter choke; C_4 the 8 mf. filter condenser; and T_2 the "tone" filter. The amplifier coupling condensers and the other filter condensers are mounted underneath the base.

By mounting the various units on a 7 x 14-inch composition panel, raised on a pair of rubber brackets, much of the wiring and many of the small parts, such as resistors, self-adjusting rheostats, by-pass and some filter condensers, are concealed from view; thus greatly enchancing the appearance of the complete unit. Each part is completely shielded in its own individual case, and all the metal cases are connected together and grounded by a common bus. Small 2 x 14-inch panels box in the under structure, and at the same time serve as terminal boards on

5-volt filament winding with centertap for heating the filament of the last audio, or 171-type power tube. The filaments of the first two audio, or "high-mu," stages are supplied from the "A" power unit. By connecting the filaments of the two tubes in parallel a ½-ampere type of self-adjusting rheostat in the common lead is made to serve the purpose of two and an additional part obviated.

The high-voltage output of the rectifier tube is passed through a special filter circuit comprising a double choke and several filter condensers, arranged as shown in the circuit diagram, Fig. 8.

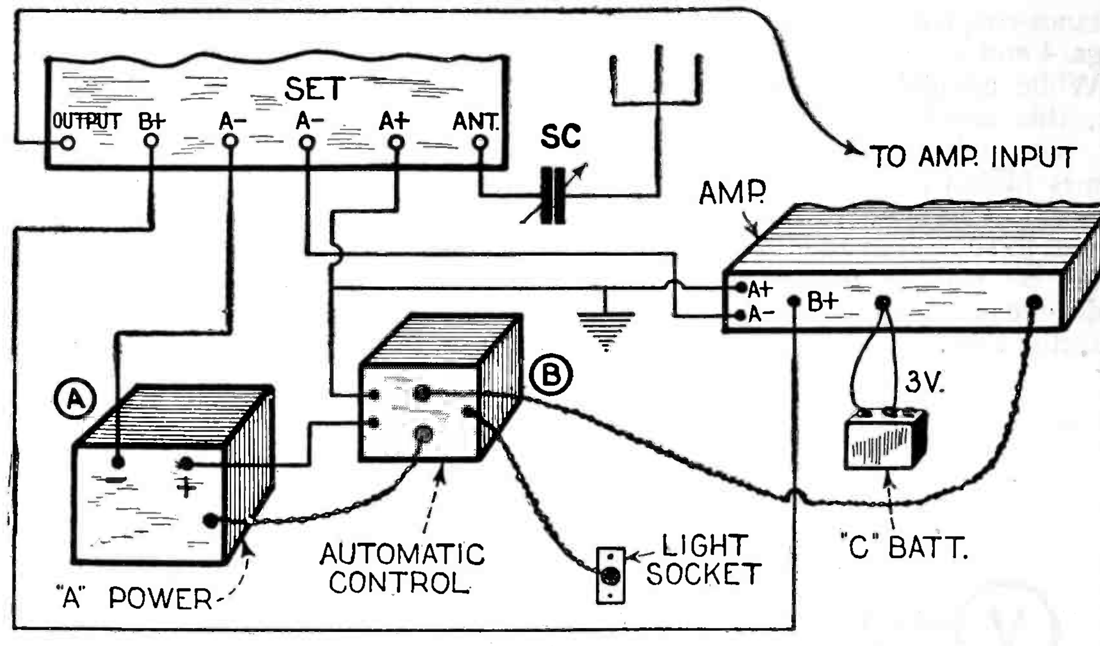
but also the alternating or audio-frequency, component which would produce an alternating voltage. The combination of the alternating and direct voltage drops would result in a pulsating biasing voltage having such phase relations as to neutralize the input and result in greatly reduced amplification.

By means of a simple filter circuit comprising a 1.0-μf. condenser (C5) and a .05-megohm resistor (R10) the audio-frequency current is kept from passing through the 2500-ohm variable resistor, (R9) across which the grid-voltage drop is obtained. Thus, as only pure D.C. passes through this resistor, a steady grid voltage is obtained. The proper grid-voltage for a 171-type tube with 180 volts on the plate is 40.5. At this plate voltage and grid bias, with normal load impedance and D.C. resistance, the plate current is approximately 25 milliamperes. It will be of considerable advantage to use a variable resistor for this purpose; as the plate voltage will vary, with different rectifier tubes, set loads, and line conditions, from the assumed value of 180 volts. Once the variable resistor has been properly adjusted for any given set of conditions, no further changes or adjustments will be required.

Two variable resistors are employed in order to obtain lower voltages for the R.F. and detector tubes. A 1.0-μf. condenser is connected from the low voltage side of each resistor to the ground.

The full 180 volts is applied to the plate circuits of the three resistance-coupled-amplifier tubes. Three 0.1-megohm resistors are employed in the plate circuits of the detector and the two "high-mu" tubes, while the grid resistors for the three audio tubes are 1.0-, 0.5- and .25-megohms respectively. The six resistors are mounted in three double bases, which require only one hole each for mounting. Their soldering lugs and clips are stamped from one piece of nickel-plated spring bronze, eliminating any possibility of a noisy contact.

In order to secure good amplification of the low notes, which is essential for natural reproduction, mellowness, and volume, coupling condensers of large capacity are used. In this amplifier three 1.0-μf. units are used, and the resultant tone quality is everything that could be desired.



- FIG. 6 -

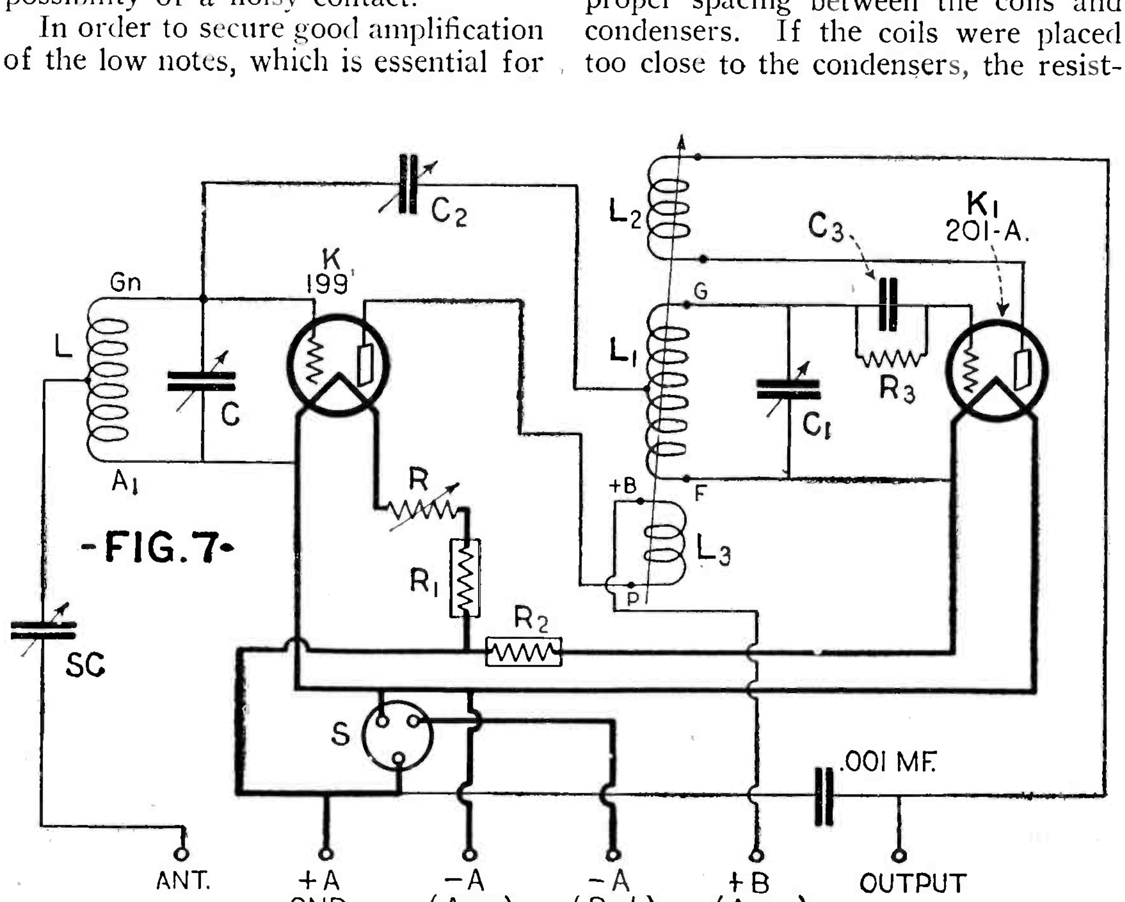
The connections between the set and the power units are shown here. The automatic control B takes care of charging the "A" power unit.

Construction of the Receiver

The construction of the actual receiver is indeed a simple task, as there are so few parts to be mounted and wired. The coils of the special Browning-Drake units, designed by Mr. Browning himself, are mounted on the condensers in a way to insure proper relations between the two coils (their axes must be in the same plane and at right angles to each other) and the proper spacing between the coils and condensers. If the coils were placed too close to the condensers, the resistance of the tuned circuit would be materially increased and the selectivity and sensitivity of the receiver would be considerably reduced. Thus, mounting the two condensers at the same time mounts the coils. Details of this can be obtained by referring to Fig. 3.

Preparing the Panel

The panel on which the two Browning-Drake tuning circuits are mounted is of 3/16" Radion or ba[k]elite, 7 x 18". The holes should be carefully laid off on the panel with the aid of a scriber, pair of dividers, steel scale, and a square. When the positions of the various holes have been determined, as shown in Fig. 9 they should all be center punched and drilled for 6/32 screws. The larger holes are most conveniently made with a reamer; as few radio constructors are likely to have drills of the exact size needed.



-FIG.7-

Complete wiring diagram of the Browning-Drake receiver. The indicating letters correspond to those in Fig. 3.

Mounting the Parts

The filament switch, volume control and the two B.-D. units are mounted on the panel. It is wise to remove the red bulb from the pilot switch until after the set is complete and ready to operate, as otherwise it may be broken. After all of the units have been mounted on the front panel, the two dials are attached.

The two tube sockets, self-adjusting rheostats, neutralizing condenser, grid condenser, by-pass condensers and binding posts are located on a 3/16-inch sub-panel or shelf 6 x 7 inches. Two brackets may be made either from ½-inch brass strip, or as in the case of the set illustrated, from ½-inch angle brass; either will serve equally well. The standard brackets available on the market at present are not suitable for this use, as they are designed for use in sets with vertical instead of sloping panels.

When all the parts have been mounted the set is ready to wire; the diagram is shown in Fig. 7. As in the case of the power amplifier and "B" supply unit, it is advisable to use flexible, unvulcanized-rubber-covered (No. 18 equivalent) stranded tinned copper wire for connections.

The completed set is mounted in the front of the cabinet and the amplifier unit is placed in the battery compartment along with the "A" power unit and control relay.

These units are then connected together as indicated in Fig. 6.

on and if everything is right the red pilot lamp and all the tubes except the 171 (and of course, the "BH") will burn. Plugging the cord of the central relay into the lamp socket will cause the 171-tube filament to light; and, if all is properly adjusted, broadcasting will immediately be heard.

Assuming that the amplifier has been properly adjusted as described by Mr. Mayo and the writer in the October issue of *Radio News,* the next step is to put the receiver in proper condition. This is best done by tuning in on a local station. As the coils and condensers used have been built with the idea of having the two dials assume similar positions for a given wavelength, it is only necessary to rotate them simultaneously from one end of the scale to the other until a station is picked up. To facilitate this operation, the variable ratio levers on the two dials should be set for the same ratios. Any ratio between 6:1 and 20:1 is obtainable. When a station has been tuned in, the two variable plate-voltage controls (of the detector and radio-frequency amplifier) located on the side of the amplifier should be adjusted for best volume and quality. They are so located on the side of the amplifier that they may be readily reached through the small door of the console table, at the lower right.

The next step is to neutralize the radio-frequency amplifier. This may best be done by turning up the volume control (left) to its maximum point and the regeneration (right) control to a point just below maximum regeneration.

Adjust the right-hand dial to the point where the signal is loudest. Then rotate the left dial up and down the scale to a point above and a point below where the strongest intensity is heard. As the left-hand dial is rotated a squeal will probably be heard. By adjusting the neutralizing condenser, this squeal may be readily eliminated. The best means of varying the neutralizing condenser is to use a long stick with one end sharpened to resemble the point of a screw driver. The use of the screw driver or other metal tool for this purpose is not satisfactory as the effect of the adjustment will be altered when the tool is removed. Once the neutralizing condenser has been properly adjusted it will require no further

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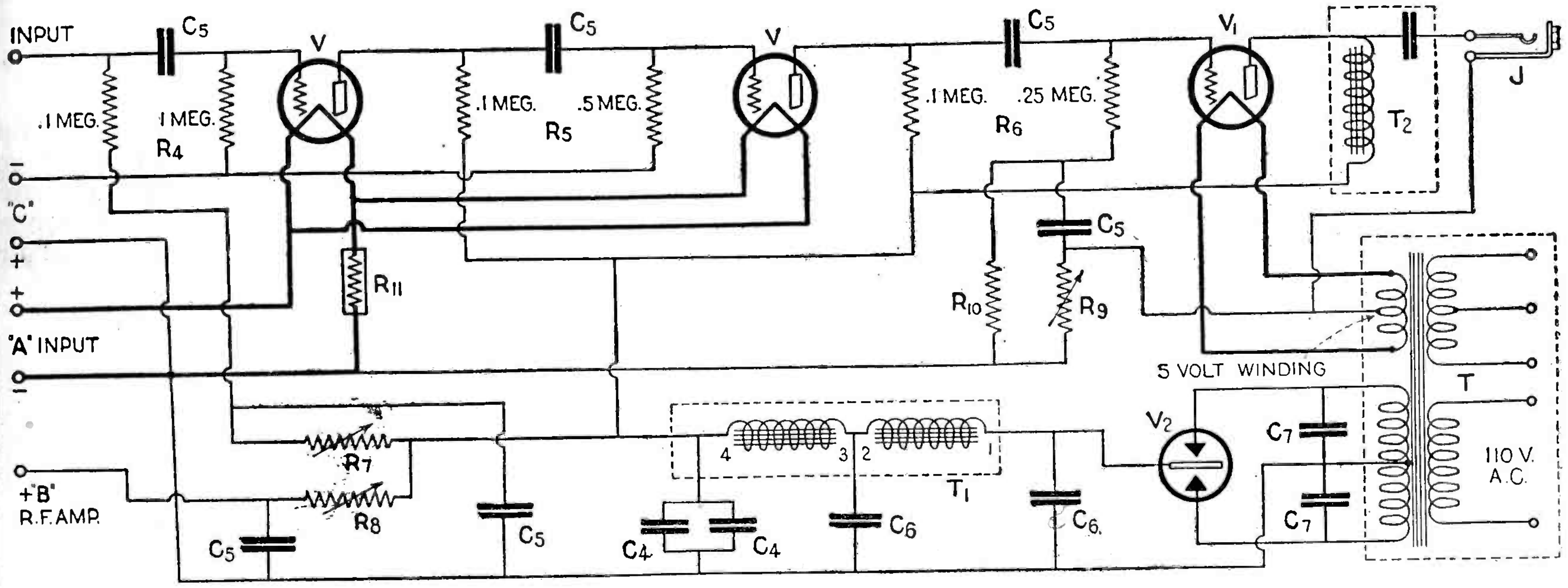


-FIG. 8-

The complete circuit wiring diagram of the combination "B"-power supply and resistance coupled audio amplifier. V are "high-mu" tubes. Note that the filament of the power tube V_1 is lighted from a special 5-volt winding of the power transformer T. The "C" voltage for the power tube is supplied through the combination of R_9, R_{10} and C_5.

Aerial and Ground

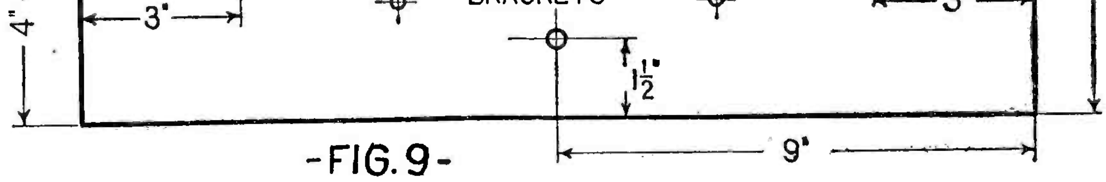
With the type of antenna coil used in the Browning-Drake receiver, it has been found that the most satisfactory length of antenna for ordinary use is about 75 feet, not including the lead-in. If the use of a longer antenna is preferred, then an antenna-series condenser (SC in Fig. 7) should be used. This condenser should be variable so that it may be so adjusted as to cause the two tuning dials to read alike. Once this has been done, no further adjustments of this condenser will be required. For this reason it is not mounted on the panel, but inside of the cabinet where its adjustment is not likely to be tampered with by anyone not familiar with its purpose. For best results with a short antenna, the series condenser should not be used, unless the receiver is located close to a powerful station.

Any type of lamp-socket-operated receiver requires a good ground. General experience indicates that the most suitable ground connection is obtained by connecting to a cold-water pipe with a good ground clamp. The surface of the pipe should first be well cleaned with emery paper or an old file.

Operating the Receiver

The 199-type tube should be placed in the R.F. amplifier (rear) socket of the receiver and the detector tube (of a new type) in the front socket. The two "high-mu" and the type-171 tubes are placed in the three sockets of the resistance-coupled amplifier. The "BH" rectifier tube is placed in the remaining socket.

The panel switch may now be turned



-FIG. 9-

Details for drilling the receiver panel which is a 7" x 18" Radion or bakelite panel.

How to Build the Shielded Six

A Dual-Control Tuned Radio Frequency Set With Individual Stages Shielded

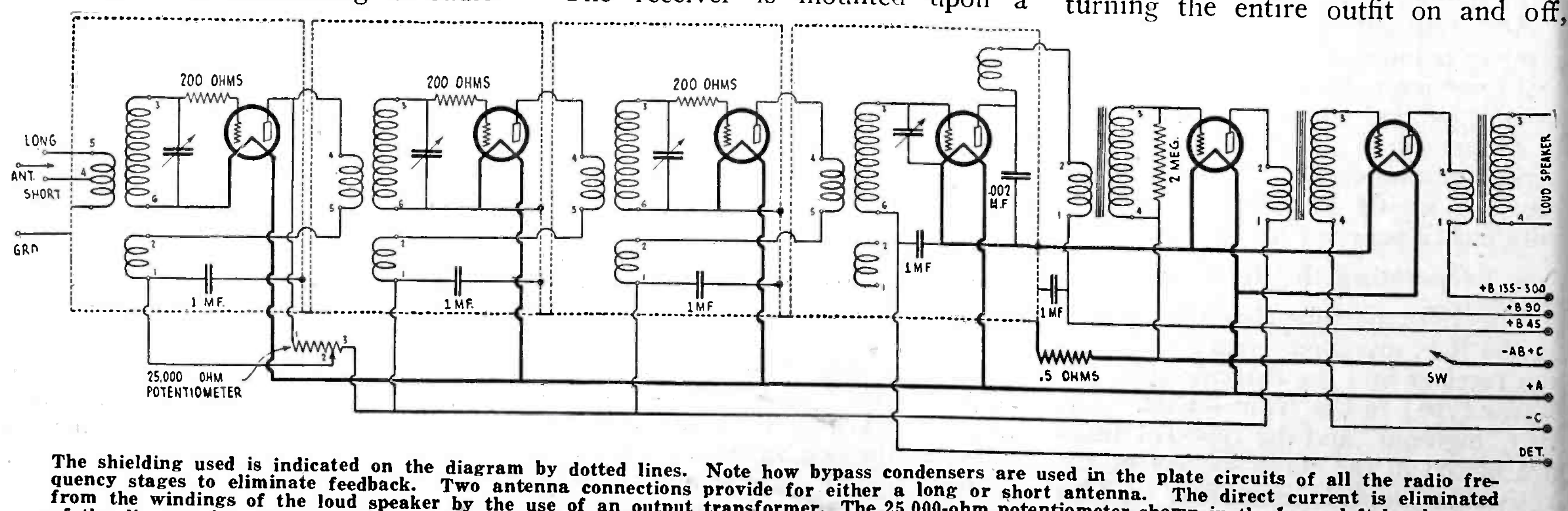
By McMURDO SILVER, A. I. R. E.

THE receiver pictured in the accompanying photograph is probably the first type of thoroughly shielded tuned radio frequency receiver ever made available to the fan public that might be satisfactorily constructed in the kitchen workshop. The design itself in its more general aspects is certainly not new; for any of the leading receivers as produced by the country's finest set manufacturers incorporate the major points evident in the construction of this particular outfit, which is known as the Silver Shielded Six.

The Shielded Six receiver contains six tubes, three functioning as radio frequency amplifiers, one as a detector, and two as audio frequency amplifiers. In this respect the receiver is unique; for up until this year it has been considered impossible by engineers to construct a receiver containing three stages of tuned radio frequency amplification which could be made to operate stably and efficiently. This the Six does by virtue of certain unusual features in its design which will be described in succeeding paragraphs, and thus it permits of the realization of an ideal in an entirely different direction at the same time, for but two controls are used to operate the entire receiver.

The receiver is mounted upon a seven by twenty-one inch walnut finished brass panel most artistically yet simply decorated. This panel carries practically no equipment and is used merely to conceal the "works" of the receiver behind it. At the left appears one of the major tuning dials which controls the antenna circuit of the receiver, while at the right is a similar dial marked "Station Selector II," which controls the tuning of the second and third radio frequency stages and the detector circuit. Below and to the center is a volume control which also serves to regulate the sensitivity of the receiver. At the right is a small switch turning the entire outfit on and off,

The completed set installed in an attractive walnut cabinet. The receiver described in this article is simplicity itself to control, as is evident from this picture showing the metal control panel.



The shielding used is indicated on the diagram by dotted lines. Note how bypass condensers are used in the plate circuits of all the radio frequency stages to eliminate feedback. Two antenna connections provide for either a long or short antenna. The direct current is eliminated from the windings of the loud speaker by the use of an output transformer. The 25,000-ohm potentiometer shown in the lower left hand corner of the diagram is a sensitivity control and functions to unbalance slightly the first tube. In this way a certain amount of regenerative amplification can be obtained with a considerable increase in volume.

while at the left a similar switch allows the use of either a long or short antenna at will, or it may be used to regulate coarsely the degree of selectivity of the receiver.

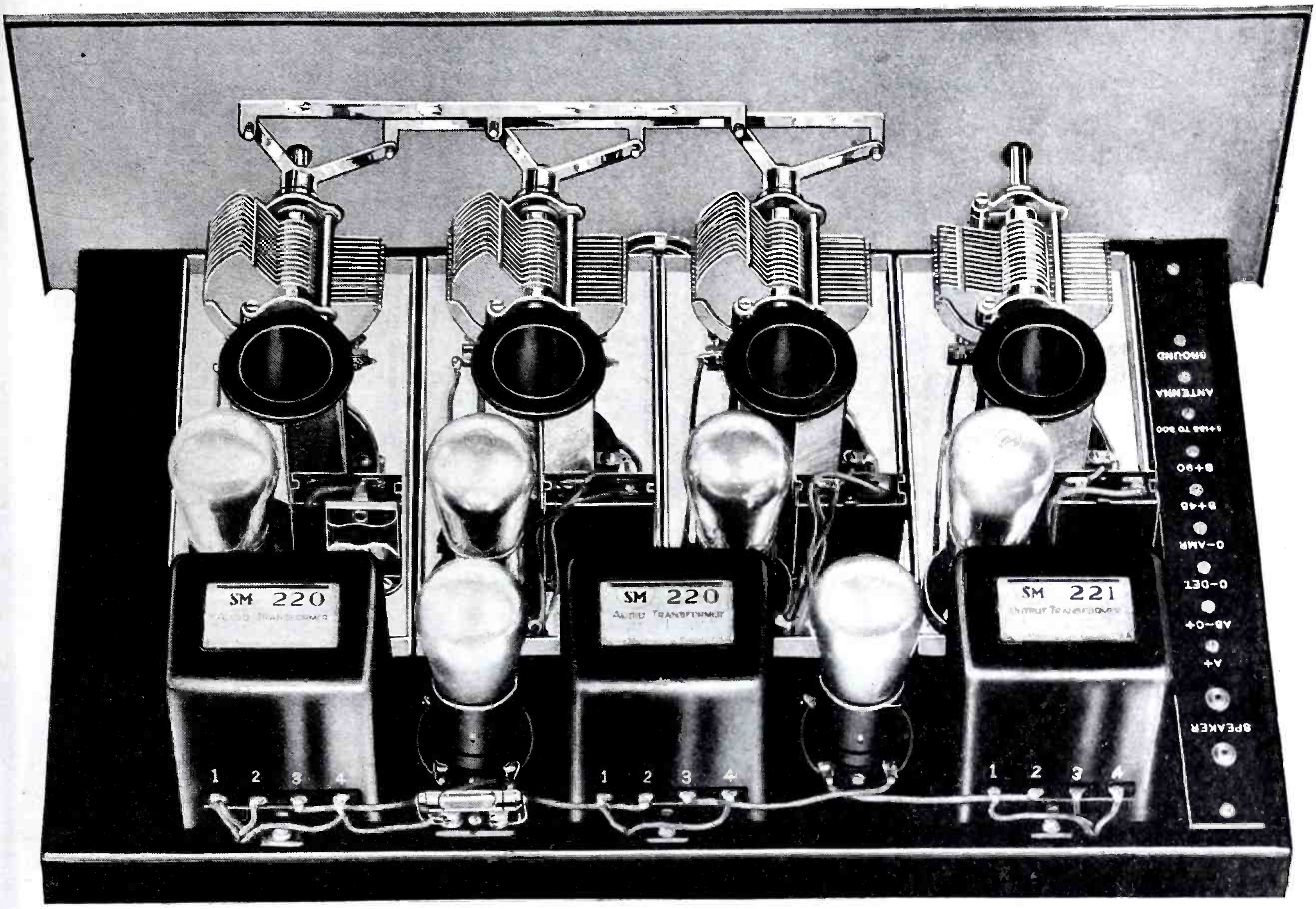
Behind this panel and fastened to it is a heavy steel sub-base. The sub-base and panel are fastened together by means of the volume control resistance and the on-off and antenna switches, which pierce both the panel and the front edge of the sub-base. This sub-base carries at the left a terminal strip to which the loud speaker cords, the antenna and ground wires and all battery wiring are connected. Thus no wires whatsoever appear upon the front of the panel, even the loud speaker connections being taken from the rear.

At the front of this sub-base are four aluminum stage shields, each containing one of the four radio frequency circuits of the receiver. This type of shielding is particularly advantageous, for not only does it prevent entirely coupling of the various circuits housed in the separate shields as well as eliminate entirely the pick-up outside disturbances, but it does this in a much more effective way than ordinary shielding. This is because, where two circuits are isolated only by a single thickness of metal, circulating currents are frequently set up in the metal shielding by one circuit and transmitted to the second circuit. In the case of the Shielded Six, due to the use of two separated walls between each circuit, the possibilities of circulating currents in one shield being communicated through another shield to the other circuits is very effectively obviated.

In each one of these stage shields is contained a specially constructed type of condenser which gives practically straight line frequency tuning over the upper range of the dial or on the lower wave-lengths and gradually verges into straight line wave-length tuning on the lower dial readings, or the higher wave-lengths.

The inductance coils used in the receiver are also built for extreme uniformity and, in fact, their inductance will vary in stock production less than one-quarter of one per cent, which is a far greater accuracy than is required for the successful construction of the Shielded Six. These coils are interchangeable and are plugged into six-contact sockets located in the respective stage shields. Thus if a coil is damaged or in any way injured, it may easily be removed and a new one substituted. Further, the possibility for seasoned experimenters of constructing special coils, say, for the European wave-length ranges, is thus left open.

In each of the three left-hand or RF amplifier shield compartments there are located in addition to the tuning condensers and inductance coils a tube socket, a by-pass condenser and a stabilized resistance. The function of the stabilizing resistance will be considered in connection with the discussion of the circuit and its operation. In the right-hand compartment practically the same equipment is located except that instead of the stabilizing resistance there is a small choke coil which aids in isolating the radio frequency and audio frequency portions of the circuit.



The set wired, with link-motion in place. The wiring above the metal sub-panel is all short and direct. The two shielded transformers to the left are for audio coupling purposes while that to the right is an output transformer.

The audio frequency amplifier is of the transformer-coupled type and consists of two stages and an output transformer. Because of the characteristics of this amplifier, it is safe to say that the quality obtained from the entire receiver will be equal to that of any manufactured receiver upon the American market during the 1926-27 season.

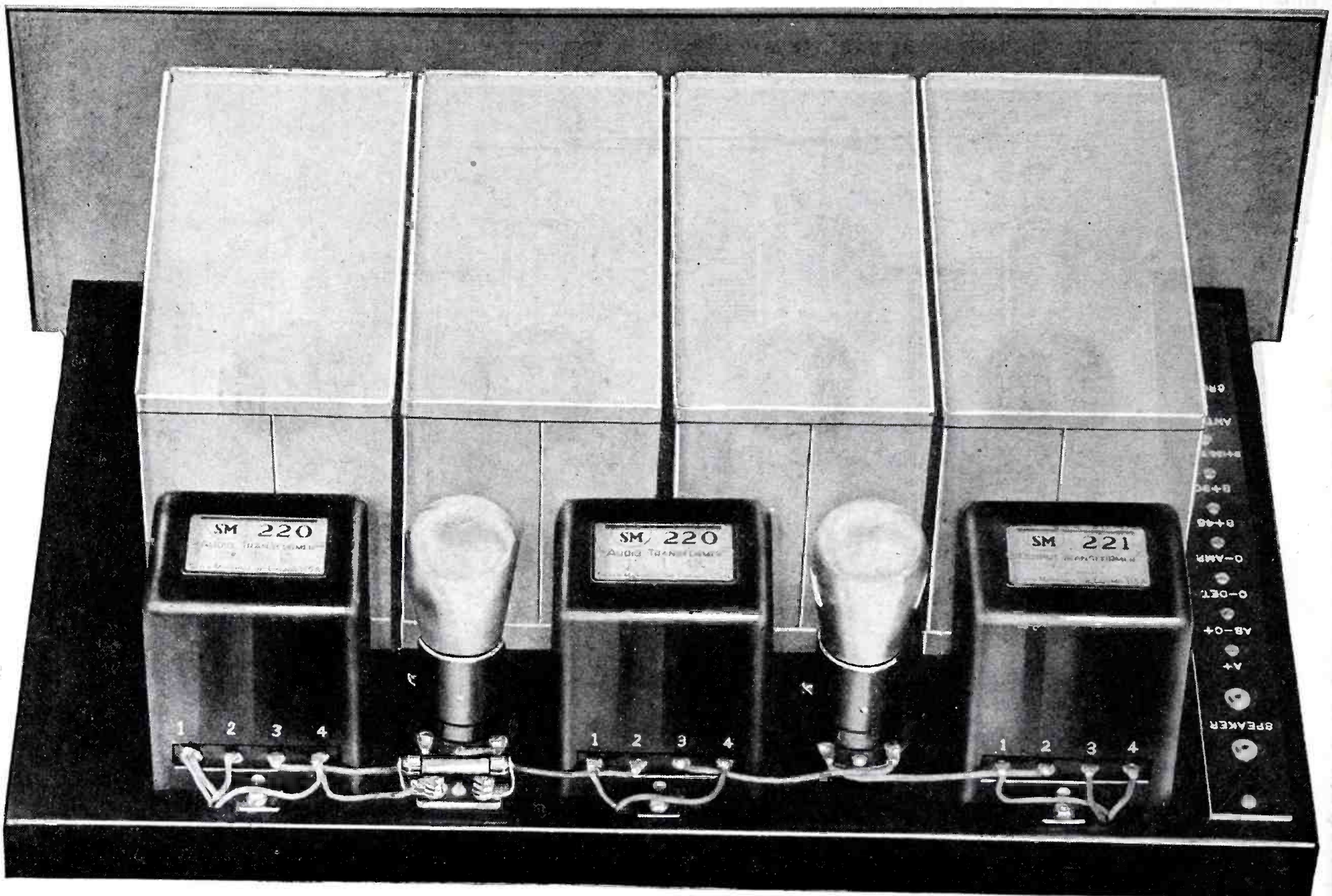
The circuit diagram for the receiver is shown schematically and pictorially. For the present, however, only the schematic diagram will be considered in explaining the operation of the circuit and the functions of the various parts. It will be noted in this diagram that there are four dotted line sections marked "631 Shields." Inside each one of these shields appears a certain amount of wiring and certain parts such as coils, condensers, tubes, etc.

Beginning at the left of the diagram appears the antenna stage, while next to it is the second radio frequency stage. To the right successively appear the third radio frequency stage and the detector stage, while in the unshielded portion of the diagram to the extreme right appear the first and second audio stages.

An examination of the radio frequency portion of the circuit will indicate that each stage circuit is completely shielded. Thus in the first or left-hand compartment we find that the shield itself (as are all other shields and metal work in the receiver) is grounded. The antenna lead feeds in through the small antenna control switch at the left of the front panel to the primary of the antenna coupling coil No. 116A. By means of a tap on this coil, adjustment can be made for either long or short antenna. This also means that if only one size of antenna is used, the selectivity of the receiver can be altered at will within certain limits by using one or the other of the two positions of the antenna switch in operation. The secondary winding of this antenna coupling coil marked with the numbers 3 and 1 is exactly similar to the secondaries of all the RF transformers and consists of a winding of enameled wire upon six supporting ridges upon a bakelite coil form. These ridges are threaded and the turns of the winding are thus spaced. The shape of the coil is such that practically maximum advantage is taken of every possible factor contributing to efficiency. One very interesting feature is the location of this coil directly upon the bottom of the stage shield separated from it only by the thickness of the coil socket. This spacing has been very carefully worked out and results in effective oscillation control at the lower end of the wave-length range and a pronounced increase in efficiency toward the higher end of the wave-length range; for the radio frequency resistance of the grid circuit actually is lower at 500 meters with the coils shielded than it is with the coils unshielded.

Two methods of securing uniform amplification over the entire wave-length range of the receiver are employed together with a variable control, the purpose of which will be considered later. The first of these methods is by means of a resistance which is included in the grid circuit of each RF amplifier tube.

This resistance combines two effects —one inductive and the other resistive. The theory of the operation is that in any tuned RF receiver as the wave-length at which it is operated decreases, the tendency to oscillate increases. This is obviously an undesirable condition inasmuch as maximum amplification will be obtained only with a uniform amount of regeneration at all wave-lengths, which is impossible without some means of compensation. The first means employed in the Six is the grid resistance, the radio frequency resistance of which increases fairly rapidly as the wave-length at which the receiver is operated decreases. Thus these resistances serve to even up the amplification over the entire wave-length range and to allow the receiver to be operated in an extremely sensitive condition both at the high and low ends of its range.

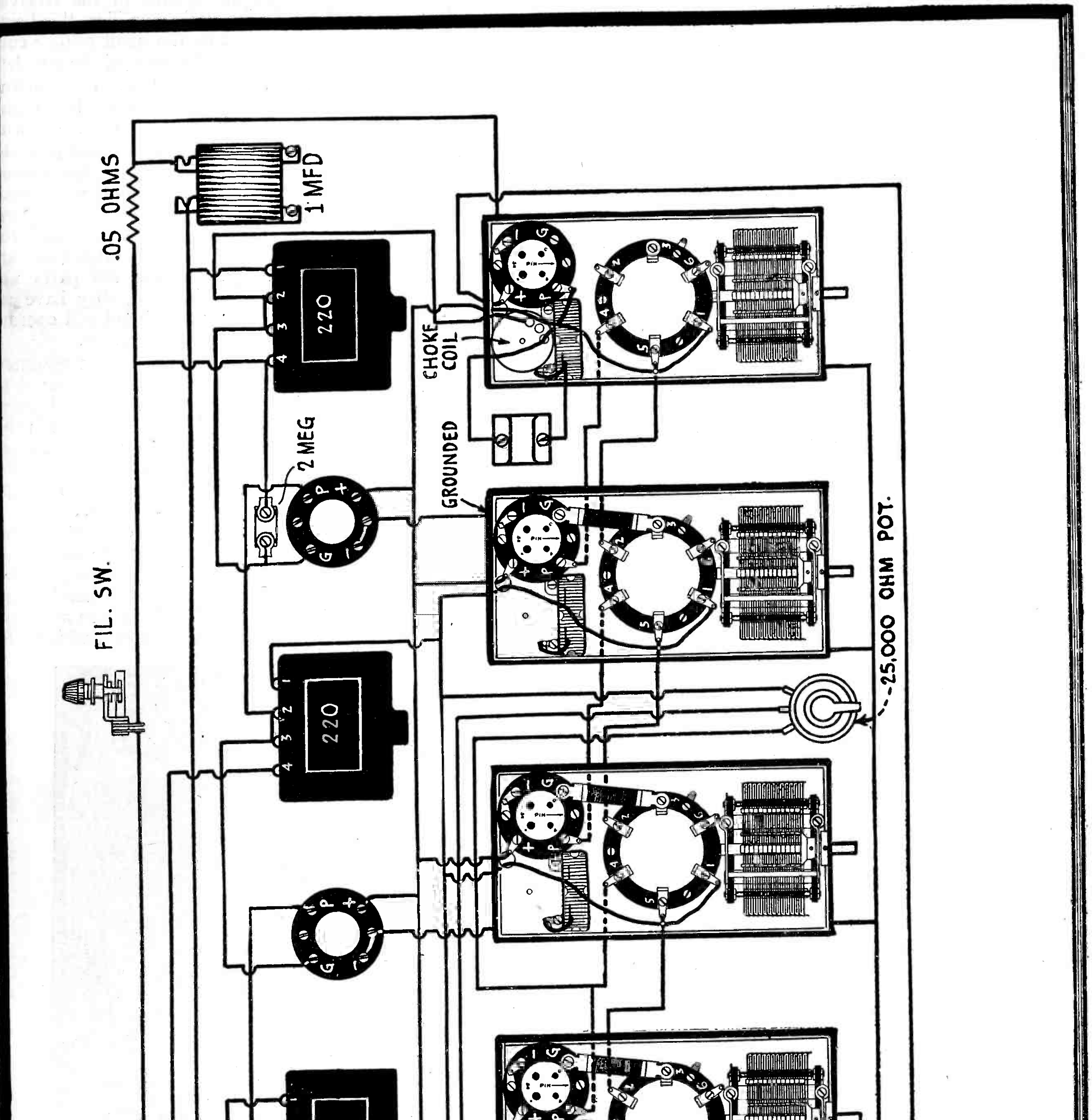


A general rear view of the receiver. The individual stage covers are in place here. The two visible tubes are the audio frequency amplifiers.

The resistances alone are not depended upon for adequate oscillation control, however. A small tickler winding "2" and "6" is used in each stage which serves to control regeneration in the stage since each stage is individually so designed that without the resistance considered it would be in an oscillating condition. With, however, a very careful balance worked out through months of laboratory work, the combination of the grid resistance and small tickler coil results in a receiver which is not only stable over its entire wave-length range but operates at practically peak efficiency at all wave-lengths.

Inasmuch, however, as there are a large number of set users, who desire the absolute limit of sensitivity from a receiver, an adjustable regeneration control has been incorporated in the receiver which terminates in the small knob appearing in the lower center of

The Shielded Six Dual Control Receiver



A picture diagram of the set. A 1 mfd. by-pass condenser is mounted directly alongside of each socket on the shielded units. A .002 mfd. by-pass condenser is shown connected across the choke coil and 1 mfd. by-pass in the detector stage.

the panel. This resistance controls the sensitivity of the first RF amplifier stage without appreciably reacting upon the adjustments of the second, third and detector stages. The method by which this is accomplished is very interesting and would in itself deserve a lengthy discussion, which would be impossible here. Suffice it to say that as the sensitivity of the first stage is increased, its effective load upon the balance of the receiver decreases and the tendency to oscillate becomes very pronounced. By means of this volume control which cuts resistance into one circuit simultaneously as it cuts it out of another, the sensitivity and stability of all circuits except the first is maintained constant, while the sensitivity of the first circuit can easily be moved up gradually toward critical regeneration. The value of this adjustment is evident to anyone who has ever operated a radio set.

Each RF circuit is very definitely localized within its shield excepting only the leads carrying energy from one shield to another. By-pass condensers are located in each stage compartment effectually preventing undesirable coupling through B battery or filament wiring. In the detector stage a small choke coil is employed together with a .002 by-pass condenser, which prevents any of the radio frequency component of the detector circuit leaking through into the audio frequency amplifier.

The use of an output transformer allows a power tube to be employed with practically any plate voltage that the builder may desire.

LIST OF PARTS REQUIRED

4 SM 631 Stage Shields.
2 SM 316A Condensers.
2 SM 316B Condensers—Long Shaft.
4 SM 515 Coil Sockets.
2 SM 411 RR Dials.
3 SM 114A Coils.
1 SM 116A Coil.
6 SM 511 Tube Sockets.
1 SM 275 Choke.
2 SM 220 Transformers.
1 SM 221 Transformer.
1 Polymet .002 Condenser.
5 Polymet 1 mfd. Condensers.
1 632 Link Motion.
2 Carter Tip Jacks.
1 Terminal Strip with Terminals.
1 Crowe Metal Panel, Pierced.
1 Steel Base, Pierced.
1 Yaxley No. 10 Switch.
1 Yaxley Special Antenna Switch.
1 Carter 25,000 Hiohm.
1 Carter .5 Ohm Resistor.
3 Carter 200 Ohm Resistors.
1 Coil Hook-up Wire.
1 Polymet 2/10 Meg. Resistance.
1 Polymet Grid Leak Mounting.

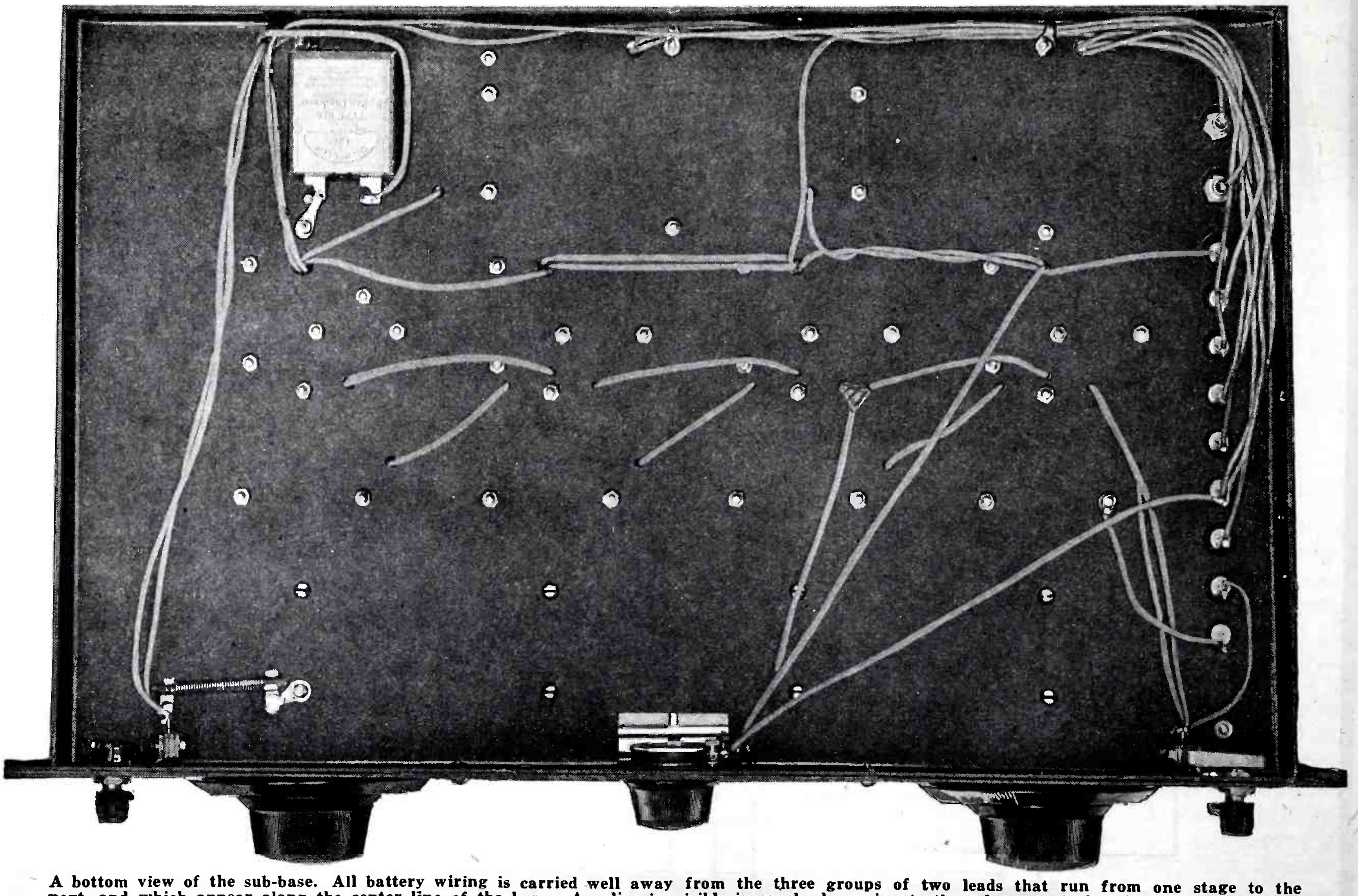
In all of the circuits UX201A tubes are used except in the first or second audio amplifier. In the first audio amplifier either a UX201A or UX112 tube is used, whereas in the second audio amplifier a UX171 or UX210 tube should be used with the highest available plate voltage in order that maximum quality of reproduction may be obtained. No provision is made for adjusting the volume of the received signal in the audio amplifier, this being taken care of by the small volume control knob at the center of the panel.

The parts needed for constructing the Shielded Six are listed below and may be procured in complete kit form.

It is essential in any event that the coils, coil sockets, stage shields, tuning condensers and link motion be procured in kit form, as unless this is done they will not be carefully measured for operation together and will not operate satisfactorily. Where the parts are purchased in kit form, they have all been laboratory tested and will operate together without any trouble.

The various parts may be mounted upon the steel sub-base as indicated in the different photographs. All parts should be placed on the sub-base in the positions as indicated from the different photographs and the panel should not be fastened to the sub-base except as one of the last operations.

There is only one caution that need be observed, particularly in mounting the parts—that is with respect to the variable condensers. It is barely possible that after they have been mounted a strain may have occurred which will pull the plates slightly out of alignment, although they are constructed to prevent just this. If it is noticed that as the rotary plates are adjusted there is a tendency for them to come closer



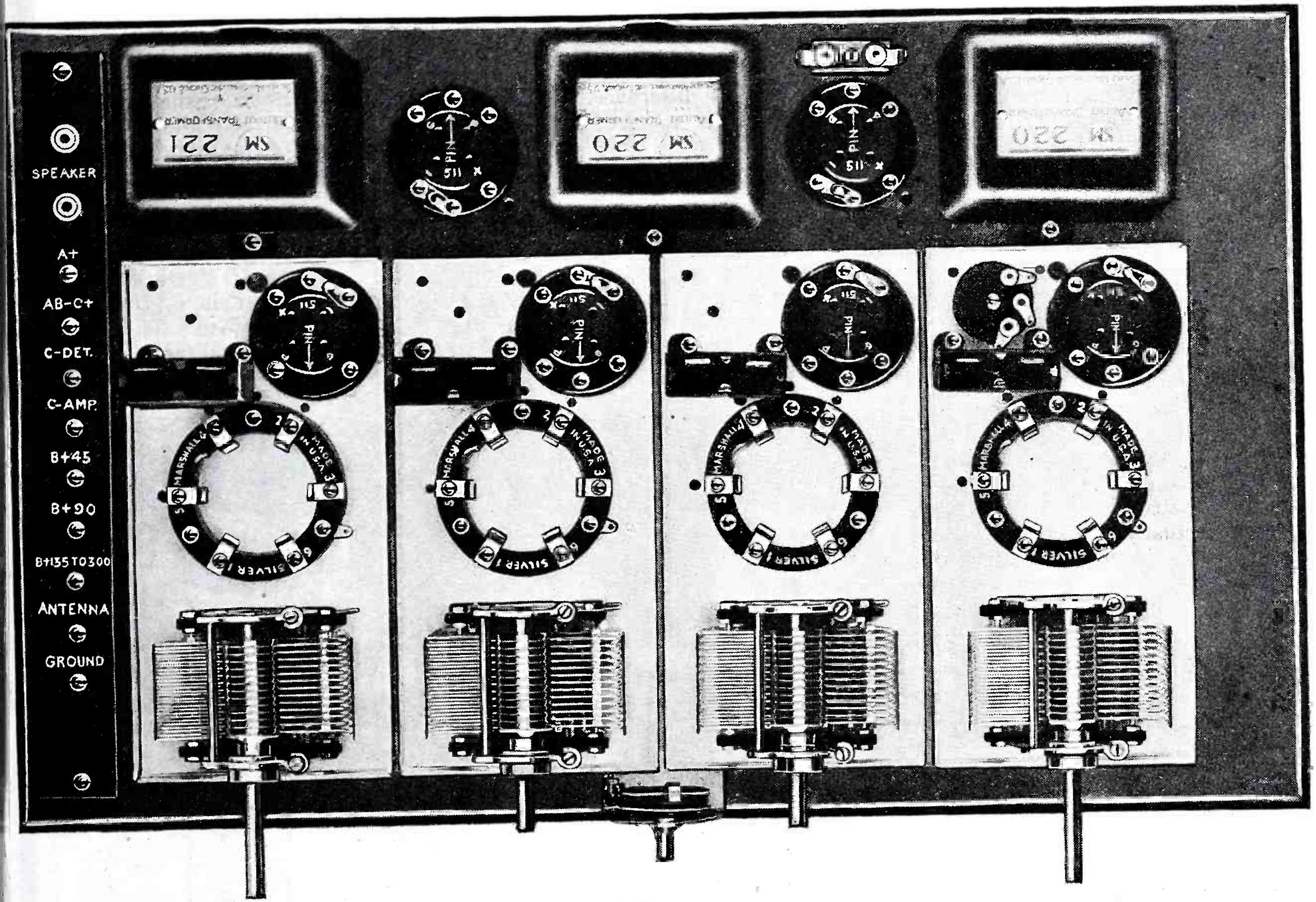
A bottom view of the sub-base. All battery wiring is carried well away from the three groups of two leads that run from one stage to the next, and which appear along the center line of the base. A splice is visible in one lead running to the volume control resistance, and its position in the wiring is quite important.

› one side of the stationary plates ıan the other, it will be necessary to ljust the positions of the stator plate ·ctions, so that each rotor plate will ·nter up between its two adjacent ator plates when viewed from above. he necessary adjustment of the posi-ion of the stator plate sections may be nade by loosening the nuts to be found on either side of the bakelite support-ng strips, these nuts being actually on he tie-bars of the stator plates. This vill allow of shifting the entire stator plate sections to any desired position where they may be locked by means of these same nuts.

The parts having been mounted on he sub-base, the wiring may be put in place using a soldering iron and Belden lexible rubber-covered hook-up wire. No difficulty will be encountered in wir-ng, as the numbers on the schematic liagram correspond exactly with those on the various instruments. It is ad-visable either that the wire have ts insulation scraped and the ends fastened beneath the terminal screws of the parts or that they be soldered to ugs in turn fastened beneath the erminal screws.

One precaution must be observed in wiring. It will be noticed that two leads run from the left-hand stage shield under the sub-base to the one next to it and from this to the next shield to the right, and, in turn, from this shield to the extreme right shield. These two wires must be kept free and away from all other wiring of the set. This can easily be arranged by carrying all wiring along the back of the sub-base, then around and down along the terminal strip toward the front. This precaution applies to the wiring which is located beneath the sub-panel. The wiring in each stage shield should be made as short as pos-sible, the placement of the individual connections being evident from the photographs. In every case the nega-tive filament connection and the nega-tive B battery connection is made through the shield and metal sub-base. It may be found in assembly that a poor contact will be made and one or more of the tubes may not light due to the lacquering of the sub-base. If this condition is encountered, it may be cor-rected by removing the lacquer from the bottom of the sub-base at the points where the screws used both for holding down the tube sockets and making the negative filament connec-tions run through the shields and sub-base into their fastening nuts.

After all wiring has been done on the sub-base, the front panel may be attached after the three right-hand condensers have first been ganged. The method of ganging them is to push the link motion over their shafts as illustrated in the photographs. The condensers should then be set so that their rotor plates are just about to interleave with the stator plates, but so that to the eye there is a tiny gap between them. This gap should be set so that it is uniform on all three con-densers and the monkey motion then locked in position in such a fashion that the condensers can be turned only about $\frac{1}{16}$ of an inch further out in each case, but so that if the shaft of one is rotated the other three will be carried to the full interleaved position due to the link connection. This hav-ing been done, the panel may be at-tached by means of the two switches at either end and the volume control at the center. The volume control should have been put in previously, before the stage shields went into place. Two washers will be found with the volume control, made of fibre. One of these should be placed on the inside of the sub-base and one on the outside of the sub-base so that no metallic contact will exist between the volume control and the metallic panel. It will be neces-sary to center the shaft of the volume control resistance in the over-sized holes in both panel and sub-base in order that there will be no connection between the shaft bushing and panels.



A top view of the set with the plug-in coils removed. The small choke-coil spool is used only in the detector stage (the last shielded stage at the right). The holes in the bottom of the units are for the wiring. The 200-ohm resistances connected in the grid circuits of the first three stages are not shown here. See picture wiring diagram.

(*Continued on page* 136)

The Henry-Lyford Receiver

Constructional Data on a New Five-Tube Set Which Has Extremely Fine Tone Quality

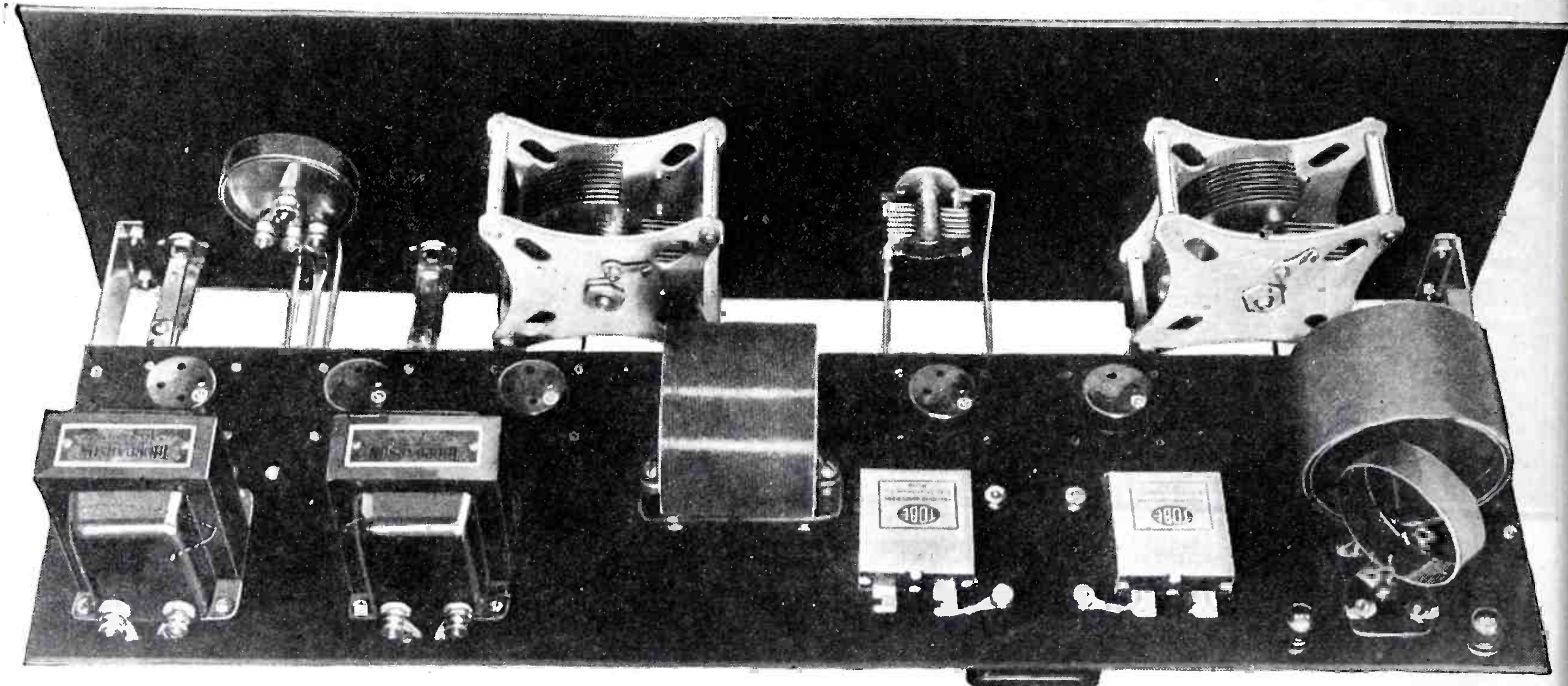
By ELMORE B. LYFORD

THE designers of the Henry-Lyford felt that a new set, which would meet all present-day demands would be accorded favor by radio enthusiasts. In touch with the whole field, they were familiar with all of the new developments, and also with the wishes and desires of the broadcast listener. They knew that a modern receiver must be simple, have as nearly perfect tone qualities as possible, be selective enough for the city dweller, and at the same time sensitive enough for the listener far from a broadcasting station. All of these things were considered, and kept in mind, during the experimental and development work on this receiver, and the finished product fully lives up to all the requirements set for it.

The accompanying schematic wiring diagram serves to explain the circuit employed, which is a slight departure from the conventional circuits with which we are all familiar. The receiver employs five tubes—two in the radio frequency amplifier, one as detector, and two in the audio frequency amplifier.

The radio frequency amplifier consists of a tuned stage followed by an untuned stage. Oscillation is controlled by one of the reversed e.m.f. methods—one of the most efficient ever developed. It is very similar to the Rice method, of which much has been said in these pages, but there is one important difference. Where the Rice circuit is a carefully balanced bridge, this circuit is deliberately unbalanced, and in addition the "balancing" condenser is mounted right on the panel. The setting of this condenser is not constant for all frequencies, but *is* constant over any considerable band, and only needs very slight adjustment for any other. The advantage of this system, however, lies in the fact that by slightly unbalancing this bridge, by a small movement of the balance condenser, until the amplifier is almost ready to break into oscillation, a very great increase in sensitivity is realized. This is a great aid in tuning for "DX," although for local or semi-local reception, it is not necessary to take advantage of the extra "boost" which this gives the radio frequency amplifier. Both of the radio frequency tubes operate at 90 volts plate potential, and are properly biased to give the greatest gain. They should both be 201A type tubes.

The detector, also a 201A, uses a "C" bias rather than a grid condenser and leak to secure detector action. The bias on this tube is the same as on the radio frequency tubes, but the plate voltage is only 22½. The use of a biased detector is preferable from the standpoint of quality as well as from the standpoint of quietness of operation. The input circuit of the detector is tuned—this tuned circuit, with the tuned circuit of the first radio frequency stage, give the receiver ample selectivity for use even in the most congested localities. There is no necessity of tuning the second radio frequency stage. Having it untuned eliminates one control, and also a great deal of coil interaction. Furthermore, under the right conditions, an untuned stage gives more gain than a tuned stage, and it always adds stability.

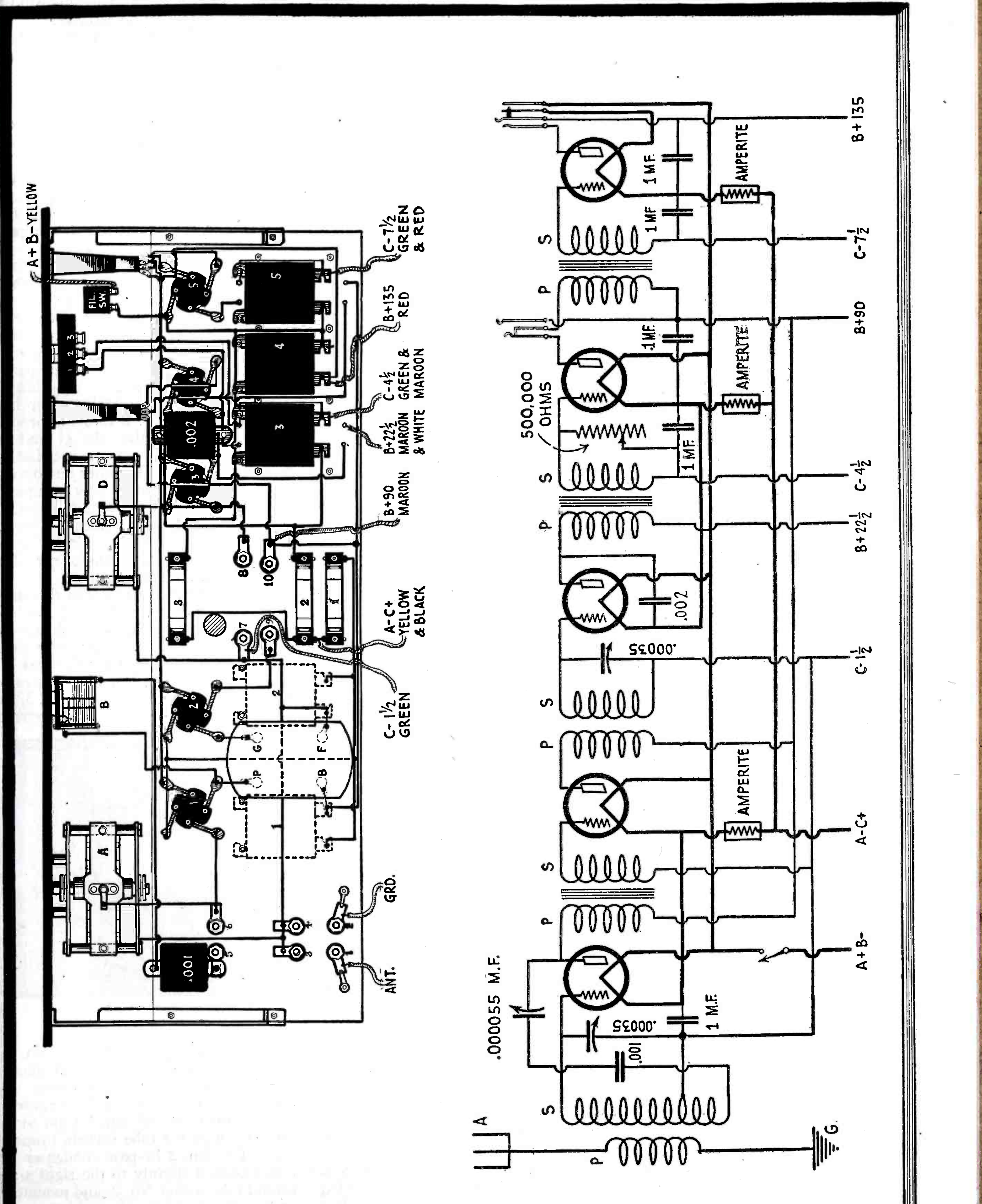


A back panel view of the Henry-Lyford receiver showing the arrangement of parts on the front and sub-panels. Neatness in design is the keynote of this set. Most all the wiring is beneath the sub-panel.

The audio amplifier in the Henry-Lyford receiver consists of two transformer coupled stages, and it is the design of this amplifier that gives the set its remarkable tone qualities. The transformers used are the new Thordarson type R200, which prove under test to have a better amplification curve than resistance coupling devices or any of the poorer grades of transformers. In addition, each grid and plate return in the audio amplifier is bypassed directly to filament by a 1 mfd. condenser. These may be seen in the accompanying photographs, and their position is shown in the schematic diagram. The use of these condensers is in accordance with the most advanced audio amplifier theory. These condensers are essential to perfect reproduction, although this fact is disregarded by the designers of nearly all receivers, if in fact they realize it at all.

Separate "C" bias leads are brought out for each of the audio frequency

Layout and Wiring Diagrams for the Henry-Lyford



tubes, as well as a separate lead for the plate supply of the second one. This makes the receiver flexible enough so that any suitable tubes may be used as audio amplifiers. However, the use of a 201A tube is recommended in the first stage, and the second should be at least a 112 tube. The 171 type tube or even the 210 type may be used in this second stage or, if it is desired, without any changes being necessary in the wiring of the receiver.

The filament circuits of this set are entirely automatic. There are no rheostats to complicate tuning and spoil the appearance of this receiver. Three Amperites keep all of the tube filaments at the proper potential, and in addition, a filament control jack is specified for the last tube, to conserve on battery consumption when only four tubes are used for near-by reception.

The operation of this set is very simple, due to the complete elimination of all rheostats and other unnecessary controls. There are only two tuning dials, and these run together over the whole range of the receiver. A small knob between them controls the sensitivity of the receiver, and another at the end of the panel controls the volume of the output.

Of course, a receiver to be thoroughly modern must have a wavelength range which is universal enough for all practical purposes. In addition to covering the band of frequencies used at present for broadcasting, it must cover also the higher frequencies now being used for rebroadcasting purposes, and this the Henry-Lyford is fully capable of doing. The coils in the tuned stages are of the plug-in type, and three different sets are available, two to a set. The broadcast coils cover from 185 to 550 meters—they actually do tune down to, and below, the low wave stations which are so difficult to get with many receivers. The short wave coils cover the band of wavelengths between 37 and 125 meters, and the intermediate set covers the band from 75 to 225 meters. There is a generous overlapping of ranges, so that there is no wave-lengths between 37 and 550 meters to which this receiver will not tune.

It is as easy to wire this set as it is to operate it. Panels and sub-panels all drilled are available, and it is the work of an evening to assemble the parts and connect them up. The diagrams and photos illustrate the way that the receiver is wired, and show how simple the job is.

PARTS NEEDED

- 1 Radion or bakelite panel, 7 x 24.
- 1 Radion or bakelite sub-panel, drilled, with 5 Benjamin sockets mounted.
- 2 Precise 350 mfd. variable condensers, type 845.
- 1 Precise 55 mfd. variable condenser, type 940.
- 1 Centralab modulator, type 500 M.
- 1 Carter "Imp" filament switch.
- 1 Carter No. 102a jack.
- 1 Carter No. 103 jack.
- 1 University antenna coupling transformer, type B-1.
- 1 University radio frequency transformer, type B-2.
- 1 University tuned radio frequency transformer, type B-3.
- 2 Thordarson audio transformers, type R-200.
- 5 Tobe Deutschmann 1 mfd. fixed condenser.
- 1 Micamold .002 mfd. permanent condenser.
- 1 Micamold .001 mfd. permanent condenser.
- 3 Amperites, type 112.
- 10 Coil mounting jacks.
- 1 Pair of Benjamin brackets, type 8629.
- 1 Sub-panel supporting post.
- 2 Eby binding posts marked, ANT, GND.
- 2 4" Kurz-Kasch dials, 100 to 0.
- 1 Eight wire battery cable.
- 1 Coil of Belden hook-up wire.
- 1 Complete set of hardware.

The designers of this receiver recommend that the specified parts only be used in its construction. If substitutions are made, there is always the possibility of lack of co-ordination between various parts of the circuit, and a consequent receiver which is less perfect than it should be.

Probably the easiest way to construct any receiver is to follow detailed instructions, if they are available. For this reason we are giving below complete constructional details for making this set. If these are carefully followed, no trouble will be experienced in building this receiver, even by one who has never before tried his hand at making his own radio receiver.

After all the parts have been secured, spread them out on a table and you are ready to begin.

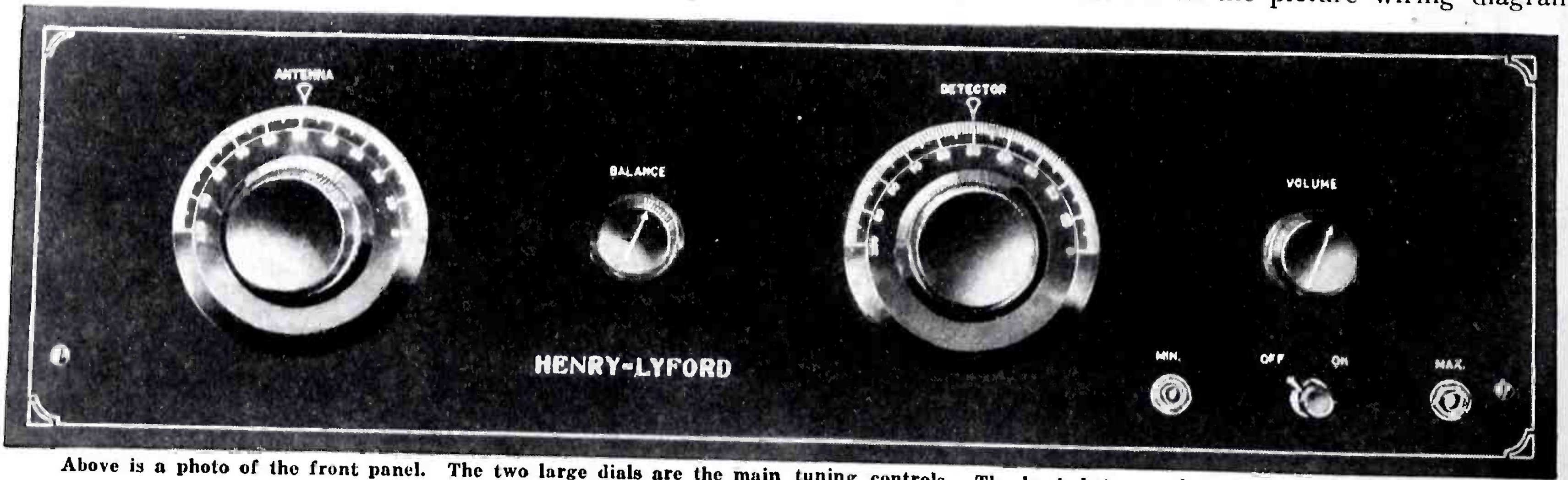
Mounting Instructions

The ten coil jacks are first mounted as shown in the picture wiring diagram, with the lugs placed as indicated. The ANT. and GND. binding posts are then mounted in their correct positions with a soldering lug on each stud pointing toward their respective jack lugs.

The Benjamin brackets are then mounted with the screws furnished with each pair. The bakelite post is then mounted in the center of the sub-panel by means of the long screw provided. The audio frequency transformer nearer the end of the sub-panel is now mounted, but before this is done, slip the mounting bolts for by-pass condenser No. 5 into the proper places. Be sure that the G and F posts of this transformer are facing the front panel. The other audio frequency transformer is now mounted, but as before, slip the mounting bolts, this time for by-pass condenser No. 3, into their proper holes. Have the G and F posts of this transformer also face toward the front panel.

It is now advisable to turn the sub-panel upside down, and mount the by-pass condenser No. 5, which should be mounted between the four bolts that hold the transformer near the end of the sub-panel. The No. 4 by-pass condenser mounts directly beside No. 5, as shown in the picture wiring diagram. Then mount by-pass condenser No. 3 as shown. The three Amperite holders are now mounted near the center of the sub-panel as shown in the diagram.

Next turn the sub-panel right side up again with the tube sockets toward you. The No. 2 by-pass condenser is now mounted slightly to the right and behind tube socket No. 2, and mounted so that the connecting lugs are toward the back edge of the sub-panel. Slightly to the left and behind tube socket No. 1, by-pass condenser No. 1



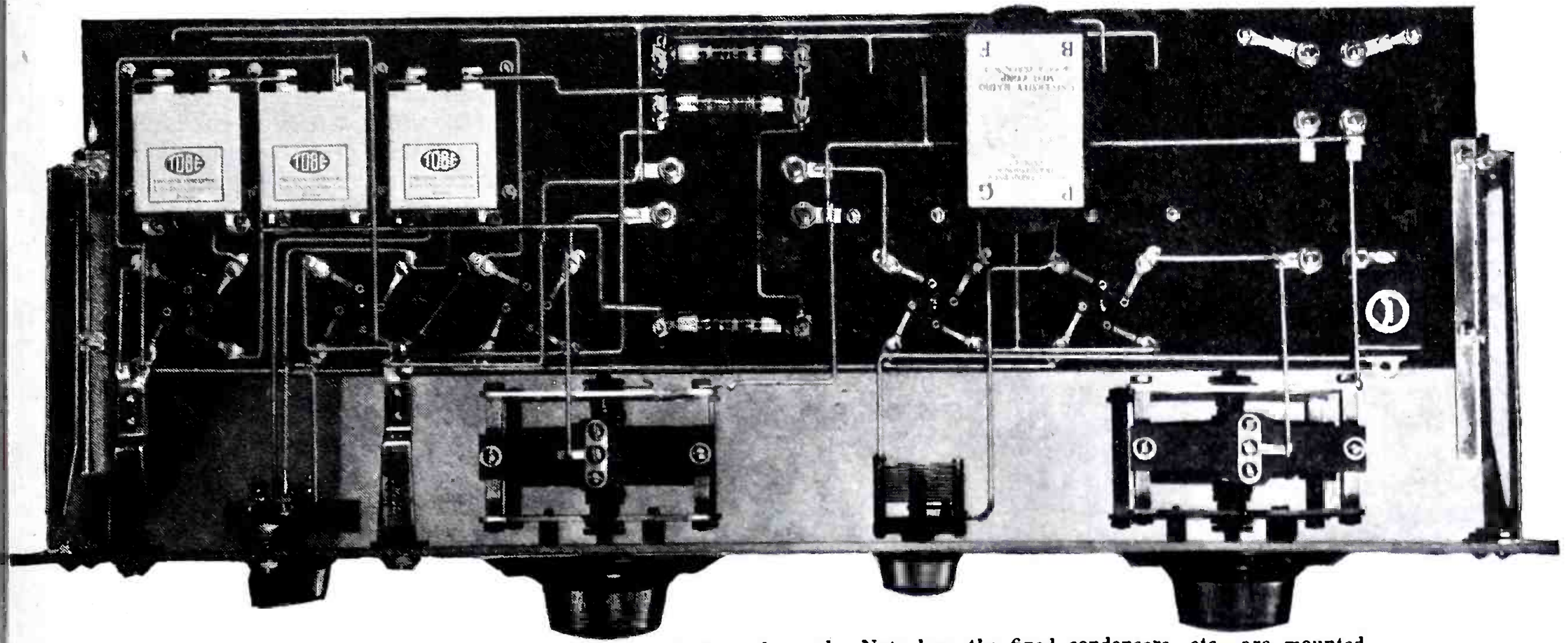
Above is a photo of the front panel. The two large dials are the main tuning controls. The knob between them is the balancing condenser and the one at the extreme right is the volume control.

s mounted. The radio frequency transformer is the only remaining instrument to mount on the sub-panel. This will be mounted later.

The front panel instruments are now mounted, and we will first mount the large variable condensers. In mounting the condensers, be sure that the bakelite strips supporting the stationary plates are toward the bottom of the panel. These condensers are held off the panel by bushings which are provided. The small balancing condenser is now mounted in the hole between the two larger condensers as shown in the illustrations. The Centralab Modulator is now mounted in the proper of the MAX. jack. This terminal is next to the top terminal of the jack, No. 1 being the terminal nearest the metal frame of the jack. The three left-hand terminals of the Amperite mountings are now connected together.

Take two short lengths of wire and solder a lug to each. The four nuts are taken off the radio frequency transformer, and the two lugs with the wires attached to the G and P posts of this transformer, and the posts inserted in the holes provided. The G and P posts are nearer the tube sockets. The transformer is held to the sub-panel by the four nuts, which are put on from the top. The short wire from the balancing condenser. The rotary plates of this balancing condenser are connected to the lower right-hand terminal of tube socket No. 1, which is the plate terminal, and this wire can also be looped under a filament wire to make a neat job.

The stationary plates of antenna condenser A are now connected to coil jack No. 6, and also to the adjacent grid contact of tube socket No. 1, which is the lower left-hand terminal, as you are looking at it. The rotary plates of this antenna condenser go to coil jacks No. 3 and No. 4, and then the wire continues under the radio frequency transformer to coil jack No. 7



A view of the set showing the wiring beneath the sub-panel. Note how the fixed condensers, etc., are mounted.

hole, and the filament switch should be mounted in the hole directly beneath the Modulator, with its binding posts in a line with the bottom edge of the panel. The two phone jacks are then mounted in their proper places, taking care to mount the No. 103 jack in the MAX. hole. In mounting the jacks, have the frames nearest the bottom of the panel.

It is now necessary to mount the panel on the brackets by means of the holes provided. We are ready to wire the receiver, and we will start by placing the chassis upside down with the by-pass condensers nearest you. The picture wiring diagram is drawn showing this view of the receiver, and the numbers are for ease of reference.

Wiring the Receiver

By using a good grade of soft strip solder, such as Kester resin core solder, a good soldered joint may be made. By making the necessary references to the picture wiring diagram and the photos, the wiring instructions will be easily understood.

We will start by connecting a wire to the upper right contact of socket No. 1. This is the positive filament connection. Run this wire to the same terminal of sockets No. 2, No. 3, and No. 4, and end it at the No. 3 terminal G post is soldered to the lower left-hand or G terminal of socket No. 2. Likewise the short wire from the P post is connected to the lower right-hand, or P terminal, of tube socket No. 1, as shown in the diagram.

We will now connect a wire to the left-hand terminal of by-pass condenser by inserting it through the hole in the sub-panel provided for this purpose. Run the other end of this wire to the right-hand terminal of Amperite No. 1. Connect another wire to the right-hand terminal of by-pass condenser No. 2 in the same manner, and run this wire to the wire that runs from by-pass condenser No. 1 to Amperite No. 1, which you have just previously connected. Continue this wire to the upper left-hand terminal of socket No. 2, and terminate it at the corresponding terminal of tube socket No. 1. These are the filament negative terminals of these sockets.

One end of the .001 permanent condenser is now bent down and soldered to coil jack No. 5, as pictured. The other terminal of the condenser is connected to the stationary plates of the balancing condenser B. This can be nicely done by looping the wire under the wire connected to the upper right-hand terminal of tube socket No. 2, and then running it straight out to the and to the rotary plates of the detector condenser D.

Next put a lug under the F post of the radio frequency transformer. Solder a wire to this lug and also to the left hand terminal of by-pass condenser No. 2. This wire goes through the adjacent hole in the sub-panel and to coil jack No. 7.

Now run a wire from the lower right-hand or P terminal of socket No. 2 to the coil jack No. 9. Another wire starts at the upper left-hand or negative filament connection of tube socket No. 4, goes to the corresponding terminal of tube socket No. 3, then to the right-hand terminal of Amperite No. 2, and finally to the left-hand terminal of by-pass condenser No. 3. These connections can all be checked by frequent reference to the picture wiring diagram.

The left-hand terminal of by-pass condenser No. 5 and the right-hand terminal of by-pass condenser No. 4 are connected together, and the wire continued on to the upper left-hand terminal of tube socket No. 5—the negative filament contact. Finish by running this wire over to the right-hand terminal of Amperite No. 3. From coil jack No. 8 run a wire to the G post of tube socket No. 3, which is

(*Continued on page* 151)

How to Build the H. F. L. Nine-Tube Super

A Super-Heterodyne Which Works Without Excuses

IN the eyes of the real radio fan, a good super-heterodyne is a thing of joy, while a super-heterodyne which

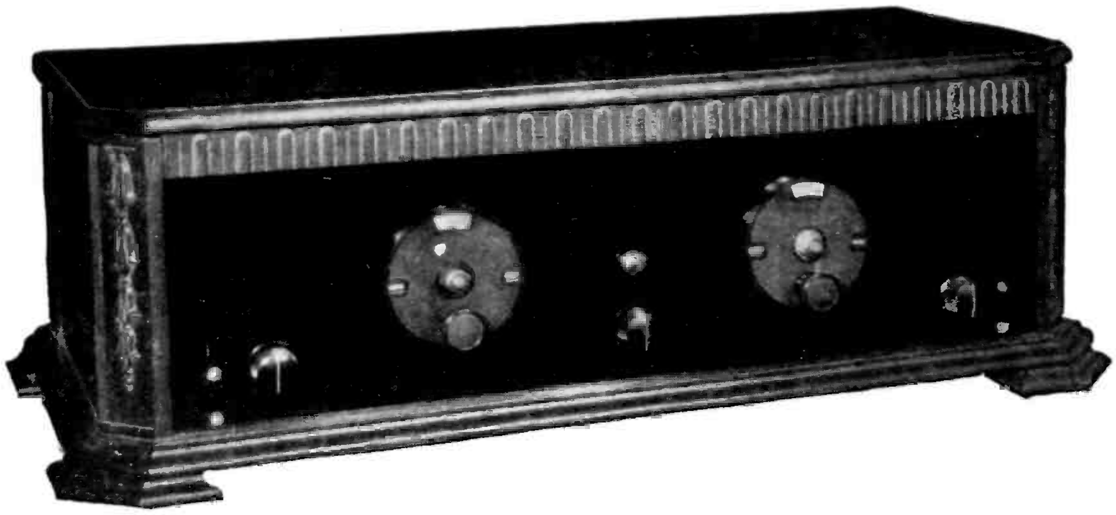


Fig. 1. Front view, showing receiver enclosed in cabinet. Note the two Marco dials.

will perform under all conditions no matter how severe, is priceless. Such a super is the H.F.L. Razor-sharp selectivity, tremendous power and true tone quality are united with simplicity of tuning and very low cost of operation. Added to the above specifications are symmetrical layout and resulting pleasing appearance. What more could be desired?

The H.F.L. nine-tube super was demonstrated recently in Chicago and brought in a score of distant stations while 13 local stations, mostly superpower, were on. It was an easy matter for the set to reach out 600 miles in the daytime bringing in the program with full loud speaker volume. This set uses the H.F.L. transformer units, incorporating four stages of intermediate frequency with two tuned stages, this being an innovation in super-heterodyne design.

The assembly of the apparatus on a Radion or bakelite base panel is shown in the upper part of Fig. 3. The directions for drilling are given in Fig. 5. When the set has been assembled, small holes should be drilled through the filament terminals of the sockets in the base or sub-panel. This enables one to reach the socket terminals from below, as the entire wiring is underneath the sub-panel. With the exception of the grids of the 6th and 7th transformers, the grid and plate terminals of the transformers are directly connected to the respective terminals of the sockets. The 6th and 7th transformer terminals are bent up and 4/32 x ⅝ in. screws are placed through the eyelet holes of those units, then being connected to the respective leads underneath the sub-panel. The same procedure is followed on the battery and filament terminals of all transformers.

LIST OF PARTS REQUIRED

1 H.F.L. H. 210 Transformers
2 H.F.L. H. 215 Transformers
2 H.F.L. F. 320 Transformers
1 H.F.L. L. 325 Radio Frequency Choke Unit
1 H.F.L. L. 330 Radio Frequency Transformer
9 Amsco Cushion Sockets
2 Remler .0005 Mfd. Tuning Condensers
2 Marco Vernier Dials
1 Chelten .000045 Mfd. Midget Condenser
2 Tobe 1 Mfd. By-Pass Condensers
2 Dubilier .0005 Mica Condensers
1 Dubilier .002 Mica Condenser
1 Culver-Stearns Filament Switch
1 Radiall ¾-ampere Filament Ballast
1 Yaxley Battery Cable, complete
1 Frost 6-ohm Rheostat
1 Frost 25-ohm Rheostat
5 Yaxley Pup Jacks
1 Pair Benjamin Brackets
1 Radion 7 x 26 in. Front Panel
1 Radion 7 x 24 in. Base Panel
4/32 in. and 6/32 in. Screws and Nuts, Bus Bar Wire, Spaghetti and Solder Lugs
1 Cabinet

There are only three connections on the radio frequency choke unit, the "F" terminal not being used. The oscillator is mounted on the lower part of the sub-panel. The L 430 radio frequency transformer is used. All connections should be made as short as possible. The transformer "B" battery leads are run close together into the prongs of the cable bracket. The schematic wiring diagram shown in the lower part of Fig. 3 will be of help in checking connections.

The bottom view of the sub-panel Fig. 2 shows the placement of the two by-pass condensers, three mica condensers, the filament ballast for the audio tube and two midget condensers. The wiring system beneath the sub-panel is also shown in this illustration.

The very best material must be used for this set, and extreme care is necessary in connecting the various components. Care should also be taken to achieve perfectly soldered joints in order to assure least resistance and consequent improved reception.

All grid returns utilize a common "C" battery, from 4½ to 6 volts being recommended. It should be noted that this provides the required bias for the second detector tube also. In this way rectification is accomplished on the negative side of the static characteristic of the second detector.

A common rheostat is used to operate the oscillator and the two detector tubes. The four intermediate frequency tubes are connected in series and controlled by a 25 ohm rheostat placed in the center of the front panel. Volume control is obtained with this rheostat. A 200,000 ohm Centralab radiohm is operated by the right-end knob. This is connected across the secondary of the first audio transformer and serves as an audio frequency modulation.

From left to right the tubes are arranged as follows: 1st detector, 4 intermediate frequency tubes, 2nd detector, oscillator, 1st audio, 2nd audio.

Fig. 2. Bottom view of sub-panel, showing wiring and location of apparatus.

One of the most annoying disadvantages of most super-heterodynes is due

Layout and Wiring Diagram of H. F. L. Super

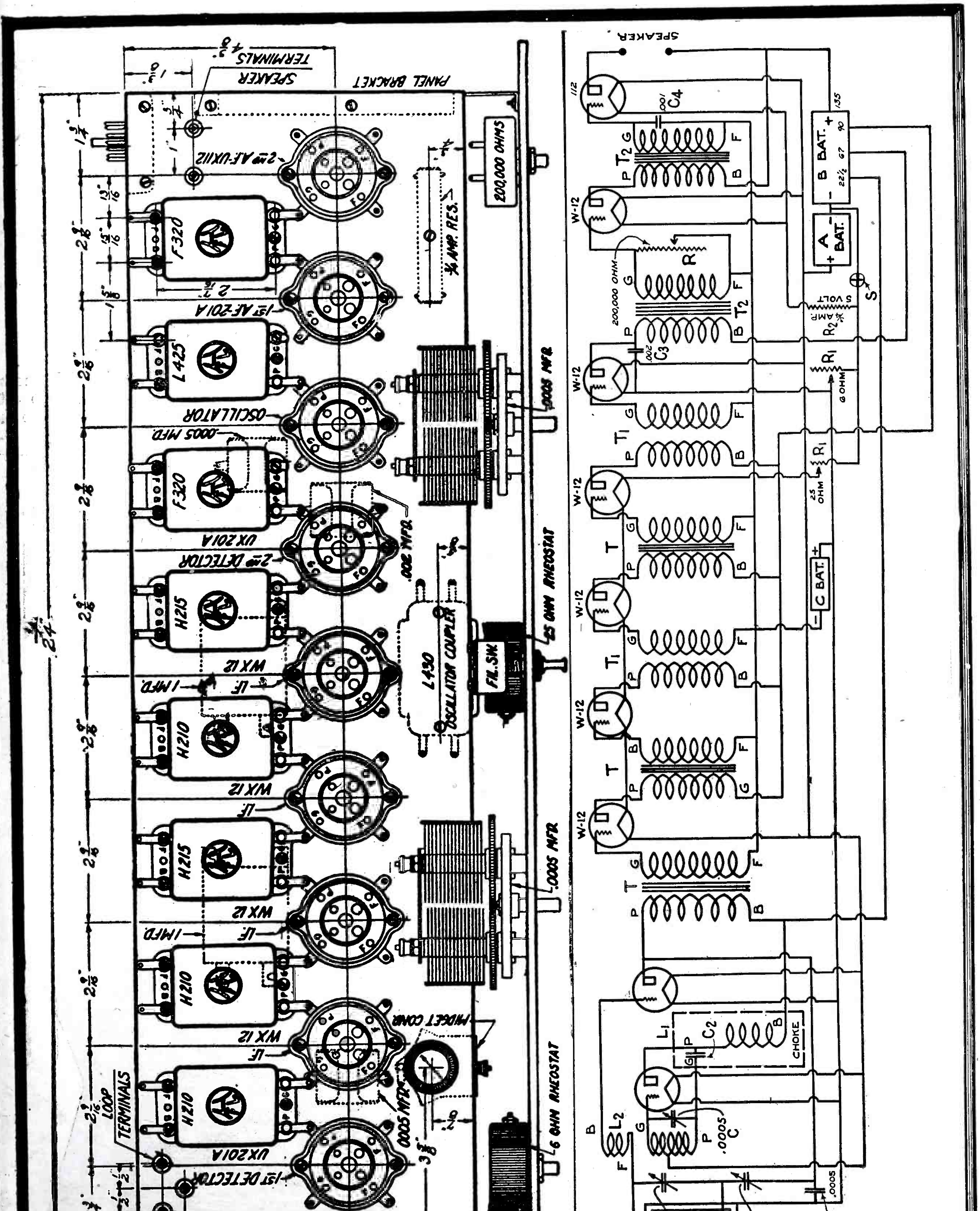


Fig. 3. The sub-panel layout showing arrangement of apparatus a ppears at the left; at the right is shown the schematic wiring diagram.

to the tendency which a highly amplified intermediate frequency signal has to feed into the audio frequency amplifying stages. Due to the fact that the audio transformers used in the H.F.L. Super are wound with the smallest gauge wire available for this purpose and are of the smallest possible dimensions and also due to the special construction of the core, there is a sharp decline of the amplification curve over 10,000 cycles created by the high impedance secondary with its increased capacity effect. As a result the transformers do not amplify the entering intermediate frequencies to the volume of audibility.

An additional factor which increases the efficiency of this receiver is due to the balancing or matching of the output energy of the oscillator to that of the loop circuit. This prevents overloading of the first detector grid with one of the two power sources. Due to the common balance obtained the input circuit is more efficient.

There are several slight differences in the H. F. L. not common to all supers, but in the main the circuit is familiar to those who have worked with super-heterodyne circuits before. There is provided a negative bias for

(*Continued on page* 124)

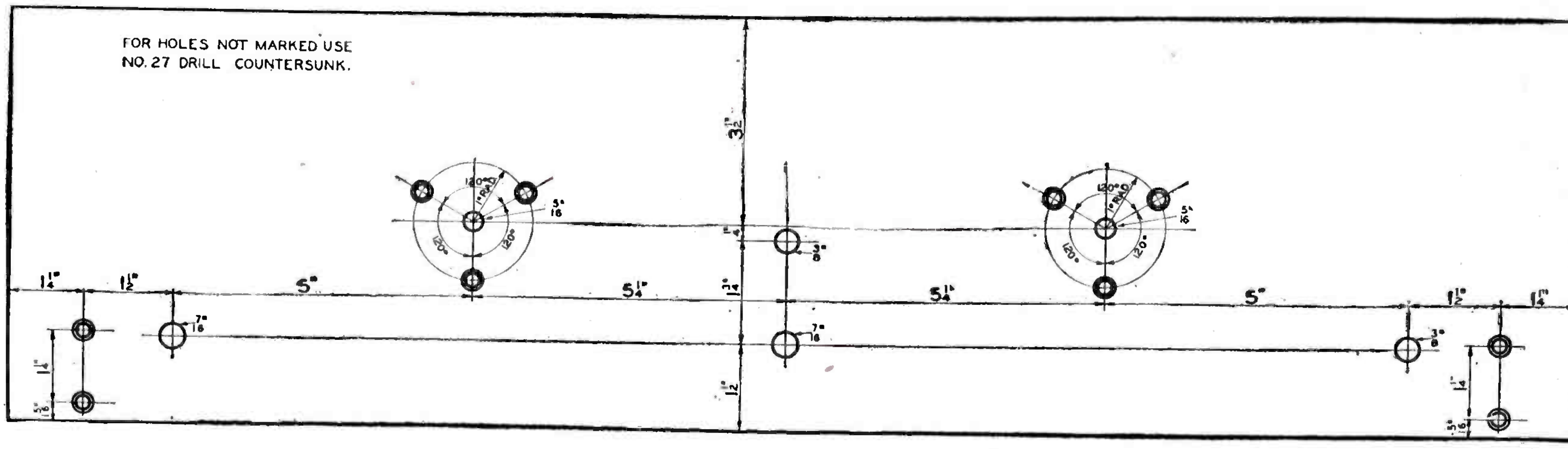


Fig. 4. Panel layout of the H.F.L. nine-tube super.

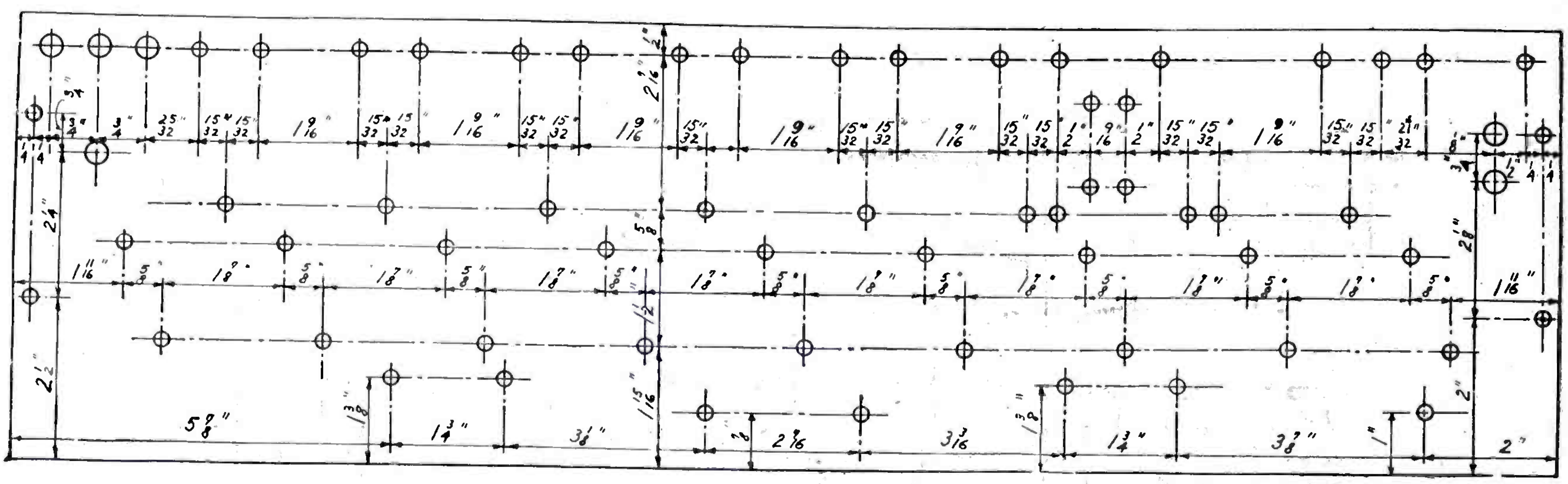


Fig. 5. Layout of sub-panel of the nine-tube super. This gives the directions for drilling.

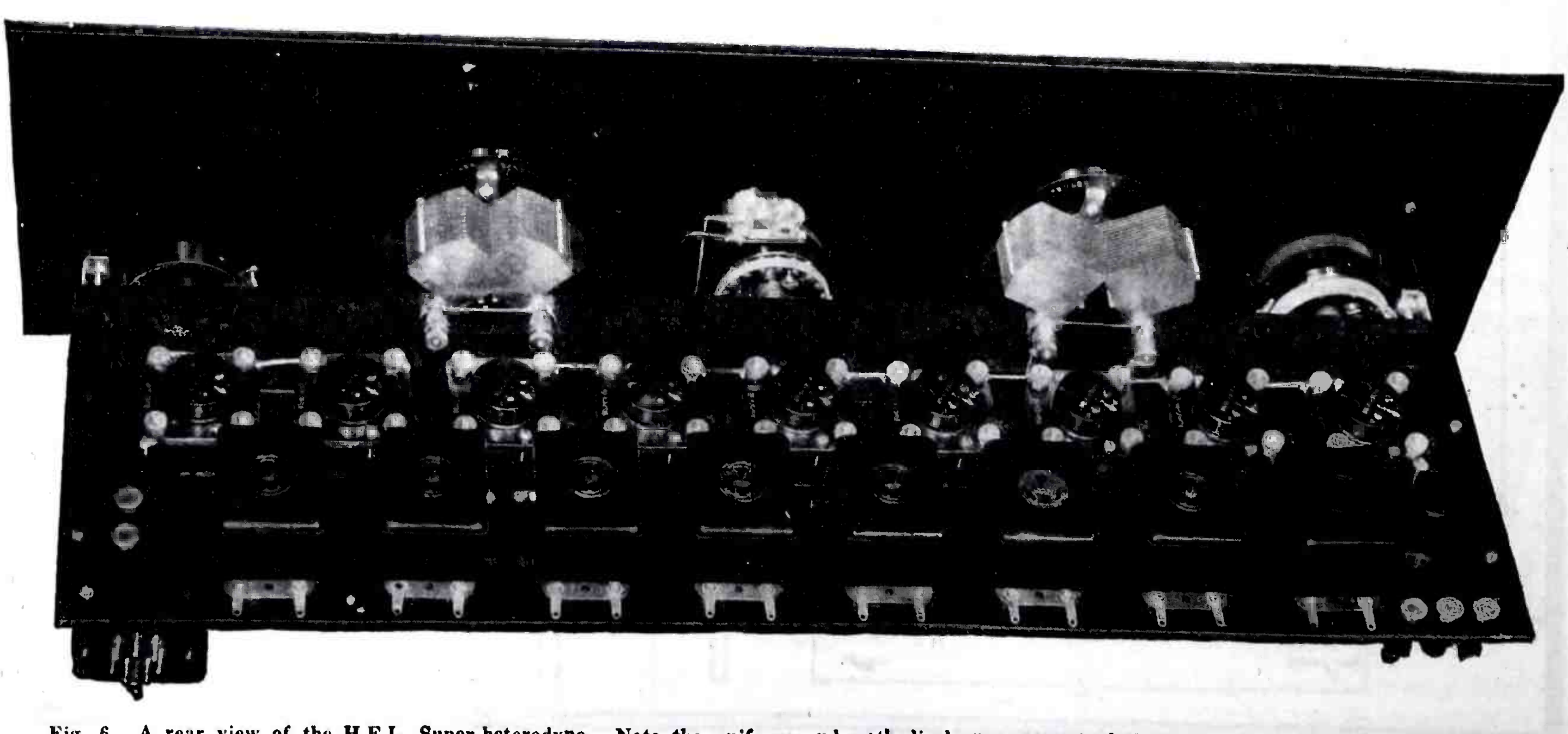


Fig. 6. A rear view of the H.F.L. Super-heterodyne. Note the uniform and methodical arrangement of the parts. The cable bracket is shown at the extreme lower left, while the loop tip jacks are located at the lower right.

How to Build the Victoreen "Universal" Circuit

By JOSEPH CALCATERRA

THERE will always be a great number of radio fans who will never be satisfied with anything but the best in radio reception. In selecting a receiver to give them this type of reception, they consider the ability of the receiver to give the best quality on both local and long distance reception.

No receiver is worth the table space which it occupies if it cannot give faithful reproduction of the quality programs sent out by the broadcasting stations.

Another factor which deserves careful consideration is that of selectivity. Tone quality is of little value if the receiver cannot be used in a congested district. It must be able to select a single station to the exclusion of all others.

The third important characteristic is the ability of a receiver to get distant stations right through local interference. One of the greatest charms of radio is the thrill of listening to programs which are being transmitted from stations hundreds, or even thousands, of miles away. The ability to get distant stations, especially through local interference, is one of the acid tests of receiver performance.

The Superheterodyne: The Peer of All Receivers

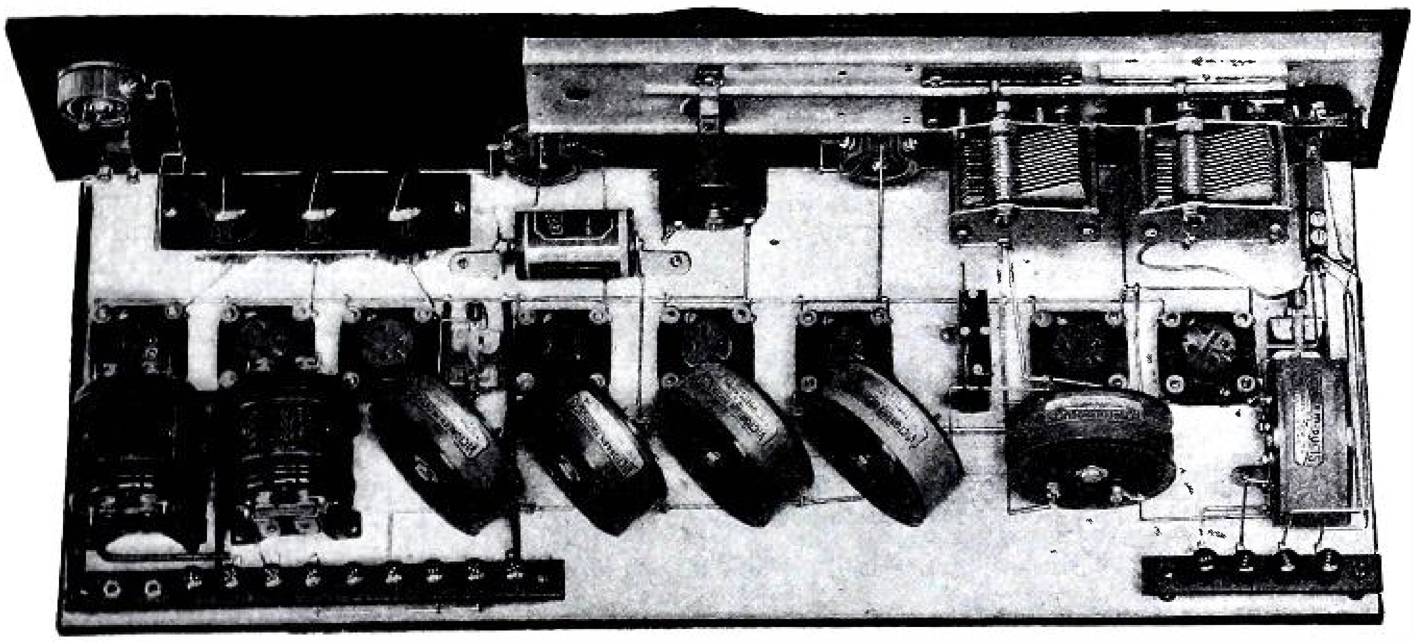
It is my personal opinion, shared by radio experts all over the country, that the super-heterodyne receiver is the one which embodies the most advanced principles of radio developments and is undoubtedly the peer of all radio receivers. There is only one catch in this statement. To measure up to this appraisal of the worth of the superheterodyne receiver, the circuit must be properly designed; the individual parts must be carefully matched and manufactured, and the receiver itself must be built with care.

In the Victoreen Superheterodyne, the circuit has been worked out very carefully and is the result of years of experimentation. The circuit is basically sound and all frills have been eliminated so as to do away with the major part of the troubles usually found in superheterodyne receivers. The parts have been designed with care and the intermediate transformers, the most important parts of the circuit, have been tuned to a precision of within 1/3 of 1%, so that matching of tubes or transformers is not required.

In this article is described the construction of this remarkable receiver, step by step, so that no difficulty will be experienced in building it in accordance with the acknowledged best principles of radio receiver construction.

The Victoreen Circuit

In its essentials, the Victoreen Superheterodyne circuit is very similar to most superheterodyne circuits. Its efficiency is due largely to the care taken in the design, manufacture and testing of the parts used in the circuit. A few of the novelties in circuit design include the master rheostat No. 1 which is used as a master control for all of the tube filaments. A voltmeter, No. 4, connected between the filament end of this rheostat and the positive "A" battery lead serves as a check to prevent overloading the tube filaments of the receiver. By adjusting this rheostat so that the voltage reading on the voltmeter corresponds to the rated filament voltage for the tubes used, the maximum voltage that can be applied to any tube is limited to its rated maximum voltage. Since tubes operate best at lower voltages than the rated voltage of the tubes, auxiliary rheostats are provided to further cut down the voltage on those tubes which operate best at lower voltages.



Illustrations by courtesy of the Geo. W. Walker Co.

Top view of the Victoreen "Universal" circuit.

Filament Control

The master rheostat, No. 1, automatically sets the voltage applied to the filaments of the oscillator tube and the first detector at the voltage indicated by the voltmeter. An auxiliary rheostat, No. 5, is used to give a fine adjustment for best results for the three intermediate frequency tubes, Nos. 19, 18 and 17. Three other auxiliary rheostats, 11, 10 and 9, are mounted on a special rheostat gang mounting inside the cabinet. These are used to adjust the second detector, first audio and second audio tubes to their best points of operation, below their rated voltages. When once set they can be left at that setting and need not be touched for the rest of the evening's program. They provide a means of getting a good adjustment on these tubes without necessitating their use on the front panel.

Potentiometer Grid Control

A potentiometer, No. 3, provides a means of adjusting the bias on the grids of the intermediate frequency tubes to best advantage. A 1½-volt "C" battery, No. 12, connected in the grid return leads of the intermediate frequency transformers gives the additional negative grid bias required on the grids of the intermediate frequency tubes when using small tubes.

A double-pole, double-throw changeover switch jack No. 8 and an antenna coupler, No. 32, make it possible to operate the receiver on a loop or an outdoor aerial as desired by a simple setting of the switch jack. A special gang condenser assembly which leaves the condensers 6 and 7 totally insulated from each other, makes possible single control operation. Any slight compensation required is taken care of by the compensator adjustment, "X," next to condenser 7.

PARTS AND ACCESSORIES REQUIRED

Quantity	Part and Type	Reference Number
1	Cabinet for 7" x 26" panel, 10" deep	
1	Radion or bakelite front panel, 7" x 26" x 3/16"	
1	Radion or bakelite binding post strip, 5/8" x 9 3/8" x 3/16"	
1	Radion or bakelite binding post strip, 5/8" x 4½" x 3/16"	
1	Wood baseboard, 9½" x 25" x ½"	
1	Victoreen No. 2, 2-ohm rheostat (use Victoreen No. 6, 6-ohm rheostat for dry cell tubes)	1
1	Yaxley No. 10 battery switch	2
1	Victoreen No. 400, 400-ohm potentiometer	3
1	Jewell, Pattern No. 135 voltmeter (0-8 volt reading for storage battery tubes; 0-5 volt reading for dry cell tubes)	
1	Victoreen No. 6, 6-ohm rheostat (use Victoreen No. 20, 20-ohm rheostat for dry cell tubes)	5
1	Victoreen master control unit. If single control is not desired, two separate .0005 mfd. variable condensers can be arranged on the panel	6, 7
1	Yaxley No. 60 double-pole double-throw jack switch	8
1	Victoreen audio control unit (for storage or dry cell tubes in detector and both audio stages use 30-ohm rheostats throughout. For power tubes in last audio stage, use a 10-ohm rheostat in the last stage, position No. 9)	9, 10, 11
1	Eveready, No. 950, 1½-volt flashlight cell with two 1" brass angle brackets for supports	12
8	Benjamin, No. 9040, Individual panel mounting, UX type tube sockets	13, 14, 15, 17, 18, 19, 21, 22
2	Dubilier, Type 601, .00025 mfd. fixed condensers with grid leak mtg. clips	16, 23
2	Lynch, 2-megohm leaks	16, 23
1	Tobe, 1 mfd. Precision condenser	20
2	New Karas Harmonik all stage ratio audio transformers	24, 25
1	Dubilier Type 601, .001 mfd. fixed condenser	26
4	Victoreen R. F. Transformers (No. 170 for storage battery tubes; No. 171 for dry cell tubes)	27, 28, 29, 30
1	Victoreen No. 150 Oscillator coil	31
1	Victoreen No. 160 Antenna coupler	32
2	Yaxley No. 416 pup jacks	33, 34
13	Eby, Ensign engraved binding posts marked respectively, "B Amp+"; "90 volts+"; "45 volts+"; "B Bat—"; "C Bat—"; "C Bat+"; "A Bat—"; "A Bat+"; "Gnd"; "Ant"; "Loop"; "Loop"	35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47
1	Mar-Co, No. 192, 0-100, Vernier dial	
6	1 3/8" No. 6 Round head brass wood screws	
23	7/8" No. 6 Round head brass wood screws	
18	3/8" No. 6 Round head brass wood screws	
4	Lengths 3/16" brass tubing or 4 angle brackets, each 7/8" long for binding post strip mounting separators	
30	Soldering lugs. Kester rosin-core solder	
30	Feet bus bar wire	
5	Feet spaghetti insulation	
1	Mathiesen Standard Loop Aerial	
8	UX or UX type tubes (power tubes can be used in last audio stage socket No. 13)	
1	Storage or dry cell "A" battery depending on tubes used	
1	4½-volt to 10½-volt "C" battery depending on tubes used in amplifier circuit. Follow tube manufacturers recommendations enclosed with each tube.	

Tip Jacks for Loudspeaker

Tip jacks for loudspeaker connection are provided in the last audio stage alone. You will find best operation possible on the last audio stage. Volume can be controlled very easily by adjustment of the rheostats and potentiometer.

A battery switch, No. 2, is provided to place the set into operation or to turn it off, as required.

The use of the push type socket and UX or CX type tubes make it possible to use either storage battery or dry cell tubes without any change in wiring. The only difference lies in the use of the proper rheostats and intermediate transformers.

The following is a complete list of the parts and accessories required to build and operate the receiver. If your dealer cannot supply all of them, he will be glad to recommend other parts of the same characteristics that can be substituted or he can get the parts from the manufacturers, the addresses of whom have been added for your convenience.

How to Drill the Panel

The construction of the set itself is a very simple proposition. Only a few holes need be drilled in the front panel. The full-sized template on the reverse side of this folder can be used for locating the holes on the panel. Then drill all the holes with a No. 18 drill. Later the hole for the voltmeter can be enlarged to two inches in diameter with a suitable cutter. The holes for mounting the rheostats, potentiometer, battery switch, jack switch and the two shaft holes for the master control unit should be drilled out with a 7/16" drill. The two small holes for fastening the master control unit plate to the panel and the holes at the bottom of the panel, used to fasten the panel to the baseboard should be countersunk on the front side of the panel. The hole just below the shaft hole for the master control gear is for the set pin for the Mar-Co dial.

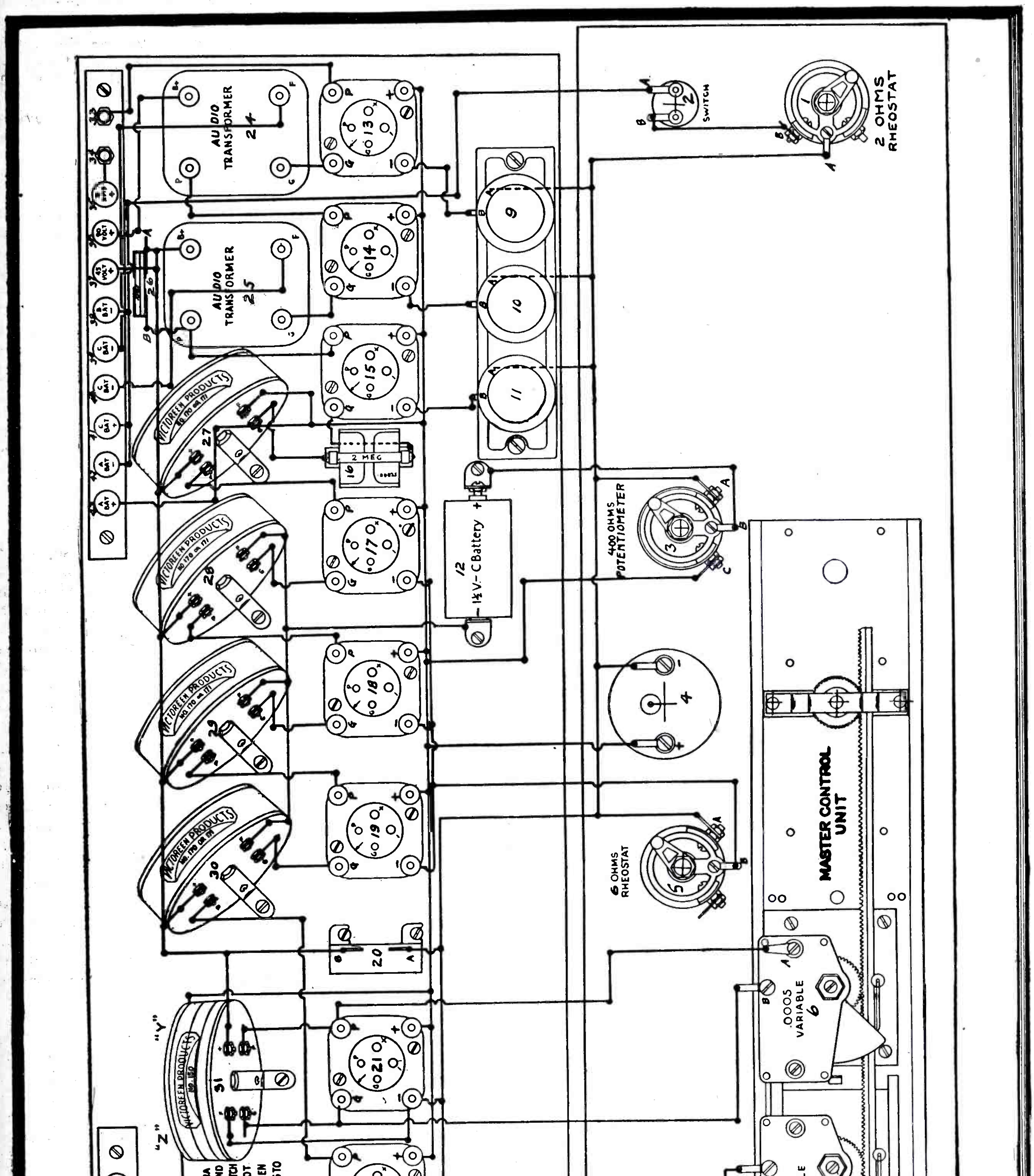
After the holes in the panel are spotted and drilled to the proper size, the panel may be polished up or grained to a dull-black finish.

The mounting of the parts does not require any special instructions. Their locations are shown very clearly in the drawing and the numbers on the drawing correspond with the reference numbers assigned to the parts in the list of parts.

Test Parts Before Mounting

Regardless of the care that may be taken in the manufacture of the individual parts, there is always a chance of damage in transit. Before you assemble any of the transformers or condensers in your receiver test them out with a battery and

Picture Wiring Diagram of the Victoreen "Universal" Receiver



The upper part of this picture wiring diagram shows the baseboard layout, while the lower part represents the layout of the apparatus on the rear of the panel.

voltmeter to be sure that there are no open circuits in the transformers or any short circuits in the condensers.

The sockets should be mounted with the "P" and "G" terminals towards the rear of the receiver and the filament positive and negative terminals towards the front panel side of the baseboard. The holder for the "C" battery 12 is made by using two small brass brackets and fastening screws and nuts to them so that they press against the case and center rod respectively of the "C" battery. If you do not care to mount it in this way you can simply solder the wires directly to the battery terminals. This battery will last several months without attention and can easily be replaced later on in the same way, by soldering.

Four lengths of tubing each about 7/8" long or angle brackets can be used as separators for the binding post strips.

The switch jack should be mounted with the frame towards the baseboard. In describing the wiring in detail, I will refer to the springs of the jack as follows: Number 1 spring is the first spring terminal counting from the frame; number 2 spring is the next; number 3 the next and so on to number 6 spring, which is the last spring in the pile and is farthest from the frame.

After all the parts are mounted as shown in the drawing you may proceed with the wiring. The scheme and routing of connections has been worked out very carefully to make it an easy and quick operation. You will obtain best results and get your set into working condition quickest if you will follow these directions.

How To Wire the Receiver

Run a wire from the "B" terminal of transformer 25 down to the baseboard and along the baseboard directly below the positive (+) terminals of transformers 27, 28, 29 and 30 and finally bend it up to terminate at the positive (+) terminal of transformer 30.

Then run connections to this wire from the positive (+) terminals of transformers 27, 28 and 29 and from the "45 volts+" binding post 37, thus connecting together the "B+" terminal of transformer 25; the "45 volt+" binding post terminal 37 and the positive (+) terminals of transformers 27, 28, 29 and 30. Then run a connection from the positive (+) terminal of transformer 30 to the positive (+) terminal of oscillator coil 31, and then run a connection to this wire from the "B" terminal of condenser 20.

Now run a wire from the positive (+) terminal of socket 13 to the positive (+) terminal of socket 22. This wire should be run along the top of the baseboard within easy reach of short connections from the other positive socket terminals but far enough away to clear the negative (—) terminals.

Then run short direct connections to this wire from the positive (+) terminal of socket 14; the positive (+) terminal of socket 15; the positive (+) terminal of socket 17; the positive (+) terminal of socket 18; the positive (+) terminal of socket 19; and the positive (+) terminal of socket 21. From the "F" terminal of R. F. Transformer 27 and from the "A Bat+" binding post terminal 43, run spaghetti covered connections to the same wire which connects the positive terminals of the sockets. Also run short connections to the same wire from the "C" terminal of potentiometer 3; the positive (+) terminal of voltmeter 4; and the "Y" terminal of oscillator coil 31. The letters "Y" and "Z" have been assigned to the back terminals of the oscillator coil because of the lack of markings on the instrument for these two terminals.

Rheostat Connections

Next run a wire from the "A" terminal of rheostat 1 down to the juncture of the panel and baseboard and along the juncture to a point just below the "A" terminal of rheostat 5, then bend it up towards the "A" terminal of rheostat 5 to terminate at that terminal. The terminal markings of the rheostats; potentiometer and battery switch have been assigned arbitrarily by position as shown on the photograph. They have also been turned up to bring them into view. If you care to do so you may turn the terminals down towards the baseboard and make shorter connections.

At convenient points from the wire last mentioned, connections should be run to the "A" terminals of rheostats 9, 10 and 11; the "A" terminal of potentiometer 3; the negative terminal of voltmeter 4 and the negative terminal of socket 21. Then run a connection from the "F" terminal of oscillator coil 31 to the negative terminal of socket 21 and another connection from the negative terminal of socket 21 to the negative terminal of socket 22, and the "A" terminal of condenser 20.

Now run a connection from the "B" terminal of battery switch 2 to the "B" terminal of rheostat 1. Run a spaghetti covered connection from the "B Bat—" binding post 38 to the "A" terminal of battery switch 2. Run a short connection from the "B" terminal of rheostat 9 to the negative terminal of socket 13. Run another connection from the "B" terminal of rheostat 10 to the negative terminal of socket 14. Run another connection from the "B" terminal of rheostat 11 to the negative terminal of socket 15.

Connect together the "B Bat—" binding post 38; the "C Bat+" binding post 41 and the "A Bat—" binding post 42.

Then connect together the negative terminals of sockets 17 and 19 and run connecting wires to this wire from the negative terminal of socket 18 and from the "B" terminal of rheostat 5.

Switch Jack Connections

Now run a connection from the number 1 spring (the spring next to the frame) of jack switch 8 to the "G" terminal of coupler 32. Then connect the number 2 spring terminal of jack switch 8 with the "A" terminal of grid condenser and leak 23 and then run a flexible connection to this spring from the stationary plates terminal "A" of condenser 7.

Connect the number 3 spring terminal of jack switch 8 with the "Loop" binding post 47. Connect number 4 spring terminal with the "F" terminal of coupler 32. Run a connection from the number 5 spring terminal to the "Z" terminal of oscillator coil 31. Then run a flexible connection from the rotary plates terminal of condenser 7 to the number 5 spring terminal. Finally run a connection from the number 6 spring terminal to the "Loop" binding post number 46.

Now connect the "Ant" binding post 45 with the "Ant" terminal of coupler 32. Connect the "Gnd" binding post 44 with the "Gnd" terminal of coupler 32.

Connect the "B" terminal of grid condenser and leak 23 with the "G" terminal of socket 22. In connecting in the grid condensers and leaks, it is best to leave them slightly above the baseboard instead of having them resting on the baseboard.

Connect the "P" terminal of socket 22 with the "P" terminal of transformer 30. Connect together, the "G" terminal of socket 21; the "G" terminal of oscillator coil 31 and the rotary plates terminal "B" of condenser 6.

Then connect together, the "P" terminal of socket 21; the "P" terminal of oscillator coil 31 and the stationary plates terminal "A" of condenser 6.

Run a connection from the "F" terminal of transformer 28, down to and along the baseboard and up to the "F" terminal of transformer 30 and then run connections to this wire from the "F" terminal of transformer 29 and from the negative (—) terminal of R. F "C" battery 12.

Next connect the positive (+) terminal of R. F. "C" battery 12 with the slider arm terminal "B" of potentiometer 3.

Check Connections Carefully

Connect the "G" terminal of transformer 30 with the "G" terminal of socket 19. Connect the "P" terminal of socket 19 with the "P" terminal of transformer 29. Connect the "G" terminal of transformer 29 with the "G" terminal of socket 18. Connect the "P" terminal of socket 18 with the "P" terminal of transformer 28. Connect the "G" terminal of transformer 28 with the "G" terminal of socket 17.

Connect the "P" terminal of socket 17 with the "P" terminal of transformer 27. Connect the "G" terminal of transformer 27 with the "B" terminal of grid condenser and leak 16. Connect the "G" terminal of socket 15 with the "A" terminal of grid condenser and leak 16.

Run a spaghetti covered connection from the "P" terminal of socket 15 to the "P" terminal of transformer 25. Run another spaghetti covered connection from the "F" terminal of transformer 25 to the "C Bat—" binding post 40. Connect the "G" terminal of transformer 25 with the "G" terminal of socket 14.

Connect the "A" terminal of fixed condenser 26 with the "B" terminal of transformer 25. Connect the "B" terminal of condenser 26 with the "P" terminal of transformer 25.

Run a spaghetti covered connection from the "P" terminal of socket 14 to the "P" terminal of transformer 24. Run another spaghetti covered connection from the "F" terminal of transformer 24 to the "C Bat—" binding post 39. Run still another spaghetti covered connection from the "B" terminal of transformer 24 to the "90 volts+" binding post terminal 36. Connect together the "G" terminal of transformer 24 and the "G" terminal of socket 13.

Connect together loudspeaker tip jack 34 and the "B Amp+" binding post 35. Then run a spaghetti covered connection from the "P" terminal of socket 13 to the loudspeaker tip jack 33.

This completes the actual wiring of the receiver.

If you have followed each instruction carefully, your wiring will be correct. It is wise, however, where the possibility of blowing out eight tubes is concerned to check up your connections against the instructions once more to make sure that you have made no mistakes.

A simple test to make sure that a "B" battery voltage is not connected across your filament leads is to connect your "A" battery up as follows, for a preliminary test: Before connecting any "B" batteries with the binding posts, connect the negative terminal of the "A" battery with the "B Bat—" binding post, number 38. Then insert all the tubes, turn on the battery switch and all the rheostats so that all the tubes would light up if a battery were connected across the filament leads. Then connect the positive terminal of the "A" battery with the "45 volts+" binding post number 37. Then connect the positive terminal of the "A" battery with the "90 volts+" binding post number 36 and finally connect it with the "B Amp+" binding post number 35. If none of the tubes light up when making these connections which connect the "A" battery across the "B" battery leads, you can be sure that no harm will come to your tubes and you can proceed to connect up your "A," "B" and "C" batteries without danger of blowing out your tubes.

If you have a "B" battery voltmeter, another test would be to connect in all your batteries, turn on battery switch and rheostats and then test across the filament terminals of the sockets to make sure that no high voltage exists across the filament terminals, before inserting your tubes in their sockets.

Regeneration and the Victoreen

Regeneration can be incorporated into the Victoreen superheterodyne but the receiver is so sensitive and selective without regeneration that it has not been deemed advisable to incorporate it in this case.

The connections to loop, aerial, ground, etc., are self-explanatory. Be sure that the small flashlight cell is connected in properly with the positive middle terminal towards the positive terminal bracket and the bottom of the case towards the negative terminal bracket. The type and voltage of the "A" battery depends on the type of tubes used.

If 201A; 301A; 199 or 299 tubes are used throughout, both "C Bat—" binding posts should be connected with the negative 4½-volt terminal of a 4½-volt external "C" battery and both the "B Amp+" and "90 volts+" binding posts should be connected with the 90-volt terminal of the "B" current supply. If a power tube is used in the last stage, the "B Amp+" binding post should be connected with the 135-volt terminal of the "B" current supply. In that case the "C Bat—" binding post 39 should be connected with the negative 9½-volt terminal of a "C" battery while the "C Bat—" binding post 40 should be connected with the negative 4½-volt terminal of the "C" battery. The number 40 is the "C Bat—" binding post for the first audio stage while the number 39 is the "C Bat—" binding post for the second audio stage. The number 36 is the "B" supply binding post for the first audio stage and the number 35 is the "B" supply binding post for the second audio stage. The loudspeaker cord tips are inserted in tip jack numbers 33 and 34.

How To Tune the Receiver

Tuning of the receiver is a simple operation, much easier than the tuning of the conventional five-tube receiver.

Either the loop or an outside aerial may be used. The only adjustment necessary to shift from loop to outside aerial is a simple twist of the knob of switch jack 8. The switch jack marker has two positions, one reading "ON" and the other "OFF." If you have followed the instructions for connecting the jack as given in this article, the "ON" position connects the loop into the circuit while the "OFF" position connects the outside aerial and ground into the circuit.

Turn on the "A" battery by turning the battery switch 2 to the "ON" position; adjust rheostat 1 until the voltmeter reads 5 volts for storage battery tube or 3 volts for dry cell tubes. Set the potentiometer at the middle position and the intermediate frequency tubes rheostat as far as it will go in a clockwise direction. Also set the rheostats 9, 10 and 11 as far as they will go in a clockwise direction. Then start tuning with the main tuning condenser dial until you hear a station to best advantage. A slight adjustment of the compensating knob will clear up the station.

Volume Control

Increase in volume is accomplished by varying the potentiometer arm towards the negative terminal of the potentiometer. The knack of tuning will come to you after a little experimenting with the control. Slight readjustment of the rheostats and potentiometer will bring in the signals to best advantage, but always remember to keep the voltmeter at the rated voltage of the tubes or slightly less by use of the master control rheostat 1.

You will also find that switching the tubes around will give you better results since some tubes are better oscillators than others.

The characteristics of getting a station on more than one setting of the dial is peculiar to a superheterodyne so do not think there is something wrong with your receiver if you receive a station at more than one place on your dial. Also remember that a loop is highly directional and that when you use a loop, the direction in which the loop points is important in receiving distant stations.

The Outside Aerial

The use of the outside aerial is not recommended in very congested districts where a large number of stations are broadcasting. It is for use in such districts only in going after distance when the locals have shut down. You will find that the loop will give you all the distance reception you want with plenty of volume, and greater freedom from interference.

If you use an outside aerial be sure to make it no longer than about fifty feet including length of lead-in. A larger aerial will prove to be a collector of undesirable interference.

Possible Troubles and Their Remedies

Success and satisfaction is assured if you have followed directions but it will help to give a few final words of caution as to possible troubles which may develop.

One poor connection is enough to spoil an otherwise good set. Check each connection carefully to be sure they are all good.

Check up on your batteries occasionally to be sure they are in good condition.

Have your tubes tested in a standard tube tester. The fact that they light up is not always an indication that they are up to the mark. It is important that all connections be made exactly as described in this article.

Shifting the rotary and stationary plates terminals on the oscillator condenser 6 for instance will cause body capacity effects.

A ringing noise which gradually builds up in volume may be due to a defective tube in the second detector tube socket, number 15. Change the tube to another position. In many cases a tube that will not function well as a detector will be all right in another position.

Due to the congested condition of the wave bands below 300 meters, reception of such stations is sometimes very difficult because when one or more of them are slightly off their wavelength, interference results in distortion.

Maximum selectivity and volume can be obtained by setting the potentiometer arm at a point about one-quarter of the way from the negative potentiometer terminal and obtaining further volume control with the R. F. rheostat, number 5.

A New Automatic Relay Switch

The advent of the "B" eliminator and the trickle charger has introduced a number of different switching operations tending to add to the complication of operating the radio set. For example, if one desires to operate a set equipped with these two devices, it is necessary to switch the trickle charger off, switch the "B" eliminator on, and then turn the filament switch on. To turn the set off, the operations are reversed, making it necessary to switch the "B" eliminator off, the filament control off and finally to switch the trickle charger on. These complications are entirely eliminated by means of the new automatic relay switch. This device performs all these various operations automatically by simply operating the filament control switch on the set. When the switch is turned on, the relay automatically cuts out the trickle charger, and cuts in the "A" battery and "B" eliminator. When the switch is turned off, the relay automatically cuts out the "B" eliminator and "A" battery, cutting in the trickle charger again.

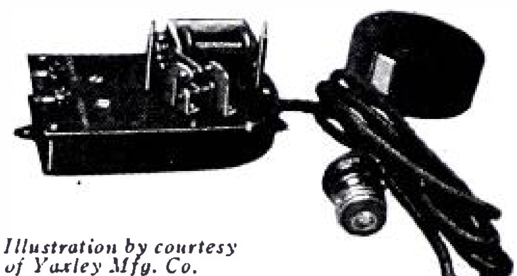


Illustration by courtesy of Yaxley Mfg. Co.

The automatic relay switch.

In order to provide an instrument that would accomplish the purpose for which this relay is intended, it was necessary to design the relay for the greatest possible efficiency, as otherwise the coil winding would have to be so high that it would seriously interfere with the operation of the tubes, due to drop of voltage.

The field part of the relay is made from carefully annealed Norway iron. The core is turned down and attached to the field piece by means of a nut, the purpose of this being not to lessen the cross-section of the core by drilling for a screw.

The field piece is designed so that at all points it has a cross-section equal to or greater than the core so as to prevent any loss of magnetic lines in the magnetic field. The armature is held against the milled end of the field piece by means of a coil spring small pins being used to hold the armature in place. In this way a perfect magnet union is made between the armature and the field piece.

Both the field piece and the armature have a very thin cadmium plate which prevents rust. This feature together with the pin mounting always insures a free and efficient working of the armature. There are two phosphor bronze springs mounted on the armature for carrying the 110-volt current. These springs are provided with pure silver contacts which make connections with adjustable screw contacts, these being provided with pure silver pins. The contact springs of the armature are bent at an angle so as to provide a slight rubbing contact between the contacts when the relay is operated.

The relay proper or the unit as described above is mounted on a bakelite plate. The unit is covered by an enameled steel box and is protected from dirt and accidental damage.

The bakelite plate is provided with screw terminals for connecting the "A" battery leads.

Plug sockets are also provided in the plate for connecting the plugs of the "B" eliminator and trickle charger. Each screw terminal and plug socket is plainly marked.

The automatic relay switch is made for universal service with the different types of radio tubes. The coil is wound to give the minimum voltage drop—actually equaling less than 0.13 volt to 1 ampere.

The relay illustrated will operate efficiently with 3 UV-199 type tubes in series on 4 volts. Of course, it will operate efficiently with any other combination of tubes drawing current equal to or more than 3 UV-199 type tubes.

Installing the Relay

To install this relay it is only necessary to disconnect one of the "A" battery wires (either polarity) from the "A" battery and connect it to one of the "A" battery posts on the relay, connecting another wire to the "A" battery post on the relay to the "A" battery.

In simple words, the relay is merely connected on one of the "A" battery leads to the set. The "B" eliminator and trickle charger are next plugged in their respective sockets which are plainly marked. The relay is then connected by the lighting circuit by means of the plug, the installation is completed and the set is ready for operation.

Data on the Norden-Hauck "Super 10"

A Ten-Tube All-Wave Receiver of Advanced Design Employing a Five-Stage Radio Frequency Amplifier

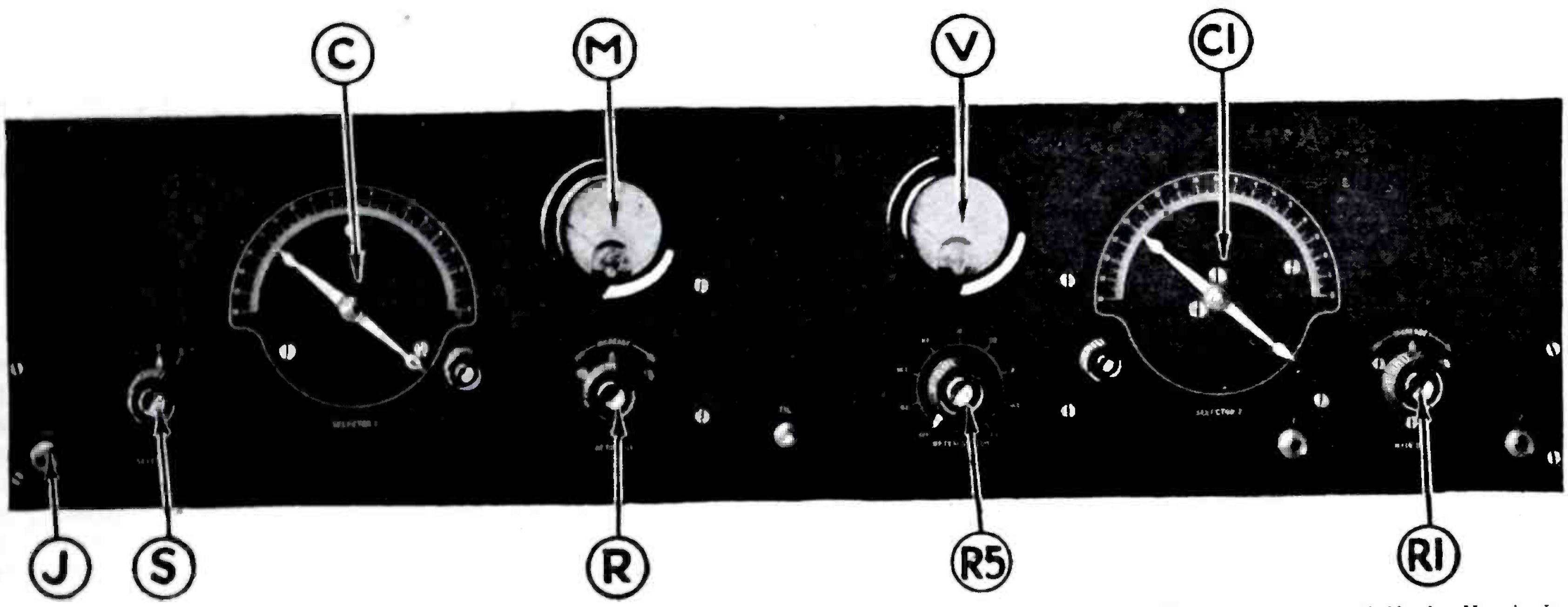
THE new "Super-10" shown in the accompanying photos meets the demand for the ideal broadcast receiver with regard to selectivity, quality of reproduction and sensitivity. While this set is sold as a completely assembled, laboratory tested radio receiver, it can be constructed with component parts. This article elaborates on the assembly details and therefore is of particular interest to those building the set, although it contains a valuable store of information for the owner of the factory-built receiver.

Tuned radio frequency amplification has long been known among radio engineers to be the most satisfactory method of building up the weak, but greatly desired distant signals. Therefore, it is obvious that the use of a number of tuned radio frequency stages of amplification is necessary to increase the sensitivity of a receiver to the desired point or the "interference level." It is also a well-known fact that the degree of selectivity obtainable is directly dependent upon the number of loosely coupled tuned circuits. The use of a number of tuned stages of radio frequency amplification is the best manner in which to utilize a great many loosely coupled circuits, as each stage is one of the necessary tuned circuits. So, while the fundamental purpose of tuned radio frequency amplification is to increase the sensitivity of a receiver, it likewise is the best method of obtaining the highest degree of selectivity. By the use of a sufficient number of tuned stages of radio frequency amplification a real degree of selectivity can be secured—even cutting through powerful, near-by local stations and bringing in distant signals on adjacent wave-length bands. Furthermore, it is not necessary to "push" each stage of amplification to obtain volume or use regeneration, which would cause a certain amount of distortion.

Heretofore, most engineers when designing radio receivers have given but little attention to the audio amplifier. But there has been an increasing tendency on the part of the listeners to demand quality reproduction as the first requisite of a good radio receiver. To meet this deficiency in most receivers several power audio amplifiers have been marketed, but it is obvious that increasing amplification in this manner is but a makeshift arrangement. Incidentally, a number of improved types of cone speakers recently developed have characteristics and requirements that cannot possibly be met by the average receiver in use today, and it has been almost impossible to utilize the full beauty of tone obtainable and intended by the originators.

The "Super-10" utilizes five stages of tuned radio frequency amplification of special design, detector and a four-stage power audio amplifier. It is non-regenerative. Thus, it can be seen that this receiver, employing ten tubes, is capable of giving perfect reproduction and sensitivity limited only by the "interference level." The selectivity obtained, due to the use of many loosely coupled circuits in the radio frequency amplifier gives a degree of selectivity that will pass only a 10,000 cycle band of frequencies.

The radio frequency amplifier has been designed to give great selectivity when using a good antenna for efficient pickup and input, rather than gain great voltage amplification per stage with a corresponding broadness in tuning which would necessitate the use of a loop or a small, inefficient antenna for selectivity. A long antenna is decidedly better than a loop—particularly on weak signals. Few receivers designed up to this time have provision made whereby it is possible to cover a wide wave-length range—necessary in foreign countries and potentially necessary to the permanency of a receiver in the event the broadcast band of wave-lengths is ever changed in the United States.



Photos by courtesy of Norden-Hauck, Inc.

Front view of the ten-tube receiver. C and C1 are the tuning controls. The switch S is used for increasing or decreasing the selectivity of the aerial circuit. A loop aerial can be used by plugging into jack J. The milliameter, M, is in the circuit at all times. The meter switch, R5, allows the reading on the voltmeter V, of the potentials of the "A," "B" and "C" batteries. R is a rheostat controlling the detector filament current, while R1 controls the five r. f. amplifier tubes.

The Panel Layout

The layout of the instruments on the panel of the "Super-10," as seen in the photo, is particularly pleasing and at the same time well-planned for efficient wiring. After the panel has been grained and engraved properly the first operation is to mount the sub-base supporting brackets and the panel instruments. The meter switch is a nine-point bi-polar switch. The jumper connections on this switch should all be made with flexible, insulated wire before it is placed on the panel. The multiple condenser and gearing should then be mounted on the panel. There are a number of sliding adjustments to align the spiral gears and other parts of the drive so that the operation of the condenser will be smooth and free from backlash. After the pointers are on the condenser shafts they should be set properly and small stops, either drops of solder or bus wire, soldered on the Vernier gears for stops at 180°.

R. F. Sub-base

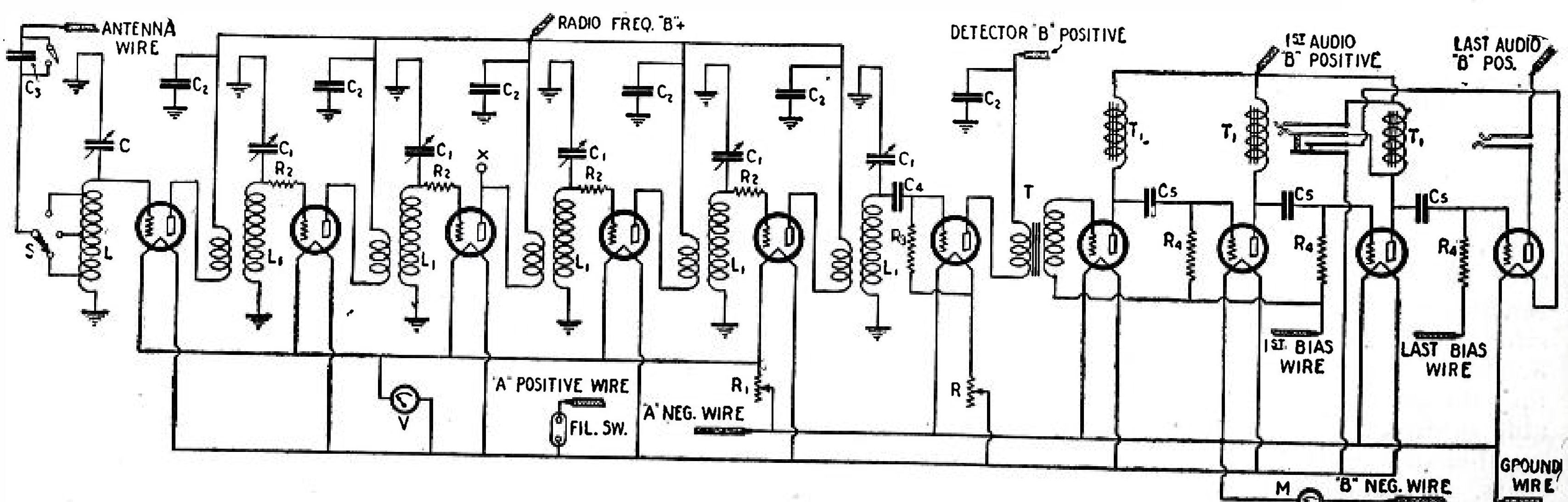
The sub-base panel containing the entire radio frequency amplifier should be wired separately. The audio amplifier should also be wired separately. It is best to use insulated bus wire in the radio frequency amplifier, but flexible, insulated wire is preferable in wiring the audio panel. It will be noticed that no provision is made for controlling the filament voltage on the audio amplifier tubes. A small, fibre strip wound with resistance wire such as 1/16″ flat Nichrone about .6 of an ohm will be satisfactory. This is a feature that is incorporated in the assembled receiver. The radio frequency sub-base panel and the audio panel should be joined and mounted on the main panel brackets. Precaution should be taken to ground all frames and cores of transformers to the negative A line. All soldered connections should be carefully inspected for rosin joints which are sometimes very elusive and may possibly kill the operation of the entire receiver.

The Completed Receiver

When the foregoing work has been done very little remains but to connect up the multiple condenser and filament leads with heavy, low-resistance bus wire, preferably insulated for protection against possible shorts. This is in accordance with U. S. Navy standard practice. The two cables should be wired up. The audio resistors and radio frequency transformers should now be put in place and the entire receiver

PARTS FOR THE "SUPER-10"

1 Cabinet—inside dimensions, 36″ x 9″ x 10¾″ deep
1 Panel—36″ x 9″ x ¼″ thick, Radion or bakelite, drilled and engraved
1 Filament Switch (C-H No. 8008 or other)
1 3-point Selector Switch, with shaft 7¾″ long (Norden-Hauck, Inc.)
1 Double-scale Voltmeter, flush type
1 Milliammeter, flush type, 0-100 M.A. scale
1 Meter Switch, 9-point Bi-Polar type, for voltmeter
1 2-ohm Rheostat (General Radio 214A)
1 7-ohm Rheostat (General Radio 214A)
4 Large Knobs and Pointers (General Radio type 137D)
6 R.F. Transformers, matched, plug base, type A, 200-550 meters (Norden-Hauck, Inc.)
1 Long Tube Shelf Assembly, Radion or bakelite, 32″ x 4″ x ¼″ thick, drilled and engraved as per specifications including coil socket-jacks, six sockets and soldering lugs (Norden-Hauck, Inc.)
1 Short Tube Shelf Assembly, 10¼″ x 4″ x ¼″ thick, Radion or bakelite, drilled, grained and engraved, with tube sockets or contacts and resistor holders mounted. (Norden-Hauck, Inc.)
2 Tube Shelf Support Brackets, as per specifications (Norden-Hauck, Inc.)
1 2meg. Grid Leaks, Metalized Type (Durham)
3 30,000 ohm Resistors, Metalized Type (Durham)
1 5-section Multiple Condenser, shielded, each section 350 MMF. capacity, complete with mounting brackets and gearing and nickled bronze pointer (Norden-Hauck, Inc.)
1 Single section shielded condenser, 350 MMF. capacity, complete with geared Vernier, Pointer and Knob (Norden-Hauck, Inc.)
6 Grid Leak Clips (Norden-Hauck, Inc.)
1 Loop Adapter, Radion or bakelite strip with plugs mounted, two flexible leads and single-control jacks (Norden-Hauck, Inc.)
1 Single-Circuit Auto. Filament (Saturn, Premier and others)
1 Open-Circuit Jack (Saturn, Premier and others)
5 750-ohm Grid Units (Ward-Leonard or Norden-Hauck, Inc.)
4 ½ MF. By-Pass Condenser (Dubilier or Norden-Hauck, Inc.)
1 .00025 MF. Antenna Series Condenser (Dubilier)
1 Antenna Series Switch (Norden-Hauck, Inc.)
1 Audio Transformer, 6:1 ratio, and bracket for mounting (Norden-Hauck, General Radio and others)
1 .00025 MF. Grid Condenser (Dubilier)
1 .005 MF. Audio By-Pass Condenser (Dubilier)
1 Triple Impedence Unit with Mounting Brackets (Norden-Hauck, Inc.)
3 .1 to 1 MFD. Blocking Condenser (Norden-Hauck, Inc., or Dubilier)
2 5-wire Battery Cables (Belden)
10 ft. Flexible, Insulated, stranded copper wire
10 ft. Solid No. 14, Insulated, soft-drawn copper wire
15 ft. No. 12 soft-drawn bare copper wire, round.
15 ft. Empire cloth tubing, No. 12 block, 7000 volt test.
Miscellaneous lugs, nuts and screws
2 ½″dia. Brass Posts to support long tube shelf.



The complete circuit of the ten-tube set. There are five stages of tuned r. f. amplification and four of a. f. amplification, the last three being of the impedance coupled type. Condensers C_2 and resistances R_2 form the stabilizing circuits. The transformer T is used in the first audio stage while high impedance chokes T_1, isolating condensers C_5 and grid resistances R_4 comprise the impedance coupled stages.

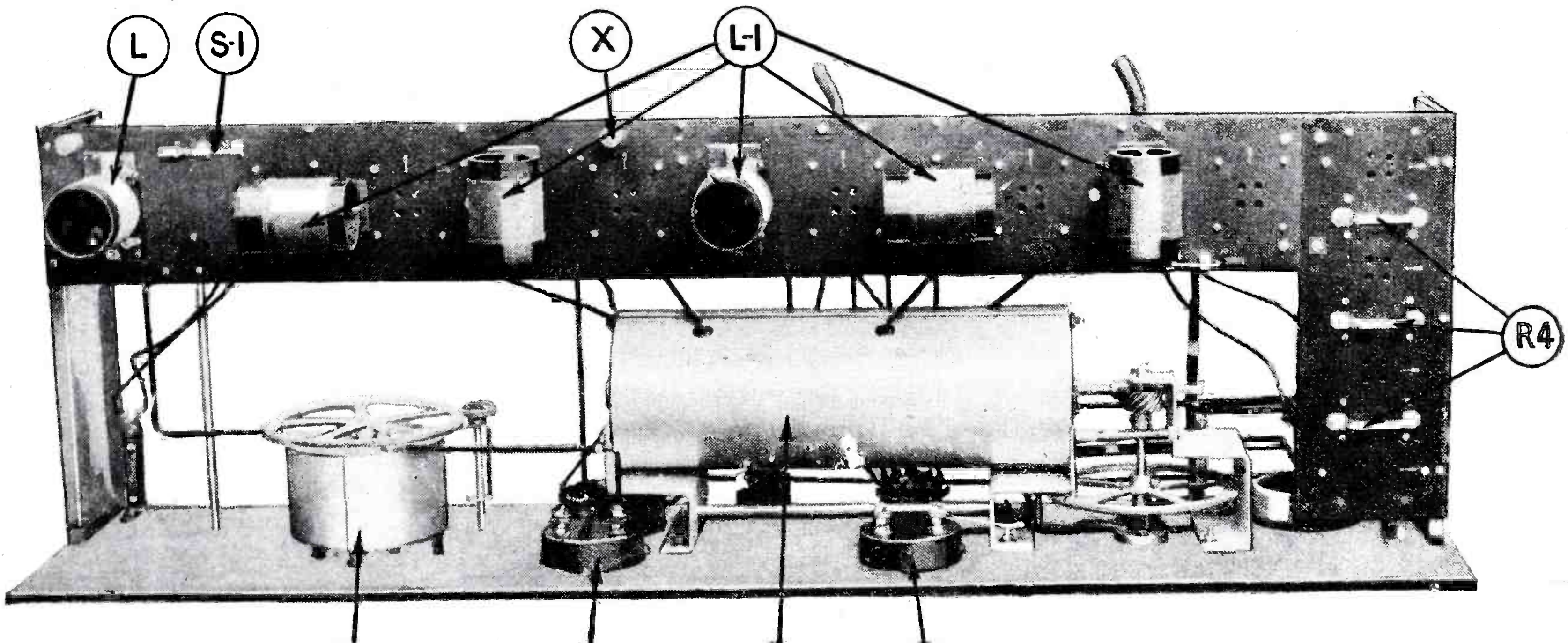
checked for errors in wiring. In testing for shorts, examining condensers, resistors, etc., a very useful and practical instrument is special voltmeter with self-contained high resistance. It is also useful in measuring current voltages in "B" eliminators.

After the "Super-10" has been thoroughly inspected to ascertain that no "shorts" exist the batteries may be hooked up. The battery voltages provided should ordinarily be 135 volts for the high audio plate voltage, 90 volts for the first three audio stages, *a separate* 22½ volts for the detector and a tap in the 135-volt block at 67½ and 90 for the radio amplifier plates. The bias batteries will be determined by the negative voltage necessary on the grids of the tubes used. It is also possible to use a 210 type tube in the last audio stage with 350 to 500 volts on the plate, but in this case an output transformer should be placed between the receiver circuit and the loudspeaker. For ordinary purposes the UX171 or its Cunningham equivalent is best in the last audio stage. This requires 135 to 180 volts on the plate and between 22½ to 40 volts grid bias for best results. Use three UX201A in the first three audio stages with 90 volts on the plate and 4½ volts bias. For the detector tube it has been found that invariably the UX200 or CX300 gives maximum results although the new UX200A or CX300A may be used. All the radio frequency amplifier tubes should be UX201A or CX301A. A 6-volt storage battery is necessary to light the filaments of the tubes. UX199 tubes for operation on dry cells may be used or the filaments can be wired in series so that the entire receiver will operate from "B" eliminators of the new, improved type.

Probable points of trouble would be in improper connections on the meter switch or shorts in the audio amplifier. If any one of the radio frequency stages is grounded the set becomes inoperative.

While most any type of good, substantially made parts may be used, care should be taken to determine their fitness for the purpose. This is noticeably true in the large, multiple condenser where the grids come so close that it is practically necessary to shield each section from each other. No other shielding should be necessary, however, as the component parts are all well-placed and the connecting leads of the various electrical circuits properly disposed to prevent interaction or undesirable coupling.

The accompanying list of parts is exactly as used in constructing this receiver, although a great many items may be substituted as indicated.



A top view of the set, showing the r. f. transformers L-1 and the r. f. tuning condenser unit C-1. C is the aerial tuning condenser. The milliammeter M and the voltmeter V can be seen. X is a special binding post provided so that the set can be operated on two stages of r. f. amplification. L is the aerial inductance and R4 are grid resistances. S-1 is a knife switch. Opening S-1 decreases the "electrical length" of the aerial.

Winding Home-made Coils

Those desiring to make their own coils may do so, using the following constants:

The A and B and C radio frequency coils (coils L, in photo and diagram) are wound on 1¾" outside diameter natural Formica tubing.

"A" Coils—(Wave-length range approximately 200/550 meters).

Primary, 5 turns No. 28 D.C.C. wire.

Secondary, 75 turns No. 28 D.C.C. wire.

The primaries and secondaries are wound in the same direction.

The antenna coil consists of a single winding the same as the secondaries and is tapped at 10 turns, 20 turns and 30 turns. (Coil L in photo and diagram.)

"B" Coils—(Wave-length range approximately 80/210 meters).

Wound with No. 20 D.C. wire for the secondary which consists of 35 turns, equally spaced, starting ⅜" in from the end of the tube, the tube being 2⅝" long.

The primary is wound with four turns No. 28 D.C.C.

The antenna inductance is the same as the secondary and is tapped at 3, 7 and 12 turns.

"C" Coils—(Wave-length range approximately 35/90 meters).

10 turns No. 20 D.C.C. wire for the secondary, equally spaced turns, ⅛" apart, starting ⅜" in from end of tube.

The tube is 2⅝" long; outside diameter, 1¾".

The primary is wound over one end of the secondary coil, in the same direction, and consists of 6 turns No. 28 D.C.C. wire, separated from secondary by a strip of Empire cloth tubing.

The antenna inductance is wound exactly the same as the secondary, but tapped at 2, 4 and 6 turns.

The "AA" and "BB" coils are wound on 3½" diameter tubing, 4⅝" long.

"AA" Coils—(Wave-length range approximately 500/1500 meters).

The secondary consists of a 4" winding, starting 5/16" from the end of the tube, No. 32 D.C.C. wire.

The primary consists of 8 turns No. 28 D.C.C. wire, bunched at one end, wound over the secondary in the same direction and separated with a strip of Empire cloth tubing.

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Making the Most of the New Power Tubes

A Special Three Stage Resistive Coupled Power Amplifier Designed for 210 and 171 Tubes

By ZEH BOUCK

THE advent of the UX210 (CX-310) and the UX171 (CX271) tubes have effected a mild revolution in the design of apparatus associated with audio amplification circuits. The 210 type, which preceded the 171 tube by almost a year, was brought forth in recognition of the fact that none of the power tubes previously on the market could handle the amount of electrical power, to be converted into the volume of sound energy demanded by the average fan, without introducing stresses and strains we recognize as distortion. The engineers, however, were rather generous in their design of the earlier power tube, and its proportions are such that when operated anywhere near its maximum output (at which point it is most satisfactory) it is capable of supplying far more volume than the living room enthusiast will ever demand, or his loudspeaker safely and without distortion can convert into sound. Operated at maximum output, with an adequate loudspeaker, the 210 type tube is capable of recreating a small orchestra in both volume and quality. And so, while the 210 has a definite place in certain high power amplification circuits, its excess power and the special design of filament and plate supply systems are never justified in average cases.

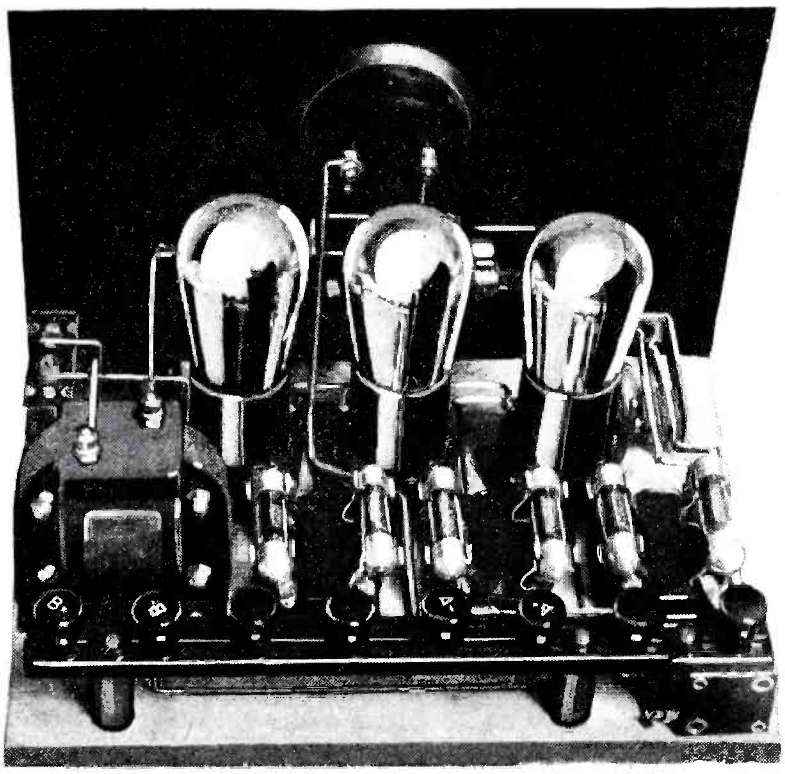


Fig. 2. A back panel view of the special three stage resistance coupled amplifier designed for power amplification.

The 171 type of tube is a compromise between the surplus power of the larger bulb and the inadequacies of the small tubes. This bulb is the ideal output tube in the average set and, *properly operated*, is capable of supplying sufficient volume to fill a small hall without other than negligible distortion.

As intimated in our opening paragraph, the introduction of these new power tubes has necessarily occasioned concomitant changes in amplifying apparatus.

While, as just mentioned, it is possible to secure excellent results from these new tubes with plate potentials under the optimum value, a large percentage of enthusiasts will wish to operate the tubes at their highest efficiency. This postulates plate voltages of at least 180 and 300 for the UX171 and 210 respectively. Batteries are impractical and the line power devices previously on the market are inadequate — few if any supplying potentials of over 150 volts under load. Thus the first effect of power tube design on associated apparatus has stimulated the manufacture of high voltage line power units.

Alterations in design should by no means be confined to power supply de-

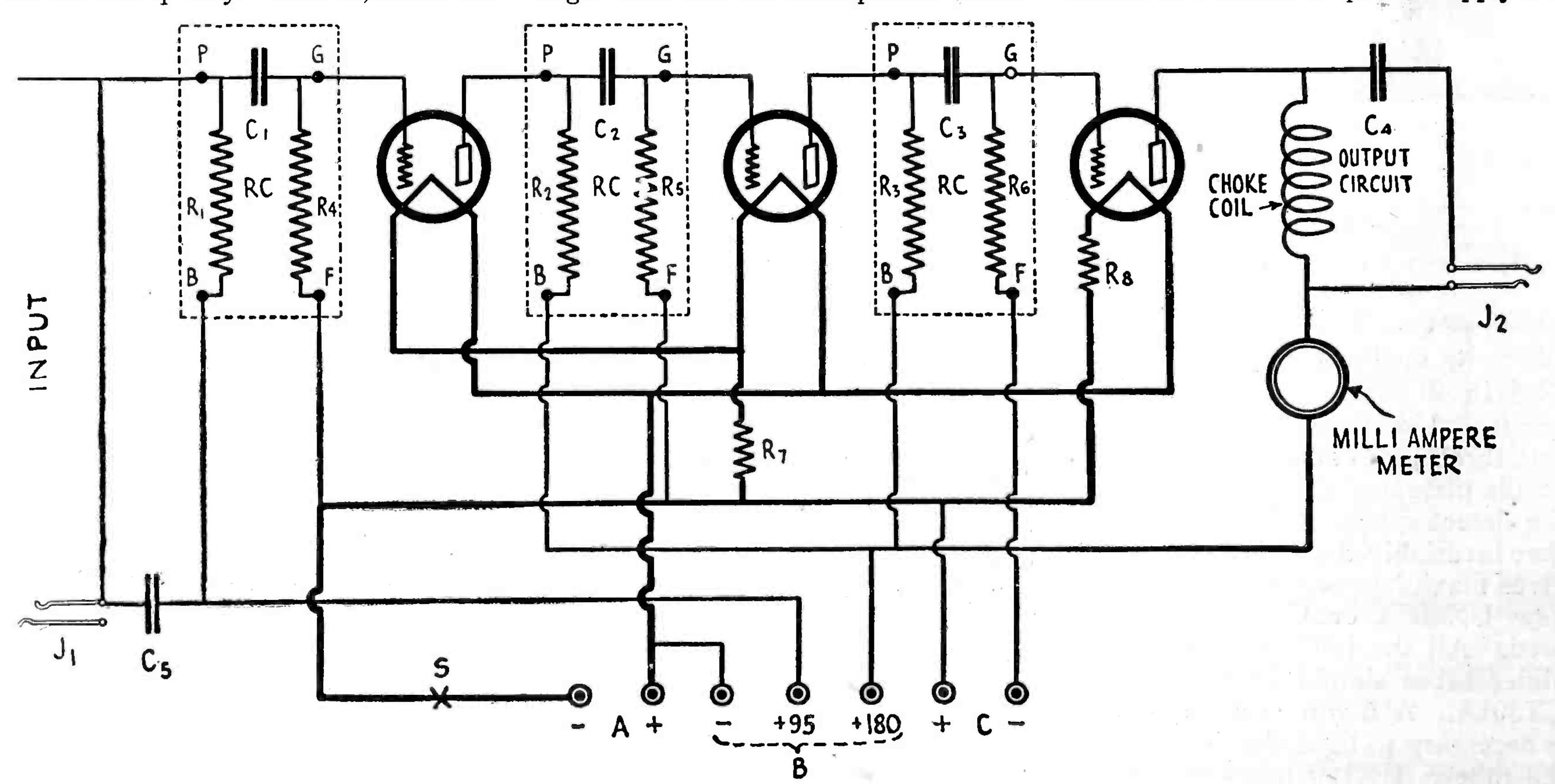


Fig. 1. Schematic wiring diagram of the three stage amplifier described in this article. The first two stages are of the conventional design while the last stage is a power amplifier.

vices. That the amplifier itself should be redesigned to meet the requirements of power amplification is immediately apparent upon consideration of the new conditions. As the power tube is employed only in the last stage of amplification the rest of the circuit remains unaltered. However, there is little sense in inputting to a distortionless stage of power amplification from preceding stages in which stresses and strains have already been set up. With the exception of resistive coupled systems there have been very few amplifiers built by either the fan or commercial manufacturer, which, in combination with a single stage of power amplification will give adequate results from the standpoint of both volume and quality. And so the writer has thought it better to describe a complete three stage unit, incorporating an output power step, rather than confine himself to this last alone.

PARTS REQUIRED

- 3 Amsco Resistor Couplers
- 3 Amsco Metaloid 100,000 ohm resistors
- 3 Amsco Gridleaks 1 meg. .5 meg. and .25 meg.
- 1 Electrad 1 mfd. bypass condenser
- 1 Electrad .0025 bypass condenser
- 1 A. F. Choke 10-15 henries.
- 1 Jewell or Weston 0-50 milliammeter
- 8 Binding posts
- 2 Yaxley open circuit No. 1 jacks
- 1 Yaxley type 210 pilot light switch
- 2 Amperites, type No. 112.
- 3 Amsco Universal Sockets
- 1 7" x 10" Radion or bakelite Panel
- 1 7" x 10" Baseboard

The alterations in design suggested by the characteristics of the new tubes, are best demonstrated by reference to the circuit diagram in Figure 1. The amplifier itself is a three stage resistive coupled intensifier which insures the inputting of practically undistorted power to the last tube. The first two stages are of conventional design.

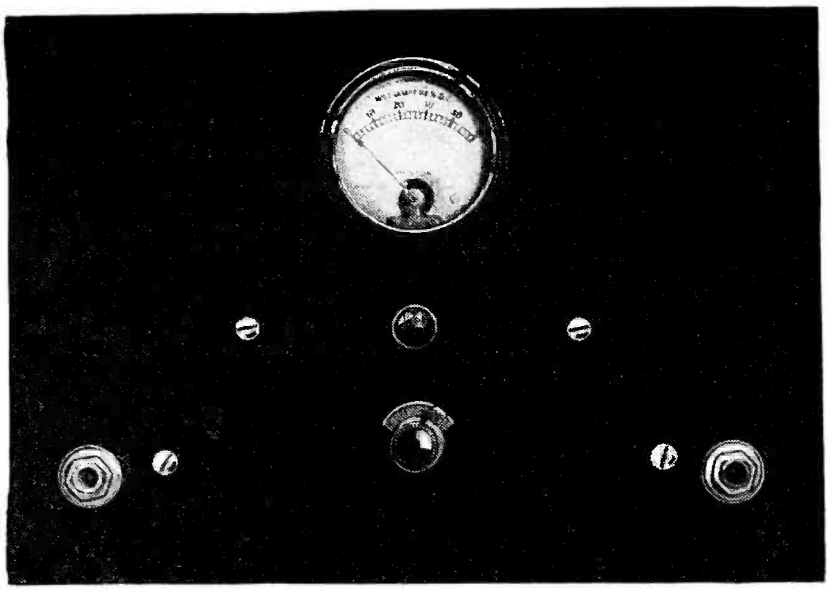
Capacities C1, C2 and C3 are .1 mfd. coupling condensers incorporated in the base of the resistor-couplers. Resistances R1, R2 and R3 are 100,000 ohm coupling resistors. (Due to the relatively high currents these resistors will carry, it is important that they be of the metallic type.) R4, R5 and R6 are gridleaks having respective values of 1 megohm .5 megohm and .2 megohm. Resistor R7 is a .5 ampere Amperite while R8 is a .75 ampere Amperite (for a 171 tube).

Jacks J1 and J2 are for input and output respectively.

The departures from the conventional arrangements are, as suggested, incorporated in the output circuit of the last tube.

(*Continued on page* 122)

Fig. 4. A photo of the front panel showing how the meter is mounted directly in the center. Just below the meter is the panel light and immediately below that is the battery switch. At the lower left hand corner is the input jack, and at the lower right is the loudspeaker output jack.



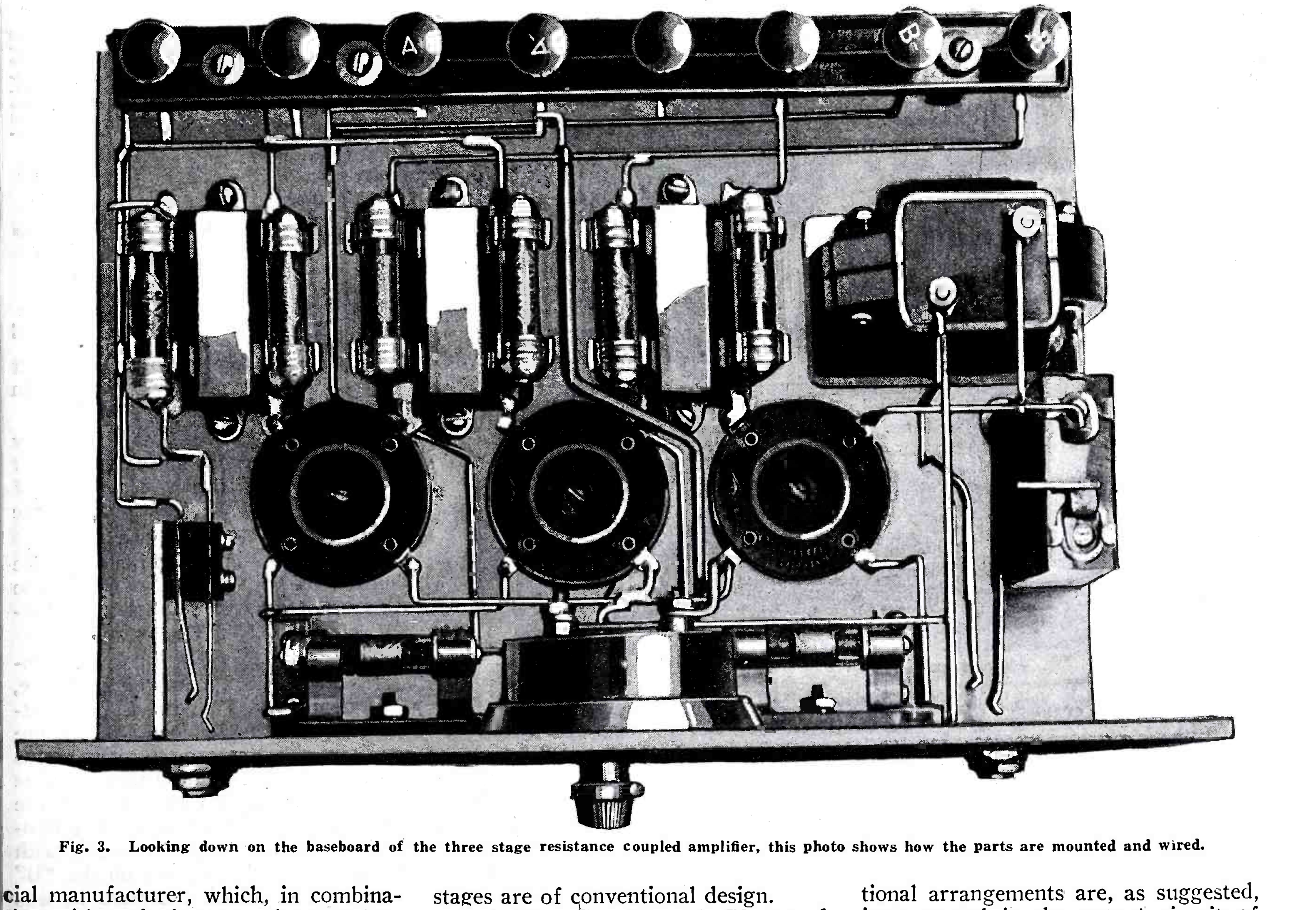
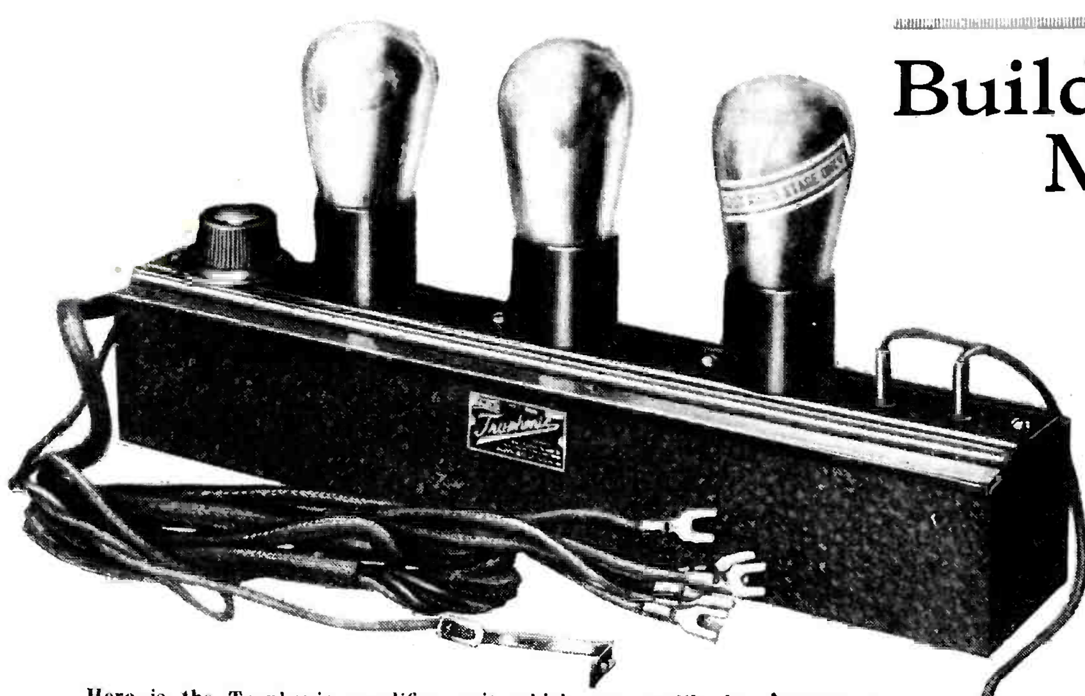


Fig. 3. Looking down on the baseboard of the three stage resistance coupled amplifier, this photo shows how the parts are mounted and wired.

Building-in a Ready-Made Audio Amplifier

By WALTER E. POWERS



Here is the Truphonic amplifier unit which can readily be attached to practically any receiver.

HOW often have you experimented with this, that and the other new tuning hook-up, whether tuned radio frequency, the many regenerative hook-ups, super-heterodynes or others, and wished when you arrived at the audio end that you could just slap a first-rate amplifier on and have your set immediately ready for operation.

Perhaps also you have built a complete set which did not at first function to your satisfaction and you did not know whether to blame the radio or the audio end. With a complete exterior audio amplifier of known results, connected to the detector output, it could easily be determined whether the radio or the audio end was at fault.

Then again, many confirmed hook-up followers like to have a number of sets employing different tuning and detector circuits. However, the cost of having a complete audio end for each set is necessarily great—but heretofore it has been more or less compulsory. With an exterior independent amplifier such as the Truphonic shown in the accompanying photos, this is unnecessary inasmuch as it can be attached in no time to any circuit directly from the plate output of the detector tube.

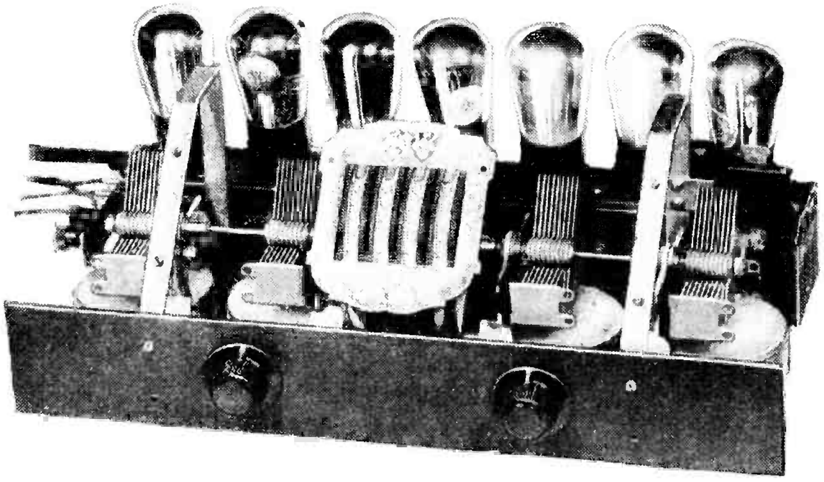
Those who are interested in short wave reception will readily see the point in the above. The Truphonic, being an exterior amplifier, can quickly be changed from the detector tube of the short wave set to the detector tube of the long wave set, or the system of employing a quick throw switch could be used.

How the Amplifier Is Attached

The Truphonic was designed to hook up instantly to a complete set already in operation, cutting out the two transformers or other amplifying devices within the set and substituting for them its own superior amplification. This is accomplished in the following general way. The six vari-colored wires in the Truphonic cable are attached to the "A," "B" and "C" batteries in accordance with specific directions. The single wire from the Truphonic is provided with a clip which fastens over the plate prong of the detector tube, the latter being reinserted in its detector socket. The two audio tubes of the set itself are lifted out and inserted in the Truphonic. One other tube is required, which may be either a 201A or a power tube.

The diagram shows how the Truphonic is attached to a regular 5 or 6 tube tuned radio frequency or Neutrodyne circuit.

The wires from the Truphonic are attached as indicated. The "C" battery wire is attached to a 4.5 volt "C" battery if a 201A is used in the last stage of the Truphonic. With most audio amplifiers the "C" battery is necessary for best quality. However, with the Truphonic using a 201A tube, a "C" battery is not necessary owing to the peculiar design and construction of the amplifier. If no "C" battery is used, the "C" wire is attached direct to the "A—" terminal. For power tubes, however, it is necessary to use a "C" battery. (A table giving the correct "B" and "C" voltages is shown in the accompanying table.)



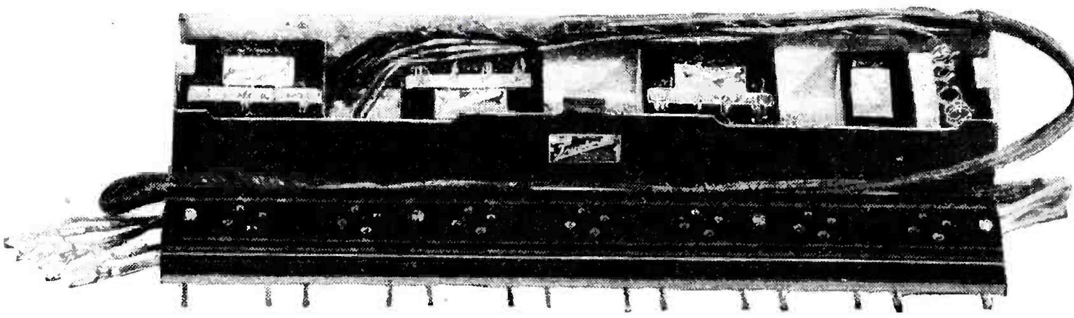
A compact seven-tube set employing the Truphonic audio amplifier system. This set principally consists of the special unit shown in the photo below and localized controlled variable condensers.

Illustrations by courtesy of Alden Mfg. Co.

The Truphonic wire marked simply B+ is invariably connected to the last B+ of the B batteries, regardless of what B voltage is used. (See table for power tube voltages.)

The wire leading from the set to the detector B voltage marked X in the diagram is disconnected from the batteries altogether.

For regenerative sets, such as Hammerlund Roberts, Browning Drake, Ambassador, etc., the directions for attaching the Truphonic Amplifier are precisely the same as described above with the single exception that the wire X from the set is removed from the detector "B" voltage and a .002 microfarad condenser is put in series with the wire X and the point on the "B" battery from which the wire X was removed.



A special seven tube unit provided with a self contained audio amplifier as described in this article. The top of the unit which is adapted with the tube sockets is removed and seen in the foreground.

In superheterodyne circuits, the only change from the tuned radio frequency directions for hooking up the Truphonic is that wire X should be left connected to the "B" battery and that the plate connection of the (second) detector tube socket should be disconnected and a .002 microfarad condenser placed in series between the plate terminal on the socket and the wire that was disconnected from it.

For reflex sets, simply disconnecting the "B" battery lead of the set is usually satisfactory. However, inasmuch as most reflex sets are apt to be fairly critical, some experimenting may have to be done in order to get the proper balance. Try placing a .001 or .002 microfarad condenser in series between wire "X" and the various detector voltages.

Special Provisions for Power Tubes

Although the regular 201A tubes have been found to give excellent results with this amplifier, nevertheless for the finest possible results in tone quality at full volume without overloading the last stage tube, a power tube such as the UX112 or UX171 is recommended. The extra "B" battery voltage required by power tubes is provided for by a special wire in the connecting cable. This wire is simply marked B+ in the diagram. This wire is connected to the last B+ of the B battery, regardless of what power tube or what "B" battery voltage is used. (Above is given a table showing the correct "B" and "C" voltages for the various tubes.)

Of course, for super volume the 210 power tube may be used with the amplifier. This will require a slight change in the last stage socket of the unit to allow for the AC filament voltage.

The "C" battery necessary for use with power tubes is also provided for by a "C—" battery wire from the connecting cable. The proper "C" battery voltage for each condition of tube and "B" battery voltage is also shown in Fig. 2.

The Truphonic system is the work of Mr. H. P. Donle, well known to most radio experimenters for his invention of the Sodion tube. It is a system which utilizes a primary and secondary winding, inductively coupled,

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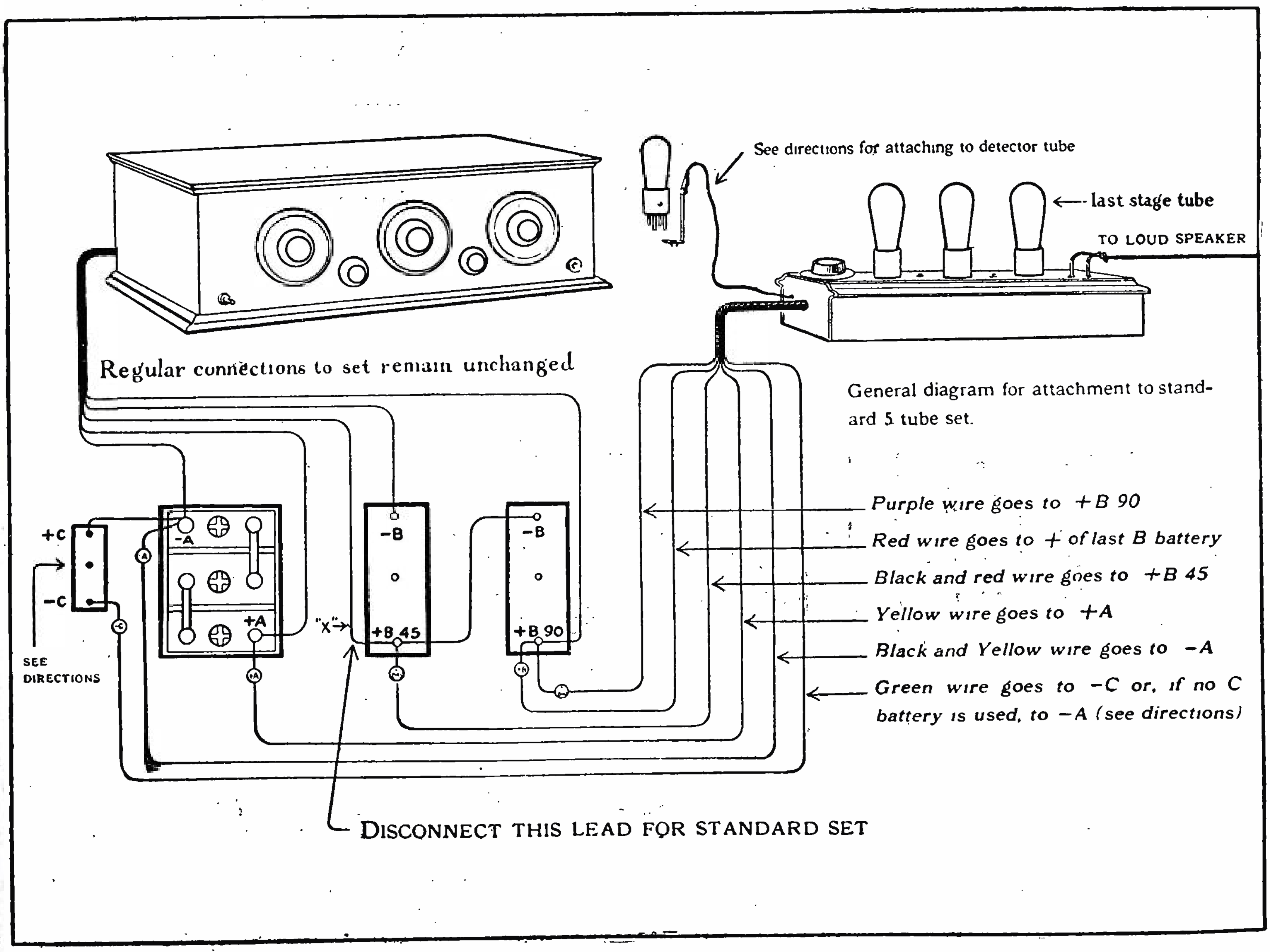
TABLE FOR C BATTERY VOLTAGES

Tube	*B Battery Voltages* volts 90	volts 135	volts 157	volts 180
201A	4½ (optional)			
112	6	9	10½	
171	16	27	33	40
120 (dry cell)	16½	22		

210, which uses heavy B battery voltage, usually from an eliminator, has the following voltages for B and C:

B	180	250	350	425
C	12	18	27	35



A picture wiring diagram showing how to connect the Truphonic amplifier unit to a standard five-tube set.

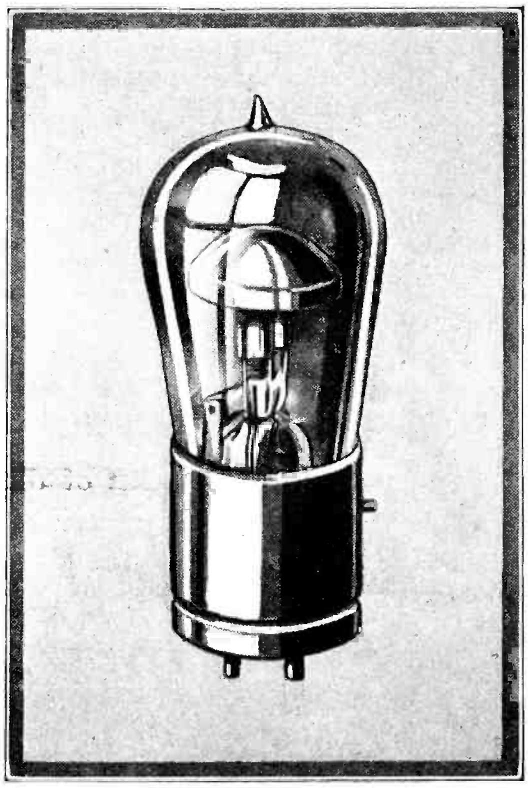
A New Rectifier for "A-B-C" Power Units

A Rectifier Tube for a Battery Eliminator Which Will Supply Complete Power for Sets Employing 199 Type Tubes

THE development of a new Raytheon rectifier tube, termed the "BH," now makes it possible, for the first time, satisfactorily to obtain "A," "B," and "C" voltages from the A.C. light socket. The radio experimenter and set builder have long awaited the opportunity to obtain a rectifier which would have sufficient current and voltage capacity to light the filaments of 199-type radio tubes, *in series,* and at the same time supply sufficient plate voltage to operate a power amplifier.

The new type fulfills these requirements in a particularly satisfactory manner; and there still remains a reserve of power from which the radio set may draw at momentary overloads, without fear of burning out the tube or impairing the quality of reproduction.

Fig. 1 is a schematic drawing of an "A-B-C" power unit with the "BH" tube. The power transformer is built to supply 350 volts, on each side of the high-voltage secondary winding, at no load. The current-carrying capacity of this winding should be equal at least to 85 milliamperes; and in order to insure good regulation in keeping with that already determined by the tube, the regulation of the power transformer should be not more than 10 per cent. The power transformer has also a filament-supply winding which delivers five volts at .5 amperes for the filament of a 112 or a 171 power-amplifier tube.



Photos courtesy Raytheon Mfg. Co.

The size of this rectifier tube is approximately the same as that of the ordinary vacuum tube. The position of the elements may be easily seen.

Filtering the Output

The usual condensers of 0.1-μf. capacity, C_1 and C_2, are placed across each half of the transformer secondary as shown in Fig. 1. The filter circuit consists of two choke coils, L, L, capable of carrying at least 85 milliamperes D.C. and having an inductance of at least 25 henries per choke when passing this amount of D.C. Several manufacturers are now supplying such choke coils. The filter condensers are arranged as shown in Fig. 1: The first, C_3 has a 4-μf. capacity, C_4 has 4-μf. and C_5 has 6-μf.

The resistance-control unit, which is used to determine the various "B" voltages for the receiver and to drop the "B+" maximum voltage to the value required by the filaments in series, presented quite a problem in its development, because practically no manufacturers of resistance units had conceived the demand for the types required particularly in the case of variable resistors. The great difficulty was to find resistors of sufficient current-carrying capacity and a wide-enough range of resistances to be of value.

The ideal unit for this service would be a variable resistor of at least 60-milliampere current-carrying capacity

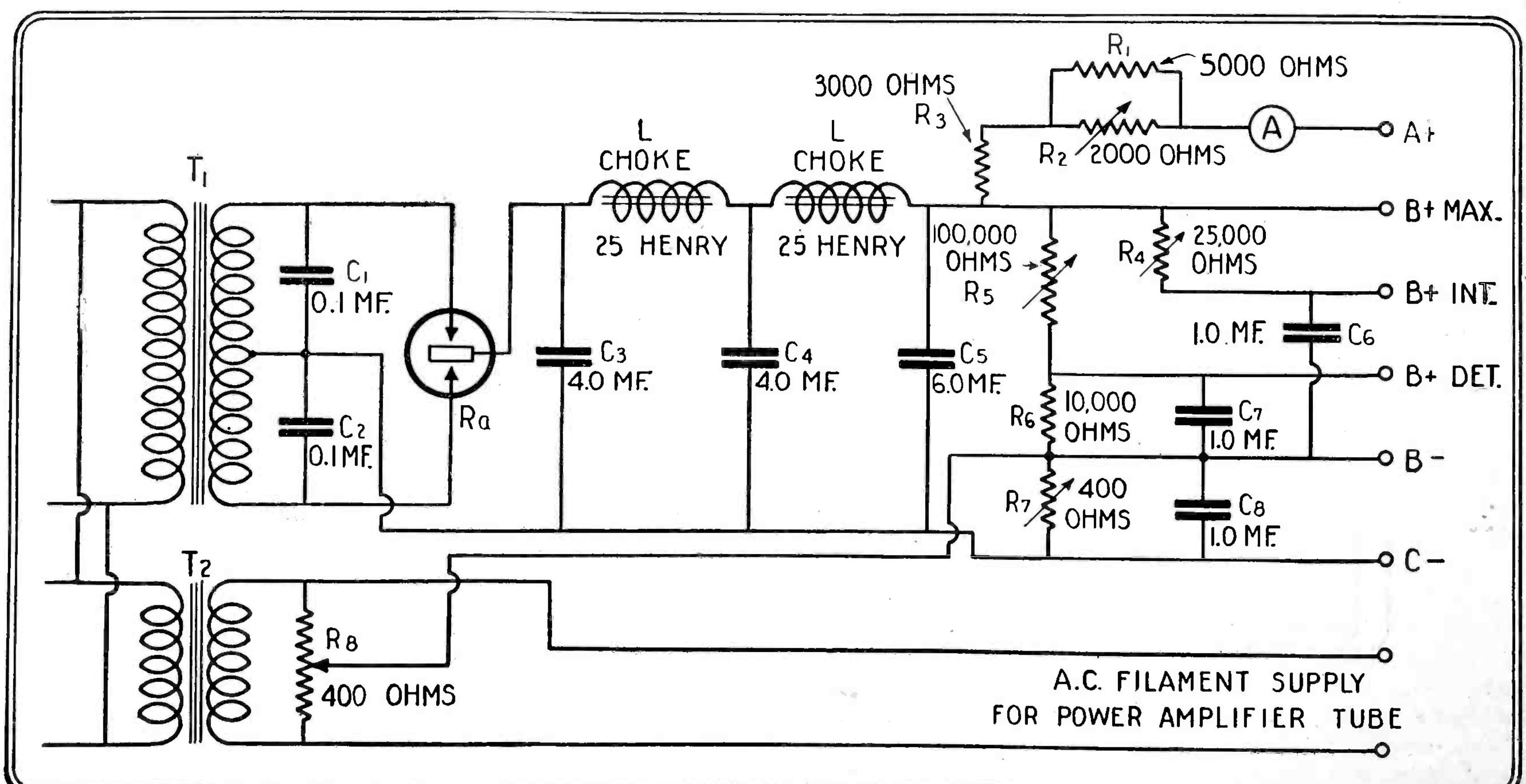
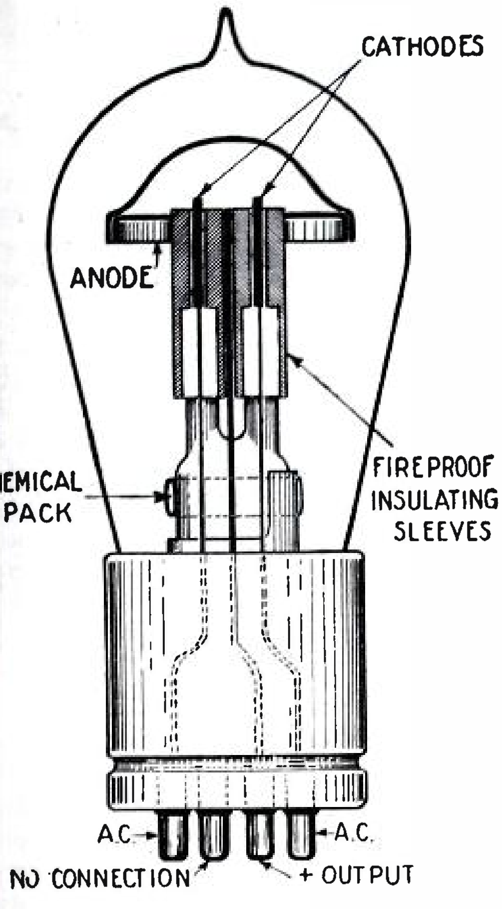


Fig. 1. The circuit diagram of an eliminator supplying "A, B and C" current to the receiving set. This is rectified by the new tube, shown above, from the 110-volt A. C. house circuit.

ith a resistance range of from 2500 5000 ohms. One arrangement which s used to achieve the degree of con- l required was a combination of a ed 3000-ohm resistance, R_3, in series



The arrangement of the elements in the new rectifier tube may be clearly seen from this sketch. The anode is connected by the center rod to the output prong; and the chemical pack to the glass stem.

ith another fixed resistance, R_1, of 000 ohms, around which was shunted third resistance, R_2, which has a ariable resistance of 2,000 ohms, aximum value.

Several potentiometers on the mar- et will fill this requirement; although ere are none yet which have been ecifically designed for the circuit. he value of the remaining resistances f Fig. 1 are shown in the diagram, nd are the customary "B" power- pply specifications.

The filament of the power-amplifier ube, being supplied with raw A.C. has 400-ohm potentiometer, R_8, connected cross its terminals. The variable tap f this potentiometer is connected to B—", and is set at such a position as give minimum A.C. hum. The "C" oltage for the power amplifier is ob- ined from a variable resistor, R_7, onnected as shown. In order to ob- in 45 volts "C" from this source, it ould be necessary that R_7 have a aximum resistance of at least 600 hms.

Additional Voltage Available

The performance of the "A-B-C" ower unit is to a very great degree ependent upon characteristics of the ew tube, which are of an extremely chnical nature, and can best be ap- reciated from a comparison with other ectifiers designed for "B" power ervice.

For example, if a "B" power supply which has hitherto been equipped with a type "B" tube is now equipped with one of the new "BH" tubes, there will be an average increase in output from the power supply unit of 30 volts for any given radio set.

When adjustment of the radio-frequency and detector voltages is made, reducing them to their previous values, there will be a further increase in the voltage output of the power supply unit, of from five to fifteen volts. This high voltage is of course available and extremely desirable for use in connection with the power amplifier; and for this reason makes the new tube more valuable as a rectifier.

Better Regulation

Another feature of the new rectifier, which is of great importance in connection with the "A-B-C" power supply unit, is the improved regulation of the tube itself. Actual measurements have shown that the new tube has a constant voltage drop from a very low current up to 85 milliamperes. If the output from the rectifier is never less than 10 milliamperes, as will be the case if a suitable system is adopted, the only regulation of the power supply needed will be that of the transformer and filter circuit. There will be no loss of voltage due to changing characteristics of the tube. This feature is really remarkable and one which has never before been available in power-supply rectifiers.

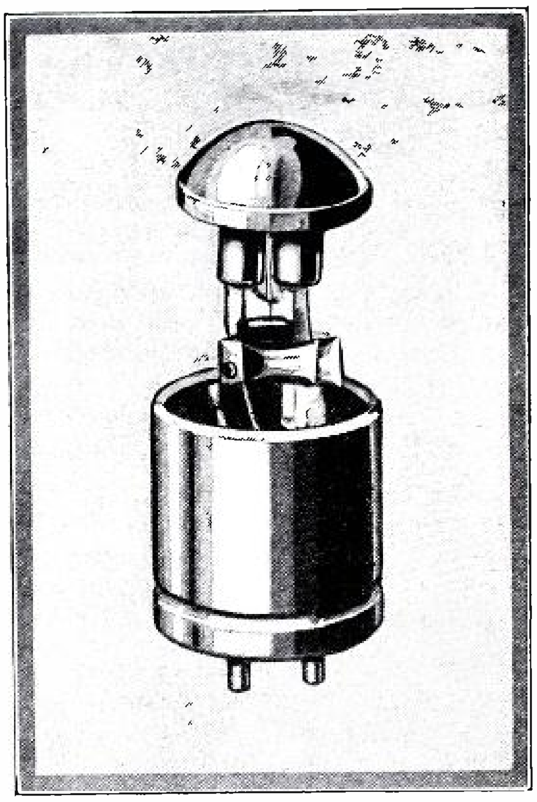
In order to take advantage of this characteristic, the constructor of the unit may well pay attention to the proper design of its power transformer and filter circuit, with regard to loss of voltage which might be caused by poor regulation.

An opportunity to improve the regulation of the filter circuit may be found in condenser C_3 of Fig. 1. By increasing this capacity from 2- to 4-μf., at 85 milliamperes, an increase in D.C. output of approximately 15 volts may be secured.

Margin of Reserve Power

Still another feature of the new tube which is of considerable importance in obtaining high-quality reproduction is the reserve power available for momentary overloads without damage to the rectifier. Extreme bursts of volume from the speaker demand proportionate amounts of energy from the power-supply unit. If this energy is not available at a *constant voltage,* there is certain to be distortion and a considerable loss of quality. If the power-supply unit is properly designed with regard to regulation, and if the rectifier is capable of delivering these peaks of energy without loss of voltage, good reproduction is insured at all times.

The various constants shown in Fig. 1 will enable the builder to construct a power supply unit of good regulation, and by using the new tube he will have achieved all that is to be desired.



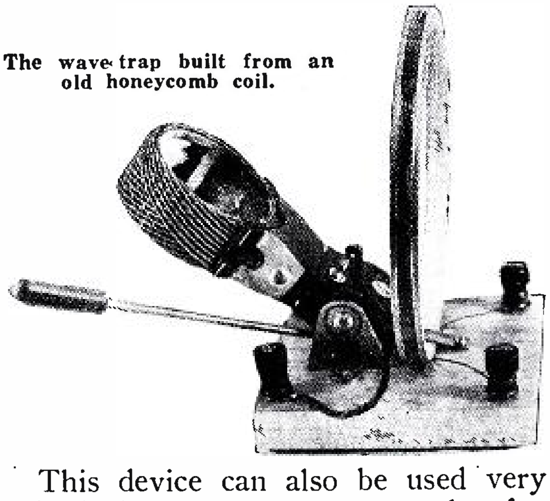
This illustration shows the elements of the new rectifier tube. The parts may be identified from the sketch at the left of this page.

Simple Wave Trap Cuts Out Interference

An old 25-turn honeycomb coil and an embroidery ring is all you need to make a simple wave trap. Wind ten turns of number 24 s.s.c. on the ring and mount as shown on a block of wood. The terminal binding posts are arranged as shown, two on each side of the little wooden block.

By changing the position of the honeycomb coil with respect to the hoop (antenna coil) the interfering station is easily silenced.

The wave trap built from an old honeycomb coil.



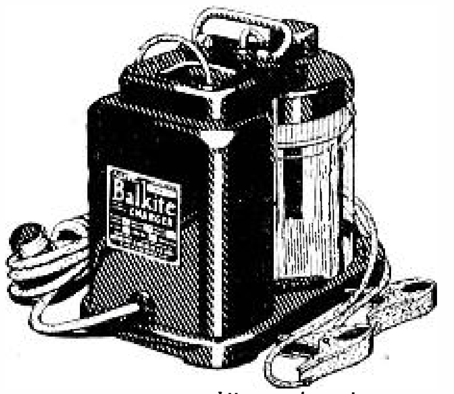
This device can also be used very effectively as an antenna coupler for super-heterodynes which are designed for use on only a loop. The 10-turn coil on the embroidery ring is employed as the aerial coil, connecting one terminal to the aerial and the other end to the ground; while the honeycomb coil is used as the secondary or connected in place of the loop.

Energy for the Radio Set

Methods of Charging "A" Batteries and of Providing Power for the Operation of Vacuum Tube Receivers

By E. W. ENGLE

EVERY radio set requires power for operation. A portion of this power is radiated from the broadcasting station and picked up by the set antenna. Though necessary for all radio sets it is only in the case of crystal sets that the power from the broadcasting station is depended upon alone. In order that signals may be had with loud speaker volume and from distant points it is necessary that auxiliary power be available at the set. Most



Illustrations by courtesy of Fansteel Products, Inc.

A charger which has two charging rates, one for heavy duty use and one for trickle charging.

sets require this power in the form of direct electric current. This is supplied in two circuits, plate and filament, commonly called B and A respectively.

The best known source of current for radio use is the battery. A battery consists of a number of cells which contain stored up chemical energy which readily converts itself into electrical energy upon proper completion of the circuit. Radio batteries are of two types, dry and wet or storage. Dry batteries are so called because they contain no liquid. They are always sold fully charged in condition to deliver their maximum power. During use this power is drained out and when used up the battery is no longer of value and must be discarded. Dry batteries have the advantages of low first cost, portability, freedom from attention during life. Their disadvantages are high cost per unit of energy, change of output during life, and the need of more or less frequent renewal. Dry batteries are more commonly used in the plate or B circuit of radio sets where relatively low currents are required at higher voltages. Some sets however are fitted with tubes especially designed for low filament or A current requirements which render dry batteries applicable, providing the recommended numbers are used.

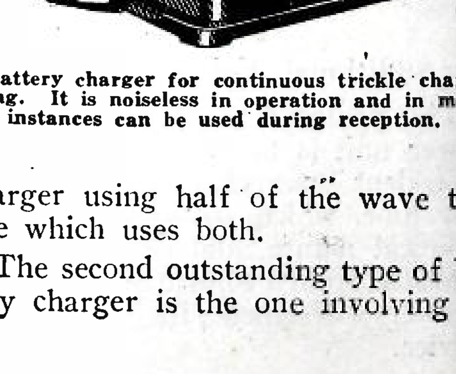
The wet or storage battery is so called because it contains liquid and is capable of having its energy restored by the process of charging. The best known type of storage battery is composed of plates of lead and lead oxide immersed in dilute sulfuric acid. The chemical energy in the battery may be released in the form of electrical energy. Electrical energy applied in the reverse direction will again store up chemical energy which may again be released at will and the process repeated many times. A good properly cared for storage battery should give several years of service. Storage batteries must be given attention whether in use or not. This involves recharging and addition of water.

A combination radio power unit. When connected to the "A" battery this combination unit furnishes automatic power to both the "A" and the "B" circuits. It is controlled by the filament switch on the set and is automatic in its operation.

Storage batteries have the advantage in radio uses especially for lighting the filament in that they may be built to a very large capacity, that is, their life—without recharging—is fairly long. Also during their cycle of discharge the voltage remains practically constant until their chemical energy is almost entirely given up. Storage batteries are used to a limited extent to supply plate current. In this case, however, a multiplicity of small cells is required and while the results are very satisfactory when the batteries are in good condition, the space required is large, the first cost is high and the attention required limits their desirability.

All storage batteries require recharging at intervals, dependent upon the frequency and the intensity of their use. Recharging may be accomplished from direct current where it is avail able. It is now only in the centers o large cities that direct current is sup plied to the householder by the electri light company. However, there ar three or four satisfactory means fo the householder to recharge his bat teries from the alternating current line This is accomplished by means of one of a number of forms of rectifier which convert the alternating current into a pulsating direct current. This type of direct current is entirely satisfactory for the recharging of storage batteries It is to meet this purpose that a great number of so-called battery chargers are on the market.

Three leading types may be mentioned, the vibrating reed type—which consists of a transformer, various magnets and a vibrator with contact points of one sort or another which vibrate in synchronism with the alternating current waves, allowing current to flow into the battery on the proper half cycle but stopping, by disconnecting the device through its contact points, the half cycle which would tend to discharge the battery. Some of these vibrating charges are so arranged as to make use of both of the cycles by changing the direction of the circuit on each half alternation, thus making use of both halves of the alternating current wave. It is to be noted in this connection, however, that the watt efficiency of the devices making use of both halves of the wave does not double the efficiency of the rectifier but increases it only to a very slight degree; that is, it costs practically no more to recharge a battery with a



Battery charger for continuous trickle charging. It is noiseless in operation and in most instances can be used during reception.

charger using half of the wave tha one which uses both.

The second outstanding type of bat tery charger is the one involving th use of the hot and cold electrodes in an atmosphere of rare gas. The phenomenon in this case is that electrons are given off by the hot electrode and flow to the cold electrode but will not operate in a reverse direction. This type of rectifier is specially adapted for charging high voltage batteries and may be used satisfactorily in the charging of 4 and 6-volt batteries at a relatively high rate.

A "B" eliminator recommended for sets having 5 tubes or less which require 67 to 90 volts.

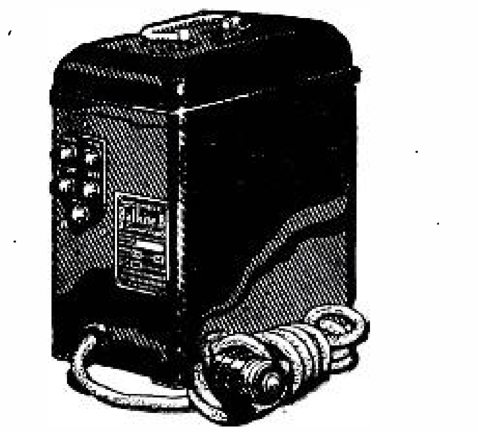
The third type of charger commonly in use is the electrolytic. Certain metals, when immersed in conducting solutions, allow electrons to flow from them into the solution but not in the reverse direction. This gives the same effect of pulsating direct current as obtained from the two other types. Both the hot and cold electrode type of rectifier and the electrolytic type may be made using both halves of the wave but it is only the latter type which is commonly made to do so.

There is a third means of obtaining power for the radio set and that is by using various types of rectifiers such as those above mentioned in conjunction with a series of choke coils and condensers which tend to flatten out the pulsating direct current to such an extent that it removes the cyclic hum to a greater or lesser degree from the circuit and may thus give results substantially similar to those given by various kinds of batteries. Great progress has been made in this direction during the past two years, especially in operating the B or plate current supply from an alternating current source. Two types of so-called B battery eliminators have been developed with more or less success and marketed to a considerable degree throughout the country. They are the tube type and the electrolytic type. The vibrating type of rectifier is not suitable for this work as there is a tendency to arc at the contact points which transmits a noise into the receiving set. A schematic diagram is shown below giving a typical circuit, in one of these so-called B battery eliminators.

The amount and capacity, that is the number and size of condensers, may be varied—and the design of the choke coil may also be varied, dependent on the amount of current which the device is required to pass, the amount of voltage which it is required to supply and the degree of filtering effect which is desired to be accomplished.

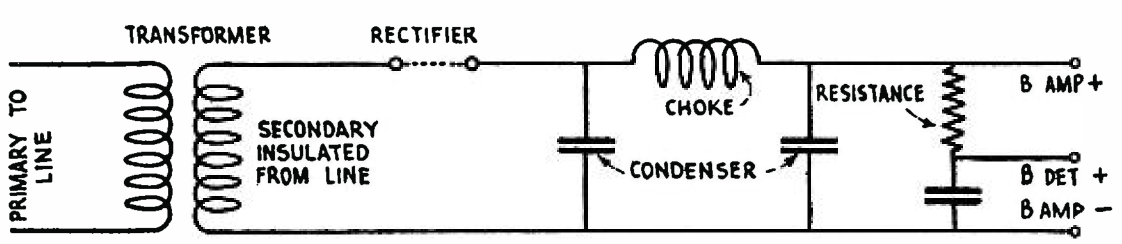
Generally speaking, a set requiring very small current on the plate at a relatively low voltage can be made with less capacity in both the condensers and the choke coil than one requiring higher voltages and more current.

The filter circuits employed have, generally speaking, been embodied in telephone apparatus for a great many years and are well known. It is the rectifier which heretofore has been the difficulty. Special types of tubes have been developed which are more and more overcoming the difficulty of changing characteristics due to deterioration of the tube. Of the electrolytic type there are two which are giving satisfactory results, one using a special aluminum and lead combination in a cell using a basic or alkaline solution, another using a tantalum and lead combination in an acid solution. The



This eliminator is suitable for sets of 5 to 8 tubes or less (including power tubes) where 90 to 135 volts are required.

former requires periodic changes of cells as the solution wears out due to electrolytic action and there is also a tendency for the aluminum electrode to wear out likewise. In the latter the necessity of adding distilled water occurs about once a year on ordinary sets. The metals in this case are at-



Diagrammatic circuit of typical "B" plate current supply operating from the lamp socket.

tacked only very slowly and the solution does not wear out except for a loss of water which is directly proportional to the amount of current which is passed through the cell.

In supplying current from the light socket to the filament of radio sets, however, less progress has been made, although continual experimentation has been going on during the past three or four years and a satisfactory "A" battery eliminator may be expected ultimately. During the past year, however, a satisfactory source of A cur-

This universal unit has a very high output and will serve practically any standard set. It is specially designed for sets using the new UX-112 and UX-171 power tubes.

rent supply has been obtained through the so-called trickle charge method which consists of a small charger of the electrolytic or hot and cold electrode type, so designed as to charge continuously a small storage battery.

In certain cases the trickle charger and the battery have been housed in one housing with switching arrangement so that the charging occurs only when the radio set is not operating. By this means the owner of a radio set may entirely disregard his batteries except for the infrequent addition of water to them. Where this type of device is a combination of the electrolytic type of trickle charger it is also necessary to add water to the charger. This is, of course, not necessary in the bulb type. In general, however, the bulb type of charger has a limited life, approximately 1,000 hours, which requires replacement of a tube. Both the aluminum and tantalum types of electrolytic charger are used in this connection. It seems probable, from developments to date, that the latter combination of continuous low rate charging with storage battery will have a lower first cost and will in general be more satisfactory than a device which completely eliminates the A battery.

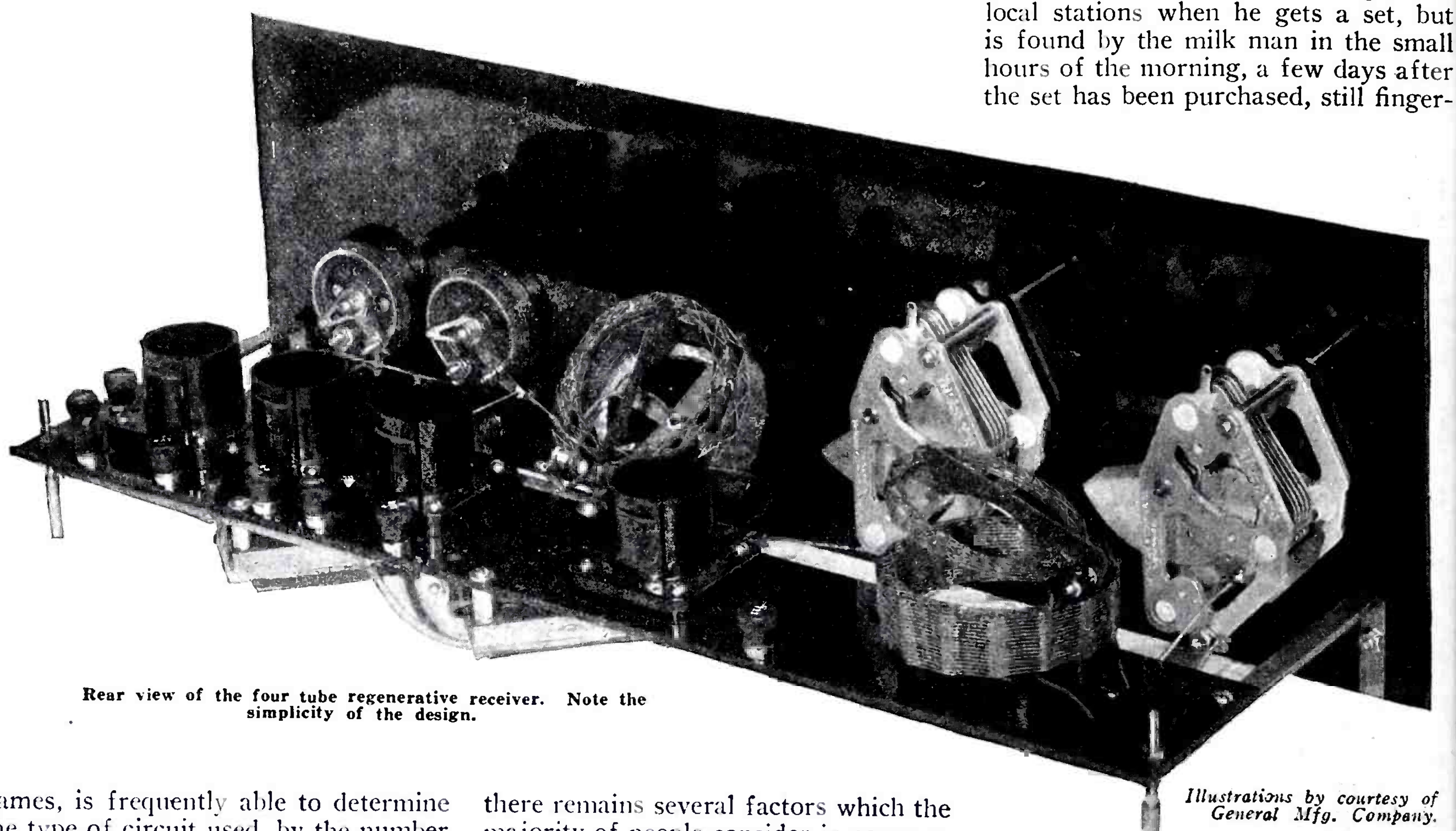
The above comments are, of course, based on the assumption that the type of radio set used, as to voltage and current required, will be approximately the same during the next year or so, as A or filament battery eliminators might be perfected more readily if radio sets were designed to operate at higher voltages and smaller currents.

A Simple and Efficient Four-Tube Set

By S. O. LAWRENCE

RADIO sets are not sold by the pound or by the peck and although a great deal of importance has been attached to the number of tubes which a set contains, this too may prove as irrelevant to the true ability of the receiver as either of the above measures. Of course it is understood that the one tube and the multi-tube set are not one and the same in operation and ability but it is not the number of tubes alone that makes the difference. One, familiar with the fundamental radio circuits, of which there are very few in spite of the great number of trade names, is frequently able to determine the type of circuit used, by the number of tubes but although the vacuum tube has made possible the present large scale of broadcast reception, it forms only a link in the chain. Without the support of a good circuit properly controlled by instruments of correct design and construction the efficiency of the tube is greatly impaired although it may continue to work, after a fashion, under very adverse conditions. Advantage has been taken of this fact and sets have been manufactured to meet a price but still fill the demand for more tubes, by omitting other parts essential to the best operation of the set. Some of the most common practices in vogue as short cuts to low prices manifest themselves in the use of the filaments of the radio frequency tubes for controlling oscillation, the omission of rheostats or other devices to control filament current supply, no control on the plate voltage and the use of inferior parts. Insufficient number of turns of wire on the primary windings of radio frequency coils tend to make the set operate more quietly and metal placed in field of the transformer will reduce oscillations but such rough shod methods also reduce the efficiency of the set.

As the tastes of the individuals vary so must the type of set vary to please the individual and although every one can not be satisfied with one receiver there remains several factors which the majority of people consider in common before purchasing or building a receiver. The initial price is important but quality can not be disregarded and the maintenance cost is considered by most people. The set that will not cover distance is lacking and one that will not separate broadcasting from stations sending on approximate wavelengths or produces nothing but harsh, raspy tones is not a pleasure to any one however indiscriminating he may be. All sets have their limitations and the atmospheric condition is the king, but for a combination which has a reserve of power for distance and will submit to control to produce clear, distinct tones, the four tube set is one to be considered. Four tubes are all it needs to do the task and do it well for it utilizes regeneration to its best advantage. Four tubes in a set does not mean that it has only four-fifths the ability of a five tube set or four-sixths that of a six, but to the contrary the regenerative four tube set with one stage of radio frequency boasts of a record for greater selectivity and for receiving broadcasts from a greater number of distant stations in an evening's operation than many of the five and six tube sets now on the market. It is a set for the individual who enjoys searching the air for distant stations and admits that he enjoys it and also for the individual who says that he will be satisfied with listening to the local stations when he gets a set, but is found by the milk man in the small hours of the morning, a few days after the set has been purchased, still fingering the dial, long after the home talent is peacefully asleep.



Rear view of the four tube regenerative receiver. Note the simplicity of the design.

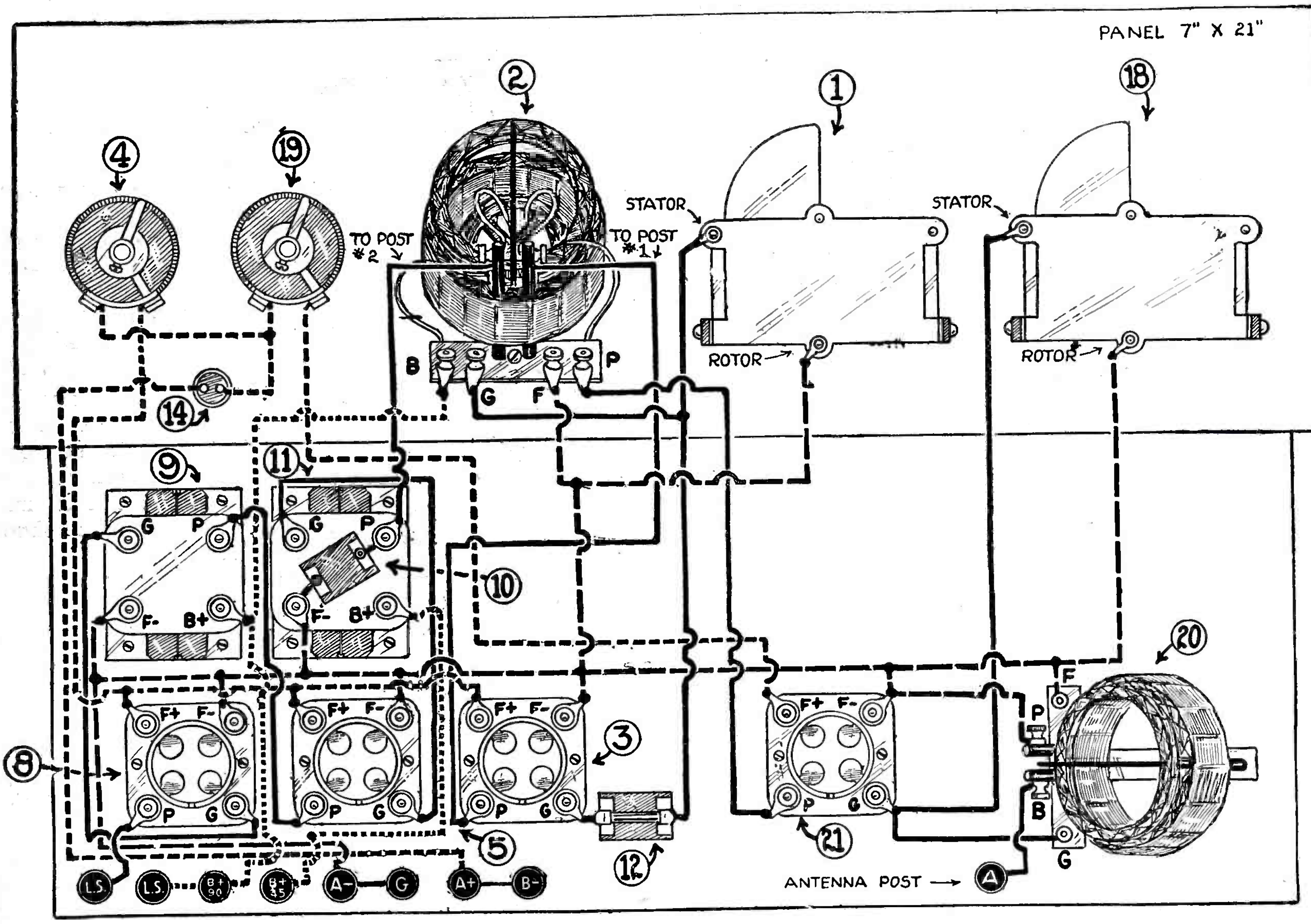
Illustrations by courtesy of General Mfg. Company.

In the four tube set we first have a stage of radio frequency, which is composed of an antenna coupler or radio frequency transformer, a variable condenser and a vacuum tube. The radio frequency transformer amplifies the incoming signal, the variable condenser tunes it to resonance with the desired wave excluding the others and the vacuum tube controls the direction of the current flow. There are several benefits derived from this stage.

First of all and probably the one of most importance for discussion is the non-reradiating effect it has on the set. There is a common confusion between ne terms reradiation and regeneration. These terms are considered by many s one and the same but in reality they re quite different, one being useful to ne operation of radio reception and ne other a detriment. Reradiation is ne result of poorly controlled regeneration but is not an ever present evil and o more present in the regenerative et than in the tuned radio frequency et which oscillates strongly. The egenerative set is one, as its name implies which regenerates part of the current supply which it has previously roduced or generated up to a particular stage in the receiver. This operation is accomplished through the gency of the three circuit tuner by assing the current which has been produced through the variable coil and e-introducing a portion of the supply nto the circuit. The variable coil or ickler coil of the tuner constitutes a ery flexible means of control, for with ny change in its position there results produces a great deal of noise and its ability to control the direction of the current flow is lessened and if allowed to continue operation under these conditions it will permit the disturbance to pass back into the antenna and be reradiated or rebroadcast in a measure. It is this condition which causes disturbance to neighboring receivers and it is to overcome the possibility of reradiation that the stage of radio frequency is used between the detector tube and the antenna where it performs the duty of a one way passage.

The additional control narrows the path of the incoming signals assisting in selectivity and the volume is increased by the additional radio frequency transformer. The added stage of radio frequency under which name this combination of parts has enjoyed much popularity is so termed because its addition to the three tube regenerative set in no way alters the original circuit and many owners of radio sets, radio frequency transformer of the first stage, and is tuned to resonance with the first stage by the variable condenser. After the current has passed through the transformer coils of the tuner and through the tube of this stage, it passes again into the tuner through its variable coil and a portion of the power is re-introducted into the transformer coils of the tuner by induction and increases the initial volume of power. In the detector stage the frequency of the waves is reduced to fall within the range of frequency to which the human ear is responsive. In comparison to the frequency of the waves broadcast from the stations, this range is very low.

The last two stages of the set are for amplifying the signals after their frequencies have been reduced to the audible range and are called the audio amplifying stages of the circuit. Each of these is composed of one tube and an audio frequency transformer, the



A picture wiring diagram of the four tube regenerative receiver. The various parts are designated by numbers in circles, thus aiding the builder in following the wiring instructions.

a corresponding change between the value of the inductance between it and the other coils of the tuner. By regulating the amount of inductance between the windings of the tuner, the tubes can be made to operate at the point of greatest efficiency which is just below the point at which they go into self oscillation. Oscillation in the tube having made their purchases before this stage was introduced into the field, have added it to their sets.

Following the radio frequency stage comes the detector, composed of a three circuit tuner and another variable condenser and tube. The three circuit tuner with the exception of its variable coil performs the same operation as the transformer differing from the radio frequency type in that it has several thousand turns of wire on the coils and has an iron core while the radio frequency type usually has less than one hundred turns on its secondary winding and as low as four turns on the primary with no core at all. The reason for the difference in construction is due to the difference in the characteristic of the high frequency currents which enter the set from the antenna and the low frequency current to which it is reduced in the detector stage of the set. The former will travel readily through space with no evident conductor while the latter travels more readily through wire and is of the same type as that which operated our telephones and electric lighting systems, being handled and applied in the same manner. After the pulsating current has been amplified by the last stage of audio it is necessary to change the electrical waves to sound waves before the ear will respond and this operation is done through the agency of the speaker unit.

Mounting the Parts

Place all of the parts to be mounted in their relative position on the front panel and sub-panel as they lay flat on the table. This enables one to determine the amount of space required for each and the position in which each will mount best. On the front panel mount the two variable condensers, the tuner, the rheostats and a filament switch in the position shown by the pictorial diagram, and on the sub-panel mount the tube sockets, audio transformers, binding posts and the Gen-Ral antenna coupler. Mark the positions of all the holes with a center punch and drill them first with a small drill and using the small drill holes as guides follow with the larger drills. It is well to drill the larger holes half way through from each side of the panel to prevent chipping.

Wiring the Set

Making the connection between the instruments of the set while not a difficult task is greatly facilitated if attention is given to a few minor details which may seem unimportant. The soldering iron must be well tinned and all connections well cleaned before a good joint can be made. The point of the iron is tinned by cleaning it with a fine file or abrasive material and applying a trace of soldering flux to the iron. Do not dip the hot iron into the flux, then bringing it into contact with several particles of solder until the metal adheres to all portions of the point. Any surplus of solder sticking to the point is removed by wiping with a clean cloth, and the iron is ready to perform its duty as a converter of small particles of solder to the successive joints as they are to be soldered. Use plenty of soldering lugs, especially on brass and nickle plated screws, since the solder adheres much more readily to the lug, and place on the tip of each a trace of non-acid soldering paste as well as on the end of the bus bar to be soldered to the lug.

PARTS NEEDED

Fig.	1	Variable condenser .00025.
Fig.	2	Gen-Ral three circuit tuner.
Fig.	3	Detector socket.
Fig.	4	Rheostat (6 ohm)
Fig.	5	Audio socket.
Fig.	19	Rheostat (20 ohm)
Fig.	18	Audio socket.
Fig.	14	Filament switch.
Fig.	12	.00025 fixed condenser and 2 meg. grid leak.
Fig.	9	Audio transformer.
Fig.	10	Fixed condenser (.001)
Fig.	11	Audio transformer.
Fig.	13	Binding posts.
Fig.	18	Variable condenser.
Fig.	20	Gen-Ral antenna coupler.
Fig.	21	R.F. Socket.

The A minus and F minus circuit are the same thing. This is the circuit which leads to the negative side of the A or storage battery, which lights the filaments of the tubes. The A plus and F plus circuit leads to the opposite side of the same battery. The former is shown on the diagram by the long dashes and the latter by the short dashes. The B plus circuit, shown by the dots, leads to the ninety volts post and to the forty-five volt post of the B battery, the dry cell batteries. Starting with the binding post, trace each of these circuit throughout their entire course and install the wires. If care is used to install every connection shown by the broken lines and to all the binding posts, there remains only one circuit, represented on the diagram by the solid black lines which is called the antenna circuit. This circuit is most easily traced by starting with the antenna post and following it into Fig. 20 at B and out at G,—into Fig. 21 at G and out at P,—into P of Fig. 2 and out at G,—into G of Fig. 3 passing through Fig. 12 and out at P,—into Fig. 2 again, but entering this time at post number 1. It is here that the current is fed back into the circuit by passing through the variable coil of the three circuit tuner where a portion of the current is induced into the secondary coils of the three circuit tuner. The circuit then continues its course out of Fig. 2 at post number 2,—into P of Fig. 10 and out at G,—into G of Fig. 5 and out at P, into P of Fig. 9 and out of G,—into G of Fig. 8 and out P from which it goes to the loud speaker binding post marked L.S. Connect the stators of the variable condensers to the relative circuits and connect a .001 fixed condenser between P and F minus of Fig. 10 and your set is completed and ready to talk.

Operation of the Set

Insert 201A tubes into the sockets and make the outside connections to the batteries, the antenna and the ground. Turn on the filament switch and turn the rheostats until the tubes are about two-thirds lighted. A station is then located by turning both the condenser dials slowly and keeping the readings the same. Once the station has been located regulate quality of the tone with the three circuit tuner and adjust the rheostats to the best operating conditions. In rotating the variable coil of the three circuit tuner it will be found that at certain positions it causes the set to whistle which will stop when the coil is turned in the reverse direction. This is the natural characteristic of the three circuit tuner and when it operates with a whistle it is functioning properly.

Removing Sulphate from Storage Battery Plates

VERY badly sulphated storage batteries which will not yield to the usual treatment of a prolonged slow charge may be saved from the scrap heap by the following method.

The acid is emptied out and the cell is filled with distilled water and allowed to stand for several hours in order that any acid held in the paste may have time to diffuse out. The cell is then filled with a solution of *pure* sodium sulphate ($Na_2So_410H_2O$). The concentration is not important, but 200 grams per litre may be mentioned as a guide. The cell is then put on charge in the usual way, when the sulphate will gradually disappear. Before refilling the cell with acid it is most important to remove all traces of the sodium sulphate solution by prolonged soaking of the plates in distilled water, two or three changes of water being made before the washing process is regarded as complete.

The action of the sodium sulphate is attributed to the fact that the solution, on electrolysis becomes acid in the neighborhood of the positive plate and alkaline near the negative plate, and that a higher voltage is necessary to liberate oxygen in the acid solution and hydrogen in the alkaline solution. There is a tendency therefore for the lead sulphate at the negative plate to be reduced to lead, and at the positive plate to be oxidized to lead peroxide.

Bigger Radio Bargains Than Ever Before

Announcement to Set Builders

HERE is a real guide for the fan and set builder, the book that hundreds of thousands of radio enthusiasts turn to when they want the latest and best in radio. It's the handiest and most reliable radio reference guide you could ask for, and a big money-saver besides. Keep up to date by utilizing Barawik service. It will help you to solve many a radio problem as well as saving you tremendous sums on the very things you need and use most. You may experiment all you want with the various circuits, for BARAWIK always gets you the parts specified by the famous circuit designers of the world.

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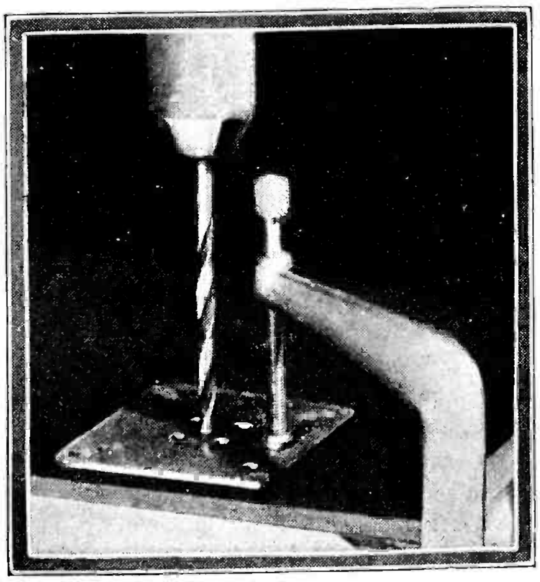
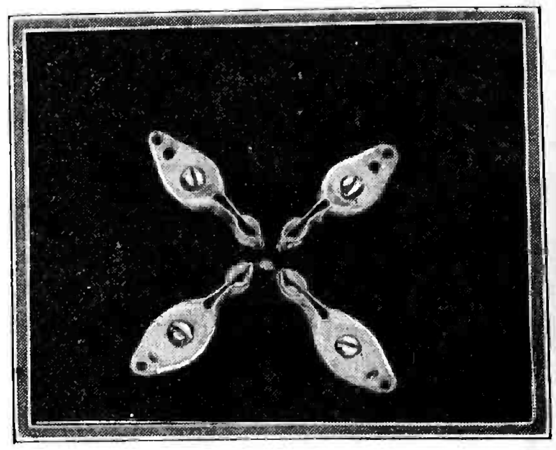
Home-Made Sub-Panel Sockets

The advent of highly competitive radio receiving sets has forced set builders to look around for means of minimizing cost of construction, without injuring performance. Necessity as usual being the mother of invention, has fostered the development of a convenient set of stampings which can be mounted beneath the sub-panel and which obviate the necessity of sockets.



A steel template provides the means of drilling the holes in sub-panel accurately.

A steel template is provided with holes of correct size and in the proper place, so that it is practically impossible to make an error in drilling the sub-panel. Each hole is marked with the size number of the twist drill to be used. The center hole for each tube is drilled in the sub-panel first, then the template is bolted in position through this hole and drills are used as numbered in the face of the template. An idea of the appearance of the finished job may be obtained from the lower illustration.



This shows the under part of the sub-panel after the prong contacts have been mounted.

Building-in a Ready-Made Audio Amplifier

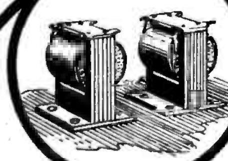
(*Continued from page* 111)

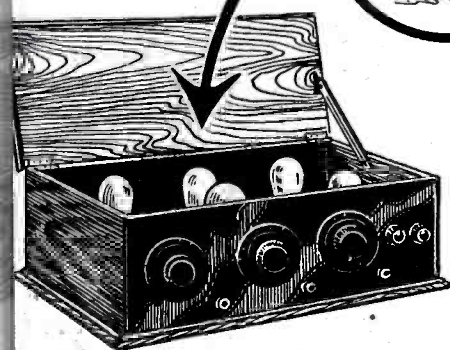
wound on opposite sides of a square iron core. Further coupling is gained by placing a coupling condenser between the two windings. The scientific balancing of the elements entering into each unit and then in turn of the three units one to another and finally the use of the output unit which protects the loud speaker and keeps it from demagnetizing, combines to give a new type of amplification which is said to give excellent reproduction.

In addition to the complete Truphonic Amplifier, that we have discussed in this article, this same principle is provided in construction units of particular interest to set builders. These units are provided in two models for the use of 6 or 7 tubes. This unit is shown in the photo. It is simply the Truphonic Amplifier in knocked down form plus the extra sockets for the radio frequency tubes and the detector tube. Three of the sockets provided for are taken up with the connections to the special units contained within. The other 3 or 4 sockets (as the case may be) are for connection to the tuning and detector end of the set.

The lacquered steel catacomb houses 3 special couplers and an output unit. A moulded socket panel of special construction which holds either UV-201A or all UX tubes, covers this catacomb. A six-foot battery cable is included. This unit may be arranged in hundreds of different ways to fit as many different requirements of every circuit and set designed. The socket panel itself is interesting. A single strip of metal forms all common filament connections. Continuous metal extends from the plate and grid leads of the sockets providing for connecting apparatus. This method of construction minimizes solder connections and does away with the necessity of drilling holes. Another photo shows the compactness with which the catacomb construction combines with tuning apparatus.

Stop thief!





Ordinary amplification is the thief of Tone in radio music—

Your own radio set *as it now stands* is a perfect reproducing instrument—up to, and including, *the detector tube*. As everyone knows, if you listened with a pair of ear phones to the music from the *detector tube* you would have *perfect reproduction*. If that same quality could only be made to come out of your loudspeaker in great volume, then you would have perfect radio enjoyment.

But it cannot—with ordinary amplification. Too much is blurred, too much is weak, too much is lost altogether.

How can we get this pure detector tone with great volume? Can it be had simply by changing the method of amplification? That depends.

Resistance coupled amplification is better, but many of the high notes are frayed and shattered, and the tone breaks down badly on strong volume.

Large size transformers are also better, but too many weak signals are absorbed. The actuality of the base, and the distinction between one musical instrument and another are lacking.

Impedance Coupling is unstable. It shares most of the faults of resistance coupling, and, like transformers, it absorbs the weak signals.

Electric-light-socket power amplifiers are also better, to be sure. But they operate *after* one of the music-distorting transformers already in the set.

The Truphonic Power Amplifier

An entirely new and different method of amplification has been developed by the eminent radio inventor, Mr. H. P. Donle, and is made by the Alden Manufacturing Company, well known for its Na-Ald quality products. It is called the "Truphonic." Already manufacturers of the higher quality sets are endorsing it, and adapting it as the finest type of reproduction. The Truphonic Power Amplifier is different from any other method of amplification. But what is most important, the *results* are different. No more need be said than that the Truphonic passes faithfully *all* notes of broadcasted music.

The Truphonic is a small compact instrument (shown below) which when attached in a few minutes to any radio brings through the loudspeaker with great volume *the detector tube music* in all of its perfect tonal quality.

What has just been said of the Truphonic can be said of no other method of amplification—regardless of the price you pay.

What Does This Mean to You?

For the price of $20 and an extra tube (using two of the tubes now in your set and one additional tube, either power tube or regular) you attach the Truphonic in a few minutes to your present radio and at one stroke convert it into the finest reproducing set that money can buy. A strong statement. But you *want* strong statements when the product backs them up.

Today! Tonight! Attach the Truphonic Power Amplifier and get all that radio can give.

For the Set Builder

Truphonic amplification is provided in separate Truphonic couplers for the set builder. Three stages not only give the finest quality of reproduction obtainable but also give considerably more volume than two stages of ordinary transformer amplification. Price $5.00 per stage.

The Truphonic Output Unit protects the speaker against burning out and demagnetization when power tubes are used. (This output is used of course in the complete Truphonic Power Amplifier described above). Price $5.00.

The Truphonic Catacomb Assembly is also of great convenience to set builders. A lacquered steel catacomb houses three Truphonic couplers and a Truphonic output unit. A special moulded socket panel with 6 or 7 sockets of special construction, which hold either UV-201A or all UX tubes, covers this catacomb. This unit may be arranged in a thousand different ways to meet all the requirements of every circuit and set design. Short direct leads to connected apparatus, with a minimum of soldered connections. No holes to drill, no apparatus to mount. A six-foot battery cable is included. Price 6 tube $20, 7 tube $22.

NA-ALD

ALDEN MANUFACTURING CO.
Dept. Q-5 **SPRINGFIELD, MASS.**

TRUPHONIC
Power Amplifier
$20

Making the Most of the New Power Tubes

(*Continued from page* 109)

The Output Choke Coil

As a rule the loudspeaker is placed directly in the plate circuit of the last tube. However, in the case of the power bulb this is questionable practice. Sudden fluctuations in the relatively intense direct plate current may easily induce sufficiently high potentials to break down the windings. Also, the high plate current draws the armature closer to one of the magnetic poles, causing the loudspeaker to rattle on loud signals. To avoid these possibilities, the plate current of the last tube is passed through a choke coil of from 10 to 15 henries inductance. This reaction coil functions as a one-to-one ratio transformer, the alternating current being bypassed through the Electrad 1. mfd. condenser, C4, to the Loudspeaker. Thus only the alternating or sound producing current is passed through the windings of the speaker.

The Power Tubes

Power tubes require relatively high "C" voltages varying from 25 to 75 volts, depending upon the type tube and plate potentials employed. These are most conveniently obtained by using the Eveready B-C battery new type 768. The "C" battery should be adjusted until there is no fluctuation of the milliammeter needle on loud signals. Any fluctuation of the needle is an indication that the tube is distorting. If the needle kicks down, the "C" battery should be increased; if the needle kicks up, the "C" potential should be decreased. There will of course be reached a limit of signal strength when the needle will fluctuate regardless of "C" battery adjustments, indicating that the distortionless limit of the tube, for the given plate voltage has been exceeded. If more volume is desired, the plate potential should be increased with readjustment of the "C" battery.

The constructional points are made clear in the photographs Figures 2 and 3. The meter, pilot light switch, two jacks and amperite clips are mounted on the panel. The relative positions of the sockets and resistor couplers should be noted in Figure 3. The Amsco resistor-coupler and Universal socket are so arranged that they may be connected by soldering the lugs of the couplers directly to the grid and plate lugs of the sockets without using bus bar, resulting in a very compact layout.

Operation

The operation of the three stage power amplifier is in no way different from that of the more conventional types. The various batteries are connected as indicated, and post P (input) is wired to the plate of the detector tube by means of the input post or by a double plug, one in the detector jack of the receiver and the other in the input jack of the amplifier.

The grid bias should be adjusted as described.

The usual 201A type tubes should be used in the first two sockets, and the 171 tube in the output stage. If the high power tube is unavailable the next best obtainable—a 112, or even another 201A—should be substituted.

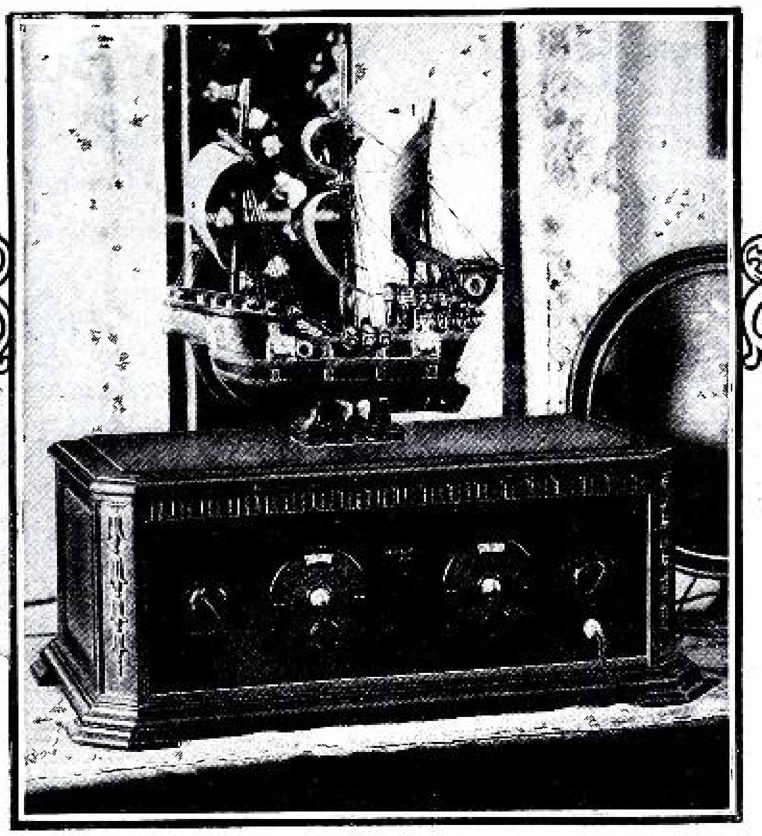
The ampifier described will output a quality superior to that of the average resistive coupled amplifier (which is already most acceptable) with any tubes due to the choke-condenser arrangement. The high impedance of the choke coil effects a better balance between the tube and load circuits, resulting in a more faithful rendering of the low frequencies.

Placement of Tubes in the Amplifier

If it is desired to use the 210 tube with this amplifier, a six ohm rheostat should be substituted for the fixed resistor at R8 and the "A" battery lead brought down to a separate post so that an extra cell may be added to the filament source supplying the large tube. For best results, the 210 and 310 tubes should be operated with seven volts across the filament.

In the majority of receiving sets, a .0025 mfd. bypass condenser will be found connected from the plate of the detector tube to one leg of the filament. This condenser is essential, and if it is missing on your receiver, it should be added, at C5, in the amplifier. The writer recommends an Electrad Certified mica condenser.

To obtain results justifying the expense and construction of this amplifier and associated apparatus, it must be outputted to a high grade loudspeaker. A three-foot cone is the writer's first choice. Other cone speakers will give very satisfactory results but due to the additional power employed, the three foot speakers can handle the load better.



"How To Build It" Book

Complete instructions for assembling, wiring and operating the Hammarlund-Roberts Hi-Q Receiver. Prepared under the direction of the Engineer-designers.

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Complete Parts
(less cabinet)

Automatic Variable Coupling, same control operates tuning condenser and primary coil coupling simultaneously, gives maximum and equal amplification and selectivity over entire tuning range.

Stage Shielding—prevents coupling between stages, eliminating oscillation and increasing selectivity. Clarifies reception.

Hi-Q Foundation Unit

Includes drilled and engraved Micarta Panel, drilled Micarta sub-panel, two complete shields, extension shaft, two equallizers, fixed resistance, hardware, wire, nuts and screws.

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Hammarlund-Roberts Performance Means A New Measure For All Radio

THE Hammarlund-Roberts Hi-Q is an outstanding example of scientific radio engineering. No ordinary standards of tone, selectivity or volume, can be applied to this new receiver.

In designing this Hi-Q Receiver, the Hammarlund-Roberts Board of Engineers representing twelve nationally known manufacturers, had at their disposal the finest experimental laboratories—and no handicap in building to establish specifications or to a set price.

This concentration of the leaders in the perfection of one radio Receiver has developed entirely new features that produce results unknown to the average radio man. Automatic variable coupling gives maximum and equal amplification and selectivity over the entire tuning range. Stage shielding eliminates coupling between stages, prevents oscillation and increases selectivity. Two dial control simplifies tuning.

ANYONE CAN BUILD THE HAMMARLUND-ROBERTS Hi-Q

All the research, the selection of parts, the exact placing of units, has been worked out in advance for you. And you have a receiver that will equal an eight tube set—simplicity of design and operation hitherto unthought of—all at less than half the price you would pay for a factory made set of anywhere near equal efficiency.

Hammarlund ROBERTS Hi-Q*

*** High ratio of reactance to resistance. High ratio—Great selectivity—Loud signals.**

Hammarlund-Roberts · 1182-S Broadway : New York

How to Build the H. F. L. Nine-Tube Super

(*Continued from page* 98)

the intermediate frequency tubes, which is unusual but not startling. There is an extra step of I. F. amplification added, making the set a nine-tuber. That is an innovation, as those who have tried to do it will agree. It means simply that the transformers have been matched to an unusual degree. To aid in the control of that part of the circuit an extra filter has been added. That might almost be expected. There are no gridleaks and condensers in the grid circuit of either of the detector tubes.

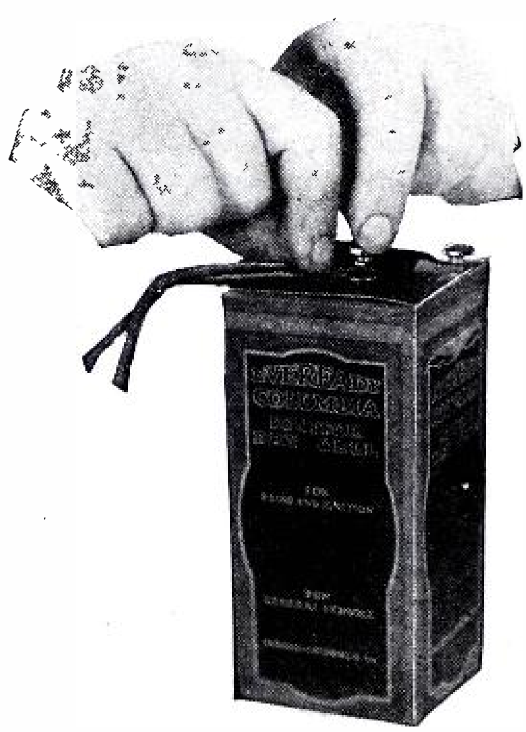
A .000045 mf. condenser controls the feedback into the loop from the plate circuit of the first detector tube. By this means the loop is stiffened so that its sensitivity and selectivity are increased. This condenser also acts in an additional capacity.

The grids of all amplifier tubes return to filament through the same "C" battery, and they should, if the designers can make the set perform satisfactorily by that method. And there is no doubt that it does. The oscillator requires only 22½ volts on the plate. That means a saving of "B" battery if you use one. An oscillator working well with that plate voltage must be working efficiently and with stability. The designers would never specify that if it did not. The idea is rather refreshing after seeing the numerous inefficient oscillators which required high-plate potential to insure that they would be forced to do the work that they were designed to do.

But as yet nothing has been said of the real reason why this set is one that the constructors should like. That is the simplicity of the design and the ease of construction. In the diagrams and the photo of the layout it is clearly shown that all of the parts are assembled as if they were an army. A double line of staggered apparatus brings the connections so close that very little wire need be used. The nine tubes line up in perfect order. The seven transformers and one choke unit fall in behind, each encased in a similar housing so that those who build the set must follow their code numbers carefully to keep from using an I. F. transformer where an A. F. transformer should be. Such an error would, to say the least, confuse the detail.

A Battery Wiring Suggestion

In many radio sets, the positive "A" terminal and the negative "B" are



Join the positive "A" and the negative "B" at the battery terminal.

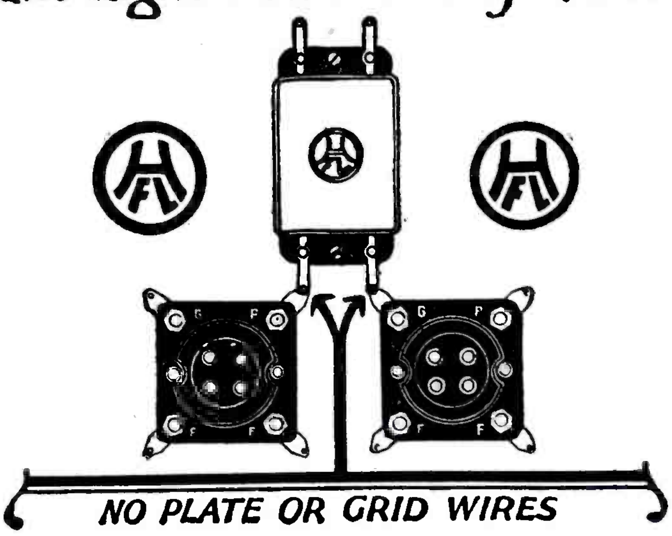
connected together. A convenient way of connecting the battery in such cases is to run a wire from the negative "B" battery terminal to the positive "A" terminal, joining the two wires at the latter point as shown in the accompanying photograph. If wires are disconnected in changing batteries, or for any reason there is less chance of reconnecting them incorrectly since the positive "A" is easily identified being joined to the wire used to connect the negative "B" terminal.

A Useful Enamel for Radio Work

Sealing wax is sold in various colors and may be dissolved in methylated spirits to form a series of different colored enamels. These are very useful in radio work for marking cable ends, the tops of battery terminals, etc. They can also be used to mark bottles containing storage battery acid, as the enamel is not attacked by acid, which may run down the outside of the bottle.

H·F·L· Transformers

The Highest Standard of Radio



Write for Literature

THE CALL BOOK SAYS:

Using H. F. L. Units, we secured hair-line selectivity, tremendous power and highest quality of tone combined with simplicity of tuning and economical cost of operation.

RADIO NEWS SAYS:

Using H. F. L. Units received 105 stations in United States, 7 Canadian, 1 Mexican, 1 Cuban, all logged while 30 local broadcast stations were on the air.

Endorsed—

H. F. L. Transformers have been endorsed and approved by Radio Authorities—Editors, Engineers and Set-Builders for their supreme excellence and the improved quality of reception that they afford. H. F. L. Transformers represent the highest development of efficiency and the most advanced construction design. They make it possible to select radio programs at choice regardless of broadcast conditions. They combine tremendous power with an unexcelled purity of tone and amplify the weakest signals to full loud speaker volume. They operate with all types of standard tubes, and are altogether unsurpassed for quality, clarity and volume. Improve your new receiver with H. F. L. Transformers.

H. 210—Iron core transformers with an exceptionally high amplification factor. Each unit carries laboratory calibration. Range 32,000 to 42,000 cycles. Price....$8.00

H. 215—Air core transformer, tuned stage, designed to amplify signals at a maximum efficiency of 37,000 cycles. Each unit carries the laboratory calibration. Price..$8.00

F. 320—Audio frequency transformer which will amplify signals to greatest volume with incomparable faithfulness of tone. These units are the result of an entirely new principle in transformer construction. Price.....$8.00

L. 425—Radio Frequency Choke Unit. Price......$5.50

L. 430—Tuned Radio Frequency Transformer. Price $5.50

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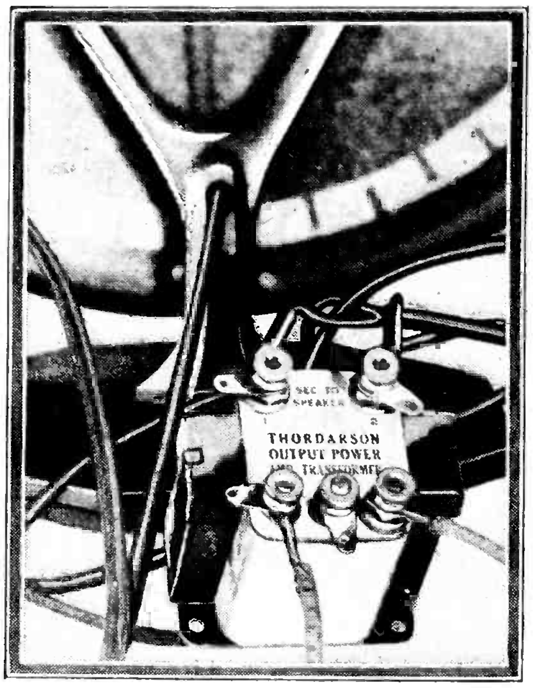
131-C N. WELLS STREET

CHICAGO

A New Use for an Old Transformer

A discarded transformer may be put to work again to serve a very useful purpose in protecting the windings of a loud speaker being operated in connection with the new power tube. It is merely necessary to connect the primary in series with the output circuit and the secondary to the loud speaker.



Push-pull transformer used to protect loud speaker.

An old push-pull transformer used for this purpose is shown in the illustration. Since there is no electrical connection between the windings of the transformer, the passage of direct current through the loud speaker is prevented, but the fluctuating currents representing the signals are communicated by means of the electro-magnetic action between the windings and these actuate the loud speaker. This greatly reduces the danger of a break-down in the loud speaker windings.

A Cheap and Efficient Aerial Insulator

One of the finest insulators obtainable especially for indoor work is shown in the accompanying illustration. This is merely a glass towel rack which can be purchased in any of the chain 5 & 10-cent stores. This glass rod has the advantage of being longer than most of the insulators made especially for use in connection with aerials. The glass is a fine insulator and does not absorb moisture and is well suited for this type of work. While it could be used for an outdoor insulator it will probably be a little bit too fragile when used in this connection, but where an aerial is to be erected in an attic, it will be found to be just the thing. These rods are molded with small flanges at each end which can be put to good use in securing the aerial wire at one end and the supporting wire at the other. This is clearly shown in the photograph.

An efficient glass insulator.

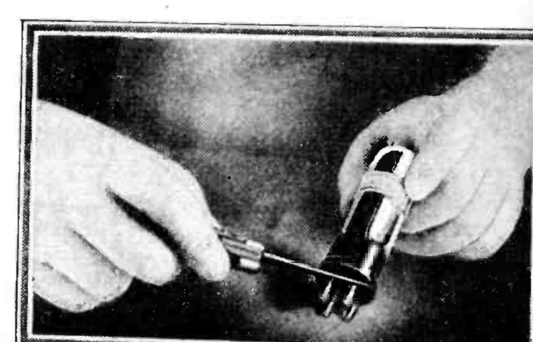
Inspect Ground Connection Periodically

It is almost certain that the ground connection receives less attention than any other part of a receiving installation, probably because it is out of sight. The possibility of trouble at this end of the antenna circuit must not be neglected, however.

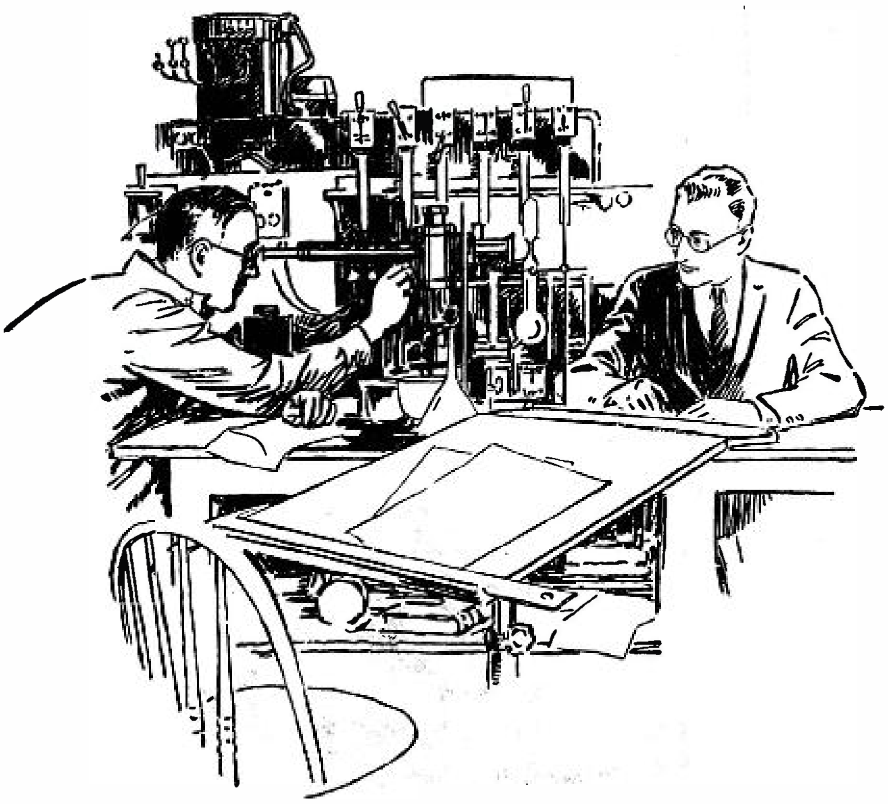
If contact is made to a water pipe, this should be examined periodically and cleaned if necessary. Test the receiver by taking off the ground connection while the set is in operation.

Watch Out for Faulty Contacts at Tubes

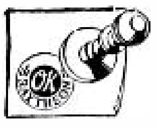
Much of the trouble experienced in connection with radio receiving sets is caused by faulty contacts. A prolific source of this trouble is the contact point between tube prong and socket. Sometimes a drop of solder sticking to the prong of the tube base will cause the fault. It is a good plan to scrape all tube prongs before placing them in the sockets. In case the socket prongs are bent out of place so that a good contact cannot be obtained, this trouble can be remedied by lifting each prong with the finger.



Faulty contacts.



A $20,000,000 IDEA



"Approved by Raytheon"

Manufacturers of Complete B-Power Units, Raytheon-equipped:

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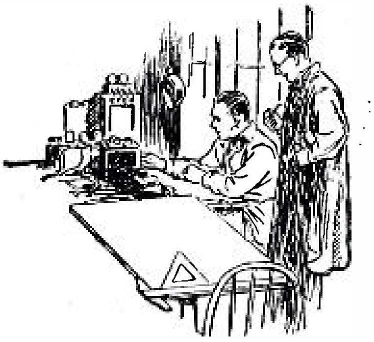
TEN YEARS ago Charles Grover Smith began the intensive study of the possibilities of handling electrical power by gaseous conduction. With the resources of the Raytheon Research Organization behind him, he produced the Raytheon Rectifier, giving for the first time full wave rectification with simplicity, long life, and absolute reliability, and making possible in the one year since its introduction, a business in Raytheon-equipped B-Power units of approximately $20,000,000.

Raytheon has many ideas. For their development Raytheon maintains a Research Organization housed in a separate building, and with a staff headed by such men as Mr. Smith, Dr. Vannevar Bush of M. I. T., Monsieur Andre of the La Radio Technique of Paris, Mr. J. A. Spencer, inventor of the Million Dollar Thermostat, and many others. The equipment at their disposal cannot be duplicated anywhere. It is little wonder that those close to radio power problems look to Raytheon for their most effective solution.

RAYTHEON MANUFACTURING COMPANY
CAMBRIDGE, MASSACHUSETTS



The Romance of Raytheon

By DONALD WILHELM

BETWEEN the time Mr. Smith set to work on his research, and the time that the Raytheon Rectifier was produced there were many hours, days, and months of dreams, discouragement, thrilling discovery, and patience. It makes good reading. For example, we think of copper as being an excellent conductor, yet Mr. Smith found that he could pass seventy times as much current through a column of gas as through a copper wire of the same diameter.

If you are interested to know more about the years of research resulting in the development of the Raytheon Rectifier, we shall be glad to mail you a leaflet telling the story in the words of Mr. Donald Wilhelm, author of "The Story of Steel," "The Story of Wrought Iron," and many other publications. Drop us a line.

RAYTHEON rectifier

Novel Placement of Loud Speaker

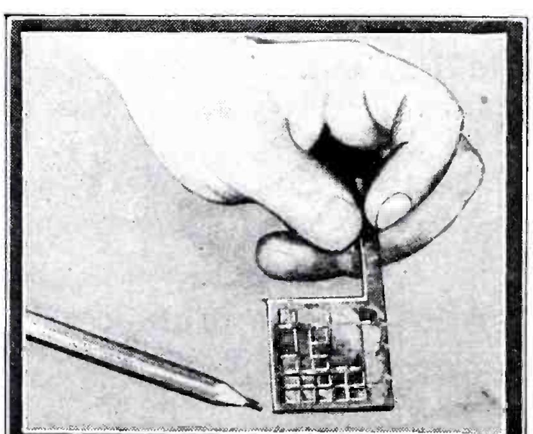
A discarded floor lamp makes an excellent support for the disc loud speaker. A bridge lamp can also be

A novel loud speaker stand.

used for this purpose. The speaker looks exceedingly well when properly mounted, is out of the way, may be adjusted to any desired height and last but not least delivers the sound exactly where wanted.

Rapid Charging Ruins Storage Battery Plates

If we could see all the changes which are taking place in the storage battery, we might be induced to treat that useful piece of apparatus with a little more

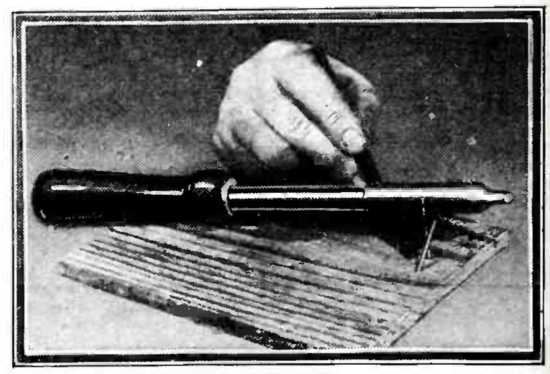


Rapid charging spoils battery plates.

consideration. The fans are warned often about keeping the electrolyte at the proper level by adding distilled water whenever necessary. Very little has been said, however, with reference to too rapid charging. The illustration shows a plate of a storage "B" battery which has been subjected to fast charging. It tells its own story. The active material has been thrown out, falling into the solution and resting in between the plates, effectively short-circuiting them. A quick charge saves time, but not battery plates, so don't try to rush your service man the next time you send the battery out to be recharged.

Nails Make Handy Soldering Iron Stand

Sometimes the electric soldering iron must be used at a place where the regular iron stand is not available. For example, the radio service man may be called upon to resolder a wire at the customer's home. Here is an emer-

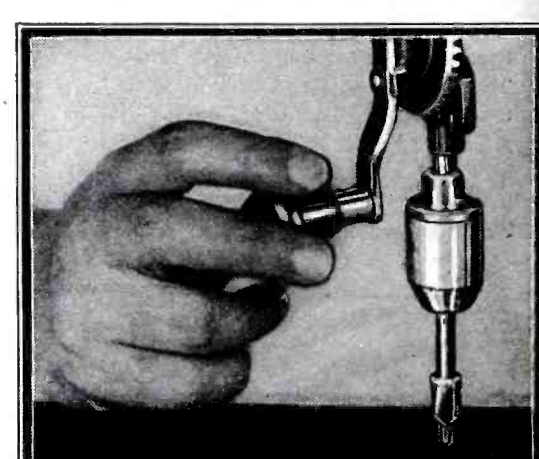


Soldering iron stand made of long nails.

gency stand which does the trick just as well as its more expensive prototype. Just a couple of long brads hammered into a block of wood and crossed as shown in the photograph and the stand is completed. The hot iron fits between the nails when not in use, thus preventing damage to the table or bench.

A Combination Drill and Countersink

The combination bit illustrated can perform two operations without the necessity of stopping the work to get

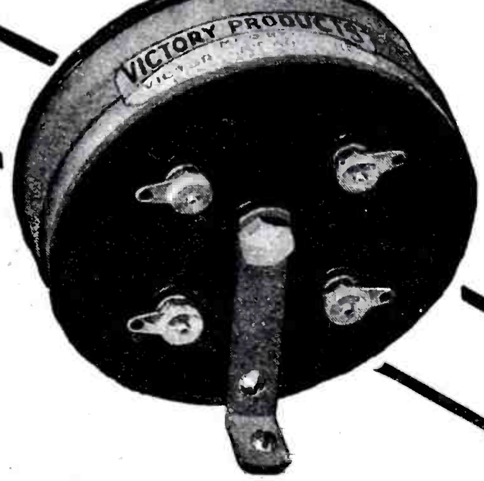


Combination drill and countersink.

another tool. It is made especially for drilling and countersinking standard radio panels.

VICTOREEN PRODUCTS

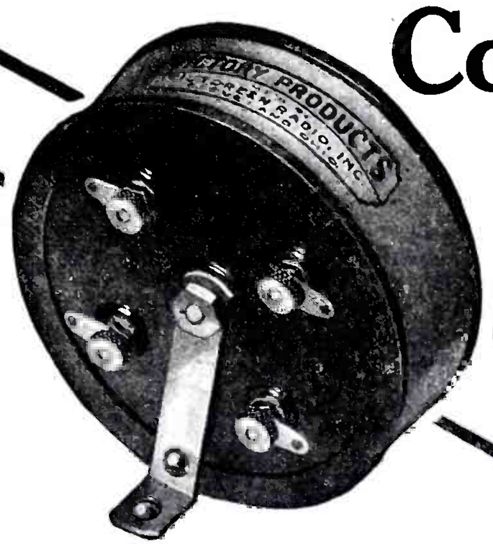
The Standard *of* Super Set Construction



VICTOREEN
Coupling Unit No. 150

This coil is especially designed for use with Victoreen transformers. The pick-up coil is wound with silk covered wire on a 3-inch Bakelite tube. The secondary and primary are wound on a 2-inch air core. It is neither necessary nor advisable to shield any part of the set as used to be considered necessary in a receiver of this type. The coil is neat and compact.

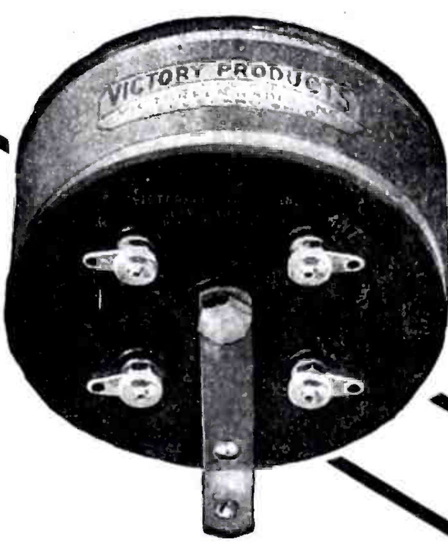
List Price, $5.50



R. F. Transformer No. 170

This unit has a 2-inch diameter air core permitting a minimum of wire to be used to obtain the proper inductance. The result is a very sharp curve or peak. Transformers can be placed in close relation to each other. Inter-stage oscillation is prevented and amplification constants are uniform due to the adjustment which is made and then sealed at the factory. No other adjustments are necessary.

List Price, $7.00



VICTOREEN
Antenna Coupler No. 160

For those desiring to use antenna and ground, as well as loop, the unit is necessary. The secondary is wound of silk covered wire, on a 3-inch Bakelite tube. The primary is space wound and securely fastened to the inner wall of the tubing. Sold in an individual carton.

List Price, $3.50

Use These Parts for Your Super.

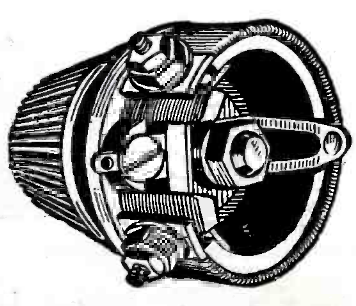
- 4 Victoreen No. 170 R.F. Transformers (No. 171—Transformer when dry cells are used.)
- 1 Victoreen No. 150 Coupling Unit.
- 1 400-ohm Victoreen Potentiometer.
- 2 6-ohm Victoreen Rheostats.
- 2 30-ohm Victoreen Rheostats.
- 1 Victoreen Master Control Unit. Type VS.

Victoreen R.F. Transformers are not merely "matched" but are actually tuned to a guaranteed precision of 1/3 of 1%.

Victoreen Super sets are free from oscillations, howls or squeals—no matching of tubes is necessary.

The B battery consumption is exceptionally low—8 to 10 milliamps with potentiometer to negative side—less than some 3 tube sets.

For range, clarity, volume, selectivity and ease of operation a Victoreen Super cannot be excelled.



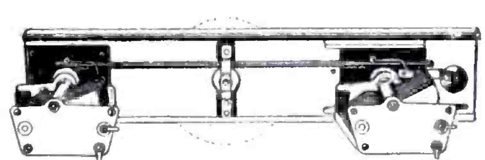
VICTOREEN RHEOSTATS

The only Rheostat with zero temperature coefficient—no matter how warm the unit becomes the resistance remains absolutely constant.

Victoreen Rheostats have double the number of turns of wire used on ordinary Rheostats—that means twice as fine adjustment.

This three terminal Rheostat simplifies wiring. Made with 5 resistances—2, 6, 10, 20, 30 ohms—**$1.20 each.**

Victoreen Potentiometers, 200 and 400 ohm resistances—**$1.50 each.**



Victoreen Master Control Unit

A completely assembled, convenient, single control unit for use on circuits employing two or more condensers of the same capacity. Easy to mount—no change of wiring necessary.

Victoreen Master Control Unit Type VS	**$19.50**
Extra Condenser, Each	**4.50**

The Free Victoreen Folder and hook-up answers all questions about the Victoreen circuit.

The George W. Walker Co.

6528 Carnegie Avenue Dept. J **Cleveland, Ohio**

Merchandisers of Victoreen Radio Products

The Karas Equamatic Receiver

(*Continued from page* 68)

Without this retard coil the slightest touch of the rheostat at any dial setting will throw the tubes into oscillation. With the retard coil there is plenty of latitude to move the rheostat a comfortable distance to control oscillations.

A 20-ohm rheostat is used on the detector tube and a 10-ohm rheostat on the radio frequency tubes.

When the coupling is properly adjusted one can tune from one end of the broadcast scale to the other without the tubes oscillating in the slightest,—but a slight turn of the rheostat dial will cause the tubes to break into oscillation at any point.

Construction of the Set

The set illustrated has a 7 in. x 28 in. panel and a 6 in. x 27 in. sub-panel, both of Radion or bakelite. On the panel are mounted three variable condensers of .00037 mfd. capacity each, with dials, and R. F. primaries, one filament switch, two jacks, and two filament rheostats. The complete front panel drilling layout with dimensions is shown. The sub-panel layout with hole drilling dimensions for mounting the other parts is also illustrated. Note that vernier dials are employed on this set,—an added tuning advantage.

The sub-panel is mounted about one inch away from the front panel, on brackets, and about one inch above the bottom of the panel, which leaves room underneath it for the wiring. On the sub-panel are mounted the cable plug, five sockets, the three R. F. transformer secondaries, audio transformers, and two retard coils. The photos clearly show the complete layout. The secondary coils should be mounted on the baseboard after the panel is assembled to it, so that their correct relation to the primary coils L, on the condenser shafts, can be determined.

A rear view of the panel is shown illustrating more clearly the battery-cable plug and the alignment of the R. F. coils and condensers.

Another photograph shows a view of the under side of the sub-panel. All of the wiring, except the connections which run up through holes in the sub-panel to the condensers and coils, is shown. Note the type of sockets used to reduce vibration of the tube with the resultant loud-speaker hum. One important point must not be overlooked—the center of the axis upon which the secondary turns, must be exactly perpendicularly underneath the center of the axis upon which the primary turns.

Now that the parts are all assembled on the panel and baseboard, let us see what is necessary to wire the set. Before starting, study over the photographs and wiring diagrams.

Those wires which pass through holes in the sub-panel, and connect to the instruments above, are provided in the panel drilling layout herewith. Spaghetti-covered busbar wire should be used throughout. Flexible wires can be used for connections to coils as shown in the illustrations.

Operation

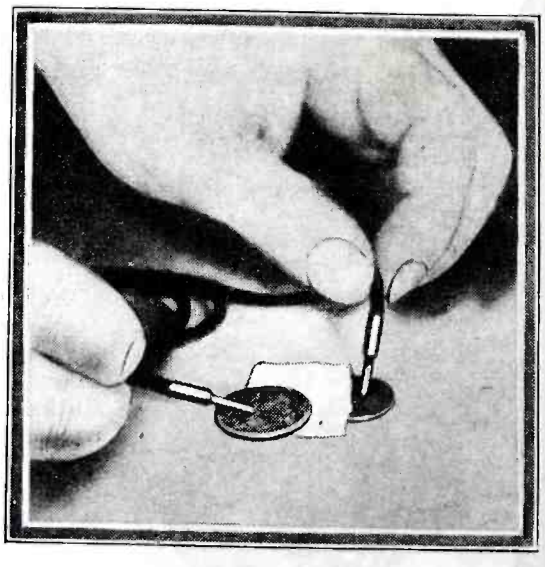
If care was taken in the wiring, the set will work more or less as it is without further adjustment; but for maximum operation and efficiency, the correct coupling angles of the R. F. coils must be determined. This requires a little care. They must be placed so that the set does not oscillate at the lower settings and also works well on the higher.

You will find that in order to prevent oscillations the secondaries will have to be moved to a considerable distance from the primaries. The coupling between the aerial coil and the secondary, in the first R. F. transformer, is not so critical.

Once adjusted for best operation at the proper filament voltages, as determined by the rheostats, no further changes are necessary.

A Phone Tester for Six Cents

A resourceful radio fan has found a cheap but practical method of testing his head set. This method can be

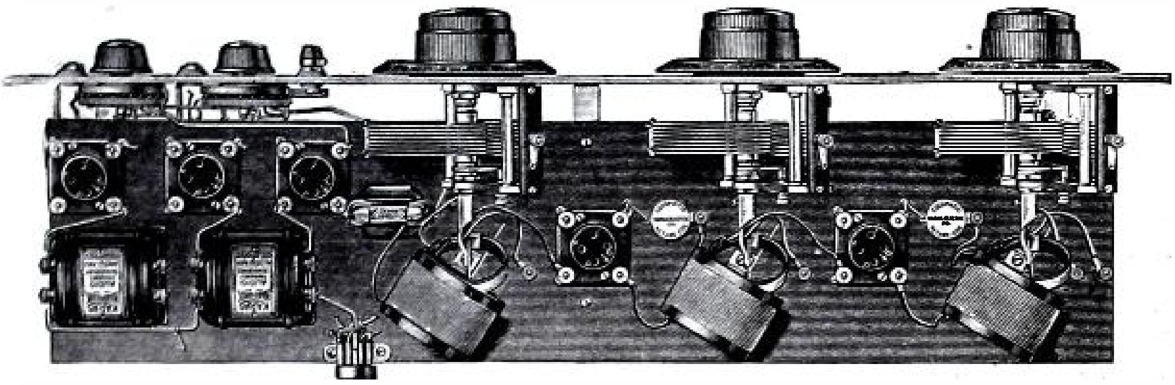


A practical coin phone tester.

used where a suitable battery is not accessible. A five cent piece and a penny are placed on either side of a small piece of blotting paper, which has been soaked in a salt solution. This constitutes a miniature electric cell. In testing, one phone tip is placed on the nickel and one on the penny. When this is done a loud click will be heard in the phones, provided they are sensitive.

Karas Equamatic

The Five Tube Wonder Circuit that has the Whole Country Talking — *Listening* — and BUILDING



Equamatic System Licensed Under King Patents Pending

STRAIGHT FREQUENCY LINE VARIABLE CONDENSERS and KARAS MICROMETRIC VERNIER DIALS. Because of this remarkable selectivity there is NO OVERLAPPING OF STATIONS. Each station comes in clear and sharp and full tone at its proper place on the dial.

HOW would you like to build a five tube radio frequency receiver that brings in every station WITH EQUAL VOLUME AND CLEARNESS from one end of the dial to the other?

How would you like to have a receiver that possesses an ALMOST UNBELIEVABLE SELECTIVITY—that enables you to CUT RIGHT THROUGH powerful local stations—to reach out after DX whenever you want to, WITHOUT THE SLIGHTEST POSSIBILITY OF LOCAL INTERFERENCE, and with an entire absence of scratchy, raspy, so-called static noises?

How would you like to own a receiver whose SWEET, CLEAR, PURE, MELLOW TONES were full-rounded, distinct and NATURAL—never fuzzy, blurry or distorted?

You can have such a set in the KARAS EQUAMATIC. You can easily and quickly build this receiver yourself in a remarkably short time. You can possess THE FINEST RADIO RECEIVER in your neighborhood—one which will out-perform any other set regardless of price or size.

The KARAS EQUAMATIC is something NEW in radio—something BETTER—something more PRECISELY ENGINEERED—something INFINITELY MORE EFFICIENT—than ANY OTHER RECEIVER ever before offered to all who really know radio and who want THE BEST.

It has been rightly called the KARAS EQUAMATIC FIVE TUBE WONDER CIRCUIT. It's a set the like of which radio fans have never before seen.

Engineers who have examined it—who have studied its principle of operation—who have exhaustively tested its performance under every conceivable condition—have been amazed at the manner in which it has SOLVED THE BIGGEST PROBLEM OF RADIO, in a simple, easily understood, AUTOMATIC manner—and solely through its application of absolutely correct engineering principles. Practically every prominent radio magazine in the country is now featuring this circuit.

Radio fans who have built the KARAS EQUAMATIC FIVE TUBE WONDER SET have also discovered that here at last is something entirely new in their whole radio experience—a new kind of TONE QUALITY—a new demonstration of VOLUME AND SELECTIVITY—plus a new principle of AUTOMATIC TUNING that makes all other systems obsolete because lacking in the very essentials that a radio set should possess to be in keeping with present day knowledge and scientific development.

Superb Tone Quality—An Equamatic Sensation

It was no small feat to design a radio receiver in which ALL OF THE MANY PERPLEXING PROBLEMS OF TUNING have been FINALLY and DEFINITELY solved through the invention of KARAS AUTOMATICALLY TUNED INDUCTANCE COILS and other KARAS parts—but it was a STILL GREATER ACHIEVEMENT to produce in the KARAS EQUAMATIC a TONE QUALITY that is ENTIRELY NEW in the field of radio frequency. THE KARAS EQUAMATIC has a marvelous golden tone that has been both the goal and the despair of radio set manufacturers ever since the era of broadcasting began.

You will find in the KARAS EQUAMATIC a quality of richness, fullness and of true tonal beauty. Its tone is never harsh—it is never coarse—just PURE, CLEAR, SWEET MELODY at every wave length setting of the dials—for EVERY station.

The remarkable tone of the KARAS EQUAMATIC is due to peak efficiency at all wave lengths and to the scientifically correct mechanical and electrical characteristics of the circuit and to the use of KARAS HARMONIK AUDIO FREQUENCY AMPLIFYING TRANSFORMERS, which amplify all of the many vital harmonics and rich overtones that combine to form what we know as audible musical sounds.

Equamatic Selectivity is Unsurpassed

Naturally you want a receiver that has the UTMOST SELECTIVITY. In the KARAS EQUAMATIC you will find a complete realization of all you ever have hoped for in this direction. The entire problem of selectivity has been solved by the EQUAMATIC principle, combined with the use of KARAS ORTHOMETRIC

The selectivity of the circuit is accompanied by a remarkable volume, due to a big gain per each stage of radio frequency and to the employment of the powerful KARAS HARMONIK TRANSFORMERS for the two audio stages.

Easy to Build This Wonder Set

Notice in the illustration of the EQUAMATIC RECEIVER how clean cut and easily wired this set actually is. EVEN THOUGH YOU MAY NEVER BEFORE HAVE BUILT A RADIO SET, you can build this one—build it easily and quickly—get from it far better results than you can obtain from the finest and most expensive manufactured set you can buy.

A 16-page manual of simple wiring diagrams and complete instructions for assembling this receiver is packed with each set of KARAS EQUAMATIC INDUCTANCE COILS. In this manual are minutely detailed instructions for the placing of every wire—the making of every connection—the correct positioning of every part. With the aid of this manual and the necessary KARAS parts you can have this wonderful receiver in operation in a remarkably short time. To build the EQUAMATIC RECEIVER you will need the KARAS parts listed on the accompanying coupon, plus other standard parts easily obtainable anywhere.

Order Today From Your Dealer or Direct From Us

Thousands of dealers throughout the country can supply the necessary KARAS parts for building this powerful, rich-toned and selective receiver. If your local dealer is not able to fill your order, you can secure your KARAS parts direct from us by filling out and mailing the coupon. SEND NO MONEY. Just hand the postman the price of the parts plus a few cents postage.

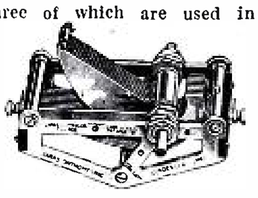
Order your parts from your dealer or from us TODAY. Build one of these sensationally better five tube EQUAMATIC RECEIVERS right away, so that you can enjoy all of the pure, rich, full-tone qualities—the remarkable selectivity—and the superb volume that it has to offer you in return for a few hours most pleasantly spent in building this totally satisfactory set.

KARAS ELECTRIC CO.,
1139 Association Bldg.,
CHICAGO, ILLINOIS

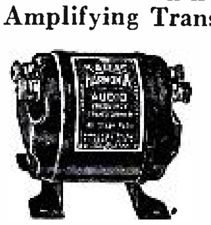
Essential Parts of the Karas Equamatic Sensation

Karas Equamatic Inductance Coils are packed three in a carton, and come to you with complete manual of simple diagrams and instructions, all necessary nuts, screws and binding posts, ready for mounting in your receiver. Price, set of three coils.............. $12.00

Karas Special 17-Plate Orthometric Condensers, three of which are used in the Equamatic Receiver, have special extended shafts upon which to mount the primary coils of the Inductances. Price, each..... $7.00



Karas Harmonik Audio Frequency Amplifying Transformers are essential to the tone quality success of the Equamatic Receiver. Two of these are used for the two stages of Audio frequency amplification. Price, each..... $7.00



Karas Equamatic Retard Coils, two of which are used, were designed especially for the Equamatic System. Price, each...$1.00

Karas Equamatic Sub-Panel Brackets. To insure the necessary exact positions of primary and secondary coils these brackets are essential. Price, set of three......70c

Karas Micrometric Dial. It has a 63 to 1 vernier and tunes to 1/1000 of an inch. Price..$3.50

KARAS ELECTRIC CO.,
1139 ASSOCIATION BLDG., CHICAGO, ILLINOIS

Please send me a set of 3 Equamatic Inductance Coils, $12.00; 3 special Orthometric Condensers with extended shafts, $7.00 each; 3 Micrometric Vernier Dials, $3.50 each; 2 Harmonik Audio Transformers, $7.00 each; 2 Equamatic Retard Coils, $1.00 each; and 3 sub-panel brackets, 70c, for which I will pay postman $60.20, plus postage, upon delivery. It is understood that I have the privilege of returning any of this apparatus for full refund any time within 30 days if it does not prove entirely satisfactory.

Name ....

Address ....

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

(If cash accompanies order we will ship postpaid)

Preparing Storage Battery Electrolyte

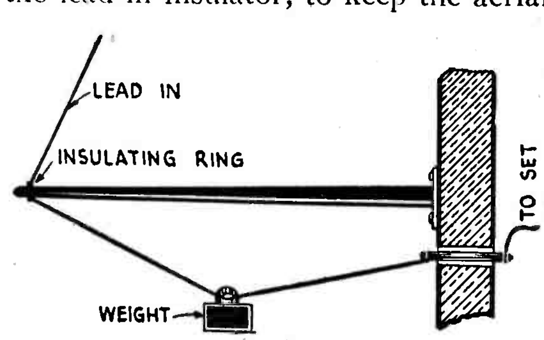
In case you are compelled to undertake the rather unpleasant task of preparing the electrolyte for your storage battery, there are several precautions

Pouring the acid into the water.

which should be taken. Most important of all, never pour water into acid. If you do this a large amount of heat will be generated, and the acid may spatter up and get into your eyes or on your clothing. The acid should be poured into the water slowly. The accompanying illustration shows the method to be used. A piece of wood should be held in the left hand, resting almost vertically in the water. The bottle containing the acid should be held in the right hand, and the acid should then be allowed to flow slowly down along the wood. The large volume of water will result in cooling the mixture below the point where spattering might occur. Note that an earthenware bowl is shown in the illustration. This is not affected by the acid and in addition aids in dissipating any heat which may be generated.

Clearing Aerial Lead-In from Wall

A wooden arm, two or three feet in length, may be fitted immediately above the lead-in insulator, to keep the aerial

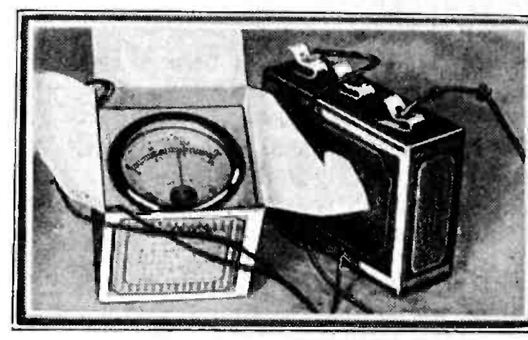


Keeping the lead-in clear of the house.

lead-in clear of the eaves and walls of the house. The end of the arm is fitted with a porcelain insulated hook through which the lead-in wire is passed. Before attaching the aerial wire to the lead-in insulator, a small weight such as a pipe coupling is slipped over the end. This will not only take up slack in the down lead, but will also serve to drain off water before it reaches the lead-in terminal. Incidentally, it may be mentioned that this terminal is to a certain extent sheltered by the projecting wood arm.

Test Batteries With Double Scale Meter

How do you know whether your detector tube is getting the correct voltage? Are you sure the power tube is obtaining the full 135 volts, simply because you have a stated number of "B" battery blocks? The voltage on



Using the voltmeter to test batteries.

the label does not operate your set. Use a double scale meter as shown and always know the condition of your batteries.

Look Out for Dust on Your Batteries

When "B" batteries have been allowed to stand, dust gathers quickly.

Keep dust away from the batteries.

Moisture in the atmosphere makes the dusty surface a fairly good conductor and this results in deterioration of the battery and noisy operation. When dusting off the radio set, it is a good plan to remember the batteries also, even though they may be located out of sight.

7 Tube Set
Single Dial Radio

30 DAYS FREE TRIAL

The Metrodyne

ONLY ONE DIAL TO TUNE

Retail Price

$75

Completely Assembled

Big Discounts to Agents and Dealers

Wonderful offer direct from the factory! The world's greatest radio.
A perfect working, single dial control, 7 tube receiver. And just to prove our claims, we will ship it to your home for **30 days' free trial.** Test it under all conditions. Test it for distance, volume and tonal quality — and if you are not convinced that it is the best single dial set you ever heard, return it to the factory. We don't want your money unless you are completely satisfied.

BIG PROFITS TO AGENTS AND DEALERS

Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lowest wholesale prices. Demonstrating set on 30 days' free trial. Greatest money-making opportunity. Send coupon below—or a letter—for our agent's proposition.

Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. Approved by America's leading radio engineers. Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet. Artistically gilded genuine Bakelite panel, nickeled piano hinge and cover support. All exposed metal parts are beautifully finished in 24-k gold.

Easiest set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, 1,000 to 3,000 miles on loud speaker! The Metrodyne Super-Seven is a beautiful and efficient receiver, and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer.** You to be the judge.

30 Days' FREE Trial

6 Tube Set $48.50 RETAIL PRICE *Completely Assembled*

Metrodyne Super-Six

Another triumph in radio. Here's the new 1927 model Metrodyne 6 tube long distance tuned radio frequency receiving set. Approved by leading radio engineers of America. Highest grade low loss parts, completely assembled in a beautiful walnut cabinet. Easy to operate. Dials easily logged. Tune in your favorite station instantly on same dial readings every time. No guessing.

Mr. Howard, of Chicago, said: "While five Chicago broadcasting stations were on the air I tuned in seventeen out-of-town stations, including New York and San Francisco, on my loud speaker horn, very loud and clear, as though they were all in Chicago."

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer,** which gives you the opportunity of trying before buying.

MAIL THIS COUPON or send a postal or letter. Get our proposition before buying a radio. Deal direct with manufacturer—Save Money.

Mail COUPON Below!

Let us send you proof of Metrodyne quality

F. L. Warnock, Greentown, Ind., writes: "I received the Metrodyne in good shape and am more than pleased with it. Got stations 2,000 miles away."

C. J. Walker, Mariposa, Calif., writes: "Received my Metrodyne Single Dial set O. K. I believe that these one-dial sets are going to be excellent sellers. I had no trouble in tuning in stations enough to satisfy anyone, so you will please send me another set."

Roy Bloch, San Francisco, Calif., writes: "Very often we travel from New York to the Hawaiian Islands quickly — from station to station — by means of the little tuning-knob which operates the electrically-lighted dial. The Metrodyne Single Dial Set is much easier to operate than any radio set I've ever seen."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal, letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal **30 days' free trial offer.**

METRO ELECTRIC COMPANY
2161-71 N. California Ave., Dept. 679
Chicago, Illinois

Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer**

*Name*________________

*Address*________________

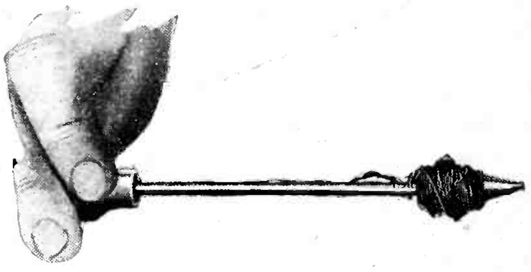
If you are interested in AGENT'S proposition, place an "X" in the square ☐

METRO ELECTRIC COMPANY

2161-71 N. California Ave. • Dept. 679 • Chicago, Illinois

Improving the Small Soldering Iron

The light soldering iron, while useful in working in cramped and "hard to get at" places, has the disadvantage

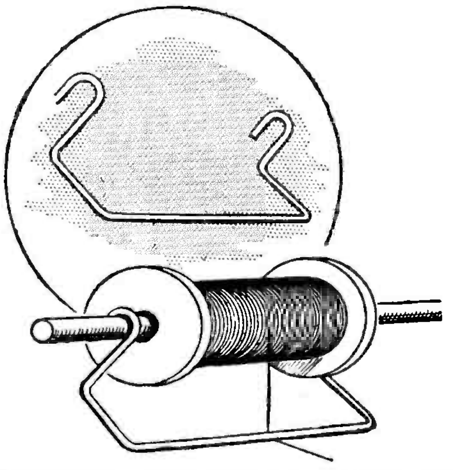


Copper wire improves heat-holding properties.

that it fails to hold the heat. Where it is necessary to use a light iron on a larger job, the constant reheating necessary is a source of considerable annoyance. The simple expedient of wrapping copper wire around the iron, as illustrated, greatly increases the heat-holding properties. After this winding with wire, the iron will give results, ordinarily obtained only with one twice its weight.

Winding Fine Wire of Phone Bobbins

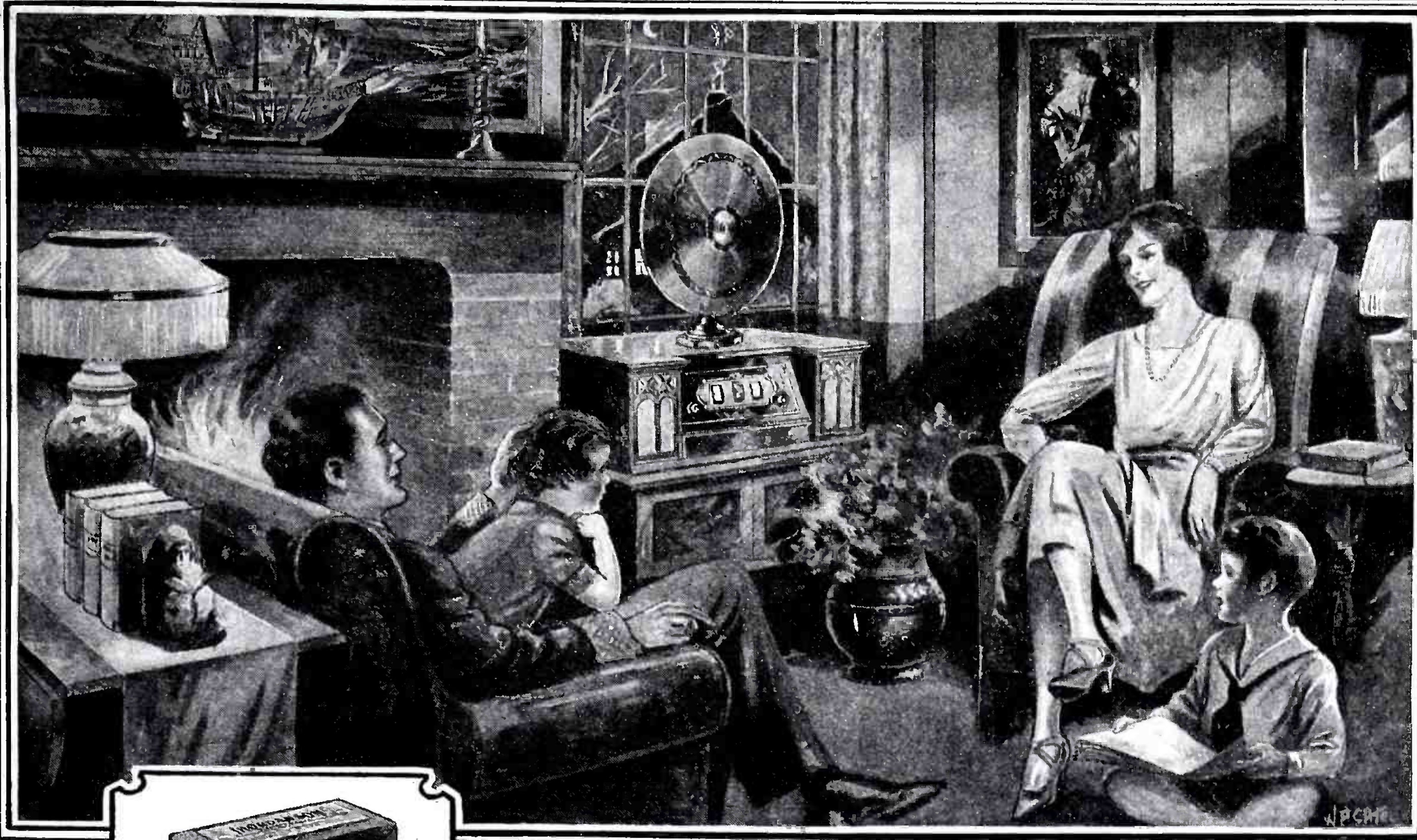
A piece of copper wire bent to the shape shown in the illustration and fitted to the spindle carrying the spool

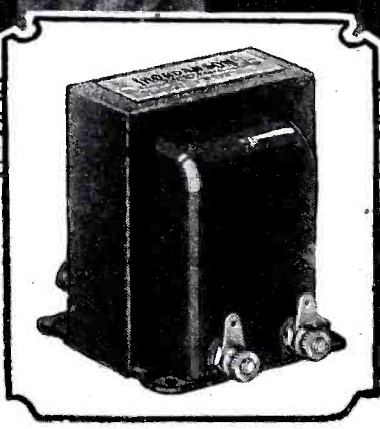


A home-made spindle holder for winding fine wire of the magnet bobbins in head-phones.

of wire will prove of great assistance when rewinding head-phone magnets with very fine magnet wire.

If wound in the ordinary way, kinks would probably be formed in the wire, if the winding were stopped for any reason, due to the fact that the heavy supply bobbin of wire continued to rotate after the phone bobbin has been stopped. With the wire in position however, the slack is automatically taken up and the speed of winding may be increased without risk of breakage.





THORDARSON
R-200
AMPLIFYING TRANSFORMER

Supreme in MUSICAL PERFORMANCE!

THE secret of good reception lies not in attempted correction of the deficiencies of *poor* broadcasting, but in faithfully reproducing the programs of the *better* stations.

Thordarson transformers employ neither a "rising" or a "falling" characteristic for corrective purposes. They are designed to give, as nearly as possible, equal attention to all notes.

The majority of leading quality receivers are equipped with Thordarson transformers—a substantial evidence of the musical supremacy of Thordarson amplification.

ZENITH
SPARTON
Neutrowound
Pfanstiehl
The Wells BEAR CAT
KENNEDY
MU-RAD
OZARKA
Valleytone
Radiodyne
Howard
Murdock
Deresnadyne
EAGLE
ARGUS
RADIO MASTER
AUDIOLA
HARTMAN
Buckingham
Mohawk
ALADDIN
Perlesz
Signola
Heraldyne
and many others

Standard on the Finest

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. 3445

How to Build the "Shielded Six"

(*Continued from page* 91)

The batteries should be connected to the terminals marked for them and a 4½ volt C battery used on the detector tubes, though it may be found that 3 volts will give somewhat better results. With the UX171 tube a 22½ volt C battery will be required for the audio amplifier in addition.

The tubes should be placed in their sockets and the coils in their respective sockets. The type 116A coil goes in the antenna or extreme left-hand socket, the 115A coils in the other sockets, while the UX171 tube goes in the socket between the 221 and 220 transformer at the left of the set.

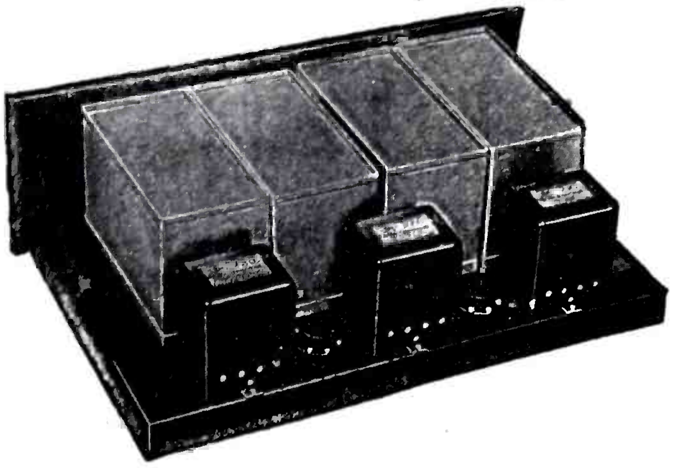
In operating the receiver the filaments of the tubes should be turned on by means of a switch at the right-hand end of the panel, the loud speaker cord tips inserted in the jacks marked for them, and an antenna, either indoor or outdoor and from 30 to 60 feet long, connected to the receiver, as well as a wire terminating in a ground clamp on a water, gas or steam pipe. With the antenna switch set in the "long" position the two dials should be varied slowly throughout their range, keeping them in approximately the same relation. Once a station has been found by this method—and it is an extremely simple one, the dial readings should be written down and saved for future reference.

If the selectivity of the receiver is insufficient for congested local conditions, this may be easily corrected by throwing the antenna switch to the short position. No filament rheostat is used on the tubes, a fixed resistor keeping them at a satisfactory operating voltage throughout the normal charge life of the storage battery. No provision is made for adjusting the volume of the receiver by cutting in or out tubes, but rather by the small volume control knob at the center of the panel.

In operating the receiver, if the volume control knob is turned all the way to the right, squeals will probably be heard and the receiver may possibly howl as a signal is being received. It will be found that with this knob set so in the middle of its range, no squealing will be experienced and the receiver may be operated, using only the two large dials. If, however, this control knob is set so that the receiver is just ready to squeal, maximum sensitivity for distant stations will be obtained. This is practically always unnecessary where reception from stations with a one hundred mile radius is required under average conditions.

SM

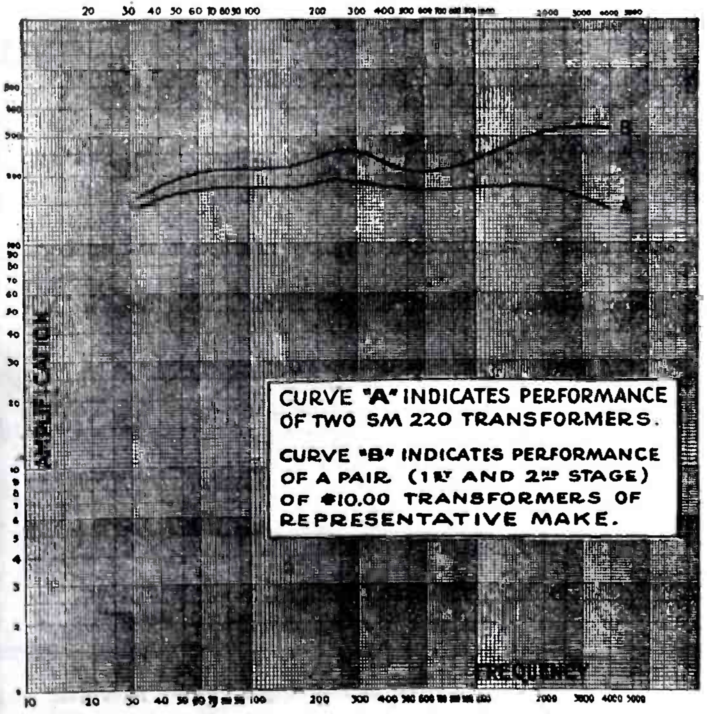
630 SILVER SHIELDED SIX



The S-M 630 Shielded Six Kit—including matched and measured parts to build this remarkable receiver—price $95.00.

The 633 Shielded Six Essential Kit contains four condensers, four radio frequency transformers, four coil sockets, four stage shields and the link motion—all factory matched—price $45.00.

Clear and complete instructions, prepared by S-M engineers, go with each kit—or will be mailed separately for 50c.



In the chart above curve "A" indicates the performance of two S-M 220 Audio Transformers. Curve "B" indicates the performance of a pair of representative transformers — note the greater distortion as evidenced by the irregular curve.

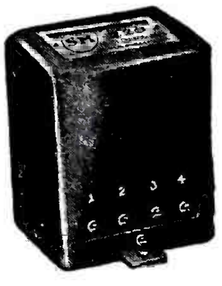
Endorsed by *Radio Broadcast* and *Radio Review*. It also bears the stamp of approval of many other leading technical publications and newspapers.

The Shielded Six is one of the highest types of broadcast receivers. It embodies complete shielding of all radio frequency and detector circuits. The quality of reproduction is *real*—true to the ear.

Behind the Shielded Six is competent engineering. It is sensitive. Day in and day out it will get distance—on the speaker. It is selective. Local stations in the most crowded area separate completely—yet there are but two dials to tune. These features—its all metal chassis and panel, its ease of assembly and many others, put it in the small class of ultra-fine factory-built sets, priced at several times the Six's cost.

220 & 221 AUDIO TRANSFORMERS

The S-M 220 is the outstanding Audio Transformer that is in demand everywhere and whose popularity has taxed in the severest way the manufacturing facilities of Silver-Marshall, Incorporated. It is the audio amplifying device that has created a new standard by which the merits of audio transformers are measured. It is the first transformer with the rising low note characteristic that means real quality—not theoretically—but to the human ear. It is a power job—yet this finest of audio amplifying devices is sold with a guarantee for but $6.00.



The S-M 221 is an Output Transformer that improves low note reproduction in any set. It is for use between the last audio tube and the loud speaker. It eliminates blasting and will increase speaker capacity for handling strong signals without distortion—price $6.00.

Prices 10% Higher West of the Rockies

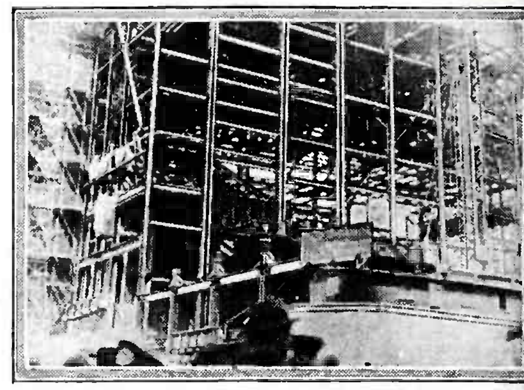
SILVER-MARSHALL, Inc.
866 W. Jackson Blvd.
CHICAGO U. S. A.

"RADIO ENCYCLOPEDIA" NOW COMPLETE
Complete bound volume now in Print of S. Gernsback's Radio Encyclopedia. See Page 192

Steel Construction Means Interference

Few people realize the amount of steel which goes into the modern, tall building. Once the stone and brick-work have been completed, the steel frame is hidden from sight, but nevertheless it is there to dampen and obstruct the elusive ether waves.

When the radio set is to be located in a forest of steel buildings, extreme sensitivity is a primary requirement, if distance is to be received. In an effort to make radio sets more sensitive to

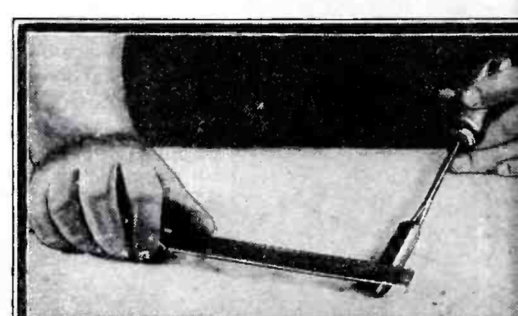


Steel work of modern buildings interferes with radio reception. This photo illustrates how the modern building appears before it receives its brick dress.

weak signals, manufacturers are building sets with three and even four stages of radio frequency amplification. Such construction calls for careful design and thorough shielding.

Rasp Used to Clean Soldering Iron

Very often the soldering iron becomes coated with a crust of oxide or other foreign substances which are

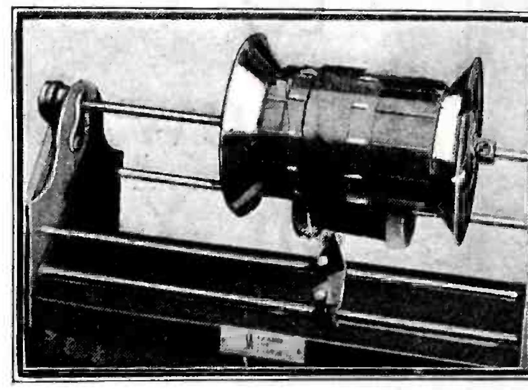


Method of cleaning soldering iron with rasp.

extremely hard to remove. The use of a coarse file or rasp for removing this coating has been found to give best results. A fine file ordinarily used fills up and becomes ineffective, whereas the coarse file or rasp works rapidly and effectively. The photograph shows the method employed.

Winding Low-Loss R.F. Coils

A commercial wire winder illustrated can be used for winding many of the low-loss type, radio frequency transformers. This winder is practically

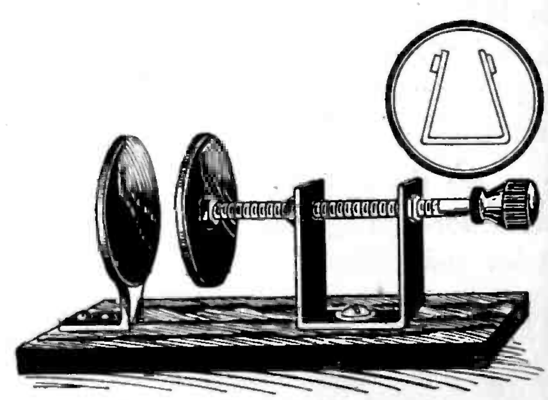


A machine for winding low-loss coils.

automatic in its operation and gives excellent results. The method of spacing the turns is clearly shown. A worm gear carries the spacer along horizontally at the same time that the coil is revolved. In the coil being wound, match sticks are shown used as spacers between the primary and the secondary.

An Easily Made Neutralizing Condenser

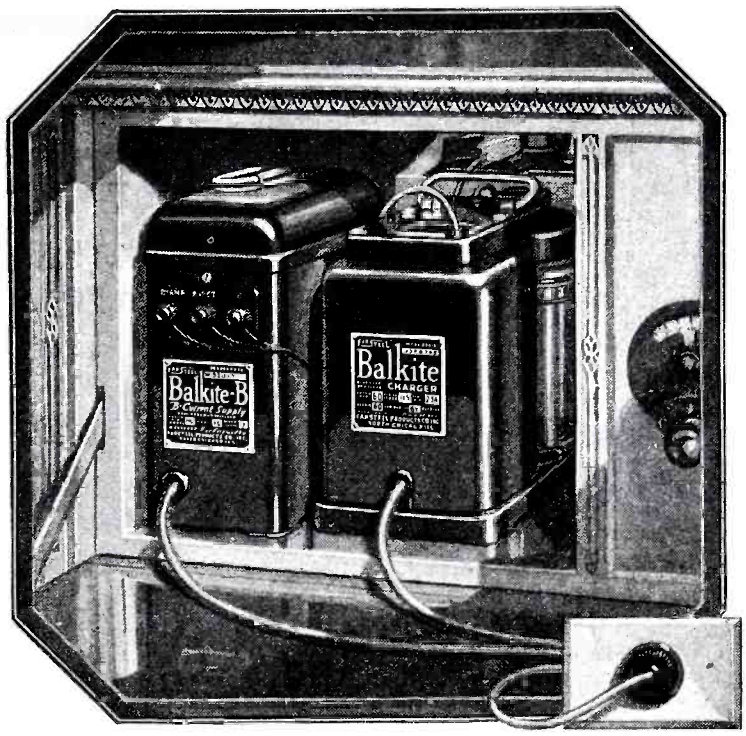
In a neutrodyne circuit which is properly designed and constructed, there should be no back-lash in the movement of a neutralizing condenser,



The home-made neutralizing condenser.

since the adjustment is always critical.

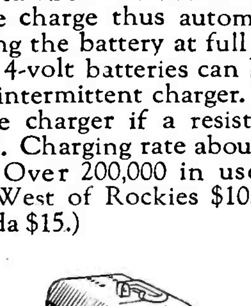
Several methods of taking up wear in the adjusting screw have been devised, such as nuts with saw cuts, etc. A far simpler method is illustrated in the diagram. The adjusting screw is supported by a U-shaped bracket of spring brass, to each side of which is soldered a brass nut. Before assembly, the sides of the bracket are bent in towards each other, so that when the screwed rod is inserted they are forced apart and exert pressure which precludes the development of any form of backlash.



The new Balkite "B" *at* $27.50 *and the new* Balkite Charger *convert your radio set into a light socket receiver*

Balkite Trickle Charger

MODEL K. With 6-volt "A" batteries can be left on continuous or trickle charge thus automatically keeping the battery at full power. With 4-volt batteries can be used as an intermittent charger. Or as a trickle charger if a resistance is added. Charging rate about .5 ampere. Over 200,000 in use. Price $10. West of Rockies $10.50. (In Canada $15.)



Balkite Combination

supplies automatic radio power

When connected to your "A" battery supplies automatic power to both "A" and "B" circuits. Controlled by the filament switch on your set. Entirely automatic in operation. Can be put either near the set or in a remote location. Will serve any set now using either 4 or 6-volt "A" batteries and requiring not more than 30 milliamperes at 135 volts of "B" current—practically all sets of up to 8 tubes. Price $59.50. (In Canada $83.)

All Balkite Radio Power Units operate from 110-120 volt AC current with models for both 60 and 50 cycles.

To enjoy the convenience of a light socket set you need not discard your present receiver. Add the new Balkite "B" and the new Balkite Charger instead.

Balkite "B"—the unique "B" power supply—eliminates "B" batteries entirely and supplies "B" current from the light socket. The new Balkite "B"-W at $27.50* serves any set of 5 tubes or less where 67 to 90 volts are required. Balkite "B"-X at $42* serves sets of up to 135 volts and 8 tubes. Balkite "B"-Y at $69* serves any standard set.

The new Balkite Charger at $19.50,* with both high and low charging rates, is the most convenient of all methods of charging your "A" battery. At the low rate it can be left on continuous or trickle charge. Thus it automatically keeps your battery at full power. With heavy-duty sets, large sets, or sets in constant use where excessive "A" current is required, a few hours' operation at the high rate quickly brings the battery to full charge. This new charger gives you in one unit the advantages of both trickle and high-rate charging.

Both the Balkite Charger and Balkite "B" are entirely noiseless in operation. Both are permanent pieces of equipment, with nothing to wear out or replace. Other than a slight consumption of household current, their first cost is the last. Both are built to conform with the standards of the Underwriters' Laboratories.

Over 600,000 radio sets—one of every ten—are already Balkite equipped. Add these two Balkite Units to your receiver now. Then you too will know the convenience of Balkite Light Socket Operation. Then you too will know the convenience of owning a radio set always ready to operate at peak power. Ask your dealer.

FANSTEEL PRODUCTS COMPANY, Inc., North Chicago, Ill.

*Balkite Charger $20 West of Rockies. In Canada: Charger $27.50; "B"-W $39, "B"-X $59.50; "B"-Y $96.

Listen to the Balkite Radio Symphony Concerts

with Walter Damrosch and the New York Symphony, Saturday nights, 9 P. M., Eastern Standard Time, beginning October 23. Stations: WEAF, WEEI, WGR, WFI, WCAE, WSAI, WTAM, WWJ, WGN, WCCO, KSD, WDAF.

FANSTEEL

Balkite

Radio Power Units

MEMBER R.M.A.

Rubber Tubing Prevents Short Circuits

In many radio sets, the battery connections are grouped at a terminal strip so that connections can be made readily

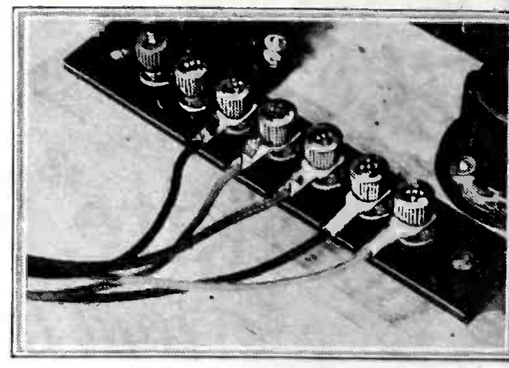


Fig. 1.—Connections made at binding post strip.

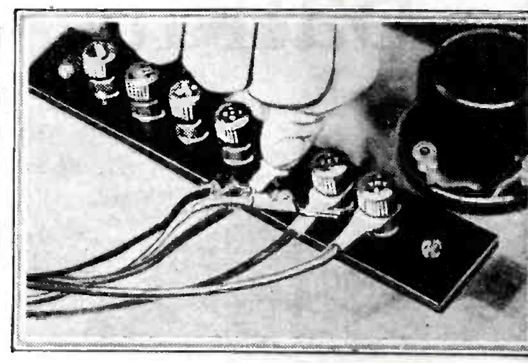


Fig. 2.—How short-circuit may occur through one wire twisting upon another.

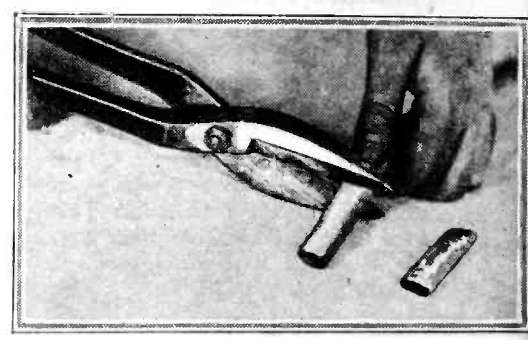


Fig. 3.—Cutting rubber tubing into short lengths.

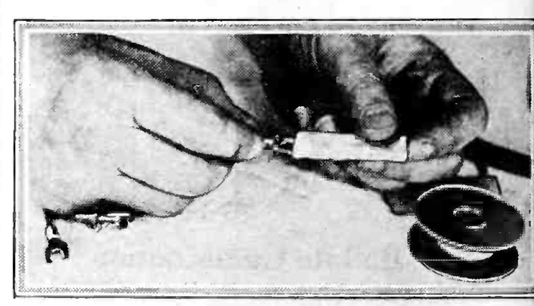


Fig. 4.—Slipping tubing over end of wire before applying tape.

to binding posts, as illustrated in Fig. 1.

Very often, when the set is moved and the connections have to be taken off the binding posts, the wires become crossed, resulting in burnt out tubes, open circuited coils, etc. The way in which this is apt to happen is shown in Fig. 2.

A method of preventing this trouble is shown in the succeeding illustrations.

Rubber tubing should be used, cut into short lengths, as shown in Fig. 3. This is slipped over the ends of the

wires and fastened in place by adhesive tape.

The method of doing this is clearly illustrated in Figs. 4, 5 and 6. In Fig. 4 is shown the method of slipping tubing over the end of the wire before applying the tape. When the wires are again fastened to the binding posts,

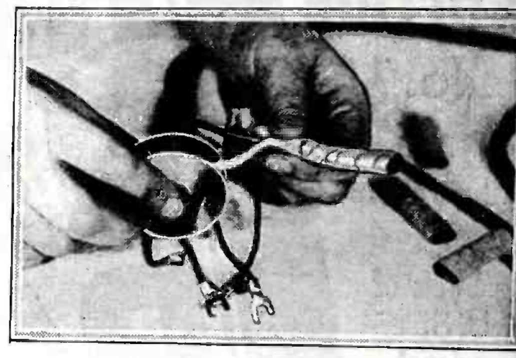


Fig. 5.—Apply the adhesive tape at one end.

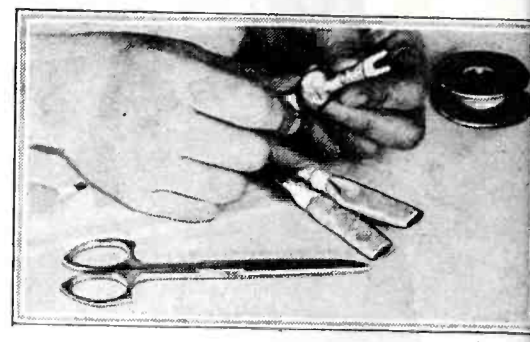


Fig. 6.—Finishing the job. When tubing is pulled back, terminal is exposed.

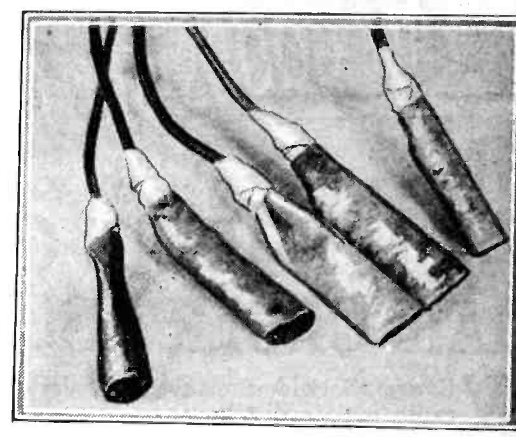


Fig. 7.—The completed job is proof against short circuits.

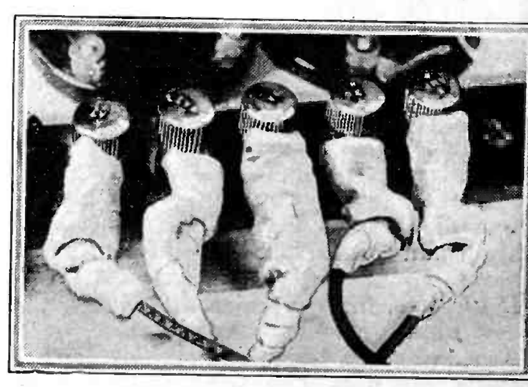


Fig. 8.—The rubber coverings are under compression.

the rubber coverings are under compression. (See Fig. 8.) As soon as a wire is disconnected from a binding post, the rubber tubing is released from its tension and slips over the uninsulated portion, effectually preventing a short-circuit. In Fig. 7, the wires are shown, with tubing over the ends.


"His Favorite Magazine"

A Lamp-Socket-Operated Browning-Drake Set

(*Continued from page* 85)

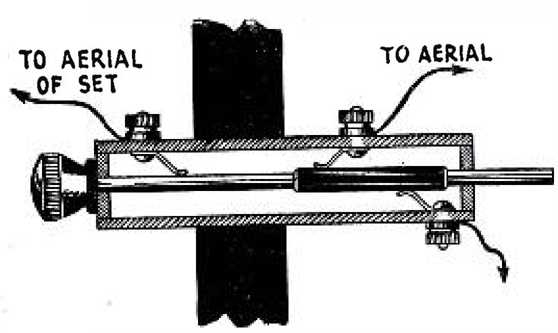
attention unless some change is made in the circuit. As a 199-type radio-frequency amplifier tube is employed, the process of neutralization is quite simple and should not cause any difficulty.

Whenever a station is tuned in, its call letters may be recorded directly on the dials to facilitate tuning to it again at some future time. When it has been tuned in satisfactorily, the volume may be regulated by a variation of the volume and regeneration controls. In tuning for distant stations the use of regeneration results in increased sensitivity and selectivity.

For the sake of better acoustical results and ease in tuning, the loudspeaker should be placed in a different part of the room from the set itself. If desired, extension cords may be run to several different parts of the house and the speaker placed wherever it is most convenient at different times.

A Lead-in Ground Switch

The diagram shows a convenient weatherproof ground switch, incorporated in a lead-in tube. The tube should be of bakelite or hard rubber

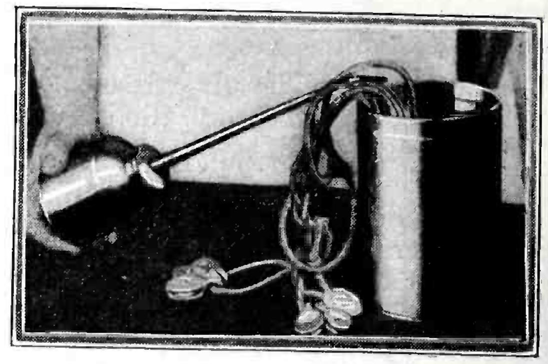


Ground switch in a lead-in tube.

and of as large a diameter as possible to facilitate the insertion of the terminals shown. Each end of the tube is plugged with a disc drilled through the center to act as a bearing for the bakelite rod actuating the switch. This rod is drawn backwards and forwards by a knob fitted inside the house. Contact between the aerial and the aerial terminal of the set is established through a piece of metal tubing fitted to the bakelite rod. This also serves to connect the aerial to ground when the rod is pushed in.

Weather - Proofing Ropes Used Outdoors

Ropes used in outdoor work for pulling up aerial wires, etc., will last a great deal longer if they are treated

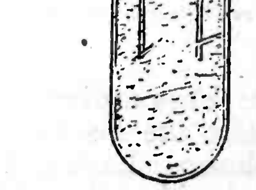


Weather-proofing ropes for outdoor use.

with engine oil as shown in the photograph. The ropes should be well soaked in oil and thereafter will have greatly increased weather resisting properties.

A Chemical Polarity Indicator

A permanent tester as shown in the illustration may be made with a glass test tube fitted with a three-hole rubber bung which can be obtained from dealers in chemical apparatus. Terminals to which short lengths of copper wire have been attached are then forced into the outside pair of holes in the bung, leaving the center hole as a vent for the gas. The tube is then filled to a suit-



Permanent polarity tester.

able height with slightly acidulated water; only a few drops of acid are necessary.

The use of a glass tube permits the electrodes to be closely observed. Gas will be formed more rapidly at the negative pole. Special test tubes, known to chemists as "boiling tubes" are recommended for strength.

Remote Tone Control for Loud Speaker

A high resistance rheostat may be used as a means of controlling the tone of a loud speaker and the entire outfit can be operated from a distance as shown in the accompanying photographs. The tone control unit consists of a Clarostat, a Carter "Hi-Ohm," Centralab "Radiohm," Bradleyohm, or a similar rheostat mounted in a small wooden cabinet as shown in Fig. 1.

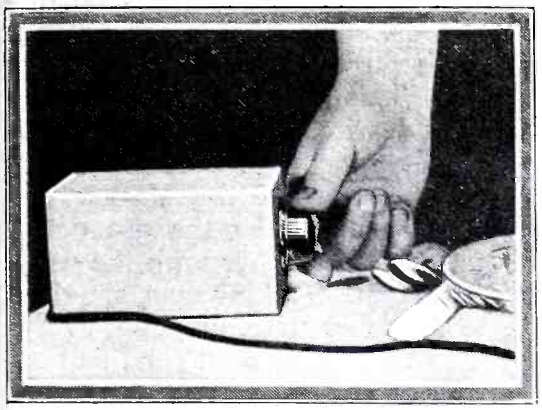


Fig. 1.—The control unit is shown mounted in box.

The control unit is shown dismounted in Fig. 2, while Fig. 3 shows how the loud speaker volume can be increased

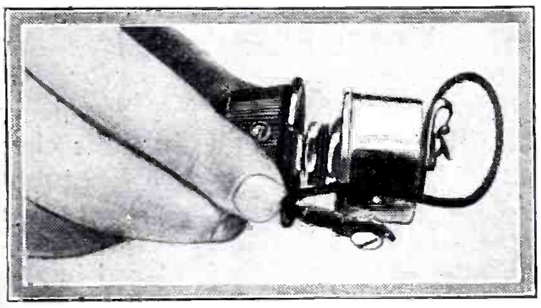


Fig. 2.—A variable resistance control unit before being mounted in a cabinet.

or decreased by the apparatus which can be located at any desired distance from the radio set. The effects ob-

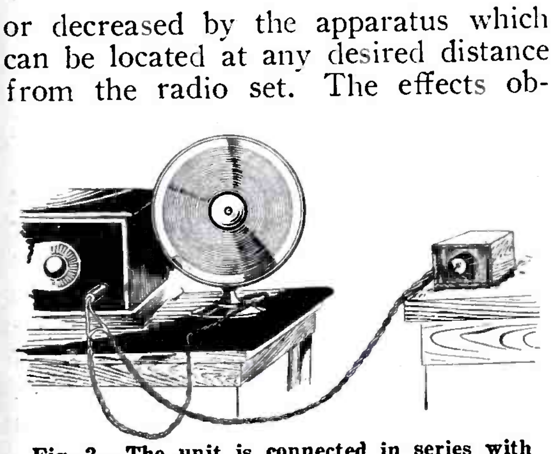


Fig. 3.—The unit is connected in series with the loud speaker from the output of set.

tainable are striking, especially when the program is a musical one as the volume of tone obtainable may be varied from a whisper to the maximum volume which the loud speaker and set are capable of giving.

While the illustration shows the control unit close to the set this is not necessary. A long connection may be used and the set may be located in one room and the speaker and control unit may be at any distant point in the house.

The "Varion" A. C. Receiver

(Continued from page 74)

type giving the maximum amplification consistent with good quality.

Placing the Varion Receiver in Operation

The following accessories will be required for the final operation of the Varion Receiver:

1. An antenna and ground system. The antenna, for best results on distant signals, should be of the outdoor type with an overall length of about 125 feet. This includes the lead-in and the ground wire. If it is more convenient, or necessary, perfectly satisfactory operation of the Varion Receiver may be had by the use of an indoor antenna together with the usual ground system. Talking tape, standard No. 18 insulated wire, or plain, everyday bell wire can be used for this purpose.

2. Five 199 tubes of the UX type are needed and a power tube of either 112 or 171 type. The latter is preferable, as it will handle signals of considerably greater intensity than will the 112. If the 112 tube is used, it will be necessary to reduce the plate voltage to 135. The 171 takes as high as 189 volts with perfect safety.

To operate The Varion Receiver, place the Raytheon Tube in the socket in the eliminator and the five 199 tubes and the 112 or 171 in their respective sockets in the set. Be sure the amplifier tube (112 or 171) is placed in the socket at the extreme right as you face the receiver.

Now turn the knob marked "filament control" in the diagram counter-clockwise (to the left), thereby turning on the current. Neither the speaker nor the antenna and ground should have been connected as yet.

The tubes should light up, and the Weston Milliammeter should register 45 or 50 milliamperes. If the 199 tubes and the power tube do not light, make sure first that the house current is actually on and then that all connections between the set and eliminator are O.K. If the power tube lights, and the 199s apparently do not, one of the 199s is burned out or defective. None of the tubes will light if the first tube is defective, or so little that they cannot be seen, normally, if any of the other tube filaments are defective.

When all the tubes are lit and obviously O.K., turn off the power from the mains and connect up antenna, ground and loud speaker. The current may then be turned on again and the filaments of the 199s regulated by turning the Filament Control to the point where 60 milliamperes is registered in the Weston meter.

Both of the main tuning controls work in almost perfect resonance over the entire frequency range. The volume control may be set to the extreme right to facilitate tuning in the first station.

When a station has been tuned in, the filament control should be set so that the meter reads as far below 60 milliamperes as possible without materially sacrificing volume or quality. A reading of 55 milliamperes usually gives excellent results.

The volume control in going from maximum to minimum will have but small effect on the filament current supply. As the variation in current with an ordinary 199 will rarely reach more than 1½ milliamperes, it can be disregarded.

The remaining instructions are few. Be sure to turn off the current supply always when adjusting or repairing the eliminator.

Be sure that your ground is actually a ground, as a small annoying hum will be the result of an imperfect ground connection. This hum is not due to the current supply from the output of the eliminator itself, but the proximity of the actual A.C. lines themselves.

The eliminator may be placed as close to, or as far from the receiver as desired. The sketches show methods of remote control which allow the placement of the eliminator in the basement, attic or other points.

The Henry-Lyford Receiver

(*Continued from page* 95)

the lower left-hand connection, and continue it on to the stationary plates of the detector condenser D.

Now run a wire through the hole in the sub-panel near the P post of audio frequency transformer No. 1, and connect to it. The other end of the wire goes to the lower right-hand terminal of tube socket No. 3, which is the P terminal of this socket. In the same manner, connect a wire to the G post of this transformer, and connect it to the lower left-hand terminal of tube socket No. 4. This is the G post, and should also be connected to the No. 1 terminal of the modulator, or volume control, as shown.

The F post of this audio frequency transformer No. 1 is now connected to the No. 2 terminal of the modulator. Now connect another wire to this wire, and also to the by-pass condenser No. 3.

The G post of audio frequency transformer No. 2 should now be connected to the lower left-hand terminal of tube socket No. 5. This is the G terminal of this socket. From the F post of this second audio transformer a wire should run to the right-hand terminal of by-pass condenser No. 5.

Now place the .002 permanent condenser between tube sockets No. 3 and No. 4, as shown in the diagram. Connect the lower right-hand terminal of tube socket No. 3 to one end of it, and the upper left-hand terminal of tube socket No. 4 to the other. These connections will be found enough to hold this condenser in place.

On the No. 1 contact of the MIN. jack, which is the contact nearest the frame, solder a wire, and connect the other end of this wire to coil jack No. 10. Now connect the No. 3, or top contact, of this jack to lower right-hand terminal of tube socket No. 4, which is the P terminal. Connect a wire to the P post of the second stage audio transformer, inserting the wire through the hole in the sub-panel directly over this terminal. The other end of this wire is connected to the No. 2 or middle terminal of the MIN. jack.

The No. 1 terminal on the MAX. jack, which is the terminal nearest the frame of the jack, is connected to the left-hand terminal of by-pass condenser No. 4. The No. 2 terminal of this jack is now connected to the lower right-hand terminal of tube socket No. 5, as shown in the illustrations. The terminal farthest away from the metal frame of the MAX. jack, which is the No. 4 terminal, is connected to the upper right-hand terminal of tube socket No. 5. This is the positive filament connection.

Run a wire through the hole in the sub-panel over the right-hand terminal of by-pass condenser No. 1, solder it to this terminal, and also to a soldering lug under the nut on the B post of the radio frequency transformer. Run this wire to the B post of the second audio transformer. Now run a wire from this wire to coil jack No. 10.

Connect a wire to the upper right-hand terminal of tube socket No. 4 and to the left-hand terminal of the filament switch. Now solder the lugs under the ANT. and GND. binding posts to the coil jacks which they overlap. The wiring of the receiver is now completed with the exception of the battery cable, which is the last thing to do.

We will start by connecting the solid yellow wire to the right-hand terminal of the filament switch. To one of the left-hand terminals of the Amperites, connect the yellow and black wire. Connect the maroon and white wire to the B post of the first audio transformer by pushing it through the hole on the sub-panel adjacent. The solid red wire is connected to the left-hand terminal of by-pass condenser No. 4. The solid green wire goes to coil jack No. 7, and the solid maroon to coil jack of by-pass condenser No. 3. The green No. 10. The green and maroon wire is onnected to the right-hand terminal ınd red wire, which is the last wire to ɔe connected, goes to the right-hand erminal of by-pass condenser No. 5.

We are now ready to mount the lials and knobs. The adjustment of the large condenser dials should be such that when the dial reads 100, the condenser plates are fully interleaved. The knob on the balancing condenser s set so that when the arrow points lirectly to the right, the condenser is it its maximum capacity. Turn the shaft of the volume control as far as possible to the left, and then put the knob on with the arrow pointing to the left. The next thing to do is to est out the finished receiver, and make sure that all of the connections are correct.

Testing the Receiver

Before any batteries are connected to the receiver, the wiring should be checked with the picture wiring diagram, to make sure that there are no mistakes. Now the yellow wire should be connected to the positive terminal of a storage battery, and the black and yellow wire to the negative. By inserting a tube in each socket, taking care to have the pin of the tube pointing in the same direction as the arrow on the socket, we can check up on the filament wiring of the first four sockets. The last tube socket may be tested in the same manner, first inserting a plug in the MAX. jack, to complete the filament circuit of this tube. If the filament switch is on, the tube should light in each socket. The B and C circuits may now be connected and tested.

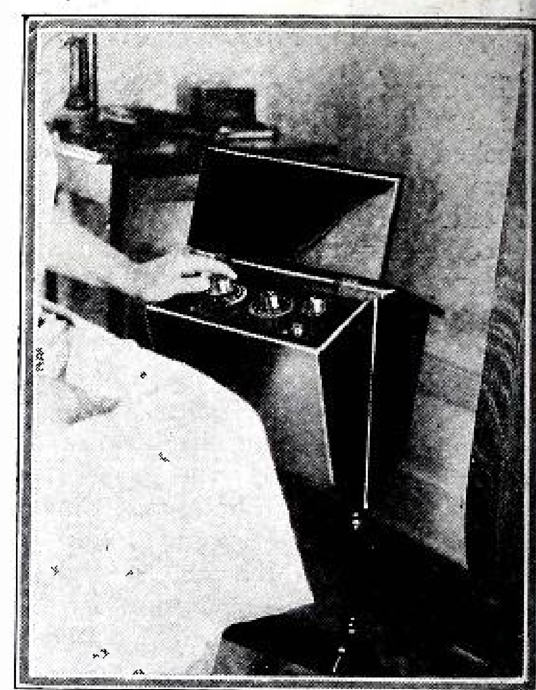
Connect the remaining wires in the cable as shown in the diagram, making sure that the B— is connected to the A+, and that the C+ is connected to the A—. Now insert a tube in each of the five sockets separately, and of course, it should light up as before. By testing with one tube, we can test the wiring in this manner without endangering all five tubes, in case there happens to be any mistake in wiring.

After this test, all tubes should be inserted in the receiver, the power tube in the fifth socket. The antenna and ground are now connected, and the plug-in coils inserted. With a loud speaker or phones in the last jack, we are ready to try out the receiver on actual signals.

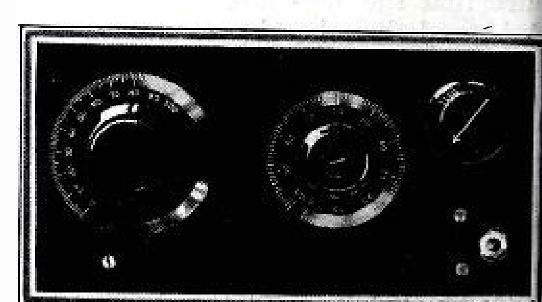
Turn the volume control all the way on—to the right—to start, and set the balance condenser so the arrow points at the letter E in the word balance. Rotate the tuning dials slowly, approximately together, until a signal is heard. When this happens, it may be necessary to adjust the balance control very slightly for clarity. The volume control is now regulated until the signal has the desired intensity. To obtain the greatest volume and distance, the antenna rotor coil should be set parallel to the fixed coil. If this coil is rotated until it is nearly at right angles to the fixed coils, the effect will be to give the receiver much greater selectivity. Once this coil is set for the location, it does not require further adjustment.

Installing Small Set in Sewing Cabinet

Very often we find some particular people who object to the appearance of a radio set in the living room of



This shows the set installed in a sewing cabinet. The set is placed in one side and the batteries in the other. When the covers are down the set is entirely hidden from view.



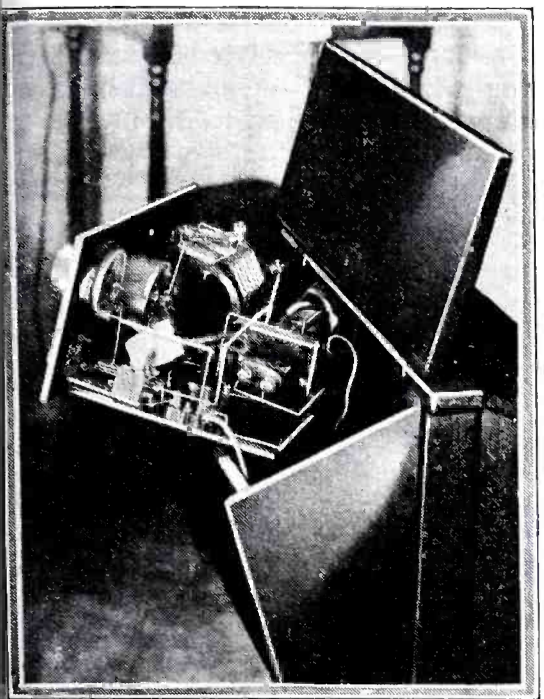
This illustrates the panel arrangement of a three-circuit set. The dial at the left controls the tuner, that in the center moves the variable condenser, while the small knob regulates the rheostat. The jack is shown at the lower right-hand corner.

their home. The sight of batteries with the usual dials and knobs in view they claim are displeasing to the "artistic taste."

Those who prefer to have a set hidden, the accompanying photographs show how a small radio set may be removed from its cabinet, and with both A & B batteries installed in a Priscilla sewing cabinet. This arrangement is ideal for portable use about the home.

nd can be placed in the drawing room r along side of the bed of a conva-scent who may prefer to tune-in any esired station at will.

The set illustrated in the photo-raphs is merely a conventional 3 cir-uit tuner arranged in compact form,



A rear view of the panel is shown in this illustration. The circuit used is that of the conventional three-circuit tuner.

mploying 199 type tubes. The set is nstalled in one side of the cabinet while the dry cell "A" batteries and "B" batteries are placed in the other.

This set will do very efficient work on local stations. As a matter of fact he compact form, at least in the pres-nt instance, seems to have added to ather than detracted from, its good

The four dry cells constitute the necessary "A" battery. These fit into the top of the battery compartment, while the "B" batteries fill the lower part of this space.

performance. The owner of this set has found it to be so convenient for use around the home, that she moves it from room to room, taking it wherever the household duties require her to be.

Remote Control for the Radio Set

This remote control relay consists essentially of an electric bell movement from which the hammer knob has been cut and the wire bent to dip into a cup containing mercury.

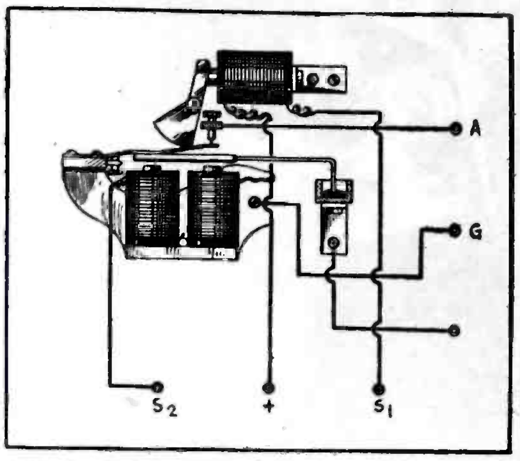


Fig. 1. A diagrammatical view of the remote control relay.

The spring contact on the armature has a small bend made in it about half an inch from the free end. Above the spring is pivoted a sector made of 1/8 inch sheet iron, held by the spring in the position shown. At the top of the sector is a projection which, when in the off position, rests against the pole of another bell coil fixed horizontally.

When a current is passed through the two lower coils, the armature is attracted and the contact is made in the mercury cup, also the sector moves around, under gravity and maintains the armature in this position after the current is switched off. During this process the projection on the sector, has of course, moved away from the top magnet.

To release, a current is passed through the top coil thus drawing the sector back into its original position and allowing the armature to rise and break contact in the mercury cup.

This form of control only necessitates the use of two extra leads, besides the 'phone leads, from the set and any number of control points may be employed.

Fig. 2 shows the arrangement of connections to an ordinary set. The armature is connected to ground and the negative side of the filaments, and the mercury cup to the negative pole of the storage battery. The ordinary contact screw of the bell, if left in position, may be connected to the aerial so that when the switch is in the "off" position it becomes connected to ground. The two electromagnet windings are joined in series, the center points and the two ends being brought out to terminals. The center point is connected in series with the control attery, which may be of the flash lamp ype, to one of the phone leads which erves as the "return." Wires are aken from the two ends of the coils o the fixed contacts of the control eys, the moving contacts of which are

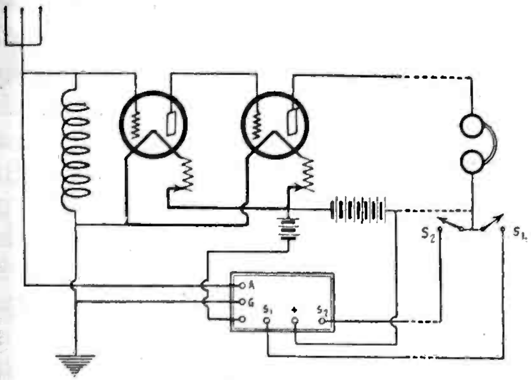


Fig. 2. Diagram showing relay connected to a radio set.

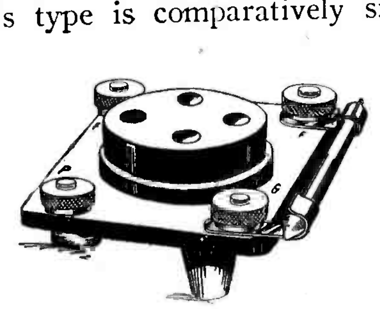
onnected to the 'phone lead. The two ush button switches may be mounted n a block together with the phone erminals and fixed in any convenient osition.

Since the "B" battery is connected o the windings through the 'phone ead, when the connections described re employed, the insulation of the coils to ground should be tested before use.

This apparatus has been used, for a considerable time and has been found to give satisfaction, the only fault being a tendency of the mercury to splash from the cup. This may be remedied by using a deeper and more enclosed cup, or to some extent, by fixing a shield on the moving contact arm.

Grid Leak Mounting on Tube Socket

A number of spring sockets are constructed with the binding post terminals at each corner for the grid plate and filament connections. The mounting of the grid leak in a set using sockets of this type is comparatively simple.



A simple grid leak mounting.

It is only necessary to place spring clips underneath the grid and positive filament terminals which will be found to have approximately the correct spacing for grid leaks of standard lengths. The method of doing this is shown in the above illustration which shows the grid leak mounted in place on the socket.

Cross Aerial Receives From Any Direction

The aerial shown in the accompanying illustration is claimed to be the last word in non-directional, compact apparatus for intercepting radio waves. It is made of large diameter hard-drawn copper wire and its peculiar shape enables it to receive the electromagnetic energy equally well from any direction. It is made in two sizes, 24 inches and 30 inches. The smaller size is used in locations where the broadcasting station is nearby or where the radio set is not very selective. The larger size is used where the receiving set is located at a considerable distance from the broadcasting stations or where a selective radio receiving set is being used.

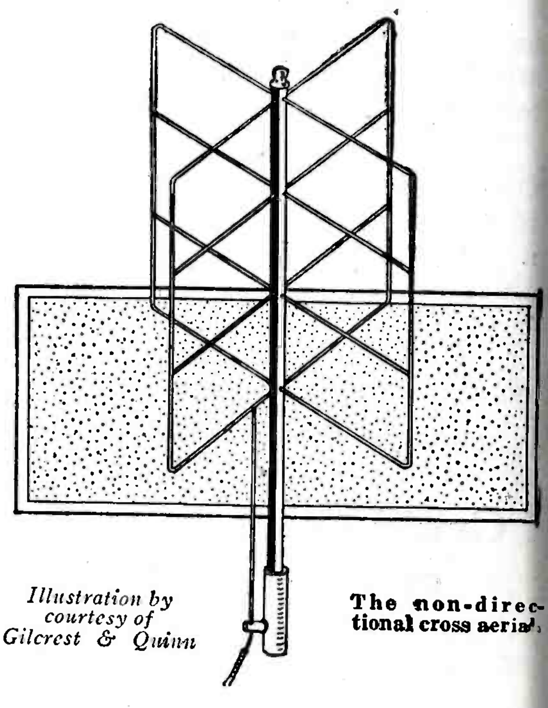


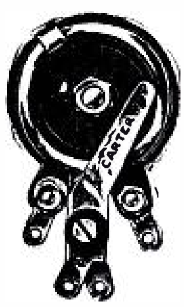
Illustration by courtesy of Gilcrest & Quinn

The non-directional cross aerial.

A single standard, 2′ x 3′ x 14′ long, held in place by three galvanized No. 14 wires, is used with the installation of the Cross Aerial, thus bringing the entire height of standard and aerial to 18 feet above the roof top. The lead-in wire passes through a ferrule on the lower wire and is soldered on the opposite side of the round standard of the aerial. The lead-in then passes down the large standard through three split insulators spaced two and one-half feet apart. From the bottom insulator, the lead-in wire is drawn tightly to another insulator at the end of a piece of board beyond the edge of the roof and then to another insulator at the window through which it passes to the radio set. This lead-in wire measures from 35 to 45 feet. Due to the extreme simplicity of this aerial, any number can be installed on a building without interference between them.

Adapting New Parts to Old Sets

THE problem of keeping a radio receiver up to date is indeed a perplexing one. Many enthusiasts solve this problem by periodically building a new receiver and selling the old one to a friend who probably never has had a set before. This friend realizes that the set is somewhat out of date, but is satisfied, for the time being, with this equipment, in view of the fact that it cost him a small percentage of the original purchase price. Of course this friend begins to study the latest set designs and soon becomes an ardent fan, desiring a set that is up to date, so



A high resistance rheostat.

the old receiver is again discarded, unless some enterprising fan attempts to bring it up to date.

After carefully studying all of the circuits that have been popular during the last few years, it will be evident that they may be divided into four different classes (disregarding audio amplification) such as superheterodyne, two stage tuned radio frequency

A tip jack which may be used for connecting loud speaker into the circuit.

amplification, one stage tuned radio frequency amplification with regenerative detector, and single tube regenerative. The various receivers in each class involve the same general principles and will differ only in the design of coils, method of biasing the grids of the tubes, type of audio frequency amplification and means of controlling oscillation. If it is desired to bring a receiver up to date it will only be necessary to choose an up to date receiver that is in the same class and in many cases only a few apparatus and circuit changes will be necessary. In most cases this will consist of replacing the coils with some of known reputable design and adding a few refinements in order to simplify the control of the receiver.

The radio public has been impressed so greatly by the marked improvement in tone quality which is brought about by the addition of a power amplifier tube to a receiver that there has been a constant demand for parts to modify the average set to include these features. An adapter is now available which will permit the addition of any power tube which has the UX type of base (UX112, UX171 or UX210) to any set without changing the wiring in any way. Four flexible leads protrude from the top of the adapter for the purpose of connecting additional "B" and "C" batteries as required.

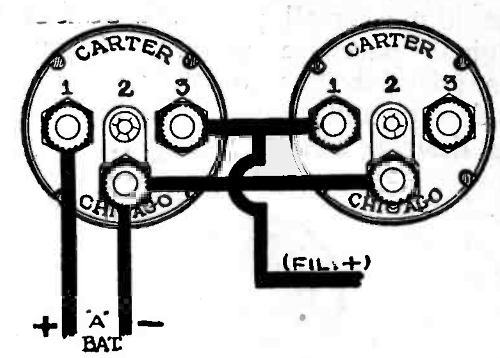
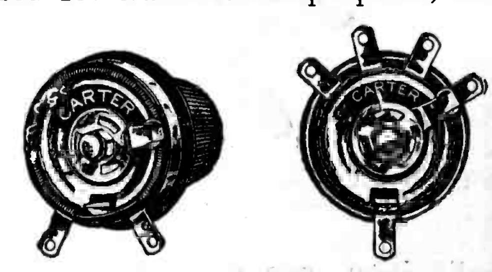


Diagram showing method of connecting pilot switch and dial light for combination control.

Rheostat design has undergone a revolutionary change during the past few years. The metal frame type of rheostat construction is now becoming very popular.

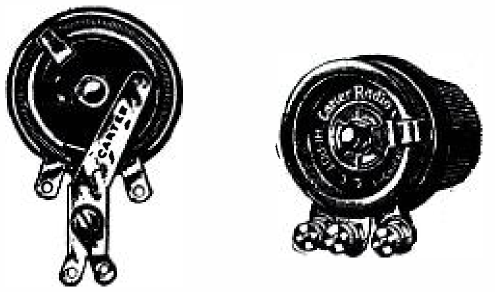
It is an established fact that the handling capacity of any resistance element is entirely dependent upon its ability to radiate heat. When a current passes from filament to plate of a vacuum tube, the resistance of this circuit causes the plate to heat. Here again (with the exception of a possible break down due to excessive plate voltage) the ability to radiate heat becomes the factor which limits the handling capacity of the tube. In power tubes used for transmission purposes, metal



At the left is a "Midget" rheostat, at the right an inductance switch.

cooling flanges are placed on the plate to obtain more radiating surface. This results in a greatly increased handling capacity. Very large capacity tubes are water cooled by circulating water near the electrodes. These tubes would be destroyed in a very short time if the liquid did not carry the heat away rapidly.

Of course it is not practical to build water-cooled rheostats and resistances for radio receivers, but it is possible to take advantage of the metal cooling flange principle which is employed in air-cooled tubes. The most practical method is to completely surround the resistance element with a metal frame, the large surface of which effectively radiates a large portion of the heat to the surrounding air. The resistance element is encased in a thin insulating shield to prevent electrical contact with



At the left is a high resistance rheostat with filament switch combined. At the right is shown a volume control potentiometer.

the frame. This method of construction increases the current-carrying capacity of a resistance element to many times that of a rheostat that depends only upon the surface of the resistance wire to dissipate its heat to the surrounding air.

The clamping of the metal frame around the resistance element serves another purpose. It is obvious that there is no possibility of the wires loosening. This insures proper spacing and constant resistance at all times. Loose wires on a rheostat very often cause a receiver to be very noisy so it is recommended that this be taken into consideration when a set is remodeled.

Special potentiometers and resistance units have been designed for use as volume controls. The resistance ele-

(*Continued on page* 162)

Data on the Norden-Hauck Super-10

(*Continued from page* 107)

The antenna inductance consists of the same winding as the secondary of the Radio Frequency Transformer, being tapped at 12 turns, 24 turns and 36 turns.

"BB" Coils—(Wave-length range approximately 1200/3600 meters).

The secondary and the antenna inductance consist of 1½" close winding of No. 38 Single-Silk Covered Wire, starting ½" in from the end of the tube.

The primary is wound in the same direction, bunched at one end of the secondary, and consists of 20 turns No. 28 D.C.C. wire, being separated by a piece of Empire cloth tubing.

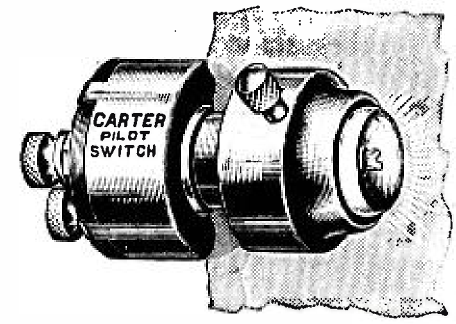
The antenna inductance is the same except that it is tapped at 20, 40 and 60 turns, being wound with No. 38 S.S.C. wire.

When fitting the chassis into the cabinet, holes can be drilled either in the bottom or back, wherever it is desired to bring through the two cables and the antenna lead.

Adapting New Parts to Old Sets

(*Continued from page* 161)

ment in these units is so constructed that the resistance rises very slowly at one end and rapidly at the other end. It is so arranged, however, that while the contact arm moves from zero to maximum there will be a uniform percent change in resistance. This curve is mathematically correct and makes possible the production of a uniform change of volume or current. The contact arm slides on protecting wires covering the special moisture proof resistance. This insures long life and unvarying electrical characteristics.



A pilot switch which lights up when the switch is in the "on" position.

Rheostats are now available with filament switches attached. This simplifies the control of the receiver, conserves space and improves the appearance of the panel. When this device is used it is merely necessary to turn the rheostat or volume control knob, as the case may be, until the proper operating conditions are received. As soon as the knob is turned the switch closes. The switch is positive in action, thereby removing any doubt as to whether or not the set is turned on or off.

A small rheostat is available with a short slotted shaft for sub-panel mounting purposes. This permits using a rheostat for each tube or group of tubes as required and connecting a low resistance master rheostat in series with the supply lead to all of the tubes. This furnishes individual control on all tubes allowing maximum efficiency to be obtained for the receiver. When these rheostats are set for best operation it will not be necessary to adjust them further until the tubes are changed. There is no possibility of the rheostat getting out of adjustment because they can only be turned by means of a screw driver. The master rheostat compensates for the voltage variation of the battery and is of the standard 2 ohm type for front panel mounting.

A new inductance switch is available for use in antenna circuits, meter circuits or any other condition where a tap switch may be required. It has firm positive acting contacts and is available with any number of taps up to nine. This device has the same type of construction as the panel mounted rheostat described above.

Mounting tip jacks on bakelite terminal strips in the rear of the set for loud speaker connections has recently become very popular. This is especially desirable in the new circuits where a power amplifier is used and no jacks are used. In these circuits the volume is either controlled in the radio frequency amplifiers or a tube is cut out by means of a jack switch. This eliminates the necessity of placing jacks in the front panel and greatly simplifies the appearance of the set.

Illuminating the panel with a suitable light is a simple, inexpensive means of beautifying a receiver. Very often when a set is located in a room that is lighted with lamps, it is necessary to illuminate a panel in this manner. The Dial Light shown in the illustration may also be used as a filament switch and pilot light in addition to illuminating the dials. In closing, the writer wishes to emphasize the importance of carefully planning a "remodel job" before it is started.

STATEMENT

Of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912, of RADIO LISTENERS GUIDE AND CALL BOOK combined with RADIO REVIEW, published quarterly at New York, N. Y., for October, 1926.

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 combined with RADIO REVIEW, 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 manager are: Publisher, the Consrad Company, Inc., 53 Park Place; Editor, Sidney Gernsback, 53 Park Place; Managing Editor, W. G. Many, 53 Park Place; Business Manager, R. W. DeMott, 53 Park Place.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given.) The Consrad Company, Inc., 53 Park Place; Hugo Gernsback, President, 53 Park Place; Sidney Gernsback, Vice-President, 53 Park Place; R. W. DeMott, Business Manager and Sec'y, 53 Park Place.

3. That the known bondholders, 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 5th day of October, 1926.

(SEAL) JOSEPH H. KRAUS.

Notary Public, Queens County Register's No. 4523, New York County Register's No. 7364, New York County Clerk's No. 481. (My commission expires March 30, 1927.)

SEE PAGE 192

A Handy Three-Tube Set

By HERBERT E. HAYDEN

A COMPACT set which can be moved readily from one room to another, is a handy thing to have around the house. Like the Ford, which the Packard owner kept in his tool box, this little set makes a useful "spare" when the big set is out of order, or in case Father monopolizes the music room listening to a prize fight and Mother wishes to listen to the philharmonic orchestra.

This set utilizes the old reliable three-circuit regenerative hook-up. It fits into a cabinet 7" x 11" x 5", a 5" x 7" panel being used. Figure 1 shows the set installed in the cabinet. This presents several interesting features. The small space occupied by the entire outfit can readily be seen. The tubes are mounted below the level of the panel, so as to be out of the way. At the lower left is the tuning condenser with home-made drum control which will be described later. The loud speaker jack is shown at the lower

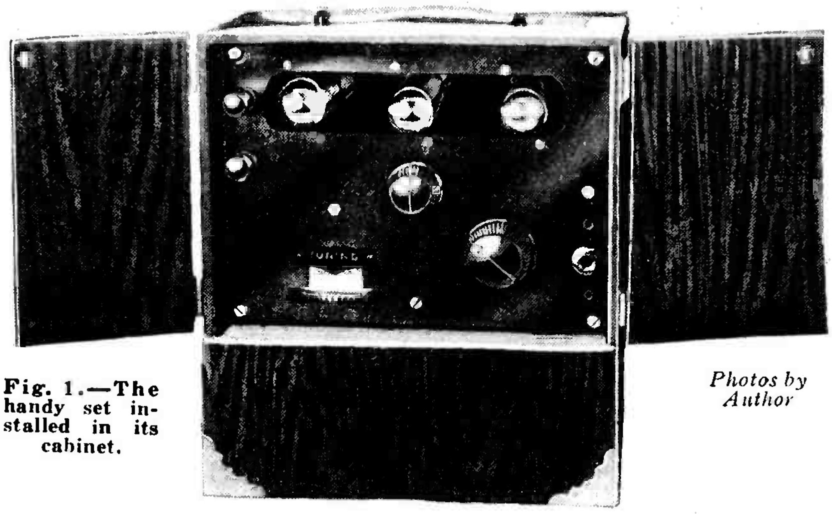


Fig. 1.—The handy set installed in its cabinet.

Photos by Author

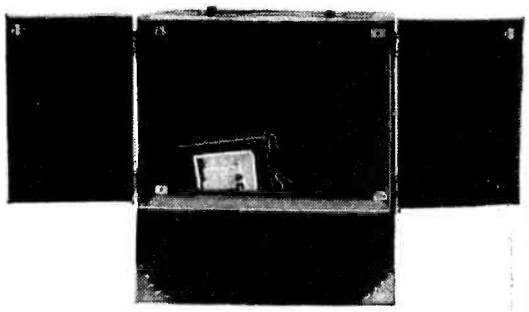


Fig. 2.—Cabinet before installation of set.

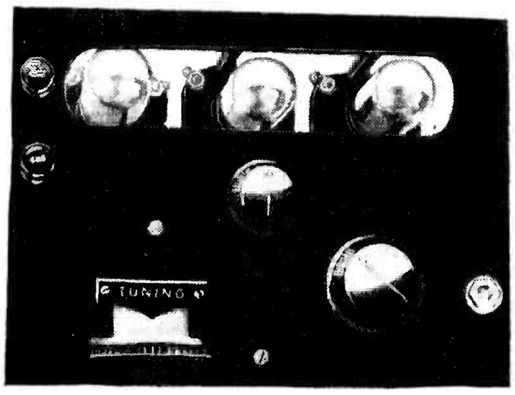


Fig. 3.—A close-up of front panel.

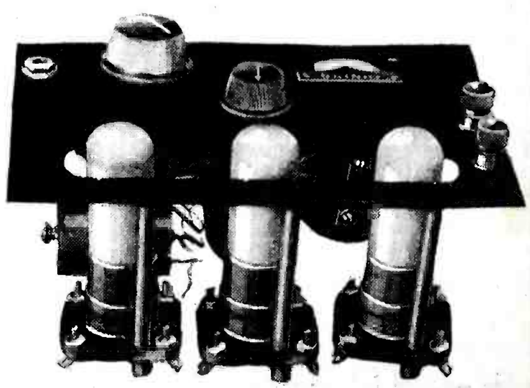
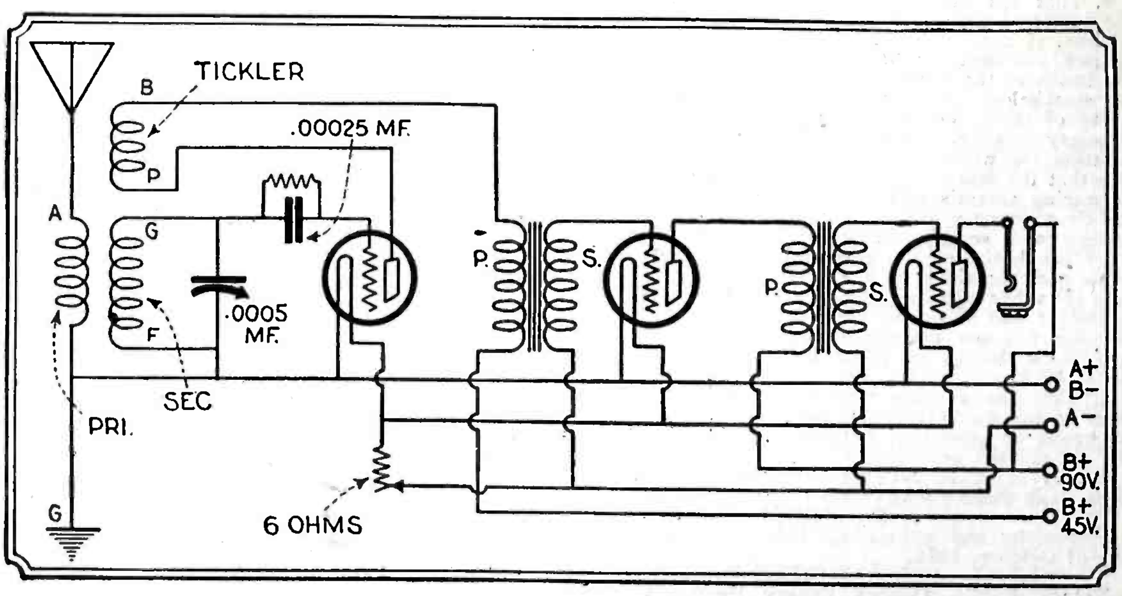


Fig. 4.—Under-panel method of mounting tubes.



Directly above is shown a wiring diagram for a three-circuit tuner with two stages of audio amplification such as used in the handy set.

right. The strap, on top of the cabinet, makes it easy to move the set around. In Figure 2, the cabinet is shown before installing the set. The space at the bottom for the batteries can be seen clearly in this illustration.

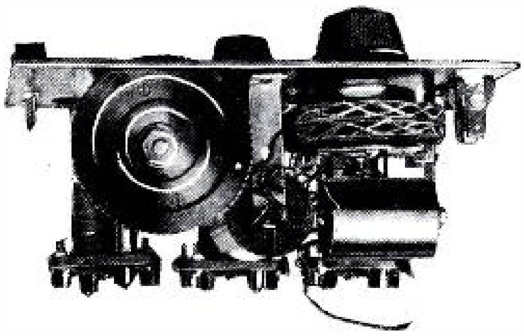


Fig. 5.—Side view of set.

The back may be hinged to facilitate installing and connecting up the batteries. Figure 3 is a close-up of the front of the panel. Figure 4 plainly shows the method of mounting the tubes below the level of the panel.

PARTS REQUIRED

- 1 .0005 Variable Condenser, Conn. Tel. Co.
- 1 6 Ohm Carter Rheostat.
- 1 Frost Jem-Jac.
- 2 MeloFormer Audio Frequency Transformers (Unshielded).
- 3 Benjamin Sockets.
- 1 Model T.C.H. Tuner, American Mechanical Laboratories.
- Drum Control on Condenser.
- 5" x 7" Bakelite Panel.
- 7" x 11" x 5" Wood Cabinet.
- 3 199 type CeCo Tubes.
- Eby Binding Posts.
- Ever-ready Batteries.

This photograph was taken before wiring the set so that the parts would show up more clearly. A side view of the "Handy" set is illustrated in Figure 5. This shows the model T.C.H. Tuner controlled by the lower right-hand knurled knob, the center knob which

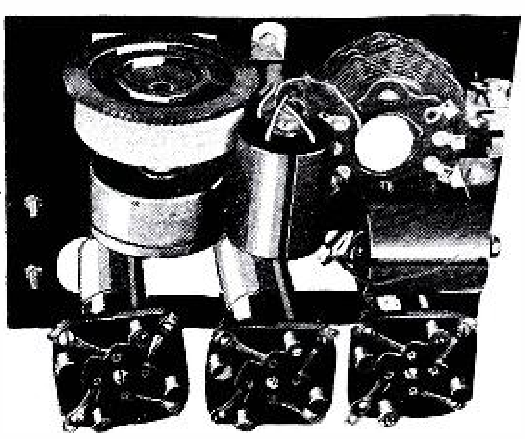


Fig. 6.—A bottom view of "Handy" set.

turns the rheostat, the unshielded audio transformers and the home-made drum control for the variable condenser. This is made from a rheostat base as shown. The notches in the drum for turning it, were cut with a file. A better view of this is shown in Figure 6. This presents a bottom view of the set.

This shows the shielded Connecticut Telephone Variable Condenser operated by the drum control. The paper band for marking stations can be seen pasted around the drum. Figure 7 is an end view of the "Handy" set and gives a good idea of its compactness.

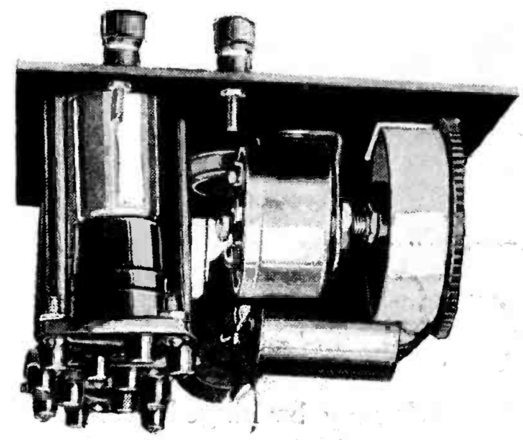


Fig. 7.—End view showing compact construction of parts.

Since the batteries are contained within the cabinet of this set, it can be moved around like a vacuum cleaner and used wherever desired. The matter of aerial and ground can be taken

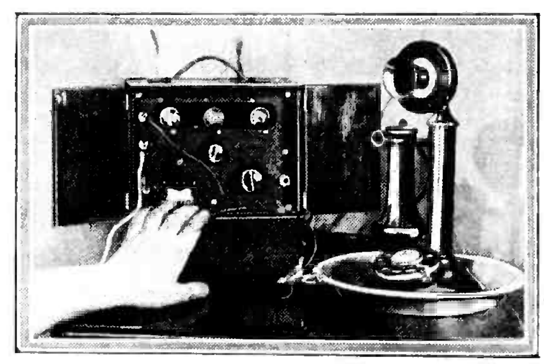


Fig. 8.—Set used with "pie-plate" aerial.

care of without any difficulty. A temporary indoor aerial can be put up readily using a flexible conductor such as "Talking Tape." Where a telephone is available, a "pie plate" aerial such as

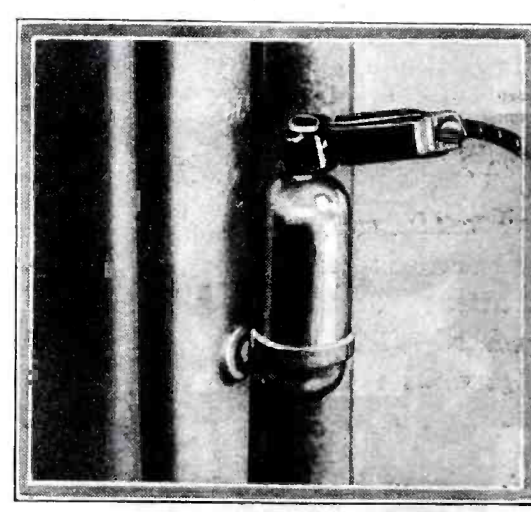


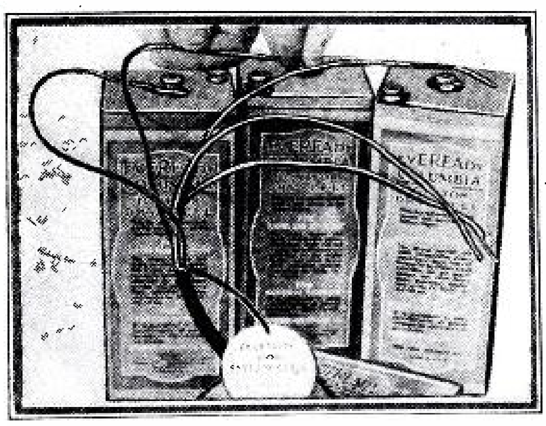
Fig. 9.—The battery clip makes a handy ground clamp.

shown in the illustration often gives fine results on local stations. Another expedient is to use a light socket aerial. As far as the ground is concerned, a battery clip fastened on the top of the radiator relief valve makes a most satisfactory ground connection, and has the advantage that it may be connected or disconnected in an instant.

The hook-up diagram of the three-circuit tuner as used in the "Handy" set is shown on a preceding page.

Best to Disconnect Battery First

At certain times, the location of the radio set must be changed and this often means that the batteries, ground and aerial must be disconnected and



Disconnect the batteries first before removing set.

then reconnected again. In this case, remember to disconnect the cable or wiring at the *battery* end first, thus avoiding short circuits and blown out tubes.

An Improvised Vise for Gluing Cabinet

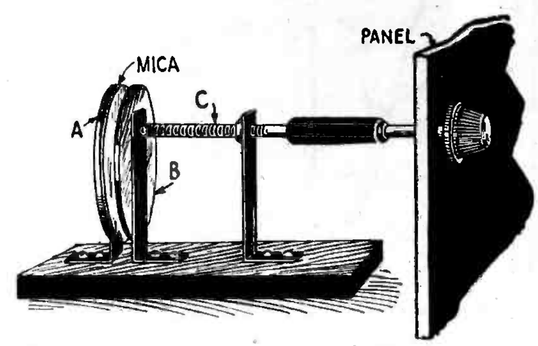
A vise is not an absolute necessity in gluing the joints of a radio cabinet. Just after finishing a job a constructor was unable to locate a conventional wooden vise for holding the work in place until after the glue had set. The

How the small piece of wood is used as a vise.

ingenious way in which he solved this difficulty is shown in the photograph. A piece of wood was nailed at the top of the cabinet in such a way that the sides were kept exactly in place. Small brads were used. The brads and the wood were removed after the glue had set and before the cabinet received its final coat of shellac.

A Vernier Tuning Condenser

A vernier condenser giving a very fine adjustment may be constructed by arranging two brass plates in the manner indicated by the diagram. The plate A is rigidly supported on a strong bracket, but the plate B may be moved towards A by pressure of the adjusting screw C.



A vernier tuning condenser. The plate A is rigidly supported on a strong bracket. Plate B may be moved towards A by pressure of the adjusting screw C.

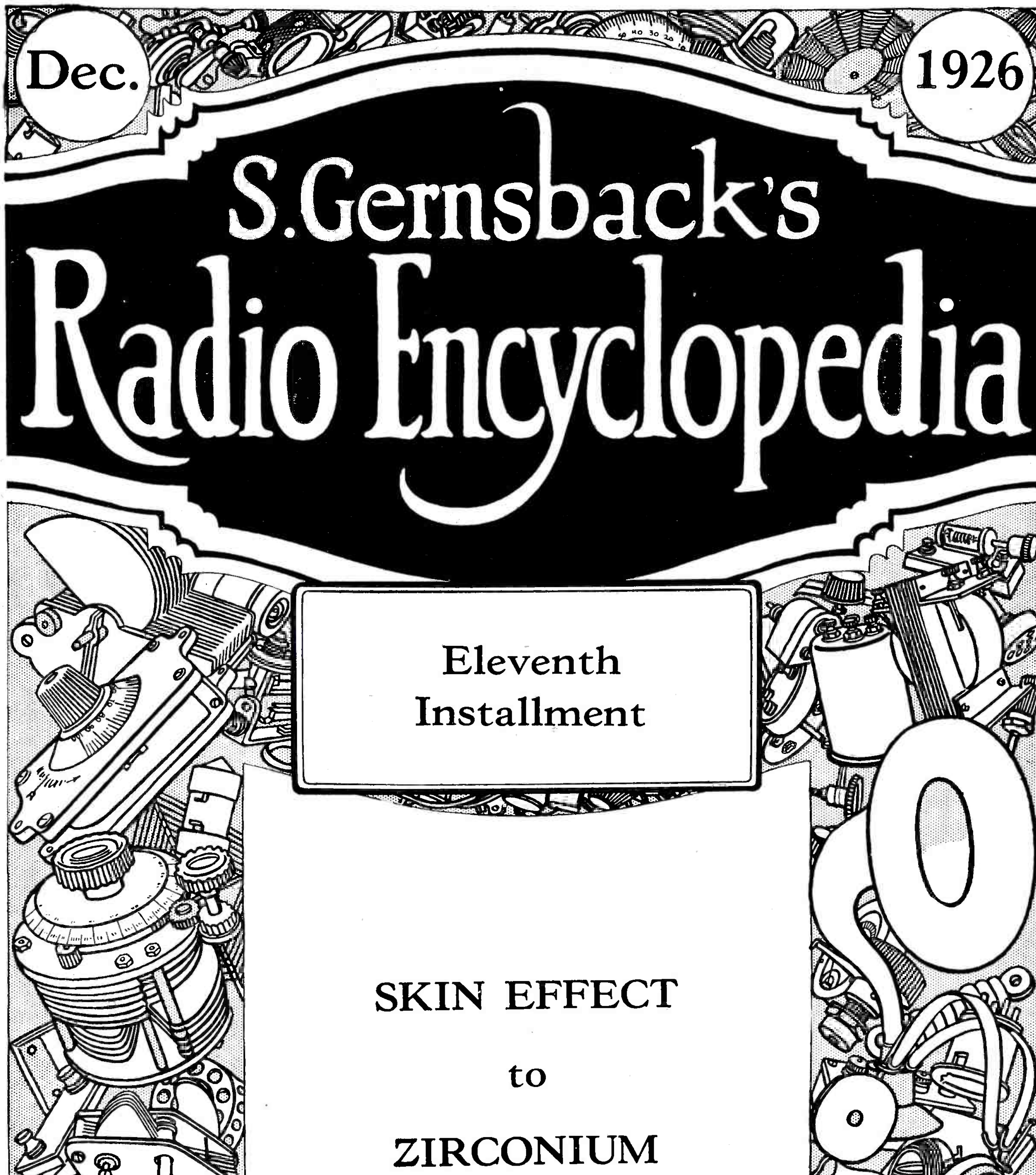
The rate of change of capacity will depend upon the distance between the point where the screw touches the plate and the bottom of the flexible bracket.

A sheet of mica should be stuck on to the plate A with shellac varnish to prevent short circuiting, and a bakelite extension handle will be found a great convenience on short wavelengths.

Method of Improving Wiring of the Set

In wiring a receiver for exhibition purposes where it is essential that every wire should be accurately bent to shape it is very convenient to construct a rough wooden model of the baseboard with the various parts in position.

Nails may be substituted readily for terminals, soldering tags, etc., and as long as the relative positions of the points of connection are strictly adhered to the remainder of the construction may be quite rough. Not only does this method of wiring ensure a neat appearance of the finished receiver, but it enables a series of experiments to be carried out to ascertain the system which will give the shortest and most direct wiring.



Dec. 1926

S. Gernsback's Radio Encyclopedia

Eleventh Installment

SKIN EFFECT to ZIRCONIUM

PREVIOUS INSTALLMENTS

FIRST INSTALLMENT	Consisting of definitions from "A" BATTERY to ARC OSCILLATOR, contained in the May, 1925, issue of Radio Review, Vol. 1, No. 1.
SECOND INSTALLMENT	Consisting of definitions from ARC SPARK to CAPACITY OF CONDENSERS IN PARALLEL, contained in the July, 1925, issue of Radio Review, Vol. 1, No. 2.
THIRD INSTALLMENT	Consisting of definitions from CAPACITY OF CONDENSERS IN SERIES to COUPLING COEFFICIENT, contained in the September, 1925, issue of Radio Review, Vol. 1, No. 3.
FOURTH INSTALLMENT	Consisting of definitions from COUPLING, DEGREE OF to EDISON, THOMAS A., contained in the October, 1925, issue of Radio Review, Vol. 1, No. 4.
FIFTH INSTALLMENT	Consisting of definitions from EDISON EFFECT to GALVANI, LUIGI, contained in the November, 1925, issue of Radio Review, Vol. 1, No. 5.
SIXTH INSTALLMENT	Consisting of definitions from GALVANOMETER to INDUCTANCE, ANTENNA, contained in the December, 1925, issue of Radio Review, Vol. 1, No. 6.
SEVENTH INSTALLMENT	Consisting of definitions from INDUCTANCE COILS to LENGTH OF AERIAL, contained in the January, 1926, issue of Radio Review, Vol. 1, No. 7.
EIGHTH INSTALLMENT	Consisting of definitions from LENTZ'S LAW to MOTOR, contained in the March, 1926, issue of Radio Review, Vol. 1, No. 8.
NINTH INSTALLMENT	Consisting of definitions from MOTOR-ALTERNATOR to POULSEN, VALDEMAR, contained in the June, 1926, issue of Radio Review, Vol. 1, No. 9.
TENTH INSTALLMENT	Consisting of definitions from POUNDAL TO SKINDERVIKEN TRANSMITTER BUTTON contained in the September, 1926, issue of Radio Review, Vol. 1, No. 10.

ANNOUNCEMENT

This is the last installment of S. Gernsback's Radio Encyclopedia and we hope that our readers have found much information and instruction in this supplement.

Responding to the thousands of requests, Mr. Gernsback has published the whole Encyclopedia in book form.

Readers interested in obtaining this unique work will find description and order blank on page 192 of this magazine.

SKIN EFFECT — The name given to the crowding of alternating or oscillatory currents into the surface layers of a solid conductor. This phenomenon increases with increased frequency. As a result the resistance of solid conductors is much higher at high than at low frequencies. (See *High Frequency*, also *High Frequency Resistance.*)

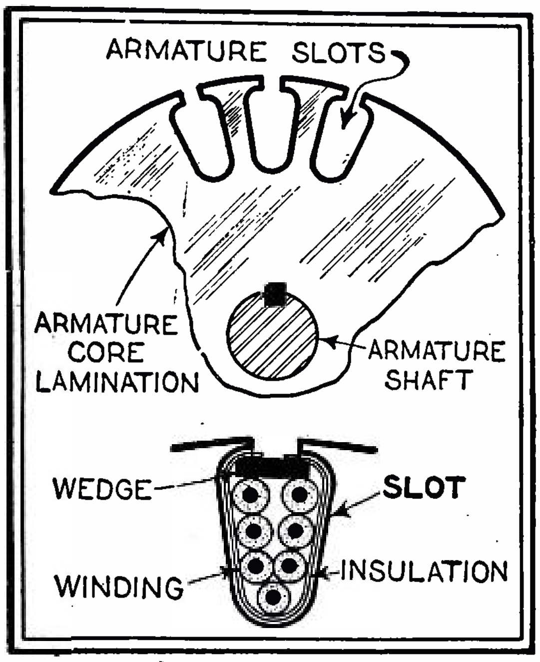
SLABY-ARCO-SYSTEM — A system of wireless telegraphy which used a quenched spark gap. This system is now obsolete.

SLABY-ARCO-VACUUM COHERER — A filings coherer enclosed in a sealed glass tube from which the air has been extracted.

A Slaby-Arco vacuum coherer.

SLIP RINGS — Metallic rings, separated by insulators, from which collecting brushes pick up current generated by an alternator. Slip rings take the place of the commutator used on the direct current generator.

SLOTS—Channels cut in the armature core discs and into which the windings fit.



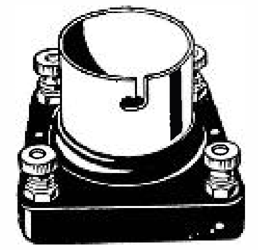
Details of armature slot.

SLUDGING OF TRANSFORMER OIL —The thickening of the oil used for cooling in large transformers. A muddy deposit is formed due to oxidation. The presence of metallic copper in contact with the oil is considered to hasten this action catalytically.

SOAKING-IN—An increase in a condenser charge above its initial value, which takes place gradually if the potential is kept applied. Soaking-in takes place due to a change in the *dielectric* (q.v.).

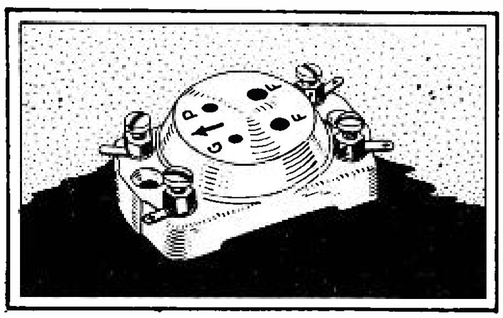
SOAKING-OUT — A gradual continuation of the discharge of a condenser after the first rapid discharge. In this case, the dielectric is returning to its original state.

SOCKET—A receptacle for holding and making electrical connections with a vacuum tube, an incandescent lamp, or a connection plug. Vacuum tube sockets are made of bakelite, hard rubber, porcelain, pyrex and other suitable *dielectrics* (q.v.). They are usually molded. One type of socket is composed of a shell of insulating material, or in some cases of metal. Four contact blades extend within the base of the socket, for making contact with the prongs of the tube. These blades may be of strong phosphor bronze. Their outer ends are attached to binding posts. It is important that the base supporting the binding posts and



A metal shell socket.

contacts be of good insulating material such as bakelite or hard rubber. Modern sockets are of the *spring* or *shock absorbing* type. This construction protects the tube and does away with microphonic sounds. One type of spring socket consists of two molded bakelite parts, the outer one square with a binding post at each corner and the inner one circular with holes for the tube prongs and steel spring contacts fastened underneath the holes.



Shock absorbing or spring-type socket.

The circular molding is suspended within the square one by means of two rubber pads. Other types of shock absorbing sockets use spring suspension instead of rubber.

SOFT IRON INSTRUMENTS — Ammeters, voltmeters and other measuring instruments which depend upon the magnetic force between a current carrying coil and a movable core of soft iron to produce the deflection of the needle or pointer. The movement of the iron may be controlled by a spring or by gravity. These instruments may be used for either direct or alternating current measurements. They are not as accurate as instruments of the dynamometer type.

SOFT TUBE — A vacuum tube which contains a gas content instead of being highly evacuated. Soft tubes were formerly recommended for use as detector tubes but at present have been superseded for this use by the ordinary amplifying tube.

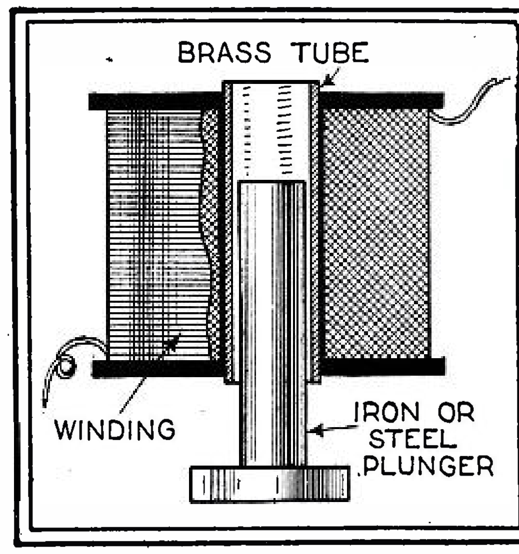
SOLDER—An alloy of lead and tin used for making good electrical connections.

SOLDERED JOINT — A connection between two metallic surfaces, cemented together by means of solder. Where the joint is between two electrical conductors, it must be made both mechanically and electrically secure.

SOLDERING — The process of joining together two or more conductors or other metallic surfaces by means of solder, so as to give a good electrical or mechanical connection, or both. After the surfaces to be united are carefully cleaned, a flux is applied to dissolve the oxides which occur on the surface of the parts to be joined with solder.

SOLDERING FLUX—A substance used to dissolve the oxides on the surfaces of the metals to be soldered. When these oxides are dissolved, the flux enables the solder to enter the minute pores of the metal surface, effectually sealing it against the penetration of oxygen. Fluxes range in character from very strong acids to very mild acid bearing substances. For radio use, it is necessary to use a flux which is non-corrosive and which in its use will leave a residual matter that will have no tendency to collect moisture, dust, or other foreign material. Rosin has been found to be very suitable as a flux in radio soldering. (See *Flux*, *Soldering.*)

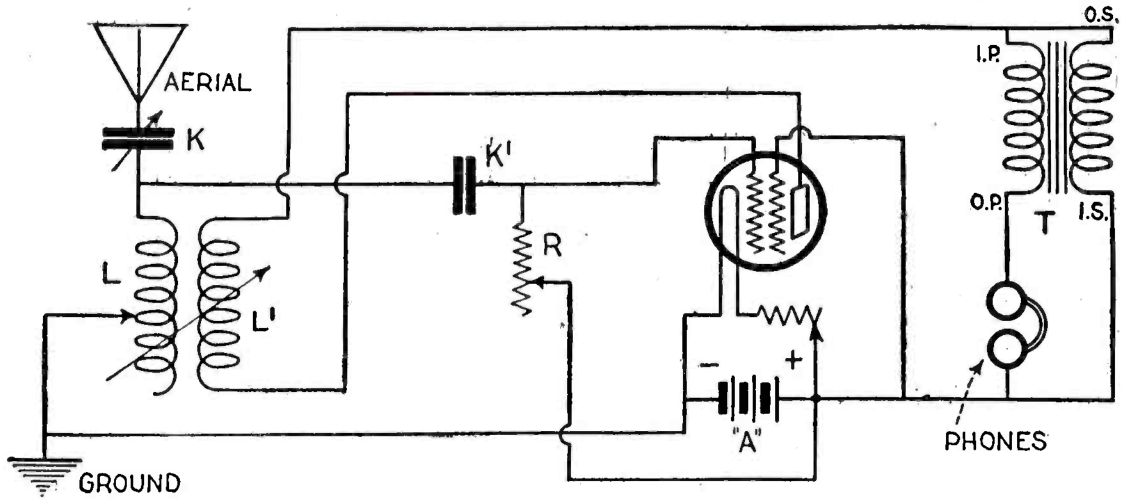
SOLENOID — A coil of wire of helical form used as an electromagnet, generally to attract a movable iron plunger, which is drawn within the



A typical solenoid.

solenoid when the current flows through the windings. The solenoid never has a fixed core. A coil wound on a cylinder so as to give uniform magnetic field within it when traversed by a current is often called a *straight solenoid.*

SOLODYNE—A radio circuit which dispenses with high-tension or "B" batteries and which utilizes a double grid vacuum tube. The solodyne principle is also known as the *Unidyne.* The theory of the solodyne is as follows: The small plate current due to the electron emission from the lighted filament passes through the tickler coil which feeds back to the main grid circuit in the usual way, the primary of a step-up transformer, through the telephone receivers, and then back again to the filament of the tube. The electron stream passing from the filament to the plate inside the tube must pass the two grids. The first of these, which may be referred to as the additional grid, is primarily made positive by connecting it directly to the positive terminal of the "A" battery. This in itself tends to assist the electron stream, to reduce the resistance of the vacuum of the tube. But the additional grid is assisted in its work by having impressed upon it the stepped up voltage from the plate circuit, due to the transformer, the secondary of which is in direct connection with the additional grid. Thus a building up process is introduced, every possible electron primarily due to the electron emission of the filament of the tube being made use of and ultimately passing through the telephone receivers to be reproduced in the form of audible signals. The main grid functions in the usual manner, except that this too, can be made to help the additional grid as well, by giving it a strong positive bias. A typical Solodyne circuit is shown in Figure 1. In this circuit L and L¹ may be honeycomb coils or a variocoupler. In Figure 2 is shown the

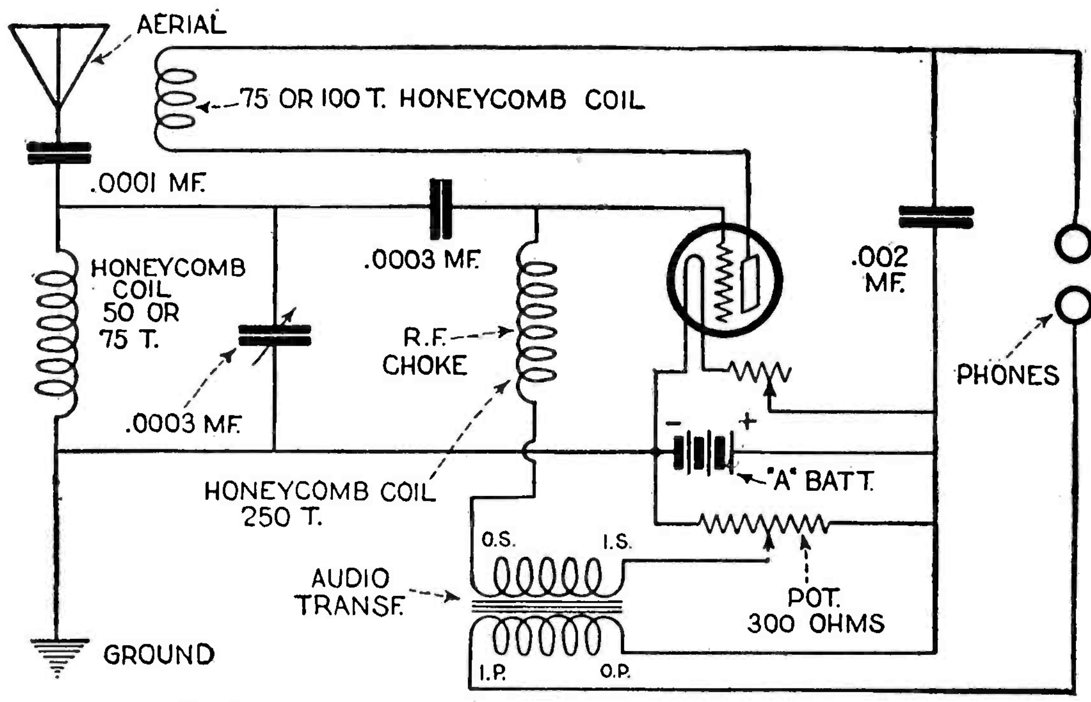


A Solodyne circuit. L and L¹ may be honeycomb coils or a vario-coupler.

Cowper Solodyne circuit which utilizes standard tubes. In this diagram, the numbers printed near each coil indicate the size of honeycomb or duo-lateral coils to use in each circuit. (See *Four Element Tube.*)

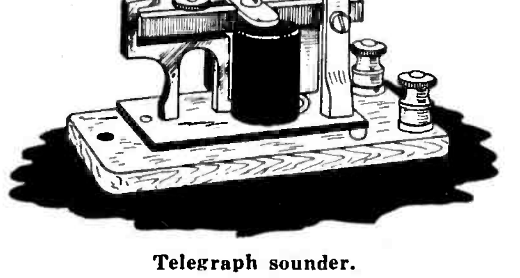
SOUTH MAGNETIC POLE—Situated in Latitude 70 South and Longitude 102 East. The South Magnetic Pole does not coincide with the geographic South Pole.

SOUTH POLE—When referring to a magnet, the pole which tends to point to the south when the magnet is freely suspended.



The Cowper circuit uses no "B" battery and is quite stable in operation.

SOUNDER—An instrument used for receiving telegraph signals which utilizes the attraction of an armature by an electromagnet to make sounds as the armature hits against stops at the beginning and end of each current impulse. The sounds thus produced form the characteristic dots and dashes of



Telegraph sounder.

the telegraph code and can be easily read by the experienced telegraph operator.

SOUND WAVE—A wave of alternate condensation and rarefication through an elastic body such as air, water, etc. Sound waves travel at the rate of 1090 feet per second in air.

SOUTH SEEKING POLE—See *South Pole.*

SPACE CHARGE—The difference between the number of electrons and positive ions in unit volume, multiplied by the charge per ion. This is also called the volume density of electrification. Let us consider the distribution of electrons in a vacuum tube, between the hot filament and the plate. An electron close to the surface of the plate is attracted to the plate by two forces, attraction from the plate and repulsion from the electrons located between it and the filament. An electron close to the surface of the filament, however, is repelled by the electrons between the plate and itself, although it receives some attraction from the plate. It may either move towards the plate or go back to the filament. This will depend upon whether the plate voltage is high enough to result in a force of attraction sufficiently great to overcome the repulsive force of the space charge.

SPACE CURRENT—Current which flows between the cathode and the anode in a vacuum tube. Space current is the result of the motion of electrons through space. It does not follow the same laws which govern the flow of current in a metallic circuit, deviating from Ohm's law to a certain extent, depending upon the relation between the impedances of the tube and the metallic portion of the circuit and also upon the nature of the discharge.

SPAGHETTI—A varnish-impregnated cloth tubing used to insulate bare conductors. (See *Cambric, Varnished.*)

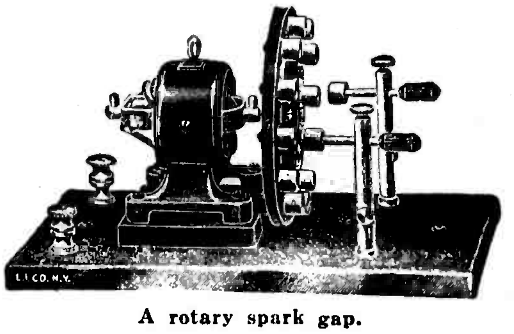
SPARK—See *Spark Discharge.*

SPARK COIL—An *induction coil* (q.v.) used to produce *spark discharges* (q.v.).

SPARK DISCHARGE—A passage of electrical current between two conductors across a previously non-conducting space. The discharge is accompanied by light, heat and sound. It may take place through a liquid, a solid or a gas but whenever it occurs, it means that there has been a breaking down of the dielectric stress. A spark passing through a solid will puncture it. The passage of a spark through a liquid does not affect the dielectric properties of the liquid. On the other hand, a spark passing through a gas, usually ionizes the gas for a period of time after the passage of the discharge and as a result a continuous arc may follow the first spark. An *oscillating current* (q.v.) may produce a rapid train of sparks which persists until the oscillations are damped out. (See *Sparking.*)

SPARK DISCHARGER—A form of *spark gap* (q.v.) such as a *rotary discharger* (q.v.) or a fixed gap, such as a *quenched spark gap* (q.v.). (See *Discharger*, also *Disc Discharger.*)

SPARK GAP—A break in an oscillating circuit which acts as an automatic safety valve to the condenser. Since the air between the gap has a high resistance, the condenser cannot discharge until the potential is sufficient to break down its insulation, thus permitting only heavy discharges to take place. (See *Quenched Spark Gap, Fixed Discharger*, also *Safety Gap.*)



A rotary spark gap.

SPARKING—The production of spark discharges, especially when an inductive circuit is broken. Sparking at the brushes of a motor or generator is caused by armature reaction and self-induction. Sparkless commutation can be obtained by shifting brushes or by the use of *interpoles* (q.v.). Sparking is injurious to contact surfaces and should be avoided if possible. Sparking between contacts of induction coil vibrators is usually reduced by placing a condenser across the gap.

SPARK MICROMETER—A graduated adjustable spark gap for determining sparking distances for various voltages, etc. This device also permits the approximate measurement of high voltages provided the sparking distances for the particular type of terminals, are known.

SPARK RATE, SPARK FREQUENCY, or GROUP FREQUENCY—The number of sparks per second occurring in a spark system of wireless telegraph transmission. It refers to the *Group Frequency* of the wave train rather than to the waves themselves.

SPARK RECORDER—An instrument for recording telegraph signals, in which sparks from an induction coil pass through and mark a paper tape carried on a drum which turns under a metallic pointer. The use of a spark recorder dispenses with the use of ink, thus doing away with the friction of the pen on the paper.

SPARK TRANSMISSION—A wireless telegraph transmitting system which uses a succession of spark discharges in an oscillating circuit, to produce oscillations. These traverse an aerial system and a series of short trains of damped waves are emitted.

SPECIFIC GRAVITY—abbreviation S.G.—The weight of a body compared with that of another, having equal bulk, considered as a standard. The standard for liquids and solids is water, while hydrogen or air is the standard for gases. The specific gravity test of the radio storage battery is an important means of testing the condition of the battery. A *hydrometer* (q.v.) is used for this purpose.

SPECIFIC INDUCTIVE CAPACITY—symbol k—abbreviation S. I. C.—A measure of the degree to which a body permits electrostatic induction through it. The ratio between the capacities of two condensers, one employing the material under consideration as the dielectric and the other using an air or vacuum dielectric. The Specific Inductive Capacity of a material is the *inductivity* (q.v.) of that material relative to that of air. (See *Inductive Capacity* also *Dielectric Coefficient or Constant.*)

SPECIFIC RESISTANCE—The resistance in ohms, of unit length and unit cross-section of a conductor. (See *Resistivity of a Material*, also *Resistivity, Surface.*)

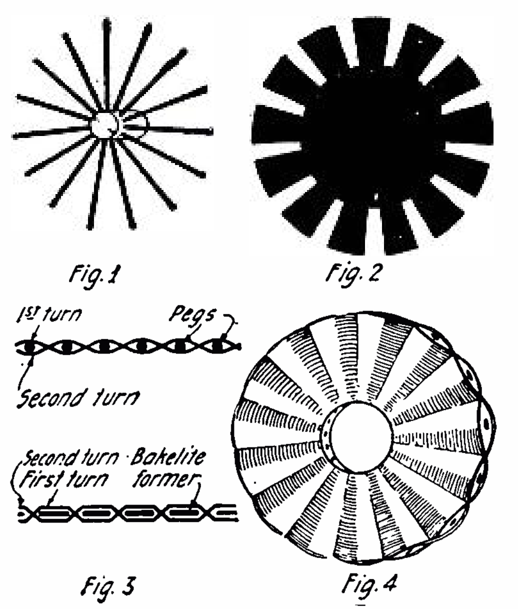
SPECTRUM—An image formed by rays of light or other radiant energy in which the parts are arranged according to their refrangibility or wave length. The image may be visible or invisible. The arrangement is such that all parts of the same wave length fall together, while those of different wave lengths are separated from each other forming a regular series. The spectrum produced by the light of the sun passing through a triangular glass prism and falling on a screen is one of the most common forms. The various colors, since they are unequally refracted, are spread out into a band, showing the seven rainbow colors. The red is at one end (that of the least deviation), while the violet is at the other end.

SPEECH AMPLIFIER—An audio frequency amplifier designed especially for public address systems, where addresses are to be heard over a comparatively wide area. By means of speech amplifiers, it is possible for one speaker to address an unlimited number of listeners.

SPEECH MODULATION—The modulation of radio frequency currents, as utilized in radio telephony. The production of speech modulated waves calls for a source of undamped waves and a method of causing variations in the current output of this source which will accurately correspond to the vibrations of the voice. The source of undamped waves may be a high-frequency alternator or an electron tube generator, the latter being in most common use. The radio frequency antenna current may be varied by inserting a speech-controlled variable resistance, such as a microphone, in the antenna circuit at the transmitter. The microphone may be put in the direct current power supply of the generating system, so that the radio frequency output of the system will be varied as the power input is varied. (See *Modulation*, also *Modulation Frequency Ratio.*)

SPEECH VIBRATIONS—The wave corresponding to a given sound. There are various methods of obtaining graphically, the picture of the wave form of any particular sound. One method is to make a phonograph record of the sound and then as the sound is reproduced from the record, to magnify the movement of the needle, using a lever to trace the form of the waves.

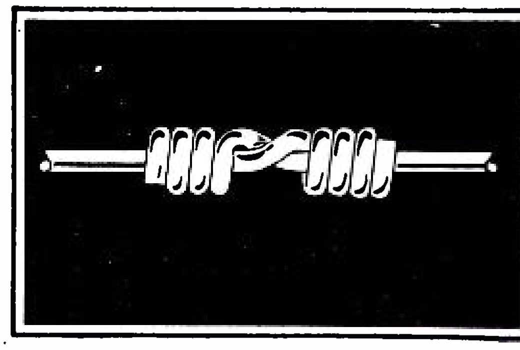
SPIDER WEB COIL—A form of inductance coil in which the wires are wound on a frame consisting of radiating arms similar to the spokes of a wheel. The wire is wound in successive turns in and out around the arms,



Details of spider web coil construction.

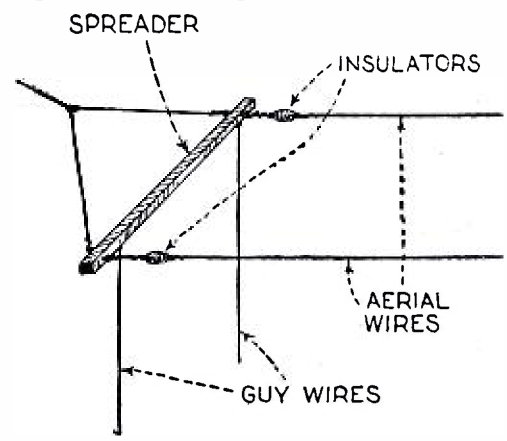
starting from the center, until it reaches the ends of the arms. An odd number of turns are used so that alternate turns will follow the same wave; that is to say, adjacent turns will be on opposite sides and separated by an arm. Coils of this type have comparatively low distributed capacity and in addition have the advantage of being extremely compact. Figure 1 illustrates the frame on which the wire is wound. This is known as the *spider*. A spider cut from $\frac{1}{16}$th inch bakelite, as shown in Figure 2, can also be used, although, owing to a smaller number of divisions, the latter does not have such a large inductance as the former. In winding, the wire is fastened around one of the pegs and is then taken in and out around the pegs, as shown in Figure 3. When starting the second turn, the wire will be around the pegs the opposite way to the first turn, and all successive odd-number turns will be on the same side as No. 1, while all successive even number turns will be on the same side as No. 2. The finished coil is shown in Figure 4. Spider web coils are also known as *basket wound* (q.v.), *basket woven*, or *stagger wound* coils.

SPLICE—A method of joining two or more conductors by interweaving or entwining the strands, in a similar manner to that of splicing a rope.



A strong splice.

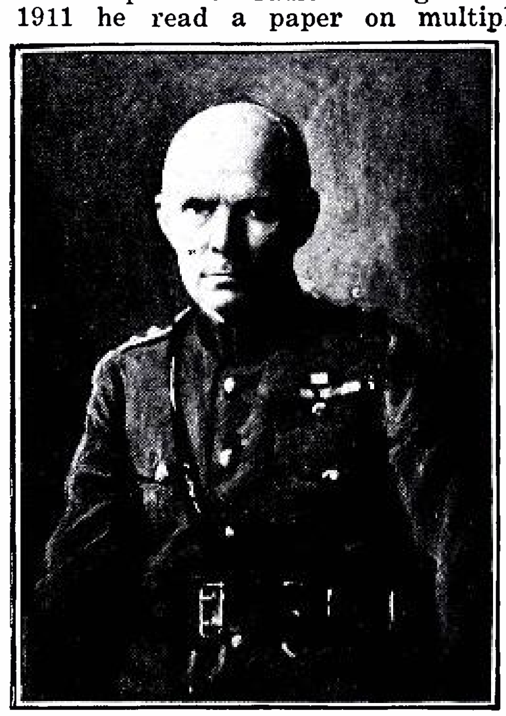
SPREADER—A spar or pole used on an aerial, where two or more wires are used, to keep these wires properly spread out and parallel to each other.



Aerial showing use of spreader.

SQUARE MIL—A square mil is the area of a square, one mil, or 0.001 inch on each side. (See *Circular, Mil.*)

SQUIER, MAJOR-GENERAL SIR GEORGE OWEN—American radio authority. He was educated at the Johns Hopkins University and became a research student under Professor Rowland and Sir William Preece at the British General Post Office. In 1904 he published his famous paper on the absorption of electromagnetic waves by living vegetable organisms and showed how trees could be used for the reception of radio messages. In 1911 he read a paper on multiple



Major-General George Owen Squier.

telephony before the American Institute of Electrical Engineers. In 1912 he was awarded the Elliot Cresson Gold Medal for his researches in multiplex telephony and in 1919 the Franklin Medal of the Franklin Institute. Major-General Squier was awarded the K. C. M. G. for distinguished services during the World War. He is a member of the National Academy of Sciences and the International Electrotechnical Commission. He is the inventor of *Line Radio* (q.v.) which is also known as *Wired Wireless, Wire-Radio Telephony, Guided Wave Telephony,* and *Carrier Current Telephony.*

SQUIRREL CAGE INDUCTION MOTOR—A type of induction motor having a rotor consisting of copper bars connected to rings at each end so as to form a short-circuited system. There are no windings in this type of rotor nor are there any external connections through slip rings. These motors are used for constant speed work, where starting is necessary only at infrequent intervals. The squirrel cage motor draws a large starting current, but has a relatively small starting torque. It is possible, however, by properly designing the rotor so as to have enough resistance, to use small motors of this type for loads requiring frequent starting, rapid acceleration and high starting torque.

SQUIRREL CAGE ROTOR—See *Squirrel Cage Induction Motor.*

STAR GROUPING—A method of connecting up polyphase apparatus or circuits. One end of each phase is connected to a common point, usually called the neutral point. This method of connection is called a "Y" grouping, in the case of a three-phase system.

STATIC—An irregular disturbing noise, heard in the radio loud speaker or head set due to atmospheric discharges, lightning and similar phenomena. A common form of static produces an intermittent crashing sound. Other types cause grinding noises or hissing sounds. Nearby lightning is usually accompanied by a sharp snap in the loud speaker. Various methods have been devised for eliminating or reducing static, although it cannot be said that any of these has been entirely successful. The combination of coil and ground aerials results in the reduction of static; also the use of *beat reception,* using continuous waves as in certain methods of wireless telegraphy. Static is also referred to under various other names, such as *strays, atmospherics, X's,* etc.

STATIC CHARACTERISTIC—The curves obtained by the use of a steady direct-current potential for showing the performance, efficiency, etc., of a vacuum tube. The static characteristics of the tube itself are obtained when the resistance of the external circuit is very small in comparison to the plate resistance of the tube. In cases where the external circuit contains reactance, the true characteristic could not be obtained using direct current. In this case, an alternating electromotive force is impressed on the grid and the curves obtained are known as *dynamic characteristics* (q.v.).

STATIC ELECTRICITY—Electricity which is stored in a circuit, manifesting itself in the form of charges at high potential. Electricity, as produced by frictional or influence machines.

STATIC ELIMINATORS—A device for eliminating or reducing the effect of *static* (q.v.). Various circuits have been proposed for accomplishing static elimination. Some of the most recent and successful of these are the McCaa anti-static circuits described in the July, 1925, issue of RADIO REVIEW, on page 63. There are two types of McCaa circuits, one applicable to radio telegraphy and the other to radio telephony. Both have for their object the reduction of signal static ratio. The wiring diagram shown is that of a standard five-tube neutrodyne receiver plus a McCaa anti-static device of the receiver type. In this diagram Ta is the repeater tube, Tb and Tc are the two radio-frequency amplifier tubes, Td is the detector tube and Te and Tf are the two audio-frequency amplifier tubes. The circuit from tube Tb on is unchanged and is the same as any standard neutrodyne receiver. The input circuit of tube Tb, however, and also the antenna circuit, have been altered to make possible the installation of the anti-static device.

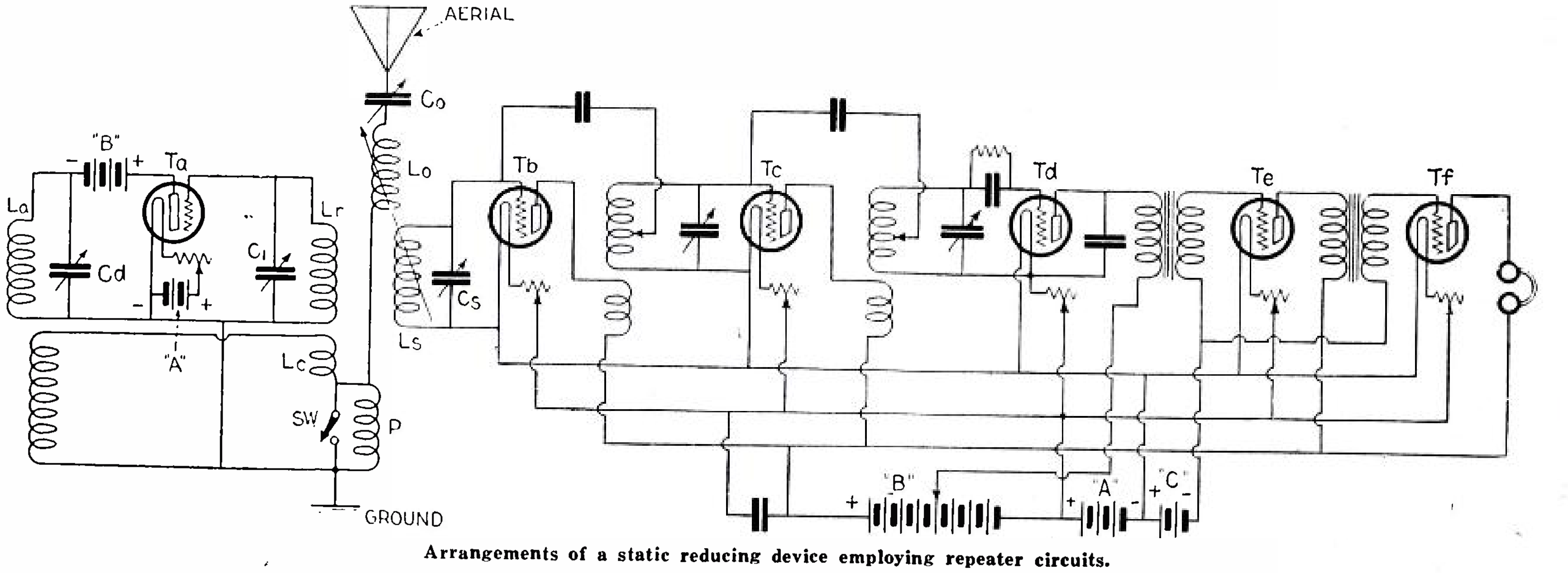
For the neutroformer which usually couples the first tube of a neutrodyne to the antenna circuit, the coils Lo, Ls and Lp have been substituted. These coils may either be homemade coils or honeycomb coils. If honeycomb coils are selected each may have fifty turns. The coupling between Ls and Lp should be fixed so that the coils are about an inch apart and some arrangement should be made for changing the coupling between Lo and Ls. If homemade coils are used each coil should have approximately sixty turns of No. 22 d. c. c. wire on a three-inch diameter tube and they should be coupled the same as the honeycomb coils.

The coils Lr and Lc are also coupled and may be either 50 and 10 turn honeycomb coils, respectively, or 60 and 10 turn homemade coils wound on a three-inch diameter tube with No. 22 d. c. c. wire. The coupling between these coils is not variable. After the proper value of coupling has been found by experiment it may be made permanent.

Coils Ld and Lq are also shown coupled in the diagram. They may be 50 and 75 turn honeycomb coils, respectively, or 60 and 90 turn homemade coils wound on a three-inch diameter tube with No. 22 d. c. c. wire. The coupling between these coils is also fixed after the proper value has been determined by experiment.

The proper values for the various capacities used in this circuit are as follows: Co., .001 mfd. (43 plate); Cs, .000035 mfd. (17 plate); Cr., .00035 mfd. (17 plate); Cd, .00035 mfd. (17 plate).

In building this set it is advisable to place both the anti-static device and the receiver in the same cabinet. This cabinet must be shielded and the shield should be connected to the ground. It is also advisable to shield the anti-static device from the receiver proper. The batteries should also be shielded either by placing them inside the cabinet or in metal boxes which are connected to the ground. The wires from the batteries to the set may be effectively shielded by using BX cable, the outside covering of which should also be connected to the ground. For the phone wires special phone cords which are shielded with a flexible copper braid are desirable.



Arrangements of a static reducing device employing repeater circuits.

STATOR—The stationary plates of a rotary condenser. The fixed portion of a motor or a generator, which carries a winding. In induction motors, that portion of the motor which is fixed in position and which carries the winding connected to the external circuit. (See *Rotor,* also *Alternator.*)

STATOR PLATES—The plates of a condenser which remain stationary in position as differentiated from the plates which rotate. (See *Shielding,* also *Stator.*)

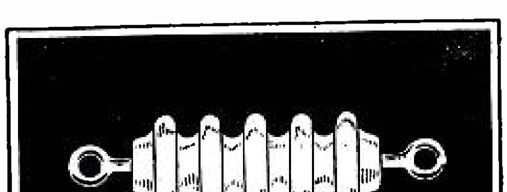
STOPPING CONDENSER—A condenser which opposes or prevents the flow of direct current, but which allows alternating current to flow in a circuit.

STORAGE BATTERY—See *Secondary Cell.*

STORAGE BATTERY TESTS—The testing instrument most commonly used in storage battery work is the *hydrometer* (q.v.). The purpose of the hydrometer is to determine the state of the charge of the battery, as indicated by the *relative* specific gravity of the electrolyte. The specific gravity of a fully charged battery is not a fixed value but depends entirely upon the standard specific gravity employed by its manufacturer which may be anywhere from 1.250 to 1.300. The user should always ascertain the correct specific gravity for the make of battery before attempting to test it with a hydrometer. A voltmeter may be employed as a means of testing a storage battery provided it is of the proper type and is used correctly. It must be accurate with sufficient length of scale to read tenths of a volt clearly. Voltmeters are obtainable which may be used for both the "A" and "B" batteries whether dry or storage. It is not possible to test the storage "A" battery with cheap types of so-called pocket voltmeters. It must be kept in mind that a voltmeter reading on a storage "A" battery is of value only when the battery is either charging or discharging, except when the battery is practically dead. A voltmeter reading taken when the battery is not connected to the circuit, either charging or discharging, may be misleading. If a reading is taken with the filaments lighted and the voltmeter indicates a full six volts, the battery is charged. Under the same conditions, if the voltmeter lags appreciably below six volts the battery should be charged in order to keep it in the best condition. When it falls to 5.4 volts the battery is discharged and cannot possibly operate the set with any degree of satisfaction. When the battery is connected to the charger and the voltmeter shows from 7.5 to 7.8 volts the battery is fully charged. It is possible to test roughly without instruments. If neither a hydrometer nor a voltmeter is handy it is possible to recognize the necessity for charging by the fact that the amplifying rheostats have to be moved forward of the normal working position, indicating low voltage and that the battery must be charged. When the battery is on the charging line, being charged at the ordinary rate of the commercial charger, and all of the cells of the battery are bubbling, this is an indication that the battery is charged. An interesting meter has recently been placed on the market which should prove of considerable use to owners of storage batteries. It is an ammeter of special design which is to be connected in series with the storage battery on charge. There is a third terminal on back of the instrument by means of which the same instrument can be used to measure the current consumption of the filaments. By pressing a small button in the center of the meter, the needle swings over to the right-hand portion of the scale and indicates whether the battery is fully charged, half charged or low.

STORAGE CELL—See *Secondary Cell.*

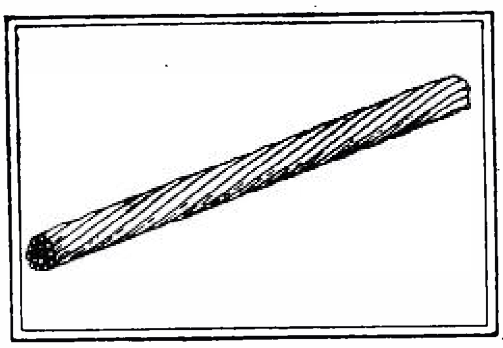
STRAIN INSULATOR—An insulator used under tension, as for example the



A strain insulator.

insulators to which the guy wires of an aerial are attached. The simplest form of strain insulator consists of a cylinder or ball having an eye-bolt at each end. Where the aerial guy is fastened to a strain insulator, the purpose of the insulator is to prevent the guy from having a natural wave length nearly the same as the wave length of the antenna. A common form of strain insulator is of nearly spherical form and is so grooved as to carry the two wires firmly, without permitting them to come into contact.

STRANDED WIRE—A wire made up of a number of smaller wires, twisted or braided together. An uninsulated, large stranded wire is generally referred to as a bare cable. Stranded wires are of four general classes; (1) wire braid, (2) bunched wire, (3) rope-lay cables, (4) concentric-lay cables. Wire braid is used to afford



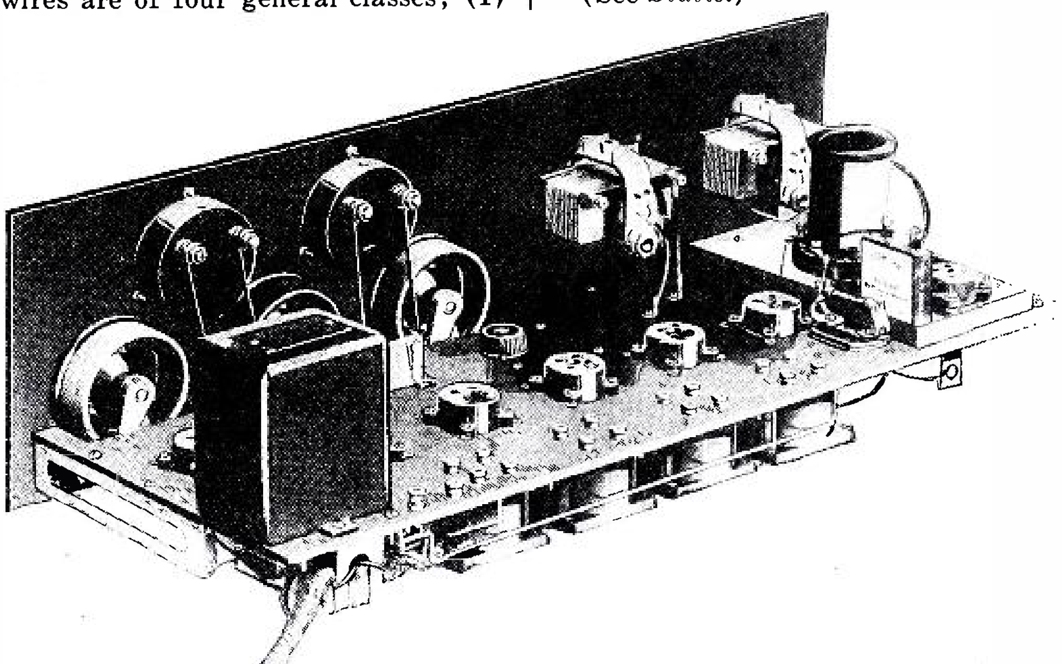
Stranded wire.

protection to the insulation of various types of cable. In flat form, it is used as a flexible lead. Bunched wire is a type of cable also referred to as a cord. This form of cable is very flexible, since the individual wires are small. Rope-lay cables are made up of a central core of stranded wire, having one or more layers of stranded wire wound helically about it. Concentric-lay cables are formed in the same way as the rope-lay type, except that the core and layers are of individual solid wires instead of stranded. Stranded wire is very often used in radio work as aerial wire. It has the advantage of being more flexible than solid wire and it also has a lower resistance at high frequencies because of *skin effect* (q.v.). A greater cross-sectional area is available in the stranded conductor than in the solid conductor of the same weight, for carrying current. If used for radio frequency currents, however it is essential that the individual strands be enameled if the lower resistance is to be attained.

STRAY CURRENTS—Currents induced by stray magnetic fields such as eddy currents. Such currents always result in an energy loss. In electric railway systems, the currents returning through the earth, through piping, etc., rather than through the path provided are known as stray currents.

STRAY FLUX—Magnetic flux which is not usefully employed. The *leakage flux* or *leakage lines* (q.v.) which stray from the closed magnetic path provided in a transformer or other electromagnetic or magnetic apparatus. (See *Magnetic Leakage.*)

STRAYS—Atmospheric disturbances which manifest themselves as noises in the radio loud speaker or head set. (See *Static.*)



This is the rear view of the Callies Super. Note particularly the long wave transformers at the rear of the set and how they support the sub-panel.

SUB-PANEL—A secondary panel in a radio set, mounted at an angle with the main panel. The sub-panel usually carries the transformers, sockets, grid condenser and grid leak. Sub-panels are made of bakelite or composition, hard rubber, etc. (See *Panel.*)

SUPER-HETERODYNE—See *Super-Heterodyne Receiver.*

SUPER-HETERODYNE RECEIVER—A circuit used in radio reception in which the wave lengths of the incoming signals are increased to several thousand meters, by the aid of a local source of oscillations. It is a recognized fact that radio signals at "radio frequencies," that is, the original signals as they are impressed on the receiving set from the aerial, must be amplified or built up in some way to operate the detector. However, signals at low wave lengths such as in use for broadcasting, cannot be amplified very efficiently at radio frequencies. By changing the waves from the ordin ry broadcast band between about 200 and 550 meters to wave lengths of from 4,500 to 10,000, it is possible to obtain more complete amplification. As a result the receiver is more sensitive and greater distance can be received. In the super-heterodyne receiver, a *difference frequency*, termed a *heterodyne note*, is created. This is done by an arrangement for generating oscillations locally. When the incoming oscillations are combined or superimposed with the local oscillations in such a manner that there is a difference in frequency, this difference will be in the form of a new set of oscillations. If the receiver is arranged in such a form that the new set of oscillations has a comparatively low frequency, the wave length will be correspondingly high. In a standard super-heterodyne receiver the action can be imagined as follows: the signal energy from a certain transmitting station is gathered on an antenna or loop aerial. These signals are tuned in by means of a condenser in the case of a loop

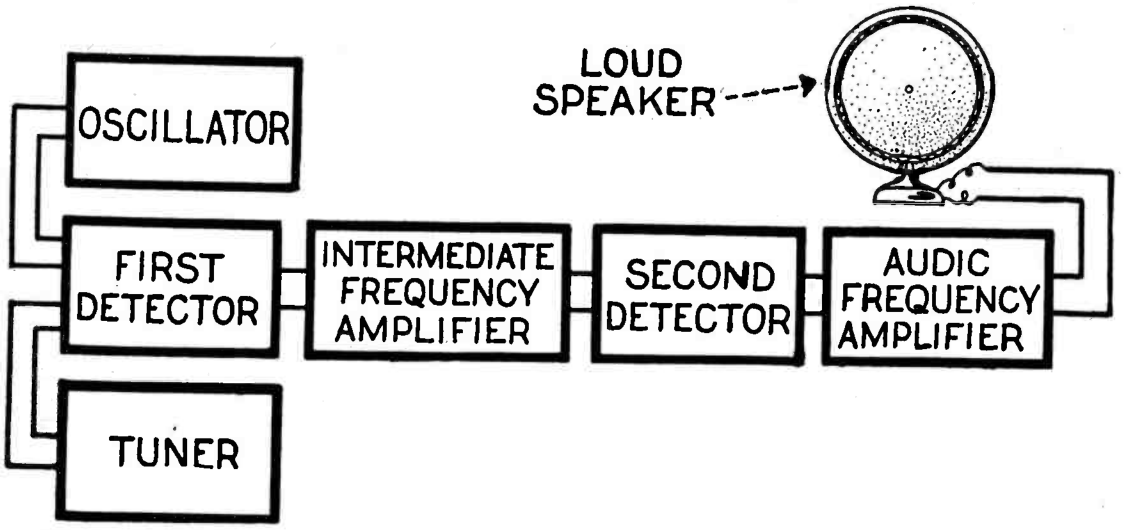


Fig. 1.—This shows the general arrangement of the units of a typical super-heterodyne receiver.

aerial, or by a regular tuning device such as a coupler and condenser in the case of an outside antenna. The energy

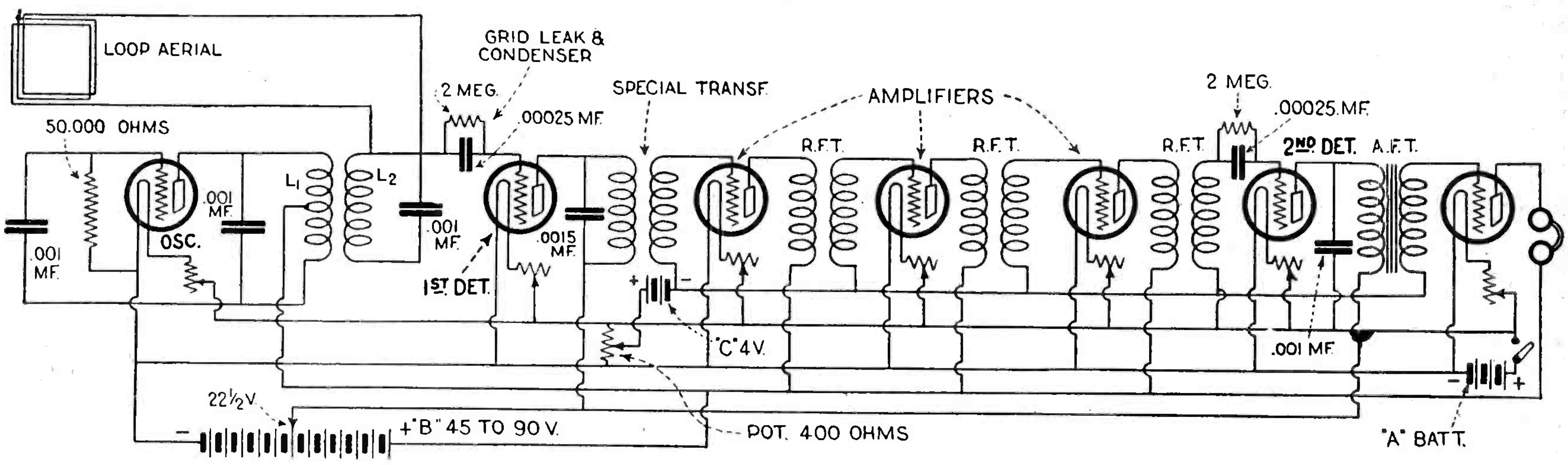
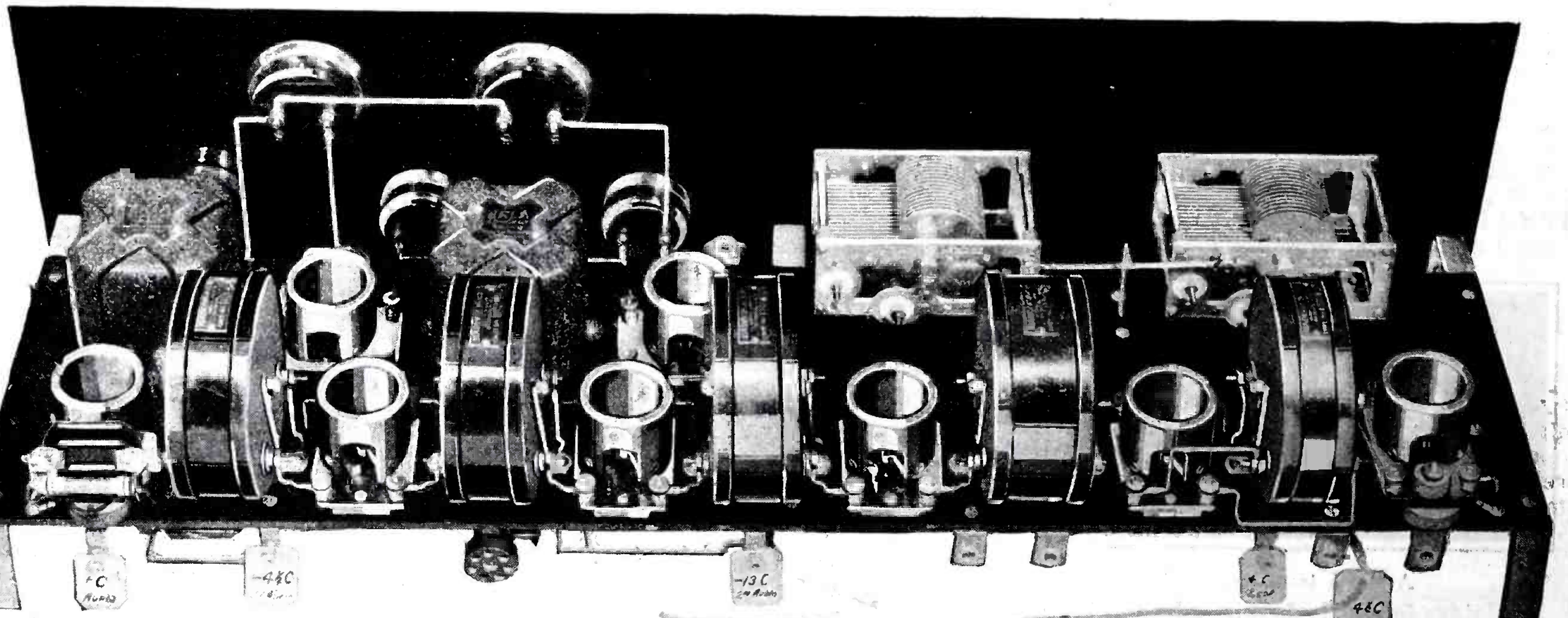


Fig. 2.—Wiring diagram of a standard 7-tube super-heterodyne.

thus obtained is passed through to the grid member of a vacuum tube, which is known as the first detector tube. (In some cases the energy is first amplified by a radio frequency amplifier, consisting essentially of a vacuum tube and a radio frequency transformer). At this point in the circuit, between the tuning device and the first detector, the apparatus for producing the heterodyne action is located. This part of the outfit consists of a vacuum tube with coupled coils in the grid and plate circuits, with a variable condenser (the heterodyne condenser) connected across them, having a suitable value for obtaining any desired local frequency. In this way, the difference between the incoming oscillations and the locally generated oscillations may be adjusted to a prearranged value or frequency. In inductive relation to the grid and plate coils, another coil is arranged, referred to as a *pick-up* coil. The energy obtained from the first detector tube signals having a frequency equal to the difference between that of the incoming signals and the local oscillations, is sent to a *filter transformer* or *tuned filter*. The construction of this filter and the number of windings used is of the utmost importance, as it determines the frequency of the new set of oscillations and will permit the passage of no other frequency than the desired band. This is a very essential feature, as it is necessary to pass only the desired frequency in order to permit maximum transfer of energy. The energy at this predetermined frequency is then passed to the *intermediate frequency amplifier* (q.v.). After being amplified or built up by the intermediate frequency amplifier consisting of tubes and transformers, the energy is then passed to the second detector tube and rectified or changed from radio frequency. The audio frequency signals are now amplified by one or two audio frequency amplifiers consisting of amplifying tubes and transformers and the resulting signals, speech or music



The photograph above shows an eight-tube super-heterodyne set of extra fine quality. Each of the heteroformers are shielded in nickel-plated metal shields. The two variable condensers for tuning the aerial and oscillator circuits should be of the straight line frequency type. The two audio frequency transformers are extra large concert type, the first stage of audio being all that is necessary for average reception on a loud speaker.

are used to operate the loud speaker. Figure 1 shows the general arrangement of the various sections or units of a typical Super-Heterodyne receiver. To go a little more fully into the action of the receiver, let us suppose that a certain station is broadcasting on a wave length of 400 meters. Every wave length is equal to a certain frequency.

That is to say, every wave has a certain number of vibrations per second. The frequency of a wave 400 meters in length will be about 750,000 cycles or 750 kilocycles. By adjusting the wave length condenser, the aerial or loop circuit is placed in resonance with this particular wave length or frequency. This energy is passed through the oscillator pick-up coil and the local oscillations super-imposed on it.

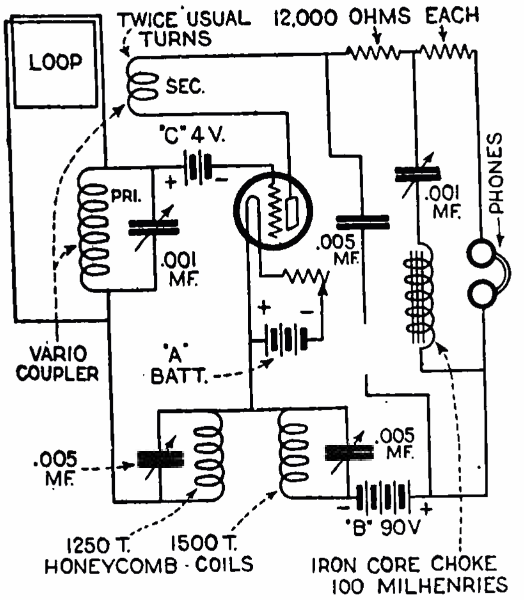
The oscillator condenser, let us say, has been adjusted to permit the oscillator circuit to produce oscillations of a frequency such that the difference between the incoming oscillations and the local ones will be in resonance with the windings of the tuned filter. For instance let us suppose that the tuned filter is arranged for tuning to 10,000 meters, which corresponds to 30,000 cycles.

Now the oscillator circuit must be tuned either 30,000 cycles above or below the incoming wave frequency. In other words, if the incoming wave frequency is as stated—750,000 meters, the oscillator circuit will be tuned to either 780,000 or 720,000 cycles so that the difference between the two frequencies will be 30,000 cycles. No matter what the frequency of the incoming oscillations, the local oscillating circuit will be tuned in a manner to produce the definite difference of 30,000 cycles. These signals will then be passed to the intermediate frequency amplifier and built up before being passed to the second detector tube for rectification.

After this, the signals that are now of audio frequency can be further amplified or built up by the audio frequency amplifier. The two operations that are of the utmost importance in receiving with the super-heterodyne are first, the tuning of the incoming signals and second, the adjustment of the oscillator circuit to produce the difference between two frequencies according to a definite plan. Figure 2 shows the hook-up of a typical Super-Heterodyne receiver.

SUPER-REGENERATION—See *Super-Regenerative Circuit.*

SUPER-REGENERATIVE CIRCUIT — A radio receiving circuit which permits reception under conditions of operation, which in an ordinary regenerative set would result in howling. In the regenerative set, which is tightly coupled, the signal strength increases to a maximum, and thereafter a still further increase in regeneration will result in greatly increased signal strength for a minute fraction of time, followed by violent oscillations. In the super-regenerative circuit, the signals are received at the point of very high amplification by suitably controlling the set. The great advantage of the super-regenerative circuit is the enormous amplification obtainable. Another advantage is the fact that radio code signals are not amplified to the same extent as radio telephony. The super-regenerative circuit was devised by Major Armstrong. The *Flewelling Circuit* (q.v.) is a modification of the Armstrong circuit. (See *Armstrong Circuits.*)



Flivver Armstrong Super-Regenerative circuit.

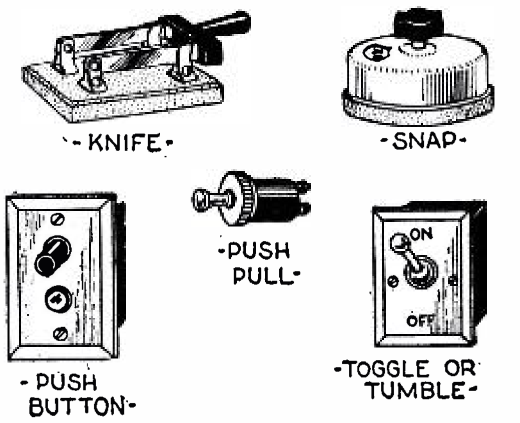
SURFACE MAGNETISM — A synonym for *Free Magnetism* (q.v.).

SUSTAINED WAVES — Continuous or undamped waves. Waves in which similar current cycles follow each other continuously instead of being broken up into groups like *damped waves* (q.v.). The sustained waves may be interrupted by means of a sending key and thus used for sending radio telegraph messages or they may be modulated and thus utilized in radio telephony. Sustained waves are obtained by the use of high frequency alternators, arc condensers, or thermionic electron tubes (vacuum tubes). The use of sustained waves has made radio telephony practicable. Sustained waves permit sharper tuning, require less energy at the transmitter than in the case of undamped waves, and permit the use of "beat" reception and other sensitive methods of reception. (See *Continuous Waves.*)

S.W.G.—Abbreviation for Standard Wire Gauge. The full name of this wire gage is the *British Standard Wire Gauge*. It is also referred to as the *New British Standard*, the *Imperial Wire Gauge*, and the *English Legal Standard*. It is the legally adopted standard of Great Britain. The following table shows a comparison between the American Wire Gauge (B. & S. Gauge and the Standard Wire Gauge:

Gauge No.	*American Wire Gauge Dia. in Mils*	*Standard Wire Gauge Dia. in Mils*
10	102	128
11	91	116
12	81	104
13	72	92
14	64	80
15	57	72
16	51	64
17	45	56
18	40	48
19	36	40
20	32	36
21	28.5	32
22	25.3	28
23	22.6	24
24	20.1	22
25	17.9	20
26	15.9	18
27	14.2	16.4
28	12.6	14.8
29	11.3	13.6
30	10.0	12.4
31	8.9	11.6
32	8.0	10.8
33	7.1	10
34	6.3	9.2
35	5.6	8.4
36	5.0	7.6
37	4.5	6.8
38	4.0	6.0
39	3.5	5.2
40	3.1	4.8

SWITCH — A device for conveniently making or breaking an electrical circuit. Switches must be designed to carry their rated current without overheating or undue voltage drop, to handle overloads, to prevent arcs on



Various types of switches.

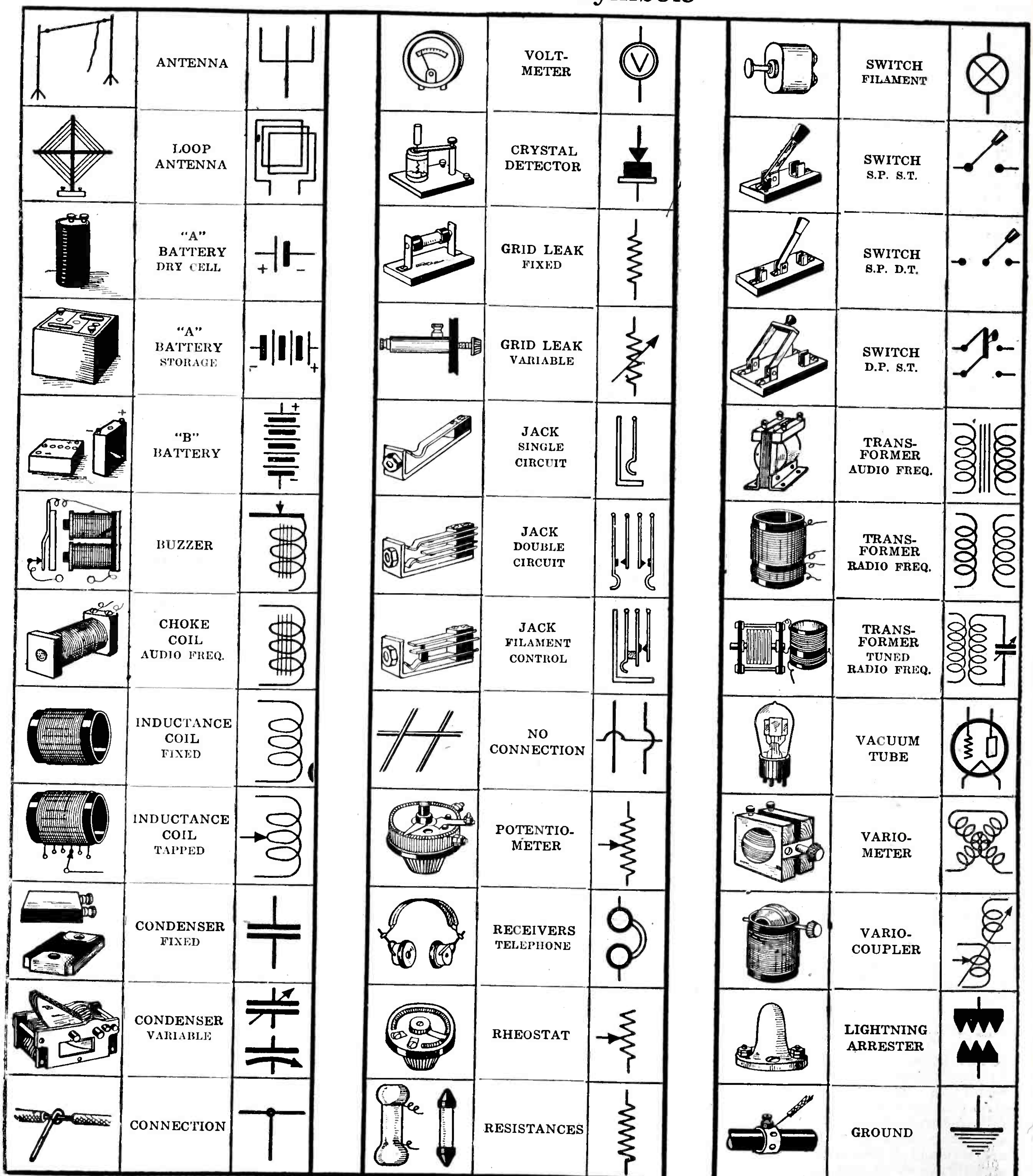
being opened and to properly insulate live parts when switch is open. The most common form of switch is the *knife switch* (q.v.). A switch which opens or closes but one circuit, that is operating in only a single position, is called a *single throw switch*. One operating when thrown in either of two positions is called a *double throw switch* (q.v.). A switch which controls only one side of a circuit is a *single pole switch;* both sides of a circuit, a *double pole switch*. The abbreviation for a single pole, single throw switch is S. P. S. T. The abbreviation for a double pole, double throw switch is D. P. D. T., etc. There are various types of switches ranging from *oil switches* used to handle enormous currents to the small push button or snap switches for turning on or off electric lights. Among the switches used in radio work may be mentioned the *ground-switch* (q.v.), *aerial switch* (q.v.), *quick break switch* (q.v.) and *anti-capacity switch*. This latter usually consists of a small handle with a cam attached to its other end which serves to press together or release spring contacts. The electrostatic capacity between the springs is low, due to the construction used. The *plug* (q.v.) and *jack* (q.v.) constitute a form of switch extensively used in radio equipment. The *push-pull switch*, operating as its name implies, is often used to control the filament lighting circuits of radio receiving sets.

SWITCHBOARD—In its broadest sense, this term is applied to any collection of control, operating and measuring apparatus mounted on a panel or panels for the purpose of starting, stopping or otherwise controlling an electrical installation. In a small electrical plant, all control and switch gear may be mounted on a single structure, which is referred to as the switchboard. Switchboards are used at the radio broadcasting station to carry the various meters, control rheostats, switches, etc. (See *Panel.*)

radio hook-ups to represent various electrical and radio apparatus. The use of symbols has been standardized and results in clearer and more easily drawn diagrams. A table of symbols is given below:

rotary gap discharger driven by a synchronous motor from the same line supplying the transformer in a radio telegraph transmitting system or a rotary gap mounted on the shaft of the alternator supplying the 500 cycle or

Table of Radio Symbols



SWITCHGEAR—Apparatus used in connection with the control of an electrical installation, such as switches, rheostats, starters, circuit breakers, etc.

SYMBOLS—Conventional signs used in

SYNCHRONOUS—As applied to alternating currents, these are said to be synchronous when of the same *frequency* (q.v.) and exactly in *phase* (q.v.).

SYNCHRONOUS DISCHARGER—A

higher frequency current. (See *Disc Discharger.*)

SYNTONY—The relationship between two oscillating currents when one resonates to the waves produced by the oscillations of the other.

T

TABLE OF DIELECTRIC STRENGTH—A table showing the voltages at which certain thicknesses of various materials will break down or puncture. The following table has been obtained from Pender's Handbook for Electrical Engineers:

MATERIAL	DIELECTRIC STRENGTH Specimen thickness mm.	Kv. per mm. (a)
Ambroin	0.84	6.0
Asbestos paper	1.2	4.2
Asphalt (Byerlyte)	3.6	14.0
Bakelite, C-1		up to 27.5
Bakelite, wood molding mixture		17.7 to 21.6
Bakelite, asbestos molding mixture		up to 9.8
Bakelite, Continental	3.2	15.7
Bakelite, Micarta-213		up to 31.4
Bakelite, Micarta-21D		5.9
Bakelite, Micarta-21H		15.7
Bakelite-Dilecto-X	3.2	25.6
Bakelite-Dilecto-XX	3.2	25.6
Celluloid (clear)	0.25	12 to 28
Celluloid (colored)	0.25	10.2 to 18.9
Condensite (molded)	5.7	19.7
Condensite (celoron)	5.7	29.5
Conite	0.13	15.7
Copal	3.0	3.2
Empire cloth, canvas	.41	28.9
Empire cloth, linen	.15	54.0
Empire cloth, muslin	.38	48.0
Empire cloth, silk	.15	48.0
Faturan	3.	10
Fiber, vulcanized, including hard fiber all colors	0.79	8.9 to 16.7
	3.2	4.9 to 10.8
	6.4	3.9 to 8.9
	12.7	3 to 5.9
Galalith (white)		6 to 8.5
Glass (ordinary)		8 to 9
Hermit		2 to 3
Jute (impregnated)	6	1.2
Lava		3 to 10
Litholite	4.5	4.5
Marble		6.5
Mica	6	21 to 28
Micabond, plate	1.6	37.5
Micabond, flexible	1.6	23.1
Micanite, plate	1.6	37.5
Micanite, flexible	1.6	23.1
Minerallac		39.4
Paper	0.13	8.7
Paraffin (parawax)		11.5
Porcelain	20	8
Pressboard (oiled)	0.25	39.3
Pressboard (oiled)	1.58	29.2
Pressboard (oiled)	3.17	21.1
Pressboard (varnished)	0.25	26.3
Pressboard (varnished)	1.58	15.5
Pressboard (varnished)	3.17	9.5
Presspahn		5.2 to 9.3
Redmanol (molded)	5.1	11.8 to 18.5
Redmanol (laminated)	0.8	41 to 51
Rubber (hard)	0.5	70
Slate	10.3	1.3
Vulcabeston	1.9	31.5 to 7.1
Wood (maple), paraffined	15.2	4.6

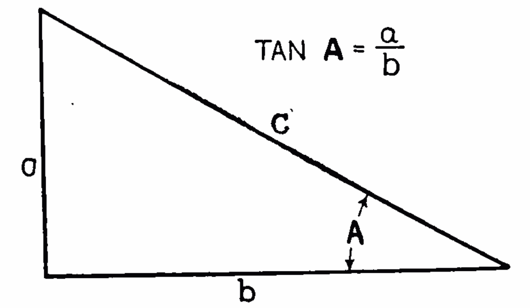
(a) To obtain volts per mil, multiply kilovolts per millimeter by 25.4.

"T" ANTENNA—A flat top antenna in which the down lead is taken from the center of the horizontal portion. (See *Aerial*, also *Flat Top Aerial.*)

TAILS—Name given to small iron wires forming core of *induction coils* (q.v.).

TANGENT GALVANOMETER—A type of galvanometer in which the strength of the currents which pass through the coil is proportional to the tangent of the angle of deflection of the magnetic needle in the center of the coil. In construction, the tangent galvanometer consists essentially of a small magnetic needle suspended in the center of a large circular coil made of the few turns of insulated wire. Attached to the needle is a light aluminum pointer which allows the deflections to be read on a horizontal scale. The coil is placed in the magnetic meridian with the needle and the coil in the same plane. When the current passes through the coil, the pointer is deflected and the angle of deflection recorded. Knowing the constant of the galvanometer, it is possible to calculate the current in absolute units or in amperes by multiplying the constant by the tangent of the angle recorded.

TANGENT OF AN ANGLE—In a right angle triangle having the given angle as one of its angles, the tangent of the



The tangent of angle A is the ratio of side a to side b.

angle under consideration is equal to the ratio of the side opposite the angle to the base of the triangle.

TAP-TAPPING—The connection made to an intermediate point in a winding thus permitting the number of turns in the circuit to be varied at will. Variometers, variocouplers and other coils are made with taps, also transformers, armatures of rotary converters, etc.

TAPPED—See *Tap*, also *Tapped Inductance.*

TAPPER—An electromagnetic device, similar to an electric bell, but with gong removed, arranged so that a hammer gently taps a coherer thus decohering filings after the passage of incoming oscillations. This device was formerly used as a detector of wireless telegraph signals.

TAPPING-BACK—The application of a light blow to a filings coherer to decohere the filings. (See *Tapper.*)

TELEFUNKEN SYSTEM—A wireless telegraph system employing a *quenched spark gap* (q.v.) and giving a singing spark of rather high note. This system has been developed and used by the Germans.

TELEGRAPH—Any system of transmitting intelligence from one point to another over a distance. The word was at one time applied to visual systems such as wig-wagging and semaphore, but at the present is used only to refer to electrical systems. The one exception to this rule is the use of the term to refer to signals sent either mechanically or electrically from the bridge of a ship to the engine room.

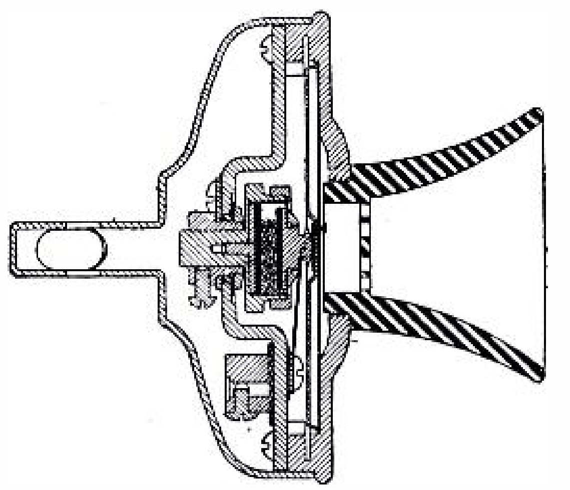
TELEGRAPHONE—A magnetic phonograph in which speech currents or signal currents are recorded as permanent magnetic impressions on a moving steel wire. Instruments such as this have been used for recording telephone conversations and also in high speed automatic wireless telegraph transmission. (See *High Speed Reception and Transmission.*)

TELEGRAPH NAUT—A nautical mile of 2,029 yards or 1.1528 statute miles. (See *Nautical Mile.*)

TELEGRAPHY, RADIO—See *Radio Telegraphy.*

TELEPHONE CONDENSER—In radio work, this is a fixed condenser shunted across the head set or loud speaker. Used in this connection, the condenser is also referred to as a by-pass condenser since it offers a path of low resistance to the radio frequency currents. By-pass condensers are usually made of tin foil with a mica or paper dielectric. Condensers used for ordinary telephone work are also referred to as telephone condensers.

TELEPHONE RECEIVER—An electromagnetic instrument by means of which variations of current are caused to reproduce sound waves corresponding to words spoken into a transmitter at a distant point. The essential features of the telephone receiver are an electromagnet, a permanent magnet and a diaphragm held in a suitable case. The diaphragm is supported by the rim of the case, at a short distance from the face of the magnet and it is attracted by the magnet when it is energized by the current flowing in the windings. The steady magnetic flux of the permanent magnet draws the diaphragm to the pole pieces, leaving a small gap between, so that the diaphragm is held under tension. The currents passing through the electromagnet are modulated in accordance with the transmitted speech. These change the tension of the diaphragm due to the change in magnetic pull and as a result the diaphragm vibrates giving forth speech or music. The telephone receivers used in radio work are of the *watch case* type. (See *Head Telephone or Head-Phone.*)


A cross sectional view of a telephone transmitter showing details of construction.

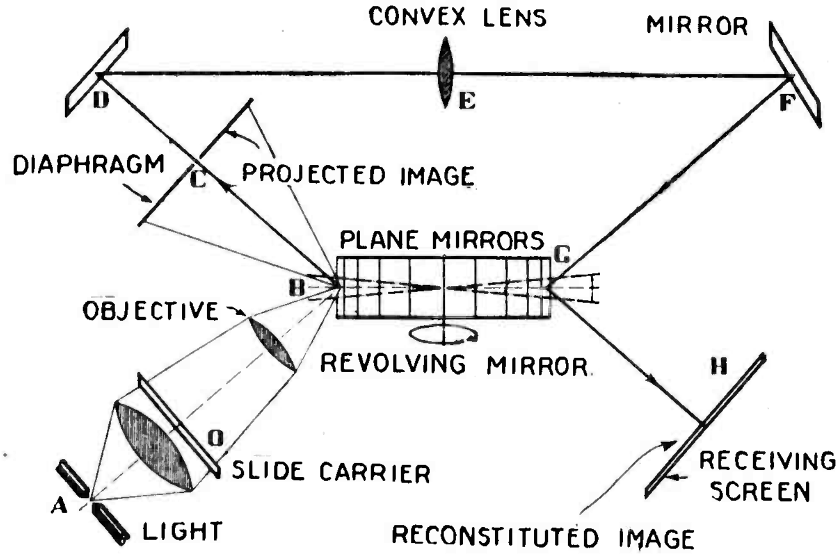
TELEPHONE TRANSMITTER—A sound-wave operated or vibration-operated device designed to produce electromagnetic waves or vibrations which correspond to the sound waves or vibrations actuating it. The standard transmitter used in ordinary telephone work is known as the "solid-back" transmitter. A gong-shaped back supports the transmitter and carries all the parts. A mouth piece of hard rubber is screwed into the front. Just to the rear of the front is placed an aluminum diaphragm which fits into a receptacle cut out for it. An insulated cushion seat of rubber is placed above and below the diaphragm. The diaphragm is held securely by damping springs having soft rubber cushions at their tips, so that it can only assume forced vibrations. An auxiliary diaphragm of mica is used which is fastened to the front electrode of the transmitter button. Both the front and the rear electrodes are made of carbon discs, between which carbon granules are placed in a cylindrical chamber lined with varnished paper. A rigidly connected pin communicates the vibrations of the diaphragm to the front electrode. The movement of the electrode varies the pressure on the carbon granules, thus giving the required variation of resistance which in turn varies the current. The *microphone* (q.v.) used in radio broadcasting is a modification of the telephone transmitter.

TELEPHONE, TUNED—See *Tuned Telephone.*

TELEPHONY, RADIO—See *Radio Telephony.*

TELEVISION—Electric vision at a distance. The transmission by wire or by radio of vision—that is to say the ability to see objects at any distance by changing the light waves to electric currents or to electromagnetic waves, transmitting these to the distant receiving point, and then retransforming them back to the original light waves. Television is still in the experimental stage. Of course, the sending of pictures by radio has been accomplished by Capt. Ranger, in this country, Belin in France, Karolus in Germany, Baird in England, and several others. Both Belin and Baird have been working on the problem of television and are reported to be nearing success. In this country, Mr. C. Francis Jenkins, of Washington, D. C., has constructed a non-commercial (that is in its present stage) machine which will send motion pictures by radio. This is practically the last word in the present development of television. It is possible to broadcast a film picture with this device at the rate of sixteen pictures per second showing the moving outlines as silhouettes, but without the intermediate tones. The method by which a photograph is transmitted by radio in the Jenkins system may be illustrated by the example of a coin covered by a thin sheet of paper on which serried pencil lines are drawn. The design of the coin appears in lines varying in intensity. The variations in the lines may be transformed into pulsing electric current by means of a light sensitive cell passing over the lines in question. Place the lines end to end and the current can modulate a carrier wave. The forming of the continuous line presented a difficulty which was solved in the following way. The inventor proceeded along the line that a prism bends a ray of light and that an image will appear upon a photographic lens placed before a picture. From this it follows that a prism placed near a lens will cause the image to be displaced sideways, the extent of the displacement being dependent on the angle of the prism. If the prism could change its angle, the result would be motion on the part of the image. The prism used is circular, with rapid change of form across the prismatic section. Around the circumference of the disc, the prism changes in thickness according to a graduated scale. Revolving the disc causes the image to move in a straight line. When the end of the prism passes the lens, there is instantaneous snapping back of the picture and the journey is repeated. If a small hole be made in the screen, the light from a given point on the picture will pass through and can be made to operate a light sensitive cell at the back of the screen. When the image is made to move down over the screen by the prismatic ring, the aperture will admit light of varying intensity, according to the light value along a line crossing the picture. This means that the light falling on the photo cell as the image travels will represent a line across the picture from top to bottom. This leads to the creation of the successive lines that make up the picture as a whole. The image is moved along from side to side by means of a second prismatic ring working along at right angles to the first, but at much lower speed. This second prism makes but one revolution during the time that the first makes one hundred, producing the hundred lines assumed to be necessary for making the picture. The cell used may be selenium or thalium oxide. The former requires twenty minutes to cover the picture, the latter six. It is obvious that to reproduce the picture at the other end the process must be reversed, the lines being replaced side by side by means of a pair of prismatic discs similar to those at the transmitting end. As noted above, the main difference between sending photographs and motion pictures is in the necessary speeding up. For this purpose, Mr. Jenkins uses a potassium light-sensitive bulb, the action of which is much more rapid than that of either selenium or thalium oxide. The cell is composed of a bulb with its inner surface coated with metallic potassium. The bulb has a high vacuum. The device has two electrodes, one being a wire through the stem, ending in a loop in the center of the bulb; the other passing through the side of the bulb and connecting with the potassium deposit. Absence of the potassium from a small part of the surface forms a "window" opposite the last named contact. Application of a positive potential to the central electrode, attended by connection with the potassium coating, permits no current to flow as long as no light enters the bulb. The admission of light frees electrons from the potassium, in numbers proportionate to the strength of the light. In this way a current flows through the bulb when light enters the "window." In this cell, there is no appreciable lag due to the amazing speed of the electrons.

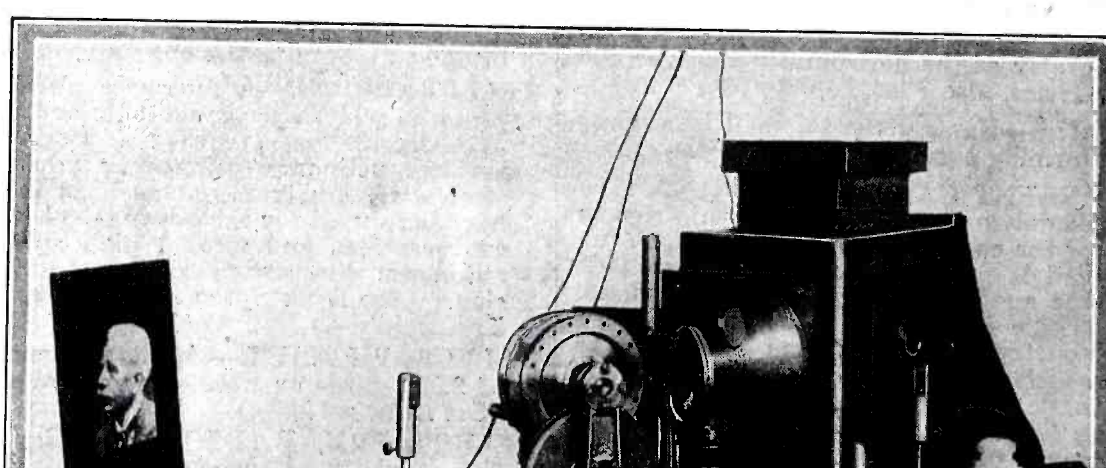
The cylinder is covered with plane mirrors, revolving downward on the side toward the lantern. One ray at a time from 1/25,000 of the area of the image, passes through the opening in C. The fixed mirrors D and F send it back to the mirror G, opposite B on the cylinder, and it is finally reflected against H in a position corresponding exactly to the portion of the image from which it was first taken. The effect of continuous vision is produced.



The sending station has a motion picture projector, a small machine used to cut up the image, a light-sensitive cell, and a transmitter. The receiving station has a radio receiving set, a machine for reassembling the picture, and a screen for the reproduction of the image.

The lamp required for the receiving station must be able to pass swiftly from darkness to extreme brilliancy, and the ordinary filament lamp could not attain the tremendous speed involved. The lamp used by Mr. Jenkins is the creation of Professor McFarlane Moore, and is capable of handling complete cycles at the rate of 75,000 to the second. This lamp has a glass bulb containing two concentric cylinders, the larger almost filling the bulb, and the smaller almost filling the larger. The inner cylinder has a small axial hole, drilled almost to the bottom and forming a deep cup. The principle of this lamp is much the same as that of the Amrad "S" valve.

It is a truism that the fundamental principle of cinema pictures is that the human eye continues to see an image



This apparatus is diagrammed above: the projecting lantern at the right; the drum of mirrors, center; and the adjusting stands for diaphragm and fixed mirrors in front. At the left a continuous image appears on the screen, although only 1/25,000 of it is actually projected at any instant.

after that image itself has disappeared. In the case of an electric spark lasting one ten thousandth of a second, the image lasts for at least one-sixteenth of a second as visualized by the eye. Mr. Jenkins assumes that if 10,000 dots of light and shade flash successively on a screen with sufficient speed, the eye will see the picture to which the dots belong even though but one dot is on the screen at a time. He, therefore, aimed at flashing the 10,000 dots on the screen within the space of one-sixteenth of a second.

Theoretically, this feat might be accomplished by halving the slow disc revolving rate to 960 revolutions per minute, keeping the faster disc at a rate exactly one hundred times greater. But the glass disc would be shattered by the centrifugal force before the attainment of a speed of 96,000 revolutions per minute.

Mr. Jenkins gets over this difficulty by the use of forty-eight lenses attached to a large aluminum disc rotating in front of the prismatic disc, thus giving the effect of a slow-moving lens. Each of these forty-eight lenses makes a line across the plate, which thus becomes the screen of the motion picture apparatus. This makes it possible to reduce the speed to one forty-eighth of that which would otherwise be required, that is, to one of 2,000 revolutions per minute.

At the receiving station, the modulated wave is received by a set but slightly different from many in common use. The last amplifier tube is one of 5 watts. By the use of the McFarlane Moore light already described, the modulations in the plate circuit of the last valve are transformed into light, and the rays are distributed over the screen by prismatic and lens discs similar to those used at the sending station. In actual practice, the picture appears on a screen about 6 in. by 8 in. More powerful lamps would allow of larger pictures.

The process described is for sending photographic pictures. But it can be adapted for the sending of direct views without the intervention of photography.

All that is done in this case, is to remove the projector and focus the lens so that it will throw the view as an image.

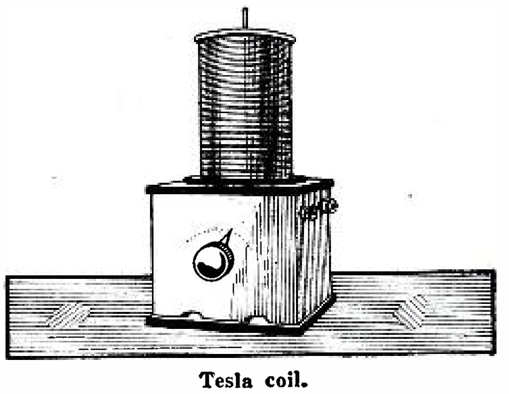
So far as radio features of the transmission are concerned, there is little to be explained. At the receiving station the circuit resembles the superheterodyne. The picture is at 75 kilocycles frequency and does not interfere with broadcasting.

The carrier wave may be modulated with voice frequency, so that the voice can travel with the picture, which enables vocal explanations to be given simultaneously with the flashing of the film or actual scene being transmitted.

TEMPORARY MAGNETS—Magnets which lose their magnetic properties as soon as the magnetizing force is removed. Soft iron displays the properties of a temporary magnet and hence is ideal for use as the core of electromagnets. (See *Magnet, Electromagnet,* also *Permanent Magnet.*)

TERMINAL—A binding post or other fitting attached to the electrodes, ends of windings or other parts of electrical apparatus so as to permit the external circuit to be connected to the apparatus.

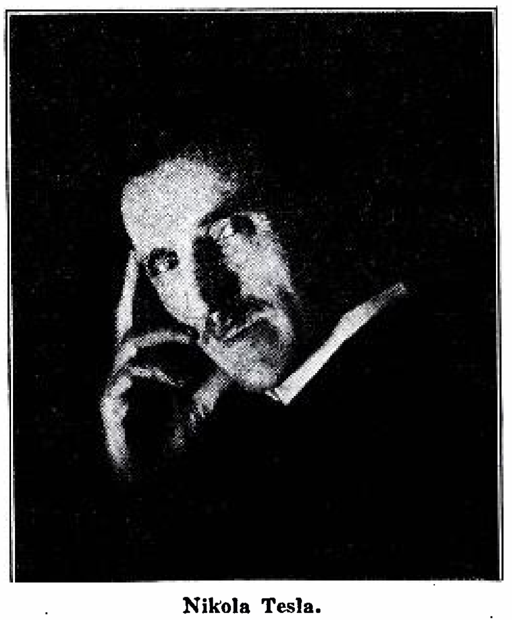
TESLA COIL—An oscillation transformer for producing high potential discharges from oscillations of low potential. The *Tesla Coil* or *Tesla Transformer*, as it is sometimes called, is somewhat similar to the ordinary transformer, although it is much more heavily insulated and has the ends of the secondary connected to a condenser which discharges across a spark gap, thus increasing the rapidity of the oscillations, which then pass into a secondary induction coil. This second coil has no iron core. The Tesla Coil consists essentially of a primary winding having a relatively small number of turns of heavy wire and a secondary having a large number of turns of fine



Tesla coil.

wire. An air, glass, or ebonite dielectric separates the primary and the secondary. Due to the sufficient thickness of the dielectric, there is no possibility of a direct discharge between the two windings. Both the primary winding and the secondary winding consist of but one layer each. The primary winding forms part of an ordinary oscillation discharge circuit. A high frequency electromotive force is induced in the secondary winding, due to the high frequency oscillating currents which flow in the primary winding thus setting up an oscillating magnetic field. Due to the high ratio between the windings of the primary and the secondary, very high voltages are set up in the secondary, in some cases as high as a million volts, and hence a very powerful brush discharge can be obtained.

TESLA, NIKOLA—American electrical and radio expert. Tesla was born at



Nikola Tesla.

Smiljan, in Jugo-Slavia, 1857, and was educated at Graz and Prague Universities. He entered the Austrian Telegraph Service and in 1884 he came to the United States where he became an assistant to Edison. He specialized in the study of high frequency and high potential alternating currents. Tesla is noted for his many revolutionary inventions which include polyphase alternating current systems, the rotating field alternating current motor, arc lighting, the *Tesla transformer* (q.v.), and radio apparatus of many kinds including *radio control* (q.v.) devices.

TESTING CIRCUIT (BUZZER)—A circuit in which a buzzer is used for the purpose of testing or of locating faults in radio apparatus. A buzzer connected in series with a dry cell can be used for locating open circuits and also for testing for short circuits. A buzzer connected in series with a battery and an inductance coil, so as to form a closed circuit and having the inductance coil placed so as to be coupled with the antenna coil of a crystal detector receiving set, can be used to determine the most sensitive point of contact of the crystal. A *tuned buzzer tester* is sometimes used in connection with radio direction finder systems.

THEORY OF CURRENT FLOW—While it is assumed for convenience, that an electric current flows along a conductor from the positive terminal of the source and back to the negative terminal, modern theory is that the electrons actually travel in the opposite direction. Whenever there is a flow of electricity in a conductor, it is believed that extremely small particles of electricity, called *electrons* (q.v.), pass along this conductor. Matter is made up of atoms, which in turn are composed of electrons. The electrons are minute particles of negative electricity revolving around a positive particle. All electric current flow is based upon the motion of electrons within a conductor.

THEORY OF DETECTOR ACTION (OF VACUUM TUBE)—The vacuum tube used as a detector performs a two-fold purpose—it rectifies the current so that it is capable of actuating a telephone receiver and in addition it amplifies or strengthens the current. The rectification takes place due to the fact that the electron flow is only possible from the filament to the plate, but not in the reverse direction. The radio frequency currents applied to the grid regulate tl. number of electrons passing from the filament to the plate, the variation being exactly in accordance with the variations of the radio frequency current. (See *Detector, Vacuum Tube.*)

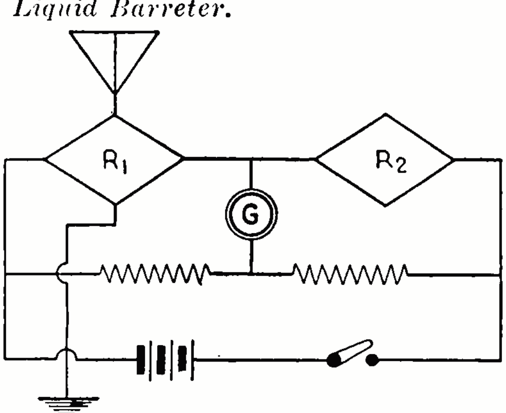
THEORY OF OPERATION OF VACUUM TUBES—The operation of the three-electrode vacuum tube depends upon the emission of electrons from the hot filament to the plate and the control of the flow of these electrons by means of the potential variations applied to the grid. The vacuum tube consists of an evacuated bulb containing a tungsten filament treated with thorium, an anode or plate, which may be in the form of a cylinder or plate, and a grid consisting of a wire grating inserted between the filament and the plate. When the filament is heated it gives forth electrons which are attracted to the plate under the influence of a difference of potential by which the plate is maintained positive with respect to the filament. The grid is an automatic control, regulating the flow of electrons from filament to plate. Potential variations applied to the grid serve to vary the electron flow between the filament and the plate. The circuit in which the vacuum tube is used may be divided into two parts, the input circuit connecting the filament to the grid through the secondary of a transformer or other method or applying potential changes to the grid, and the output circuit between filament and plate. The vacuum tube may be used as a detector or rectifier, as an oscillator or generator of high frequency oscillations, as an amplifier, as an electrostatic voltmeter, as a voltage and current regulator, a power limiting device, etc.

THEORY OF PROPAGATION OF ELECTROMAGNETIC WAVES—Waves are due to vibrations transmitted through a continuous elastic medium. Electromagnetic waves are due to vibrations caused by an oscillating electric charge in a circuit (the transmitting aerial circuit). The current flowing in the aerial is oscillating (surging back and forth) at an enormously high frequency and in addition to its induction field, the aerial has associated with it a *radiation field* which spreads out in all directions from the aerial. The strength of the radiation field decreases in inverse proportion to the distance from the aerial. At any given point the strength is directly proportional to the frequency. The transmission of electromagnetic waves is considered as due to the motion of the lines of force. There is a displacement of electricity along these lines against the elastic force of the medium, termed for convenience the *ether* (q.v.). Displaced electricity continuously tends to go back to its position of rest under the action of the elastic forces. There is pressure at right angles to the lines of force in addition to the tension along them. The pressures may be considered as due to the repulsion between the displaced charges of the same sign in neighboring lines of force.

THEORY OF RECEPTION OF ELECTROMAGNETIC WAVES—As electromagnetic waves cut across a receiving aerial, the electric field intensity along the aerial alternates in value. There is an alternating potential between the aerial and the ground which gives rise to the flow of an alternating current. Another explanation is based on the principle of induction. The magnetic and electric fields, in cutting the aerial, induce electromotive forces which cause current to flow. This is radio frequency current and it is passed to the grid of the detector tube and rectified as explained under *Theory of Detector Action (of Vacuum Tube)*. (See *Electromagnetic Waves.*)

THEORY OF VACUUM TUBE OPERATION—See *Theory of Operation of Vacuum Tubes.*

THERMAL—Pertaining to heat. There are various electrical and radio devices which depend upon heating or thermal properties. The *thermal ammeter* (q.v.) is described under the heading *Hot-Wire Ammeter*. The *thermal detector* is taken up under *Barreter* and *Liquid Barreter.*



A thermal detector. By means of the change of resistance of a conductor, due to heating, electro-magnetic waves are detected. R_1 and R_2 are two rectangles of very fine iron wire.

THERMAL AMMETER—A current meter, in which the current or a fixed proportion of the current in question, passes along a fine wire. This heats the wire, causing it to expand or sag. This deflects a pointer or mirror across a calibrated scale. The thermal ammeter can be used for measuring direct or alternating currents. (See *Electrothermal Meter*, also *Hot-Wire Ammeter.*)

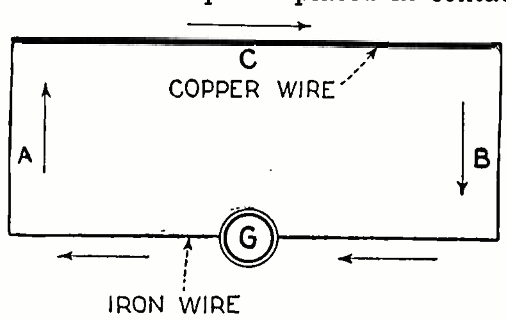
THERMAL DETECTOR—A radio *detector* (q.v.) which depends for its operation upon the heating of a fine wire by the passage of electrical oscillations. (See *Barreter.*)

THERMAL JUNCTION—THERMO-ELECTRIC JUNCTION—The contact *point* or joining point of the two dissimilar metals of a *thermo-electric couple* (q.v.). (See *Klemencic Thermal Junction.*)

THERMAL TELEPHONE—A telephone receiver in which the movements of the diaphragm are regulated by the variations of expansion of a wire heated by the telephone currents thus reproducing sound waves. In another type of thermal telephone, the diaphragm is dispensed with, sound waves being reproduced directly through the expansion and contraction of air in contact with the heated wire. This device is also known as a *thermal receiver* or a *hot-wire telephone.*

THERMIONIC EMISSION—The emission of a stream of negative electrons from a heated filament (cathode) in a vacuum tube.

THERMO-ELECTRIC COUPLE—THERMO-COUPLE—A pair of dissimilar metal pieces placed in contact

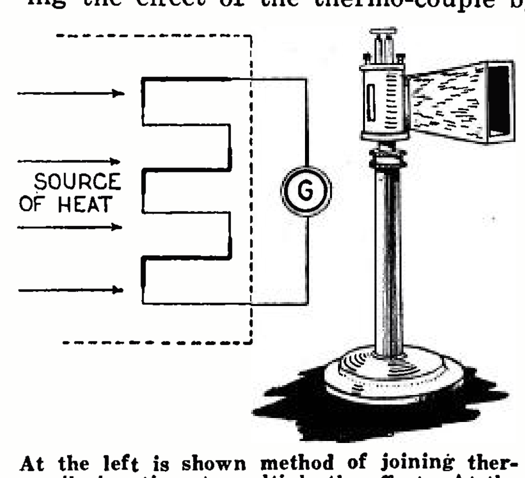


A current is caused to flow by heating the junction of two dissimilar metals. If the end at B is heated the direction of flow will be as shown by the arrows.

and connected by electrical conductors in a closed circuit. When the junction of the two dissimilar metals is heated, an electric current will flow.

THERMO-ELECTRIC CURRENT—A current which is caused to flow due to an electromotive force set up at the junction of two dissimilar metals when these metals are at different temperatures. (See *Peltier Effect.*)

THERMOPILE—A device for magnifying the effect of the thermo-couple by



At the left is shown method of joining thermopile junctions to multiply the effect. At the right is a sensitive thermopile.

connecting a number of these in series and exposing one set of alternate junctions to the heat, thus causing the electromotive forces to add up.

THOMSON EFFECT—The phenomenon of the appearance or disappearance of heat when a current flows from a cold towards a hot part of a conductor. If copper is unequally heated, heat is liberated at a point when the current and the heat flow in the same direction and is absorbed when they flow in opposite directions. The Thomson effect is measured by a quantity termed "the specific heat of electricity."

THORIUM—A rare metal which in certain compounds in radio-active. This metal has a specific gravity of eleven and an atomic weight of 232.5. Thorium is used for coating Welsbach mantles and is also used in connection with the coating of the tungsten filaments used in vacuum tubes. (See *Filament, Thoriated,* also *Thorium Treatment of Filaments.*)

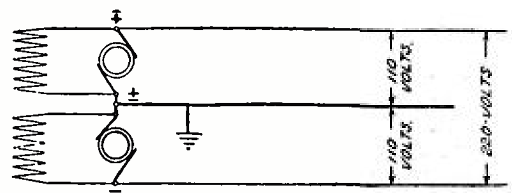
THORIUM TREATMENT OF FILAMENTS—A compound of thorium, thoria (ThO_2) is used extensively in the manufacture of filaments for vacuum tubes. Sometimes thorium nitrate is used for this purpose. The filament so treated is termed thoriated tungsten. Since the rate of electron emission from a thoriated tungsten filament at a given temperature is several thousand times greater than in the case of the ordinary tungsten filament, it is possible to use the former at a much lower temperature. (See *Filament, Thoriated.*)

THREE CIRCUIT TUNER—A *regenerative circuit* (q.v.) in which the primary, the secondary or grid circuit, and the plate circuit are capable of being tuned in resonance with each other.

THREE-ELECTRODE THERMIONIC TUBE—An evacuated bulb or vessel containing a combination of a heated cathode, a relatively cold anode and a third electrode for controlling the current flowing between the other two electrodes. (See *Triode,* also *Vacuum Tube.*)

THREE-ELECTRODE TUBE—The three element thermionic vacuum tube having a filament or cathode, a plate or anode, and a grid. This tube can be used with minor modifications as a *rectifier* (q.v.) or *detector* (q.v.) of radio signals, an *amplifier* (q.v.), an *oscillation generator* (*oscillator* (q.v.)), an *electrostatic voltmeter* (q.v.), as a *power limiting device,* etc.

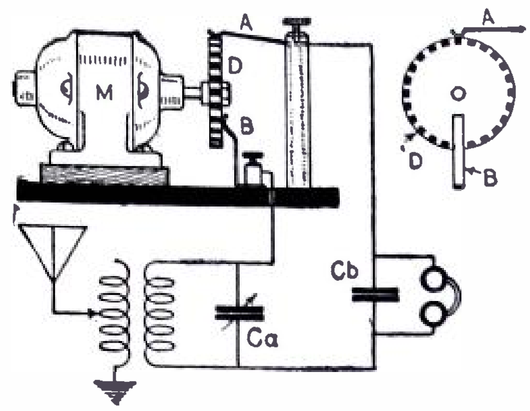
THREE WIRE SYSTEM—In direct current work, a system of transmitting electrical energy, which utilizes three wires, one of which is maintained at a potential, midway between the other two. A part of the load is connected



THE EDISON THREE WIRE SYSTEM

between one wire and the neutral and part between the other wire and the neutral. As a result the neutral wire only carries current equal to the difference in the loads. The main advantages of this system are a saving in copper and availability of double voltage. Thus 110 volts may be required for lights, whereas 220 may be wanted for electric motors. In alternating current work reference is sometimes made to a two-phase three wire system. In this system there are two single phase currents which differ in phase by 90 degrees. Each current has a separate outgoing wire, but unites in a common return wire. (See *Neutral Wire.*)

TICKER or TIKKER—A form of interrupter or an equivalent apparatus, used in sustained wave telegraphy. It is really a commutator interrupter. In a commercial type illustrated, a disk is mounted on a motor shaft. The disk has a number of teeth filled in between with fibre or other insulating material. The radio frequency currents flow



A simple Poulsen ticker. This is used to interrupt circuits of a receiving tuner at a uniform rate per second.

from one brush to the other through the disk which interrupts them at the rate of from 300 to 1000 times per second. A charge is built up in the condenser C_a by resonance with the aerial system and this discharges into the telephone condenser C_b at regular intervals. The telephone condenser then discharges through the head set, thus producing a single sound corresponding to the charge accumulated. Since the tikker discharges the condenser, C_a at different places on the cycle of the incoming oscillations, the note produced is not uniform and is hard to read through atmospheric interference. (See *Chopper*.)

TICKLER—TICKLER COIL—A coil placed in the plate circuit of a regenerative receiver and coupled inductively in the grid coil in order to obtain regeneration. (See *Feed-Back, Feed-Back Coil, Feed-Back Coupling, Regenerative Circuit, Regenerative Coupling,* also *Regeneration*.)

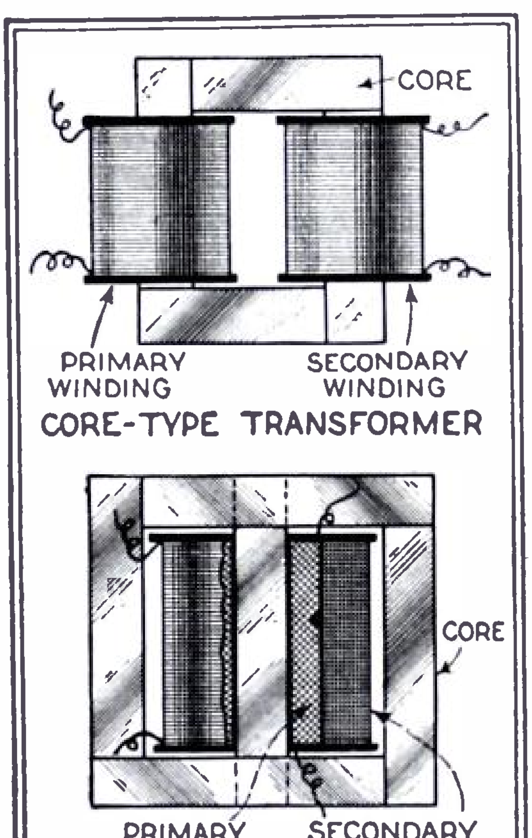
TIME CONSTANT—The ratio, in an electric circuit, of the inductance in henries to the resistance in ohms. It is the time, in seconds, required for a current to attain 63.2 per cent of its ultimate value as given by Ohm's Law. (See *Impulse E.M.F.*)

TONE WHEEL—An apparatus used in the reception of wireless telegraph signals in continuous wave systems, utilizing a wheel in which the conducting teeth are separated by insulating material. A brush is used to make contact with the wheel. The tone wheel is similar in principle to the *tikker* (q.v.) except that it converts the incoming oscillations to audio frequency currents, thus doing away with the non-uniform note of the tikker. In addition to this the tone wheel utilizes more of the incoming energy than does the tikker. The tone wheel is run at such a speed that the frequency of the interruptions differs slightly from that of the incoming oscillations thus giving *beats* (q.v.) which produce audio frequency currents which can be heard in the telephone receiver. Since the tone wheel mechanically converts radio frequency currents into audio frequency currents it is sometimes called a *frequency transformer.*

TORQUE—The moment of a system of forces tending to produce rotation. It is usually measured in foot-pounds. Torque may also be defined as that which produces or tends to produce torsion. Thus if a force acts at a tangent to the periphery of a circle, thus producing a turning moment about the center of the circle, the product of the force and the radius of the circle is called the torque.

TRAIN RADIOPHONE—Communication by means of radio between moving trains and ordinary land-line telephone systems. Such a system is in operation commercially in Germany on trains operating between Berlin and Hamburg. The voice frequency currents from the telephone are impressed on a carrier wave by a method similar to the *Heising Modulation* (q.v.) system. Each train has a special wave length assigned to it. The modulated wave is emitted through a four-wire antenna, strung along the roofs of two coaches. The nearby telegraph wires pick it up and carry it to the receiving sets, located in stations along the line. The ground for the system is obtained through contact of the car wheels with the rails. In reverse order, the voice frequencies of messages from the telephone at the other end are used to modulate a carrier wave (using a different frequency) at the nearest train-telephone switchboard. They are then transmitted over the wires and inductively to the train. An arrangement is provided to prevent interference between the sending and the receiving sets.

TRANSFORMER—A type of induction apparatus, usually stationary, having primary and secondary windings, ordi-



Two standard types of transformers.

narily insulated from each other. These are wound about an iron core. The function of the transformer is to change the electrical energy either increasing or decreasing the voltage, current, frequency or phase. Transformers can only be used in connection with alternating currents. Transformers for changing voltage have a different number of turns in the primary than in the secondary. In the step-up transformer, the primary usually consists of a small number of turns of comparatively heavy wire, while the secondary consists of a larger number of turns of fine wire. The ratio of the primary and secondary windings determines the ratio between the input and the output voltages; thus a 10 to 1 step-up transformer could be used to step a primary voltage of ten to a secondary voltage of 100. There are various methods of classifying transformers, namely, according to their operating characteristics, according to their method of cooling, or to their construction. Transformers which are meant to give a constant voltage on the secondary side are known as *constant potential transformers.* Those meant to give constant current are called *constant current transformers.* Transformers may be air cooled, water cooled or oil cooled. In some cases a natural air draft is used as in transformers of the smaller types. Larger transformers may be designed with special ducts through which blowers force a current of air. Oil cooled transformers may have the cores and windings immersed in oil, or the oil may be circulated through external coils. Water cooled transformers are immersed in oil, but have pipes carrying running water submerged in the oil. According to construction, transformers are of the core type and the shell type. The core type transformer is used more for high voltage, low capacity work, while the shell type is used for low voltages and high capacities. Transformers find a wide application in radio apparatus. *Audio transformers* are used to couple audio frequency circuits as for example in the case of an audio frequency amplifier. Audio transformers have an iron core and may be *shielded* or *unshielded. Radio frequency* transformers are used to couple radio frequency circuits. They are usually of air core type, although in special instances iron cores are used. Transformers are also used in alternating current chargers, in "A" and "B" battery eliminators and in power sets which operate directly from alternating current houselighting circuits. (See *Charger, Storage Battery, Audio Amplifier, Coupling Transformer, Jigger, Intermediate Transformer, Inductive Coupler, Oscillation Transformer, Air Core Transformer, Core Transfomer, Ratio of Transformation,* also *Shielded Transformer.*)

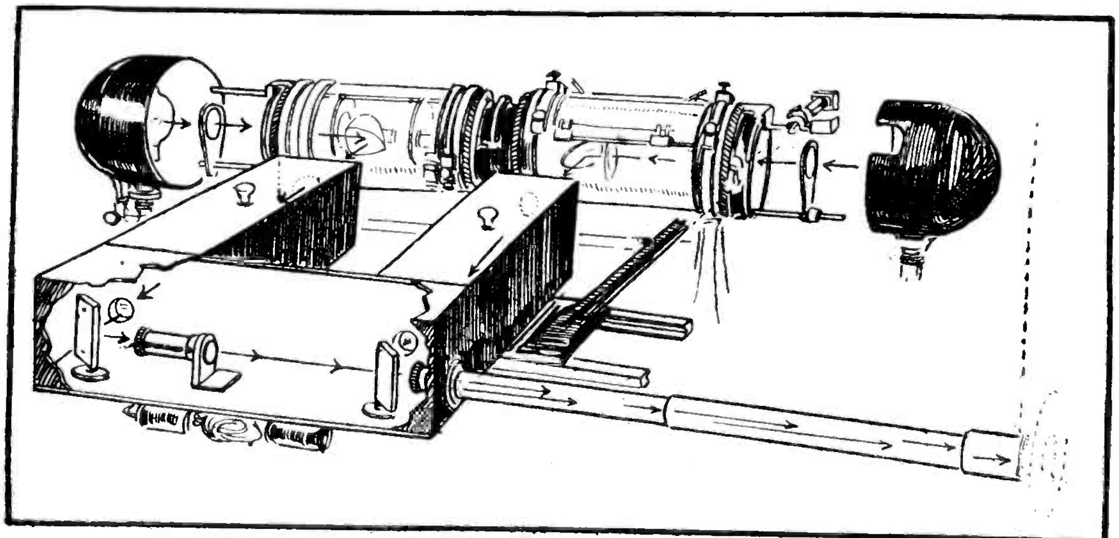
TRANSFORMER COUPLING—A method of transferring the electrical energy of an alternating current from one circuit to another inductively by means of a transformer, one of whose windings is connected in one circuit, the other winding being connected in the second circuit. Radio frequency circuits are usually coupled by *radio frequency transformers, audio frequency transformers* being used to couple audio circuits. (See *Coupling,* also *Amplifier, Intermediate Frequency.*)

TRANSFORMER STEEL—A special steel usually containing a high silicon content used for stamping out transformer laminations. (See *Eddy Currents.*)

TRANSFORMER, TUNED—See *Resonance Transformer.*

TRANSMISSION—As applied to radio communication, this is the sending of signals, speech or music from one point to another by means of electromagnetic waves. (See *Radio Telephony, Radio Telegraphy, Theory of Propagation of Electromagnetic Waves.*)

TRANSMISSION OF PHOTOGRAPHS BY RADIO—Various methods have been devised and are now in use for the transmission of photographs by radio. Among these may be mentioned the systems of *Belin* (q.v.), *Baird*, and *Jenkins*. The principles underlying the Jenkins system are explained under the heading of *Television*. Using the system developed by Capt. R. H. Ranger, photographs were transmitted by radio from Honolulu to New York, a distance of 5,136 miles. Recently commercial picture transmission service has been inaugurated between New York and London using the Ranger apparatus. Two distinct methods have been applied for analyzing the picture in the process of transmission. One arrangement consists of producing an image as a non-conducting deposit upon a metal foil which is traversed by a stylus, while the other method makes use of an opaque image deposited upon a transparent film which is traversed by a beam of light, the light interruptions being recorded by a light sensitive cell. The Ranger system makes use of this latter method. The image is photographically recorded upon a celluloid sheet large enough to accommodate easily a picture of half-plate size. In the case of sketches and written messages the image for transmission is made directly by writing upon a piece of transparent film with a dense black ink. The image is then secured to the face of a glass cylinder, and by means of a lamp, focussing lens and reflecting prism, a narrow pencil of light is passed through the film. The cylinder is mounted on a carrier which is caused to be moved backward and forward so that the beam of light is concentrated in turn on all parts of the picture. A rotary motion is applied, as well as the transverse motion, the cylinder being given a slight rotation when it completes each transverse motion. The beam of light is passed through a special photo-electric cell. This consists of a spherical globe, coated on the inside with potassium hydroxide, which is very sensitive to light. The coating is connected to the grid of a vacuum tube, while an "electron collector" near the center of the tube is joined to the plate of the first amplifier. When no light is falling on the deposit on the inner surface of the globe, the grid acquires a negative charge, stopping the flow of electrons between filament and plate, and hence no current flows in the external circuit. The ray of light, however, causes an electron stream to flow between the coating and the collector, and since the coating is connected to the grid, the electron flow constitutes a discharged circuit, so that the grid becomes less negative. The first amplifying tube is a direct current potential amplifier, and is resistance coupled. The grid and plate connections of the amplifier are connected across a condenser which becomes discharged with the fall in the grid to plate resistance of the valve brought about by the grid potential fluctuations. A charging circuit is connected to the condenser and is controlled by a valve, the grid circuit of which operates by variations of the potential across the condenser. The charging current is fed through the plate circuit of this valve, in which a relay is connected, which working through other mechanical relays in cascades, controls the radio transmitter. Wave trains from the transmitting station after detection and amplification, are applied to the picture recorder. The recording mechanism, in order that it may be sensitive to exceedingly small currents, comprises, a small moving coil, in a magnetic field created by three electromagnets. The coil of wire, in moving in the field, as the received fluctuations are applied through its windings, operates a stylus while travelling across the surface of the paper. The stylus traverses the paper in perfect synchrony with the carriage of the transmitter, the paper being lifted each time the stylus completes a forward and backward movement across the paper. A small flashing neon lamp is used to indicate the correct speed adjustment of the driving motor.



A pencil of light traverses the picture which is attached to the glass drums and is analyzed by a slow rotating action as well as a backwards and forwards movement of the carrier.

TRANSMITTER—An apparatus for sending out electrical messages. As applied to radio telegraphy or radio telephony, the transmitter refers to the entire sending apparatus. The term transmitter is often used to refer to a *telephone transmitter* (q.v.). (See *Automatic Transmitter*, also *Wheatstone Transmitter*.)

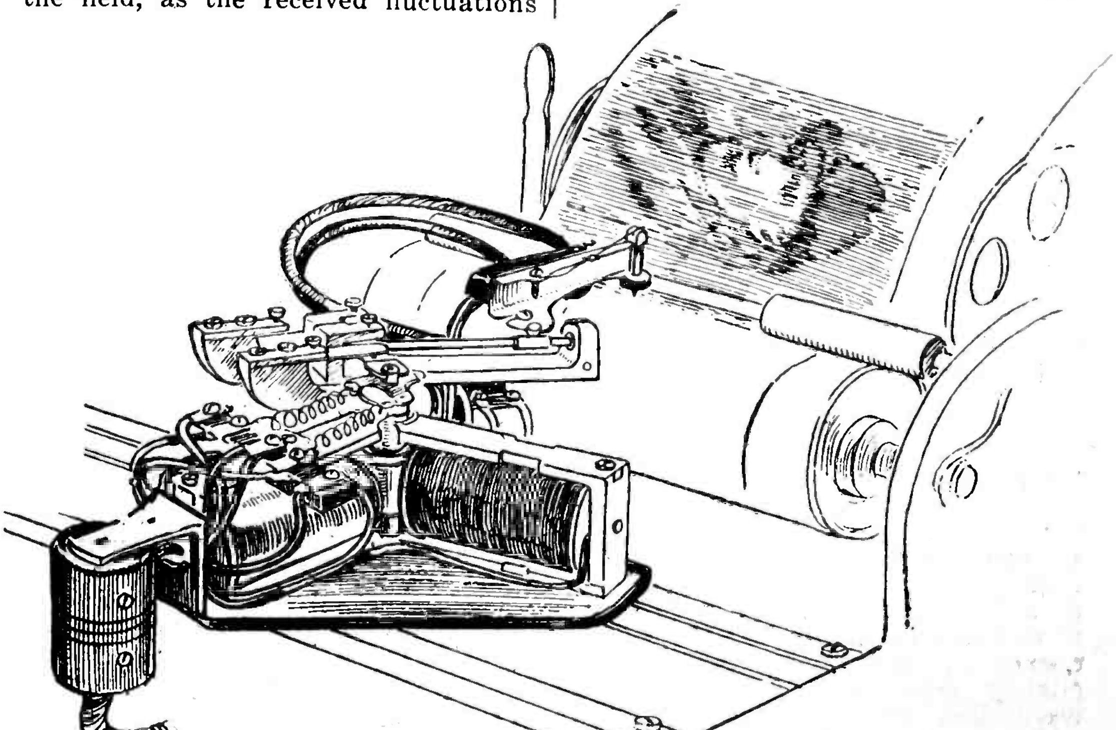
TRANSMITTING AERIAL—A wire, or more usually a group of wires, suspended at a suitable height and connected to a radio transmitting set. The purpose of the aerial is to facilitate the radiation of the electromagnetic waves generated by the high frequency oscillating current which flows in the aerial. (See *Directional*, also *Receiving Aerial*.)

TRANSMITTING JIGGER—An *oscillation transformer* (q.v.) having a variable secondary, permitting of various degrees of coupling, by adjustment, between the two circuits. (See *Jigger*).

TRANSMITTING KEY—A telegraph key, used in the sending of radio code messages. This key must be of rather heavy construction since it handles larger currents than those used in ordinary wire telegraphy. Pressing the key, closes the circuit, and by holding the key down for a longer or a shorter period, the dots and dashes of the continental code are reproduced. (See *Code, Key, Key High Speed*.)

TRANSMITTING TUBE, POWER RATING—The useful power output from an oscillating tube is the power expended by the oscillating current in the resistance of the output circuit. The power input to the tube, not counting that expended in heating the filament, is the product of the plate supply voltage and the average plate current during an oscillation.

TREMBLER—A springy metallic blade carrying a soft iron armature. The spring makes contact with a fixed contact point, but when current passes through the electromagnet, the armature is attracted and the contact is broken. The spring then resumes its normal position, re-establishing the contact and the same process is re-



The recording mechanism of the receiver. Three electromagnets produce the magnetic field in which a moving coil controls the stylus.

peated again and again. (See *Interrupter.*)

TRIGGER BATTERY—A term (seldom used) denoting a small battery inserted in the grid circuit to give the grid its initial charge when a tube is being used for radio transmission. In this connection, the battery is used to replace the potentiometer. (See *Grid Battery,* also *Grid Bias.*)

TRIODE — A name used to designate the three-electrode type of *thermionic tube.* Other names sometimes applied to the same device are *audion* (q.v.), *audiotron, aerotron, electron relay* (q.v.), *electron tube* (q.v.), *pliotron* (q.v.), *thermionic valve, oscillion* (q.v.), *vacuum tube* (q.v.), etc. (See *Three-Electrode Thermionic Tube.*)

TRUE POWER—The product of the *apparent power* and the *power factor* (q.v.) in an alternating current circuit. (See *Power, True,* also *Power, Apparent.*)

"T" TYPE AERIAL—See *"T" Antenna.*

TUBE OF FORCE—A theoretical conception, similar to *Line of Force* (q.v.) used in mathematical considerations of electrostatic or electromagnetic fields.

TUBE RECTIFIER—A vacuum tube or gas filled tube used to change or rectify alternating current to direct current. The principle of the action of the vacuum tube rectifier is the fact that the electrons will flow from the hot filament to the plate, but not in the reverse direction. Tubes are made for half-wave or full-wave rectification. (See *Rectifying Tube.*)

by short transverse ribs for the purpose of giving strength to the plate. This gives a large surface and since there is no central web, the electrolyte is enabled to circulate through the plate thus working the active material uniformly.

TUNED ANTENNA — A transmitting aerial, having a loading inductance or a variable condenser or both in series with it, for the purpose of changing the antenna wave length.

TUNED IMPEDANCE—This refers especially to a circuit, or to a method of radio frequency amplification in which a tuned inductance connected in parallel with a variable condenser is used as the method of coupling rather than transformer or resistance coupling. (See *Impedance Coupled Amplifier.*)

TUNED RADIO FREQUENCY — See *Tuned Radio Frequency Circuit.*

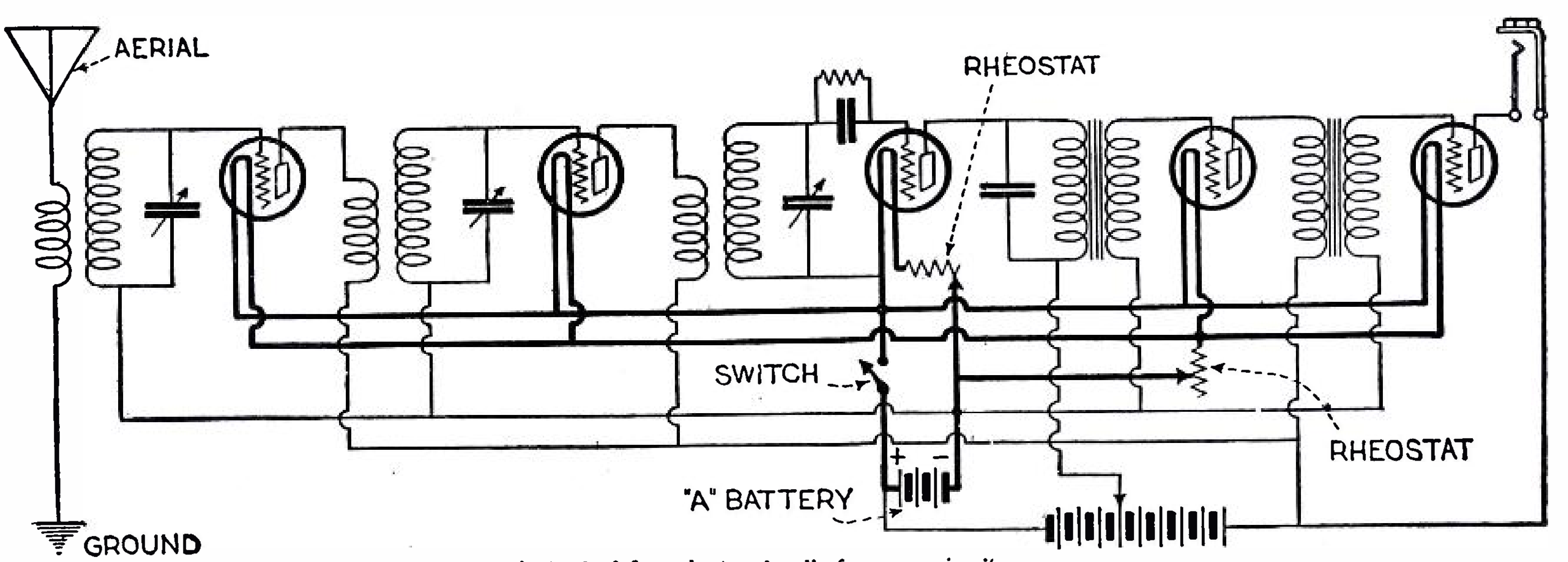
TUNED RADIO FREQUENCY AMPLIFIER—A combination of a *radio frequency transformer,* a variable condenser and an amplifying vacuum tube in a radio receiving circuit for the purpose of increasing the intensity or amplifying the radio frequency signals.

TUNED RADIO FREQUENCY CIRCUIT—A radio receiving circuit employing radio frequency amplification in which the radio frequency amplifier circuits may be tuned to the desired wave lengths by varying the inductance or the capacity, or both although the usual method of tuning is by means of a variable condenser in parallel with the secondary of the radio frequency transformer. A typical five-tube tuned radio frequency circuit is shown in the accompanying illustration. This consists of two stages of tuned radio frequency amplification, a detector and two stages of audio frequency amplification.

TUNED TRANSFORMER — See *Resonance Transformer.*

TUNGAR — A trade name for a two-electrode vacuum tube especially designed for rectifying purposes. Tungar tubes are made in two ampere and five ampere capacities. They are used in *chargers* (q.v.) and also in radio sets operating directly from the lighting socket without the use of batteries. (See *Rectifying Tube.*)

A typical rectifier tube of the Tungar type. The screw-base allows it to be inserted in a standard lamp socket from which current is obtained for the filament. Connection is made to the graphite disc by means of a Fahnestock connector which clips on to the wire post projecting from the other end of the tube.



A standard five tube tuned radio frequency circuit.

TUBE, THREE ELEMENT—See *Triode,* also *Three-Electrode Thermionic Tube.*

TUBE, TWO ELEMENT—See *Fleming Valve.*

TUBING—In general, this refers to the bakelite or hard rubber forms used to wind inductance coils on. Another type of radio tubing is defined under *Spaghetti.*

TUDOR ACCUMULATOR — A storage battery having special positive plates formed by the *Plante* process and negative plates of the *Faure* or pasted type. The Tudor positive is of the cast-lead type. This plate has no central web and is made by casting pure soft lead in a mold. Casting is advantageous since it permits the distribution of the metal in the plate without limitations in the manufacturing process. After the plate is removed from the mold, its surface consists of a large number of short vertical ribs which run entirely through the plate. These are bound together

TUNED RADIO FREQUENCY TRANSFORMERS — An air core *transformer* (q.v.) shunted by a variable condenser used in a *tuned radio frequency circuit* (q.v.). (See *Fixed Coils,* also *Low Loss Coils.*)

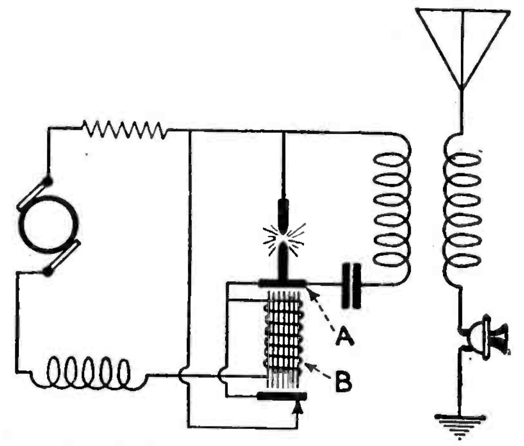
TUNED TELEPHONE — One in which the diaphragm is adjusted to vibrate at the same frequency as the current impulses to be indicated. In addition the telephone circuit may have its inductance and capacitance chosen to have the same electrical frequency, and a tuned acoustic resonator may intervene between the diaphragm and the ear.

TUNING — The process of regulating the inductance and the capacity of a radio circuit in order to be in unison with a desired wave length.

TUNING, BROAD—Reception of a signal over a wide range, that is on a number of wave lengths, rather than on a single one. A receiving set which tunes broadly cannot be used where the broadcasting stations are transmitting on wave lengths near to one another. Too long an aerial may result in a receiving set tuning broadly. (See *Selectivity.*)

TUNING COIL—A coil of wire so arranged that each turn is electrically insulated from its neighbor and with a device by which contact may be made to bring any desired number of turns into the circuit so as to increase or decrease the inductance of a radio circuit so as to tune it to the desired wave length. A variable *inductance* (q.v.) used for tuning an oscillatory circuit. (See *Lengthening Coil.*)

T.Y.K. ARC—A transmitting arc used for radio telephony invented by W. Torikata, E. Yokoyama and M. Kitamura of Japan. This arc uses magnetite and brass electrodes instead of copper-carbon electrodes. A circuit diagram of the T.Y.K. system is shown in the illustration. The materials used for the electrodes are such that a high resistance film forms on their surfaces. This requires a temporary high voltage to start the discharge. This is accomplished as follows: An armature, A, is attached to one of the electrodes. The two electrodes are in contact, and a steady current is caused to flow in



Circuit diagram of the T. Y. K. arc.

the circuit, through the spark induction coil B. This attracts the armature A, drawing the electrodes apart. The break of the spark coil current at its interrupter induces a high electromotive force which, acting through the coil and the spark gap in series, breaks down the film on the gap electrodes. The power supplied to the gap is 500 volts and 0.2 ampere. A condenser of approximately .05 mfd. is used in the primary oscillating circuit.

T.Y.K. sets have been used only in small units, having a range of 30 or 40 miles.

Several unusual features appear in the circuit shown in the accompanying illustration, which gives the circuit diagram of the T.Y.K. arc.

U

ULTRA-AUDION—A name sometimes applied to the vacuum tube used in connection with *beat* reception for supplying local oscillations. In general, however, the name ultra-audion applies to a circuit for radio reception. (See *Ultra-Audion Circuit.*)

ULTRA-AUDION CIRCUIT—A type of circuit used for long wave radio recep-

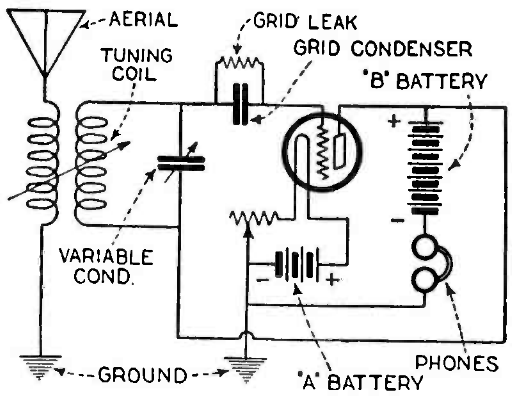


Diagram of an ultra-audion regenerative circuit.

tion which uses a form of regeneration, without calling for the introduction of auxiliary equipment in the circuit. A typical ultra-audion circuit is illustrated. It will be noticed that while one terminal of the secondary goes to the grid, the other terminal, which usually goes to the filament, in this case goes to the plate. Thus there is a direct plate-filament circuit which does not involve the plate and filament batteries in the usual manner.

ULTRADYNE—A modification of the *super-heterodyne circuit* (q.v.), which uses the modulation method to produce beats. In this method the incoming signal is caused to modulate the oscillations produced locally in a similar way to that in which the speech or music modulate the carrier wave of a broadcast station. It is claimed that this method is simpler than the ordinary super-heterodyne and also more sensitive to weak signals.

The circuit of the improved model L-2 Ultradyne, incorporating regeneration is shown below. The long wave intermediate transformers are accurately tuned to a wave length of 3000 meters. Referring to the diagram, it will be noted that a special form of oscillator, comprising a grid and plate coil, are used together with an oscillator tuning condenser connected across the grid coil. The first tube, which is usually the detector in the standard super-heterodyne circuit, is known as the modulator tube. (See *Super-Heterodyne Receiver.*)

UMBRELLA ANTENNA—An antenna, the conductors of which form elements of a cone with the apex at the top to which the *down lead* (q.v.) is connected.

UNDAMPED—See *Undamped Alternating Current,* also *Undamped Waves.*

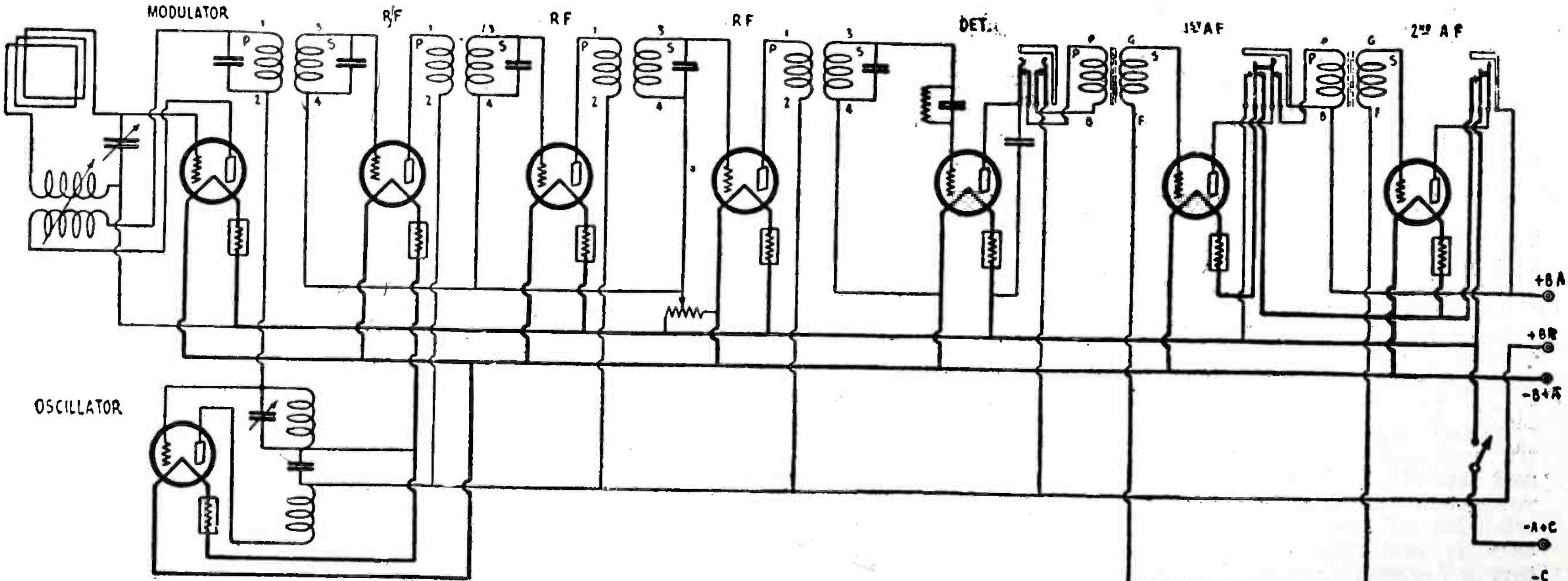
UNDAMPED ALTERNATING CURRENT—Periodic current (i.e., current passing through successive equal cycles of values) whose average value is zero.

UNDAMPED OSCILLATIONS—Oscillations which are sustained. *Undamped alternating current* (q.v.). Oscillations such as are generated by a *vacuum tube oscillator* or by an *arc generator.*

UNDAMPED WAVES—Continuous waves. Waves in which similar current cycles follow each other continuously instead of being broken up into groups. (See *Sustained Waves, Decadent Wave,* also *Damped Waves.*)

UNITS—Specified amounts of physical quantities used as a basis of measurement. (See *Practical Units.*)

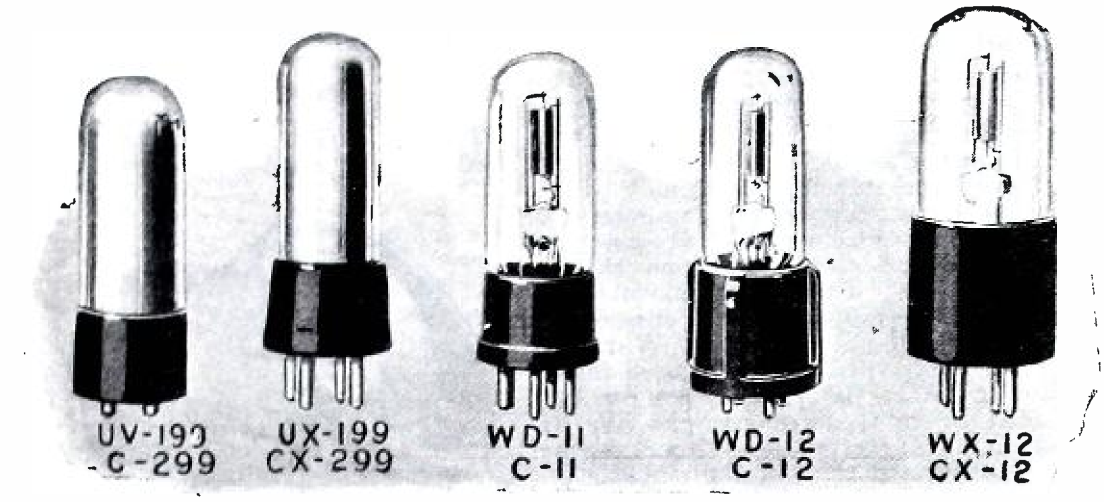
UNITS, ELECTROMAGNETIC—See *Electromagnetic Units.*



This shows the hook-up of the Ultradyne super-het. This set is not radically different from the average super-heterodyne. The heteroformers are of the tuned air core type and the filter is shown at the input side of the circuit. Aerial and ground as well as loop may be used with this set and instead of the first detector the inventor uses a tube known as the "modulator."

V

VACUUM TUBE—An evacuated bulb, or one containing a rare gas and having three elements, filament, plate and grid. (See *Three-Electrode Thermionic Tube, Triode,* also *Dynatron.*)



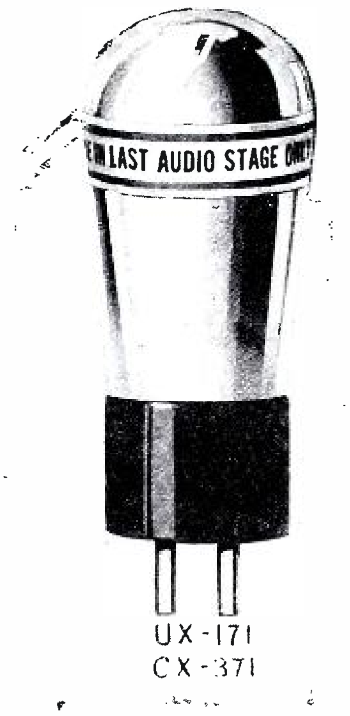
A group of dry-cell vacuum tubes. The first two differ only as to the type of base; both are intended to be operated from a 4½-volt "A" battery, that is, three dry-cells connected in series. The filaments draw very little current, as can be determined from the chart. The last three tubes also have identical characteristics, but are designed to fit different types of sockets. These tubes operate from a single 1½-volt dry cell and draw approximately ¼ ampere of current. The filaments are oxide-coated and very rugged.

VACUUM TUBE AMPLIFIER, THEORY OF—The vacuum tube may be used as an amplifier or magnifier because of the fact that under proper conditions, a small variation of the electromotive force applied between the filament and the grid produces a very large variation in the current flowing in the plate circuit. It is usual to use several amplifying tubes together, suitably coupling the plate of one tube to the grid of the next, thus increasing the amplification to the desired value.

VACUUM TUBE CHARACTERISTICS Performance curves of vacuum tubes. These are obtained experimentally by keeping the filament current constant and applying various known voltages between the plate and the filament and between the grid and the filament and reading the resultant currents that flow to the plate and the grid. The various values obtained are then plotted on cross-section or graph paper. Such curves are convenient for determining the operating characteristics of a particular vacuum tube under consideration. (See *Characteristic Curve.*)

VACUUM TUBE GENERATOR—The vacuum tube can be used to produce sustained oscillations without the necessity of supplying potential variations to the grid from an external source. This can be accomplished as a direct result of the amplification properties of the vacuum tube, since the energy of the output circuit is greater than the energy of the input circuit and part of this output energy may be returned to the input to produce constant reamplification.

VACUUM TUBE, POWER—A tube of special design, made for use in the last audio stage of a radio receiving set, which will handle greater current than the ordinary amplifying tube, thus resulting in more volume and at the same time clearer and more satisfactory tone reproduction. Power tubes now on the market require higher plate voltages than conventional tubes, ranging from 135 volts upwards. The amount of grid bias or "C" battery ranges from approximately 4½ volts to 45 volts, depending upon the type of power tube. Tubes suitable for developing considerable power, in radio transmission are also referred to as power tubes. By increasing the surface area and hence the filament emission or by increasing the degree of evacuation of the bulb, thus allowing a higher plate voltage, the output of the tube may be increased. A form of transmitting power tube is described under the heading *Pliotron.* The illustration below shows one of the new power tubes used for reception.



A new storage-battery type power amplifier tube, for use in the last stage audio amplifier only. This tube takes the same filament voltage and filament current as the No. 112 tube but employs a "B" voltage of 180 and 40½-volt "C" battery. Special means should be provided for handling its heavy output.

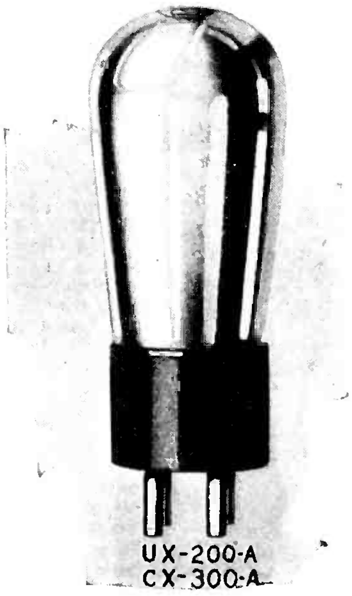
VACUUM TUBE RECTIFIER—A vacuum tube designed or used to change alternating current to direct current. (See *Rectifying Tube, Kenotron,* also *Tube Rectifier.*)

VACUUM TUBE, THEORY OF OPERATION—See *Theory of Operation of Vacuum Tubes.*

CHART OF VACUUM TUBE TYPES AND CHARACTERISTICS

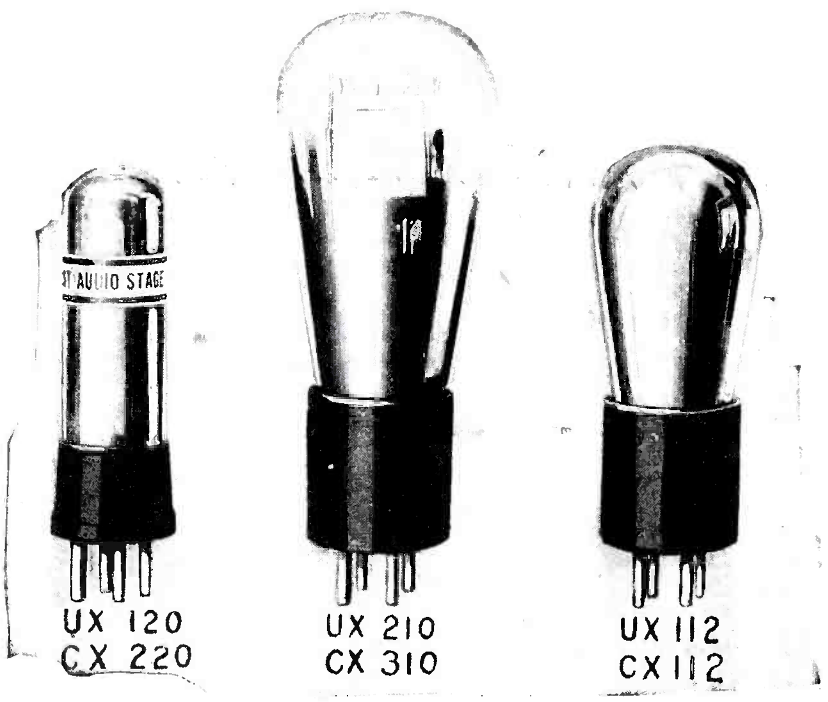
TYPE	USE	"A" battery volts (Supply)	Filament Terminal Volts	"A" Battery Current Amperes	"B" Battery Volts Det.	"B" Battery Volts Amp.	Negative "C" Battery Volts	Voltage Amplification Factor	Output Resistance Ohms
UV. UX-199 C. CX-299	Det. or Amp.	4.5	3	.06	45	90	4.5	6.25	15,000
UV. UX-200 C. CX-300	Det. only	6	5	1.0	16 to 22½				
UX-200-A CX300-A	Det. only	6	5	.25	Max. 45				
UV. UX.201-A C. CX. 201-A	Det. or Amp.	6	5	.25	45	90 to 135	4.5 9.0	8 8	12,000 11,000
UX-120 CX-220	Pow. Amp. (Lst. stg. only)	4.5	3	.125		135	22.5	3.3	6,600
UX-112 CX-112	Det. or Amp.	6	5	.5	22½ to 45	135	9.0	Var.	Var.
UX-171 CX-371	Pow. Amp. (Lst. stg. only)	6	5	.5		180	40.5		
UX-210 CX-310	Pow. Amp. Oscillator	6	6	1.1		90 to 425	4.5 to 35	Var.	Var.
WD-11 C-11	Det. or Amp.	1.5	1.1	.25	22½	90	4.5	5.6	14,000
WD. WX-12 WX. CX-12	Det. or Amp.	1.5	1.1	.25	22½	90	4.5	5.6	14,000
3VB-199 3VBX-199	Det. or Amp.	4.5	3	.06	20	80	4.5	6.0	
3V-A 3VAX	Det. or Amp.	4.5	3	.12	20	90	4.5	6.5	
5V-A 5VAX	Det. or Amp.	6	5	.25	20	100	4.5 to 9.0	9.4	9,400
5VC 5VX	Pow. Amp. or Det.	6	5	.5	22½	90 to 157½	6 to 10.5	8.6	5,900
99 99X	Det. or Amp.	4.5	3	.06	22½	90 to 150	3 to 12		
O1A O1X	Det. or Amp.	6	5	.25	22½	90 to 150	3 to 12		
MU-20	Audio Amp.	6	6	.25		90 to 150	4.5 to 10.5	20	40,000
MU-6	Pow. Amp. (Lst. stg. only)	6	6	.5		90 to 150	4.5 to 10.5	6	5,000
B-6	Det. only	6	5	.25	16 to 22½				
A	Det. or Amp.	6	5	.25	20	120	4.5 to 9		
B C	Det. or Amp.	4.5	3	.06	20	80	4.5		
E	Pow. Amp. (Lst. stg. only)	4.5	3	.125		135	22.5		
F	Pow. Amp. (Lst. stg. only)	6	5	.5		90 to 180	4.5 to 9		
G	Audio Amp.	6	5	.25		90 to 180	4.5 to 9		
DC—	Det. or Amp.	4.5	3	.06	45	90	4.5	6.3	16,500
DC—	Det. or Amp.	6	5	.25	45	90	4.5	8.5	10,000
DC—	Pow. Amp. (Lst. stg. only)	4.5	3	.125		112 to 135	13 to 22.5	3.3	6,300
DC—	Pow. Amp. (Lst. stg. only)	6	5	.5		90 to 157.5	6 to 10.5	8.0	8,500

VACUUM TUBES, TYPES OF—Vacuum tubes are of various types and designs depending upon the work which they must do. They may be divided into two general classes, receiving tubes and transmitting tubes.



A new type of detector tube which has greater sensitivity than former types, due to the use of an alkaline vapor. It can be used as a detector in any type of receiving circuit.

Tubes for receiving purposes are designed either for dry cell operation or else are of the storage battery type.



These power amplifier tubes are designed for use in the last stage of an audio frequency amplifier. On the left is a dry cell tube which requires a 4½-volt "A" battery. The center tube employs exceptionally high "B" battery voltage, and is usually employed with an amplifier that operates from the house current. This tube can also be used for transmitting purposes. The right-hand tube is of the storage battery type and has a very rugged filament. It makes an excellent detector tube as well as a power amplifier.

They may be further classified as detector tubes, amplifying tubes or power tubes. There are many special types of tubes, such as *kenotrons* (q.v.), *pliotrons* (q.v.), etc.

VALENCY—The property possessed by elements in combining with or replacing other elements in a certain definite proportion. Also referred to as *valence*. (See *Electro-Chemical Equivalent.*)

VALVE—This generally refers to a vacuum tube used as a detector or rectifier. The name *valve* is used in many foreign countries to refer to the thermionic vacuum tube, as used for any purpose.

VALVE DETECTOR—See *Valve.*

VARIABLE CONDENSER—A condenser having rotable or movable metal plates and an air dielectric. Both the stationary and rotating plates may be made of brass, copper or aluminum. Bakelite, fibre or composition are used to insulate the stationary from the movable plates. Turning the movable plates either increases or decreases the capacity of the condenser. Variable condensers are primarily used in radio for *tuning* (q.v.). They are constructed so as to have straight line frequency characteristics either by undercutting a portion of the movable plates or else by making these of a variable thickness.

VARIABLE GRID LEAK—A variable high resistance unit designed to be placed in the grid circuit of a vacuum tube used as a detector. Certain types of variable grid leaks may have their resistance varied from ¼ megohm to 10 or more megohms by merely tightening a thumb-screw. (See *Grid Leak,* also *Adjustable Grid Leak.*)

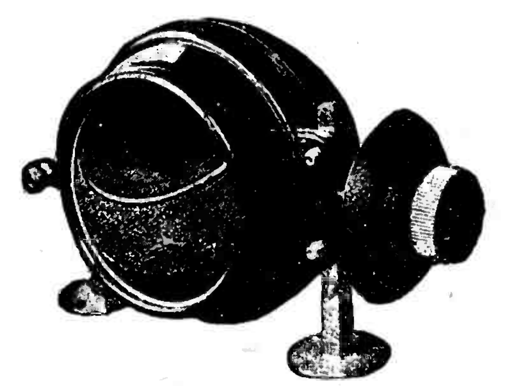
VARIABLE RATIO TRANSFORMER—A transformer in which the ratio between the primary and the secondary windings can be varied, usually by means of suitably located taps.

VARIABLE RESISTANCE—Both the *rheostat* and the potentiometer used in radio work, are variable resistances. Variable resistances are usually of high resistance wire type, with a sliding contact so that the resistance can be easily altered.

VARIO COUPLER—A tuner formerly used in radio receiving sets, having a

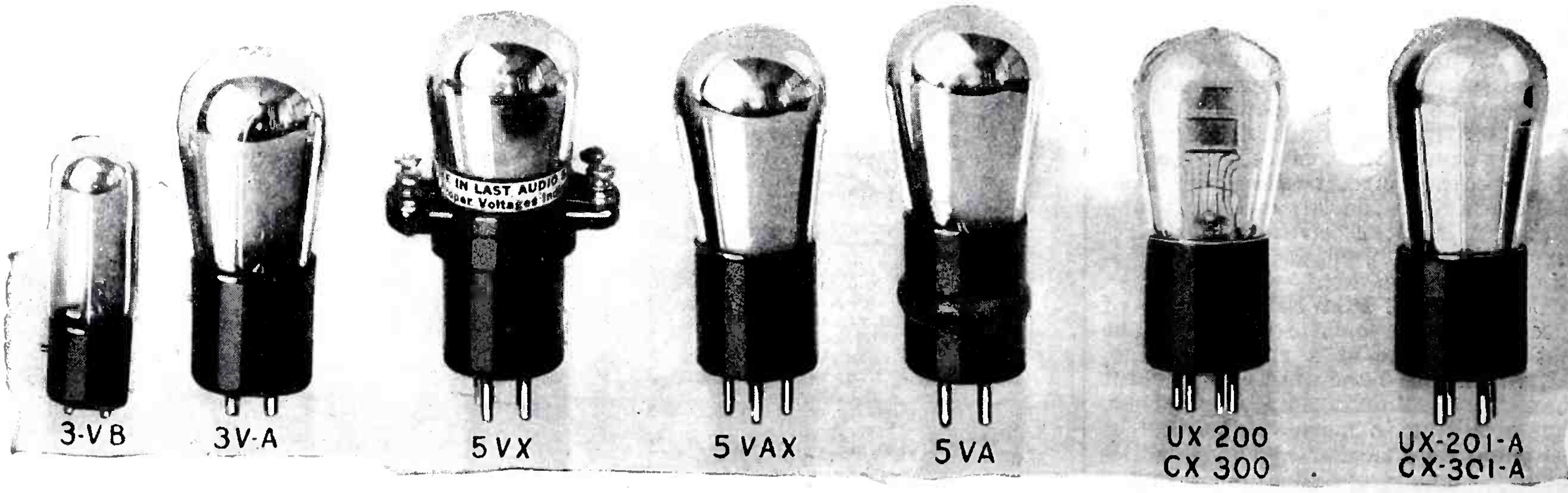
A standard form of vario coupler.

primary and a secondary coil inductively coupled, with the secondary arranged so as to be rotable within the primary. The amount of coupling depends upon the variation of the angle between the axes of the two coils.



A variometer.

VARIOMETER—A tuner, similar to the vario-coupler, except that the primary and secondary coils are electrically connected.



The characteristics of these vacuum tubes are given in the vacuum tube chart on page 187. The first tube is of the dry-cell type, requiring a 4½-volt "A" battery for lighting the filament. 3V-A is a standard 5-volt tube. 5VX is a power amplifier which can be used in the last stage of any audio-frequency amplifier. There is no necessity of changing any of the wiring in the set for the addition of more "B" battery, as binding posts are included on the tube itself. 5VA has a sponge rubber ring included as a part of the base which tends to absorb all vibrations which might otherwise cause the tube to become noisy. The next type of tube is for use as a detector only. The last is the well-known 201-A type, which can be employed as a detector or an amplifier.

VECTOR—A graphical illustration used in mathematical calculations, consisting of a line with an arrow-head at one end, used to show by means of its length, direction and the angle between itself and another vector or vectors, the magnitude, direction and phase angle of alternating current quantities.

VELOCITY—The distance passed through in a certain time. Velocity is measured in feet per second, miles per hour, etc.

VIBRATION—A to and fro motion. An oscillating or swinging motion.

VITREOUS—Consisting of or pertaining to glass. (See *Resinous Electricity.*)

VOLT—The practical unit of *electromotive force* (q.v.). The volt is a measure of the electromotive force which will cause a current of one ampere to flow through a resistance of one ohm. It is equal to 10^8 absolute electromagnetic units (Abvolts).

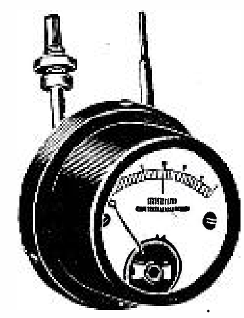
VOLTAGE—The electrical pressure or the electromotive force between two points in an electrical circuit, measured in volts.

VOLTAGE, CONSTANT—A steady unvarying electrical pressure or electromotive force, as differentiated from a pulsating or fluctuating voltage.

VOLTAGE DROP—The fall in potential caused by the resistance of the conductor through which the current is flowing. The longer the conductor, the greater will be the voltage drop. The greater the cross-section of the conductor, the less will be the voltage drop.

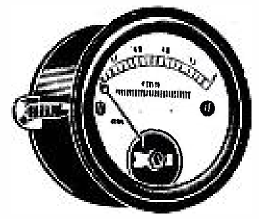
VOLT-AMPERES—The product of volts as measured with a voltmeter, by the current as shown on an ammeter, in an alternating current circuit, gives the apparent power, or in other words the apparent watts. (See *Instantaneous Values.*)

VOLTMETER—An instrument for measuring voltage drop or potential difference. Most of the voltmeters



A plug-in type of voltmeter.

used in radio work operate on the moving coil principle. (See *Galvanometer.*)



Panel-type of voltmeter.

VOLTMETER CALIBRATION—A method of correctly marking the voltage readings on the scale of a voltmeter or of checking up the voltmeter readings to make sure that they are accurate. The usual method of calibration is to check the voltmeter reading by comparison with a standard voltmeter. (See *Calibration.*)

V.T.—Abbreviation for *vacuum tube.*

VULCANITE — (EBONITE) — A hard black substance produced by vulcanizing rubber with about 25 per cent sulphur. It is readily polished and has excellent insulating properties.

VULCANIZED RUBBER—Pure rubber, mixed with five per cent sulphur and baked at a temperature of about 150 degrees Centigrade. Vulcanized rubber must not be allowed to come into contact with copper, which is chemically attacked by the sulphur.

W

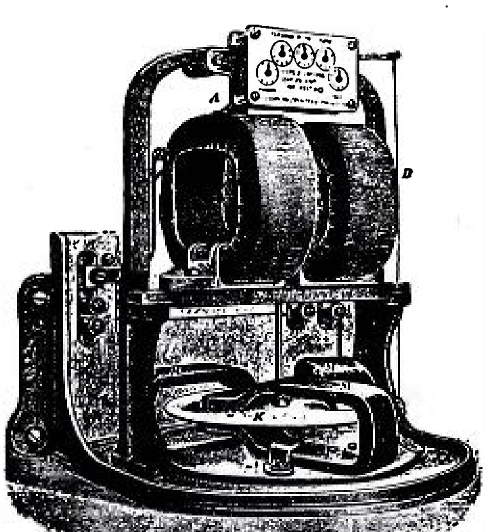
WALL TUBE—See *Partition Insulator.*

WATCHCASE RECEIVER—A telephone receiver having a shape somewhat similar to a watch. Watch case receivers are compact in construction and are the usual type used in the radio telephone *head set.*

WATT—The unit of electric power. One *Joule* (q.v.) per second. To find power in a direct current circuit, multiply voltage by amperage. The *Kilowatt* (q.v.) equals one thousand watts. Seven hundred and forty-six watts are equivalent to one electrical horsepower.

WATT HOUR—The commercial unit of electrical work. The work done in one hour by a current of one ampere flowing between two points of a conductor having a difference of potential of one volt.

WATT-HOUR METER—An integrating



A direct current watt-hour meter.

meter which measures energy in watt-hours or in kilowatt-hours. (See *Integrating Wattmeter.*)

WATT, INTERNATIONAL—symbol W —The energy expended per second by an unvarying electric current of one International ampere under an electrical pressure of one International volt. IW = 1 Joule per second = 10^7 ergs per second.

WATTLESS COMPONENT—WATTLESS CURRENT—The component of an alternating current which is in quadrature with the voltage. (See *Reactive Component.*)

WATTMETER—An instrument designed to measure the power being expended in an electrical circuit. The most common form of direct current wattmeter is of the dynamometer type. This has two coils, one fixed and one movable, one coil being connected so as to exert a force proportional to the current flowing in the circuit, and the other coil exerting a force proportional to the electromotive force. The *induction* type of wattmeter is in general use for alternating current circuits. (See *Electro-Dynamometer, Dynamometer,* also *Induction Wattmeter.*)

WATT SECOND—A unit of electrical energy, representing the energy expended by one watt flowing for a second. The watt second is the same as the *Joule* (q.v.) and is usually applied to the measurement of heat developed by an electric current.

WAVE—A periodic alternation of an alternating current. As applied to an electric or electromagnetic disturbance, an electric wave is an undulatory movement of the ether, radiated from conductors carrying electrical oscillations.

WAVE ANALYSIS—A study of the wave form of an alternating current or other type of wave. The wave form of commercial alternating current used for lighting purposes approximates a *sine curve* (q.v.). A convenient instrument for the analysis and study of alternating current wave form is known as the *oscillograph* (q.v.).

WAVE ANTENNA—A horizontal antenna, the physical length of which is approximately equal to the length of signaling waves to be received, and which is so used as to be strongly directional.

WAVE DISTORTION—Alteration in the wave form of a wave after it has traversed a considerable distance. (See *Distortion.*)

WAVE FORM—Referring to an alternator, the "shape" of the curve of the current generated.

WAVE FREQUENCY—See *Frequency.*

WAVE LENGTH—symbol λ (lambda) —The distance between two successive *antinodes* (q.v.) in the same direction. In referring to the wave length of electrical oscillations in a circuit, this means the length of the waves in free space that would have a frequency corresponding to the given oscillations. Electromagnetic waves used in radio work have frequencies of from 10,000 to 3,000,000 cycles per second. Since these waves have a velocity of approximately 300,000,000 meters per second, it is possible to calculate the length of a wave by dividing the velocity by the frequency. In other words meters per second divided by cycles per second gives length of the wave in meters. Thus a wave having a frequency of 100 kilocycles (100,000 cycles) will have a wave length of 300,000,000 divided by 100,000 or 3,000 meters.

WAVE LENGTH ALLOCATIONS—In order to prevent radio transmitting stations from interfering with each other, or creating interference at a receiving station, various wave length bands have been allotted to each type of service. The following table shows the present short wave assignments and the service for which they are used:

Wave-length in Meters	*Service*
109–105	Relay broadcasting only.
105–85.7	Public toll service, Government mobile, and point-to-point communication by electric power supply utilities, and point-to-point and multiple address message service by press organizations only.
85.7 –75.0	Amateur, Army mobile, naval aircraft, and naval vessels working aircraft only.
75.0 –66.3	Public toll service, mobile Government point-to-point and point-to-point public utilities.
66.3 –60.0	Relay broadcasting only.
60.0 –54.5	Public toll service only.
54.5 –52.6	Relay broadcasting only.
52.6 –42.8	Point-to-point only.
42.8 –37.5	Amateur and Army mobile only.
37.5 –33.1	Public toll service, mobile, Government point-to-point, and point-to-point public service utilities.
33.1 –30.0	Relay broadcasting only.
30.0 –27.3	Public toll service only.
27.3 –26.3	Relay broadcasting only.
26.3 –21.4	Public service, mobile, and Government point-to-point.
21.4 –18.7	Amateur only.
18.7 –16.6	Public toll service, mobile and Government point-to-point.
16.6 – 5.35	Experimental.
5.35 – 4.69	Amateur.
4.69 – 0.7496	Experimental.
0.7496– 0.7477	Amateur.

Radio broadcast stations work within the wave length band of 200 to 545 meters at intervals of 10 kilocycles. 600 meters is reserved for distress signals. The higher wave lengths are allocated to various marine, government, university, aircraft and other uses.

WAVE LENGTH CALCULATION FOR ANTENNA—For the ordinary vertical wire grounded antenna, the fundamental wave length is slightly greater than four times the length of the wire. A constant suggested is 4.2 and applies approximately also to flat top antennae having vertical lead ins. For other calculations see *Fundamental Wave Length.*

WAVE LENGTH, FUNDAMENTAL—See *Fundamental Wave Length.*

WAVE LENGTH, NATURAL—In a loaded antenna (that is with series inductance or capacity) the natural wave length corresponds to the lowest free oscillation. (See *Natural Wave Length.*)

WAVE LENGTH OF STATIONARY S. H. M. WAVES—On a straight wire, the smallest distance between two points where the disturbance is of the same amplitude and phase; or, since consecutive loops (q.v.) are in opposite phases, the wave length is double the distance between consecutive loops or consecutive *nodes* (q.v.). (See *S.H.M.*)

WAVEMETER—A radio instrument for measuring frequency. A calibrated resonator of variable frequency, capable of easy excitation by the oscillation under test, combined with a means of indicating the attainment of resonance. The calibration may be given directly in wave lengths or frequencies or both.

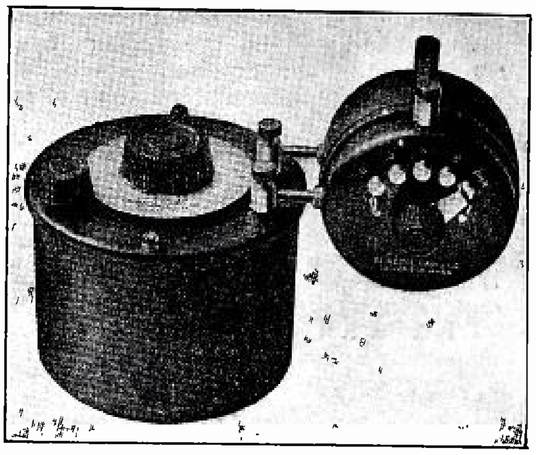


Photo by courtesy of General Radio Co.

The selectivity of the radio set may be greatly increased by the use of this wavemeter as a radio filter.

WAVEMETER CALIBRATION—Wavemeters may be calibrated by comparison with a standard wavemeter. An accurate method of calibrating a wavemeter, known as the *Three-Way Method* is shown in the accompanying diagram. In this illustration A is the standard wavemeter, B the wavemeter to be calibrated, and C is a condenser and coil of size permitting resonance

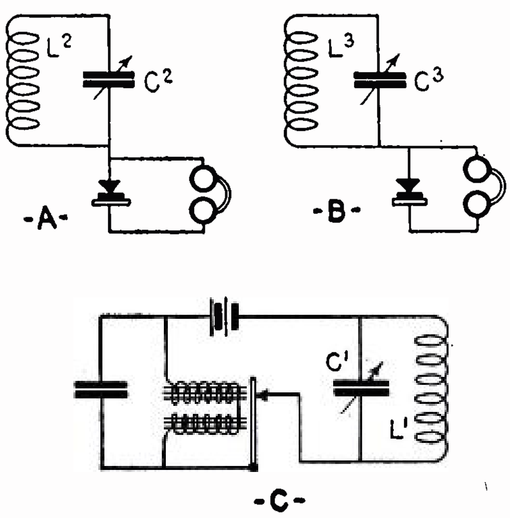


Diagram showing three-way method of wavemeter calibration.

with A. To calibrate, the buzzer should be put in operation, varying the capacity of the condenser C^1 until L^1C^1 is in resonance with L^2C^2 as noted in the head set. The wavemeter B should then be put in inductive relation to C and the condenser C^2 varied until the wavemeter A resonates with C. The wave length of B is now the same as A. This procedure should be carried out over the whole range of the condenser C^3.

WAVE MOTION—A disturbance of the equilibrium of a medium or body, extended or propagated from point to point with a continuous motion, each particle vibrating only on each side of its position of equilibrium, while each phase of vibration moves onward. Examples of wave motion are the propagation of electromagnetic waves, or the waves on the surface of a body of water.

WAVES, CONTINUOUS—See *Continuous Waves.*

WAVES, CONTINUOUS, KEY MODULATED—See *Continuous Waves, Key Modulated.*

WAVES, CONTINUOUS, MODULATED AT AUDIO FREQUENCY—See *Continuous Waves at Audio Frequency.*

WAVES, ELECTROMAGNETIC—Periodic electromagnetic disturbances progressive through space. (See *Wave.*)

WAVES, SUSTAINED—See *Sustained Waves,* also *Continuous Waves.*

WAVE TRAIN—A series of waves. An example of a wave train is the series of disturbances set up by each spark in a spark system of radio telegraphy.

WAVE TRAP—A device consisting of a variable condenser and coil, usually connected in the antenna circuit of a receiving set, to eliminate interference from undesired stations. (See *Filter, Filter Condenser, Acceptor,* also *Rejector.*)

WAVE-WOUND—A class of drum armature in which connections produce a "stepping forward" in a zig-zag wavy line all the time. Also called *Series* and *Two Circuit Windings.*

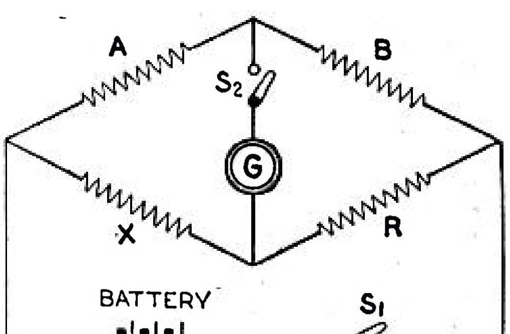
WEBER—The *Practical Unit* (q.v.) of magnetic flux. The engineers' unit is the "line" which is also the electromagnetic unit. 1 Weber is equal to 10^8 electromagnetic units (or "lines"). The Weber is produced by a current of one ampere flowing through a circuit having one henry of inductance.

WEHNELT BREAK—An *electrolytic interrupter* (q.v.).

WEIGHT—The force with which the earth attracts a body. A body varies in weight according to its distance from the centre of the earth, although its mass remains constant.

WESTON CELL—The present standard cell. It consists of mercury with a paste of mercurous and cadmium sulphates which form the cathode. The Weston cell has an anode of 12.5 per cent cadmium amalgan in an electrolyte of saturated solution of cadmium sulphate. It has a constant electromotive force of 1.0125 volts at 20 degrees Centigrade. (See *Electromotive Force,* also *Cadmium.*)

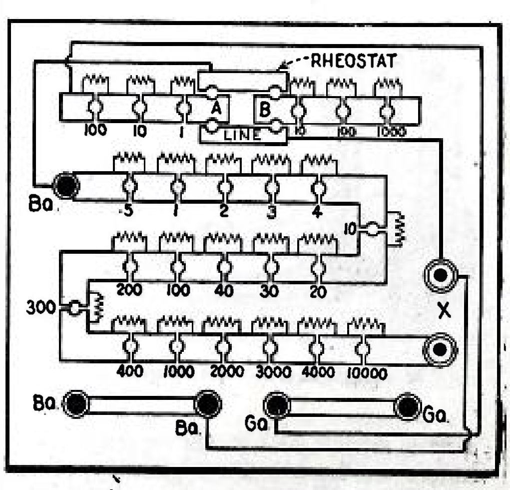
WHEATSTONE BRIDGE—An instrument for measuring resistance in



$$X = \frac{A}{B} \times R$$

Diagram illustrating principle of the Wheatstone Bridge.

which the current from a battery divides into two parallel circuits, each



Post-Office type of Wheatstone Bridge.

divided into two "arms" capable of being adjusted so that there is no difference of potential between the dividing points on both sides. The point of zero difference of potential is indicated by the absence of deflection of a galvanometer placed across the dividing points. The ratio of the resistance of the two parts of the arms is then the same, so that if the resistance of three of the arms is known, that of the fourth arm (i.e. the resistance to be measured) can be determined.

WHEATSTONE TRANSMITTER—An apparatus for delivering telegraphic currents to a line at high speed. Control is effected by aid of a moving perforated paper tape, prepared according to a code.

WHIPPING—The binding of string or small wire round the end of a rope or multiple wire to prevent the ends from fraying out.

WIMSHURST—A type of Induction or Influence Machine consisting, in a simple form, of two discs of insulating material revolving in opposite directions. These carry a number of equal sectors which form combined inductors and carriers. There are usually two collectors and two pair of brushes. (See *Induction Machine.*)

WINDOW LEAD-IN—A form of insulator for passing an aerial *lead-in* through a window. In some cases porcelain tubes are used as window lead-in's. A common form of window lead-in consists of a flat copper conductor covered with woven cotton insulation.

WIRED WIRELESS—A method of transmitting radio messages, in which the waves are guided by wires instead of radiating freely through the ether. (See *Line Radio.*)

WIRE GAUGE—A device for measuring the diameter of a round wire in accordance with a predetermined scale. The gauge commonly used in this country is the Brown and Sharpe (B. & S.) or American gauge.

WIRELESS TELEGRAPHY—Also known as RADIO TELEGRAPHY (q.v.).—A system of telegraphy, utilizing electromagnetic waves set up by oscillating currents as the means of transmission. The waves generated at the transmitting station spread out from the *aerial* (q.v.) in all directions. They are intercepted by the receiving aerial, detected by a rectifying device such as a crystal or vacuum tube, amplified and delivered to a head set or loud speaker. A key is used at the transmitter to control the duration of the waves so that they will correspond to the dots and dashes of the *continental code* and these dots and dashes are reproduced in the phones at the receiving station.

WOLLASTON WIRE—Platinum wire, drawn extremely fine by the process of coating fine platinum wire with ductile material, drawing the whole down together, and (if required) removing the coating by dissolving it off.

WORK—The action of a force upon a body to overcome resistance. Work is measured by the product of the force exerted and the distance moved. Work may be measured by *ergs* (q.v.), *foot-pounds*, *horsepower*, etc.

WOOD'S METAL—A soft metallic alloy having a low melting point. This alloy consists of two parts of lead, one part of tin, four parts of bismuth, and one part of cadmium, all by weight. This metal has been used extensively for setting detector crystals in their cups, so as to make a good electrical contact.

X, Y, Z

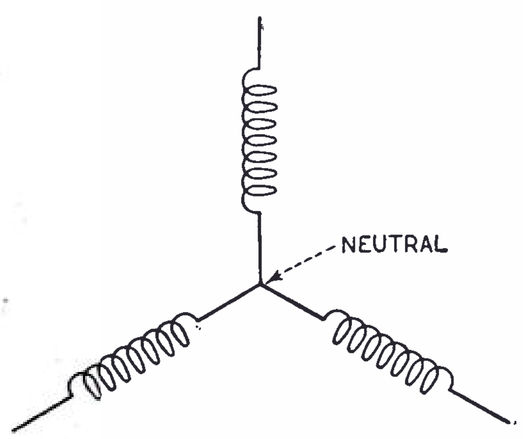
X—Symbol for *Reactance* (q.v.).

"X" RAYS—Also called *Roentgen Rays.* Electric waves of much higher frequency than light, produced by the striking of *cathode rays* upon a solid substance. These rays are not deflected by electric or magnetic fields and possess the property of penetrating solid substances which could not be penetrated by ordinary light rays. The use of the "X" Rays permit photographs to be taken of bones or other parts of the human body which could not be seen in any other way.

X'S—Disturbances of an erratic nature heard from time to time in the 'phones or loud speaker of a radio receiving set, due to storms, electric disturbances, etc. (See *Atmospherics, Natural Electric Waves, Static,* also *Strays.*)

YAGI SPARK GAP—A form of spark gap originated by H. Yagi. It is a quenched spark gap, the electrodes of which are aluminum and brass. The gap functions in an atmosphere of coal gas.

"Y" GROUPING—See *Star Grouping.*



A three-phase "Y" connection.

YOKE—A piece of soft iron used in certain forms of electromagnets to yoke two parallel cores together magnetically. The cores of the ordinary electric bell are fastened together at one end by means of a yoke.

YOKOJAMA, EITARO—Japanese radio expert. He was born in 1883 and was educated at the Engineering College of the Tokyo Imperial University. While at college, he specialized in radio. He was appointed to the Electro-technical Laboratory of the Japanese Ministry of Communications, to carry out research work in wireless telegraphy and telephony. He was one of the inventors of the T.Y.K. oscillation gaps for radio telephony, for which he received many distinctions. In 1910 he was appointed head of the Radio Section. Yokojama, who is one of the most brilliant Japanese radio experts, is a member of the Institute of Radio Engineers and of many other scientific societies.

ZEEMAN EFFECT—Doubling of the spectrum lines of light sources when placed in a strong magnetic field.

ZENNECK, J.—German wireless expert. He was born April 15th, 1871, at Wurtemberg and was educated at Tuebingen. In 1895 he was appointed assistant in the Physical Institute in Strassburg, a post he held until 1899, when he carried out a series of tests in radio telegraphy in the North Sea. In 1905 he was appointed assistant professor of physics at the Institute of Technology, Brunswick and was appointed professor at Munich in 1913. Professor Zenneck has written a number of authoritative books on wireless and also a large number of articles on electro-magnetic oscillations.

ZERO BEAT RECEPTION—The detection of continuous modulated waves using a local source of high frequency current having a frequency equal to that of the incoming wave. When this continuous voltage is impressed on the incoming modulated voltage, (both of the same frequency) the output of the detector contains a current of audio frequency similar in character to the modulated current at the transmitter.

ZERO METHOD—A method of measurement in which various adjustments are made until the current flowing through a galvanometer is reduced to zero, as in a *Wheatstone Bridge* (q.v.). (See *Null Method.*)

ZINC—A metallic element. Its chemical symbol is Zn. In color, zinc is bluish-gray. It is practically noncorrosive in the atmosphere, is capable of taking a high polish, is unaffected by water, but is soluble in nitric acid and in soda and potash solutions. Pure zinc is attacked very slowly by sulphuric acid, but this feature is one of the greatest in the application of zinc in radio work and in electrical work generally.

Zinc is one of the most important components of most dry cells. It forms the negative terminal in most "B" batteries. Zinc in rod form is used in most forms of wet cells.

ZINCITE—An oxide of zinc. Zincite crystals can be distinguished by their red color, often broken up by orange-yellow streaks. This crystal, in combination with several other crystals makes a very excellent detector for radio purposes. The *perikon detector* (q.v.) is a combination of zincite and chalcopyrites. Zincite is also used in combination with bornite, galena, copper, iron pyrites, tellurium and silicon.

ZIRCONIUM—One of the metallic elements. Its chemical symbol is Zr, and its atomic weight is 90.6. Zirconium is an iron-gray powder in one form, or it may be made to crystallize. The crystals look like antimony, are very brittle and extremely hard, being capable of scratching glass and rubies. Zirconium resembles thorium in many of its chemical properties. For the control of the vacuum in high vacuum tubes, a small quantity of thorium or zinconium is included in the tube. These metals combine with hydrogen, oxygen, nitrogen, etc., to form compounds of very low vapor pressure.