January 15, 1925
15 Cents a Copy

# RADIO PROGRESS



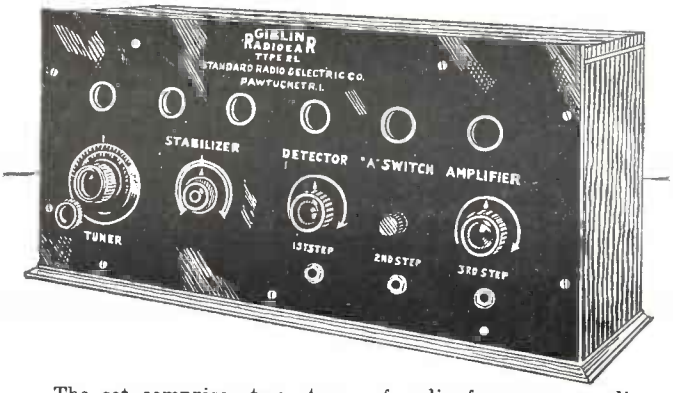
"Always Abreast of the Times"


PUBLISHED TWICE A MONTH

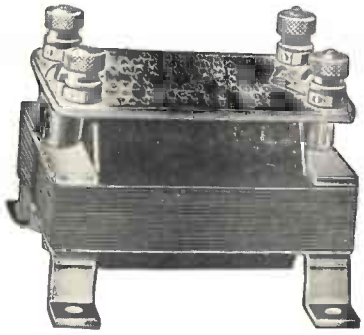
# GIBLIN
## RADIO APPARATUS

# The Giblin Broadcast Receiver

THE Giblin Radio Frequency Broadcast Receiver makes it possible to obtain radio entertainment without the necessity of erecting outside antenna wires or using a troublesome ground wire. A small, loop aerial placed near the set will pick up signals, which, though they have come long distances, and are weakened by hills, valleys, trees and buildings, will be clear and of great volume. Many families, living in apartments where it is undesirable or impossible to erect antenna wires, can now hear enjoyable, ever-changing programs through the day and evening by "listening-in" with a Giblin Radio Frequency Broadcast Receiver.




The set comprises two stages of radio frequency amplification, a detector and three stages of audio frequency amplification. The parts are mounted on a sub-base to which a Bakelite panel is attached. It is enclosed in a handsome solid mahogany cabinet.



**The Giblin Audio-Frequency Amplifying Transformer**
**Price $4.50**


**The Giblin Radio-Frequency Amplifying Transformer**
**Price $5.00**

## Buy Giblin Products from your dealer

*Write for descriptive circulars*

## STANDARD RADIO & ELECTRIC CO.
PAWTUCKET, RHODE ISLAND

## UNITED STATES BROADCASTING STATIONS ARRANGED ALPHABETICALLY BY CALL LETTERS

Abbreviations: W.L., wave length in meters; K.C., frequencies in kilocycles; W.P., wattpower of station.

| | W.L. | K.C. | W.P. |
|---|---|---|---|
| KDKA—Westinghouse Elec. & Mfg. Co., East Pittsburgh | 326- | 920- | 1000 |
| KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, O. | 270-1110- | | 500 |
| KDPT—Southern Electrical Co., San Diego, Cal. | 244-1230- | | 100 |
| KDYL—Salt Lake Telegram, Salt Lake City, Utah | 360- | 833- | 100 |
| KDYM—Savoy Theatre, San Diego, Cal. | 280-1070- | | 100 |
| KDYQ—Oregon Institute of Technology, Portland, Ore. | 360- | 834- | 100 |
| KDZB—Frank E. Seifert, Bakersfield, Cal. | 240-1250- | | 100 |
| KDZE—The Rhodes Co., Seattle, Wash. | 270-1110- | | 100 |
| KDZF—Auto. Club of So. Cal., Los Angeles, Cal. | 278-1080- | | 500 |
| KFAB—Buick Auto Co., Lincoln, Neb. | 240-1250- | | 200 |
| KFAD—McArthur Bros. Mercantile Co., Phoenix, Ariz. | 360- | 908- | 100 |
| KFAE—State College of Washington, Pullman, Wash. | 330- | 910- | 500 |
| KFAF—Western Radio Corp., Denver, Col. | 360- | 833- | 500 |
| KFAJ—University of Colorado, Boulder, Col. | 360- | 833- | 100 |
| KFAQ—City of San Jose, San Jose, Cal. | 360- | 833- | 250 |
| KFAR—Studio Lighting Service Co., Hollywood, Cal. | 227-1320- | | 100 |
| KFAU—Boise High School, Boise, Idaho | 270-1110- | | 150 |
| KFBB—F. A. Buttrey & Co., Havre, Mont. | 275-1090- | | 100 |
| KFBG—Search Light Publishing Co., Fort Worth, Tex. | 254-1180- | | 100 |
| KFBK—Kimball-Upson Co., Sacramento, Cal. | 283-1060- | | 100 |
| KFCF—Frank A. Moore, Walla Walla, Wash. | 360- | 833- | 100 |
| KFCL—Los Angeles Union Stockyards, Los Angeles, Cal. | 236-1270- | | 500 |
| KFCM—Richmond Radio Shop, Richmond, Cal. | 244-1220- | | 100 |
| KFCZ—Omaha Central High School, Omaha, Neb. | 259-1160- | | 100 |
| KFDH—University of Arizona, Tucson, Ariz. | 268-1120- | | 150 |
| KFDM—Magnolia Petroleum Co., Beaumont, Texas | 306- | 980- | 500 |
| KFDX—Frst Baptist Church, Shreveport, La. | 250-1200- | | 100 |
| KFDY—So. Dakota State College, Brookings, So. Dakota | 273-1100- | | 100 |
| KFEL—Winner Radio Corp., Denver, Col. | 254-1180- | | 100 |
| KFEQ—J. L. Scroggin, Oak, Neb. | 268-1120- | | 100 |
| KFEX—Augsburg Seminary, Minneapolis, Minn. | 261-1150- | | 100 |
| KFFV—Graceland College, Lamoni, Iowa | 360- | 834- | 100 |
| KFFY—Louisiana College, Alexandria, La. | 275-1090- | | 100 |
| KFGC—Louisiana State University, Baton Rouge, La. | 254-1180- | | 100 |
| KFGD—Chickasha Radio & Elec. Co. | 248-1195- | | 200 |
| KFGH—Leland Stanford Jr. Univ., Stanford Univ., Cal. | 273-1100- | | 250 |
| KFGJ—Mo. Natl. Guard, 138th Infantry, St. Louis, Mo. | 265-1130- | | 100 |
| KFGX—First Presbyterian Church, Orange, Tex. | 250-1200- | | 50C |
| KFGZ—Emmanuel Missionary Col., Berrien Springs, Mich. | 268-1120- | | 500 |
| KFHD—Utz Elec. Shop Co., St. Joseph, Mo. | 226-1365- | | 100 |
| KFHJ—Fallon & Co., Santa Barbara, Cal. | 360- | 833- | 100 |
| KFHR—Star Elec. & Radio Co., Seattle, Wash. | 263-1140- | | 100 |
| KFI—Earle C. Anthony, Inc., Los Angeles, Cal. | 469- | 640- | 1500 |
| KFIF—Benson Polytechnic Institute, Portland, Ore. | 360- | 833- | 100 |
| KFIX—R. C., Jesus Christ of L. D.Stas., Ind'p'nd'n'e,Mo. | 268-1120- | | 250 |
| KFIZ—D'ly C'm'nw'h & S. Radio C'p., Fond d'L'c, Wis. | 273-1100- | | 100 |
| KFJC—Seattle Post Intellegencer, Seattle, Wash. | 270-1110- | | 100 |
| KFJF—National Radio Mfg. Co., Oklahoma, Okla. | 261-1150- | | 225 |
| KFJK—Delano Radio & Electric Co., Bristow, Okla. | 233-1290- | | 100 |
| KFJM—University of N. Dakota, Grand Forks, N. Dak. | 280-1070- | | 100 |
| KFKB—Brinkley-Jones Hospital Assn., Milford, Kans. | 286-1070- | | 500 |
| KFKQ—Conway Radio Laboratories, Conway, Ark. | 250-1200- | | 100 |
| KFKX—Westinghouse Elec. & Mfg. Co., Hastings, Neb. | 285- | 880- | 1000 |
| KFLE—National Education Service, Denver, Col. | 268-1110- | | 100 |
| KFLR—Korber Wirelss Station, Albuquerque, N. Mexico. | 254-1180- | | 100 |
| KFLZ—Atlantic Automobile Club, Atlantic, Ia. | 273-1098- | | 100 |
| KFLV—Swedish Evang. Mission Church, Rockford, Ill. | 229-1310- | | 100 |
| KFMQ—Univ. of Arkansas, Fayetteville, Ark. | 263-1140- | | 100 |
| KFMX—Carleton College, Northfield, Minn. | 283-1071- | | 500 |
| KFNF—Henry Field Seed Co., Shenandoah, Iowa | 266-1145- | | 500 |
| KFOA—The Rhodes Co., Seattle, Wash. | 454- | 660- | 500 |
| KFOC—First Christian Church, Whittier, Cal. | 236-1290- | | 100 |
| KFON—Echophone Radio Shop, Long Beach, Cal. | 234-1290- | | 100 |
| KFOU—Hommel Mfg. Co., Richmond, Cal. | 254-1180- | | 100 |
| KFOX—Technical High School, Omaha, Neb. | 248-1210- | | 100 |
| KFOZ—Taft Radio Co., Hollywood, Cal. | 240-1250- | | 250 |
| KFPG—Garretson & Dennis, Los Angeles, Cal. | 238-1260- | | 100 |
| KFPL—C. C. Baxter, Dublin, Texas | 252-1190- | | 100 |
| KFPO—Colorado Nat'l Guard, Denver, Col. | 231-1300- | | 500 |
| KFPR—L. A. County Forestry Dept., Los Angeles, Cal. | 231-1300- | | 500 |
| KFPT—The Deseret News, Salt Lake City, Utah | 360- | 833- | 500 |
| KFPX—First Presbyterian Church, Pine Bluff, Ark. | 242-1240- | | 100 |
| KFPY—Symons Investment Co., Spokane, Wash. | 283-1060- | | 100 |
| KFQC—Kidd Brothers Radio Shop, Taft, Cal. | 227-1320- | | 100 |
| KFQD—Chovin Supply Co., Anchorage, Alaska | 280-1070- | | 100 |
| KFQG—Southern Cal. Radio Assn., Los Angeles, Cal. | 226-1330- | | 100 |
| KFQI—Thomas H. Ince Corp., Culver City, Cal. | 234-1280- | | 100 |
| KFQM—Texas Highway Bulletin, Austin, Texas | 268-1120- | | 100 |
| KFQU—W. Riker, Holy City, Cal. | 234-1280- | | 100 |
| KFQV—Omaha Grain Exchange, Omaha, Neb. | 231-1300- | | 100 |
| KFQX—Alfred M. Hubbard, Seattle, Wash. | 233-1290- | | 500 |
| KFRA—Marvin S. Olsen, Carver, Minn. | 240-1250- | | 100 |
| KFRB—Hall Brothers, Beeville, Texas | 248-1210- | | 250 |
| KFRN—United Churches of Olympia, Olympia, Wash. | 220-1360- | | 100 |
| KFSG—Echo Park Evangelistic Ass'n, Los Angeles, Cal. | 278-1069- | | 500 |
| KGO—General Electric Co., Oakland, Cal. | 312- | 960- | 1000 |
| KGU—Marion A. Mulreny, Honolulu, Hawaii | 360- | 833- | 500 |
| KGW—Portland Morning Oregonian, Portland, Ore. | 492- | 610- | 500 |
| KHJ—Times-Mirror Co., Los Angeles, Cal. | 395- | 760- | 500 |
| KHQ—Louis Wasmer, Seattle, Wash. | 360- | 833- | 100 |
| KJR—Northwest Radio Service Co., Seattle, Wash. | 270-1110- | | 100 |
| KJS—Bible Institute of Los Angeles, Los Angeles, Cal. | 360- | 833- | 750 |
| KLS—Warner Brothers, Oakland, Cal. | 360- | 833- | 250 |
| KLX—Tribune Publishing Co., Oakland, Cal. | 508- | 590- | 500 |
| KLZ—Reynolds Radio Co., Denver, Col. | 283-1060- | | 500 |
| KNT—Grays Harbor Radio Co., Aberdeen, Wash. | 263-1140- | | 250 |
| KNV—Radio Supply Co., Los Angeles, Cal. | 256-1188- | | 100 |
| KNX—Los Angeles Express, Los Angeles, Cal. | 337- | 890- | 500 |
| KOA—General Electric Co., Denver, Col. | 323- | 930- | 1500 |
| KOB—N. M. C. of Agri. & Mech. Arts, State Col., N. M. | 360- | 833- | 500 |
| KOP—Detroit Police Dept., Detroit, Mich. | 286-1050- | | 500 |
| KPO—Hale Bros., San Francisco, Cal. | 422- | 710- | 500 |
| KQV—Doubleday-Hill Electric Co., Pittsburgh, Pa. | 275-1090- | | 500 |
| KSD—Post Dispatch, St. Louis, Mo. | 545- | 550- | 500 |
| KTHS—New Arlington Hotel, Hot Springs, Ark. | 375- | ....- | 500 |
| KTW—First Presbyterian Church, Seattle, Wash. | 360- | 833- | 750 |
| KUO—Examiner Printing Co., San Francisco, Cal. | 360- | 833- | 150 |
| KUS—City Dye Works & Laundry Co., L. Angeles, Cal. | 360- | 833- | 100 |
| KUVQ—Kreetan Co., Johnswood Drummond Island, Mich. | 450- | 666- | 1000 |
| KWG—Portable Wireless Tel. Co., Stockton, Cal. | 360- | 833- | 100 |
| KWH—Los Angeles Examiner, Los Angeles, Cal. | 360- | 833- | 500 |
| KYQ—Electric Shop, Honolulu, Hawaii | 270-1110- | | 100 |
| KYW—Westinghouse Elec. & Mfg. Co., Chicago, Ill. | 535- | 560- | 1500 |
| KZM—Western Radio Institute, Oakland, Cal. | 360- | 833- | 100 |
| KZKZ—Electrical Supply Co., Manila, P. I. | 270-1110- | | 100 |
| KZN—The Desert News, Salt Lake City, Utah | 360- | 834- | 500 |
| WAAB—Valdemar Jensen, New Orleans, La. | 268-1120- | | 100 |
| WAAC—Tulane University, New Orleans, La. | 360- | 833- | 400 |
| WAAF—Chicago Daily, Drovers Journal, Chicago, Ill. | 278-1080- | | 200 |
| WAAM—I. R. Nelson Co., Newark, N. J. | 263-1140- | | 250 |
| WAAW—Omaha Grain Exchange, Omaha, Neb. | 286-1050- | | 500 |
| WAAZ—Hollister-Miller Motor Co., Emporia, Kans. | 360- | 833- | 100 |
| WABE—Y. M. C. A., Washington, D. C. | 283-1060- | | 100 |
| WABI—Bangor Ry. & Elec. Co., Bangor, Me. | 240-1250- | | 100 |
| WABL—Conn. Agri. College, Storrs, Conn. | 283-1060- | | 100 |
| WABM—F. E. Doherty Auto. & R'dio Co., Saginaw, M. | 254-1180- | | 100 |
| WABP—Robert F. Weinig, Dover, Ohio | 265-1130- | | 100 |
| WABT—Holliday-Hall Elec. Engineers, Washington, Pa. | 252-1190- | | 100 |
| WABU—Victor Talking Machine Co., Camden, N. J. | 225-1330- | | 100 |
| WABX—Henry B. Joy, Mount Clemens, Mich. | 270-1110- | | 150 |
| WAHG—A. H. Grebe & Co., Richmond Hill, N. Y. | 316- | 950- | 500 |
| WBAA—Purdue University, West Lafayette, Ind. | 283-1060- | | 250 |
| WBAD—Sterling Electric Co., Minneapolis, Minn. | 360- | 833- | 100 |
| WBAK—Penn. State Dept. of Police, Harrisburg, Pa. | 400- | 750- | 500 |
| WBAN—Wireless Phone Corp., Paterson, N. J. | 244-1230- | | 100 |
| WBAP—Wortham-Carter Pub. Co., Fort Worth, Tex. | 476- | 630- | 1000 |
| WBAV—Erner & Hopkins Co., Columbus, Ohio. | 390- | 770- | 500 |
| WBAW—Marietta College, Marietta, Ohio. | 246-1220- | | 250 |
| WBAX—John H. Stenger, Jr., Wilkes-Barre, Pa. | 254-1180- | | 100 |
| WBAY—American Tel. & Tel. Co., New York, N. Y. | 492- | 610- | 500 |
| WBBF—Georgia School of Technology, Atlanta, Ga. | 270-1110- | | 500 |
| WBBG—Irving Vermilya, Mattapoisett, Mass. | 248-1210- | | 500 |
| WBBL—Grace Covenant Church, Richmond, Va. | 283-1060- | | 100 |
| WBBM—H. Leslie Atlass, Chicago, Ill. | 226-1330- | | 200 |
| WBBR—Peoples' Pulpit Ass'n, Roseville, N. Y. | 244-1230- | | 100 |
| WBL—T. & H. Radio Co., Anthony, Kansas. | 254-1180- | | 100 |
| WBN—Ott Radio, Inc., La Crosse, Wis. | 244-1230- | | 500 |
| WBR—Penn. State Police, Butler, Pa. | 286-1050- | | 250 |
| WBS—D. W. May, Inc., Newark, N. J. | 360- | 833- | 100 |
| WBT—Southern Radio Corp., Charlotte, N. C. | 360- | 833- | 500 |
| WBU—City of Chicago, Chicago, Ill. | 286-1050- | | 500 |
| WBZ—Westinghouse Elec. & Mfg. Co., Springfield, Mass. | 337- | 890- | 1500 |
| WCAD—St. Lawrence University, Canton, N. Y. | 263-1140- | | 250 |
| WCAE—Kaufmann & Baer Co., Pittsburgh, Pa. | 461- | 650- | 500 |
| WCAH—Entrekin Electric Co., Columbus, Ohio. | 286-1050- | | 100 |
| WCAJ—Nebraska Wesleyan Univ., Univ. Place, Neb. | 280-1070- | | 500 |
| WCAL—St. Olaf College, Northfield, Minn. | 360- | 833- | 500 |
| WCAP—Chesapeake & Potomac Tel. Co., Washingt'n, D. C. | 469- | 640- | 500 |
| WCAR—Alamo Radio Elec. Co., San Antonio, Texas | 360- | 833- | 100 |
| WCAS—W. H. Dunwoody Ind. Inst., Minneapolis, Minn. | 280-1220- | | 100 |
| WCAT—S. Dakota State Sch. of Mines, Rapid City, S. D. | 240-1250- | | 100 |
| WCAU—Durham & Co., Philadelphia, Pa. | 278-1080- | | 500 |
| WCAX—Univ. of Vermont, Burlington, Vt. | 360- | 834- | 100 |
| WCAY—Milwaukee Civic Broad. Assn., Milwaukee, Wis. | 266-1130- | | 250 |
| WCBC—Univ. of Michigan, Ann Arbor, Mich. | 229-1310- | | 200 |
| WCBD—Wilbur G. Voliva, Zion, Ill. | 345- | 870- | 500 |
| WCBI—Nicoll, Duncan & Rush, Bemis, Texas | 226-1330- | | 100 |
| WCBN—Chicago, Ill. | 266- | ....- | 500 |
| WCBQ—First Baptist Church, Nashville, Tenn. | 236-1270- | | 100 |
| WCBT—Clark University, Worcester, Mass. | 238-1260- | | 250 |
| WCCO—Washburn-Crosby Co., Minneapolis, Minn. | 417- | 720- | 500 |
| WCK—Stix, Baer & Fuller Dry Goods Co., St. Louis, Mo. | 360- | 833- | 100 |
| WCX—Detroit Free Press, Detroit, Mich. | 517- | 580- | 500 |
| WCKB—E. Richard Hall, St. Petersburg, Fla. | 266-1130- | | 500 |
| WCM—Texas Mkts. & Warehouse, Dept., Austin, Tex. | 268-1120- | | 250 |
| WDAE—Tampa Daily Times, Tampa, Fla. | 273-1100- | | 250 |
| WDAF—Kansas City Star, Kansas City, Mo. | 411- | 730- | 500 |
| WDAG—J. Laurance Martin, Amarillo, Texas | 263-1140- | | 100 |
| WDAH—Trinity Methodist Church, El Paso, Texas | 268-1120- | | 100 |
| WDAR—Lit Brothers, Philadelphia, Pa. | 395- | 760- | 500 |
| WDAU—Slocum & Kilburn, New Bedford, Mass. | 360- | 833- | 100 |
| WDAX—First National Bank, Centerville, Iowa | 360- | 833- | 100 |
| WDBH—C. T. Sherer, Co., Worcester, Mass. | 268-1120- | | 100 |
| WDBR—Tremont Temple Baptist Church, Boston, Mass. | 256-1170- | | 100 |
| WDBY—North Shore Cong. Church, Chicago, Ill. | 258-1160- | | 500 |
| WDWF—D. W. Flint, Providence, R. I. | 286-1050- | | 500 |
| WEAA—Frank D. Fallon, Flint, Mich. | 234-1280- | | 100 |
| WEAF—Amer. Tel. & Tel. Co., New York, N. Y. | 492- | 610- | 1500 |

| | W.L. | K.C. | W.P. |
|---|---|---|---|
| WEAH—Wichita Board of Trade, Wichita, Kas | 280 | 1070 | 100 |
| WEAI—Cornell University, Ithaca, N. Y | 286 | 1050 | 500 |
| WEAJ—Univ. of S. Dakota, Vermillion, S. Dakota | 283 | 1060 | 100 |
| WEAM—Borough of N. Plainfield, N. Plainfield, N. J | 261 | 1150 | 250 |
| WEAN—Shepard Co., Providence, R. I | 273 | 1100 | 100 |
| WEAO—Ohio State University, Columbus, Ohio | 360 | 834 | 500 |
| WEAP—Mobile Radio Co., Mobile Ala | 263 | 1140 | 100 |
| WEAS—Hecht Co., Washington, D. C | 360 | 833 | 100 |
| WEAU—Davidson Bros. Co., Sioux City, Iowa | 275 | 1090 | 100 |
| WEAY—Iris Theatre, Houston, Texas | 360 | 833 | 500 |
| WEB—Benson Radio Co., St. Louis, Mo | 273 | 1130 | 500 |
| WEBH—Edgewater Beach Hotel Co., Chicago, Ill | 370 | 810 | 1000 |
| WEBJ—Third Avenue Ry. Co., New York, N. Y | 273 | 1100 | 500 |
| WEBL—R. C. A. United States (portable) | 226 | 1330 | 100 |
| WEBW—Beloit College, Beloit, Wis | 268 | 1120 | 500 |
| WEEI—Edison Elec. Ill'm'n't'g Co., Boston, Mass | 303 | 990 | 500 |
| WEV—Hurlburt-Still Electric Co., Houston, Texas | 263 | 1140 | 100 |
| WEW—St. Louis University, St. Louis, Mo | 280 | 1070 | 100 |
| WFAA—Dallas News & Dallas Journal, Dallas, Tex | 476 | 630 | 500 |
| WFAB—Carl F. Woese, Syracuse, N. Y | 234 | 1280 | 100 |
| WFAN—Hutchinson. Elec. Serv. Co., Hutchinson, Minn | 286 | 1050 | 100 |
| WFAV—Univ. of Nebraska, Dept. of E. Eng., Lincoln, Neb | 261 | 1250 | 250 |
| WFBB—Eureka College, Eureka, Ill | 261 | 1250 | 150 |
| WFBG—William F. Gable Co., Altoona, Pa | 261 | 1150 | 100 |
| WFBH—Concourse Radio Corp., New York, N. Y | 273 | 1100 | 500 |
| WFBI—Galvin Radio Supply Co., Camden, N J | 236 | 1270 | 100 |
| WFBK—Dartmouth College, Hanover, N. H | 256 | 1170 | 100 |
| WFBL—Onondaga Hotel, Syracuse, N. Y | 286 | 1050 | 100 |
| WFBM—Merchants Heat & Light Co., Indianapolis, Ind | 268 | 1120 | 250 |
| WFBN—Radio Sales & Service Co., Bridgewater, Mass | 226 | 1330 | 200 |
| WFBR—5th Infantry, Maryland, N. G., Baltimore. Md | 254 | 1180 | 100 |
| WFBW—Ainsworth-Gates Radio Co., Cincinnati, Ohio | 309 | 970 | 750 |
| WFI—Strawbridge & Clothier, Philadelphia, Pa | 395 | 760 | 500 |
| WGAQ—Youree Hotel, 406 Market St., Shreveport, La | 263 | 1140 | 100 |
| WGAY—Northwestern Radio Co., Madison, Wis | 360 | 833 | 100 |
| WGAZ—South Bend Tribune, South Bend, Ind | 275 | 1090 | 250 |
| WGBS—Gimbel Brothers, New York, N. Y | 316 | 950 | 1000 |
| WGI—Am. R'dio & Res'ch Corp., Medf'd Hillside, Mass | 360 | 833 | 100 |
| WGL—Thomas F. J. Rowlett, Philadelphia, Pa | 360 | 833 | 500 |
| WGN—Drake Hotel (Whitestone Co.), Chicago. Ill | 370 | 710 | 1000 |
| WGR—Federal Manufacturing Co., Buffalo. N. Y | 319 | 940 | 750 |
| WGY—General Electric Co., Schenectady, N. Y | 380 | 790 | 1000 |
| WHA—University of Wisconsin, Madison, Wis | 275 | 1090 | 500 |
| WHAA—State Univ. of Iowa, Iowa City, Iowa | 484 | 620 | 500 |
| WHAD—Marquette University, Milwaukee, Wis | 280 | 1070 | 100 |
| WHAG—University of Cincinnati, Ohio | 233 | 1290 | 100 |
| WHAM—University of Rochester, Rochester, N. Y | 283 | 1060 | 100 |
| WHAR—Seaside Hotel, Atlantic City, N. J | 275 | 1090 | 200 |
| WHAS—Courier-Journal & Louisville Times, Louisville, Ky | 400 | 750 | 500 |
| WHAV—Wilmington Elec. Spec. Co., Wilmington, Del | 266 | 1130 | 100 |
| WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y | 380 | 790 | 500 |
| WHB—Sweeney School Co., Kansas City, Mo | 411 | 730 | 500 |
| WHK—Radiovex Co., Cleveland, Ohio | 283 | 1060 | 100 |
| WHN—Loew's State Theatre Bldg., New York, N. Y | 360 | 833 | 500 |
| WHO—Bankers Life Co., Des Moines, Iowa | 526 | 570 | 500 |
| WHQ—E. M. Tellefson, Mackinac Island, Mich | 300 | 999 | 200 |
| WIAC—Galveston Tribune, Galveston, Texas | 360 | 833 | 100 |
| WIAD—Howard R. Miller, Philadelphia, Pa | 234 | 1180 | 100 |
| WIAK—Journal-Stockman Co., Omaha, Neb | 278 | 1080 | 250 |
| WIAR—Paducah Evening Sun, Paducah, Ky | 360 | 833 | 100 |
| WIAS—Home Electric Co., Burlington, Iowa | 283 | 1060 | 100 |
| WIK—K. L. Electric Co., McKeesport, Pa | 234 | 1280 | 100 |
| WIP—Gimbel Brothers, Philadelphia, Pa | 508 | 590 | 500 |
| WJAB—American Electric Co., Lincoln, Neb | 229 | 1310 | 100 |
| WJAD—Jackson's Radio Eng. Laboratories, Waco, Tex | 360 | 833 | 150 |
| WJAG—Norfolk Daily News, Norfolk, Neb | 283 | 1060 | 250 |
| WJAN—Peoria Star, Peoria. Ill | 280 | 1070 | 100 |
| WJAR—The Outlet Co., Providence, R. I | 360 | 833 | 500 |
| WJAS—Pittsburgh Radio Supply House, Pittsburgh, Pa | 286 | 1050 | 500 |
| WJAX—Union Trust Co., Cleveland, Ohio | 390 | 770 | 500 |
| WJAZ—Zenith Radio Corp., Chicago, Ill. (portable) | 268 | 1120 | 100 |
| WJH—Wm. P. Boyer Co., Washington, D. C | 273 | 1100 | 100 |
| WJJD—Supreme Lodge Moose, Mooseheart, Ill | 278 | 1080 | 500 |
| WJY—R. C. A., New York, N. Y | 405 | 660 | 500 |
| WJZ—Broadcast Central, New York, N. Y | 454 | 660 | 500 |
| WKAA—H. F. Parr, Cedar Rapids. Iowa | 278 | 1080 | 100 |
| WKAF—W. S. Radio Supply Co., Wichita Falls, Tex | 360 | 833 | 100 |
| WKAQ—Radio Corp. of Porto Rico, San Juan, P. R | 360 | 833 | 500 |
| WKAR—Michigan Agr. College, E. Lansing, Mich | 280 | 1070 | 500 |
| WKY—WKY Radio Shop, Oklahoma, Okla | 360 | 833 | 500 |
| WLAG—Cutting & Radio Wash. Corp., Minneapolis, Minn | 417 | 720 | 500 |
| WLAH—Samuel Woodworth, Syracuse. N. Y | 360 | 834 | 500 |
| WLAL—Naylor Electric Co., Tulsa, Okla | 360 | 833 | 100 |
| WLAN—Putnam Hardware Co., Houlton, Me | 283 | 1060 | 250 |
| WLAW—Police Dept., New York City, N. Y | 360 | 834 | 500 |
| WLBL—Wisconsin Dept. of Markets, Stevens Pt., Wis | 278 | 1080 | 500 |
| WLS—Sears. Roebuck & Co., Chicago, Ill | 345 | 870 | 500 |
| WLW—Crosley Radio Corp., Cincinnati, O | 423 | 710 | 1000 |
| WMAC—Clive B. Meredith, Cazenovia, N. Y | 275 | 1090 | 100 |
| WMAF—Round Hills Radio Corp., Dartmouth, Mass | 360 | 833 | 500 |
| WMAH—General Supply Co., Lincoln, Neb | 254 | 1180 | 100 |
| WMAK—Norton Laboratories, Lockport, N. Y | 273 | 1100 | 500 |
| WMAP—Utility Battery Service, Easton, Pa | 246 | 1220 | 150 |
| WMAQ—Chicago Daily News, Chicago, Ill | 448 | 670 | 500 |
| WMAT—Paramount Radio Corp., Duluth, Minn | 226 | 1130 | 250 |
| WSY—Alabama Polytechnic Institute, Auburn, Ala | 250 | 1200 | 500 |
| WMAY—Kingshighway Presbytern Church, St. Louis, Mo | 280 | 1070 | 100 |
| WMAZ—Mercer University, Macon, Ga | 261 | 1150 | 100 |
| WMC—"Commercial Appeal," Memphis, Tenn | 500 | 600 | 500 |
| WMH—Ainsworth-Gates Radio Co., Cincinnati, Ohio | 309 | 970 | 750 |
| WMU—Doubleday-Hill Elec. Co., Washington, D. C | 261 | 1150 | 100 |
| WNAC—Shepard Stores, Boston, Mass | 278 | 1080 | 100 |
| WNAD—University of Oklahoma, Norman. Okla | 254 | 1180 | 100 |
| WNAP—Wittenberg College, Springfield, Ohio | 275 | 1090 | 100 |
| WNAT—Lenning Brothers Co., Philadelphia, Pa | 250 | 1200 | 100 |
| WNAX—Dakota Radio Apparatus Co., Yankton, S. D | 244 | 1230 | 100 |
| WNYC—City of New York, New York, N. Y | 526 | 570 | 1000 |
| WOAC—Pagan Organ Co., Lima, Ohio | 265 | 1130 | 150 |
| WOAI—Southern Equipment Co., San Antonio, Tex | 384 | 780 | 500 |
| WOAL—William E. Woods, Webster Groves, Mo | 229 | 1310 | 100 |
| WOAN—Vaughn Conserv't'y Music, Lawrenceb'rg, Tenn | 360 | 833 | 200 |
| WOAR—Henry P. Lundskow, Kenosha, Wis | 229 | 1310 | 100 |
| WOAV—Penn. Nat'l Guard, 2d Bat., 112th Inf., Erie, Pa | 242 | 1240 | 100 |
| WOAW—Woodmen of the World, Omaha, Neb | 526 | 570 | 500 |
| WOAX—Franklyn J. Wolff, Trenton, N. J | 240 | 1250 | 500 |
| WOI—Iowa State College, Ames, Iowa | 360 | 833 | 500 |
| WOO—John Wanamaker, Philadelphia, Pa | 508 | 590 | 500 |
| WOQ—Unity School of Christianity, Kansas City, Mo | 278 | 1080 | 500 |
| WOR—L. Bamberger & Co., Newark, N. J | 405 | 740 | 500 |
| WOS—Mo. State Marketing Bureau, Jefferson City, Mo | 441 | 680 | 500 |
| WPAB—Pennsylvania State College, State College, Pa | 283 | 1060 | 500 |
| WPAC—Donaldson Radio Co., Okmulgee, Okla | 360 | 833 | 100 |
| WPAH—Wisconsin Dept. of Markets, Waupaca, Wis | 360 | 833 | 500 |
| WPAJ—New Haven, Conn | 268 | 1120 | 100 |
| WPAK—North Dakota, Agri Col., Agri. College, N. D | 283 | 1060 | 250 |
| WPAL—Avery & Loeb Elec. Co., Columbus, Ohio | 286 | 1050 | 100 |
| WPAM—Auerbach & Guettel, Topeka, Kansas | 275 | 1090 | 100 |
| WPAZ—John R. Koch (Dr.), Charleston, W. Va | 273 | 1100 | 100 |
| WQAA—Horace A. Beale, Jr., Parkesburg, Pa | 220 | 1360 | 500 |
| WQAC—E. B. Gish, Amarillo, Texas | 234 | 1280 | 100 |
| WQAM—Electrical Equipment Co., Miami, Fla | 268 | 1120 | 100 |
| WQAN—Scranton Times, Scranton, Pa | 250 | 1120 | 100 |
| WQAO—Calvary Baptist Church, New York, N. Y | 360 | 833 | 100 |
| WQAQ—Abilene Daily Reporter. Abilene, Tex | 360 | 833 | 100 |
| WQAS—Prince-Walter Co., Lowell, Mass | 265 | 1130 | 100 |
| WQAX—Radio Equipment Co. Peoria, Ill | 248 | 1210 | 100 |
| WQJ—Calument Rainbo Broadcasting Co., Chicago, Ill | 448 | 670 | 500 |
| WRAL—No. States Power Co., St. Croix Falls, Wis | 248 | 1210 | 100 |
| WRAM—Lombard College, Galesburg, Ill | 244 | 1230 | 250 |
| WRAV—Antioch College, Yellow Springs, Ohio | 242 | 1240 | 100 |
| WRAX—Flexon's Garage, Gloucester City, N. J | 268 | 1120 | 100 |
| WRBC—Immanuel Lutheran Church, Valparaiso, Ind | 278 | 1080 | 500 |
| WRC—Radio Corp. of America, Washington, D. C | 469 | 640 | 500 |
| WREO—Reo Motor Car Co., Lansing, Mich | 288 | 1040 | 500 |
| WRK—Doren Bros. Electric Co., Hamilton, Ohio | 270 | 1110 | 200 |
| WRL—Union College. Schenectady, N. Y | 360 | 833 | 500 |
| WRM—University of Illinois, Urbana, Ill | 273 | 1100 | 500 |
| WRW—Tarrytown Radio Research Lab., Tarrytown, N. Y | 273 | 1100 | 500 |
| WSAB—State Teachers College, Cape Girardeau, Mo | 275 | 1090 | 100 |
| WSAC—Clemson Agri. Col., Clemson College, S. C | 360 | 833 | 500 |
| WSAD—J. A. Foster Co., Providence, R. I | 261 | 1150 | 100 |
| WSAH—A. G. Leonard, Jr., Chicago, Ill | 248 | 1210 | 500 |
| WSAI—U. S. Playing Card Co., Cincinnati, Ohio | 309 | 970 | 1000 |
| WSAJ—Grove City College, Grove City, Pa | 254 | 1180 | 250 |
| WSAP—7th Day Adventist Church, New York, N. Y | 263 | 1140 | 250 |
| WSAR—Doughty & Welch Elec. Co., Fall River, Mass | 254 | 1181 | 100 |
| WSAV—Clifford W. Vick Radio Const. Co., Houston, Tex | 360 | 833 | 100 |
| WSAY—Chamber of Commerce, Port Chester, N. Y | 233 | 1304 | 100 |
| WSAX—Chicago Radio Laboratory, Chicago, Ill | 448 | 670 | 1000 |
| WSB—Atlanta Journal, Atlanta, Ga | 428 | 700 | 500 |
| WSK—Reiss Steamship Co., Sheboygan, Wis | 300 | 999 | 1000 |
| WSL—J. & M. Electric Co., Utica, N. Y | 273 | 1100 | 100 |
| WSOE—School of Eng. of Milwaukee, Milwaukee, Wis | 246 | 1220 | 100 |
| WSY—Alabama Power Co., Birmingham, Ala | 360 | 833 | 500 |
| WTAB—Fall River Daily Hearld, Fall River, Mass | 248 | 1130 | 100 |
| WTAC—Pennsylvania Traffic Co., Johnstown, Pa | 275 | 1090 | 150 |
| WTAM—The Willard Storage Battery Co., Cleveland, O | 489 | 770 | 1500 |
| WTAN—Orndorff Radio Shop, Mattoon, Ill | 240 | 1250 | 100 |
| WTAQ—S. H. Van Gorden & Son, Ossea. Wis | 254 | 1180 | 100 |
| WTAR—Reliance Electric Co., Norfolk, Va | 261 | 1150 | 100 |
| WTAS—Charles E. Erbstein, Elgin, Ill., near | 286 | 1050 | 500 |
| WTAT—Edison Electric Illum. Co., Boston, Mass | 246 | 1220 | 100 |
| WTAW—Agri. & Mech. College, College Station, Texas | 270 | 1110 | 250 |
| WTAY—Oak Leaves Broadcasting Station, Oak Park, Ill | 283 | 1330 | 500 |
| WTG—Kansas State Agri. Col., Manhattan, Kas | 485 | 620 | 1000 |
| WWAD—Wright & Wright, Inc., Philadelphia, Pa | 250 | 1200 | 500 |
| WWAE—Alamo Ball Room Joliet, Ill | 242 | 1240 | 500 |
| WWAF—Galvin Radio Sup. Co., Camden, N. J | 236 | 1260 | 500 |
| WWAO—Michigan College of Mines, Houghton, Mich | 244 | 1230 | 250 |
| WWI—Ford Motor Co., Dearborn, Mich | 273 | 1100 | 500 |
| WWJ—Detroit News, Detroit, Mich | 517 | 580 | 500 |
| WWL—Loyola University, New Orleans, La | 268 | 1120 | 100 |

# RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 1 Number 21

*Contents for*

## *JANUARY 15, 1925*



Because of so much space taken by "Fifteen Worthwhile Hook-ups," regular departments are omitted for this issue only.

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# Good Things in Next Issue

So much has been done in testing receiving sets that the sending end, particularly the aerial, has seemed somewhat neglected. This is to be remedied shortly, as described in **"53 Acres of Testing Aerial."**

The large amount of material in this issue on Hook-ups forced the postponement of two very interesting articles, **"Silencing Ether Squeals,"** by Goldsmith, and **"Taking Portraits of Heart Beats,"** by Arnold. They will appear in the February 1 issue.

You know by now that 1924 was a banner year in the advance of radio. What can we expect for the coming year? A good prophecy will be found in **"1925—A Forecast of Radio,"** by Dunlap.

The "A" battery is always a problem. Even with dry cell tubes one or two cells of storage battery are often an advantage. To charge them yourself read **"Build Your Own Charger,"** by Rados.

Many a good hook-up is spoiled by the wrong wiring. **"How to Wire Your Hook-up,"** by Taylor, tells what kind of wire is used and how to use it.

# RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. No. 21 JANUARY 15, 1925 15c PER COPY, $3 PER YEAR


# Understanding a Hookup

## *It is Easy to Read a Diagram When You Know How*

By HORACE V. S. TAYLOR

AT first sight many people think that a hookup is perhaps a new kind of crossword puzzle. Once you get the hang of it however, reading such a diagram is as easy as picking out your route on a road map. The only difference is that you are already accustomed to the signs for streets, rivers, railroads and cities, while the symbols for the various radio parts may seem strange to you.

The signs have been built with the idea of making them depend on common sense. For instance, we have all seen how the rotating plates of a variable condenser turn in and out of the sta-

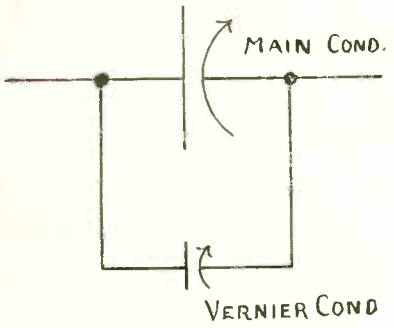


Fig. 1. Rotor and Stator

tionary ones. A sign for such a unit is shown in Fig. 1, which represents a main condenser with a small vernier unit connected in parallel. Of course, the flat part represents the straight or stationary plates and the curve, the round or movable ones.

### Coils May be Adjustable

The drawing for a coil is shown in Fig. 2. At the left appears a coil with an arrow pointing to it which means that the number of turns can be varied. Such a coil is frequently used connected between the aerial and ground. When made adjustable, a tap switch ordinarily picks out which turn is wanted by contacting with a switch point as shown in the right hand part of Fig 2. Such a diagram takes up too much space so the left hand is used to represent the same thing.

A rheostat is made by wrapping a resistance wire around a strip of fibre with a turning arm sliding on the wire to cut more or less into the circuit. This is well represented by Fig. 3. In the same way a transformer consisting of two windings, primary and secondary, is suggested by the symbols of Fig. 4. The number of turns are specified here but ordinarily they are not given as a transformer has to be bought ready made from the manufacturer.

The symbol for a vacuum tube is a circle with grid, plate, and filament as shown in Fig. 5. Here also are seen the tuning condenser at the left, and the symbol for phones and by-pass condenser at the right. This takes up most of the ordinary signs. In well constructed diagrams any unusual markings are explained.

### When Wires Cross

Many diagrams are somewhat confusing as they do not show at a glance whether two wires which touch are connected together or not. To make this easy we are using the scheme shown in Fig. 6. At A is shown a cross connection—a main wire with two branches. Such a connection is oftentimes indicated by the lines at B which has a dot over the intersection. Indeed some hookups do not even show the dot and that sometimes leaves the reader in doubt whether it was intended to join the wires together or not. Diagram A in Fig. 6, cannot possibly mean that the wires are crossing each other without touching, and so no doubt is felt by the reader. When two lines cross without being connected they appear as shown in C.

The "A" and "B" batteries are represented as in Fig. 7. The long line is

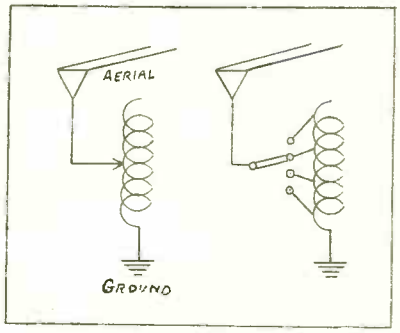


Fig. 2. Signs of Tapped Coil

always to represent the positive (plus) although so many people make a mistake here that it is well to indicate the polarity by the signs + and —. It makes no difference in operating the set whether the negative side of the "B" battery runs to the + or — of the "A." It is customary to hook up the "A" + and "B" — as the lower part of Fig. 7 shows. When, however, a diagram makes a better looking job by showing the two

negative terminals hooked together as at the top of Fig. 7 then this is done. It should be understood that in constructing the set either connection may be used.

### The General Hook-up

When you see a hook-up of several tubes, which look at first sight rather complicated, there is one way of running the wires down which will give you a good idea of the whole thing. The first thing to do is to notice the filament connections. These will run from the "A" battery through one or more rheostats, to the filament of the different tubes. As a general thing the rheostat should be in the negative line of the "A" battery. Occasionally it will work just as well in the positive, but even in such cases it might be put in the former with equally good results. A rule which will always work is a good one to follow, and that is why we always show the rheostat connected to the "A" minus in our diagrams.

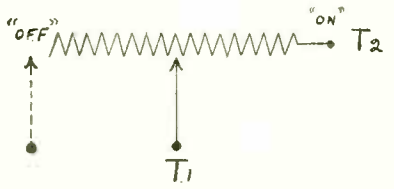


Fig. 3. Rheostat Has Two Terminals

After the circuit of the "A" battery and filament has been traced through for all the tubes, you are ready to pick out the grid and the plate circuits for each tube. The general scheme is shown in Fig. 5. Ordinarily a coil will be found running from the grid to the filament. This coil may be the stator of the vario-coupler, or a variometer, or it may be the secondary winding of a radio or audio transformer. In a few hook-ups the opposite end from the grid does not go to the filament. (See Hook-up No. 7). In such cases, however, the oscillations get back to the filament through the leakage capacity of the set, and indeed it is likely that a positive connection to the filament would increase the volume of the music.

### Tuning the Grid

If the tube in question is handling radio frequency, it is quite likely that a tuning condenser will be shown connected in parallel across this coil. In such a case the stator should always run to the grid.

The output of the tube always runs from the plate through the receiver to the "B" battery. The receiver may be the phones (if it is the last tube) or the primary of the transformer, if a further tube is used.

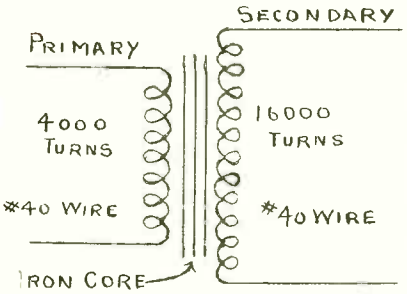


Fig. 4. Transformer Symbol

These three circuits, filament, grid and plate, will be found in every hook-up, and if taken for each tube in that order, will make a reading of the diagram much simpler.

### The By-pass Condenser

Whenever radio and audio frequency are present in the same wire, it is necessary to put a by-pass condenser around the unit which is operated by the low speed audio vibration. The reason is that the inductance or electrical weight of such a device is so great that it cannot be made to oscillate at a million times a second or so, corresponding to the radio frequency. This stopping condenser may have a value of .001 or .002 mfd. (microfarad) interchangably. It is shown around the phones in Fig. 5. For that reason it is sometimes called a "phone condenser." That is not a good name for it, because the same condenser must be used around the primary of the first audio transformer when one step of amplification is used.

This condenser may be connected around the phones in either way as shown in Fig. 8. The first method is the one usually drawn out in a hook-up. It by-passes the high frequency around the phones only. The second way is, however, better as by this connection the high frequency does not have to pass through either phones or "B" batteries. In this way the bad effect of a "B" battery in poor condition is removed from the radio frequency circuit.

### Size of Condensers

As just mentioned, whenever a by-pass condenser is used, it may be either .001 or .002, with equally good results. In any hook-up where you see one called for, the other may be substituted. The variable air condensers may be specified either by the number of plates or by the capacity. When an 11 or 13 plate variable is called for it is understood that .00025 mfd. is meant. If your brand of condenser happens to have wider spacings between the plates than usual, you may need a 17 plate unit to get this capacity. The 23 plate condensers are meant to have a value of .0005 mfd. A 43 plate condenser should never be used except in very special work, as that capacity is too big for use with coils which are properly made unless wave lengths of over 600 meters are to be brought in.

### Size of Wire to Use

In general the size of wire for radio work is not very important. One or two numbers larger or smaller can be substituted in almost any hook-up without ma-

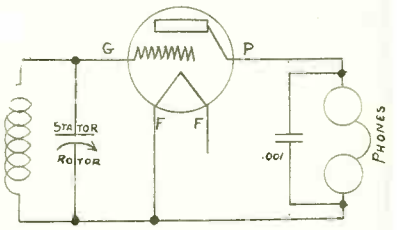


Fig. 5. Basic Tube Circuits

terially changing the inductance of the coil. Small differences in this value are compensated for by a slight difference in the setting of the dials. For this reason any diagram calling for, say No. 23 DC (double cotton covered) wire, can be followed just as well with No. 22 or No. 24. About the only time when this is important is when a spool of a certain size is to be wound full. In such a case the smaller wire will require more turns to fill the space and this will run up the inductance too high. In such a case winding on the *same number* of turns as called for of a smaller size will not fill the space full, but will give the right value of inductance.

Dials are not mentioned by size, as the diameter should be made to harmonize with the general appearance of the set. Three and one-half inch dials are about right for ordinary work, although 4 units make a little easier tuning. For controls which are not at all critical

and so do not need very accurate settings, 3" or even 2½" are big enough for satisfactory service.

As already explained, the tap switch (Fig. 2) selects the number of turns in a coil so as to vary its useful value. Since it is impractical to change the number of turns by less than one turn steps, it follows that fine tuning cannot be done with a tap switch. Where inductance must be varied continuously, instead of in steps, a variometer is used. The tap switch may come as a single unit with the switch points mounted in a disk of bakelite or the switch points may be bought separately and the panel drilled to take them.

### What Kind of Vacuum Tube?

When you consider that there are four different styles of tubes on the market which are very popular, besides a number of others, made by different kinds of factories, it is something of a problem to know which one to use. These four tubes may be called the 199, 200, 201A,

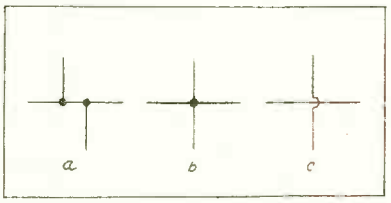


Fig. 6. Cross-overs and Connections

and WD. These are the numbers assigned by the Radio Corporation, but in this discussion it should be understood that equivalent tubes of other manufacture are included in these names.

For use with storage batteries the 200 makes the best detector and the 201A the best amplifier. For dry battery use the 199 takes three volts from three cells in series. The WD is operated by 1.1 volts from a single cell. The WD11 and the WD12 are electrically just alike. The only difference between them lies in the base. For those who do not mind the expense and bother of keeping up the storage battery the 200 and the 201A tubes will be the proper selection as they give louder volume particularly on local stations. Those who prefer the great advantages of dry cells will use the 199 or WD. Of these two, the former is the better radio amplifier and also uses less filament energy than the latter. For sets using three tubes or more we recommend the 199 tubes. If only one or two are called for in the set then the WD will have the advantage that a single cell will serve for an "A" battery, while three cells are necessary to give the voltage required to operate from one to six 199 tubes.

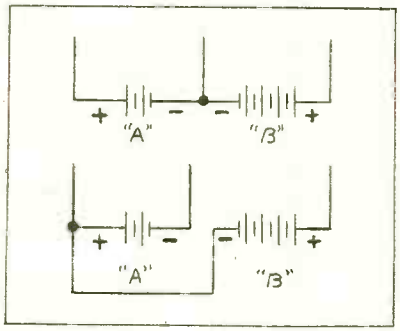


Fig. 7. Two Ways of Connecting "B"

### Rheostat to Fit

Notice that in the hoop-ups the resistance of the rheostat is not mentioned. This is because different values are needed depending on what style is employed. When using the various tubes as described above the following values of resistance are suitable. The number of tubes means those connected to one rheostat.

| | |
|---|---|
| 1 200 Tube | 6 ohms |
| 1 or 2 201A Tubes | 6 ohms |
| 3 to 8 201A Tubes | 2 ohms |
| 1 199 Tube | 30 ohms |
| 2 or 3 199 Tubes | 20 ohms |
| 4 to 6 199 Tubes | 6 ohms |
| 1 to 3 WD Tubes | 6 ohms |
| 3 to 6 WD Tubes | 2 ohms |

The rheostat may be used as a switch to turn off the set or a filament switch may be inserted in either of the "A" battery leads to do the same thing. This has the advantage that the rheostats may be left at about the correct setting when the current is turned off.

### Different Kinds of Jacks

In any hook-up a jack may be used to connect the phones or loud-speaker into the circuit at either detector first or second step of audio. The intermediate jacks may be omitted if desired. For the last tube a jack with from one to four springs is needed. The intermediate tubes require jacks that have at least two springs.

This was explained at length in "Judging Jacks for Real Results" in the September 1, 1924, issue of RADIO PROGRESS. The two-spring unit is better than the four since it does not have as many unsoldered contacts which might cause trouble. The method of connecting such a jack into any audio circuit appears in Fig. 9.

The most popular sizes of panels at the present time are the 7x14, 7x21, and 7x26. These are the ones specified in our lists of material. If you have some other size which is similar it will do just as well. The preferred material is either some form of hard rubber or else the synthetic product like bakelite, condensite, or the like.

### Testing a Set

When building a set it is well to test it as it is being put together. First connect the "A" battery and filament circuits. Put the tubes in and make sure that the rheostats control their brightness. When the wiring for each tube is completed it is best to insert it and then connect the "B" battery to see whether there is a short circuit or not. Touch the wire to the "B" battery for only an

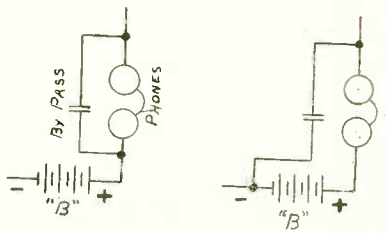


Fig. 8. By-pass is Around "B"

instant while looking at the tube. Of course it should not light up, and if it does, it shows a mistake, which should be corrected immediately. This test will save you from burning out your tubes by a wrong connection.

When operating a set be sure to retune for the station you are listening to after every change or adjustment that is made. This is necessary, because even such a simple thing as adjusting the rheostat may cause a slight shift in wave length. This must be corrected or else the music will be faint because of incorrect tuning.

### Prices of Material

It is not an easy matter to put prices on radio parts which will represent good value all over the country, there are so many different grades of parts. We have tried to give the figures for the cheaper variety of good parts in the simple sets, while the elaborate hook-ups call for

Continued on Page 8

# American Radio Relay League

## "SIX WEEKS," SAID THE JUDGE

In some respects it is not as pleasant to live in Czechoslovakia as it is in the United States. They do things differently there.

According to information received by the American Radio Relay League from a correspondent, a radio fan in that country was recently sent to prison for six weeks because he built a radio receiving set and occasionally sold parts without a license. The accused fan filed an appeal but the court would not change its judgment on the sentence.

In order to obtain a license for operating a receiving set under the government regulation of April 17 of last year, one must furnish a diagram of the set with a list of units employed, pay the tax and advise whether the receiver is home-built, or obtained from a manufacturer of radio equipment. The law of December 20, 1923, requires the applicant to be a subject of the Czechoslovak Republic and a permanent resident of the country.

Despite these requirements, there are at present in that country about 1,000 receiving sets. The correspondent further tells us that enthusiasm among listeners is not very high as government recognition and privileges were long in coming and the present programs are poor. Most of the receivers come from France, England and Germany.

While the prices for radio parts and complete sets are about the same as those in the United States, they are far beyond the reach of the poor farmers, indicating that it may be a long time before radio becomes as popular generally among all classes of people as it is in this country. There is a great demand, however, for radio text books and magazines.

## PRIZE BY MYSTERY MAN

The amateur radio operator who handles the greatest number of radio telegraph messages for three consecutive months will receive a valuable plaque, suitably engraved with the name of the winner, it was recently announced by the American Radio League Traffic Department. Only members of the A. R. R. L. who hold an amateur operator's license and operate a transmitting station, are eligible to compete.

The man who offers the prize is himself an amateur, but as he does not wish his name to be known, we cannot tell you who it is. The object of the gift is to stimulate the amount of message traffic on the short waves and to allow for improvement in the quality of the messages handled. The contest will start with the beginning of the March operating month in each of the A. R. R. L. Divisions. Amateurs in doubt as to the exact time should write their Division Manager. The leader for each month will be announced.

The provision is made that all messages must be transmitted in accordance with the usual A. R. R. L. practice with respect to prefix, number and date. Abbreviations will not be permitted and messages held more than forty-eight hours for relay cannot be counted. Contestants will be permitted to send "applause messages" for broadcast listeners.

To give some idea of the traffic, it was announced at the American Radio Relay League that Ralph Barnett of St. Louis, Mo., operator of amateur station 9ACI, had handled 335 private radio messages during December, which is the best individual record of any amateur operator for that period.

## DOUBLE YOU BE ZED

No, the call letters of the Westinghouse station at Springfield, Mass., have not been changed. They are still WBZ. But on the air the letter "Z" sounds like many other possible letters. It might be mistaken for a "V," a "C," a "D," or a "G." All radio fans like to know the station they are listening to. So the announcers were instructed to try pronouncing "Z" like "Zed." The proposal was tried, and met with the immediate approval of listeners. Many fans are tickled with the idea. They say that "Zed" leaves no room for doubt. The scheme was tried during international tests for the benefit of listeners on the other side, but United States fans were quite enthusiastic over the new pronunciation.

## STILL GOING STRONG

The total value of radio apparatus and tubes manufactured in this country last year aggregated $48,032,927.

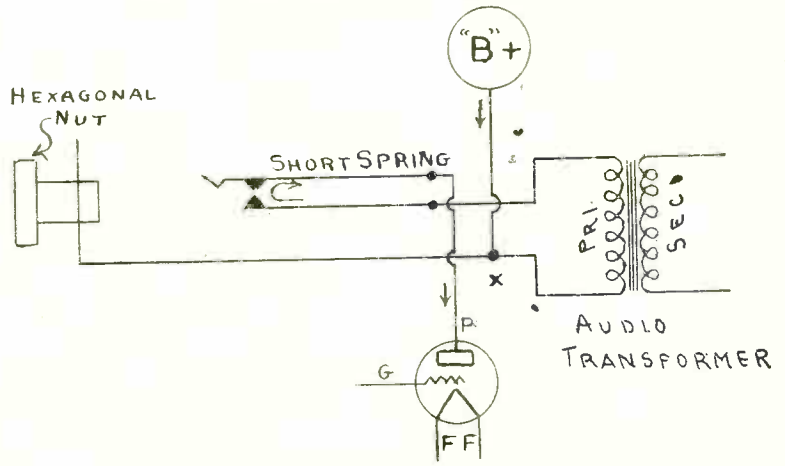


Fig. 9. Connecting a Jack in Audio Circuit

## UNDERSTANDING A HOOK-UP

Continued from Page 7.

prices on the best equipment. The idea is to give a set builder some idea of what it will cost him to put together such a hook-up. He can always pay more than what we have indicated and sometimes good parts may be procured for less. These figures will be found in general to be about average.

# Waving Photographs 3000 Miles

## *A New Process That Static Does Not Bother Much*

By VANCE

YOU have probably seen in the newspapers some reproductions of photographs that have been sent across the Atlantic by radio. There have also appeared with them some so-called explanations of how they work, but most such articles have not given a very clear description of what happened.

Part of the apparatus which is used is comparatively old. Pictures have been carried over telegraph lines for some little time. The principle of such transmission is that each illustration has been broken up into a large number of small dots by photographing it through a screen. That is the same process which is used in making portraits for magazines and newspapers. The difference between the appearance of the figures in these two mediums is that magazines use high priced, smooth finished paper, and so are able to use screens having 120 wires per inch, while newspapers are printed on much cheaper and coarser paper which will not print well if more than half that number are used.

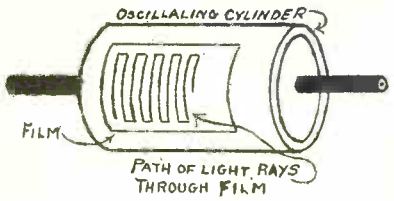


Fig. 1. Film is Clipped to Roll

### Big and Little Dots

By this method, which is called the half tone process, a dark part of the picture consists of a group of large black dots. They are so large in fact that they overlap oftentimes, and leave only small white spaces between them. A gray part of the picture appears as smaller dots, completely surrounded by white space. The sky will be represented by dots so small that they are hardly visible at all. Naturally, there are all sizes of these dots in any picture, depending on the amount of light and shade in the original.

In transmitting pictures over a telegraph line the mechanism transmits a series of electrical impulses or waves, corresponding with the various dots. The sending mechanism takes one after another right straight across the picture, and where the spot is large and black, a heavy current flows. A light spot, on the other hand, causes only a small current through the wire. If a sixty mesh screen is used, then when sixty of such current changes have occured, a single inch of the photograph has been transmitted.

### 3600 Points Per Square Inch

But notice that this is not a square inch of photograph. It is only a line one-inch long. To complete a square inch there must be sixty of such lines. That means, sixty times sixty, or 3600 separate current impluses to one square inch of picture. Naturally by using a coarser screen, the number may be cut down a great deal, but the appearance of the completed photograph is made correspondingly rougher. By comparing the illustrations in magazines with those in newspapers a good idea can be obtained as to the result of increasing the mesh of the screen in this process.

When it comes to sending by telegraph lines, it is a problem to know just how big a mesh it is best to use. If we employ a screen with twice as many wires per inch, then it will take four times as many current changes to complete the figure. From this it is easily seen that the time of reproducing a good sized negative will be very long if we try to make it out of very small dots.

### Static Gives a Black Eye

The same process of sending can be used as well in radio as over a wire as far as theory is concerned. But just think what would happen if interference should occur. If static came in just while the eye of the subject happened to be transmitted, he would certainly get a black eye. And if a neighbor started oscillating while his face was being printed, each squeal would show up as a freckle, with the result that not even a mother could love the face which would appear.

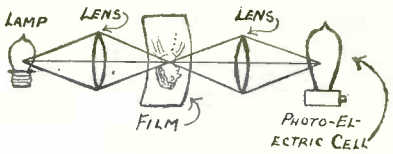


Fig. 2. Light Strikes Electric Eye

This new invention was created with the idea of getting away as far as possible from the disturbance of static and interference. And results show that if conditions are favorable, pictures will come through which do not show the blemishes from small disturbances and interference which might be expected. Of course, if static gets to be too bad, then it is advisable to postpone sending until a time when the atmosphere quiets down a bit.

### Preparing the Picture

The first step in the process is to make a negative like those which you take in the ordinary camera. If a regular negative is obtainable, no further work on it has to be done, but if it is an ordinary picture, an illustration in a magazine, or the like, then it is hung up on the wall and a studio camera takes a photograph of it, thus making a regular negative on a film. A plate nega-

tive will not do, since the film is next bent around a glass cylinder, to which it is held firmly by metal clips along each edge.

This glass cylinder with the film on it is shown in Fig 1. Inside the cylinder is a very powerful electric light and lens. The light naturally shines through the glass of the cylinder and also through the film. It is concentrated into a beam by the lens between the lamp and the film itself. The lens is designed so that the rays of light come to a sharp focus or point at a single spot on the film about as big as the head of a pin. From there the rays go on (see Fig. 2) spreading out until they strike a second lens.

This photo-electric cell is found to have the curious property that when light shines upon it, it reduces the resistance as measured by an electrical current, to a very low value. The brighter the light the more current will flow when a voltage is impressed on the tube. You will see that this becomes an electrical eye and transforms the changes in light into variations in electric current.

### Following the Zigzag Trail

The glass cylinder, with the film attached to it, turns on its axis slowly back and forth without making a complete revolution. When the light beam gets to the edge of the film, as Fig. 1 shows, the rotation reverses and so it is a standard apparatus. Fortunately, the amount of light which strikes the cell causes an instantaneous change in the current flowing so there is no lost motion. As the light creeps back and forth across the film its variations are picked up and at the same moment the radio waves crossing the Atlantic respond to the slightest changes in the original picture. As the film rocks back and forth and keeps advancing a notch at a time, the record of what the photo cell sees is broadcast to the world and so line by line the picture is put on the air.

### Getting on the Air

The modulator feeds the radio waves to an ordinary amplifier to increase

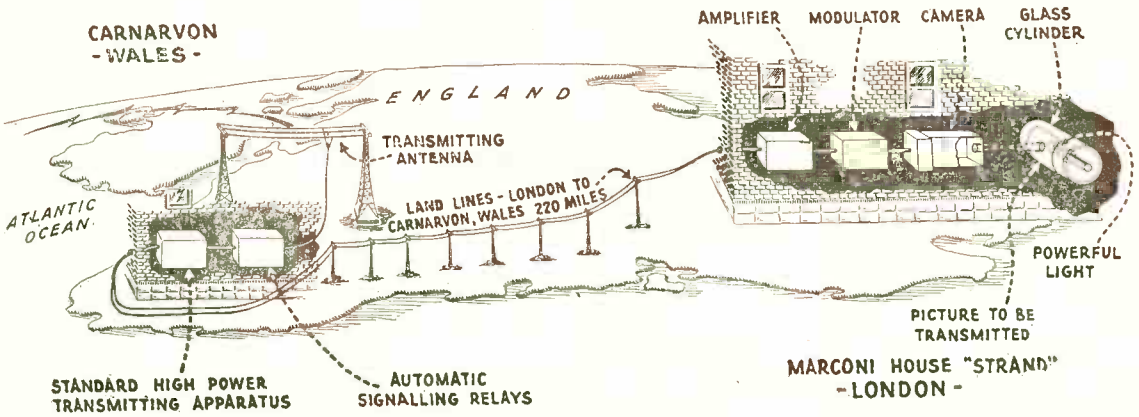


Fig. 3. London Puts Picture on Air from Aerial 200 Miles Away

### The Electrical Eye

This second lens concentrates the rays again on a special tube, called a photo-electric cell. This is a kind of vacuum tube which contains a special form of the metal "sodium." You never see such a metal in its pure state, because it has such a strong affinity or desire for oxygen, that if a piece of the pure metal is dropped into water it breaks the water molecules up into its ingredients, oxygen and hydrogen, and seizes on the oxygen with such violence that it gets red hot and sets fire to the hydrogen. It can be preserved without oxidizing in a vacuum, where there is no oxygen and that is why a vacuum tube is used. Although you never see any pure sodium, still you are very familiar with the element in combination as when sodium and chlorine unite in equal parts they form ordinary table salt, (sodium chloride).

rocks back and forth first to the left and then to the right. Every time it changes its direction, however, the whole business moves endwise on its axis for a distance of about 1/64th of an inch. This makes a path for the beam of light through the film of a lot of parallel lines connected on the ends, as illustrated.

From this you can see that the electric-eye (photo-electric cell) is getting a continuous series of bright and dark rays of light as the patches of black and white film let more or less light through. The current, passing through the cell, varies up and down in a way that corresponds with the shading of the negative being transmitted. This current is fed to a modulator of a broadcasting station, which works just like any ordinary transmitter such as is used to send out radio concerts. This is not described in detail here, as it

their volume. From there they might go directly to the aerial, but in the recent tests the pictures were sent from Marconi House in London, and the transmitting antenna was located at Carnavon, in Wales, so a telephone line 220 miles long was used to conduct the waves between the two stations. See Fig. 3. This is the same idea as had been employed recently in the United States when land lines linked up from twenty to thirty different sending stations to give out the same program on several different occasions.

At Carnavon, is located the 200 kilowatt transmitting station of the Marconi Company. This amount of power is 200 times as great as the biggest broadcasting stations which have been allowed in the United States up till very recently. However, broadcast listeners will not have "heard" this picture since it is sent out at very long wave

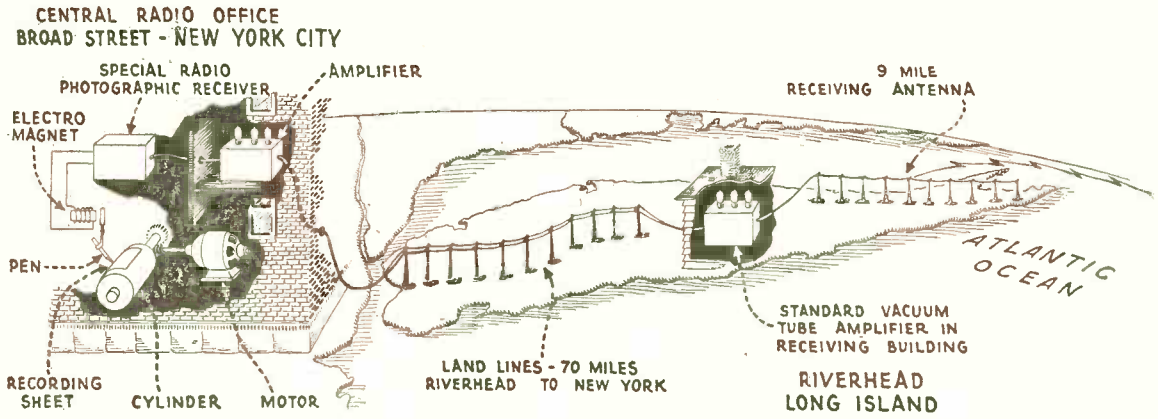


Fig. 4. Using 9-Mile Antenna Brings Photo to Cylinder in New York

lengths—far above the range of any ordinary receiving set.

At this sending station the electric waves from the land line stretching from London, operate small relays which turn the aerial current on and off. This tremendous electrical power radiates from the aerial in interrupted blocks of energy, very much like the dots and dashes of telegraph code, except that the latter has dashes all of equal length, whereas in sending a picture if a large dark part of the negative comes into focus the dash transmitted will be a very long one.

### No Special Broadcasting Station

You will notice that at the sending station no particular new circuits are required. Of course, the wave length is much longer, as has been explained, but this was for two reasons; the absorption by the atmosphere on such low frequencies is less than the ordinary speeds of oscillation, and furthermore it would not do to blanket ordinary broadcast programs by using such tremendous power at regular wave lengths. There is nothing in the actual requirements of the transmission which necessitates such lengths.

It is also worth observing that any of the powerful trans-Atlantic stations could use such a system of sending. It is not confined to special apparatus which requires a lot of expensive equipment and special trained operators. This is a very good point in favor of this system.


Fig. 5. Our President as Flashed from London

### Snatching Pictures from the Air.

We now come to the receiving station, which pulls in the ether vibrations and makes a photograph out of them. An aerial nine miles long, (Fig. 4), is installed at Riverhead, Long Island, to pick-up the Carnavon transmitter. This is the regular equipment used for commercial messages. An amplifier equipment at Riverhead increases the volume of the electrical impulses enough, so that they can be transmitted 70 miles over the land to the New York office on Broad Street.

Another amplifier makes up for the weakening effect of the 70 miles of cable. The waves are then fed to a detector which operates in the usual manner. The output, instead of running through a telephone or loud speaker, is connected to an electro magnet, which pulls a

Continued on Page 14

# The Year 1924 in Radio History

## *Westinghouse Tells of Progress in Radio and Electricity*

By H. W. COPE, Assistant Director of Engineering, Westinghouse Electric and Manufacturing Co.

DURING the year 1924 a great deal of progress was made in radio as well as along other electrical lines. Of course, many improvements were of a detail nature which do not sound like very much when described, although they make a great deal of difference in the smoothness and efficiency with which a device may operate. However, there were a large number of basic improvements, which make interesting reading. Some of these are described here as seen by the Westinghouse Company.

In making such a review of its electrical engineering achievements of the past year the company has reported only the most noteworthy improvements. Some developments are of great popular interest. Others, of apparently little significance to-day, are undoubtedly the start of achievements to come in the future.

### Every Night in Europe

In the radio field, KDKA, the world's pioneer station, at East Pittsburgh, Pa., and its sister stations, KYW at Chicago, Ill., WBZ, at Springfield, Mass., and KFKX, at Hastings, Neb., added new laurels to a crown already well-filled. Through the use of short-wave repeating, KDKA was heard consistently in all parts of the North and South American continents, in Great Britain and continental Europe and even in such remote places as South Africa. In the International listening tests, recently completed, KDKA was the only United States station to be heard in Europe every night of the tests. Such a record speaks well for the reliability of radio broadcasting.

### Two Giant Generators

In electrical lines other than radio great improvements are noted. For instance, two generators, having a rating of 62,500 kv-a (kilovolt-amperes), 1,200 revolutions per minute (r. p. m.) each were placed in operation. These were the largest single generator units ever built. The rotor had a net weight of 230,000 pounds. The output of this single machine is enough to light a large city. Using the ordinary 25 watt bulbs, this unit would light two and one-half million (2,500,000) lamps. The largest 3600 r. p. m. generator yet constructed also went into service during the year. It had a rating of 12,500 kv-a.

As a result of the careful study given to the various problems entering into the design of large machines, it has been possible to place in service a frequency changer, converting 25 into 60 cycles, having an efficiency for each of the two machines comprising the set of better than 98%. This is the highest efficiency that has ever been obtained in a 60-cycle motor or generator. This frequencies changer is used to tie together two different systems, one working at a frequency of sixty cycles and the other of twenty-five cycles. Very few twenty-five cycle generators are built for new installations, since the higher rrequency is much more popular. However, existing systems which use twenty-five cycles and need new apparatus naturally continue at that speed of oscillation. When such a system grows until it strikes the territory of a sixty cycle installation, it is necessary to use a frequency changer to tie the two lines together.

### One Motor Drives Two Generators

A notable advance has been made in motor-generator sets for steel mills. This consists in the use of a single motor driving two generators connected in parallel. One set of this type is now in very successful operation, having capacity for a 5000 h. p. reversing mill motor. Two other sets of 500 and 7500 h. p. capacity are under construction and will be delivered shortly.

A new type of high speed contr has been perfected, which allows a lo dispatcher in a central office to op and close circuit breakers, which ma be located in various sub-stations. Th position of each separate breaker shown on a control board in the di patcher's office. Of course, such a sy tem has been in use in a small way f a long time, but the trouble in the pa has been that the large number breakers has required a prohibiti equipment in the way of separate wir for each breaker. The new system r duces the number to a small fractio

### Keeping Ends in Step

This new form of supervisory co trol selects entirely by relays. It called the "synchronous relay type," b cause the contacts on the two ends the system operate in step with o another. This system is acknowledge the best yet developed. As a result its remarkable efficiency, it is possib for a company to use a selective mete ing equipment whereby 52 current a 54 voltage readings are obtained ov only two pairs of telephone wires.

The largest automatically controll motor-generator set in the world Edison service was placed in successf operation in St. Louis under full aut matic control. Such a machine h almost human intelligence as it star operating automatically when neede and shuts itself off when no longer ne essary. If one of the bearings ge hot, instead of wrecking it, it immed ately comes to a stop. If for any re son the speed gets too high it is take care of automatically. If the wat supply cooling the transformers shou cease to flow, they would not be burne

out as the wise generator would immediately shut itself off.

### No Oxygen Touches It

The Inertaire Transformer marks one of the most progressive steps forward in transformer engineering yet taken. These transformers make impossible either explosions or fire from the oil insulation in transformers. Nitrogen taken from the air is used to act as a cushioning blanket between the transformer oil and the air, preventing oxygen from reaching the oil.

Auto-valve lightning arresters have been built for voltages up to 140,000 volts. Another type of arrester has been developed for use on lines where surges of dangerous magnitude or duration may appear.

### When You Visit the "Follies"

When you see some of the musical comedies you may be surprised at the marvelous lighting effects. Up to recently it was possible for the electrician to set his levers to control the various lights just one step ahead of the time he wanted to use them. Then by pressing a button the correct change in all the circuits would occur at once. He was then required immediately to get ready for the next set. A "multi-preset" stage lighting system has been developed with twenty preset switches, each controlling 95 pilot circuits. As a result the stage electrician working feverishly between each lighting effect, opening and closing the switches is no more seen. With this board, all the lighting effects for every scene of a theatrical production may be set up in advance and remain undisturbed for the run of a production.

The rapid expansion in transmission systems has made it necessary to develop some means for obtaining information of the nature of voltage disturbances. To meet this need, the Klydonograph was developed. It works on the basis of an electrical stress thrown on the emulsion of an ordinary photographic plate and which, when developed, shows figures that give details concerning the voltage impressed. The instrument will show whether the voltage was alternating or not, and if not, will show whether it was positive or negative. Voltages of extremely short duration can be recorded. A description of this instrument and samples of its records appeared in the April 1, 1924, issue of RADIO PROGRESS in, "A Lifetime in a Second."

### A Throb-less Mill Motor

An accurate method of balancing rotating machinery has been developed that can be operated by almost anyone. A means has been devised for eliminating the vibration caused by the pulsating torque of single-phase machines. New methods for driving steel mills, rubber mills, paper mills and the drilling of oil wells have been perfected.

Several new types of instruments have been developed, among which are the Klydonograph and the kv-a meter, while others such as the oscillograph and the watthour meter have been greatly improved.

A number of marked improvements have been made in stoker design by Westinghouse engineers the past year as follows:

A new model underfeed stoker for use with preheated air.

A modified clinker grinder equipment for the successful handling of low grade coal.

A device to prevent the formation of clinkers.

### Hats Off to the "Colorado"

In the field of marine applications, 1924 was a notable year of achievements. The U. S. battleship Colorado was given her final trials during the summer and accepted by the Navy Department. This is the mightiest dreadnaught afloat and surpasses all other capital vessels in striking power, rapidity of action, facility of control and thoroughness of protection. Her electric drive permits the use of her full power for both forward and reverse operation, thus providing the highest degree of maneuvering power. As an instance of this latter, is the ability to stop this great ship, from a full speed of 21 knots to standstill, in three minutes.

Four Diesel electric hopper dredges, built for the U. S. War Department, Corps of Engineers, were completed and put through their trials. Each vessel is fitted with the largest Diesel electric plant ever installed on a ship. Trial runs have been completed on the first Diesel electric tanker to go in service on the Atlantic Coast. Also the first Diesel electric tug in the world went into operation in New York Harbor the past year.

### Henry Ford's Railroad Equipped

Deliveries of power house and substation equipment for the Virginian Railway, the greatest single order ever placed for complete electrification, are nearing completion. Locomotives will be ready for shipment as soon as the trolley line is erected and has had voltage applied to it. The first motor-generator type locomotive ever built is just on the point of completion. It has been designed and built by the joint efforts of the engineers of the Ford Motor Company and those of the Westinghouse Company. The initial electrification of the Detroit and Ironton Railroad Company consists of approximately 17 miles of double track railroad, extending from the River Rouge plant of the Ford Motor Company to Flat Rock, Mich.

### High Speed Elevators

In elevator equipment, the necessary apparatus and controls have been developed which makes speeds of 1,000 feet per minute entirely possible. In order to test all elevator apparatus, and develop and demonstrate new systems of control, a new elevator tower was built at East Pittsburg. This tower is designed and equipped to test any kind of hoisting apparatus for duties up to 10,000 pounds and speeds of 1,000 feet per minute.

The phenomenal growth of street traffic and the increased demand for ornamental types of street lighting fixtures has stimulated a careful study of the lighting of city thoroughfares. Notable in engineering development was the Bi-Lux refractor which divides the light flux into two wide beams which diverge in opposite directions up and down the street, resulting in a higher illumination evenly distributed between lighting units and with the glare reduced to a minimum.

### To Charge Your "A" Batteries

Further refinement in the design and manufacture of rectigon bulbs have brought the average service life of this product up to 4,000 hours under full load conditions. These are the bulbs which contain a heavy tungsten filament which burns in the rare gas Argon. It is used as a rectifier for charg-

ing "A" and "B" batteries. as electricity will flow from the carbon electrode to the tungsten, but not in the reverse direction.

A new type of electric iron has been developed. This holds the temperature constant at any heat you desire. A new style of thermostat which is very rugged, can be adjusted from the outside. For ironing light silk waists the temperature may be set to a low figure and if you are forgetful and leave the iron on one spot too long it will not heat up and scorch the dress. For ironing heavy sheets or linens the thermostat can be adjusted to give all the heat which the laundress can use.

### Reaching the World's Corners

In the field of radio, developments have gone forward at a great rate. Broadcasting has been developed. and with the perfecting of short wave repeating, the range has been so extended that almost every corner of the globe can be reached. The use of carrier current telephone systems has proved their reliability in dispatching service for large power systems. Vacuum tubes have been built in sizes hitherto undreamed.

One year ago, December 31, 1923, radio repeating on short waves received an International impetus when a New Year's message from KDKA was picked up in England and repeated through all the stations operated by the British Broadcasting Company. During the year many variations of the short wave repeating theme have been carried out successfullly. On some occasions KDKA has supplied the same program to KFKX at Hastings, the seven British Stations, and KGO at San Francisco simultaneously.

### They'll Tell the World

On March 7, 1924, the banquet of the Massachusetts Institute of Technology Alumni was broadcast to the English speaking people of the world. Wire connection was used between the banquet hall and station WJZ and WGY, whose signals were picked up by station KDKA and relayed to station KFKX and station KGO, California, and was also relayed to the British Broadcasting Company, who in turn broadcast it to the British Isles. This was the first time extensive radio interconnection had been attempted in connection with radio broadcasting.

On March 14, 1924, station KDKA gave its first concert entirely in Spanish for the benefit of the Spanish speaking people of the West Indies, Mexico, Central and South America. The program was relayed by station KFKX and also by a station in Buenos Aires, Argentine. This was so successful that several other Spanish programs have been broadcast during the year.

### Talking to McMillan

July 4th to September 22nd, the Company carried on short wave communications with Captain McMillan's relief expedition on the Canadian Government ship "Arctic." During the same period, constant communication was also maintained on short wave length with the Hudson Bay ships "Nascopie" and "Bayeskimo."

At the time of the Wills-Firpo fight at "Boyle's 30 Acres," Hoboken, N. J., the Buenos Aires daily paper, La Nacion, had an announcer at the ringside who broadcast the entire fight, blow by blow, to his paper by the use of station KDKA.

### New Powerful Radio Tubes

Until recently it has been impossible to produce large size vacuum tubes that could be made to oscillate at frequencies above 2,000 kilocycles (150 meters wave length). As a result of the careful study given this problem by Westinghouse engineers, it has been possible to develop a water-cooled metal anode (plate) tube that will successfully operate on frequencies up to 6,000 kilocycles (50 meters).

About 30 sets of carrier current telephone equipment were placed in service on the lines of six different power companies during the year. By means of this equipment, different parts of an interconnected system can be separated remotely by the main dispatcher's office. This system which uses the main power wires to carry at the same time the voice currents, is a great advantage to the central station especially in times of trouble. The high voltage lines are much more rugged than the usual telephone wires and in a severe storm the latter will go down long before the former. This system gives the companies the chance to keep communication going between substations as long as there are any power wires at all which are still up. Another name for this method is "wired wireless," since it uses high radio frequency waves along the wires.

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## WAVING PHOTOGRAPHS

Continued from Page 11

fountain pen against a piece of paper fastened to an oscillating drum. Every time the pull is strong enough the pen makes a little dot on the paper. This drum is rotated back and forth and advanced a notch each time exactly in step with the oscillating film at the sending end.

### Keeping up With the Procession

Of course, it is of great importance indeed that the two oscillating drums keep exactly in step. If one were to get ahead of the other, it would shift the picture so that instead of a man's two eyes being put side by side, one might be shifted down opposite his mouth. A good deal of research work was needed before the two drums could be kept exactly in phase at the two sides of the Atlantic Ocean.

The result of such a series of dots is shown in Fig. 5. President Coolidge will be recognized as the subject of this picture. Notice the series of fine dots which go to make up the whole. In some places they are entirely absent, leaving pure white paper. In other spots they are so thick that they make practically jet black. In most places, however, they lie between these two values and so give lighter or darker gray. Observe too, that the picture has a stippled or wavy effect. This is quite characteristic of the transmitted pictures which are now coming through. This effect is caused by slight irregularities in the spacing of the mechanism. A very slight shift of a few thousandths of an inch shows up in making a wavy line.

The picture made by the pen and ink can be seen by the operators as it is being drawn. It is fascinating to see the pen wiggling back and forth, gradually making a picture. Besides this the same detector operates a special photographic receiver which makes a negative on an ordinary film. This is developed like any other one and can then be used to make any number of photographic prints.

# Fifteen Worthwhile Hook-Ups

## 1—SIMPLE CRYSTAL DETECTOR

THE simplest set which it is possible to make, uses nothing but a coil, crystal, and phones. Its merit is that aside from the phones the entire cost can be limited to less then 50c. Of course, it does not have a very great range, as it is not likely to be very satisfactory much over six or eight miles away from a good broadcasting station.

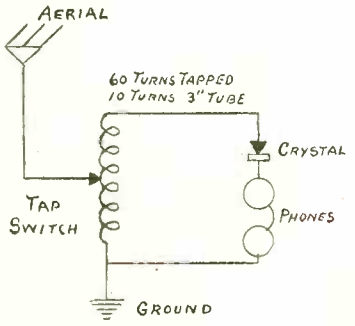



Fig. 1. The Simplest Set

Nor is it at all selective as if there happen to be two local transmitters in a town, then it will be difficult to tune out the stronger and pick up the weaker when they are both going at once. However, if there is only one in your city, or if several of them divide the time without conflicting, then this set gives very clear, smooth tone, and plenty of volume.

### List of Materials

(First read article, Page 5)

| | | |
|---|---|---|
| 1 | Crystal | $ .15 |
| 1 | Tap switch | .25 |
| 1 | Winding form | .05 |
| ⅛ | lb. No. 22 DCC copper wire | .15 |

### Extra

| | |
|---|---|
| Aerial and ground complete | $1.50 |
| Phones | 3.00 |

### Optional

| | |
|---|---|
| Jack and phone plug | $ .50 |
| 4 Binding posts for aerial, ground and phones @ 3c | .12 |

### Winding the Coil

A spider web form made of fibre about five inches in diameter may be used for the coil, although, if you prefer, a three inch diameter tube will work just as well. The spider web coil is considerably easier to wind, as it does not try to unwrap itself if you accidentally let go of the end. Wind on sixty turns of wire, taking a tap off every ten turns at 10, 20, etc. The inside lead runs to the ground and also to one phone connection. The outside lead runs to the crystal detector. Another connection is needed tying together the other side of the crystal and the phones.

The tap switch uses six points although a unit with any number more than this can be employed by omitting the extra points. Of course, the coil could be tapped at more places if desired, but six is enough to take in the ordinary broadcast range. The center connection of the tap switch runs to the aerial.

### Operation

To operate this set connect aerial and ground and listen in at the phones while turning the tap switch. If the broadcasting station is near at hand it will be picked up on all taps, but some one will be louder than the others. This is the proper one to use. If it is at a greater distance, it will perhaps be heard on only one or two buttons.

## 2—TWO CIRCUIT CRYSTAL SET

This set is considerably more selective than the simple crystal set described in hook-up No. 1. It also will receive from greater distances. A powerful broadcaster may be heard fifteen or more miles away. However, the range should not be expected to exceed twenty-miles, even from a 1000-watt station. Occasionally, we hear of this set bringing in stations a couple of hundred miles away, but in such cases it always comes from a near-by powerful tube set. which is re-radiating the distant program.

There are two controls on this set, neither of which is very critical. However, the set is coupled loosely enough so that it is considerably sharper tuning than the single circuit set. Even when two local broadcasters are going at the same time you will be able to tune either one out at will and pick up the other.

### List of Materials

(First read article, Page 5)

| | | |
|---|---|---|
| 1 | Tap switch | $ .25 |
| 2 | Winding forms @ 5c | .10 |
| 1 | Crystal | .15 |
| 1 | 23-Plate .0005 condenser | 2.00 |
| ¼ | lb. No. 22 DCC copper wire | .25 |

### Extras

| | |
|---|---|
| Aerial and ground complete | $1.50 |
| Phones | 3.00 |

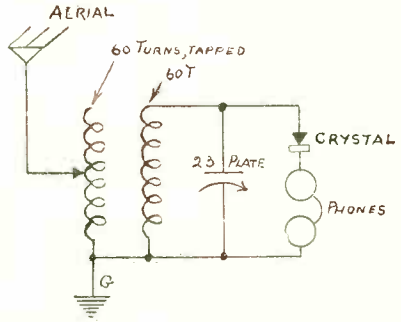



Fig. 2. A Selective Crystal

### Optional

| | |
|---|---|
| Phone jacks and plug | $ .50 |
| Binding posts for aerial, ground and phones at | .03 |
| Ordinary variocoupler instead of two coils | 2.00 |

### Construction

The two coils are wound just alike, except that the first one, or primary, has six taps based every ten turns, while the secondary does not require taps. The total number of turns on each coil is sixty. The direction of winding (whether right or left hand) makes no difference. The inside lead of each coil runs to the ground. The outside lead of first or primary coil, runs to one of the taps of the tap switch just as the rest of the taps do. The outside end of the secondary coil is connected to the condenser and also to the crystal.

The two coils are to be separated about an inch apart by means of a small wooden spacer. Depending on the size and shape of your aerial it will sometimes be found by increasing this distance somewhat. or in some cases reducing it the signals will come in stronger. After once experimenting with those points the final setting of the coils may be left undisturbed.

### Paths of Current

The primary oscillation coming in from the aerial runs through the left hand coil direct to ground. It is tuned by adjusting the tap switch to get the right length of wire in the coil. Owing to the high resistance of the ground lead it is unnecessary to try to use any fine tuning on the primary. The secondary is adjusted by the 23-plate condenser. By this means any local broadcasting station may be cut out and another one picked up.

course, when it is operated correctly, this trouble does not occur.

Its advantage is that it is simple and easy to construct, and is quite inexpensive. Furthermore, the operation is quite simple, and the range is up to 1500 miles on a good night. Every advantage which this particular circuit possesses, except a slight one in the case of building, is to be had in the two circuit tuner, which is described in the 5th hook-up. The only reason this is given here is because it is in such large use, that it must

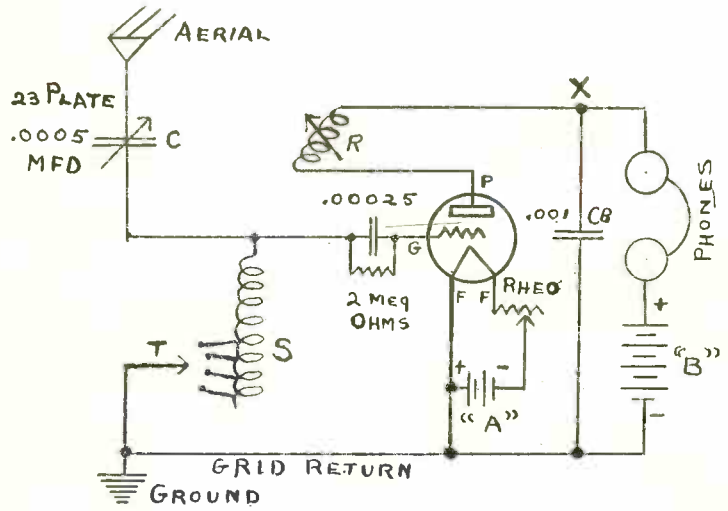



Fig. 3. Single Circuit. Popular, but a Squealer

### Operation

To operate this set connect up aerial and ground to posts as usual. With the tap switch set at about 40 turns rotate slowly the secondary condenser until a station is heard. Then try the primary on a different tap and tune again. The loudest combination is the correct one. It may be necessary occasionally to change the adjustment of the catwhisker on the surface of the crystal. This will be avoided, if one of these units which is alive all over or a fixed crystal is used instead of the ordinary one.

## 3—SINGLE REGENERATOR—VARIOCOUPLER

This circuit is the one which is used probably more than any other, which is to be regretted, since it has one bad fault—it is a terrible squealer. Not that it squeals for the user, as he can stop it by adjustment, but its howls and whistles are broadcast to everybody within a radius of several blocks. Of

be included, to present anything like a complete catalogue.

### List of Materials

(First read Page 5)

| | | |
|---|---|---|
| 1 | 23 plate (.0005) condenser | $2.00 |
| 1 | Tap switch | .50 |
| 1 | Variocoupler | 2.25 |
| 1 | Grid condenser .00025 | .35 |
| 1 | Grid leak | .25 |
| 1 | Socket | .35 |
| 1 | Rheostat | .35 |
| 1 | Panel 7x14 | 1.00 |
| 2 | Dials | .50 |
| 1 | .001 by-pass condenser | .15 |
| | Binding posts @ 3c.; 1 Ant., 1 Gr., 2 "A," 2 "B," 2 phones. Busbar, etc. | |

### Extras

| | | |
|---|---|---|
| | Aerial and ground | $2.00 |
| 1 | Tube | 4.00 |
| | Phones | 3.00 |
| 22 | Volt "B" battery | 1.75 |
| 1 | Dry cell "A" battery | .40 |

### Optional

| | | |
|---|---|---|
| 1 | Jack (1 spring) | $ .30 |
| 1 | Plug for phones | .35 |
| 1 | Adjustable grid leak | .75 |
| 1 | Cabinet 7x14x7 deep | 3.50 |
| | "A" battery switch | .25 |

### Theory of the Circuits

This is one of the easiest sets in theory. The audio waves come in through the aerial and are tuned by the condenser C and the tapswitch T. The latter gives the coarse adjustments in steps, while the condenser allows the fine tuning to pick up the distant station. The path of the primary waves is from the aerial through condenser C, stator S, and tap-switch T, to ground. The secondary circuit oscillates from the filament through grid return, tap-switch T, coil S, and grid condenser to the grid.

The output runs from plate P, through adjustable rotor R, to the point X, where the high or radio frequency divides through by-pass condenser Cb, to the filament and the low or audio frequency takes the path through the phones and "B" battery to the filament.

### Construction

A good way of laying out this set is to mount the 23-plate condenser at the left; next to this is the tap switch; the variocoupler knob will appear about in the center of the panel. To the right of this is the rheostat, followed by the jack for the phones. This gives a symmetrical appearance.

The connections are shown in Fig. 3. Wire up the filament circuit first. The rheostat goes in the negative line, which runs from the A minus to the filament. The other filament wire runs to the A plus and also to ground. When this circuit is done it is well to test it by hooking up the "A" battery and noticing if the rheostat controls the brightness of the filament.

The aerial is connected direct to the rotor of the 23-plate adjustable condenser. The stator runs to the top of the stator of the variocoupler and also through the grid condenser and leak to the grid. The center of the tap switch runs to ground, plus of the "A" battery, and minus of the "B" battery.

The lead from the plate goes to the rotor of the variocoupler. If this is the ordinary 180 degree unit, it makes no difference which lead is connected to the plate, but if the 90 degree coupler, which

is mounted at an angle is used, then you will have to find out by trial which is the proper lead to use. When the correct one is found the set will squeal as the tickler is turned on, but if the wrong one, then no squeal can be produced. The other lead of the rotor runs to the phone jack or binding post. The other side of the phones hooks up with the "B" plus. A by-pass condenser is shunted across the phones and "B" battery. This completes the wiring.

### Operating the Set

To work this radio turn on the rheostat until the tube comes up to normal brightness. Then with the tap switch set at about the center, turn up the rotor dial until the hissing noise shows the set is oscillating. It should now immediately be turned down again until the hissing just disappears. By doing this you avoid disturbing your neighbors with your squeal. Now turn the 23-plate condenser until some station is picked up. As you turn the condenser, you usually have to readjust the tickler (rotor) to keep it at the point where it does not oscillate. It is well to turn one dial with one hand while you adjust the feedback with the other.

After bringing in the station it is well to shift the tap switch to a new position and try the same station again. The condenser will have to be turned to a lower reading when you increase the turns on the stator to get the same station. This adjustment of the tap switch should be continued until you find the best setting for a given wave length. Once this has been determined the tap switch should always be placed on the button which you find best for that particular wave length and then the exact adjustment made with the condenser.

## 4—SINGLE REGENERATOR—VARIOMETER

This circuit is similar in operation to the Single Circuit Regenerator with a variocoupler, as described in Hook-up 3. The principle difference is that the variometer is used to control the regeneration instead of a variocoupler. It has no advantage over the coupler circuit, except for those fans who happen to possess a variometer but no coupler. Control of regeneration is not as satisfactory with this set as with Hook-up 3, since to increase the feedback it is sometimes necessary to turn the variometer rotor to the left and sometimes to the right. This is because the output must be in resonance (tuned the same) with the input in order to get maximum regeneration. If the variometer dial happens to be tuned to a higher wave length, then it must be turned to the left to increase the feedback, while if it is too low, then a turn to the right brings it up.

### List of Materials

(First read Page 5)

This list is exactly like that of Hook-up 3, except that the variocoupler is omitted and the following is added:

| | | |
|---|---|---|
| 1 | Variometer | $4.00 |
| 1 | Spider web form 5 in. diameter | .05 |
| ⅛ | lb. No. 22 DCC wire | .15 |

### Construction

In winding the primary coil, sixty turns of the double cotton covered (DCC) wire is wound on the spider web form. Six taps, one every ten turns, are enough to get satisfactory control, although of course, more may be used if desired. These taps run to the tap switch. The hook-up is just the same, except that the plate circuit includes the variometer instead of the rotor of the coupler.

### Operation

The rules given in Hook-up 3 apply here except as regards the feedback. As has just been described, the amount of regeneration is controlled by getting the secondary into resonance with the primary, and this is done sometimes by rotating the variometer to the left and at other times to the right. Your ear is the guide—you can hear when it starts to squeal or hiss. As before, this condition should be avoided so as not to disturb the other radio listeners within a few blocks. Turn the dial away from the position of hiss about one degree, then no such trouble will be caused.

## 5—TWO CIRCUIT REGENERATIVE TUNER

This hook-up is one of the best that have been constructed. It is particularly good in that the distant stations up to 1500 miles on a favorable night, will come in with considerable volume and clearness and yet the tendency to squeal and disturb the neighbors is very much less than almost any other regenerative single tube set. Besides this the selectivity is considerably improved over the single circuit hook-ups.

In addition to these advantages, it is a rather easy set to build. Indeed it would be an advantage for each owner to re-build his single circuit squealer into this model—an advantage not only for him but for all his neighbors. The reason why this set is not so much of a radiator as the others is because the coupling between primary and secondary is quite loose, and so only a small portion of the regenerative energy which causes the oscillation is fed back from the secondary to the primary coil. However, a small part of the energy is transferred in this manner, and for this reason the operator should be careful not to make the set oscillate, as a small amount of disturbance would be caused in spite of the fact that the coupling is loose.

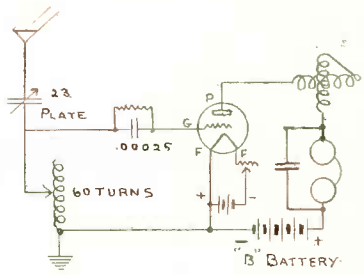



Fig. 4. Single Circuit-Variometer

### List of Materials

(First read Page 5)

| | | |
|---|---|---|
| 1 | 23 plate condenser | $2.00 |
| 1 | Variocoupler | 2.25 |
| 1 | Grid condenser | .35 |
| 1 | Grid leak | .25 |
| 1 | Socket | .35 |
| 1 | Rheostat | .35 |
| 1 | Panel 7x14 | 1.00 |
| 2 | Dials | .50 |
| 1 | .001 by-pass condenser | .15 |
| | Binding posts @ 3c, 1 Ant., 1 Gr., 2 "A," 2 "B," 2 phones. | |

### Extras

| | | |
|---|---|---|
| | Aerial and ground | $2.00 |
| 1 | Tube | 4.00 |
| | Phones | 3.00 |
| 22 | Volt "B" battery | 1.75 |
| 1 | Dry cell "A" battery | .40 |

### Optional

Same as in hook-up No. 3, but add:

1 Spider web coil, tapped
2 Tap switches

### Construction

The actual laying out of the panel depends on whether you wish to include the two tap switches or not. The primary of this hook-up consists of a few turns. The smaller the number is, the more selective the set, while the greater the number up to about fifteen, the more powerfully the distant stations will come in. Many fans use a 15-turn primary tapped at five and ten turns. Then the five-turn coil is marked "S" for selectivity, the 15 "P" for power, and the ten turn "M" for medium.

the diagram Fig. 5, so as not to be confusing. It is connected between the aerial and the primary coil. The details will be explained later.

In case either or both these tap switches are to be used, they will appear at the left hand side of the panel. Next to them come the secondary condenser and then the rotor (tickler) of the variocoupler. At the right are the rheostat and the phone jack or binding posts.

The secondary coil and tickler are the stator and rotor of the variocoupler. In case you desire to wind these, use fifty

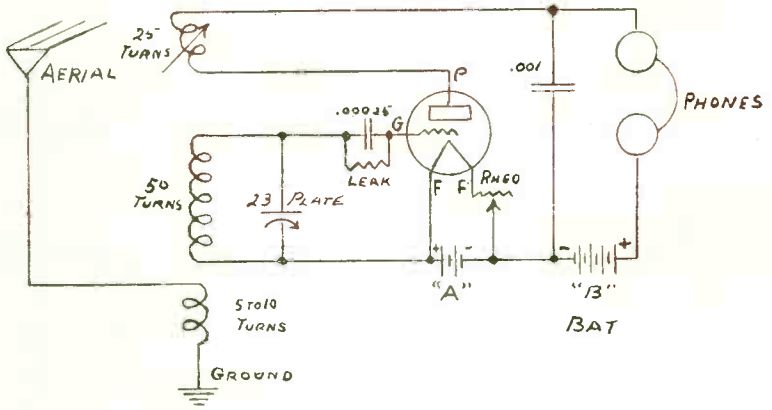



Fig. 5. One of the Best Single Tubes—2 Circuit

Of course, more than these three taps can be used if desired, although they usually will be enough. A switch may be used to pick out one of these taps, in that way regulating the selectivity or else a loop can be made on the primary out of the wire, and a small spring clip used to make the connection to the loop. If a tap switch is to be used, then it is desirable to have the first tap at the first or second turn, as this will give the maximum in selectivity, although the volume will not be very great.

### Increasing the Range

The primary, as just described, is non-adjustable. Some people call it "untuned." This is really incorrect, as it is always tuned for some frequency, although with so few turns the tuning would be for a vibration speed of 2000 or 3000 k.c. (150 to 100 meters). Since this tuning is way outside the broadcasting range, the coil appears to be untuned. The selectivity can be still further increased, and with it the loudness too, if another coil (loading coil) is connected into the circuit. This is not shown in

turns of No. 22 on the stator and 25 turns of smaller wire, say No. 24, on the secondary. If these numbers are not exactly the same as on your coupler, it makes no difference, as the adjustment of the condenser and the tickler takes care of any variations automatically.

On top of the stator at its lower end, wind a couple of turns of good wrapping paper, the strip being about an inch wide. The ends should be fastened down with sealing wax or shellac (not glue, which will absorb moisture). On top of this insulation wind on in either direction the primary of No. 22 DCC wire. If you are going to use a tap switch to control the selectivity, then use fifteen turns with three to five taps. If you do not wish to have the bother of making an adjustment here, then use five turns if you want the best selectivity, or ten turns, if you prefer the greatest volume. The upper end of this coil, or the center of the tap switch, if used, goes to the aerial or to the inside end of the loading coil.

### The Loading Coil

To get the best results as just explained, a loading coil should be connected into the aerial line. This consists of sixty turns of No. 22 DCC wire, wound on a spider web form and tapped every ten turns. This is connected with the inside end to the primary tap switch and the center of the loading tap switch hooked up to the aerial.

The rest of the hook-up is made as shown in Fig. 5. The "A" battery is connected to the rheostat in the negative side and the tube. When this circuit is done, it should be tested before going any further. The output from the plate runs to the rotor of the variocoupler. The right polarity may be found by experiment. When the set is working, turning the dial to the higher numbers ought to cause a hissing or squeal in the phones. If it does not, then reverse the two leads to the stator. The .001 stopping condenser is shunted across the phones and "B" battery. The "B" minus is shown connected to the "A" minus, although the "A" plus would be just as good.

### Operating the Set

First turn on the rheostat and bring the tube up to normal brightness. Then with the tap switches adjusted to middle position, turn up the tickler until the hissing of oscillation is heard in the phones. Turn it down one or two divisions to stop the oscillations. Now rotate the condenser until you hear a station. While making this adjustment you will probably need to readjust the tickler to keep the set just at the point of starting to oscillate. That is all there is to it. If you have the tap switches, you may now turn the primary to take in 3 or 5 turns if you want to cut out local broadcasting. Then try adjusting the loading coil (if you use it) at the same time readjusting the secondary condenser. When the right value for loading coil is found you will see that the music is considerably louder and also more selective. Once you have found the best button for the loading coil, using a certain condenser setting, you can always work the two pairs together with advantage.

As explained before, this set will not disturb the neighbors very much, but be sure not to operate it above the point where it begins to squeal.

## 6—THREE-CIRCUIT TUNER

This has proved a very popular hook-up, as it contains an adjustment for varying the amount of selectivity and loudness, and does not require any adjustable condenser at all. Instead, it uses two variometers, one for tuning, one for feedback, and a variocoupler. The tuning is rather sharp, because the variometer gives the largest amount of inductance in the grid circuit which can be used, which is an advantage.

| | | |
|---|---|---|
| 1 | By-pass condenser .001 | .15 |
| 1 | Panel 7x14 | 1.00 |
| 3 | Dials, @ $ .25 | .75 |
| | Buss bar, etc. | |

### Extras and Optional

Just the Same as in Hook-up No. 3.

### Construction of Set

In laying this equipment out on the panel it is well to space the three dials controlling the variocoupler and two variometers so that they are symmetrical. The tap switch may then be put at the left and the rheostat at the right to balance each other. The tube should be located near the first variometer, so as to have the grid leak short.

The ordinary style of variocoupler should be used with the taps on the stator running to the tap switch. The center of the switch goes to the aerial. The rotor is connected with one lead to the "A" plus, and the other to the tuning variometer. It makes no difference which is which of the rotor leads or of either variometer. The other lead of the tuning variometer is connected through the grid condenser and leak to the grid.

The "A" battery has the plus running to the filament and the minus to the rheostat. The "A" battery filament switch may be inserted in either lead if it is desired to use one.

The output from the plate is led through the regeneration variometer to the jack and "B" battery. The by-pass condenser is across the jack and "B" battery, if desired. Another lead, which is oftentimes advantageous, but has no direct part in the hook-up, and so is not shown, is a connection from the "A" + to ground. This has no effect except that of reducing body capacity. This completes the hook-up.

### The Current Paths

The radio frequency oscillations coming in from the aerial go through the tap switch and stator to ground. The rotor is excited more or less by the magnetism from the stator. When the two coils are at right angles, then there is practically no action and the set is in the most selective adjustment but the volume is very small owing to the tiny amount of leakage energy transferred from primary to secondary. As the rotor is turned in *either* direction, it brings the two coils more into line, which increases the coupling. This makes the music sound considerably louder, but at the same time cuts down the selectivity.

The oscillations generated in the rotor flow between the filament and the tuning variometer to the grid. When the variometer is adjusted so that the rotor and stator help each other, then the inductance or electrical weight is heavy and the system oscillates slowly to give a long wave length. When the rotor is

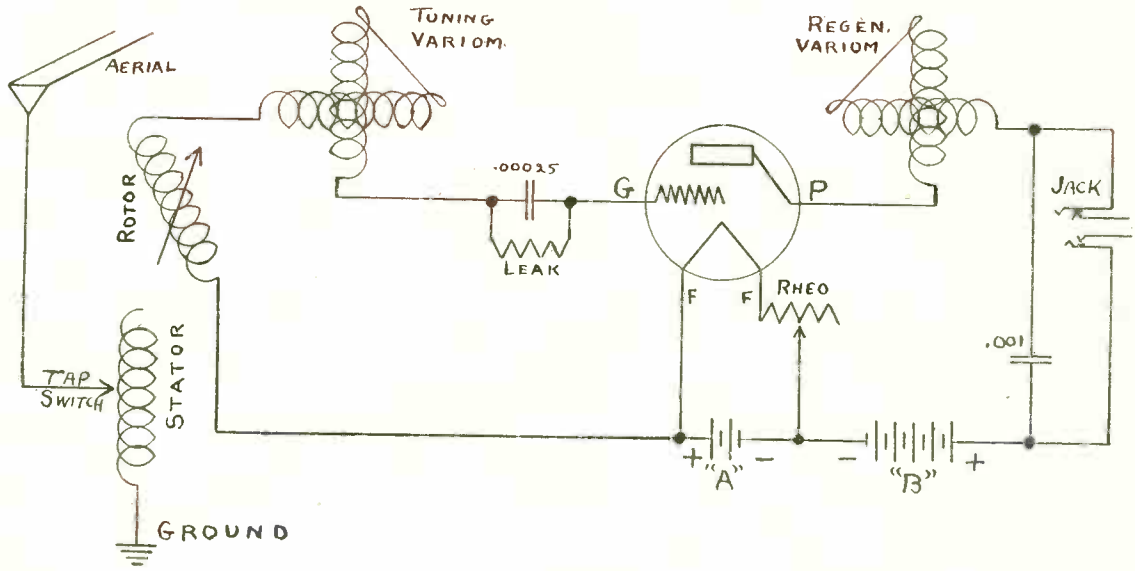



Fig. 6. Three-Circuit Tuner Uses No Adjustable Condenser

The range is as good as will be found with any single tube set. The principle disadvantage is that the regeneration control is had by adjusting the output circuit from the plate, so that it is in tune with the input. For this reason, to get the greatest feedback it is sometimes necessary to drop the wave length by turning the dial down, and at other times increasing it. That is why you can not tell before hand which way to turn the tickler to get more feedback. Of course, it is easily found out by trial.

### List of Materials

(First Read Page 5)

| | | |
|---|---|---|
| 1 | Variocoupler | $2.25 |
| 2 | Variometers, @ $3.25 | 6.50 |
| 1 | Tap switch | .50 |
| 1 | Grid condenser .00025 | .35 |
| 1 | Grid leak | .25 |
| 1 | Socket | .35 |
| 1 | Rheostat | .35 |

turned in the opposite direction, so that the two halves buck or oppose each other, then the inductance is small and the high speed vibration gives a short wave length.

The output from the plate is tuned to resonance by the regeneration variometer. The radio frequency waves leaving it go through the .001 by-pass condenser to the "B" battery and filament while the low frequency audio waves take the path through the jack and phones.

## 7—FOUR-CIRCUIT TUNER

This is a simplification of the Cockaday Circuit. When properly built and adjusted it is unusually selective. The range is good too, as 1500 miles can be picked up on a good night. It is a little more fussy to build than some of the other single tube sets, and will perhaps cause more bother in adjustment. The thing that distinguishes it is the wave trap, which is wound on the same tube as the secondary and the single turn primary which is tuned by an adjustable loading coil, located at right angles to the trap coil.

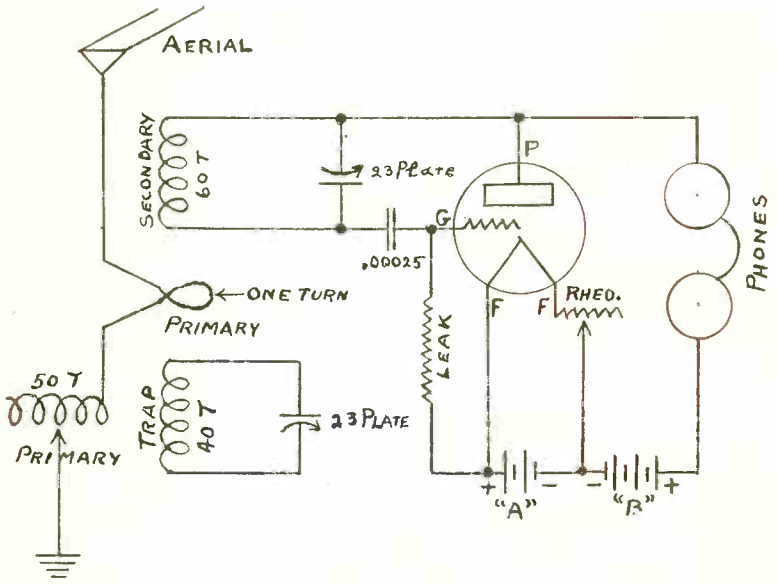



Fig. 7. Four-Circuit Tuner Has Wave Trap

### How to Operate

After bringing the filament up to the right brightness with the rheostat, turn the tap switch about to the middle, and then adjust the rotor so that it is in line either side up with the stator. This will give the loudest signals. Now turn one variometer with one hand and the other with the other, so as to keep the regeneration as great as possible without causing a squeal.

When a station is heard, be sure that the set does not oscillate as this hook-up will radiate and tell all your squeals to the nearby listeners.

Now adjust the tap switch to see if you can make the station louder. After each shift it is necessary to re-tune with both variometers. If no local station is going, that is all that is needed, but if you want to get greater selectivity, then turn the coupler so that the coils are nearly at right angles and re-tune.

The arrangement of the plate circuit is also somewhat novel in that the output divides—the low frequency flowing through the phones and the high frequency acting as a feedback through the secondary to the grid. The amount of this action is not adjustable, and this sometimes causes trouble. The grid leak too is not in the ordinary position. No by-pass condenser is needed.

### List of Materials

(First Read Page 5)

| | | |
|---|---|---|
| 2 | 23-plate condensers @ $2.00 | $4.00 |
| 2 | 3-inch fibre tubes, @ $ .20 | .40 |
| 1 | Tap switch | .50 |
| 1 | Grid condenser .00025 | .35 |
| 1 | Grid leak | .25 |
| 1 | Socket | .35 |
| 1 | Rheostat | .35 |
| 1 | Panel 7x14 | 1.00 |
| 2 | Dials, @ $ .25 | .50 |
| ⅜ | lb. No. 22 DCC wire | .40 |

### Extra and Optional

Just the Same as in Hook-up No. 3.

### Assembling the Set

Of course, a combined tuner and loading coil may be bought, but it is probably more fun to wind your own. On a 3″ diameter tube wind forty turns of No. 22 double cotton covered (DCC) wire in either direction.

Leave one-half inch space along the tube and then wind on in the same direction sixty turns of the same wire. This is the secondary coil. In the half inch space one turn of wire constitutes the primary coil. In the manufactured coil this is a turn of busbar, but that is merely for looks. Although a single turn is specified, it is often wise to wind on five, bringing out taps at the first, second and fifth turns. A clip can be used to make connections to some one of the taps or an additional tap switch can be installed. Using one turn gives it the greatest selectivity while five gives considerable more volume.

The loading coil is in the primary circuit and is wound fifty turns on a three-inch tube with taps every six or eight turns. A spider web will do just as well for this position, and it is somewhat easier to wind, but it does not harmonize as well in looks. It must be placed so that it has no magnetic effect on the other coils. For this reason it is usually put at right angles to the others, right along side. Since it is practically impossible to get this adjusted so as to give *no* effect at all, on the other coils, it is well to reverse the polarity of the one turn primary after the set has been tested. One way often gives better results than the other.

This tuner should be mounted at the left hand end of the panel. The 23-plate condenser for the trap is the left hand dial and that of the secondary is at the right. The tap switch, which controls the primary loading coil is at the extreme left. The rheostat at the right is in symmetry with the tap switch at the left.

The grid leak is to be connected from the grid to the *plus* side of the "A" battery. This is necessary, because if it were hooked up in the usual way (across the grid condenser) it would

allow full "B" battery voltage to pass through phones and secondary direct to the grid. This would stop the operation of the tube, as you will remember that the voltage of the grid should always be small.

### Theory of Circuits

The oscillation from the aerial goes through the primary of a few turns and then the loading coil to ground. The forty-turn coil and its condenser act exactly like a wave trap. They prevent unwanted stations from being heard. The secondary is excited from the magnetic action of the primary and tuned by the 23-plate condenser. The oscillations of the secondary are strengthened by the feedback action from the plate. The vibrations from the secondary do not get back to the filament directly, but are carried by the leakage capacity, which exists throughout the set.

The output from the plate divides—the radio frequency going to the left where it gives regeneration as already noticed, and the audio frequency to the right to the phones. If a by-pass condenser had been used around the phones then the feedback action of the radio frequency would have been lost.

### Operation

First adjust the filament to the proper voltage by turning the rheostat. Then with the primary loading coil set to about the middle, turn both condensers at the same time. Usually they will work at something like the same reading, although this can not be counted on. By adjusting the number of turns on the trap they may be brought to nearly the same readings. As no separate tickler control is used, there is not any chance of getting such an adjustment wrong.

## 8—HONEYCOMB (SPIDER WEB) REGENERATIVE

This hook-up is quite popular, using either honeycomb coils which may be bought or wound (although we do not advise winding them) or else employing spider web coils, which you can easily wind. Instead of using a dial for adjusting the amount of tickler action, and also for changing the coupling between primary and secondary, use is made of a swinging frame, which allows the coils to be set at any angle one to another as they swing apart.

Since the honeycomb of spider web coils have lower distributive capacity than most variocouplers, and also since the coupling can be reduced to low values, the set is capable of very sharp tuning. The chief disadvantage is that special rigging has to be made for supporting the coils, and there is some difficulty in getting away from body capacity, unless the panel is well shielded.

Hook-up 5. The biggest difference is that instead of tuning the primary with a tap switch, we use a series aerial condenser, Cp, to reduce the wave length from the highest value to lower ones. For this reason when the condenser is turned so that the plates are fully meshed, then no higher wave length can be picked up except by increasing the length of the aerial or the number of turns on the 50-turn primary.

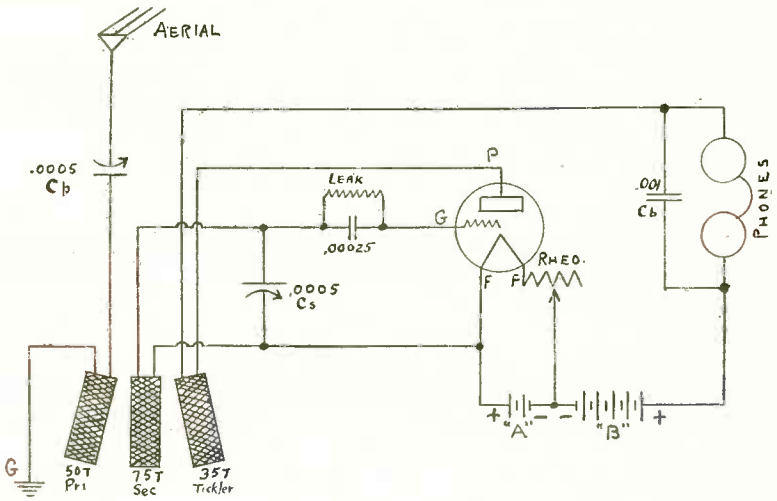



Fig. 8. Honeycomb or Spiderweb Coils Give Sharp Tuning

### List of Materials

(First See Page 5)

| | | |
|---|---|---|
| 3 | Honeycomb coils, mounted, @ $1.50. . . . . | $4.50 |
| 2 | 23-plate condensers, @ $2.00 . . . | 4.00 |
| 1 | Grid condenser .00025 . . . . . | .35 |
| 1 | Grid leak . . . . . | .25 |
| 1 | Socket. . . . . | .35 |
| 1 | Rheostat. . . . . | .35 |
| 1 | Panel 7x14 . . . . . | 1.00 |
| 2 | Dials, @ 25c . . . . . | .50 |
| 1 | .001 By-pass condenser . . . . . | .15 |
| 1 | Set of 8 binding posts . . . . . | .25 |
| | Busbar, wire, etc. | |

### Extras

Same as in Hook-up 3.

### Optional

| | | |
|---|---|---|
| 1 | Jack (one spring) . . . . . | .30 |
| 1 | Plug for phones . . . . . | .35 |
| 1 | Adjustable grid leak . . . . . | .75 |
| 1 | Cabinet 7x14x7 deep . . . . . | 3.50 |
| 1 | "A" battery switch . . . . . | .25 |
| | Instead of honeycomb coils. | |
| 3 | Spider forms, @ 5c . . . . . | $ .15 |
| ⅜ | lb. No. 22 DCC wire . . . . . | .40 |

### Theory of the Circuit

The theory and operation of this circuit is practically the same as that of

When the primary is moved to the left, away from the secondary, it reduces the coupling, which improves the selectivity, but cuts down the loudness of the music. When the right hand or 35-turn tickler is swung away from the secondary, it reduces the feedback and so cuts down on the volume.

### Construction

In building this set the swinging coils are arranged on the left, oftentimes on the outside of the panel. A special rigging for holding the coils may be bought, but most builders prefer to rig up their own method of swinging the two outside coils. Tuning of the primary is accomplished by condenser Cp which is in series with the aerial.

An extra lead, running from the "A" +, to the ground, although not shown, is oftentimes an advantage in reducing body capacity. The rest of the circuit is constructed as in Hook-up 5. The operation of the set is also the same except for the method of swinging the coils instead of turning them.

## 9—AUDIO FREQUENCY AMPLIFIER

Any set may have two audio frequency amplifier steps hooked up to the detector. Furthermore, these amplifiers are exactly the same, no matter whether connected to the cheapest crystal set or the most elaborate superheterodyne. A possible exception to this statement may be taken in the cases where a push-pull amplifier is used as the last step, but this is really a combination of two such units working together, and the pair do not give any louder amplification, but only a slight improvement in the tone of the music.

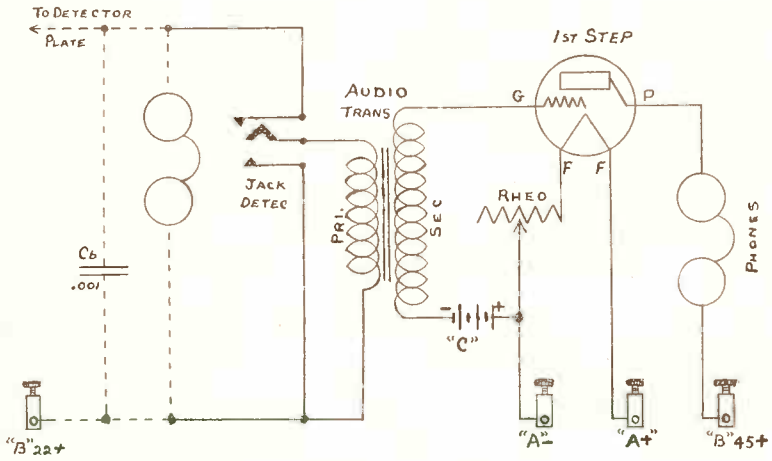



Fig. 9. One or Two of These Steps May be Added to Any Detector

Any one of the previous hook-ups may have one or two sets of audio added to them in the way which will be described. In fact, three steps of audio are sometimes used, but the third is very apt to howl, and in any event the slight outside noises, which come in through the detector, are amplified so strongly that the result is usually unsatisfactory. Instead of putting on three steps with ordinary transformers, you will be better pleased to use only two and be sure that you get non-distorting transformers.

By adding one step to a detector in any single tube circuit, the range will be increased slightly—say about two hundred miles—but the big gain comes in the loudness. Stations that you had to strain your ears to hear before will now be quite loud in the phones. Local stations will operate a loud speaker. By adding one more step (two in all) the range will not be any greater than with one, but even distant stations will be brought in loud enough to work a horn. Unless the transformers are good ones and don't make a noise of their own you will not be able to get much enjoyment out of listening in on two steps with the phones.

### List of Materials

(First Read Page 5)

| | | |
|---|---|---|
| 1 | Good audio transformer | $4.00 |
| 1 | Socket | .35 |
| 1 | Jack (two spring) | .40 |
| 1 | Binding post for "B" + 45 | .05 |
| | Busbar, etc. | |

### Extras

| | | |
|---|---|---|
| | "B" Battery 22 volts | $1.75 |
| 1 | Tube | 4.00 |
| | Stopping condenser .001 | .15 |

### Optional

| | | |
|---|---|---|
| 1 | Rheostat | $ .35 |
| 1 | "C" battery | .50 |
| | Extra "B" battery up to 90 volts | |
| | Loud speaker | $6.00 to $50.00 |

### Theory of the Circuit

The current comes from the plate of the detector tube and divides. The higher, or radio frequency, uses the stopping condenser, Cb to get back to the filament, while the audio frequency traverses the jack and primary of the audio transformer to the "B" + 22. The secondary of the audio impresses the oscillation on the grid and through the "C" battery (if used) on the filament. The output goes from the plate of the tube through the phones or loud speaker to the "B" + 45.

If the phone plug is inserted in the detector jack, then the audio vibrations will go through the phones to the "B" battery instead of the audio transformer. In case a second step is added, the same action occurs all over again, thus multiplying the output a second time.

### Building the Amplifier

In adding this unit, the first thing to do is to find where the phones were connected before. This is shown dotted in Fig. 9. If these connections were not made by a jack, which had two or four springs, then a two spring (or four spring) jack must be substituted. Many listeners do not want to plug in on the detector alone, as the first step gives so much better results. In such a case the detector jack may be omitted entirely, and the upper end of the primary run direct to the connection, which is used to carry the phones. If it is ever expected to add a second step of audio, then the phones should be connected through a spring jack inserted in the plate circuit of the first step. Of course, a jack can be used here anyway to make an easy connection to the phones.

The next thing to do is to locate by-pass condenser, Cb. Most sets use such a unit, but a few especially of the older make, depend on the capacity of the phone cord itself to supply the capacity needed to by-pass the radio frequency. Since the phone and its cord is now taken out of the detector circuit, it can no longer supply this action. For that reason it is necessary that such a condenser be connected across the primary of the audio transformer (or the jack) in order to get satisfactory detector action. If you find that such a condenser, with a capacity of .001 or .002 mfd. is already used in the set, then no change here is required, but if it is omitted, then it must be inserted as shown in the dotted line.

If a second step of audio is added, it is not necessary to use a second stopping condenser. This unit passes only the radio frequency, and no such high speed oscillations appear after the first audio transformer. That is why in adding the second step, no second condenser is needed.

### Omitting Rheostat

The tendency of the modern set toward amplification is seen in the fact that the rheostat, as shown in the diagram, is usually omitted. Just as good results can be obtained when the detector rheostat is used to control the amplifier

filaments as well. For those who wish a separate control, the diagram may be followed exactly. Those who do not wish the extra complication should run the filament lead (now shown connected to the rheostat) direct to the corresponding point on the detector rheostat. When this is done, observe that turning the latter makes both tubes brighten at the same time.

When adding a second step of audio, the same reasoning applies to its control. Since most of the time both steps will be in use, it seems unnecessary to employ a separate switch to cut the last tube off. If such action is wanted it can be arranged by using a filament control jack in the second step. On the older sets a rheostat was used with each detector tube and so the individual control was arranged for. If the second step rheostat is omitted, the lead should also be connected to the rheostat of the previous tube.

### Using a "C" Battery

If only 45 volts of "B" battery are hooked up, then no "C" battery should be used. In such a case the lower end of the secondary runs direct to the "A" minus binding post. Note that this post as shown is not a separate one, but is the same as is used for the detector. With 67 or 90 volts of "B" there is a double advantage in using a "C". In the first place the life of the "B" battery is doubled or even tripled, and besides that the music comes through clearer and with less distortion Either 3 or 4½ volts of "C" should be used, depending on the pressure of the "B" battery.

The same "C" should be hooked up to both steps when a second audio is added. To make this connection run a wire from the lower end of the secondary of the last transformer direct to the minus terminal of the "C", which will then have two connections on it.

### Adding a Second Step

If your set already has one audio amplifier, or you are going to install one, you may wish to add a second. This can be done using the same diagram, Fig. 9. Just repeat the same connections over again substituting the two (or four) spring jacks as shown at the left, in place of the phone connection of the previous step as drawn at the right of the figure. As has already been explained, a separate rheostat may be used, but is not needed. The same "C" battery does for both sets and the same is true of the "B" + 45.

### Operation

To operate one or two stages of audio frequency amplification, the only adjustment necessary is that of the rheostat to light the tubes to the proper temperature. Then plug in detector, first or second step jack, and if the tuner has been already set to catch the music, you will hear it several times as loud for each multiplication by the amplifier.

## 10—COMPLETE THREE-TUBE REGENERATIVE

Of all the sets which may be built we advise this one as being the best for any one who wants to put together his first three tube outfit. It is quite selective, has a range of 1500 miles under good conditions, and is loud enough to work a horn very well indeed up to 1000 miles.

This hook-up is really a combination of the two-circuit single tube set hook-up No. 5 with a two step amplifier, as shown in Hook-up 9. It is drawn out here in detail because it is so very popular. that combining both elements in one diagram is an advantage.

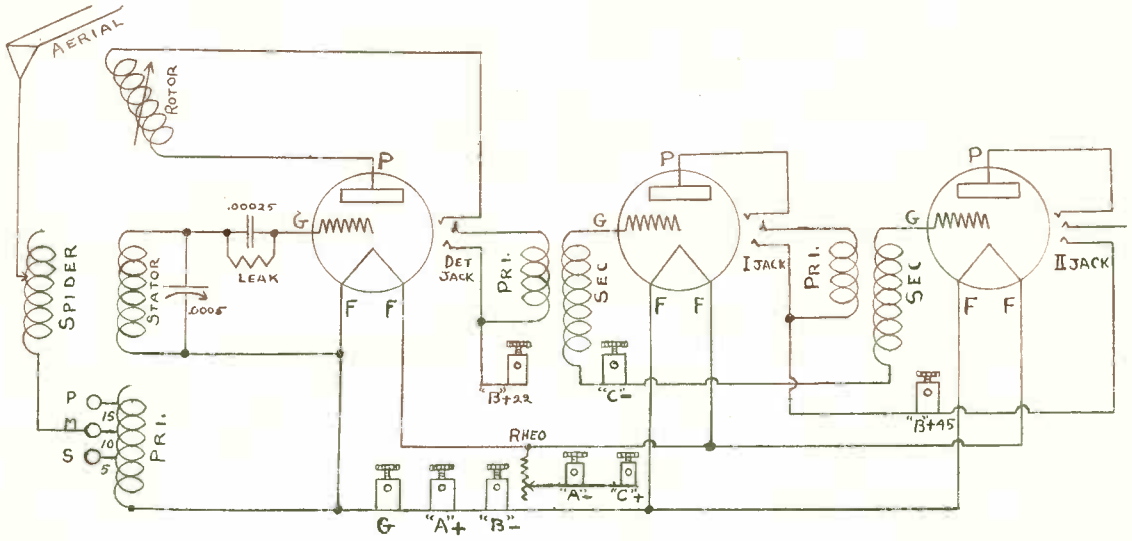



Fig. 10. This is Recommended as One of the Best 3 Tubes—Not Bad Squealer

If a start is made to build the entire circuit, since it is more ambitious than the single tube set, we recommend using a little better material. For that reason we are adjusting the prices to give a good grade of the various parts.

### List of Materials

(First read Page 5)

| | | |
|---|---|---|
| 1 | 23 plate condenser | $3.00 |
| 1 | Spider web coil, tapped | .30 |
| 1 | Variocoupler | 3.00 |
| 2 | Tap switches @ $1.00 | 2.00 |
| 1 | Grid condenser | .35 |
| 1 | Adjustable grid leak | .75 |
| 3 | Sockets @ $.50 | 1.50 |
| 1 | Rheostat | .50 |
| 1 | Panel 7x21 | 2.00 |
| 2 | Dials @ $.35 | .70 |
| 1 | .001 By-pass condenser | .15 |

2 Good audio transformers @ $4.00 8.00
3 Jacks (two spring) @ 40c.... 1.20
Set of Binding posts—Ant, G, A+, A—, B+45, B+22, B—, C+, C— .45
Busbar, etc.

**Extras**

Aerial and Ground .....$3.00
3 Tubes @ $4.00 .....12.00
Phones . . . . . 5.00
Phone plug ..... .40
45 Volt "B" battery ..... 4.00
3 Dry cell "A" batteries @ $.40.. 1.20
1 Loud Speaker $6.00 to $50.00
1 Cabinet 7x21x7 deep ..... 6.00

**Optional**

45 Volt Additional "B" battery....$4.00
1 4½-volt "C" battery ..... .50
Extra rheostat to control amplifiers .50

### Theory and Operation

This set works in the same way as was described for hook-up No. 5.

### Construction

In laying out the panel, the two tap switches which control the spider loading coil and the primary are at the left. Next comes the rotor dial for adjusting the tickler, and at its right the .0005 mfd. secondary condenser for tuning. At the right will be found the rheostat and the jacks. The method of hooking up the set is the same as described in Hook-ups 5 and 9.

## 11—RADIO FREQUENCY AMPLIFIER

Under hook-up No. 9 we explained that by adding one or more steps of audio frequency amplification the loudness was increased quite a lot, but the range was not extended very much. The only way to increase the distance which your set will pick up is to include one or more radio frequency tubes ahead of the detector. Such a tube should add several hundred miles to your range, but will not increase the loudness to any great extent.

However, it should be explained right at the start that it is not very easy to add radio amplifiers to a set already built and get much improvement. Most fellows after putting this addition on their set report that it works nearly as well as before. The reason is that radio frequency has such a high speed of vibration (about 1,000,000 cycles per second) that the small amount of leakage capacity which exists in any set is apt to steal so much of the current that the loss is greater than the gain from the amplification.

### Difficulties of R. F.

With this in mind it is absolutely necessary to take all precautions to keep the leads as short and direct as possible. They should not be run close to each other nor parallel unless they are spaced at least an inch apart. Even then the average builder has great trouble in adding to the distance he can pick up.

The most popular set using radio frequency (R. F.) is the neutrodyne, but this set does not include regeneration. For that reason the two steps of R. F. ahead of the detector give just about the same range in miles as a good regenerative set. When it comes to adding a step ahead of a detector which uses a tickler that is something else again. That is why you cannot compare the action of such a unit on a neutrodyne with its behavior on a regenerative set.

### List of Materials

(First Read Page 5)

1 Variocoupler. . . . . $3.00
1 Tap switch ..... 1.00
1 23-plate condenser ..... 3.00
1 R. F. Transformer..... 2.50
1 Grid condenser ..... .35
1 Grid leak ..... .25
2 Sockets @ 50c..... 1.00

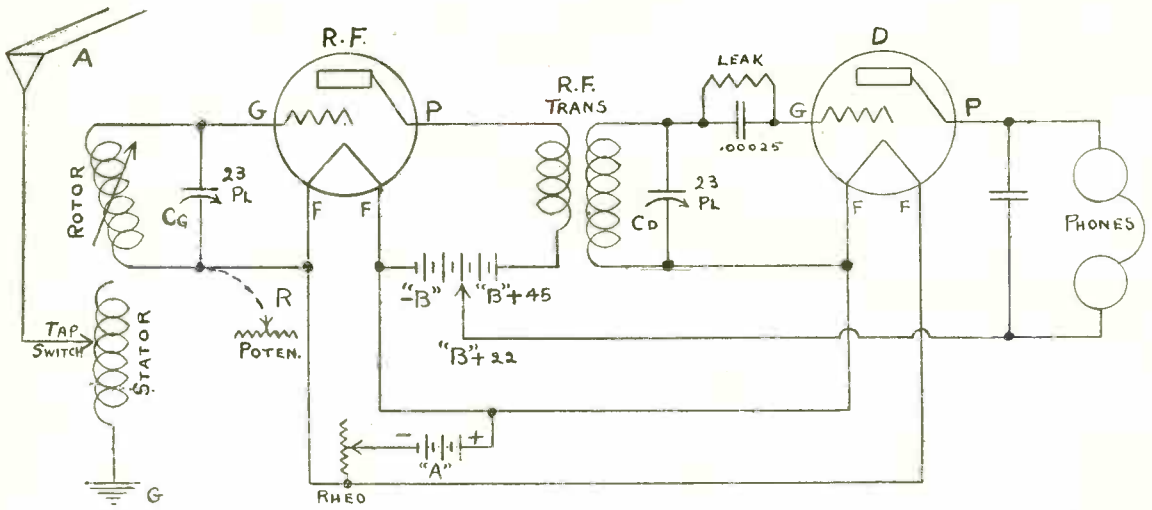



Fig. 11. How to Put a Radio Amplifier Ahead of Detector Tube to Increase Range

1 Rheostat. . . . . .50
1 Panel 7x14 ..... 1.00
2 Dials, @ 35c..... .70
1 .001 By-pass condenser..... .15
Set of 7 binding posts..... .35
Busbar, and etc.

**Extras**

Aerial and ground.....$3.00
2 Tubes, @ $4.00..... 8.00
Phones. . . . . 5.00
45 Volt "B" battery..... 4.00
3 Dry cell "A" batteries, @ 40c.. 1.20
1 Cabinet 7x14x7. . . . . 4.00

**Optional**

1 200-Ohm potentiometer ..... .75
1 .002 Condenser ..... .15
1 23-plate condenser ..... 3.00
1 Dial . . . . . .35
1 Phone jack ..... .40
1 Phone plug ..... .40

### Construction

This radio amplifier will usually be added to a three-tube set consisting of detector and two audio steps. If the two audios have not already been supplied then it is better to add them first before using the radio step. The diagram Fig. 11 shows only the detector since the steps of audio have already been illustrated in hook-ups 9 and 10. If, however, only two tubes are to be used, a panel 7x14 is big enough. In this case the variocoupler dial will be in the center with the tap switch on the left and the tuning condenser at the right. The second condenser Co may be used if you want to get the sharpest tuning, and in that case you should leave room for its dial at the right.

The ordinary radio frequency transformer will not require such a condenser. In looks it is a small device about as big around as a UV-201A tube, and usually only about two thirds of its height. If you are going to get the maximum of sharpness of tuning out of this set so as to be able to pick up distance through loud, local stations, then you will do better to use the neutrodyne style of transformer.

### Building Your Own RF

If you wish to build your own transformer, get two fibre tubes, one of which fits fairly closely inside the other, with diameters of about three inches. The primary, which is the inside coil, is made by winding on fifteen turns of No. 22 DCC wire at one end of the tube. The secondary, consists of sixty turns of the same wire, spaced so that the beginning of the winding lies right over that of the primary underneath. It is customary to wind these two coils in opposite directions, although in many sets it makes no difference. Such a transformer must have its secondary tuned by an adjustable condenser, as shown in Fig. 11. In case the first style of transformer is used, just omit this condenser.

Notice at the left hand side of the diagram the wire R running dotted to the potentiometer. This unit is not really necessary, but may be employed to control the loudness of the set. Also it is an advantage to prevent any undesirable oscillations, which might occur and so distort the music. If it is used wire, R, should be taken off the filament lead and run to the center of the potentiometer. The two end connections should go to the "A" plus and "A" minus. It makes no difference which is which, as the adjustment of the center arm will take care of the polarity. Then the radio frequency oscillations must thread their way through this resistance to get to the filament, which reduces the sharpness of tuning to a slight extent. To prevent this loss, it is well to connect a .002 condenser from the center terminal to the "A" plus of the filament. This allows the radio frequency to go through the condenser instead of the high resistance of the potentiometer.

### Theory of the Circuits

The antenna waves come through the tap switch and stator to the ground. It is tuned by adjusting the number of turns with the switch. The magnetic energy is picked up by the rotor. By turning it in line with the stator the maximum energy is picked up, which gives the loudest signals but reduced selectivity. The rotor is the secondary and is tuned by condenser Cg. The potentiometer (if used) puts the proper bias on the grid. If this is omitted the grid return should be connected to the minus of the "A" battery rather than to the minus of the filament as shown.

The output from the plate excites the primary of the radio frequency transformer, and returns to the high pressure side of the "B" battery. Notice that no by-pass condenser is used across the transformer since owing to the lack of an iron core this latter unit is able to pass the radio frequency.

The secondary of this transformer (which may be tuned by condenser, Co. as described) passes on the amplified oscillations to the filament and through the grid condenser to the grid of the detector tube. The output from the plate excites the phones in the ordinary manner. The phones are by-passed by a .001 condenser to allow the high frequency to get back to the "B" battery and filament.

### Operation

This set is controlled like any other non-regenerative hook-up. With the tap switch adjusted for about the wave length you wish to get and the rotor of the coupler in line with the stator (to give loudest signals) turn condenser, Cg, and also Co, (if used) keeping them about together until a signal is heard. The tap switch may be turned to another button and the condensers readjusted to see if the signals can be made any louder. When the tuning has been found best the rotor should be shifted to give increased selectivity if a local station interferes.

### Connecting the Detector

The second tube, which is the detector is hooked up in the regular way. The output is shown going to the phones, but as already explained it is better to use a jack at this point so that one or two steps of audio amplification can be used to increase the volume of the programs. Notice that the return from the phones goes to the 22-volt tap of the "B" battery, while the first tube makes use of 45 to 90 volts.

The same rheostat is used to adjust the voltage for the filaments of both tubes. This is an advantage in reducing complication, but if separate control is desired, the extra rheostat can be connected in for the second tube.

## 12—FOUR-TUBE REGENERATIVE SET

Here is a set that will work on a loop. Of course, with such an aerial you can not expect to get the range which will be obtained by using an outside aerial. It is a question of size, and the small loop cannot scoop up as much energy as a large antenna. Of course, this hook-up may be used with the latter by substituting the rotor of a variocoupler for the loop and connecting the stator through a tap switch, direct to the aerial and ground.

Although two stages of radio frequency are used, the detector is made regenerative, which still further increases the range. The two tubes of RF ahead of the detector prevent this set from disturbing the neighbors. There may be a small amount of oscillation which is carried backward through the capacity of each tube, but with the two in series the amount is reduced to such a low figure that no trouble will be experienced from this cause, even when the regeneration variometer is adjusted wrong, so that the detector itself is forced into oscillation.

The grid of the first tube is tuned to resonance by condenser Cs. The second and third tubes are not shown in Fig. 12 as being tuned, as it is not necessary, provided the ordinary style of radio transformer is used to couple the tubes together. If the sharpest tuning of this

set is wished for, then it will be an advantage to substitute RF transformers of the neutrodyne class and in that case two more variable air condensers will be needed to tune the grids of tubes II and III. These are not shown in the hookup, but it will be understood that they are connected between the grid and the filament.

| | | |
|---|---|---|
| 1 | Tap switch | 1.25 |
| 1 | Dial | .50 |

If RF transformers are to be tuned, add

| | | |
|---|---|---|
| 2 | Variable condensers, .00025, @ $3.50 | $7.00 |
| 2 | Dials @ 50c | 1.00 |

### Theory of the Circuit

The loop picks up the broadcasting and after being tuned by condenser Cs the oscillations are impressed on the grid and through condenser C1 on the filament. If an aerial is used instead of the loop, then the primary, which is tuned by a tap switch, runs from aerial through the stator to ground. The rotor or secondary then takes the place of the loop and is tuned by condenser Cs as just explained. The output from the plate of the first tube goes through RF1 transformer to the "B"+45 battery. The secondary oscillates between the grid of tube II and its filament, through condenser C1.

The output of RF amplifier II passes the high frequency on through RF2 transformer to the grid condenser and grid of detector III. The plate of the detector is tuned by the variometer, which when adjusted to resonance gives a feedback action and so gets the extra increase in loudness due to regeneration. The high frequency passes back to the filaments through condenser C2, but the audio waves thread the primary of AF transformer to the "B"+22. The secondary from this unit is hooked up to the audio amplifier IV in the usual way.

### Building the Set

The layout on the panel depends on whether you are to use *tuned* RF transformers or not. At any rate, you need a dial for condenser Cs and one for the variometer. The two other condensers, if used, will require dials. The loudness of the set is just as great, and the operation is considerably easier if they are omitted. In cities where there is a large amount of interference perhaps it is better to use them, as they assist somewhat in getting rid of local stations.

The outside aerial, if used, will pick up much greater distances, but will require two more controls—the tap switch to tune the primary and a dial to adjust the coupling through the angle of the rotor. Since this latter will not need to be shifted when it is once set for the position which gives you the best results, it is not really necessary to mount such a dial on the panel.

### Using the Jacks

In the diagram no phone jacks are illustrated. It will not be required to use them, as the phones can be connected to the first step of audio all the time without any trouble. It is rare that a detector jack would ever be used. However, it can be cut into the plate circuit between condenser C2 and the primary of the AF transformer if wanted. In case a second tube of audio is to be used (not shown here), then run the plate of tube IV to this unit instead of connecting direct to the phones. Such a second step may be added to advantage by fol-

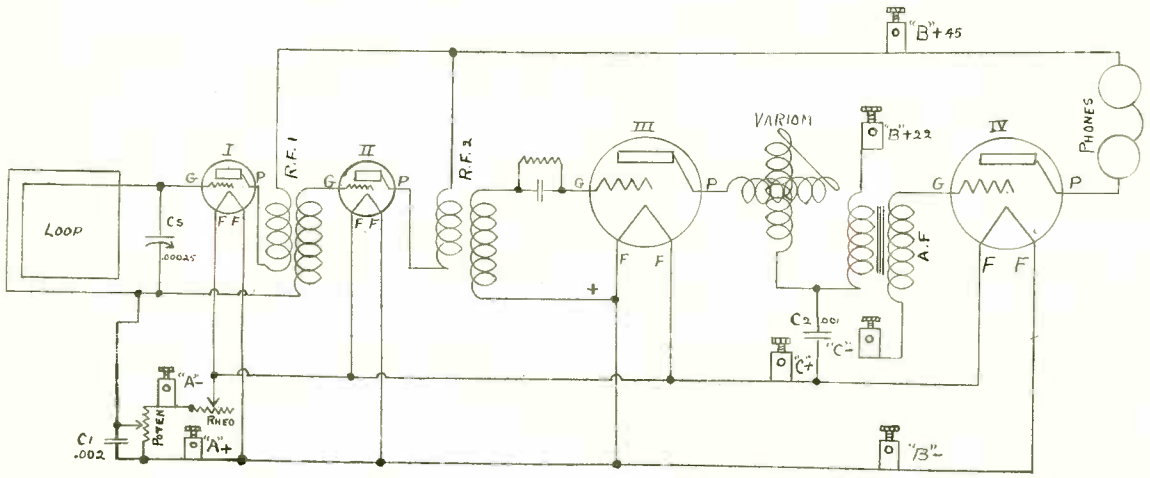



Fig. 12. Two-Step RF Amplifier Has Regenerative Detector. One AF is Added

### List of Materials

(First see Page 5)

| | | |
|---|---|---|
| 1 | Variable condenser, .00025 | $3.50 |
| 1 | Paper condenser, .002 | .15 |
| 1 | Mica Condenser, .001 | .40 |
| 1 | Grid condenser, .00025 | .35 |
| 2 | RF transformers @ $2.50 | 5.00 |
| 1 | AF transformer, 3½ x 1 | 4.00 |
| 1 | Variometer | 4.00 |
| 1 | Adjustable grid leak | .75 |
| 1 | 200-ohm potentiometer | 1.00 |
| 1 | Rheostat | .60 |
| 4 | Sockets @ 75c | 3.00 |
| 2 | Dials @ 50c | 1.00 |
| 1 | Panel, 7x21 | 2.50 |
| | Set of nine binding posts | .50 |
| | Busbar, etc. | |

#### Extras

| | | |
|---|---|---|
| | Loop | $5.00 |
| 4 | Tubes @ $4.00 | 16.00 |
| | Phones | 5.00 |
| 45-Volt "B" battery | | 4.00 |
| 3 | Dry cell "A" batteries @ 40c | 1.20 |
| 1 | Cabinet, 7x21x7 deep | 7.00 |

#### Optional

| | | |
|---|---|---|
| 2 | Phone jacks @ 40c | $ .80 |
| 1 | Phone plug | .40 |

If aerial is to be used, omit loop and add

| | | |
|---|---|---|
| 1 | Variocoupler | $3.00 |

lowing hook-up 9.

Notice that a "C" battery connection is made for the first step of audio. If the "B" pressure is only 45 volts, then the "C" battery should be omitted and a short wire run from binding post C+ to C—. More than 45 volts of "B" requires a "C" battery or 3 to 4½ volts.

### Connecting the Potentiometer

This unit is connected right across from "A"+ to "A"—, with the center post connected so as to put a bias on the grids of the two RF amplifiers. This bias potential reaches the grid of tube I through the loop and grid II through the secondary of RF1 transformer.

As remarked when discussing radio frequency hook-ups, it is quite necessary to make the grid leads as short and direct as you can. The plate connections also should be short and kept some distance away from the grid. Otherwise a self-oscillation may cause distortion in the music.

Only a single rheostat is used to control all the tubes. This is in line with modern practice, but if you prefer a separate rheostat for the detector it may be cut into the negative side. Notice that the grid return from the detector must go to the positive side of the filament.

### Operation

First set the potentiometer to about the middle, then with the variometer turned up so that the set is just about ready to squeal, turn the Cs condenser until a station is brought in. If the tuned RF condensers are employed it will be necessary to turn all three of their grid control dials at the same time, which is a much harder method of tuning. When the station is brought in clearly, the variometer may be used to get more or less feedback. The potentiometer is adjusted to prevent radio frequency oscillations in the first two tubes. It should be held as near the negative end of the wire as possible without causing any squealing in the phones.

## 13—THREE TUBE REFLEX CRYSTAL

Here is a reflex set using a crystal which will work on a loop. Of course, more energy is brought in by a larger aerial and we recommend the latter where greater distances are to be picked up. The loop, however, because of its directional effect, is able to tune out even the most powerful broadcasting stations when it is turned so that the axis of the coil points toward the unwanted station.

Only two steps of audio are hooked up and so the third tube is used only for RF amplification. If preferred, this later may also be employed for audio, but is usually not desirable, as three steps using good AF transformers give so much amplification, that the smallest noises coming in are apt to be amplified so much that the music will not be enjoyed through the racket.

Some three tube reflex hook-ups show the first tube instead of the third, as the one which is used on only frequency. This has the disadvantage that the third tube carries the greatest RF load and also the largest AF currents. In this way the tube may be overloaded. With our connection the third tube has the biggest RF load and the second tube the greatest AF current. By thus dividing the energy neither tube becomes overloaded.

### List of Material

(First, see Page 5).

| | | |
|---|---|---|
| 1 | Variable condenser, .00025 | $3.50 |
| 5 | Mica condensers, .001 @ 40c | 2.00 |
| 1 | Condenser, .002 | .15 |
| 2 | RF transformers @ $2.50 | 5.00 |
| 2 | AF transformers @ $4.00 | 8.00 |
| 1 | Crystal detector, complete | 1.00 |
| 1 | 200-ohm potentiometer | 1.00 |
| 1 | Rheostat | .50 |
| 3 | Sockets @ 75c | 2.25 |
| 1 | Dial | .50 |
| 1 | Panel, 7x21 | 2.50 |
| 6 | Binding posts | .30 |
| | Busbar, etc. | |

### Extras

| | | |
|---|---|---|
| | Loop | 5.00 |
| 3 | Tubes @ $4.00 | 12.00 |
| | Phones | 5.00 |
| 45 | Volt "B" battery | 4.00 |
| 3 | Dry cell "A" batteries @ 40c | 1.20 |
| 1 | Cabinet, 7x21x7 deep | 7.00 |

### Optional

| | | |
|---|---|---|
| | Phone jack and plug | .80 |

If aerial is to be used omit loop and add

| | | |
|---|---|---|
| 1 | Varioeoupler | 3.00 |
| 1 | Tap Switch | 1.25 |
| 1 | Dial | .50 |

### Theory of the Set

This hook-up employs the first two tubes as amplifier of both radio and audio frequency waves. The energy from the broadcasting station is picked up by the loop and tuned by condenser Cs. The oscillations are fed to the grid and through condensers C1 and C6 to the filament of tube 1. The output from the plate, after passing the primary of transformer RF1, uses by-pass C2 to reach the "B" battery.

The amplified waves reach the grid of tube II from the secondary. The other end of this winding passes them on through C3 and C6 to the filament. The same operation again increases the signals through transformer RF2 to tube III and the primary of RF 3. The secondary of this latter has its output rectified by the crystal detector. After separation by the crystal into radio and audio waves, the former return by condenser C5 and the latter by transformer AF1.

The secondary of the audio transformer is not shorted by condenser C1 as might appear from the diagram, since this capacity is too small to conduct the audio waves. Instead the low speed vibrations run through the potentiometer to the filament and through the loop winding to the grid of tube I and thus make the input to the first audio amplifier. The output from this tube, owing to its low frequency, is not affected by the primary of transformer RF1, nor the capacity C2. It, therefore, threads the primary of audio transformer AF2 to the "B" + 45 terminal. The secondary of this transformer excites the grid of tube II. The output of its plate works the phones or loud speaker in the usual way.

### Why the Potentiometer

Notice the potentiometer is at the left hand end. This is used to put the proper voltage or bias on the grids of the three amplifier tubes. The resistance wire of this unit is connected to the "A" — and the "A" +. The center post carries the voltage to the different grids by way of the secondaries of audio and radio transformers. By adjusting this unit to the proper value it allows the set to give the maximum volume without breaking into oscillations. Many hookups show the first tube connected in this way but the second and third steps have the grid return connected to the "A" —. This is a disadvantage since the proper setting of bias for one tube is also correct for the others. By the scheme shown here all the tubes get the same bias and so are equally efficient.

No grid leak condenser is needed with

this radio since all the tubes act as amplifiers and the dectetor is a crystal. Of course another tube could be substituted for the crystal with a gain in efficiency. It would then require a grid condenser and leak. Since the detector tube is never reflexed no trouble will be experienced in substituting it for the crystal.

### Building the Set

If the loop is to be used to pick up the waves, then notice that only a single control condenser Cs, is used to tune in and adjust for various stations. This is one of the few sets with a single control appear on the right of the panel. The condensers, C1 to C5, should all be of mica, so as to reduce the losses as far as possible. Condenser C6 is not really necessary, but is used as a by-pass around the potentiometer so that the waves do not have to go through the resistance of this unit. A paper condenser will do here although a mica one would be perhaps a slight improvement.

If an outside aerial is to take the place of the loop then connect the rotor of this unit just as the loop is now shown. The stator has one lead connected to ground and the taps running it.

Of course the detector must be either the fixed kind or else you must be sure that the cats whisker is on a sensitive spot. With such a hookup it is convenient to use a crystal which is alive all over. Such a one will bring in the music no matter where it is set and then different spots can be tried to see which is the best.

## 14—THREE-TUBE INVERSE REFLEX

When properly built this set is the most powerful in this list of hook-ups.

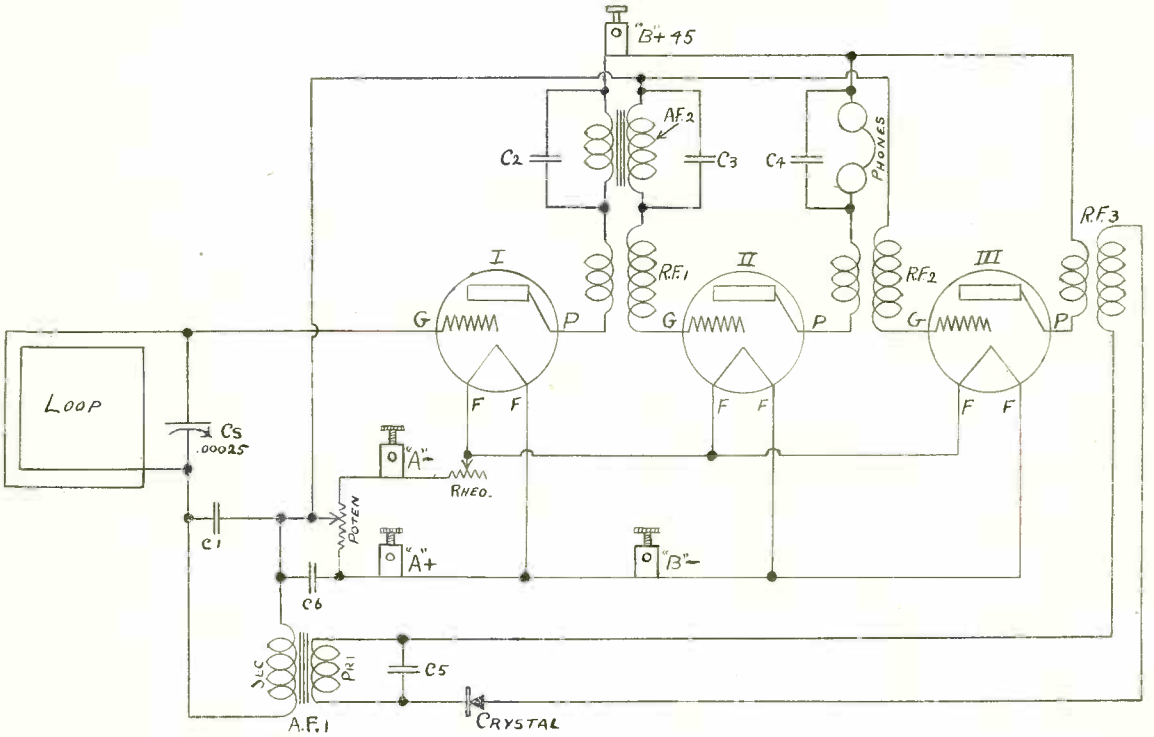



Fig. 13. Three RF Amplifiers, Crystal and Two AF Steps With Loop

which is satisfactory in theory and in practice. In that case symmetry would demand that the control dial should be in the center of the panel. It is probably better to sacrifice the looks slightly, as by such a location it is difficult to have all the grid leads short. A better place at least from the electrical point of view, is at the left hand side next to the grid of tube I.

The radio frequency transformers RF1 and RF2 should lie between the tubes across the front of the cabinet. The audio transformers can be placed at the rear. Potentiometer and rheostat will through the tap switch to the aerial. This gives considerable more volume and distance but sacrifices the advantage of the directional effect which the loop possesses.

### Operating the Set

It is easy to work this equipment. After bringing the filaments up to the proper brightness there is only one control—the variable condenser Cs. When you have picked up a station then try turning the loop around to point in different directions and you will find that the station is loudest when the coil is pointing with one edge directly towards It has only three tubes but with them we get two steps of radio frequency amplification, then a regenerative tube detector, and this is followed by two steps of audio amplification. However, as is always the case where you make one article serve two distinct purposes, there is apt to be considerable more trouble than if each has only one function to perform.

The particular thing about the inverse reflex is the order in which the audio amplification occurs. Instead of going through tubes I, II, III, I and II, as is customary, it uses the tubes

in this order, I, II, III, II, I. This reverses the direction through the last two tubes, as you will notice. The advantage of this order is that of the two amplifier tubes (I and II), the second carries considerably heavier load of RF than the first. This is because the first amplifies the input up to four or five times what it originally was before impressing it on tube II. The ordinary method of reflexing puts the output from the detector on tube I again and amplifies this at audio frequency into tube II.

Thus it will be seen that the second step gets the big load of *audio* as well as *radio*. In this hook-up since the order of AF is reversed, the second tube gets the output from the detector, and amplifies this to the first. By this means the two tubes divide the load much more evenly, as the heavy load of radio comes on the second, while the audio frequency load is large on the first tube.

There is no particular trouble in accomplishing this result. Instead of feeding the output from the plate through the first tube it merely is switched to the second. The actual path of the current will be clear from Fig. 14.

### List of Materials
(First see Page 5)

| | | |
|---|---|---|
| 1 | Variometer | $4.50 |
| 1 | Variocoupler | 3.50 |
| 1 | Variable condenser, .00025 | 3.50 |
| 5 | By-pass condensers, .001, @ 40c | 2.00 |
| 2 | RF transformers, @ $2.50 | 5.00 |
| 2 | AF transformers, @ $4.00 | 8.00 |
| 1 | Rheostat | .50 |
| 3 | Sockets, @ 75c | 2.25 |
| 3 | Dials, @ 50c | 1.50 |
| 1 | Grid condenser, .0025 | .35 |
| 1 | Leak | .50 |
| 1 | Panel, 7x21 | 2.50 |
| 7 | Binding posts | .35 |
| | Busbar, etc. | |

### Extras

| | |
|---|---|
| Aerial and ground | $3.00 |
| 3 Tubes @ $4.00 | 12.00 |
| Phones | 5.00 |
| 45-Volt "B" batteries | 4.00 |
| Cabinet, 7x21x7 deep | 7.00 |

### Optional

| | | |
|---|---|---|
| 1 | Phone Plug | $ .40 |
| 1 | 2 or 3 jacks, @ 40c | |
| 1 | 4½-Volt "C" battery | .60 |
| 1 | Extra 45-volt, "B" battery | 4.00 |

### Theory of Circuits

The waves from the aerial run through the stator or primary to the ground. This coil is tuned by the tap switch. The magnetic energy is transferred to the rotor in greater or lesser degree, depending on the angle it bears to the primary. When in line the least selectivity and loudest volume results. The secondary is tuned by Condenser Cs. The input to the first tube then oscillates from the grid through the rotor, and condenser C1 to the filament. The output of tube I excites the primary of radio frequency transformer RF1 and through condenser C3 returns to the filament.

The secondary of this transformer impresses the amplified RF on the grid of Tube II and through condenser C4 to the filament. This action is repeated through transformer RF2 to the detector tube III. The output from the plate of the detector is tuned by the variometer, which thus gives regeneration or feedback. After passing the variometer the RF uses condenser C5 as a grid return. The audio frequency which cannot pass such a small condenser, passes the primary of audio frequency transformer AF1 to get to the "B" + 22 terminal of the "B" battery.

The output from this transformer goes direct to the grid of amplifier tube through the secondary of RF1, which does not affect the audio frequency. The AF output from tube II,

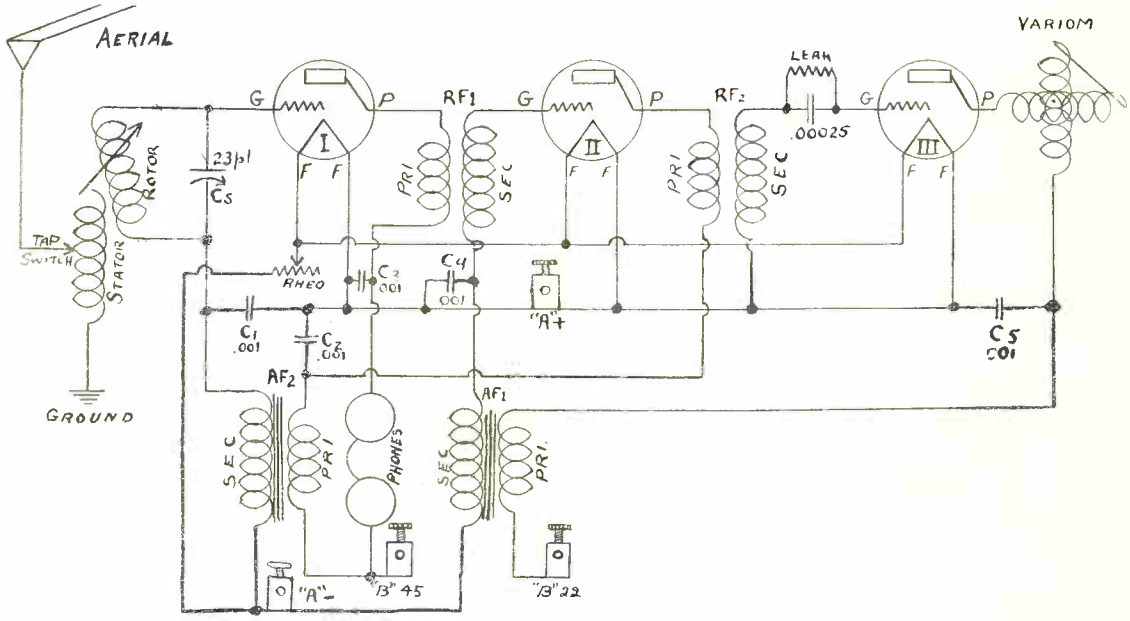



Fig. 14. A Most Powerful Set—Two RF Steps, Regenerative Detector, and 2 Inverse Reflexed AF Steps

after threading the primary of RF2, (which does not affect it) passes through the primary of audio frequency transformer AF2 to the "B" + 45 post. The secondary of this transformer transfers the audio oscillations to the grid of tube 1 through the rotor of the coupler, and through the rheostat to the filament.

The audio output from tube I, after passing RF1 operates the phones and then goes to the "B" + 45. The audio waves have not been by-passed by any which runs from each of the audio secondaries to the "A"—, and connect these two wires together to the minus of the "C" battery. The plus of the "C" battery then will run to "A" minus.

No phone jack is shown after either detector or first step of AF amplification. If these are desired they can be inserted across the primary of the AF transformers in the usual way. However, in all good reflex sets the wiring should be kept down to the absolute minimum, so we recommend that this

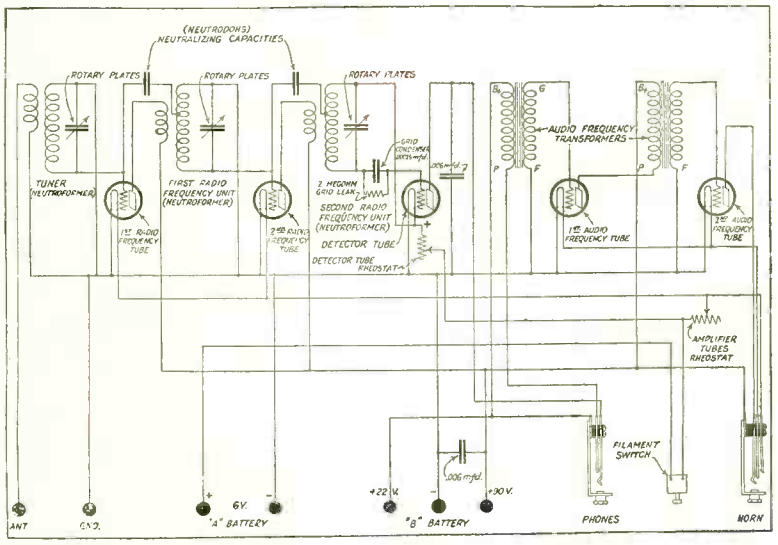



Fig. 15. One of the Best Neutrodyne Sets

of the .001 condenser since this value is too small to allow these slow vibrations to pass through it. The radio frequency, however, is able to use these units as short circuits around the large inductance or weight of the AF transformer coils.

### Construction

The layout of this set is quite similar to Reflex Hook-up 13. The main difference is that two additional dials are needed, one controlling the coupler, and the other the variometer. The wiring itself also is similar, but notice that no crystal detector is needed but a grid condenser and leak are used on the third tube. The connection between the tubes is the same as before except that Tube III is followed by Tube II, as already noted.

No "C" battery is shown in the hookup, but it is an advantage to use one in case the "B" battery runs more than 45 volts. To use a "C" remove the lead added device be omitted.

### Operation

The first dial determines the selectivity and loudness. The second is the wave length selector and picks out the stations. The variometer adjuster is for resonance of the plate circuit, and so adjusts the amount of feedback or regeneration.

## 15—5-TUBE NEUTRODYNE

This set has been regarded as one of the best for the last two years. It has the advantages of sharp tuning (selectivity) and also will pick up one thousand to 1500 miles. Another good point is that it will not oscillate and disturb the surrounding listeners. The stations once heard can be logged and picked up again at the same settings.

The drawbacks are that the five tubes require enough energy to light them so that it is best to use a storage battery. Also three dials must be turned to the correct setting at once to be able to hear the distant station. This is sometimes rather difficult and faint signals are apt to be overlooked.

### List of Materials

(First read Page 5)

| | | |
|---|---|---|
| 3 | Variable condensers, .00025 @ $3.50 | $10.50 |
| 3 | Neutroformers, @ $3.00 | 9.00 |
| 2 | Audio transformers, @ $4.00 | 8.00 |
| 2 | By-pass condensers, @ 40c | .80 |
| 2 | Neutrodyne condensers, @ $1.25 | 2.50 |
| 1 | Grid condenser, .00025 | .35 |
| 1 | Grid leak | .35 |
| 2 | Rheostats, @ 50c | 1.00 |
| 5 | Sockets, @ 75c | 3.75 |
| 3 | Dials, @ 50c | 1.50 |
| 1 | Panel, 7x26 | 2.75 |
| 2 | Phone jacks (2 spring) | .50 |
| 1 | Phone jack (Filament control) | .90 |
| 7 | Binding posts | .35 |
| 1 | Filament switch | .40 |
| | Busbar, etc. | |

### Extras

| | | |
|---|---|---|
| | Aerial and ground | 3.00 |
| 5 | Tubes, @ $4.00 | 20.00 |
| | Phones | 5.00 |
| | 90-Volt "B" Battery | 8.00 |
| | 6-Volt "A" Battery | 18.00 |
| 1 | Cabinet, 7x26x7 deep | 8.00 |

### Optional

| | | |
|---|---|---|
| 1 | "C" Battery | .50 |
| 3 | Vernier Dials, @ $2.00 | 6.00 |

### Theory of Hookup

The radio waves oscillate from the antenna through the primary of the first neutroformer to ground. The secondary tuned by the first condenser carries the input to the grid. The output from the plate operates the primary of the second neutroformer. This action is repeated to the third or detector tube which contains the leak and condenser in the grid circuit. The output goes through two audio transformers and amplifiers as explained in hookup 9.

The phone jack is inserted in the output of the detector and may be used for sharp tuning. The amplifier jack takes in both steps and when the plug is inserted the filament control turns on the "A" battery for the last two tubes.

### Building This Radio

The layout for the panel usually follows the arrangement in the same order as shown in Fig. 15. The exact drilling plan for this set was given on

Continued on Page 32.

# Will the Moon Shadow Shut Out Radio?

Radio listeners are asked to help in these experiments.

The Bureau of Standards at Washington have been interested in radio for a long time. They have now decided to measure the fading and the apparent direction of radio signals as the moon's shadow passes over the United States. The eclipse which will occur on the morning of Saturday, January 24, is the first total eclipse which northeastern United States has seen for a great many years. As a matter of fact the zone passes over an area which is more thickly populated than any that has *ever* been eclipsed before.

The path of darkness starts at Buffalo, Rochester, New Haven and Springfield, and then goes out into the Atlantic Ocean. In the path of complete darkness there are eleven astronomical observatories. These are all arranging to take photographs of the heavens at the time.

The general investigation is being organized by Mr. G. W. Pickard, a prominent radio engineer of Boston. The Bureau of Standards is co-operating with Mr. Pickard by collecting data from laboratories, while the Scientific American has undertaken to gather information from amateurs, in accordance with a special program it has outlined. Stations WGR (940 kc.) at Buffalo, N. Y.; WGY, (790 kc.) at Schenectady; WBZ, (920 kc.) at Springfield, Mass.; and WEAF, (610 kc.) in New York City are to send the signals on which measurements are to be made. The first of these is in the center of the shadow path, the second and third on its northern edge, and the fourth on its southern edge.

Laboratories having the necessary equipment are to make measurements on the carrier wave, recording the actual strength of the wave. It is expected that this will vary as the shadow passes, showing effects similar to those observed with change from day to night. Possible reflections from the shadow wall and other changes in direction are also looked for. It is expected that the effects will be most pronounced with short waves, and perhaps not noticeable with long waves.

The radio investigation will take in the effect the darkness has on transmission between various listeners located in pairs. One will be at the north of the dark zone and one at the south and the idea is to see how the transmission between them varies as the dark shadow advances across the country. The material to be sent has been prepared already and is known to the receiving stations. They will follow the reading and notice which words are especially loud or soft.

The list of questions sent out is as follows:

1. If the sun is not quite eclipsed at your station there will always be a bright edge of the sun visible, or perhaps only a single point. One bright point may appear on one edge of the sun before the other has entirely disappeared. At your station was there any time at which no bright edge of the sun was visible? Answer YES or NO.....

2. If the bright edge of the sun entirely disappeared, how many seconds elapsed before another bright part of the sun became visible? Answer..... seconds.

3. Was the time set down in the last question merely guessed at or was it actually measured? If measured, how was the measurement made?.....
.....

4. The fringe of light surrounding the sun and called the corona is fully visible only if the face of the sun is entirely covered. At your station was there any time at which you could see the corona all around the sun? Answer YES or NO.....

5. Could you see any stars or planets at the time when the sun was most completely covered and how many did you see? .....
(If convenient draw a little map showing the positions in the sky of the eclipsed sun and of the stars and planets that you saw.)

6. If you are on a high building or a hill near the edge of the shadow path you may be able to see the shadow advancing across the country. If so, what buildings or other land-marks were inside and what were outside the edge of the shadow?.....
Landmarks inside the shadow: .....
.....
Landmarks outside the shadow: .....
.....

7. It is necessary to locate your position very accurately, so that the engineers who compile the reports will know just where to place your observations on the map. Accordingly, give your position by means of the nearest street intersection (if in a city or town) or by means of some easily located building such as a railroad station, a town hall, or some landmark which can be placed easily on a map by a person familiar with the district .....
.....

If you have a map of your district published in a newspaper or from any other source, mark a cross on the map at the position where you stood and send in the map with your report.

Even if only one of the questions 1 to

5 be answered, question 7 should be carefully answered.

Name .....

Address .....

Answers may be sent to "Eclipse," National Research Council, or the Editor, *Scientific American*, 233 Broadway, New York City.

## A WORD A DAY BY RADIO

Station WJZ has instituted a program novelty of decided value. Dr. Frank H. Vizetelly, managing editor of Funk and Wagnalls New Standard Dictionary, is broadcasting a radio talk under the title "Learn a Word a Day." Dr. Vizetelly speaks to the radio audiences every night for not longer than one minute, presenting a new word every day and explaining its uses. He is the final authority on the correctness of over 455,000 words—the largest number of words ever compiled in one dictionary—and his "Learn a Word a Day" radio project is an exceptional feature of the WJZ programs.



## BALLOON AERIAL FOR PEAK RECEPTION ON THE WEEK-END, ETC.

A large 30-inch rubber balloon is blown up with hydrogen and to which is attached an aluminum alloy wire for the antenna. Write for literature.

Price all complete, $5.00 plus postage. Shipping weight 3 lbs. Includes instructions, large hand reel, calcium chloride drying tube, rubber tubing, stopples and two extra 30-inch balloons.

Has been approved for experimental use. **EVERETT SCANLON, Radio Specialties, Lakewood, Rhode Island.**

## NEW GENERAL ELECTRIC STATION

Millions heard Denver's new radio voice KOA, the Rocky Mountain Broadcasting Station of the General Electric Company, on its opening recently. Telegraphic reports began pouring in from the four corners of America within thirty minutes after the opening program was put on the air. Telegrams and long distance telephone calls nearly swamped the operators. Reports were received from all but three states in the United States and more than a dozen points in Canada. Those omitted in the first telegraphic applause were West Virginia, Mississippi and Tennessee.

Officials of the Atlanta Journal, at Atlanta, Ga., were among the first to send congratulations on the successful opening of KOA, the sister station of KGO at Oakland, California, and WGY at Schenectady N. Y. "Congratulations and greetings from the voice of the South WSB," the Atlanta wire said. Pine Bluff, Ark., wired that the program was coming in fine down south. "All radio fans in Leadville are listening down on you to-night from an altitude of ten thousand two hundred feet," read another message.

More than four thousand letters and telegrams and telephone calls were received during the next two weeks in response to tests conducted preparatory to the opening of the station. During the test period the call letters of the station were 3XA. The greatest distance from which response was received during this period was Hawaii, approximately three thousand five hundred miles from Denver. The station was picked up in the Pacific, according to a report received from a sailor, following his arrival in Los Angeles.

KOA will be operated on a frequency of 930 k. c. (323 meters) and the power rating will be 1,500 watts. Regular programs will be broadcast by the giant plant three nights a week, Monday Wednesday and Friday nights. in addition to morning and evening church services on Sunday.

## KINGS AND PAWNS BY RADIO

For five and one half hours a group of students at Haverford College, Haverford, Pa., recently sat before several tables moving chess men in accordance with the instructions, shouted at them by a radio operator in the next room. At the same time, another group of students of Oxford University, England, 3,000 miles distant, were making the identical moves and discussing the same points.

The instructions from both teams on either side of the Atlantic were being sent back and forth in dots and dashes; the first international chess match by amateur radio was being played. The game which started at 7:45 p. m., Eastern Standard Time, was carried on without a halt until 12:45 the next morning, at which time the match was adjourned because of lengthy consultations by the Oxford team.

During the entire period, excellent contact was maintained between two stations of the Haverford College Radio Club and the English amateur station operated by Gerald Marcuso, honorary secretary of the Transmitters Section, Radio Society of Great Britain. All communication was on a wavelength of 85 meters. Few interruptions were necessary despite heavy static and interference. The moves averaged four an hour, or one every fifteen minutes, which is normal time for two chess teams playing under ordinary circumstances.

## FIFTEEN HOOK-UPS

Continued from Page 30.

page 10 of the April 15, 1924, issue of RADIO PROGRESS in "Constructing a Five-tube Neutrodyne." A method of neutralizing was also explained at length in this same article. Care must be taken that the spacing and angle of the neutroformer coils are correct or else the signals will come through distorted.

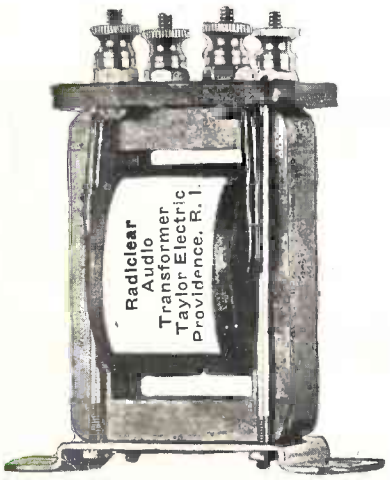
### Operation

After adjusting the filaments to the proper brilliancy, try turning all three dials slowly until a station is picked up. The readings of the three will be nearly alike. Some few sets will have identical settings, but this is rare as it is very difficult to make three coils and three condensers exactly alike all through their range. If it is found one dial is consistently one or two degrees ahead of the other two then the screw which fastens it to the shaft may be loosened and the whole dial turned until it lines up with the others.

# Would You Be Deaf For $6.00?

If you have a one or two tube set you can add one step of audio amplification and this will improve the loudness of your set so much that WITHOUT it it will seem as if you were deaf.

It is easy to add one more tube yourself. Our complete kit of audio includes everything you need at a cost of $6.00. In it you will find the well known Radiclear transformer, socket, rheostat, 4-spring jack, "B" Battery binding post, and wire for the whole job. The directions with it are clear so that you will have no trouble in making the connections.




Since the heart of the amplifier is the transformer we use one that does not make music come in like a tin pan serenade. The ratio in which the loudness is increased should be the same for both high and low notes. Most makes of unit do not have such regularity. The Radiclear transformer gives exceptional smoothness in this respect. When buying it alone the price is $3.95 post paid.

When you order a complete kit at $6.00 let us know what kind of a tube you want the socket to fit.

The Taylor Electric Company,
1206 Broad Street,
Providence, R. I.

Please send me the following by parcel post. (Mark which one you want.)

Radiclear Audio Transformer @ $3.95
Amplifier Kit for.....tube @ $6.00
Audion Crystal @ 25c.
Gold Plated Cat Whisker @ 15c.

☐ I enclose $.... to pay for these. (These above prices include the postage.)

☐ Send them to me C. O. D. I will pay the above price plus postage. (Indicate which way you wish to pay.)

Name.....

Address.....

## TAYLOR ELECTRIC CO.

**1206 Broad Street**

**Providence, R. I.**