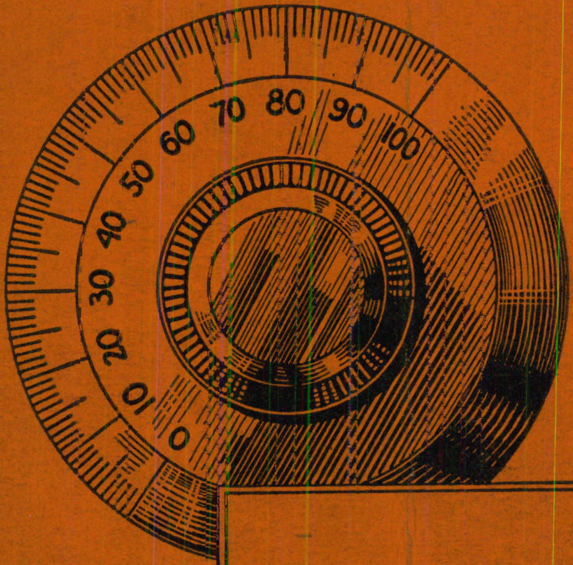

Boston Transcript's
RADIO
Handbook

Compiled to December 15, 1924

The Boston Evening Transcript's

Directory of Radio Broadcasting Stations

of the

United States, Canada and Cuba

Hook-ups and Trouble-Shooting Chart

By JAMES KILTON CLAPP

Compiled by

FREDERICK WILLIAM FORD

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Broadcasting
Stations
Arranged
Alphabetically
by
Call Signals

The Boston Transcript's

DIRECTORY OF RADIO BROADCASTING STATIONS

Call Signal	Owner of Station	Location of Station	Your Adjustment
KDKA	Westinghouse Electric & Mfg Co	East Pittsburgh	
KDPM	Westinghouse Electric & Mfg Co	Cleveland, O	
KDPT	Southern Electrical Co	San Diego, Calif	
KDYL	Newhouse Hotel	Salt Lake City, Utah	
KDYM	Savoy Theatre	San Diego, Calif	
KDYQ	Portland. Ore	Oregon Institute of Tech	
KDZB	Frank E. Siefert	Bakersfield, Calif	
KDZR	Bellingham Publishing Co	Bellingham, Wash	
KFAB	Nebraska Buick Auto Co	Lincoln, Nebr	
KFAD	McArthur Bros. Mercantile Co	Phoenix, Ariz	
KFAE	State College of Washington	Pullman, Wash	
KFAF	Western Radio Corporation	Denver, Ohio	
KFAJ	University of Colorado	Boulder, Colo	
KFAN	The Electric Shop	Moscow, Idaho	
KFAQ	City of San Jose	San Jose, Calif	
KFAR	Studio Lighting Service Company	Hollywood, Calif	
KFAU	In. School Dist. of Boise City, Boise H. School	Boise, Idaho	
KFAV	Kinney Company	Venice, Calif	
KFAW	The Radio Den	Santa Ana, Calif	
KFAY	Virgin's Radio Service	Medford, Ore	
KFBB	Havre, Buttrey & Co	Havre, Mont	
KFBC	W. K. Azbill	San Diego, Calif	
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	
KFBG	First Presbyterian Church	Tacoma, Wash	
KFBK	Kimball-Upson Company	Sacramento, Calif	
KFBL	Lucas Bros	Everett, Wash	
KFBS	Trinidad Q. & E. Supply Co	Trinidad, Colo	
KFBU	The Cathedral	Laramie, Wyo	
KFCB	Neilson Radio Supply Co	Phoenix, Ariz	
KFCC	First Congregational Church	Helena, Mont	
KFCD	Salem Electric Co	Salem, Calif.	
KFCF	Frank A. Moore	Walla Walla, Wash	
KFCL	Leslie E. Rice	Los Angeles, Calif.	
KFCP	Ralph W. Flygare	Ogden, Utah	
KFCV	Fred Mahaffey, Jr	Houston, Tex	
KFCY	Western Union College	Le Mars, Iowa	
KFCZ	Omaha Central High School	Omaha, Neb	
KFDD	St. Michael's Cathedral	Boise, Idaho	
KFDH	University of Arizona	Tucson, Ariz	
KFDJ	Oregon Agricultural College	Corvallis, Ore	
KFDL	Knight-Campbell Music Co.	Denver, Colo.	
KFDN	Magnolia Petroleum Co	Beaumont, Texas	
KFDX	First Baptist Church	Shreveport, La	
KFDY	Brookings College of Agr. and Mechanic Arts.	Brookings, So. Da	
KFDZ	Harry O. Iverson	Minneapolis, Minn	
KFEC	Meier & Frank Company	Portland, Ore	
KFEL	Winner Radio Corp	Denver, Col	
KFEQ	J. L. Scroggin	Oak, Neb	
KFER	Auto Electric Service Co	Fort Dodge, Ia	
KFEX	Augsburg Seminary	Minneapolis, Minn	
KFFP	First Baptist Church	Moberly, Mo	
KFFR	Nevada State Journal	Sparks, Nev	
KFFV	Graceland College	Lamoni, Iowa	
KFFY	Louisaiana College	Alexandria, La	
KFGC	Louisiana State University	Baton Rouge, La	
KFGD	Oklahoma College for Women	Chickasha, Okla	
KFGH	Leland Stanford University	Stanford Univ., Calif	

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Call Signal	Owner of Station	Location of Station	Your Adjustment
KFGQ	Crary Hardware Company	Boone, Io	....
KFGX	First Presbyterian Church	Orange, Tex	....
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	....
KFHA	Western State College	Gunnison, Col	....
KFHJ	Fallon & Co	Santa Barbara, Calif.	....
KFHL	Penn College	Oskaloosa, Iowa	....
KFHP	Radio Bug Products Co	Kearney, Neb	....
KFHR	Star Electric & Radio Company	Seattle, Wash	....
KFI	Earle C. Anthony, Inc	Los Angeles, Calif	....
KFIF	Benson Polytechnic Institute	Portland, Ore	....
KFIO	North Central High School	Spokane, Wash	....
KFIQ	First Methodist Church	Yakima, Wash	....
KFIU	Alaska Electric Light & Power Company	Juneau, Alaska	....
KFIX	Reo. Ch. of Jesus Christ of Lat. Day Saints	Independence, Mo	....
KFIZ	Daily Commonwealth and Oscar A. Heulsman	Fond du Lac, Wis	....
KFJB	Marshall Electrical Company	Marshalltown, Iowa	....
KFJF	National Radio Manufacturing Co	Oklahoma City, Okla.	....
KFJI	Liberty Theatre	Astoria, Ore.	....
KFJK	Delano Radio and Electric Co	Bristow, Okla.	....
KFJM	University of North Dakota	Grand Forks, N. D.	....
KFJR	Ashley C. Dixon & Son	Portland, Ore	....
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa	....
KFJY	Tunwall Radio Co	Fort Dodge, Iowa	....
KFJZ	Texas National Guard, 112th Cavalry	Fort Worth, Tex	....
KFKA	Colorado State Teachers College	Greeley, Col.	....
KFKB	Brinkley-Jones Hospital Association	Milford, Kan.	....
KFKQ	Conway Radio Laboratories	Conway, Ark.	....
KFKV	F. F. Gray	Butte, Mont.	....
KFKX	Westinghouse Electric & Manufacturing Co	Hastings, Neb.	....
KFKZ	Nassour Bros. Radio Co	Colorado Springs, Colo	....
KFLA	Abner R. Wilson	Butte, Mont.	....
KFLB	Signal Electric Manufacturing Co	Menominee, Mich.	....
KFLE	National Educational Service	Denver, Colo.	....
KFLQ	Bizzell Radio Shop	Little Rock, Ark	....
KFLR	University of New Mexico	Albuquerque, N. M.	....
KFLU	Rio Grande Radio Supply House	San Benito, Tex	....
KFLV	Swedish Evangelical Mission Church	Rockford, Ill	....
KFLX	George R. Clough	Galveston, Tex	....
KFLZ	Atlantic Automobile Co	Atlantic, Iowa	....
KFMB	Christian Churches of Little Rock	Little Rock, Ark	....
KFMQ	University of Arkansas	Fayetteville, Ark	....
KFMR	Morningside College	Sioux City, Iowa	....
KFMT	George W. Young	Minneapolis, Minn	....
KFMW	M. G. Sateren	Houghton, Mich	....
KFMX	Carleton College	Northfield, Minn	....
KFNF	Henry Field Seed Co	Shenandoah, Iowa	....
KFNG	Wooten's Radio Shop	Coldwater, Miss	....
KFNL	Radio Broadcast Association	Paso Robles, Calif	....
KFNV	L. A. Drake	Santa Rosa, Calif	....
KFNY	Montana Phonograph Co	Helena, Mont	....
KFNZ	Royal Radio Co	Burlingame, Calif	....
KFOA	The Rhodes Co	Seattle, Wash	....
KFOC	First Christian Church	Whittier, Calif	....
KFOD	The Radio Shop	Wallace, Idaho	....
KFOF	Rohrer Electric Co	Marshfield, Ore	....
KFOJ	Moberly High School Radio Club	Moberly, Mo	....
KFON	Echophone Radio Shop	Long Beach, Calif	....

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Call Signal	Owner of Station	Location of Station	Your Adjustment
KFOO	Latter Day Saints University	Salt Lake City, Utah	....
KFOR	David City Tire & Electric Co	David City, Neb	....
KFOT	College Hill Radio Club	Wichita, Ks	....
KFOU	Hommel Manufacturing Co	Richmond, Calif	....
KFOX	Technical High School (Board of Education)	Omaha, Neb	....
KFOY	Beacon Radio Service	St. Paul, Minn	....
KFOZ	Leon Hudson Real Estate Co	Fort Smith, Ark	....
KFPG	Oliver S. Garretson	Los Angeles, Calif	....
KFPH	Howard C. Mailander	Salt Lake City, Utah	....
KFPL	C. C. Baxter	Dublin, Tex	....
KFPM	New Furniture Co	Greenville, Tex	....
KFPN	Missouri N. G. Hdqrs. Co., 70th Infantry	Jefferson City, Mo	....
KFPO	Colorado Nat'l Guard 45th Div. Tank Co	Denver, Col	....
KFPP	G. & G. Radio & Electric Shop	Olympia, Wash	....
KFPR	Los Angeles County Forestry Department	Los Angeles, Calif	....
KFPT	The Deseret News	Salt Lake City, Utah	....
KFPV	Heintz & Kohlmoos	San Francisco, Calif	....
KFPW	St. John's Church	Carterville, Mo	....
KFPX	First Presbyterian Church	Pine Bluff, Ark	....
KFPY	Symons Investment Co	Spokane, Wash	....
KFQA	The Principia	St. Louis, Mo	....
KFQB	Searchlight Publishing Co	Fort Worth, Tex	....
KFQC	Kidd Brothers Radio Shop	Taft, Calif	....
KFQD	Chovin Supply Co	Anchorage, Alaska	....
KFQE	Dickenson-Henry Radio Laboratories	Colorado Springs, Colo	....
KFQG	So. California Radio Asso	Los Angeles, Calif	....
KFQH	Albert Sherman	Burlingame, Calif	....
KFQK	Democrat Leader	Fayette, Mo	....
KFQL	Oklahoma Free State Fair Asso	Muskogee, Okla	....
KFQM	Texas Highway Bulletin	Austin, Tex	....
KFQN	Third Baptist Church	Portland, Ore	....
KFQO	Meier Radio Shop	Russell, Ks	....
KFQP	George S. Carson, Jr	Iowa City, Iowa	....
KFQR	Walter L. Ellis	Oklahoma City, Okla	....
KFQT	Texas Nat'l Guard, 36th Signal Co	Denison, Tex	....
KFQU	W. Riker	Holy City, Calif	....
KFQV	Omaha Grain Exchange	Omaha, Neb	....
KFQW	C. F. Knierim Photo Radio & Elec. Shop	North Bend, Wash	....
KFQX	Alfred M. Hubbard	Seattle, Wash	....
KFQY	Farmers State Bank	Belden, Neb	....
KFQZ	Taft Radio Co.	Hollywood, Calif	....
KFRB	Hall Brothers	Beeville, Texas	....
KFRC	Radicart Studio	San Francisco, Calif	....
KFRF	W. R. Brown	Alexandria, La	....
KFRG	Cleveland High School	St. Louis, Mo	....
KFRH	The Radio Shop	Grafton, N. D	....
KFRI	Reynolds Radio Co	Denver, Colo	....
KFRJ	Guy Simmons, Jr	Conway, Ark	....
KFRL	Men's Club of First Presbyterian Church	Grand Forks, N. D	....
KFRM	James P. Boland	Fort Sill, Okla	....
KFRN	M. Laurence Short	Hanford, Calif	....
KFRO	Curtis Printing Co.	Fort Worth, Texas	....
KFRP	Trinity Episcopal Church	Redlands, Calif	....
KFRQ	Radio Market Service Co	Portland, Ore	....
KFRR	Nebraska Buick Auto Co	Lincoln, Neb	....
KFRW	United Churches of Olympia	Olympia, Wash	....
KFRX	J. Gordan Klemgard	Pullman, Wash	....

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Call Signal	Owner of Station	Location of Station	Your Adjustment
KFRY	New Mexico College of Agriculture	State College, N. M.	
KFRZ	The Electric Shop	Hartington, Neb.	
KFSG	Echo Park Evangelistic Association	Los Angeles, Calif.	
KFSY	Van Blaricom Co	Helena, Mon	
KFUC	Concordia Seminary	St. Louis, Mo.	
KFUL	Thomas Coggan & Bros. Music Co	Galveston, Tex	
KFUM	W. B. Corley	Colorado Sprnigs, Col.	
KGB	Tacoma Daily Ledger	Tacoma, Wash	
KGG	Hallock & Watson Radio Service	Portland, Ore	
KGO	General Electric Co	Oakland, Calif	
KGU	Marion A. Mulreny	Honolulu, Hawaii	
KGW	Portland Morning Oregonian	Portland, Ore	
KGY	St. Martins College	Lacey, Wash	
KHJ	Times-Mirror Co.	Los Angeles, Calif	
KHQ	Louis Wasmer	Seattle, Wash	
KJQ	C. O. Gould	Stockton, Calif	
KJR	Northwest Radio Service Co.	Seattle, Wash	
KJS	Bible Institute of Los Angeles	Los Angeles, Calif	
KLS	Warner Brothers	Oakland, Calif	
KLX	Tribune Publishing Co.	Oakland, Calif	
KLZ	Reynolds Radio Co.	Denver, Colo	
KMJ	San Joaquin Light & Power Corp	Fresno, Calif	
KMO	Love Electric Co.	Tacoma, Wash	
KNT	Walter Hemrich	Kukak Bay, Alaska	
KOA	General Electric Co	Denver, Colo	
KOB	New Mexico Col. of Agri. & Mechanic Arts	State College, N. Mex.	
KOP	Detroit Police Dept.	Detroit, Mich	
KPO	Hale Bros.	San Francisco, Calif	
KQP	Apple City Radio Club	Hood River, Ore	
KOV	Doubleday-Hill Electric Co.	Pittsburgh, Pa	
KQW	Charles D. Herrold	San Jose, Calif	
KRE	Berkeley Daily Gazette	Berkeley, Calif	
KSAC	Kansas State Agricultural College	Manhattan, Kansas	
KSD	Post Dispatch	St. Louis, Mo	
KTW	First Presbyterian Church	Seattle, Wash	
KUO	Examiner Printing Co.	San Francisco, Calif	
KWG	Portable Wireless Telephone Co	Stockton, Calif	
KWH	Los Angeles Examiner	Los Angeles, Calif	
KYQ	Electric Shop	Honolulu, Hawaii	
KYW	Westinghouse Electric & Mfg. Co	Chicago, Ill	
KZKZ	Electric Supply Co	Manila, P. I	
KZM	Preston D. Allen	Oakland, Calif	
NAA	U. S. Navy	Arlington, Va	
WAAB	Valdemar Jensen	New Orleans, La	
WAAC	Tulane University	New Orleans, La	
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	
WAAF	Chicago Daily Drovers Journal	Chicago, Ill	
WAAM	I. R. Nelson Co	Newark, N. J	
WAAN	University of Missouri	Columbia, Mo	
WAAW	Omaha Grain Exchange	Omaha, Neb	
WABB	Harrisburg Sporting Goods Co	Harrisburg, Pa	
WABD	Parker High School	Dayton, O	
WABH	Lake Shore Tire Co	Sandusky, O	
WABI	Bangor Railway & Electric Co	Bangor, Me	
WABL	Connecticut Agricultural College	Storrs, Conn	
WABM	F. E. Doherty Automotive & Radio Equip. Co	Saginaw, Mich	
WABN	Ott Radio, Inc	La Crosse, Wis	
WABO	Lake Avenue Baptist Church	Rochester, N. Y	

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Call Signal	Owner of Station	Location of Station	Your Adjustment
WABP	Robert F. Weinig	Dover, O	
WABQ	Haverford College Radio Club	Haverford, Pa	
WABR	Scott High School	Toledo, O	
WABU	Victor Talking Machine Co	Camden, N. J	
WABW	College of Wooster	Wooster, O	
WABX	Henry B. Joy	Mount Clemens, Mich	
WABY	John Magaldi, Jr	Philadelphia, Pa	
WABZ	Coliseum Place Baptist Church	New Orleans, La	
WAHG	A. H. Grebe & Co	Richmond Hill, N. Y	
WBAA	Purdue University	West Lafayette, Ind	
WBAN	Wireless Phone Corp	Paterson, N. J	
WBAO	James Milliken University	Decatur, Ill.	
WBAP	Wortham-Carter Publishing Co	Fort Worth, Tex	
WBAV	Erner & Hopkins Co	Columbus, O.	
WBAX	John H. Stenger, Jr	Wilkes-Barre, Pa.	
WBAY	Western Electric Co	New York, N. Y	
WBBD	Barbey Battery Service	Reading, Pa.	
WBBF	Georgia School of Technology	Atlanta, Ga	
WBBG	Irving Vermilya	Mattapoisett, Mass.	
WBBH	J. Irving Bell	Port Huron, Mich	
WBBK	Kaufmann & Baer Co	Pittsburgh, Pa.	
WBBL	Grace Covenant Church	Richmond, Va.	
WBBN	H. Leslie Atlass	Chicago, Ill	
WBBP	Petoskey High School	Petoskey, Mich.	
WBBR	Peoples Pulpit Association	Rossville, N. Y	
WBBS	First Baptist Church	New Orleans, La	
WBBU	Jenks Motor Sales Co	Monmouth, Ill.	
WBBV	Johnstown Radio Co	Johnstown, Pa.	
WBBW	Ruffner Junior High School	Norfolk, Va.	
WBBY	Washington Light Infantry	Charleston, S. C	
WBBZ	Noble B. Watson	Indianapolis, Ind.	
WBL	T. & H. Radio Co.	Anthony, Ks	
WBS	D. W. May, Inc	Newark, N. J	
WBT	Southern Radio Corp	Charlotte, N. C	
WBZ	Westinghouse Elec. & Mfg. Co	Springfield, Mass	
WCAD	St. Lawrence University	Canton, N. Y	
WCAE	Kaufmann & Baer Co	Pittsburgh, Pa	
WCAG	Clyde R. Randall	New Orleans, La	
WCAH	Entrekin Electric Co	Columbus, Ohio	
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	
WCAK	Alfred P. Daniel	Houston, Tex	
WCAL	St. Olaf College	Northfield, Minn	
WCAO	Baldiman & Stayman Co	Baltimore, Md	
WCAP	Chesapeake & Potomac Telephone Co	Washington, D. C	
WCAR	Southern Radio Corp. of Texas	San Antonio, Tex	
WCAS	William Hood Dunwoody Industrial Institute	Minneapolis, Minn	
WCAT	South Dakota State School of Mines	Rapid City, S. D	
WCAU	Durham & Co	Philadelphia, Pa	
WCAV	Dice Electric Co	Little Rock, Ark	
WCAX	University of Vermont	Burlington, Vt	
WCAY	Milwaukee Civic Broadcasting Association	Milwaukee, Wis	
WCBA	Charles W. Heimbach	Allentown, Pa	
WCBC	University of Michigan	Ann Arbor, Mich	
WCBD	Wilbur G. Voliva	Zion, Ill	
WCBE	Uhalt Brothers Radio Co	New Orleans, La	
WCBG	Howard S. Williams	Pascagoula, Miss	
WCBH	University of Mississippi	Oxford, Miss.	

Call Signal	Owner of Station	Location of Station	Your Adjustment
WCBI	Nicoll, Duncan & Rush	Bemis, Tenn.	
WCBJ	J. C. Mans	Jennings, La.	
WCBK	E. Richard Hall	St. Petersburg, Fla.	
WCBL	Northern Radio Manufacturing Co.	Houlton, Me.	
WCBO	Radio Shop (Inc.)	Memphis, Tenn.	
WCBQ	First Baptist Church	Nashville, Tenn.	
WCBR	Charles H. Messter Portable	Providence, R. I. (port)	
WCBT	Clark University	Worcester, Mass.	
WCBV	Tullahoma Radio Club	Tullahoma, Tenn.	
WCBW	George P. Rankin, Jr., and Maitland Soloman	Macon, Ga.	
WCBY	Forks Electrical Shop	Buck Hill Falls, Pa.	
WCBZ	Coppotelli Brothers Music House	Chicago Heights, Ill.	
WCCO	Washburn Crosby Co.	Minneapolis, Minn.	
WCEE	Charles E. Erbstein	Elgin, Ill.	
WCK	Stix, Baer & Fuller Co.	St. Louis, Mo.	
WCM	Texas Markets and Warehouse Depts.	Austin, Texas	
WCX	Detroit Free Press	Detroit, Mich.	
WDAE	Tampa Daily Times	Tampa, Fla.	
WDAF	Kansas City Star	Kansas City, Mo.	
WDAG	J. Laurance Martin	Amarillo, Tex.	
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	
WDAR	Lit Brothers	Philadelphia, Pa.	
WDAS	Samuel A. Waite	Worcester, Mass.	
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	
WDBB	A. H. Waite & Co.	Taunton, Mass.	
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	
WDBD	Herman E. Burns	Martinsburg, W. Va.	
WDBF	Robert G. Phillips	Youngstown, O.	
WDBH	C. T. Sherer Co.	Worcester, Mass.	
WDBI	Radio Specialty Co.	St. Petersburg, Fla.	
WDBJ	Richardson-Wayland Electric Corporation	Roanoke, Va.	
WDBN	Maine Electric Light & Power Co.	Bangor, Me.	
WDBO	Rollins College	Winter Park, Fla.	
WDBP	Superior State Normal School	Superior, Wis.	
WDBQ	Morton Radio Supply Co.	Salem, N. J.	
WDBR	Tremont Temple Baptist Church	Boston, Mass.	
WDBS	S. M. K. Radio Corporation	Dayton, O.	
WDBT	Taylor's Book Store	Hattiesburg, Miss.	
WDBU	Somerset Radio Co.	Skowhegan, Me.	
WDBW	The Radio Den	Columbia, Tenn.	
WDBX	Otto Baur	New York, N. Y.	
WDBY	North Shore Congregational Church	Chicago, Ill.	
WDBZ	Boy Scouts of America, Ulster County Council	Kingston, N. Y.	
WDM	Church of the Covenant	Washington, D. C.	
WDZ	James L. Bush	Tuscola, Ill.	
WEAA	Frank D. Fallain	Flint, Mich.	
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	
WEAH	Wichita Board of Trade and Lander Radio Co.	Wichita, Kans.	
WEAI	Cornell University	Ithaca, N. Y.	
WEAJ	University of South Dakota	Vermillion, S. Dak.	
WEAM	Borough of North Plainfield	North Plainfield, N. J.	
WEAN	Shepard Co.	Providence, R. I.	
WEAO	Ohio State University	Columbus, Ohio	
WEAP	Mobile Radio Co.	Mobile, Ala.	
WEAU	Davidson Bros. Co.	Sioux City, Iowa	
WEAY	Iris Theatre	Houston, Tex.	
WEB	Benson Radio Co.	St. Louis, Mo.	

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Call Signal	Owner of Station	Location of Station	Your Adjustment
WEBA	The Electric Shop	Highland Park, N. J.	....
WEBC	Walter C. Bridges	Superior, Wis.	....
WEBD	Electrical Equipment & Service Co.	Anderson, Ind.	....
WEBE	Roy W. Waller	Cambridge, Ohio.	....
WEBH	Edgewater Beach Hotel	Chicago, Ill.	....
WEBI	Walter Gibbons	Salisbury, Md.	....
WEBJ	Third Avenue Railway Co.	New York, N. Y.	....
WEBK	Grand Rapids Radio Co	Grand Rapids, Mich.	....
WEBL	Radio Corp. of America (Portable)		....
WEBO	Radio Company	Hamilton, O.	....
WEBP	E. Budd Peddicord	New Orleans, La.	....
WEBQ	Tate Radio Co	Harrisburg, Ill	....
WEBR	H. H. Howell	Buffalo, N. Y.	....
WEBT	Co-operative Industrial High School	Dayton, O.	....
WEBU	De Land Piano & Music Co	De Land, Fla	....
WEBW	Beloit College	Beloit, Wis.	....
WEBX	John E. Cain, Jr.	Nashville, Tenn	....
WEBY	Hobart Radio Co.	Roslindale, Mass	....
WEBZ	Savannah Radio Corp.	Savannah, Ga.	....
WEEI	Edison Electric Illuminating Co	Boston, Mass	....
WEV	Hurlburt-Still Electrical Co	Houston, Tex.	....
WEW	St. Louis University	St. Louis, Mo.	....
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	....
WFAM	Times Publishing Co.	St. Cloud, Minn.	....
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	....
WFAV	University of Nebraska	Lincoln, Neb.	....
WFBB	Eureka College	Eureka, Ill.	....
WFBC	First Baptist Church	Knoxville, Tenn.	....
WFBD	Gethsemane Baptist Church	Philadelphia, Pa.	....
WFBE	John Van de Walle	Seymour, Ind.	....
WFBG	William F. Gable Co.	Altoona, Pa.	....
WFBH	Concourse Radio Corp.	New York, N. Y.	....
WFBI	Galvin Radio Supply Co.	Camden, N. J.	....
WFBJ	St. Johns University	Collegeville, Minn.	....
WFBK	Wilder Laboratory, Dartmouth College	Hanover, N. H.	....
WFBL	Onondaga Hotel Co.	Syracuse, N. Y.	....
WFBM	Merchants Heat & Light Co	Indianapolis, Ind.	....
WFBN	Radio Sales & Service Co	Bridgewater, Mass.	....
WFBQ	Wynne Radio Co.	Raleigh, N. C.	....
WFBR	Fifth Inf. Md. Nat'l Guard	Baltimore, Md.	....
WFBT	Gloucester Co. Civic League	Pitman, N. J.	....
WFBU	Commonwealth Radio Asso	Boston, Mass.	....
WFBY	Signal Officer	Fort Ben Harrison, Ind.	....
WFI	Strawbridge & Clothier	Philadelphia, Pa.	....
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	....
WGAQ	Youree Hotel	Shreveport, La.	....
WGAZ	South Bend Tribune	South Bend, Ind.	....
WGBA	Jones Elec. & Radio Mfg. Co.	Baltimore, Md.	....
WGBC	First Baptist Church	Memphis, Tenn.	....
WGBS	Gimbel Bros. Inc.	New York, N. Y.	....
WGBT	Furman University	Greenville, S. C.	....
WGI	American Radio & Research Corp.	Medford Hillside, Mass.	....
WGL	Thomas F. J. Rowlett	Philadelphia, Pa.	....
WGN	Chicago Tribune	Chicago, Ill.	....
WGR	Federal Telephone Mfg. Co.	Buffalo, N. Y.	....
WGY	General Electric Co.	Schenectady, N. Y.	....
WHAA	State University of Iowa	Iowa City, Iowa	....

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Call Signal	Owner of Station	Location of Station	Your Adjustment
WHAD	Marquette University	Milwaukee, Wis.	
WHAG	University of Cincinnati	Cincinnati, Ohio	
WHAM	University of Rochester	Rochester, N. Y.	
WHAR	Seaside House	Atlantic City, N. J.	
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	
WHAV	Wilmington Electric Specialty Co	Wilmington, Del.	
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	
WHB	Sweeney School Co	Kansas City, Mo	
WHK	Radiovex Co.	Cleveland, Ohio	
WHN	George Schubel	New York, N. Y.	
WHO	Bankers Life Co.	Des Moines, Ia.	
WIAB	A. A. Johnson	Rockford, Ill.	
WIAC	Galveston Tribune	Galveston, Tex.	
WIAD	Howard R. Miller	Philadelphia, Pa.	
WIAK	Journal-Stockman Co.	Omaha, Neb.	
WIK	K. & L. Electric Co.	McKeesport, Pa.	
WIP	Gimbel Brothers	Philadelphia, Pa.	
WJAB	American Electric Co.	Lincoln, Neb.	
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	
WJAG	Norfolk Daily News	Norfolk, Neb.	
WJAK	Clifford L. White	Greentown, Ind.	
WJAM	D. M. Perham	Cedar Rapids, Iowa	
WJAN	Peoria Star	Peoria, Ill.	
WJAR	The Outlet Company	Providence, R. I.	
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	
WJAX	Union Trust Company	Cleveland, Ohio	
WJAZ	Zenith Radio Corporation	Chicago, Ill.	
WJD	Richard H. Howe	Granville, Ohio	
WJJD	Loyal Order of Moose	Mooseheart, Ill.	
WJY	R. C. A.	New York, N. Y.	
WJZ	R. C. A.	New York, N. Y.	
WKAA	H. F. Paar	Cedar Rapids, Iowa	
WKAD	Charles Looff	East Providence, R. I.	
WKAF	W. S. Radio Supply Company	Wichita Falls, Tex.	
WKAN	United Battery Service Company	Montgomery, Ala.	
WKAP	Dutee W. Flint	Cranston, R. I.	
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	
WKAR	Michigan Agriculture College	East Lansing, Mich.	
WKAV	Laconia Radio Club	Laconia, N. H.	
WKBF	Dutee W. Flint	Cranston, R. I.	
WKY	WKY Radio Shop	Oklahoma, Okla.	
WLAL	Naylor Electrical Co.	Tulsa, Okla.	
WLAP	W. V. Jordan	Louisville, Ky.	
WLAX	Greencastle Community Broadcasting Station	Greencastle, Ind.	
WLB	University of Minnesota	Minneapolis, Minn.	
WLBL	Wisconsin Department of Markets	Stevens Point, Wis.	
WLS	Sears, Roebuck & Co.	Chicago, Ill.	
WLW	Crosley Radio Corp.	Cincinnati, O.	
WMAC	Clive B. Meredith	Cazenovia, N. Y.	
WMAF	Round Hills Radio Corp.	S. Dartmouth, Mass.	
WMAH	General Supply Co.	Lincoln, Neb.	
WMAK	Norton Laboratories	Lockport, N. Y.	
WMAN	First Baptist Church	Columbus, Ohio	
WMAQ	Chicago Daily News	Chicago, Ill.	
WMAT	Paramount Radio Corp.	Duluth, Minn.	
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	
WMAZ	Mercer University	Macon, Ga.	
WMBF	Fleetwood Hotel	Miami Beach, Fla.	
WMC	"Commercial Appeal"	Memphis, Tenn.	

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Call Signal	Owner of Station	Location of Station	Your Adjustment
WMH	Ainsworth Gates Radio Co.	Cincinnati, Ohio	
WMU	Doubleday-Hill Electric Co.	Washington, D. C.	
WNAC	Shepard Stores	Boston, Mass.	
WNAD	University of Oklahoma	Norman, Okla.	
WNAP	Wittenberg College	Springfield, Ohio	
WNAR	First Christian Church	Butler, Mo.	
WNAT	Lennig Brothers Co.	Philadelphia, Pa.	
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	
WNJ	Radio Shop of Newark	Newark, N. J.	
WNYC	City of New York	New York, N. Y.	
WOAC	Page Organ Co.	Lima, Ohio	
WOAE	Midland College	Fremont, Neb.	
WOAF	Tyler Commercial College	Tyler, Tex.	
WOAI	Southern Equipment Co.	San Antonio, Tex.	
WOAJ	Ervins Electrical Supply Co.	Parsons, Kansas	
WOAN	Vaughn Conservatory of Music	Lawrenceburg, Tenn.	
WOAR	Henry P. Lundskow	Kenosha, Wis.	
WOAV	Pennsylvania Nat'l Guard, 2d Bat. 112th Inf.	Erie, Pa.	
WOAW	Woodmen of the World	Omaha, Neb.	
WOAX	Franklyn J. Wolff	Trenton, N. J.	
WOC	Palmer School of Chiropractic	Davenport, Iowa	
WOI	Iowa State College	Ames, Iowa	
WOO	John Wanamaker	Philadelphia, Pa.	
WOQ	Unity School of Christianity	Kansas City, Mo.	
WOR	L. Bamberger & Co.	Newark, N. J.	
WOS	Missouri State Marketing Bureau	Jefferson City, Mo.	
WPAB	Pennsylvania State College	State College, Pa.	
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	
WPAK	North Dakota Agricultural College	Agric. College, N. D.	
WPAR	Ward Battery & Radio Co.	Beloit, Ks.	
WPAU	Concordia College	Moorhead, Minn.	
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	
WQAA	Horace A. Beale, Jr.	Parkesburg, Pa.	
WQAC	E. B. Gish	Amarillo, Tex.	
WQAE	Moore Radio News Station	Springfield, Vt.	
WOAF	Sandusky Register	Sandusky, Ohio	
WQAM	Electrical Equipment Co.	Miami, Fla.	
WQAN	Scranton Times	Scranton, Pa.	
WQAO	Calvary Baptist Church	New York, N. Y.	
WQAQ	Abilene Daily Reporter	Abilene, Tex.	
WQAS	Prince-Walter Co.	Lowell, Mass.	
WQAX	Radio Equipment Co.	Peoria, Ill.	
WQJ	Calumet Rainbo Broadcasting Co.	Chicago, Ill.	
WRAA	Rice Institute	Houston, Tex.	
WRAF	The Radio Club, Inc.	Laport, Ind.	
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	
WRAM	Lombard College	Galesburg, Ill.	
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	
WRAO	Radio Service Co.	St. Louis, Mo.	
WRAV	Antioch College	Yellow Springs, Ohio	
WRAW	Avenue Radio Shop	Reading, Pa.	
WRAX	Flaxon's Garage	Gloucester City, N. J.	
WRBC	Immanuel Lutheran Church	Valparaiso, Ind.	
WRC	Radio Corporation of America	Washington, D. C.	
WREO	Reo Motor Car Co.	Lansing, Mich.	
WRK	Doren Bros. Electric Co.	Hamilton, Ohio	
WRL	Union College	Schenectady, N. Y.	
WRM	University of Illinois	Urbana, Ill.	

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Call Signal	Owner of Station	Location of Station	Your Adjustment
WRR	City of Dallas	Dallas, Tex.	....
WRRF	Washington Radio Hospital Fund	Washington, D. C.	....
WRW	Tarrytown Radio Research Laboratory	Tarrytown, N. Y.	....
WSAC	Clemson Agricultural College	Clemson College, S. C.	....
WSAD	J. A. Foster Company	Providence, R. I.	....
WSAI	United States Playing Card Co.	Cincinnati, Ohio	....
WSAJ	Grove City College	Grove City, Pa	....
WSAN	Allentown Call Publishing Co.	Allentown, Pa	....
WSAP	Seventh Day Adventist Church	New York, N. Y.	....
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	....
WSAU	Camp Marienfeld	Chesham, N. H.	....
WSAV	Clifford W. Vick Radio Construction Co.	Houston, Tex.	....
WSAZ	Chase Electric Shop	Pomeroy, O.	....
WSB	Atlanta Journal	Atlanta, Ga.	....
WSL	J. & M. Electric Co.	Utica, N. Y.	....
WSOE	School of Engineering of Milwaukee	Milwaukee, Wis.	....
WSY	Alabama Polytechnic Institute	Auburn, Ala.	....
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	....
WTAC	Penn Traffic Co.	Johnston, Pa.	....
WTAF	Louis J. Gallo	New Orleans, La.	....
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	....
WTAM	Willard Storage Battery	Cleveland, Ohio	....
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	....
WTAQ	S. H. Van Gorden & Son	Osseo, Wis.	....
WTAR	Reliance Electric Co.	Norfolk, Va.	....
WTAS	Charles E. Erbstein	Elgin, Ill. (near)	....
WTAT	Edison Electric Illuminating Co. (Portable)	Boston, Mass.	....
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Neb.	....
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	....
WTAX	Williams Hardware Co.	Streator, Ill.	....
WTAY	Oak Leaves Broadcasting Station	Oak Park, Ill.	....
WTAZ	Thomas J. McGuire	Lambertville, N. J.	....
WTG	Kansas State Agricultural College	Manhattan, Kan.	....
WWAD	Wright & Wright, Inc.	Philadelphia, Pa.	....
WWAE	Alamo Ball Room	Joliet, Ill.	....
WWAO	Michigan School of Mines	Houghton, Mich.	....
WWI	Ford Motor Co.	Dearborn, Mich.	....
WWJ	Detroit News	Detroit, Mich.	....
WWL	Loyola University	New Orleans, La.	....

Government Daily Market Reports

Call Signal	Owner of Station	Location of Station	Your Adjustment
NAA	United States Navy	Arlington, Va.	....

Wave Length 435 Metres.

(Eastern Time)

9.45 A.M.	Weather.
10.05 A.M.	Weather Forecasts.
10.25 A.M.	Fruit and Vegetable Shipping Reports.
12.25 P.M.	Livestock Market Reports.
1.45 P.M.	Fruit and Vegetable Market Reports.
3.25 P.M.	Complete Livestock Market Quotations and Comment.
3.45 P.M.	Special Weather Forecasts.
4.05 P.M.	(except Saturday, when time will be 4.25 P.M.) Crop Reports and Special News Items.
5.05 P.M.	Market Reports, covering Grain, Livestock, Meats, etc.
9.55 P.M.	Time Signals.
10.05 P.M.	Weather Forecasts.

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CANADA

Call Signal	Owner of Station	Location of Station	Your Adjustment
CFAC	The Calgary Herald	Calgary, Alb	....
CFCA	Star Publishing & Printing Co	Toronto, Ont	....
CFCF	Marconi Wireless Tel. Co. of Canada, Ltd	Montreal, Que	....
CFCH	Abitibi Power & Paper Co., Ltd	Iroquois Falls, Ont	....
CFCK	Radio Supply Co., Ltd	Edmonton, Alb	....
CFCL	Centennial Methodist Church	Victoria, B. C.	....
CFCN	W. W. Grant Radio, Ltd	Calgary, Alb	....
CFCQ	Radio Specialties, Ltd	Vancouver, B. C.	....
CFCR	Laurentide Air Service, Ltd	Sudbury, Ont	....
CFCT	The Victoria City Temple	Victoria, B. C.	....
CFCW	London Radio Co	London, Ont	....
CFCU	J. V. Elliot, Ltd	Hamilton, Ont	....
CFDC	Sparks Company	Nanaimo, B. C.	....
CFHC	Henry Birks & Son, Ltd	Calgary, Alb	....
CFKC	D. J. Fendell	Thoroid, Ont	....
CFLC	C. G. Hunter	London, Ont	....
CFQC	The Electric Shop, Ltd	Saskatoon, Sask	....
CFRC	Queen's University	Kingston, Ont	....
CFXC	Westminster Trust Co	New Westminster, B. C.	....
CFYC	Victor W. Odlum	Vancouver, B. C.	....
CHBC	The Albertan Publishing Co	Calgary, Alb	....
CHCE	Western Canada Radio Supply, Ltd	Victoria, B. C.	....
CHCM	Riley & McCormack, Ltd	Calgary, Alb	....
CHCS	The Hamilton Spectator	Hamilton, Ont	....
CHNC	Toronto Radio Research Society	Toronto, Ont	....
CHUC	International Bible Students Association	Saskatoon, Sask	....
CHXC	J. R. Booth, Jr	Ottawa, Ont	....
CHYC	Northern Elecric Co., Ltd	Montreal, P. Q	....
CJBC	Jarvis St. Baptist Church	Toronto, Ont	....
CJCA	The Edmonton Journal, Ltd	Edmonton, Alb	....
CJCD	T. Eaton Co., Ltd	Toronto, Ont	....
CJCE	Sprott-Shaw Radio Co	Vancouver, B. C.	....
CJCF	The News Record	Kitchener, Ont	....
CJCK	Radio Corporation of Calgary, Ltd	Calgary, Alta	....
CJCM	J. L. Phillipe Landry	Monti Joli, Que	....
CJCN	Simons Agnew & Co	Toronto, Ont	....
CJGC	London Free Press Printing Co., Ltd	London, Ont.	....
CJSC	The Evening Telegram	Toronto, Ont	....
CKAC	La Presse Publishing Co	Montreal, Que	....
CKCD	Vancouver Daily Province	Vancouver, B. C.	....
CKCE	Canadian Independent Telephone Co., Ltd	Toronto, Ont	....
CKCI	"Le Soleil," Ltd	Quebec, Que	....
CKCK	Leader Publishing Co., Ltd	Regina, Sask	....
CKCO	Dr. G. M. Geldert	Ottawa, Ont	....
CKCX	P. Burns & Co., Ltd	Calgary, Alta	....
CKFC	First Congregational Church	Vancouver, B. C.	....
CKLC	Wilkinson Electric Co., Ltd	Calgary, Alta	....
CKOC	Wentworth Radio Supply Co., Ltd	Hamilton, Ont	....
CKY	Manitoba Telephone System	Winnipeg, Man	....
CNRA	Canadian National Railways	Moncton, N. B	....
CNRC	Canadian National Railways	Calgary, Alta	....
CNRE	Canadian National Railways	Edmonton, Alta	....
CNRM	Canadian National Railways	Montreal, Que	....
CNRO	Canadian National Railways	Ottawa, Ont	....

Call Signal	Owner of Station	Location of Station	Your Adjustment
CNRR	Canadian National Railways	Regina, Sask	
CNRS	Canadian National Railways	Saskatoon, Sask	
CNRT	Canadian National Railways	Toronto, Ont	
CNRW	Canadian National Railways	Winnipeg, Man	
OA	Dept. of Marine and Fisheries, Radio Branch Test Room	Ottawa, Ont	

CUBA

Call Signal	Owner of Station	Location of Station	Your Adjustment
PWX	Cuban Telephone Company	Havana	
2AB	Alberto S. Bustamante	Havana	
2BY	Frederick W. Borton	Havana	
2CX	Frederick W. Borton	Havana	
2LC	Luis Casas	Havana	
2MG	Manuel y Guillermo Salas	Havana	
2HS	Julio Power	Havana	
2OL	Oscar Collado	Havana	
2HP	Credito y Construcciones Company	Havana	
2KP	George A. Lindeaux	Havana	
2JP	Julio Power	Havana	
2OK	Mario Garcia Velez	Havana	
2RY	Raoul Karman	Havana	
2TW	Roberto E. Ramirez	Havana	
2WW	Amadeo Saenz Calahorra	Havana	
5EV	Leopoldo V. Figueroa	Matanzas	
6KW	Frank H. Jones	Central Tuinucu	
6KJ	Frank H. Jones	Central Tuinucu	
6CX	Antonio T. Figueroa	Cienfuegos	
6DW	Eduardo Terry	Cienfuegos	
6GR	Luis del Castillo	Cienfuegos	
6HS	Santiago Ventura	Sagua le Grande	
6BY	José Ganduxe	Cienfuegos	
6GT	Juan Pablo Ros	Cienfuegos	
6EV	Maria J. Alvarez	Caibarien	
6YR	Diego Yborra	Camajuani	
7AZ	Pedro Nogueras	Camaguey	
7BY	Eduardo V. Figueroa	Ciego de Avila	
7SR	Salvador Rionda	Camaguey	
8AZ	Alfredo Broocks	Santiago de Cuba	
8BY	Alberto Ravelo	Santiago de Cuba	
8DW	Pedro C. Andux	Santiago de Cuba	
8EV	Eduardo Mateos	Santiago de Cuba	
	Andrés Vinnet	Santiago de Cuba	
8GT	Juan E. Chibás	Santiago de Cuba	
8CX	Pedro T. Azcarate	Santiago de Cuba	
8HS	Guillermo Polanco	Santiago de Cuba	

Broadcasting Stations Arranged Alphabetically by States

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Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
	ALABAMA				
Auburn	Alabama Polytechnic Institute	KSY	500	250	1070
Mobile	Mobile Radio Co	WEAP	100	263	1140
Montgomery	United Battery Service Co	WKAN	15	226	1330
	ARIZONA				
Phoenix	McArthur Bros. Mercantile Co	KFAD	100	360	*....
	Nielsen Radio Supply Co	KFCB	10	238	1260
Tucson	University of Arizona	KFDH	50	268	1120
	ARKANSAS				
Conway	Conway Radio Laboratories	KFKQ	100	250	1200
Fayetteville	Guy Simmons, Jr	KFRJ	10	250	1200
Fort Smith	Leon Hudson Real Estate Co	KFOZ	20	233	1290
Little Rock	Bizzell Radio Shop	KFLQ	20	261	1150
	Christian Churches of Little Rock	KFMB	...	254	1180
	Dice Electric Co	WCAV	10	263	1140
	University of Arkansas	KFMQ	100	263	1140
Pine Bluff	First Presbyterian Church	KFPX	100	242	1240
	CALIFORNIA				
Bakersfield	Frank E. Siefert	KDZB	100	240	1250
Berkeley	Berkeley Daily Gazette	KRE	50	275	1090
Burlingame	Royal Radio Co	KFNZ	10	231	1294
	Albert Sherman	KFQH	50	231	1300
Fresno	San Joaquin Light & Power Corp	KMJ	50	248	1210
Hanford	M. Laurence Short	KFRN	5	224	1340
Hollywood	Studio Lighting Service Co	KFAR	200	227	1320
	Taft Radio Co	KFQZ	250	240	1250
Holy City	W. Riker	KFQU	100	234	1280
Long Beach	Echophone Radio Shop	KFON	100	234	1282
Los Angeles	Echo Park Evangelistic Association	KFSG	500	278	1080
	Oliver S. Garretson	KFPG	10	238	1260
	Los Angeles County Forestry Department	KFPR	500	231	1300
	Bible Institute of Los Angeles	KJS	500	252	1190
	Earle C. Anthony, Inc	KFI	1500	469	640
	Los Angeles Examiner	KWH	250	360	....
	Times-Mirror Co	KHJ	500	395	760
	Leslie E. Rice	KFCL	500	236	1270
	So. California Radio Asso	KFQG	100	226	1330
Oakland	Preston D. Allen	KZM	100	360	....
	Tribune Publishing Co	KLX	250	509	500
	Warner Brothers	KLS	250	360	....
	General Electric Co	KGO	1000	312	960
Paso Robles	Radio Broadcast Association	KFNL	10	240	1250
Redlands	Trinity Episcopal Church	KFRP	10	211	1420
Richmond	Fommel Manufacturing Co	KFOU	100	254	1180
Sacramento	Kimball-Upson Co	KFBK	100	283	1060
Salem	Salem Electric Co	KFCD	20	...	....
Santa Ana	The Radio Den	KFAW	10	280	1070
Santa Barbara	Fallon & Company	KFHJ	100	360	....
San Diego	Savoy Theatre	KDYM	100	280	1070
	Southern Electrical Co	KDPT	50	244	1230
	W. K. Azbill	KFBC	5	278	1080

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*Where the frequency (kilocycle) is desired it can be found by dividing 300,000 by the wave length. In each case where dots are used the figure for frequency or kilocycles is 833.

CALIFORNIA (Continued)

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
San Francisco	Examiner Printing Co	KUO	150	360	....
	Hale Brothers	KPO	500	423	....
	Heintz & Kohimoos	KFPV	50	236	1270
	Radicart Studio	KFRC	5	280	1070
San Jose	City of San Jose	KFAQ	250	360	....
	Charles D. Herrold	KQW	50	240	1230
San Luis Obispo	Reuben H. Horn	KFBE	50	242	1240
Santa Rosa	L. A. Drake	KFNV	5	227	1320
Stanford Univ	Leland Stanford University	KFGH	500	273	1100
Stockton	C. O. Gould	KJQ	5	273	1100
	Portable Wireless Telephone Co	KWG	50	360	....
Taft	Kidd Brothers Radio Shop	KFQC	100	227	1320
Venice	White Kinney Co	KFAV	5	224	1340
Whittier	First Christian Church	KFOC	100	236	1271
	COLORADO				
Boulder	University of Colorado	KFAJ	100	360	....
Colorado Springs	Nassour Bros. Radio Co	KFKZ	10	234	1280
	Dickenson-Henry Radio Laboratories	KFQE	10	224	1340
	W. D. Corley	KFUM	100	242	1240
Denver	General Electric Co	KOA	1500	323	928
	National Educational Service	KFLE	25	268	1120
	Reynolds Radio Co	KLZ	500	283	1060
	Reynolds Radio Co	KFRI	5	224	1340
	Western Radio Corp	KFAF	500	278	1080
	Winner Radio Corp	KFEL	50	254	1180
	Colorado National Guard, 45th Div. Tank Co.	KFPO	500	231	1300
	Knight-Campbell Music Co	KFDL	5	226	1330
Greeley	Colorado State Teachers College	KFKA	50	273	1100
Gunnison	Colorado State Normal School	KFHA	50	252	1190
Trinidad	Trinidad Gas & El. Sup. Co. and Chron. News	KFBS	10	280	1070
	CONNECTICUT				
New Haven	Doolittle Radio Corp	WPAJ	100	268	1120
Storrs	Connecticut Agricultural College	WABL	100	283	1060
	DELAWARE				
Wilmington	Wilmington Electrical Specialty Co	WHAV	100	266	1130
	DISTRICT OF COLUMBIA				
Washington	Chesapeake & Potomac Telephone Co	WCAP	500	469	640
	Doubleday-Hill Electric Co	WMU	100	261	1150
	Radio Corp. of America	WRC	500	469	640
	Church of the Covenant	WDM	50	234	1280
	Washington Radio Hospital Fund	WRRF	50	256	1170
	FLORIDA				
De Land	De Land Piano & Music Co	WEBU	5	258	1160
Miami	Electrical Equipment Co	WQAM	100	268	1120
Miami Beach	Fleetwood Hotel	WMBF	500	330	909
St. Petersburg	Radio Specialty Co	WDBI	20	226	1330
	E. Richard Hall	WCBK	500	266	1130
Tampa	Tampa Daily Times	WDAE	250	273	1100
Winter Park	Rollins College	WDBO	50	240	1250

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GEORGIA

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Atlanta	Georgia School of Technology	WBBF	500	270	1110
	Atlanta Journal	WSB	500	429	700
Macon	George P. Rankin, Jr., and Maitland Soloman	WCBW	10	226	1330
	Mercer University	WMAZ	100	261	1150
Savannah	Savannah Radio Corporation	WEBZ	5	280	1070

IDAHO

Boise	Ind. School Dist. of Boise City, Boise High	KFAU	150	270	1110
	St. Michael's Cathedral	KFDD	10	252	1190
Moscow	The Electric Shop	KFAN	50	360	833
Wallace	The Radio Shop	KFOD	10	224	1339

ILLINOIS

Cambridge	Cambridge Radio & Electric Co	WTAP	50	242	1240
Chicago	Chicago Daily Drovers Journal	WAAF	200	278	1080
	Chicago Daily News	WMAQ	500	448	670
	Zenith Radio Corp. (Portable)	WJAZ	100	268	1120
	Westinghouse Elec. & Manf. Co	KYW	1500	536	560
	Edgewater Beach Hotel	WEBH	1000	370	810
	No. Shore Congregational Church	WDBY	500	258	1160
	Calumet Rainbo Broadcasting Co	WQJ	500	448	670
	Chicago Tribune	WGN	1000	370	810
	Sears, Roebuck & Co	WLS	500	345	870
	H. Leslie Atlass	WBBN	10	226	1330
Chicago Heights	Coppotelli Brothers Music House	WCBZ	50	248	1210
Decatur	James Milliken University	WBAO	50	275	1090
Elgin	Charles E. Erbstein	WTAS	500	286	1050
	Charles E. Erbstein	WGEE	1000	536	560
Eureka	Eureka College	WFBB	50	240	1250
Galesburg	Lombard College	WRAM	100	244	1230
Harrisburg	Tate Radio Co	WEBQ	10	226	1330
Joliet	Alamo Ball Room	WWAE	500	278	1080
Monmouth	Jenks Motor Sales Co	WBBU	10	224	1339
Mooseheart	Loyal Order of Moose	WJJD	500	278	1080
Oak Park	Oak Leaves Broadcasting Station	WTAY	500	283	1060
Peoria	Peoria Star	WJAN	100	280	1070
	Radio Equipment Co	WQAX	100	248	1210
Rockford	A. A. Johnson	WIAB	50	252	190
	Swedish Evangelical Mission Church	KFLV	100	229	1310
Streator	Williams Hardware Co	WTAX	50	231	1300
Tuscola	James L. Bush	WDZ	10	278	1080
Urbana	University of Illinois	WRM	500	275	1090
Zion	Wilbur G. Voliva	WCBD	500	345	870

INDIANA

Anderson	Electrical Equipment & Service Co	WEBD	10	246	1220
Ft. Ben Harrison	Signal officer	WFBY	100	258	1160
Greencastle	Greencastle Community Broadcasting Station	WLAX	10	231	1300
Greentown	Clifford L. White	WJAK	50	254	1180
Indianapolis	Noble B. Watson	WBBZ	50	227	1321
	Merchants Heat & Light Co	WFBM	250	268	1120
Laporte	Radio Club, Inc	WRAF	10	224	1340
Seymour	John V. de Walle	WFBE	20	226	1330
South Bend	South Bend Tribune	WGAZ	250	275	1090
Valparaiso	Immanuel Lutheran Church	WRBC	500	278	1080
West Lafayette	Purdue University	WBAA	250	283	1060

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DIRECTORY OF RADIO BROADCASTING STATIONS

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
	IOWA				
Ames	Iowa State College	WOI	500	360	833
Atlantic	Atlantic Automobile Co	KFLZ	100	273	1100
Boone	Crary Hardware Co	KFGQ	10	226	1330
Cedar Falls	Iowa State Teachers' College	KFJX	50	258	1160
Cedar Rapids	D. M. Perham	WJAM	20	258	1120
	H. F. Paar	WKAA	50	278	1080
Davenport	Palmer School of Chiropractic	WOC	500	484	620
Des Moines	Bankers Life Co	WHO	500	526	570
Fort Dodge	Auto Electric Service Co	KFER	10	231	1300
	Tunwall Radio Co	KFJY	50	246	1220
Iowa City	State University of Iowa	WHAA	100	484	620
	George S. Carson, Jr	KFQP	10	224	1340
Lamoni	Graceland College	KFFV	100	280	1070
Le Mars	Western Union College	KFCY	50	252	1190
Marshalltown	Marshall Electrical Co	KFJB	10	248	1210
Oskaloosa	Penn College	KFHL	10	240	1250
Shenandoah	Henry Field Seed Co	KFNF	500	266	1128
Sioux City	Davidson Bros. Co	WEAU	100	275	1090
	Morningside College	KFMR	10	261	1150
Waterloo	Black Hawk Electrical Co	WRAN	10	236	1270
	KANSAS				
Anthony	T and H Radio Co	WBL	100	254	1180
Beloit	Ward Battery & Radio Co	WPAR	10	236	1270
Manhattan	Kansas State Agricultural College	WTG	50	273	1100
	Kansas State Agricultural College	KSAC	500	341	880
Milford	Brinkley-Jones Hospital Association	KFKB	500	286	1050
Parsons	Ewins Electrical Co	WOAJ	15	258	1160
Russell	Meier Radio Shop	KFQO	10	261	1150
Wichita	Wichita Board of Trade & Lander Radio Co	WEAH	50	280	1070
	College Hill Radio Club	KFOT	50	231	1300
	KENTUCKY				
Louisville	Courier-Journal & Louisville Times	WHAS	500	400	750
	W. V. Jordan	WLAP	20	286	1050
	LOUISIANA				
Alexandria	W. R. Brown	KFRF	10	242	1240
	Louisiana College	KFFY	50	275	1090
Baton Rouge	Louisiana State University	KFGC	100	254	1180
Jennings	J. C. Mans	WCBJ	10	244	1230
New Orleans	E. Budd Peddicord	WEBP	50	280	1070
	Coliseum Place Baptist Church	WABZ	50	263	1140
	Uhalt Brothers Radio Co	WCBE	5	263	1140
New Orleans	Louis J. Gallo	WTAF	10	268	1120
	Valdemar Jensen	WAAB	100	268	1120
	Loyola University	WWL	5	280	1070
	Clyde R. Randall	WCAG	50	268	1120
	Tulane University	WAAC	400	360	....
	First Baptist Church	WBBS	50	252	1190
Shreveport	First Baptist Church	KFDX	100	250	1200
	Corp Youree Hotel	WGAQ	150	263	1140
	MAINE				
Bangor	Bangor Railway & Electric Co	WABI	100	240	1250
	Maine Electric Light & Power Co	WDBN	5	252	1190

The Boston Transcript's

DIRECTORY OF RADIO BROADCASTING STATIONS

MAINE (Continued)

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Houlton	Northern Radio Manufacturing Co.	WCBL	50	280	1070
Skowhegan	Skowhegan Somerset Radio Co.	WDBU	10	258	1160

MARYLAND

Baltimore	Fifth Inf., Md. National Guard	WFBR	100	254	1180
	Jones Elec. & Radio Mfg. Co.	WGBA	50	254	1180
	Sanders & Stayman Co.	WCAO	50	275	1090
Salisbury	Walter Gibbons	WEBI	15	242	1240

MASSACHUSETTS

Boston	Edison Electric Illuminating Co.	WEEI	500	303	990
	Edison Electric Illuminating Co. (Portable)	WTAT	100	244	1228
	Shepard Stores	WNAC	100	278	1080
	Tremont Temple Baptist Church	WDBR	100	256	1170
	Commonwealth Radio Ass'n	WFBU	..	..	..
Bridgewater	Radio Sales & Service Co.	WFBN	200	226	1330
Fall River	Doughty & Welsh Elec Co.	WSAR	100	254	1180
	Fall River Daily Herald Publishing Co.	WTAB	100	266	1130
Lowell	Brines-Walter Co.	WQAS	100	266	1130
Mattapoisett	Irving Vermilya	WBBG	500	248	1210
Medford Hillside	America Radio & Research Corp.	WGI	100	360	833
Roslindale	Hobart Radio Co.	WEBY	10	226	1330
So. Dartmouth	Round Hills Radio Corp.	WMAF	100 to 500	363	826
Springfield	Westinghouse Electric & Mfg. Co.	WBZ	1500	337	890
Taunton	A. H. Waite & Co.	WDBB	10	229	1310
Worcester	Clark University	WCBT	250	238	1260
	C. T. Sherer Co.	WDBH	100	268	1120
	Samuel A. Waite	WDAS	10	360	....

MICHIGAN

Ann Arbor	University of Michigan	WCBC	200	229	1310
Berrien Springs	Emmanuel Missionary College	KFGZ	500	286	1050
Dearborn	Ford Motor Co.	WWI	250	273	1100
Detroit	Detroit Free Press	WCX	500	517	580
	Detroit News	WWJ	500	517	580
	Police Department	KOP	500	286	1050
East Lansing	Michigan Agriculture College	WKAR	500	280	1070
Flint	Fallain & Lathrop	WEAA	50	234	1280
Grand Rapids	Grand Rapids Radio Co.	WEBK	20	242	1240
Houghton	M. G. Sateren	KFMW	50	266	1130
	Michigan College of Mines	WWAO	250	244	1230
Lansing	Reo Motor Car Co.	WREO	500	288	1040
Menominee	Signal Electric Manufacturing Co.	KFLB	50	248	1210
Mount Clemens	Henry B. Joy	WABX	500	270	1110
Port Huron	J. Irving Bell	WBBH	50	246	1220
Petoskey	Petoskey High School	WBBP	10 and 100	246	120
Saginaw	F. L. Doherty Auto & Radio Supply Co.	WABM	100	254	1180

MINNESOTA

Collegeville	St. Johns University	WFBJ	50	236	1270
Duluth	Paramount Radio Corp.	WMAT	250	266	1130
Hutchinson	Hutchinson Electric Service Co.	WFAN	300	286	1050
Minneapolis	Augsburg Seminary	KFEX	100	261	1150
	University of Minnesota	WLB	5	278	1080

MINNESOTA (Continued)

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Minneapolis	William Hood Dunwoody Industrial Institute	WCAS	100	280	1070
	Harry O. Iverson	KFDZ	5	231	1300
	George W. Young	KFMT	100	231	1300
	Washburn Crosby Co	WCCO	500	417	720
Moorhead	Concordia College	WPAU	10	286	1050
Northfield	St. Olaf College	WCAL	500	360	....
	Carleton College	KFMX	500	283	1060
St. Cloud	Times Publishing Co	WFAM	10	273	1100
St. Paul	Beacon Radio Service	KFOY	50	226	1330

MISSISSIPPI

Coldwater	Wooten's Radio Shop	KFNG	10	254	1180
Hattiesburg	Taylor's Book Store	WDBT	10	236	1270
Oxford	University of Mississippi	WCBH	10	242	1239
Pascagoula	Howard S. Williams	WCBG	10	268	1120

MISSOURI

Butler	First Christian Church	WNAR	20	231	1300
Carterville	St. Johns Church	KFPW	20	268	1120
Columbia	University of Missouri	WAAN	50	254	1180
Fayette	Democrat Leader	KFQK	10	236	1270
Independence	Reorg. Ch'ch of Jesus Christ of Lat. Day Sts.	KFIX	250	268	1120
Jefferson City	Missouri State Marketing Bureau	WOS	500	441	680
	Missouri N. G. Hdqurs. Co., 70th Infantry.	KFPN	10	242	1240
Kansas City	Kansas City Star	WDAF	500	411	730
	Sweeney School Co	WHB	500	411	730
	Unity School of Christianity	WOQ	500	278	1080
Moberly	Moberly High School Radio Club	KFOJ	5	246	1215
	First Baptist Church	KFFP	50	266	1130
St. Louis	Benson Radio Company	WEB	100	273	1110
	Cleveland High School	KFRG	20	236	1270
	Kingshighway Presbyterian Church	WMAY	100	280	1070
	Post Dispatch	KSD	500	546	550
	Radio Service Co	WRAO	10	227	1321
	St. Louis University	WEW	100	280	1070
	Stix, Baer & Fuller Dry Goods Co	WCK	100	360	....
	The Principia	KFQA	50	261	1150
	Concordia Seminary	KFUC	500	545	550

MONTANA

Butte	Abner R. Willson	KFLA	5	258	1160
	F. F. Gray	KFKV	50	283	1060
Havre	Havre, Buttrey & Co	KFBB	50	275	1090
Helena	Montana Phonograph Co	KFNY	5	261	1145
	Van Blaricom Co	KFSY	10	248	1210
	First Congregational Church	KFCC	10	248	1210

NEBRASKA

Belden	Farmers State Bank	KFQY	10	273	1100
David City	David City Tire & Electric Co	KFOR	20	226	1330
Fremont	Midland College	WOAE	15	280	1070
Hartington	The Electric Shop	KFRZ	15	222	1350
Hastings	Westinghouse Electric & Manufacturing Co	KFKX	1000	341	880

NEBRASKA (Continued)

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Kearney	Radio-Bug Products Co.	KFHP	10	246	1220
Lincoln	American Electric Co.	WJAB	100	229	1310
	General Supply Co.	WMAH	100	254	1180
	Univeristy of Nebraska	WFAV	500	275	1090
	Nebraska Buick Auto Co.	KFAB	200	240	1250
	Nebraska Buick Auto Co.	KFRR	200	240	1250
Norfolk	Norfolk Daily News	WJAG	250	283	1060
Oak	J. L. Scroggin	KFEQ	100	268	1070
Omaha	Journal-Stockman Co.	WIAK	250	273	1080
	Omaha Central High School	KFCZ	50	258	1160
	Omaha Grain Exchange	WAAW	500	286	1050
	Woodmen of the World	WOAW	500	526	570
	Technical High School (Board of Education)	KFOX	100	248	1210
	Omaha Grain Exchange	KFQV	100	231	1300
Tecumseh	Ruegg Battery & Elec. Co.	WTAU	10	242	1239
University Place	Nebraska Wesleyan University	WCAJ	500	280	1070

NEVADA

Sparks	Nevada State Journal	KFFR	10	226	1330

NEW HAMPSHIRE

Chesham	Camp Marienfeld	WSAU	10	229	1310
Hanover	Dartmouth College	WFBK	100	256	1170
Laconia	Laconia Radio Club	WKAV	50	254	1180

NEW JERSEY

Atlantic City	Seaside House	WHAR	200	275	1090
Camden	Victor Talking Machine Co.	WABU	50	226	1330
	Galvin Radio Supply Co.	WFBI	100	236	1270
Gloucester City	Flexon's Garage	WRAX	100	268	1120
Highland Park	The Electric Shop	WEBA	15	233	1290
Lambertville	Thomas J. McGuire	WTAZ	15	261	1150
Newark	L. Bamberger & Co.	WOR	500	405	740
	D. W. May, Inc.	WBS	50	360	....
	I. R. Nelson Co.	WAAM	250	263	1140
	Radio Shop of Newark	WNJ	100	233	1290
North Plainfield	Borough of North Plainfield	WEAM	250	261	1150
Paterson	Wireless Phone Corporation	WBAN	100	244	1230
Pitman	Gloucester County Civic League	WFBT	50	231	1300
Salem	Morton Radio Supply Co.	WDBQ	50	234	1280
Trenton	Franklyn J. Wolff	WOAX	500	240	1250

NEW MEXICO

Albuquerque	University of New Mexico	KFLR	100	254	1180
State College	New Mexico College of Agri. and Mech. Arts.	KOB	500	360	....
	New Mexico College of Agr. and Mech. Arts	KFRY	50	266	1130

NEW YORK

Buffalo	Federal Tel. Mfg. Co.	WGR	750	319	940
	H. H. Howell	WEBR	15	240	1250
Canton	St. Lawrence University	WCAD	250	263	1140
Cazenovia	Clive B. Meredith	WMAC	100	275	1090
Ithaca	Cornell University	WEAI	500	286	1050
Kingston	Boy Scouts of America, Ulster Co. Council	WDBZ	5	233	1290

NEW YORK (Continued)

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Lockport	Norton Laboratories	WMAK	500	273	1100
New York	Am. Tel. & Tel. Co	WEAF	1500	492	610
	Calvary Baptist Church	WQAO	100	360	833
	Gimbel Bros., Inc	WGBS	500	316	950
	Western Electric Co	WBAY	500	492	610
	Radio Corporation of America	WJZ	500	455	660
	Radio Corporation of America	WJY	750	405	740
	Geo. Schubel, 1540 Broadway	WHN	100-500	360	833
	Seventh Day Adventist Church	WSAP	250	263	1140
	Third Ave. Ry. Co.	WEBJ	500	273	1100
	Concourse Radio Corp	WFBH	500	273	1100
	City of New York	WNYC	1000	526	570
	Otto Baur	WDBX	5	233	1290
Richmond Hill	A. H. Grebe & Co	WAHG	500	316	950
Rochester	Lake Ave. Baptist Church	WABO	10	283	1060
	University of Rochester	WHAM	100	283	1060
Rossville	Peoples Pulpit Association	WBBR	500	273	1100
Schenectady	General Electric Co.	WGY	1000	380	790
	Union College	WRL	500	360	833
Syracuse	Onondaga Hotel Co	WFBL	100	286	1050
Tarrytown	Tarrytown Radio Research Laboratory	WRW	500	273	1100
Troy	Rensselaer Polytechnic Institute	WHAZ	500	380	790
Utica	J. & M. Electric Co	WSL	100	273	1100

NORTH CAROLINA

Charlotte	Southern Radio Corp	WBT	250	360	....
Raleigh	Wynne Radio Co	WFBQ	50	252	1190

NORTH DAKOTA

Agri. College	North Dakota Agricultural College	WPAK	50	283	1060
Fargo	Fargo Radio-Electric Co	WDAY	50	244	1230
Grafton	The Radio Shop	KFRH	10	268	1120
Grand Forks	University of North Dakota	KFJM	100	280	1070
	Men's Club of First Presbyterian Church	KFRL	10	240	1250

OHIO

Cambridge	Roy W Waller	WEBE	10	248	1210
Cincinnati	Crosley Radio Corp	WLW	1000	423	710
	Ohio Mechanics Institute	WAAD	25	360	....
	United States Playing Card Co	WSAI	500	309	970
	University of Cincinnati	WHAG	100	233	1290
	Ainsworth-Gates Radio Co	WMH	750	309	970
Cleveland	Radiovex Co	WHK	100	263	1060
	Westinghouse Elec. & Mfg. Co	KDPM	500	270	1110
	Willard Storage Battery Co	WTAM	1500	390	770
	Union Trust Co	WJAX	500	390	770
Columbus	Entrekin Electric Co	WCAH	100	286	1050
	Erner & Hopkins Co	WBAV	500	423	710
	First Baptist Church	WMAN	10	286	1050
	Ohio State University	WEAO	500	294	1020
Dayton	Parker High School	WABD	5	283	1060
	S. M. K. Radio Corp	WDBS	5	283	1060
	Coöperative Industrial High School	WEBT	5	270	1110
Dover	Robert F. Weinig	WABP	200	266	1130

OHIO (Continued)

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Granville	Richard H. Howe	WJD	10	229	1310
Hamilton	Doren Bros. Elec. Co.	WRK	200	270	1110
	Radio Company	WEBO	5	250	1200
Lima	Page Organ Co.	WOAC	50	266	1130
Pomeroy	Chase Electric Shop	WSAZ	50	244	1230
Sandusky	Lake Shore Tire Co.	WABH	10	240	1250
	Sandusky Register	WQAF	5	240	1250
Springfield	Whittenberg College	WNAP	100	275	1090
Toledo	Toledo Radio & Electric Co.	WTAL	10	252	1190
	Scott High School	WABR	50	270	1110
Wooster	College of Wooster	WABW	20	234	1280
Yellow Springs	Antioch College	WRAV	100	242	1240
Youngstown	Robert G. Phillips	WDBF	50	246	1220

OKLAHOMA

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Bristow	Delano Radio & Electric Co.	KFJK	100	233	1290
Chickasha	Oklahoma College for Women	KFGD	50	252	1190
Fort Sill	James P. Boland	KFRM	50	263	1140
Muskogee	Oklahoma Free State Fair Association	KFQL	20	252	1190
Norman	University of Oklahoma	WNAD	100	254	1180
Oklahoma	National Radio Mfg. Co.	KFJF	225	261	1150
	WKY Radio Shop	WKY	100	360	833
	Walter L. Ellis	KFQR	50	250	1200
Okmulgee	Donaldson Radio Co.	WPAC	100	360	833
Tulsa	Naylor Electrical Co.	WLAL	100	360	833

OREGON

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Astoria	Liberty Theatre	KFJI	10	252	1190
Corvallis	Oregon Agricultural College	KFDJ	50	360	....
Hood River	Apple City Radio Club	KQP	10	360	....
Marshfield	Rohrer Electric Co.	KFOF	10	240	1250
Medford	Virgin's Radio Service	KFAY	50	283	1060
Portland	Benson Polytechnic Institute	KFIF	100	360	....
	Radio Market Service Co.	KFRQ	5	213	1410
	Hollock & Watson Radio Service	KGG	50	360	....
	Meier & Frank Co.	KFEC	10	248	1210
	Oregon Institute of Technology	KDYQ	50	360	....
	Portland Morning Oregonian	KGW	500	492	610
	Third Baptist Church	KFQN	5	283	1060
	Ashley C. Dixon & Son	KFJR	5	263	1140

PENNSYLVANIA

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Allentown	Charles W. Heinbach	WCBA	10	254	1180
	Allentown Call Publishing Co.	WSAN	10	229	1310
Altoona	William F. Gable Co.	WFBG	100	261	1150
Buck Hill Falls	Forks Electrical Shop	WCBY	10	268	1120
East Pittsburgh	Westinghouse Elec. & Mfg. Co.	KDKA	1000	326	920
Erie	Pennsylvania National Guard	WOAV	50	242	1240
Grove City	Grove City College	WSAJ	250	258	1160
Harrisburg	Harrisburg Sporting Goods Co.	WABB	10	266	1130
Haverford	Haverford College Radio Club	WABQ	50	261	1150
Johnstown	Penn Traffic Club	WTAC	150	275	1090
	Johnstown Radio Co.	WBBV	5	248	1209

PENNSYLVANIA (Continued)

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Lancaster	Kirk, Johnson & Co	WDBC	50	258	1160
	Lancaster Elec. Supply & Construction Co	WGAL	10	248	1210
McKeesport	K. & L. Electric Co	WIK	100	234	1280
Parkesburg	Horace A. Beale, Jr	WQAA	500	220	1360
Philadelphia	Durham & Co	WCAU	500	278	1080
	Gimbel Brothers	WIP	500	509	590
	Lennig Brothers Co	WNAT	100	250	1200
	Lit Brothers	WDAR	500	395	760
	Thomas F. J. Rowlett	WGL	500	360	833
	Strawbridge & Clothier	WFI	500	395	760
	John Wannamaker	WOO	500	509	590
	Wright & Wright, Inc	WWAD	100	250	1200
	John Magaldi, Jr	WABY	50	242	1240
	Howard R. Miller	WIAD	100	254	1180
	Gethsemane Baptist Church	WFBD	5	234	1280
Pittsburgh	Kaufmann & Baer Co	WBBK	10	254	1180
	Doubleday-Hill Electric Co	KQV	250	275	1090
	Kaufmann & Baer Co	WCAE	500	462	650
	Pittsburgh Radio Supply House	WJAS	500	286	1050
Reading	Avenue Radio Shop	WRAW	10	238	1260
	Barbey Battery Service	WBBD	50	234	1280
Scranton	Scranton Times	WQAN	100	250	1200
State College	Pennsylvania State College	WPAB	500	283	1060
Wilkes-Barre	John H. Stenger, Jr	WBAX	20	254	1180

RHODE ISLAND

Cranston	Dutee W. Flint	WKBF	500	286	1050
	Dutee W. Flint	WKAP	50	360	833
East Providence	Charles Looff	WKAD	20	240	1250
Providence	J. A. Foster Co	WSAD	100	261	1150
	The Outlet Co	WJAR	500	360	833
	Shepard Co	WEAN	100	273	1100
	Charles H. Messter (portable)	WCBR	50	246	1226

SOUTH CAROLINA

Charleston	Washington Light Infantry	WBBY	10	268	1119
Clemson College	Clemson Agricultural College	WSAC	500	360	833
Greenville	Furman University	WGBT	15	236	1270

SOUTH DAKOTA

Brookings	Brookings Dakota State College	KFDY	100	273	1100
Rapid City	South Dakota State School of Mines	WCAT	50	240	1250
Vermilion	University of South Dakota	WEAJ	100	283	1060
Yankton	Dakota Radio Apparatus Co	WNAX	100	244	1230

TENNESSEE

Bemis	Nicoll, Duncan & Rush	WCBI	50	240	1250
Columbia	The Radio Den	WDBW	20	268	1120
Knoxville	First Baptist Church	WFBC	50	250	1200
Lawrenceburg	Vaughn Conservatory of Music	WOAN	200	360	833
Memphis	Commercial Appeal	WMC	500	500	600
	Radio Shop (Inc.)	WCBO	20	250	1200
	First Baptist Church	WGBC	10	266	1130
Nashville	John E. Cain, Jr	WEBX	50	263	1140
	First Baptist Church	WCBQ	100	236	1270
Tullahoma	Tullahoma Radio Club	WCBV	10	252	1190

TEXAS

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Abilene	West Texas Radio Co	WQAQ	100	360	833
Amarillo	J. Laurence Martin	WDAG	100	263	1140
	E. B. Gish	WQAC	100	234	1280
Austin	Texas Highway Bulletin	KFQM	100	268	1120
	Texas Markets and Warehouse Department	WCM	250	268	1120
Beaumont	Magnolia Petroleum Co	KFDN	500	306	950
Beeville	Hall Brothers	KFRB	250	248	1210
College Station	Agricultural & Mechanical College of Texas	WTAW	250	270	1110
Dallas	City of Dallas (Police & Fire Sig. Dept.)	WRR	200	261	1150
	Dallas News and Dallas Journal	WFAA	500	476	630
Denison	Texas Nat'l Guard, 36th Signal Co	KFQT	10	252	1190
Dublin	C. C. Baxter	KFPL	15	242	1240
El Paso	Trinity Methodist Church (South)	WDAH	50	268	1120
Fort Worth	Texas National Guard, 112th Cavalry	KFJZ	20	254	1180
	Wortham-Carter Publishing Co	WBAP	750	476	630
	Searchlight Publishing Co	KFQB	100	254	1180
	Curtis Printing Co	KFRO	50	246	1220
Galveston	Galveston Tribune	WIAC	100	360	833
	George R. Clough	KFLX	10	240	1250
	Thomas Coggan & Bros. Music Co	KFUL	10	258	1160
Greenville	New Furniture Co	KFPM	10	242	1240
Houston	Clifford W. Vick Radio Construction Co	WSAV	100	360	833
	Alfred P. Daniel	WCAK	10	263	1140
	Hurlburt-Still Electrical Co	WEV	100	263	1140
	Iris Theatre	WEAY	500	360	....
	Fred Mahaffey, Jr	KFCV	10	360	....
	Rice Institute	WRAA	100	256	1170
Orange	First Présbyterian Church	KFGX	500	250	1200
San Antonio	Southern Radio Corp. of Texas	WCAR	100	263	1140
	Southern Equipment Co	WOAI	500	385	780
San Benito	Rio Grande Radio Supply House	KFLU	100	236	1270
Tyler	Tyler Commercial College	WOAF	10	360	833
Waco	Jackson's Radio Eng. Laboratories	WJAD	150	360	833
Wichita Falls	W. S. Radio Supply Co	WKAF	100	360	833

UTAH

Ogden	Ralph W. Flygare	KFCP	10	360	....
Salt Lake City	The Deseret News	KFPT	500	360	....
	Newhouse Hotel	KDYL	100	360	....
	Howard C. Mailander	KFPH	50	242	1240
	Latter Day Saints University	KFOO	10	261	1150

VERMONT

Burlington	University of Vermont	WCAX	100	360	....
Springfield	Moore Radio News Station	WQAE	50	275	1090

VIRGINIA

Arlington	United States Navy	NAA	....	435	689
Norfolk	Reliance Electric Co	WTAR	100	261	1150
	Ruffner Junior High School	WBBW	50	222	1351
Richmond	Grace Covenant Church	WBBL	100	229	1310
Roanoke	Richardson-Wayland Electrical Corporation	WDBJ	50	229	1310

WASHINGTON

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Bellingham	Bellingham Publishing Co	KDZR	50	231	1300
Everett	Lucas Brothers	KFBL	15	224	1340
Lacey	St. Martin's College	KGY	5	258	1160
North Bend	C. F. Knierim Photo Radio and Electric Shop	KFQW	50	248	1210
Olympia	G. & G. Radio & Electric Shop	KFPP	20	236	1270
	United Churches of Olympia	KFRW	100	220	1360
Pullman	J. Gordon Klemgard	KFRX	10	217	1380
	State College of Washington	KFAE	500	330	908
Seattle	Alfred M. Hubbard	KFQX	500	233	1290
	First Presbyterian Church	KTW	750	360	....
	Northwest Radio Service Co	KJR	100	270	1110
	Rhodes Co	KFOA	500	455	660
	Star Elec. & Radio Co	KFHR	50	283	1060
	Louis Wasmer	KHQ	100	360	....
Spokane	North Central High School	KFIO	50	252	1190
	Symons Investment Co	KFPY	100	283	1060
Tacoma	First Presbyterian Church	KFBG	50	360	....
	Love Electric Co	KMO	10	360	....
	Tacoma Daily Ledger	KGB	50	252	1190
Walla Walla	Frank A. Moore	KFCF	100	256	1170
Yakima	First Methodist Church	KFIQ	50	256	1170

WEST VIRGINIA

Charleston	John R. Koch (Dr.)	WPAZ	10	273	1100
Martinsburg	Herman E. Burns	WDBD	5	268	1120

WISCONSIN

Beloit	Beloit College	WEBW	500	268	1120
Fond du Lac	Daily Commonwealth and Oscar A. Heulsman	KFIZ	100	273	1100
Kenosha	Henry P. Lundskow	WOAR	50	229	1310
La Crosse	Ott Radio, Inc	WABN	500	244	1230
Milwaukee	Marquette University	WHAD	100	280	1070
	School of Eng. of Milwaukee	WSOE	100	246	1220
	Milwaukee Civic Broadcasting Association	WCAY	250	266	1130
Osseo	S. H. Van Gorden & Son	WTAQ	100	254	1180
St. Croix Falls	Northern States Power Co	WRAL	100	248	1210
Stevens Point	Wisconsin Department of Markets	WLBL	500	278	1080
Superior	Superior State Normal School	WDBP	50	261	1150
	Walter C. Bridges	WEBC	10	242	1240

WYOMING

Laramie	The Cathedral	KFBU	50	283	1060

The Boston Transcript's
DIRECTORY OF RADIO BROADCASTING STATIONS

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
	ALASKA				
Anchorage	Chovin Supply Co	KFQD	100	280	1070
Juneau	Alaska Electric Light & Power Co	KFIU	10	226	1330
Kukak Bay	Walter Hemrich	KNT	100	263	1140
	HAWAII				
Honolulu	Electric Shop	KYQ	100	270	111
	Marion A. Mulreny, Waikiki Beach	KGU	500	360	....
	PHILIPPINE ISLANDS				
Manila	Electrical Supply Co	KZKZ	100	270	1110
	PORTO RICO				
San Juan	Radio Corporation of Porto Rico	WKAQ	500	360	833
	UNITED STATES				
Portable	Radio Corp. of America	WEBL	100	226	1330

CANADA

Alphabetically by Provinces

QUEBEC

Location of Station	Owner of Station	Call Signal	Wave Length
Monti Joli	J. L. Phillipe Landry	CJCM	312
Montreal	La Presse Publishing Co	CKAC	430
	Marconi Wireless Tel. Co. of Canada, Ltd	CFCF	440
	Canadian National Railways	CNRM	341
	Northern Electric Co., Ltd	CHYC	341
Quebec	"Le Soleil," Ltd	CKCI	295

ONTARIO

Hamilton	J. V. Elliot, Ltd	CFCU	410
	The Hamilton Spectator	CHCS	410
	Wentworth Radio Supply Co	CKOC	410
Iroquois Falls	Abitibi Power & Paper Co., Ltd	CFCH	400
Kingston	Queen's University	CFRC	450
Kitchener	The News Record	CJCF	295
London	London Free Press Printing Co., Ltd	CJGC	430
	C. G. Hunter	CFLC	430
	London Radio Co	CFCW	430
Ottawa	Dept. of Marine and Fisheries, Radio Branch Test Room	OA	510
	Dr. G. M. Geldert	CKCO	400
	J. R. Booth, Jr	CHXC	435
	Canadian National Railways	CNRO	435
Sudbury	Laurentide Air Service, Ltd	CFCR	410
Thorola	D. J. Ferdell	CFKC	295
Toronto	Canadian Independent Telephone Co., Ltd	CKCE	450
	Star Publishing & Printing Co	CFCA	400
	T. Eaton Co., Ltd	CJCD	410
	The Evening Telegram	CJSC	430
	Toronto Radio Research Society	CHNC	350
	Jarvis St. Baptist Church	CJBC	312
	Simons, Agnew & Co	CJCN	410
	Canadian National Railways	CNRT	400

MANITOBA

Winnipeg	Manitoba Telephone System	CKY	450
	Canadian National Railways	CNRW	450

SASKATCHEWAN

Regina	Leader Publishing Co., Ltd	CKCK	420
	Canadian National Railways	CNRR	420
Saskatoon	The Electric Shop, Ltd	CFQC	400
	International Bible Students Association	CHUC	400
	Canadian National Railways	CNRS	400

ALBERTA

Calgary	Riley & McCormack, Ltd	CHCM	440
	The Albertan Publishing Co	CHBC	410
	The Calgary Herald	CFAC	430
	W. W. Grant Radio, Ltd	CFCN	440
	Wilkinson Electric Co., Ltd	CKLC	400
	Henry Birks & Son, Ltd	CFHC	440
	Radio Corporation of Calgary, Ltd	CJCK	316
	P. Burns & Co., Ltd	CKCX	440
	Canadian National Railways	CNRC	440
Edmonton	Radio Supply Co., Ltd	CFCK	410
	The Edmonton Journal, Ltd	CJCA	450
	Canadian National Railways	CNRE	450

The Boston Transcript's
DIRECTORY OF RADIO BROADCASTING STATIONS

BRITISH COLUMBIA

Call Signal	Owner of Station	Location of Station	Your Adjustment
Nanaimo	Sparks Company	CFDC	430
New Westminster	Westminster Trust Co	CFXC	440
Vancouver	Sprott-Shaw Radio Co	CJCE	400
	Vancouver Daily Province	CKCD	410
	Victor W. Odlum	CFYC	400
	Radio Specialties Co	CFCQ	450
	First Congregational Church	CKFC	385
Victoria	Western Canada Radio Supply, Ltd	CHCE	400
	Centennial Methodist Church	CFCL	400
	The Victoria City Temple	CFCT	410

NEW BRUNSWICK

Moncton	Canadian National Railways	CNRA	313

CUBA

Location of Station	Owner of Station	Call Signal	Power	Wave Length	Frequency in Kilocycles
Havana	Cuban Telephone Co	PWX	500	400	750
	Alberto S. Bustamante	2AB	20	240	1250
	Frederick W. Borton	2BY	100	260	1150
	Frederick W. Borton	2CX	10	320	938
	Luis Casas	2LC	30	250	1200
	Manuel y Guillermo Salas	2MG	20	280	1071
	Julio Power	2HS	20	180	1666
	Oscar Collado	2OL	15	290	1034
	Credito y Construcciones Co	2HP	100	295	1017
	George A. Lindeaux	2KP	10	195	1538
	Julio Power	2JP	20	270	1111
	Mario Garcia Velez	2OK	100	360	833
	Raoul Karman	2RY	20	275	1090
	Roberto E. Ramirez	2TW	20	230	1304
	Amadeo Saenz Calahorra	2WW	20	210	1429
Matanzas	Leopoldo V. Figueroa	5EV	10	360	833
Central Tuinucu	Frank H. Jones	8KW	100	340	882
	Frank H. Jones	6KJ	100	275	1090
Cienfuegos	Antonio T. Figueroa	6CX	20	170	1765
	Eduardo Terry	6DW	10	225	1333
	Luis del Castillo	6GR	10	250	1200
Sagua la Grande	Santiago Ventura	6HS	10	200	1500
Cienfuegos	José Ganduxe	6BY	100	300	1000
	Juan Pablo Ros	6GT	10	190	1579
Caibarien	Maria J. Alvarez	6EV	50	250	1200
Camajuani	Diego Yborra	6YR	20	200	1500
Camaguey	Pedro Nogueras	7AZ	10	225	1333
Ciego de Avila	Eduardo V. Figueroa	7BY	20	235	1276
Camaguey	Salvador Rionda	7SR	500	350	857
Santiago de Cuba	Alfredo Broocks	8AZ	20	240	1250
	Alberto Ravelo	8BY	100	250	1200
	Pedro C. Andux	8DW	50	275	1090
	Eduardo Mateos	8EV	75	180	1666
	Andrés Vinnet	8FU	15	225	1333
	Juan E. Chibás	8GT	50	260	1150
	Pedro T. Azcarate	8CX	50	245	1225
	Guillermo Polanco	8HS	10	200	1500

Supplementary

Call Signal	Owner of Station	Location of Station	Your Adjustment

Supplementary

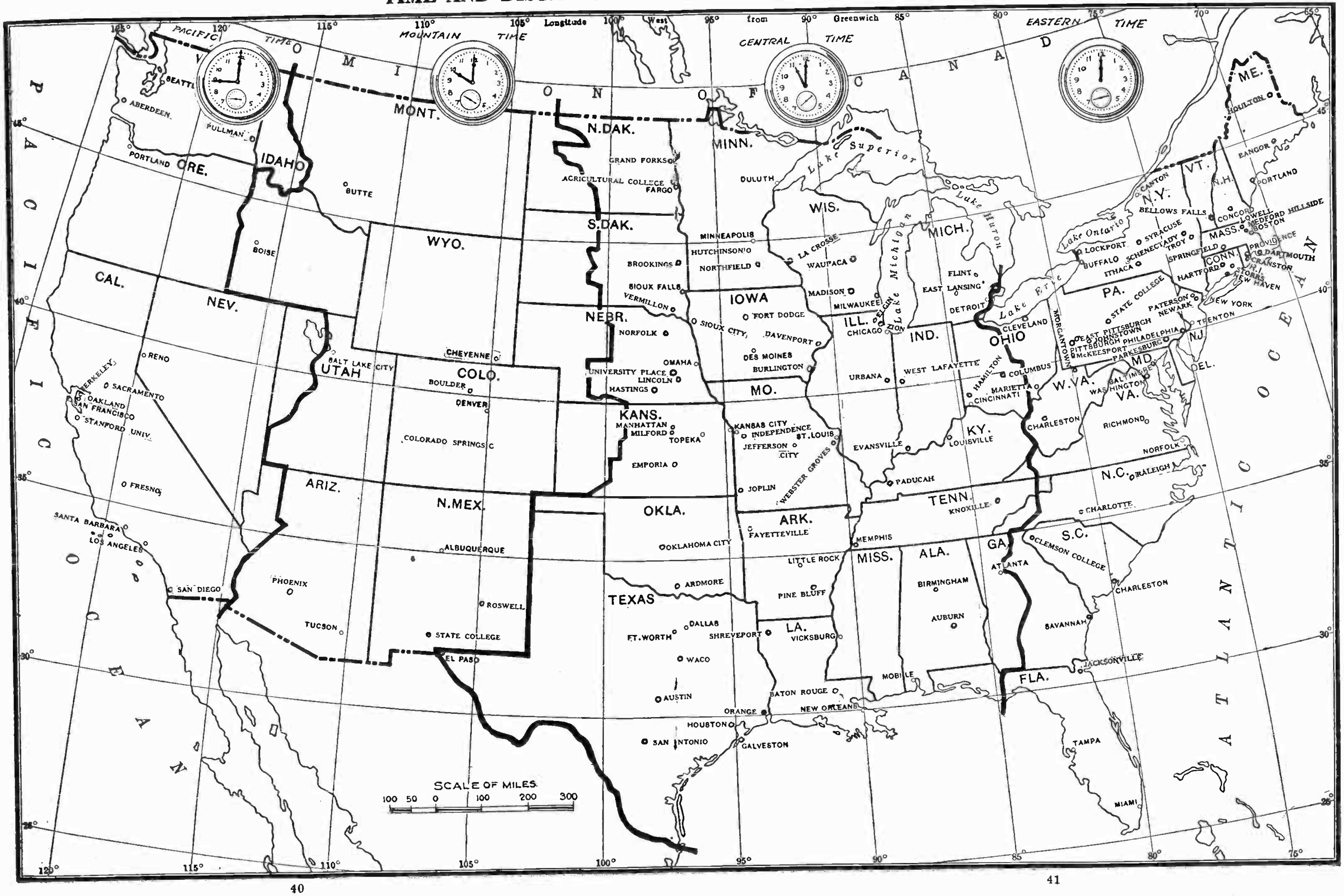
Call Signal	Owner of Station	Location of Station	Your Adjustment

The Boston Transcript's
DIRECTORY OF RADIO BROADCASTING STATIONS

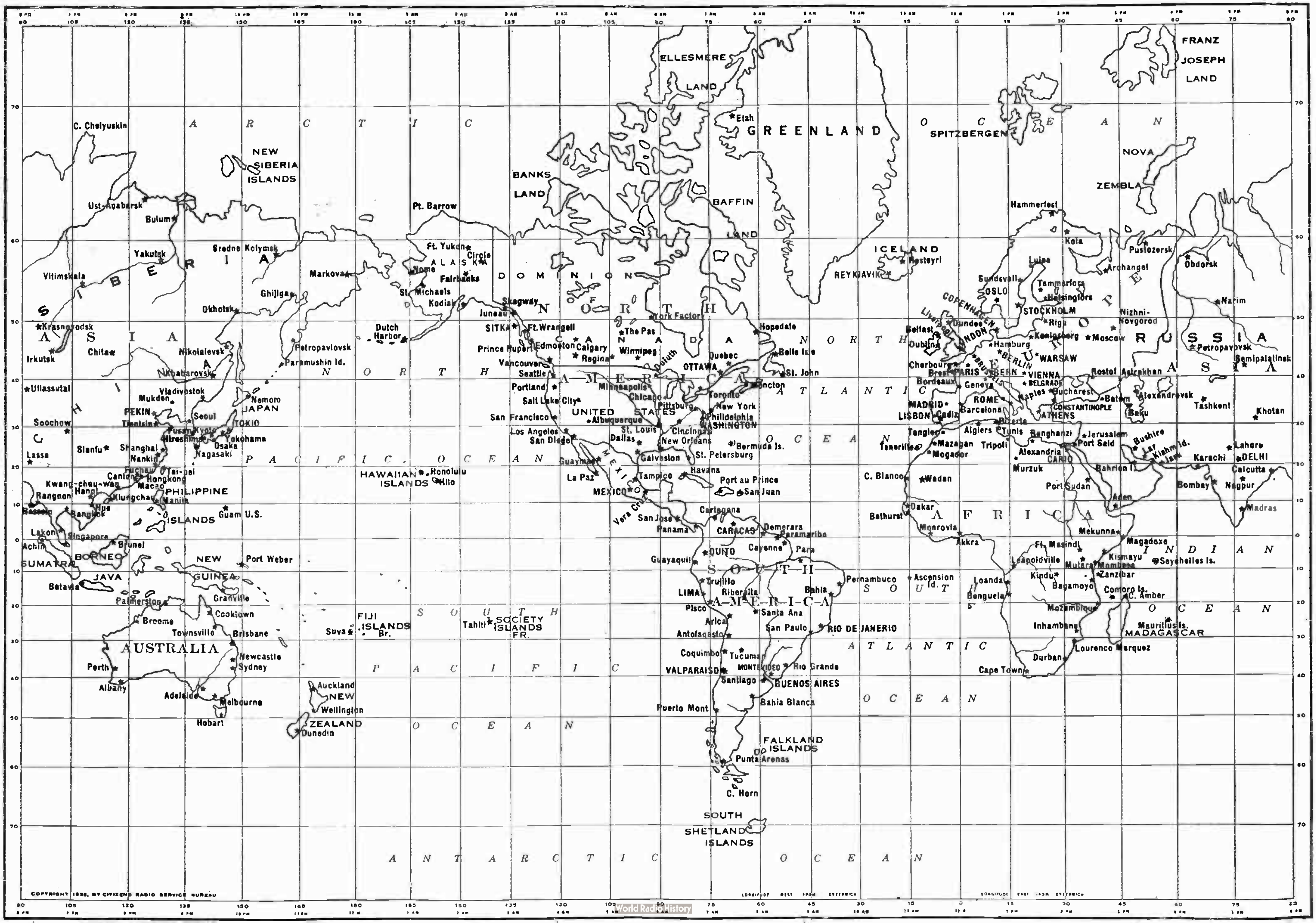
Supplementary

Call Signal	Owner of Station	Location of Station	Your Adjustment

TIME AND DISTANCE CHART FOR RADIO OPERATORS



RADIO MAP OF THE WORLD



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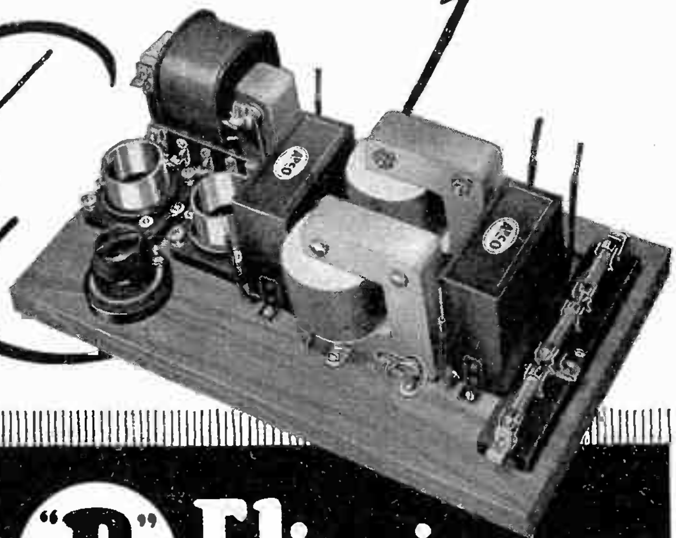
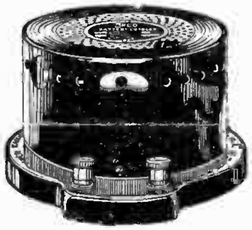
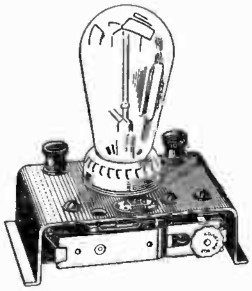


Rectodyne



"A" Battery Charger No. 77

"A" Battery Charger No. 79



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"A" Battery Charger, No. 77,	$18.50
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Some Successful Hookups Described and Illustrated

By
J. K. CLAPP

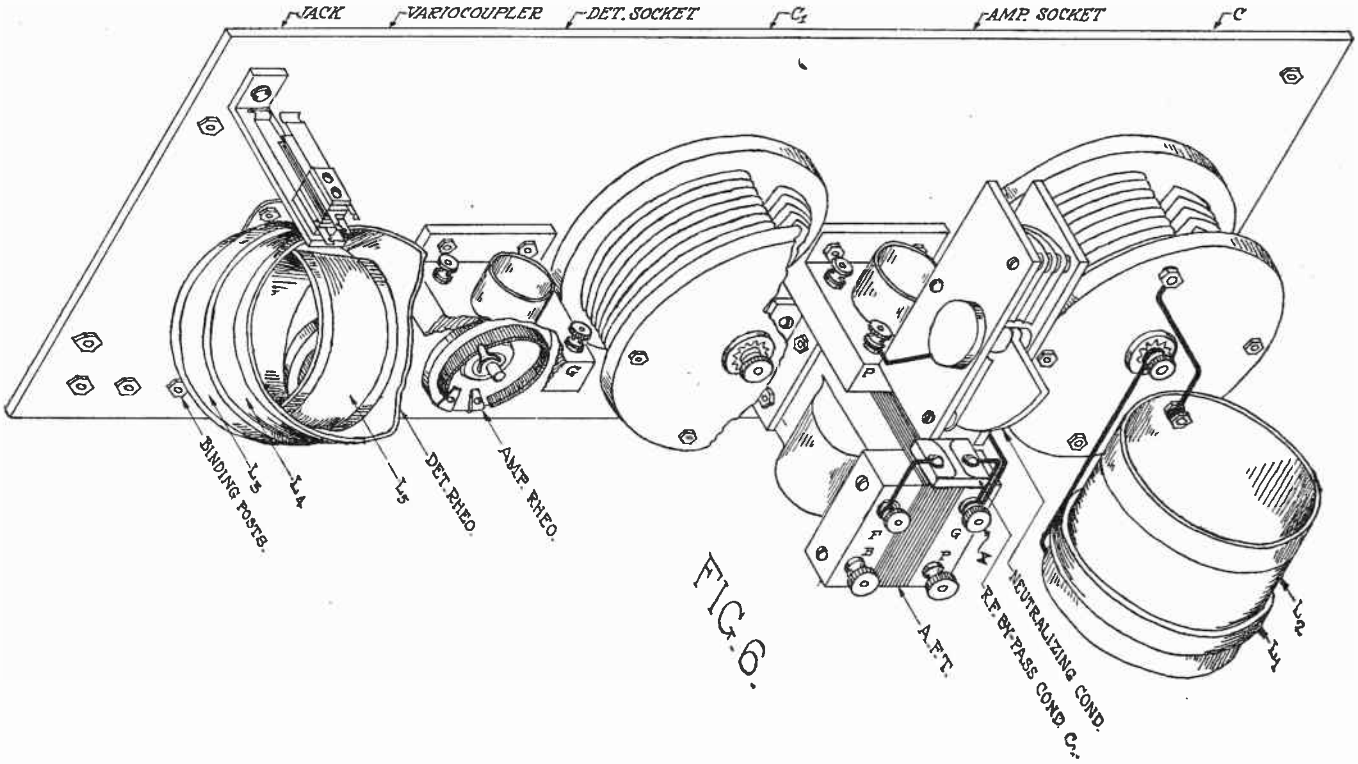

FIG. 6.

This drawing represents the layout of the apparatus behind the panel corresponding to the "Open Panel Arrangement" shown in Figure 2. Because of the comparatively close arrangement of the apparatus it has been necessary to cut away part of the detector tube socket and the tuning condenser C-1, in order that the apparatus may be more clearly seen, and it has not been possible to show the full wiring of the set. The supporting wires for the first radio frequency transformer, L-1 and L-2, for the neutralizing condenser and for the radio frequency by-pass condenser C-2 are shown as these pieces of apparatus are not supported by the panel.

THE TRANSCRIPT'S RADIO RECEIVER

A Two-Tube Set of Great Sensitiveness and Wide Range

THE Radio Department of the Transcript has for several months been searching for a circuit involving the use of not more than two tubes which should give satisfactory reception over considerable distances with head phones and give loud speaker reception over medium distances. If the number of tubes available for use as amplifiers is limited, it is at once evident that a very sensitive detector must be employed. This limitation makes it necessary to employ a tube detector, and to gain the utmost in sensitiveness, regeneration in the detector circuit is necessary. A comparative test of various tubes suitable for use as detectors has shown that the performance of the D-21 Sodion tube is distinctly better than that of the other tubes on the market, so that this type of tube is recommended. The circuit will operate with any of the usual tubes for a detector, but the results will not compare with those obtained with the D-21. To provide increased sensitiveness to weak signals, and to some extent to provide for increased selectivity, a stage of radio frequency amplification was found advantageous. The demand for both sensitivity and selectivity immediately limits the possible types of amplifier circuits to one of the "sharply tuned" class. As is well known, this type of circuit has an inherent tendency to oscillate, resulting in poor reception, so that a form of neutralization must be employed to stabilize the amplifier. There are available a number of circuits which will fulfill these conditions—it remained to choose that type which offers the greatest possibilities in sensitiveness and selectivity.

Circuit of Remarkable Range

The combination of sensitive detector and sensitive radio frequency amplifier results in a receiver circuit which has a remarkable range. However, the volume of signal obtained, even on comparatively nearby stations, is not markedly great—a condition which does not meet with the approval of the average listener. It would be a simple matter to add a stage of audio frequency amplification to obtain the desired volume of signal, but this method would necessitate the use of a third tube, a procedure which it is desired to avoid. The radio frequency amplifier tube may be made to serve for an audio frequency amplifier tube by the process of "reflexing." Tests of this method of obtaining the desired audio frequency amplification show that the volume of signal obtained is to all intents and purposes equal to that obtainable from a separate tube. In choosing a suitable type of radio frequency amplifier circuit it was necessary not only to pick out a circuit which is simple and easy to stabilize, when used as a "straight" radio frequency amplifier, but also to choose a circuit such that the introduction of the necessary audio frequency apparatus (for reflexing) would not render the balancing of the circuit so critical as to be unsatisfactory. After a number of trials of various well-known circuits, one was chosen which has qualities rendering it especially suited to the stabilization of a reflexed tube. While this form of circuit is mentioned in the technical literature,* it has not been applied to the stabilization of a reflexed tube in so far as the writer is aware.

The circuits of the amplifier tube, showing the audio and radio frequency inputs, are shown in Figure 1. Here L-1 and L-2 compose a common form of fixed coupler as used in many broadcast receivers. The signal desired is tuned in by means of the condenser C, the circuit L-2, C, being so proportioned as to cover the entire broadcast band of frequencies. In order to use the tube as a reflex amplifier, the secondary of an audio frequency transformer must be introduced into the grid circuit of this tube, preferably between the tuning unit and the filament of the tube. The secondary winding of the transformer then becomes a part of the radio frequency circuit, and as the capacity of this winding is not generally large enough to provide an efficient by-pass for the radio frequency currents, a small by-pass condenser, C-2, is provided across the terminals of this winding. The condenser C-2 must be kept rather small, for if it is increased in size it will materially affect the audio frequency amplification obtainable from the transformer. A condenser of 0.00025 mfd. capacity provides an ample by-pass for the proper operation of the radio frequency portion of the circuit and at the same time has practically no effect on the operation of the audio frequency transformer.

In most forms of neutralized radio frequency amplifiers no use is made of the

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*"Anti-Regenerative Amplification," L. M. Hull, QST, Jan., 1924, p. 12.

capacity of the secondary of the audio transformer, or the by-pass condenser if one is used, in the balancing of the circuit, and, as a matter of fact, the introduction of this condenser into the circuit often renders the proper stabilization very difficult to attain. In the form of circuit of Figure 1, this condenser forms a definite part of the balancing arrangement, so that instead of being an undesirable factor it becomes an actual necessity. (In stabilizing a "straight" radio frequency tube, a large honeycomb coil may be used in place of the audio frequency transformer to obtain the conditions for balance). A second point of difference in this balancing circuit is that the internal capacity of the tube between grid and filament is utilized, as well as the internal capacity between plate and grid, to obtain a balance. These small condensers are represented in Figure 1 by the capacities C-gf and C-pg respectively.

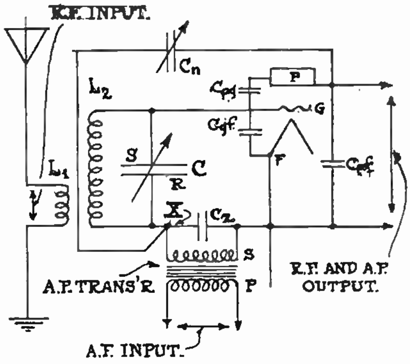


FIG. 1.

Figure 2 shows the schematic representation of the "Wheatstone Bridge" circuit employed in Figure 1. The four corners of the bridge are respectively the plate, grid and filament of the tube, and the junction point "X," between the tuning circuit L-2, C and the grid side of the audio frequency transformer secondary. It will be noticed that all the arms of the bridge are capacitative, so that a balance is obtained between these four condensers for neutralization. Three of the four arms are fixed in capacity, so that all that is necessary to obtain a balance is to adjust C-n to the proper value. The method used in accomplishing the balance is given in detail below. The capacity C-pf, between plate and filament of the tube, does not enter into the balancing arrangement.

The combination thus arrived at — one stage of tuned neutralized radio frequency amplification, regenerative Sodion D-21 detector and one stage of reflexed audio frequency amplification, represents the results of trials of over twenty circuits and gives the most in volume and sensitivity for broadcast reception, for the number of tubes involved.

Some idea of the sensitiveness of the circuit is given when it is realized that stations 1000 miles away have been clearly heard with head phones when a 10-foot indoor wire is used for an antenna. Repeatedly stations have thus been picked up and "held" under atmospheric conditions which render the use of an outside antenna extremely unsatisfactory, owing to the tremendous crashes and rumblings which interrupt the programmes. Stations within about 500 miles may be heard on a wire from three to five feet long. It may seem to some that when the antenna wire has been reduced to such small dimensions, that reception is taking place by some other means—through the ground wire, for example. Removal of the antenna wire in every case resulted in the complete elimination of the station heard—no matter how carefully the receiver circuits were readjusted, indicating that the reception was actually being carried on by means of the short antenna wire. These results were

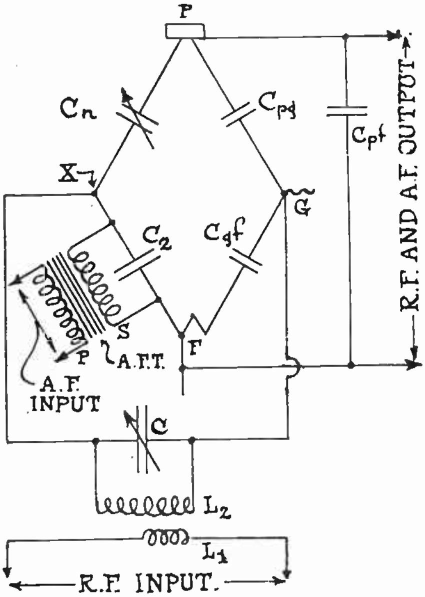


FIG. 2.

obtained when the apparatus was located in a wooden building—if the receiver is located in a steel frame building the results with an extremely short wire cannot be expected to be as good. One of these receivers mounted in an automobile, using a few feet of wire stretched in the top of the car for an antenna, and using the chassis as a "counterpoise" ground, has given loud speaker signals on stations within 80 miles, with the car moving at any desired speed. With the engine stopped, satisfactory reception by head phones over distances of 500 miles has been obtained. Using a large loop aerial on an automobile, head phone reception over distances of 1000 miles has been obtained with the engine stopped.

Note 1

Stations heard during July, 1924, on 10-foot indoor wire, 5 feet above receiver, 14 feet above ground; water-pipe ground connection made directly below receiver. Stations are not listed unless they were held during several numbers and were clearly heard to announce calls, location and ownership. Receiver located at Mattapoisett, Mass.

WNAC	Boston	WDAR	Philadelphia
WBZ	Springfield	WOR	Newark
KDKA	Pittsburgh	WJZ	NY City
WGY	Schenectady	WHAZ	Troy
WMAF	So. Dartmouth	WJAX	Cleveland
WJAR	Providence	WGN	(WDAP) Chicago
WEAN	Providence		
WHN	NY City	WEBH	Chicago
WTAB	Fall River	WKBF	Providence
WJY	NY City	WSAI	Cincinnati
WFBH	NY City	WIP	Philadelphia
WFI	Philadelphia	KFKX	Hastings
WTAM	Cleveland	WCAE	Pittsburgh
WQAM	Miami	WGR	Buffalo
WCAP	Washington	WNYC	NY City
CKAC	Montreal	WTAT	Boston
WHAS	Louisville	CKCH	(CNRO)Ottawa
WAH	Cincinnati	WTAS	Elgin

In assembling this receiver the following apparatus will be required:

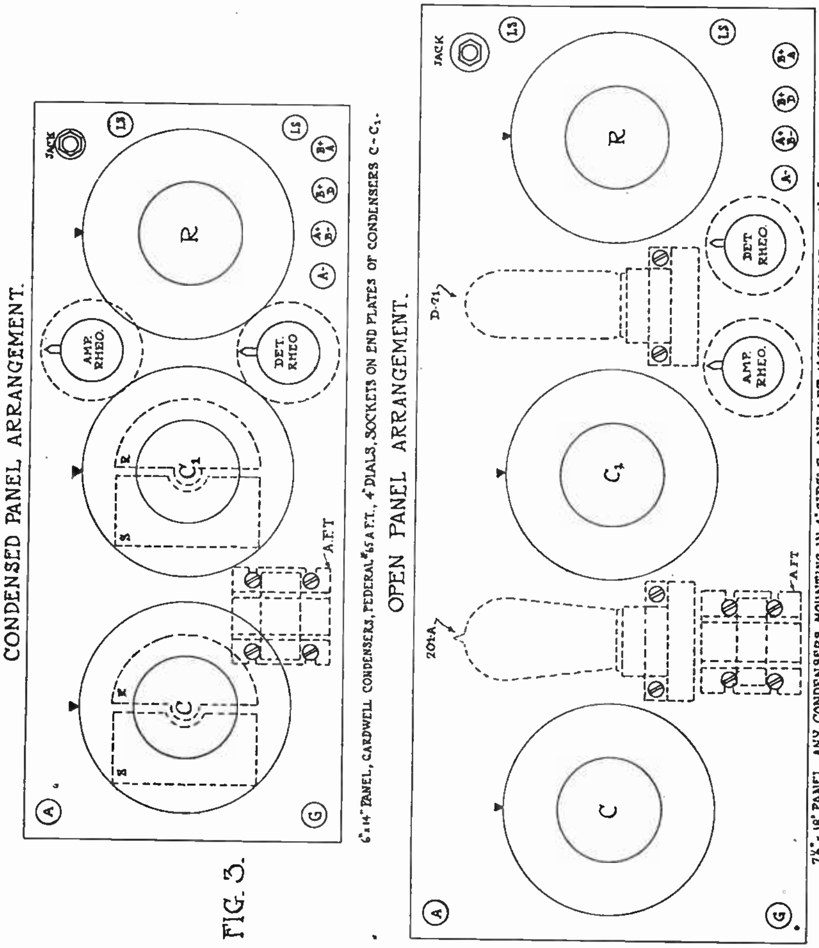
2 Low loss variable condensers, 0.0005 mfd. maximum.
1 Variocoupler form, for use with home-made coils.
1 5 plate condenser, for use as neutralizing condenser. (11 plate may be used.)
2 Standard sockets.
2 Rheostats, preferably of the "universal" type, such as the Federal 27, or the Crossley Triplex. (Total resistance 60 ohms.)
1 Fixed mica condenser, capacity 0.001 mfd.
2 Fixed mica condensers, capacity 0.00025 mfd., one at least, and preferably both, fitted with grid leak resistance clips.
1 Audio frequency amplifying transformer. 3 to 1 to 6 to 1 ratio.
1 2-Circuit jack (optional).
1 Phone plug (optional).
1 Amplifier tube, Cunningham 301-A "brown" preferably, but any C-301-A or UV 201-A is satisfactory.
1 D-21 Sodion regenerative detector. (Recommended, but circuit will operate with any standard detector.)
1 Pair telephone receivers.
3 22.5 volt "B" battery units.
"A" Battery 6 volts (Set may be operated from four or five dry cells for a period of approximately 100 hours.)
1 Panel, 7½ by 18 inches. A panel as small as 6 by 14 may be used, but the larger panel is desirable.
8 Small binding posts.
3 3½ or 4-inch instrument dials.
12 Feet number 14 bus-wire; 14 soft drawn copper may be used if desired.

Instruments Mounted on the Panel

The placing of the condensers, rheostats, variocoupler, jack and binding posts on the panel is shown in Figure 3. The general arrangement is the same, no matter what type of instruments are used. The antenna and ground binding posts are mounted at the left; the posts for loudspeaker at the right, with the telephone jack in the upper right-hand corner. Binding post may be used for the telephones and loud speaker if desired, omitting the jack. The left hand and center dials control the condensers of the radio frequency amplifier and detector circuits. The right hand dial controls the rotor of the variocoupler, which is used as a regeneration control in the detector plate circuit. The binding posts for the various battery connections are brought out along the lower edge of the panel, to the right, or may be brought out at rear of set. The first step is to mount up this much of the equipment. This can be done irrespective of the particular type of equipment chosen. There are certain details which must be observed which depend solely upon the apparatus used, so that the "works" behind the panel are described in detail in the following paragraphs.

Mounting of Coudensers, Sockets, and A. F. Transformer

If it is desired to keep the size of the panel down, making the set with the utmost compactness, it is a good plan to mount the sockets on the end plate of the variable condensers. When Cardwell or National condensers are used, this is easily accomplished by removing one of the hex-head machine screws and substituting a 6/32 brass machine screw which is long enough to pass through the socket and end plate. If the set is to be operated with the panel vertical, then it is best to use panel type sockets, so that the tubes will be operated in a vertical position. The coils are supported by the wiring entirely, as indicated below.



CONDENSED PANEL ARRANGEMENT.

6" x 14" PANEL, CARDWELL CONDENSERS, FEDERAL #65 A.F.T., 4" DIALS, SOCKETS ON END PLATES OF CONDENSERS C-C1.

OPEN PANEL ARRANGEMENT.

7½" x 18" PANEL, ANY CONDENSERS MOUNTING IN 4" CIRCLE, ANY A.F.T. MOUNTING IN SPACE 2" x 4", PANEL SOCKETS.

FIG. 3.

If condensers with insulating end plates are used, such as the Federal, or General Radio, it will be necessary to drill a hole through the end plate for the machine screw which is to hold the socket. The socket may be held with a nut, placed on the underside of the end plate, or the hole in the plate may be tapped for the thread of the machine screw, and the use of the nut avoided. There is plenty of room under the end plate in Federal condensers to permit the use of a nut, if desired.

If extreme compactness is not essential, the sockets may be mounted on the rear of the panel, using panel type sockets. In this case the positions of the condensers and sockets should be adjusted so that the plates of the variable condensers will not strike the tubes—a space of at least one-half inch between the rotor plates, when swung out, and the tube, is desirable. This applies to condensers in which the rotor plates protrude from the stationary plates and frame, when they are moved out into the "zero" position, such as the Cardwell. If condensers such as the Federal are used, the end plates entirely cover the operating space taken by the rotary plates, so that no precautions are necessary to provide for sufficient clearance.

The grid terminal of the secondary winding of the audio frequency transformer is an important point in both the radio and audio frequency circuits. In order to provide for proper operation of the radio frequency portion of the circuit, the audio frequency transformer should be mounted in such a position that the leads from the grid terminal to the tuning coil L-2 and the neutralizing condenser C-n are short and direct. This means that the transformer will have to be mounted between the two tuning condensers, either on the panel or on the baseboard just behind the panel. For panel mounting a transformer of the upright type, such as the Federal No. 65 or the Amertran, is desirable, since this type of transformer can be mounted with a minimum of panel space. If the transformer is to be mounted on the baseboard behind the panel it makes but little difference what the type of the transformer is.

The by-pass condenser C-2 should be mounted directly on the audio frequency transformer, being connected between the two secondary posts. The "grid" terminal of the secondary of the audio transformer should be connected to the primary end of L-2 and to the rotary plates of the tuning condenser C. The filament terminal of the audio frequency transformer secondary is connected to the negative "A" battery line (or to the negative "F" terminal of the amplifier tube socket—it makes little difference which). The full connections are indicated in Figure 7.

Assembly of RF Transformers

For the first radio frequency transformer a piece of bakelite tubing 3 inches in diameter and 2½ inches long will be required. Use number 24 double cotton covered wire, starting the winding about one-half inch from one end of the tube. The wire may be securely fastened in place by passing it through two small holes drilled through the tubing about a quarter of an inch apart. Wind on 50 turns, as closely and tightly as possible. Secure the end by passing through two holes as at the beginning. This completes the grid circuit coil L-2.

Cut some strips of flexible cardboard, about one-half inch in width, and wind them around the outside of the grid coil, having one edge of the strips even with one end of the grid coil. It makes no difference on which end of the coil the strips are wound. Wind on enough of the cardboard to form a ring half an inch wide and one-eighth of an inch thick. On this ring wind the primary coil, making sure that the turns of the primary are wound on in the same direction as were those of the secondary, or grid, coil. The primary winding should have about fifteen turns for use with small and moderate sized antennas. For extremely large antennas the number of turns in the primary should be slightly reduced. The ends of the primary winding may be passed through holes drilled through the ends of the bakelite tubing, in the same manner as the ends of the secondary were secured. Figure 4 shows a sketch of the completed transformer, with the terminals of the windings marked with their proper connections.

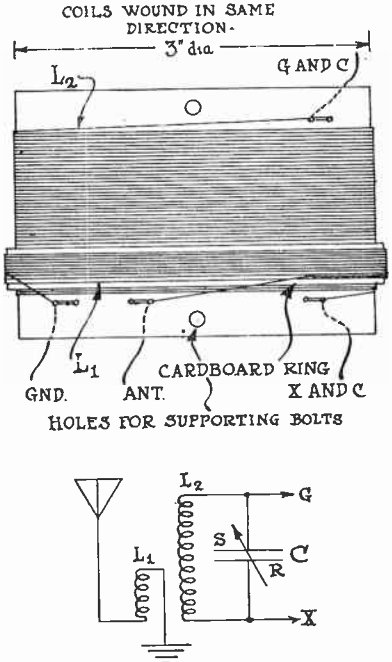


FIG. 4.

The second radio frequency transformer, used between the amplifier and the detector, is best wound on a variocoupler form, preferably of the "180" degree type. This is not necessary, however, and construction should not be held up simply because this type of mounting is not available. The essential thing is to get the proper number of turns on the stator windings, in order that the two variable condensers will read alike. A common size of stator tube is 3⅝ inches in diameter, and if this is the size available, 40 turns of number 24 DCC wire will be just right. If the tube available is smaller than 3⅝ inches, more turns must be used, while if it is larger, fewer turns will be required. A rough-and-ready rule which is handy here is to change the number of turns by two for every eighth of an inch difference in size between the tube available and the one of 3⅝ inches specified. Thus for a 3 inch tube we would use 40 plus 5x2 or 50 turns, which comes out the same as specified for the first unit which is wound on that size tube. For a four inch tube we would use 40 minus 3x2 or 34 turns.

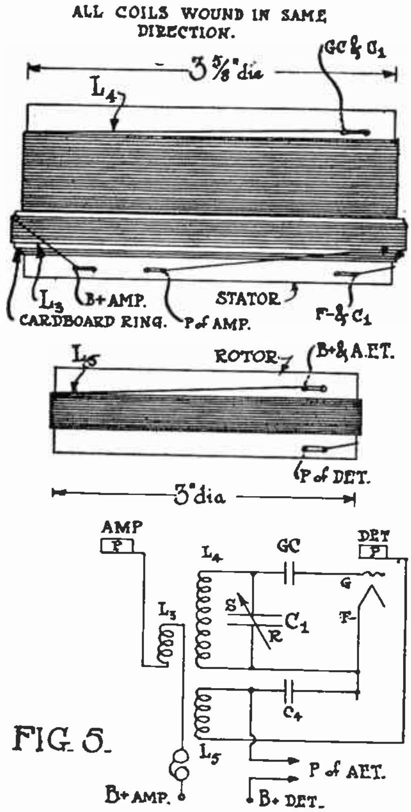


FIG. 5.

Now wind on a ring of cardboard strip at the end of the stator which is nearest to the rotor. The ring should be about one-half inch wide and one-eighth inch thick, as before. Over this ring, and in the same direction as the first winding, wind fifteen turns of number 24 DCC wire. The ends of this winding may be fastened through holes drilled in the stator form. This completes the transformer. The windings are shown in Fig. 5, with terminals marked.

In order to obtain regeneration the rotor coil is coupled back on the grid circuit coil, the rotor coil being connected in the plate circuit of the detector. In this method the variation in coupling, accomplished by moving the rotor with respect to the stator, is the means used for regulating regeneration. The rotor coil must not be too large or else it will be difficult to control oscillation in the detector circuit. A coil of from 25 to 35 turns is ample; 30 turns of number 24 DCC wire on a cyclindrical rotor form 3 inches in diameter is good. If a ball form is used, a few turns should be added, while if the cylindrical form is larger than 3 inches a few turns should be removed. The number of turns is not critical—it may be made 30 turns irrespective of the size and form of the rotor form and satisfactory operation will be obtained.

The connections of the windings of this second transformer, and its rotor are of the utmost importance. The end of the secondary winding which is farthest from the primary winding must be connected to the grid condenser of the detector, and to the stator plates of the condenser C-1. The opposite end of this winding connects with the negative filament terminal of the detector tube socket, and to the rotor plates of C-1. The end of the primary winding nearest the center of the stator is connected to the "B" battery of the amplifier, through the telephone receivers. The outside end of the primary must be connected to the plate of the amplifier tube. This is the familiar "reversed" primary connection which is commonly employed in the Hazeltine neutrodyne circuit. The connections of the rotor must be correctly made if the coupler is of the 180 degree type; if the coupler is of the 90 degree type no particular attention need be paid to the order in which the rotor connections are made, unless the rotor can be moved through only ninety degrees. In that case the connections should be made as for the 180 degree coupler. In Figure 5 the rotor form is indicated as outside of the stator form merely for clearness. In position, the rotor would be moved upward until it is wholly or partially covered by the stator. If the rotor winding is made in the same direction as the stator windings, then the connections are as follows: End of rotor nearest to grid terminal of stator goes to "B" battery of detector, through the primary of the audio frequency transformer. The end farthest from the grid terminal of the stator goes to the plate of the detector tube. If the rotor winding is in the opposite direction to the stator windings, reverse the above connections.

A telephone by-pass condenser of 0.001 to 0.005 mfd. capacity, of the "fixed mica" type, should be connected between the end of the rotor coil, attaching to the primary of the audio transformer, and the "minus A" line. The proper position of this condenser is indicated at C-4 in Figure 7.

Mounting of Coils and Neutralizing Condenser

The first radio frequency transformer is easily mounted by means of two pieces of bus-wire secured to the bolts of the first condenser. These pieces of bus-wire are fastened to the coil form by means of a 6-32 brass machine screw ⅜ or ½ inch long, passed through the winding form. The variocoupler form automatically takes care of the mounting of the second transformer.

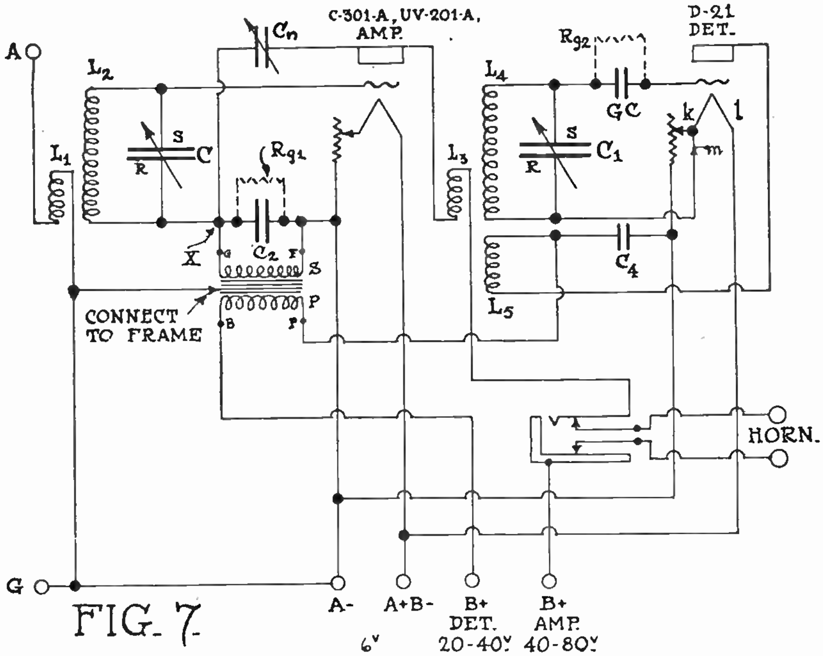


FIG. 7

The position and mounting of the neutralizing condenser will depend upon the arrangement of the apparatus which has been chosen and upon the type and size of the neutralizing condenser. This condenser is preferably mounted "in the air" by means of its connecting wires. As this condenser is not varied, once the neutralizing balance has been attained, there is no advantage in having it mounted on the panel, especially as this is likely to so crowd the condenser near other pieces of apparatus as to cause trouble.

A sketch of the rear of the receiver, showing the relative positions of the various instruments is given in Figure 6. As indicated, all the apparatus, with the exception of the first radio frequency transformer and the neutralizing condenser, is mounted on the panel itself, no equipment being mounted on the baseboard.

Where a neutralizing condenser is necessary (see details below) a condenser having at least five, and preferably seven, standard size plates should be used which may be purchased, or the parts of such a condenser may be obtained and the condenser assembled at home. A special small neutralizing condenser, such as the "neutrodon" or "Midget" is not suitable for use in this circuit. If it is possible to obtain an 11 or 13 plate condenser for temporary use, such a condenser may be used to neutralize the circuit. The setting required to obtain a balance will give an indication of the size of condenser which should be used permanently, and such a condenser may then be purchased with assurance that it will be of the correct size. For example: 20 divisions on a scale of 100 divisions on an 11 or 13-plate condenser correspond to a capacity of 20-100 or 1-5 of the maximum capacity of 0.00025 mfds. or 0.00005 mfd. This would be the required maximum capacity of the neutralizing condenser.

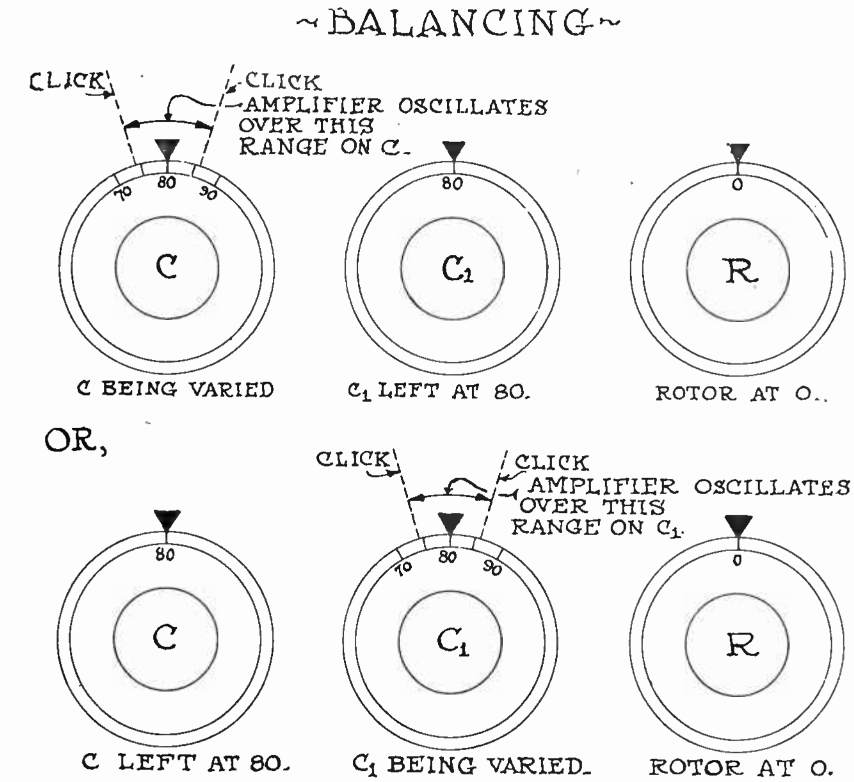


FIG. 8.

Balancing and Operation

If the directions for the assembly of the radio frequency transformers have been closely followed, and the tuning condensers have maximum capacities of 0.0005 mfd., the tuning range of the receiver will be from 180 to 585 meters, more than covering the present band of broadcast wavelengths. Furthermore the two tuning condensers will read practically alike throughout the tuning range of the receiver.

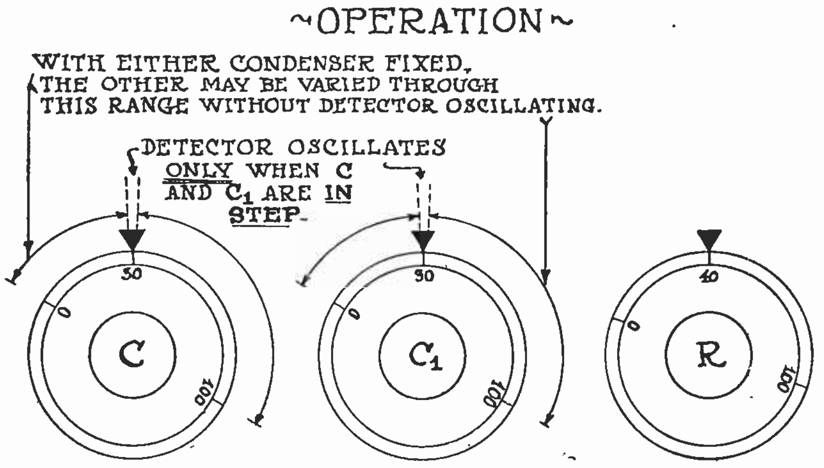
After checking up the wiring according to the diagram, turn on the rheostats, insert the tubes in the sockets and connect the "A" battery to the posts intended for the "B" battery. If the tubes light up there is an error in the connections which must be eliminated before the set can be operated. If the tubes do not light up it is safe to transfer the "A" battery to its proper posts and to connect the "B" battery.

First set the tuning condensers C and C-1 at maximum, set the neutralizing condenser at zero, insert the telephone plug in the jack and light the amplifier tube only. (No antenna or ground necessary for balancing). Vary the tuning condensers through the upper twenty divisions, or so, on their scales, listening for a pair of clicks in the telephones. It will be found that if one condenser is set at 80 (on a 100 division scale) that when the other condenser is moved up toward 80 a click will be heard in the phones when the condenser being moved is set within five or six divisions of

80. This indicates the commencing of radio frequency oscillations in the amplifier tube. If the condenser is now moved past 80 another click will be heard at a point a few divisions beyond. This click indicates the stopping of the radio frequency oscillations. These conditions are clearly indicated in the sketch of the controls in Figure 8.

Now advance the neutralizing condenser a few divisions and vary the condenser C past the 80 division point. The clicks will still be heard, but will be closer together. Keep on advancing the neutralizing condenser—the two clicks will come closer and closer together on the dial of condenser C, until they merge into a single click. The neutralizing condenser should then be advanced far enough to stop this single click entirely.

Now move the two tuning condensers down scale to about 30 divisions. It will be found that the clicks will have re-appeared and the neutralizing condenser will have to be advanced slightly to stop them. After the clicks have been eliminated at this point reduce the setting of both condensers to about 10 divisions and advance the neutralizing condenser to the point where no click appears. This completes the balance of the radio frequency circuits.



EITHER, OR BOTH, C AND C_1 BEING VARIED. ROTOR AT 40.

UNDER THESE CONDITIONS REDUCE ROTOR SETTING SLIGHTLY FOR BEST RESULTS.

FIG. 9.

In many instances no clicks at all will be heard over the upper ranges of the condensers—the first indications of oscillation in the reflex amplifier tube being obtained at a low setting of the tuning condensers—say at five or ten degrees. This should not be taken as an indication that the radio frequency circuits are not correct—start from the point that the "clicks" or "thumps" are obtained and proceed to neutralize the amplifier tube so that the clicks disappear.

In a number of cases *no clicks at all could be obtained on any position of the tuning dials.* This condition does not indicate that the amplifier tube will not operate satisfactorily. It is possible that the tube is "accidentally" neutralized, without the addition of any neutralizing condenser, by the "stray" capacities of the wiring and of the apparatus. It is further possible that slight variations in the construction of the receiver have somewhat reduced the tendency of the tube to oscillate. If *no clicks can be obtained* simply omit the neutralizing condenser and all the processes involved in neutralizing the receiver. The receiver may be operated without further adjustments. Though this condition is not as common as the one mentioned above, it is rather frequently met, so do not feel disappointed when no "clicks" are heard—

rather feel relieved, for a lot of troublesome adjustment is avoided. One of the most successful models of the Transcript receiver came in this class.

The next step is to attach the antenna and ground and light the detector tube. The detector tube, if of Sodion D-21 type, will have to burn for a minute or so until the heater has had an opportunity to warm up the tube before the full results can be obtained. Turn up the detector tube rheostat until a faint hiss is heard. Even with the variometer rotor set at zero coupling, good reception may be had on reasonably good signals by tuning with the two condensers, keeping them in step as they are changed. When the rotor setting is advanced far enough it will be found that the hiss of the detector will disappear with a slight "thump" on either side of the resonance setting when either of the condensers are moved. This indicates that the detector is oscillating. By varying either of the condensers the hiss may be made to reappear. See Figure 9. This indicates that the detector tube has stopped oscillating. This feature of the circuit—the necessity of having *both* condensers *accurately* in step before the detector may be made oscillate—is invaluable in operation. If you happen to turn one condenser too far, everything simply stops, instead of having a loud squeal appear, as frequently happens with the usual type of circuit.

The width of the band over which detector oscillation occurs is controlled by the setting of the rotor of the variocoupler. In hunting for and picking up weak stations the rotor should be set so that oscillation occurs over just as narrow a band as possible. When the "squeal" of a carrier wave is picked up the rotor should immediately be moved back slightly and the signal tuned in by careful adjustment of the two condensers. If the set is constructed according to the directions here given, it should not be necessary to change the setting of the rotor very much in tuning over the whole range of the receiver. The rotor control becomes almost a "fixed control," being adjusted but infrequently. (See Note 2.)

Operating Data

The set will perform well on an antenna from 10 to 60 feet long, used with a ground connection. A length of 60 feet, including lead-in, is advisable. It is possible to use it with good results, with a "counterpoise" ground, consisting of a length of wire stretched below the antenna. Indoors, this combination may take the form of a wire stretched the length of the room behind the picture moulding for the antenna, and another length stretched under the antenna along the baseboard for the counterpoise. Where extremely short wires are being used for the antenna, it is sometimes better to connect the antenna directly to the grid side of the coil L-2. This is not advised where the antenna is greater than 10 feet in length.

Very good results may be obtained from the use of a loop antenna, though, in general, these results will not be as good as those from even a comparatively small antenna. In using a loop, the loop may simply be connected to the antenna and ground posts, adjusting the number of turns of the loop until the condenser C reads most nearly to condenser C-1. As the neutralizing balance depends in no way upon the coil L-2, this coil may be removed and the loop substituted in its place. This latter procedure will give the most efficient results from the loop.

If a record is kept of the settings for the condensers, a station once heard may be easily picked up at a later time. The condenser C does not vary at all with any changes in the tuning of the detector circuit. The condenser C-1 varies slightly if the rotor setting is changed through a wide range. This variation is not large, however—usually less than one-half of one division—so that no trouble is experienced in duplicating the settings, if the approximate setting of the rotor is known. The following table of stations, with the condenser settings, will be a great aid to those who are operating the circuit for the first time. The settings of the condensers should correspond quite closely to those given if the directions have been carefully followed. The setting of the rotor will probably not agree exactly with the settings given here, as this setting varies somewhat with the temperature of the detector tube filament and the "B" battery voltage on the detector plate.

On loud signals clearer reception will be obtained if a grid leak of about one megohm resistance is inserted at R-g-2 in the detector circuit when the D-21 tube is used. If a standard tube is used, the grid leak should be inserted at R-g-2 and the wire "m" should be transferred to the point "l" from the point "k."

Once in a while it will be found that the audio frequency transformer will have characteristics which cause the production of audio frequency oscillations in the amplifier circuit. If a howl is heard, no matter what the position of the neutralizing condenser, try reversing the connections to the primary of the transformer. This will nearly always remedy the difficulty, though occasionally it will not. If the howl still persists, insert a grid leak at R-g-1, using as high a value of resistance as is possible without having the amplifier howl. This will still permit the operation of the circuit, though the results will not be the best possible.

Note 2

LIST OF STATIONS HEARD DURING AUGUST IN TESTING RECEIVER

Call	Location	Condenser Settings	Rotor (180°)	Wave Length Meters
WMAF	S. Dartmouth, Mass. (2d Harmonic)	5.0	30	181*
WBBG	Mattapoisett, Mass.	13.0	35	248*
WFAH	New York City	15.0	35	...
WEAN	Providence, R. I.	16.5	35	273*†
WEBH	New York City	17.0	35	273
WNAC	Boston, Mass	17.5	40	278*†
WQAM	Miami, Fla	20.5	40	283*
WTAS	Elgin, Ill	21.5	42	286
WAAF	Chicago, Ill	22.0	42	286
WSAI	Cincinnati, O.	23.5	45	309*
WGR	Buffalo, N. Y.	24.5	45	319
KDKA	E. Pittsburgh, Pa	27.0	45	326*
WBZ	Springfield, Mass	29.5	45	337*†
WJAR	Providence, R. I.	31.0	45	360*†
KFKX	Hastings, Neb	31.0	45	341
CHYC	Montreal, Canada	31.5	45	341
WHN	New York City	34.0	45	360*†
WEBH	Chicago, Ill	36.5	50	370*
WGN	Chicago, Ill	37.0	50	360*
WMAF	S. Dartmouth, Mass.	37.5	50	363*
WGY	Schenectady, N. Y.	39.0	55	380*†
WTAM	Cleveland, O.	40.5	55	389*
WJAX	Cleveland, O.	41.0	60	390*
WFI	Philadelphia, Pa	42.5	60	395
WDAR	Philadelphia, Pa	43.0	60	395*
WHAS	Louisville, Ky	44.5	60	400
WOR	Newark, N. J.	45.0	60	405*
WJY	New York City	45.5	60	405
PWX	Havana, Cuba	46.0	60	400
CKAC	Montreal, Canada	48.5	60	425
WLW	Cincinnati, O.	49.5	60	423
WSB	Atlanta, Ga	53.5	60	428
WQJ	Chicago, Ill	59.0	60	448
WJZ	New York City	60.0	60	454*†
WCAE	Pittsburgh, Pa	62.0	60	461*
WCAP	Washington, D. C.	63.0	60	469*
WRC	Washington, D. C.	64.0	60	469
WEAF	New York City	69.0	60	492*
WMC	Memphis, Tenn	76.5	60	500
WOO	Philadelphia, Pa	77.0	60	508
WIP	Philadelphia, Pa	78.0	60	508
WNYC	New York City	82.5	60	526*
KYW	Chicago, Ill	85.5	60	535

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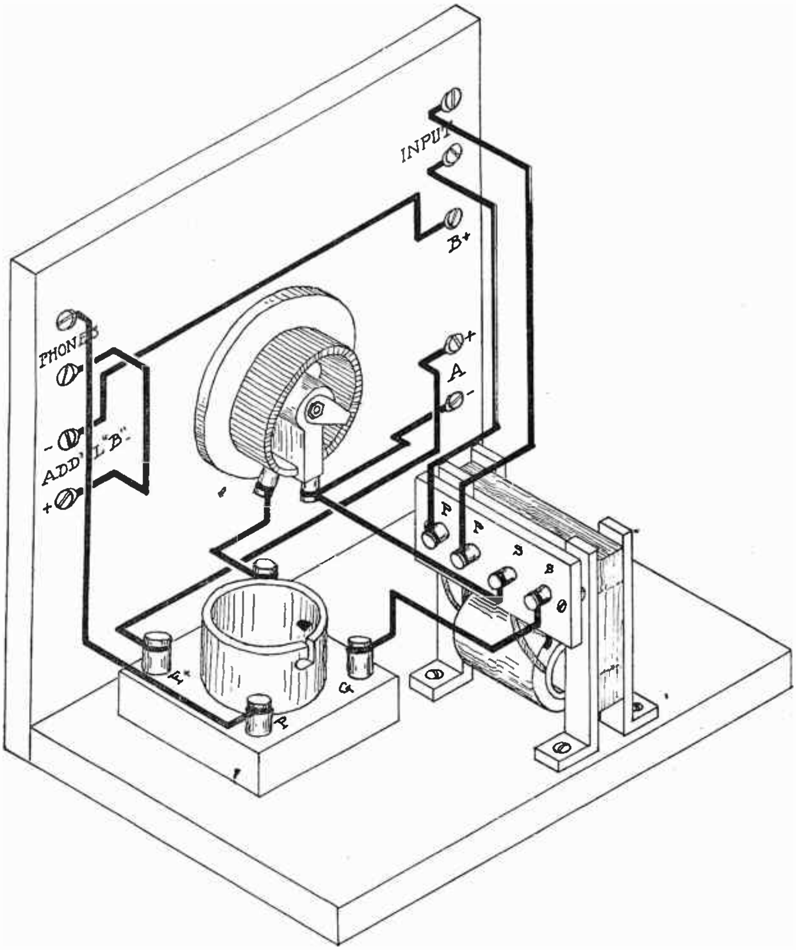
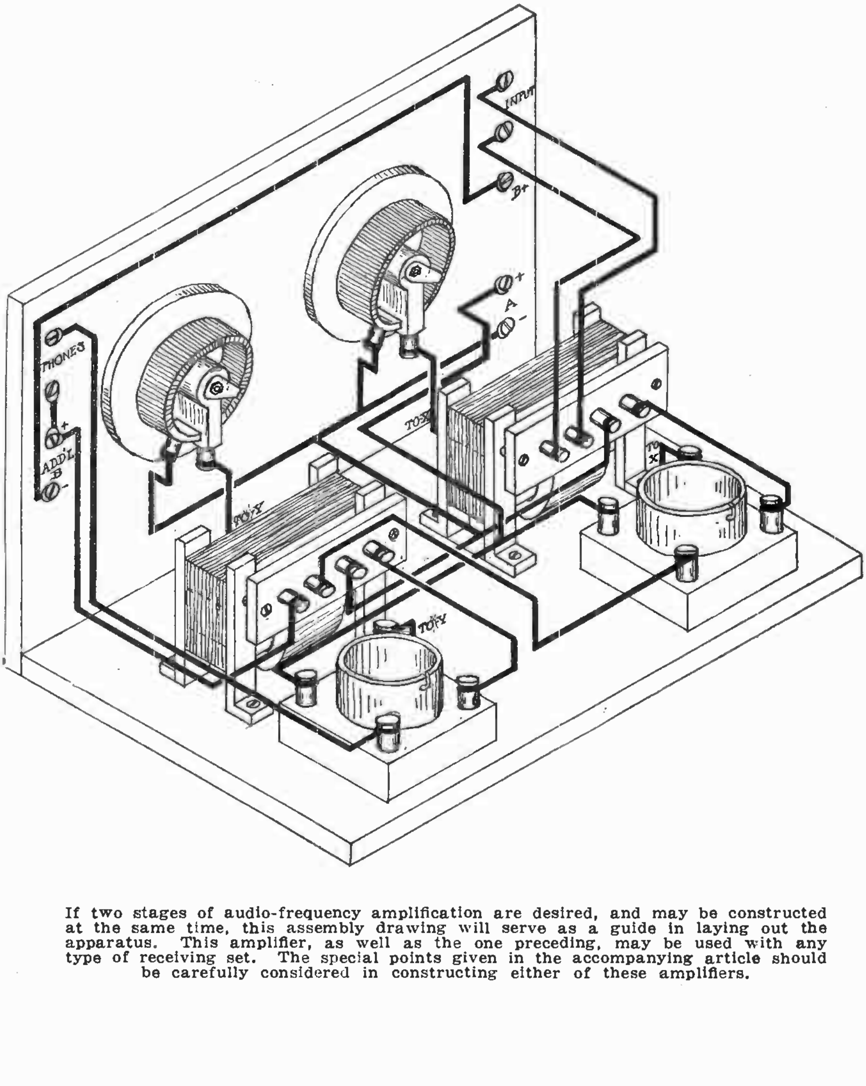
*Heard on loud speaker. (Head set attachment on phonograph.) †Heard by head set in day time. Receiver located at Mattapoisett, Mass. 50 ft. outside wire.

SINGLE STAGE OF AUDIO-FREQUENCY AMPLIFICATION



Many listeners believe that a special connection must be employed with each type of receiver when audio-amplification is used. This is not the case. An audio-frequency amplifier may be built which may be added to any type of receiving apparatus to increase the volume of signals. Here is shown a simple method of assembling a one-step amplifier. The binding posts shown at the left (looking at the front of the panel) may be connected by short jumpers to the corresponding posts of the receiver. The posts marked "Additional B" are for the amplifier "B" battery. If the same voltage is to be used for both amplifier and receiver tubes, these two posts should be connected together.

DOUBLE STAGE OF AUDIO-FREQUENCY AMPLIFICATION



If two stages of audio-frequency amplification are desired, and may be constructed at the same time, this assembly drawing will serve as a guide in laying out the apparatus. This amplifier, as well as the one preceding, may be used with any type of receiving set. The special points given in the accompanying article should be carefully considered in constructing either of these amplifiers.

AUDIO-FREQUENCY AMPLIFICATION

One and Two-Stage Amplifiers Which May Be Used With Any Receiver

THE layout and arrangement of the apparatus for one and two-stage audio-frequency amplifiers are shown in the two preceding assembly drawings. Diagrams of connections are given herewith for the one and two-stage amplifiers shown in the assemblies.

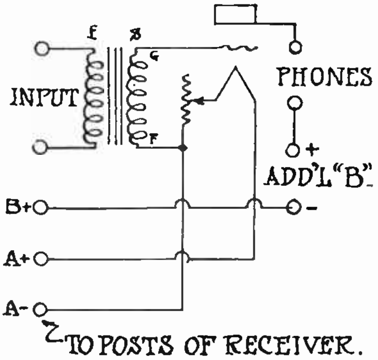
Great latitude is allowable in the placing of the instruments used in the assembly of the amplifiers and in the positions and arrangements of the binding posts. The "Input" posts should be placed in line with the "telephone" posts of the receiver with which the amplifier is to be used, so that connections may be made between the receiver and the amplifier by means of short "jumpers." The posts for the connection of the filament lighting, or "A" battery, and the posts for the connection of the "B" battery may be placed on the front of the amplifier panel in line with the corresponding posts of the receiver, if these are mounted on the receiver panel, or the battery posts may be mounted along the rear edge of the amplifier base board, if this construction has been used in the receiver. It is best to arrange the apparatus and secure it in place before commencing the actual wiring.

Special Points

Certain of the leads should be run in as short and direct a manner as possible between the two points which they connect. These leads have been marked in the diagrams with the letter "S." It has not been possible to show these leads as short and direct in the assembly drawings without making the drawings too complicated to follow. It will be noticed that the leads marked with an "S" are the leads between the transformers and the grids and plates of the tubes. In arranging the apparatus the positions of the parts should be chosen to make these wires as short as may be conveniently arranged.

The leads from the "A" or "F" terminal of the secondary winding of the transformer to the filament circuits of the tubes should be made to the negative terminal of the "A" battery. This method of connection places a small biasing voltage on the grids of the tubes, due to the drop in voltage in the resistance of the filament rheostat, which is sufficient to permit the use of fairly high plate voltages on the tubes. This results in good amplification and volume without the necessity of employing a separate biasing or "C" battery. It is only in rare cases that the separate "C" battery will give any marked improvement in results.

A "kink" that is well worth a trial is that of connecting the cores of the audio-frequency transformers to the positive terminal of the "B" battery, or to the minus terminal of the "A" battery. Both connections should be tried, as in some cases the best results will be obtained with one method and in others best results are obtained with the other. A definite improvement in results is not always obtained, though oftentimes the amplifier operates more quietly when the cores are connected in this manner. None of the usual amplifying transformers have binding posts for making a connection to the core. A connection may be obtained by loosening one of the bolts holding the core in place and slipping a wire under the head. Tightening up the bolt will then hold the core firmly, giving also a sufficiently good connection for the purpose desired.

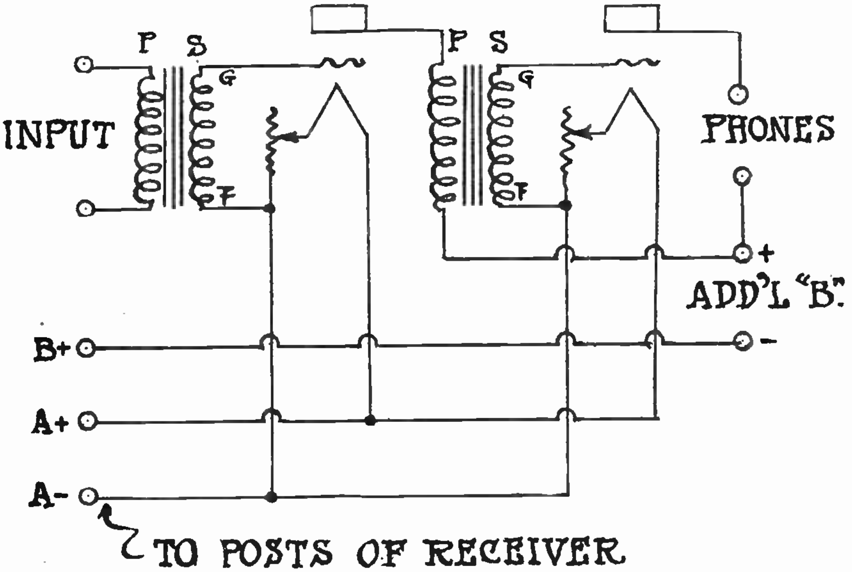


For audio-frequency amplification it is recommended that UV-201-A tubes be employed (C-301-A are similar), as these tubes have a fairly good amplification factor and at the same time have quite a low plate circuit resistance. This latter property permits the flow of a larger current in the plate circuit with a resulting increase in volume of signal over that obtainable with other tubes under similar conditions. The low filament current required by this type of tube furthermore makes the amplifier very inexpensive to operate.

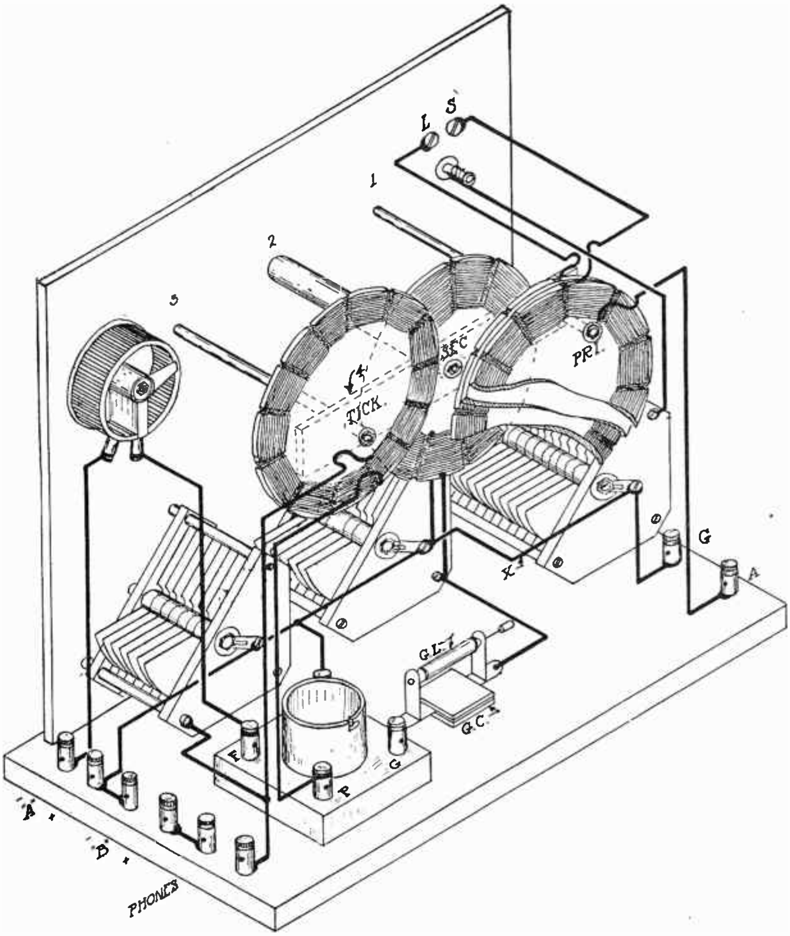
Any of the standard audio-frequency transformers made by reputable manufacturers may be used in this circuit. In this connection it is better to employ two identical transformers of a fairly low ratio rather than a very high ratio transformer for the first stage and a lower ratio for the second stage. Very high ratio transformers, in general, tend to distort the signal rather badly, so that if two stages of amplification employing such transformers are used the signal becomes so badly distorted as to be very unpleasant. The use of a low ratio in the second transformer of a two-stage amplifier will often give better results than those obtained with a high ratio transformer, as far as the apparent quality of the signal is concerned. Careful comparison will usually show that even better results are obtained from the use of two low ratio transformers. This combination gives better quality and still gives all the amplification that is required for practical purposes.

In some cases persistent howling may be encountered when the amplifier is used. Sometimes this is due to the placing of the two transformers in such a position that one can react on the other. In such cases turning one of the transformers so that its core is at right angles to the core of the other transformer often stops the howling. Small fixed condensers connected across the secondary terminals of the transformers will sometimes stop howling. Where condensers are used the capacity should be kept as low as possible, for otherwise the signals will be given a muffled quality which is indistinct and unpleasant. Grid leak resistances connected across the transformer secondary are sometimes used to stop howling and also to improve the clarity of the signal. A variable grid leak resistance, connected across the secondary of the second transformer of a two-stage amplifier, or across the secondary of the transformer of a single-stage amplifier, may be used as a smooth volume control. The lower the resistance is made the weaker will be the signals. This method is handy where it is desired to control the volume of signal obtained from various stations.

If it is desired to operate these amplifiers with other than a tube receiver connect the posts marked "Input" to the telephone posts of the receiver. Connect the "A" battery for the amplifier tubes to the posts of the amplifier marked correspondingly. Connect a wire between the posts marked "B plus" and "A plus," connecting the "B" battery for the amplifier to the posts marked "Additional B." Such an arrangement is suitable for use with crystal receivers.



A THREE-CIRCUIT SINGLE-TUBE RECEIVER



This figure shows a good method of mounting a three-coil tuner and a tube detector. While this receiver is slightly more complicated than the usual broadcast receiver, the greater selectivity obtainable with this type more than overcomes the disadvantage of the additional controls. The coils for this set are easily made by the experimenter. A receiver of this type should bring in broadcasting stations 200 or 250 miles away with good regularity. Under very good conditions reception has been accomplished over distances as great as 1000 miles, using head phones. If it is desired to operate a loud-speaker, it will be necessary to employ one or two stages of audio-frequency amplification for satisfactory results.

A THREE CIRCUIT SINGLE TUBE RECEIVER

A Satisfactory Hook-Up Designed to Eliminate Interference

THE circuit which is used is given in Figure 5, and is popularly spoken of as a "three circuit" receiver. Under this classification the various tuned circuits are (1) the primary, or antenna circuit, L1, C1 and the aerial. (2) the secondary circuit, L2, C2. (3) the plate circuit, L3, C3. This latter circuit is not rigorously a tuned circuit, in the sense that it is brought into resonance with the incoming signal.

A loose-coupled circuit has been recommended, for such a circuit is much more satisfactory in eliminating interference than the ordinary "single-circuit" set, but it is not so complicated that the various adjustments required in tuning cannot be easily mastered.

The constants for the circuit as here presented are applicable for use with any of the dry-cell tubes, such as the WD-11, UV-199, etc. If larger tubes, such as the UV-200 or VT-1, are used, the size of the secondary coil may have to be slightly reduced.

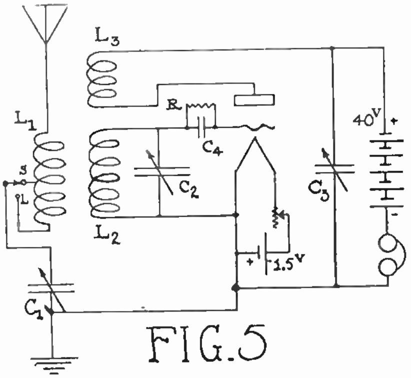


FIG.5

Coil Forms

In Figure 6 are given the dimensions of the forms for the coils, which forms may be cut from heavy cardboard, about one-sixteenth of an inch in thickness. An odd number of radial slots is then cut in the circular piece of cardboard, the width of the slots being approximately equal to the thickness of the cardboard. The sides of the slots should be parallel, so that the slots are not any wider at the edge of the form than they are at the centre.

In winding these coils the wire is started at the inner edge of one of the slots and woven in and out through the slots. After going around the form once, the next turn will lie on the opposite sides of all of the teeth of the form from the first turn. The third will occupy the same sides as the first, and so on. In this way the turns are practically spaced a dis-

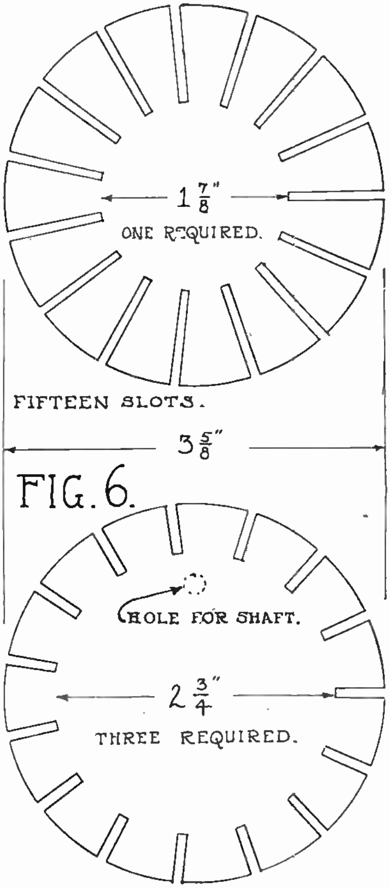
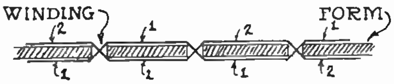


FIG. 6.



tance equal to the diameter of one wire throughout their length, except at the points where they go through the slots. In the lower part of Figure 6 there is shown a developed view of the edge of the winding of one of the coils. At the points where the successive turns cross each other it is desirable to have them cross at as near right angles as possible. This form of winding has a number of advantages—it stays "put" without the use of any binder on the winding; the turns are comparatively far apart, which results in a very low self-capacity for the coil; it is compact and easy to handle in mounting.

The coils should be wound with No. 28 double cotton covered copper wire, the form with the deep slots having an even sixty turns, while the other three coils have twenty-five turns each. The sixty-turn coil will be used for the secondary; one of the twenty-five-turn coils for the "tickler," L3, and the remaining two of the twenty-five-turn coils will be used together for the primary, L1. These two coils should be placed one upon the other, with a disc of the cardboard from which they were made placed between them. The two coils should then be connected in series, care being taken that the connections are so made that the current will flow in the same direction around both coils. A lead should be brought out from the junction point between the two coils for connection to the switch.

Having constructed the coils, we require the following material to complete the set: 1 variable condenser, 0.001 mfd. maximum; 1 variable condenser, 0.00025 mfd. maximum; 1 fixed condenser, 0.00025 mfd; 1 grid leak resistance 2 megohms; 1 vacuum tube, with its filament heating battery, rheostat, and "B" battery. A dry-cell tube is very convenient, and requires no expensive storage battery for its operation.

Wavelength Range

Placing the 0.001 mfd. variable condenser in the ground lead, with the movable plates connected to ground will reduce body capacity effects considerably. With the switch placed so that only one of the sections of the primary coil is in the circuit, the variation in the antenna circuit wavelength will be somewhat as indicated by the lower dashed curve of Figure 7 By varying the condenser throughout its range, we are enabled to tune the antenna circuit from approximately 170 metres to 325 metres. Placing the switch so as to include both sections of the primary winding enables us to tune from approximately 300 metres to about 525 metres, as shown by the upper dashed curve in the figure. The numerical values of the wavelength given will be only approximate, as the values will change with different aerials. If a large antenna is used, the primary coils may be reduced to fifteen or twenty turns each, instead of the twenty-five turns given above.

Placing the 0.00025 mfd. variable condenser across the secondary coil (sixty turns) we are enabled to adjust the secondary wavelength from approximately 200 to 525 metres, thereby covering practically the entire new allotment of wavelengths for broadcasting stations. If the coil has been carefully made as indicated above, and the condenser has a maximum capacity close to the value mentioned, the curve of wavelengths given in Figure 7 will come within a few per cent of the values actually obtained with the set. Owing to changes in the wiring of the set, differences in the tubes used, and differences in the capacities of the condensers used, an accurate prediction of the wavelength range which may be obtained on the secondary condenser cannot be made. The particular condenser used in obtaining these curves was of 0.000257 mfd. capacity, maximum and had thirteen plates, but there are wide variations in capacity of condensers having "thirteen plates," so that to recommend a specific capacity in terms of "plates" is meaningless.

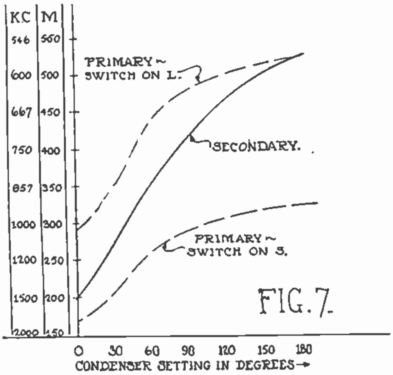


FIG. 7.

The condenser C3 may be a variable condenser of the same capacity as C2, or it may be a fixed condenser of approximately the same capacity. However, it is usually possible to operate the set without any condenser at all in this part of the circuit, since the capacity of the telephone cords will serve as a by-pass, for the radio frequency currents, around the telephone receivers. In general, it will be found that the smaller the value of C3, or its equivalent, the better the quality of the speech and music received.

Mounting the Apparatus

The apparatus for this set may be conveniently mounted on a panel eight by twelve inches in size, with a supporting base behind it as indicated in the diagram. The three variable condensers are mounted in a line at the bottom of the panel. The coils are supported from a frame consisting of the rod (2), which is fastened to the panel by a machine screw and a piece of insulating material (4), which is fastened to the end of the rod (2) by means of a machine screw. This latter screw is also used to fasten the secondary coil in place. The primary coil and the tickler coil are mounted on the ends of small shafts which pass freely through the insulating strip (4). Between the backs of these coils and the face of the supporting strip there should be placed a small piece of brass tubing, over the shafts (2 and 3). The tube for the tickler coil shaft should be about 3-16 inch long, while that for the primary coil shaft should be about three-eighths inch long. These tubes serve to keep the coils at the proper distance apart, so that they will not rub against one another as they are being turned. The shafts (2 and 3) should be passed through holes in the supporting strip which are bored through at a distance from the edge of the secondary winding of from one-eighth to one-quarter inch. The lengths of the shafts should be made such that when the knobs are screwed on the knob will bear firmly against the front of the panel. There is sufficient friction then to hold the primary or tickler coils in any position without making the knobs turn too hard.

The primary winding is in two sections of twenty-five turns each, which are connected together in such a manner that a current will flow around the two coils in the same direction. The junction point between the two sections is brought out for connection to the switch. From the inside winding terminal of one coil a lead is taken to the antenna post (A). From the junction point between the two windings a lead is taken to the switch point "S," and from the outside end of the primary section a lead is taken to the switch point "L." From the center of the switch runs a wire to the stationary plates of the 0.001 variable condenser (left-hand condenser, viewed from the front of the panel). From the rotor plates of this condenser a lead is taken to the ground binding post (G). This completes the antenna circuit.

For connections of the secondary winding take a lead from the outside terminal of the spider-web to the stationary plates of the middle variable condenser and then on to the grid leak and grid condenser. The inside terminal of the secondary coil should be connected to the rotor plates of this variable condenser and thence to the positive filament terminal of the socket. This completes the secondary circuit.

From the plate terminal of the socket a connection should be made to one end of the tickler winding. The other tickler connection is run to one of the telephone receiver binding posts and also to the stationary plates of the third variable condenser. The rotor plates of this condenser are connected to the positive filament terminal of the socket.

The filament circuit of the tube consists simply in the connections between the negative "A" battery terminal, the filament rheostat, the negative filament socket terminal and from the positive socket terminal to the positive terminal of the "A" battery. The short connections between the various binding posts are clearly shown in the diagram.

It will be observed that all of the rotor plates of the three variable condensers are connected to the positive filament terminal of the "A" battery, and that this point is also connected to ground. This arrangement is chosen as it materially reduces the effects of the operator's hands upon the strength of the signals.

In assembling such a receiver, keep the drawing at hand as you make the connections, and the process will automatically be followed through without difficulty. The mounting shown in the drawing has everything supported from the panel but the socket and the binding posts. If it is desired to mount all of the instruments on the panel, so that the panel could be removed from a containing cabinet without any trouble, it is a simple matter to fasten the socket and binding posts in position on the panel and change the wiring to correspond with the new arrangement.

Adjustments

Let us now consider the adjustments necessary to bring in a desired signal on the receiver described in the last article. Having the connections made as in the diagram, the batteries giving full voltage, the first step is to light the filament of the tube. The rheostat is adjusted until the filament is a dull red (for oxide coated filaments, as in the WD-11, which was mentioned for this set). Next, turn the right-hand knob on the top of the panel so that the tickler coil partially covers the secondary coil. If a variable condenser is used at C3, it should be set near maximum. If the set is properly connected, the tube should now oscillate. A test for oscillation is to place the finger-tip on the grid connection of L2. If the tube is oscillating a sharp click will be heard when the finger touches the connection, and another click will also be heard when the finger is removed. If both clicks are not heard, the connections to the tickler coil L3 should be reversed. If the set has been constructed as directed, we may now set the secondary condenser, C2, at approximately sixty degrees and know that the secondary circuit is tuned approximately to 360 metres. Now bring the primary coil near to the secondary coil by turning the left-hand knob on top of the panel. Place the switch on the point marked "S" and vary the condenser rather quickly over its entire range. If the antenna circuit tunes to 360 metres at any setting of the condenser, a sharp click will be heard in the telephones when the antenna circuit is tuned to the secondary circuit. If no such click is obtained, place the switch on the point marked "L" and repeat the procedure.

If the primary condenser, C1, is now moved slowly past the point where the click was heard, it will usually be found that a click is heard at one point on the condenser scale and a second click heard at some other point, a few degrees away. If the primary coupling is now loosened, these two clicks will move closer and closer together, until they finally merge into one. If the coupling is still further loosened the click gets weaker and weaker and finally disappears. The proper point to operate the set is at that value of coupling where the clicks have just merged together.

Now, if the secondary condenser setting is changed to some other value, it will be found that the setting of the primary condenser, where the click occurs, will have moved correspondingly, on the scale. Now, if we know the wavelength corresponding to any setting of the secondary condenser we can immediately tune the primary circuit to it by hunting for the point where the click occurs on the primary condenser scale. This is very handy, for we may mark down the settings of the secondary for the different stations heard, and return to them at will, it being unnecessary to keep any record of the primary condenser settings.

If a telephone station is transmitting, a note will be heard in the telephones when the secondary condenser is moved past the point of resonance for that particular station. This note will at first be of very high pitch, but as the condenser is moved toward the exact setting of the condenser for the best reception of this station, the tone will drop lower and lower, and at the point where the circuit is tuned to the station, it will disappear altogether. If the condenser is moved past this point, the note will rise again to very high pitch. At the point where the note is of low pitch the voice or music may be heard, but will probably be distorted and unpleasant. The next step is to "clear up" the signals.

The tickler coil should be moved away from the secondary coil a small amount. The note mentioned above will now appear again, and the condenser C2 should be reset to the point where the note is lowest in pitch. The primary condenser should be varied slightly, and set at the point where the sounds from the distant transmitter are heard loudest. The tickler coupling should thus be reduced in small steps, the secondary condenser being changed each time so as to keep the steady tone from reappearing. When the tickler coupling has been reduced sufficiently the tube will stop oscillating and the signals will come through clear and strong. The tuning on the primary and secondary condensers will now be very sharp, and little trouble should be experienced from interference.

The quickest method of tuning in a station has been outlined above: First, make the tube oscillate, and listen for the beat note with its carrier frequency; second adjust the set until this beat note is loud, and low in tone; third, "clear up" the signal by slowly reducing the tickler coupling until the regenerative action is no longer sufficient to maintain the tube in the oscillating condition. This procedure is practically the only one which may be used for quickly picking up very weak signals. If continuous wave telegraph signals are being received, the procedure is exactly the same, except that the note heard is left at a good musical pitch and the process of "clearing up" is omitted.

Remember that when the note is heard in the receivers, other listeners in your vicinity will also hear it. Therefore, operate your receiver in this condition just as little as possible.

THE CONSTRUCTION AND USE OF A WAVE TRAP

A Great Help in Minimizing Interference from Stations Not Wanted

MUCH interest has centred in the use of a "wave trap," or wave filter, as a means of reducing interference in the reception of broadcast programmes. While such filters may be purchased ready-made, they are easily assembled at home. To make up a filter the following material will be required:

1 Low-loss variable condenser, maximum capacity preferably 0.0005 mfd. (23 plate). With dial.
1 Stout cardboard tube, 3½ to 4 inches in diameter, 3 inches long.
⅛ lb. number 22 D. C. C. copper wire.
12 ft. number 18 D. C. C. copper wire.
1 pc. panel material (Condensite, Formica, etc.) 6 inches square.
1 Base-board.
2 Binding posts.
Small angles, screws, etc.

The first step is to wind the coil. On the cardboard tube wind 55 turns of the number 22 wire, starting about one-quarter inch from one end of the tube. The wire may be held in place by passing it through two small holes punched in the tube about one-quarter inch apart. It is best not to use any shellac or binder to hold the winding in place. The terminals of this winding are to be connected to the terminals of the variable condenser. Now take the number 18 wire and wind ten turns over the centre of the 55-turn winding, tying the ends of the winding together with thread. This will hold the winding firmly in place.

Mount the variable condenser in the centre of the panel, and mount the tube, carrying the two windings, on the back of the condenser by means of two small brass angles. If desired, these angles may be made to serve as the connections between the 55-turn winding and the variable condenser, but this is not essential. The terminals of the 55-turn winding should be connected to the terminals of the variable condenser. No care is necessary in the order in which these connections are made—either order will operate satisfactorily The two binding posts should be mounted in a line with the lower edge of the panel, as indicated in the drawing. The terminals of the 10-turn winding should then be connected to these binding posts. Again the order of the connections is immaterial.

Now mount the panel on the base-board by means of two or three round headed wood screws placed along the lower edge This completes the construction of the instrument. Drawings of the assembly are shown in Figure 1.

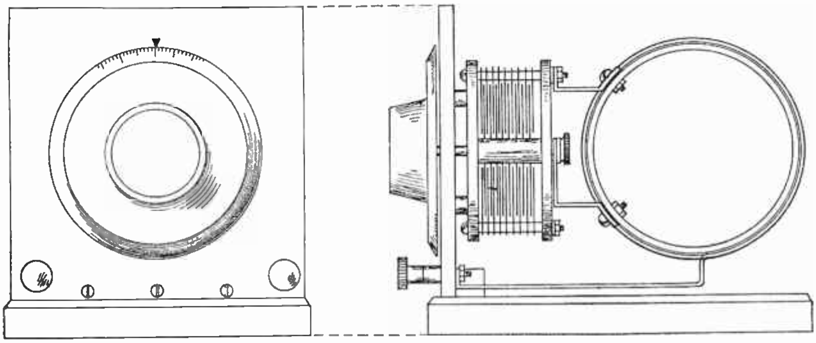


FIG. 1.

How the Filter May Be Used

There are two ways in which the filter may be used with a receiving set of the usual type, which may be termed the "series" and "shunt" connections. These are illustrated diagrammatically in Figures 2 and 3. The connections of Figure 2, or the "series" connection, is generally the more useful. In this connection, the antenna wire is removed from the receiver and the antenna is transferred to one terminal of the filter. The other terminal of the filter is then connected to the antenna binding post of the receiver. When used in this manner the filter is a great aid in eliminating interference from one station, while permitting reception from any other stations. In use, the variable condenser of the filter is adjusted so that the interfering signal is cut out, or reduced in intensity as much as possible. The filter adjustment is then left alone, and the receiver is tuned in the usual manner for the desired signal. Where strong interference is had from two or more stations, this method of connecting the filter does not yield as good results as the connections of Figure 3.

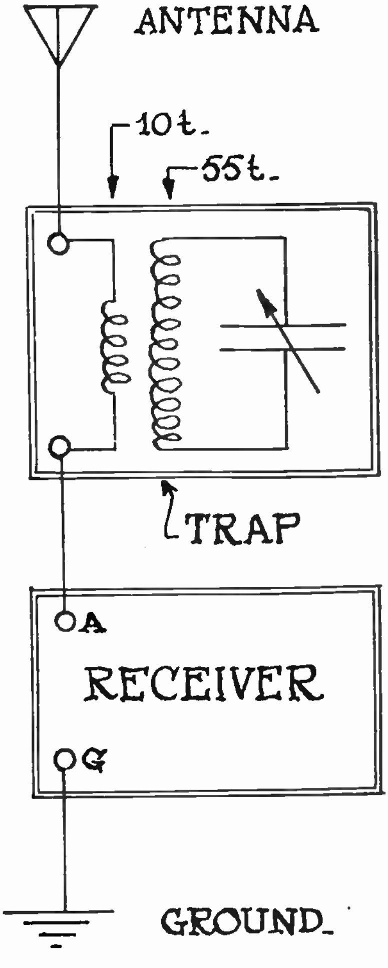


FIG. 2.

For using the filter in the "shunt" connection, the two binding posts of the filter are connected with the antenna and ground binding posts of the receiving set. While not absolutely necessary, it is very convenient to have a single pole single throw switch in the lead between the antenna binding post of the receiver and the filter. In using this circuit, first open the switch, or, if no switch is used, disconnect the filter lead at the point "a." Tune in the desired station on the receiving set, bringing the signal in as loud as possible, even though there is interference going on at the time. Then close the switch, or re-connect the lead at "a," and adjust the filter variable condenser until the desired station is once more heard. If the wavelength of

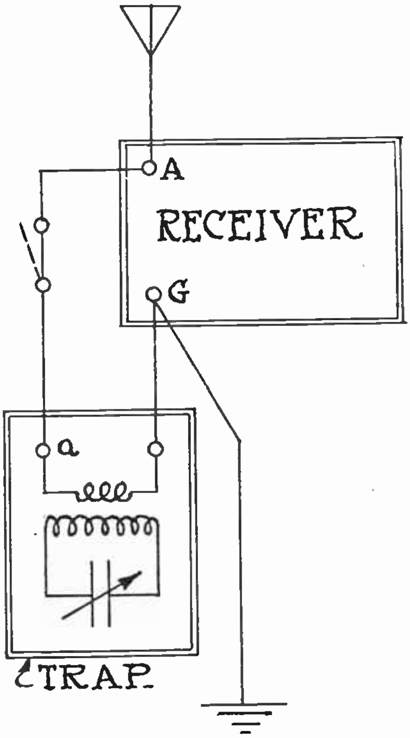


FIG. 3.

the interfering station is not too close to that of the desired station, the interfering station will be completely eliminated, leaving only the desired signal. In other words, the connection of the apparatus allows of the reception of one station, to the exclusion of all others, outside of a narrow band of wavelengths about that of the desired station. This circuit is also most effective against telegraph interference.

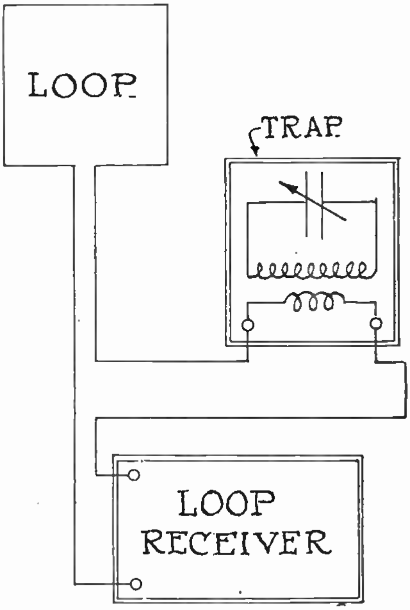


FIG. 4.

Putting It Into the Loop Circuit

While less interference is generally experienced with receivers employing loop, or coil, antennas, owing to the directive properties of the loop, there are times when the location of the various stations is such that they cannot be eliminated by turning the loop. The connection of a filter into the loop circuit, as shown by Figure 4, will give very good results. This circuit is equivalent to the "series" connection previously outlined, permitting reception on all wavelengths but a narrow band near that to which the filter circuit is tuned. The filter condenser is adjusted to eliminate the undesired signal, or reduce it as much as possible; the receiver is then operated in the usual manner to obtain as loud a signal as possible from the desired station. After the filter condenser has once been adjusted to cut out one interfering station, it need not be readjusted unless it is desired to eliminate some other station.

There are other possible arrangements of filter circuits, but these are the simplest and easiest to handle.

HOW A RADIO RECEIVER WORKS

Explanation, in Simple Language, of How Wireless Signals Are Received

LET us first consider a simple hydraulic analogy which will make clear the essential principles of reception in radio telephony without the complication due to the varied electrical phenomena which take place in the actual receiver.

Analogy

Suppose that we have a long trough, running from the transmitter to the receiver. Let our transmitter be a faucet which is capable of supplying water to the trough so that it will flow smoothly along to the receiver. At the receiving end of the trough we will place our receiving equipment, which consists of a cork or a chip of wood. In order that the receiver will not be carried away by the flow of water, let the chip be secured to the sides of the trough by means of two threads, as indicated in the diagram. These conditions are represented in Figure 1, and represent the conditions when the transmitter is closed down. We are waiting for the broadcast station to start its program.

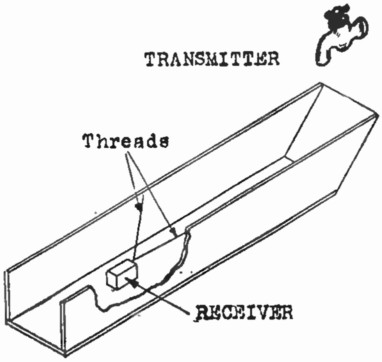


FIGURE 1.

Now when the transmitter is placed into operation a steady supply of water is let into the trough, and this water flows smoothly down toward the receiving end as long as the supply is constant. At the receiving station the chip rides upon the surface of the water, but quietly, as long as there are no ripples. This condition is shown in Figure 2, which represents the conditions after the transmitting station has been placed in operation, ready to start the program. The speaker has not yet begun to make his announcement.

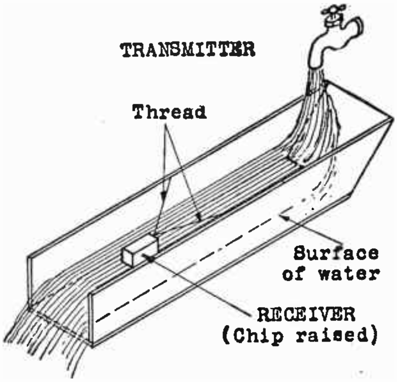


FIGURE 2.

Now let us vary the amount of water which is let into the trough by turning the handle of the faucet back and forth, never shutting the supply entirely off. The result will be that a series of waves or ripples will move down the trough, in accordance with the manner in which the supply is varied. At the receiver the chip will move up and down on the surface of the water, its motions corresponding to the ripples. Thus the signals, transmitted by varying the supply of water to the trough,

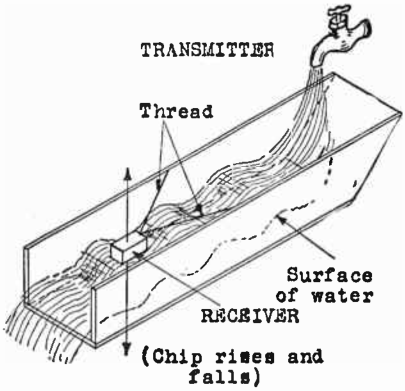


FIGURE 3.

are recorded by the motion of the chip. These conditions are indicated in Figure 3. The programme is now being transmitted.

Radio Reception—The Receiving Equipment

Now let us consider the actual radio apparatus. At the transmitting station we have apparatus which sends out electric energy into space. At the receiving station we have an elevated wire, called the antenna, which serves to collect some of the energy. In order that the energy thus collected may be led to the apparatus which makes known the presence of the signal, we have a wire connected to the elevated wire and brought down to the instruments. This is called the lead-in. The exterior conditions at the receiving station may now be shown as follows (Figure 4):

Now inside of our receiving station we may have any one of a large number of types of equipment. For the purposes of this article we will choose a type which has been very widely used; but, in general, the discussion applies to any type. The exterior appearance of such an equipment is indicated in Figure 5. Such a set would be called a single-circuit vacuum tube receiver. The lead-in from the outside aerial wire is brought to the antenna binding post, marked "A." The antenna circuit is completed, externally to the receiving set, by the connection which goes from the post marked "G" to a water-pipe, or to a metal plate buried in moist earth. The remainder of the external connections are those to the filament lighting battery ("A" battery), from which power is taken to light the filament of the vacuum tube, within the cabinet. This "A" battery may consist of from one to three of the familiar dry cells, or may be a storage battery, such as is used for lighting and starting in automobiles. The other battery shown, the "B" battery, consists of a number of small flashlight cells made up in a single container, and is necessary for the operation of the vacuum tube, as will be described. The signals are made audible in the telephones (telephone receivers), which are similar to the usual telephone receiver used for wire telephony. So much for the outside of the receiver.

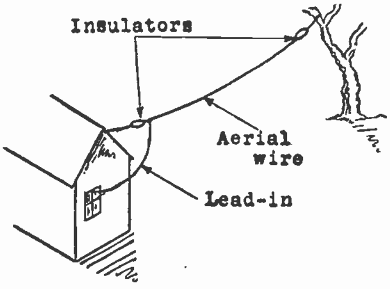


FIGURE 4.

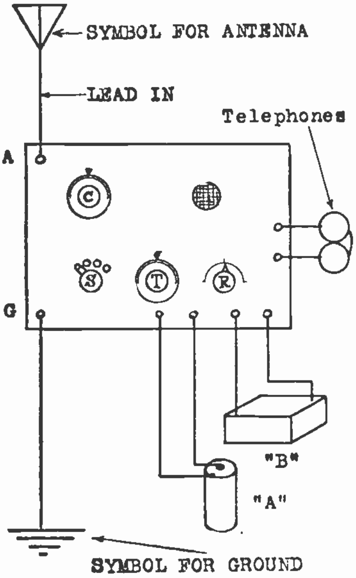


FIGURE 5

Inside the Cabinet—the Condenser

Let us now take a look at the interior of the cabinet and see where the signal goes. From the antenna binding post we find that a wire connects with an instrument called a variable condenser (which is shown in the various assembly drawings).

It consists of two sets of parallel metal plates; one set fixed in position—the other movable on a shaft, so that these plates may be made to enter into the spaces between the fixed plates. There is no metallic connection between the two sets of plates. The size of the condenser depends upon the size and number of the plates and upon the distance between the fixed and movable plates. A condenser is rated by its ability to store electric energy—a large condenser being one which can store a large amount of energy. The condensers used in radio reception are generally quite small, that is, their capacity is small. (The unit of capacity is the farad. The farad is much too large a unit for practical purposes, so that a microfarad, or one one-millionth of a farad is commonly used. Even this unit is large for radio work, so that a micro-micro-farad is often employed, which is one one-trillionth of a farad.) The symbol for the condenser consists of two parallel lines, separated by a small distance, representing the two sets of plates as they are separated in the condenser. A variable condenser is represented by the same symbol, with an arrow drawn through it, to indicate that the condenser is variable. These symbols are shown in the Key to Symbols of Apparatus.

The Vario-Coupler

From the condenser we find that there is a connection taken to one end of the stationary winding of an instrument which is called a vario-coupler—a drawing of this may be seen in the Haynes assembly. The stationary winding is called the stator and the rotatable winding the rotor. From a number of points on the stationary winding, taps are taken off to the points of the switch "S." The taps are simply connections which are made at various points to the continuous winding on the stationary form. By means of this switch it is possible to vary the number of turns which are included between the end of the coil and the arm of the switch. A coil is rated by its ability to store magnetic energy, and this is given the name inductance. The inductance of a coil depends upon the number of turns of wire, the size of the wire, the spacing between the turns and the area enclosed by the turns. (The unit of inductance is the henry, but this unit is too large for general work in radio, so that the milli-henry, one one-thousandth of a henry, or the micro-henry, one one-millionth of a henry, is commonly employed.) The symbol for a coil ("inductor" and "variable inductor") is shown in the Key to Symbols of Apparatus.

Now we find that the center of the arm of the switch is connected to the ground binding post on the panel, and we have seen that this post is connected to the water pipe or to a buried plate. We may now show the complete antenna circuit of this receiver as in Figure 8.

Electrical Pitch; Tuning

We are all familiar with the fact that a stretched string may be made to give out notes of different pitch as the length of the string is changed, as is done on stringed instruments. In a similar manner the electrical circuit of Figure 8 may be adjusted to different electrical pitches or frequencies by adjusting its electrical length. This electrical length may be changed by changing the position of the movable plates of the variable condenser, or by changing the position of the switch "S." When the condenser is set so that the movable plates are all within the stationary plates, and the switch is set so that all of the turns of the coil are included in the circuit, then the electrical pitch or frequency of the circuit is lowest. As the movable plates of the condenser are withdrawn from within the stationary plates, or the number of active turns of the coil are reduced, the electrical pitch, or frequency, of the circuit is raised. Thus we have means of tuning this circuit to various electrical frequencies.

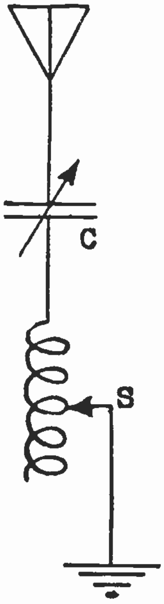


FIGURE 8.

When energy is collected by the antenna a current is caused to flow back and forth through the circuit of Figure 8, between the antenna and ground, and then between the ground and antenna, and so on, as long as the energy is supplied. When the electrical pitch of the circuit is made exactly equal to the electrical pitch of the distant transmitter, then the receiver circuit is said to be in resonance, or tuned, with the distant transmitter. Under this condition a maximum current will flow in the antenna circuit for a given amount of energy radiated from the transmitting station.

We now have a receiving equipment which can be adjusted to receive certain radio frequencies, but we have no means of making these frequencies apparent to our senses. We must now attach to the circuit of Figure 8 some device which will convert electrical frequencies into some form of vibration which is detected by our five senses. Generally, although not necessarily, the electrical vibrations are converted into vibrations in the air so that we may detect the signal by our sense of hearing. The apparatus which thus converts the electrical vibrations into audible vibrations is called the detector and reproducing apparatus. The purpose of the detector is to convert the electrical radio frequency vibrations into electrical vibrations which are so slow that their pitch is within the range of response of the ear. The reproducing apparatus takes these slow electrical or audio frequency vibrations and creates vibrations in the air, of the same frequency. These air vibrations then affect our sense of hearing.

The Vacuum Tube Detector

The most commonly used detection device is the three electrode vacuum tube. This device is one of the most complicated and useful of all modern inventions, so that it will be possible to give but the briefest outline of its action and uses here. The tube consists of an evacuated glass container, having within it a filament somewhat after the manner of the filament of an ordinary incandescent light; a plate, which is simply a plate of metal and a grid, which is a ladder-like structure of fine wire, placed between the filament and plate of the tube. The filament is connected to a battery through a variable resistor, or rheostat, as indicated in Figure 9. The purpose of the battery is to heat the filament, as at high temperatures the filament may be made to give off small particles of negative electricity, called electrons. These electrons are boiled out of the filament in much the same manner that water particles are shot out from the surface of boiling water. If the plate of the tube is connected to the positive terminal of a high voltage battery, "B," as indicated in Figure 9, and the negative terminal of this battery is connected to the filament circuit, the small particles, or eltrons which are shot out of the filament will be attracted to the positively charged plate. If the battery is left connected, this attraction will cause a large number of these small particles to cross over the space between the filament and plate, which is equivalent to a current flowing in the plate circuit. If the plate were charged negatively, by reversing the connections to the high voltage battery, then no electrons would go to the plate, since they are repelled by a negative charge.

Action of the Grid

Now in the modern tube, the ladder-like grid is most important. When the grid is charged negatively, as by the battery "C," it repels electrons which are attempting to pass through it and get to the positively charged plate. However, some of the electrons have their right-of-way signals up and shoot right through the spaces of the grid and finally arrive at the plate. The total number of such electrons is less, however, than when the grid was not charged. If the grid is charged positively

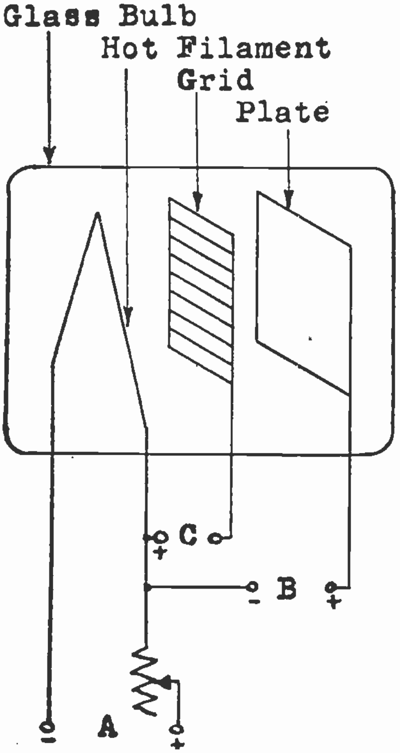


FIGURE 9.

(as by reversing the battery "C", figure 9) it tends to attract electrons to itself, but it also gives all of the electrons coming out of the filament a higher speed, so that a large number of electrons still slip through the meshes of the grid and go to the plate. The number of electrons which thus reaches the plate is greater than that when the grid was uncharged.

Thus the grid is seen to act as a control of the number of electrons reaching the plate, or in other words, a control of the plate current. It is further found that the charge on the grid is much more effective in controlling the plate current, than is the charge on the plate. That is, if we vary the voltage of the battery "C" by one volt, we will produce a much greater change in the plate current, than we would obtain by varying the battery "B" by one volt. Thus we obtain an amplifying action in the tube, a feature which is most important in its practical application.

Connection of Tube to Receiver

If now we supplant the battery "C" by a portion of the antenna circuit of Figure 8, as between the points "A" and "B," we can charge the grid by means of the incoming signal, as shown in Figure 10. This means that the signal itself may be used to control the plate current of the tube. If we should insert a pair of telephone receivers in the plate circuit, as shown in the diagram, to make the signal audible, we would find that we could hear nothing. This is because the tube is acting to vary the plate current at the same frequency at which the antenna circuit is vibrating. If it were possible for the telephone receiver diaphrams to vibrate this fast, we still would hear nothing because our ears will not respond to such tremendously high frequencies. (The frequencies used in broadcast work range from 540,000 to 1,330,000 vibrations per second. The highest note that an average person can hear is about 15,000 vibrations per second.) If we can slow up the high frequency, or make several vibrations of the high frequency produce a single vibration, then we have a means of reducing these tremendously high vibrations to lower ones, which our ears can hear.

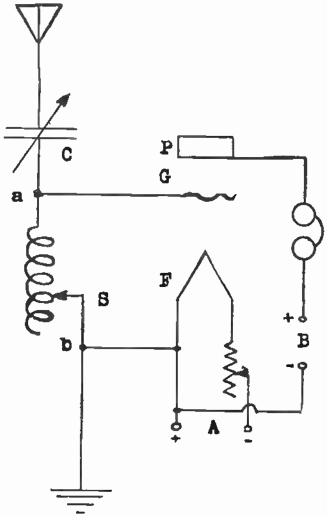


FIGURE 10

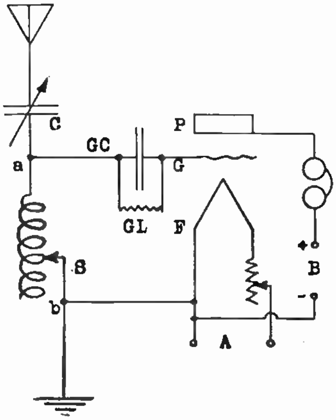


FIGURE 11.

If we make use of a small condenser and a high resistance, connected in the grid circuit of the tube, as shown in Figure 11, then we have the effect mentioned above. These instruments are known as the grid condenser GC, and the grid leak resistance, GL.

Action of the Circuit

Now let us consider the action of the circuit when signals are being received. When no signals are being sent out from the transmitting station, the grid of the tube will have practically a zero charge upon it. The plate current is then steady and at a certain value. These conditions correspond to the conditions outlined for Figure 1, of our analogy. Now let the transmitting station prepare to send signals, though no words are yet spoken. Energy, in an unvarying amount, will then be radiated from the transmitting station, some of this energy being collected by the receiving antenna. This results in a voltage being impressed upon the grid of the tube, and this voltage is steady in value. The plate current of the tube will then change to a new value, and will remain at this value as long as the charge on the grid remains constant. When this change in plate current takes place, we hear a single click in the telephone receivers, but we hear nothing more, under these conditions, until the apparatus at the transmitting station is shut down. If this is done the voltage applied to the grid is removed and the plate current will return to its original value. When this occurs another click will be heard in the telephone receivers. This corresponds to the rise and fall of the block when the water is turned on or shut off completely in the analogy. (Figure 2.)

Now let the transmitter apparatus be placed in operation and words be spoken into the microphone. The energy radiated from the transmitter will no longer be constant, but will vary in amount with the control effected by the voice. On the steady flow of energy, which takes place when no words are being spoken, are superimposed various ripples, these ripples being in accordance with the voice. This corresponds to the analogy pertaining to Figure 3. Now at the receiver the amount of energy collected by the antenna will vary, according as the amount sent out by the transmitter is large or small. The current flowing in the antenna circuit will then vary in accordance with these changes, and the changes in current will be reproduced as changes in the voltage or charge applied to the grid of the tube. These changes in the charge on the grid of the tube cause corresponding changes in the plate current. As these changes take place at audio frequency the diaphragms of the telephone receivers will respond to the changes, and as they move in and out they set up air waves which, striking our ears, produce the sensation of sound. In this connection it should be noticed that it is not the energy of the signal which operates the telephones, but energy supplied by the "B" battery. The signal simply acts through the tube to control the flow of this energy through the telephone receivers.

Regeneration

Since the vacuum tube is an amplifying device we have a greater amount of energy flowing in the plate current than came in through the antenna circuit. Some of this energy may be taken out of the plate circuit to be led back to the grid circuit, where it can be made to amplify or regenerate the signal present there. If this is done the receiving set is said to be regenerative. One method for accomplishing this result is indicated in Figure 12. The rotor winding of the variocoupler is connected in the plate circuit of the tube in such a manner that part of the radio frequency energy present in the plate circuit may be fed back into the grid circuit through the magnetic transfer between the rotor coil and the stator coil. (In the diagram the rotor winding is indicated as being placed beside the stator winding for greater clearness in the drawing.) The effect of a signal is thus increased very greatly, so that it is possible to hear signals clearly that would be entirely too weak to hear with the arrangement of Figure 11.

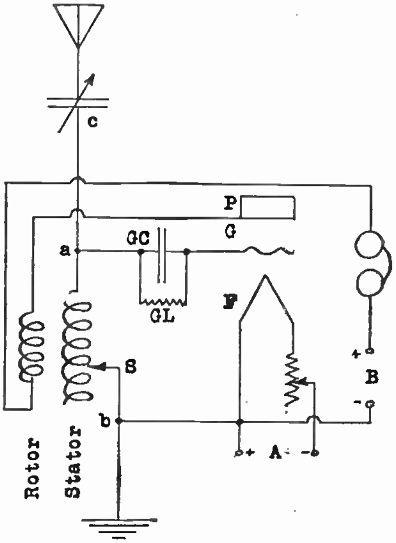
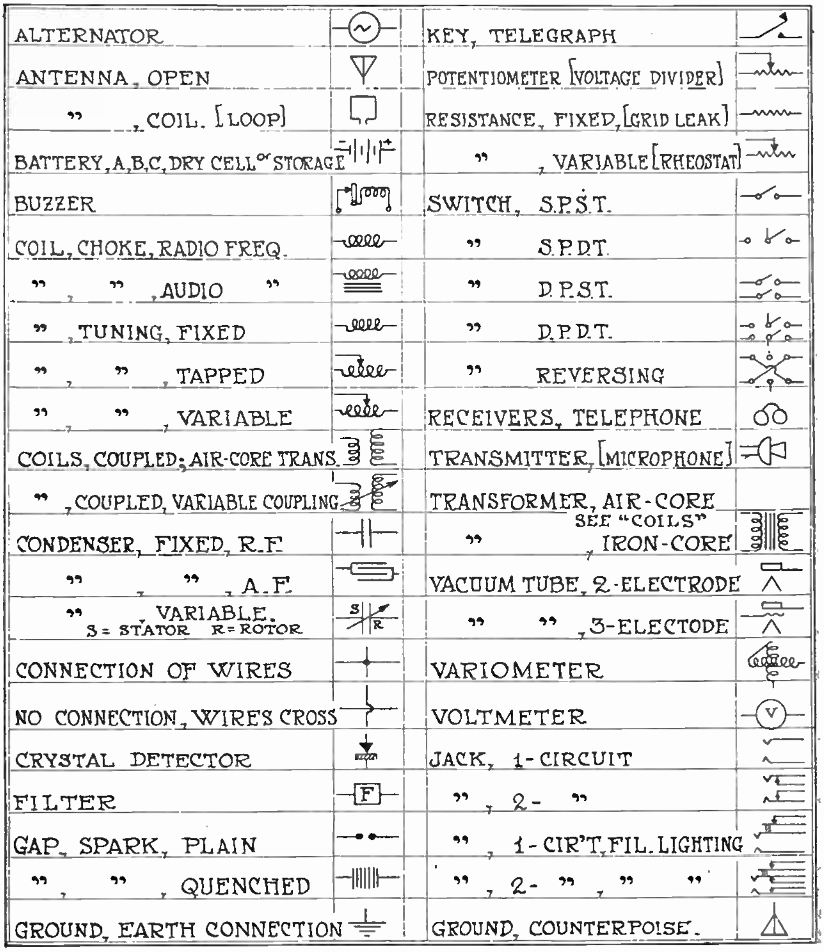


FIGURE 12.

This is but a brief and far from rigorous explanation of the operation of a radio receiving set. However, if it serves to make clearer the mysteries of the why of radio its purpose is accomplished.

KEY TO SYMBOLS OF APPARATUS



ALTERNATOR		KEY, TELEGRAPH	
ANTENNA, OPEN		POTENTIOMETER [VOLTAGE DIVIDER]	
" , COIL. [LOOP]		RESISTANCE, FIXED, [GRID LEAK]	
BATTERY, A, B, C, DRY CELL or STORAGE		" , VARIABLE [RHEOSTAT]	
BUZZER		SWITCH, S.P.S.T.	
COIL, CHOKE, RADIO FREQ.		" S.P.D.T.	
" , " , AUDIO "		" D.P.S.T.	
" , TUNING, FIXED		" D.P.D.T.	
" , " , TAPPED		" REVERSING	
" , " , VARIABLE		RECEIVERS, TELEPHONE	
COILS, COUPLED; AIR-CORE TRANS.		TRANSMITTER, [MICROPHONE]	
" , COUPLED, VARIABLE COUPLING		TRANSFORMER, AIR-CORE SEE "COILS"	
CONDENSER, FIXED, R.F.		" , IRON-CORE	
" , " , A.F.		VACUUM TUBE, 2-ELECTRODE	
" , VARIABLE. S = STATOR R = ROTOR		" " , 3-ELECTODE	
CONNECTION OF WIRES		VARIOMETER	
NO CONNECTION, WIRES CROSS		VOLTMETER	
CRYSTAL DETECTOR		JACK, 1-CIRCUIT	
FILTER		" , 2- "	
GAP, SPARK, PLAIN		" , 1-CIR'T, FIL. LIGHTING	
" , " , QUENCHED		" , 2- " , " "	
GROUND, EARTH CONNECTION		GROUND, COUNTERPOISE.	

International Morse Code and Conventional Signals

[To be used for all general public-service radio communication. (1) A dash is equal to three dots; (2) the space between parts of the same letter is equal to one dot; (3) the space between two letters is equal to three dots; (4) the space between two words is equal to five dots.]

A	• —
B	— • • •
C	— • — •
D	— • •
E	•
F	• • — •
G	— — •
H	• • • •
I	• •
J	• — — —
K	— • —
L	• — • •
M	— —
N	— •
O	— — —
P	• — — •
Q	— — • —
R	• — •
S	• • •
T	—
U	• • —
V	• • • —
W	• — —
X	— • • —
Y	— • — —
Z	— — • •

Ä (German)	• — • —
Á or Å (Spanish-Scandinavian)	• — — • —
CH (German-Spanish)	— — — —
É (French)	• • — • •
Ñ (Spanish)	— — • — —
Ö (German)	— — — •
Ü (German)	• • — —

1	• — — — —
2	• • — — —
3	• • • — —
4	• • • • —
5	• • • • •
6	— • • • •
7	— — • • •
8	— — — • •
9	— — — — •
0	— — — — —

Period	• • • • • •
Semicolon	— • — • — •
Comma	• — • — • —
Colon	— — — • • •
Interrogation	• • — — • •
Exclamation point	— — • • — —
Apostrophe	• — — — — •
Hyphen	— • • • • —
Bar indicating fraction	— • • — •
Parenthesis	— • — — • —
Inverted commas	• — • • — •
Underline	• • — — • —
Double dash	— • • • —
Distress call	• • • — — — • • •
Attention call to precede every transmission	— • — • —
General inquiry call	— • — • — — • —
From (de)	— • • •
Invitation to transmit (go ahead)	— • —
Warning—high power	— — • • — —
Question (please repeat after ......)—interrupting long messages	• • — — • •
Wait	• — • • •
Break (Bk.) (double dash)	— • • • —
Understand	• • • — •
Error	• • • • • • • •
Received (O. K.)	• — •
Position report (to precede all position messages)	— • — •
End of each message (cross)	• — • — •
Transmission finished (end of work) (conclusion of correspondence)	• • • — • —

RADIO AND INSURANCE

Rules for Installing the Apparatus Illustrated by Diagrams

FOLLOWING are the insurance regulations covering the installation of radio apparatus as recommended by the National Fire Protection Association and accepted recently for the National Electric Code. A new set of specifications has now been evolved which will interest every amateur in the land. It is still believed by insurance engineers that an outdoor antenna may be slightly hazardous through becoming a conductor for lightning. However, it is now recognized that when properly installed, it may become a protection rather than otherwise.

General

A. The requirements of this article shall not apply to equipment installed on shipboard, but shall be deemed to be additional to, or amendatory of, those prescribed in articles 1 to 19, of this code.

B. Transformers, voltage reducers, keys and other devices employed shall be of types expressly approved for radio operation.

For Receiving Stations Only

A. Antenna and counterpoise outside buildings shall be kept well away from all electric light or power wires of any circuit of more than 600 volts, and from railway, trolley or feeder wires, so as to avoid the possibility of contact between the antenna or counterpoise and such wires under accidental conditions.

B. Antenna and counterpoise where placed in proximity to electric light or power wires of less than 600 volts, or signal wires, shall be constructed and installed in a strong and durable manner, and shall be so located and provided with suitable clearances as to prevent accidental contact with such wires by sagging or swinging.

C. Splices and joints in the antenna span shall be soldered unless made with approved splicing devices.

D. The preceding paragraphs, a, b, and c, shall not apply to light and power circuits used as receiving antenna, but the devices used to connect the light and power wires to radio receiving sets shall be of approved type.

E. Lead-in conductors shall be of copper, approved copper-clad steel or other metal which will not corrode excessively, and in no case shall they be smaller than No. 14 except that bronze or copper-clad steel not less than No. 17 may be used.

F. Lead-in conductors on the outside of buildings shall not come nearer than 4 inches to electric light and power wires unless separated therefrom by a continuous and firmly fixed non-conductor which will maintain permanent separation. The non-conductor shall be in addition to any insulating covering on the wire.

G. Lead-in conductors shall enter the building through a non-combustible, non-absorptive insulating bushing slanting upward toward the inside.

H. Each lead-in conductor shall be provided with an approved protective device (lightning arrester) which will operate at a voltage of 500 volts or less, properly connected and located either inside the building at some point between the entrance and the set which is convenient to a ground, or outside the building as near as practicable to the point of entrance. The protector shall not be placed in the immediate vicinity of easily ignitable stuff, or where exposed to inflammable gases or dust or flyings of combustible materials.

I. If an antenna grounding switch is employed, it shall in its closed position form a shunt around the protective device. Such a switch shall not be used as a substitute for the protective device.

It is recommended that an antenna grounding switch be employed, and that in addition a switch rated at not less than 30 amperes, 250 volts, be located between the lead-in conductor and the receiver set.

J. If fuses are used, they shall not be placed in the circuit from the antenna through the protective device to ground.

Fuses are not required.

K. The protective grounding conductor may be bare and shall be of copper, bronze or approved copper-clad steel. The grounding conductor shall be not smaller than the lead-in conductor, and in no case shall be smaller than No. 14 if copper nor smaller than No. 17 if of bronze or copper-clad steel. The grounding conductor shall be run in as straight a line as possible from the protective device to a good permanent ground. Preference shall be given to water piping. Other permissible grounds are grounded steel frames of buildings or other grounded metal work in the building, and artificial grounds such as driven pipes, rods, plates, cones, etc. Gas piping shall not be used for the ground.

L. The protective grounding conductor shall be guarded where exposed to mechanical injury. An approved ground clamp shall be used where the grounding conductor is connected to pipes or piping.

M. The grounding conductor may be run either inside or outside the building. The protective grounding conductor and ground, installed as prescribed in the preceding paragraphs K and L, may be used as the operating ground.

It is recommended that in this case the operating grounding conductor be connected to the ground terminal of the protective device.

If desired, a separate operating grounding connection and ground may be used, the grounding conductor being either bare or provided with an insulating covering.

N. Wires inside buildings shall be securely fastened in a workmanlike manner and shall not come nearer than 2 inches to any electric light or power wire not in conduit unless separated therefrom by some continuous and firmly fixed non-conductor such as porcelain tubes or approved flexible tubing, making a permanent separation. This non-conductor shall be in addition to any regular insulating covering on the wire. Storage battery leads shall consist of conductors having approved rubber insulation.

It is recommended that the circuit from the storage battery be properly protected by fuses as near as possible to the battery.

For Transmitting Stations Only

A. Antenna and counterpoise outside buildings shall be kept well away from all electric light or power wires of any circuit of more than 600 volts, and from railway trolley or feeder wires, so as to avoid the possibility of contact between the antenna or counterpoise and such wires under accidental conditions.

B. Antenna and counterpoise where placed in proximity to electric light or power wires of less than 600 volts, or signal wires, shall be constructed and installed in a strong and durable manner, and shall be so located and provided with suitable clearances as to prevent accidental contact with such wires by sagging or swinging.

C. Splices and joints in the antenna and counterpoise span shall be soldered unless made with approved splicing devices.

D. Lead-in conductors shall be of copper, bronze, approved copper-clad steel or other metal which will not corrode excessively and in no case shall be smaller than No. 14.

E. Antenna and counterpoise conductors and wires leading therefrom to ground switch, where attached to buildings, shall be firmly mounted 5 inches clear of the surface of the building, on non-absorptive insulating supports such as treated pins or brackets, equipped with insulators having not less than 5 inches creepage and air-gap distance to inflammable or conducting material. Suspension type insulators may be used.

F. In passing the antenna or counterpoise lead-in into the building a tube or bushing of non-absorptive insulating material, slanting upward toward the inside, shall be used and shall be so insulated as to have a creepage and air-gap distance of at least 5 inches to any extraneous body. If porcelain or other fragile material is used it shall be protected where exposed to mechanical injury. A drilled window pane may be used in place of a bushing provided 5 inches creepage and air-gap distance is maintained.

G. A double throw knife switch having a break distance of at least 4 inches and a blade not less than ⅛ inch by ½ inch shall be used to join the antenna and counterpoise lead-in to the grounding conductor. The switch may be located inside or outside the building. The base of the switch shall be of non-absorptive insulating material. This switch shall be so mounted that its current-carrying parts will be at least 5 inches clear of the building wall or other conductors. The conductor from grounding switch to ground shall be securely supported.

It is recommended that the switch be located in the most direct line between the lead-in conductors and the point where grounding connection is made.

H. Antenna and counterpoise conductors shall be effectively and permanently grounded at all times when station is not in actual operation and unattended, by a conductor at least as large as the lead-in and in no case smaller than No. 14 copper, bronze, or approved copper-clad steel. This grounding conductor need not have an insulated covering or be mounted on insulating supports. The grounding conductor shall be run in as straight a line as possible to a good permanent ground. Preference shall be given to water piping. Other permissible grounds are the grounded steel frames of buildings and other grounded metal work in buildings and artificial grounding devices such as driven pipes, rods, plates, cones, etc. The grounding conductor shall be protected where exposed to mechanical injury. A suitable approved ground clamp shall be used, where the ground conductor is connected to pipes or piping. Gas piping shall not be used for the ground.

It is recommended that the protective grounding conductor be run outside the building.

I. The radio-operating grounding conductor shall be of copper strip not less than ⅝ inch wide by 1/32 inch thick, or of copper, bronze, or approved copper-clad steel having a periphery, or girth, of at least ¾ inch, such as a No. 2 wire, and shall be firmly secured in place throughout its length.

J. The operating grounding conductor shall be connected to a good permanent ground. Preference shall be given to water piping. Other permissible grounds are grounded steel frames of buildings or other grounded metal work in the building, and artificial grounding devices such as driven pipes, rods, plates, cones, etc. Gas piping shall not be used for the ground.

K. When the current supply is obtained directly from lighting or power circuits, the conductors whether or not lead covered shall be installed in approved metal conduit, armored cable or metal raceways.

L. In order to protect the supply system from high-potential surges and kick-backs there shall be installed in the supply line as near as possible to each radio-transformer, rotary spark gap, motor and generator in motor generator sets and other auxiliary apparatus one of the following:

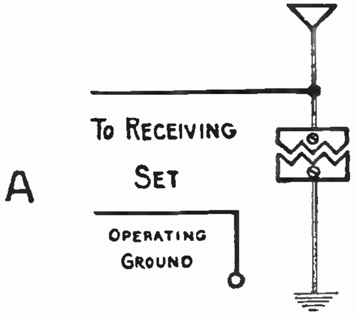
1. Two condensers (each of not less than ½ microfarad capacity and capable of withstanding 600 volt test) in series across the line with mid-point between condensers grounded; across (in parallel with) each of these condensers shall be connected a shunting fixed spark-gap capable of not more than 1/32 inch separation.

2. Two vacuum tube type protectors in series across the line with the mid-point grounded.

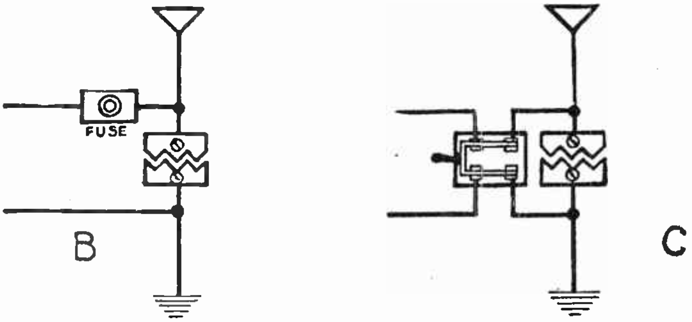
3. Resistors having practically zero inductance connected across the line with mid-point grounded.

   It is recommended that this third method be not employed where there is a circulation of power current between the mid-point of the resistors and the protective ground of the power circuit.

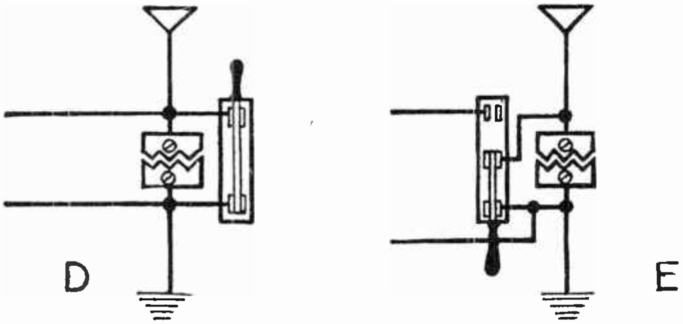
4. Electrolytic lightning arresters such as the aluminum cell type.



Required Protection For Radio Receiving Sets



Illustrative Permissible Additions To Protection For Radio Receiving Sets



TROUBLE SHOOTING

The Purpose of the Detailed Chart Is a Short Cut Remedy for Defects

THE purpose of this chart is to aid in the elimination of troubles which are experienced in the operation of radio receiving equipment. Owing to the large variety of equipments, and the varied names which have been given to them, it has been necessary to classify the different circuits by type, and not by name. The first table lists a large number of the popular names beside the type name, so that no difficulty will be experienced in classifying the receiving equipment according to the chart. First pick out the designating letter for the particular type of receiver which you are using. Single tube sets are given separate letters; multi-tube sets are classified according to the tuning equipment and given the same letter as the corresponding single tube set, with separate letters to cover the amplifiers as a distinct unit. Special circuits are given distinctive letters.

List of Receivers

For example, suppose the receiver to be a "single circuit," with tube detector and two stages of audio frequency amplification. The tuning equipment and detector are covered by the designating letter "C"; the two-stage amplifier by the designating letter "K." To look up the possible causes for troubles which may be experienced in the operation of this receiver, we would then enter the large table under the heading of the particular trouble experienced and in the portion of the column sub-headed "C" we would find the sources which might exist in the receiver and detector; in the portion sub-headed "K" we would find the possible sources which might exist in the amplifier. Complete information for the receiver as a whole is thus available.

Numbers 1 to 5

Troubles are due to certain causes, some of which occur rather frequently. Those which are most likely to occur are checked in the small squares with numbers from 1 to 5. As far as possible these numbers have been assigned in the order in which the troubles are most frequently experienced. This could not be rigidly adhered to, however, so that in first looking up the source of trouble, run down the column, checking off all causes which are designated by a number of 5 or less.

Numbers 6 to 9

Troubles of secondary frequency are given numbers from 6 to 9, and, as before, these have been arranged as far as possible in the order in which they are most likely to occur. If the first search through the column did not reveal the cause of the trouble, the column should again be run through, checking all sources which are designated by numbers from 6 to 9.

In some instances it will be found that the same number appears more than once. This just means that the sources opposite these numbers have about equal chances of being the cause of the trouble in question.

Letter "P"

There are certain possibilities which are rarely experienced as sources of trouble, but which are nevertheless of a type which is very elusive and sometimes very difficult of solution. Wherever possible, these sources have been designated by a letter "P," which indicates that such sources are "Possibilities." The column should be checked through, if the first two trials have not located the trouble, and each source designated by a letter "P" considered.

Letter "X"

As a final resort extremely unlikely sources, but those which are at least theoretically possible, have been given the designating letter "X." This designation holds throughout the table, except in section "K-GENERAL," in which an X is also used to designate informative, or suggestive entries which may apply to the various troubles experienced.

TROUBLE SHOOTING CHART

TROUBLE	NO SIGNALS											FRYING, CLICKING NOISES	SCRATCHY SIGNALS		MUFFLED SIGNALS		LOW HUMMING		BROAD TUNING	SQUEALS, HOWLS TOO MUCH REGENERATION		WEAK SIGNALS, NO "	NO AMPLIFICATION	MARKED DISTORTION	LOUD CONTINUOUS HOWLING		SIGNALS, TUBE OUT OF SOCKET	BODY CAPACITY	DOES NOT TUNE TO LONG WAVES		DOES NOT TUNE TO SHORT WAVES		DOES NOT REFLEX	TUBE DOES NOT LIGHT	FADING, CAUSE IN SET
TYPE OF RECEIVER	A	B	C D F	E	G	H	I M	J	K M	L	M	ALL TYPES	A B	C D E F G H I J K L M	A B K	C D E F G H I J K L M	A B	C D E F G H I J K L M	ALL TYPES	C D E F G	H I J M	C D E F G	H I J K L	ALL TYPES	C D E F G M	H I J K L	G H I J M	C D E F G H I J K M	A C D F G	B E H I J M	A C D F G	B E H J M	G M	C D E F G H I J K L M	ALL TYPES
CAUSE																																			
A DEFECTIVE:																																			
1 Aerial; Aerial connections	P	P	P	P	P												P		8										X	X	X	X			P
2 Ground, ground connections	P	P	P	P	P												3	8	8										X	X	X	X			P
3 Inductance coils	3	3	2	2	2	P						X	X				8	6	4			P							X	X	X	X			X
4 Sliders or switches	4	4	3	3	3							X	X				4	4	4			P							X	X	X	X			P
5 Primary condenser	4	4	4	4	4								X						3			X							X	X	X	X			X
6 Secondary condenser	P	5	P	5	5	P		X					X						6			P	P	X	X				X	X	X	X			X
7 Grid variometer			7	5								X		X				8	6			P		X	X	X			X	X	X	X			X
8 Crystal	P	P			P		P				P	X	2	3	3	8	P	P	3			X	X	4		P							2		8
9 Grid leak			P	P		X	X	P		3	8	4		8		3		6	4	7		P	X	P	3	P							X		
10 Grid Condenser			P	P		X	9	8		3	8	4		8		2		7	4	8		P		P	3	P							X		
11 Socket connections			6	6	8	P	P	P	8	8	7	5		X				7	P	P		8	9				P						2	3	
12 Filament lighting contacts on first jack.			P	P	P	X		X	3														X										2	3	P
13 Filament rheostat			P	P	P	P	P	P	8	8	8	X																					P	P	1
14 "A" battery			P	P	P	P	P	P	8	9	P	X										X	X										P	4	X
15 Vacuum tube			X	X	X	X	X	P	P	P	P	P		8		7		P	P	P		8	X	X									P	3	X
16 Phone condenser	5	5	P	P	P				P	P	P	8	4	4	2	2						4	X	X			X						3		P
17 Phones; phone cords	P	P	P	P	P				P	P	P	P	4	4	3	3						X	X	P											7
18 "B" battery			7	7	7	2	2	2	3	4	3	1		3		X						7	6	8	8	8	8						7		2
19 Potentiometer			P	P	P	2	1				P	P		3				X		X	3	P	5	8	3	4							P	X	9
20 Plate variometer			2	8								X										6					3								P
21 Radio frequency transformer					X	P	8	3			P	X		8				X	X				5	X	X	P							X		
22 Audio frequency transformer					X	P			P		P	X		5		X		8					5	7	X	P							X		
23 Choke coil						X				3								8					5	X											
24 First jack	P	P	P	P	P			X	8		X		X	X			X		3			X	X										X	P	
25 Second jack									8					X									X										X	P	
26 Third jack									8					X									X											P	
27 "C" battery									8			2		3		5							7	5	7	7									X
28 Insulation	X	X	X	X	X	P	X	6	X	X	X	3	X	X				X	7	X	X	X	X	X									X		P
B OPEN CIRCUIT IN																																			
1 Antenna or ground circuits	P	P	P	P	P								X	X			3	8	X										X	X	X	X			
2 Primary coil	2	2	2	2	2								X	X			4	8																	
3 Primary condenser	3	3	4	4	4								X	X			X	P	X																
4 Secondary coil		3	P	2	2			7					X	X			4	6				4													
5 Secondary condenser	P	5	P	5	5			P					X	X								P													
6 Grid leak resistance			P	P	P	X					X			X				7		1	P	X			4										
7 Grid condenser			P	P	P	X						P		P				7		X	P	X													
8 Socket contacts			6	8	8	P	P	9	8	8	7	P		P				8		X	P	5	p										2	3	
9 Filament rheostat			P	P		X	P	P	8	8	8	P											X										3	3	
10 "A" battery connections			P	P	P	X	P	P	8	8	7												X											2	
11 First jack	P	P	P	P	P	P			8	P		X	X	X			X					X	X										X	P	
12 Second jack									8	P				X									X											P	
13 Third jack									8	P				X									X											P	
14 Plate circuit			2	8	7	P	P	8	6	5	P			X								9	8												
15 Tickler coil			2	8										X								6													
16 Radio Frequency transformer					X	P	8	8			P	X		X				X					9	P		P	P						P		
17 Audio frequency transformer					X				P		P	X		X				X					9	P		P	P						P		
18 Choke coil						X				3		X						X				X	9												
19 "B" battery connections			7	7	7	6	2	6	5	4	4			X								3	7										X		
20Between plug and jack	P	P	P	P	P	P	P	P	P	P	P		P	P			X					X	6										X		
C SHORT CIRCUIT IN																																			
1 Antenna (to ground)	P	P	P	P	P																	P													
2 Antenna coil	2	3		2	2														4			P													
3 Antenna condenser	4	4	2	4	2								X	X								X													
4 Primary coil	2	3	2	2	2									X					4			8		X											
5 Secondary coil		3	P	2	3	8		6						X					3			3		X											
6 Secondary condenser	P	5	P	5	3	P		X						X									P												
7 Between elements of tubes			X	X	X	X	X	X	X	X	X								X			X	X										X	X	
8 Between springs of socket			X	X	X	X	X	X	X	X	X								X			X	X										X	X	
9 Tickler coil			2	2																		3													
10 Feed back condenser			2	2																		X													
11 Phone condenser	5	6	P	P	P	X	X	P	X	X	X	4	X									7											X		
12 Phones; phone cords	P	P	P	P	P	P	P	P	P	P	P	X	X																				X		
13 First jack	P	P	P	P	P	X	X	X	8	8	X	X	X									X	X											P	
14 Second jack									8	8													X											P	
15 Third jack									8	8													X											P	
16 Wiring	X	X	8	9	9	3	9	9	P	P	P	X	X	X					X			X	9	X										8	
17 Wiring to shield	X	X	X	X	X	X	9	X	P	X	X								X			X	9												
18 Apparatus, to shield	X	X	X	X	X	X	9	X	X	X	X								X			X	X												
19 Wiring, to apparatus	X	X	X	X	X	X	X	X	X	X	X								X			X	X												
D REVERSED																																			
1 Primary condenser connections																		P										4							
2 Secondary condenser connections																		P	X									4							
3 Secondary coil connections						P	6											X	8			X	3												
4 "C" battery							P		6							X							9	6											
5 "A" battery			X	X	X	X	P	P	8	X	P			X		X						X	8	9									9		
6 "B" battery			7	7	1	2	8	3	4	4	7			X		X						8	9										4		
7 Tickler connections			1	1										X								2													
8 Compensator coil connections								3													P														
9 AFT secondary connections					3				3		3			8		X					2		6	8		X							2		
10 AFT primary connections					5				3		5			4		X					P		X	X		3							8		
E RUN DOWN																																			
1 "A" battery			P	P	P	X	P	P	8	6	7	5		P		X						P	X	X	X	X							8	5	P
2 "B" battery			P	P	P	P	P	3	7	4	5	1		2		P						4	P	P	P	P							2		2
3 "C" battery							9		6		P	1		3		P							P	5											P
F TOO LOW, OR TOO SMALL																																			
1 Antenna length	P	P	P	X	X																X								P	P					
2 Number of turns on primary coil	6	2	2	X	X														4		X								5	5					
3 Primary condenser	7	3	P	X	X														X										9	9					
4 Number of turns on secondary coil		3	2	X	X														X				P						5	5					
5 Secondary condenser		5	P	X	X														X		X								8	8					
6 Grid condenser										4				6				X						P			P								
7 Grid leak			P	P	P					4				6		1						8			7										
8 Grid variometer			P	P	X						X								6							X			8	8					
9 "A" battery voltage			P	P	P	X	P	P	P	8	P			X						9		X	P	X	P	P							4	7	P
10 "B" battery voltage			7	7	P	X	9	X	X	3	8			8								6	8	8									3		
11 Number of turns on tickler coil			2	P	X																	3							9	9					
12 Feed-back condenser			P	P																		3													
13 Plate variometer			P	P																		3							9	9					
14 Phone condenser					X						P		1	3								5		X											
15 Turns on compensator coil																					6					P									
16 Filament current			P	P	P	P	P	P	X	P	P			P								X	P	X	P	P							4	7	
G TOO HIGH, OR TOO LARGE																																			
1 Antenna length.	P	P	P	X															3												3	3			
2 Number of turns on primary coil	8	2	2	X	X																										2	2			
3 Antenna condenser	8	3	P	X	X																										3	3			
4 Number of turns on secondary coil		3	2	X	X																X					P						3			
5 Secondary condenser.		5	P	X	X																											3			
6 Grid variometer			P	X																	X														
7 Grid leak			P	X												2		8		1	3			3	2										
8Grid condenser																3				P	4			X	X										
9 "A" battery voltage			P	P								P		X		X				P				P	X	7									
10 "B" battery voltage			X	X	X	P						8		P		6				7	1			2	3	2									
11 "C" battery voltage														2		X					2			1	X	2									
12 Number of turns on tickler coil																				1	1			X	4						P				
13 Feed-back condenser																				3	1			X	4						P				
14 Plate variometer																				3	2			X	4						P				
15 Number of turns on compensator coil								9																X							P				
16 Condenser across AFT secondary					P				P		3					1								8											
17 High ratio AFT											8			7		7								1											
18 Filament current			X	X				P			P	5		X		X					X			P	X										
19 Length of Grid leads						P	6				2			X		X		6	4	6	3		P	P	8	2									
20 Phone condenser															1	1				4	X		X	X									X		
H TOO CLOSE																																			
1 Plate and grid leads						P	4	X			2			X		X		P	6	2	2		8	8	2	2					X	X			
2 Apparatus.						X	8				3			P		X			3	6	6		9	9	X	3					X	X			
3 AF tranformers									X		5			P		X					P		P	P		P									
4 RF transformers						P	7	X			5			X		X			3		P		P	P		P						P			
5 Coil and panel																			P									3							
6 Tickler and grid windings; (capacity feed-back between windings)								5												5	5											X			
I OUT OF ADJUSTMENT																																			
1 Receiver	1	1	1	1	P	1	2	1			3		3	3	5	4			5	X		4	4	X	P	P			3	3	3	3			
2 Crystal detector	1	1			P						5		2	2	2	2	8	P	P					X	P								3		
3 Telephone receivers	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X							X	6											
4 Neutralizing condensers						2															2			X		4	3								
5 Radio frequency transformers					X	2					X								5		3		X	X		4							X		
J INCORRECT																																			
1 Tap on secondary winding		X	P	X															X	X	X														
2 Grid return connection			P	X	P	3	5	5	3	X	4	X		4		4			5	6	7	9	3	2	P								6		
3 Number of turns on secondary of transformer					P		P				P								P		P	X								X		X			
4 "C" battery voltage							3							2		X					6		6	P		X									
5 Grid leak resistance			P	P				7			P			7		1				1	3			4	P										
6 Grid condenser capacity			X	X		5					P			6		2			P	5	4			4	P										
7 Wiring.	9	7	1	1	1	1	2	2	5	2	2	X	X	X				P	P	P	X	3	8				X	X						2	
K GENERAL																																			
1 Aerial near high voltage lines																	9	9																	
2 High resistance antenna or ground circuits												X	X	X					3										X	X	X	X			P
3 Outside sources; Static, X-rays arc-lights, grounds on power lines												1					8	8																	
4 Loose connections	3	3	3	3	3	4	5	5	6	4	4	1	X	X			X	X	X	X	X	P			8	X									3
5 Shield panel; connect shield to minus "A" and ground.																				X	X							X							
6 Rotary plates to ground or minus "A".																			X									X							
7 Loose connections on, or in, transformer									P		P	P		X						X	X		X			X									
8 Ground cores of AF transformers to minus "A" or plus "B"					X				X		X			X		X					X		X	X		X									
9 Use "C" battery							X		X		X												X	X											
10 Use ¼ or ½ megohm leak across AFT secondary														X										X											
11 Use leak on amplifier tubes										2				X										X											
12 Use power tube and high "B" voltage														X		X							X	X											
13 Use potentiometer						P	X				X			X						X	X			X	X	X									
14 Microphonic noises from tube												2																							
15 Noisy detector tube												2																							
16 Receiver oscillating														P						1	1				X	X									
17 Interference between carrier waves of two transmitting radiophone stations																				2	2				X	X									
18 Radiation from nearby receivers													X	X	X	X				2	2				X	X									
19 Clocking at audio frequency																				X	X				X	X									
20 AF oscillations in amplifier																					X			X	X	X									
21 Mechanical coupling between phones and loud speaker																				X	X				X	X									
22 Leakage in apparatus			X	X	X	8	6			X	X	3	X	X	X		X		6			P	P	X											9
23 Use loose coupled receiver or wave-trap																			X																
24 Filaments burned out			X	X	X	X	X	X	X	X	X																								
25 Shielded by steel in building or surroundings			P																							X									
26 Put transformers at rightangles																																			

TABLE OF RECEIVERS

Crystal Receivers

Code Letter	General Type	Popular Name
A	Direct Coupled	One, two or three slide tuners, variometers, with crystal detector.
B	Loose Coupled	Loose couplers, variocouplers with crystal detector.
	Single Tube Receivers	
C	Direct Coupled	One, two or three slide tuners, "single circuit," Green circuit, Westinghouse RC, Aeriola, Maclite, AceV, Jacobs, two-coil honey-comb and spider-web sets, and variations.
D	Semi-tuned, directly coupled, or closely coupled	Haynes, Reinartz, Sodion DR6, Tuning equipment of Radiodyne, Superdyne, etc., and variations.
E	Loose Coupled	"Two circuit" non-regenerative; "three-circuit" regenerative; ultra-audion, four circuit, Zenith, Federal, Amrad, Sodion DR9, Variocoupler-two-variometer, Variocoupler-condenser-variometer; three coil honeycomb or spider-web sets, and variations.
F	Loop Receivers Direct Coupled Loose Coupled	 See "C" See "E"
G	Reflex	Acme, Erla, etc., with crystal detector. Tuning equipment as in C, D, E or F.
	Radio Frequency Amplifiers with Detector	
H	One to three stages tuned radio frequency	Tuning equipment as in C to F, or special with amplifier as in Radiodyne, Neutrodyne, Balentine, XYZ. Cabot, etc.
I	One to three stages transformer-coupled radio frequency	Acme, Erla, Amrad, Federal, composite and others.
J	Magnetically neutralized tuned radio frequency amplifier	Superdyne, home-made variations.
	Audio Frequency Amplifiers	
K	One to three stages transformer coupled audio frequency	Standard circuits used in general practice.
L	One to three stages choke coil coupled audio frequency (Resistance coupled amplifiers behave very nearly the same)	Not generally used.
	Reflex, Multistage	
M	Several stages of combined radio and audio frequency amplification using the same tubes for both	Acme, DeForest, Erla, Fada Neutrodyne, etc. Tuning equipment as in C to F.
	Super Heterodyne	
	Composite	Tuning equipment as in C to F; radio frequency amplifier as in H, I or J; audio frequency amplifier as in K.

TROUBLE SHOOTING CHART

TROUBLE	NO SIGNALS											FRYING, CLICKING NOISES	SCRATCHY SIGNALS		MUFFLED SIGNALS		LOW HUMMING		BROAD TUNING	SQUEALS, HOWLS, TOO MUCH REGENERATION		WEAK SIGNALS, NO "	NO AMPLIFICATION	MARKED DISTORTION	LOUD CONTINUOUS HOWLING		SIGNALS, TUBE OUT OF SOCKET	BODY CAPACITY	DOES NOT TUNE TO LONG WAVES		DOES NOT TUNE TO SHORT WAVES		DOES NOT REFLEX	TUBE DOES NOT LIGHT	FADING, CAUSE IN SET
TYPE OF RECEIVER	A	B	C D F	E	G	H	I M	J	K M	L	M	ALL TYPES	A B	C D E F G H I J K L M	A B K	C D E F G H I J K L M	A B	C D E F G H I J K L M	ALL TYPES	C D E F G	H I J M	C D E F G	H I J K L	ALL TYPES	C D E F G M	H I J K L	G H I J M	C D E F G H I J K M	A C D F G	B E H I J M	A C D F G	B E H I J M	G M	C D E F G H I J K L M	ALL TYPES
CAUSE																																			
A DEFECTIVE:																																			
1 Aerial; Aerial connections	P	P	P	P	P												P		8										X	X	X	X			P
2 Ground, ground connections	P	P	P	P	P												3	8	8										X	X	X	X			P
3 Inductance coils	3	3	2	2	2	P						X	X				8	6	4			P							X	X	X	X			X
4 Sliders or switches	4	4	3	3	3							X	X				4	4	4			P							X	X	X	X			P
5 Primary condenser	4	4	4	4	4								X						3			X							X	X	X	X			X
6 Secondary condenser	P	5	P	5	5	P		X					X						6			P	P	X	X				X	X	X	X			X
7 Grid variometer			7	5								X		X				8	6			P		X	X	X			X	X	X	X			8
8 Crystal	P	P			P		P				P	X	2	3	3	8	P	P	3			X	X	4		P							2		
9 Grid leak			P	P		X	X	P		3	8	4		8		3		6	4	7		P	X	P	3	P							X		
10 Grid Condenser			P	P		X	9	8		3	8	4		8		2		7	4	8		P		P	3	P							X		
11 Socket connections			6	6	8	P	P	P	8	8	7	5		X				7	P	P		8	9				P						2	3	
12 Filament lighting contacts on first jack.			P	P	P	X		X	3														X										2	3	P
13 Filament rheostat			P	P	P	P	P	P	8	8	8	X																					P	P	1
14 "A" battery			P	P	P	P	P	P	8	9	P	X										X	X										P	4	X
15 Vacuum tube			X	X	X	X	X	P	P	P	P	P		8		7		P	P	P		8	X	X									P	3	X
16 Phone condenser	5	5	P	P	P				P	P	P	8	4	4	2	2						4	X	X			X						3		P
17 Phones; phone cords	P	P	P	P	P				P	P	P	P	4	4	3	3						X	X	P											7
18 "B" battery			7	7	7	2	2	2	3	4	3	1		3		X						7	6	8	8	8	8						7		2
19 Potentiometer			P	P	P	2	1				P	P		3				X		X	3	P	5	8	3	4							P	X	9
20 Plate variometer			2	8								X										6					3								P
21 Radio frequency transformer					X	P	8	3			P	X		8				X	X				5	X	X	P							X		
22 Audio frequency transformer					X	P			P		P	X		5		X		8					5	7	X	P							X		
23 Choke coil						X				3								8					5	X											
24 First jack	P	P	P	P	P			X	8		X		X	X			X		3			X	X										X	P	
25 Second jack									8					X									X										X	P	
26 Third jack									8					X									X											P	
27 "C" battery									8			2		3		5							7	5	7	7									X
28 Insulation	X	X	X	X	X	P	X	6	X	X	X	3	X	X				X	7	X	X	X	X	X									X		P
B OPEN CIRCUIT IN																																			
1 Antenna or ground circuits	P	P	P	P	P								X	X			3	8	X										X	X	X	X			
2 Primary coil	2	2	2	2	2								X	X			4	8																	
3 Primary condenser	3	3	4	4	4								X	X			X	P	X																
4 Secondary coil		3	P	2	2			7					X	X			4	6				4													
5 Secondary condenser	P	5	P	5	5			P					X	X								P													
6 Grid leak resistance			P	P	P	X					X			X				7		1	P	X			4										
7 Grid condenser			P	P	P	X						P		P				7		X	P	X													
8 Socket contacts			6	8	8	P	P	9	8	8	7	P		P				8		X	P	5	P										2	3	
9 Filament rheostat			P	P		X	P	P	8	8	8	P											X										3	3	
10 "A" battery connections			P	P	P	X	P	P	8	8	7												X											2	
11 First jack	P	P	P	P	P	P			8	P		X	X	X			X					X	X										X	P	
12 Second jack									8	P				X									X											P	
13 Third jack									8	P				X									X											P	
14 Plate circuit			2	8	7	P	P	8	6	5	P			X								9	8												
15 Tickler coil			2	8										X								6													
16 Radio Frequency transformer					X	P	8	8			P	X		X				X					9	P		P	P						P		
17 Audio frequency transformer					X				P		P	X		X				X					9	P		P	P						P		
18 Choke coil						X				3		X						X				X	9												
19 "B" battery connections			7	7	7	6	2	6	5	4	4			X								3	7										X		
20Between plug and jack	P	P	P	P	P	P	P	P	P	P	P		P	P			X					X	6										X		
C SHORT CIRCUIT IN																																			
1 Antenna (to ground)	P	P	P	P	P																	P													
2 Antenna coil	2	3		2	2														4			P													
3 Antenna condenser	4	4	2	4	2								X	X								X													
4 Primary coil	2	3	2	2	2									X					4			8		X											
5 Secondary coil		3	P	2	3	8		6						X					3			3		X											
6 Secondary condenser	P	5	P	5	3	P		X						X									P												
7 Between elements of tubes			X	X	X	X	X	X	X	X	X								X			X	X										X	X	
8 Between springs of socket			X	X	X	X	X	X	X	X	X								X			X	X										X	X	
9 Tickler coil			2	2																		3													
10 Feed back condenser			2	2																		X													
11 Phone condenser	5	6	P	P	P	X	X	P	X	X	X	4	X									7											X		
12 Phones; phone cords	P	P	P	P	P	P	P	P	P	P	P	X	X																				X		
13 First jack	P	P	P	P	P	X	X	X	8	8	X	X	X									X	X											P	
14 Second jack									8	8													X											P	
15 Third jack									8	8													X											P	
16 Wiring	X	X	8	9	9	3	9	9	P	P	P	X	X	X					X			X	9	X										8	
17 Wiring to shield	X	X	X	X	X	X	9	X	P	X	X								X			X	9												
18 Apparatus, to shield	X	X	X	X	X	X	9	X	X	X	X								X			X	X												
19 Wiring, to apparatus	X	X	X	X	X	X	X	X	X	X	X								X			X	X												
D REVERSED																																			
1 Primary condenser connections																		P										4							
2 Secondary condenser connections																		P	X									4							
3 Secondary coil connections						P	6											X	8			X	3												
4 "C" battery							P		6							X							9	6											
5 "A" battery			X	X	X	X	P	P	6	X	P			X		X						X	8	9									9		
6 "B" battery			7	7	1	2	8	3	4	4	7			X		X						8	9										4		
7 Tickler connections			1	1										X								2													
8 Compensator coil connections								5													P														
9 AFT secondary connections					3				3		3			8		X					2		6	8		X							2		
10 AFT primary connections					5				3		5			4		X					P		X	X		3							8		
E RUN DOWN																																			
1 "A" battery			P	P	P	X	P	P	8	6	7	5		P		X						P	X	X	X	X							8	5	P
2 "B" battery			P	P	P	P	P	3	7	4	5	1		2		P						4	P	P	P	P							2		2
3 "C" battery							9		6		P	1		3		P							P	5											P
F TOO LOW, OR TOO SMALL																																			
1 Antenna length	P	P	P	X	X																X								P	P					
2 Number of turns on primary coil	6	2	2	X	X														4		X								5	5					
3 Primary condenser	7	3	P	X	X														X										9	9					
4 Number of turns on secondary coil		3	2	X	X														X				P						5	5					
5 Secondary condenser		5	P	X	X														X		X								8	8					
6 Grid condenser										4				6				X						P			P								
7 Grid leak			P	P	P					4				6		1						8			7										
8 Grid variometer			P	P	X						X								6							X			8	8					
9 "A" battery voltage			P	P	P	X	P	P	P	8	P			X						9		X	P	X	P	P							4	7	P
10 "B" battery voltage			7	7	P	X	9	X	X	3	8			8								6	8	8									3		
11 Number of turns on tickler coil			2	P	X																	3							9	9					
12 Feed-back condenser			P	P																		3													
13 Plate variometer			P	P																		3							9	9					
14 Phone condenser					X						P		1	3								5		X											
15 Turns on compensator coil																					6					P									
16 Filament current			P	P	P	P	P	P	X	P	P			P								X	P	X	P	P							4	7	
G TOO HIGH, OR TOO LARGE																																			
1 Antenna length	P	P	P	X															3												3	3			
2 Number of turns on primary coil	8	2	2	X	X																										2	2			
3 Antenna condenser	8	3	P	X	X																										3	3			
4 Number of turns on secondary coil		3	2	X	X																X					P						3			
5 Secondary condenser.		5	P	X	X																											3			
6 Grid variometer			P	X																	X														
7 Grid leak			P	X												2		8		1	3			3	2										
8Grid condenser																3				P	4			X	X										
9 "A" battery voltage			P	P								P		X		X				P				P	X	7									
10 "B" battery voltage			X	X	X	P						8		P		6				7	1			2	3	2									
11 "C" battery voltage														2		X					2			1	X	2									
12 Number of turns on tickler coil																				1	1			X	4						P				
13 Feed-back condenser																				3	1			X	4						P				
14 Plate variometer																				3	2			X	4						P				
15 Number of turns on compensator coil								9																X							P				
16 Condenser across AFT secondary					P				P		3					1								8											
17 High ratio AFT											8			7		7								1											
18 Filament current			X	X				P			P	5		X		X					X			P	X										
19 Length of Grid leads						P	6				2			X		X		6	4	6	3		P	P	3	2									
20 Phone condenser															1	1				4	X		X	X									X		
H TOO CLOSE.																																			
1 Plate and grid leads						P	4	X			2			X		X		P	6	2	2		8	8	2	2					X	X			
2 Apparatus.						X	8				3			P		X			3	6	6		9	9	X	3					X	X			
3 AF tranformers									X		5			P		X					P		P	P		P									
4 RF transformers						P	7	X			5			X		X			3		P		P	P		P						P			
5 Coil and panel																			P									3							
6 Tickler and grid windings; (capacity feed-back between windings)								5												5	5											X			
I OUT OF ADJUSTMENT																																			
1 Receiver	1	1	1	1	P	1	2	1			3		3	3	5	4			5	X		4	4	X	P	P			3	3	3	3			
2 Crystal detector	1	1			P						5		2	2	2	2	8	P	P					X	P								3		
3 Telephone receivers	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X							X	6											
4 Neutralizing condensers						2															2			X		4	3								
5 Radio frequency transformers					X	2					X								5		3		X	X		4							X		
J INCORRECT																																			
1 Tap on secondary winding		X	P	X															X	X	X														
2 Grid return connection			P	X	P	3	5	5	3	X	4	X		4		4			5	6	7	9	3	2	P								6		
3 Number of turns on secondary of transformer					P		P				P								P		P	X								X		X			
4 "C" battery voltage							3							2		X					6		6	P		X									
5 Grid leak resistance			P	P				7			P			7		1				1	3			4	P										
6 Grid condenser capacity			X	X		5					P			6		2			P	5	4			4	P										
7 Wiring.	9	7	1	1	1	1	2	2	5	2	2	X	X	X				P	P	P	X	3	8				X	X						2	
K GENERAL																																			
1 Aerial near high voltage lines																	9	9																	
2 High resistance antenna or ground circuits												X	X	X					3										X	X	X	X			P
3 Outside sources; Static, X-rays arc-lights, grounds on power lines												1					8	8																	
4 Loose connections	3	3	3	3	3	4	5	5	6	4	4	1	X	X			X	X	X	X	X	P			8	X									3
5 Shield panel; connect shield to minus "A" and ground.																				X	X							X							
6 Rotary plates to ground or minus "A".																			X									X							
7 Loose connections on, or in, transformer									P		P	P		X						X	X		X			X									
8 Ground cores of AF transformers to minus "A" or plus "B"					X				X		X			X		X					X		X	X		X									
9 Use "C" battery							X		X		X												X	X											
10 Use ¼ or ½ megohm leak across AFT secondary														X										X											
11 Use leak on amplifier tubes										2				X										X											
12 Use power tube and high "B" voltage														X		X							X	X											
13 Use potentiometer						P	X				X			X						X	X			X	X	X									
14 Microphonic noises from tube												2																							
15 Noisy detector tube												2		P						1	1				X	X									
16 Receiver oscillating																																			
17 Interference between carrier waves of two transmitting radiophone stations													X	X	X	X				2 2	2 2				X X	X X									
18 Radiation from nearby receivers																				X	X				X	X									
19 Clocking at audio frequency																					X			X	X	X									
20 AF oscillations in amplifier																																			
21 Mechanical coupling between phones and loud speaker																				X	X				X	X									
22 Leakage in apparatus			X	X	X	8	6			X	X	3	X	X	X		X		6			P	P	X											9
23 Use loose coupled receiver or wave-trap																			X																
24 Filaments burned out			X	X	X	X	X	X	X	X	X																								
25 Shielded by steel in building or surroundings			P																							X									
26 Put transformers at rightangles																																			

TABLE OF RECEIVERS

Code Letter	General Type	Popular Name
	Crystal Receivers	
A	Direct Coupled	One, two or three slide tuners, variometers, with crystal detector.
B	Loose Coupled	Loose couplers, variocouplers with crystal detector.
	Single Tube Receivers	
C	Direct Coupled	One, two or three slide tuners, "single circuit," Green circuit, Westinghouse RC, Aeriola, Maclite, AceV, Jacobs, two-coil honey-comb and spider-web sets, and variations.
D	Semi-tuned, directly coupled, or closely coupled	Haynes, Reinartz, Sodion DR6, Tuning equipment of Radiodyne, Superdyne, etc., and variations.
E	Loose Coupled	"Two circuit" non-regenerative; "three-circuit" regenerative; ultra-audion, four circuit, Zenith, Federal, Amrad, Sodion DR9, Variocoupler-two-variometer, Variocoupler-condenser-variometer; three coil honey-comb or spider-web sets, and variations.
F	Loop Receivers Direct Coupled Loose Coupled	 See "C" See "E"
G	Reflex	Acme, Erla, etc., with crystal detector. Tuning equipment as in C, D, E or F.
	Radio Frequency Amplifiers with Detector	
H	One to three stages tuned radio frequency	Tuning equipment as in C to F, or special with amplifier as in Radiodyne, Neutrodyne, Balentine, XYZ, Cabot, etc.
I	One to three stages transformer-coupled radio frequency	Acme, Erla, Amrad, Federal, composite and others.
J	Magnetically neutralized tuned radio frequency amplifier	Superdyne, home-made variations.
	Audio Frequency Amplifiers	
K	One to three stages transformer coupled audio frequency	Standard circuits used in general practice.
L	One to three stages choke coil coupled audio frequency (Resistance coupled amplifiers behave very nearly the same)	Not generally used.
	Reflex, Multistage	
M	Several stages of combined radio and audio frequency amplification using the same tubes for both	Acme, DeForest, Erla, Fada Neutrodyne, etc. Tuning equipment as in C to F.
	Super Heterodyne	
	Composite	Tuning equipment as in C to F; radio frequency amplifier as in H, I or J; audio frequency amplifier as in K.