Radio Call Book Magazine and Technical Review

Established 1921

25¢

May, 1932

In This Issue:

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C Bias Elimination
Majestic 175kc Oscillator
Capacity Decade Box
Set Tester
Signal Generator for Servicemen
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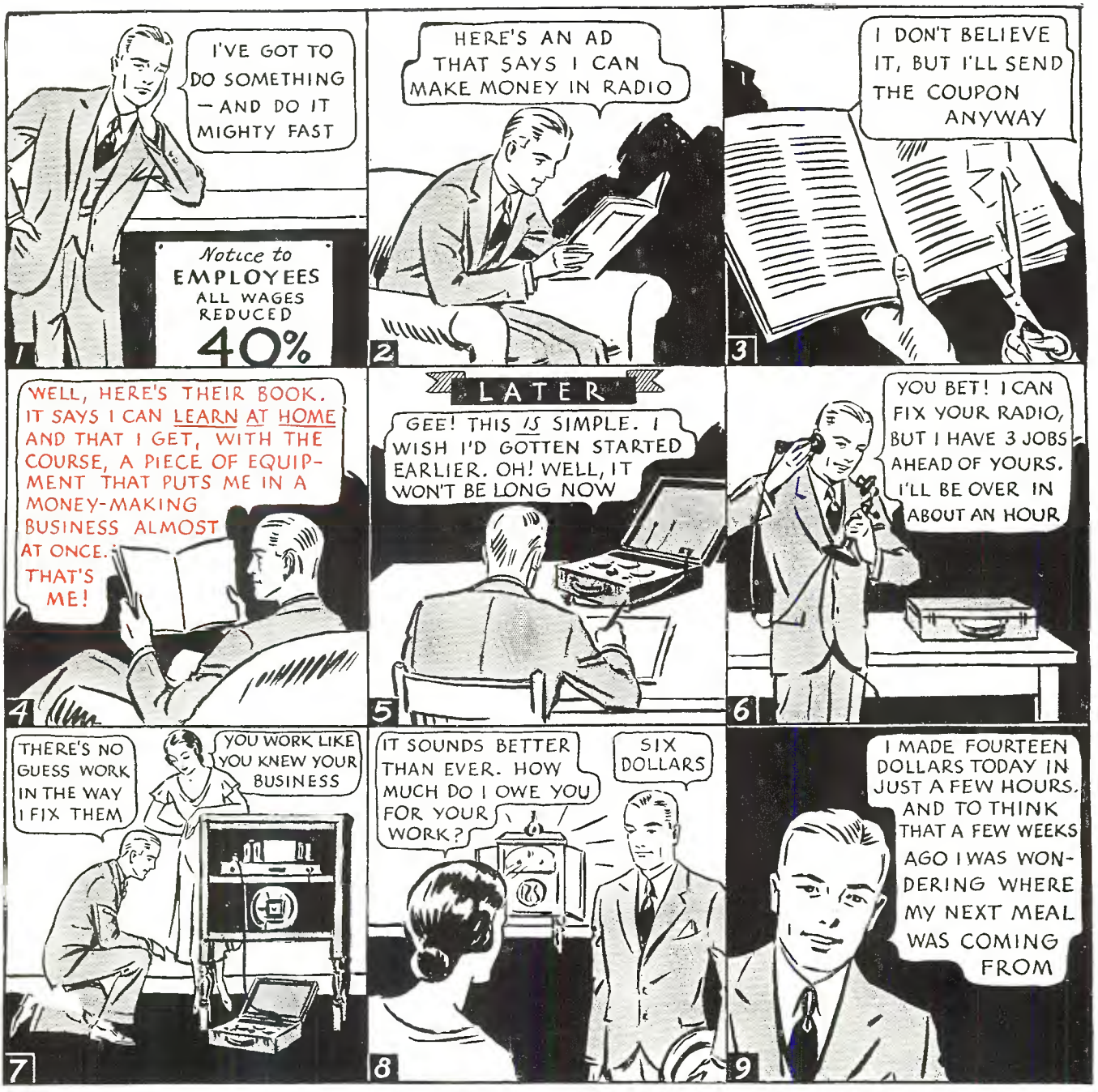
Frequency Assignments of All Broadcast, Short Wave Relay, Police, and Visual Stations

SERVICE - ENGINEERING - SALES



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If your pay has been cut—or, if you're slaving away on some hopeless job—*here's your chance to get on your feet in a hurry!* R. T. A.—one of the oldest, best known radio organizations in the world—offers you the opportunity to go to work for yourself—to name your own pay—and to start making money almost at once. R. T. A. is not just a school that teaches you and then lets you shift for yourself. Instead, R. T. A. makes you a Certified Radiotechnician and provides you with a wonderful service outfit that makes money for you just as soon as you get it. Real money too—up to $20 a day! With R. T. A. Training and with the R. T. A. Set Analyzer and Trouble Shooter you should be the most popular radio service man in town, and have all the business you want to take care of. No pay cuts—no worry about losing your job—nobody to boss you but yourself.

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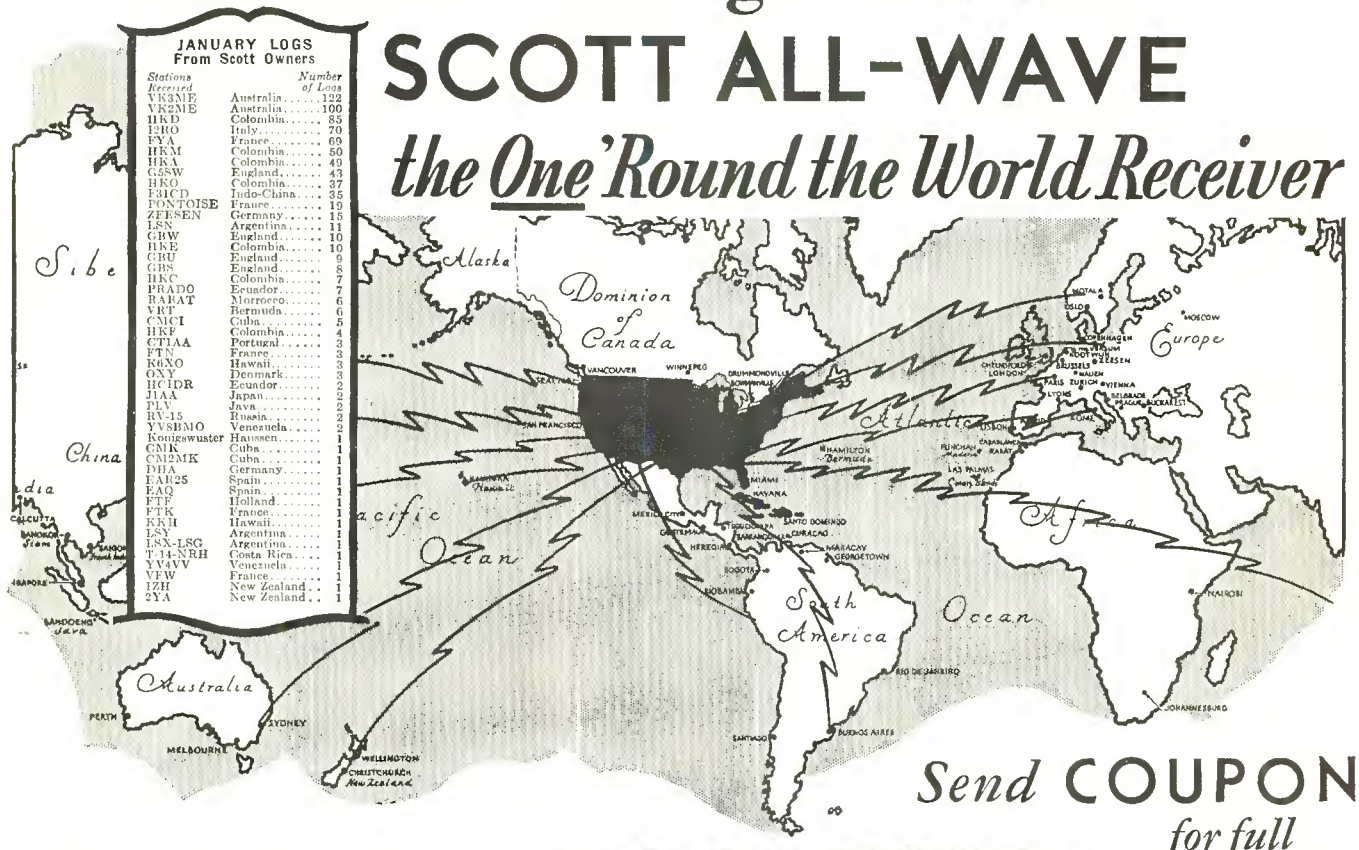
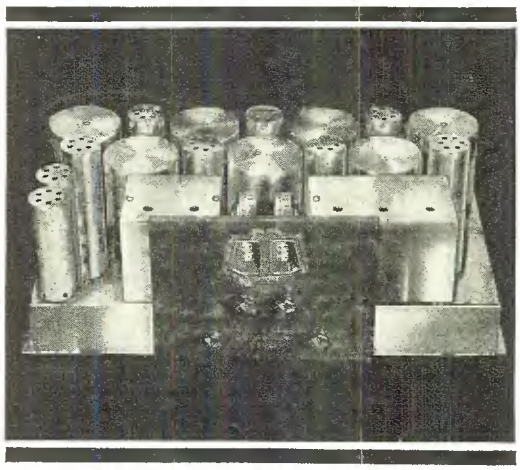
815 Logs *of 48 foreign stations received in* U.S. again Prove SCOTT ALL-WAVE *the One 'Round the World Receiver*



Send COUPON *for full* PARTICULARS

FROM NEW YORK AND SAN FRANCISCO—from Canada and the Gulf Coast—from everywhere in the United States—verified logs of foreign reception have poured in—815 in all—during the month of January. The most distant station was 10,500 miles away from the receiver! And most of the logs that came in were of stations over 6,000 miles distant.

These logs—this reception of foreign stations was accomplished with Scott All-Wave Receivers operating under all possible conditions. The results obtained are, therefore, AVERAGE—and represent the results YOU will get when YOU buy a Scott All-Wave for yourself. They constitute actual PROOF of the SCOTT ALL-WAVE'S ability to give daily 'round the world performance. Not just once in a while — but daily, summer and winter. And by reception, we mean loud, clear, reproduction—ample volume—clear, undistorted tone—thoroughly satisfactory in every way.



A radio that does not cover a range of 15-550 meters is completely out of date. But you want more than just a set that "dials" 15-550 meters. Even "promises" of foreign reception won't do. The set you want is the one that can PROVE its world-wide prowess BEFORE you buy it. That ONE receiver is the Scott All-Wave 15-550 Meter Superhetrodyne—a custom-built jewel of advanced design and precision engineering. The coupon will bring you full details — and you'll be happily surprised at the modest price. Clip —fill in — mail the coupon now.

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Town ..... *State* .....

RADIO CALL BOOK MAGAZINE AND TECHNICAL REVIEW, May, 1932. VOL. XIII, No. 5. Published monthly at Chicago, Ill. Subscription price, $2.00 per year. 25 cents per copy. Entered as second-class matter September 3, 1931, at the Post Office of Chicago, Ill., under the Act of March 3, 1879. Citizens Radio Service Bureau, Inc., Publishers, 508 S. Dearborn St., Chicago.

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AND TECHNICAL REVIEW

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MAY, 1932

Vol. 13, No. 5

Table of Contents

Editorial

This issue should appeal very strongly to all classes of our readers because of the varied editorial content. First of all, there appears a list of stations by states and cities, for which we have received many calls, the most interesting of which concerns engineers and the problem of images in congested broadcast areas. Now, at a glance, it will be possible to predetermine the likely difficulties, and provide the necessary selectivity and intermediate frequency to minimize such conditions.

An illuminating article on Speech Input Equipment, fully illustrated, should be of interest to those building or installing sound systems for public address, theaters, recording on films and records, etc. Another Power Amplifier appears on page 28, made by Webster Electric Company.

For the experimenter, we are beginning a series of ten consecutive articles on how to use the Weston Photronic Cell for useful as well as instructive purposes. This cell, described in detail in past issues, is an innovation in the photoelectric cell field, since it requires absolutely no voltage supply itself, and furnishes enough power output to operate a relay directly.

Audio degeneration may be overcome by using a system of separate bias supply for audio amplifier tubes found on page 31. On this same page is a complete oscillator for intermediate frequency alignment purposes. Another set tester, a service man's signal generator, new tube characteristics, real status of television at present, and mercury vapor full wave rectifiers are some additional subjects found in this issue.

May we ask you to give us your candid opinion so that we may better serve you? Perhaps you agree or disagree with some of the letters given in the Brief Items columns. It is your outlet to let the other fellow know what you think yourself or about his ideas. Don't neglect this voice which serves to show the trend of thought of our readers.—EDITOR.

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$100 a week

"My earnings in Radio are many times greater than I ever expected they would be when I enrolled. They seldom fall under $100 a week. If your course cost four or five times more I would still consider it a good investment."

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Jumped from $35 to $100 a week

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"In looking over my records I find I made $500 from January to May in my spare time. My best week brought me $107. I have only one regret regarding your course —I should have taken it long ago."

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If you are dissatisfied with your present job, if you are struggling along in a rut with little or no prospect of anything better than a skinny pay envelope—clip the coupon NOW. Get my big FREE book on the opportunities in *Radio*. Read how quickly you can learn at home in your spare time to be a Radio Expert —what good jobs my graduates have been getting—real jobs with real futures.

Many Radio Experts Make $50 to $100 a week

In about ten years the Radio Industry has grown from $2,000,000 to hundreds of millions of dollars. Over 300,000 jobs have been created by this growth, and thousands more will be created by its continued development. Many men and young men with the right training—the kind of training I give you in the N. R. I. course—have stepped into Radio at two and three times their former salaries.

Get Ready now for Jobs Like These

Broadcasting stations use engineers, operators, station managers, and pay up to $5,000 a year. Manufacturers continually employ testers, inspectors, foremen, engineers, service men, buyers, for jobs paying up to $6,000 a year. Radio Operators on ships enjoy life, see the world, with board and lodging free, and get good pay besides. Dealers and jobbers employ service men, salesmen, buyers, managers, and pay up to $100 a week. My book tells you about these and many other kinds of interesting radio jobs.

Many N. R. I. Men Have made $200 to $1,000 in spare time while learning

The day you enroll I send you material which you should master quickly for doing 28 jobs, common in most every neighborhood, for spare time money. Throughout your course I send you information on servicing popular makes of sets; I give you the plans and ideas that have made $200 to $1,000 for N. R. I. students in their spare time while studying. My course is famous as the course that pays for itself.

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Special training in Talking Movies, Television and Home Television experiments, Radio's use in Aviation, Servicing and Merchandising Sets, Broadcasting, Commercial and Ship Stations are included. I am so sure that N. R. I. can train you satisfactorily that I will agree in writing to refund every penny of your tuition if you are not satisfied with my Lessons and Instruction Service upon completion.

64-page book of information FREE

Get your copy today. It tells you where Radio's good jobs are, what they pay, tells you about my course, what others who have taken it are doing and making. Find out what Radio offers you without the slightest obligation. ACT NOW!

J. E. SMITH, President
National Radio Institute Dept., 2EE
Washington, D. C.

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Pioneer and World's Largest Home-Study Radio training organization devoted entirely to training men and young men for good jobs in the Radio industry. Our growth has paralleled Radio's growth. We occupy three hundred times as much floor space now as we did when organized in 1914.

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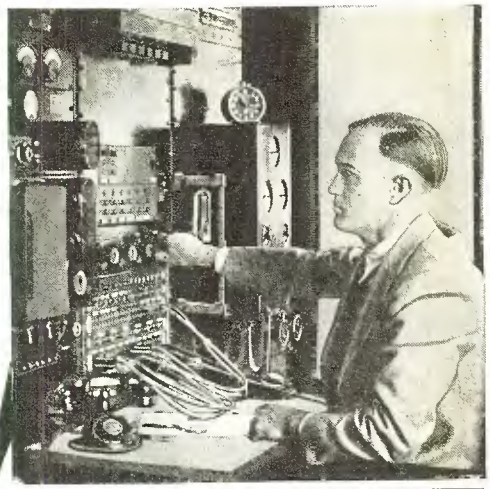
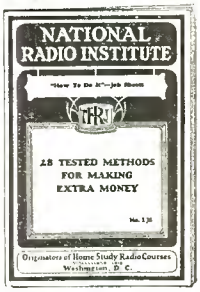


Special Free Offer!



Act Quickly!

In addition to my big free book, "Rich Rewards in Radio," I'll send you my valuable manual "28 Tested Methods for Making Extra Money." Never before available except to students. Now, for a limited time, it is free to readers of this magazine. How to make a good baffle for cone speakers, how to reduce hum in externally fed dynamic speakers, how to operate 25 cycle apparatus on 60 cycle current, how to operate 110 v. A. C. receivers on D. C., how to shield sets from local interfcrence are five of the subjects covered. There are 23 others. Get this valuable book by mailing the coupon.

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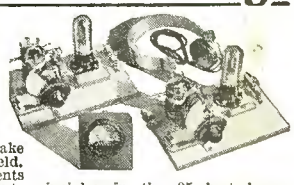

With this equipment you work out many of the things you read about in your text books. From it you get the valuable experience that tells an expert from a beginner. In a short time you have learned what would take years to learn in the field. You make experiments illustrating the important principles in the 25 best known receiving sets.

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"J"

American Broadcasting Stations

Station assignments shown in the following pages were made by the Federal Radio Commission. This list is revised from issue to issue and is therefore up-to-the-minute. Initials such as E, C, M, and P denote Eastern, Central, Mountain and Pacific time.

KABC—1420 kc, San Antonio, Texas, Alamo Broadcasting Co., 100 w, C.
KARK—890 kc, Little Rock, Ark., Arkansas Radio & Equip. Co., 250 w.
KBPS — 1420 kc, Portland, Ore., Benson Polytechnic School, 100 w, P.
KBTM—1200 kc, Paragould, Ark., Beard's Temple of Music, 100 w, C.
KCMC—1420 kc, Tupelo, Miss., No. Miss. Bdcstg. Corp., 100 w, C.
KCRC—1370 kc, Enid, Okla., Champlin Refining Co., 100 w, C.
KCRJ—1310 kc, Jerome, Ariz., C. C. Robinson, 100 w.
KDB—1500 kc, Santa Barbara, Calif., Santa Barbara Broadcasters, Ltd., 100 w, P.
KDFN—1440 kc, Casper, Wyo., D. L. Hathaway, 500 w, P.
KDKA—980 kc, Pittsburgh, Pa., Westinghouse E. & M. Co., 50,000 w, E.
KDLR—1210 kc, Devils Lake, N. D., KDLR, Inc., 100 w.
KDYL—1290 kc, Salt Lake City, Utah, Intermountain Broadcasting Corp., 1000 w, M.
KECA—1430 kc, Los Angeles, Calif., Earle C. Anthony, Inc., 1000 w, P.
KELW—780 kc, Burbank, Calif., Magnolia Park, Ltd., 500 w, P.
KERN—1200 kc, Santa Maria, Cal., The Bee Bakersfield Bdcstg. Co., 100 w, P.
KEX — 1180 kc, Portland, Ore., Western Broadcasting Co., 5000 w, P.
KFAB — 770 kc, Lincoln, Nebr., KFAB Broadcasting Co., 5000 w, C.
KFAC—1300 kc, Los Angeles, Calif., L. A. Bdcstg. Co., 1000 w, P.
KFBB—1280 kc, Great Falls, Mont., Buttrey Broadcast, Inc., 1000 w, M.
KFBK—1310 kc, Sacramento, Calif., James McClatchy Co., 100 w, P.
KFBL — 1370 kc, Everett, Wash., Leese Bros., 50 w, P.
KFDM—560 kc, Beaumont, Tex., Magnolia Petroleum Co., 500 w, C.
KFDY—550 kc, Brookings, S. D., State College, 500 w, C.
KFEL—920 kc, Denver, Colo., Eugene P. O'Fallon, Inc., 500 w, M.
KFEQ—680 kc, St. Joseph, Mo., Scroggin & Co., 2500 w, C.
KFGQ—1310 kc, Boone, Iowa, Boone Biblical College, 100 w, C.
KFH—1300 kc, Wichita, Kan., Radio Station KFH Co., 1000 w, C.
KFI—640 kc, Los Angeles, Calif., Earl C. Anthony, Inc., 50,000 w, P.
KFIO—1120 kc, Spokane, Wash., Spokane Broadcasting Corp., 100 w, P.
KFIU—1310 kc, Juneau, Alaska, Alaska Elec. Light & Power Co., 10 w.
KFIZ—1420 kc, Fond du Lac, Wis., Reporter Printing Co., 100 w, C.
KFJB—1200 kc, Marshalltown, Iowa, Marshall Electric Co., 100 w, C.
KFJF—1480 kc, Oklahoma City, Okla., National Radio Mfg. Co., 5000 w, C.
KFJI—1210 kc, Klamath Falls, Ore., KFJI Broadcasters, Inc., 100 w, P.
KFJM—1370 kc, Grand Forks, N. D., University of North Dakota, 100 w, C.
KFJR—1300 kc, Portland, Ore., Ashley C. Dixon, KFJR, Inc., 500 w, P.
KFJY—1310 kc, Ft. Dodge, Iowa, Cedar Rapids Broadcast Co., w, C.
KFJZ—1370 kc, Ft. Worth, Texas, Ralph S. Bishop, 100 w, C.
KFKA—880 kc, Greeley, Colo., Mid-Western Radio Corp., 500 w, M.
KFKB — 1050 kc, Milford, Kan., KFKB Brdcstg. Assn., 5000 w, C.
KFKU—1220 kc, Lawrence, Kan., University of Kansas, 500 w, C.
KFLV—1410 kc, Rockford, Ill., Rockford Broadcasters, Inc., 500 w, C.
KFLX—1370 kc, Galveston, Texas, Geo. Roy Clough, 100 w, C.
KFMX—1250 kc, Northfield, Minn., Carleton College, 1000 w, C.
KFNF—890 kc, Shenandoah, Iowa, Henry Field Seed Co., 500 w, C.
KFOR—1210 kc, Lincoln, Neb., Howard A. Shuman, 100 w, C.
KFOX—1250 kc, Long Beach, Calif., Nichols & Warriner, Inc., 1000 w, P.
KFPL—1310 kc, Dublin, Texas, C. C. Baxter, 100 w, C.
KFPM—1310 kc, Greenville, Texas, The New Furniture Co., 15 w, C.
KFPW—1340 kc, Ft. Smith, Ark., John Brown Schools, 50 w, C.
KFPY—1340 kc, Spokane, Wash., Symons Broadcasting Co., 1000 w, P.
KFQD—1230 kc, Anchorage, Alaska, Anchorage Radio Club, 100 w.
KFQW—1420 kc, Seattle, Wash., KFQW, Inc., 100 w, P.
KFRC—610 kc, San Francisco, Calif., Don Lee, Inc., 1000 w, P.
KFRU—630 kc, Columbia, Mo., Stephens College, 500 w, C.
KFSD—600 kc, San Diego, Calif., Airfan Radio Corp., 500 w, P.
KFSG—1120 kc, Los Angeles, Calif., Echo Park Evan. Assn., 500 w, P.
KFUL—1290 kc, Galveston, Texas, W. H. Ford, 500 w, C.
KFUO—550 kc. St. Louis, Mo., Concordia Theological Seminary, 500 w, C.
KFUP—1310 kc, Denver, Colo., Fitzsimmons General Hospital, 100 w, M.
KFVD—1000 kc, Culver City, Calif., Los Angeles Broadcasting Co., 250 w, P.
KFVS — 1210 kc, Cape Girardeau, Mo., Hirsch Battery & Radio Co., 100 w, C.
KFWB—950 kc, Hollywood, Calif., Warner Bros. Broadcasting Corp., 1000 w, P.
KFWF—1200 kc, St. Louis, Mo., St. Louis Truth Center, Inc., 100 w.
KFWI—930 kc, San Francisco, Calif., Radio Entertainments, Inc., 500 w, P.
KFXD—1420 kc, Nampa, Idaho, Frank E. Hurt, 100 w, M.
KFXF—920 kc, Denver, Colo., Colorado Radio Co., 500 w, M.
KFXJ—1310 kc, Edgewater, Colo., Western Slope Broadcasting Co., 50 w, M.
KFXM—1210 kc, San Bernardino, Calif., Lee Bros. Broadcasting Co., 100 w, P.
KFXR—1310 kc, Oklahoma City, Okla., Exchange Avenue Baptist Church, 100 w, C.
KFXY—1420 kc, Flagstaff, Ariz., Mary M. Costigan, 100 w, M.
KFYO—1420 kc, Abilene, Texas, Kirksey Bros., 100 w, C.
KFYR—550 kc, Bismarck, N. D., Meyer Broadcasting Co., 1000 w, C.
KGA—1470 kc, Spokane, Wash. Northwest Broadcasting System, Inc., 5000 w, P.
KGAR—1370 kc, Tucson, Ariz., Tucson Motor Service Co., 100 w, M.
KGB—1330 kc, San Diego, Calif., Don Lee, Inc., 500 w, P.
KGBU—900 kc, Ketchikan, Alaska, Alaska Radio & Service Co., 500 w.
KGBX—1310 ke, St. Joseph, Mo., KGBX, Inc., 100 w.
KGBZ—930 kc, York, Nebr., Geo. R. Miller, 500 w, C.
KGCA—1270 kc, Decorah, Iowa, Chas. W. Greenley, 50 w, C.
KGCR—1210 kc, Watertown, S. D., Greater Kampeska Radio Corp., 100 w.
KGCU—1240 kc, Mandan, N. D., Mandan Radio Association, 250 w, M.
KGCX—1310 kc, Wolf Point, Mont., First State Bank of Vida, 100 w, M.
KGDA—1370 kc, Mitchell, S. D., Mitchell Broadcasting Corp., 100 w, M.
KGDE—1200 kc, Fergus Falls, Minn., Jaren Drug Co., 100 w, C.
KGDM—1100 kc, Stockton, Calif., E. F. Peffer, 250 w.
KGDY—1200 kc, Huron, S. D., J. A. Loesch, 15 w, C.
KGEF—1300 kc, Los Angeles, Calif., Trinity Methodist Church, 1000 w, P.
KGEK—1200 kc, Yuma, Colo., Beehler Elec. Equip. Co., 100 w, M.
KGER—1360 kc, Long Beach, Calif., Consolidated Bdcstg. Corp., 1000 w, P.
KGEW—1200 kc, Kearney, Nebr., 100 w, P.
KGEZ—1310 kc, Kalispell, Mont., Donald C. Treloar, 100 w, M.
KGFF—1420 kc, Shawnee, Okla., KGFF Bdcstg. Corp., 100 w, C.
KGFG—1370 kc, Oklahoma City, Okla., Oklahoma Broadcasting Co., Inc., 100 w, C.
KGFI — 1500 kc, Corpus Christi, Texas, Eagle Broadcasting Co., 100 w, C.
KGFJ—1200 kc, Los Angeles, Calif., Ben S. McGlashan, 100 w, P.
KGFK — 1500 kc, Moorhead, Minn., Red River Broadcasting Co., Inc., 50 w, C.
KGFL—1370 kc, Raton, N. Mex., KGFL, Inc., 50 w, M.
KGFW—1310 kc, Kearney, Neb., Central Neb. Bdcstg. Co., 100 w.
KGFX—630 kc, Pierre, S. D., Dana McNeil, 200 w, C.
KGGC — 1420 kc, San Francisco, Calif., Golden Gate Broadcasting Co., 100 w, P.
KGGF—1010 kc, South Coffeyville, Okla., Powell & Platz, 500 w.
KGGM—1230 kc, Albuquerque, N. Mex., New Mexico Broadcasting Co., 250 w.
KGHF—1320 kc, Pueblo, Colo, Ritchie & Finch, 250 w, M.
KGHI—1200 kc, Little Rock, Ark., O. A. Cook, 100 w.
KGHL—950 kc, Billings, Mont., Northwestern Auto Supply Co., 1000 w, M.
KGIQ—1320 kc, Twin Falls, Idaho, Radio Broadcasting Corp.
KGIR—1360 kc, Butte, Mont., KGIR, Inc., 500 w, M.
KGIW—1420 kc, Trinidad, Colo., Leonard E. Wilson, 100 w, M.
KGIX—1420 kc, Las Vegas, Nev., J. M. Heaton, 100 w.
KGIZ—1500 kc, Grant City, Mo., Grant City Park Corp., 100 w, C.
KGKB—1500 kc, Tyler, Tex., Tyler Commercial College, 100 w, C.
KGKL—1370 kc, San Angelo, Tex., KGKL, Inc., 100 w, C.
KGKO—570 kc, Wichita Falls, Tex., Wichita Falls Broadcasting Co., 250 w, C.
KGKX—1420 kc, Sandpoint Idaho, W. W. von Cannon, 100 w, P.
KGKY—1500 kc, Scottsbluff, Nebr., Hilliard Co., Inc., 100 w, C.
KGMB—1320 kc, Honolulu, Hawaii, Honolulu Broadcasting Co., 250 w, P.
KGMP—1210 kc, Elk City, Okla., Bryant Radio & Elec. Co., 100 w, C.
KGNF—1430 kc, North Platte, Nebr., H. L. Spencer, 500 w, M.
KGNO—1210 kc, Dodge City, Kans., Dodge City Broadcasting Co., Inc., M.
KGO—790 kc, San Francisco, Calif., National Broadcasting Co., Inc., 7500 w, P.
KGRS—1410 kc, Amarillo, Texas, Gish Radio Service, 1000 w, C.
KGU—750 kc, Honolulu, Hawaii, Marion Mulrony, Advertising Publ. Co., 2500 w.
KGVO—1420 kc, Missoula, Mont., Mosby's, Inc.
KGW—620 kc, Portland, Ore., Oregonian Pub. Co., 1000 w, P.
KGY—1200 kc, Lacey, Wash., KGY, Inc., 100 w, P.
KHJ—900 kc, Los Angeles, Calif., Don Lee, Inc., 1000 w, P.
KHQ—590 kc, Spokane, Wash., Louis Wasmer, Inc., 1000 w, P.
KICA—1370 kc, Clovis, N. M., W. E. Whitmore, 100 P.
KICK—1420 kc, Red Oak, Iowa, Red Oak Radio Corp., 100 w.
KID — 1320 kc, Idaho Falls, Ida., KID Broadcasting Co., 250 w, M.
KIDO—1350 kc, Boise, Idaho, Boise Broadcasting Station, 1000 w, P.
KIT—1310 kc, Yakima, Wash., C. E. Haymond, 100 w, P.
KJBS—1070 kc, San Francisco, Calif., Julius Brunton & Sons Co., 100 w, P.
KJR—970 kc, Seattle, Wash., Northwest Broadcasting System, Inc., 5000 w, P.
KLCN—1290 kc, Blytheville, Ark., C. L. Lintzenich, 50 w, C.
KLO—1400 kc, Ogden, Utah, Interstate Bdcstg. Corp., 500 w, M.
KLPM — 1420 kc, Minot, N. D., John B. Cooley, 100 w, C.
KLRA—1390 kc, Little Rock, Ark., Arkansas Broadcasting Co., 1000 w.
KLS — 1440 kc, Oakland, Calif., Warner Bros., 250 w, P.
KLX—880 kc, Oakland, Calif., Tribune Pub. Co., 500 w, P.
KLZ—560 kc, Denver, Colo., Reynolds Radio Co., Inc., 1000 w, M.
KMA—930 kc, Shenandoah, Iowa, May Seed & Nursery Co., 500 w, C.
KMAC—1370 kc, San Antonio, Texas, W. W. McAllister, 100 w, C.
KMBC—950 kc, Kansas City, Mo., Midland Broadcasting Co., 1000 w, C.
KMED—1310 kc, Medford, Ore., Mrs. W. J. Virgin, 100 w, P.
KMJ—1210 kc, Fresno, Calif., J. McClatchy Co., 100 w, P.
KMLB—1200 kc, Monroe, La., Liner's Bdcstg. Station, Inc., 100 w, C.

KMMJ—740 kc, Clay Center, Neb., The M. M. Johnson Co., 1000 w, C.
KMO—860 kc, Tacoma, Wash., KMO, Inc., 500 w, P.
KMOX—1090 kc, St. Louis, Mo., Voice of St. Louis, Inc., 50,000 w, C.
KMPC—710 kc, Beverly Hills, Calif., R. S. Macmillan, 500 w, P.
KMTR—570 kc, Los Angeles, Calif., KMTR Radio Corp., 500 w, P.
KNOW—1500 kc, Austin, Tex., KNOW Bdcstg. Co., 100 w, C.
KNX—1050 kc, Hollywood, Calif., Western Broadcast Co., 5000 w, P.
KOA—830 kc, Denver, Colo., National Broadcasting Co., Inc., 12,500 w, M.
KOAC—550 kc, Corvallis, Ore., Oregon State Agricultural College, 1000 w, P.
KOB—1180 kc, State College, N. M., N. M. College of Agri. & Mech. Arts, 20,000 w, M.
KOCW—1400 kc, Chickasha, Okla., Oklahoma College for Women, 250 w, C.
KOH—1370 kc, Reno, Nevada, Jay Peters, Inc., 500 w.
KOIL—1260 kc, Council Bluffs, Iowa, Mona Motor Oil Co., 1000 w, C.
KOIN—940 kc, Portland, Ore., KOIN, Inc., 1000 w, P.
KOL—1270 kc, Seattle, Wash., Seattle Broadcasting Co., 1000 w, P.
KOMO—920 kc, Seattle, Wash., Fisher's Blend Station, Inc., 1000 w, P.
KONO—1370 kc, San Antonio, Tex., Mission Broadcasting Co., 100 w, C.
KOOS—1370 kc, Marshfield, Ore., H. H. Hanseth, Inc., 100 w, P.
KORE—1420 kc, Eugene, Ore., Eugene Broadcast Station, 100 w, P.
KOY—1390 kc, Phoenix, Ariz., Nielsen Radio & Sporting Goods Co., 500 w, M.
KPCB—650 kc, Seattle, Wash., Queen City Broadcasting Co., 100 w, P.
KPJM—1500 kc, Prescott, Ariz., A. P. Miller, 100 w, M.
KPO—680 kc, San Francisco, Calif., Hale Bros. & The Chronicle, 5000 w, P.
KPOF—880 kc, Denver, Colo., Pillar of Fire, Inc., 500 w, M.
KPPC—1210 kc, Pasadena, Calif., Pasadena, Presbyterian Church, 50 w, P.
KPQ—1500 kc, Wenatchee, Wash., Wescoast Broadcasting Co., 50 w, P.
KPRC—920 kc, Houston, Texas, Houston Printing Co., 1000 w, C.
KQV—1380 kc, Pittsburgh, Pa., KQV Bdcstg. Co., 500 w, E.
KQW—1010 kc, San Jose, Calif., Pacific Agric. Foundation, 500 w, P.
KRE—1370 kc, Berkeley, Calif., First Congregational Church, 100 w, P.
KREG—1500 kc, Santa Ana, Calif., Pacific-Western Broadcasting Federation. 100 w, P.
KRGV—1260 kc, Harlingen, Texas, KRGV, Inc., 500 w.
KRKD—1120 kc, Inglewood, Cal., Dalton's, Inc., P.
KRLD—1040 kc, Dallas, Texas, KRLD, Inc., 10,000 w, C.
KRMD—1310 kc, Shreveport, La., Robert M. Dean, 50 w, C.
KROW—930 kc, Oakland Calif., Educational Broadcasting Corp., 500 w, M.
KRSC—1120 kc, Seattle, Wash., Radio Sales Corp., 50 w, P.
KSAC—580 kc, Manhattan, Kan., Kansas State Agricultural College, 500 w, C.
KSCJ—1330 kc, Sioux City, Iowa, Perkins Bros. Co., 1000 w, C.
KSD—550 kc, St. Louis, Mo., Pulitzer Pub. Co., 500 w, C.
KSEI—900 kc, Pocatello, Idaho, Radio Service Corp., 250 w, M.
KSL—1130 kc, Salt Lake City, Utah, Radio Service Corp., 5000 w, M.
KSO—1380 kc, Clarinda, Iowa, Iowa Bdcstg. Co., 500 w, C.
KSOO—1110 kc, Sioux Falls, S. D., Sioux Falls Broadcasting Assn., 2000 w, C.
KSTP—1460 kc, St. Paul, Minn., National Battery Broadcasting Co., 10,000 w, C.
KTAB—560 kc, San Francisco, Calif., Associated Broadcasters, 1000 w, P.
KTAR—620 kc, Phoenix, Ariz., KTAR Broadcasting Co., 500 w, M.
KTAT—1240 kc, Ft. Worth, Tex., S. A. T. Broadcasting Co., 1000 w, C.
KTBR—1300 kc, Portland, Ore., M. E. Brown, 500 w, P.
KTBS—1450 kc, Shreveport, La., Tri-State Broadcasting Co., 1000 w, E.
KTFI—1240 kc, Twin Falls, Idaho, Radio Broadcasting Corp., 250 w, M.
KTHS—1040 kc, Hot Springs, Ark., Chamber of Commerce, 10,000 w, C.
KTLC—1310 kc, Houston, Tex., Houston Broadcasting Co., 100 w, C.
KTM—780 kc, Los Angeles, Calif., Pickwick Broadcasting Corp., 500 w, P.
KTRH—1120 kc, Houston, Tex., Rice Hotel, 500 w, C.
KTSA—1290 kc, San Antonio, Texas, Lone Star Broadcast Co., 1000 w, C.
KTSL—1310 kc, Shreveport, La., Houseman Sheet Metal Works, Inc., 100 w, C.
KTSM—1310 kc, El Paso, Tex., W. S. Bledsoe and W. T. Blackwell, 100 w, C.
KTW—1220 kc, Seattle, Wash., First Presbyterian Church, 1000 w, P.
KUJ—1370 kc, Walla Walla, Wash., KUJ, Inc., 100 w, P.
KUOA—1390 kc, Fayetteville, Ark., University of Arkansas, 1000 w, C.
KUSD—890 kc, Vermilion, S. Dak., University of South Dakota, 500 w, C.
KVI—760 kc, Tacoma, Wash., Puget Sound Radio Broadcasting Co., 1000 w, P.
KVL—1370 kc, Seattle, Wash., KVL, Inc., 100 w, P.
KVOA—1260 kc, Tucson, Ariz., R. M. Riculfi, 500 w.
KVOO—1140 kc, Tulsa, Okla., Southwestern Sales Corp., 5000 w, C.
KVOR—1270 kc, Colorado Springs, Colo, W. D. Corley, 1000 w, M.
KVOS—1200 kc, Bellingham, Wash., KVOS, Inc., 100 w, P.
KWCR—1310 kc, Cedar Rapids, Iowa. Cedar Rapids Bdcst. Co., 100 w, C.
KWEA—1210 kc, Shreveport, La., Hello World Broadcasting Corp., 100 w, C.
KWG—1200 kc, Stockton, Calif., Portable Wireless Tel. Co., 100 w, P.
KWJJ—1060 kc, Portland, Ore., KWJJ Broadcasting Co., Inc., 500 w, P.
KWK—1350 kc, Kirkwood, Mo., Thos. Patrick, Inc., 1000 w, C.
KWKC—1370 kc, Kansas City, Mo., Wilson Duncan Broadcasting Co., 100 w.
KWKH—850 kc, Shreveport, La., Hello World Broadcasting Corp., 10,000 w, C.
KWLC—1270 kc, Decorah, Iowa, Luther College, 100 w, C.
KWSC—1220 kc, Pullman, Wash., State College of Washington, 1000 w, P.
KWWG—1260 kc, Brownsville, Texas, Brownsville Herald Publishing Co., 500 w, C.
KXA—570 kc, Seattle, Wash., American Radio Tel. Co., 500 w, P.
KXL—1420 kc, Portland, Ore., KXL Broadcasters, Inc., 100 w, P.
KXO—1500 kc, El Centro, Calif., Irey & Bowles, 100 w, P.
KXRO—1310 kc, Aberdeen, Wash., KXRO, Inc., 100 w, P.
KXYZ—1420 kc, Houston, Texas, Harris County Broadcasting Co., 100 w, C.
KYA—1230 kc, San Francisco, Calif., Pacific Broadcasting Corp., 1000 w, P.
KYW—1020 kc, Chicago, Ill., Westinghouse E. & M. Co., 10,000 w, C.
NAA—690 kc, United States Navy Department, Washington, D. C., 1000 w, E.
WAAB—1410 kc, Quincy, Mass., Bay State Bdcstg. Corp.
WAAF—920 kc, Chicago, Ill., Drovers Journal Pub. Co., 500 w daytime, C.
WAAM—1250 kc, Newark, N. J., WAAM, Inc., 1000 w, E.
WAAT—940 kc, Jersey City, N. J., Bremer Broadcasting Corp., 300 w, E.
WAAW—660 kc, Omaha, Neb., Omaha Grain Exchange, 500 w daytime, C.
WABC—860 kc, New York City, N. Y., Atlantic Broadcasting Corp., 50,000 w, E.
WABI—1200 kc, Bangor, Maine, Pine Tree Broadcasting Co., 100 w, E.
WABO—See under WHEC.
WABZ—1200 kc, New Orleans, La., Coliseum Place Baptist Church, 100 w, C.
WACO—1240 kc, Waco, Tex., Central Texas Broadcasting Co., Inc., 1000 w, C.
WADC—1320 kc, Tallmadge, Ohio, Allen T. Simmons, 1000 w, E.
WAGM—1420 kc, Presque Isle, Me., Aroostook Bdcstg. Corp., 100 w.
WAIU—640 kc, Columbus, Ohio, Associated Radiocasting Corp., 500 w, E.
WALR—1210 kc, Zanesville, O., Roy W. Waller, 100 w, E.
WAPI—1140 kc, Birmingham, Ala., Alabama Polytechnic Institute, 5000 w, C.
WASH—1270 kc, Grand Rapids, Mich., Kunsky-Trendle Bdcstg. Corp., 500 w, C.
WAWZ—1350 kc, Zarepath, N. J., Pillar of Fire, 250 w, E.
WBAA—1400 kc, Lafayette, Ind., Purdue University, 500 w, C.
WBAK—1430 kc, Harrisburg, Pa., Pennsylvania State Police, 500 w, E.
WBAL—1060 kc, Baltimore, Md., Consolidated Gas, Elec. Co., 10,000 w, E.
WBAP—800 kc, Ft. Worth, Tex., Carter Publications, Inc., 10,000 w, C.
WBAX—1210 kc, Wilkes-Barre, Pa., John H. Stenger, Jr., 100 w, E.
WBBC—1400 kc, Brooklyn, N. Y., Brooklyn Broadcasting Corp., 500 w.
WBBL—1210 kc, Richmond, Va., Grace Covenant Presbyterian Church, 100 w, E.
WBBM—770 kc, Chicago, Ill., WBBM Bdcstg. Corp., 25,000 w, C.
WBBR—1300 kc, Brooklyn, N. Y., People's Pulpit Association, 1000 w, E.
WBBZ—1200 kc, Ponca City, Okla., C. L. Carrell, 100 w, C.
WBCM—1410 kc, Bay City, Mich., James E. Davidson, 500 w, E.
WBEN—900 kc, Buffalo, N. Y., WBEN, Inc., 1000 w, E.
WBEO—1310 kc, Marquette, Mich., Lake Superior Bdcstg. Co.
WBGF—1370 kc, Glens Falls, N. Y., W. Parker & N. Metcalf, 50 w, E.
WBHS—1200 kc, Huntsville, Ala., Hutchens Co., 50 w.
WBIG—1440 kc, Greensboro, N. C., North Carolina Broadcasting Co., 500 w, E.
WBIS—See under WNAC.
WBMS—1450 kc, Hackensack, N. J., WBMS Broadcasting Corp., 250 w.
WBNX—1350 kc, New York, N. Y., Standard Cahill Co., Inc., 250 w, E.
WBOQ—See under WABC.
WBOW—1310 kc, Terre Haute, Ind., Banks of Wabash, Inc., 100 w, C.
WBRC—930 kc, Birmingham, Ala., Birmingham Broadcasting Co., 500 w, C.
WBRE—1310 kc, Wilkes-Barre, Pa., Louis G. Baltimore, 100 w, E.
WBSO—920 kc, Needham, Mass., Bdcstg. Service Org., Inc., 250 w, E.
WBT—1080 kc, Charlotte, N. C., Station WBT, Inc., 5000 w, E, shared.
WBTM—1370 kc, Danville, Va., Piedmont Bdcstg. Corp., 100 w, E.
WBZ—990 kc, Boston, Mass., Westinghouse E. & M. Co., 25,000 w, E.
WBZA—990 kc, Springfield, Mass., Westinghouse E. & M. Co., 1000 w, E.
WCAC—600 kc, Storrs, Conn., Connecticut Agricultural College, 250 w, E.
WCAD—1220 kc, Canton, N. Y., St. Lawrence University, 500 w, E.
WCAE—1220 kc, Pittsburgh, Pa., WCAE, Inc., 1000 w, E.
WCAH—1430 kc, Columbus, Ohio, Commercial Radio Service Co., 500 w, E.
WCAJ—590 kc, Lincoln, Neb., Nebraska Wesleyan University, 500 w, C.
WCAL—1250 kc, Northfield, Minn., St. Olaf College, 1000 w, C.
WCAM—1280 kc, Camden, N. J., City of Camden, 500 w, E.
WCAO—600 kc, Baltimore, Md., Monumental Radio, Inc., 250 w, E.
WCAP—1280 kc, Asbury Park, N. J., Radio Industries Broadcast Co., 500 w, E.
WCAT—1200 kc, Rapid City, S. D., South Dakota State School of Mines, 100 w, M.
WCAU—1170 kc, Philadelphia, Pa., Universal Broadcasting Co., 50,000 w, E.
WCAX—1200 kc, Burlington, Vt., Burlington Daily News, 100 w, E.
WCAZ—1070 kc, Carthage, Ill., Superior Broadcasting Co., 50 w.
WCBA—1440 kc, Allentown, Pa., B. B. Musselman, 250 w, E.
WCBD—1080 kc, Zion, Ill., Wilbur Glen Voliva, 5000 w, C.
WCBM—1370 kc, Baltimore, Md., Baltimore Broadcasting Corp., 100 w, E.
WCBS—1210 kc, Springfield, Ill., Dewing & Meester, 100 w, C.
WCCO—810 kc, Minneapolis, Minn., Northwestern Broadcasting Inc., 5000 w, C.
WCDA—1350 kc, New York, N. Y., Italian Educational Broadcasting Co., 250 w, E.
WCFL—970 kc, Chicago, Ill., Chicago Federation of Labor, 15,000 w, C.
WCGU—1400 kc, Brooklyn, N. Y., U. S. Broadcasting Corp., 500 w, E.
WCHI—1490 kc, Chicago, Ill., People's Pulpit Association, 5000 w, C.
WCKY—1490 kc, Covington, Ky., L. B. Wilson, 500 w, E.
WCLB—1500 kc, Long Beach, N. Y., Arthur Faske, 100 w, E.
WCLO—1200 kc, Janesville, Wis., WCLO Radio Corp., 100 w, C.
WCLS—1310 kc, Joliet, Ill., WCLS, Inc., 100 w, C.
WCMA—1400 kc, Culver, Ind., General Broadcasting Co., 500 w, C.
WCOA—1340 kc, Pensacola, Fla., Pensacola Bdcstg. Co., 500 w, E.
WCOC—880 kc, Meridian, Miss., Mississippi Broadcasting Co., 500 w, C.
WCOD—1200 kc, Harrisburg, Pa., Keystone Broadcasting Corp., 100 w, E.
WCOH—1210 kc, Yonkers, N. Y., Westchester Broadcasting Corp., 100 w, E.

WCRW—1210 kc, Chicago, Ill., Clinton R. White, 100 w, C.
WCSC—1360 kc, Charleston, S. C., Lewis Burk, 500 w, E.
WCSH—940 kc, Portland, Me., Congress Square Hotel Co., 1000 w, E.
WDAE—1220 kc, Tampa, Fla., Tampa Publishing Co., 1000 w, E.
WDAF—610 kc, Kansas City, Mo., Kansas City Star Co., 1000 w, C.
WDAG—1410 kc, Amarillo, Texas, National Radio & Broadcasting Corp., 250 w, C.
WDAH—1310 kc, El Paso, Texas, W. S. Bledsoe, 100 w, M.
WDAS—1370 kc, Philadelphia, Pa., WDAS Broadcasting Station, Inc., 100 w, E.
WDAY—940 kc, Fargo, N. D., WDAY, Inc., 1000 w, C.
WDBJ—930 kc, Roanoke, Va., Times-World Corp., 250 w, E.
WDBO—1120 kc, Orlando, Fla., Orlando Broadcasting Co., 250 w, E.
WDEL—1120 kc, Wilmington, Del., WDEL, Inc., 250 w, E.
WDEV—1420 kc, Waterbury, Vt., H. C. Whitehill, 50 w.
WDGY—1180 kc, Minneapolis, Minn., Dr. Geo. W. Young, 1000 w, C.
WDIX—1420 kc, Texarkana, Ark., North Mississippi Broadcasting Corp., 100 w, C.
WDOD—1280 kc, Chattanooga, Tenn., WDOD Broadcasting Co., Inc., 5000 w, C.
WDBC—1330 kc, Hartford, Conn., Doolittle Radio Corp., 500 w, E.
WDSU—1250 kc, New Orleans, La., Jos. H. Uhalt, 1000 w, C.
WDZ—1070 kc, Tuscola, Ill., James L. Bush, 100 w.
WEAF—660 kc, New York, N. Y., National Broadcasting Co., Inc., 50,000 w, E.
WEAI—1270 kc, Ithaca, N. Y., Cornell Univ., 1000 w, E.
WEAN—780 kc, Providence, R. I., Shepard Broadcasting Service, 250 w, E.
WEAO—570 kc, Columbus, Ohio, Ohio State University, 750 w, E.
WEBC—1290 kc, Superior, Wis., Head of The Lakes Broadcasting Co., 1000 w, C.
WEBQ—1210 kc, Harrisburg, Ill., First Trust & Savings Bank, 100 w, C.
WEBR—1310 kc, Buffalo, N. Y., Howell Broadcasting Co., 100 w, E.
WEDC—1210 kc, Chicago, Ill., Emil Denemark, Inc., 100 w.
WEEI—590 kc, Boston, Mass., Edison Elec. Illum. Co., 1000 w, E.
WEEU—830 kc, Reading, Pa., Berks Bdcstg. Co., 1000 w.
WEHC—1350 kc, Emory, Va., Emory and Henry College, 500 w, E.
WEHS—1420 kc, Evanston, Ill., WEHS, Inc., 100 w, C.
WELL—1420 kc, Battle Creek, Mich., Enquirer-News Co., 100 w, E.
WENR—870 kc, Chicago, Ill., Great Lakes Radio Broadcasting Co., 50,000 w, C.
WEPS—See under WORC.
WERE—1420 kc, Erie, Pa., Erie Dispatch-Herald, 30 w, E.
WEVD—1300 kc, Brooklyn, N. Y., Debs Memorial Radio Fund, 500 w, E.
WEW—760 kc, St. Louis, Mo., St. Louis University, 1000 w, C.
WEXL—1310 kc, Royal Oak, Mich., Royal Oak Broadcasting Co., 50 w, E.
WFAA—800 kc, Dallas, Texas, Dallas News and Journal, 50,000 w, C.
WFAM—1200 kc, La Porte, Ind., South Bend Tribune, 100 w, C.
WFAN—610 kc, Philadelphia, Pa., Keystone Broadcasting Co., Inc., 500 w, E.
WFBC—1200 kc, Knoxville, Tenn., First Baptist Church, 50 w, E.
WFBE—1200 kc, Cincinnati, Ohio, Post Publ. Co., 100 w, E.
WFBG—1310 kc, Altoona, Pa., William F. Gable Co., 100 w, E.
WFBL—1360 kc, Syracuse, N. Y., The Onondaga Co., Inc., 1000 w, E.
WFBM—1230 kc, Indianapolis, Ind., Indianapolis, Power & Light Co., 1000 w, C.
WFBR—1270 kc, Baltimore, Md., Baltimore Radio Show, Inc., 1000 w, E.
WFDF—1310 kc, Flint, Mich., Frank D. Fallain, 100 w, E.
WFDV—1310 kc, Rome, Ga., Dolies Goings, 100 w, E.
WFDW—1420 kc, Anniston, Ala., R. C. Hammett, 100 w, C.
WFEA—1430 kc, Merrimack, N. H., New Hampshire Bdcstg. Co., 500 w, E.
WFI—560 kc, Philadelphia, Pa., Strawbridge & Clothier, 500 w, E.
WFIW—940 kc, Hopkinsville, Ky., WFIW, Inc., 1000 w, C.
WFLA—620 kc, Clearwater, Fla., Clearwater Chamber of Commerce and St. Petersburg Chamber of Commerce, 250 w, E.
WFOX—1400 kc, Brooklyn, N. Y., Paramount Broadcasting Corp., 500 w.
WGAL—1310 kc, Lancaster, Pa., WGAL, Inc., 100 w, E.
WGAR—1450 kc, Cleveland, Ohio, WGAR Broadcasting Co., 500 w, E.
WGBB—1210 kc, Freeport, N. Y., Harry H. Carman, 100 w, E.
WGBC—See under WNBR.
WGBF—630 kc, Evansville, Ind., Evansville on the Air, Inc., 500 w, E.
WGBI—880 kc, Scranton, Pa., Scranton Broadcasters, Inc., 250 w, E.
WGCM—1210 kc, Gulfport, Miss., Great Southern Land Co., Inc., 100 w, C.
WGCP—1250 kc, Newark, N. J., May Radio Broadcast Corp., 250 w, E.
WGEO—1000 kc, York, Pa., York Bdcstg. Co., 1000 w, E.
WGES—1360 kc, Chicago, Ill., Oak Leaves Broadcasting Corp., 500 w, C.
WGH—1310 kc, Newport News, Va., Hampton Roads Broadcasting Corp., Inc., 100 w, E.
WGL—1370 kc, Ft. Wayne, Ind., Allen-Wayne Co., 100 w, C.
WGMS—See under WLB.
WGN—720 kc, Chicago, Ill., Tribune Co., 25,000 w, C.
WGR—550 kc, Buffalo, N. Y., Buffalo Broadcasting Corp., 1000 w, E.
WGST—890 kc, Atlanta, Ga., Georgia School of Technology, 250 w, E.
WGY—790 kc, Schenectady, N. Y., General Electric Co., 50,000 w, E.
WHA—940 kc, Madison, Wis., University of Wisconsin, 750 w, C.
WHAD—1120 kc, Milwaukee, Wis. Marquette University, 250 w, C.
WHAM—1150 kc, Rochester, N. Y., Stromberg-Carlson Tel. Mfg. Co., 5000 w, E.
WHAP—1300 kc, New York, N. Y., Defenders of Truth Society, Inc., 1000 w, E.
WHAS—820 kc, Louisville, Ky., The Courier Journal Co. & Louisville Times Co., 10,000 w, C.
WHAT—1310 kc, Philadelphia, Pa., Independence Broadcasting Co., 100 w, E.
WHAZ—1300 kc, Troy, N. Y., Rensselaer Polytechnic Institute, 500 w, E.
WHB—860 kc, Kansas City, Mo., WHB Broadcasting Co., 500 w, C.
WHBC—1200 kc, Canton, Ohio, St. John's Catholic Church, 10 w, E.
WHBD—1370 kc, Mt. Orab, Ohio, F. P. Moler, 100 w, E.
WHBF—1210 kc, Rock Island, Ill., Beardsley Specialty Co., 100 w, C.
WHBL—1410 kc, Sheboygan, Wis., Press Pub. Co., 500 w, C.
WHBQ—1370 kc, Memphis, Tenn., Station WHBQ, Inc., 100 w, C.
WHBU—1210 kc, Anderson, Ind., Anderson Bdcstg. Corp., 100 w. C.
WHBY—1200 kc, Green Bay, Wis., St. Norbert's College, 100 w, C.
WHDF—1370 kc, Calumet, Mich., Upper Michigan Brdcstg. Co., 100 w, C.
WHDH—830 kc, Boston, Mass., Matheson Radio Co., Inc., 1000 w, E.
WHDI—1180 kc, Minneapolis, Minn., Dr. G. W. Young, 500 w, C.
WHDL—1420 kc, Tupper Lake, N. Y., Tupper Lake Broadcasting Corp., 100 w, E.
WHEC—1440 kc, Rochester, N. Y., WHEC, Inc., 500 w, E.
WHFC—1420 kc, Cicero, Ill., WHFC, Inc., 100 w, C.
WHIS—1410 kc, Bluefield, W. Va., Daily Telegraph Printing Co., 250 w, E.
WHK—1390 kc, Cleveland, Ohio, Radio Air Service Corp., 1000 w, E.
WHN—1010 kc, New York, N. Y., Marcus Loew Booking Review, 250 w, E.
WHO—1000 kc, Des Moines, Iowa, Central Broadcasting Co., 50,000 w, C.
WHOM—1450 kc, Jersey City, N. J., New Jersey Broadcasting Corp., 250 w, E.
WHP—1430 kc, Harrisburg, Pa., WHP, Inc., 500 w, E.
WIAS—1420 kc, Ottumwa, Iowa, Poling Electric Co., 100 w, C.
WIBA—1280 kc, Madison, Wis., Capital Times Co., 500 w, C.
WIBG—930 kc, Elkins Park, Pa., WIBG, Inc., 25 w, E.
WIBM—1370 kc, Jackson, Mich., WIBM, Inc., 100 w.
WIBO—560 kc, Chicago, Ill., Nelson Bros. Bond and Mortgage Co., 1000 w, C.
WIBU—1210 kc, Poynette, Wis., W. C. Forrest, 100 w, C.
WIBW—580 kc, Topeka, Kan., Topeka Broadcasting Assn., Inc., 1000 w, C.
WIBX—1200 kc, Utica, N. Y., WIBX, Inc., 100 w, E.
WICC—600 kc, Bridgeport, Conn., Bridgeport Broadcasting Station, Inc., 500 w, E.
WIL—1200 kc, St. Louis, Mo., Missouri Broadcasting Co., 100 w, C.
WILL—890 kc, Urbana, Ill., University of Illinois, 250 w, C.
WILM—1420 kc, Wilmington, Del., Delaware Broadcasting Co., Inc., 100 w, E.
WINS—1180 kc, New York, N. Y., American Radio News Corp., 500 w, E.
WIOD—1300 kc, Miami, Fla., Isle of Dreams Broadcasting Co., 1000 w, E.
WIP—610 kc, Philadelphia, Pa., Gimbel Bros., Inc., 500 w, E.
WIS—1010 kc, Columbia, S. C., South Carolina Broadcasting Co., Inc., 500 w, E.
WISJ—See under WIBA.
WISN—1120 kc, Milwaukee, Wis., Evening Wisconsin Co., 250 w, C.
WJAC—1310 kc, Johnstown, Pa., Johnstown Automobile Co., 100 w, E.
WJAG—1060 kc, Norfolk, Neb., Norfolk Daily News, 1000 w, C.
WJAK—1310 kc, Marion, Ind., The Truth Pub. Co., Inc., 50 w.
WJAR—890 kc, Providence, R. I., The Outlet Co., 250 w, E.
WJAS—1290 kc, Pittsburgh, Pa., Pittsburgh Radio Supply House, 1000 w, E.
WJAX—900 kc, Jacksonville, Fla., City of Jacksonville, 1000 w, E.
WJAY—610 kc, Cleveland, Ohio, Cleveland Radio Broadcasting Corp., 500 w, E.
WJBC—1200 kc, LaSalle, Ill., Kaskaskia Broadcasting Co., 100 w, C.
WJBI—1210 kc, Red Bank, N. J., Monmouth Broadcasting Co., 100 w, E.
WJBK—1370 kc, Highland Park, Mich., J. F. Hopkins, 50 w, C.
WJBL—1200 kc, Decatur, Ill., Commodore Broadcasting Co., 100 w, C.
WJBO—1420 kc, New Orleans, La., Valdemar Jensen, 100 w, C.
WJBU—1210 kc, Lewisburg, Pa., Bucknell University, 100 w. E.
WJBW—1200 kc, New Orleans, La., C. Carlsen, Jr., 30 w, C.
WJBY—1210 kc, Gadsden, Ala., Gadsden Broadcasting Co., 100 w, C.
WJDX—1270 kc, Jackson, Miss., Lamar Life Ins. Co., 1000 w, C.
WJJD—1130 kc, Chicago, Ill., Loyal Order of Moose, 20,000 w, C.
WJKS—1360 kc, Gary, Ind., Johnson-Kennedy Radio Corp., 1000 w, C.
WJMS—1420 kc, Ironwood, Mich., Johnson Music Store, 100 w.
WJR—750 kc, Detroit, Mich., The Goodwill Station, Inc., 10,000 w, E.
WJSV—1460 kc, Alexandria, Va., WJSV, Inc., 10,000 w.
WJTL—1370 kc, Oglethorpe University, Ga., 100 w, E.
WJW—1210 kc, Mansfield, Ohio, Mansfield Broadcasting Association, 100 w, E.
WJZ—760 kc, New York City, N. Y., National Broadcasting Co., 30,000 w, E.
WKAQ—890 kc, San Juan, Porto Rico, Radio Corp. of Porto Rico, 250 w, E.
WKAR—1040 kc, East Lansing, Mich., Michigan State College, 1000 w, E.
WKAV—1310 kc, Laconia, N. H., Laconia Radio Club, 100 w, E.
WKBB—1310 kc, Joliet, Ill., Sanders Bros., 100 w, C.
WKBC—1310 kc, Birmingham, Ala., R. B. Broyles Furniture Co., 100 w, C.
WKBF—1400 kc, Indianapolis, Ind., Indianapolis Broadcasting Corp., 500 w, C.
WKBH—1380 kc, LaCrosse, Wis., WKBH, Inc., 1000 w, C.
WKBI—1420 kc, Chicago, Ill., WKBI, Inc., 100 w, C.
WKBN—570 kc, Youngstown, Ohio, WKBN Bdcstg. Corp., 500 w, E.
WKBO—1450 kc, Jersey City, N. J., Camith Corp., 250 w, E.
WKBS—1310 kc, Galesburg, Ill., Permil N. Nelson, 100 w, C.
WKBV—1500 kc, Connersville, Ind., Knox Battery & Electric Co., 100 w, C.
WKBW—1480 kc, Buffalo, N. Y., WKBW, Inc., 5000 w, E.
WKBZ—1500 kc, Ludington, Mich., K. L. Ashbacker, 50 w.
WKJC—1200 kc, Lancaster, Pa., Lancaster Bdcstg. Service, Inc., 100 w, E.
WKRC—550 kc, Cincinnati, Ohio, WKRC, Inc., 1000 w, E.
WKY—900 kc, Oklahoma City, Okla., WKY Radiophone Co., 1000 w, C.
WKZO—590 kc, Berrien Springs, Mich., WKZO, Inc., 1000 w, C.
WLAC—1470 kc, Nashville, Tenn., Life & Casualty Ins. Co., 5000 w, C.

WLAP—1200 kc, Louisville, Ky., American Broadcasting Corp. of Kentucky, 100 w, C.

WLB—1250 kc, Minneapolis, Minn., University of Minnesota, 1000 w, C.

WLBC—1310 kc, Muncie, Ind., Donald A. Burton, 50 w.

WLBF—1420 kc, Kansas City, Kan., WLBF Broadcasting Co., 100 w, C.

WLBG—1200 kc, Petersburg, Va., WLBG, Inc., 100 w, E.

WLBL—900 kc, Stevens Point, Wis., Wisconsin Department of Agriculture, 2000 w, daytime, C.

WLBW—1260 kc, Oil City, Pa., Radio-Wire Program Corp., 500 w, E.

WLBX—1500 kc, Long Island City, N. Y., John N. Brahy, 100 w.

WLBZ—620 kc, Bangor, Me., Mainc Broadcasting Co., 500 w, E.

WLCI—1210 kc, Ithaca, N. Y., Lutheran Assn. of Ithaca, 50 w, E.

WLEY—1370 kc, Lexington, Mass., Lexington Air Station, 100 w, E.

WLIT—560 kc, Philadelphia, Pa., Lit Brothers, 500 w, E.

WLS—870 kc, Chicago, Ill., Agricultural Broadcasting Co., 5000 w, C.

WLSI—See under WPRO.

WLTH—1400 kc, Brooklyn, N. Y., Voice of Brooklyn, Inc., 500 w, E.

WLVA—1370 kc, Lynchburg, Va., Lynchburg Broadcasting Corp., 100 w, E.

WLW—700 kc, Cincinnati, Ohio, Crosley Radio Corp., 50,000 w, E.

WLWL—1100 kc, New York, N. Y., Missionary Society of St. Paul, 5000 w, E.

WMAC—See under WSYR.

WMAL—630 kc, Washington, D. C., M. A. Leese Co., 250 w, E.

WMAQ—670 kc, Chicago, Ill., National Broadcasting Co., 5000 w, C.

WMAZ—1180 kc, Macon, Ga., Southeastern Broadcasting Co., 500 w, E.

WMBA—1500 kc, Newport, R. I., LeRoy Joseph Beebe, 100 w, E.

WMBC—1420 kc, Detroit, Mich., Michigan Broadcasting Co., Inc., 100 w, E.

WMBD—1440 kc, Peoria Heights, Ill., Peoria Bdcstg. Co., 500 w.

WMBF—See under WIOD.

WMBG—1210 kc, Richmond, Va., Havens & Martin, Inc., 100 w, E.

WMBH—1420 kc, Joplin, Mo., Edwin Dudley Aber, 100 w, C.

WMBI—1080 kc, Chicago, Ill., Moody Bible Institute Radio Station, 5000 w, C, shared.

WMBJ—1500 kc, Wilkinsburg, Pa., Rev. John W. Sproul, 100 w, E.

WMBO—1310 kc, Auburn, N. Y., WMBO, Inc., 100 w, E.

WMBQ—1500 kc, Brooklyn, N. Y., Paul J. Gollhofer, 100 w.

WMBR—1370 kc, Tampa, Fla., F. J. Reynolds, 100 w, E.

WMC—780 kc, Memphis, Tenn., Memphis Commercial Appeal, Inc., 500 w, C.

WMCA—570 kc, New York, N. Y., Knickerbocker Broadcasting Co., Inc., 500 w, E.

WMIL—1500 kc, Brooklyn, N. Y., Arthur Faske, 100 w, E.

WMMN—890 kc, Fairmont, W. Va., Holt Rowe Novelty Co., 250 w, E.

WMPC—1500 kc, Lapeer, Mich., First Methodist Protestant Church, 100 w, E.

WMBJ—1210 kc, Jamaica, N. Y., Peter J. Prinz, 10 w, E.

WMSG—1350 kc, New York, N. Y., Madison Square Garden Broadcast Co., 250 w, E.

WMT—600 kc, Waterloo, Iowa, Waterloo Broadcasting Co., 500 w, C.

WNAC—1230 kc, Boston, Mass., The Shepard Broadcasting Service, 1000 w, E.

WNAD—1010 kc, Norman, Okla., University of Oklahoma, 500 w, C.

WNAX—570 kc, Yankton, S. Dak., Gurney Seed & Nursery Co., 1000 w, C.

WNBF—1500 kc, Binghamton, N. Y., Howitt-Wood Radio Co., 100 w, E.

WNBH—1310 kc, New Bedford, Mass., New Bedford Broadcasting Co., 100 w, E. shared.

WNBO—1200 kc, Silver Haven, Pa., J. B. Spriggs, 100 w, E.

WNBR—1430 kc, Memphis, Tenn., Memphis Broadcasting Co., 500 w, C.

WNBW—1200 kc, Carbondale, Pa., Home Cut Glass & China Co., 10 w, E.

WNBX—1200 kc, Springfield, Vt., First Congregational Church Corp., 10 w, E.

WNBZ—1290 kc, Saranac Lake, N. Y., Smith & Mace, 50 w, E.

WNJ—1450 kc, Newark, N. J., Radio Investment Co., 250 w, E.

WNOX—560 kc, Knoxville, Tenn., WNOX, Inc., 1000 w, C.

WNYC—570 kc, New York, N. Y. Department of Plant & Structures, 500 w, E.

WOAI—1190 kc, San Antonio, Texas, Southern Equipment Co., 50,000 w, C.

WOAN—See WREC.

WOAX—1280 kc, Trenton, N. J., WOAX, Inc., 500 w, E.

WOBU—580 kc, Charleston, W. Va., WOBU, Inc., 250 w, E.

WOC—1000 kc, Davenport, Iowa, Central Broadcasting Co., 50,000 w, C.

WOCL—1210 kc, Jamestown, N. Y., A. E. Newton, 50 w, E.

WODA—1250 kc, Paterson, N. J., Richard E. O'Dea, 1000 w, E.

WODX—1410 kc, Mobile, Ala., Mobile Brdcstg. Corp., 500 w, C.

WOI—640 kc, Ames, Iowa, Iowa State College, 5000 w, C.

WOKO—1440 kc, Albany, N. Y., WOKO, Inc., 500 w, E.

WOL—1310 kc, Washington, D. C., American Broadcasting Co., 100 w, E.

WOMT—1210 kc, Manitowoc, Wis., Francis M. Kadow, 100 w.

WOOD—1270 kc, Grand Rapids, Mich., Walter B. Stiles, Inc., 500 w, C.

WOPI—1500 kc, Bristol, Tenn., Radiophone Broadcasting Co., 100 w, E.

WOR—710 kc, Newark, N. J., J. Bamberger Broadcasting Service, Inc., 50,000 w, E.

WORC—1200 kc, Worcester, Mass., A. F. Kleindienst, 100 w, E.

WOS—630 kc, Jefferson City, Mo., John D. Heiny, 500 w, C.

WOV—1130 kc, New York, N. Y., International Broadcasting Corp., 1000 w, E.

WOW—590 kc, Omaha, Neb., Woodmen of the World, 1000 w, C.

WOWO—1160 kc, Ft. Wayne, Ind., Main Auto Supply Co., 10,000 w, C.

WPAD—1420 kc, Paducah, Ky., Paducah Broadcasting Co., 100 w, C.

WPAP—See under WQAO.

WPCC—560 kc, Chicago, Ill., North Shore Congregational Church, 500 w, C.

WPCH—810 kc, New York, N. Y., Eastern Broadcasters, Inc., 500 w, E.

WPEN—1500 kc, Philadelphia, Pa., Wm. Penn Broadcasting Co., 250 w, E.

WPFB—1370 kc, Hattiesburg, Miss., Hattiesburg Bdcstg. Co., 100 w, C.

WPG—1100 kc, Atlantic City, N. J., WPG Broadcasting Corp., 5000 w, E.

WPOR—See under WTAR.

WPRO—1210 kc, Providence, R. I., Cherry & Webb Bdcstg. Co., 100 w, E.

WPSC—1230 kc, State College, Pa., Pennsylvania State College, 500 w, day, E.

WPTF—680 kc, Raleigh, N. C., Durham Life Insurance Co., 1000 w, E.

WQAM—560 kc, Miami, Fla., Miami Broadcasting Co., 1000 w, E.

WQAN—880 kc, Scranton, Pa., Scranton Times, 250 w, E.

WQAO—1010 kc, New York, N. Y., Calvary Baptist Church, 250 w, E.

WQBC—1360 kc, Vicksburg, Miss., Delta Broadcasting Co., 300 w, C.

WQDM—1370 kc, St. Albans, Vt., A. J. St. Antoine, 100 w, E.

WQDX—1210 kc, Thomasville, Ga., Stevens Luke, 100 w, E.

WRAK—1370 kc, Williamsport, Pa., C. R. Cummins, 50 w, E.

WRAM—1370 kc, Wilmington, N. C., Wilmington Radio Association, 100 w, E.

WRAW—1310 kc, Reading, Pa., Reading Broadcasting Co., 50 w, E.

WRAX—1020 kc, Philadelphia, Pa., WRAX Broadcasting Co., 250 w, E.

WRBL—1200 kc, Columbus, Ga., WRBL Radio Station, Inc., 50 w, E.

WRBQ—1210 kc, Greenville, Miss., J. Pat Scully, 250 w, C.

WRBX—1410 kc, Roanoke, Va., Richmond Development Corp., 250 w, E.

WRC—950 kc, Washington, D. C., National Broadcasting Co., 500 w, E.

WRDO—1370 kc, Augusta, Me., Albert S. Woodman, 100 w, E.

WRDW—1500 kc, Augusta, Ga., Davenport's Musicove, Inc., 100 w, E.

WREC—600 kc, Memphis, Tenn., WREC, Inc., 500 w.

WREN—1220 kc, Lawrence, Kan., Jenny Wren Co., 1000 w, C.

WRHM—1250 kc, Minneapolis, Minn., Minnesota Broadcasting Corp., 1000 w, C.

WRJN—1370 kc, Racine, Wis., Racine Broadcasting Corp., 100 w, C.

WRNY—1010 kc, New York, N. Y., Aviation Radio Station, 250 w, E.

WROL—1310 kc, Knoxville, Tenn., Stuart Broadcasting Corp., 100 w, C.

WRR—1280 kc, Dallas, Texas, City of Dallas, 500 w, C.

WRUF—830 kc, Gainesville, Fla., University of Florida, 5000 w, E.

WRVA—1110 kc, Richmond, Va., Larus Bros. & Co., Inc., 5000 w, E.

WSAI—1330 kc, Cincinnati, Ohio, Crosley Radio Corp., 500 w, E.

WSAJ—1310 kc, Grove City, Pa., Grove City College, 100 w, E.

WSAN—1440 kc, Allentown, Pa., Allentown Call Pub. Co., 250 w, E.

WSAR—1450 kc, Fall River, Mass., Doughty & Welch Electrical Co., Inc., 250 w, E.

WSAZ—580 kc, Huntington, W. Va., WSAZ, Inc., 250 w, E.

WSB—740 kc, Atlanta, Ga., Atlanta Journal Co., 5000 w, E.

WSBC—1210 kc, Chicago, Ill., World Battery Co., 100 w, C.

WSBT—1230 kc, South Bend, Ind., South Bend Tribune, 500 w, C.

WSEN—1210 kc, Columbus, Ohio, Columbus Broadcasting Corp., 100 w, E.

WSFA—1410 kc, Montgomery, Ala., Montgomery Brdcstg. Co., 500 w, C.

WSIX—1210 kc, Springfield, Tenn., 638 Tire & Vulcanizing Co., 100 w, C.

WSJS—1310 kc, Winston-Salem, N. C., The Journal Co., 100 w, E.

WSM—650 kc, Nashville, Tenn., National Life & Accident Ins. Co., 5000 w, C.

WSMB—1320 kc, New Orleans, La., WSMB, Inc., 500 w, C.

WSMK—1380 kc, Dayton, Ohio, Stanley M. Krohn, Jr., 200 w, C.

WSOC—1210 kc, Gastonia, N. C., A. J. Kirby Music Co., 100 w, E.

WSPA—1420 kc, Spartanburg, S. C., 100 w. E.

WSPD—1340 kc, Toledo, Ohio, Toledo Broadcasting Co., 1000 w, E.

WSUI—880 kc, Iowa City, Iowa, State Univ. of Iowa, 500 w, C.

WSUN—See under WFLA.

WSYS—1370 kc, Buffalo, N. Y., Seneca Vocational High School, 50 w, E.

WSYB—1500 kc, Rutland, Vt., Weiss Music Co., 100 w, E.

WSYR—570 kc, Syracuse, N. Y., Clive B. Meredith, 250 w, E.

WTAD—1440 kc, Quincy, Ill., Illinois Broadcasting Corp., 500 w.

WTAG—580 kc, Worcester, Mass., Worcester Telegram Pub. Co., Inc., 250 w, E.

WTAM—1070 kc, Cleveland, Ohio, National Broadcasting Co., 50,000 w, E.

WTAQ—1330 kc, Eau Claire, Wis., Gillette Rubber Co., 1000 w, C.

WTAR—780 kc, Norfolk, Va., WTAR Radio Corp., 500 w, E.

WTAW—1120 kc, College Station, Texas, Agri. & Mech. College of Texas, 500 w, C.

WTAX—1210 kc, Springfield, Ill., WTAX, Inc., 100 w.

WTBO—1420 kc, Cumberland, Md., Associated Brdcstg. Corp., 100 w, E.

WTEL—1310 kc, Philadelphia, Pa., Foulkrod Radio Eng. Co., 50 w, E.

WTFI—1450 kc, Athens, Ga., Toccoa Falls Bdcstg. Co., 500 w, E.

WTIC—1060 kc, Hartford, Conn., Travelers Broadcasting Service Corp., 50,000 w, E.

WTJS—1310 kc, Jackson, Tenn., Sun Publishing Co., 100 w, C.

WTMJ—620 kc, Milwaukee, Wis., Milwaukee Journal, 1000 w, C.

WTNT—1470 kc, Nashville, Tenn., Life and Casualty Ins. Co. of Tenn., 5000 w, C.

WTOC—1260 kc, Savannah, Ga., Savannah Broadcasting Corp., 500 w, E.

WWAE—1200 kc, Hammond, Ind., Hammond-Calumet Broadcasting Corp., 100 w, C.

WWJ—920 kc, Detroit, Mich., Evening News Assn., 1000 w, E.

WWL—850 kc, New Orleans, La., Loyola University, 10,000 w, C.

WWNC—570 kc, Asheville, N. C., Citizens Broadcasting Co., 1000 w, E.

WWRL—1500 kc, Woodside, N. Y., Long Island Broadcasting Corp., 100 w.

WWSW—1500 kc, Pittsburgh, Pa., Walker & Downing Radio Corp.

WWVA—1160 kc, Wheeling, W. Va., West Virginia Broadcasting Corp., 5000 w, E

WXYZ—1240 kc, Detroit, Mich., Kunsky Trendle Broadcasting Co., 1000 w, E.

U. S. Broadcasting Stations by Frequencies

550 Kilocycles, 545.1 Meters:
KOAC, WGR, WKRC, KFUO, KSD, KFDY, KFYR

560 Kilocycles, 535.4 Meters.
WLIT, WFI, KFDM, WNOX KTAB, KLZ, WIBO, WPCC, WQAM

570 Kilocycles, 526.0 Meters:
WNYC, WMCA, WSYR, WMAC, WKBN, WWNC, KGKO, WNAX, KXA, KMTR, WEAO

580 Kilocycles, 516.9 Meters—Canadian Shared:
WTAG, WOBU, WSAZ, KSAC, WIBW

590 Kilocycles, 508.2 Meters:
WEEI, WCAJ, WOW, KHQ, WKZO

600 Kilocycles, 499.7 Meters—Canadian Shared:
WCAO, WREC, WOAN, KFSD, WCAC, WMT WICC

610 Kilocycles, 491.5 Meters:
WFAN, WIP, WDAF, KFRC, WJAY

620 Kilocycles, 483.6 Meters:
WLBZ, WTMJ, KGW, WFLA, WSUN, KTAR

630 Kilocycles, 475.9 Meters—Canadian Shared:
WMAL, WOS, KFRU, WGBF, KGFX

640 Kilocycles, 468.5 Meters:
WAIU, KFI, WOI

650 Kilocycles, 461.3 Meters:
WSM, KPCB

660 Kilocycles, 454.3 Meters:
WEAF, WAAW

670 Kilocycles, 447.5 Meters:
WMAQ

680 Kilocycles, 440.9 Meters:
WPTF, KPO, KFEQ

690 Kilocycles, 434.5 Meters—Canadian Wave:

700 Kilocycles, 428.3 Meters:
WLW

710 Kilocycles, 422.3 Meters:
WOR, KMPC

720 Kilocycles, 416.4 Meters:
WGN

730 Kilocycles, 410.7 Meters—Canadian Wave:

740 Kilocycles, 405.2 Meters:
WSB, KMMJ

750 Kilocycles, 399.8 Meters:
WJR, KGU

760 Kilocycles, 394.5 Meters:
WJZ, WEW, KVI

770 Kilocycles, 389.4 Meters:
KFAB, WBBM, WJBT

780 Kilocycles, 384.4 Meters—Canadian Shared:
WTAR, WPOR, KELW, KTM, WMC, WEAN

790 Kilocycles, 379.5 Meters:
WGY, KGO

800 Kilocycles, 374.8 Meters:
WBAP, WFAA

810 Kilocycles, 370.2 Meters:
WPCH, WCCO

820 Kilocycles, 365.6 Meters:
WHAS

830 Kilocycles, 361.2 Meters:
KOA, WHDH, WRUF, WEEU

840 Kilocycles, 356.9 Meters—Canadian Wave:

850 Kilocycles, 352.7 Meters:
KWKH, WWL

860 Kilocycles, 348.6 Meters:
WBOQ, WABC, KMO, WHB

870 Kilocycles, 344.6 Meters:
WLS, WENR, WBCN

880 Kilocycles, 340.7 Meters—Canadian Shared:
WQAN, WGBI, WCOC, KLX, KPOF, KFKA, WSUI

890 Kilocycles, 336.9 Meters—Canadian Shared:
WJAR, WMMN, WGST, KARK, WILL, KUSD, KFNF, WKAQ

900 Kilocycles, 331.1 Meters:
WKY, WLBL, KHJ, KSEI, KGBU, WJAX, WBEN

910 Kilocycles, 329.5 Meters—Canadian Wave:

920 Kilocycles, 325.9 Meters:
WWJ, KPRC, WAAF, WBSO, KOMO, KFXF, KFEL

930 Kilocycles, 322.4 Meters—Canadian Shared:
WIBG, WDBJ, WBRC, KGBZ, KMA, KFWI, KROW

940 Kilocycles, 319 Meters:
WCSH, WFIW, KOIN, WHA, WDAY, WAAT

950 Kilocycles, 315.6 Meters:
WRC, KMBC, KFWB, KGHL

960 Kilocycles, 312.3 Meters—Canadian Wave:

970 Kilocycles, 309.1 Meters:
KJR, WCFL

980 Kilocycles, 305.9 Meters:
KDKA

990 Kilocycles, 302.8 Meters:
WBZ, WBZA

1000 Kilocycles, 299.8 Meters:
WHO, WOC, KFVD, WGEO

1010 Kilocycles, 296.9 Meters—Canadian Shared:
WQAO, WPAP, WHN, WRNY, KGGF, WNAD, KQW, WIS

1020 Kilocycles, 293.9 Meters:
KYW, KFKX, WRAX

1030 Kilocycles, 291.1 Meters—Canadian Wave:

1040 Kilocycles, 288.3 Meters:
WKAR, KTHS, KRLD

1050 Kilocycles, 285.5 Meters:
KNX, KFKB

1060 Kilocycles, 282.8 Meters:
WBAL, WJAG, KWJJ, WTIC

1070 Kilocycles, 280.2 Meters:
WTAM, WCAZ, WDZ, KJBS

1080 Kilocycles, 277.6 Meters:
WBT, WCBD, WMBI

1090 Kilocycles, 275.1 Meters:
KMOX

1100 Kilocycles, 272.6 Meters:
WPG, WLWL, KGDM

1110 Kilocycles, 270.1 Meters:
WRVA, KSOO

1120 Kilocycles, 267.7 Meters—Canadian Shared:
WTAW, WISN, WHAD, KFSG, KRSC, WDEL, WDBO, KFIO, KTRH, KMBC, KRKD

1130 Kilocycles, 265.3 Meters:
WOV, KSL, WJJD

1140 Kilocycles, 263.0 Meters:
WAPI, KVOO

1150 Kilocycles, 260.7 Meters:
WHAM

1160 Kilocycles, 258.5 Meters:
WWVA, WOWO

1170 Kilocycles, 256.3 Meters:
WCAU

1180 Kilocycles, 254.1 Meters:
KEX, KOB, WHDI, WDGY, WMAZ, WINS

1190 Kilocycles, 252.0 Meters:
WOAI

1200 Kilocycles, 249.9 Meters: Canadian Shared:
WABI, WNBX, WORC, WIBX, WHBC, WBHS, WLBG, WNBQ, WKJC, WNBW, WABZ, WJBW, WBBZ, WFBC, WRBL, WJBC, WJBL, WWAE, WFAM, KFJB, WCAT, KGDY, KFWF, KGDE, WCLO, WHBY, KERN, WIL, KVOS, KGY, KGEK, KGEW, KGHI, WCAX, WCOD, WFBE, KBTM, WEPS, KMLB, KGFJ, KWG, WLAP

1210 Kilocycles, 247.8 Meters—Canadian Shared:
WJBI, WGBB, WCOH, WOCL, WLCI, WPAW, WPRO, WLSI, WJW, WBAX, WJBU, WMBG, WSIX, WJBY, WRBO, WGCM, KWEA, KDLR, KGCR, KFOR, WHBU, KFVS, WEBQ, WODX, WCRW, WEDC, WCBS, WTAX, WHBF, WOMT, WSBC, KMJ, KFXM, KPPC, WALR, WBBL, WMRJ, KGMP, KGNO, WSEN, WSOC, WIBU, KFJI

1220 Kilocycles, 245.6 Meters:
WCAD, WCAE, WREN, KFKU, WDAE, KWSC, KTW

1230 Kilocycles, 243.8 Meters:
WNAC, WBIS, WPSC, WSBT, WFBM, KFQD, KYA, KGGM

1240 Kilocycles, 241.8 Meters:
WACO, KTAT, WXYZ, KGCU, KTFI

1250 Kilocycles, 239.9 Meters:
WGCP, WODA, WAAM, WLB, WGMS, WRHM, KFMX, WCAL, KFOX, WDSU

1260 Kilocycles, 238.0 Meters:
WLBW, KWWG, KRGV, KOIL, KVOA, WTOC

1270 Kilocycles, 236.1 Meters:
WEAI, WASH, WOOD, KWLC, KGCA, KOL, KVOR, WFBR, WJDX

1280 Kilocycles, 234.2 Meters:
WCAM, WCAP, WOAX, WDOD, WRR, KFBB, WIBA, WISJ

1290 Kilocycles, 232.4 Meters:
WNBZ, WJAS, KTSA, KFUL, KLCN, KDYL, WEBC

1300 Kilocycles, 230.6 Meters:
WBBR, WHAP, WEVD, WHAZ, KFH, KGEF, KFAC, KFJR, KTBR, WIOD, WMBF, WOQ

1310 Kilocycles, 228.9 Meters:
WKAV, WEBR, WNBH, WOL, WGH, WHAT, WFBG, WRAW, WGAL, WSAJ, WBRE, WKBC, WTJS, KRMD, KFPM, WDAH, KFPL, KFXR, WKBS, WCLS, WKBB, KWCR, KFJY, KFGQ, WBOW, WJAK, WLBC, KTSL, KFUP, KFNJ, KFBK, KGEZ, KMED, KTSM, KGCX, WJAC, WSJS, KXRO, KGFW, KFIU, KGBX, KIT, WMBO, KCRJ, KTLC, WEXL, WROL, WTEL, WBEO, WFDV

1320 Kilocycles, 227.1 Meters:
WADC, WSMB, KID, KGHF, KGMB, KGIQ

1330 Kilocycles, 225.4 Meters:
WDRC, WTAQ, KSCJ, WSAI, KGB

1340 Kilocycles, 223.7 Meters:
KFPW, WCOA, KFPY, WSPD

1350 Kilocycles, 222.1 Meters:
WMSG, WCDA, WBNX, KWK, WAWZ, WEHC KIDO

1360 Kilocycles, 220.4 Meters:
WOBC, WGES, KGIR, KGER, WFBL, WCSC WJKS

1370 Kilocycles, 218.8 Meters:
WSVS, WCBM, WHBD, WJBK, WIBM, WRAK, WDAS, WHBQ, WRAM, KGFG, KFJZ, KGKL, KFLX, KGDA, KRE, WPOE, KFBL, KWKC, WRJN, KGAR, KVI, KGFL, WHDF, KOOS, WGL, KFJM, KCRC, WMBR, WPFB, WLEY, WBGF, WBTM, WLVA, WQDM, WRDO, KONO, KMAC, KUJ, WJTL, KOH

1380 Kilocycles, 217.3 Meters:
KQV, KSO, WKBH, WSMK

1390 Kilocycles, 215.7 Meters:
WHK, KLRA, KUOA, KOY

1400 Kilocycles, 214.2 Meters:
WCGU, WFOX, WLTH, WBBC, WCMA, WKBF, KOCW, WBAA, KLO

1410 Kilocycles, 212.6 Meters:
KGRS, WDAG, KFLV, WHBL, WBCM, WODX, WSFA, WAAB, WRBX, WHIS

1420 Kilocycles, 211.1 Meters:
WTBO, WKBI, WEDH, WMBC, KGFF, KABC, KFYO, KICK, WIAS, KGGC, WLBF, WMBH, KFIZ, KORE, WILM, KGIW, KGKX, KFQW, KLPM, KXL, WHDL, WHFC, WEHS, KFQU, KFXD, KGIX, WJBO, WELL, WFDW, WPAD, WSPA, KBPS, KFXY, KXYZ, WAGM, WDEV, KGVO, WJMS, WDIX, KCMC

1430 Kilocycles, 209.7 Meters:
WHP, WCAH, WGBC, WNBR, WBAK, KECA, KGNF, WFEA

1440 Kilocycles, 208.2 Meters:
WHEC, WABO, WOKO, WCBA
WTAD, WMBD, KLS, WSAN, WBIG, KDFN

1450 Kilocycles, 206.8 Meters:
WBMS, WNJ, WKBO, WSAR, WGAR, WTFI, KTBS, WHOM

1460 Kilocycles, 205.4 Meters:
WJSV, KSTP

1470 Kilocycles, 204.0 Meters:
KGA, WTNT, WLAC

1480 Kilocycles, 202.6 Meters:
KFJF, WKBW

1490 Kilocycles, 201.6 Meters:
WCKY, WCHI

1500 Kilocycles, 199.9 Meters:
WMBA, WNBF, WMBQ, WLBX, WWRL, WKBZ, WMPC, WOPI, WPEN, KGKB, WKBV, KPJM, KDB, KGFI, WMBJ, KREG, WCLB, WRDW, KGIZ, KGKY, KPQ, KXO, KGFK, WSYB, WWSW, KNOW

U. S. Broadcasting Stations Listed by States

ALABAMA

Anniston, WFDW
Birmingham, WBRC, WKBC, WAPI
Gadsden, WJBY
Huntsville, WBHS
Mobile, WODX
Montgomery, WSFA

ALASKA

Anchorage, KFQD
Juneau, KFIU
Ketchikan, KGBU

ARIZDNA

Flagstaff, KFXY
Jerome, KCRJ
Phoenix, KTAR, KOY
Prescott, KPJM
Tucson, KGAR, KVOA

ARKANSAS

Blytheville, KLCN
Fort Smith, KFPW
Fort Smith, KEPW
Hot Springs, KTHS
Little Rock, KLRA, KGHI, KARK
Paragould, KBTM

CALIFDRNIA

Bakersfield, KERN
Berkeley, KRE
Beverley Hills, KMPC
Burbank, KELW
Culver City, KFVD
El Centro, KXO
Fresno, KMJ
Hollywood, KNX, KFWB
Long Beach, KFOX, KGER
Los Angeles, KFI, KFSG, KGEF, KGFJ, KHJ, KECA, KMTR, KTM, KFAC
Oakland, KLS, KLX, KROW
Pasadena, KPPC
Sacramento, KFBK
San Bernardino, KFXM
San Diego, KFSD, KGB
San Francisco, KFRC, KFWI, KJBS, KPO, KGGC, KYA, KGO, KTAB
San Jose, KQW
Santa Ana, KREG
Santa Barbara, KDB
Stockton, KGDM, KWG

CDLORADO

Colorado Springs, KVOR
Denver, KFEL, KFUP, KFXF, KOA, KPOF, KLZ
Edgewater, KFXJ
Greeley, KFKA
Pueblo, KGHF
Trinidad, KGIW
Yuma, KGEK

CDNNECTICUT

Bridgeport, WICC
Hartford, WTIC, WDRC
Storrs, WCAC

DELAWARE

Wilmington, WDEL, WILM

DISTRICT DF COLUMBIA

Washington, NAA, WMAL, WRC, WOL

FLORIDA

Clearwater, WFLA, WSUN
Gainesville, WRUF
Jacksonville, WJAX
Miami, WIOD, WMBF, WQAM
Orlando, WDBO
Pensacola, WCOA
Tampa, WDAE, WMBR

GEDRCIA

Athens, WTFI
Atlanta, WGST, WSB
Augusta, WRDW
Columbus, WRBL
Macon, WMAZ
Oglethorpe U., WJTL
Rome, WFDV
Savannah WTOC
Thomasville, WQDX

HAWAII

Honolulu, KGU, KGMB

IDAHO

Boise, KIDO
Idaho Falls, KID
Nampa, KFXD
Pocatello, KSEI
Sandpoint, KGKX
Twin Falls, KTFI, KGIQ

ILLINDIS

Carthage, WCAZ
Chicago, KYW, WAAF, WCFL, WCBW, WEDC, WENR, WGES, WKBI, WPCC, WGN, WMAQ, WMBI, WBBM, WSBC, WIBO, WLS, WJJD, WCHI
Cicero, WIIFC
Decatur, WJBL
Evanston, WEHS
Galesburg, WKBS
Harrisburg, WEBQ
Joliet, WCLS, WKBB
La Salle, WIBC
Peoria Heights, WMBD
Quincy, WTAD
Rockford, KFLV
Rock Island, WHBF
Springfield, WCBS, WTAX
Tuscola, WDZ
Urbana, WILL
Zion, WCBD

INDIANA

Anderson, WHBU
Connersville, WKBV
Culver, WCMA
Evansville, WGBF
Fort Wayne, WGL, WOWO
Gary, WJKS
Hammond, WWAE
Indianapolis, WFBM, WKBF
Lafayette, WBAA
La Porte, WFAM
Marion, WJAK
Muncie, WLBC
South Bend, WSBT
Terre Haute, WBOW

IDWA

Ames, WOI
Boone, KFGQ
Cedar Rapids, KWCR
Clarinda, KSO
Council Bluffs, KOIL
Davenport, WOC
Decorah, KGCA, KWLC
Des Moines, WHO
Ft. Dodge, KFJY
Iowa City, WSUI
Marshalltown, KFJB
Ottumwa, WIAS
Red Oak, KICK
Shenandoah, KFNF, KMA
Sioux City, KSCJ
Waterloo, WMT

KANSAS

Dodge City, KGNO
Kansas City, WLBF
Lawrence, KFKU, WREN
Manhattan, KSAC
Milford, KFKB
Topeka, WIBW
Wichita, KFH

KENTUCKY

Covington, WCKY
Hopkinsville, WFIW
Louisville, WHAS, WLAP
Paducah, WPAD

LDUISIANA

Monroe, KMLB
New Orleans, WABZ, WJBO, WJBW, WSMB, WWL, WDSU
Shreveport, KTSL, KWEA, KRMD, KTBS, KWKH

MAINE

Augusta, WRDO
Bangor, WABI, WLBZ
Portland, WCSH
Presque Isle, WAGM

MARYLAND

Baltimore, WCAO, WCBM, WBAL, WFBR
Cumberland, WTBO

MASSACHUSETTS

Boston, WBZA, WEEI, WNAC, WBIS, WHDH
Fall River, WSAR
Lexington, WLEY
Needham, WBSO
New Bedford, WNBH
Quincy, WAAB
Springfield, WBZ
Worcester, WTAG, WORC, WEPS

MICHIGAN

Bay City, WBCM
Berrien Springs, WKZO
Calumet, WHDF
Detroit, WMBC, WWJ, WJR, WXYZ
East Lansing, WKAR
Flint, WFDF
Grand Rapids, WASH, WOOD
Highland Park, WJBK
Ironwood, WJMS
Jackson, WIBM
Lapeer, WMPC
Ludington, WKBZ
Marquette, WBEO
Royal Oak, WEXL

MINNESDTA

Fergus Falls, KGDE
Minneapolis, WDGY, WHDI, WLB, WRHM, WCCO, WGMS
Moorhead, KGFK
Northfield, KFMX, WCAL
St. Paul, KSTP

MISSISSIPPI

Greenville, WRBQ
Gulfport, WGCM
Hattiesburg, WFFB
Jackson, WJDX
Meridian, WCOC
Vicksburg, WQBC

MISSDURI

Cape Girardeau, KFVS
Columbia, KFRU
Grant City, KGIZ
Jefferson City, WOS
Joplin, WMBH
Kansas City, KWKC, WDAF, WHB, KMBC
Kirkwood, KWK
St. Joseph, KGBX, KFEQ
St. Louis, KFWF, KSD, WEW, WIL, KMOX, KFUO

MONTANA

Billings, KGHL
Butte, KGIR
Great Falls, KFBB
Kalispell, KGEZ
Missoula, KGVO
Wolf Point, KGCX

NEBRASKA

Clay Center, KMMJ
Lincoln, KFAB, KFOR, WCAJ
Norfolk, WJAG
North Platte, KGNF
Omaha, WAAW, WOW
Kearney, KGEW
Scottsbluff, KGKY
York, KGBZ

NEVADA

Las Vegas, KGIX
Reno, KOH

NEW HAMPSHIRE

Laconia, WKAV
Merrimack, WFEA

NEW JERSEY

Asbury Park, WCAP
Atlantic City, WPG
Camden, WCAM
Hackensack, WBMS
Jersey City, WAAT, WKBO, WHOM
Newark, WAAM, WGCP, WNJ, WOR
Paterson, WODA
Red Bank, WJBI
Trenton, WOAX

NEW MEXICD

Albuquerque, KGGM
Raton, KGFL
State College, KOB

NEW YDRK

Albany, WOKO
Auburn, WMBO
Binghamton, WNBF
Brooklyn, WBBC, WLTH, WMBQ, WFOX, WMIL, WBBR, WCGU, WEVD
Buffalo, WEBR, WGR, WKBW, WSVS, WBEN
Canton, WCAD
Freeport, WGBB
Glens Falls, WHGF
Ithaca, WLCI, WEAI
Jamaica, WMBJ
Jamestown, WOCL
Long Beach, WCLB
Long Island City, WLBX
New York, WHN, WJZ, WBNX, WMCA, WMSG, WNYC, WPCH, WRNY, WABC, WOV, WQAO, WLWL, WBOQ, WCDA, WEAF, WHAP, WPAP
Rochester, WHAM, WHEC, WABD
Saranac Lake, WNBZ
Schenectady, WGY
Syracuse, WFBL, WSYR, WMAC
Tupper Lake, WHDL
Troy, WHAZ
Utica, WIBX
Woodside, WWRL
Yonkers, WCOH
Zarepath, WAWZ

NORTH CARDLINA

Asheville, WWNC
Charlotte, WBT
Gastonia, WSOC
Greensboro, WBIG
Raleigh, WPTF
Wilmington, WRAM
Winston-Salem, WSJS

NDRTH DAKOTA

Bismarck, KFYR
Devils Lake, KDLR
Fargo, WDAY
Grand Forks, KFJM
Mandan, KGCU
Minot, KLPM

DHIO

Canton, WHBC
Cincinnati, WKRC, WSAI, WLW, WFBE
Cleveland, WHK, WJAY, WTAM, WGAR
Columbus, WAIU, WCAH, WEAO, WSEN
Dayton, WSMK
Mansfield, WJW
Mt. Orab, WHBD
Tallmadge, WADC
Toledo, WSPD
Youngstown, WKBN
Zanesville, WALR

DKLAHDMA

Chickasha, KOCW
Elk City, KGMP
Enid, KCRC
Norman, WNAD
Oklahoma City, KFJF, KFXR, KGFG, WKY
Ponca City, WBBZ
Shawnee, KGFF
South Coffeyville, KGGF
Tulsa, KVOO

DREGDN

Corvallis, KOAC
Eugene, KORE
Klamath Falls, KFJI
Marshfield, KOOS
Medford, KMED
Portland, KEX, KOIN, KFJR, KGW, KTBR, KWJJ, KXL, KBPS

PENNSYLVANIA

Allentown, WCBA, WSAN
Altoona, WFBG
Carbondale, WNBW
Elkins Park, WIBG
Erie, WERE
Grove City, WSAJ
Harrisburg, WCOD, WBAK, WHP
Johnstown, WJAC
Lancaster, WGAL, WKJC
Lewisburg, WJBU
Oil City, WLBW
Philadelphia, WCAU, WFI, WIP, WLIT, WRAX, WPEN, WFAN, WHAT, WTEL, WDAS
Pittsburgh, KDKA, KQV, WCAE, WJAS, WWSW
Reading, WRAW, WEEU
Scranton, WGBI, WQAN
Silver Haven, WNBO
State College, WPSC
Wilkes-Barre, WBAX, WBRE
Wilkinsburg, WMBJ
Williamsport, WRAK
York, WGEO

PORTO RICO

San Juan, WKAQ

RHODE ISLAND

Newport, WMBA
Providence, WEAN, WPRO, WJAR

SDUTH CAROLINA

Charleston, WCSC
Columbia, WIS
Spartanburg, WSPA

SOUTH DAKDTA

Brookings, KFDY
Huron, KGDY
Mitchell, KGDA
Pierre, KGFX
Rapid City, WCAT
Sioux Falls, KSOO
Vermilion, KUSD
Watertown, KGCR
Yankton, WNAX

TENNESSEE

Bristol, WOPI
Chattanooga, WDOD
Jackson, WTJS
Knoxville, WFBC WNOX, WROL
Memphis, WGBC, WHBQ, WMC, WNBR, WOAN, WREC
Nashville, WLAC, WSM, WTNT
Springfield, WSIX

TEXAS

Abilene, KFYO
Amarillo, KGRS, WDAG
Austin, KNOW
Beaumont, KFDM
Brownsville, KWWG
College Station, WTAW
Corpus Christi, KGFI
Dallas, KRLD, WFAA, WRR
Dublin, KPPL
El Paso, WDAH, KTSM
Fort Worth, KFJZ, WBAP, KTAT
Galveston, KFLX, KFUL
Greenville, KFPM
Harlingen, KRGV
Houston, KPRC, KTLC, KTRH, KXYZ
San Angelo, KGKL
San Antonio, KTSA, KABC, WOAI, KONO, KMAC
Tyler, KGKB
Waco, WACO
Wichita Falls, KGKO

UTAH

Ogden, KLO
Salt Lake City, KDYL, KSL

VERMONT

Burlington, WCAX
St. Albans, WQDM
Springfield, WNBX
Rutland, WSYB
Waterbury, WDEV

VIRGINIA

Alexandria, WJSV
Arlington, NAA
Danville, WBTM
Emory, WEHC
Lynchburg, WLVA
Newport News, WGH
Norfolk, WTAR, WPOR
Petersburg, WLBG
Richmond, WBBL, WMBG, WRVA
Roanoke, WDBJ, WRBX

WASHINGTDN

Aberdeen, KXRO
Bellingham, KVOS
Everett, KFBL
Lacey, KGY
Pullman, KWSC
Seattle, KOL, KFQW, KJR, KOMO, KPCB, KRSC, KTW, KVI, KXA
Spokane, KFIO, KFPY, KGA, KHQ
Tacoma, KMO, KVI
Walla Walla, KUJ
Wenatchee, KPQ
Yakima, KIT

WEST VIRGINIA

Bluefield, WHIS
Charleston, WOBU
Fairmont, WMMN
Huntington, WSAZ
Wheeling, WWVA

WISCONSIN

Eau Claire, WTAQ
Fond Du Lac, KFIZ
Green Bay, WHBY
Janesville, WCLO
La Crosse, WKBH
Madison, WHA, WIBA
Manitowoc, WOMT
Milwaukee, WHAD, WISN, WTMJ
Poynette, WIBU
Racine, WRJN
Sheboygan, WHBL
South Madison, WISJ
Stevens Point, WLBL
Superior, WEBC

WYOMING

Casper, KDFN

LIST OF POLICE BROADCASTING STATIONS

Call	Kilocycles	Meters	Location
WPDO	2,458	122.05	Akron, Ohio
WPDY	2,452	122.34	Atlanta, Ga.
WPED	1,712	175.2	Arlington, Mass.
KGPS	2,416	124.17	Bakersfield, Calif.
KGPJ	1,712	175.23	Beaumont, Tex.
KSW	2,410	124.50	Berkeley, Calif.
WEY	1,596	187.97	Boston, Mass.
WPEE	2,450	122.4	Brooklyn, N. Y.
WRDU	1,596	187.97	Brooklyn, N. Y.
WMJ	2,422	123.86	Buffalo, N. Y.
WBR	257	1,165.00	Butler, Pa.
KGOZ	2,470	121.50	Cedar Rapids, Iowa
WPDV	2,458	122.05	Charlotte, N. C.
WPDB	1,712	175.23	Chicago, Ill.
WPDC	1,712	175.23	Chicago, Ill.
WPDD	1,712	175.23	Chicago, Ill.
WKDU	1,712	175.23	Cincinnati, Ohio
WRBH	2,452	122.34	Cleveland, Ohio
WPDI	2,416	124.17	Columbus, Ohio
KVP	1,712	175.23	Dallas, Tex.
KGPN	2,470	121.50	Davenport, Iowa
WPDM	2,416	124.17	Dayton, Ohio.
KGPX	2,442	122.8	Denver, Colo.
KGPV	2,506	180.51	Des Moines, Iowa.
WKDT	1,596	187.97	Detroit, Mich.
WCK	2,410	124.50	Detroit, Mich.
WPDX	2,410	124.50	Detroit, Mich.
WPDF	2,440	123.00	Flint, Mich.
KGPR	1,712	175.23	Ft. Worth, Tex.
WMP	1,662	180.51	Framingham, Mass.
KGZA	2,416	124.2	Fresno, Calif.
WPEB	2,440	123.00	Grand Rapids, Mich.
WJL	257	1,165.00	Greensburg, Pa.
WRDR	2,410	124.50	Grosse Point Village, Mich.
WBA	257	1,165.00	Harrisburg, Pa.
WMO	2,410	124.50	Highland Park, Mich.
KGPQ	2,452	122.35	Honolulu, T. H.
KGZB	1,712	175.2	Houston, Tex.
WMDZ	2,440	123.00	Indianapolis, Ind.
WRDS	1,662	180.51	Ingham, Mich.
KGPE	2,422	123.86	Kansas City, Mo.
WPDT	2,470	121.50	Kokomo, Ind.
WPDL	2,440	123.00	Lansing, Mich.
KGPL	1,712	175.23	Los Angeles, Calif.
WPDE	2,440	123.00	Louisville, Ky.
WPEC	2,470	121.50	Memphis, Tenn.
WPDK	2,452	122.34	Milwaukee, Wis.
KGPE	2,416	124.17	Minneapolis, Minn.
WPY	438	685.00	New York, N. Y.
WPY	500	600.00	New York, N. Y.
WCF	1,596	187.97	New York, N. Y.
WPEF	2,450	122.4	New York, N. Y.
WPEG	2,450	122.4	New York, N. Y.
KGPH	2,452	122.34	Oklahoma City, Okla.
KGPJ	2,470	121.50	Omaha, Neb.
KGJX	1,712	175.23	Pasadena, Calif.
WPDP	2,440	123.00	Philadelphia, Pa.
WPDU	1,712	175.23	Pittsburgh, Pa.
KGPP	2,416	124.17	Portland, Ore.
WPDH	2,416	124.17	Richmond, Ind.
WPDR	1,712	175.23	Rochester, N. Y.
KGPC	1,712	175.23	St. Louis, Mo.
WPDS	2,416	124.17	St. Paul, Minn.
KGPW	2,470	121.50	Salt Lake City, Utah.
KGPD	1,596	187.97	San Francisco, Calif.
KGPD	2,410	124.50	San Francisco, Calif.
KGPM	2,470	121.50	San Jose, Calif.
KGPA	2,416	124.17	Seattle, Wash.
KGPY	1574	190.5	Shreveport, La.
WPEA	2,458	122.2	Syracuse, N. Y.
KGPK	2,470	121.50	Sioux City, Iowa
WRDQ	2,470	121.50	Toledo, Ohio
WPDA	2,416	124.17	Tulare, Calif.
KGPG	2,410	124.50	Vallejo, Calif.
WPDW	2,410	124.50	Washington, D. C.
WMB	257	1,165.00	West Reading, Pa.
KGPZ	2,452	122.3	Wichita, Kans.
WDX	257	1,165.00	Wyoming, Pa.
WPDG	2,458	122.05	Youngstown, Ohio

U. S. VISUAL BROADCASTING STATIONS

Call	Kilocycles	Meters	Owner
W1XAU	1,500	193.6	Short Wave & Television, Boston, Mass.
W1XAV	2,950	101.8	Short Wave & Television, Boston, Mass.
W2XAB	2,750	109.10	Atlantic Broadcasting, New York, N. Y.
W2XBC	2,750	109.10	United Research Corp., Long Island City, N. Y.
W2XBU	2,000	150.00	Harold E. Smith, Beacon, N. Y.
W2XCD	2,000	150.00	DeForest Radio Co., Passaic, N. J.
W2XCR	2,100	142.90	Jenkins Television, Jersey City, N. J.
W2XCR	2,000	150.00	Jenkins Television, Jersey City, N. J.
W2XCW	2,100	142.90	General Electric, Schenectady, N. Y.
W2XDA	1,544	194.30	Atlantic Broadcasting, New York, N. Y.
W2XDS	43,000	6.98	Jenkins Television, New York, N. Y.
W2XDS	48,500	6.19	Jenkins Television, New York, N. Y.
W2XDS	60,000	5.00	Jenkins Television, New York, N. Y.
W2XF	43,000	6.97	National Broadcasting, New York, N. Y.
W2XF	48,500	6.18	National Broadcasting, New York, N. Y.
W2XF	60,000	5.00	National Broadcasting, New York, N. Y.
W2XR	2,850	105.30	Radio Pictures, Inc., Long Island City, N. Y.
W3XAD	43,000	6.97	RCA-Victor, Camden, N. J.
W3XAD	48,500	6.18	RCA-Victor, Camden, N. J.
W3XAD	60,000	5.00	RCA-Victor, Camden, N. J.
W3XAD	2,100	142.90	RCA-Victor, Camden, N. J.
W3XK	2,000	150.00	Jenkins Laboratories, Wheaton, Md.
W6X4H	2,000	150.00	Pioneer Mercantile Co., Bakersfield, Calif.
W6XAO	43,000	6.97	Don Lee, Inc., Los Angeles, Calif.
W6XS	2,100	142.90	Don Lee, Inc., Los Angeles, Calif.
W8XAV	2,100	142.90	Westinghouse, East Pittsburgh, Pa.
W9XAA	2,750	109.10	Federation of Labor, Chicago, Ill.
W9XAB	1,564	191.82	Federation of Labor, Chicago, Ill.
W9XAO	2,000	150.00	Western Television Corp., Cbicago, Ill.
W9XAP	2,100	142.90	National Broadcasting, Chicago, Ill.
W9XD	43,000	6.97	Journal Company, Milwaukee, Wis.
W9XD	48,500	6.18	Journal Co., Milwaukee, Wis.
W9XD	60,000	5.00	Journal Co., Milwaukee, Wis.
W9XG	2,750	109.10	Purdue University, W. Lafayette, Ind.
W9XK	2,000	150	Iowa City, Iowa.
W9XR	2,850	105.30	Great Lakes Broadcasting, Chicago, Ill.

U. S. RELAY BROADCASTING STATIONS

Call	Kilocycles	Meters	Owner
W1XAL	6,040	49.67	Short Wave Bdcstg. Corp., Boston, Mass.
W1XAL	11,800	25.42	Short Wave Bdcstg. Corp., Boston, Mass.
W1XAL	15,250	19.67	Short Wave Bdcstg. Corp., Boston, Mass.
W1XAL	21,460	13.97	Short Wave Bdcstg. Corp., Boston, Mass.
W1XAZ	9,570	31.35	Westinghouse Elec., East Springfield, Mass.
W2XAD	15,340	19.56	General Electric, Schenectady, N. Y.
W2XAF	9,530	31.48	General Electric, Schenectady, N. Y.
W2XAG	550	545.00	General Electric, Schenectady, N. Y.
W2XAG	660	455.00	General Electric, Schenectady, N. Y.
W2XAG	790	380.00	General Electric, Schenectady, N. Y.
W2XAG	1,150	260.90	General Electric, Schenectady, N. Y.
W2XAG	1,500	200.00	General Electric, Schenectady, N. Y.
W2XE	6,120	49.02	Atlantic Broadcasting, Jamaica, N. Y.
W2XE	11,840	25.34	Atlantic Broadcasting Co., Jamaica, N. Y.
W2XE	15,280	19.63	Atlantic Broadcasting Co., Jamaica, N. Y.
W2XZ	610	491.50	National Broadcasting, Bellmore, N. Y.
W3XAL	6,100	49.18	National Broadcasting, New York, N. Y.
W3XL	6,425	46.70	National Broadcasting, New York, N. Y.
W3XAU	6,060	49.50	Universal Broadcasting, Newton Township, Pa.
W3XAU	9,590	31.28	Universal Broadcasting, Newton Township, Pa.
W4XA	2,368	126.7	Miami, Fla.
W6XAF	2,938	112.10	Dept. Agriculture, Sacramento, Calif.
W6XAF	5,870	51.11	Dept. Agriculture, Sacramento, Calif.
W6XAL	6,080	49.34	Pacific-Western Broadcasting, Westminster, Calif
W6XAL	15,250	19.67	Pacific-Western Broadcasting, Westminster, Calif
W6XAL	21,500	13.95	Pacific-Western Broadcasting, Westminster, Calif.
W6XN	12,850	23.35	General Electric, Oakland, Calif.
W8XAL	6,060	49.50	Crosley Radio Corp., Cincinnati, Ohio
W8XK	6,140	48.86	Westinghouse, East Pittsburgh, Pa.
W8XK	9,570	31.35	Westinghouse, East Pittsburgh, Pa.
W8XK	11,880	25.25	Westinghouse, East Pittsburgh, Pa.
W8XK	15,210	19.72	Westinghouse, East Pittsburgh, Pa.
W8XK	17,780	16.87	Westinghouse, East Pittsburgh, Pa.
W8XK	21,540	13.93	Westinghouse, East Pittsburgh, Pa.
W9XAA	6,080	49.34	Federation of Labor, Chicago, Ill.
W9XAA	11,840	25.34	Federation of Labor, Chicago, Ill.
W9XAA	17,780	16.87	Federation of Labor, Chicago, Ill.
W9XF	6,020	49.83	Great Lakes Broadcasting, Chicago, Ill.
W9XF	11,800	25.42	Great Lakes Broadcasting, Chicago, Ill.
W9XF	21,500	13.95	Great Lakes Broadcasting, Chicago, Ill.
W9XU	6,060	49.50	Mona Motor Oil Co., Council Bluffs, Iowa

SIMPLE TIME CHART

(Time changes every 15 degrees of Longitude East or West)

← WEST

LONGITUDE WEST OF GREENWICH	180°	165°	150°	135°	120°	105°	90°	75°	60°	45°	30°	15°	0°
PLACES ON, OR NEARLY ON, THE MERIDIAN INDICATED.	FIJI ISLANDS	UNALASKA	SEWARD	JUNEAU	LOS ANGELES	DENVER	CHICAGO	NEW YORK	BUENOS AIRES	RIO JANEIRO	AZORES	ICELAND	(GREENWICH) LONDON
TIME	Midnight	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon

↑ International date line. When it's Monday East of 180° it is Tuesday West of 180°. ↓

EAST →

LONGITUDE EAST OF GREENWICH	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°
PLACES ON, OR NEARLY ON, THE MERIDIAN INDICATED.	(GREENWICH) LONDON	BERLIN	ODESSA CAIRO	ADEN	MAURITIUS ISL.	LAHORE	CALCUTTA	BATAVIA	MANILA	KOBE	EASTERN AUSTRALIA	NEW CALEDONIA	FIJI ISLANDS
TIME	Noon	1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.	10 p.m.	11 p.m.	Midnight

FOREIGN BROADCAST STATIONS

Call	Location	Kc.
	AFRICA	
ZTC	Capetown	800
ZTD	Durban	732
ZTJ	Johannesburg	667
	ALGERIA	
.....	Algiers	824
	ARGENTINA	
LP4	Buenos Aires	670
LR1	Buenos Aires	790
LR2	Buenos Aires	870
LR3	Buenos Aires	950
LR4	Buenos Aires	990
LR5	Buenos Aires	830
LR6	Buenos Aires	990
LR7	Buenos Aires	750
LR8	Buenos Aires	1150
LR9	Buenos Aires	1030
LS1	Buenos Aires	710
LS2	Buenos Aires	1190
LS3	Buenos Aires	1270
LS5	Buenos Aires	1070
LS6	Buenos Aires	1350
LS8	Buenos Aires	1230
LS9	Buenos Aires	1388
LT1	Concordia	810
12	Concordia	1327
LV2	Cordoba	911
LT7	General Pico	1441
LT2	La Plata	685
LV8	Los Molinos	...
LT4	Mendoza	759
LT5	Parana	1249
LT3	Rosario	1080
LV5	Rosario	1369
LV6	Rosario	1079
LT6	San Juan	730
LP2	Villaguay	1140
	AUSTRALIA	
5CL	Adelaide	730
5DN	Adelaide	960
5KA	Adelaide	1200
5AD	Adelaide	1310
2AY	Albury	1320
2AY	Albury	1480
3BA	Ballarat	1300
3BO	Bendigo	970
4QG	Brisbane	760
4BC	Brisbane	1145
4BH	Brisbane	1380
4BK	Brisbane	1290
2XL	Broken Hill	1365
2CA	Canberra	1050
3KZ	Carlton	1350
4CH	Charleville	1170
3GL	Geelong	1400
2GN	Goulburn	1390
2MO	Gunnedah	1320
7ZL	Hobart	580
7HO	Hobart	890
7HO	Hobart	1160
7LA	Launceston	1100
2NN	Lismore	1340
4MK	Mackay	1190
3AR	Melbourne	610
3LO	Melbourne	800
3UZ	Melbourne	930
3DB	Melbourne	1180
3KZ	Melbourne	1350
2MV	Moss Vale	1220
2NC	Newcastle	1245
2HD	Newcastle	1110
6WF	Perth	690
6ML	Perta	1135
6PR	Perth	880
4RK	Rockhampton	910
2FC	Sydney	665
2BL	Sydney	855
2GB	Sydney	950
2UE	Sydney	1025
2KY	Sydney	1070
2UW	Sydney	1125
4GR	Toowoomba	1000
4TO	Townsville	1170
3TR	Trafalgar	1280
3WR	Wangaratta	1260
	AUSTRIA	
.....	Graz	851
.....	Innsbruck	1058
.....	Klagenfurt	662
.....	Linz	1220
.....	Vienna	581
	BELGIUM	
ON4ED	Antwerp	1455
ON4GT	Bruxells	1375
ON4RB	Bruxells	590
ON4RC	Bruxells	1448
ON4FO	Bruxells	1219
ON4CE	Chatelineau	1388
ON4FG	Dampremy	1455
ON4RG	Gand	1219
ON4RW	Liege	1219
ON4BQ	Marchienne	1035
ON4KX	Ottomont	1388
ON4CF	Verviers	1455
	BOLIVIA	
CPX	La Paz	1350
	BRAZIL	
PRAM	Amparo	638
PRAH	Bahia	674
PRAF	Belem	842
PRAQ	Bello Horizonte	1090
PRAN	Curvtiba	882
PRAZ	Franca	1111
PRAJ	Juiz de Fora	857
PRAY	Mogy das Cruzes	1000
PRAD	Pelotas	920
PRAG	Porto Alegre	706
PRAP	Pernambuco	706
PRAI	Ribeirao Preto	1070
PRAA	Rio de Janeiro	750
PRAB	Rio de Janeiro	937
PRAC	Rio de Janeiro	857
PRAX	Rio de Janeiro	1364
PRAK	Rio de Janeiro	1153
PRAS	Santos	887
PRAE	Sao Paolo	815
PRAR	Sao Paolo	1006
PRAL	Sao Paolo	750
PRAO	Sao Paolo	934

Call	Location	Kc.
	CANADA	
CKGW	Bowmanville	910
CJBC	Bowmanville	910
CJSC	Bowmanville	910
CPRY	Bowmanville	910
10AE	Bowmanville	1199
10BQ	Brantford	1200
CKX	Brandon	540
CNRC	Calgary	690
CFCN	Calgary	985
CJCJ	Calgary	690
CHCA	Calgary	690
CFAC	Calgary	690
10BU	Canora	1200
CHCK	Charlottetown	1010
CFCY	Charlottetown	580
CFCO	Chatham	1210
CHWK	Chilliwack	665
CKMC	Cobalt	1210
CHMA	Edmonton	580
CKUA	Edmonton	580
CJCA	Edmonton	930
CNRE	Edmonton	930
CJRW	Flenjing	665
CFNB	Fredericton	1210
CHNS	Halifax	920
CNRH	Halifax	930
CHCS	Hamilton	1010
CHML	Hamilton	880
CKOC	Hamilton	1010
CFJC	Kamloops	1120
10AY	Kelowna	1200
CKOV	Kelowna	1200
CFRC	Kingston	930
CFRB	King, York Co.	960
CNRX	King, York Co.	960
CJOC	Lethbridge	1120
10CB	Liverpool	1200
CJGC	London	910
CNRL	London	910
CKPR	Midland	930
CNRA	Moncton	630
CFCF	Montreal	1031
CJRM	Moose Jaw	665
10AB	Moose Jaw	1425
CFCH	North Bay	930
CKCO	Ottawa	890
CNRO	Ottawa	600
CHWC	Pilot Butte	960
CKPR	Port Arthur	890
CFLC	Prescott	930
CKPC	Preston	1210
10BI	Prince Albert	1200
CHRC	Quebec	880
CKCI	Quebec	645
CKCV	Quebec	880
CNRQ	Quebec	880
CNRD	Red Deer	840
CKLC	Red Deer	840
CHCT	Red Deer	840
CKCK	Regina	960
CJBR	Regina	960
CNRR	Regina	960
CFQC	Saskatoon	910
CNRS	Saskatoon	910
CJOR	Sea Island	1210
CKAC	St. Hyacinthe	730
CHYC	St. Hyacinthe	730
CNRM	St. Hyacinthe	730
CFBO	St. John	890
10AK	Stratford	1200
CHGS	Summerside	1120
CJCB	Sydney	880
CNRT	Toronto	840
CPRY	Toronto	840
CFCA	Toronto	840
CKOW	Toronto	840
CKCL	Toronto	580
CKNC	Toronto	580
CFCL	Toronto	580
CNRV	Vancouver	1030
CKCD	Vancouver	730
CHLS	Vancouver	730
CKFC	Vancouver	730
CKMO	Vancouver	730
CKWX	Vancouver	730
CFCT	Victoria	630
CKCR	Waterloo	645
10BP	Wingham	1200
CKY	Winnipeg	780
CNRW	Winnipeg	780
CKIC	Wolfville	1010
CJGX	Yorkton	630
	CANARY ISLANDS	
EAR5	Las Palmas	1071
	CEYLON	
VPB	Colombo	600
	CHILE	
CMAB	Santiago	625
CMAC	Santiago	804
CMAK	Santiago	1333
CMAO	Santiago	1016
CMAQ	Santiago	1224
CMAJ	Valparaiso	1034
	CHINA	
CAB	Canton	689
XGY	Chekiang	895
COHB	Harbin	674
COMK	Mukden	723
XGZ	Nanking	606
XOPP	Pieping	937
KRC	Shanghai	869.5
KSMS	Shanghai	1088
NKS	Shanghai	952
RSC	Shanghai	1276.5
XGX	Shanghai	1071
XGAH	Shanghai	937.5
COTN	Tientsin	625
GEC	Tientsin	1000
	CHOSEN	
JODK	Keijo	690
	COLOMBIA	
HJN	Bogota	684.9
HKF	Bogota	1304
	COSTA RICA	
TIRA	Electra Cartago	560
TICR	San Jose	911
TIFB	San Jose	714

Call	Location	Kc.
TIGP	San Jose	666
TISO	San Jose	600
TITR	San Jose	1333
TITV	San Jose	999
	CUBA	
CMBR	Arroyo Apolo	1500
CMHD	Calbarien	950
CMJA	Camaguey	1200
CMJC	Camaguey	1382
CMJE	Camaguey	856
CMJF	Camaguey	930
CMGE	Cardenas	1375
CMJA	Ciego de Avila	1017
CMHJ	Cienfuegos	645
CMGA	Colon	834
CMCG	Guanabacoa	1345
CMBR	Havana	1500
CMCW	Havana	1345
CMCQ	Havana	1150
CMBL	Havana	1500
CMCU	Havana	1285
CMBY	Havana	1225
CMCD	Havana	925
CMBC	Havana	965
CMBG	Havana	1070
CMQ	Havana	1150
CMCA	Havana	1225
CMK	Havana	730
CMW	Havana	588
CMCJ	Havana	620
CMBZ	Havana	1010
CMBI	Havana	1405
CMCB	Havana	1070
CMCH	Havana	1405
CMX	Havana	890
CMC	Havana	840
CMBT	Havana	790
CMBS	Havana	790
CMCF	Havana	890
CMCY	Havana	1345
CMW	Havana	588
CMBD	Havana	965
CMCR	Havana	1345
CMBN	Havana	1405
CMCM	Marianao	1405
CMDC	Marianao	660
CMBW	Marianao	1010
CMBQ	Marianao	1500
CMCN	Marianao	925
CMCO	Marianao	660
CMGB	Matanzas	1205
CMGF	Matanzas	977
CMGH	Matanzas	1370
CMAB	Pinar del Rio	1249
CMAC	Pinar del Rio	1375
CMHI	Santa Clara	1110
CMKC	Santiago de Cuba	1034
CMHC	Tuinicu	790
	CZECHOSLOVAKIA	
OKR	Bratislava	1075
OKB	Brunn	878
OKK	Kosice	1024
.....	Moravska-Ostrava	1141
OKP	Prague	616
	DANZIG	
PTB	Danzig	662
	DENMARK	
.....	Copenhagen	1067
.....	Kalundborg	1153
	DOMINICAN REPUBLIC	
HIX	Santo Domingo	625
	ESTONIA	
.....	Tallinn	1013
.....	Tartu	735
	FINLAND	
.....	Abo	1219
.....	Bjorenborg	1219
.....	Helsingfors	840
.....	Jakobstad	1220
.....	Lahti	167
.....	Viborg	1031
	FRANCE	
.....	Angers	1091
.....	Beziers	1364
.....	Biarritz	1515
.....	Bordeaux	1199
.....	Bordeaux	986
.....	Caen	1080
.....	Grenoble	914
.....	Lille	1132
.....	Limoges	1022
YR	Lyons	1030
YN	Lyons	644
.....	Mont de Marsan	750
.....	Marseilles	950
.....	Montpelier	1049
.....	Nice	1219
.....	Nimes	1250
.....	Paris	901
FPTT	Paris	671
FSGC	Paris	825
.....	Paris	968
.....	Rennes	1103
.....	Rheims	777
.....	St. Etienne	1364
SPTT	Strasburg	867
.....	Toulon	1200
MRD	Toulouse	1175
.....	Toulouse	770
	GERMANY	
.....	Aix la Chapelle	1319
.....	Augsburg	536
.....	Berlin 1	716
.....	Berlin 11	1059
.....	Bremen	950
.....	Breslau	923
.....	Cologne	1319
.....	Dresden	941
.....	Flensburg	1373
.....	Frankfurt	770
.....	Freiburg	527
.....	Gleiwitz	1157
.....	Hamburg	806
.....	Hanover	530
.....	Kaiserslautern	1112
.....	Kassel	1220

Call	Location	Kc.
.....	Kiel	1292
.....	Koln	1319
.....	Konigsberg	1085
.....	Langenberg	635
.....	Leipzig	1184
.....	Magdeburg	1058
.....	Muehlacker	833
.....	Munich	563
.....	Munster	1319
.....	Nurnberg	1256
.....	Stettin	1058
.....	Stuttgart	833
	GREAT BRITAIN	
2BD	Aberdeen	995
2BE	Belfast	1238
6BM	Bournemouth	1040
2LS	Bradford	1500
5WA	Cardiff	968
5GB	Daventry, Regional	626
2DE	Dundee	1040
2EH	Edinburgh	1040
5SC	Glasgow	752
6KH	Hull	1040
2LS	Leeds	1500
6LV	Liverpool	1040
2LO	London, Regional	842
2ZY	Manchester	796
5NO	Newcastle	1148
5PY	Plymouth	1040
6FL	Sheffield	1040
6ST	Stoke-on-Trent	1040
5SX	Swansea	1040
	GUATEMALA	
TGW	Guatemala City	571
	HAITI	
HHK	Port au Prince	920
	HOLLAND	
.....	Bloemendaal	1220
PFB1	Hilversum	1004
PH9	Huizen	1004
PCF	Scheveningen	280
.....	The Hague	1000
	HONDURAS	
JRL	San Pedro Sula	1350
	HONG KONG	
ZBW	Victoria	845
	HUNGARY	
HAL	Budapest	545
	ICELAND	
TFA	Reykjavik	1999
	INDIA	
VUB	Bombay	840
VUC	Calcutta	810
VUL	Lahore	882
VUM	Madras	769
	IRISH FREE STATE	
6CK	Cork	750
2RN	Dublin	940
	ITALY	
IIBA	Bari	...
IBZ	Bolzano	662
IFI	Firenze	...
IGE	Genoa	959
IMI	Milan	599
INA	Naples	905
IIPA	Palermo	554
IIRO	Rome	680
IITO	Torino	1013
IITR	Trieste	1211
	JAPAN	
JQAK	Dairen	760
JOLK	Fukuoka	680
JOFK	Hiroshima	850
JOJK	Kanazawa	710
JODK	Keijyo	690
JOSK	Kokura	741
JOGK	Kumamoto	790
JONK	Nagano	635
JOCK	Nagoya	810
JOQK	Niigata	625
JOKK	Okayama	700
JOBK	Osaka	750
JOIK	Sapporo	830
JOHK	Sendai	770
JOPK	Shizuoka	780
JFAK	Taihoku	670
JOAK	Tokyo	870
JOAK	Tokyo	590
	KENYA	
7LO	Nairobi	750
	LATVIA	
YLZ	Riga	571
	LITHUANIA	
RYK	Kovno	155
	LUXEMBURG	
LOAA	Luxemburg	1344
	MEXICO	
XFC	Aguascalientes	805
XEF1	Chihuahua	1000
XFF	Chihuahua	923
XEJ	Ciudad Juarez	1000
XETZ	Coyoacan	1500
XEQ	Ciudad Juarez	750
XEA	Guadalajara	1000
XETC	Jalapa	1000
XEY	Merida	1000
XEFC	Merida	1050
XEX	Mexico City	1190
XEN	Mexico City	711
XEB	Mexico City	1030
XFG	Mexico City	638
XEG	Mexico City	1360
XFI	Mexico City	818
XEO	Mexico City	940
XFX	Mexico City	860
XEW	Mexico City	910
XEX	Mexico City	1210
XEZ	Mexico City	780
XFZ	Mexico City	860
XEK	Mexico City	990
XEM	Mexico City	1300
XETA	Mexico City	1140
XEFA	Mexico City	1250
XETQ	Mexico City	1230
XET	Monterrey	690
XEH	Monterrey	1132
XEFB	Monterrey	1270
XE1	Morelia	1000
XEFE	Nuevo Laredo	1000
XEP	Nuevo Laredo	1400
XEE	Oaxaca	1000
XEV	Puebla	1000
XEFS	Queretaro	1000
XED	Reynosa	965
XEL	Saltillo	1000
XFA	Tacubaya	500
XFA	Tacubaya	600
XES	Tampico	890
XEFD	Tiajuana	1020
XEC	Toluca	1000
XETG	Torreon	1000
XETB	Torreon	1380
XEU	Vera Cruz	1000
XETF	Vera Cruz	630
XFE	Villahermosa	804
XER	Villa Acuna	735
	MONACO	
.....	Monaco	1266
	MOROCCO	
CNO	Casablanca	983
.....	Rabat	414
	NEWFOUNDLAND	
VOGT	Bell Island	890
VONA	St. Johns	950
VOWR	St. Johns	675
VOX	St. Johns	1400
SRA	St. Johns	950
	NEW ZEALAND	
1YA	Auckland	910
1ZR	Auckland	1090
1ZJ	Auckland	1320
1ZQ	Auckland	1188
3YA	Christchurch	980
3ZC	Christchurch	1199
2ZU	Dannevirke	1100
4YA	Dunedin	650
4ZB	Dunedin	1079
4ZO	Dunedin	1078
4ZM	Dunedin	1078
4ZL	Dunedin	1219
2ZE	Eketahuna	1210
2ZJ	Gisborne	1150
3ZR	Greymouth	820
1ZH	Hamilton	630
2ZI	Hastings	1330
2ZL	Hastings	1330
4ZP	Invercargill	1160
4ZI	Invercargill	1160
1ZM	Manurewa	1210
2ZD	Masterton	1180
2ZH	Napier	1260
2YB	New Plymouth	1230
2ZF	Palmerston North	1040
2ZO	Palmerston North	1120
2ZP	Wairoa	820
2ZK	Wanganui	600
2ZR	Wanganui	600
2YA	Wellington	710
2ZW	Wellington	1120
	NORWAY	
LKA	Alesund	671
LKB	Bergen	824
LKD	Bodo	662
LKF	Fredriksstad	837
LKH	Hamar	511
LKK	Kristianssand	1274
LKN	Notodden	671
LKO	Oslo	280
LKP	Porsgrund	662
LKR	Rjuken	671
LKS	Stavanger	1247
LKM	Tromso	662
LKT	Trondelag	608
	PERU	
OAX	Lima	790
OA4M	Lima	1428
	PHILIPPINE ISLANDS	
KZRC	Cebu	937
KZRM	Manila	618
	POLAND	
.....	Krakow	959
.....	Kattowitz	734
.....	Lodz	1229
.....	Lwow	779
.....	Poznan	896
.....	Wilna	779
	PORTUGAL	
CT1AA	Lisbon	1056
CT1AN	Lisbon	1056
CT1BO	Lisbon	1056
CT1DH	Lisbon	1056
CT1EB	Lisbon	1056
CT1GL	Lisbon	909
PRP1	Oporto	1249
.....	Oporto	1448
	ROUMANIA	
.....	Bucharest	759
	SALVADOR	
RUS	Salvador	664
	SAMOA	
5ZA	Apia	940
	SIAM	
HSP1	Bangkok	857
HSP3	Bangkok	938
HS7PJ	Bangkok	923
HS7PJ	Bangkok	810
HS11PJ	Bangkok	882
	SPAIN	
EAJ18	Almeria	1195
EAJ13	Barcelona	1119
EAJ1	Barcelona	860
EAJ15	Cartagena	1219
EAJ7	Madrid	707.5
EAJ2	Madrid	750
EAJ19	Oviedo	1119
EAJ8	San Sebastian	662
EAJ5	Seville	815
	SWEDEN	
SBE	Boden	250
SCA	Boras	1301
SCB	Eskilstuna	1220
SCC	Falun	932
SCD	Gavle	1471
SBB	Goteborg	932
SCE	Halmstad	1389
SCG	Halsingborg	1299
SBH	Horby	1167
SCF	Hudiksvall	1111
SCH	Jonkoping	1490
SCI	Kalmar	1220
SCJ	Karlskrona	1531
SCK	Karlstadt	1373
SCL	Kiruna	1220
SCM	Kristmehamm	1481
SCN	Malmberget	688
SBC	Malmo	1299
SBG	Motala	222
SCO	Norrkoping	1111
SCV	Orebro	1266
SCW	Ornskoldsvik	1373
SBF	Ostersund	770
SCP	Saffle	1220
SBA	Stockholm	688
SBD	Sundsvall	553
SCQ	Trollhattan	1112
SCR	Uddevalla	1058
SCS	Umea	1301
SCT	Uppsala	662
SCU	Varborg	1060
	SWITZERLAND	
.....	Beromunster	653
.....	Geneva	395
.....	Lausanne	441
.....	Sottens	743
	TUNISIA	
TUA	Tunis	235
	TURKEY	
TAE	Angora	193
TAL	Istanbul	250
.....	Osmanieh	250
	UNION OF SOVIET SOCIALIST REPUBLICS	
RW19	Achkhabad	334
RW60	Alma-Ata	310
RW36	Arkhangelsk	770
RW35	Astrakhan	434.8
RW8	Bakou	238
RW8	Bakou	245
RW43	Bakou	238
RW30	Dnepropetrovsk	511
RW21	Erivan	404
RW40	Gomel	621
RW23	Groznyi	676
RW14	Irkoutsk	187
RW31	Ivanovo-Voznesensk	604
RW46	Karaganda	687
RW17	Kazan	551
RW17	Kazan	644
RW54	Khabarovsk	1052
RW54	Khabarovsk	320
RW4	Kharkov	320
RW20	Kharkov	704
RW9	Kiev	368
RW9	Kiev	200
RW33	Krasnodar	650
RW66	Krasnoiarsk	333
RW53	Leningrad	300
RW27	Makhatch Kala	796
RW10	Minsk	428.6
RW1	Moscow	203
RW2	Moscow	416.7
RW37	Moscow	793
RW39	Moscow	707
RW58	Moscow	373
RW58	Moscow	268
RW49	Moscow	230
RW51	Naltchik	748
RW42	Nijni-Novgorod	394
RW6	Novosibirsk	238
RW13	Odessa	666
RW44	Omsk	471
RW45	Orenbourg	461
RW22	Oufa	444
RW22	Oufa	617
RW67	Oukhta	354
RW56	Penza	640
RW29	Petrozavodsk	468
RW29	Petrozavodsk	779
RW24	Piatigorsk	468
RW55	Pokrovsk	730
RW12	Rostov-sur-le-Don	353
RW16	Samara	521
RW16	Samara	404
RW18	Samarkand	843
RW3	Saratov	340
RW52	Simferopol	630
RW52	Simferopol	725
RW24	Smolensk	531
RW47	Stulinabad	421
RW26	Stalino	811
RW32	Stavropol	608
RW38	Sverdlovsk	157
RW5	Sverdlovsk	364
RW41	Syktykvaz	560
RW11	Tachkent	256
RW7	Tiflis	280
RW48	Tomsk	645
RW63	Verkhneoudinsk	350
RW64	Vladikavkag	752
RW28	Vladivostok	636
RW28	Vladivostok	725
RW25	Voronej	385
RW25	Voronej	450
	URUGUAY	
CX6	Montevideo	650
CX10	Montevideo	730
CX12	Montevideo	770
CX14	Montevideo	810
CX16	Montevideo	850
CX18	Montevideo	890
CX20	Montevideo	930
CX22	Montevideo	970
CX24	Montevideo	1010
CX26	Montevideo	1050
CX30	Montevideo	1130
CX32	Montevideo	1170
CX34	Montevideo	1210
CX36	Montevideo	1250
CX38	Montevideo	1290
CX40	Montevideo	1330
CX42	Montevideo	1370
CX44	Montevideo	1410
CX46	Montevideo	1450
CX48	Montevideo	1490
CW40	Paysandu	1340
CW44	Paysandu	1420
CW32	Salto	1180
CW34	Salto	1220
CW36	Salto	1260
CW38	Salto	1300
CW30	Tucuarembo	1140
	UNION OF SOUTH AFRICA	
ZTC	Capetown	810
ZTD	Durban	731
ZTJ	Johannesburg	666
.....	Pretoria	1000
	VENEZUELA	
1BC	Caracas	960
	YUGOSLAVIA	
.....	Belgrade	696
.....	Ljubljano	569
.....	Zagreb	977

FOREIGN SHORT WAVE PHONE STATIONS

Call	Location	Kc.
AFRICA		
FSKR	Algiers	6,667
ARGENTINA		
LSOR	Buenos Aires	9,810
LSX	Buenos Aires	10,382
AUSTRALIA		
VK3ME	Melbourne	9,510
VK3LO	Melbourne	9,369
VK3UZ	Melbourne	8,820
VK2BL	Sydney	9,230
VK2FC	Sydney	10,520
VK2ME	Sydney	9,590
VK2ME	Sydney	10,527
VK2ME	Sydney	16,330
AUSTRIA		
UOR2	Vienna	11,801
UOR2	Vienna	6,072
BRAZIL		
PPU	Rio de Janeiro	6,122
PPU	Rio de Janeiro	19,270
BRITISH COLONIES		
VRY	Georgetown, Guiana	6,726
VS3AB	Johore Bahu	7,055
VS1AB	Singapore	7,260
VQ7LO	Nairobi	6,000
VQ7LO	Nairobi	6,134
VQ7LO	Nairobi	9,616
CANADA		
VE9GW	Bowmanville, Ont.	6,095
CGE	Calgary, Alta.	7,550
CKS	Calgary, Alta.	7,550
VE9CG	Calgary, Alta.	6,110
VE9CA	Calgary, Alta.	6,030
CGA	Drummondville, Que.	9,335
VE9DR	Drummondville, Que.	11,780
VE9CF	Halifax, N. S.	6,050
CFH	Halifax, N. S.	9,030
VE9CL	Middlechurch, Man.	6,148
VE9DN	Montreal, Que.	6,005
VE9DN	Montreal, Que.	9,580
VE9DN	Montreal, Que.	11,895
VE9BA	Montreal, Que.	6,130
VE9BA	Montreal, Que.	11,705
VE9BA	Montreal, Que.	15,190
VE9OS	Montreal, Que.	2,100
VE9AF	Montreal, Que.	2,850
VE9AK	Red Deer, Alta.	2,830
VE9BJ	St. John, N. B.	6,090
VE9AR	Saskatoon, Alta.	2,850
VE9RM	Toronto, Ont.	2,004
VE9CS	Vancouver, B. C.	6,148
VE9BZ	Vancouver, B. C.	2,750
CANARY ISLANDS		
EAR58	Teneriffe	7,211
CHINA		
XCTE	Shanghai	5,000
COLOMBIA		
HKA	Barranquilla	6,160
HKD	Barranquilla	5,837
HKD	Barranquilla	6,050
HKC	Bogota	6,275
HKF	Bogota	7,616
HKF	Bogota	8,692
HKF	Bogota	7,143
HKT	Manizales	7,130
HKN	Medellin	11,712
COSTA RICA		
TI4NR	San Jose	10,240
TI4NR	San Jose	9,734
TIRA	Electra Cartago	6,080
TIRA	Electra Cartago	9,590
CUBA		
CM6DW	Cienfuegos	7,300
CM2LA	Havana	10,013
CM2MK	Havana	9,360
CM2MK	Havana	7,184
CZECHOSLOVAKIA		
OK1MPI	Prague	5,169
DENMARK		
OXO-ONZ	Copenhagen	6,057
OXO-ONZ	Copenhagen	9,488
OXO-ONZ	Copenhagen	15,300
DOMINICAN REPUBLIC		
HIX	Santo Domingo	4,610
DUTCH EAST INDIES		
PLE	Bandoeng	9,410
PLE	Bandoeng	18,860
HBR	Bandoeng	5,170
PK1AA	Batavia	3,998
PLF	Malabar	17,640
PK4PA	Palembang	59,964
PK2AF	Djocjacorta, Java	5,996
PK6KZ	Makassar	11,993
PK2AG	Semerang, Java	7,890
PK3AN	Surabaya, Java	6,040
.....	Surabaya	2,143
PK3CH	Surabaya	6,662
.....	Tandjong Priok	6,045
.....	Tandjong Priok	9,579
.....	Tandjong Priok	15,336
ECUADOR		
.....	El Prado	7,538
EGYPT		
SUS	Cairo	9,110
FIJI		
VPD	Suva	14,420
FRANCE		
YR	Lyons	7,463
FL	Paris (Eiffel Tower)	6,124
FSGC	Paris	4,262
.....	Paris	7,317
FYA	Paris (Pontoise)	15,235
FYA	Paris (Pontoise)	11,899
FYA	Paris (Pontoise)	11,308
FRENCH COLONIES		
FMSKR	Constantine	7,009
FMSKR	Constantine	3,750
GERMANY		
DJC	Konigs Wusterhausen	6,020
DJA		9,560
DJD		11,760
DJB		15,200
DJE		17,760
GREAT BRITAIN		
GBK	Bodmin	18,105
GBK	Bodmin	9,260
.....	Chelmsford	11,750
GBX	Rugby	16,164
GBS	Rugby	18,310
GBW	Rugby	18,138
GBW	Rugby	14,493
GBU	Rugby	12,290
GBX	Rugby	12,195
GBS	Rugby	12,195
GBS	Rugby	9,020
GBS	Rugby	6,993
G2MN	Sonning-on-Thames	14,320
GUATEMALA		
TGGA	Guatemala City	10,708
TGGA	Guatemala City	9,370
TGW	Guatemala City	6,661
TGX	Guatemala City	9,516
HOLLAND		
PBF5	Hague	6,438
PCJ	Hilversum	9,590
PHI	Huizen	17,775
PCK	Kootwijk	18,400
PCV	Kootwijk	17,836
HONDURAS		
HRB	Tegucigalpa	6,170
HRB	Tegucigalpa	6,005
HUNGARY		
HAT	Szekesfehervar	9,125
INDIA		
VUC	Calcutta	11,870
INDO-CHINA		
F3ICD	Chi-hoa	6,119
FZR	Saigon	12,010
FZG	Saigon	13,010
ITALY		
HAX	Rome	6,667
I2RO	Rome	11,810
I2RO	Rome	3,750
.....	Turin	3,750
HVJ	Vatican City	5,965
HVJ	Vatican City	15,112
JAPAN		
JHBB	Hirasio	7,995
JIAA	Kemikawa	8,105
JFAB	Taipeh, Taiwan	7,590
MADAGASCAR		
.....	Tananarive	5,552
MADEIRA		
CT3AG	Funchal	6,383
MEXICO		
XDA	Mexico City	14,630
XDA	Mexico City	9,375
XDA	Mexico City	6,818
XDA	Mexico City	5,857
XDA	Mexico City	11,763
XFD	Mexico City	6,667
XFD	Mexico City	9,091
XFD	Mexico City	11,111
X26A	Nuevo Laredo	7,616
MOROCCO		
FSMC	Casablanca	10,710
FSMC	Casablanca	6,875
.....	Rabat	6,877
.....	Rabat	12,830
.....	Rabat	9,300
NEWFOUNDLAND		
VOSZ	St. Johns	6,800
NEW ZEALAND		
ZL3ZC	Christchurch	6,000
ZLW	Wellington	10,990
ZL2XX	Wellington	4,776
PHILIPPINE ISLANDS		
KA1XR	Manila	12,245
KZRM	Manila	11,840
KZRM	Manila	9,570
KZRM	Manila	6,140
POLAND		
.....	Poznan	9,836
PORTUGAL		
CT1AA	Lisbon	6,995
CT1BO	Lisbon	10,710
ROUMANIA		
YO1	Bucharest	13,950
SHIP PHONE STATIONS		
GMJQ	SS. Belgenland	17,650
GMJQ	SS. Belgenland	13,040
GMJQ	SS. Belgenland	8,570
GMJQ	SS. Belgenland	4,762
DDDX	SS. Bremen	11,710
DDDX	SS. Bremen	7,560
1BDX	SS. Electra (Marconi's Yacht)	11,240
.....	SS. Hamburg	13,040
GDLJ	SS. Homeric	12,380
GDLJ	SS. Homeric	4,754
WSBN	SS. Leviathan	8,830
WSBN	SS. Leviathan	6,637
WSBN	SS. Leviathan	4,392
WSBN	SS. Leviathan	3,429
GFWV	SS. Majestic	17,590
GFWV	SS. Majestic	13,228
GFWV	SS. Majestic	4,430
GFWV	SS. Majestic	4,180
GLSQ	SS. Olympic	12,387
GLSQ	SS. Olympic	16,456
GLSQ	SS. Olympic	8,840
SIAM		
HS2PJ	Bangkok	10,167
HSP2	Bangkok	9,500
HSP2	Bangkok	7,300
SPAIN		
EAR25	Barcelona	6,000
EAR25	Barcelona	6,124
EAM	Madrid	9,772
EAR100	Madrid	6,976
EAR125	Madrid	7,025
SWEDEN		
SAS	Karlsborg	11,760
SBG	Motala	3,030
SBG	Motala	6,065
SWITZERLAND		
HB9OC	Berne	9,130
HB9XD	Zurich	9,380
HB9XD	Zurich	7,220
HB9XD	Zurich	3,483
TUNISIA		
F8KR	Constantine	7,005
UNION OF SOVIET SOCIALIST REPUBLICS		
RW15	Khabarovsk	4,273
RW3KAA	Leningrad	8,333
.....	Leningrad	11,111
.....	Leningrad	10,526
RW82	Minsk	6,420
RW61	Moscow	51,724
RW38	Moscow	5,515
RW59	Moscow	6,000
RW54	Moscow	4,273
RW50	Moscow	11,924
RW65	Peredvijka	3,560
RW19	Tomsk	8,111
UNION OF SOUTH AFRICA		
ZTJ	Johannesburg	6,098
VENEZUELA		
YV2BC	Caracas	6,061
YV4BV	Valencia	11,700
YUGOSLAVIA		
.....	Belgrade	10,000

Speech Input Equipment

By Ralph P. Glover *

A DEGREE of satisfaction derived from electrically reproduced entertainment, whether obtained through the home broadcast receiver or the loudspeakers of an extensive sound system, depends on many rather complicated factors. Laying aside the points of purely psychological nature (for they are by no means thoroughly understood as yet), we can briefly tabulate the more basic requirements of satisfactory reproduction which engage the attention of the sound engineer.

1. Each listener of average hearing ability must be furnished an adequate sound intensity. The intensity must be high enough to over-ride local noise but not so high as to become objectionable. The matter of proper volume is evidently one for experimentation.

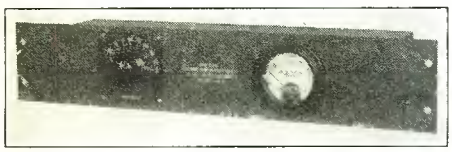


Figure 1

2. Given proper volume, the reproduced sound must also be intelligible and of pleasing quality. This calls for equipment capable of transforming acoustic energy into electrical energy, of properly controlling and amplifying this electrical energy, and then converting back into the acoustic form, with nearly uniform efficiency overall throughout, the useful portion of the audio-frequency spectrum. In the case of broadcasting, the receiver itself is naturally an important link in the chain of complicated equipment which begins at the studio microphone. Probably each individual mechanism in the reproducing channel, including the auditory facilities of the listener, leaves its imprint on the eventual sense impressions, but it is evident that any form of distortion becomes increasingly serious the closer it occurs to the original sound source. Thus the radio receiver can do practically nothing to compensate for deficiencies inherent in the broadcast station itself, nor is it possible within the broadcast station itself, for instance, to correct in subsequent amplifiers for certain forms of distortion arising in the mixer. As still another example, there is nothing that can be done at the loudspeaker end of the public address system which will remedy the effects of an overloaded amplifier.

3. There is still a third characteristic of satisfactory reproduction, not included in the general points mentioned above, which for want of better nomenclature we may term *pleasing and accurate control.* An excellent example can be borrowed from the technique of the motion picture cameraman. Prior to the production of "The Birth of a Nation," by Griffith, the scenes shifted from locale to locale with disconcerting abruptness, and when the last scene reached its invariant culmination the picture simply stopped. Griffith saw the artistic shortcomings of the abrupt transitions and developed the "fadeout" whereby there is a gradual blending or merging of one scene into the next. Every broadcast listener will recognize the acoustic counterpart of this effect in the "fading" from one selection to the next accomplished in the studio control room. Where fading is not possible and it is necessary to switch rapidly from one source to another, preliminary adjustments are always made to insure constant volume. What has been said above also applies generally to all kinds of high quality sound systems such as public address installations, sound recording plants and the like.

A title, "speech input equipment," is loosely applied to all of the audio-frequency apparatus closely associated with the sound source. In the broadcast station this includes the mixing, fading and switching equipment operated by the monitoring control operator, the line and monitoring amplifiers, volume indicators and similar equipment. Only minor differences apply to similar apparatus in sound systems. Practically all control of the outgoing program is centered in the speech input equipment, and its vital nature and position in the circuit combine to emphasize its importance as outlined above.

Volume Indicator

The volume indicator is a most important accessory of the speech input system, and a typical panel-mounting instrument is shown in Fig. 1. As might be judged from its name, the function of the volume indicator is to measure the "volume," or more strictly, the *power level* of the electrical energy at some point in the circuit. It is obvious that constant sound volume will obtain if the power level is constant.

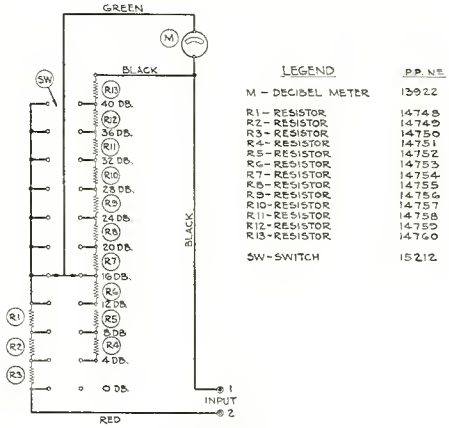


Figure 2

Volume indicators occupy a position in the communications field which is closely comparable to that of the wattmeter in commercial-frequency power measurements. When correctly used, it provides an accurate quantitative measure of power just as the wattmeter does. This property enables the control operator to keep the signal well below the overload level of succeeding amplifiers. In broadcasting this is of the utmost importance, for there is a certain peak signal level at which overmodulation of the radio-frequency carrier takes place, resulting in very evident distortion to the listener.

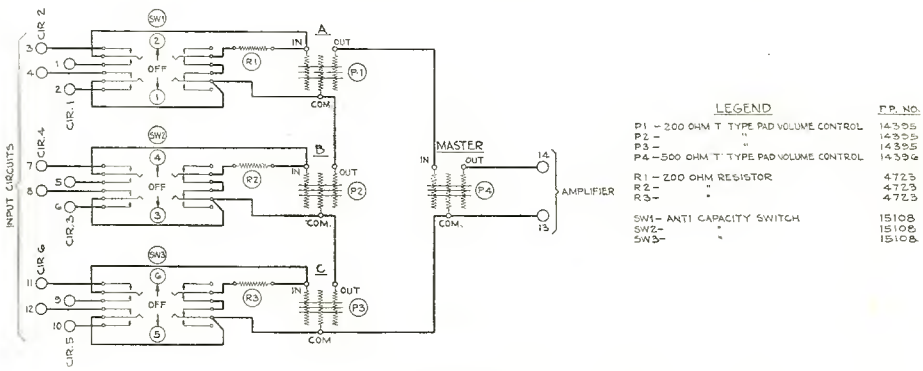


Figure 3

* Sound Engineer, Silver-Marshall, Inc.

It should be remembered that during ordinary speech or music there is no such thing as constant volume from instant to instant. The volume actually varies with the inflection of the speaker's voice from syllable to syllable. Volume changes are also inherently necessary to the proper rendition of any type of music. As a result, the pointer of the volume indicator meter fluctuates back and forth over a considerable range. As mentioned before, the maximum indica-

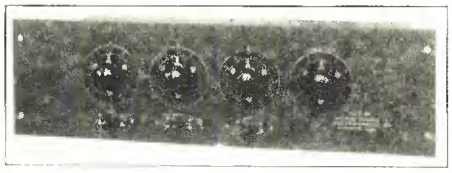


Figure 4

tion of the meter is of importance in broadcast work for overmodulation, as a rule, will only occur during instants of maximum level.

Instead of being calibrated directly in watts as in the case of the wattmeter, the volume indicator is calibrated in decibels. The decibel (DB) is a logarithmic unit long used by the telephone systems for voice-frequency measurements and is based on the common logarithm of the ratio of two powers. One of these powers is arbitrarily selected as a reference power, and any other power can then be stated in terms of decibels above or below the reference value. There are a number of different reference powers in use, the more common ones being .006 watts and .010 watts. If we assume the .006-watt reference power, a power of .06 watts would have a power level of +10 decibels. A power of 0.6 watts would correspond to +20 decibels, and so on. Six milliwatts is evidently at a power level of 0 decibels, and similarly, a power level of 6 microwatts would be —30 decibels in our adopted reference system. The decibel, sometimes known as the transmission unit (TU), is very convenient in all sorts of sound work, for a change in level of 2 decibels is approximately the minimum change in volume readily detected by the human ear, the ear following a logarithmic rather than a linear response law. Thus if the power level fed to a loudspeaker were raised in steps of 2 decibels, the listener would sense a number of volume changes increasing at a constant rate. The usefulness of this relationship is at once evident.

There are two general types of volume indicators. Both types are in reality voltmeters calibrated in terms of decibels for the adopted reference system. It is thus only necessary to connect the volume indicator across the circuit at the point where the power level is to be measured. A direct indication of power level will be afforded provided the impedance of the circuit is the same as that for which the meter was calibrated. Volume indicators are usually calibrated to read directly on 500-ohm circuits, although a correction factor can be readily applied for other impedances. It is very desirable for obvious reasons that the bridging of the volume indicator across the circuit introduce a negligible volume change due to the shunting effect, which can be compared to the necessity for using a high-resistance voltmeter when checking D.C. plate supply voltages. The early types of volume indicators found in telephone offices and broadcast stations made use of vacuum-tube voltmeter circuits, for no switchboard meters of sufficient sensitivity were

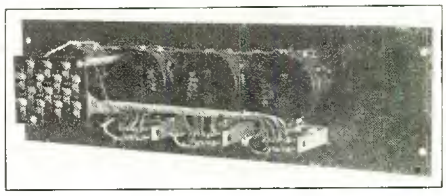


Figure 5

then available. The recent perfection of the rectifier meters simplified the problem greatly by eliminating the expense of vacuum tubes with attendant power supply, and, at the same time, made unnecessary the critical adjustments of grid bias that were formerly required to maintain accuracy. The volume indicator illustrated in Fig. 1 consists of a sensitive low-range rectifier-type meter of high resistance whose scale is calibrated directly in decibels above and below 6 milliwatts. This power is assumed to be dissipated in a 500-ohm circuit. The meter itself covers a range of —8 to +8 decibels, and this is extended, by means of a tapped network, 40 decibels in ten steps of 4 db each.

In the broadcast studio, the volume indicator is usually connected across the telephone line leading to the transmitting station. The peak power level at this point must be limited to 0 decibels to avoid interference by induction in other nearby telephone lines. In public address systems, the volume indicator may be connected across the voice-coil line and thus enables the operator to maintain a constant volume which can be set definitely below the level at which there is danger of damage to the reproducers.

The Mixing Panel

While we have discussed the need for maintaining constant volume, the method of volume or power level measurements and the desirability of means for producing gradual volume changes without impairing the quality in any way, nothing has been said about the actual method of controlling volume in speech input circuits.

A simple method of controlling volume is obviously that of regulating a potentiometer at the input of the amplifier. Unfortunately this system is never feasible when a variety of input sources, such as microphone or phonograph pickup, are fed to the amplifier, and it is desired to switch from one source to the other without pronounced volume changes. This is evident, for the output level of a high-quality double-button carbon microphone is seldom more than —45 decibels, while that of a phonograph pickup is usually about —20 decibels. It has therefore become common practice to provide separate volume controls for each input source itself, and these volume controls are usually connected together to form a *mixing circuit*. The most rudimentary mixing circuit consists merely of a number of potentiometers connected across the individual sources, the potentiometer outputs being connected in series with the amplifier input terminals. This elementary mixer, however, has a great many drawbacks, and a really satisfactory solution involves a somewhat more complicated arrangement. In the first place, the simple potentiometer mixing control presents an impedance to the source which varies with the position of the potential arm or slider. This does not impair the quality of reproduction when the source is a microphone, but in the case of phonograph input, the quality undergoes marked changes as the control is varied. Moreover, adjustment of any one of the potentiometers will affect the output of other sources not connected directly to the potentiom-

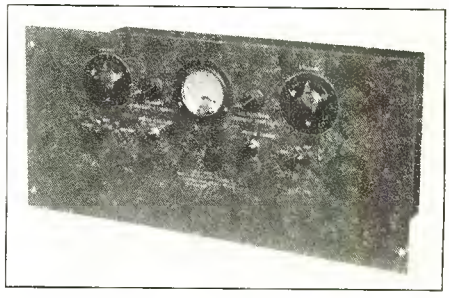


Figure 6

eter in question.

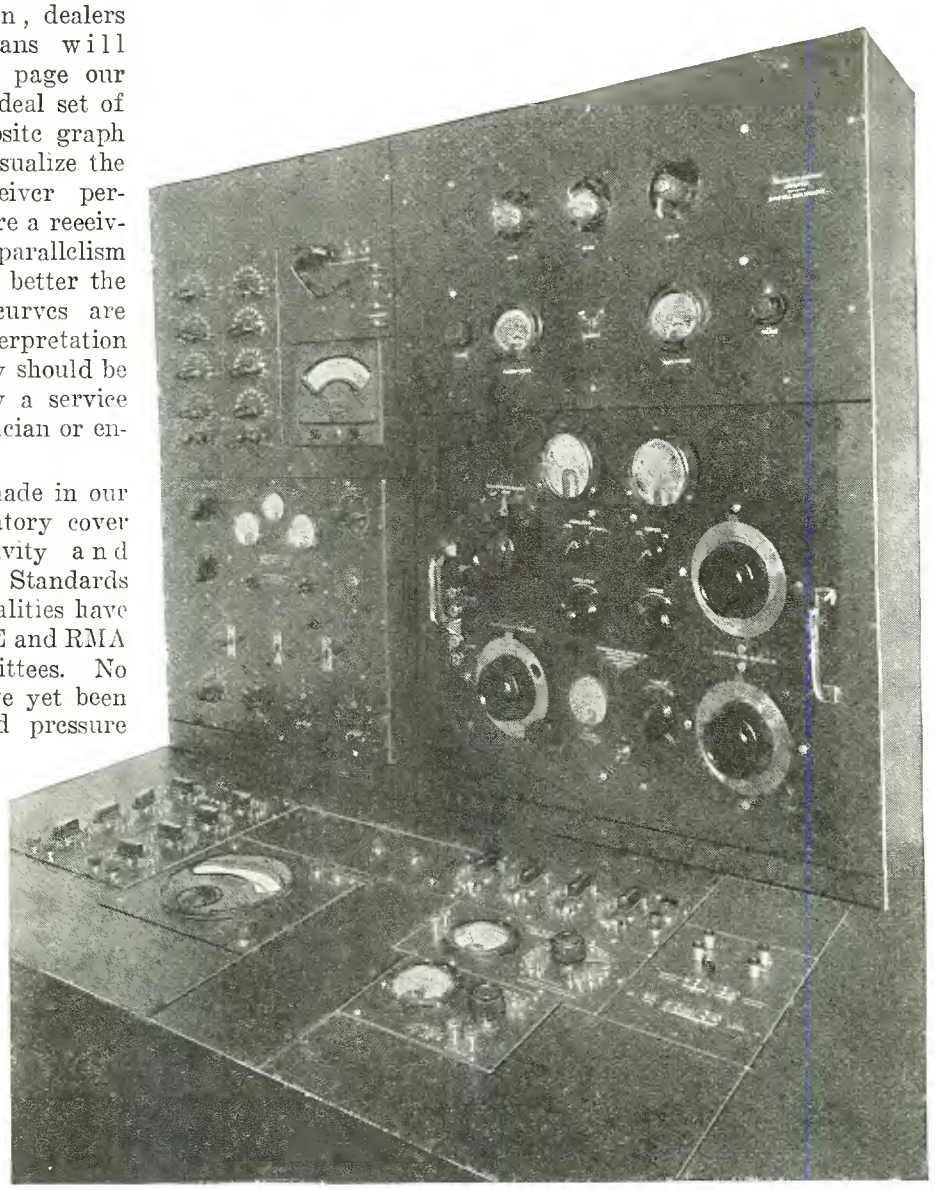
These difficulties are eliminated in the mixing circuit illustrated in Fig. 3. The three mixing controls marked A, B and C, as well as the master control are all of the constant impedance type and are familiarly known as "T" pads. Such volume controls present a constant impedance to both the

(*Continued on page* 38)

Receiver Performance Curve Section

SERVICE men, dealers and technicians will find on this page our conception of an ideal set of curves. The composite graph may be used to visualize the best possible receiver performance. The more a reeeiver's curves near parallelism with the ideal, the better the receiver. These curves are not capable of interpretation by a layman. They should be translated only by a service man, dealer, technician or engineer.

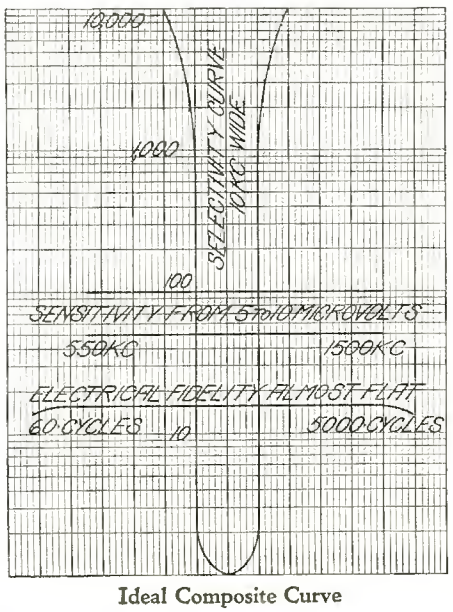
Measurements made in our engineering laboratory cover sensitivity, selectivity and electrical fidelity. Standards for these three qualities have been set by the IRE and RMA engineering committees. No standards have yet been adopted for sound pressure measurements. Until a standard is selected, our laboratory will measure only electrical fidelity, which disregards speaker response curves. The fourth measurement appearing with the sensitivity, selectivity and electrical fidelity curves represents power overload curves, or automatic volume control curves, as the case may be.



Definitions of the three major characteristics of a receiver are:

Sensitivity is that characteristic of a receiver which determines *to how weak* a signal it is capable of responding. It is measured quantitatively in terms of the input voltage required to give standard output. The ideal sensitivity, according to the graph on this page, would fall between the two lines, ranging from 10 to 5 microvolts (absolute) or less. This is an arbitrary value.

Selectivity is the degree to which a receiver is capable of *differentiating between* the desired signal, and signals of other carrier frequencies. This characteristic is not expressible by a single numerical value, but requires one or more graphs for its expression. Best selectivity possible would be somewhat like a "chimney" whose sides would be 10 kilocycles apart nearly all the way up the graph sheet. Selectivity as measured by our laboratory only concerns itself with energy entering the receiver via the input circuit (disregarding shielding effectiveness), since no standard has as yet been adopted to simulate selectivity conditions in the field.



Ideal Composite Curve

Fidelity is the degree to which the receiver *accurately reproduces* at its output terminals, the modulated form of the received wave impressed upon it. Ideal electrical fidelity curve would be a horizontal line almost flat over the frequency range from 60 to 5000 cycles. This range is also of an arbitrary width.

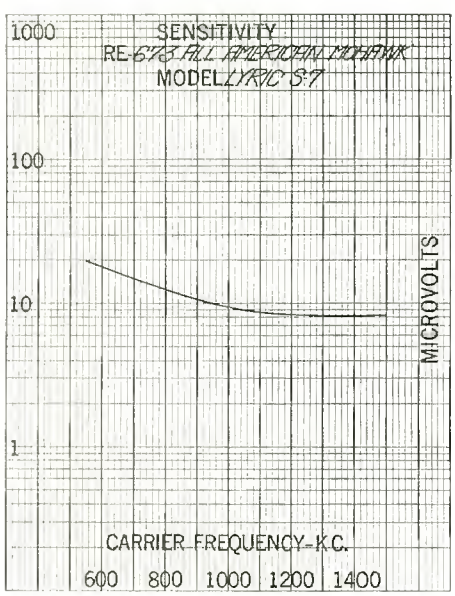
The photograph illustrates the equipment used in making the measurements. It conforms to the specifications of the IRE and RMA Standardization Committees. All test frequencies are determined by zero beat of a crystal-controlled dynatron oscillator. Voltmeters and microvoltmeters are periodically checked against calibrated standards for accuracy of adjustment. Individual conditions of measurement pertaining to each receiver will be found in the text accompanying each family of curves.

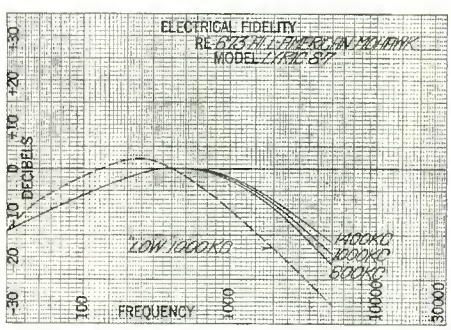
Since curves of all receivers are taken under the same conditions, it may be said that such curves constitute a yardstick by which receivers of the same general class may be compared, as long as this analysis is made by those technically competent to do so.

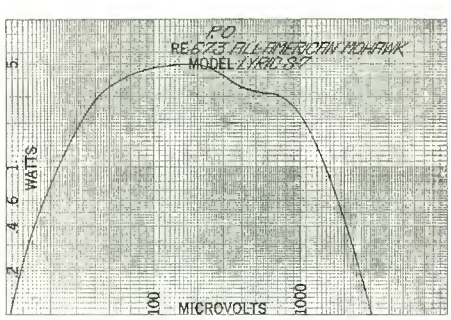
All American Mohawk, Lyric S-7

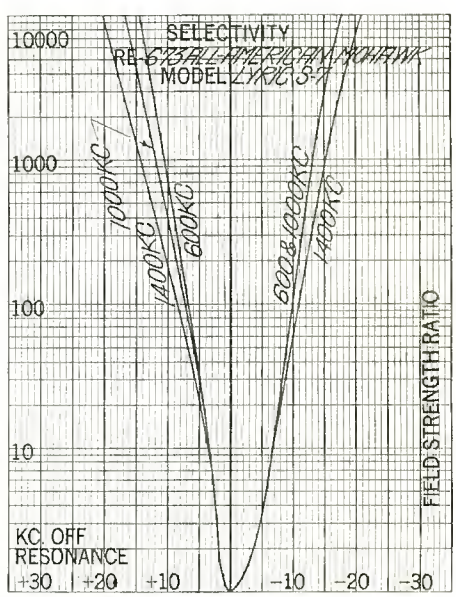
INCLUDED overall performance curves on the All-American Mohawk Lyric model S-7, recently made in our laboratory, are given here as indicative of this superheterodyne's performance.

Input to the receiver antenna circuit was through the standard dummy antenna of 20 uh, 200 uuf and 25 ohms. An output level of .05 watts was maintained for all measurements









except that of power overload. A non-inductive load resistance of 7000 ohms matched the optimum operating impedance of the single 247 pentode power tube, the plate of which was capacitatively coupled to the output indicating tube voltmeter. To prevent any error in output reading due to secondary load, the voice coil of the speaker was opened.

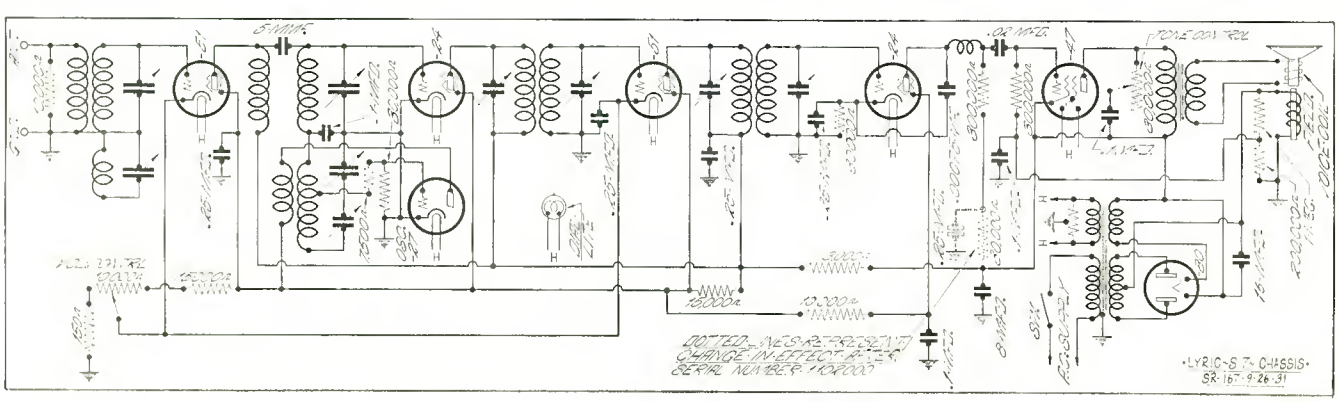
A line voltage of 119 volts gave the receiver power transformer primary a current drain of .67 amperes. For all tests the volume control was turned to its maximum position, no alterations were made on the alignment of any of the tuned circuits from factory adjustment, and the tubes employed were those furnished as standard equipment with the receiver by the manufacturer.

From the sensitivity curve of column 1, an average value of 11.82 microvolts absolute is taken. This value corresponds to 2.95 microvolts per meter when a standard four-meter antenna is used. At 600 kc the minimum noise level of 7.6 per cent occurred, while the maximum of 36 per cent was found at 1400 kc. At 1000 kc the measured image ratio was found to be 95,300 times. In column 2, the power overload curve gives a maximum output of 4.89 watts. This value does not take into consideration any harmonics introduced into the wave form in the amplifier. Under the selectivity curves given in column 3 are the tabulated band widths.

At the bottom of the page is the schematic wiring diagram of the model S-7. The seven required tubes are a 551 r-f, 224 first detector, 227 oscillator, 551 second i-f, 224 second detector, 247 output tube, and a 280 full wave rectifier. The speaker field is used as a choke in the negative return system and has across it the resistance network necessary for properly biasing the output pentode tube. No other filter system is employed in this receiver. Oscillator energy is coupled inductively to the grid coil of the first detector tube. Tone control is accomplished with a 30,000 ohm variable resistor in series with a condenser with a capacity of one-tenth microfarad, both connected from the plate of the pentode to plus B.

Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	10	10	10.5
100	17	17.5	19.5
1000	24	25.5	29.5
10000	32	34	41



Balkeit Model L-8

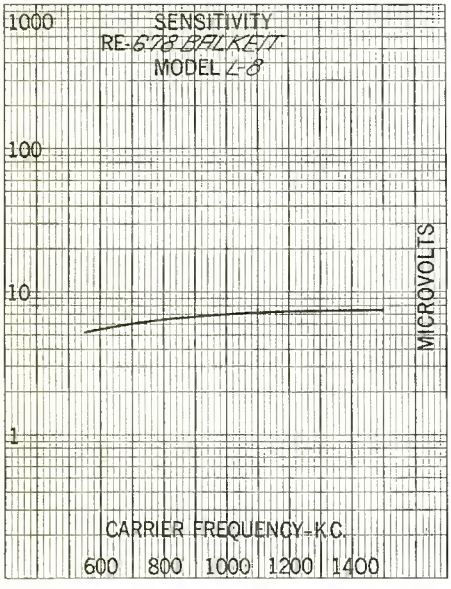
CURVES, made from measurements in our laboratory on the Balkeit model L-8 superheterodyne, are given on this page.

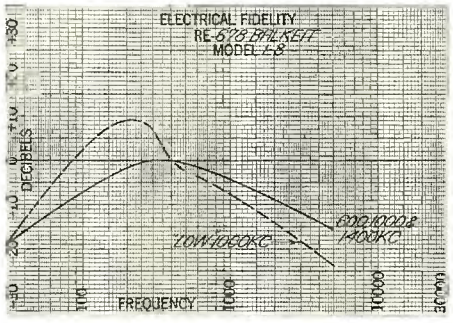
Input to the antenna circuit of the receiver was through a standard dummy antenna of 20 uh, 200 uuf, and 25 ohms. A non-inductive load resistance of 14,000 ohms was used to match the optimum operating impedance of the push-pull pentode tubes. Their plates were capacitatively coupled to the output tube voltmeter which gave a reading corresponding to the standard output level of .05 watts except for the power overload measurements. In order that there would be no error due to impedance reflection, the voice coil circuit was broken.

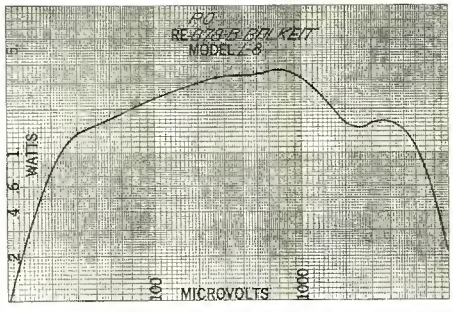
With an a-c line voltage of 120 volts, the current drawn by this chassis was .73 amperes. For all measurements, the tubes employed were those furnished as standard equipment with the receiver, the volume was at maximum, and no changes were made in the alignment of tuned circuits from factory adjustment.

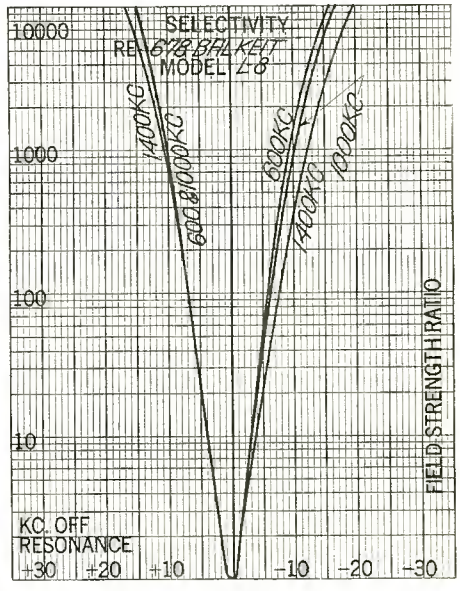
Average sensitivity, taken from the curve of column 1, is 7.10 microvolts absolute which is equivalent to 1.78 microvolts per meter when employing a four-meter antenna. Maximum noise level occurred at 600 kc, having a value of 16%, while the minimum was recorded at 11.6% at 1000 kc and 1200 kc. With the receiver dial set at 1000 kc, the measured image ratio was 10,000 times. In column 2, the power overload curve shows the maximum output of audio power to be 3.58 watts. This figure does not take into consideration the harmonic content of the voltage wave form across the output transformer. In tabular form, under the selectivity curves from which they were taken, are the band widths.

At the bottom of the page is the complete schematic wiring diagram of this receiver. For operation, the following tubes are required: a 551 r-f, 551 first detector, 227 oscillator, 551 second i-f, 227 second detector, push-pull 247 power pentodes, and a 280 full-wave rectifier. The 1500 ohm speaker field in conjunction with one choke coil, furnishes the necessary B supply filtration for hum. Bias for the pentodes is obtained across the 425 ohm resistance placed from the midpoint of the filament winding to ground.



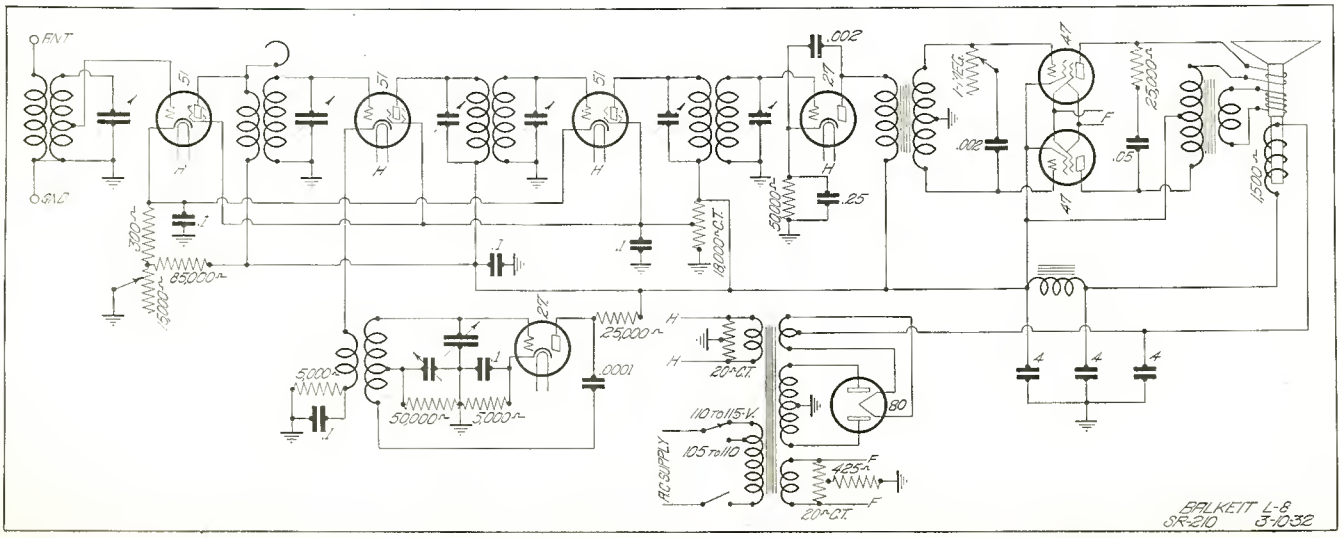






Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	7	7	7.5
100	13	13.5	14.5
1000	19.5	20.5	23
10000	30.5	31.5	36



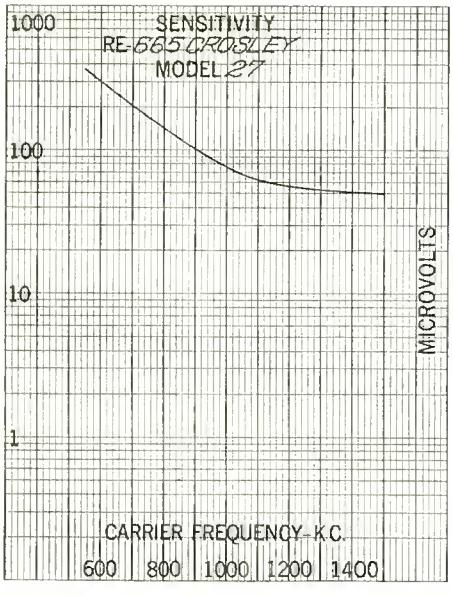
Crosley Battery Model 27

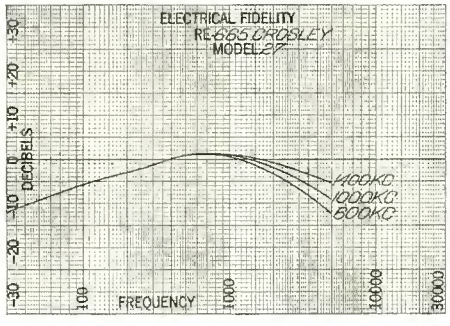
CROSLEY'S model 27 battery operated receiver, when recently measured in our laboratory, gave the performance curves shown on this page.

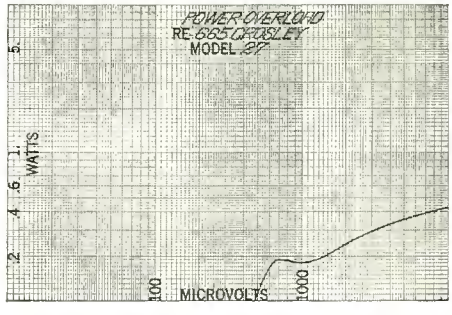
Output of the signal generator was coupled to the input circuit of the receiver by means of a dummy antenna standard of 20 uh, 200 uuf and 25 ohms. To match the push-pull 231 tubes used as the last audio amplifier, a non-inductive load resistance of 9,900 ohms was connected across their plates, the latter being capacitatively coupled to the output indicating tube voltmeter, which read the standard output of .05 watts for all measurements except the power overload curve. To prevent any reflection of secondary load impedance on the primary circuit, the speaker transformer was replaced by a choke of suitable value. For all measurements the tubes used were those furnished with the receiver by the manufacturer, the volume control was turned for maximum receiver sensitivity, and no changes were made in the alignment of the tuned circuits from factory adjustment.

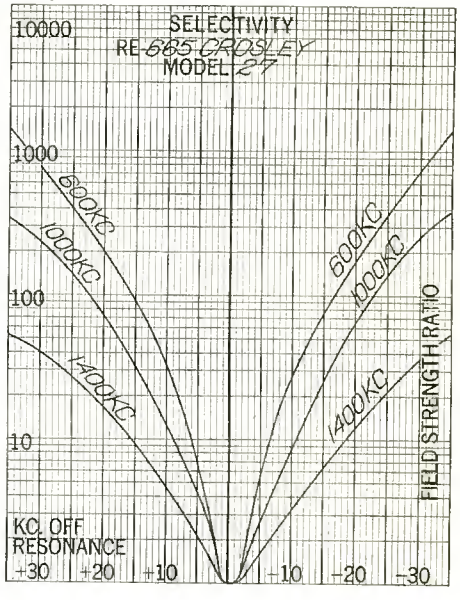
From the sensitivity curve of column 1, the average is found to be 130 microvolts absolute, which is equivalent to 32.5 microvolts per meter. Noise levels at all points on the dial were less than 1 per cent and hence negligible. From the power overload curve of column 2 the maximum output is found, at 10,000 microvolts input to the receiver, to have a value of .416 watts. However, no consideration is made of the harmonic distortion present at this high level across the plate circuit of the output tubes. Band widths will be found tabulated under the selectivity curves in column 3.

Below is the schematic wiring diagram of the model 27. Required tubes are seen to be a 232 first r-f, 232 second r-f, 232 detector, 231 intermediate audio, and push-pull 231 output power tubes. It will be seen that the antenna is coupled to the antenna coil through two series condensers.



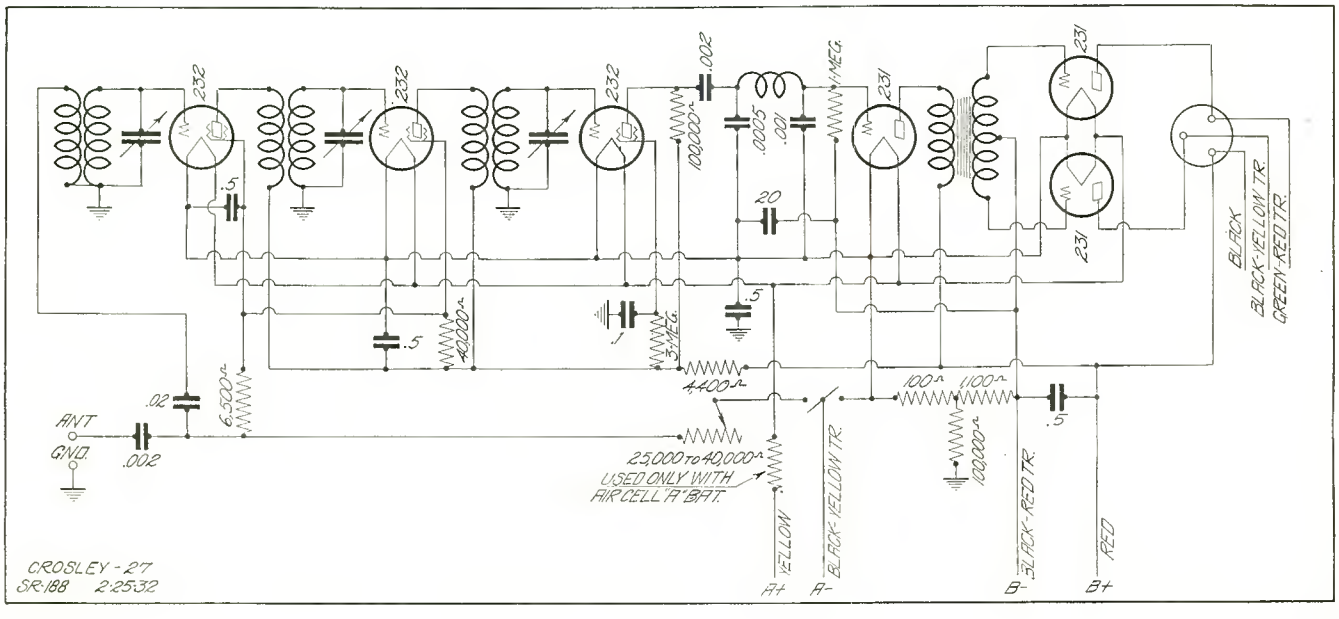






Band Widths

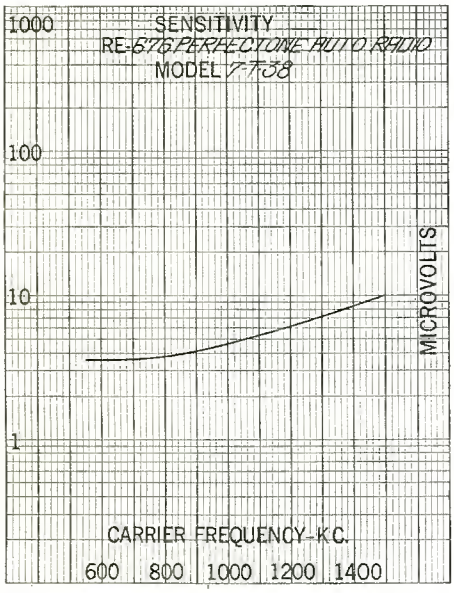
Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	12.5	19	34
100	32	45	..
1000	65	..	..
10000	..	..	..



Perfectone Auto Radio Model 7-T-38

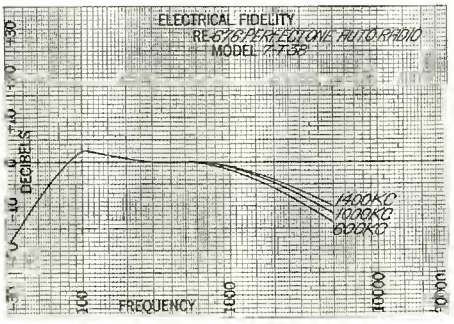
PERFORMANCE curves of the Perfectone Auto Radio model 7-T-38 are given on this page.

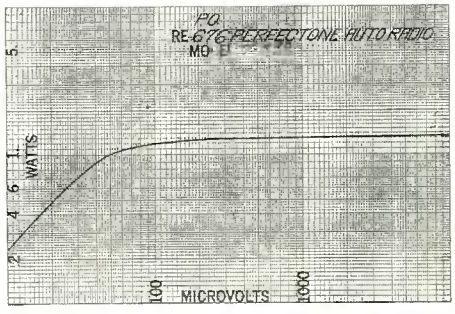
A dummy antenna standard of 20 uh, 200 uuf and 25 ohms was used to couple the output of the signal generator to the receiver input circuit. To match the push-pull 238 pentodes in the last audio stage, a non-inductive load resistance of 30,000 ohms was connected across their plates, which in turn were capacitatively coupled to the output indicating voltmeter. The voice coil of the dynamic speaker was opened to prevent any secondary loading effects.



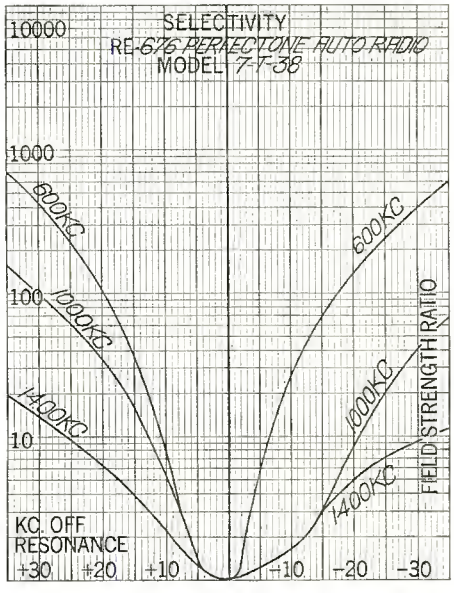
Measured drain on the 180 volt B battery supply was 44 ma in the —B lead. No changes were made in circuit alignment, the volume control was turned to maximum, and the tubes were furnished with the receiver.

An average sensitivity of 5.64 microvolts absolute was taken from the sensitivity curve, this value corresponding to 1.41 microvolts per meter. At 600 kc the noise level was 8.4%, the maximum, and at 1400 kc, 1.6%, the minimum. The automatic volume control curve gives the maximum output as 1.33 watts, no consideration being made of the harmonic content of the output wave form. Band widths are given under the selectivity curves of column 3.



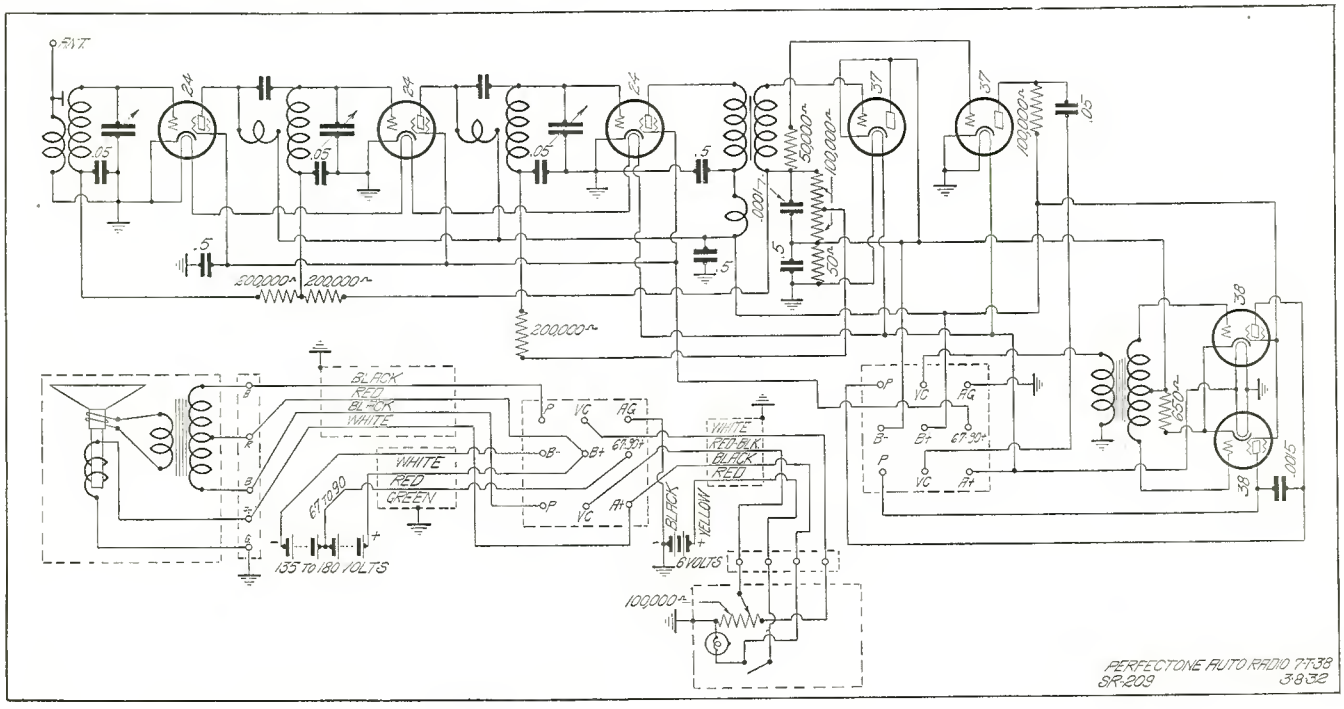


At the bottom of the page is a schematic wiring diagram. Tubes necessary for operation are a 224 first r-f, 224 second r-f, 224 detector, 237 automatic volume control, 237 intermediate audio, and push-pull 238 output tubes. Volume control is accomplished by means of a variable resistance from ground to the plate of the intermediate audio stage, parallel feed being used on this tube.



Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	17.5	33.5	58
100	37	72	. . .
1000	81	. . .	. . .
10000	. . .	. . .	. . .



Philco Models 51 & 51-A

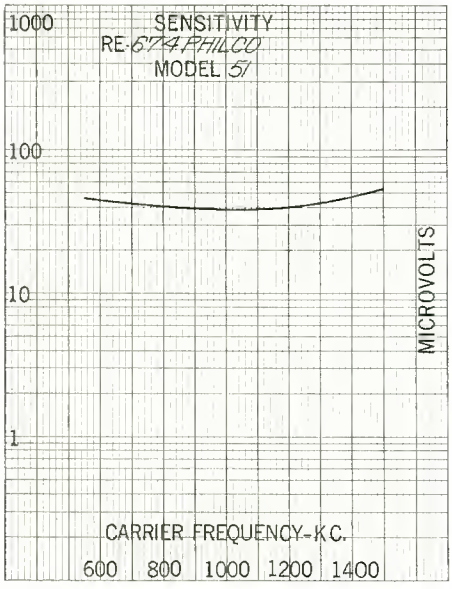
RESPONSE curves made on the Philco model 51, given on this page, were recently made in our laboratory.

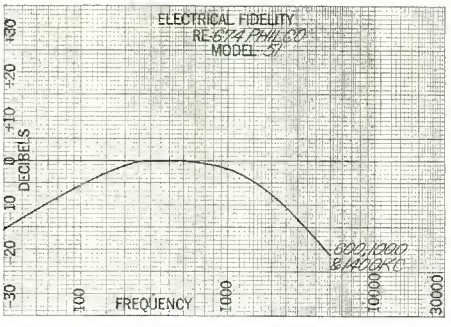
To couple the signal from the standard signal generator to the receiver, a dummy antenna standard of 20 uh, 200 uuf, and 25 ohms was connected to the antenna circuit. The output indicating tube voltmeter, used to indicate watts output, read the standard audio output level of .05 watts except for the power overload curve. To match the single pentode output tube, a non-inductive load resistance of 7000 ohms was connected across the plate circuit. This was in turn capacitatively coupled to the tube voltmeter. The voice coil circuit of the dynamic speaker was opened to prevent any impedance reflection from the secondary circuit to the primary.

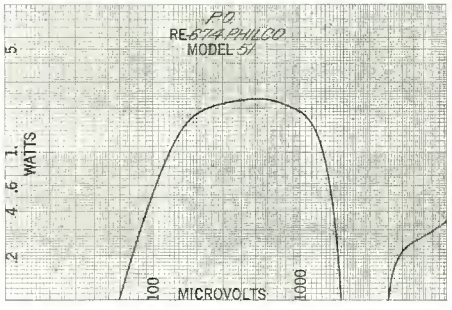
A line voltage of 111 gave the receiver a drain of .51 amperes a-c. In all measurements, the tubes furnished as standard equipment were employed, no changes from factory adjustment of tuned circuits was made, and the volume control was turned to its maximum position.

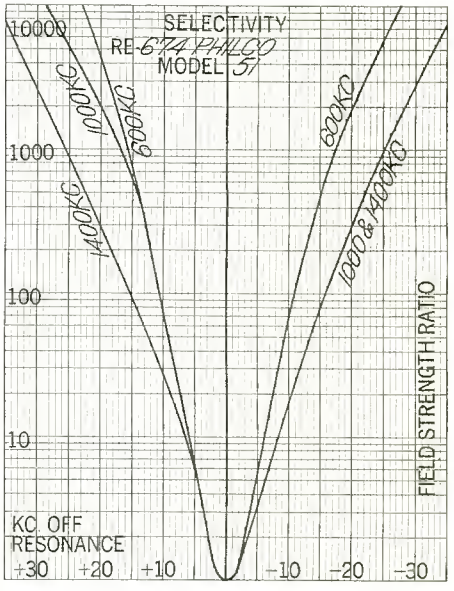
Column 1 shows the sensitivity average to be 44.4 microvolts absolute, corresponding to 11.1 microvolts per meter when using the standard 4 meter height antenna. Noise level maxima and minima were respectively 2.1% at 800 kc, and 1.2% at 600 kc. At 1000 kc the measured image ratio was found to be 5300 times. Column 2 gives the maximum power output to be 2.27 watts. However, this figure does not take into account the harmonic distortion present in the wave form of the audio voltage across the primary of the output transformer. Tabulated band widths are given under the selectivity curves of column 3 from which they were taken.

A schematic wiring diagram of this Philco superheterodyne is given below in detail. Only five tubes are required, a 224 combination first detector and oscillator, a 235 second i-f, 224 second detector, resistance coupled to the 247 power output pentode, and a 280 type rectifier for power supply to the receiver. The speaker field is used in the B return lead to provide bias voltage for the pentode. This bias is taken from a tapped high resistance shunt across the field coil. The volume control operates on the i-f stage, and to provide complete control on locals, on the minimum position it is grounded.



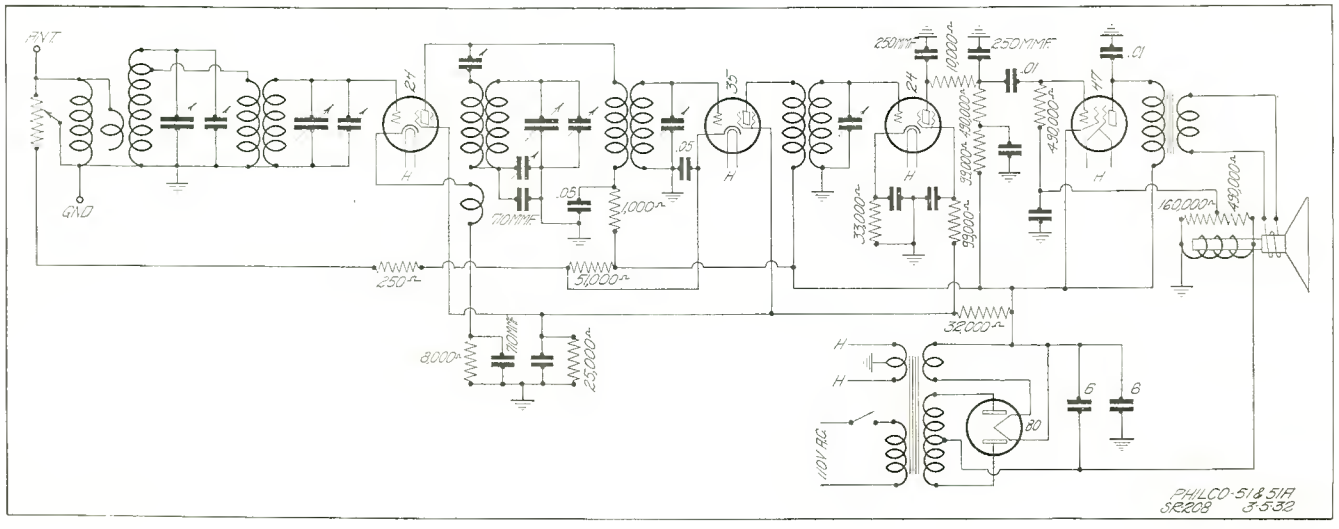






Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	12	14	15
100	22	27	31
1000	33	42	51
10000	50	66	75



RCA-Victor Model 43

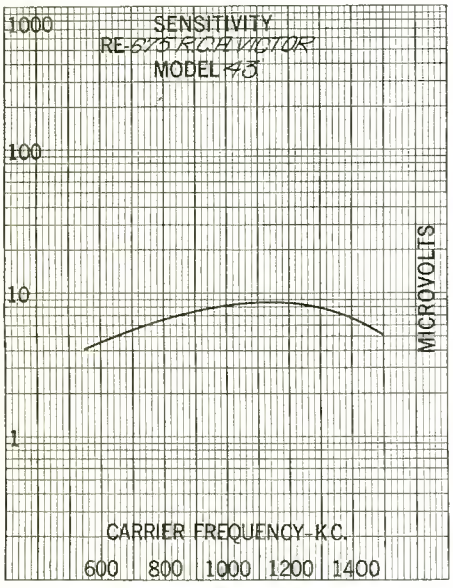
RCA Victor's model 43 gave the included performance curves on measurement in our laboratory recently.

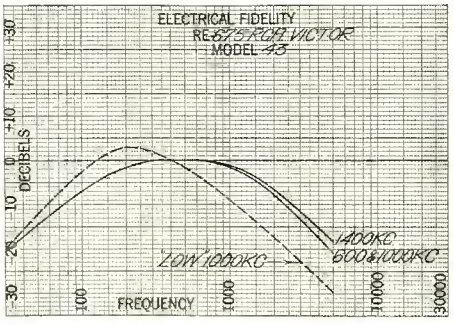
Energy from the signal generator was coupled to the receiver input terminals through a standard dummy of 20 uh, 200 uuf and 25 ohms. The output impedance of the class B 230 push-pull output tubes was matched with a non-inductive load resistance of 25,000 ohms connected across the plates. These were in turn capacitatively coupled to the output indicating voltmeter, which read the voltage corresponding to an output of .05 watts for all curves except that of power overload. The voice coil of the permanent magnet type dynamic speaker was opened during measurements to prevent any load reflection to cause error in output readings.

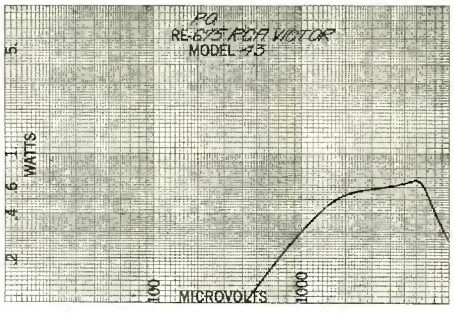
A drain of 14 ma was measured in the —B lead of the battery supply. During measurements the volume control was turned to its maximum position, tubes employed were furnished with the receiver as standard equipment, and the factory adjustment of the tuned circuits was not altered.

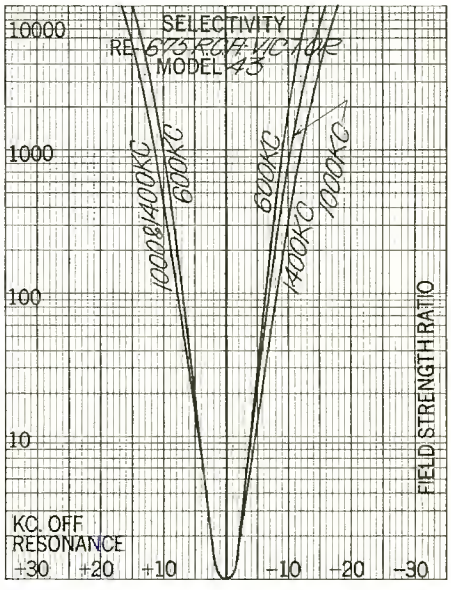
From the curve of column 1 an average sensitivity of 6.65 microvolts absolute is found, which corresponds to 1.66 microvolts per meter when a standard four-meter antenna is used. A maximum noise level of 30 per cent was measured at 1400 kc, while the minimum of 4 per cent is found at 1000 kc. With the dial adjusted to 1000 kc, the image ratio measured 1900 times. A maximum output of .655 watts is taken from the power overload curve of column 2. No account was taken, however, of the produced harmonics present across the output transformer primary. Band widths are tabulated under the selectivity curves from which they were taken in column 3.

A schematic wiring diagram is given below. From it the tubes necessary for operation are found to be a 232 r-f, 232 first detector, 230 oscillator, 232 i-f, 230 second detector, 230 intermediate audio, and push-pull 230 tubes used in class B amplification. It is interesting to note that the unusual output of more than half a watt of audio power is obtained by using 230 tubes in push-pull by employing class B amplification. Also the B battery drain for this eight-tube superheterodyne is only 14 ma. Most of the saving is due to the output tube circuit which is the first of this system we have measured. A permanent magnet type dynamic speaker gives full dynamic results without requiring external field excitation.



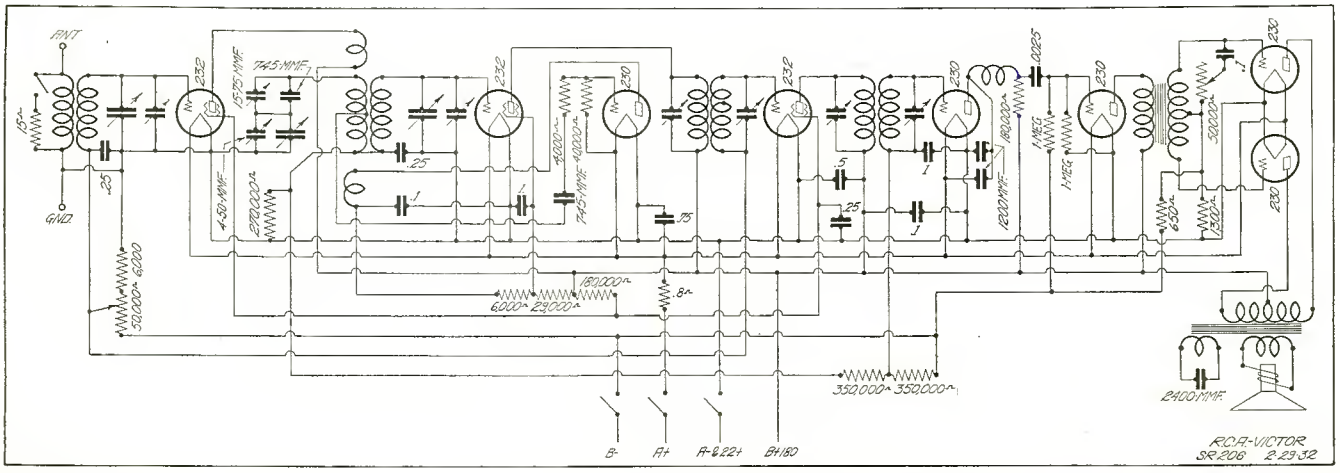






Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	8.5	9	9.5
100	13.5	14	16
1000	19	21	23.5
10000	28	32.5	34.5

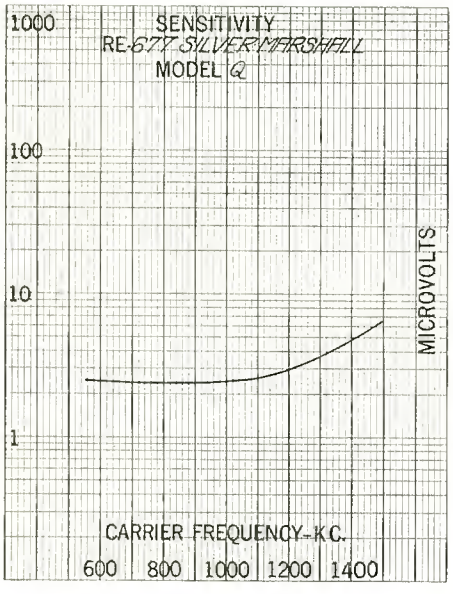


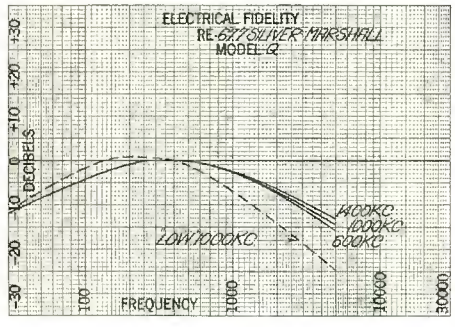
Silver-Marshall Model Q

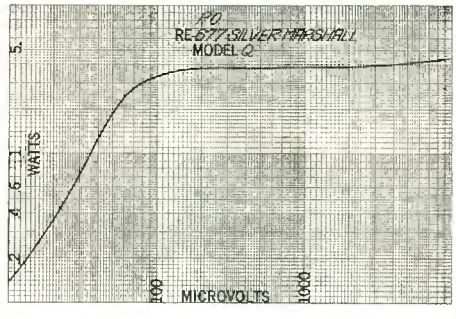
OVERALL performance curves on the Silver-Marshall model Q are given on this page from data made in the laboratory upon measurement of this combination short wave and broadcast receiver.

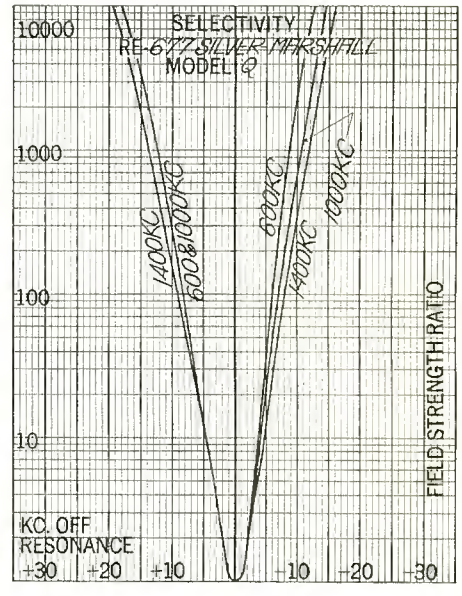
Input to the receiver was through the standard dummy antenna of 20 uh, 200 uuf and 25 ohms. The plate control was turned to maximum, the tubes as furnished with the receiver were employed, and no changes were made in the adjustment of the tuned circuits.

An average sensitivity of 3.31 microvolts absolute is found from the curve of column 1. This value corresponds to .83 microvolts per meter.









load of the parallel 247 pentodes was matched by a 3500 ohm non-inductive resistance connected across the output circuit. The plates of the output tubes were capacitatively coupled to the output meter, the voice coil being disconnected during measurements.

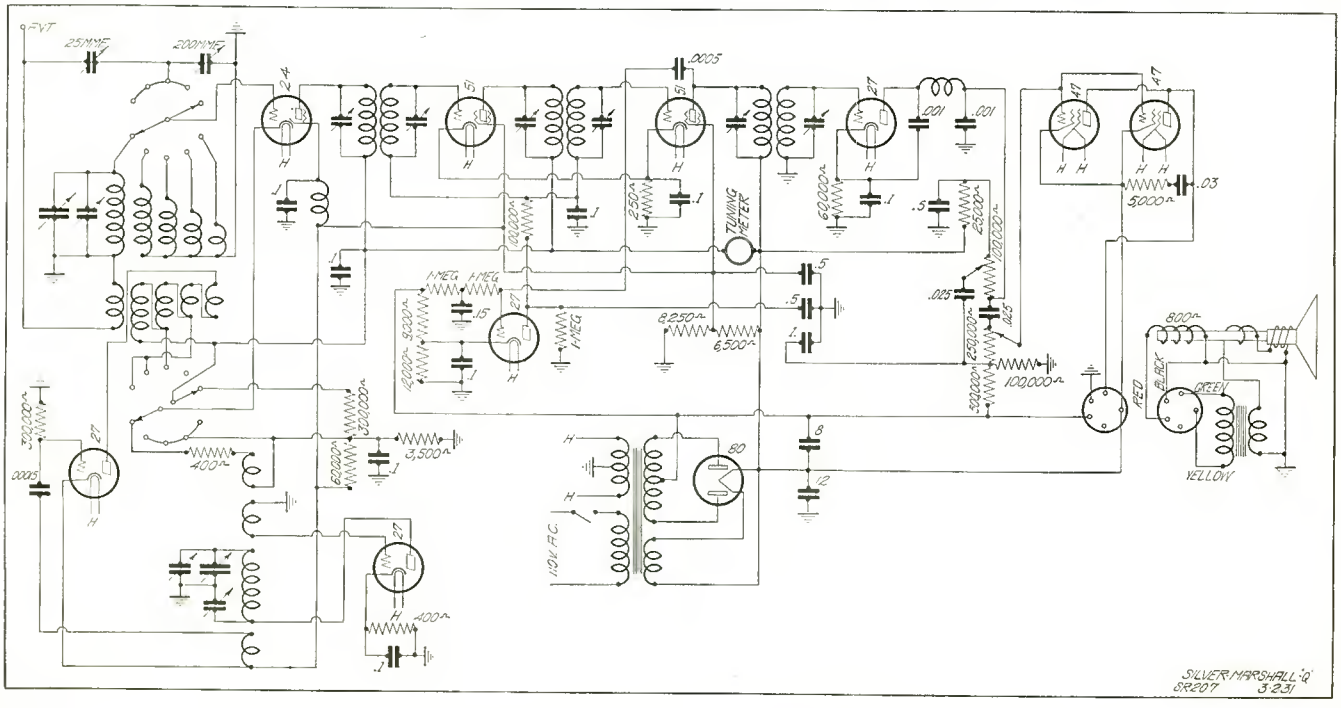
With a line voltage of 118 volts, the current drain of this receiver was 1.09 amperes. For all tests the volume

At 600 kc, the minimum noise level of 19.2 per cent was measured, while the maximum of 63.5 per cent occurred at 1400 kc. An image ratio of 14,500 was found at 1000 kc. Power output reached a maximum value of 4.45 watts, but this figure makes no consideration of the harmonics produced in the audio system. Under the selectivity curves of column 3 are found the band widths.

At the bottom of the page is a schematic wiring diagram of this superheterodyne. Tubes required for operation are a 224 first detector, 551 second i-f, 551 third i-f, 227 oscillator, 227 automatic volume control, 227 harmonic producer, 227 second detector, parallel 247 pentodes, and a 280 full wave rectifier.

Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	8	8.5	9
100	14.5	15.5	17
1000	21.5	23	25.5
10000	30.5	32.5	34



Stromberg-Carlson Model 29

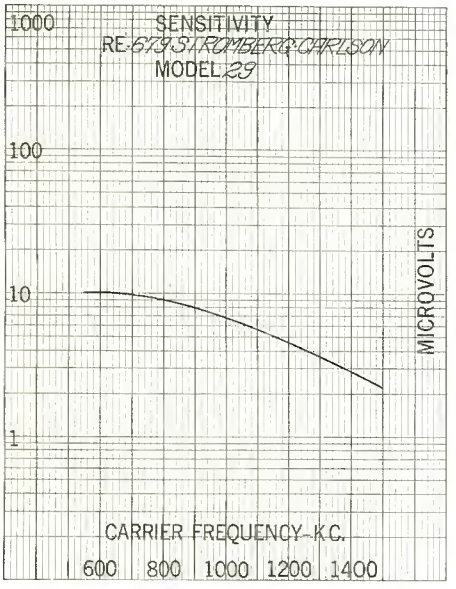
STROMBERG - CARLSON'S model 29 is presented here with curves to indicate its performance. It is supplied with an automatic volume control feature which operates very satisfactorily.

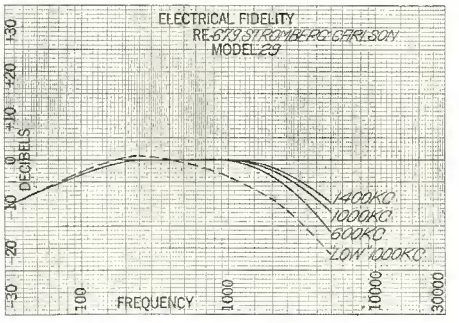
A dummy antenna of 20 uh, 200 muf, and 25 ohms served to couple the generator to the input system of the receiver. To properly match the push-pull 245 power tubes employed, a non-inductive load resistance of 7800 ohms was connected across their plates which were in turn connected to the output indicating tube voltmeter which read a standard output level of .05 watts for all of the curves with the exception of the power overload. Due to errors which would be introduced otherwise, the voice coil circuit of the dynamic speaker was broken for measurement purposes.

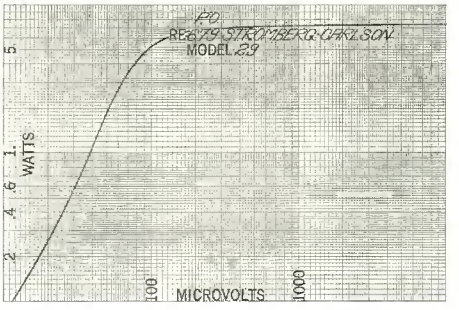
Power transformer primary current was .99 amperes with an impressed line voltage of 118 volts a-c. In all tests, the volume control was adjusted for maximum receiver sensitivity, no changes were made from factory adjustment of tuned circuits, and the tubes employed were those furnished by the manufacturer with the receiver.

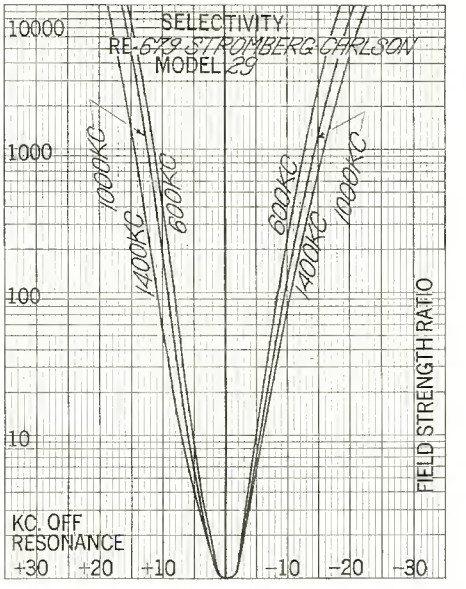
A sensitivity average of the curve of column 1 gives a value of 6.94 microvolts absolute, which is equivalent to 1.73 microvolts per meter when a standard height antenna is used. At 1400 kc occurred the maximum noise level with a value of 19%, while the minimum value was found at 600 kc, namely 10.6%. With the set tuned to 1000 kc, the image ratio was measured as 137,000 times. The power overload curve in column 2 shows the maximum value to come at an input of 10,000 microvolts. It is 7.4 watts. No account is made of the harmonic content of the audio wave form at this high level of output. Under the selectivity curves of column 3 are the band widths in tabular form.

A schematic wiring diagram of this superheterodyne is shown below. From it the required tubes are seen to be, a 235 r-f, 235 first detector, 235 second i-f, 227 oscillator, 227 second detector, 235 audio stage, push-pull 245 power tubes, and a 280 full-wave rectifier. A line filter for the a-c line is made up of two .01 mfd condensers connected across the line with their common point grounded. A tuning meter makes possible exact tuning.



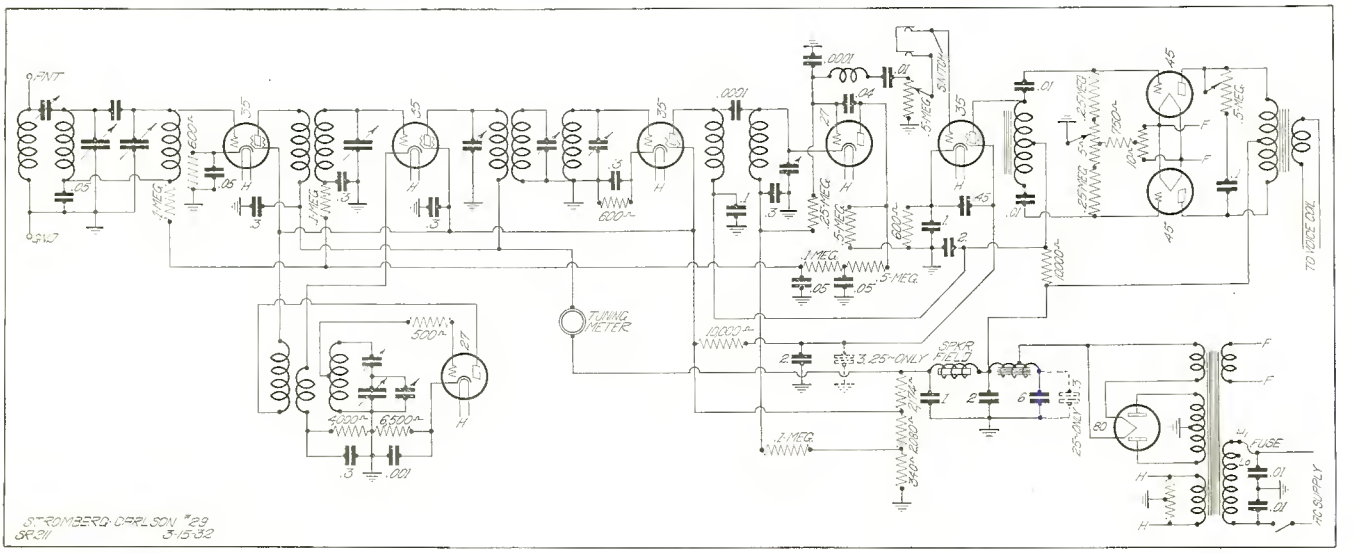






Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	10	11.5	13
100	17	18.5	21.5
1000	24	28	30.5
10000	34	37	41.5



United American Bosch Model 5

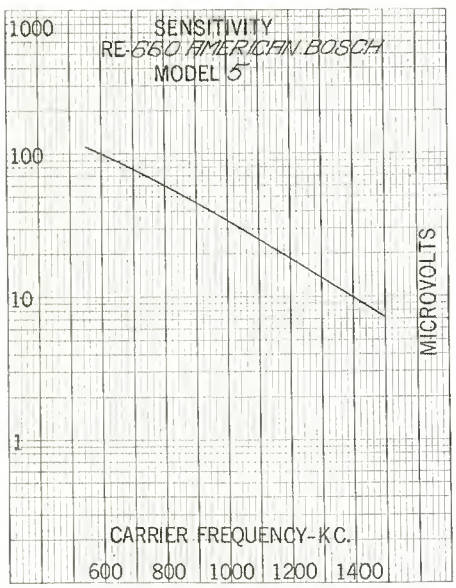
RECENT measurements on the United American Bosch model 5 resulted in the included overall performance curves.

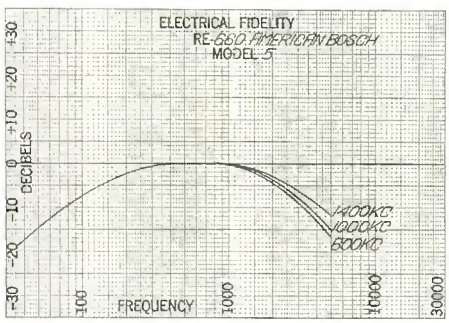
For antenna input, the signal generator was coupled by means of a dummy antenna standard of 20 uh, 200 uuf, and 25 ohms. A non-inductive load resistance of 7000 ohms matched the output impedance of the single pentode employed in the output stage, while the plate circuit was capacitatively coupled to the output measuring tube voltmeter. The voice coil circuit was opened to eliminate any undesirable loading on the primary circuit.

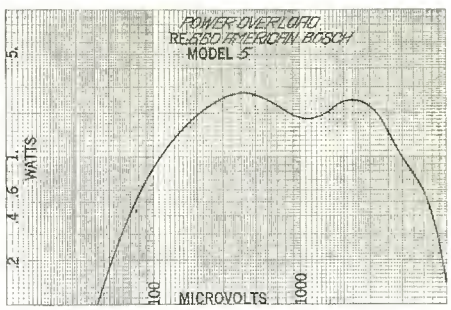
During all tests, the tubes used were those furnished with the chassis, the volume control was turned to its maximum position, and no alterations were made on the adjustment of the circuit trimmers. A line current of .53 amperes was drawn with a line voltage of 115 volts.

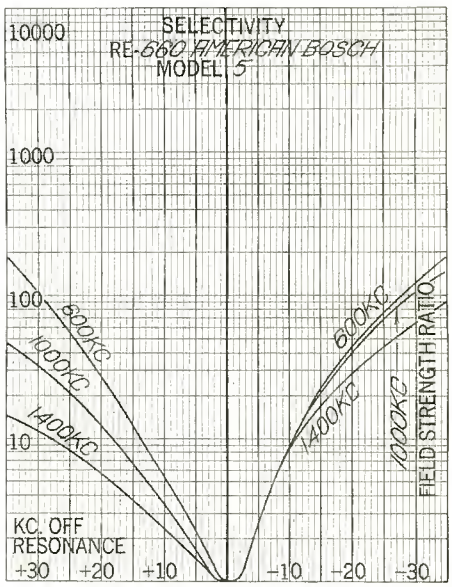
An average sensitivity of 44 microvolts absolute is taken from the curve of column 1. The equivalent in microvolts per meter is therefore 11. A maximum noise level of 3.3% is found at 1400 kc, while at all other frequencies it is negligible, running about .4%. A power output maximum of 2.3 watts is found from the power overload curve of column 2, but this value does not take into consideration the existing harmonics introduced by the amplifier at this power level. Under the selectivity curves in column 3 from which they were taken, are the band widths.

Below is a schematic wiring diagram of the Bosch 5. Required tubes for operation are, a 551 first r-f, 551 second r-f, 224 detector, 247 output power pentode, and a 280 rectifier for complete receiver B supply voltages. The only choke employed in the power supply filter is the field of the dynamic speaker which is connected in the high side of the voltage supply.



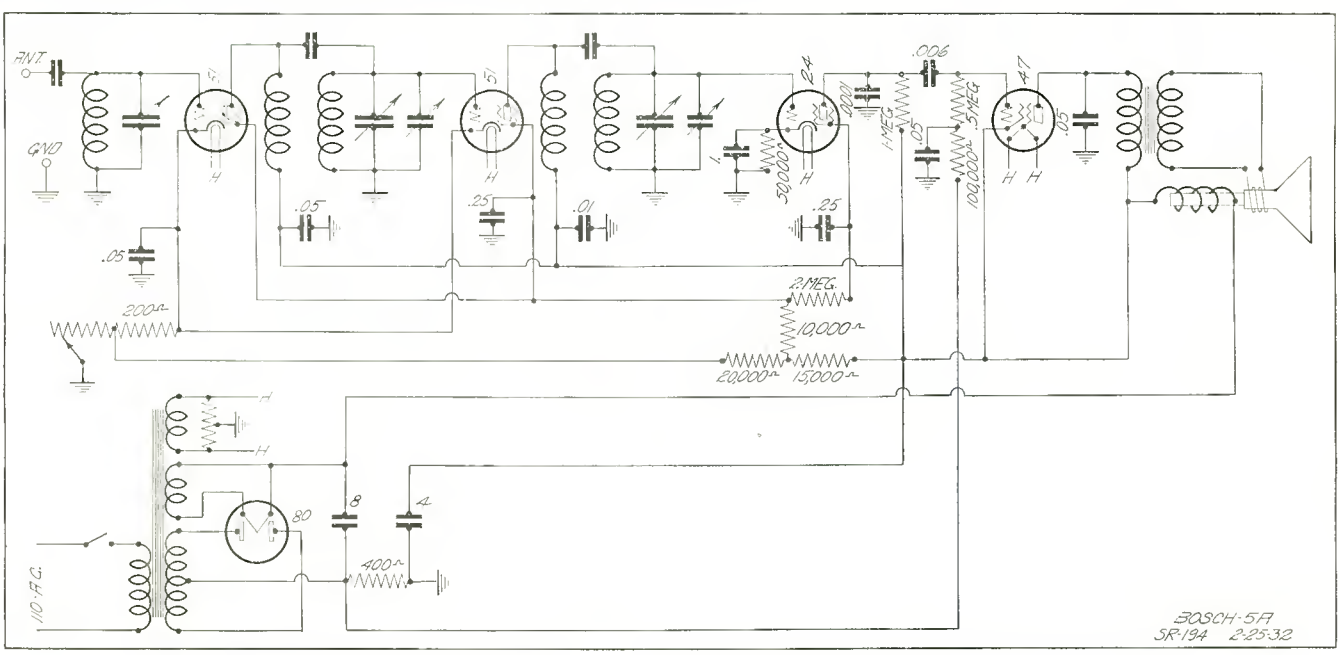






Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	24.5	29	39
100	58	79	..
1000	..	..	..
10000	..	..	..



Power Amplifier Systems

WEBSTER (RACINE) MODEL 6043-R

AT the bottom of this page is the overall response curve of the Webster 6043-R audio power amplifier made by the Webster Electric Company. Measurements were made on it in our laboratory recently.

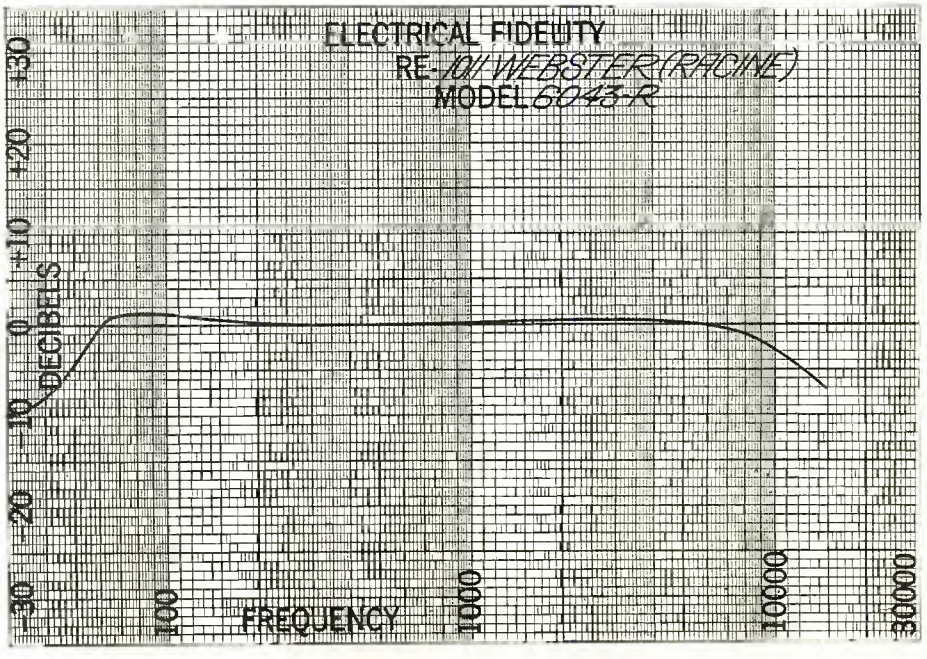
The upper illustration indicates its small size and compactness, and also that all connections are made on a terminal board at one end of the unit. Two pieces of auxiliary equipment may be had in the CB-713 Control Box and the MC-713 Microphone Coupling Unit. Three stages of amplification are used, a 235 first audio, 227 second audio, push-pull 250 power tubes and two 281 half-wave rectifiers, the latter supplying all high voltages and excitation for one 2500 ohm speaker field. When this is not used, the field is replaced by a suitable resistance-reactance unit described as CR-35 to give the necessary filtration of the B supply voltage.

Since a resistance input system is employed in this power amplifier, the source of input is not required to be of any definite type, and can be either high or low impedance in its characteristics. For maximum output, the signal input is required to be .12 volts of audio voltage, but smaller inputs will satisfactorily operate the unit, though not at maximum output. Overall gain is in the neighborhood of 68 decibels for the amplifier alone, and about 85 decibels when a microphone transformer is used preceding it.

Supplementary features are a B voltage supply for a radio tuner and detector unit, but an external filament transformer is necessary since no voltages are supplied for heaters by the amplifier in addition to those for its own tubes. A tap is found on the terminal board for the required voltage supply for a standard two-button carbon type microphone.

An undistorted output of audio power of 15 watts may be had from the output stage of the 250 tubes. Power consumption of the amplifier itself from the a-c line is about 140 watts. Coupling is supplied for 8 ohm and 16 ohm voice coils of dynamic speakers, or any combinations of them to give either or both of these impedance values. The output is sufficient for four or five dynamic speakers or up to twenty-five magnetic speakers, using a suitable matching transformer between them and the amplifier output system.

No volume or tone control is supplied on the amplifier itself, making necessary this auxiliary equipment for proper installation and use. All transformers, chokes and parts mounted on the chassis are covered in two metal cases, the tubes alone being accessible for replacement purposes. A bottom plate prevents any danger from the wiring underneath the chassis. The manufacturer supplies this type of power amplifier for 115 volt, 60 cycle operation, 220 volt, 60 cycle operation, and for 115 volt, 25 cycle operation, the key letters being R, RA, and RZ, respectively.



Service and Repair

SCHEMATICS PUBLISHED TO DATE

Model	*Published*	*Drawing No.*
A. C. Dayton		
Navigator	November, 1929	SR24
Acme Mfg. Co.		
AC7	March, 1929	SR3
AC4	March, 1929	SR4
All-American Mohawk		
Lyric 90	November, 1930	SR74
Lyric 6	March, 1929	SR1
Lyric 8	March, 1929	SR2
Lyric J	October, 1931	SR128
Lyric B-7	December, 1931	SR165
Lyric S-8	January, 1932	SR170
Lyric S-6	April, 1932	SR204
Amrad		
70	November, 1929	SR22
81	March, 1930	SR44
84	January, 1931	SR106
Apex		
48	November, 1930	SR80
31 (U. S. Radio)	January, 1931	SR108
10B (U. S. Radio)	March, 1932	SR191
7-A (U. S. Radio)	April, 1932	SR189
Atwater-Kent		
38	January, 1930	SR28
55, 55C (Cap.)	September, 1930	SR51
55, 55C (Ind.)	September, 1930	SR52
66	March, 1931	SR114
H-2	December, 1931	SR131
Audiola		
Series 31 (t.r.f.)	November, 1930	SR79
Super 31	March, 1931	SR111
Junior	March, 1931	SR112
13-S7	February, 1932	SR181
Balkeit		
A	September, 1929	SR12
Bosch		
48	November, 1930	SR73
58	January, 1931	SR109
60	March, 1931	SR117
28-29	November, 1929	SR21
Auto	November, 1930	SR94
7DC	November, 1931	SR160
31	March, 1932	SR198
20	April, 1932	SR193
Bremer-Tully		
7-70	September, 1929	SR10
81-82	November, 1930	SR75
S81-82	October, 1931	SR126
Brunswick		
3KRO	November, 1929	SR23
15, 22, 32 and 42	November, 1930	SR86
S14	November, 1930	SR71
11, 12, 16	October, 1931	SR148
17, 24	December, 1931	SR164
E	February, 1932	SR183
Colonial		
31AC	January, 1930	SR29
33 and 34 a-e	November, 1930	SR95
47-48	December, 1931	SR160
Crosley		
Roamio	September, 1930	SR67
40S, 41S, 42S, 82S	September, 1930	SR57
608 Gembox	March, 1930	SR41
705 Showbox	March, 1929	SR6
Jewelbox 704B	March, 1929	SR5
77	November, 1930	SR83
53, 54, 57	January, 1931	SR103
120	October, 1931	SR133
121-1	November, 1931	SR149
124	December, 1931	SR150
125	January, 1932	SR174
127	March, 1932	SR187
Dayfan		
5080	September, 1929	SR11
Delco		
Auto Radio	September, 1930	SR66
Edison		
R4, R5, C4	November, 1930	SR49
R6, R7	January, 1931	SR99
Erla		
Duo Concerto R-2	January, 1930	SR33
Eveready		
50	March, 1931	SR50
Fada		
7AC	September, 1929	SR13
35-35Z	November, 1930	SR70
KW28-29	December, 1931	SR158
Federal		
H	November, 1929	SR19
Freed-Eisemann		
NR80	November, 1929	SR20
Freshman		
2-N-12	September, 1929	SR14
General Electric		
H-32	January, 1932	SR166
S-22	January, 1932	SR137
K-62	March, 1932	SR168
General Motors		
A	November, 1930	SR68
120-A	November, 1931	SR116
S3A	November, 1931	SR154
S9A	January, 1932	SR173
S-10A	February, 1932	SR179
Gilfillan Bros.		
100	January, 1930	SR32
Graybar		
600	March, 1930	SR42
Grebe		
7AC	November, 1929	SR17
AH1	November, 1930	SR96
Gulbransen		
Nine-in-Line	March, 1930	SR40
161	March, 1931	SR110
10, 13	February, 1932	SR175
23	March, 1932	SR186
Hammarlund		
Comet	April, 1932	SR200
Howard		
S. G. A.	September, 1930	SR56
Green Diamond 8	September, 1929	SR16
H	October, 1931	SR145
SG-B	November, 1931	SR130
O	December, 1931	SR163
AVII	March, 1932	SR177
DL	April, 1932	SR203
Jesse French, Jr.		
G	March, 1931	SR118
Kellogg		
523-528	November, 1930	SR77
Kennedy		
20	March, 1930	SR48
26	November, 1930	SR81
10	January, 1931	SR38
30-32	November, 1931	SR129
52	February, 1932	SR184
56	March, 1932	SR185

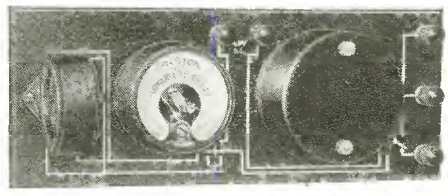
Model	*Published*	*Drawing No.*
King		
J	January, 1930	SR31
Kolster		
K20, K22, K25 and K27	September, 1929	SR8
K21, K23, K24 and K28	March, 1930	SR45
K-43	November, 1930	SR72
K80	November, 1931	SR159
90, 92	February, 1932	SR182
Kylectron		
70	November, 1930	SR65
Majestic		
70	September, 1929	SR7
90B	September, 1930	SR55
130-A	November, 1930	SR84
50	January, 1931	SR98
20	October, 1931	SR124
60	October, 1931	SR138
15	November, 1931	SR157
25	February, 1932	SR178
Philco		
86-82	November, 1929	SR26
95	September, 1930	SR60
90-90A	November, 1931	SR156
112	January, 1932	SR172
70	April, 1932	SR202
Pilot		
148	February, 1932	SR176
Radiette		
F14	January, 1931	SR104
Radiola		
60	January, 1930	SR30
66	September, 1930	SR64
44	January, 1931	SR102
18	October, 1931	SR127
RCA-Victor		
R-7	October, 1931	SR137
R50-55	December, 1931	SR166
R11	January, 1932	SR168
Scott		
31	December, 1931	A-1
Sentinel		
11, 12, 15, 16	March, 1931	SR115
106B	March, 1931	SR113
108A	October, 1931	SR146
108	November, 1931	SR123
111	November, 1931	SR155
Silver		
36A	January, 1931	SR105
30B	September, 1930	SR53
30	January, 1930	SR35
35-A	November, 1930	SR82
782	October, 1931	SR120
726SW	October, 1931	SR144
D-E	November, 1931	SR152
F	December, 1931	SR140
G	January, 1932	SR153
A	February, 1932	SR169
J	April, 1932	SR196
Slagle (Continental)		
9	January, 1930	SR27
R-20	March, 1930	SR46
Sonora		
5R	November, 1929	SR25
Sparton		
AC89	September, 1929	SR9
589	September, 1930	SR63
600, 610, 620	March, 1931	SR91
25-26	December, 1931	SR161
10	February, 1932	SR180
15	March, 1932	SR192
Splitdorf		
E175	January, 1930	SR36
Steinite		
261	September, 1929	SR15
70, 80, 95	November, 1930	SR76
600, 605, 630, 635	November, 1931	SR132
Stewart-Warner		
950	September, 1930	SR62
Series 900	January, 1930	SR34
R100	January, 1931	SR85
102A	October, 1931	SR147
R-102A	March, 1932	SR195
Stromberg-Carlson		
846	September, 1930	SR54
635-636	November, 1929	SR18
12-14	November, 1930	SR93
10-11	November, 1931	SR134
19-20	November, 1931	SR151
22	April, 1932	SR201
Transformer Corp.		
50	November, 1930	SR78
80-81	October, 1931	SR139
Temple		
8-60, 8-80, 8-90	March, 1930	SR37
SG 8-61, 8-81, 8-91	October, 1931	SR125
Transitone		
Auto Radio	November, 1930	SR69
Trav-Ler		
C	March, 1931	SR120
U. S. Radio		
37	March, 1930	SR39
26P	October, 1931	SR143
99A	January, 1932	SR171
Universal Auto Radio		
70	April, 1932	SR205
Victor		
R32, RE45, R52	September, 1930	SR61
R35, R39, RE57	January, 1931	SR101
Wells-Gardner		
50 (Arcadia)	April, 1932	SR199
Westinghouse		
WR-5	November, 1930	SR92
WR-4	January, 1931	SR107
WR10-12	November, 1931	SR137
WR15	January, 1932	SR168
Zaney-Gill		
54	March, 1931	SR119
Zenith		
52, 53, 54, 522, 532 and 542	March, 1930	SR43
71, 72, 73 and 77	November, 1930	SR97
A, B, C, D	November, 1931	SR141
91, 92	March, 1932	SR190

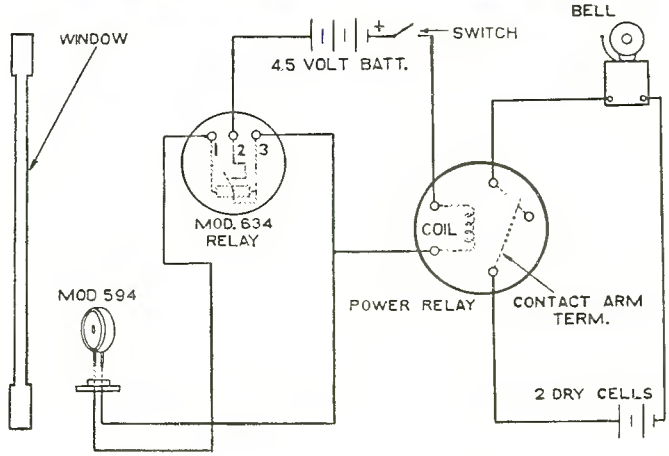
Photronic Cell Experiments

AN alarm which will ring exactly at sunrise on clear days may be easily constructed with the Weston Type 1 Photronic Relay, and provides an interesting and entertaining example of the real usefulness of the Photronic Cell.

Inserted in a UX radio tube socket, the Cell itself should be placed near a window exposed directly to the morning sun unshaded at sunrise by trees or buildings while the relays may be located in any convenient position. The small (plus) prong must be connected to terminal No. 3 of the Miniature Relay and the larger prong goes to terminal No. 1. Studs 2 and 3 should be connected to the coil of the Power Relay in series with a 4½ volt radio "C" battery, as shown in the diagram. All Power Relay terminals can be reached by unscrewing the fiber disc underneath them, and if there is any doubt as to which are

(*Continued on page* 31)





C BIAS ELIMINATION

By Robert M. Ellis

TO the experimenter, who demands the finest in audio amplifying equipment, the idea of using a separate C bias supply will have a strong appeal. A C bias eliminator will remove all tendency toward audio degeneration in the output stage. With high grade audio coupling units, amplification to the lower limits of audibility can easily be secured which will be an absolute revelation to the listener. Of course, to secure such reproduction a high grade dynamic speaker must be used, and this must be mounted in a sufficiently large baffle so that the low frequency amplification secured can be reproduced. There would be little justification, for instance, in using such a system where the receiver is mounted in a midget or consolette cabinet and the baffling area of the speaker is so small that tones lower than 100 cycles cannot be reproduced. The following parts are required:

2 replacement type audio transformers.

1 10,000 ohm potentiometer.

2 1 mfd. 200 volt paper filter condensers.

1 UY type socket.

1 '27 tube. A discarded low emission tube may be used since the load is very light. The tube used in the bias eliminator will last practically indefinitely.

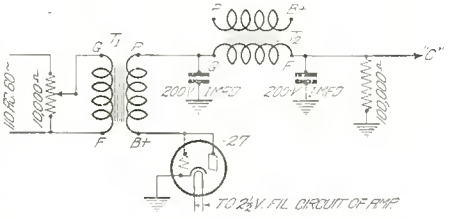
Connections are shown in the diagram. One replacement transformer is used as a power transformer, while the secondary of the second is used as a filter choke. The value of the applied bias is governed by the adjustment of the 10,000 ohm potentiometer. This control is placed in the 110 volt circuit as by so doing no load is placed on the delicate windings of the audio transformer. The windings, however, are amply heavy to carry the minute amount of current required for bias. The only time when any appreciable load is placed on the transformer is in charging the filter condensers (C1 and C2) when the power pack is first turned on and this is only momentary.

It will be noted that the first transformer is connected backwards—that is, the secondary to the 110 volt source and the primary to the load, to give a step down effect. If a transformer having a 3:1 ratio is used the secondary voltage may be varied from a maximum of 110/3 or 36⅔ volts to zero. If a transformer having a ratio of 4:1 is used the voltage may be varied from 110/4 or 27½ volts to zero.

A.C. voltages are measured by the R.M.S. value. The D.C. voltage output of the rectifier will be practically the peak voltage of the power source and will be approximately 1.4 the A.C. voltage since as previously stated the rectifier operates practically under an unloaded condition. The unloaded condition is responsible for the entirely hum-free operation of the unit.

Adjustment of C Bias

Because any load placed on the output of the rectifier will cause the voltage to drop it is impractical to directly measure the bias, even with a high resistance voltmeter, because of power drawn by that instrument. The method used by the writer is to insert a 0-100 range milliameter in the plate lead to the power tube and adjust the potentiometer so that the plate current will agree with the tube manufacturers specifications for the plate voltage employed.



The installation of a C bias eliminator in an existing power pack will boost the plate voltage, and give increased undistorted output, since part of the plate voltage is no longer diverted for bias. In the event that the plate voltage exceeds the recommended maximum for the tube, danger of shortening the tube life can be eliminated by increasing the bias to the point where the plate current does not exceed the value given for maximum rated voltage.

In a push-pull circuit the tubes may be considerably over-biased, with a corresponding increase in tube life. Any tendency toward distortion from rectification will be eliminated by the characteristics of the push-pull system. For extremely high outputs the C bias may approach the cut-off point of the power tubes, for class "B" audio amplification.

Majestic 175kc Oscillator Instructions:

The i-f transformer shown in the circuit diagram, suitable for 175 kc operation, may be purchased from Grigsby-Grunow through the local distributor.

Operation:

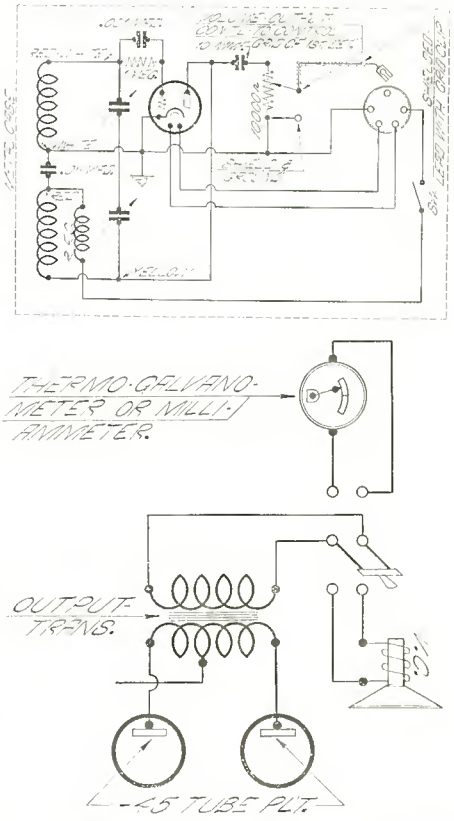
1. Insert 227 plug in oscillator socket.

2. Place 227 oscillator tube taken from chassis in the 175 kc oscillator socket.

3. Set output meter switch to "Speaker" position.

4. After tube warms up, close circuit switch.

5. Adjust volume output control to give a scale reading on the output meter.



6. Align i-f stage in chassis to resonance, which occurs with maximum reading on the output meter.

Note:

Oscillator should be checked before using by plugging in on a standard chassis known to be operative, and adjust aligning screw on the 175 kc oscillator to resonance with the i-f stage of the standard chassis to insure proper oscillator frequency.

Photronic Cell Experiments

(*Continued from page* 30)

which, the Relay may be opened by removing the round black cover, and the connections then traced out. One side of the alarm circuit goes to the Power Relay arm and to the contact point which is closed when the coil is energized. If an ordinary door bell is used, a couple of dry cells will serve for power.

Adjustment of the Miniature Relay should be made at some time in the fairly early morning when the sun is still shining in the window selected. With the light full on the Photronic Cell, the screw in the face of the Miniature Relay should be turned to the

(*Continued on page* 35)

Capacity Decade Box

MANY times, the need for a variable capacity of large value is keenly felt by the experimenter and the service man. With the aim of utmost utility in mind, the author built the instrument described in this article. The effective range is from .05 microfarads to 8.0 microfarads in the steps given in the right-hand column of the schematic layout at the bottom of the page. These steps may be altered by the builder if he feels that other combinations will be of greater value to him in his work.

Uses of Instrument

Need for a capacity decade box, similar to the familiar resistance decade box, is found in any and all power supply filter work, location and elimination of hum, tuning audio chokes, determining the value of bypass and filter capacitors, etc. The usefulness becomes apparent when the builder has such an instrument in his possession. It may also be used for determining open bypass condensers in a receiver, allowing checks with the specified value of condenser without having a dozen different values on hand, scattered all over the work bench.

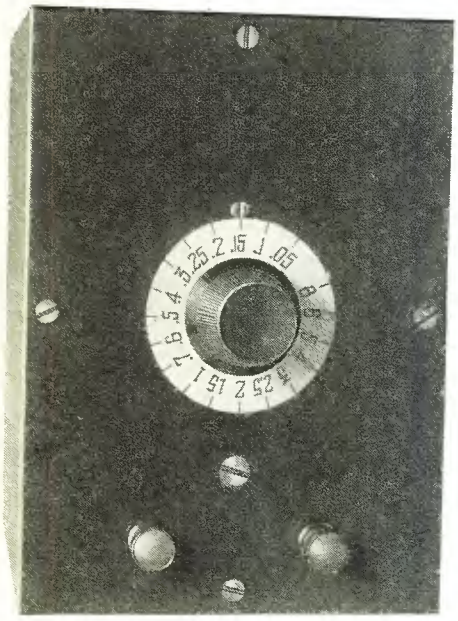


Figure 1

Constructional Details

Aerovox condensers of at least 600 volts d-c rating were used in the building. In the legend at the bottom of the diagram are the required capacity values. It will be noted in the circuit layout that some seem to be duplicated, but this is not the case. Only one condenser is denoted by a single letter, but for clarity in wiring, some are repeated. In designing any piece of apparatus in which a part is used in more than one position, care must be exercised that it is not permanently connected in the circuit through one of the connections. For more combinations, either the number of switch arms or the number of condensers must be increased.

The switch shown in part in figure 2 was built up with four independent arms and nineteen switch points for each arm. Outside of the tediousness of inserting and connecting so many points (some are blank as seen on the diagram), no difficulty should be experienced. They are mounted on a circular piece of bakelite between 4½ and 5 inches in diameter. The contact arms are of spring brass so that the desired electrical contact will always be well made. Stops are mounted at the ends of the arc to limit the revolution of the dial.

Figure 1 shows the external appearance of the unit, with the two binding posts for circuit connections, and the small dial upon which are the capacity values for each of the nineteen settings. If precision work is to be done with this instrument, the condensers employed must be accurate in value. Either they may be picked from a quantity and measured, or, at greater expense, they may be purchased with tolerances which are far better than the ordinary production runs.

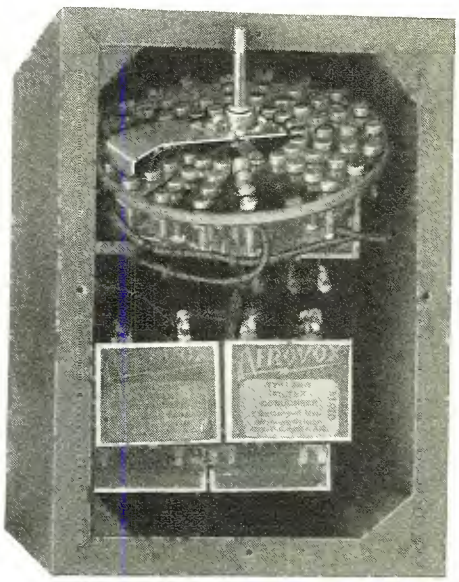
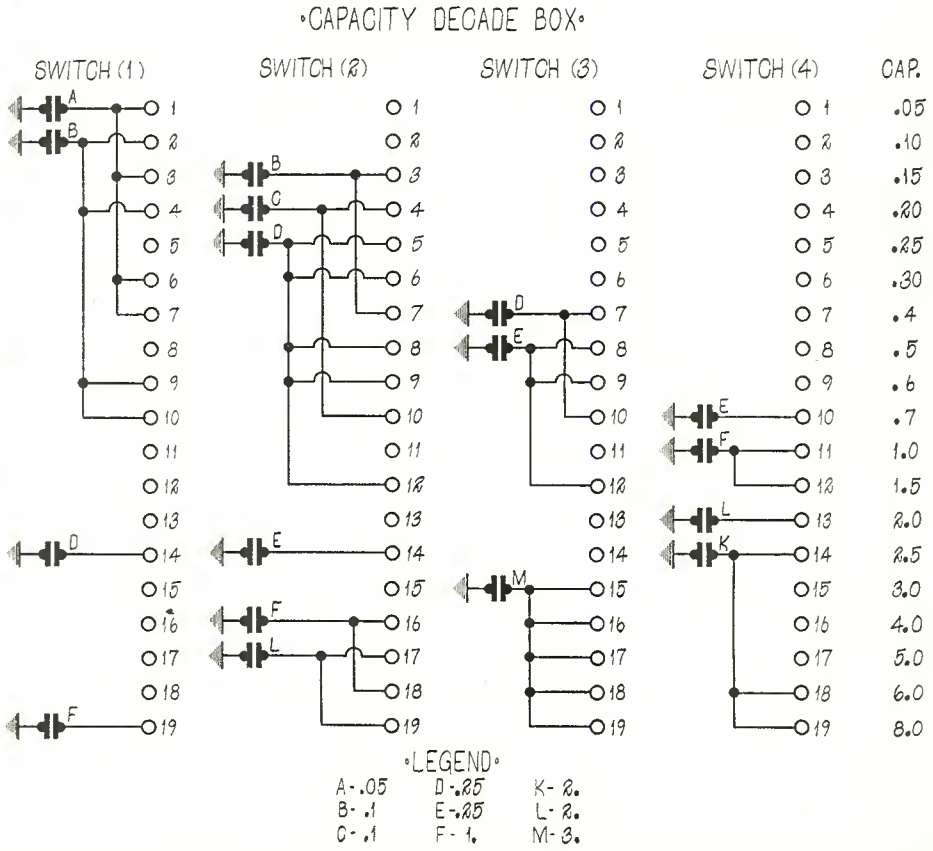


Figure 2

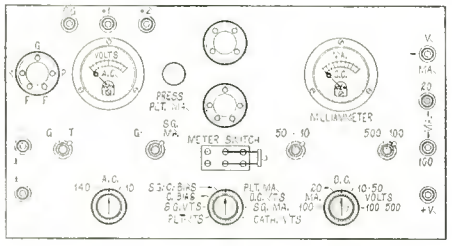
The panel measures approximately 5 x 7 inches and the box is about 6 inches in height.



Set Tester

WE present on this page the set tester which was promised our readers some time ago. Space prevented us from giving it before this issue. The three illustrations give clearly all of the constructional details as well as the schematic wiring diagram. The author submitted the following details as to operation:

Tube, when taken from the receiver is plaeed in the proper soeket of the tester, and the eable plug is inserted in the tester and reeeiver sockets, using the Control Grid Tip Jack when testing sereen-grid tubes.



Read A-C Volts—Adjust sw2 to 10 and read a-e meter. In this test a special plug is useful, made with two leads with phone tips soldered to them for house line voltage tests, using the tip jaeks at the left of the meter, putting sw2 to 140.

Read Plate Volts—Set sw1 to plate volts as marked. Also sw6 or sw7 to proper voltage indieation. Set sw3 to proper volts and read. In reference to the double seales of the 20-100 milliameter readings, the voltages are read as follows: all 10 volts or less on 20 seale divided by 2; all 500 volts or less on 100 seale multiplied by 5; all 100 volts or less on 20 scale multiplied by 5.

Read Plate Ma—After plate voltage reading turn sw1 to Plate Ma and sw3 to 20 or 100 Ma as neeessary. Press sw8 for direet reading on scale selceted.

Emission Test—Swing sw4 to T while pressing sw8 and take Ma reading. In this referenee, new tubes ean be tested and notes made for comparisons.

Read Screen Volts—Same method as for plate volts exeept that sw1 is set to SG volts.

Read Screen Current—Same method as for plate ma exeept that sw8 is not nsed, and sw5 is turned to SG ma.

Read Bias—Set sw1, sw3, sw6 or sw7 to proper position and read meter.

Read D-C Filament Volts—Set sw1, sw3, and sw6 to proper plaee and read.

Read SG Control Grid Volts—Lead from eap of tube in tester is inserted in Tip Jaek 1. Set sw1, sw3 and sw6 to proper position and read meter.

Emission Test for SG Tubes—After plate ma reading remove lead from Tip Jaek 1 and insert this lead in Tip Jaek 2 while pressing sw8 and read.

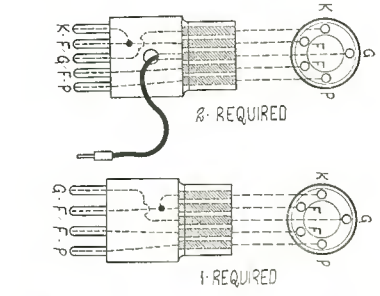
Read Cathode Volts—Set sw1, sw3, sw6 or sw7 to proper position and read.

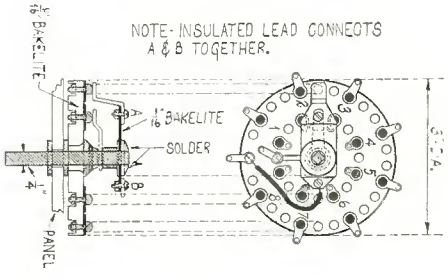
Test Rectifiers—Separate plates ean be tested by applying plate and sereen grid voltage methods alternately.

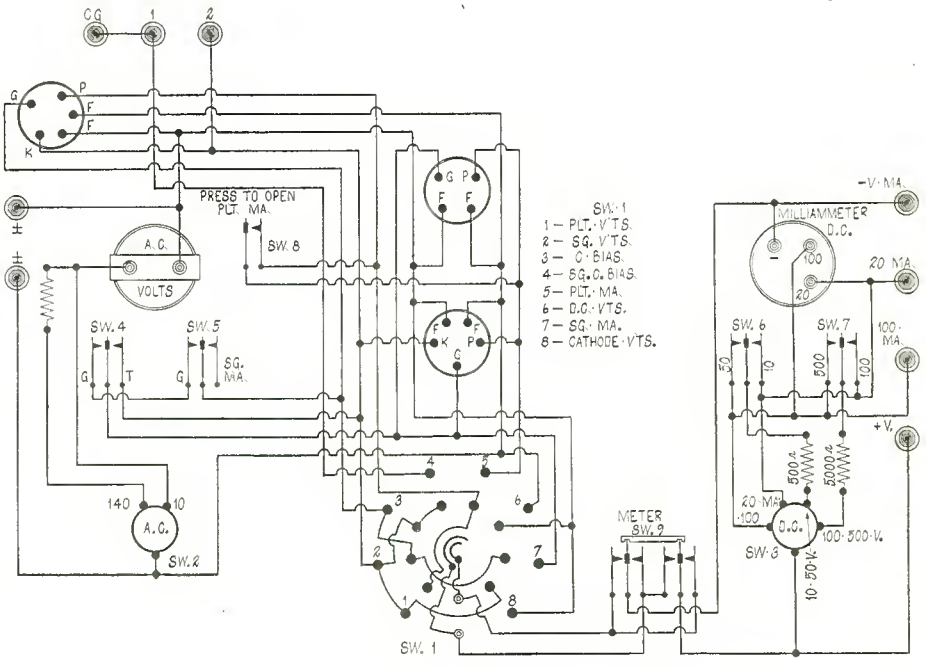
Test Pentodes—By use of the two pentode adapters at the tester, one for the input and the other for the tube, all tests are made similar to those for the sereen grid tube. The wire extending from the side of the adapters is inserted in the tip jaeks, while that from the input adapter is inserted in the Tip Jaek CG. Also the one from the tube adapter is put in Tip Jaek 1.

Switch 9 is a double-pole, double-throw type for reversing the meter when sueh is required. After eaeh reading, all switehes should be turned to their off positions.

For eable, about four feet of six wire eable was nsed. The adapters and plugs were made up from old sockets and old tube bases. The end of the eable to be inserted in the reeeiver was eonneeted to a plug with five pins, the sixth wire being fastened to the side of the plug to make eontrol grid eonneetion at the reeeiver while at the tester end of the eable the sixth wire extended from the side of the plug with a phone tip soldered to it for the Tip Jaek CG. One 5 to 4 adapter and two pentode adapters will be neeessary, the eonstruetional details of whieh are given in the illustrations.







Signal Generator for Service Men

A WELL equipped service department should have some means for checking the sensitivity of receivers. This is not only necessary for determining whether a particular set is healthy, but is also useful in determining the relative merits of different makes of sets.

Standard Signal Generators are too expensive for the average service department to buy and are altogether too complicated to build if they were to be constructed along ordinary lines.

However, a new type of signal generator is finding its way into use that is so simple and yet so accurate that most laboratories are using it for a primary standard to check all other such devices, and it can be built by any service man.

It is called a "Second Harmonic Signal Generator." It makes use of the fact that in an average vacuum tube the magnitude of the second harmonic current developed in the plate circuit when a fundamental a-c. voltage is applied in the grid circuit is equal to the increase in the d-c. plate current. In other words, if sufficient 500 kc. signal from any source is applied to the grid of a properly biased 236 tube, it will cause the plate current to increase. This increase can be measured with a micrometer and is exactly equal to peak value of the 1000 kc. current flowing in the plate circuit. Then if this plate current is passed through a one ohm resistance, the number of microamperes increase in d-c. plate current is an exact indication of the number of microvolts (peak) of 1000 kc. signal across the resistance. If the resistance is 1.41 ohms, the micrometer will indicate R.M.S. volts directly.

Of course, there will also be a strong 500 kc. signal across the resistor, but this is of no consequence when making receiver sensitivity measurements. The inherent selectivity of any set is sufficient to cut out a signal with a two to one difference in frequency even though it is several hundred times as strong as the desired signal.

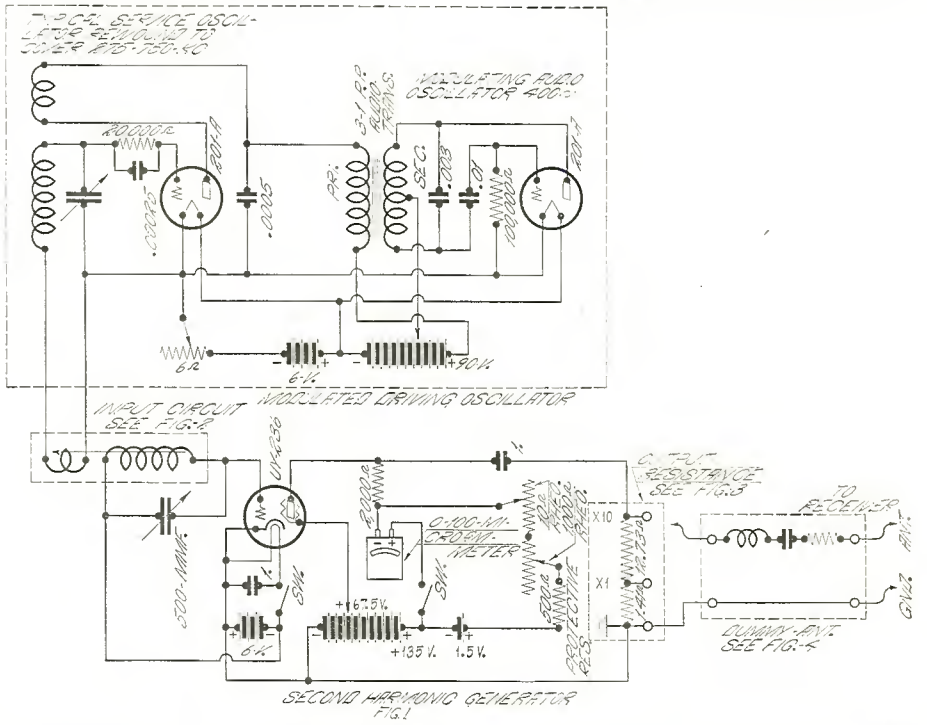
One advantage of this device is that there cannot be any leakage error. This is always a factor when working with low outputs on standard signal generators. With this system, there is no signal voltage generated except at the point where it is being used and therefore there cannot be any leakage from other parts of the circuit. It is not necessary to shield the generator tube or its circuit parts, although it is best to have the driving oscillator and its batteries completely inclosed in a metal box.

Most any service oscillator will do for this purpose if the coil of its tank circuit is rewound to cover a band of from 275 to 750 kc. If it originally tuned from 550 to 1500 kc., rewind it with wire of just half the diameter so that there are twice as many turns in the same space. This will give the coil exactly four times its original inductance and the frequency at any dial setting will be just half of its former value.

The tank circuit of the oscillator is opened near the cathode or filament connection to the tube and a pair of twisted wires led off to make connections with the coupling coil which feeds energy into the generator tube grid circuit. (See Fig. 1.) If the tube draws more than two or three milliamperes when oscillating, the grid resistor value should be increased or a C battery inserted in the grid return.

The oscillator must be modulated by inserting an a-c. voltage in series with its B battery. This should be at approximately 400 cycles and can be obtained by connecting the secondaries of a 3-1 pushpull audio transformer as a Hartley oscillator in the grid and plate circuits of another tube as shown in the diagram. The modulating voltage is obtained across the primary. The B battery of the audio oscillator should be adjusted until a high resistance output meter shows 9.5 volts across the primary when both tubes are operating. Then if the B voltage of the r.f. oscillator is 90 volts, it will be modulated 15% and the second harmonic developed across the resistor in the plate of the generator tube will be modulated 30%.

The only piece of apparatus required that will not be found in the average service department is the 0-100 micrometer. This should be of a type that can be read accurately to one microampere so that receivers with a sensitivity of one microvolt can be measured.



There are only two parts of the generator circuit that will require any particular thought in construction. These are the input coupling coil and the output resistance.

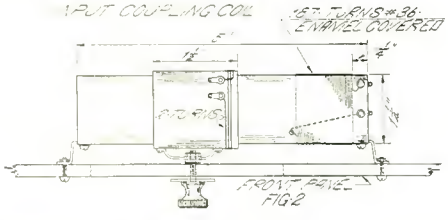
The input coil (see Fig. 2) is wound on a 1¼ in. tube, 5 in. long. It consists of 187 turns of No. 36 enameled wire. The winding should be started ¼ in. from one end and will cover about 1 1/16 in. The small coupling coil consists of 2 turns of No. 30 enameled wire wound at one end of a 1½ in. length of tube of the proper inside diameter so that it will slide easily over the unused portion of the 1¼ in. tube. It will probably be necessary to turn down a wooden mandrel 1 5/16 in. in diameter and make this tube out of several layers of gummed paper tape. After such a tube has dried for several hours, it should be soaked in a bath of melted beeswax and rosin at 300 degrees F. until it stops foam-

(Continued on next page)

(*Continued from page* 34)

ing. Mounting supports are fastened to each end of the long coil and a bracket is riveted to the short coil so that it can be slid along the 1¼ in. tube by means of a knob which extends through a slot in the front panel.

The output resistor is the most critical part of the circuit. It must be as near non-inductive as possible and its r.f. resistance must be exactly equal to its d-c. resistance. Otherwise, the accuracy of the whole devise is spoiled. The resistor is made in two parts (see Fig. 3). The small part has a resistance of 1.41 ohms and the other part 12.73 ohms. The wire is .003 in. Nichrome or Chromel which has a resistance of about 73 ohms per foot. The base is made of ⅜ in. bakelite. The clamps are made of 3/32 in. brass with the corners well smoothed down to prevent cutting the wire.

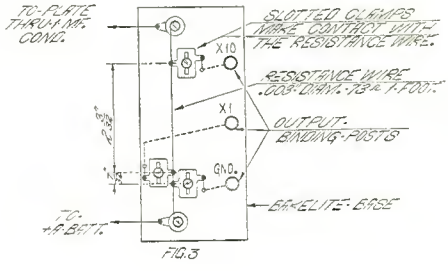


It is best to use an accurate resistance bridge when setting the clamps but if this is impossible they may be adjusted for the proper resistance by the voltmeter-ammeter method. Pass exactly .3 amperes through the entire wire by placing an eight volt battery, a 0-1 or 0-.5 ammeter and a 10 ohm rheostat in series with it. Screw down the clamp which connects to the GND binding post and connect an accurate low reading high resistance voltmeter between the posts marked GND and X7. Adjust the middle clamp until the voltmeter reads .42 volts. Next connect the voltmeter between the GND and X10 posts and adjust the top clamp until the reading is 4.23 volts. Be sure the clamps are secure but not tight enough to damage the wire.

The rest of the circuit is exceedingly simple. The six volt heater battery for the 236 tube also supplies the grid bias. Four dry cells are probably more satisfactory than a storage battery for the ordinary amount of use that such a piece of equipment receives. The "B" battery drain is exceedingly light so the smallest type of batteries is all that will be needed. The 10 ohm and 1000 ohm rheostats are for adjusting the bucking current through the micrometer. The small rheostat acts as a vernier for the larger one. The 1½ volt bucking battery is a single dry cell. The switch in the micrometer circuit is provided so that when the generator is not in use this circuit can be opened to stop the flow of current backward through the micrometer.

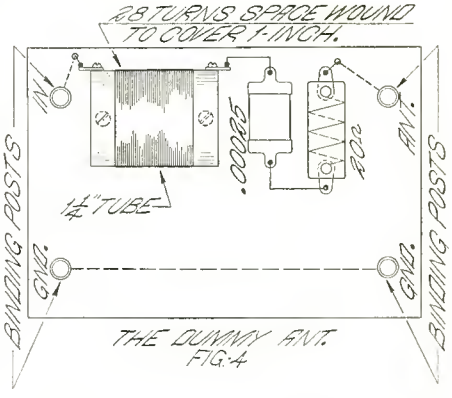
There are two accessories required for use with the signal generator. These are the dummy antenna and the output meter. The output meter should be purchased and must be calibrated in such a manner that it will indicate when 50 milliwatts are being delivered in the output circuit. If it includes a load resistor, this should be variable in order to operate with the different types of output circuits and tubes in different sets.

The dummy antenna can easily be made. It consists of inductance capacity and resistance in series. (See Fig. 4.) The inductance is made by space winding 28 turns of No. 30 wire on a 1¼ in. tube so that it covers approximately 1 in. The capacity is a .00025 mfd. fixed mica condenser, and the resistance is 3¼ in. of the same resistance wire as used to make the output resistor. In use, the dummy antenna is connected between the aerial binding post of the receiver under test and either of the output terminals of the signal generator. The ground terminal of the output resistor is connected to the ground terminal of the set.



Operation

After the whole assembly has been properly mounted and all connections made, the operation is as follows. Close both the A battery and the micrometer circuit switches and when the tube has come up to heat adjust the bucking battery rheostats until the micrometer reads zero current. It may be necessary to try two or three different tubes in order to find one which holds its zero adjustment well. In case it is impossible to bring the reading to zero, it will be necessary to change the value of the protective resistance either one way or the other. Next turn on the modulated oscillator and adjust it to the proper frequency. This will be just half of whatever frequency is to be delivered by the generator tube. Move the sliding coil to about ¾ in. from the stationary winding and tune the input of the generator tube until the micrometer shows maximum deflection. Then the sliding coil can be moved until the output meter on the receiver under test indicates fifty milliwatts. If the dummy antenna is connected across the whole resistance, the reading of the micrometer must be multiplied by 10 to give the output of the generator or the receiver sensitivity, but if it is connected across the 1.41 ohm portion only, the micrometer will indicate microvolts sensitivity directly.



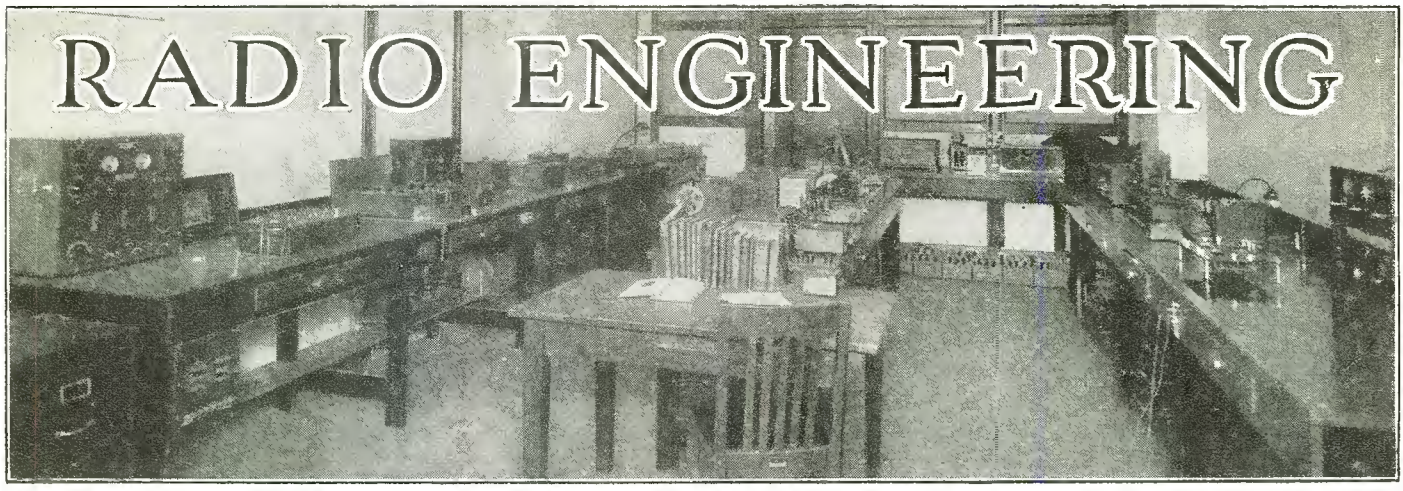
The output range is from 1 to 1000 microvolts, which is sufficient to measure the sensitivity of most any receiver. The only precautions in using this device are to be sure that the receiver under test is tuned to twice the frequency of the modulated oscillator which drives the generator, and that the input circuit of the generator tube is tuned exactly to the oscillator. This last precaution is neeessary in order to filter out whatever second harmonic is produced in the oscillator tube itself.

Photronic Cell Experiments

(*Continued from page* 31)

right until the little arm makes firm contact with the point. If connections have been made correctly the bell will ring. When the hand or some other object is placed in front of the Cell, the contact should open and silence the bell. If the results are not perfect after the first trial, further adjustment should be made until satisfactory operation has been obtained. A distinct click from the Power Relay indicates that all of the connections from the Cell to the coil are correct. If this click is heard and the bell fails to ring, the fault lies somewhere between the Power Relay output and the bell itself. For shutting off the apparatus when not in use a switch may be provided in the "C" battery circuit or else a box or hood may be placed over the Photronic Cell to exclude the light.

After sunset, the device should be placed in readiness with the Cell at the window facing East, and in the morning, when the first rays of the sun appear, the alarm will ring and will continue until it is shut off by hand.



Filter Design by Graphs

PART I'

AS a matter of fact, this situation calls attention to a very important property of the graph. Suppose we have a series inductance capacity combination, and we wish to find its reactance at some frequency other than the frequency of resonance. We follow the line representing the frequency level in which we are interested to the points where it crosses the particular inductance and capacity lines involved, and note the reactance level of each crossing. Then we have only to subtract the lower reactance level from the higher one to obtain the expression for reactance.

Let us assume that we have an inductance of 300 millihenrys in series with a capacity of .04Mfd. and we want to know the total reactance at 2,000 cycles. For one thing, we see immediately that the frequency of resonance of this combination is approximately 1,440 cycles, because it is at this frequency level that the line marked .04Mfd. crosses the 300Mh. line. However, we are at present interested in reactance at 2,000 cycles, so we go to that level and up to where it crosses the .04Mfd. line. This is at a reactance level of nearly 2,000 ohms. If we continue upward to where the 2,000-cycle level crosses the 300Mh. line we are at a point on the reactance level of 3,770 ohms. Subtracting the 2,000 ohms just mentioned from 3,770 ohms, we have 1,770 ohms, the total reactance. The highest reactance (3,770 ohms) was inductive, and thus we say that the 1,770 ohms has an inductive reactance predominance. This is mentioned because the reactance of this same coil-condenser combination at 1,060 cycles is also 3,770 minus 2,000 or 1,700 ohms, the difference

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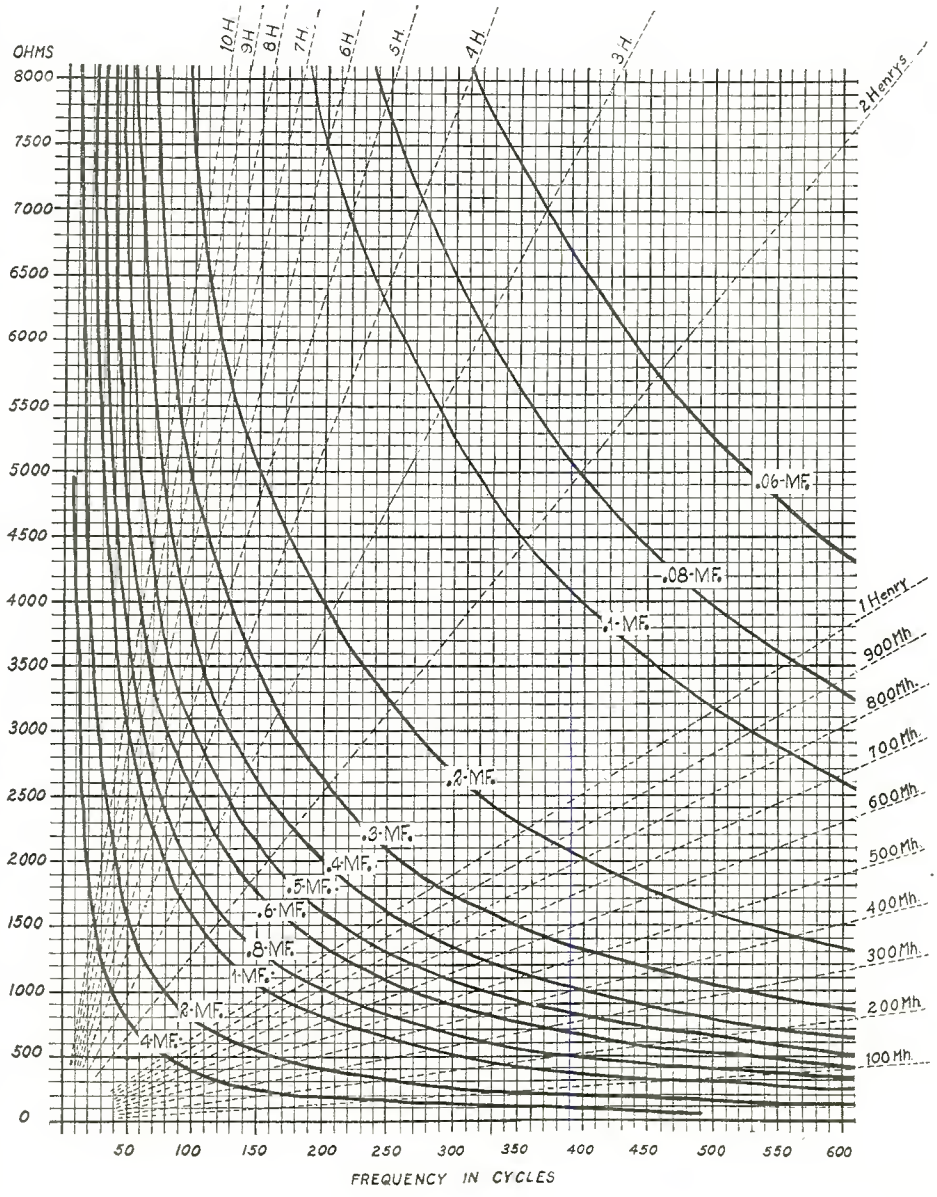


Figure 3.

(Continued from page 36)

being that at 1,060 cycles capacity reactance predominates. For any combination on the graph it is safe to say that reactanee differences measured on the left side of the resonance intersection are capacity reactances, while those on the right are predominantly inductive reactances.

So far we have only considered series connections of eoil and eondenser, and the resonance thereby effected. Had conneetions been made in parallel as in Figure 2b, the frequency which would have been the resonant frequency in a series connection is now the anti-resonant frequency. Whereas the reactance of a series connection would have been zero at this frequency, it becomes infinity (infinitely large) with a parallel connection. Perhaps we might wish to know what the total reactanee (between A and B in Figure 2b) would be, at any given frequency, for the parallel arrangement. Unfortunately the writer is unable to offer any suggestion of how this may be read directly from the graph, but the answer may be obtained quite speedily by using the graph in conjunction with a simple arithmetical operation.

It is first necessary to obtain from the graph the reactance which the combination would have had if the units were connected in series. Then we must note the rating of the inductance in henrys and the value of the capacity in *farads*. If we denote the inductance by L (as is the eommon practice) and the capacity by C, and finally refer to the parallel reactance as X_p, and the reactanee which the combination would have had at this frequency if it were in series as X_s, then

$$X_p = \frac{\frac{L}{C}}{X_s}$$

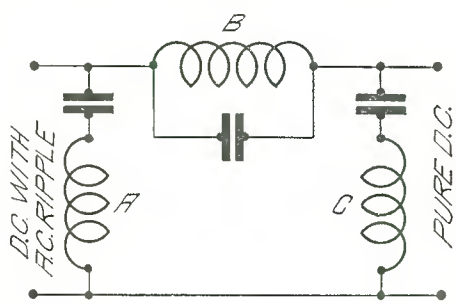
Of course most of us would much prefer to express the value of the capacity in microfarads. Since there are 1,000,000 microfarads to one farad, we need only to multiply the above formula by 1,000,000 to get

$$X_p = \frac{1{,}000{,}000 - \frac{L}{C}}{X_s}$$

where c is the capacity in microfarads.

In Figure 3 we have a graph which may, at first, seem identical with Figure 1. It has a lower frequeney range, however, and is presented for the benefit of those who may be interested in designing low frequency filters for the suppression of "power hum," ete. In principle it is quite the same as Figure 1, and consequently needs very little further description. However, by way of summary, and also to give additional facility in the use of the graph, let us assume that we need to design a filter for the suppression of power hum from a 60-cycle full wave rectifier.

Figure 4 is a suggestion of the possible arrangement of the reaetance units. Since we are dealing with a 60-cycle souree of power, we shall probably find that the most serious power ripple is either at 60 eyeles or its first harmonic, 120 eyeles. Of the two, the latter is frequently the most distressing, since it is a high enough frequency to be distinctly audible, and is present in many rectifiers to a very large degree. If, in Figure 4, we were to choose the units of the series combinations A and C so that their frequency of resonance was 60 eyeles, it would produce the desired effect of



shunting out the 60-cycle ripple before it eould reaeh the pure D.C. terminals. Then, if we made the anti-resonant circuit B anti-resonant at 120 eyeles, it would effectively bar the passage of this frequency by reason of its infinitely high reactance.

Turning to Figure 3 and reading upward along the 60-cycle line we find that the 2 Henry line erosses the 4Mfd. at 56 cycles, also that the 7 and 8 Henry lines cross the 1Mfd. and .8Mfd. lines, respectively, at 60 eyeles. Of these combinations, it would probably be best to ehoose the first, in spite of the fact that its resonant frequency is 56 instead of 60 cycles. One reason for this choice is that it is easier to obtain these rated values of inductance and eapacity than the others. Another mueh more important reason is that we should like, as far as possible, to shunt out 120 cycles through A and C, and the graph shows that at 120 cycles the reactance of the first combination is only 1,505 minus 318, or 1,187 ohms, whereas, with the combination of 7 Henrys and 1Mfd., for instance, the reactance at 120 eyeles would be 5,300 minus 1,320, or 3,980 ohms.

In eonstructing the anti-resonant circuit B, we follow the 120-cycle line and find that it marks the crossing of the 2Mfd. line with 900 millihenrys. If this combination were put in series, its reactance at 120 cyeles would be zero, but since we put it in parallel, its reactance is theoretically infinite. It is to be hoped that it also offers a high reactance at 60 cycles. Let us see if it does.

Here we need to reeall our little formula for the reactance of an anti-resonant circuit, namely,

$$X_p = \frac{1{,}000{,}000 - \frac{L}{C}}{X_s}$$

First desiring to find X_s, we look at the 60-cycle line and find that the total reaetanec of the series combination of 900 millihenrys with 2 microfarads is 1,300 minus 340, or 960 ohms. This is the value of X_s. Now, the value of L is 900 millihenrys or .9 Henrys, and the value of c is 2 microfarads, so the ratio $\frac{L}{c}$ is $\frac{.9}{2}$ or .45. Forty-five hundredths of one million is 450,000, and, if we divide 450,000 by X_s, that is, 960 (ohms), we obtain the desired reactance figure, 468.7 ohms.

In the light of the figures we have just compiled, we are enabled to estimate the effectiveness of the filter we have designed. In Figure 4, the series combination A and C are now each made up of a 4 microfarad condenser and a 2 Henry choke coil. In the anti-resonant circuit B, we have a 2 microfarad condenser and 900 millihenrys inductance. If a 120-cycle ripple started through the system, it must immediately take the choiee of passing through A (which we found had a reactance of 1,187 ohms at 120 cycles), or through B, which has infinite reactance. If we rate the reactance of B more conservatively, say at 1,000,000 ohms, the 120-cycle current still has nearly 900 times the chanee of shunting itself out through the much lower reactance A. If we consider a 60-cycle current at the same point, we find that the reactance of A is 90 ohms, while the reactance of B was given 468.7 ohms. Here the 60-cycle current has more than five times as much opportunity to shunt itself out through A as to pass through B. And, finally, if small currents of either frequency do manage to pass through B, we still have the shunt circuit C to operate on them.

If it is possible that this presentation of certain aspects of resonance by graphical means has been valuable, or even interesting, to the reader, he may regret that the limits were not extended to radio frequency. This might very well have been done, howbeit with a certain sacrifice of accuracy, since the very thickness of a line might represent hundreds of cycles, or ohms, as the case may be. Any reader who desires to modify the graph to fit the

(Continued on page 40)

Speech Input Equipment

(*Continued from page* 17)

source and the load when incorporated in the circuit shown, and this relationship holds regardless of the volume control setting. Each volume control is associated with a cam switch which can be thrown to either of two input circuits or "OFF." The input circuits may lead to a number of microphones which can be operated simultaneously in any desired proportion, or alternative sources can be thrown in and out of circuit with previously determined correct settings on the individual pickup channels. The provision of the master control makes it possible to compensate for unwanted changes in the combined output level without disturbing the adjustments of the individual channel controls. Fading between two channels is easily accomplished by reducing volume on one channel and simultaneously increasing volume on another. Mixing circuits of this type are in use in practically all broadcast control rooms, and in public address and other sound systems as well. Figures 4 and 5 are front and back-of-panel views of such a mixing panel.

Still another type of input control panel is illustrated in Fig. 6. With the mixing panel described above, it is evident that the volume controls must be set to reduce the outputs of all sources to approximately the level of the "weakest." The amount of gain required of the main amplifier (the studio or line amplifier in broadcast work) is thus determined by the "weak" source. The input control panel of Fig. 6 is fundamentally a two-channel mixer without master control in which a self-contained single-stage amplifier has been introduced ahead of the microphone volume control. The other volume control may be switched to either of two other pickup devices, such as a radio detector output or phonograph pickup. "OFF" positions are provided for these switches so that it is possible to cut out any circuit without disturbing the volume control setting. Mixing between channels is accomplished as in the orthodox unit described above.

While the amplifier-mixer unit is not as flexible as the straight mixer, it may be applied in conjunction with main amplifiers having approximately 20 decibels less gain—a feature which adapts the panel to many already existing sound installations with insufficient gain for microphone operation. The meter on the front panel indicates the filament current of the amplifier tube, but can be thrown into the microphone circuit by means of a push-button switch.

841 Operating Characteristics

Operating Conditions—Class B Service

Maximum Operating Plate Voltage		450 Volts
Maximum D-C Plate Current (Unmodulated)		50 Milliamperes
Maximum Plate Dissipation		15 Watts
Maximum R-F Grid Current		5 Amperes
Typical Operation:		
Filament Voltage (D.C.)	7.5	7.5 Volts
Plate Voltage	350	450 Volts
Grid Voltage (Approx.)¶	—5	—8 Volts
D-C Plate Current (Unmodulated)	43	36 Milliamperes
Peak Power Output	12	16 Watts
Carrier Output, Modulation Factor 1.0	3	4 Watts

Operating Conditions—Class C Service

Maximum Operating Plate Voltage			
Modulated (D.C.)			350 Volts
Unmodulated (D.C.)			450 Volts
A-C (R.M.S.)			450 Volts
Maximum D-C Plate Current			60 Milliamperes
Maximum Plate Dissipation			15 Watts
Maximum D-C Grid Current			20 Milliamperes
Maximum R-F Grid Current			5 Amperes
Typical Operation:			
Filament Voltage (D.C.)	7.5	7.5	7.5 Volts
Plate Voltage	250	350	450 Volts
Grid Voltage (Approx.)¶	—20	—25	—30 Volts
Power Output	6	10	13 Watts

NOTE: If grid bias is obtained by means of a grid leak, its value should be about 5,000 ohms. This value is not critical and correct circuit adjustment may be obtained with considerably different values.

¶ Grid voltage is given with respect to negative end of d-c operated filament; if the filament is a-c operated, the given values of grid voltage should be increased by 3.75 volts.

SPEED TELEVISION LAMP

This SPEED Television Lamp differs from those formerly available in that it is of the Wall-Electrode type. This construction offers marked advantages including improved efficiency and greatly increased high frequency response.

The Wall-Electrode tube may be operated directly in the plate circuit of a '71A tube. It is not however, recommended for use with the '45 or '47 except where the plate current is limited to 20 m.a. With the '47 Pentode, a series resistance should be used.

Ignition Potential (approx.)	100 volts
Ignition Current (approx.)	0.5 m. a.
D.C. Resistance at .020 Amp. of the order of 6000 ohms.	
Recommended Operating Current	10 m. a.
Power necessary for complete modulation of light values, 140 milliwatts.	
Optional Operating Current	20 m. a.
Power necessary for complete modulation of light values, 500 milliwatts.	

RCA-864 and CX-864

RATING AND CHARACTERISTICS

Filament Voltage	1.1 Volts D.C.
Filament Current	0.25 Ampere
Plate Voltage	135 Volts Maximum
Grid Voltage	–9 Volts
Typical Operation and Characteristics:	
Filament Voltage	1.1 Volts D.C.
Plate Voltage	90 Volts
Grid Voltage	–4.5 Volts
Plate Current	2.9 Milliamperes
Amplification Factor	8.2
Plate Resistance	13500 Ohms
Mutual Conductance (Grid-Plate Transconductance)	610 Microhms
Approximate Direct Interelectrode Capacities:	
Plate to Grid	2.3 uuf.
Grid to Filament	5.4 uuf.
Plate to Filament	3.5 uuf.

Status of Television

FOLLOWING its policy to advise the public accurately regarding the progress of experiments in developing television, an authoritative statement was issued today by the Radio Manufacturers Association, the national industry organization. A similar statement was made about a year ago and the new statement, emphasizing that many engineering problems must be overcome before television can be a satisfactory means of home entertainment, was prepared by the Association's Engineering Division which includes all prominent engineers working toward development of television broadcasting and receiving apparatus. The statement follows:

"From such a confused mass of conflicting statements and data regarding Television, only by picking out the pertinent facts from the work that has been done in the past and the facts that are presented in the present situation, is it possible to draw any conclusions regarding the future of Television. These facts have been so many times oversold, at times maligned and altogether misunderstood, not only by the public but by the leaders of the radio industry itself, which must sponsor this new art.

"This statement regarding Television is only intended to array the facts of the past and present to point out some of the future possibilities thus made apparent.

"As far back as 1884 there was recognized by Nipkow, a German experimenter, that to transmit visual images it would be necessary to resolve those images into elements, each element to be faithfully transmitted and re-converted into a corresponding light value at the receiving end. To do this Nipkow employed scanning discs, and later in 1894 Amstutz, an Illinois experimenter, carried on the work in this country even further. In 1913 Jenkins of Washington started his work on the development of Television which culminated in 1925 in the showing of animated motion pictures by Television. In England, John Baird, after several years of work, showed his first pictures in 1926. In 1928 the Bell Telephone Laboratories transmitted a picture from Washington to New York, and since that time several other experimenters have been carrying forward the development of Television. Prominent among these have been the RCA Victor Company in Camden, the Jenkins Television Corporation of Passaic, Philo Farnsworth now with the Philadelphia Storage Battery Company, General Electric Laboratories in Schenectady, and U. A. Sanabria of Chicago.

"The problems encountered in accomplishing Television transmission and reception have in the past been manifold.

"First—the problem in the method of scanning which started with the ordinary disc, was followed later by a disc with lenses which greatly increased the efficiency. Then came the drums and discs with mirrors. Starting with a Russian named Rosing, twenty years ago, several experimenters have been using electrical principles of scanning which are utilized in the cathode ray oscillograph tube.

"Second—the problem of transmission has proven to be very difficult. The light values of the elements of the transmitted picture must be converted to electrical values and then transmitted faithfully either by wire or by radio. This is only successfully accomplished by employing a frequency side band of several hundred thousand cycles. This becomes of interest when compared with the width of a side band for present day radio voice transmission which is approximately 5000 cycles. Modulation of the high carrier frequencies for these picture transmissions becomes very difficult.

"Third—the reception of Television signals has presented still more complicated problems. The radio Television signals must be received, amplified, de-modulated and again amplified to operate a light source. Demodulation above 30,000 cycles has presented many engineering difficulties. Much work has been done on the light sources, the most common of which have been the neon discharge glow lamp, the Kerr cell and the cathode ray tube.

"Fourth—the great problem has been that of securing finances. Unfortunately, companies have resorted to overstatements, lured prospects with the possibilities of Television in order to sell stock, and often in these statements misrepresentations were made, with the result that the public has been very much confused as to the actual state and present possibilities of the Television art.

"It was early recognized that in this maze of Television work some official organization, representing most of the Television experimenters, should endeavor to crystallize as much as possible the growing embryonic art. Consequently, in 1928 a sub-committee of the Engineering Division of the R.M.A., known as the Committee on Television, under the direction of D. E. Replogle as Chairman, was appointed. This committee not only embraces members of the R.M.A., but invites as Guest Members every outstanding experimenter. It has helped in encouraging experimenters along every line of development and in securing Federal aid in the wave length assignment of Television, and has been the only official recommended party in this country whose function has been to guide, if possible, this growing art. Due to the work of this committee, much confusion in regard to practices, terms and definitions of Television have been eliminated.

"The present facts of Television which are available are as follows:

"First—for scanning, mechanical features using rotating parts are in wide use and offer a most practical means of securing passable Television pictures.

"Second—a direct pick-up system which has come to the front rapidly this year is that of the camera idea. This system can be used for Television pick-up in a lighted studio, for outdoor pick-up, etc.

"Third—a great deal of successful development has been made with the cathode ray tube system for transmission and reception. This system has proven technically sound and shows the greatest possibility. Its chief difficulties are in the production of large quantities of these systems at a reasonable cost.

"Fourth—the Television broadcast transmission spectrum allows only for five channels, namely 2000-2100 kc, 2100-2200 kc, 2200-2300 kc, 2750-2850 kc, and 2850-2950 kc. This frequency spectrum for Television is not adequate for good picture transmission on account of the very wide side band frequency necessary for picture detail, so in addition to these bands, on the extreme short waves—5-7 meters, frequencies from 35000-80000 kc have been requested for Television service. Most of the present transmitters are operating in the first mentioned bands, but a few operate in the neighborhood of 46000 to 48000 kc.

"Fifth—the reception of Television has been possible by tuning with either a superheterodyne or tuned radio frequency receiver designed for Television reception. Synchronized sound very often accompanies the picture transmission and it is common practice to receive the voice transmission on the standard broadcast receiver.

(*Continued on page* 40)

Status of Television

(Continued from page 39)

This required two receivers for receiving synchronized sound and picture transmission. In the Television receivers, mechanical scanning and cathode ray electrical scanning have been employed. The cathode ray type of scanning has been capable of excellent results and shows great possibilities for further development.

"Sixth—with the present economics of broadcasting, it has been impossible to secure much data on the entertaining value of the subjects that can be broadcast due to the cost in presenting programs. The Federal Radio Commission has up to the present time considered Television only experimental and will grant no commercial rights. This means that all broadcasting must be done for the experimental value only and no paid programs can be transmitted by Television. This ruling has made impossible the receipt of any money in staging Television programs. With commercial rights granted by the Federal Government, the problem will still be complicated as to whether advertisers will continue to assume the increased costs that Television must impose for its successful operation, or whether the public can satisfactorily be taxed to bear this burden.

"Many problems appear which must be overcome before Television can be a satisfactory means of home entertainment. The most important of these are listed as follows:

"1. Greater detail should be obtained in received picture.

"2. Television transmission pick-up equipment should be portable and as easily used as present day sound picture pick-up equipment.

"3. Transmitting systems must be evolved which will have a satisfactory and reliable service range.

"4. Receivers as simple in operation as our present radio receivers must be designed and built at a reasonable cost.

"5. Quiet and satisfactory illuminated picture equipment for the home must be designed and built at a reasonable cost.

"Regardless of the present problems that confront the industry, there has been enough work done to justify some predictions which can be conscientiously made. With the development of the new short wave channels at frequencies higher than 35,000,000 cycles, reliable transmission of Television can be predicted. Ample room for an adequate number of transmitting stations can be visualized in this short wave region. It is perfectly conceivable that a sight and sound service can be worked out to be received on a single receiver with a simplified tuning and control mechanism.

"As never before, the new art of Television is going to require the rigid and sure hand of a governing body to set up the standards for both transmission and reception. Surely no better body is suited for this task than the Radio Manufacturers Association, which embraces both transmitting and receiving set manufacturers. Because of this situation, Television presents a real challenge to the R.M.A., which if accepted, can and will bring new prosperity to its members but only if this challenge is correctly and courageously met by the entire co-operation of its members."

Filter Design by Graphs

(Continued from page 37)

requirements of a limited radio frequency band will find that this may be done quite satisfactorily in the first graph (Figure 1). Here we have only to multiply the frequency range by 100, and divide both the inductance and capacity values by 100. The scale of ohms reactance is left precisely where it is. Now the graph has a frequency range of zero to 600,000 cycles. In the inductance scale, the broken line now marked 10 millihenrys becomes one-tenth of a millihenry; the 1 Henry line becomes 10 millihenrys, with proportionate changes in the other inductance values. In the heavy capacity lines, the line marked .1 Mfd. becomes .001 Mfd.; the .02 Mfd. capacity becomes .0002 Mfd., all other capacity values changing in the same proportion. As has been said before, the reactance range still remains between zero and 8,000 ohms.

It is probably true that the subject of resonance by the graph has not, in the past, been exploited very extensively, if at all, and since it is quite improbable that the writer should have discovered all of the possible uses of the graph, the reader is strongly urged to look over the graph with a view to finding its applications to his own particular problems. It is hoped that with this graph, or some subsequent development of it, many routine problems may be brought to a solution quickly and profitably.

RCA RADIOTRON COMPANY, INC., and E. T. Cunningham, Inc., have announced to the trade a new tube designated respectively as RCA-234 and CX-234.

This new tube, a Super-Control R-F Amplifier Pentode, is an addition to the line of 2-volt tubes and is designed primarily for service in receivers operating from dry cells or from a storage battery where economy of filament-current drain is important.

The 234 will not be available through the regular channels of distribution until March 1 or later, when equipment using this type becomes available.

The 234 is recommended for use as a radio-frequency amplifier, intermediate-frequency amplifier, and first detector in battery-operated receivers. Its design is such as to make it especially useful in portable receivers.

It is very effective in reducing cross-modulation and modulation distortion over the usual range of received signals. The design of the 234 is such as to permit easy control of a moderate range of signal voltages without the use of antenna potentiometers or auxiliary volume-control switches. This super-control characteristic makes the tube uniquely adaptable for use in the r-f and i-f stages of receivers incorporating automatic volume control.

The filament employed in the 234 is of the coated type. It is designed to consume as little power as possible consistent with satisfactory operating performance.

TENTATIVE RATING AND CHARACTERISTICS

Filament Voltage				2.0	Volts D.C.
Filament Current				0.060	Ampere
Plate Voltage	67.5**	90	135	180	Volts Max.
Screen Voltage, Maximum*	67.5	67.5	67.5	67.5	Volts
Grid Voltage, Variable	−3	−3	−3	−3	Volts Min.
Plate Current	2.7	2.7	2.8	2.8	Milliamperes
Screen Current	1.1	1.1	1.0	1.0	Milliamperes
Plate Resistance	400000	500000	600000	1000000	Ohms
Amplification Factor	224	290	360	620	
Mutual Conductance	560	580	600	620	Microhms
Mutual Conductance at −22.5 volts grid bias	15	15	15	15	Microhms

Maximum Overall Dimensions:	
Length	$4\frac{11}{16}$"—$5\frac{1}{4}$"
Diameter	$1\frac{13}{16}$"
Cap	0.346"—0.369"
Bulb	S-14
Base	Medium 4-Pin
Socket	Standard 4-Contact

* Under conditions of maximum plate current.

** Recommended values for use in portable receivers.

New Electronic Relay

POSITIVELY controlling a current of six amperes at 220 volts with a minute flow of one one-millionth (0.000001) of an ampere—that sums up the achievement realized in the latest form of electronic relaying device which we have named the Burgess Micro Relay. Or to put the case in more dramatic yet equally accurate terms, this latest electronic device permits such minute mechanical energy as 1 fly-power, which is more than ample, to control well over 1½ electrical horse-power of energy.

The relay in question transforms normally indistinguishable contacts into readily distinguishable, powerful, useful forces. In this characteristic lies its greatest value for temperature control work, go and no-go, and maximum and minimum control settings on sensitive indicating meters and other apparatus. It fulfills a function heretofore held uncertain because of the lack of a relay mechanism capable of such a wide spread between controlled and controlling energies. This device is particularly recommended wherever it is desired to provide indication or control at some predetermined value as shown by any indicating instrument, such as voltmeter, ammeter, pressure gauge, thermometer, etc., or in industrial equipment wherein positive action must be obtained by the closing of an electrical circuit through a pair of contacts under slightest pressure. The minimum current required eliminates the hazzard of variation or uncertainty of contact due to sparking, arcing, oxidation or contamination of contacts.

The Burgess Micro-Relay consists of an electronic tube in the plate circuit of which is a normally closed mechanical relay, said relay being held open by the residual value of plate current with an unbiased grid. The controlling contacts are so wired that when they come into contact a negative bias is placed on the grid, immediately causing the relay to close. This action occurs even with extremely high contact resistance in the order of twenty megohms; in fact, the relay will function with any contact resistance appreciably less than the insulation between the electrodes of the tube.

The components of this electronic relay are mounted in a stout metal cabinet measuring 7x8½x4¼ inches. A terminal strip inside the cabinet provides for connections with the external circuits. Knockouts permit of permanent wiring using BX or conduit. The relay is arranged to operate with a standard 25-watt lamp wired in series with the filament of the tube. This lamp serves the triple purpose of a resistor, pilot light to indicate that the relay is operative, and illuminator for the indicating instrument to which it is attached.

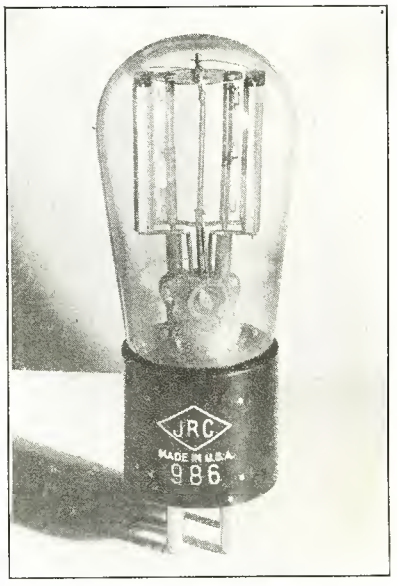
The mechanical relay of the unit is provided with a Burgess Vacuum Contact in place of the usual exposed contact points. This feature permits the handling of currents up to 6 amperes at 220 volts. In addition, the relay may safely be used in explosive atmospheres, since the contact is totally enclosed and no danger of ignition exists. It will be noted that with an infinitesimal operating current for the control end, and a vacuum contact device capable of handling over 1200 watts for the controlled end, this electronic device produces the greatest span between controlled and controlling functions yet attained in actual practice.

The delicate controlling current required to actuate the micro relay must result in successful applications in equipment which might operate only temporarily without it. The infinitesimal current is reduced to the point where oxidation, arcing and similar undesirable and indeed deleterious phenomena are positively eliminated. As an example of this point, the useful life of a contacting mercury thermometer may be increased indefinitely.

Mercury Full-Wave Rectifiers

THOUGH rectifiers containing mercury within the bulbs have been in use some time for supplying high voltage and high current requirements of power amplifiers and transmitters, only recently has this type of tube been brought to the attention of the public in the form of full-wave rectifiers for receiver use. Illustrations are given of two types, the first, a 282 type, and the second, a 986 type. The former has been presented by the Cable Radio Tube Corporation and the Hygrade Sylvania Corporation, while the latter is developed by the Johnsonburg Radio Corporation. Though serving the same purpose, the characteristics vary somewhat, especially as to the filament voltage and current required. One feature of the 280 type tubes has been overcome with the advent of the mercury vapor tubes, namely the high voltage drop across the tube itself which represents loss. A first look at the new tubes immediately impresses the individual because the glass bulb used is that of the familiar 201-A tubes so prevalent in early receivers. This means that the heat produced in rectification must be far less than heretofore. In operation this may be quickly ascertained by touching the bulb. Only one objectionable feature has been noticed in using these tubes, and that is that there is a transfer of noise in the power transformer, probably necessitating a static shield between windings that was not required before. Bypassing from plates to the filament may serve to help reduce the noise.

Tentative characteristics of these two types of tubes follow:



282 Type

Filament Voltage .....2.5 Volts
Filament Current .....3.0 Amperes
Maximum a-c Voltage per Plate .....500 Volts rms
Maximum Peak Inverse Voltage .....1400 Volts
Maximum d-c Output Current (continuous).....125 Milliamperes
Maximum Peak Plate Current .....400 Milliamperes
Tube Voltage Drop (approximate) .....15 Volts

986 Type

Filament Voltage.....5.0 Volts
Filament Current.....1.0 Amperes
Maximum a-c Voltage per Plate (recommended)....400 Volts
Maximum Plate Current (recommended) .....150 Milliamperes

This tube may be used to replace the 280 type tube directly with no changes in the circuit since the filament voltage is the same.

Voltage Analyses Charts

Crosley 121-1

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	1st R. F.	2.3	170		4		90
35	2nd R. F.	2.3	170		4		90
35	1st Det.	2.3	170		7		85
24	Osc.	2.3	35		0		95
24	I. F.	2.3	175		2		95
27	2nd Det.	2.3	0		0		
27	A. F.	2.3	150		10		
47	P. P.	2.3	250	17			255
47	P. P.	2.3	250	17			255
80	Rect.	4.9					

Crosley 120

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
24	R. F.	2.5	160		3		90
24	Osc.	2.5	18		1.5		90
24	1st Det.	2.5	155		7		90
24	I. F.	2.5	160		3		90
27	2nd Det.	2.5	145		15		
45	P. P.	2.4	260	54			
45	P. P.	2.4	260	54			
80	Rect.	4.9					

United American Bosch 5

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
24	1st R. F.	2.3	250	2.5	2.5	4.5	90
24	2nd R. F.	2.3	250	2.5	2.5	4.5	90
24	Det.	2.3	150*	1.5	3.0	.5	20*
47	Output	2.3	250	16*		32	250
80	Rect.	4.8				20–20	

General Electric H-32

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	R. F.	2.5	230	.2*	2	3.5	60
27	Osc.	2.5	50	0	5	4.0	
24	1st Det.	2.5	230	3.5	4	.5	60
35	I. F.	2.5	230	.2*	2	3.5	60
27	A. V. C.	2.5	30	0	0	.1	
35	I. F.	2.5	230	3.5	20	2.5	60
27	2nd Det.	2.5	210	8*		.5	
47	P. P.	2.5	235	10*		25	250
47	P. P.	2.5	235	10*		25	250

Crosley 124

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
235	R. F.	2.38	250		3		90
224	1st Det.	2.38	180		7.5		60
227	Osc.	2.38	90		8		
235	I. F.	2.38	250		3		90
227	2nd Det.	2.38	180		20		
247	P. P.	2.38	250	16.5			250
247	P. P.	2.38	250	16.5			250
280	Rect.	4.80					

Philco 51

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
24	Osc. & Det.	2.2	220	9	9		85
35	I. F.	2.2	210	3	3	6.2	85
24	2nd Det.	2.2	75*	5.2	5.2		54
47	Output	2.2	210	.2*			240
80	Rect.	5.0	240			30–30	

Voltage Analyses Charts

General Motors S-10A

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	1st Det.	2.25	170	5	100	4	87
35	I. F.	2.25	200	1	100	8	95
24	2nd Det.	2.25	120	6	7	.5	77
47	Output	2.25	270	7		35	255
27	Osc.	2.25	90	0	0	8	
27	A. V. C.	2.25	30	2	15	0	
80	Rect.	4.10	360			30–30	

General Electric S-22

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	R. F.	2.4	240		3.5	5.0	70
27	Osc.	2.4	65		2.5	5.5	
24	1st Det.	2.4	235		5.0	.5	70
35	I. F.	2.4	240		3.5	5.0	70
27	2nd Det.	2.4	220	5*	25	.5	
45	P. P.	2.4	245	30*		25	
45	P. P.	2.4	245	30*		25	

RCA-Victor Radiola 43

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
32	R. F.	2.0	155	22			55
30	Osc.	2.0	50			3	
32	1st Det.	2.0	150	.5		.5	65
32	I. F.	2.0	155	22			55
30	2nd Det.	2.0	90*	5			
30	Audio	2.0	150	2		2.5	
30	P. P., "B"	2.0	150	15		.5	
30	P. P., "B"	2.0	150	15		.5	

Balkeit L-8

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
51	R. F.	2.5	198		3.0		85
51	1st Det.	2.5	198		10.5		85
27	Osc.	2.5	105		17.0		
51	I. F.	2.5	198		3.0		85
27	2nd Det.	2.5	195		16		
47	P. P.	2.5	195	13.5			
47	P. P.	2.5	195	13.5			
80	Rect.	5.0	325				

Brunswick E, 17, 24, 25

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
51	R. F.	2.4	250		2.8	4.5	76
24	1st Det.	2.4	250		2	.5	68
51	I. F.	2.3	250		3	3	76
24	2nd Det.	2.3	200		.2	.2	60
24	Osc.	2.3	35		0	1	16
27	A. V. C.	2.3	22		7	0	
47	Parallel	2.5	250	.2*		25	250
47	Parallel	2.5	250	.2*		25	250
80	Rect.	4.8	400			43–43	

Kolster K-70

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	R. F.	2.5	190	.5*	80	.25	60
27	Osc.	2.5	80	2.5	80	5.0	
24	1st Det.	2.5	180	5.0	84	.6	50
35	I. F.	2.5	195	3.0	80	1.0	75
24	A. V. C.	2.5	20	.25	50		25
24	2nd Det.	2.5	100*	4.0	80	.25	24*
47	Output	2.5	235	4.0*		35	260
80	Rect.	5.0				46–46	

Voltage Analyses Charts

Howard DL

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath Volts	Plate Ma.	S. G. Volts
35	1st R. F.	2.3	180		3.2		89
35	2nd R. F.	2.3	180		4.3		88
35	1st Det.	2.3	175		8		87
27	Osc.	2.3	80		9		
35	I. F.	2.3	180		3		89
35	I. F.	2.3	180		4.4		89
27	2nd Det.	2.3	175		17		
27	A. V. C.	2.4	112*		31*		
27	Phono	2.3	175				
47	Output (4)	2.25	245		8		250
80	Rect. (2)	4.75	408		16		

All American Lyric S-7

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
51	R. F.	2.5	195		2		70
24	1st Det.	2.5	195				70
27	Osc.	2.5	70		0		
51	I. F.	2.5	195		2		70
24	2nd Det.	2.5	168*		4.5		70
47	Output	2.5	230	17			250
80	Rect.	5.0	350				

Kolster K-60

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	R. F.	2.5	230	.25*	3	6.0	80
27	Osc.	2.5	85	0	0	6.0	
24	1st Det.	2.5	225	6.4	6	1.0	74
35	I. F.	2.5	225	3.5	4	7.0	80
24	2nd Det.	2.5	125*	4.2	6	.2*	22*
47	Output	2.5	225	2*		24	245
80	Rect.	5.0				48–48	

Silver-Marshall Q

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
24	1st Det.		244		14		88
51	I. F.		244		3.4		88
51	I. F.		244		3.4		88
27	2nd Det.		140*		20		
47	Parallel		224	15			244
47	Parallel		224	15			244
27	Freq. Chan'r		244		88		
27	Osc.		88		5		
27	A. V. C.		0	0	—46	0	
80							

Sparton 10

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	R. F.	2.5	270	4.0		8.0	100
35	1st Det.	2.5	270	7.5*		3.5*	110
35	I. F.	2.5	270	4.0		8.0	110
27	Osc.	2.5	110				
27	2nd Det.	2.5	135*	14		.7	
47	Output	2.5	260	18		36	260
80	Rect.	5.0	420			55–55	

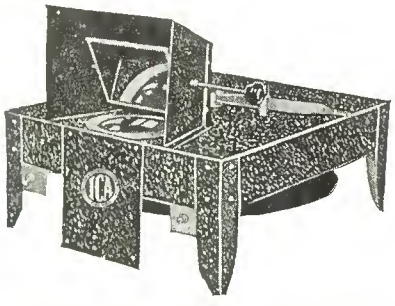
General Motors S-9A

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
224	1st Det.	2.35	290	6	6	1.5	80
235	I. F.	2.35	290	3	3	6.5	83
224	2nd Det.	2.35	180	7	7	.3	63
247	Output	2.35	270	5*		35	260
227	Osc.	2.35	80	.5		7	
280	Rect.	4.80	370			30–30	

NEW PRODUCTS FOR THE TRADE

ICA Visionette

Insuline Corp. of America, 23 Park Place, New York City, announce the new Insuline sight reproducer known as the Visionette.



The manufacturers state that the Visionette uses a 5 inch square image having three dimensional depth and permits the whole family to view the television images simultaneously.

The motor utilizes a wound stator for its field and two rotors both on the same vertical shaft. One of the rotors is of the squirrel-cage induction type and is used to bring the scanning disc up to speed, and the other rotor is of the laminated iron-toothed synchronous type.

The Visionette employs a novel magnifying lens system, arranged so as to give maximum enlargement, with accurate correction for spherical aberration.

Lynch Steel Resistor Cabinet Free

To enable jobbers, dealers and service men to keep an accurate check on their resistor stock and to facilitate the filling of orders by being able to find at a glance the resistors wanted. The Lynch Mfg. Co. offers to supply a useful, durable, 50 drawer steel filing cabinet with a special introductory deal on their metallized and precision wire wound resistors. The drawers are 8″ x 3″ x 2½″ wide. The case is 33″ x 18½″ x 8½″. This is just a part of their sales service to the trade, as they also furnish catalog sheets, R. M. A. color code cards, and service men's resistor replacement manuals. For further details, address A. E. Stevens, Sales Mgr., Lynch Mfg. Co., Inc., Dept. P, 1775 Broadway, New York City.

New Aluminum Solder

The discovery of an all-metal solder that repairs aluminum, pot metal, die castings and steel, promises to be of decided importance to the radio industry. This solder is called Alumaweld and is a development of the Allied Research Laboratories, Glendale, Calif.

As the name Alumaweld implies, the solder actually breaks down the structure of the metal being repaired and fuses or welds with it to form a single, solid piece. It is not to be confused with a surface solder.

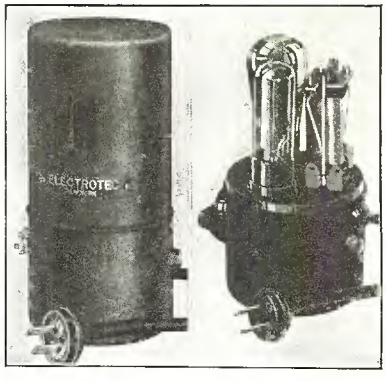
Alumaweld is applied to any metal with an ordinary soldering iron or blow torch. It melts at an exceedingly low temperature, but once applied requires a much higher temperature to melt again. The fact that it has a tensile strength of 12,000 lbs., which is over ten times that of ordinary solder, indicates its permanency.

Alumaweld is now being used extensively in radio work for the repair of aluminum cabinets, aluminum housings, and other metal work. Average repairs take from 10 to 12 minutes, and there is no need to tear down the set or remove any parts. Alumaweld is quite ductile, machines easily, and will take a nice polish over which chromium plating or any other plating can be applied.

This solder can be used by anyone regardless of experience. It replaces welding at a fraction of the time and cost, without any danger of cracking during preheating or cooling. Alumaweld cannot possibly rust, inasmuch as there is no electrolytic action between the solder and metal. A free sample of Alumaweld may be secured by writing the discoverers.

Electrotec-Phototube-Relay

Electrotec Engineering Corp., 180 Madison Ave., New York City, announces a universal model phototube relay that covers a wide range of light control applications.



This model has been designed so that it may be set up and operated by anyone with no previous experience. It has an external adjustment that may be set to operate on a change of one-tenth of one foot candle in illumination, from absolute dark to daylight or for impulse operation from a light source.

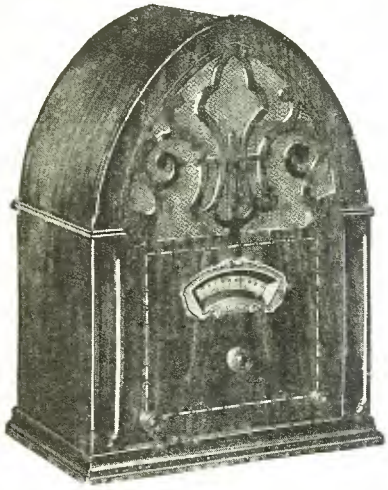
The Electrotec phototube relay is manufactured in three models that may be purchased from jobbers and dealers, a-c, d-c, and battery types. All models have cord and plugs and terminals for open and closed circuit operation, overall dimensions of all three models are height 7 inches, diameter 3½ inches. Electrotec Engineering Corp. also manufacture a complete line of auxiliary relays for power work and are equipped to furnish engineering services for any specialized application of light control.

NEW PRODUCTS ITEMS

Manufacturers who have items that come within the scope of this department will find it of advantage to keep our name on their mailing list for announcements of new products. Halftones or electros should not exceed 2¼ inches in width. Address—New Products Editor, care this magazine.

Balkeit Model DP

Balkeit Radio Co., North Chicago, Ill., announces their model DP using two pentode tubes, which they state supplies greatly increased volume if the listener desires, or if the receiver is placed in an unusually large room.

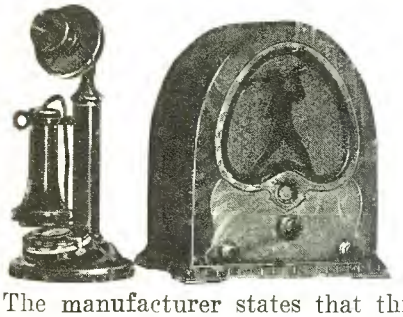


This receiver employs a full sized dynamic speaker, with a hum bucking coil, three gang ball-bearing variable condenser, and dry electrolytic condenser, with full vision illuminating dial.

Tubes used consist of three 224s, two 247s and one 280. Shipping weight 27 lbs.

Jackson-Bell "Peter Pan"

Jackson-Bell Co., Ltd., Los Angeles, Calif., announce their model Peter Pan, which sells for $29.95, complete with tubes.



The manufacturer states that this receiver comprises the smallest modern radio set on the market today and uses the full efficiency of the pentode tube. The Peter Pan weighs just 10 lbs. and is not quite as high as the standard size telephone which is shown in the illustration above. Licensed under RCA, Hazeltine and Latour patents.

Record Playing Attachment for Radio Sets and Address Systems

A new portable and completely self-contained unit for reproducing records through radio sets and power amplifiers has been announced by the Operadio Mfg. Co., St. Charles, Ill.

Housed in the leatherette carrying case are an electric phonograph motor and turntable, and a sensitive electro-magnetic pick-up. A carrying case in the cover provides for storage of

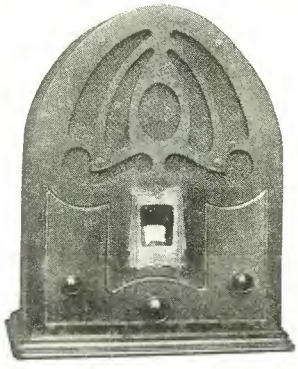
several records without danger of breakage.

This unit is adapted for use with all radio sets and amplifiers having provision for connection to either high or low impedance pick-ups. Adapters are available for connections to most other radio sets.

Available with either high or low impedance pick-up, and with 78 or 33⅓ r.p.m. motors, for 25 or 60 cycle, 110 volt power supplies.

Simplex Model K

The Simplex Radio Co., Sandusky, Ohio, announces their 5 tube model K midget receiver.



This receiver is shown in the illustration above. It is 9 inches wide, 12 inches high, 6½ inches deep, and weighs 13 lbs. The tubes used are two 224s, one 235, one 247, and one 280.

Tung-Sol Announces a High Power Output Pentode Tube

Tung-Sol announces the development of a new Tung-Sol tube called a d-c power amplifier, pentode, bearing the designation, TS-257.

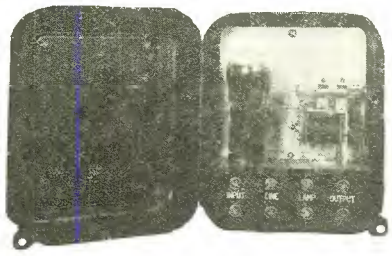
This new tube is intended for use in the power output stage of 115 volt direct current operated sets especially designed for it.

TS-257 is designed to operate at a maximum plate and screen voltage of 110 volts and will produce a power output of 800 mw, which is approximately 3½ times the power output of the 171-A type and more than twice the output of the TS-233 or TS-238 types when operated at the same plate voltage.

In receivers designed for operation on direct current power lines, the filaments of two or more of these tubes may be connected in series. Since the filament current rating of the TS-257 is the same as the TS-236, TS-237, TS-238 and TS-239, i. e., 300 amperes, these tubes may be operated in series.

Burgess Micro-Relay

C. F. Burgess Laboratories, Inc., 202 E. 44th St., New York City, have taken over the activities of the Burgess Battery Co. in the sale of Burgess Radio-visor Bridges (light-sensitive cells), vacuum contacts, vacuum contact relays, micro relays, light control units and other electronic devices, as well as the acoustimeter line of the Burgess-Parr Co.



The illustration above shows the Burgess micro-relay with electron tube, mechanical relay equipped with vacuum contact, and terminal strip.

New Ohmite Bulletin

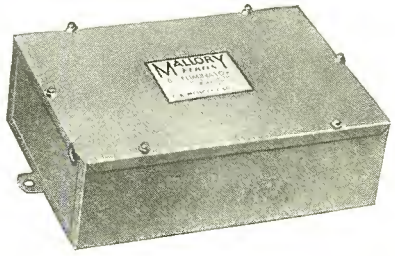
Ohmite Mfg. Co., 636 N. Albany Ave., Chicago, announces the publication of a new stock list, bulletin No. 10, which illustrates and describes Carbohm and Wirohm resistors.

The bulletin lists 75 different values of carbon resistors in both 1 watt and ½ watt sizes, as well as 42 different values of wire-wound resistors. These wire-wound resistors, called Wirohms, are of special interest because of their high wattage rating and very small size.

The Ohmite Mfg. Co. will gladly send this bulletin to anyone requesting it.

Mallory-Elkon Announces New Auto B Eliminator

P. R. Mallory & Co., Inc., Indianapolis, are manufacturing a B battery elminator for automobile radio.



This new unit is energized by the 6 volt A battery in the car which is constantly supplied with energy by the automobile generator. It boosts

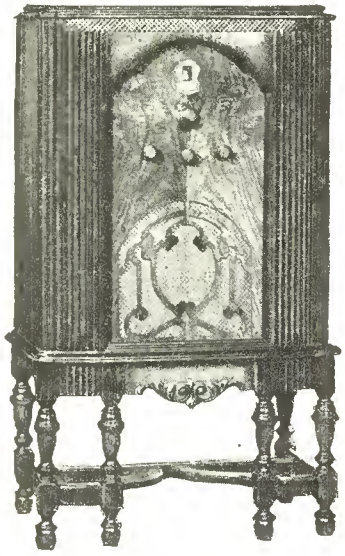
the 6 volts in the A battery up to 180 volts or the equivalent of four 45 volt B batteries.

The Mallory-Elkon B eliminator can be used for all popular brands of automobile radio sets. It is compact, size 10 inches by 7 inches by 3¼ inches, and is easily installed in the car.

The list price of this new unit is $24.50 complete with nothing else to buy. The installation instructions in full detail are packed with each unit.

New All-Wave Receiver

United Air-Cleaner Corp., 9705 Cottage Grove Ave., Chicago, announce their new Sentinel No. 125 eight tube all-wave superheterodyne console model.



This receiver covers a range from 13 to 550 meters. Tubes used include one 224 screen grid first detector, one 227 oscillator, two 235 variable mu intermediate frequency amplifiers, one 227 diode detector, which also acts as the automatic volume control tube, one 235 variable mu controlled audio amplifier, one 247 power pentode output tube, and one 280 full-wave rectifier.

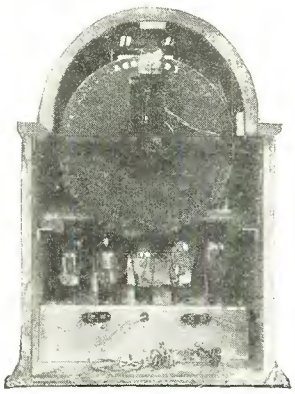
Radio Physics Course

The Radio Technical Publishing Co., 80 Fifth Ave., New York City, announces the completion of their Radio Physics Course, including short waves, television and sound pictures. Price $3.50. Also Radio Servicing Course, which contains a complete course in modern radio servicing, using up-to-date methods. Price $1.50.

Midget Television Set

The Globe Television & Phone Co., 26th St. and 11th Ave., New York City, announce their midget television receiver in a cabinet no larger than the usual broadcast receiver. The pictures appear on a ground glass screen measuring 4 by 5½ inches. Illuminated scale and control knobs are placed below the screen.

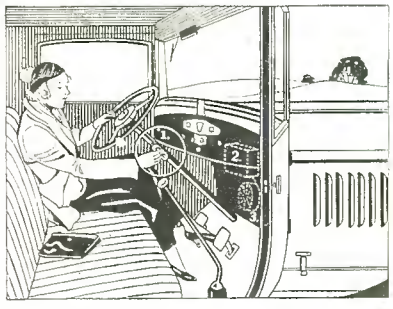
The receiver is mounted on a metal chassis, and uses two screen grid –24 tubes, one –27 detector, one –24 first audio, one –27 second audio and two –45 power tubes for the third audio stage, together with the –80 full wave rectifier. A power pack is included for full a-c operation.



The cabinet measures 16½ inches wide by 14½ inches deep and 24½ inches high. It is finished in walnut.

New Auto Radio

Motorphone Radio Corp. of America, 136 Liberty St., New York City, announce their auto radio known as the Bonded Motortone. The manufacturers state that this receiver can be mounted in any automobile in one hour and does not require drills or any other tools.



The 1932 model uses six tubes, which consist of three 236s, one 237 and one 238 in a screen grid push-pull pentode circuit.

The manufacturers state further that this receiver is completely shielded and will withstand all shocks and vibrations. The chassis can be removed from the car by unloosening two hooks, and if repairs are necessary can be repaired in the workshop. The equipment consists of a Utah remote control, Utah 8 inch dynamic speaker mounted in a metal casing, and shielded battery cable.

New Pierce Airo Super

Pierce Airo, Inc., 510 Sixth Ave., New York City, announces to the radio trade a new seven tube pentode superheterodyne, dual wave, single dial receiver, with shadowgraph tuning. It is available in alternating or direct current.

The tubes used are one pentode, two 224s, one 35, one 180, one Amperite L-3, and one 227. It is equipped with phonograph pick-up jacks. The speaker is acoustically correct, with the cabinet design in two-toned walnut veneer.

Anyone interested in ranges from 60 to 600 meters, police calls, short wave and amateur calls will be more than satisfied with the performance and results obtained from this receiver. The price complete is $49.50.

Literature will be furnished by writing Pierce Airo, Inc., at the above address.

New Show Rooms Feature Free Institute For Radio Service Men

The Wholesale Radio Service Co., formerly at 38 Vesey St., New York City, is now installed in a new location at 100 Sixth Avenue, New York City. The city sales room embraces a spacious lobby, equipped with soundproof booths and a miniature theatre. Special provision is made for the radio service man and his needs. Special testing instruments have been installed and a competent radio engineer is on hand at all times for consulting purposes.

Norden-Hauck Announces New Models

Norden-Hauck engineers, pioneers in the radio field since 1922, have completed several new designs, incorporating the very latest improvements in receiving equipment. These will include a de luxe fifteen tube broadcast receiver, which is also equipped for short wave reception, to be known as the Norden-Hauck Custom Imperial.

A smaller model with single dial feature will be a medium priced combination short and long wave receiver, super DX-10.

A short wave adapter is also included in this group, which is a four tube unit, completely self-contained, and will provide high efficiency on short waves when used in conjunction with other standard receivers.

Further information may be obtained by writing Norden-Hauck Elec. & Mfg. Co., 402 Cherry St., Philadelphia, Pa.

BRIEF ITEMS OF INTEREST TO MANY

There has been a long felt want in the radio field for a school of recognized standing to give a complete, comprehensive, well balanced course in Radio Communication, to be complete within itself and capable of being finished within a reasonable time. Realizing this need, the University of Wisconsin, Extension Division in Milwaukee, is giving such a course to fit students for advanced places in radio activities. This is a new type of college training of a semi-professional nature with the object of training young men for positions existing in a field between the skilled craftsman and the trained professional engineer.

All trades and professions are now demanding that the men participating in them shall be thoroughly trained in the theory and fundamentals of the trade or profession in question. The ever expanding science of radio is possibly more exacting in this than any other because of the extremely technical nature of the subject and of the enormous responsibilities upon the shoulders of an operator. A few years ago a man could be a fairly good operator or technician without any particular training, but today, if a man expects to succeed in this field he must be thoroughly grounded in the theory and practical applications of the fundamental principles of radio communication. The question has been to the serious-minded person, "Where can I secure such an education without taking a regular degree in engineering?"

The course given in Milwaukee is not an experiment, for it has grown out of auxiliary courses given during the past six years and is planned as a definite preparation for the actual problems met in practice. The work given is substantially of collegiate grade, requiring only a high school education or the equivalent for entrance. The training is very intensive, requiring the entire time of a student for two semesters. The entire day is occupied from eight until four-thirty with lectures, class work and laboratory experiments and special problems and assignments to be completed after class hours. This same course may be taken in evening classes over a period of two years or by correspondence.

The principal course of a complete training in Radio Communication is strengthened by supplementary subjects which assure a thorough understanding of the various phases of the theory and practical applications of receiving and transmitting circuits. These correlated subjects include Elementary Electricity, High Frequency Currents, Thermionic Vacuum Tubes, and laboratory work which is divided into three parts; (1) actual experiments, (2) design of apparatus and circuits and (3) adequate drill in International Morse Code. The entire list of studies is completed more easily because of a study of Technical Mathematics as applied to electricity and Technical English, which pertains to the writing of reports and experiments. The satisfactory completion of the course qualifies a student for the government examination for a Second Class Commercial Operator's License or he may enter many of the allied branches of the radio industry.

Mr. D. T. Siegel, General Manager of the OHMITE MANUFACTURING COMPANY, 636 N. Albany Ave., Chicago, announces that this company has developed a new simple COLOR-CODE CHART for use with R. M. A. coded resistors.

This chart, which may be carried in the pocket or hung upon the wall, consists of a full size drawing of a coded resistor and a reproduction of the actual colors used in the code. This makes it possible to read the value of any coded resistor at a glance without any manipulation or bother.

(*Continued on page* 50)

Brief Items

(Continued from page 48)

The color-code Chart is offered free to any radio dealer, service man, or manufacturer who writes the OHMITE MANUFACTURING COMPANY on his business stationery.

Wm. A. Schofield, Philadelphia, Pa.: We received your service schematics and reply to my question in regard to sensitivity and noise levels in receivers, in which you state, "if noise levels were the same, then a receiver with a sensitivity of 10 microvolts absolute would not be as desirable as one of 1 microvolt sensitivity. This, however, is never the case, because the noise level increases rapidly as the sensitivity is increased due to normal inherent qualities." I admit that I exaggerated the data I had in mind in order to clarify the question. After obtaining the March issue, I can state my question more definitely: Would not a receiver with a sensitivity of ¼ microvolt absolute with a noise level of 9 per cent to 38 per cent be more desirable than one with a sensitivity of 1.9 microvolts absolute and 57 per cent to 69 per cent noise level? I know your policy has always been to be absolutely impartial and that you have always refused to compare one receiver against another, so I selected two sets of the same manufacture, not because they interested me, but because I wish to clarify the matter in my own mind. In other words, how much consideration should be given sensitivity curves and is there a definite limit beyond which sensitivity does not make much difference? I note that the smaller receiver is more sensitive than the larger and would outperform it if the sensitivity curve is to be taken as the sole method of comparison. Is there any evident reason for this? I have examined the schematic thoroughly and cannot find any radical departure from the expected. Of course, the larger receiver has a greater audio output, i. e., 10 watts against 3.2 watts, but according to authorities, such as G. H. Browning and J. Millen, "an audio output of 50 milliwatts will give about the required volume in a medium sized room provided the loud speaker is of average sensitivity." With the set having a sensitivity as great as ¼ microvolt absolute, the additional audio amplification could not be used on any station this side of China. There is no need of my stating that I think your magazine is just right. Any criticism, constructive or otherwise, would be like looking a gift horse in the mouth. Ans. Noise level in any case determines the utility of the sensitive receiver. The examples you gave showed the most sensitive receiver to have the lowest noise level and, of course, this receiver would be better than that having higher noise level and a lower sensitivity. It would, of course, be a mistake to judge a receiver merely by its sensitivity because of a factor which may, to some people, be more important, and that is selectivity, and, too, tone quality must not be overlooked, and lastly the power overload or automatic volume control. We suggest that the receiver which you mention does contain a considerable amount of regeneration to give such extreme sensitivity. This fact is not desirable in any receiver, especially in a superheterodyne. The above statements should then answer your question as to why one should buy a receiver containing more than seven tubes when a seven tube receiver will give you as much sensitivity as will ever be required.

E. A. Hesing, Harrisonburg, Va.: Every month for some months I have been buying your magazine to keep up to date with the broadcasting stations. Your receiver performance curve section took my eye at once, but as I am just a layman, may I ask you a question? Is there such a thing, and if so, where can I get the same data that a layman can understand? In other words, taking two receivers of about the same price and the same number of tubes, can I get any

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Brief Items

(Continued from preceding page)

data as to which should give the best performance without trying both of them out. Ans. After a study of the page entitled Receiver Performance Curve Section, which immediately precedes the ten receiver write-ups, you should be able to understand the points which are necessary for judgment of a receiver. Other than this it is rather difficult to give a further explanation. Our curves are used in many, many cases, not only by service men and dealers, but also by engineers, so you may be sure that they can be relied upon. You cannot be very wrong in assuming that receivers may be compared by means of their curves, since performance in the field will very nearly duplicate these results. This would not be true if receivers were not shielded, but in the present day almost without exception they are. We might point out the following facts to aid you in your selection of a receiver or a comparison between two receivers. First, the lower the average sensitivity, that is, the nearer it approaches the base line, the more sensitive the receiver becomes. The shaping of the curve should not influence the reader's mind to any great degree, but instead, the average sensitivity should be taken. One thing must be considered in connection with ultra-sensitive receivers and that is the attendant noise level. As far as selectivity is concerned, the less spread between the curves, that is, the narrower the band widths, the more selective the receiver becomes. We believe that the fidelity and power overload or automatic volume control curves are self-explanatory.

Sid's Radio Service, Salem, Ore.: I agree with those who wish socket data and voltage charts with the other valuable information you give us. I believe you could make a composite curve to show selectivity and sensitivity and another for fidelity and power overload without crowding. This method would save half the space now devoted to charts or approximately five column inches. Then by explaining on the first page of the performance section that each set was tested under standard conditions you could utilize the space saved by avoiding repetition or about three to three and one-quarter column inches, and you could gain over eight column inches and give no more dope upon which to cogitate except on one page. Let me thank you for making this informative magazine a monthly.

James Wood, WLAYG, Millis, Mass.: I read *Radio Call Book Magazine* and like it very much. I really believe it is the outstanding publication dealing with broadcast problems. Your diagrams contain more complete information than many of the expensive radio manuals which are available. Every resistor and condenser is accurately marked.

Furniture Distributing Corp., Chicago, Ill.: Please explain what is a good power overload curve and why some have so many irregularities. Ans. A good power overload curve is one which rises rapidly with increased input and becomes practically flat after the bend. Irregularities in the curves are due to various overloading phenomena in the detector and audio circuits, especially when automatic volume control is not used.

G. A. Weatherby, Wingo, Ky.: I should like to have information with regard to receiving sets. If a station broadcasts on a frequency, for example 1320 kc with 1000 watts output, how many miles will be its effective range? Ans. There is no rule, absolute or empirical, which will even approximately give a broadcast station's range when the frequency and power are known. Some of the factors which enter into the problem are the height of the antenna system of the broadcast station, its location with regard to the surrounding country, the direction of the antenna, the percentage of modulation, signal absorption by structures and

(Continued on next page)

Brief Items

(Continued from preceding page)

ore deposits, the intervening terrain, local interference, natural interference, seasons, time of day, etc.

H. E. Kline, Buffalo, N. Y.: Please publish in your next issue in the Brief Items columns the quickest and most efficient way of testing an electrolytic condenser. Ans. To our knowledge the easiest way to check electrolytic condensers would be to apply rated d-c voltage to them and place in series a d-c milliammeter to read "leakage current." A shunt should be used on the first check to protect the meter in case a short circuit exists. Leakage should not be more than about .2 milliamperes for every 1 mfd capacity. This is higher than most dry types run.

Henning Laub, Haddon Heights, N. J.: I thought your list of broadcasting stations and specifications were the latest. I also find some Canadian and Mexican stations do not correspond with your data. Also may I suggest that *Radio Call Book Magazine* give a page with abbreviations and symbols used in radio and their explanations. I am enjoying your magazine very much. Ans. We are sorry that sometimes our foreign broadcast list is not corrected immediately when changes are made. This is not any fault of ours, since it is quite difficult to receive the bulletins on foreign stations as soon as the changes are made. Changes in the American list are made every month and are a compilation of not less than ten bulletins from several sources. You will find that the Canadian and Mexican lists have been entirely revised, and in this issue the entire foreign list and short wave phone station lists have been thoroughly checked.

A Canadian reader, Arundel, Quebec, Canada: I agree with the men who made a few remarks with bricks on page 33 of a recent issue. I agree with one gentleman in regard to the certain troubles in sets and also the voltage and current readings. As to the experimenter, I see nothing for him except to compare curves with some he has drawn himself. You should have a section named Service Notes for such letters as the one about the WR-15 set. Then another section named "Bricks and Bouquets for This Magazine." Also why do you not make a schematic on one side of the paper only and leave the other side for peculiarities of the radio set? Why not publish a few schematics of the Marconi line of radios, also the Ozarka line? King has made more radios than the model G, also the Philco battery set and the Sonora. It would be a good idea to publish a few old schematics of such receivers as the Radiola 111-A, RCA portable superheterodyne and Westinghouse superheterodyne.

Jerry Davidson, Green Bay, Wis.: In the September issue of the *Call Book Magazine*, page 31, there was a circuit drawn pointing out the use of Ohm's law. It so happens that we have a radio class made up of service men, and this article was right in step with the subject we were on, so it was brought in. And there was one point about the drawing about which the class did not seem to agree. That was the direction of the arrows on the screen grid leads of the 551 tubes. Ans. We can only say that we mention in the Radio Engineering columns the fact that the arrow direction is of no consequence in calculations. According to existing conventions, the arrows are drawn backwards, but if you consider that the electron flow is opposite to the conventional direction, then they are correct. Either may be assumed with no effect whatsoever on the results, as long as the notation is not changed during the course of calculations.

J. W. Schuler, Chicago, Ill.: I should like to know who

(Continued on next page)

Brief Items

(Continued from preceding page)

and where station KDA, Chicago, is located. It gives weather reports for the northwestern parts of the United States and also some kind of time signals. I take your "Call Book" every month and have looked high and low for that call in your magazine and can't seem to find it. Ans. Station KDA broadcasts on a frequency of 350 kc and is located near the Municipal Airport. What you took for time signals was an aircraft beacon signal. In nearby locations the second harmonic is picked up on 700 kc and third harmonic on 1050 kc.

Research engineers of the Westinghouse Electric and Manufacturing Company have perfected an ultra short radio wave, 42 centimeters long, which can be focused into a beam. Since it will penetrate the Heaviside layer, such a beam affords a means of communicating with the Moon, Mars or any other planet.

Electricity has been known since Thales of Miletus rubbed a piece of amber and made it attract light bodies in 600 B. C., according to S. M. Kintner, vice-president of Westinghouse Electric. Theophratus wrote a treatise on the subject in 300 B. C., and William Gilbert published "De Magnete" in 1600 A. D. "But the past 50 years have produced more knowledge of electricity and its possibilities than all the ages that are gone," according to Kintner.

Dr. Phillips Thomas, Westinghouse research engineer, makes and breaks electric circuits by barking "On" or "Out" into an ordinary telephone mouthpiece after connection has been established by dialing a number. The voice travels over a light beam instead of a wire. Fans and other equipment are operated in the same manner.

J. B. Rostron, Traffic Manager of R. C. A. Communications, Inc., gave out the following statement as a result of published reports that radio communication service between the United States and Shanghai had been disrupted by the fighting in Shanghai:

"Normal service by radio was maintained between Shanghai and the United States continuously. In addition to the main circuit linking Shanghai directly with San Francisco, supplementary transmitters are maintained in the international area of Shanghai giving direct connection with Manila, which has direct connection with San Francisco. This additional safeguard to traffic has not been necessary, as the main circuit has been in operation during the normal traffic hours. The only disruption of the main circuit occurred early one morning, due to a brief interference with the wire line connections between the receiving office in Shanghai and the transmitting station. The wires were repaired quickly and normal traffic via the main circuit was restored before the resumption of business in the United States that morning.

"R. C. A. Communications had handled a greatly increased volume of business between Shanghai and the United States with the beginning of the Shanghai disturbance. Due to the increase in traffic, both the Chinese Government Radio Administration at Shanghai and R. C. A. Communications at San Francisco have placed in service at times second transmitters on the direct circuit, thereby doubling the traffic handling capacity. A large volume of press dispatches has been handled over the main circuit and the American people have been kept advised of happenings from hour to hour by this medium. This is the only direct communications connection between Shanghai and the United States. The circuit, which was placed in operation a little more than a year ago, is one of the longest and most reliable in the world, having installations of the most modern short wave transmitting and receiving apparatus."

(Continued on next page)

Brief Items

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"Cy Clops" is the name given a new member of the Westinghouse Electric family. Appropriately, Cy has one great eye, right in the middle of his forehead. His head turns and bobs up and down as his scanning orb looks for a fire. When it spots a flame, a stream of extinguisher shoots from Cy's cigar and the fire's out. He's truly a one-man fire department.

Four dozen automobiles can be parked above the ground space occupied by six in the new Westinghouse vertical parking machine. A novel control unit makes parking as simple as pushing a button. As the button is flipped a door to the machine opens. The patron drives on the cradle, moves a small lever that closes the door and gives him a check. Getting the car back is just like retrieving a chapeau from the hat-check girl.

More than 500 engineers visited the Westinghouse works in East Pittsburgh recently to witness a demonstration of the new mercury arc rectifier. Although 3,000,000 times as powerful, this device handled tremendous quantities of electricity as quietly as a small glass tube performs the same service for a radio receiving set.

Engineers of many nations will participate in the International Electrical Congress in Paris, France, in June, 1932, which is a fiftieth anniversary celebration of a similar congress held in 1881, also in Paris.

Recognition of America's important contributions toward engineering and scientific progress is seen in the fact that 22 engineers of the Westinghouse Electric and Manufacturing Company have been invited to prepare technical papers for the Congress.

Plans for the meeting originated with a group of French technical societies in cooperation with the International Electrotechnical Commission, a body organized 20 years ago to handle and direct all technical electrical engineering matters having an international aspect.

Westinghouse men and the subjects they will handle are as follows:

T. D. Yensen, "The Search for Better Ferro-Magnetic Materials."

J. F. Peters, "Measurements of Surges."

F. D. Newbury, "Survey of Progress in Electrical Machinery in the United States."

H. V. Putman, "Transformers."

R. E. Hellmund and L. R. Ludwig, "Commutation and Flashing."

C. L. Fortescue, "Lightning and Its Effects on Transmission Lines."

Joseph Slepian, "The Electric Arc in Circuit Interrupters."

R. D. Evans and C. Wagner, "Stability of Power Systems."

F. H. Shepard, "Railway Electrification."

D. D. Knowles, "The Stroboglow — A New Portable Stroboscope."

E. D. Wilson, "Photoelectric Cells."

W. S. Scott, "Industrial Furnaces."

Frank Thornton, Jr., "Electrical Appliances for the Home."

R. J. Wensley, "Transmission of Signals and Motions." (Supervisory Control.)

D. D. Knowles, "Electric Phenomena in Vacuum Tubes."

A. M. Candy and J. G. Ritter, "Electric Welding."

I. E. Mouromtseff, in conjunction with W. C. White of the General Electric Company, a joint report on "Very Short Waves, Generation and Maintenance by High Frequency Oscillations."

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Brief Items

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C. R. Hanna, "Noise Measuring Instruments."

F. C. Hanker, "Electric Power Development in the United States."

While one group of scientists has been perfecting electrical machinery that will run at higher and still higher speeds, another group has been going to the other extreme by perfecting a timing motor that will revolve only twice a day. In fact, according to L. W. Chubb, director of research for Westinghouse Electric & Manufacturing Company, by following the same principles, the speed could be slowed down to once a year or even less, and theoretically there is no limit to the slowness that could be achieved.

Although still in the experimental stage, and not commercially available, the fact that it is practical and workable has been demonstrated in a clock of unique design. The clock has only four moving parts, each of which is neecssary to operate one of the hands. The fastest of these revolves only 60 times a minute. If the four points of wear were to be sealed in oil cups and jewels used for bearings as in good watches, the clock should run forever without attention. Such performance, however, would require that electric enrrent never be interrupted. In Chubb's "gearless" clock there are no gear teeth to mesh. The electrical "gears" are held together by magnetism so there is neither wear nor need for lubrication. This prompts the statement that the clock should run forever. The slowest motor in this clock runs but one revolution per minute, and is the speed desired for the second hand.

WGY, the General Electric Company's broadcasting station, is celebrating its tenth birthday with the announcement that it has begun installing at South Schenectady one of the most modern 50-kilowatt broadcasting transmitters in the United States. Approximately three months will be needed to put the transmitter into service, according to the announcement by C. H. Lang, manager of the publicity department of the company, and the work is to be completed by May 8.

This transmitter is designed by General Electric radio engineers for improved operating characteristics, particularly as regards frequency stability, quality of transmission, and continuity of operation. Many of these improvements are being incorporated as a result of the company's experience in operating and maintaining broadcasting transmitters for the past ten years. This experience has continually been used as a basis for continued improvements up to the present time. Throughout the earlier period new design features have been incorporated at WGY for thorough operating tests under actual service conditions before such features were included in transmitters manufactured.

No more than nine other stations on the air today can claim to be as old or to have had as active a part in the development of broadcasting as WGY. In the carliest days of radio experimentation the General Electric Company secured a license to operate a broadcasting station, both to provide a medium for experiments and to promote programs valuable for instruction and entertainment. When the right of WGY to full-time operation and an exclusive channel was threatened, the station's popularity was demonstrated by the thousands of letters from its hearers whieh poured into the federal radio commission. Through its close association with radio engineering, WGY was able to pioneer in many essential developments—erystal frequency eontrol in the transmitter, the eondenser type of microphone, wave propagation tests, and other important adjunets. From WGY signals of 50,000 watts were heard for the first time—and many listeners feared their receiving sets would be set afire and that their radio tubes would give way under the load.

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Brief Items

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At a later date WGY experimented with 100,000 and 200,000 watts. Through the use of short-wave transmitters WGY has offered its listeners many unique programs.

In the new transmitter the signals, controlled, metered, and amplified, pass through a power amplifier, the first stage of which employs a 50-watt radiotron. The second stage consists of two 250-watt radiotrons operating in push-pull. After passing through this stage, the signals attain a voltage level equivalent to ten times the voltage of the ordinary lighting circuit, and the power developed is greater than that required to operate three ordinary radio receivers. Improved operation has been effected in the power amplifier circuits so that the correct phase relationship of the various frequencies is maintained.

Important from the listeners' standpoint is the fact that the radio frequency for the transmitter is obtained from one of two crystal-controlled oscillators. Both oscillators are operated continuously day and night and are instantly available for use. The highest degree of frequency stability is attained, and provides maximum assurance that interference with other high-class stations will not be experienced.

From the 50-kilowatt stage—with a maximum rating of more than 200 kilowatts—combined currents are sent to the antenna over a new type of three-wire transmission line and are then broadcast to the radio audience.

In order that the operators may have proper control of the transmitting apparatus, it is essential that the functioning of the various parts may be readily checked. The new remote control room will be equipped with special monitoring loud speakers which may be connected at various points in the circuit for direct quality checking by ear. Volume controls will be used for maintaining the audio currents within predetermined limits. Two different types of modulation indicating devices are provided for checking the modulating process. One of these is an oscillagraph of special design by means of which either visual observation or permanent recording of the combined currents may be made. The second device is a modulation alarm indicator equipped with an automatic alarm mechanism, so that when a predetermined degree of modulation is exceeded, it is immediately called to the operator's attention by a buzzer. These precautions are elaborate, but recent tests have shown that if the modulation is allowed to exceed one hundred per cent an additional range of audio frequencies is produced which not only causes a loss of efficiency but may cause interference in adjacent channels because of the increased width of the sidebands.

Herbert J. Westenlandt, Baltimore, Md.: I have been a consistent reader of your magazine for two years and was very much pleased when it graduated into a monthly. I have kept the past issues, torn them apart and filed the various subjects separately, all cross-indexed. I am not one of the so-called old-timers and not in the business. I am interested in radio only as a hobby, this hobby being two years old. When I first became interested I bought copies of every radio magazine I could find and, needless to say, yours is the only one which has survived. I do think you could be more careful to avoid errors. For instance, two of the reactance formulas on page 87 of the fall issue of 1930 are wrong. This issue, by the way, I consider the most valuable and instructive ever published. One of the main purposes of this letter is to inquire about the antenna installation described on page 38 of the January 1932 issue. I have settled, to the complete satisfaction of both parties, many controversies on receiver performances by means of your published curves. The whole radio world owes you homage by publishing curves which may be relied upon. By no stretch of the imagination could a better way be conceived to promote honest ad-

Brief Items

(Continued from preceding page)

vertising by radio manufacturers. I note an inquiry in the last issue by R. F. Renaud of Syracuse, N. Y. On a circuit for the new Weston Universal meter. I have designed and am using a circuit that requires only one selector switch and one DPDT switch to get any reading, either a-c or d-c voltages or current. The layout is far cheaper and simpler than any I have ever seen published. How about the set tester you promised the last months? Ans. We are sorry that an error occurred on the diagram concerning the antenna and counterpoise installation about which you ask. The dimension should be in feet and not in inches, which makes it about correct. If you are going to use such an installation for short wave reception, we recommend the inductance as given, but for broadcast it is often found that increasing the turns to give an inductance between 200 and 300 mh gives better results. We cannot give a definite answer because different locations and different receivers react differently. Hence, we suggest a little personal experimentation in these lines will give the required results in addition to some knowledge of the behavior of such a system. The set tester circuit that we had mentioned before appears in the April and May issues.

Stewart Taylor, Memphis, Tenn.: I am sure you will never know what your magazine means to me. I don't believe there is another magazine which can be compared with it. I want to know how to find the correct resistance and condenser capacities in circuits where parts are not marked. Ans. The most convenient way is to use an ohmmeter such as was described on page 28 of the February, 1932, issue, and the capacity meter as described on page 36 of the November, 1931, issue.

Lewis Ceasy Umlauf, Fleetwood Hall, Moon P. O., Mathews County, Va.: I have been subscribing directly for quite some time, but before that, I used to have the magazine sent in by my jobber. In response to queries when renewing previous subscriptions I have indicated interest as that of "experimenter." Now the average experimenter usually uses batteries rather than line current for receiver voltage supply. Of course, I don't know what your reactions are to this class of "bugs," but all with whom I have come in contact are doing as I am, simply not renewing or no longer getting the journal because there is practically nothing in it of any interest to them. For instance, young fellows getting interested in radio ask me for a reference. How can I tell them to be sure to get the *Call Book* when I know there will be nothing in it of any service to them. I am writing bluntly and directly to the point, for it does seem to me that the *Call Book* as now gotten out is a mighty fine piece of work for the regularly employed service man, but not worth a nickel to any other. Battery sets are still built and sold to those who really want results. As a WMAQ man a short time ago said: "Some people think interest is dying out in DX. Well, they should see the volume of inquiries which is sent in with regard to XER." I do not know the WMAQ man, for I never met him that I know of, but just quote him at random, as you may wish to communicate with him. As you probably know, the usual factory set does not satisfy DX demands. Sorrowfully submitted, as like many, many others, I hate to lose the good old *Call Book* of a few years ago. Ans. We should appreciate comments from our interested readers on this letter. Being a DX hound himself, the editor has some of his own ideas on battery sets versus a-c sets, which are quite at variance with those of Mr. Umlauf. Should the demand be great enough for the type of material referred to above, the Editorial Department will include data which will be

Brief Items

(Continued from preceding page)

of value to this class of reader, but sentiment along these lines must be definitely proved before material of value is deleted to make room.

Franklin S. Lerch, Schenectady, N. Y.: I bought copies of the December and March issues of RADIO CALL BOOK MAGAZINE. The performance curves of radio receivers published in these issues interested me and I, therefore, am submitting my subscription. With most receivers you give some information about the noise level. However, you omitted this from the Scott All-Wave superheterodyne in your December issue. May I request this information about the minimum and maximum values? My occupation is teaching college mathematics. I feel that your performance curve information on standard receivers is valuable even to the public, as a guide for buying the proper kind of set. I am interested in your magazine for just such a reason. Ans. The noise levels which you request are 79 per cent, the maximum, at 1000 kc, and 46 per cent, the minimum, at 1400 kc. We appreciate your kind words and hope that you will always be a satisfied follower.

Experimental work with the ultra short, 42-centimeter wave, radio beam reveals a new power for such short waves and it is believed the studies will have an important bearing on the commercial development of television.

Electric tubes now sort thousands of cards, bills or checks daily. They simplify the process of taking gold, silver, cement, sulphuric acid, arsenic, coal tar products and other valuables out of smoke and flue gases and they match colors perfectly. Others containing resistances of several billion ohms, make possible the amplification of photo electric currents 10,000 times.

Education by Radio

FORTY authorities on economics, psychology and related fields will speak over a National Broadcasting Company network in its weekly coast-to-coast educational feature for the spring term of 1932.

The speakers will be presented by the National Advisory Council on Radio in Education as a continuation of its "Listen and Learn" lecture series inaugurated last Fall. An economist and psychologist will speak for fifteen minutes each every Saturday over an NBC-WEAF network at 8:30 p. m., E. S. T. The series will continue twenty weeks, closing with a valedictory program the last week in May.

International trade, the tariff and industrial planning will be economic subjects touched upon during the series by James Harvey Rogers of Yale, Ernest M. Patterson of Pennsylvania, F. W. Taussig of Harvard, George Henry Soule, Jr., editor of The New Republic, Walton H. Hamilton of Yale and others.

Changes and growth in personalities, animal behavior and psychology in education will be discussed by Fred A. Moss of George Washington University, Henry W. Nissen of Yale, Frank N. Freeman of Chicago, and others.

Public response to the initial ten lectures broadcast in the Fall has indicated, according to the council, that they reached listening groups in the home, school, special neighborhood gatherings and even remote fishermen of the Nova Scotian coast.

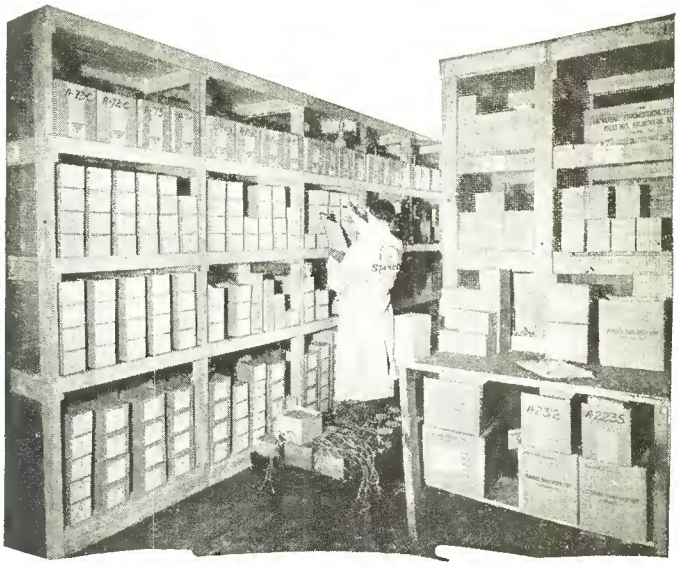
John W. Elwood, NBC vice president who arranged the broadcast series with Levering Tyson, director of the Council, said the series demonstrated what could be accomplished by coordinated effort between educators and broadcasters.

"The series has proved that where there is a sincere desire, educators and broadcasters can get along without stepping on each other toes," Elwood said. "It has demonstrated what can come from practical and sensible cooperation and organized effort between the educators and the broadcasters.

"I feel that the broadcasters have learned a good deal about education, and that the educators have learned a good deal about broadcasting technique. It is only the beginning, but it is the first practical research that has been done in radio by educators on a nation-wide scale."

Tyson said the correspondence resulting from the first programs had convinced him that the public welcomes broadcasting that gives authentic information in an interesting way.

The story of a service you needed...and how to get it.



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THERE'S several million perfectly good receiving sets in operation in these great United States . . . good, if certain vital parts can be replaced quickly, easily and at not too great a cost. Those sets are going to be in operation for a long time to come too, or the folks who own them just aren't going to have any radio.

But, where are those parts to come from?

The radio industry has grown up so fast, manufacturers of sets have, neeessarily, been vastly more concerned with the production of new models than with service of the old.

And now the time has come when the service men and dealers, on whom the burden of maintenance falls, must have adequate, reliable sources for replacement parts for all those millions of sets . . . many of which are no longer made, by name . . . many more of which are no longer current models.

Replacement Transformers are in the front of these considerations and that's where this organization fits into your scheme of things and begins to help you make money and satisfy your customers.

Since its inception, the transformer units designed and produced by this organization have become the preferred equipment for original installation among radio manufacturers generally. It wasn't long before we began to be swamped with requests for this, that and the other transformer for such and such a model of so and so's make. We made 'em and we made so many we decided to *stock exact-duplicate* transformers for a wide range of makes and models of receiving sets so the service man could replace transformers quickly, easily, at a profit to himself and a saving to his customer.

Stancor Replacement Transformers are *exact-duplicates* of the physical and electrical characteristics of the transformers of the sets for which they were primarily designed; properly balanced with other equipment, insure renewal of the original performance of the set. They become an integral part in fact as well as theory.

There is no re-fitting or re-drilling necessary in their installation and there is no unsightly re-wiring to detract from a workmanlike appearance in the completed job.

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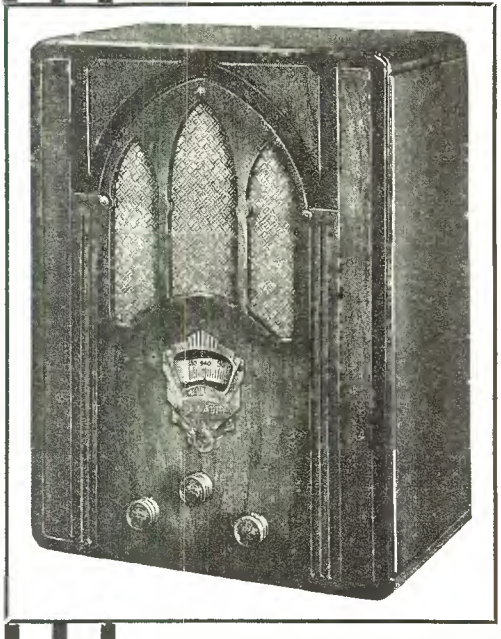

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