CITIZENS

Radio Call Book Magazine

N.S.E.

and TECHNICAL REVIEW

WINTER EDITION

50¢

SERVICE - REPAIR - ENGINEERING

TRAIN

with the R.T.A.—where Radio Employers

HIRE!

We Could Have Placed 5000 More Qualified Men Last Year in Good Pay RADIO Positions

GET into the rich field of Radio via the training school that supplies big Radio employers with their new men! The Radio Training Association of America has a standing order from radio trade organizations, large manufacturers and dealers, for members qualified for full time work at splendid pay.

So great is this demand from Radio employers that positions offering good pay and real opportunity are going begging. If you want to cash in on Radio quick, earn $3.00 an hour and up spare time, $40 to $100 a week full time, prepare for a $10,000, $15,000, $25,000 a year Radio position, investigate the R. T. A. now.

Special Attention to Radio Service Work

Thousands of trained Radio Service Men are needed now to service the new all-electric sets. Pay is liberal, promotions rapid. The experience you receive fits you for the biggest jobs in Radio. The R. T. A. has arranged its course to enable you to cash in on this work within 30 days!

Would you like to work "behind the scenes" at Hollywood, or for a talking picture manufacturer? R. T. A. training qualifies you for this work. Television, too, is included in the training. When television begins to sweep over the country, R. T. A. men will be ready to cash in on the big pay jobs that will be created.

Expert Supervision Lifelong Consultation Service

As a member of the Association you will receive personal instruction from skilled Radio Engineers. Under their friendly guidance every phase of Radio will become an open book to you. And after you graduate the R. T. A. Advisory Board will give you personal advice on any problems which arise in your work. This Board is made up of big men in the industry who are helping constantly to push R. T. A. men to the top.

Because R. T. A. training is complete, up-to-date, practical, it has won the admiration of the Radio industry. That's why our members are in such demand—why you will find enrolling in R. T. A. the quickest, most profitable route to Radio.

Mail Coupon for *No-Cost* Training Offer

Memberships that need not—should not—cost you a cent are available for a limited time. The minute it takes to fill out coupon at right for details can result in your doubling and trebling your income in a few months from now. If you are ambitious, really want to get somewhere in life, you owe it to yourself to investigate. Learn what the R.T.A. has done for thousands — and can do for you. Stop wishing and start *actually doing something* about earning more money. Fill out the coupon and mail today.

Radio Training Association of America
Dept. RCB-11 4513 Ravenswood Ave., Chicago, Ill.

Fill Out and Mail Today!

RADIO TRAINING ASSOCIATION OF AMERICA
Dept. RCB-11, 4513 Ravenswood Ave., Chicago, Ill.

Gentlemen: Send me details of your No-Cost Training Offer and information on how to make real money in Radio *quick*.

Name _____

Address _____

City _____ *State* _____

Citizens Radio Call Book Magazine and Technical Review, November, 1930. Published 4 times yearly, January 1, March 1, September 1, November 1. Volume XI, No. 4. Published at Chicago, Ill. Subscription price, $2.00 yearly. Entered as second-class matter January 24, 1930, at the Post Office at Chicago, Ill., under the Act of March 3, 1879. Citizens Radio Service Bureau, Inc., Publishers, 508 So. Dearborn St., Chicago.

"PROVE *to my satisfaction* that Brunswick can out-perform *any set on the market in selectivity,*" said a prominent upstate New York dealer, "and *I'll guarantee* that Brunswick will *out-sell* any set *in this market!*"

Located in a territory notorious for its difficult receiving conditions, with one powerful station blanketing the ether, this dealer was naturally skeptical. His sales depended absolutely upon his being able to supply his customers with a radio that would cut through the all-powerful local station and give them a choice of out-of-town programs.

Brunswick engineers gladly met his challenge. They offered to make a wide open test under any conditions, against the most selective competing set he could name.

He picked a model widely known for its selectivity—a brand that had led in sales in his district because of that very reason.

The test was made in a room in a hotel located only a few blocks away from the broadcasting station.

Point-for-point, this dealer checked the two instruments. Brunswick won—*hands down*—not only on selectivity, but also on distance, tone quality, and ability to shield out local interference coming from the hotel elevators, and nearby power-stations.

"All right," said the dealer with a grin, "you can sign me up. This town is going Brunswick from now on!"

BRUNSWICK RADIO CORPORATION—MANUFACTURERS OF RADIO, PANATROPE AND RECORDS—NEW YORK, CHICAGO, TORONTO—SUBSIDIARY OF WARNER BROS. PICTURES, INC.

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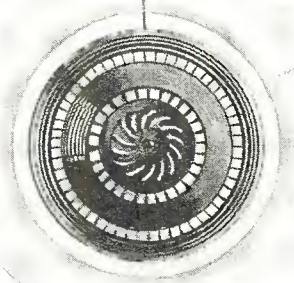
PIN-POINT SELECTIVITY IS A FEATURE OF THE NEW BRUNSWICK



Brunswick RADIO

Citizens Radio Call Book Magazine

AND TECHNICAL REVIEW

Registered in U. S. Patent Office
Established 1921

C. O. STIMPSON, President
H. ANHEISER, Treasurer

Executive Offices:
508 So. Dearborn St., Chicago, Ill.

Member Audit Bureau of Circulations

F. A. HILL, Editor
RICHARD K. PEW, Technical Editor

NOVEMBER, 1930 | Published January, March, September, November | Vol. 11, No. 4

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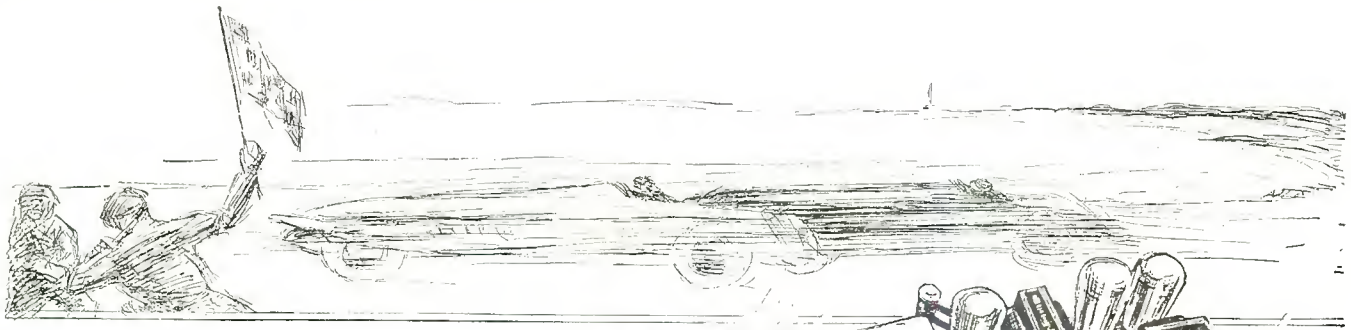
Citizens Radio Call Book Magazine is published four times a year and is on sale approximately the first of January, March, September and November. Subscription price $2.00 per year in U. S. A. Canada and Foreign $2.25 per year, payable in advance. Single copies 50 cents. Remit by check, draft, or P. O. order. No foreign stamps or coins accepted. Mail subscriptions to 508 So. Dearborn Street, Chicago. We will not be responsible for cash sent for subscriptions unless registered.

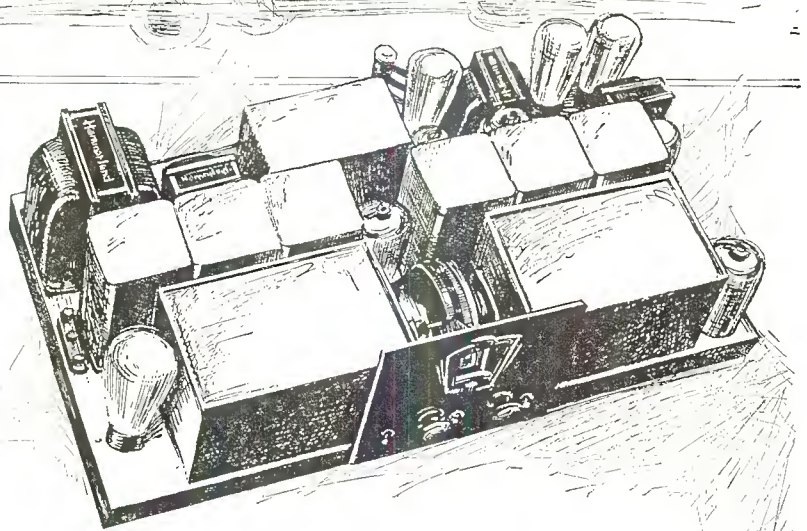
Advertising Representatives:
Chicago—A. B. Mills, 508 So. Dearborn St. Wabash 1901.
New York—(Branch Office)—154 W. 42nd St., Room 1125. Wisconsin 5681.
Entered as second class matter November 15, 1928, at the Postoffice at Chicago, Illinois, under the act of March 3, 1879.

Distribution of Broadcast Chains by Cities

	Chain	Kilocycles
Akron, Ohio		
WFJC	National	1450
Asheville, N. C.		
WWNC	Columbia	570
Atlanta, Ga.		
WGST	Columbia	890
WSB	National	740
Atlantic City, N. J.		
WPG	Columbia	1100
Baltimore, Md.		
WBAL	National	1060
WCAO	Columbia	600
Bangor, Me.		
WLBZ	Columbia	620
Bay City, Mich.		
WBCM	Columbia	1410
Birmingham, Ala.		
WAPI	National	1140
WBRC	Columbia	930
Boston, Mass.		
WEEI	National	590
WBZA	National	990
WNAC	Columbia	1230
Buffalo, N. Y.		
WGR	National	550
WBEN	Columbia	900
WKBW	Columbia	1480
Charlotte, N. C.		
WBT	National	1080
Chattanooga, Tenn.		
WDOD	Columbia	1280
Chicago, Ill.		
WGN	National	720
WLIB	National	720
WENR	National	870
WLS	National	870
KYW	National	1020
KFKX	National	1020
WCFL	National	970
WIBO	National	560
WMAQ	Columbia	670
WBBM	Columbia	770
WJJD	Columbia	1130
Cincinnati, Ohio		
WLW	National	700
WSAI	National	1330
WKRC	Columbia	550
Clearwater, Fla.		
WFLA	National	620
WSUN	National	620
Cleveland, Ohio		
WTAM	National	1070
WHK	Columbia	1390
Columbus, Ohio		
WAIU	Columbia	640
WCAH	Columbia	1430
Council Bluffs, Iowa		
KOIL	Columbia	1260
Covington, Ky.		
WCKY	National	1490
Dallas, Texas		
WFAA	National	800
KRLD	Columbia	1040
WRR	Columbia	1280
Davenport, Iowa		
WOC	National	1000
Denver, Colo.		
KLZ	Columbia	560
KOA	National	830
Des Moines, Iowa		
WHO	National	1000
Detroit, Mich.		
WWJ	National	920
WJR	National	750
Fargo, N. Dak.		
WDAY	Columbia	940
Ft. Wayne, Ind.		
WOWO	Columbia	1160
Ft. Worth, Texas		
WBAP	National	800
Harrisburg, Pa.		
WHP	Columbia	1430
Hartford, Conn.		
WTIC	National	1060
Hopkinsville, Ky.		
WFIW	Columbia	940
Hot Springs, Ark.		
KTHS	National	1040
Houston, Texas		
KPRC	National	920
KTRH	Columbia	1120
Independence, Mo.		
KMBC	Columbia	950
Indianapolis, Ind.		
WFBM	Columbia	1230
Jackson, Miss.		
WJDX	National	1270
Jacksonville, Fla.		
WJAX	National	900
Kansas City, Mo.		
WDAF	National	610
Lawrence, Kan.		
WREN	National	1220
Lincoln, Neb.		
KFAB	National	770
Little Rock, Ark.		
KLRA	Columbia	1390
London, Can.		
CJGC	Columbia	910
Los Angeles, Calif.		
KECA	National	1430
KFI	National	640
KHJ	Columbia	900
Louisville, Ky.		
WHAS	National	820
Memphis, Tenn.		
WMC	National	780
WREC	Columbia	600
Miami, Fla.		
WQAM	Columbia	560
Miami Beach, Fla.		
WIOD	National	1300
Milwaukee, Wis.		
WTMJ	National	620
WISN	Columbia	1120
Minneapolis, Minn.		
WCCO	Columbia	810
WRHM	Columbia	1250
Montreal, Can.		
CKAC	Columbia	730
Nashville, Tenn.		
WSM	National	650
WLAC	Columbia	1470
New Orleans, La.		
WSMB	National	1320
WDSU	Columbia	1250
New York, N. Y.		
WEAF	National	660
WJZ	National	760
WABC	Columbia	860
Norfolk, Va.		
WTAR	Columbia	780
Oil City, Pa.		
WLBW	Columbia	1260
Oklahoma City, Okla.		
WKY	National	900
KFJF	Columbia	1480
Omaha, Neb.		
WOW	National	590
Orlando, Fla.		
WDBO	Columbia	1120
Philadelphia, Pa.		
WFI	National	560
WLIT	National	560
WCAU	Columbia	1170
WFAN	Columbia	610
Phoenix, Ariz.		
KTAR	National	620
Pittsburgh, Pa.		
WCAE	National	1220
KDKA	National	980
WJAS	Columbia	1290
Portland, Me.		
WCSH	National	940
Portland, Ore.		
KGW	National	620
KOIN	Columbia	940
Providence, R. I.		
WJAR	National	890
WEAN	Columbia	780
Raleigh, N. C.		
WPTF	National	680
Richmond, Va.		
WRVA	National	1110
Roanoke, Va.		
WDBJ	Columbia	930
Rochester, N. Y.		
WHAM	National	1150
WHEC	Columbia	1440
Salt Lake City, Utah		
KSL	National	1130
KDYL	Columbia	1290
San Diego, Calif.		
KFSD	National	600
San Antonio, Texas		
WOAI	National	1190
KTSA	Columbia	1290
San Francisco, Calif.		
KGO	National	790
KPO	National	680
KFRC	Columbia	610
Savannah, Ga.		
WTOC	Columbia	1260
Schenectady, N. Y.		
WGY	National	790
Seattle, Wash.		
KOL	Columbia	1270
KOMO	National	920
Sioux City, Iowa		
KSCJ	Columbia	1330
Spokane, Wash.		
KHQ	National	590
KFPY	Columbia	1340
Springfield, Mass.		
WBZ	National	990
St. Louis, Mo.		
KSD	National	550
KWK	National	1350
KMOX	Columbia	1090
St. Paul, Minn.		
KSTP	National	1460
Superior, Wis.		
WEBC	National	1290
Syracuse, N. Y.		
WFBL	Columbia	1360
Tacoma, Wash.		
KVI	Columbia	760
Tallmadge, Ohio		
WADC	Columbia	1320
Tampa, Fla.		
WDAE	Columbia	1220
Toledo, Ohio		
WSPD	Columbia	1340
Toronto, Can.		
CKGW	National	690
CFRB	Columbia	960
Topeka, Kan.		
WIBW	Columbia	580
Tulsa, Okla.		
KVOO	National	1140
Washington, D. C.		
WRC	National	950
WMAL	Columbia	630
Waterloo, Ia.		
WMT	Columbia	600
Wichita, Kan.		
KFH	Columbia	1300
Worcester, Mass.		
WTAG	National	580
Yankton, S. Dak.		
WNAX	Columbia	570
Youngstown, Ohio		
WKBN	Columbia	570



There's Something BETTER *in a Winner!*



STAMINA! they call it—or *grit*, if you prefer—that's what makes a winner.

Motor or radio—it's got to be BETTER or fall out.

Six years of glorious success are back of Hammarlund-Roberts Custom-Built Radio—six years of persistent pioneering—six years of leading the procession.

With such a record you can expect the new HiQ-31 to be exactly what it is—a *perfected* radio, cleverly engineered, superbly designed and built to out-perform the field.

Name your ideal features and check against these HiQ-31 highlights:—

Hair-splitting selectivity through a three-stage tuned band-filter and three-stage screen-grid radio frequency amplifier—both brand new; new linear power detector using a shielded screen-grid tube; new resistance coupled first audio stage feeding direct into push-pull '45's; amazing sensitivity, four times that of standard receivers; dazzling brilliance of tone; new automatic phonograph connection; new oversize power plant; new local and distance volume control; new high-frequency noise filter and tone regulator; six tuned circuits; nine tubes, including automatic line voltage control and full-wave rectifier; a wide choice of beautiful cabinets.

And the best of all—you can easily assemble it yourself from factory-wired units, or for a small fee, delegate the work to your local custom-builder.

Choice of ten charming consoles, including three radio-phonograph combinations.

Mail coupon for the 48-page illustrated HiQ-31 Manual. It contains a wealth of valuable radio data.

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NEW YORK, N. Y.

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New York, N. Y.
Enclosed 25c (stamps or coin) for which
please send copy of the HiQ-31 Manual.
Name .....
Address .....

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.

KBPS
1420 kc, Portland, Ore., Benson Polytechnic School, 100 w, P.

KBTM
1200 kc, Paragould, Ark., Beard's Temple of Music, 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., D. Faulding, 100 w, P.

KDFN
1210 kc, Casper, Wyo. D. L. Hathaway, 100 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, "On the Air, Goes Everywhere.

KECA
1430 kc, Los Angeles, Calif., Pacific Development Radio Co., 1000 w, P.

KELW
780 kc, Burbank, Calif., Earl L. White, 500 w, P, "The White Spot of the San Fernando Valley."

KEX
1180 kc, Portland, Ore., Western Broadcasting Co., 5000 w, P, "A Public Service Necessity."

KFAB
770 kc, Lincoln, Nebr., KFAB Broadcasting Co., 5,000 w, C, "Home Sweet Home."

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, "The Voice of Puget Sound."

KFDM
560 kc, Beaumont, Tex, Magnolia Petroleum Co., 500 w, C, "Kall for Dependable Magnolene."

KFDY
550 kc, Brookings, S. D., State College, 500 w, C.

KFEL
920 kc, Denver, Colo., Eugene P. O'Fallon, Inc., 500 w, M, "The Argonaut Station."

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, "Kansas' Finest Hotel, in the Very Heart of God's Country."

KFHA
1200 kc, Gunnison, Colo., The Hawkins Craig Syndicate, 50 w.

KFI
640 kc, Los Angeles, Calif., Earl C. Anthony, Inc., 5000 w, P, "National Institution."

KFIO
1120 kc, Spokane, Wash., Spokane Broadcasting Corp., 100 w day, 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, "Marshalltown, the Heart of Iowa."

KFJF
1480 kc, Oklahoma City, Okla., National Radio Mfg. Co., 5000 w, C, "Radio Headquarters of Oklahoma."

KFJI
1370 kc, Astoria, 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 & Son, 500 w, P.

KFJY
1310 kc, Ft. Dodge, Iowa, C. S. Tunwal, 100 w, C.

KFJZ
1370 kc, Ft. Worth, Texas, Henry Clay Meacham, 100 w, C.

KFKA
880 kc, Greeley, Colo., Mid-Western Radio Corp., 500 w, M. Shared.

KFKB
1050 kc, Milford, Kan., KFKB Brdcstg. Assn., 5000 w, C, "The Sunshine Station in the Heart of the Nation."

KFKU
1220 kc, Lawrence, Kan., University of Kansas, 1000 w, C, "Up at Lawrence on the Kaw."

KFKX
See under KYW.

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, "Known for Neighborly Folks."

KFOR
1210 kc, Lincoln, Neb., Howard A. Shuman, 100 w, C.

KFOX
1250 kc, Long Beach, Calif., Nichols & Warriner, Inc., 1000 w, P, "Where Your Ship Comes In."

KFPL
1310 kc, Dublin, Texas, C. C. Baxter, 100 w, C, "Baxter's Place."

KFPM
1310 kc, Greenville, Texas, The New Furniture Co., 15 w, C, "Biggest Little Ten Watts on the Air."

KFPW
1340 kc, Ft. Smith, Ark., John Brown Schools, 50 w, C.

KFPY
1340 kc, Spokane, Wash., Symons Broadcasting Co., 500 w, P.

KFQD
1230 kc, Anchorage, Alaska, Anchorage Radio Club, 100 w.

KFQU
1420 kc, Holy City, Calif., W. E. Riker, 100 w, P.

KFQW
1420 kc, Seattle, Wash., KFQW, Inc., 100 w, P, "Gateway to Alaska and the Orient."

KFRC
610 kc, San Francisco, Calif., Don Lee, Inc., 1000 w, P.

KFRU
630 kc, Columbia, Mo., Stephens College, 500 w, C, "Where Friendliness Is Broadcast Daily."

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, "The Church of the Air."

KFUL
1290 kc, Galveston, Texas, W. H. Ford, 500 w, C, "The City of Perpetual Sunshine."

KFUM
1270 kc, Colorado Springs, Colo., W. D. Corley, 1000 w, M, "Known for Unsurpassed Mountain Scenery."

KFUO
550 kc, St. Louis, Mo., Concordia Theological Seminary, 500 w, C, "The Gospel Voice."

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, "The City of Opportunity."

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.

KFWM
930 kc, Richmond, Calif., Oakland Educational Society, 500 w, P, "The Most Good to the Most People."

KFXD
1420 kc, Nampa, Idaho, Service Radio Co., 50 w, M.

KFXF
920 kc, Denver, Colo., Colorado Radio Co., 500 w, M, "The Voice of Denver."

KFXJ
1310 kc, Edgewater, Colo., R. G. Howell, 50 w, M. "America's Scenic Center."

KFXM
1210 kc, San Bernardino, Calif., Lee Bros. Broadcasting Co., 100 w, P, "The Voice of the Orange Empire."

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, T. E. Kirksey, 100 w, C, "Breckenridge, the Dynamo of West Texas."

KFYR
550 kc, Bismarck, N. D., Meyer Broadcasting Co., 500 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, "Way Out on the Desert."

KGB
1330 kc, San Diego, Calif., Pickwick Broadcasting Corp., 250 w, P, "Music for the Sick."

KGBU
900 kc, Ketchikan, Alaska, Alaska Radio & Service Co., 500 w.

KGBX
1310 kc, St. Joseph, Mo., KGBX, Inc., 100 w.

KGBZ
930 kc, York, Nebr., Geo. R. Miller, 500 w, C, "The Swine and Poultry Station."

KGCA
1270 kc, Decorah, Iowa, Chas. W. Greenley, 50 w, C.

KGCI
1370 kc, San Antonio, Texas, W. W. McAllister, 100 w, C, "Radio Sam at San Antonio."

KGCR
1210 kc, Watertown, S. D., Cutler's Radio Broadcasting Service, Inc., 100 w.

KGCU
1200 kc, Mandan, N. D., Mandan Radio Association, 100 w, M, "The Voice of the West."

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., Loesch & Wright, 15 w, C.

KGEF
1300 kc, Los Angeles, Calif., Trinity Methodist Church, 1000 w, P.

KGEK
1200 kc, Yuma, Colo., Beehler Elec. Equip. Co., 50 w, M. Shared.

KGER
1360 kc, Long Beach, Calif., C. Merwin Dobyns, 1000 w, P, "The Service Club of the Air."

KGEW
1200 kc, Ft. Morgan, Colo., City of Ft. Morgan, 100 w, P.

KGEZ
1310 kc, Kalispell, Mont., Chamber of Commerce, 100 w, M, "Located in the Switzerland of America—The Beautiful Flathead Valley."

KGFF
1420 kc, Alva, Okla., D. R. Wallace, 100 w, C.

KGFG
1370 kc, Oklahoma City, Okla., Oklahoma Broadcasting Co. Inc., 100 w, C, "The Whole Gospel to the Whole World."

KGFI
1500 kc, Corpus Christi, Texas, Eagle Broadcasting Co., 100 w, C, "The Voice of West Texas."

KGFJ
1200 kc, Los Angeles, Calif., Ben S. McGlashan, 100 w, P, "Keeps Good Folks Joyful"

KGFK
1500 kc, Moorhead, Minn., Red River Broadcasting Co. Inc., 50 w, C.

KGFL
1370 kc, Raton, N. Mex., W. E. Whitmore, 50 w, M.

KGFW
1310 kc, Ravenna, Neb., Sothman & McConnell, 50 w.

KGFX
580 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, Picher, 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.

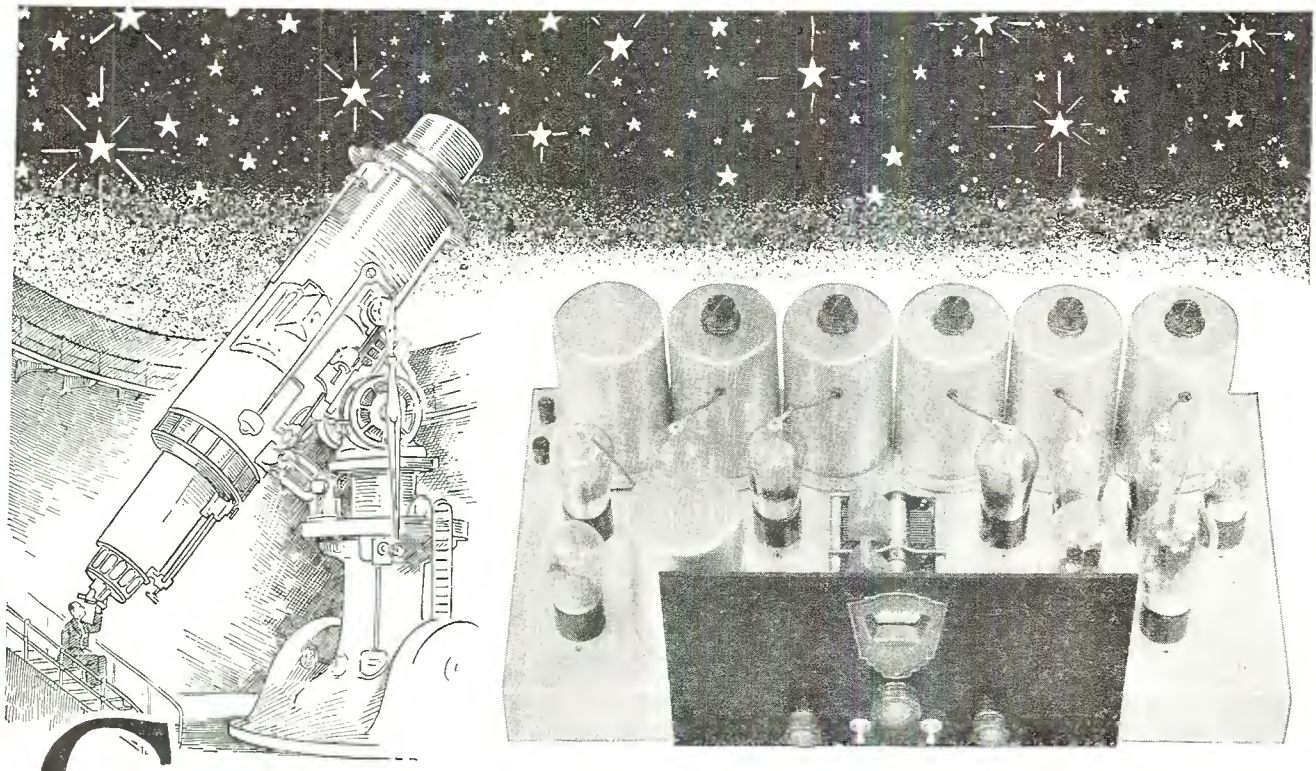
KGHI
1200 kc, Little Rock, Ark., Berean Bible Class, 100 w.

KGHL
950 kc, Billings, Mont., Northwestern Auto Supply Co., 500 w, M.

KGIQ
1320 kc, Twin Falls, Idaho, Radio Broadcasting Corp., 250 w, M.

KGIR
1360 kc, Butte, Mont., KGIR, Inc., 500 w, M.

KGIW
1420 kc, Trinidad, Colo., Leonard E. Wilson, 100 w, M.



Get the *Distant Stars* of the Broadcast Firmament!

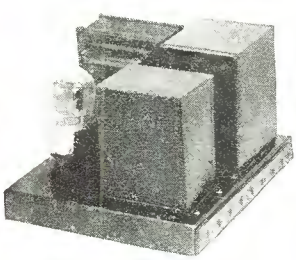
WITH THE LINCOLN DE LUXE 31

AS the Powerful Telescope Brings the Distant Stars to the Eye So will the Lincoln De Luxe 31 Bring You Programs from Distant Stations.

Stop and analyze before you buy. Don't spend your money for advertised claims. Talk to someone who knows "radio." Talk to Lincoln owners, hundreds, who will verify our statements. Ask them if we have ever claimed one-half of what the De Luxe 31 is capable of doing. Ask them to demonstrate their receiver; and if you are only acquainted with factory built performance, you will get a new conception of how much you have missed.

WHY? Because LINCOLN engineering has produced equipment which has consistently outperformed every radio set known; it has done it for years and is doing it today. LINCOLN EQUIPMENT has had what you must have if you want maximum performance out of a radio set.

YOU MUST HAVE high amplification coupled with extreme selectivity and sensitivity, and, at the same time, good fidelity. THE LINCOLN DE LUXE 31 HAS ALL THIS, AND MORE. (Read the laboratory report in Citizens Radio Call Book Fall Edition.)



LINCOLN DE LUXE 31-ABC supplies correct voltages for "31" chassis

Six Screen Grid Tubes with high gain perfectly controlled brings signals you have never heard before into your home with a volume equal to local.

Capable of amplifying the weakest signal to any degree desired without background from adjacent channels.

Regulation of fidelity, eliminating any possibility of side band cutting.

Seven tuned circuits producing a filter system never before equalled. Perfect rejectivity on a 10 KC band with tremendous amplification. Tuned plate system (originated on Lincoln 8-80 in 1928). Cadmium plated steel chassis with general refinements throughout, including shielded antenna and oscillator.

THERE'S A REASON WHY our laboratory is turning out these equipments as fast as possible to fill the many orders on file. Just put two and two together and write us for complete information on the most powerful receiver made today.

DISTRIBUTION: Made only through qualified distributors. You can net from $200 to $400 a week profit if you are qualified to sell and service this equipment among the wealthy homes in your community. You can demonstrate perfect 10 KC separation from local with full volume, which has been the proved performance of LINCOLN equipment for years. You are not only selling verified performance but you also receive the full co-operation of everyone in our nine-year-old Corporation, who, together with hundreds of our good friends and authorized distributors have put LINCOLN equipment into many of America's most prominent homes. *Write for full information and special demonstrator discounts stating your qualifications to handle this equipment.*

LINCOLN RADIO CORPORATION

329 SOUTH WOOD ST. — CHICAGO - ILLINOIS.

Chassis Dimensions
21" x 10¾" x 7½"
"31-ABC"
8" x 9" x 7"

LINCOLN RADIO CORP., Dept. C
329 S. Wood St., Chicago
Send full information on De Luxe 31.

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(Print plainly)

Tubes Required
6—Type '24 S. G.
2—Type '27
2—Type '45
1—Type '80

KGIX
1420 kc, Las Vegas, Nev., J. M. Heaton, 100 w.

KGIZ
1500 kc, Grant City, Mo., Grant City Park Corp., 50 w, C.

KGJF
890 kc, Little Rock, Ark., First Church of the Nazarene, 250 w.

KGKB
1500 kc, Brownwood, Tex., Eagle Publ. Co., 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, C. E. Twiss and F. H. McCann, 100 w, P.

KGKY
1500 kc, Scottsbluff, Nebr., Hilliard Co., Inc., 100 w, C.

KGMB
1320 kc, Honolulu, Hawaii, Honolulu Broadcasting Co., 500 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. Shared.

KGU
940 kc, Honolulu, Hawaii, Marion Mulrony, Advertising Publ. Co., 500 w. "In the Land of Sunshine, the Future Playground of America."

KGW
620 kc, Portland, Ore., Oregonian Pub. Co., 1000 w, P, "Keep Growing Wiser."

KGY
1200 kc, Lacey, Wash., St. Martins College, 10 w, P, "Out Where the Cedars Meet the Sea."

KHJ
900 kc, Los Angeles, Calif., Don Lee, Inc., 1000 w, P, "Kindness, Happiness, Joy."

KHQ
590 kc, Spokane, Wash., Louis Wasmer, Inc., 1000 w, P, "In the Friendly City."

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
1250 kc, Boise, Idaho, Boise Broadcasting Station, 1000 w, P.

KIT
1310 kc, Yakima, Wash., C. E. Haymond, 50 w, P.

KJBS
1070 kc, San Francisco, Calif., Julius Brunton & Sons Co., 100 w, P, "The Voice of the Storage Battery."

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, Peery Building Co., 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, "The City of Golden Opportunity."

KLX
880 kc, Oakland, Calif., Tribune Pub. Co., 500 w, P, "Where Rail and Water Meet."

KLZ
560 kc, Denver, Colo., Reynolds Radio Co., Inc., 1000 w, M, "The Pioneer Station of the West."

KMA
930 kc, Shenandoah, Iowa. May Seed & Nursery Co., 500 w, C, "Keeps Millions Advised."

KMBC
950 kc, Kansas City, Mo., Midland Broadcasting Co., 1000 w, C, "Kansas City's Most Powerful Public Service Broadcasting Station."

KMED
1310 kc, Medford, Ore., Mrs. W. J. Virgin, 50 w, P, 'See Crater Lake."

KMIC
1120 kc, Inglewood, Calif., Dalton's, Inc., 500 w, P.

KMJ
1210 kc, Fresno, Calif., J. McClatchy Co., 100 w, P.

KMLB
1200 kc, Monroe, La., J. C. Liner, 50 w, C.

KMMJ
740 kc, Clay Center, Neb., The M. M. Johnson Co., 1000 w, C, The Old Trusty Station."

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, "Your Friend in Hollywood."

KNX
1050 kc, Hollywood, Calif., Western Broadcast Co., 5000 w, P, "The Voice of Hollywood."

KOA
830kc, Denver, Colo., National Broadcasting Co. Inc., 12,500 w, M.

KOAC
550 kc, Corvallis, Ore., Oregon State Agricultural College, 1000 w, P, "Science for Service."

KOB
1180 kc, State College, N. M., N. M. College of Agri. & Mech. Arts, 20,000 w, M, "The Sunshine State of America."

KOCW
1400 kc, Chickasha, Okla., Oklahoma College for Women, 250 w, C.

KOH
1370 kc, Reno, Nevada, Jay Peters, Inc., 100 w.

KOIL
1260 kc, Council Bluffs, Iowa, Mona Motor Oil Co., 1000 w, C, "The Hilltop Studio."

KOIN
940 kc, Portland, Ore., KOIN, Inc., 1000 w, P, "The Station of the Hour."

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., 50w, 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, "Kind Friends Come Back."

KPCB
650 kc, Seattle, Wash., Wescoast Broadcasting Co., 100 w, P. Shared.

KPJM
1500 kc, Prescott, Ariz., Miller & Klahn, 100 w, M.

KPO
680 kc, San Francisco, Calif., Hale Bros. & The Chronicle, 5000 w, P, "The City of the Golden Gate."

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, "Kotton Port Rail Center."

KPSN
1360 kc, Pasadena, Calif., Pasadena Star-News, 1000 w, P.

KPWF
1490 kc, Los Angeles, Calif., Pacific Western Broadcasting Federation, 10,000 w, P.

KQV
1380 kc, Pittsburgh, Pa., Doubleday-Hill Elec. Co., 500 w, E, "The Smoky City Station."

KQW
1010 kc, San Jose, Calif., Pacific Agric. Foundation, 500 w, P, "For God and Country."

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.

KRLD
1040 kc, Dallas, Texas, KRLD, Inc., 10,000 w, C, "Down Where the Blue Bonnets Grow."

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, KSEI Broadcasting Assn., 250 w, M, "Kummunity Southeast Idaho."

KSL
1130 kc, Salt Lake City, Utah, Radio Service Corp., 5000 w, M, "The Voice of the Intermountain Empire."

KSMR
1200 kc, Santa Maria, Calif., Santa Maria Valley R. R. Co., 100 w, P. "The Valley of Gardens."

KSO
1380 kc, Clarinda, Iowa, Berry Seed Co., 500 w, C. "Keep Serving Others."

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. "Knowledge, Truth and Beauty."

KTAP
1420 kc, San Antonio, Texas, Alamo Broadcasting Co., 100 w, C, "The World's Biggest Little Station."

KTAR
620 kc, Phoenix, Ariz., KTAR Broadcasting Co., 500 w, M, "Phoenix, Where Winter Never Comes."

KTAT
1240 kc, Ft. Worth, Tex., S. A. T. Broadcasting Co., 1000 w, C.

KTBI
1300 kc, Los Angeles, Calif., Bible Institute of Los Angeles, 750 w, P.

KTBR
1300 kc, Portland, Ore., M. E. Brown, 500 w, P.

KTBS
1450 kc, Shreveport, La., Tri-State Broadcasting Co., 1000 w, E.

KTHS
1040 kc, Hot Springs, Ark., Chamber of Commerce, 10,000 w, C, "Kum to Hot Springs."

KTLC
1310 kc, Houston, Tex., Houston Broadcasting Co., 100 w, C.

KTM
780 kc, Los Angeles, Calif., Pickwick Broadcasting Corp., 500 w, P, "The Station with a Smile."

KTNT
1170 kc, Muscatine, Iowa, Norman Baker, 5000 w, C, "The Voice of the Iowa Farmers' Union."

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
1270 kc, Seattle, Wash., First Presbyterian Church, 1000 w, P.

KUJ
1500 kc, Longview, Wash., Columbia Broadcasting Co., Inc., 10 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.

KUT
1500 kc, Austin, Tex., Rice Hotel, 100 w, C.

KVI
760 kc, Tacoma, Wash., Puget Sound Radio Broadcasting Co., 1000 w, P, "Puget Sound Station."

KVL
1370 kc, Seatle, Wash., KVL, Inc., 100 w.

KVOA
1260 kc, Tuscon, Ariz., R. M. Riculfi, 500 w.

KVOO
1140 kc, Tulsa, Okla., Southwestern Sales Corp., 5000 w, C, "The Voice of Oklahoma."

KVOS
1200 kc, Bellingham, Wash., KVOS, Inc., 100 w, M.

KWCR
1310 kc, Cedar Rapids, Iowa, Harry F. Paar, 100 w.

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, "The Voice from Broadway."

KWK
1350 kc, St. Louis, Mo., Greater St. Louis Broadcasting Corp., 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, 500 w, P, "The Voice of the Cougars."

KWWG
1260 kc, Brownsville, Texas, Brownsville Herald Publishing Co., 500 w, C, "Good Night, World."

KXA
570 kc, Seattle, Wash., American Radio Tel. Co., 500 w, P.

KXL
1420 kc, Portland, Ore., KXL Broadcasters, Inc., 100 w, P, "The Voice of Portland."

KXO
1500 kc, El Centro, Calif., Irey & Bowles, 100 w, P.

KXRO
1310 kc, Aberdeen, Wash., KXRO, Inc., 75 w.

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.

KZM
1370 kc, Hayward, Calif., Leon P. Tenney, 100 w, P.

NAA
690 kc, 434.5 m, United States Navy Department, Washington, D. C., 1000 w, "Where the Time Signals Originate," E.

WAAF
920 kc, Chicago, Ill., Drovers Journal Pub. Co., 500 w daytime, C.

WAAM
1250 kc, Newark, N. J., WAAM, Inc., 1000 w, E, "Sunshine Station."

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, "Pioneer Market Station of the West."

WABC
860 kc, New York City, N. Y., Atlantic Broadcasting Corp., 5000 w, E.

WABI
1200 kc, Bangor, Maine, Pine Tree Broadcasting Co., 100 w, E, "The Pine Tree Wave."

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., 100 w, C.

WADC
1320 kc, Tallmadge, Ohio, Allen T. Simmons, 1000 w, E, "Watch Akron Develop Commercially."

WAIU
640 kc, Columbus, Ohio, American Insurance Union, 500 w, E, "The Radio Voice of the American Insurance Union."

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., WASH Broadcasting Corp., 500 w, C.

WBAA
1400 kc, Lafayette, Ind., Purdue University, 500 w, C.

WBAK
1430 kc, Harrisburg, Pa., Pennsylvania State Police, 500 w, E, "The Voice of Pennsylvania."

WBAL
1060 kc, Baltimore, Md., Consolidated Gas, Elec. Co., 10,000 w, E, "The Station of Good Music."

WBAM
1440 kc, Greensboro, N. C., North Carolina Broadcasting Co., 500 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, "In Wyoming Valley, Home of the Anthracite."

WBBC
1400 kc, Brooklyn, N. Y., Brooklyn Broadcasting Corp., 500 w.

WBBL
1210 kc, Richmond, Va., Grace Covenant Presbyterian Church, 100 w, E, "Richmond, the Gateway North and South."

WBBM
770 kc, Chicago, Ill., Atlass Investment Co., 25,000 w, C.

WBBR
1300 kc, Brooklyn, N. Y., People's Pulpit Association, 1000 w, E, "Watch Tower."

WBBZ
1200 kc, Ponca City, Okla., C. L. Carrell, 100 w, C.

WBCM
1410 kc, Bay City, Mich., James E. Davidson, 500 w, E, "Where the Summer Trail Begins."

WBCN
See under WENR.

WBEN
900 kc, Buffalo, N. Y., Buffalo Evening News, 1000 w, E.

WBGF
1370 kc, Glens Falls, N. Y., W. Parker & N. Metcalf, 50 w, E.

WBIS
See under WNAC.

WBMS
1450 kc, Hackensack, N. J., WBMS Broadcasting Corp., 250 w.

WBNY
1350 kc, New York, N. Y., Baruchrome Corp., 250 w, E, "The Voice of the Heart of New York."

WBOQ
See under WABC.

WBOW
1310 kc, Terre Haute, Ind., Banks of Wabash Broadcasting Assn., 100 w, C, "On the Banks of the Wabash."

WBRC
930 kc, Birmingham, Ala., Birmingham Broadcasting Co., 500 w, C, "The Biggest Little Station in the World."

WBRE
1310 kc, Wilkes-Barre, Pa., Louis G. Baltimore, 100 w, E.

WBSO
920 kc, Wellesley Hills, Mass., Babson's Statistical Org., Inc., 250 w, E.

WBT
1080 kc, Charlotte, N. C., Station WBT, Inc., 5000 w, E, shared, "The Queen City of the South."

WBTM
1370 kc, Danville, Va., Clarke Elec. Co., 100 w, E.

WBZ
990 kc, Springfield, Mass., Westinghouse E. & M. Co., 15,000 w, E, "The Broadcasting Station of New England."

WBZA
990 kc, Boston, Mass., Westinghouse E. & M. Co., 500 w, E.

WCAC
600 kc, Storrs, Conn., Connecticut Agricultural College, 250 w, E, "Voice from the Nutmeg State."

WCAD
1220 kc, Canton, N. Y., St. Lawrence University, 500 w, E, "The Voice of the North Country."

WCAE
1220 kc, Pittsburgh, Pa., Kaufman & Baer Co. 1000 w, E, "Where Prosperity Begins."

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, "The College on the Hill."

WCAM
1280 kc, Camden, N. J., City of Camden, 500 w, E.

WCAO
600 kc, Baltimore, Md., Monumental Radio, Inc., 250 w, E, "The Gateway of the South."

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., 10,000 w, E, "Where Cheer Awaits U."

WCAX
1200 kc, Burlington, Vt., University of Vermont, 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, Zian, 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., 7500 w, C, "Service to the Northwest."

WCDA
1350 kc, New York, N. Y., Italian Educational Broadcasting Co., 250 w, E.

WCFL
970 kc, Chicago, Ill., Chicago Federation of Labor, 1500 w, C, "The Voice of Labor."

WCGU
1400 kc, Brooklyn, N. Y., U. S. Broadcasting Corp., w, E.

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, "The Voice of Culver."

WCOA
1340 kc, Pensacola, Fla., City of Pensacola, 500 w, E, "Wonderful City of Advantages."

WCOC
880 kc, Meridian, Miss., Mississippi Broadcasting Co., 500 w, C.

WCOD
1200 kc, Harrisburg, Pa., N. R. Hoffman Co., 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., Jordan & Burk, 500 w, E.

WCSH
940 kc, Portland, Me., Congress Square Hotel Co., 1000 kc, E, "The Voice From Sunrise Land."

WCSO
1450 kc, Springfield, Ohio, WGAR Broadcasting C., 500 w, E.

WDAE
1220 kc, Tampa, Fla., Tampa Publishing Co., 1000 w, E, "WDAE, the Voice of the Times at Tampa."

WDAF
610 kc, Kansas City, Mo., Kansas City Star Co., 1000 w, C, "Enemies of Sleep."

WDAG
1410 kc, Amarillo, Texas, National Radio & Broadcasting Corp., 250 w, C, "Where Dollars Always Grow."

WDAH
1310 kc, El Paso, Texas, Eagle Broadcasting Co., 100 w, M.

WDAY
940 kc, Fargo, N. D., WDAY, Inc., 1000 w, C.

WDBJ
930 kc, Roanoke, Va., Richardson-Wayland Elec. Corp., 250 w, E, "The Magic City."

WDBO
1120 kc, Orlando, Fla., Orlando Broadcasting Co., 1000 w, E, "Down Where the Oranges Grow."

WDEL
1120 kc, Wilmington, Del., WDEL, Inc., 250 w, E, "First City of the First State."

WDGY
1180 kc, Minneapolis, Minn., Dr. Geo. W. Young, 1000 w, C.

WDIX
1500 kc, Tupelo, Miss., Blair & Anderson, 100 w, C.

WDOD
1280 kc, Chattanooga, Tenn., WDOD Broadcatsing Co., Inc., 1000 w, C.

WDRC
1330 kc, New Haven, Conn., Doolittle Radio Corp., 500 w, E.

WDSU
1250 kc, New Orleans, La., Jos. H. Uhalt, 1000 w, C.

WDWF
1210 kc, Providence, R. I., Dutee W. Flint and The Lincoln Studios, 100 w, E.

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, "We Entertain a Nation."

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, "We Extend Buffalo's Regards."

WEDC
1210 kc, Chicago, Ill., Emil Denemark, Inc., 100 w.

WEDH
1420 kc, Erie, Pa., Erie Dispatch-Herald, 30 w, E.

WEEI
590 kc, Boston, Mass., Edison Elec. Illum. Co., 1000 w, E, "The Friendly Voice."

WEHC
1200 kc, Emory, Va., Emory and Henry College, 100 w, E.

WEHS
1420 kc, Evanston, Ill., WEHS, Inc., 100 w, C.

WELK
1370 kc, Philadelphia, Pa., WELK Broadcasting Station, Inc., 100 w, E.

WELL
1420 kc, Battle Creek, Mich., Enquirer-News Co., 50 w, E.

RADIO SERVICE SCHEMATICS

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NAME.....

STREET & NO.....

CITY..... STATE.....

WENR
870 kc, Chicago, Ill., Great Lakes Radio Broadcasting Co., 50,000 w, C, "Voice of Service."

WEPS
See under WORC.

WEVD
1300 kc, New York, 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, "Working for All Alike."

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, WFBE, Inc., 100 w, E.

WFBG
1310 kc, Altoona, Pa., William F. Gable Co., 100 w, E, "The Original Gateway to the West and We Wish You All the Very Best."

WFBJ
1370 kc, Collegeville, Minn., St. Johns University, 100 w, C, "In the Heart of the Landscape Paradise."

WFBL
1360 kc, Syracuse, N. Y., The Onondaga Co., Inc., 1000 w, E, "When Feeling Blue, Listen."

WFBM
1230 kc, Indianapolis, Ind., Indianapolis Power & Light Co., 1000 w, C.

WFBR
1270 kc, Baltimore, Md., Baltimore Radio Show, Inc., 250 w, E, "Home of the Star Spangled Banner."

WFDF
1310 kc, Flint, Mich., Frank D. Fallain, 100 w, E.

WFDV
1370 kc, Rome, Ga., Dolies Goings, 100 w, E.

WFDW
1420 kc, Talladega, Ala., R. C. Hammett, 100 w, C.

WFI
560 kc, Philadelphia, Pa., Strawbridge & Clothier, 500 w, E.
"Key City of Industry."

WFIW
940 kc, Hopkinsville, Ky., WFIW, Inc., 100 w, C. 1000 w, C.

WFJC
1450 kc, Akron, Ohio, WGAR Broadcasting Co., 500 w, E.

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

WFLA
620 kc, Clearwater, Fla., Clearwater Chamber of Commerce and St. Petersburg Chamber of Commerce, 1000 w, E, "Inviting the World to the Springtime City."

WGAL
1310 kc, Lancaster, Pa., WGAL, Inc., 100 w, E, "World's Gardens at Lancaster."

WGBB
1210 kc, Freeport, N. Y., Harry H. Carman, 100 w, E, "The Voice of the Sunrise Trail."

WGBC
1430 kc, Memphis, Tenn., Memphis Broadcasting Co., 500 w, C. Shared.

WGBF
630 kc, Evansville, Ind., Evansville on Air, 500 w, E, "Gateway to the South."

WGBI
880 kc, Scranton, Pa., Scranton Broadcasters, Inc., 250 w, E.

WGBS
600 kc, New York, N. Y., General Broadcasting System, Inc., 500 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.

WGES
1360 kc, Chicago, Ill., Oak Leaves Broadcasting Corp., 500 w, C, "World's Greatest Entertainment Service."

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., WGR, Inc., 1000 w, E,

WGST
890 kc, Atlanta, Ga., Georgia School of Technology, 250 w, E, "The Southern School with the National Reputation."

WGY
790 kc, Schenectady, N. Y., General Electric Co., 50,000 w

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, "Ohio's Highest Point."

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., Broadcasting Station WHBQ, Inc., 100 w, C.

WHBU
1210 kc, Anderson, Ind., Citizens Bank, 100 w, C, "First Hoosier Bank on the Air.

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., Wm. Hood Dunwoody Ind. Inst., 500 w, C.

WHDL
1420 kc, Tupper Lake, N. Y., Tupper Lake Broadcasting Corp., 10 w, E.

WHEC
1440 kc, Rochester, N. Y., Hickson Electric Co., Inc., 500 w, E.

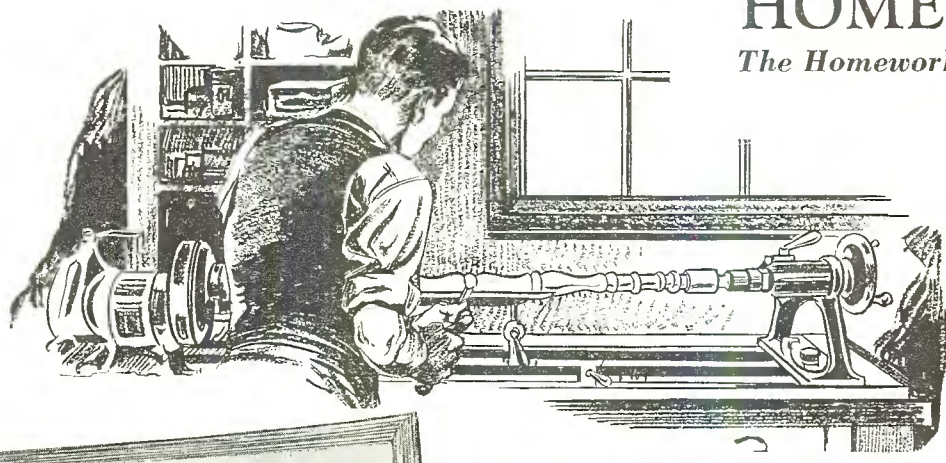
WHFC
1420 kc, Cicero, Ill., Triangle Broadcasters, 100 w, C.

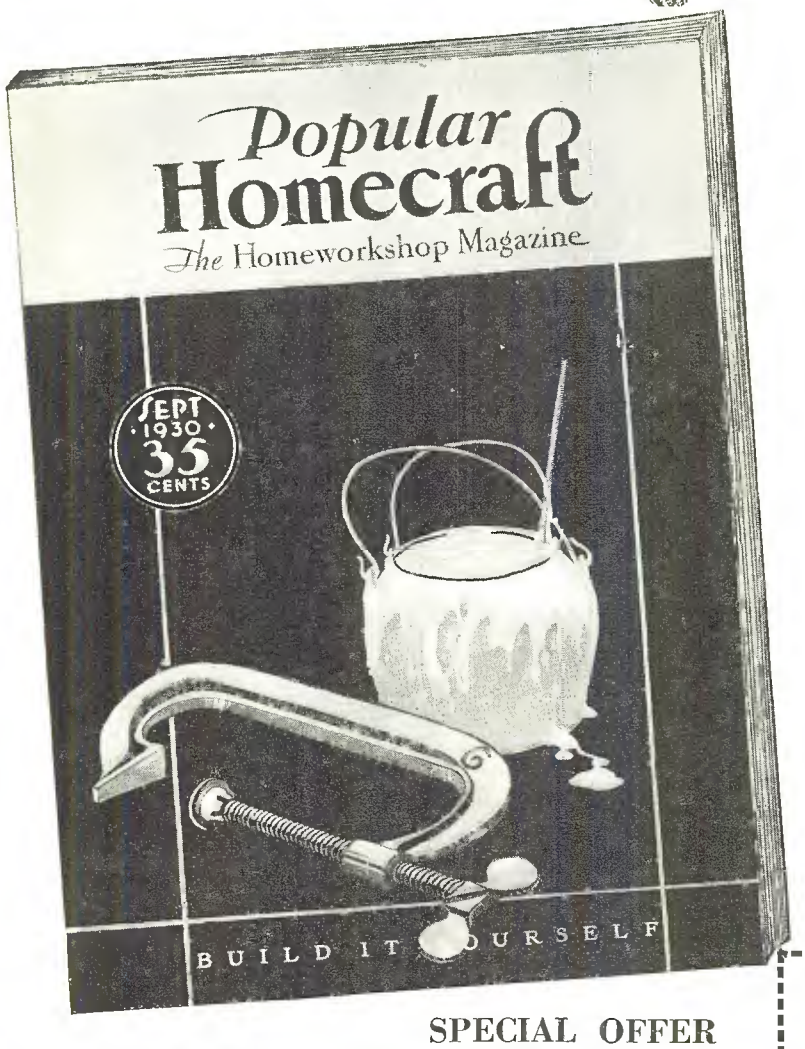
WHIS
1420 kc, Bluefield, W. Va., Daily Telegraph Printing Co., 100 w, E.

It's out!

The November Issue of Popular HOMECRAFT

The Homeworkshop Magazine





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WHK
1390 kc, Cleveland, Ohio, Radio Air Service Corp., 1000 w, E, "Cleveland's Pioneer Station."

WHN
1010 kc, New York, N. Y., Marcus Loew Booking Review, 250 w, E, "Voice of the Great White Way."

WHO
1000 kc, Des Moines, Iowa, Central Broadcasting Co., 5000 w, C.

WHOM
1450 kc, Jersey City, N. J., New Jersey Broadcasting Corp., 250 w, E.

WHP
1430 kc, Harrisburg, Pa., Pennsylvania Broadcasting Co., 500 w, E.

WIAS
1420 kc, Ottumwa, Iowa, Poling Electric Co., 100 w, C.

WIBA
1210 kc, Madison, Wis., Capital Times Co., 100 w, C.

WIBG
930 kc, Elkins Park, Pa., St. Paul's M. E. Church, 50 w, E.

WIBM
1370 kc, Jackson, Mich., C. L. Carrell, 100 w.

WIBO
560 kc, Chicago, Ill., Nelson Bros. Bond & Mortgage Co., 1000 w, C.

WIBR
1420 kc, Steubenville, Ohio, G. W. Robinson, 50 w, E, "Where Investments Bring Results."

WIBU
1310 kc, Poynette, Wis., W. C. Forrest, 100 w, C.

WIBW
580 kc, Topeka, Kan., Topeka Broadcasting Assn., Inc., 1000 w, C, "Topeka—Where Investment Brings Wealth."

WIBX
1200 kc, Utica, N. Y., WIBX, Inc., 100 w, E.

WICC
1190 kc, Bridgeport, Conn., Bridgeport Broadcasting Station, Inc., 500 w, E, "The Industrial Capital of Connecticut."

WIL
1200 kc, St. Louis, Mo., Missouri Broadcasting Co., 100 w, C, "A Wave Length Ahead."

WILL
890 kc, Urbana, Ill., University of Illinois, 250 w, C.

WILM
1420 kc, Wilmington, Del., Delaware Broadcasting Co., Inc., 100 w, E.

WIOD
1300 kc, Miami Beach, Fla., Isle of Dreams Broadcasting Co., 1000 w, E, "Wonderful Isle of Dreams."

WIP
610 kc, Philadelphia, Pa., Gimbel Bros., Inc., 500 w, E, "Watch Its Progress."

WIS
1010 kc, Columbia, S. C., George T. Barnes, Inc., 500 w, E.

WISN
1120 kc, Milwaukee, Wis., Evening Wisconsin Co., 250 w, C.

WISJ
560 kc, Beloit, Wis., Wisconsin State Journal Broadcasting Co., 500 w, C.

WJAC
1310 kc, Johnstown, Pa., Johnstown Automobile Co., 100 w, E, "The Voice of the Friendly City."

WJAG
1060 kc, Norfolk, Neb., Norfolk Daily News, 1000 w, C, "Home of the Printer's Devil."

WJAK
1310 kc, Marion, Ind., Marion Brdcst. Co., 50 w.

WJAR
890 kc, Providence, R. I., The Outlet Co., 250 w, E, "The Southern Gateway of New England."

WJAS
1290 kc, Pittsburgh, Pa., Pittsburgh Radio Supply House, 1000 w, E.

WJAX
900 kc, Jacksonville, Fla., City of Jacksonville. 1000 w, E, "WJAX—W for Wonderful, JAX for Jacksonville."

WJAY
610 kc, Cleveland, Ohio, Cleveland Radio Broadcasting Corp., 500 w, E.

WJAZ
1490 kc, Chicago, Ill., Zenith Radio Corp., 5000 w, C.

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.

WJBT
See under WBBM.

WJBU
1210 kc, Lewisburg, Pa., Bucknell University, 100 w, E, "In the Heart of the Keystone State."

WJBW
1200 kc, New Orleans, La.. C. Carlsen, Jr., 30 w. C. "The Serve You Broadcasting Sttaion at New Orleans.

WJBY
1210 kc, Gadsden, Ala., Gadsden Broadcasting Co., 50 w, C.

WJDX
1270 kc, Jackson, Miss., Lamar Life Ins. Co., 500 w, C.

WJJD
1130 kc, Chicago, Ill., Loyal Order of Moose, 20,000 w, C, "Every Child Is Entitled to a High School Education and a Trade."

WJKS
1360 kc, Gary, Ind., Johnson-Kennedy Radio Corp., 1000 w, C.

WJR
750 kc, Detroit, Mich., The Goodwill Station, Inc. 5000 w, E.

WJSV
1460 kc, Alexandria, Va., Independent Publishing Co., 10,000 w.

WJW
1210 kc, Mansfield, Ohio, Mansfield Broadcasting Association, 100 w, E.

WJZ
760 kc, New York City, N. Y., Radio Corporation of America, 30,000 w, E.

WKAQ
890 kc, San Juan, Porto Rico, Radio Corp. of Porto Rico, 500 w, E. "Porto Rico, The Island of Enchantment in the Caribbean Sea."

WKAR
1040 kc, East Lansing, Mich., Michigan State College, 1000 w, E.

WKAV
1310 kc, Laconia, N. H., Laconia Radio Club, 100 w, E, "The Voice of the Winnepesaukee Lake Region."

WKBB
1310 kc, Joliet, Ill., Sanders Bros., 100 k, 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, "We Keep Building Friendships."

WKBH
1380 kc, LaCrosse, Wis., WKBH, Inc., 1000 w, C.

WKBI
1420 kc, Chicago, Ill., Fred L. Schoenwolf, 100 w, C.

WKBN
570 kc, Youngstown, Ohio, W. P. Williamson, Jr., 500 w, E.

WKBO
1450 kc, Jersey City, N. J., Camith Corp., 250 w, E.

WKBQ
1350 kc, New York, N. Y., Standard Cahill Co., Inc., 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., Kirk Johnson & Co., 100 w, E.

WKRC
550 kc, Cincinnati, Ohio, WKRC, Inc., 1000 w, E, "WKRC, K—Kodel, R—Radio, C—Corporation."

WKY
900 kc, Oklahoma City, Okla., WKY Radiophone Co., 1000 w, C.

WKZO
590 kc, Berrien Springs, Mich., WKZO, Inc., 1000 w, C. "The Radio Lighthouse."

WLAC
1470 kc, Nashville, Tenn., Life & Casualty Ins. Co., 5000 w, C, "The Thrift Station."

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, "Where Listeners Become Friends."

WLBG
1200 kc, Petersburg, Va., Robert Allen Gamble, 100 w, E.

WLBL
900 kc, Stevens Point, Wis., Wisconsin Department of Markets, 2000 w, daytime, C, "Wisconsin, Land of Beautiful Lakes."

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., Maine Broadcasting Co., 500 w, E.

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

WLEX
1410 kc, Lexington, Mass., Lexington Air Station, 500 w, E.

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

WLIB
See under WGN.

WLIT
560 kc, Philadelphia, Pa., Lit Brothers, 500 w, E, "The Quaker City Siren."

WLOE
1500 kc, Boston, Mass., Boston Broadcasting Co., 100 w.

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

WLSI
See under WDWF.

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
570 kc, Casenovia, N. Y., Clive B. Meredith, 250 w, E. "Voice of Central New York."

WMAF
1410 kc, So. Dartmouth, Mass., Round Hills Radio Corp., 500 w, E.

WMAK
1040 kc, Buffalo, N. Y., WMAK Broadcasting System, 1000 w, E.

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

WMAQ
670 kc, Chicago, Ill., WMAQ Inc., 5000 w, C.

WMAY
1200 kc, St. Louis, Mo., Kingshighway Presbyterian Church, 100 w, C.

WMAZ
890 kc, Macon, Ga., Macon Junior Chamber of Commerce, 250 w, E, shared, "Watch Mercer Attain Zenith."

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 Heights Radio Laboratory, 500 w.

WMBF
See under WIOD.

WMBG
1210 kc, Richmond, Va., Havens & Martin, Inc., 100 w, E, "The Daytime Station."

WMBH
1420 kc, Joplin, Mo., Edwin Dudley Aber, 100 w, C, "Where Memories Bring Happiness."

WMBI
1080 kc, Chicago, Ill., Moody Bible Institute Radio Station, 5000 w, C, shared, "The West Point of Christian Service."

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

WMBO
1310 kc, Auburn, N. Y., Radio Service Laboratories, 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, "WMBR, Everything for Radio at Tampa, Fla."

WMC
780 kc, Memphis, Tenn., Memphis Commercial Appeal, Inc., 500 w, C, "WMC, Memphis, Down in Dixie."

WMCA
570 kc, New York, N. Y., Knickerbocker Broadcasting Co., Inc., 500 w, E, "Where the White Way Begins."

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

WMPC
1500 kc, Lapeer, Mich., First Methodist Protestant Church, 100 w, E, "Where Many Preach Christ."

WMRJ
1210 kc, Jamaica, N. Y., Peter J. Prinz, 10 w, E, "The Gateway of the Sunrist Trail."

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, "The Voice of Soonerland."

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

WNBF
1500 kc, Binghamton, N. Y., Howitt-Wood Radio Co., 100 w, E, "The Voice of the Triple Cities."

WNBH
1310 kc, New Bedford, Mass., New Bedford Broadcasting Co., 100 w, E, shared. "The Gateway to Cape Cod."

WNBO
1200 kc, Silver Haven, Pa., J. B. Springs, 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, "The Voice of Newark."

WNOX
560 kc, Knoxville, Tenn., Sterckl Bros., 1000 w, C, "Smoky Mountain Station."

WNYC
570 kc, New York, N. Y., Department of Plant & Structures, 500 w, E, "Municipal Broadcasting Station of the City of New York."

WOAI
1190 kc, San Antonio, Texas, Southern Equipment Co., 50,000 w, C, "The Winter Playground of America."

WOAN
See WREC.

WOAX
1280 kc, Trenton, N. J., WOAX, Inc., 500 w, E, "Trenton Makes, the World Takes."

WOBT
1310 kc, Union City, Tenn., Titsworth's Radio & Music Shop, 100 w, C

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

WOC
1000 kc, Davenport, Iowa, Central Broadcasting Co., 5000 w, C.

WOCL
1210 kc, Jamestown, N.Y., A. E. Newton, 25 w, E.

WODA
1250 kc, Paterson, N. J., Richard E. O'Dea, 1000 w, E, "The Voice of the Silk City."

WODX
?410 kc, Mobile, Ala., Mobile Brdcstg. Corp., 500 w, C.

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

WOKO
1440 kc, Poughkeepsie, N. Y., Hudson Valley Broadcasting Corp., 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, "The Voice of the Whispering Pines."

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

WOQ
1300 kc, Kansas City, Mo., Unity School of Christianity, 1000 w, C.

WOR
710 kc, Newark, N. J., J. Bamberger Broadcasting Service, Inc., 5000 w, E.

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

WORD
1490 kc, Chicago, Ill., People's Pulpit Association, 5000 w, C, "The Watch Tower—Radio WORD."

WOS
630 kc, Jefferson City, Mo., State Marketing Bureau, 500 w, C, "Watch Our State."

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, "The Omaha Station."

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.

WPAW
1210 kc, Pawtucket, R. I., Shartenberg & Robinson, 100 w, E, "The City of Diversified Industries."

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., 100 w, E, "First Wireless School in America."

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

WPOE
1370 kc, Patchogue, N. Y., Nassau Broadcasting Corp., 100 w, E.

WPOR
See under WTAR.

WPSC
1230 kc, State College, Pa., Pennsylvania State College, 500 w, day, E, "The Voice of the Nittany Lion."

WPTF
680 kc, Raleigh, N. C., Durham Life Insurance Co., 1,000 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.,

WQDM
1370 kc, St. Albans, Vt., A. J. St. Antoine, 5 w, E.

WQDX
1210 kc, Thomasville, Ga., Stevens Luke, 50 w.

WRAF
1200 kc, La Porte, Ind., Chas. Middleton, 100 w.

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

WRAW
1310 kc, Reading, Pa., Reading Broadcasting Co., 50 w, E, "The Schuylkill Valley Echo."

WRAX
1020 kc, Philadelphia, Pa., Berachah Church, Inc., 250 w, E.

WRBI
1310 kc, Tifton, Ga., Kent's Furniture & Music Store, 20 w, E.

WRBJ
1370 kc, Hattiesburg, Miss., Woodruff Furniture Co., 10 w, C.

WRBL
1200 kc, Columbus, Ga., David Parmer, 50 w, E.

WRBQ
1210 kc, Greenville, Miss., J. Pat Scully, 100 w, C.

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

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

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

WRC
950 kc, Washington, D. C., Radio Corporation of America, 500 w, E, "The Voice of the Capital."

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, "Welcome Rosedale Hospital, Minneapolis."

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., 50 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, "Carry Me Back to Old Virginny."

WSAI
1330 kc, Cincinnati, Ohio, Crosley Radio Corp., 500 w, E, "The Gateway to Dixie."

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

WSAN
1440 kc, Allentown, Pa., Allentown Call Pub. Co., 250 w, E, "We Serve Allentown Nationality." ity."

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, "The Voice of the South."

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

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

WSDA
See under WSGH.

WSEN
1210 kc, Columbus, Ohio, Columbus Broadcasting Corp., 50 w, E.

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

WSGH
1400 kc, Brooklyn, N. Y., Paramount Broadcasting Corp., 500 w.

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, "We Shield Millions."

WSMB
1320 kc, New Orleans, La., Saenger Theaters, Inc., & Maison Blanche Co., 500 w, C, "America's Most Interesting City."

WSMK
1380 kc, Dayton, Ohio, Stanley M. Krohn, Jr., 200 w, C, "The Home of Aviation."

WSPA
1420 kc, Spartanburg, S. C., 100 w, E, "The Voice of South Caroline."

WSPD
1340 kc, Toledo, Ohio, Toledo Broadcasting Co., 500 w, E.

WSSH
1410 kc, Boston, Mass., Tremont Temple Baptist Church, 500 w, E, "Stranger's Sunday Home."

WSUI
880 kc, Iowa City, Iowa, State Univ. of Iowa, 500 w, C, "The Old Gold Studio."

WSUN
See under WFLA.

WSVS
1370 kc, Buffalo, N. Y., Seneca Vocational High School, 50 w, E, "Watch Seneca Vocational School."

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

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

WTAG
580 kc, Worcester, Mass., Worcester Telegram Pub. Co., Inc., 250 w, E. "The Voice From the Heart of the Commonwealth."

WTAM
1070 kc, Cleveland, Ohio, WTAM, Inc., 50,000 w, E, "The Voice From the Storage Battery."

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, Streator, Ill., Williams Hardware Co., 50 w.

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

WTFI
1450 kc, Toccoa, Ga., Toccoa Falls Institute, 500 w, E.

WTIC
1060 kc, Hartford, Conn., Travelers Broadcasting Service Corp., 50,000 w, E, "The Insurance City."

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

WTNT
1470 kc, Nashville, Tenn., Tenn. Pub. Co., 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.

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

WWL
850 kc, New Orleans, La., Loyola University, 5000 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.

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.

Consolidated Broadcast List

Call	Town
KBPS	Portland, Ore.
KBTM	Paragould, Ark.
KCBC	Enid, Okla.
KCRJ	Jerome, Ariz.
KDB	Santa Barbara, Calif.
KDFN	Casper, Wyo.
KDKA	Pittsburgh, Pa.
KDLR	Devils Lake, N. D.
KDYL	Salt Lake City, Utah
KECA	Los Angeles, Calif.
KELW	Burbank, Calif.
KEX	Portland, Ore.
KFAB	Lincoln, Neb.
KFBB	Great Falls, Mont.
KFBK	Sacramento, Calif.
KFBL	Everett, Wash.
KFDM	Beaumont, Tex.
KFDY	Brookings, S. D.
KFEL	Denver, Colo.
KFEQ	St. Joseph, Mo.
KFGQ	Boone, Iowa
KFH	Wichita, Kans.
KFHA	Gunnison, Colo.
KFI	Los Angeles, Calif.
KFIO	Spokane, Wash.
KFIU	Juneau, Alaska
KFIZ	Fond du Lac, Wis.
KFJB	Marshalltown, Iowa.
KFJF	Oklahoma City, Okla.
KFJI	Astoria, Ore.
KFJM	Grand Forks, N. D.
KFJR	Portland, Ore.
KFJY	Fort Dodge, Ia.
KFJZ	Fort Worth, Tex.
KFKA	Greeley, Colo.
KFKB	Milford, Kans.
KFKU	Lawrence, Kans.
KFKX	Chicago, Ill.
KFLV	Rockford, Ill.
KFLX	Galveston, Tex.
KFMX	Northfield, Minn.
KFNF	Shenandoah, Ia.
KFOR	Lincoln, Neb.
KFOX	Long Beach, Calif.
KFPL	Dublin, Tex.
KFPM	Greenville, Tex.
KFPW	Ft. Smith, Ark.
KFPY	Spokane, Wash.
KFQD	Anchorage, Alaska
KFQF	Holy City, Calif.
KFQW	Seattle, Wash.
KFRC	San Francisco, Calif.
KFRU	Columbia, Mo.
KFSD	San Diego, Calif.
KFSG	Los Angeles, Calif.
KFUL	Galveston, Tex.
KFUM	Colorado Spgs., Colo.
KFUO	St. Louis, Mo.
KFUP	Denver, Colo.
KFVD	Culver City, Calif.
KFVS	Cape Girardeau, Mo.
KFWB	Hollywood, Calif.
KFWF	St. Louis, Mo.
KFWI	San Francisco, Calif.
KFWM	Richmond, Calif.
KFXD	Nampa, Idaho.
KFXF	Denver, Colo.
KFXJ	Edgewater, Colo.
KFXM	San Bernardino, Calif.
KFXR	Oklahoma City, Okla.
KFXY	Flagstaff, Ariz.
KFYO	Abilene, Tex.
KFYR	Bismarck, N. D.
KGA	Spokane, Wash.
KGAR	Tucson, Ariz.
KGB	San Diego, Calif.
KGBU	Ketchikan, Alaska.
KGBX	St. Joseph, Mo.
KGBZ	York, Neb.
KGCA	Decorah, Ia.
KGCI	San Antonio, Tex.
KGCR	Watertown, S. D
KGCU	Mandan, N. D
KGCX	Wolf Point, Mont.
KGDA	Mitchell, S. D.
KGDE	Fergus Falls, Minn.
KGDM	Stockton, Calif.
KGDY	Huron, S. D.
KGEF	Los Angeles, Calif.
KGEK	Yuma, Colo.
KGER	Long Beach, Calif.
KGEW	Fort Morgan, Colo.
KGEZ	Kalispell, Mont.
KGFF	Alva, Okla.
KGFG	Oklahoma City, Okla.
KGFI	Corpus Christi, Tex.
KGFJ	Los Angeles, Calif.
KGFK	Moorhead, Minn.
KGFL	Raton, N. M.
KGFW	Ravenna, Neb.
KGFX	Pierre, S. D.
KGGC	San Francisco, Cal.
KGGF	Picher, Okla.
KGGM	Albuquerque, N. M.
KGHF	Pueblo, Colo.
KGHI	Little Rock, Ark.
KGHL	Billings, Mont.
KGHX	Richmond, Tex.
KGIO	Twin Falls, Idaho
KGIR	Butte, Mont.
KGIW	Trinidad, Colo.
KGIX	Las Vegas, Nev.
KGIZ	Grant City, Mo.
KGJF	Little Rock, Ark.
KGKB	Brownwood, Tex.
KGKL	San Angelo, Tex.
KGKO	Wichita Falls, Tex.
KGKX	Sandpoint, Idaho
KGKY	Scottsbluff, Nebr.
KGMB	Honolulu, Hawaii.
KGMP	Elk City, Okla.
KGNF	North Platte, Nebr.
KGNO	Dodge City, Kans.
KGO	San Francisco, Calif.
KGRS	Amarillo, Tex.
KGU	Honolulu, T. H.
KGW	Portland, Ore.
KGY	Lacey, Wash.
KHJ	Los Angeles, Calif.
KHQ	Spokane, Wash.
KICK	Red Oak, Ia.
KID	Idaho Falls, Idabo
KIDO	Boise, Idaho
KIT	Yakima, Wash.
KJBS	San Francisco, Calif.
KJR	Seattle, Wash.
KLCN	Blytheville, Ark.
KLO	Ogden, Utah
KLPM	Minot, N. D.
KLRA	Little Rock, Ark.
KLS	Oakland, Calif.
KLX	Oakland, Calif.
KLZ	Denver, Colo.
KMA	Shenandoah, Ia.
KMBC	Kansas City, Mo.
KMED	Medford, Ore.
KMIC	Inglewood, Calif.
KMLB	Monroe, La.
KMJ	Fresno, Calif.
KMMJ	Clay Center, Neb.
KMO	Tacoma, Wash.
KMOX	St. Louis, Mo.
KMPC	Beverly Hills, Calif.
KMTR	Los Angeles, Calif.
KNX	Hollywood, Calif.
KOA	Denver, Colo.
KOAC	Corvallis, Ore.
KOB	State College, N. M.
KOCW	Chickasha, Okla.
KOH	Reno, Nev.
KOIL	Council Bluffs, Ia.
KOIN	Portland, Ore.
KOL	Seattle, Wash.
KOMO	Seattle, Wash.
KONO	San Antonio, Tex.
KOOS	Marshfield, Ore.
KORE	Eugene, Ore.
KOY	Phoenix, Ariz.
KPCB	Seattle, Wash.
KPJM	Prescott, Ariz.
KPO	San Francisco, Calif.
KPOF	Denver, Colo.
KPPC	Pasadena, Calif.
KPQ	Wenatchee, Wash.
KPRC	Houston, Tex.
KPSN	Pasadena, Calif.
KPWF	Los Angeles, Calif.
KQV	Pittsburgh, Pa.
KQW	San Jose, Calif.
KRE	Berkeley, Calif.
KREG	Santa Ana, Calif.
KRGV	Harlingen, Tex.
KRLD	Dallas, Tex.
KRMD	Shreveport, La.
KROW	Oakland, Calif.
KRSC	Seattle, Wash.
KSAC	Manhattan, Kans.
KSCI	Sioux City, Ia.
KSD	St. Louis, Mo.
KSEI	Pocatello, Idaho
KSL	Salt Lake City, Utah
KSMB	Santa Maria, Calif.
KSO	Clarinda, Ia.
KSOO	Sioux Falls, S. D.
KSTP	St. Paul, Minn.
KTAB	San Francisco, Calif.
KTAP	San Antonio, Tex.
KTAR	Phoenix, Ariz.
KTAT	Ft. Worth, Tex.
KTBI	Los Angeles, Calif.
KTBR	Portland, Ore.
KTBS	Shreveport, La.
KTLC	Houston, Tex.
KTUS	Hot Springs, Ark.
KTM	Los Angeles, Calif.
KTNT	Muscatine, Ia.
KTRH	Houston, Tex.
KTSA	San Antonio, Tex.
KTSL	Shreveport, La.
KTSM	El Paso, Tex.
KTW	Seattle, Wash.
KUJ	Longview, Wash.
KUOA	Fayetteville, Ark.
KUSD	Vermillion, S. D
KUT	Austin, Tex.
KVI	Tacoma, Wash.
KVL	Seattle, Wash.
KVOA	Tucson, Ariz.
KVOO	Tulsa, Okla.
KVOS	Bellingham, Wash.
KWCR	Cedar Rapids, Ia.
KWEA	Shreveport, La.
KWG	Stockton, Cal.
KWJJ	Portland, Ore.
KWK	St. Louis, Mo.
KWKC	Kansas City, Mo.
KWKH	Shreveport, La.
KWLC	Decorah, Ia.
KWSC	Pullman, Wash.
KWWG	Brownsville, Tex.
KXA	Seattle, Wash.
KXL	Portland, Ore.
KXO	El Centro, Calif.
KXRO	Aberdeen, Wash.
KXYZ	Houston, Tex.
KYA	San Francisco, Calif.
KYW	Chicago, Ill.
KZM	Hayward, Calif.
WAAF	Chicago, Ill.
WAAM	Newark, N. J.
WAAT	Jersey City, N. J.
WAAW	Omaha, Neb.
WABC	New York City, N. Y.
WABI	Bangor, Me.
WABO	Rochester, N. Y.
WABZ	New Orleans, La.
WACO	Waco, Tex.
WADC	Tallmadge, Ohio
WAIU	Columbus, Ohio
WALR	Zanesville, Ohio.
WAPI	Birmingham, Ala.
WASH	Grand Rapids, Mich.
WBAA	Lafayette, Ind.
WBAK	Harrisburg, Pa.
WBAL	Baltimore, Md.
WBAM	Greensboro, N. C.
WBAP	Fort Worth, Tex.
WBAX	Wilkes-Barre, Pa.
WBBC	Brooklyn, N. Y.
WBBL	Richmond, Va.
WBBM	Chicago, Ill.
WBBR	Brooklyn, N. Y.
WBBZ	Ponca City, Okla.
WBCM	Bay City, Mich.
WBCN	Chicago, Ill.
WBEN	Buffalo, N. Y.
WRGF	Glens Falls, N. Y.
WBIS	Boston, Mass.
WBMS	Hackensack, N. J.
WBNY	New York, N. Y.
WBOQ	New York, N. Y.
WBOW	Terre Haute, Ind.
WBRC	Birmingham, Ala.
WBRE	Wilkes-Barre, Pa.
WBSO	Wellesley Hills, Mass.
WBT	Charlotte, N. C.
WBTM	Danville, Va.
WBZ	Springfield, Mass.
WBZA	Boston, Mass.
WCAC	Storrs, Conn.
WCAD	Canton, N. Y.
WCAE	Pittsburgh, Pa.
WCAH	Columbus, Ohio
WCAJ	Lincoln, Neb.
WCAL	Northfield, Minn.
WCAM	Camden, N. J.
WCAO	Baltimore, Md.
WCAP	Ashury Park, N. J.
WCAT	Rapid City, S. D.
WCAU	Philadelphia, Pa.
WCAX	Burlington, Vt.
WCAZ	Carthage, Ill.
WCBA	Allentown, Pa.
WCBD	Zion, Ill.
WCBM	Baltimore, Md.
WCBS	Springfield, Ill.
WCCO	Minneapolis, Minn.
WCDA	New York, N. Y.
WCFL	Chicago, Ill.
WCGU	Brooklyn, N. Y.
WCKY	Covington, Ky.
WCLB	Long Beach, N. Y.
WCLO	Janesville, Wis.
WCLS	Joliet, Ill.
WCMA	Culver, Ind.
WCOA	Pensacola, Fla.
WCOC	Meridian, Miss.
WCOD	Harrisburg, Pa.
WCOH	Yonkers, N. Y.
WCBW	Chicago, Ill.
WCSC	Charleston, S. C.
WCSH	Portland, Me.
WCSO	Springfield, Ohio
WDAE	Tampa, Fla.
WDAF	Kansas City, Mo.
WDAG	Amarillo, Tex.
WDAH	El Paso, Tex.
WDAY	Fargo, N. D.
WDBJ	Roanoke, Va.
WDBO	Orlando, Fla.
WDEL	Wilmington, Del.
WDGY	Minneapolis, Minn.
WDIX	Tupelo, Miss.
WDOD	Chattanooga, Tenn.
WDRC	New Haven, Conn.
WDSU	New Orleans, La.
WDWF	Providence, R. I.
WDZ	Tuscola, Ill.
WEAF	New York, N. Y.
WEAI	Ithaca, N. Y.
WEAN	Providence, R. I.
WEAO	Columbus, Ohio
WEBC	Superior, Wis.
WEBQ	Harrisburg, Ill.
WEBR	Buffalo, N. Y.
WEDC	Chicago, Ill.
WEDH	Erie, Pa.
WEEI	Boston, Mass.
WEHC	Emory, Va.
WEHS	Evanston, Ill.
WELK	Philadelphia, Pa.
WELL	Battle Creek, Mich.
WENR	Chicago, Ill.
WEPS	Worcester, Mass.
WEVD	New York, N. Y.
WEW	St. Louis, Mo.
WEXL	Royal Oak, Mich.
WFAA	Dallas, Tex.
WFAN	Philadelphia, Pa.
WFBC	Knoxville, Tenn.
WFBE	Cincinnati, Ohio
WFBG	Altoona, Pa.
WFBJ	Collegeville, Minn.
WFBL	Syracuse, N. Y.
WFBM	Indianapolis, Ind.
WFBR	Baltimore, Md.
WFDF	Flint, Mich.
WFDV	Rome, Ga.
WFDW	Talladega, Ala.
WFI	Philadelphia, Pa.
WFIW	Hopkinsville, Ky.
WFJC	Akron, Ohio
WFKD	Philadelphia, Pa.
WFLA	Clearwater, Fla.
WGAL	Lancaster, Pa.
WGBB	Freeport, N. Y.
WGBC	Memphis, Tenn.
WGBF	Evansville, Ind.
WGBI	Scranton, Pa.
WGBS	New York, N. Y.
WGCM	Gulfport, Miss.
WGCP	Newark, N. J.
WGES	Chicago, Ill.
WGH	Newport News, Va.
WGL	Fort Wayne, Ind.
WGMS	Minneapolis, Minn.
WGN	Chicago, Ill.
WGR	Buffalo, N. Y.
WGST	Atlanta, Ga.
WGY	Schenectady, N. Y.
WHA	Madison, Wis.
WHAD	Milwaukee, Wis.
WHAM	Rochester, N. Y.
WHAP	New York, N. Y.
WHAS	Louisville, Ky.
WHAT	Philadelphia, Pa.
WHAZ	Troy, N. Y.
WHB	Kansas City, Mo.
WHBC	Canton, Ohio
WHBD	Mt. Orab, Ohio
WHBF	Rock Island, Ill.
WHBL	Sheboygan, Wis.
WHBQ	Memphis, Tenn.
WHBU	Anderson, Ind.
WHBY	Green Bay, Wis.
WHDF	Calumet, Mich.
WHDH	Boston, Mass.
WHDI	Minneapolis, Minn.
WHDL	Tupper Lake, N. Y.
WHEC	Rochester, N. Y.
WHFC	Cicero, Ill.
WHIS	Bluefield, W. Va.
WHK	Cleveland, Ohio
WHN	New York, N. Y.
WHO	Des Moines, Iowa
WHOM	Jersey City, N. J.
WHP	Harrisburg, Pa.
WIAS	Ottumwa, Ia.
WIBA	Madison, Wis.
WIBG	Elkins Park, Pa.
WIBM	Jackson, Micb.
WIBO	Chicago, Ill.
WIBR	Steubenville, Oblo
WIBS	Elizabeth, N. J.
WIBU	Poynette, Wis.
WIBW	Topeka, Kans.
WIBX	Utica, N. Y.
WICC	Bridgeport, Conn.
WIL	St. Louis, Mo.
WILL	Urbana, Ill.
WILM	Wilmington, Del.
WIOD	Miami Beach, Fla.
WIP	Philadelphia, Pa.
WIS	Columbia, S. C.
WISJ	Beloit, Wis.
WISN	Milwaukee, Wis.
WJAC	Johnstown, Pa.
WJAG	Norfolk, Neb.
WJAK	Marion, Ind.
WJAR	Providence, R. I.
WJAS	Pittsburgh, Pa.
WJAX	Jacksonville, Fla.
WJAY	Cleveland, Ohio
WJAZ	Chicago, Ill.
WJBC	LaSalle, Ill.
WJBI	Red Bank, N. J.
WJBK	Highland Park, Micb.
WJBL	Decatur, Ill.
WJBO	New Orleans, La.
WJBT	Chicago, Ill.
WJBU	Lewisburg, Pa.
WJBW	New Orleans, La.
WJBY	Gadsden, Ala.
WJDX	Jackson, Miss.
WJJD	Chicago, Ill.
WJKS	Gary, Ind.
WJR	Detroit, Mich.
WJSV	Alexandria, Va.
WJW	Mansfield, Ohio
WJZ	New York, N. Y.
WKAQ	San Juan, P. R.
WKAR	E. Lansing, Mich.
WKAV	Laconia, N. H.
WKBB	Joliet, Ill.
WKBC	Birmingham, Ala.
WKBF	Indianapolis, Ind.
WKBH	La Crosse, Wis.
WKBI	Chicago, Ill.
WKBN	Youngstown, Ohio
WKBO	Jersey City, N. J.
WKBP	Battle Creek, Mich.
WKBQ	New York, N. Y.
WKBS	Galesburg, Ill.
WKBV	Connersville, Ind.
WKBW	Buffalo, N. Y.
WKBZ	Ludington, Mich.
WKJC	Lancaster, Pa.
WKRC	Cincinnati, Ohio
WKY	Oklahoma City, Okla.
WKZO	Berrien Springs, Mich.
WLAC	Nashville, Tenn.
WLAP	Louisville, Ky.
WLB	Minneapolis, Minn.
WLBC	Muncie, Ind.
WLBF	Kansas City, Kans.
WLBG	Petersburg, Va.
WLBL	Stevens Point, Wis.
WLBW	Oil City, Pa.
WLBX	Long Island City, N. Y.
WLBZ	Bangor, Me.
WLCI	Ithaca, N. Y.
WLEX	Lexington, Mass.
WLEY	Lexington, Mass.
WLIB	Chicago, Ill.
WLIT	Philadelphia, Pa.
WLOE	Boston, Mass.
WLS	Chicago, Ill.
WLSI	Providence, R. I.
WLTH	Brooklyn, N. Y.
WLVA	Lynchburg, Va.
WLW	Cincinnati, Ohio
WLWL	New York, N. Y.
WMAC	Cazenovia, N. Y.
WMAF	S. Dartmouth, Mass.
WMAK	Buffalo, N. Y.
WMAL	Washington, D. C.
WMAQ	Chicago, Ill.
WMAY	St. Louis, Mo.
WMAZ	Macon, Ga.
WMBA	Newport, R. I.
WMBC	Detroit, Mich.
WMBD	Peoria Heights, Ill.
WMBF	Miami Beach, Fla.
WMBG	Richmond, Va.
WMBH	Joplin, Mo.
WMBI	Chicago, Ill.
WMBJ	Wilkinsburg, Pa.
WMBO	Auburn, N. Y.
WMBQ	Brooklyn, N. Y.
WMBR	Tampa, Fla.
WMC	Memphis, Tenn.
WMCA	New York, N. Y.
WMMN	Fairmont, W. Va.
WMPC	Lapeer, Mich.
WMBJ	Jamaica, N. Y.
WMSG	New York, N. Y.
WMT	Waterloo, Ia.
WNAC	Boston, Mass.
WNAD	Norman, Okla.
WNAT	Philadelphia, Pa.
WNAX	Yankton, S. D.
WNBF	Binghamton, N. Y.
WNBH	New Bedford, Mass.
WNBO	Silver Haven, Pa.
WNBR	Memphis, Tenn.
WNBW	Carhoudale, Pa.
WNBX	Springfield, Vt.
WNBZ	Saranac Lake, N. Y.
WNJ	Newark, N. J.
WNOX	Knoxville, Tenn.
WNYC	New York, N. Y.
WOAI	San Antonio, Tex.
WOAN	Memphis, Tenn.
WOAX	Trenton, N. J.
WOBT	Union City, Tenn.
WOBU	Charleston, W. Va.
WOC	Davenport, Ia.
WOCL	Jamestown, N. Y.
WODA	Paterson, N. J.
WODX	Mobile, Ala.
WOI	Ames, Ia.
WOKO	Poughkeepsie, N. Y.
WOL	Washington, D. C.
WOMT	Manitowoc, Wis.
WOOD	Grand Rapids, Mich.
WOPI	Bristol, Tenn.
WOQ	Kansas City, Mo.
WOR	Newark, N. J.
WORC	Worcester, Mass.
WORD	Chicago, Ill.
WOS	Jefferson City, Mo.
WOV	New York, N. Y.
WOW	Omaha, Neb.
WOWO	Ft. Wayne, Ind.
WPAD	Paducah, Ky.
WPAP	New York, N. Y.
WPAW	Pawtucket, R. I.
WPCC	Chicago, Ill.
WPCH	New York, N. Y.
WPEN	Philadelphia, Pa.
WPG	Atlantic City, N. J.
WPOE	Patchogue, N. Y.
WPOR	Norfolk, Va.
WPSC	State College, Pa.
WPTF	Raleigh, N. C.
WQAM	Miami, Fla.
WQAN	Scranton, Pa.
WQAO	New York, N. Y.
WQBC	Vicksburg, Miss.
WQDM	St. Albans, Vt.
WQDX	Thomasville, Ga.
WRAF	La Porte, Ind.
WRAK	Williamsport, Pa.
WRAW	Reading, Pa.
WRAX	Philadelphia, Pa.
WRBI	Tifton, Ga.
WRBJ	Hattiesburg, Miss.
WRBL	Columbus, Ga.
WRBQ	Greenville, Miss.
WRBT	Wilmington, N. C.
WRRU	Gastonia, N. C.
WRBX	Roanoke, Va.
WRC	Washington, D. C.
WRDO	Augusta, Me.
WRDW	Augusta, Ga.
WREC	Memphis, Tenn.
WREN	Lawrence, Kans.
WRHM	Minneapolis, Minn.
WRJN	Racine, Wis.
WRNY	New York, N. Y.
WROL	Knoxville, Tenn.
WRR	Dallas, Tex.
WRUF	Gainesville, Fla.
WRVA	Richmond, Va.
WSAI	Cincinnati, Ohio
WSAI	Grove City, Pa.
WSAN	Allentown, Pa.
WSAR	Fall River, Mass.
WSAZ	Huntington, W. Va.
WSB	Atlanta, Ga.
WSBC	Chicago, Ill.
WSBT	South Bend, Ind.
WSDA	Brooklyn, N. Y.
WSEN	Columbus, Ohio
WSFA	Montgomery, Ala.
WSGH	Brooklyn, N. Y.
WSIX	Springfield, Tenn.
WSJS	Winston-Salem, N. C.
WSM	Nashville, Tenn.
WSMB	New Orleans, La.
WSMK	Dayton, Ohio
WSPA	Spartanburg, S. C.
WSPD	Toledo, Ohio
WSSH	Boston, Mass.
WSUI	Iowa City, Ia.
WSUN	Clearwater, Fla.
WSVS	Buffalo, N. Y.
WSYR	Syracuse, N. Y.
WTAD	Quincy, Ill.
WTAG	Worcester, Mass.
WTAM	Cleveland, Ohio
WTAQ	Eau Claire, Wis.
WTAR	Norfolk, Va.
WTAW	College Station, Tex.
WTAX	Streator, Ill.
WTBO	Cumberland, Md.
WTFI	Toccoa, Ga.
WTIC	Hartford, Conn.
WTMJ	Milwaukee, Wis.
WTNT	Nashville, Tenn.
WTOC	Savannah, Ga.
WWAE	Hammond, Ind.
WWJ	Detroit, Mich.
WWL	New Orleans, La.
WWNC	Asheville, N. C.
WWRL	Woodside, N. Y.
WWVA	Wheeling, W. Va.
WXYZ	Detroit, Mich.

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, WISJ.

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

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

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

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

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

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, WLIB

730 Kilocycles, 410.7 Meters—Canadian Wave:

740 Kilocycles, 405.2 Meters:
WSB, KMMJ

750 Kilocycles, 399.8 Meters:
WJR

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

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, WMAZ, WGST. KGJF, 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, KFWM, KFWI, KROW

940 Kilocycles, 319 Meters:
WCSH, WFIW, KOIN, KGU, 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

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, WMAK

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, KMIC, KRSC, WDEL, WDBO, KFIO, KTRH

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, KTNT

1180 Kilocycles, 254.1 Meters:
KEX, KOB, WGDY, WHDI

1190 Kilocycles, 252.0 Meters:
WICC, WOAI

1200 Kilocycles, 249.9 Meters: Canadian Shared:
WABI, WNBX, WORC, WIBX, WHBC, WLAP, WLBG, WNBO, WKJC, WNBW, WABZ, WJBW, WBBZ, WFBC, WRBL, KGCU, WJBC, WJBL, WWAE, WRAF, WMT, KFJB, WCAT, KGDY, KFWF, KGDE, WCLO, WHBY, KSMR, WIL, KFHA, KVOS, KGY, WMAY, KGEK, KGEW, KGHI, WCAX, WCOD, WFBE, KBTM, WEHC, WEPS, KMLB, KGFJ, KWG.

1210 Kilocycles, 247.8 Meters—Canadian Shared:
WJBI, WGBB, WCOH, WOCL, WLCI, WPAW, WDWF, WLSI, WJW, WBAX, WBAX, WJBU, WMBG, WSIX, WRBU, WJBY, WRBQ, WGCM, KWEA, KDLR, KGCR. KFOR, WHBU, KFVS, WEBQ, WQDX, WCRW, WEDC, WCBS, WTAX, WHBF, WIBA. WOMT, WSBC, KDFN. KMJ, KFMX, KPPC, KGFJ, WALR, WBBL, WMRJ, KGMP, KGNO, WSEN.

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

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

1240 Kilocycles, 241.8 Meters:
WACO, KTAT, WXYZ.

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

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

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

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

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

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

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

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

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

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

1350 Kilocycles, 222.1 Meters:
WBNY, WMSG, WCDA, WKBQ, KWK

1360 Kilocycles, 220.4 Meters:
WQBC, WJKS, WGES, KGIR, KGER, KPSN, WFBL, WCSC.

1370 Kilocycles, 218.8 Meters:
WSVS, WCBM, WHBD, WJBK, WIBM, WRAK, WELK, WHBQ, WRBT, KGFG, KGCI, KFJZ, KGKL, KFLX, WFBJ, KGDA, KZM, KRE, WPOE, KFBL, KWKC, WRJN, KGAR, KOH, KVL, KFJI, KGFL, WHDF, KOOS, WGL, KFJM, KCRC, WMBR, WRBJ, WLEY, WBGF, WBTM, WFDV, WLVA, WQDM, WRDO, KONO

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

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

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

1410 Kilocycles, 212.6 Meters:
KGRS, WDAG, KFLV, WHBL, WBCM, WODX, WSFA, WLEX, WSSH, WMAF, WRBX.

1420 Kilocycles, 211.1 Meters:
WTBO, WKBI, WIBR. WEDH, WMBC. KGFF, WHIS, KTAP, KTUE, 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.

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

1440 Kilocycles, 208.2 Meters:
WHEC, WABO, WOKO, WCBA
WTAD, WMBD, KLS, WSAN, WBAM.

1450 Kilocycles, 206.8 Meters:
WBMS, WNJ, WKBO, WSAR, WFJC, WTFI, KTBS, WCSO, 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:
KPWF, WCKY, WJAZ, WORD

1500 Kilocycles, 199.9 Meters:
WMBA, WLOE, WNBF, WMBQ, WLBX, WWRL, WKBZ, WMPC, WOPI, WPEN, KGKB, WKBV, KPJM, KDB, KUJ, KGFI, WMBJ, KREG, WCLB, WRDW. KGIZ, KGKY, KPQ, KUT, WDIX, KXO, KGFK.

U. S. Broadcasting Stations Listed by States

ALABAMA
Birmingham, WBRC, WKBC, WAPI
Gadsden, WJBY
Mobile, WODX
Montgomery, WSFA
Talladega, WFDW

ALASKA
Anchorage, KFQD
Juneau, KFIU
Ketchikan, KGBU

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

ARKANSAS
Blytheville, KLCN
Fayetteville, KUOA
Fort Smith, KEPW
Hot Springs, KTHS
Little Rock, KLRA, KGHI, KGJF
Paragould, KBTM

CALIFORNIA
Berkeley, KRE
Beverley Hills, KMPO
Burbank, KELW
Culver City, KFVD
El Centro, KXO
Fresno, KMJ
Hayward, KZM
Hollywood, KNX, KFWB
Holy City, KFQU
Inglewood, KMIC
Long Beach, KFOX, KGER
Los Angeles, KFI, KFSG, KGEF, KGFJ, KHJ, KTBI, KECA, KMTR, KPWF, KTM
Oakland, KLS, KLX, KROW
Pasadena, KPPC, KPSN
Richmond, KFWM
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
Santa Maria, KSMR
Stockton, KGDM, KWG

COLORADO
Colorado Springs, KFUM
Denver, KFEL, KFUP, KFXF, KOA, KPOF, KLZ
Edgewater, KFXJ
Fort Morgan, KGEW
Greeley, KFKA
Gunnison, KFHA
Pueblo, KGHF
Trinidad, KGIW
Yuma, KGEK

CONNECTICUT
Bridgeport, WICC
Hartford, WTIC
New Haven, WDRC
Storrs, WOAO

DELAWARE
Wilmington, WDEL, WILM

DISTRICT OF COLUMBIA
Washington, NAA, WMAL, WRC, WOL

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

GEORGIA
Atlanta, WGST, WSB
Augusta, WRDW
Columbus, WRBL
Macon, WMAZ
Rome, WFDV
Savannah, WTOC
Thomasville, WQDX
Tifton, WJBJ
Toccoa, WTFI

HAWAII
Honolulu, KGU, KGMB

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

ILLINOIS
Carthage, WCAZ
Chicago, KYW, WAAF, WCFL, WCRW, WEDC, WENR, WGES, WKBI, WPCC, WGN, WMAQ, WMBI, WBBM, WSBC, WBCN, WIBO, WJAZ, WJBT, WLIB, WLS, WORD, KFKX, WJJD
Cicero, WHFC
Decatur, WJBL
Evanston, WEHS
Galesburg, WKBS
Harrisburg, WEBQ
Joliet, WCLS, WKBB
La Salle, WJBC
Peoria Heights, WMBD
Quincy, WTAD
Rockford, KFLV
Rock Island, WHBF
Springfield, WCBS
Streator, 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, WRAF
Marion, WJAK
Muncie, WLBO
South Bend, WSBT
Terre Haute, WBOW

IOWA
Ames, WOI
Boone, KFGQ
Cedar Rapids, KWOR
Clarinda, KSO,
Council Bluffs, KOIL
Davenport, WOC
Decorah, KGCA, KWLO
Des Moines, WHO,
Ft. Dodge, KFJY
Iowa City, WSUI
Marshalltown, KFJB
Muscatine, KTNT
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

LOUISIANA
Cedar Grove, KGGH
Monroe, KMLB
New Orleans, WABZ, WCBE, WJBO, WJBW, WSMB, WWL, WDSU
Shreveport, KTSL, KWEA, KRMD, KTBS, KWKH

MAINE
Augusta, WRDO
Bangor, WABI, WLBZ
Portland, WCSH

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

MASSACHUSETTS
Boston, WBZA, WEEI, WNAC, WSSH, WBIS, WHDH, WLOE
Fall River, WSAR
Lexington, WLEX, WLEY
New Bedford, WNBH
So. Dartmouth, WMAF
Springfield, WBZ
Wellesley Hills, WBSO
Worcester, WTAG, WORC, WEPS

MICHIGAN
Battle Creek, WELL
Bay City, WBCM
Berrien Springs, WKZO
Calumet, WHDF
Detroit, WMBC, WWJ, WJR WXYZ
East Lansing, WKAR
Flint, WFDF
Grand Rapids, WASH, WOOD
Highland Park, WSBK
Jackson, WIBM
Lapeer, WMPC
Ludington, WKBZ
Royal Oak, WEXL

MINNESOTA
Anoka, WCCO
Collegeville, WFBJ
Fergus Falls, KGDE
Minneapolis, WDGY, WHDI, WLB, WRHM, WCCO, WGMS
Moorhead, KGFK
Northfield, KEMX, WCAL
St. Paul, KSTP

MISSISSIPPI
Greenville, WRBQ
Gulfport, WGCM
Hattiesburg, WRBJ
Jackson, WJDX
Meridian, WCOC
Tupelo, WDIX
Vicksburg, WQBC

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

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

NEBRASKA
Clay Center, KMMJ
Lincoln, KFAB, KFOR, WOAJ
Norfolk, WJAG
North Platte, KGNF
Omaha, WAAW, WOW
Ravenna, KGFW
Scottsbluff, KGKY
York, KGBZ

NEVADA
Las Vegas, KGIX
Reno, KOH

NEW HAMPSHIRE
Laconia, WKAV

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

NEW MEXICO
Albuquerque, KGGM
Raton, KGFL
State College, KOB

NEW YORK
Auburn, WMBO
Binghamton, WNBF
Brooklyn, WBBC, WLTH, WMBQ, WSGH, WSDA, WBBR, WCGU
Buffalo, WEBR, WGR, WKBW, WSVS, WBEN, WMAK
Canton, WCAD
Cazenovia, WMAC
Freeport, WGBB
Glens Falls, WBGF
Ithaca, WLCI, WEAI
Jamaica, WMBJ
Jamestown, WOCL
Long Beach, WCLB
Long Island City, WLBX
New York, WBNY, WHN, WJZ, WKBQ, WMCA, WMSG, WNYC, WPCH, WRNY, WABC, WOV, WQAO, WLWL, WBOQ, WCDA, WEAF, WEVD, WGBS, WHAP, WPAP
Patchogue, WPOE
Poughkeepsie, WOKO
Rochester, WHAM, WHEC
Saranac Lake, WNBZ
Schenectady, WGY
Syracuse, WFBL, WSYR
Tupper Lake, WHDL
Troy, WHAZ
Utica, WIBX
Woodhaven, WEVD
Woodside, WWRL
Yonkers, WCOH

NORTH CAROLINA
Asheville, WWNC
Charlotte, WBT
Gastonia, WRBU
Greensboro, WBAM
Raleigh, WPTF
Wilmington, WRBT
Winston-Salem, WSJS

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

OHIO
Akron, WFJC
Canton, WHBC
Cincinnati, WKRO, WSAI, WLW, WFBE
Cleveland, WHK, WJAY, WTAM
Columbus, WAIU, WCAH, WEAO, WSEN
Dayton, WSMK
Mansfield, WJW
Middleton, WSRO
Mt. Orab, WHBD
Springfield, WCSO
Steubenville, WIBR
Tallmadge, WADC
Toledo, WSPD
Youngstown, WKBN
Zanesville, WALR

OKLAHOMA
Alva, KGFF
Chickasha, KOCW
Elk City, KGMP
Enid, KCRC
Norman, WNAD
Oklahoma City, KFJF, KFXR, KGCB, KGFG, WKY
Picher, KGGF
Ponca City, WBBZ
Tulsa, KVOO

OREGON
Astoria, KFJI
Corvallis, KOAC
Eugene, KORE
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, WEDH
Frankford, WFKD
Grove City, WSAJ
Harrisburg, WCOD, WBAK, WHP
Johnstown, WJAC
Lancaster, WGAL, WKJC
Le Moyne, WHP
Lewisburg, WJBU
Oil City, WLBW
Philadelphia, WCAU, WFI, WIP, WLIT, WRAX, WPEN, WFAN, WELK, WHAT, WFKD
Pittsburgh, KQV, WCAE, WJAS, KDKA
Reading, WRAW
Scranton, WGBI, WQAN,
Silver Haven, WNBO
State College, WPSC
Wilkes-Barre, WBAX, WBRE
Wilkinsburg, WMBJ
Williamsport, WRAK

PORTO RICO
San Juan, WKAQ

RHODE ISLAND
Cranston, WDWF
Newport, WMBA
Pawtucket, WPAW
Providence, WEAN, WJAR, WDWF

SOUTH CAROLINA
Charleston, WCSC
Columbia, WIS
Spartanburg, WSPA

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

TENNESSEE
Bristol, WOPI
Chattanooga, WDOD
Knoxville, WFBC, WNOX, WROL
Memphis, WGBC, WIBO, WMC, WNBR, WOAN, WREC
Nashville, WLAC, WSM, WTNT
Springfield, WSIX
Union City, WOBT

TEXAS
Abilene, KFYO
Amarillo, KGRS, WDAG
Austin, KUT
Beaumont, KFDM
Brownsville, KWWG
Brownwood, KGKB
College Station, WTAW
Corpus Christi, KGFI
Dallas, KRLD, WFAA, WRR
Dublin, KFPL
El Paso, WDAH, KTSM
Fort Worth, KFJZ, WBAP, KTAT
Galveston, KFLX, KFUL
Greenville, KPLM
Harlingen, KRGV
Houston, KPRC, KTLC, KTRH, KNYZ
San Angelo, KGFI, KGKL
San Antonio, KTAP, KTSA, WOAI, KONO
Waco, WACO, KGCI
Wichita Falls, KGKO

UTAH
Ogden, KLO
Salt Lake City, KDYL, KSL

VERMONT
Burlington, WCAX
St. Albans, WQDM
Springfield, WNBX

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

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

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

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

WYOMING
Casper, KDFN

SHORT WAVE RELAY BROADCASTING STATIONS

United States

Call	Owner	Kilocycles	Meters
W2XAC	General Electric, Schenectady, N. Y.	8,690	34.5
W2XAD	General Electric, Schenectady, N. Y.	15,340	19.56
W2XAF	General Electric, Schenectady, N. Y.	9,530	31.48
W2XAL	Aviation Radio, Coytesville, N. J.	6,040	49.67
W2XAL	Aviation Radio, Coytesville, N. J.	11,800	25.42
W2XAL	Aviation Radio, Coytesville, N. J.	15,250	19.67
W2XAL	Aviation Radio, Coytesville, N. J.	21,460	13.97
W2XBR	Baruchrome Corporation, New York, N. Y.	6,020	49.83
W2XCX	L. Bamberger, Newark, N. J.	6,080	49.34
W2XE	Atlantic Broadcasting Co., Jamaica, N. Y.	11,840	25.34
W2XE	Atlantic Broadcasting Co., Jamaica, N. J.	15,280	19.63
W3XAL	Radio Corporation, New York, N. Y.	6,100	49.18
W3XAL	Radio Corporation, New York, N. Y.	9,570	31.35
W3XAL	Radio Corporation, New York, N. Y.	11,720	25.6
W3XAL	Radio Corporation, New York, N. Y.	15,130	19.83
W3XAL	Radio Corporation, New York, N. Y.	17,780	16.87
W3XAL	Radio Corporation, New York, N. Y.	21,500	13.95
W3XL	Radio Corporation, New York, N. Y.	6,020	49.83
W3XAU	Universal Broadcasting Co., Philadelphia, Pa.	6,060	49.5
W3XAU	Universal Broadcasting Co., Philadelphia, Pa.	9,590	30.1
W6XAL	Pacific-Western Broadcasting Fed., Westminster, Calif.	6,080	49.34
W6XAL	Pacific-Western Broadcasting Fed., Westminster, Calif.	15,250	19.67
W6XAL	Pacific-Western Broadcasting Fed., Westminster, Calif.	21,500	13.95
W6XN	General Electric, Oakland, Calif.	12,850	23.35
W8XAL	Crosley Radio Corporation, Cincinnati, Ohio	6,060	49.5
W8XK	Westinghouse, East Pittsburgh, Pa.	6,140	48.86
W8XK	Westinghouse, East Pittsburgh, Pa.	9,570	31.35
W8XK	Westinghouse, East Pittsburgh, Pa.	18,880	15.89
W8XK	Westinghouse, East Pittsburgh, Pa.	15,210	19.72
W8XK	Westinghouse, East Pittsburgh, Pa.	17,780	16.87
W8XK	Westinghouse, East Pittsburgh, Pa.	21,540	13.93
W9XA	General Electric, Denver, Colo.	9,530	31.48
W9XAA	Federation of Labor, Chicago, Ill.	6,080	49.34
W9XAQ	Chicago Daily News, Chicago, Ill.	6,040	49.67
W9XU	Mona Motor Oil Co., Council Bluffs, Iowa	6,060	49.5
W9XF	Great Lakes Broadcasting Co., Chicago, Ill.	6,020	49.83
W9XF	Great Lakes Broadcasting Co., Chicago, Ill.	11,800	25.42
W9XF	Great Lakes Broadcasting Co., Chicago, Ill.	21,500	13.95

Foreign

XDO	Chapultepec, Mexico	17,440	17.2
G5SW	Chelmsford, England	12,500	24
GBX	Rugby, England	10,770	27.86
PJZ	Curacao, Curacao	11,718.9	25.60
TJW	Hamilton, Bermuda	9,500	31.6
PCJ	Hilversum, Holland	15,220	19.71
PCJ	Hilversum, Holland	9,590	31.28
PHI	Huizen, Holland	17,775	16.88
OXQ	Kopenhavn, Denmark	9,520	31.51
OXQ	Kopenhavn, Denmark	6,090	49.26
	Lyngby, Denmark	9,520	31.51
	Koenigswusterhausen, Germany	9,560	31.38
	Koenigswusterhausen, Germany	15,200	19.74
	Koenigswusterhausen, Germany	21,500	13.95
VK3ME	Melbourne, Australia	9,510	31.55
VK6WF	Perth, Australia	3,000	100
VK2ME	Sydney, Australia	9,590	31.28
UOR2	Vienna, Austria	6,072	49.4
	Vieuna, Austria	11,801	25.42
	Rome, Italy	11,810	25.40
	Paris, France	6,122	49.02
CJRX	Winnipeg, Canada	11,720	25.60
ZTD	Durban, South Africa	7,400	40.5
RV15	Khabarovsk, U. S. S. R.	4,273.5	70.2
RV38	Moscow, U. S. S. R.	5,514.7	54.4
NRH	Heredia	.....	30.8
HRB	Tegucigalpa, Honduras	6,005	49.96

VISUAL BROADCASTING STATIONS

Call	Kilocycles	Meters	Owner
W1XAE	2000-2100	150-143	Westinghouse, Springfield, Mass.
W1XAY	2000-2100	150-143	Air Station, Lexington, Mass.
W1XB	2100-2200	143-136	General Industries, Somerville, Mass.
W1XB	2750-2850	109-105	General Industries, Somerville, Mass.
W2XBA	2750-2850	109-105	WAAM, Inc., Newark, N. J.
W2XBS	2000-2100	150-143	R. C. A., New York, N. Y.
W2XBU	2000-2100	150-143	H. E. Smith, Beacon, N. Y.
W2XBW	2000-2100	150-143	R. C. A., New York, N. Y.
W2XCL	2000-2100	150-143	Pilot Electric, Brooklyn, N. Y.
W2XCO	2100-2200	143-136	R. C. A., New York, N. Y.
W2XCP	2000-2100	150-143	Freed-Eisemann, New York, N. Y.
W2XCP	2850-2950	105-102	Freed-Eisemann, New York, N. Y.
W2XCR	2750-2850	109-105	Jenkins, Jersey City, N. J.
W2XCW	2100-2200	143-136	General Electric, Schenectady, N. Y.
W2XR	2850-2950	105-102	Radio Pictures, Inc., New York, N. Y.
W2XR	2100-2200	143-136	Radio Pictures, Inc., New York, N. Y.
W2XX	2000-2100	150-143	R. F. Gowen, Ossining, N. Y.
W3XAK	2100-2200	142.9-136.4	R. C. A., Bound Brook, N. J.
W3XK	2000-2100	150-143	Jenkins, Washington, D. C.
W3XK	2850-2950	105-102	Jenkins, Washington, D. C.
W4XE	2000-2100	150-143	W. J. Lee, Winter Park, Fla.
W6XAM	2000-2100	150-143	B. S. McGlashan, Los Angeles, Calif.
W7XAO	2750-2850	109-105	W. Jermau, Portland, Ore.
W8XAV	2000-2100	150-143	Westinghouse, Pittsburgh, Pa.
W8XAV	2100-2200	143-136	Westinghouse, Pittsburgh, Pa.
W8XAV	2750-2850	109-105	Westinghouse, Pittsburgh, Pa.
W9XAG	2000-2100	150-143	Aero Products, Chicago, Ill.
W9XAO	2000-2100	150-143	Nelson Bros. Co., Chicago, Ill.
W9XAP	2750-2850	109.1-105.3	Chicago Daily News, Chicago, Ill.
W9XAZ	2000-2100	150-143	University of Iowa, Iowa City, Ia.
W9XR	2850-2950	105-102	Great Lakes Broadcasting Co., Chicago, Ill.
WRNY	1010-	297-	Aviation Radio, Coytesville, N. J.

FOREIGN BROADCAST STATIONS

Call		Meters
	ARGENTINA	
LOZ	Buenos Aires	330
LOS	Buenos Aires	291.2
LON	Buenos Aires	210
LOR	Buenos Aires	344.8
LOV	Buenos Aires	361.5
LOY	Buenos Aires	315.2
LOX	Buenos Aires	380
LOQ	Buenos Aires	261.8
LOO	Buenos Aires	252
LOJ	Buenos Aires	270
LOW	Buenos Aires	303
LOT	Buenos Aires	400
LOL	Buenos Aires	236
D3	Buenos Aires	253.3
B2	Buenos Aires	275
H5	Cordova	275
H6	Cordova	250
LOP	La Plata	425
LOU	Mendoza	380
M6	Mendoza	348
F2	Rosaria	270
F1	Santa Fe	279
	AUSTRALIA	
5CL	Adelaide	409
5DN	Adelaide	313
5KA	Adelaide	250
2MK	Bathhurst	275
4QG	Brisbane	385
7ZL	Hobart	516
3AR	Melbourne	484
3LO	Melbourne	371
3UZ	Melbourne	319
3DB	Melbourne	255
2HD	Newcastle	288
6WF	Perth	440
6ML	Perth	297
2KY	Sydney	280
2FC	Sydney	451
2BL	Sydney	353
2BE	Sydney	316
2GB	Sydney	316
2UE	Sydney	293
2UW	Sydney	267
4GR	Toowoomba	294
	AUSTRIA	
	Graz	352
	Innsbruck	283
	Insbruck	218
	Klageufurt	453
	Linz	246
	Vieuna	517
	BELGIUM	
EB4ED	Anvers	250
EB4GT	Bruxells	260
EB4RB	Bruxells	508.5
EB4RC	Bruxells	215
BAV	Bruxells	589.4
EB4FO	Bruxells	230
EB4CE	Chatelineau	220
EB4FG	Dampremy	210
EB4RG	Gand	275
EB4RW	Liege	280
EB4BQ	Marchienne-Docherie	290
EB4EX	Ottomont	225
EB4CF	Verviers	215
	BOLIVIA	
	La Paz	175
	La Paz	300
	BRAZIL	
PRAM	Amparo	230
PRAH	Bahia	350
PRAN	Curytiba	340
PRAZ	Franca	270
PRAJ	Juiz de Fora	350
PRAY	Mogy das Cruzes	300
PRAD	Pelotas	326
PRAG	Porto Alegre	275
PRAF	Belem, Para	220
PRAP	Recife	400
PRAI	Ribeirao Preto	260
PRAA	Rio de Janeiro	400
PRAB	Rio de Janeiro	320
PRAC	Rio de Janeiro	360
PRAK	Rio de Janeiro	260
PRAS	Santos	300
PRAE	Sao Paulo	350
PRAL	Sao Paulo	400
PRAO	Sao Paulo	320
PRAR	Sao Paulo	295
	BRITISH COLONIES	
TJW	Hamilton, Bermuda	545
ZBW	Victoria Peak, Hong Kong	350
7LO	Narobi	90
1SE	Singapore	330
	BRITISH INDIA	
VUB	Bombay	357.1
VUC	Calcutta	370.4
7CA	Calcutta	370.8
VPB	Colombo	480
VUR	Rangoon	398
	CANADA	
CKCR	Brantford	296.9
CFAC	Calgary	434.5
CKCN	Calgary	434.5
CHCA	Calgary	434.5
CJCJ	Calgary	434.5
CNRC	Calgary	434.5
CFCY	Charlottetown	312.3
CHCK	Charlottetown	312.3
CHWK	Chilliwack	247.8
CKMC	Cobanlt	247.8
CJRW	Fleming	296.9
CFNB	Fredericton	247.8
CHMA	Edmonton	516.9
CJCA	Edmonton	516.9
CKUA	Edmonton	516.9
CNRE	Edmonton	516.9
CHNS	Halifax	322.4
CHNS	Halifax	322.4
CKOC	Hamilton	340.9
CHCS	Hamilton	340.9
CFCH	Iroquois Falls	499.7
CFJC	Kamloops	267.7
CFMC	Kingston	267.7
CFRC	Kingston	267.7
CJOC	Lethbridge	267.7
CNRL	London	329.7
CJGC	Londou	329.5
CKPR	Midland	267.7
CFCF	Montreal	410.7
CHYC	Montreal	410.7
CKAC	Montreal	410.7
CNRM	Montreal	410.7
CJRM	Moose Jaw	296.9
CNRA	Moncton	475.9
CHML	Mt. Hamilton	340.9
CKCO	Ottawa	434.5
CNRO	Ottawa	434.5
CFLC	Prescott	296.9
CKPC	Preston	247.8
CKCI	Quebec	340.9
CKCV	Quebec	340.7
CNRQ	Quebec	340.9
CHRC	Quebec	340.9
CFCR	Regina	312.5
CHWC	Regina	312.3
CJBR	Regina	312.3
CNRR	Regina	312.3
CKCK	Regina	312.3
CHCT	Red Deer	356.9
CKLC	Red Deer	356.9
CNRD	Red Deer	357.1
CJHS	Saskatoon	329.5
CFQC	Saskatoon	329.5
CNRS	Saskatoon	329.5
CJOR	Sea Island	291.1
CKSH	St. Hyacinthe	296.9
CFBO	St. John	336.9
CHGS	Summerside	267.7
CJCB	Sydney, N. S.	340.9
CFRB	Toronto	312.3
CHNC	Toronto	516.9
CKNC	Toronto	516.9
CKGW	Toronto	434.8
CJBC	Toronto	517.2
CNRT	Toronto	356.9
CJSC	Toronto	516.9
CKCL	Toronto	516.9
CKOW	Toronto	356.9
CFCA	Toronto	356.9
CHLS	Vancouver	410.7
CKCD	Vancouver	410.7
CKFC	Vancouver	410.7
CKMO	Vancouver	410.7
CKWX	Vancouver	410.7
CNRV	Vancouver	291.1
CFCT	Victoria	475.9
CKY	Winnipeg	384.4
CNRW	Winnipeg	384.4
CJGX	Yorktown	475.9
	CHILE	
CMAO	Antofagasta	
	Asuncion	
CMAI	Concepcion	345
CMAD	Santiago	320
CMAE	Santiago	280
CMAT	Tacna	550
CMAK	Temuco	245
	Valparaiso	400
	CHINA	
COHB	Harbin	445
COMK	Mukden	425
	Shanghai	342
XGAH	Shanghai	328
XOI.	Tientsin	480
GEC	Tientsin	280
	COSTA RICA	
NRH	Heredia	306
	CUBA	
CMGEV	Caibarien	250
CMGLO	Caibarien	325
CM7AZ	Camaguey	225
CM7LO	Camaguey	230
CM6XR	Camajuani	200
CM7BY	Ciego de Avila	235
CM7EU	Ciego de Avila	200
CM7HS	Ciego de Avila	192
CM6BY	Cienfuegos	260
CM5EV	Colon	360
CM1PK	Guanajay	190
CMI	Habana	376
CMC	Habana	357
CM2AB	Habana	250
CM2AR	Habana	248
CM2AZ	Habana	334
CM2CP	Habana	280
CM2HP	Habana	205
CM2JP	Habana	270
CM2OH	Habana	300
CM2OK	Habana	360
CM2PK	Habana	326
CM2TF	Habana	208
CM2SE	Habana	255
CM2TW	Habana	228
CM2WX	Habana	341
CM2XA	Habana	230

Call		Meters
CM2XX	Habana	225
CM2BX	Habana	312.5
CM2JK	Habana	342.5
CM2LO	Habana	315
CM2LP	Habana	359
CM2LR	Habana	215
CM2MC	Habana	343
CM2MG	Habana	292
CM2PC	Habana	212
CM2RC	Habana	258
CM2FG	Hershey	226
CM2WD	Marianao	274
CM2XX	Marianao	225
CM2JF	Marianao	252
CM2JL	Marianao	294
CM2MA	Marianao	278
CM2SW	Marianao	274
CM1AZ	Mariel	275
CM7NM	Nuevitas	264
CM6HS	Sagua la Grande	200
CM6KP	Sancti Spiritus	280
CM6MN	Santa Clara	210
CM8HS	Santa Clara	200
CM6WT	Santiago	200
CM8HY	Santiago	150
CM8KW	Santiago	250
CM6KW	Yuinucu	368
	CZECHOSLOVAKIA	
OKR	Bratislava	279
OKB	Brno	342
	Kosice	293
	Moravska-Ostrava	263
OKP	Praha	487
	Prague	250
	DANZIG	
	Danzig	453
	DENMARK	
	Kalundborg	1153.8
	Kobenhavn	281
	Soro	1153.8
	DUTCH EAST INDIES	
PFC	Batavia	220.7
PLE	Bandoeng	31.86
PLE	Bandoeng	15.93
	Bandoeng	310
PLF	Malabar	17
	Surabaya	140
	EGYPT	
SRE	Cairo	255
	ESTONIA	
	Tallinn	401
	Tartu	285
	FINLAND	
OFA	Helsinki	221
OFC	Jakobstad	291
OFB	Lahti, Suomi	1796
OFD	Pori	218
OFE	Tampere	453
OFG	Turku	246
OFH	Viipuri	291
	FRANCE	
	Bordeaux-Lafayette	304.3
PTT	Ecole Superieure	447
	Grenoble	328.2
	Lille	265.5
	Limoges	293.6
	Lyon La-Doua	465.8
	Marseille	315.8
	Montpellier	286
	Petit Parisien	326
	Radio-Agen	311.5
	Radio-Beziers	212
	Radio Juan-les-Pins	248
	Radio L. L.	368.1
	Radio Lyon	285.8
	Radio-Mont-de-Marsan	400
	Radio-Montpellier	250.1
	Radio-Nimes	240
	Radio Normandie	213.5
	Radio-Paris	1724
	Radio-Sud-Quest	237.2
	Radio Toulouse	380.7
	Eiffel	1444
	Radio Vitus	309
	Rennes	22
	Strasbourg	345.2
	Toulouse-Pyrenees	255.3
	FRENCH COLONIES	
8DB	Algiers	363.7
8KR	Constantine	42.8
	Haiphong	320
	Radio S. Denis, Reunion	500
TUA	Tunis	1450
	GERMANY	
	Aachen	453
	Augsburg	560
	Berlin I	419
	Berlin II	384
	Bremen	319
	Breslau	325
	Dresden	319
	Flensburg	218
	Frankfurt	390
	Freiburg	569
	Gleiwitz	253
	Hamburg	372
	Hanover	560
	Kaiserslautern	270
	Kassel	246
	Kiel	246
	Koln	227
	Konigsberg	276
	Konigswusterhausen	1635
	Langenberg	473
	Leipzig	259
	Magdeburg	283
	Minchen	533
	Munster	234
	Nordeich	1630
	Nurnberg	239
	Stettin	283
	Stuttgart	360
	Zeesen	1635
	GREAT BRITAIN	
2BD	Aberdeen	301
2BE	Belfast	242
6BM	Bournemouth	288.5
2LS	Bradford	288.5
5WA	Cardiff	310
5GB	Daventry	479
5XX	Daventry	1553
2DE	Dundee	288.5
2EH	Edinburgh	288 5
5SC	Glasgow	399
6KH	Hull	288.5
2LS	Leeds-Bradford	200
6LV	Liverpool	288.5
2LO	London	356
2ZY	Manchester	377
5NO	Newcastle	261
5PY	Plymouth	288.5
6FL	Sheffield	288.5
6ST	Stoke-on-Trent	288.5
5SX	Swansea	288.5
	HAITI	
HHK	Port au Prince	361.2
	HOLLAND	
	Bloemendaal	245.9
HDO	Hilversum	1071
	Hilversum	298
	Huizen	1875
	Scheveningeu	1071
	HUNGARY	
	Lakihegy	550
	ICELAND	
	Akureyri	192
	Reykjavik	
	IRISH FREE STATE	
6CK	Cork	225
2RN	Dublin	413
	ITALY	
1BO	Bolzano	445.9
1GE	Genoa	385.1
1MI	Milan	500.8
1NA	Naples	331.4
	Palermo	209.8
1RO	Rome	441.1
1TO	Torino	275.2
	Trieste	256.4
	JAPAN	
JQAK	Dairen	395
JOFK	Hiroshima	353
JOJK	Kanazawa	423
JODK	Keijo	366
JOGK	Kumamoto	380
JOCK	Nagoya	370
JOBK	Osaka	400
JOIK	Sapporo	361
JOHK	Sendai	390
JOAK	Tokyo	345
	JUGOSLAVIA	
	Belgrade	429
	Ljubljano	566
	Zagreb	308
	LATVIA	
YLZ	Riga	525
	LITHUANIA	
RYK	Kaunas	1935
	MEXICO	
XFF	Chihuahua	325
XEA	Guadalajara	250
XFC	Jalapa	475
XES	Lerdo	250
XEY	Merida	548.6
XEX	Mexico City	325
XFX	Mexico City	357
XEN	Mexico City	410
XEB	Mexico City	450
XFG	Mexico City	470
XFI	Mexico City	507
XFA	Mexico City	600-500
XEO	Mexico City	254
XER	Mexico City	254
XEW	Mexico City	385
XEH	Monterey	311
XEI	Morelia	300
XEF	Oaxaca	265
XEE	Puebla	312
	MONACO	
	Monaco	237
	MOROCCO	
CNO	Casablanca	250
AIN	Casablanca	51
	Rabat	416
	Rabat	724.6
	NEW ZEALAND	
1ZB	Auckland	275.2
1ZQ	Auckland	252.1
1YA	Auckland	333.3
3ZC	Christchurch	250
3YA	Christchurch	306.1
4ZB	Dunedin	277.8
4ZO	Dunedin	277.8
4ZL	Dunedin	245.9
4ZM	Dunedin	277.8
4YA	Dunedin	461.5
2ZE	Eketahuna	247.9
2ZM	Gisborne	260.9
4ZI	Invercargill	258
4ZP	Invercargill	258
2ZD	Masterton	254.2
2ZQ	Masterton	254.2
2ZH	Napier	238
2YB	New Plymouth	254.9
2ZF	Palmerston	285.7
2ZG	Wanganui	500
2ZK	Wanganui	500
2YA	Wellington	416.7
	NORWAY	
LKA	Alesund	453
LKB	Bergen	364
LKF	Fredriksstad	394
LKH	Hamar	570
LKN	Notodden	283
LKO	Oslo	493
LKP	Porsgrund	453
LKR	Rjuken	447
LKM	Tromso	453
	Trondihen	1072
LKT	Trondelag Kringkoster	453.1
	PERU	
OAX	Lima	380
	PHILIPPINE ISLANDS	
KZRC	Cebu	230.8
KZIB	Manila	260
KZKZ	Manila	270.3
KZRM	Manila	413
	POLAND	
	Krakow	313
	Krakow	244
	Kattowitz	408
SP6	Lodz	233.8
	Poznan	335
SP6	Lwow	385.1
SP8	Warsawa II	214
	Warszawa	1411
	Wilno	385.1
	PORTUGAL	
PIAA	Lisbon	305
	ROUMANIA	
	Bucharest	394
	Bucharest	226
	Jassy	211
	SALVADOR	
AQM	Salvador	482
	SPAIN	
EAJ18	Almeria	251
EAJ13	Barcelona	462
EAJ1	Barcelona	344.8
EAJ12	Barcelona	268
EAJ9	Bilbao	434.8
EAJ3	Cadiz	400
EAJ16	Cartagena	246
EAR5	Las Palmas	250
EAR5	Las Palmas	350
EAJ7	Madrid	373
EAJ2	Madrid	424
EAJ25	Malaga	100
EAJ19	Oviedo	268
EAJ27	Salamanca	453
EAJ8	San Sebastian	349
EAJ17	Seville	368
	SWEDEN	
SBE	Boden	1200
SCA	Boras	231
SCB	Eskilstuna	246
SCC	Falum	322
SCD	Gavle	204.1
SBB	Goteborg	322
SCE	Hamstad	216
SCG	Halsingborg	231
SBH	Horby	257
SCF	Hudiksvall	270
SCH	Jonkoping	202
SCI	Kalmar	246
SCJ	Karlskrona	196
SCK	Karlstadt	218
SCL	Kiruna	246
SCM	Kristmehamm	203
SCN	Malmberget	436
SBC	Malmo	231
SBG	Motala	1348
SCO	Norrkoping	270
SCV	Orebro	237
SCW	Ornskoldsvik	218
SBF	Ostersund	770
SCP	Saffle	246
SCP	Stockholm	436
SBA	Sundsvall	542
SRD	Trollhattan	270
SCQ	Uddevalla	283
SCR	Umea	231
SCS	Uppsla	453
SCT	Varborg	283
SCU		
	SWITZERLAND	
HB3	Bale	1010
	Berne	403
	Geneva	760
	Lausanne	680
HBZ	Zurich	459
	TURKEY	
	Angora	1806
TAL	Istanbul	1200
	Osmanieh	1200
	UNION OF SOVIET SOCIALIST REPUBLICS	
RV19	Achkhabad	899.1
RV26	Artemovsk	370
RV35	Astrakhan	690
RVS	Bakou	1380
RV30	Dnepropetrovsk	383
RV21	Erivan	750
RV40	Gomel	483
RV23	Groznyi	577
RV14	Irkoutsk	1600
RV31	Ivanovo-Voznesensk	337
RV17	Kazan	486
RV4	Kharkov	1304
RV20	Kharkov	426
RV9	Kiev	800
RV33	Krasnodar	461.5
RV3	Leningrad	1000
RV36	Leningrad	351
RV27	Makhatch Kala	443.8
RV10	Minsk	700
RV1	Moscow	1481
RV2	Moscow	720
RV37	Moscow	379
RV39	Moscow	379
RV42	Nijni-Novgorod	406
RV43	Nikolaev	366
RV6	Novosibirsk	1250
RV13	Odessa	411
RV44	Omsk	636
RV45	Orenbourg	650
RV22	Onfa	554.7
RV46	Petropavlovsk	437
RV29	Petrozavodsk	778
RV34	Piatigorsk	347
RV12	Rostov-sur-le-Don	848.7
RV16	Samara	417
RV18	Samarkand	875
RV24	Smolensk	565
RV32	Stavropol	545
RV49	Stchelkovo	938
RV5	Sverdlovsk	825
RV11	Tachkent	712
RV7	Tiflis	1060
RV48	Tomsk	465
RV41	Veliki Oustug	535.7
RV28	Vladivostok	480
RV25	Voronej	468.8
	URUGUAY	
CWOA	Montevideo	428.4
CWOH	Montevideo	300
CWOO	Montevideo	294.1
CWOR	Montevideo	394.6
CWOS	Montevideo	380
CWSK	Montevideo	250
CWSC	Montevideo	277.8
CWOB	Montevideo	290
CWOW	Montevideo	450
CWSI	Paysandu	268
CWOI	Salto	246
CWOJ	Salto	250
	UNION OF SOUTH AFRICA	
ZTC	Capetown	375
ZTD	Durban	406.5
ZTJ	Johannesburg	450
ZTJ	Johannesburg	32
	Pretoria	323
	VENEZUELA	
AYRE	Caracas	375

AIR-LINE DISTANCES IN STATUTE MILES

FROM/TO	Albuquerque, N. Mex.	Atlanta, Ga.	Baltimore, Md.	Boise, Idaho	Boston, Mass.	Brownsville, Tex.	Buffalo, N. Y.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Denver, Colo.	Des Moines, Iowa	Detroit, Mich.	El Paso, Tex.	Fargo, N. Dak.	Fort Worth, Tex.	Galveston, Tex.	Hastings, Nebr.	Hot Springs, Ark.	Houghton, Mich.	Jacksonville, Fla.	Kansas City, Mo.	Los Angeles Calif.	Louisville, Ky.	Memphis, Tenn.
Albuquerque, N. Mex.	.....	1273	1670	774	1967	838	1577	1126	1248	1417	332	833	1360	228	968	561	803	588	773	1252	1492	717	663	1174	938
Atlanta, Ga.	1273	.....	575	1830	933	960	695	583	368	550	1208	738	595	1293	1112	750	688	901	498	947	286	675	1935	317	335
Baltimore, Md.	1670	575	.....	2055	358	1525	273	603	423	305	1505	913	398	1750	1143	1239	1245	1154	964	808	682	962	2313	498	792
Boise, Idaho	774	1830	2055	.....	2266	1610	1872	1453	1663	1754	637	1155	1671	969	975	1263	1538	934	1384	1367	2098	1158	663	1623	1506
Boston, Mass.	1967	933	358	2266	.....	1881	398	849	737	550	1766	1159	613	2067	1304	1574	1598	1415	1302	922	1015	1250	2590	823	1133
Brownsville, Tex.	838	960	1525	1610	1881	.....	1575	1234	1184	1402	1047	1102	1398	682	1445	471	287	1013	650	1543	1025	923	1370	1093	777
Buffalo, N. Y.	1577	695	273	1872	398	1575	.....	454	392	175	1368	762	218	1690	923	1221	1289	1019	956	560	880	862	2195	483	802
Chicago, Ill.	1126	583	603	1453	849	1234	454	.....	249	307	918	310	236	1249	571	820	954	566	585	367	861	413	1741	268	481
Cincinnati, Ohio	1248	368	423	1663	737	1184	392	249	.....	218	1090	509	234	1333	818	839	897	742	569	589	628	541	1892	92	410
Cleveland, Ohio	1417	550	305	1754	550	1402	175	307	218	.....	1223	617	94	1521	838	1046	1116	871	787	518	768	700	2044	309	627
Denver, Colo.	332	1208	1505	637	1766	1047	1368	918	1090	1223	.....	607	1153	554	642	643	925	353	749	970	1468	555	828	1035	878
Des Moines, Iowa	833	738	913	1155	1159	1102	762	310	509	617	607	.....	545	980	397	640	851	256	488	458	1024	180	1433	477	485
Detroit, Mich.	1360	595	398	1671	613	1398	218	236	234	94	1153	545	.....	1475	745	1018	1111	800	761	427	832	643	1976	315	621
El Paso, Tex.	228	1293	1750	969	2067	682	1690	1249	1333	1521	554	980	1475	.....	1161	543	723	757	302	1422	1481	836	702	1253	978
Fargo, N. Dak.	968	1112	1143	975	1304	1445	923	571	818	838	642	397	745	1161	.....	973	1218	440	875	393	1400	548	1426	818	882
Fort Worth, Tex.	561	750	1239	1263	1574	471	1221	820	839	1046	643	640	1018	543	973	.....	283	544	273	1093	943	460	1212	751	448
Galveston, Tex.	803	688	1245	1538	1598	287	1289	954	897	1116	925	851	1111	723	1218	283	.....	808	375	1277	799	677	1423	807	492
Hastings, Nebr.	588	901	1154	934	1415	1013	1019	566	742	871	353	256	800	757	440	544	808	.....	513	666	1178	226	1177	693	591
Hot Springs, Ark.	773	498	964	1384	1302	650	956	585	569	787	749	488	761	802	875	273	375	513	.....	901	728	326	1437	480	176
Houghton, Mich.	1252	947	808	1367	922	1543	560	367	589	518	970	458	427	1422	393	1093	1277	666	901	.....	1216	633	1787	636	830
Jacksonville, Fla.	1492	286	682	2098	1015	1025	880	861	628	768	1468	1024	832	1481	1400	943	799	1178	728	1216	.....	952	2153	595	591
Kansas City, Mo.	717	675	962	1158	1250	923	862	413	541	700	555	180	643	836	548	460	677	226	326	633	952	.....	1352	480	370
Los Angeles, Calif.	663	1935	2313	663	2590	1370	2195	1741	1892	2044	828	1433	1976	702	1426	1212	1423	1177	1437	1787	2153	1352	.....	1825	1602
Louisville, Ky.	1174	317	498	1623	823	1093	483	268	92	309	1035	477	315	1253	818	751	807	693	480	636	595	480	1825	.....	319
Memphis, Tenn.	938	335	792	1506	1133	777	802	481	410	627	878	485	621	978	882	448	492	591	176	830	591	370	1602	319	.....
Miami, Fla.	1710	610	958	2368	1258	1100	1184	1190	957	1088	1732	1338	1156	1662	1721	1150	941	1468	983	1545	328	1247	2355	923	878
Minneapolis, Minn.	980	905	948	1140	1125	1335	733	356	603	632	699	235	542	1156	219	870	1087	399	722	272	1192	413	1522	605	700
Missoula, Mont.	895	1790	1947	252	2124	1706	1740	1348	1578	1640	670	1074	1552	1115	819	1312	1595	891	1385	1208	2070	1117	910	1550	1483
Nashville, Tenn.	1117	218	597	1631	941	952	626	394	239	456	1018	523	468	1169	900	643	666	697	370	760	502	472	1777	153	195
New Orleans, La.	1030	427	1001	1713	1359	536	1087	831	708	922	1079	825	938	986	1221	470	288	870	358	1187	511	678	1675	623	358
New York, N. Y.	1810	747	170	2153	188	1695	291	711	568	404	1628	1023	483	1902	1213	1398	1415	1275	1125	849	838	1097	2446	650	953
Norfolk, Va.	1696	507	167	2137	467	1465	435	696	474	429	1562	983	522	1755	1258	1226	1195	1216	955	946	548	1009	2352	528	778
Oklahoma, Okla.	518	753	1173	1138	1490	659	1117	689	755	946	503	469	905	578	786	188	456	357	260	926	988	293	1182	675	422
Omaha, Nebr.	718	815	1026	1044	1280	1061	883	432	620	738	485	122	666	875	390	590	828	135	490	547	1098	165	1312	579	529
Philadelphia, Pa.	1748	663	90	2113	268	1614	278	664	501	343	1575	972	444	1834	1186	1324	1335	1222	1051	827	758	1037	2388	580	878
Phoenix, Ariz.	330	1592	2002	733	2295	1023	1904	1451	1578	1745	585	1154	1685	347	1225	858	1065	901	1094	1550	1800	1045	357	1512	1264
Pittsburgh, Pa.	1498	520	194	1863	478	1424	178	411	258	115	1320	718	208	1592	952	1097	1140	967	825	630	703	784	2135	345	660
Portland, Me.	2015	1022	446	2282	100	1961	438	892	802	603	1803	1197	657	2126	1313	1642	1678	1454	1371	924	1113	1300	2631	892	1205
Portland, Oreg.	1107	2172	2367	349	2553	1944	2167	1765	1987	2063	985	1479	1975	1286	1248	1612	1885	1271	1733	1638	2442	1397	825	1953	1852
Richmond, Va.	1628	470	128	2060	471	1428	375	618	399	353	1488	905	445	1695	1180	1170	1154	1142	897	870	953	937	2283	457	722
St. Louis, Mo.	938	467	731	1389	1036	975	662	259	308	490	793	270	452	1033	658	568	697	455	325	591	755	238	1585	242	242
Salt Lake City, Utah	483	1580	1858	292	2099	1317	1701	1260	1450	1567	372	952	1490	689	865	977	1249	708	1116	1242	1840	922	577	1400	1250
San Francisco, Calif.	893	2133	2451	516	2696	1675	2298	1855	2037	2163	946	1547	2087	993	1447	1454	1693	1297	1648	1833	2375	1500	345	1983	1800
Schenectady, N. Y.	1823	840	278	2120	150	1770	249	702	605	408	1618	1012	467	1930	1157	1445	1487	1267	1175	776	960	1107	2445	695	1010
Seattle, Wash.	1178	2180	2341	405	2508	2015	2130	1743	1974	2035	1020	1470	1945	1373	1206	1658	1938	1288	1759	1588	2450	1505	956	1945	1867
Shreveport, La.	764	548	1064	1433	1410	510	1080	725	688	904	799	624	891	752	1002	209	233	615	142	1043	733	326	1420	598	279
Spokane, Wash.	1028	1960	2110	290	2279	1852	1900	1514	1746	1804	827	1243	1715	1238	976	1470	1753	1061	1552	1360	2239	1286	939	1720	1652
Springfield, Mass.	1889	863	282	2196	79	1805	325	774	659	473	1692	1085	540	1990	1240	1495	1524	1340	1224	860	957	1173	2515	745	1055
Vermillion, S. Dak.	742	917	1083	973	1314	1161	916	479	694	785	468	187	705	920	284	689	938	167	605	510	1203	280	1291	663	642
Washington, D. C.	1648	542	33	2045	392	1493	290	594	403	303	1490	985	397	1726	1141	1210	1214	1139	936	813	647	943	2295	473	763

AIR-LINE DISTANCES IN STATUTE MILES

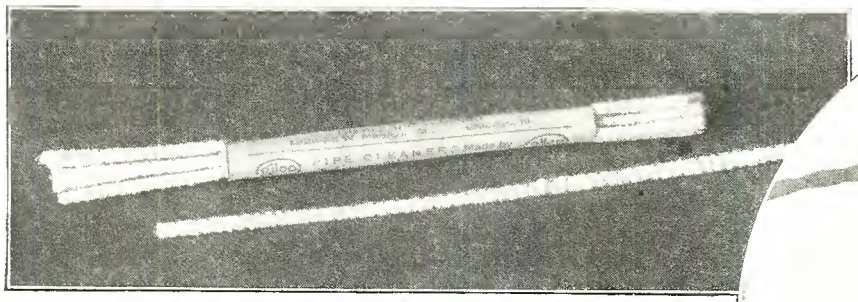
FROM/TO	Miami, Fla.	Minneapolis, Minn.	Missoula, Mont.	Nashville, Tenn.	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma, Okla.	Omaha, Nebr.	Philadelphia, Pa.	Phoenix, Ariz.	Pittsburgh, Pa.	Portland, Me.	Portland, Ore.	Richmond, Va.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Schenectady, N. Y.	Seattle, Wash.	Shreveport, La.	Spokane, Wash.	Springfield, Mass.	Vermillion, S. Dak.	Washington, D. C.
Albuquerque, N. Mex.	1710	980	895	1117	1030	1810	1696	518	718	1748	330	1498	2015	1107	1628	938	483	893	1823	1178	764	1028	1889	742	1648
Atlanta, Ga.	610	905	1790	218	427	747	507	753	815	663	1592	520	1022	2172	470	467	1580	2133	840	2180	548	1960	863	917	542
Baltimore, Md.	958	948	1947	597	1001	170	167	1173	1026	90	2202	194	446	2367	128	731	1858	2451	278	2341	1064	2110	282	1083	33
Boise, Idaho	2368	1140	252	1631	1713	2153	2137	1138	1044	2113	733	1863	2282	349	2060	1389	292	516	2120	405	1433	290	2196	973	2045
Boston, Mass.	1258	1125	2124	941	1359	188	467	1490	1280	268	2295	478	100	2553	471	1036	2099	2696	150	2508	1410	2279	79	1314	392
Brownsville, Tex.	1100	1335	1706	952	536	1695	1465	659	1061	1614	1023	1424	1961	1944	1428	975	1317	1675	1770	2015	510	1852	1805	1161	1493
Buffalo, N. Y.	1184	733	1740	626	1087	291	435	1117	883	278	1904	178	438	2167	375	662	1701	2298	249	2130	1080	1900	325	916	290
Chicago, Ill.	1190	356	1348	394	831	711	696	689	432	664	1451	411	892	1765	618	250	1260	1855	702	1743	725	1514	774	479	594
Cincinnati, Ohio	957	603	1578	239	708	568	474	755	620	501	1578	258	802	1987	399	308	1450	2037	605	1974	688	1746	659	694	403
Cleveland, Ohio	1088	632	1640	456	922	404	429	946	738	343	1745	115	603	2063	353	490	1567	2163	408	2035	904	1804	473	785	303
Denver, Colo.	1732	699	670	1018	1079	1628	1562	503	485	1575	585	1320	1803	985	1488	793	372	946	1618	1020	799	827	1692	468	1490
Des Moines, Iowa	1338	235	1074	523	825	1023	983	469	122	972	1154	718	1197	1479	905	270	952	1547	1012	1470	624	1243	1085	187	895
Detroit, Mich.	1156	542	1552	468	938	483	522	905	666	444	1685	208	657	1975	445	452	1490	2087	467	1945	891	1715	540	705	397
El Paso, Tex.	1662	1156	1115	1169	986	1902	1755	578	875	1834	347	1592	2126	1286	1695	1033	689	993	1930	1373	752	1238	1990	920	1726
Fargo, N. Dak.	1721	219	819	900	1221	1213	1258	786	390	1186	1225	952	1313	1248	1180	658	865	1447	1157	1206	1002	976	1240	284	1141
Fort Worth, Tex.	1150	870	1312	643	470	1398	1226	188	590	1324	858	1097	1642	1612	1170	568	977	1454	1445	1658	209	1470	1495	689	1210
Galveston, Tex.	941	1087	1595	666	288	1415	1195	456	828	1335	1065	1140	1678	1885	1154	697	1249	1693	1487	1938	233	1753	1524	938	1214
Hastings, Nebr.	1468	399	891	697	870	1275	1216	357	135	1222	901	967	1454	1271	1142	455	708	1297	1267	1288	615	1061	1340	167	1139
Hot Springs, Ark.	983	722	1385	370	358	1125	955	260	490	1051	1094	825	1371	1733	897	325	1116	1648	1175	1759	142	1552	1224	605	936
Houghton, Mich.	1545	272	1208	760	1187	849	946	926	547	827	1550	630	924	1638	870	591	1242	1833	776	1588	1043	1360	860	510	813
Jacksonville, Fla.	328	1192	2070	502	511	838	548	988	1098	758	1800	703	1113	2442	953	755	1840	2375	960	2450	733	2239	957	1203	647
Kansas City, Mo.	1247	413	1117	472	678	1097	1009	293	165	1037	1045	784	1300	1397	937	238	922	1500	1107	1505	326	1286	1173	280	943
Los Angeles, Calif.	2355	1522	910	1777	1675	2446	2352	1182	1312	2388	357	2135	2631	825	2283	1585	577	345	2445	956	1420	939	2515	1291	2295
Louisville, Ky.	923	605	1550	153	623	650	528	675	579	580	1512	345	892	1953	457	242	1400	1983	695	1945	598	1720	745	663	473
Memphis, Tenn.	878	700	1483	195	358	953	778	422	529	878	1264	660	1205	1852	722	242	1250	1800	1010	1867	279	1652	1055	642	763
Miami, Fla.		1516	2359	821	681	1095	802	1233	1402	1023	1998	1014	1357	2716	831	1067	2098	2603	1229	2740	950	2528	1210	1510	927
Minneapolis, Minn.	1516		1010	695	1050	1019	1047	692	291	985	1279	745	1145	1435	968	464	988	1585	975	1403	859	1173	1056	238	936
Missoula, Mont.	2359	1010		1582	1733	2030	2045	1162	978	1997	932	1754	2133	430	1967	1331	435	762	1978	395	1457	170	2060	887	1940
Nashville, Tenn.	821	695	1582		470	758	586	602	604	683	1445	472	1015	1970	526	253	1390	1958	820	1973	470	1752	863	704	567
New Orleans, La.	681	1050	1733	470		1173	932	575	845	1090	1318	923	1445	2063	899	599	1433	1923	1259	2098	280	1898	1287	960	968
New York, N. Y.	1095	1019	2030	758	1173		293	1324	1144	83	2142	313	277	2455	287	873	1972	2568	142	2419	1230	2190	120	1189	204
Norfolk, Va.	802	1047	2045	586	932	293		1186	1095	220	2027	316	565	2458	79	771	1925	2510	426	2440	1037	2211	411	1166	145
Oklahoma, Okla.	1233	692	1162	602	575	1324	1186		405	1256	843	1013	1550	1488	1122	456	862	1386	1354	1523	297	1324	1412	502	1150
Omaha, Nebr.	1402	291	978	604	845	1144	1095	405		1094	1032	837	1318	1373	1020	352	833	1425	1133	1372	617	1149	1205	115	1012
Philadelphia, Pa.	1023	985	1997	683	1090	83	220	1256	1094		2079	254	360	2419	205	808	1923	2518	205	2388	1153	2159	201	1143	122
Phoenix, Ariz.	1998	1279	932	1445	1318	2142	2027	843	1032	2079		1829	2345	1007	1960	1270	504	652	2152	1112	1067	1020	2220	1043	1980
Pittsburgh, Pa.	1014	745	1754	472	923	313	316	1013	837	254	1829		545	2174	242	561	1670	2264	350	2145	939	1918	400	891	188
Portland, Me.	1357	1145	2133	1015	1445	277	565	1550	1318	360	2345	545		2563	565	1094	2127	2725	197	2513	1484	2285	159	1345	480
Portland, Oreg.	2716	1435	430	1970	2063	2455	2458	1488	1373	2419	1007	2174	2563		2381	1723	636	536	2405	143	1783	295	2488	1293	2360
Richmond, Va.	831	968	1967	526	899	287	79	1122	1020	205	1960	242	565	2381		699	1850	2436	406	2362	985	2133	407	1089	96
St. Louis, Mo.	1067	464	1331	253	599	873	771	456	352	808	1270	561	1094	1723	699		1158	1738	898	1722	466	1500	958	450	710
Salt Lake City, Utah	2098	988	435	1390	1433	1972	1925	862	833	1923	504	1670	2127	636	1850	1158		592	1950	697	1155	548	2027	785	1845
San Francisco, Calif.	2603	1585	762	1958	1923	2568	2510	1386	1425	2518	652	2264	2725	536	2436	1738	582		2548	680	1655	730	2625	1383	2437
Schenectady, N. Y.	1229	975	1978	820	1259	142	426	1354	1133	205	2152	350	197	2405	406	989	1950	2548		2363	1290	2139	86	1165	313
Seattle, Wash.	2740	1403	395	1973	2098	2419	2440	1523	1372	2388	1112	2145	2513	143	2362	1722	697	680	2363		1820	229	2445	1282	2335
Shreveport, La.	950	859	1457	470	280	1230	1037	297	617	1153	1067	939	1484	1783	985	466	1155	1655	1290	1820		1621	1333	726	1035
Spokane, Wash.	2528	1173	170	1752	1898	2190	2211	1324	1149	2159	1020	1918	2285	295	2133	1500	548	730	2139	229	1621		2216	1055	2105
Springfield, Mass.	1210	1056	2060	863	1287	120	411	1412	1205	201	2220	400	159	2488	407	958	2027	2625	86	2445	1333	2216		1242	321
Vermillion, S. Dak.	1510	238	887	704	960	1189	1166	502	115	1143	1043	891	1345	1293	1089	450	785	1383	1165	1282	725	1055	1242		1073
Washington, D. C.	927	936	1940	567	968	204	145	1150	1012	122	1980	188	480	2360	96	710	1845	2437	313	2335	1035	2105	321	1073	

—Compiled by Department of Commerce.

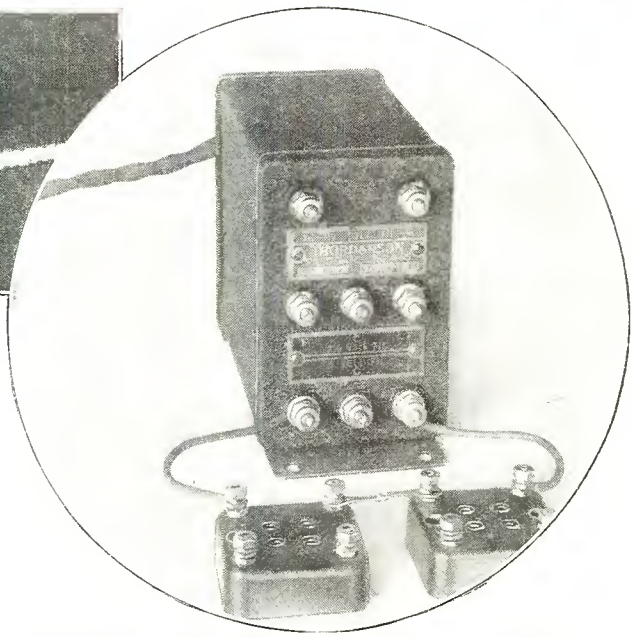
KC	Meters	STATIONS	DIALS 1	2
1500	199.9			
1490	201.2			
1480	202.6			
1470	204.0			
1460	205.4			
1450	206.8			
1440	208.2			
1430	209.7			
1420	211.1			
1410	212.6			
1400	214.2			
1390	215.7			
1380	217.3			
1370	218.8			
1360	220.4			
1350	222.1			
1340	223.7			
1330	225.4			
1320	227.1			
1310	228.9			
1300	230.6			
1290	232.4			
1280	234.2			
1270	236.1			
1260	238.0			
1250	239.9			
1240	241.8			
1230	243.8			
1220	245.8			
1210	247.8			
1200	249.9			
1190	252.0			
1180	254.1			
1170	256.3			
1160	258.5			
1150	260.7			
1140	263.0			
1130	265.3			
1120	267.7			
1110	270.1			
1100	272.6			
1090	275.1			
1080	277.6			
1070	280.2			
1060	282.8			
1050	285.5			
1040	288.3			
1030	291.1			

KC	Meters	STATIONS	DIALS 1	2
1020	293.9			
1010	296.9			
1000	299.8			
990	302.8			
980	305.9			
970	309.1			
960	312.3			
950	315.6			
940	319.0			
930	322.4			
920	325.9			
910	329.5			
900	333.1			
890	336.9			
880	340.7			
870	344.6			
860	348.6			
850	352.7			
840	356.9			
830	361.2			
820	365.6			
810	370.2			
800	374.8			
790	379.5			
780	384.4			
770	389.4			
760	394.5			
750	399.8			
740	405.2			
730	410.7			
720	416.4			
710	422.3			
700	428.3			
690	434.5			
680	440.9			
670	447.5			
660	454.3			
650	461.3			
640	468.5			
630	475.9			
620	483.6			
610	491.5			
600	499.7			
590	508.2			
580	516.9			
570	526.0			
560	535.4			
550	545.1			

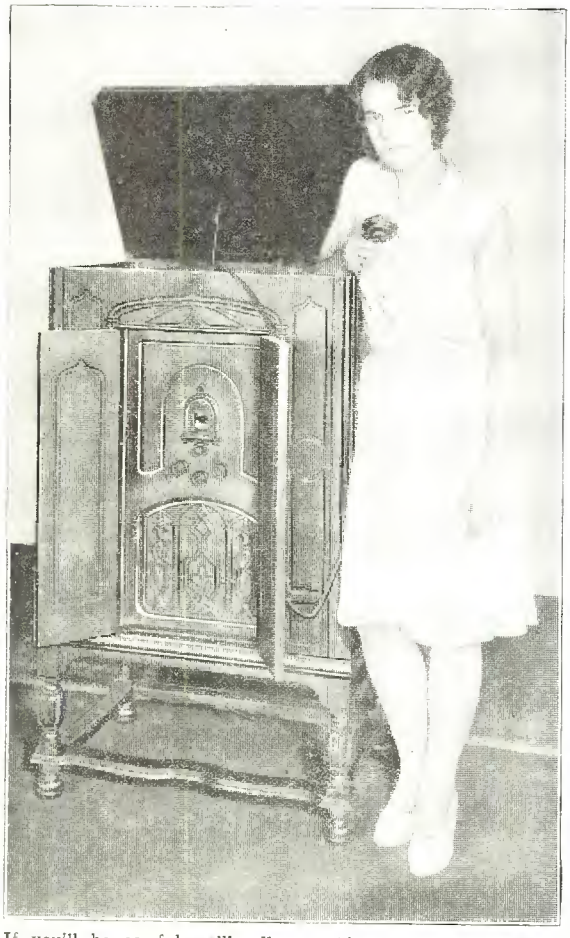
PICTORIAL RADIO



We're not interested in selling cigar store supplies, but Service Sam tells us he finds it quite handy to carry a few pipe-cleaners stuck away in the repair kit for those cases where it is necessary to clean out the dust and other debris that has fallen between the plates of variable condensers. Of course, in a modern set everything is well shielded, but S. S. says carry a few anyway

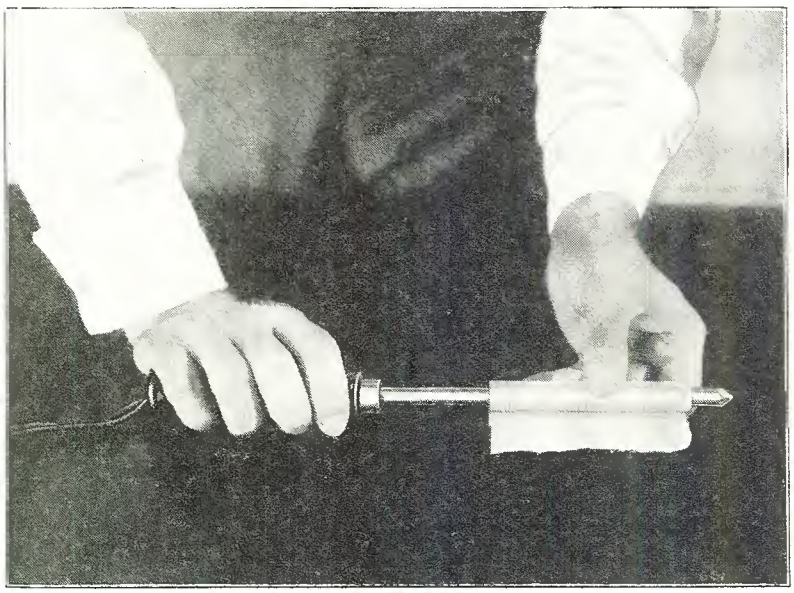


When changing from the 171 power output to the 245 output (push-pull) you needn't discard the old filament transformer used on the 171. Merely put your 245's in two sockets, the filaments being in series, each tube thus getting 2.5 volts from the 5 volt source. The center tap is taken off as before

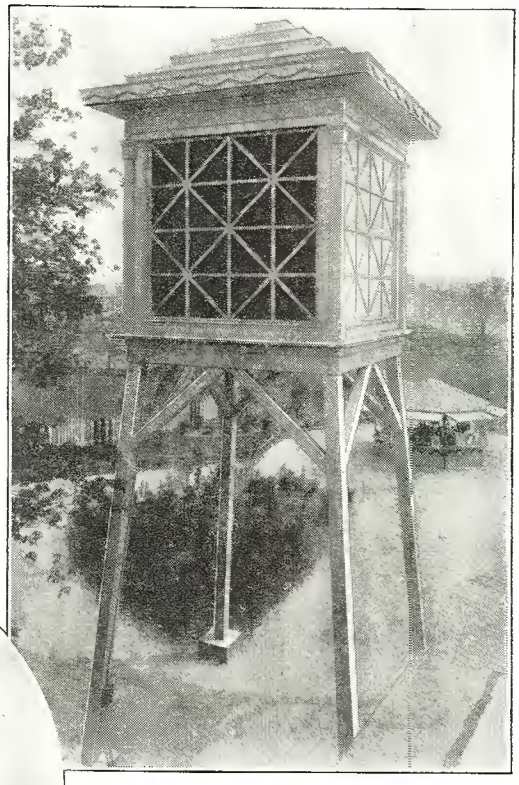


If you'll be careful we'll tell you this young lady is Miss Eleanor Gosa making a record of her voice with the home recording device on the new Radiola 86 which also incorporates a new screen grid superheterodyne and an improved electric phonograph. The movement of a single switch also makes it possible automatically to record excerpts from radio programs

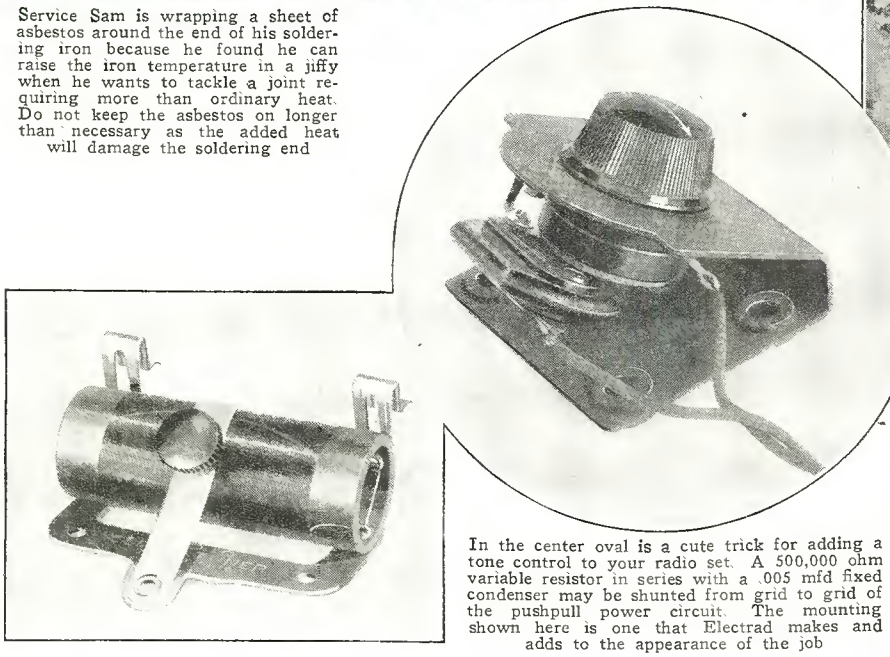
Now we know the maker of these ingenious pads once lived in an apartment with a radio set above furnished plenty of oooompahs and zoom zooms, in fact to such an extent the china in the buffet below was constantly chattering, and there was no sleeping because the bedroom walls vibrated in resonance with the low notes from above. The device, placed under the legs of the offender's radio set, will protect the carpet, stop traffic jars, and keep the oompaaaahs where they belong. It is made by the Dalitze Mfg. Co., of Cleveland, Ohio, and is called the No-Vibe



Service Sam is wrapping a sheet of asbestos around the end of his soldering iron because he found he can raise the iron temperature in a jiffy when he wants to tackle a joint requiring more than ordinary heat. Do not keep the asbestos on longer than necessary as the added heat will damage the soldering end

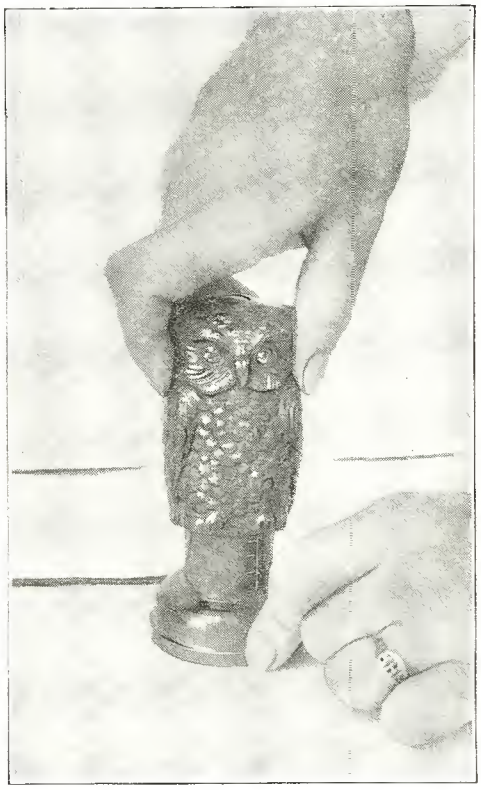


Here's the way one enterprising owner of an outdoor amusement center had his Western Electric public address speakers housed to add to the beauty of his place. Stentorian tones emanating from the elevated house caused the visitors to crane their necks to discover the source of sound

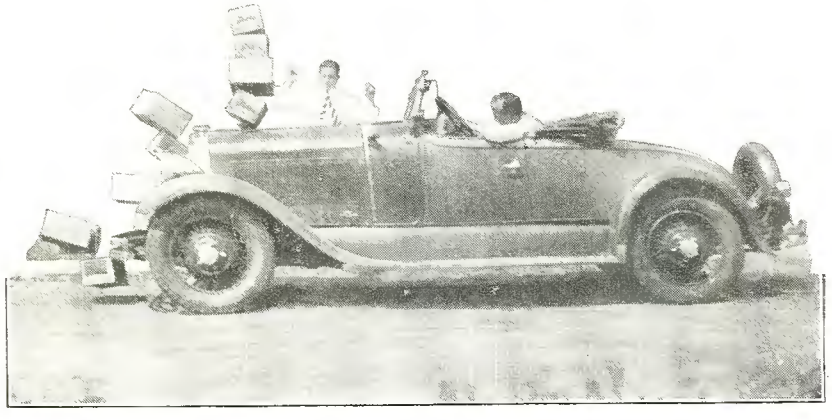


In the center oval is a cute trick for adding a tone control to your radio set. A 500,000 ohm variable resistor in series with a .005 mfd fixed condenser may be shunted from grid to grid of the pushpull power circuit. The mounting shown here is one that Electrad makes and adds to the appearance of the job

Above is what is known as a Claratuner. In effect it is a loading coil for the antenna circuit. By its use the low frequency end of your dial (the higher wavelength end) can be made to furnish a little more pep than before. On the high frequency end the loading coil is cut out

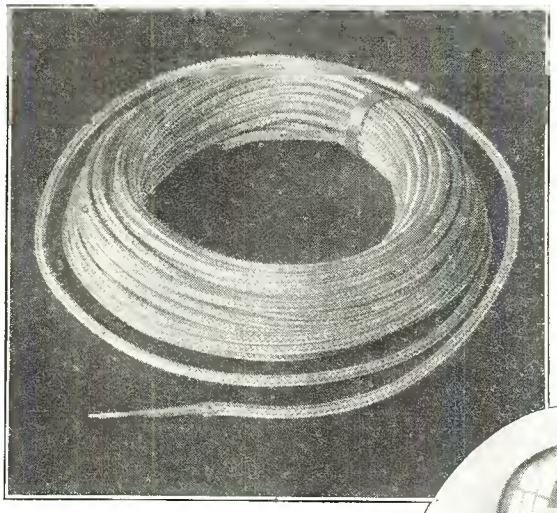


The Radio Owl shown above never lets you forget to turn off the radio set when bed-time arrives, since it shuts off any electric household appliance when plugged into the socket and adjusted to shut off the appliance at any time desired from a few minutes to two hours. It is a product of the Taylor-Travers Corp., Ltd., of Los Angeles, Calif.

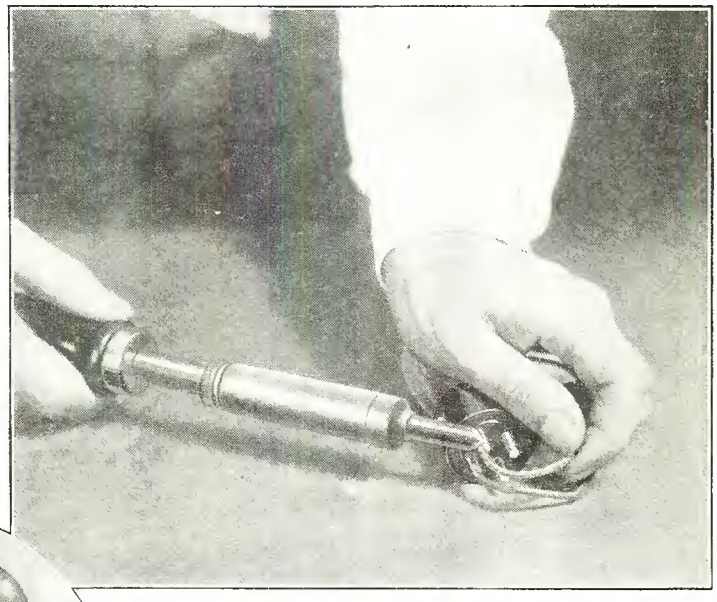


When George Lewis, of the Arcturus Tube Co., wants to find out what happens to tubes in shipment, he has a neat pile of cartons piled up on the road, steps into his benzine buggy, and wallops the pile with the front bumper of his car travelling at a merry clip. George is seen ducking behind the windshield as some of the cartons are headed in his direction

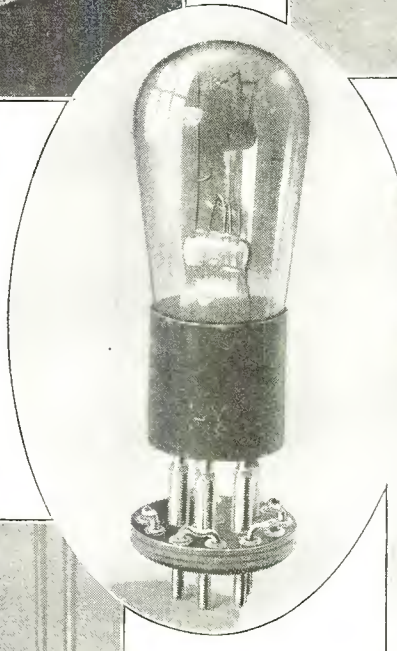
Sometimes when troubled with interference in a certain location, you may be able to run your antenna in a shielded conductor to another location and materially reduce such interference. The shielded conductor made by Belden comes in quite nicely for these jobs, the inside wire being insulated and then shielded with the outer woven wire shield. Experiment will determine whether or not it's best to ground the shield; generally it's left ungrounded

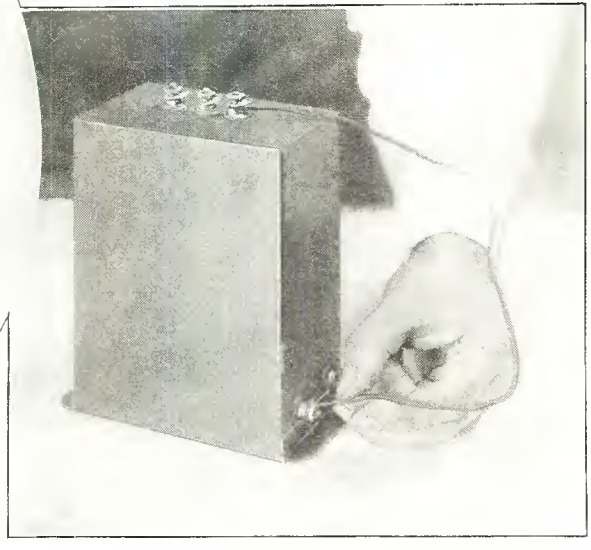


The socket connector shown at the right is one made by Best Mfg. Co., at Irvington, N. J. It may be used for neutralizing a set; any circuit may be broken by removing the connector pins. Maybe you can think up some other use for it around the shop

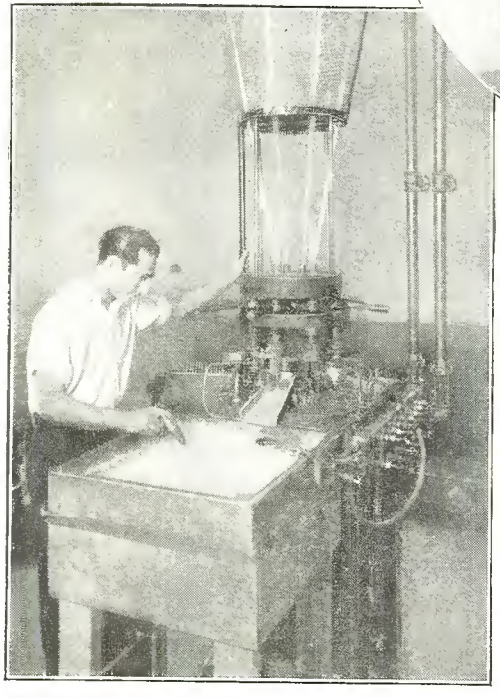


A vacuum tube may be used as a temporary neutralizing condenser by soldering leads to the G and P prongs, leaving the filament prongs untouched. The capacity of one tube is generally quite close to that of another

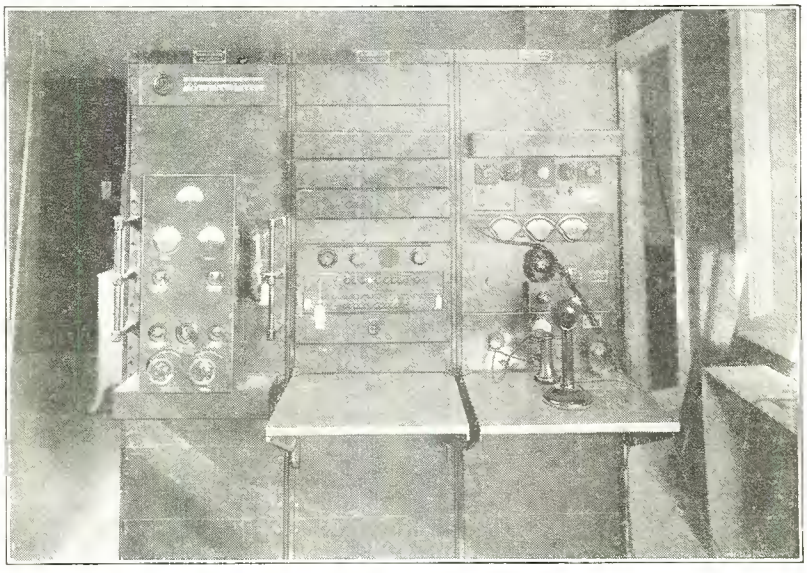




Be sure, says Service Sam, to discharge any of the filter condensers before either working on it or setting it aside. Some of the good condensers will retain a healthy charge for half an hour



Here's one of the machines in the Duovac plant where they automatically make the flares for the vacuum tubes. This permits production in keeping with the heavy demands made on the tube manufacturers during this season



In the KMOX broadcasting station at St. Louis may be seen such an installation as is shown in the photograph above. It's one of the control positions with all necessary measurement apparatus to determine incoming sound levels, switching arrangements for pickups and other activities of a busy broadcasting station

Hammarlund Hi-Q 31 AC Receiver Performance Is Measured

MEASUREMENTS on the Hammarlund Hi-Q 31 a.c. have recently been made in our laboratory and are presented for the first time to our readers, the sensitivity, selectivity and fidelity curves being shown at the bottom of the following page. From the schematic printed in Figure 2 readers may see the electrical details of the circuit which includes a band pass amplifier in the head end, followed by three stages of radio frequency amplification. The detector is of the power detection type using a type –24 tube, resistively connected to the first audio where a type –27 is used. The output stage consists of a pair of –45 tubes in pushpull. The receiver is designed for use with a special Hammarlund speaker.

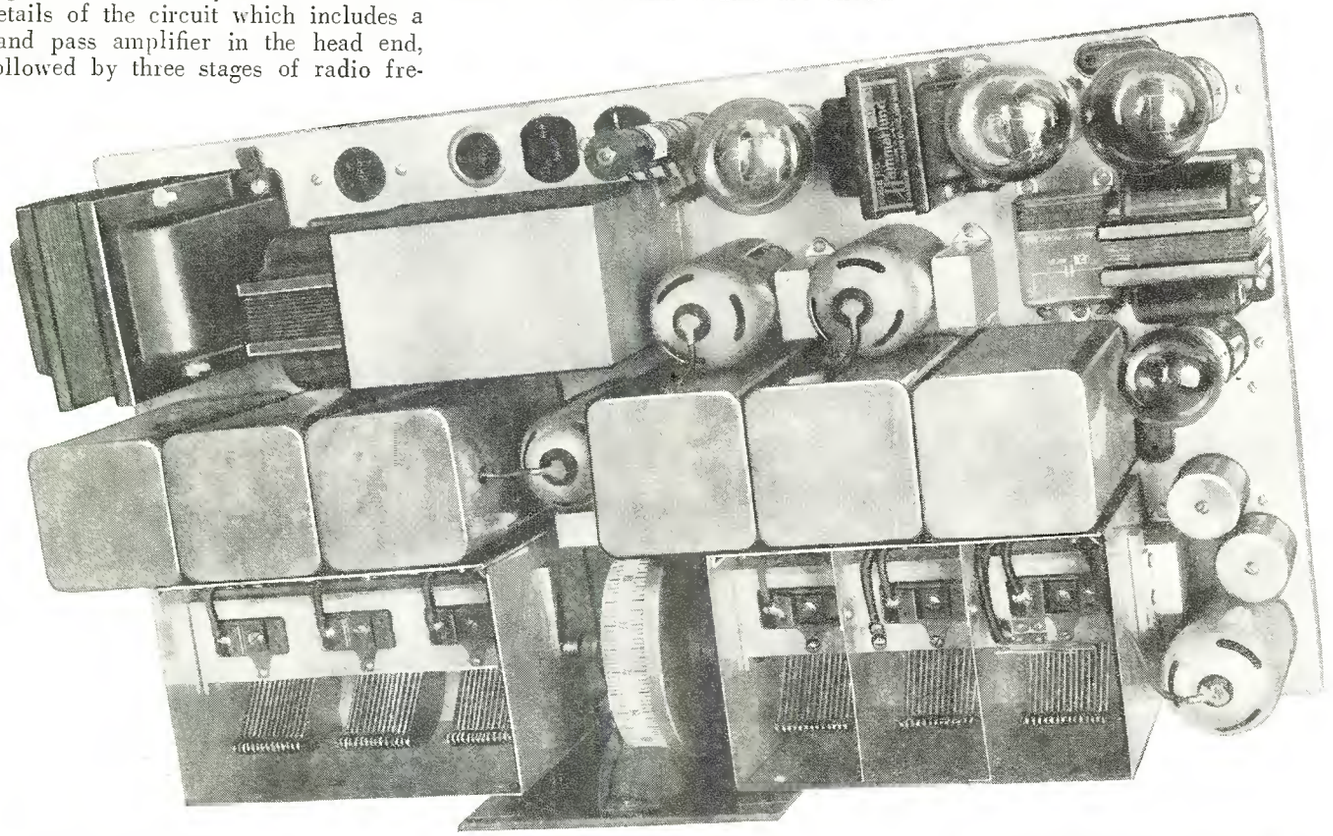


Fig. 1. This photograph shows a top front view of the Hammarlund Hi-Q 31 a.c. recently measured in our laboratory

How Measured

In measuring the receiver the output impedance load was 4,000 ohms coupled capacitatively to the plates of the –45 tubes. Output was maintained at .050 watts, which is the standard output for receivers. The dummy antenna, used on the long tap, consisted of 20 uh, 200 mmf and 25 ohms. The phasing frequency was 1,400 kc except on the antenna stage, where 600 kc was maintained. The volume control was turned on full. No oscillation nor hum was encountered.

Mutual conductance of the tubes used in making these measurements were: 1 r.f. 1080; 2 r.f. 1020; 3 r.f. 960; detector 980; 1 a.f. 1400; p.p. 1200 and p.p. 1300.

Tables indicating the interference ratio and the band widths are shown below, this data having been taken from the work sheet in the laboratory:

Interference Ratio

Resonance	Kilocycles off resonance Plus 10	Plus 20	Plus 30
600 kc.	150.0	.....	.....
1000 kc.	5.5	155.0	.....
1400 kc.	5.0	48.0	680.0
	Minus 10	Minus 20	Minus 30
600 kc.	265.0	.....	.....
1000 kc.	45.0	1000.0	.....
1400 kc.	45.0	280.0	660.0

Band Widths

Times field strength	Kilocycles wide 600 kc.	1000 kc.	1400 kc.
10	10.0	18.0	19.7
100	16.5	31.0	36.0
1000	28.5	44.0	.....

Operating Notes

Operating notes accompanying the Hi-Q 31 receiver indicate that on account of the three stage input filter, or pre-selector, the length of antenna does not have a very marked effect on the selectivity of the receiver. There are two antenna binding posts, one for a long and one for a short antenna. In general a long antenna may be considered as one having an overall length including lead-in of 75 feet or more, and normally such an antenna should be connected to the middle of the three binding posts. A shorter outside or indoor antenna in general will give best results if connected to the post marked "short antenna."

Test Best Position

However, the most efficient combination can be determined best by experiment under actual operating conditions. When testing for best results, it will generally be necessary to slightly readjust the first equalizer when shifting the antenna from one post to another. When the best connection for a par-

Some Operating Notes Given On Receiver

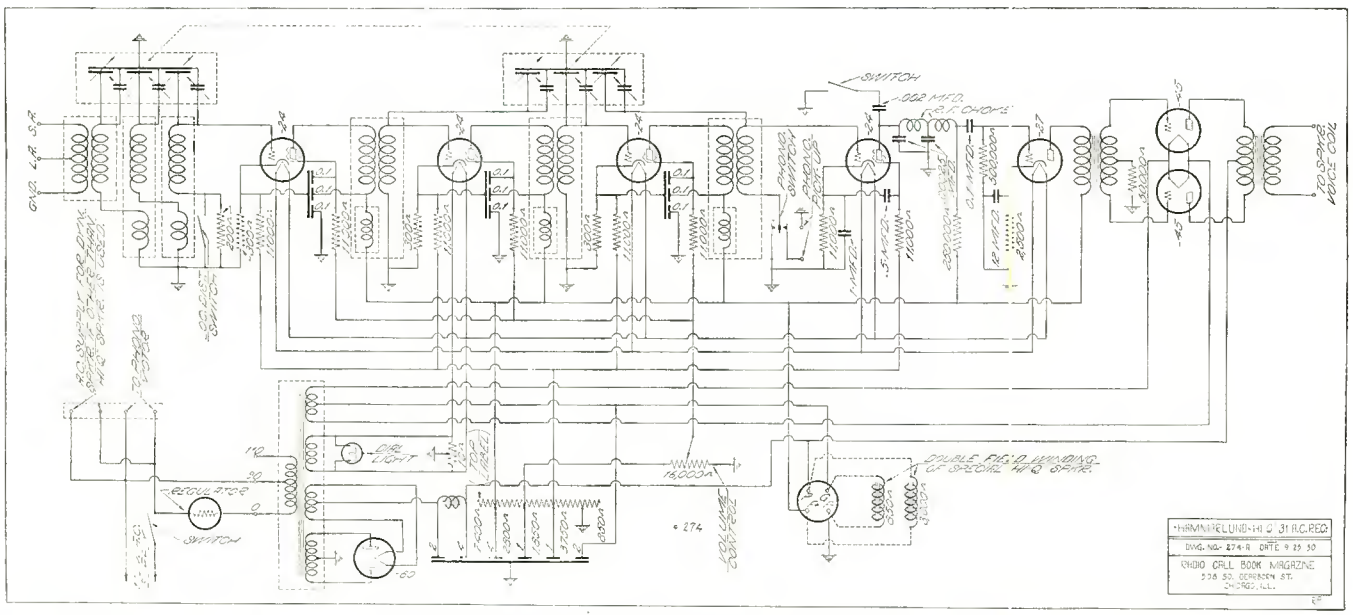


Fig. 2. In this schematic diagram the reader may trace all the electrical connections in the Hammarlund Hi-Q 31 a.c.

ticular set and location has been secured this first equalizer can be finally adjusted, preferably at a low dial setting, after which no change should be necessary.

Do Not Detune Set

Ordinarily best reception is had when the receiver is accurately tuned to the incoming signal and the volume control setting reduced to the lowest point for the desired amount of sound from the speaker. In no case should the receiver be detuned to reduce the volume, as when this is done the quality of the output from the speaker is materially affected.

In general it is advisable to use the distance-local switch in the L position on strong signals. This not only results in smoother control of volume but also affords better tone quality in the case of very powerful local signals.

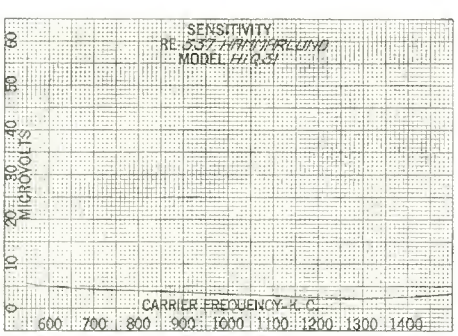
Tone Control

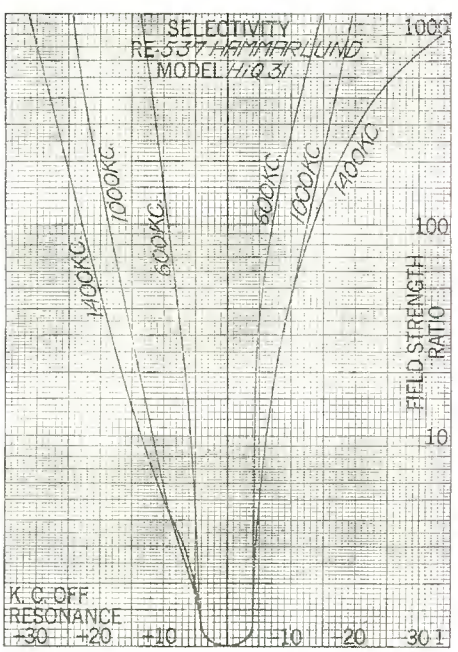
When listening to the distant stations it will be found advantageous to have the tone control switch turned to the bass or B position. This will eliminate or at least reduce much of the annoying scratching and hissing usually associated with distance reception.

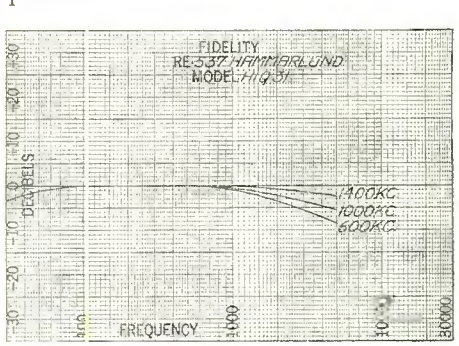
Special Speaker

The instructions accompanying the receiver assume that the set is used with a special Hi-Q 31 speaker. This speaker had two separate field energizing windings, one of 3000 ohms resistance and 40 mil capacity, the other 850 ohms resistance capable of handling a current of 65 ma. The terminals of these two windings are brought out in a four wire cable and attached to a standard four prong plug fitting a standard UX socket. When this plug is inserted in the socket marked "Spkr" the 3000 ohm field coil acts as a second filter choke of the plate supply, and also replaces the top section of the voltage divider (this section being left open in the schematic Figure 2). The 850 ohm field coil acts as a biasing resistance for the pushpull 245 tubes and replaces the bottom section of the voltage divider which is also shown open in the schematic. This scheme provides about 8 watts of d.c. power for energizing the speaker field without increasing the drain on the power supply, since this power would otherwise be dissipated in the voltage divider in the form of heat. This arrangement also obviates the need for a separate rectifier in the speaker, thus eliminating one of the most troublesome sources of hum.

The receiver however can be used with any speaker having its own field supply by the addition of a special 40 mil choke and a four prong plug. Two wires should be soldered to the terminals of this choke and their free ends connected to the P and F+ terminals of the four prong plug; the other two terminals being left open. These wires should be of such length as to permit the choke being placed on the lower shelf in the console, or other convenient place.







Howard Remote Control System

A REMOTE control system developed by the engineers of that company has recently been announced by the Howard Radio Co., of South Haven, Mich., and is presented pictorially in this article, together with a description. The system in addition to being designed for use with the Howard receiver may also be used with other receivers, opening up a field for service men to add to their profits by such installations.

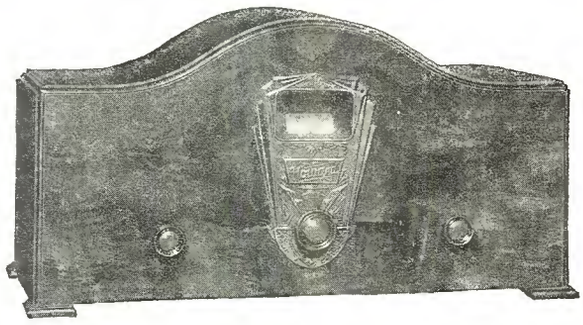


Fig. 4. This illustration is of the remote control unit in an attractive housing

The photograph shown in Fig. 1 shows the chassis with the driving mechanism on it; Fig. 3 is a front view showing the Howard dial system and the automatic locking device; Fig. 2 shows the rear of the remote control unit; Fig. 4 is the remote control unit in its attractive housing, while Fig. 5 shows the electrical circuit connections.

In order to give a clear idea of the system we are abstracting from a recent description supplied by A. Crossley, chief engineer of the Howard interests.

Figure 1 shows a front view of the remote control unit after it has been removed from the cabinet, showing three dials. The center dial rotates the control motor and has attached to it a brass cylinder around which is wound the special driving cord associated with the dial strip. Rotating the knob to the right or the left also produces a similar motion of the dial strip. A gear wheel is attached to the shaft of the motor as can be seen in the picture. Above the gear wheel is a pawl, connected to a lever arm which rotates about a center point; the opposite end of this lever arm fits into a cam mechanism associated with the switch arm. This pawl and cam mechanism, together with the gear wheel on the main shaft, provide locking means whereby the remote control, unit will not get out of synchronism with the chassis driving mechanism. When the switch is turned on and power is furnished the remote control drivers (or rotoformers as Howard calls them) it is possible to rotate the center knob and the system is in condition to operate, but as soon as the switch is turned off, the pawl mechanism engages the gear wheel, making it impossible to rotate the shaft of the rotoformers or driving mechanism. This eliminates trouble met with should an inexperienced operator try to turn the middle knob when the current is turned off. It also eliminates trouble met with when youngsters are fooling with the mechanism. The knob at the right in this photograph is the volume control governing the output of the receiver.

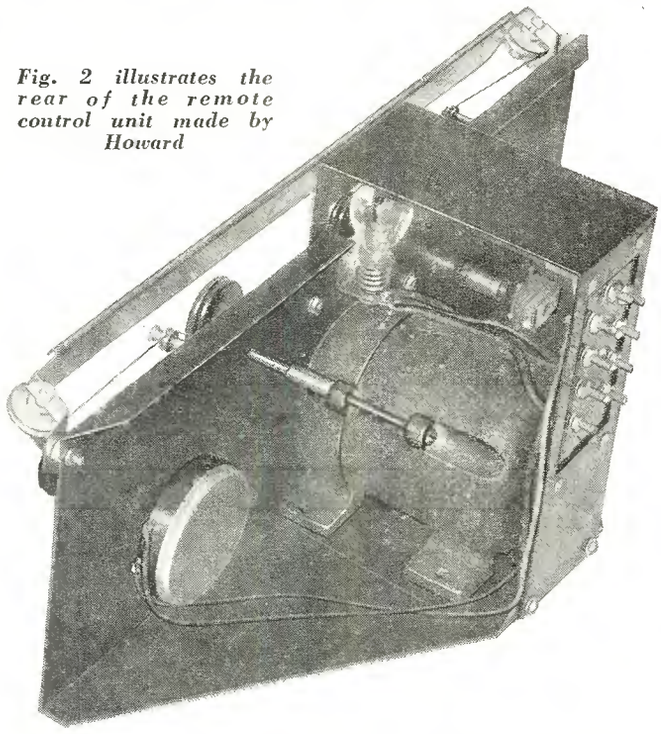


Fig. 2 illustrates the rear of the remote control unit made by Howard

The rear of the remote control unit may be seen in the photograph Figure 2. The rotoformers, closely resembling a motor in construction can be seen in the picture, with the pilot light above; the volume control is also discernible. The bracket arm to the right has the bakelite terminal strip and in the extreme corner may be noted the switch which turns on and off the current both for the driving mechanism and the receiver.

Photographically in Figure 3 we find the standard Howard chassis with the volume control, switch and standard mechanism removed. In place of the standard driving mechanism we observe to the right a gear wheel around which is a chain drive which in turn engages a gear wheel on the rotoformer or driving mechanism. This unit is made fast to the right hand side of the chassis by means of a special reinforced bracket. On the lower part of this bracket will be noticed a brass rod with a spring between the end of the brass rod and the side of the bracket

(*Continued on page* 95)

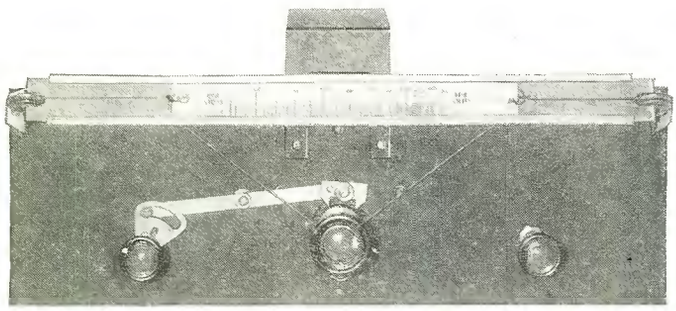


Fig. 1 shows a front view of the remote control unit after it has been removed from the cabinet

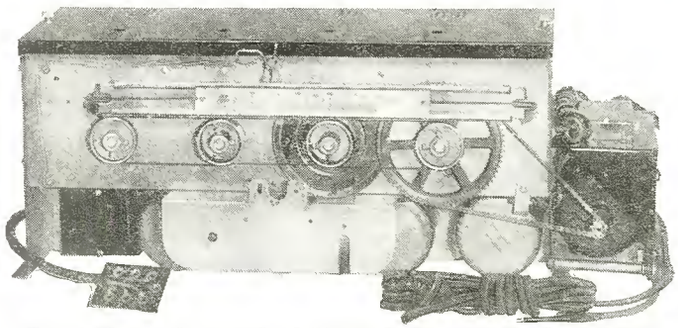
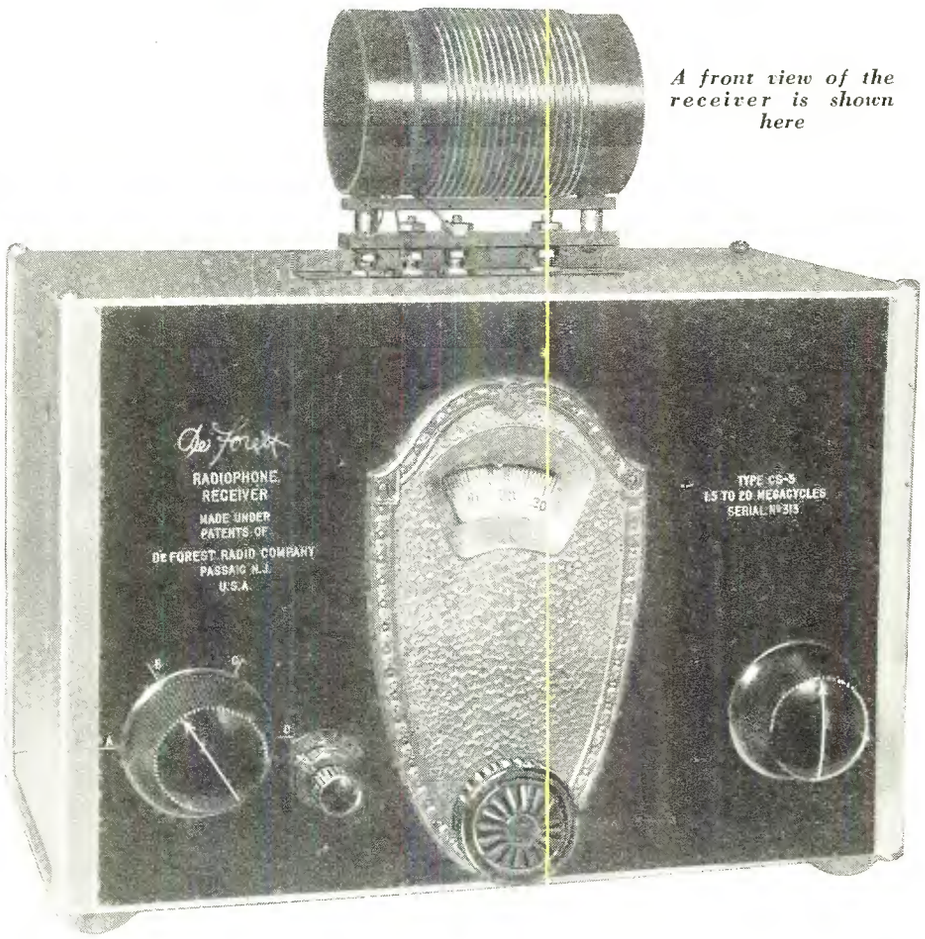


Fig. 3 shows the standard Howard chassis with the volume control, switch and standard driving mechanism removed

De Forest Radiophone Receiver

Range 15-200 Meters



A front view of the receiver is shown here

SHORT wave enthusiasts who have found numerous circuits for the higher frequencies described in this magazine for the past several years, may be interested in a recent simplified short wave phone receiver (also can be used for code) marketed by the De Forest Radio Co., and known as their type CS-5, with a range from 1.5 to 20 megacycles (15 to 200 meters).

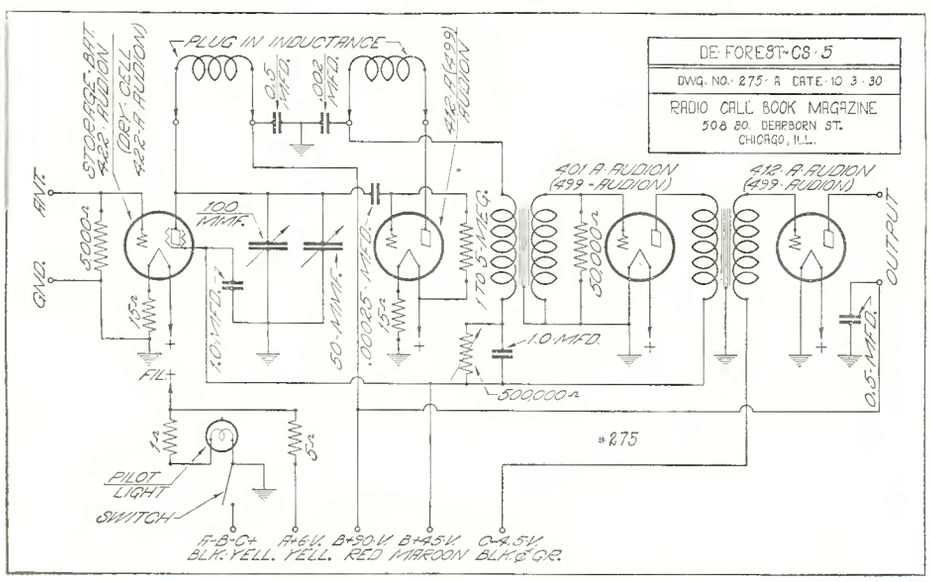
The front view of the receiver is shown at the heading of this article; an inside photograph at the bottom of the page, right, and the schematic diagram of the CS-5 in the illustration at the bottom, left, of this page. The job is designed for operation on storage batteries or dry cells and has sufficient output on average signal inputs to operate a magnetic speaker at normal volume.

What It Covers

Within the tuning range of the CS-5 are all short wave broadcasting channels, commercial point-to-point telegraph and telephone circuits, shop-to-shore short wave channels, amateur telephone and telegraph bands, and the government short wave radio services.

An inspection of the schematic circuit of the receiver will disclose its r.f. input circuit is aperiodic, followed by a regenerative detector, regeneration being controlled by a 500,000 ohm variable resistor in shunt to the 1 mfd condenser shown in the circuit diagram. The remainder of the circuit is conventional as our readers will readily note.

In the r.f. stage the DeForest 422 is used, while the 412A is employed in the detector circuit. The 401-A is normally used in the first a.f. with a 412-A in the last stage for better quality on short wave broadcast reception. The battery cable provides a C bias lead for the last audio tube in order that proper C bias be afforded the last tube. Both the 401-A or 412-A take 4.5 volts C. While normally intended for storage battery operation the CS-5 will operate on dry cells where a 6 ohm resistance is inserted in series with the yellow plus A lead, and substituting three 1.5 volt dry cells. In this case Audion 422-A is used in the r.f. and type 499 in the remainder of the tubes.



Above is the schematic diagram for the receiver

Coil Ranges

In operating the receiver the wavelength control is the main tuning dial

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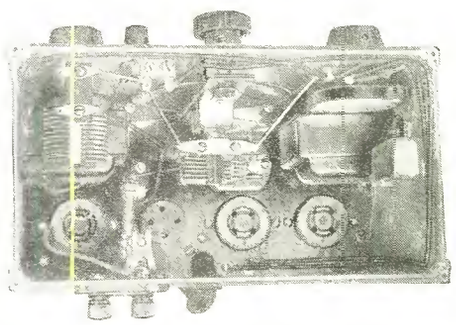


This photo shows the inside of the DeForest CS-5 short wave receiver

H. F. L. 1931 Mastertone

THE H. F. L. 1931 Mastertone described in this article is a "super" employing the latest adaptation of the Hopkins band rejector system which is responsible for the high degree of selectivity obtained. It will be seen, as the description is carefully read, how this selectivity is obtained, and, more important, why it is actually maintained under the most powerful barrage of high powered local stations. This point is becoming increasingly important in view of the seeming failure of other well known systems to maintain the desired transmission band width when confronted with extremely high input signals.

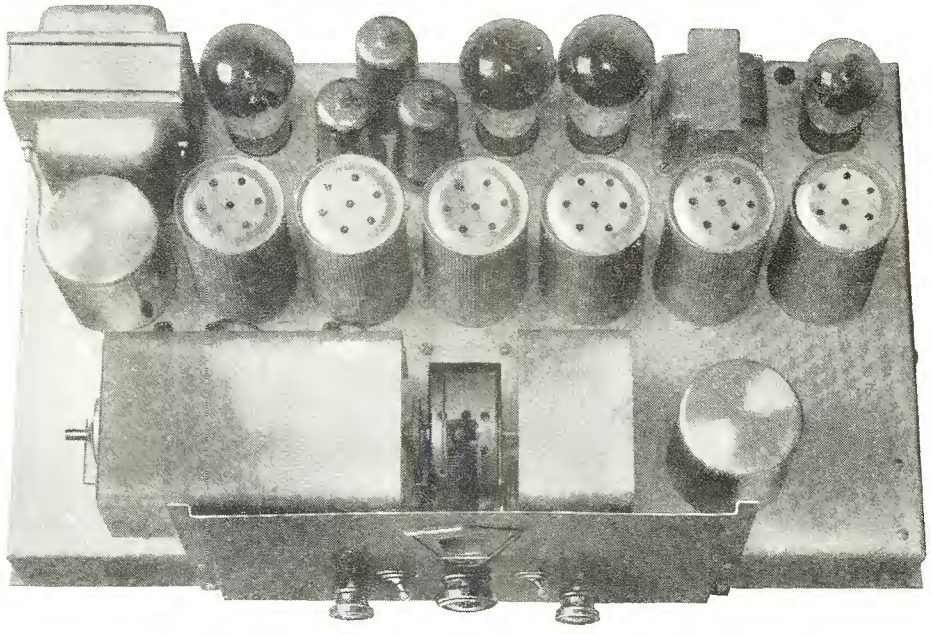


Fig. 8. The chassis of the H. F. L. 1931 Mastertone is shown above; receiver and power supply being on the same chassis

Impedence Amplifier

The Hopkins circuit is actually an impedance-coupled amplifier in which the impedance of the output circuit of one tube is common to that of the input circuit of the succeeding tube. Of course, one object of the amplifier is to give as much increase in the voltage impressed upon the grids of successive tubes as possible, and in order to do this it is necessary that the voltage drop across the elements of the external plate circuit be as great as is compatible with stable operation.

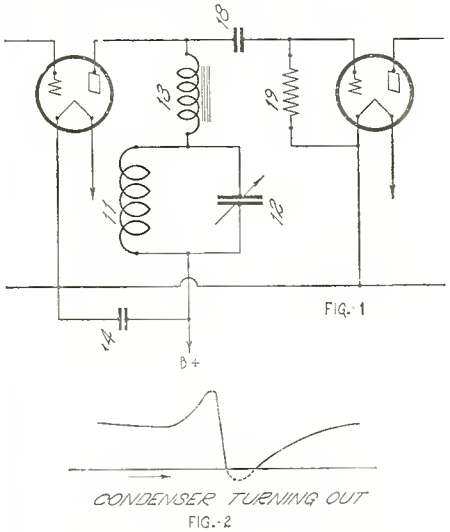
With screen-grid tubes the high plate resistance makes it necessary to greatly increase the impedance of the external plate circuit, over that necessary with the -27 type, in order to create a high voltage drop for impression upon the grid of the following tube. A parallel resonant circuit of the type sometimes called a wave-trap was selected as the best means for supplying the high impedance, in spite of the fact that such a system, as usually employed, presents problems due to the tendency of such circuits to oscillate and become decidedly unstable when as many as three stages are used.

Fig. 1 shows a form of coupling means which is used in the set. The plate circuit is seen to consist of a combination of a choke coil in series with a parallel tuned circuit, with plate return through these impedance elements and a fixed condenser, 14. The fixed condenser, 18, between the plate of the first tube and the grid of the second, is for the sole purpose of isolating the grid from high plate voltage. A leak, 19, is provided to prevent blocking of the second tube.

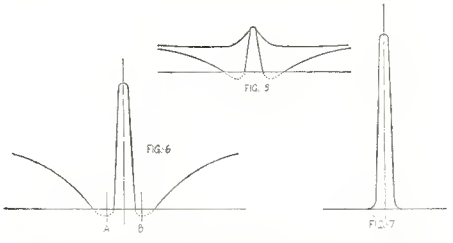
The choke coil, designated as 13 in the diagram, is so designed that it has a large value of inductance with a very small distributed capacity. At the same time the capacity is sufficient to tune the circuit to a frequency much lower than the frequency used in the amplifier, so that the choke acts as a capacity reactance to the intermediate frequency, and functions as a very small condenser; that is, a condenser having high capacitive reactance.

Two Laws Involved

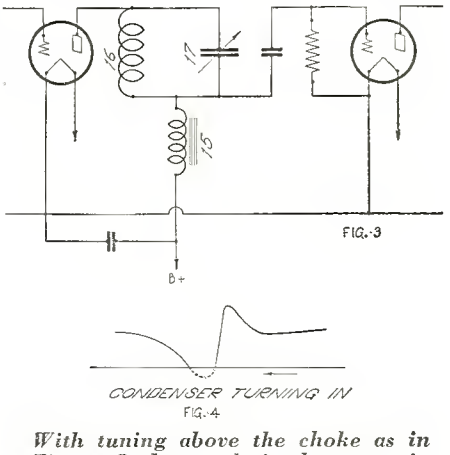
Two fundamental electrical laws enter into the analysis of the working of this system. The first is that when a capacity and an inductance are in series and the reactances are mutually balanced at some particular frequency, the current at that frequency meets with no impedance other than the ohmic resistance of the circuit, and consequently no voltage drop will occur across them. The second law is that when a circuit, such as that incorporated in inductance, 11, and condenser, 12, is brought into parallel resonance at a certain fre-



When the tuning is below the plate choke shown in Figure 1 the curve shown in Figure 2 is the result

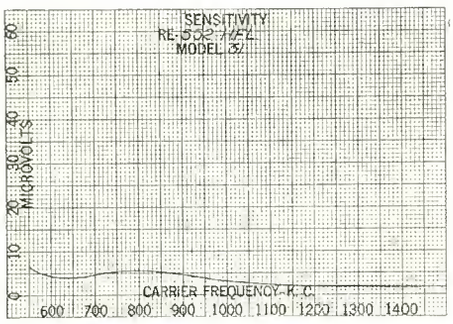


In Figure 5 are the combined curves of Figs. 1 and 3. In Fig. 6 the points A and B indicate signal cutoff beginning, while in Figure 7 is the overall response curve from the combination of the two methods of plate tuning



With tuning above the choke as in Figure 3 the result is the curve in Figure 4, exactly the opposite of that in Figure 2

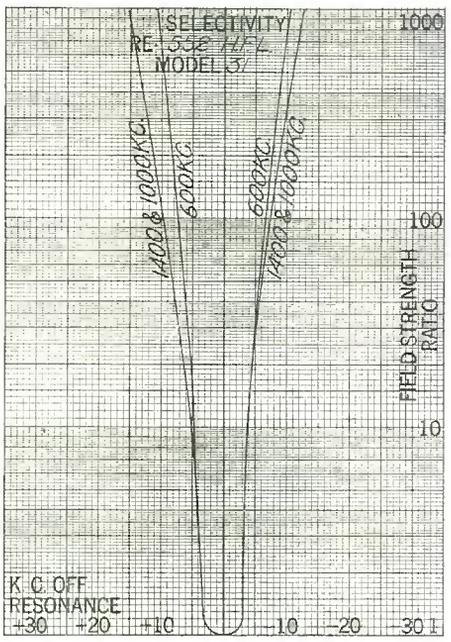
Described and Measured



quency there is no reactive impedance at that frequency, but the ohmic resistance is extremely high.

Now, if the trap circuit comprising the inductance, 11, and capacity, 12, are tuned slightly higher than the frequency of the radio signal, the impedance across the circuit becomes highly inductive, and, if it is tuned slightly lower in frequency, the impedance becomes highly capacitive. The combination of elements in the plate circuit, when arranged as shown in Fig. 1, therefore offers to the amplifier plate current either inductive reactance, capacitive reactance, or series resonance (no reactance) because of the fact that one of the elements is variable.

Due to the fact that the adjustment may be such that the reactance of the plate circuit cancels out, there will be a frequency at which there is no voltage drop and consequently no voltage swing impressed on the grid of the second tube. In other words, the signal may be shorted out or shunted back to the input of the first tube. Under these circumstances the ohmic resistance of the choke coil, the only remaining coupling impedance, would not be sufficient to afford a voltage drop great enough to pass the signal to the following tube. At the same setting of the tuning element there will be another frequency at which the trap circuit offers extremely high resistive impedance, and the voltage drop across the trap is all impressed on the succeeding grid.



To study these effects, the circuit shown in Fig. 1 may be set up with suitable means for either hearing or measuring the output of the second tube, with a standard frequency applied to the first tube, and with the condenser set at maximum capacity. Slowly turning the condenser out from its maximum value, the strength of the signal will be seen to increase gradually to a certain point and then rise much more rapidly until at another setting it will drop sharply, and again gradually rise until eventually it will approximate the first value. Fig. 2 shows the form of the response curve obtained by adjusting the capacity of condenser 12. It is evident that the impedance of the plate circuit is very high at the setting that gives the peak in the curve so that a high voltage amplification is obtained.

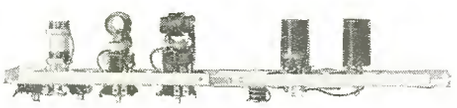
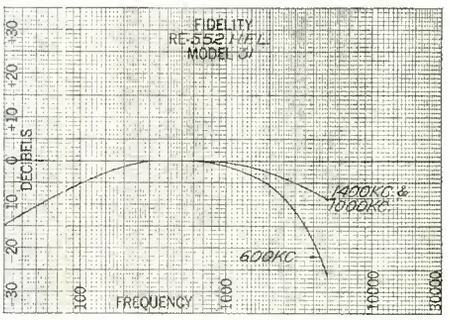


Fig. 9. This photograph shows the intermediate section before being placed in the chassis. Each of the I. F. coils has its respective padding condensers



Shunts Unwanted Signals

It will be seen that with the arrangement of Fig. 1 signals of one frequency are passed along to the second tube, while signals of another and lower frequency will be shorted out, or shunted back. There is thus provided a circuit which has a high degree of selectivity on one side of the desired band of frequencies, but, because of the non-symmetrical shape of the curve, has a less than normal degree of selectivity on the other side. Therefore, the system must include a circuit to give a means for eliminating stations on the other side of the band.

Fig. 3 shows a circuit arrangement which gives a curve which is the reverse or complement of the curve shown in Fig. 2. Here again we shall consider the tubes as the first and second, although they are actually the second and third tubes of the circuit. Note that the resonant circuit, 16, 17, and choke coil 15, are connected as in Fig. 1, except that their relative positions are reversed. The lead to the grid of the second tube is taken from the common connection between the trap circuit and the choke, instead of from the plate of the first tube, as in the previous stage. Here it

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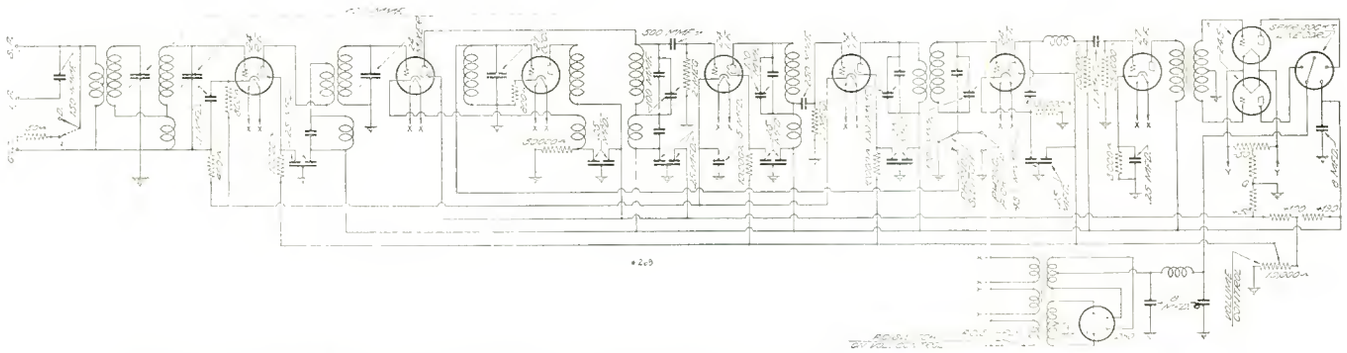

Fig. 10. The schematic of the receiver under discussion in this article is shown in this illustration

W2XAF SCHENECTADY

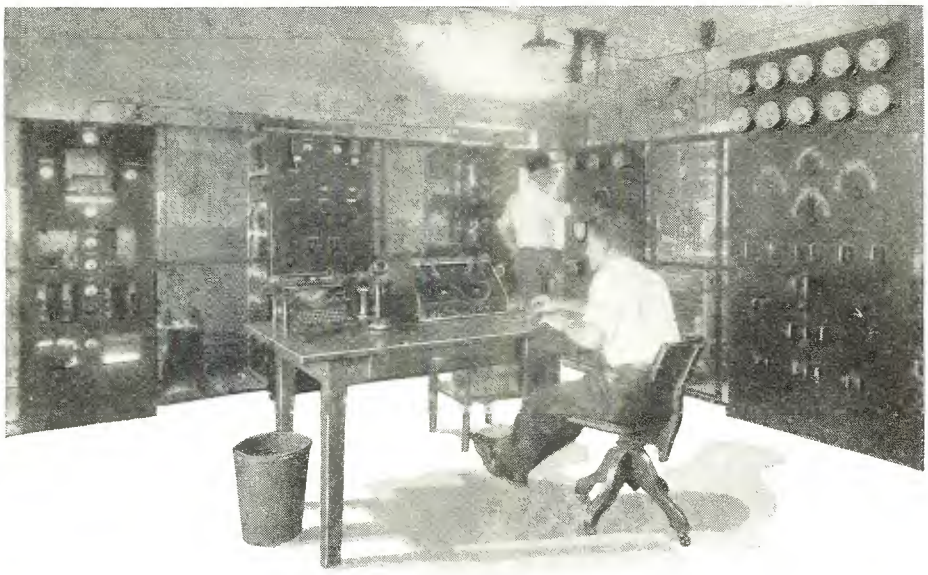

Fig. 1. Looking from left to right there are the low power speech amplifier and modulator unit, the power supply and control, the 1 kw. radio frequency unit whose output is modulated with the modulator unit, the intermediate 5 kw. amplifier, and finally the power amplifier which supplies the antenna with 35 kw. of carrier power 100 per cent modulated. The operator's desk is located in the foreground.

OUT of years of research and experimentation by radio engineers at Schenectady, N. Y., has grown a transmitter which is probably without parallel in the radio art. Today it is used by W2XAF, one of the group of short wave stations of WGY, to sustain that station's standing as the unofficial ambassador of the United States to the nations of the world.

Here is a single transmitter so built that three musical programs can be simultaneously broadcast without interference.

Six separate, independent and non-interfering voice channels are available. In other words, should occasion demand, and the federal license permit, addresses by six different people could be transmitted by the same equipment, on six different wave lengths without interference.

The same transmitter may be used for television signals up to sixty-line scanning at twenty pictures per second.

The transmitter may be used for television and voice transmission at the same time. That is one channel may be used for picture and another for voice.

When the demand for service is created W2XAF'S new transmitter may be used for the simultaneous transmission of eight still pictures (facsimile) each in its own channel or independent wavelength.

All that is needed for multi-service is the addition of crystal control, low power intermediate amplifiers and low power modulators of standard design for each additional program.

Several Antennas

W2XAF is equipped with three independent antenna systems for broadcast purposes: a single doublet of special construction to avoid corona discharge on high powers; a horizontal checkerboard antenna directive on South America; a similar directional antenna for transmission to the Far East. The directional antenna steps up the power, directionally from 35 kilowatts, the

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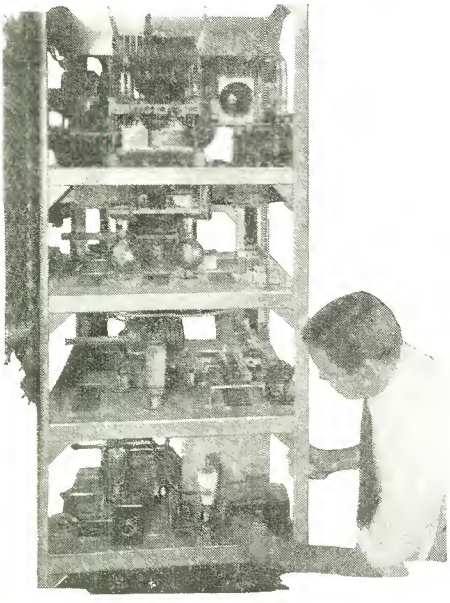

Fig. 2. This unit comprises the crystal oscillator and multipliers and larger air cooled amplifier tubes. The crystal oscillator for this transmitter has an especially effective automatic temperature control. No neutralizing condensers are used in this unit, for use is made of screen grid tubes throughout with the exception of the three electrode crystal oscillator tubes. This unit may be tuned from 13 to 56 meters. Six quartz are available in the oven for wavelength changes.

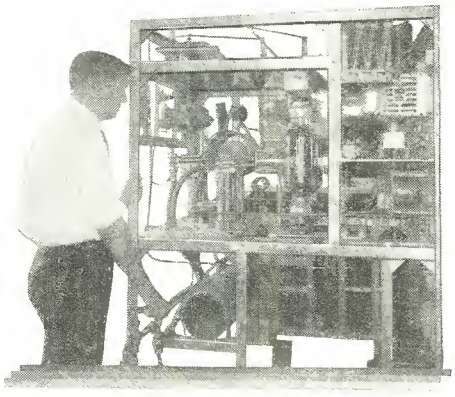

Fig. 3. This amplifier follows the 1 kw. modulated stage and increases the power to 5 kw., where it is applied to the input of the final power amplifier. The tubes used in this stage are water cooled screen grid tubes. Note the water for cooling the tubes actually enters the tube and flows within the hollow plate. This unit is capable of supplying 20 kw. as a telegraph transmitter.

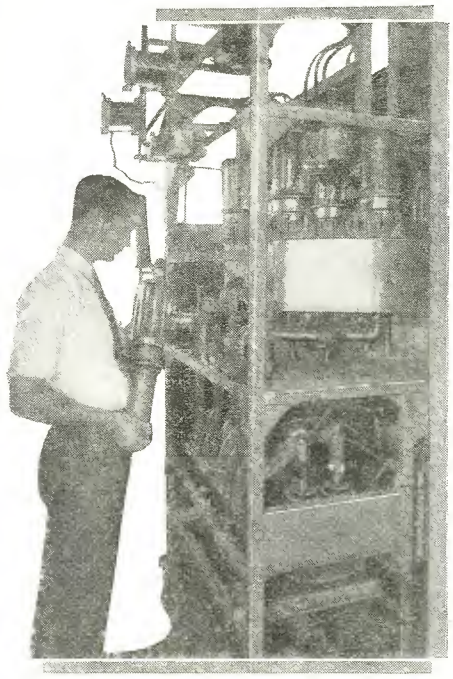

Fig. 4. This amplifier takes the modulated power at a 5 kw. level and amplifies it by means of 6 powerful short wave vacuum tubes to a power level of 35 kw. carrier for the antenna. This unit is capable of supplying 135 kw. continuously to the antenna as for telegraph work. The output of this unit may be switched to either a simple antenna for normal broadcasting, or to directional antennas for transmission to South America or Australia. The man shown in the picture is holding one of the UV858 vacuum tubes used in this power amplifier.

Submariner Adapter Is Described

FROM time to time our information department has been asked for data covering some of the converters that have been old time favorites, and at this time the number of requests covering the Submariner made by the J.M.P. Manufacturing Co., of Milwaukee, makes it desirable to include such information in the columns of this magazine.

Many Requests

At this time when so many manufacturers are producing a superheterodyne receiver, short wave fans are wondering if this receiver can be used for the reception of short wave signals by the use of an adapter. This question comes up not only because some adapters have not been quite successful on a.e. receivers, but preliminary trials have shown they will not function properly on some of the new screen grid superheterodynes.

Ordinarily short wave adapters have been attached to supers by inserting the adapter plug in the first detector socket with fairly good results. But now with the diminished number of intermediate stages, we find the first tuned intermediate is thrown out of alignment with the succeeding stages.

Old Circuit

Over four years ago when the Submariner short wave adapter was put on the market all receivers were operated from batteries. Using the circuit shown in Figure 1 satisfactory results were obtained when the adapter was plugged into the detector socket.

In 1928 the Submariner was changed over to include what they term the J feature, shown in Figure 2. This arrangement enabled the tube operating on short waves to be supplied with the proper voltages and also adds one more stage of audio for use on short wave

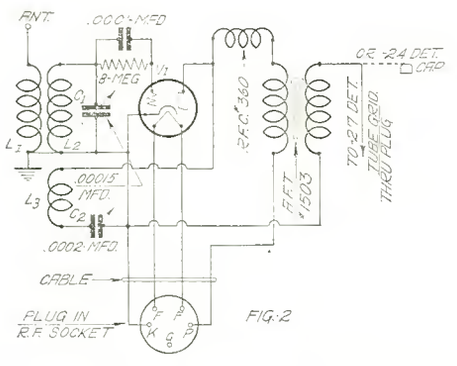

Fig. 2. The Submariner used this circuit to gain added audio volume from the use of an adapter in an a.c. receiver

Fig. 4. The complete adapter unit is shown in this photograph. The tube goes atop the unit, the coil fits in a socket at the rear of the unit

reception when attached to a modern a.c. receiver.

At that time (1928) many of the sets in use had been discarded in favor of the alternating current receivers. The circuit in Figure 1 with minor changes for a.c. tubes does not work out so well on the a.c. receivers because loud speaker reception is not very strong.

The circuit of Figure 1 also operated well as an oscillator detector circuit with battery type superheterodynes, and with minor changes for the a.c. tube superheterodynes. However it will not be satisfactory on the present season's screen grid superheterodyne re-

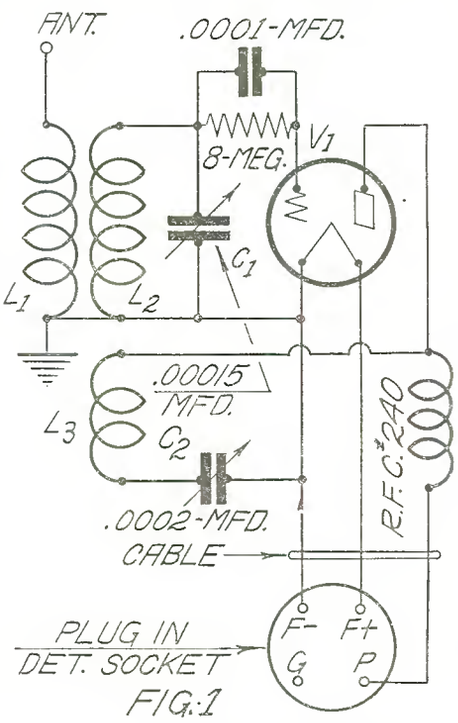

Fig. 1. The original circuit used on adapters during the d.c. or battery operated set era

ceivers of which the Radiola 80 may be said to be an example. Here again the J feature incorporated in the Submariner is an effective solution of the difficulty.

Present Circuit

The circuit is shown in Figure 3 and it will be noticed the main difference between Figure 2 and Figure 3 is that the transformer in Figure 3 is for 175 kc. instead of audio freuency. It is thus observed that the first detector in the new screen grid supers is not discarded, but is left in the set and functions as one additional stage of intermediate amplification for short wave

Fig. 5. A set of three coils covers the band from 13 to 145 meters; these coils being plugged into the back of the Submariner

reception. Figure 4 shows the complete instrument using the circuit of Figure 3, while Figure 5 shows the coils used in the adapter.

Used on Radiola 80

When the circuit in Figure 3 is plugged into the oscillator socket on a Radiola 80, the dial C1 is tuned to say a signal on 31.48 meters, which the circuit changes to 1725 meters, going through to the grid of the first detector and thence through the remainder of the system, being detected a second time and issuing from the speaker after passage through the audio channel. When this adapter is plugged in on a Radiola

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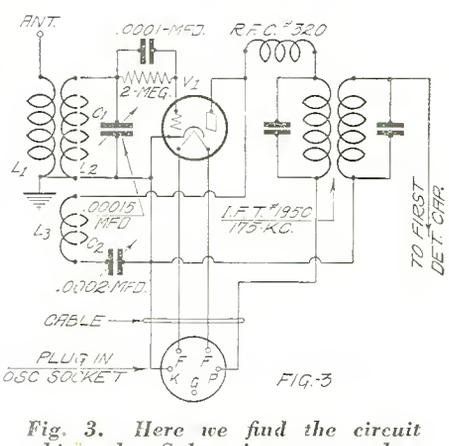


Fig. 3. Here we find the circuit which the Submariner uses when plugging into the screen grid supers of the type similar to the Radiola 80 series

Response Curves On Silver 724 Super

IT was originally intended that the response curves of the Silver-Marshall 724 superheterodyne should accompany the article describing that receiver, which information appeared on page 50 of the September issue of this magazine. However at press time the curves had not been made due to a delay in the receipt of the chassis, and these measurements were held over for the present issue.

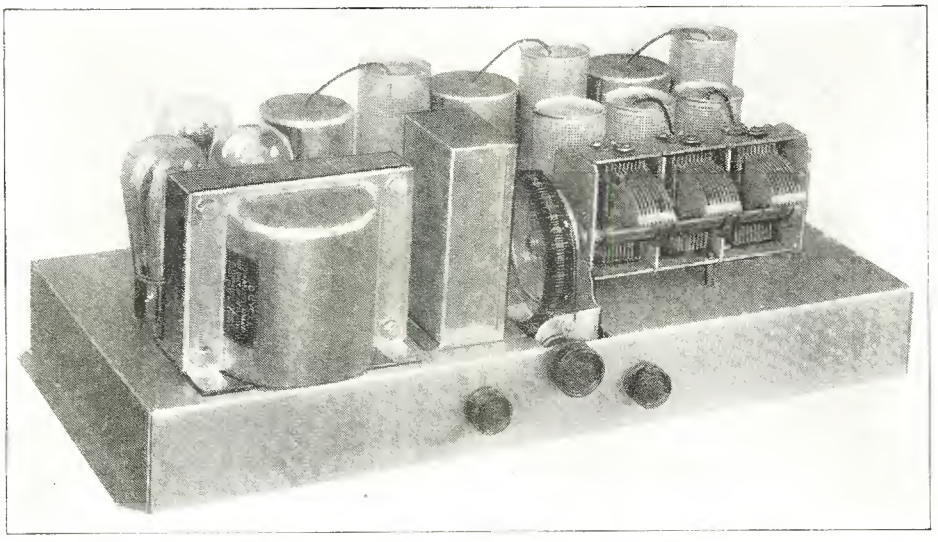


Figure 1. The chassis of the 724 superheterodyne made by Silver-Marshall and described in our September issue is shown above

Particular attention should be paid to the sensitivity curve so that it will be noted that the microvolts reading is shown in tenths of a microvolt rather than in microvolts.

Electrical Fidelity

As indicated in the laboratory report the fidelity curves cover only the electrical fidelity and do not indicate what issues from the speaker itself. It is indicated that the designers compensate for the droop on the fidelity curve by the employment of a speaker that is corrected for frequency, that is, the speaker has an increase in response at the point where a droop is found in the electrical fidelity, a policy that is prevalent among set manufacturers and others who wish to present as flat a reproduction range as possible and yet retain the greatest selectivity in the receiver itself.

The photograph shown in Figure 1 is the chassis itself which is operated with a special speaker designed for this particular receiver. The circuit diagram was reproduced in the September issue and is not needed here for the presentation of the response curves.

Measurement Conditions

In making the measurements on this chassis the output impedance load was 4000 ohms coupled capacitatively to the plates of the 245 tubes in pushpull. An output was maintained at .050 watts. The dummy antenna consisted of the standard 20 uh, 200 mmf and 25 ohm resistance. The receiver was left at the frequency at which it was phased at the factory, and operated with the volume control at maximum. No oscillation nor hum shown in the measurements.

Mutual conductance of the tubes employed in measuring the receiver: 1 r.f. 880; 1 L.F. 870; 2 I.F. 980; detector 1220; p.p.a.f. 1980; p.p. a.f. 1970; 2nd detector 890, and oscillator 1030 micromhos.

In the tables following will be found in the interference radio and the band widths as taken from the work sheet and the curves.

Interference Ratio

Resonance	Kilocycles off resonance: Plus 10	Plus 20	Plus 30
600 kc.	230.0	.....	.....
1000 kc.	230.0	.....	.....
1400 kc.	440.0	.....	.....
	Minus 10	**Minus 20**	**Minus 30**
600 kc.	880.0	.....	.....
1000 kc.	310.0	.....	.....
1400 kc.	620.0	.....	.....

Band Widths

Times field strength	Kilocycles wide: 600 kc.	1000 kc.	1400 kc.
10	8.2	8.2	8.2
100	15.0	15.5	14.0
1000	23.3	26.3	22.5

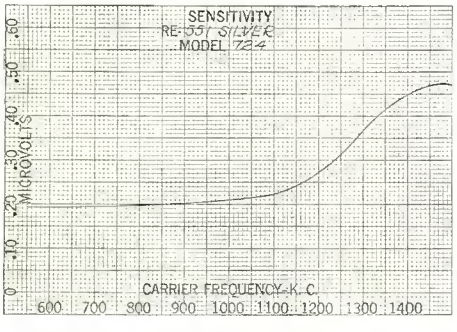


Fig. 2. It will be noted in this sensitivity graph that the values are indicated in tenths of a microvolt instead of the usual microvolts

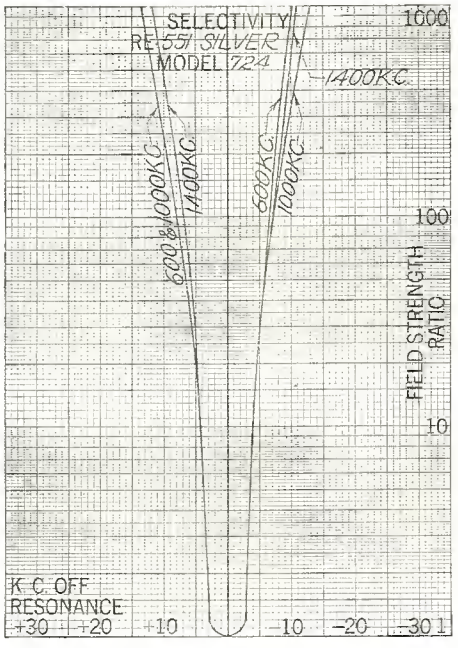


Fig. 3. The selectivity of the Silver 724 is shown by the curves in this graph

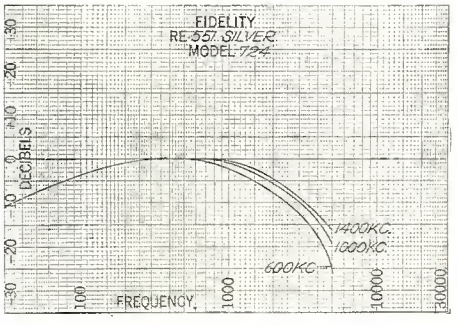


Fig. 4. Electrical fidelity of the receiver is found in this graph. The receiver, however, is designed to operate with a frequency corrected speaker which compensates for the attenuation of the highs in this illustration

Low Grid Current Tube Measures .000,000,000,000,000,01 Ampere

Four element tube so sensitive astronomers can use it with photoelectric cells to determine amount of heat radiated by stars countless miles away

A NEW type of vacuum tube, so sensitive that it will measure a hundredth of a millionth of a billionth of an ampere, has been developed by the General Electric Company, it was announced by Ellis L. Manning, of the company's research laboratory in a recent talk over WGY.

What It Measures

The electron flow in this new four element tube, Mr. Manning explained, is such that a current expressed as 0.000,000,000,000,000,01 ampere, compares with the electron flow through the usual 50-watt incandescent lamp as do two drops of water with the enormous volume of water spilled over Niagara Falls in a year. Something like three quintillion electrons per second (3,000,000,000,000,000,000) flow through the ordinary 50-watt incandescent lamp; the new vacuum tube is able to measure accurately a flow of about 63 electrons per second.

Astronomers Can Use It

The new tube is so sensitive to infinitesimal flows of current that astronomers can use it with photoelectric tubes in determining the amount of heat radiated by stars countless miles away—bodies so far away in space that, in spite of their enormous size, they remain simply as points of light, however powerful the telescope through which they are viewed. The current is measured in fractions of quadrillionths of an ampere — the stellar distances in multiples of quadrillions of miles.

In the measurement of small currents the new tube will to a great extent, replace electrometers which are now used. The tube has the advantages of greater sensitivity and much greater ease of mounting.

Other Possible Uses

One of the major applications will be in the laboratory measurement of currents in ionization chambers which are used to indicate the intensities of x-ray and ultraviolet light beams.

Another important application of the tube will be in the photoelectric measurement of stellar intensities. At the Washburn Observatory in Madison, Wisc., work is now being done on apparatus for the giant reflecting telescope for California, the 200-inch fused quartz mirror for which is now being constructed at the Thomson Research Laboratory of the General Electric Company at Lynn, Mass. Professor Joel Stebbins, director of the Washburn Observatory, is using two of the low grid current tubes in connection with a quartz photoelectric tube to indicate the position, intensity and spectrum of even very faint stars. It is possible, according to Professor Stebbins, to make nearly all astronomical observations photoelectrically rather than visually or photographically as has been done in the past, with decided advantages in rapidity and sensitivity.

Figure 1. B. J. Thompson holding the electron tube described in this article

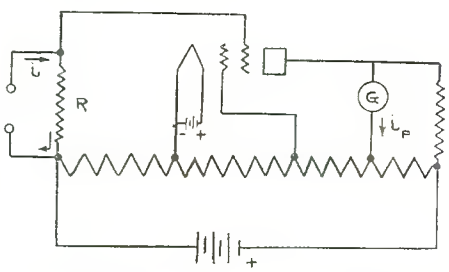


Figure 2. Diagram of method of use of the low grid current tube for measuring small currents. Here i = measured current, and i_p = current indicated on galvanometer

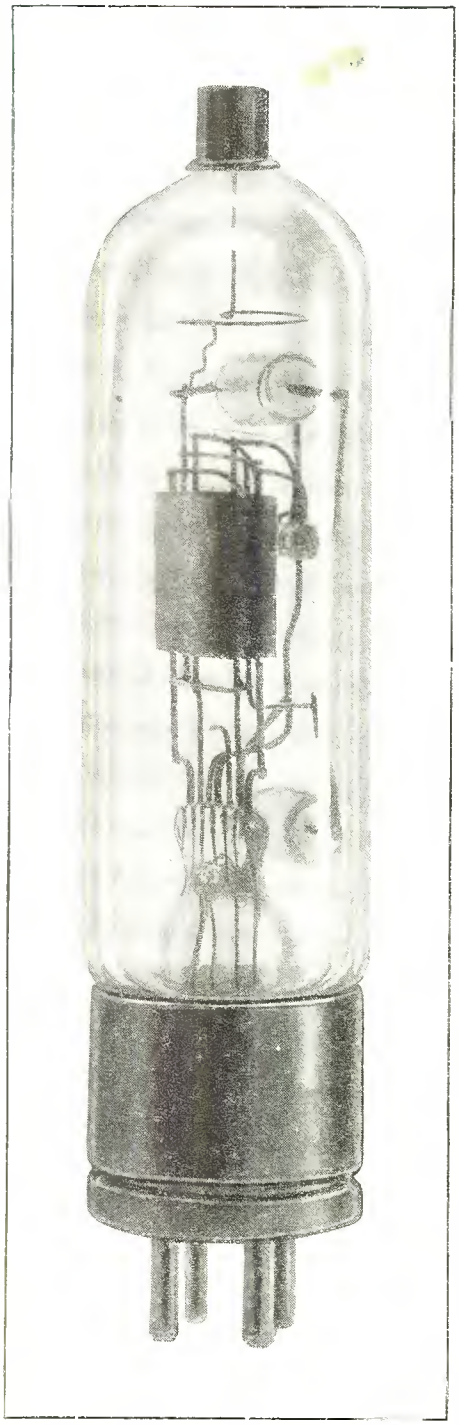


Figure 3. This is the G. E. type FP-54 low grid current pliotron whose sensitiveness to current is indicated in the heading of this article

Field Strength Data Is Important

THOSE following the activities of broadcast station owners before the Federal Radio Commission will have observed a growing tendency on the part of the commission to expect, in the several hearings recently held, more evidence based on engineering principles than upon politics or rhetorical flights of fancy as has apparently been the case in the past.

Consequently it is interesting to note one of the latest developments of Doolittle and Falknor, two Chicago broadcast consultants and manufacturers, who have completed the design of apparatus for making field strength measurements. The complete equipment is illustrated in the photograph shown in Figure 1, and a description of this apparatus together with some interesting possibilities for its use is here given our readers.

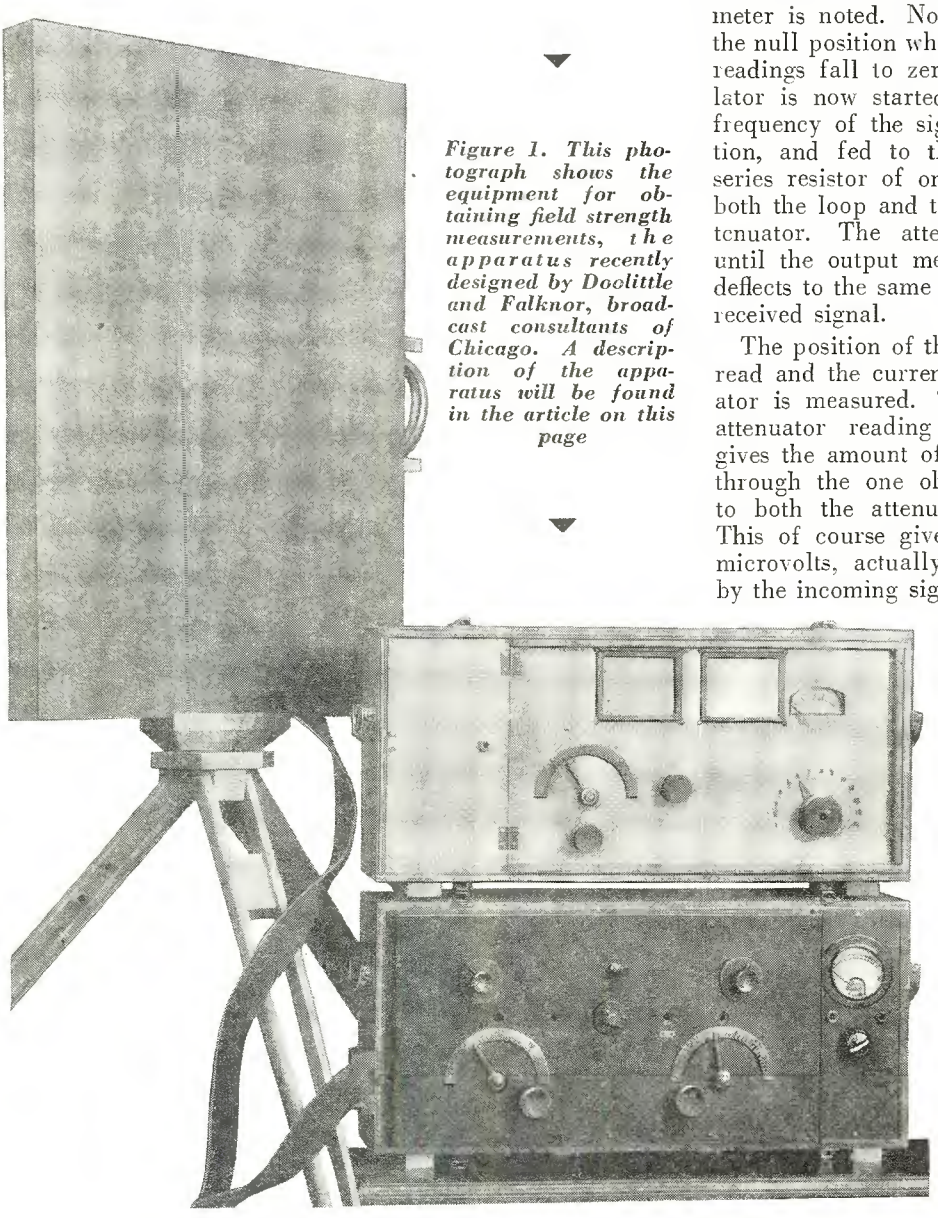


Figure 1. This photograph shows the equipment for obtaining field strength measurements, the apparatus recently designed by Doolittle and Falknor, broadcast consultants of Chicago. A description of the apparatus will be found in the article on this page

Actually the apparatus shown in the photograph consists of a loop of a known effective height, a selective receiver of high sensitivity, a visual indicator to show the relative receiver outputs, a heterodyne driver to beat with the received signal, a local oscillator to substitute for the measured signal, an attenuator to attenuate the local oscillator, and a meter to read the current fed to the attenuator.

The top box shown in the picture contains the local oscillator, attenuator, meter for the attenuator current, together with A, B and C batteries for the local oscillator.

The bottom case contains the receiver, the heterodyne driver, and the indicator to show receiver output. Its power supply is not self contained.

The loop seen at the left of the photograph has no metal anywhere in its field. It is encased in a wooden case to protect it mechanically, and it is also hermetically sealed to prevent a change in the moisture in the air affecting the dielectric of the loop. The absence of metal in the field is to keep the effective height of the loop near the value calculated by well known equations.

It is interesting to note the oscillator is double shielded so the signal from it, with the output terminals shorted, is practically zero. The double shielding is tied together only at one point, to prevent the individual shields acting as a radio frequency loop with corresponding radiation.

The technique for the operation of the apparatus in the taking of a set of field strength measurements follows: Tune in a desired signal; start the heterodyne driver, adjusting the loop for maximum deflection as indicated on the output meter; also adjust the receiver for maximum output, also indicated by the meter. The deflection on the output meter is noted. Now turn the loop to the null position where the output meter readings fall to zero. The local oscillator is now started and tuned to the frequency of the signal under observation, and fed to the loop through a series resistor of one ohm, common to both the loop and the output of the attenuator. The attenuator is adjusted until the output meter on the receiver deflects to the same value caused by the received signal.

The position of the attenuator is then read and the current fed to the attenuator is measured. The product of the attenuator reading times the current gives the amount of current circulating through the one ohm that is common to both the attenuator and the loop. This of course gives the millivolts, or microvolts, actually fed into the loop by the incoming signal. This voltage is then divided by the effective height of the loop for frequency under observation, and the result is the intensity of the signal under observation in millivolts, or microvolts, per meter.

In measuring the field strength of a local station, numerous readings are taken at varying distances in all directions from the transmitter; each position is marked on a map with the field strength noted at each position on the map. All points having the same readings are then connected with a line. If sufficient readings are taken, all the lines will form a boundary of a certain class of service area, either good, bad or poor.

The important thing to remember in the field strength of a station is not the numerical value of microvolts per meter field strength, but the ratio of that field strength to the noise, or interference level. In general it might be said if the signal level is 1,000 microvolts per meter, for good receiver service the interference level should never exceed 100 microvolts pr minute. In other words the signal level should always be at

Government Checks Frequency Deviation

least ten times greater than the interference level if satisfactory service is to be rendered.

Such field strength readings enable a broadcast station to determine exactly its coverage of any district; it will indicate where poor signal is delivered and where good signal is found; it will show whether increased power is required to cover its service area; all of this data being of great importance, not only for the station owner's information, but also for presentation to the commission as engineering data to substantiate a station's claim for added power.

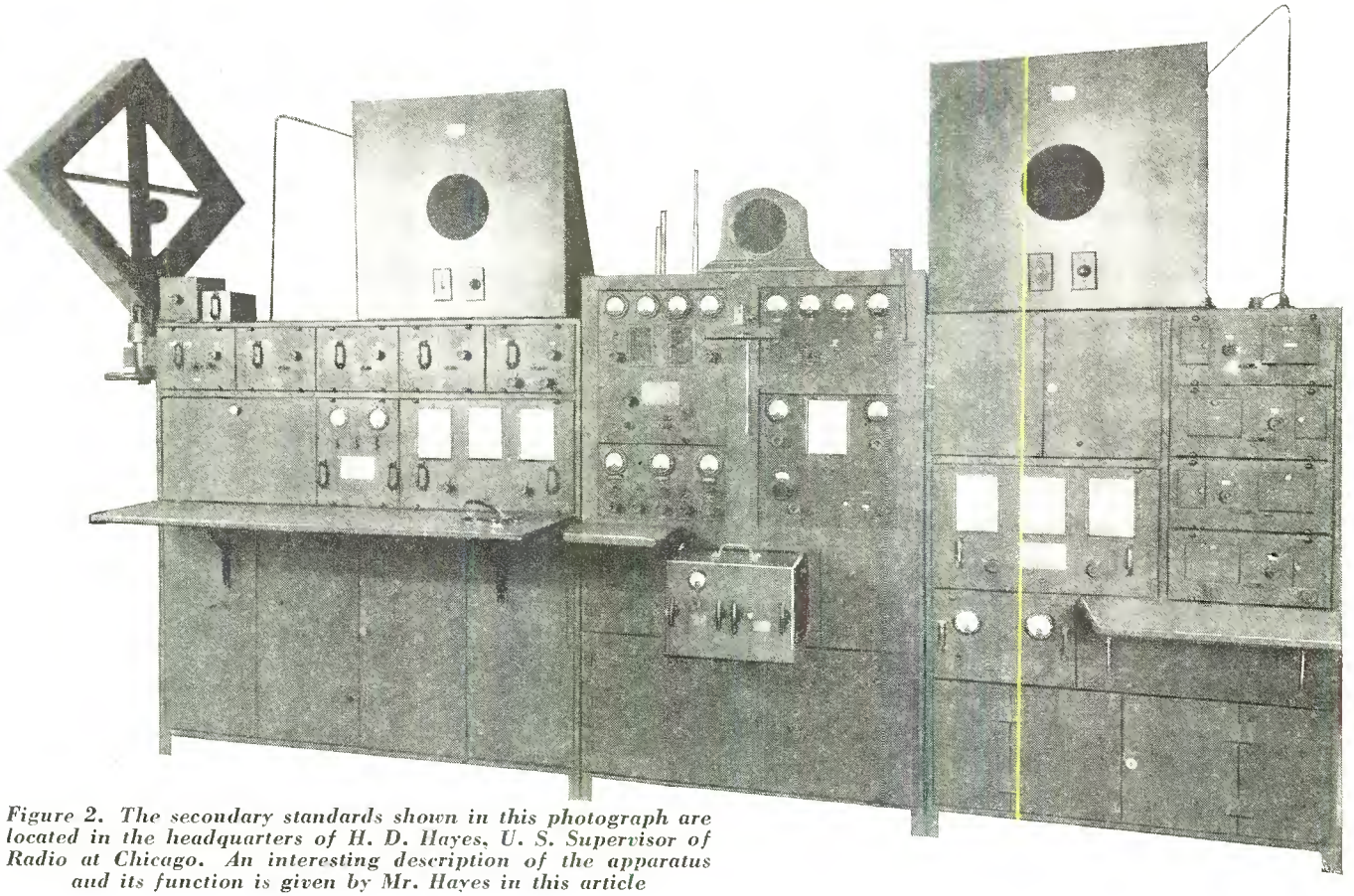


Figure 2. The secondary standards shown in this photograph are located in the headquarters of H. D. Hayes, U. S. Supervisor of Radio at Chicago. An interesting description of the apparatus and its function is given by Mr. Hayes in this article

IF importance is attached by the Radio Commission to engineering data of a definite nature being presented before it, our readers can readily understand how much more importance the government attaches to the measurement of broadcasting station frequencies, and the station's rigid adherence to a standard set by the government.

This measurement work comes under the U. S. Supervisor of Radio in each of the inspection districts of the United States. In the Chicago and Middle West area this work comes under H. D. Hayes, U. S. Supervisor of Radio with headquarters in Room 2202 of the Engineering Building, and to whom we are indebted for a description of the secondary standards of frequency equipment, this apparatus being illustrated in the photograph Figure 2.

Mr. Hayes advises the secondary standards equipment shown in the picture can roughly be considered as three individual units. Referring to the photograph the panel at the left comprises the low and intermediate frequency receiver, while to the extreme right is seen the high frequency receiver. In between the two receivers are the secondary frequency standards and associated equipment by means of which the station tuned in on either of the receivers above mentioned is accurately measured.

Continuing the description Mr. Hayes relates:

Low and I. F. Receiver

"Undoubtedly, the majority of broadcast listeners will be interested in the low and intermediate receiver in view of the fact that this is the instrument on which all broadcast stations are received, although, as will be noted, there is little, if any, resemblance between this receiver and the magnificent and elaborate furniture exhibits which we have now come to expect of the manufacturers Once upon a time broadcast receivers were known by their size and number of tuning controls and under this method of rating equipment, our receiver should be par excellence, although it is extremely doubtful if the average broadcast listener could now be induced to manipulate the large number of controls with which this instrument is equipped.

"In the first place, in order to turn this receiver on there are no less than four switches on the receiver proper, while on the control panels, which are not shown in this illustration, there are other controls too numerous to mention. It will be noted, on close observation, that this receiver is of the plug-in coil variety and that each radio frequency stage is individually tuned with a main dial as well as a vernier control. Thus, we have four stages of tuned radio frequency amplification, regenerative detector and three stages of audio amplification. Altogether, there are sixteen tuning controls in addition to the

(*Continued on page* 97)

Lightning!

Map of seasonal lightning gives radio fan idea of where ideal reception conditions may be found, and where greatest amount of electrical disturbances exist. Some interesting data from recent booklet issued by Westinghouse.

IN 1927 the Westinghouse Company did considerable pioneering work in the investigation of the behavior of transients on transmission lines using a surge generator, cathode ray oscillograph and a five mile 22 kv. idle line. In 1928 and 1929 the field studies of lightning and controlled surges were given greater impetus by the use of the Norinder oscillograph. To complement the laboratory work with adequate field activity on the problem Westinghouse, in co-operation with operating utilities entered upon and is carrying out a comprehensive program of field lightning investigation.

According to "Lightning, investigation, discoveries and control," a pamphlet recently issued by Westinghouse, some of the work is being done in Chicago, some in the Tennessee mountains, and some in West Virginia and New Jersey.

Photographs Lightning

The Norinder oscillograph used in these studies may be connected permanently to a transmission line where it will record any passing transient, giving a complete picture of its rate of rise, its maximum value, its decay and its duration.

The field stations mentioned contain oscillographs, Klydonographs, micro phonic thunder recorders and special cameras, so that complete information is secured about the lightning stroke, its location, and appearance, and the transient surge that follows.

In addition to the studies of natural lightning, valuable data has been secured on the second phase of this work, that of the study of controlled transients, by a million volt portable surge generator and a portable cathode ray oscillograph of the Norinder type on a 220 kv. idle line in New Jersey.

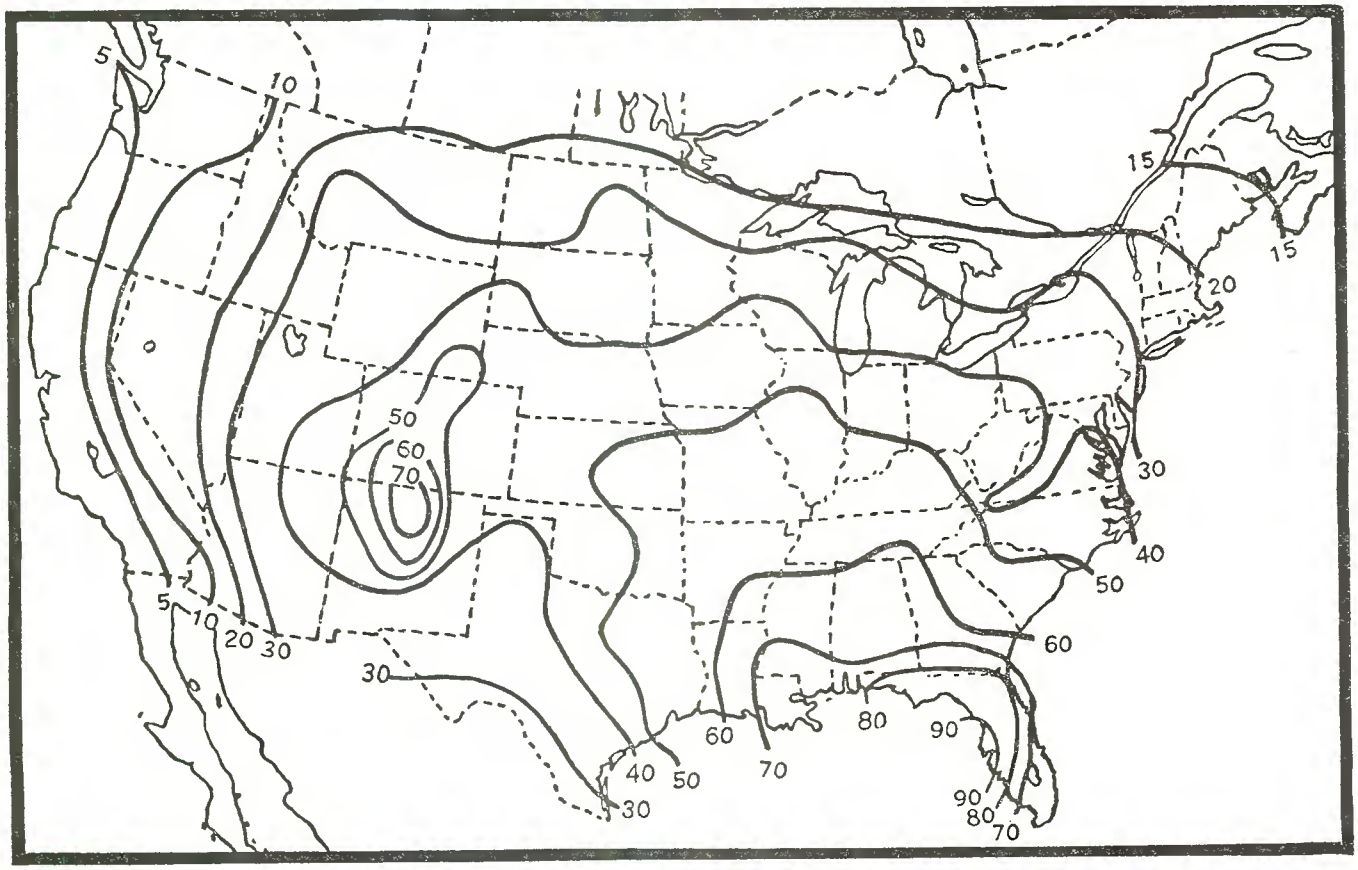
May Predict Disturbances

Possessing the added knowledge of the lightning phenomena gained during the past years, it is now possible to predict with some assurance the transmission disturbances that may be expected on transmission systems, the behavior of these disturbances when they reach station apparatus, and to design protective apparatus to fit the particular needs of the system.

Radio Reception Conditions

Radio listeners will be interested in the map shown at the bottom of this page which is excerpted from the Westinghouse publication, since it will indicate the different electrical disturbance regions of this country. Thus it may be

(*Continued on page* 92)



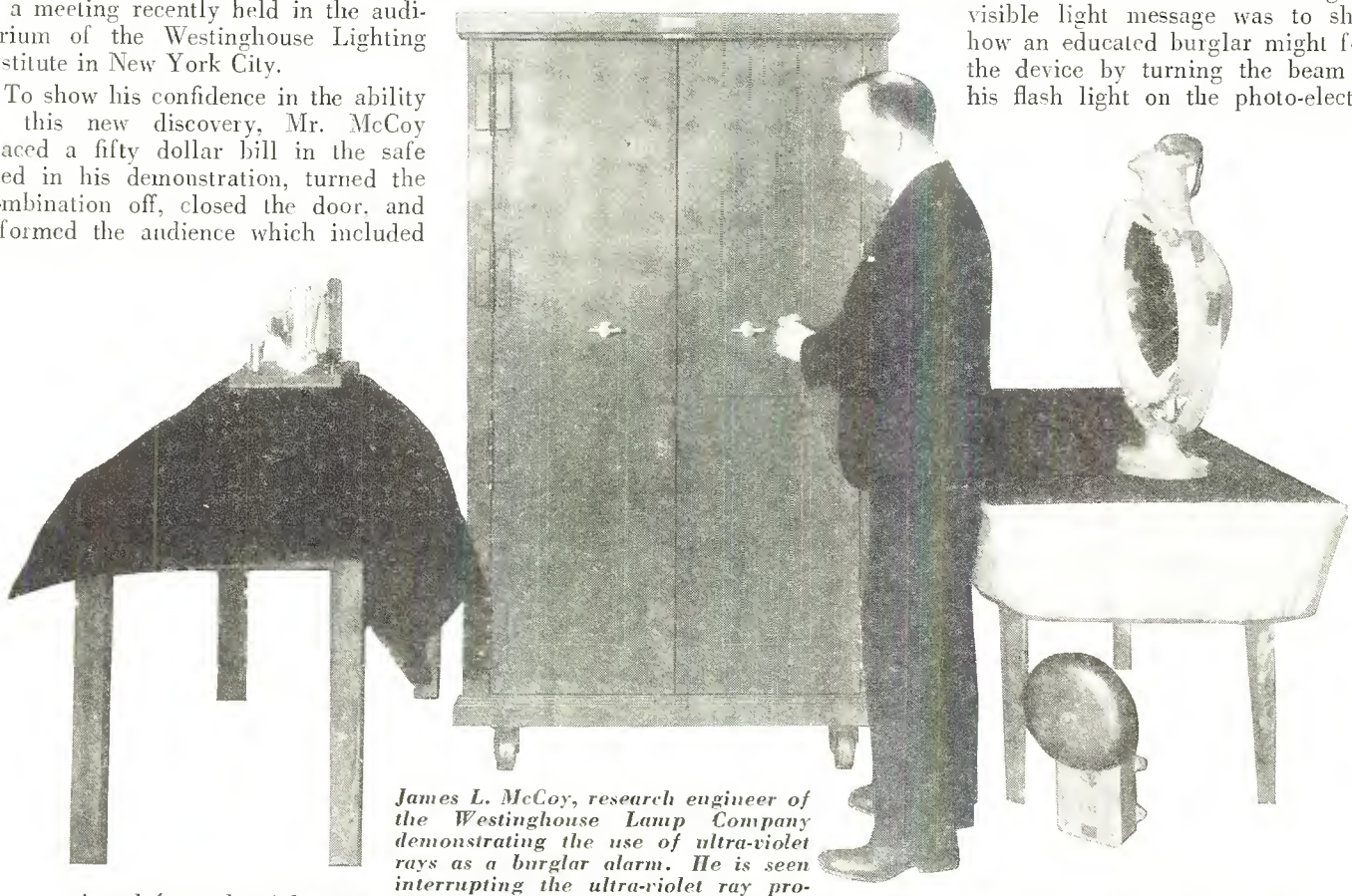
This map shows the average number of thunderstorm days per season in the United States. The data is compiled in accordance with the records of the United States Weather Bureau

Invisible Ultra Violet Rays Used As Sure-Fire Burglar Alarm

Light Sensitive Apparatus Used in Demonstration by Westinghouse Engineers

AN invisible or ultra violet ray light for the protection of valuables, or burglar alarm, science's latest contribution to the law enforcement authorities, was demonstrated by James L. McCoy, research engineer of the Westinghouse Lamp Company, before the members of the New York Section of the Illuminating Engineering Society at a meeting recently held in the auditorium of the Westinghouse Lighting Institute in New York City.

To show his confidence in the ability of this new discovery, Mr. McCoy placed a fifty dollar bill in the safe used in his demonstration, turned the combination off, closed the door, and informed the audience which included representatives of the police department of the City of New York, that anyone who could get the money without sounding the alarm was welcome to it. This apparatus is to be part of the permanent exhibit at the Lighting Institute in Grand Central Palace.



James L. McCoy, research engineer of the Westinghouse Lamp Company demonstrating the use of ultra-violet rays as a burglar alarm. He is seen interrupting the ultra-violet ray projected from the right to the sensitive photo-cell at the left, which interruption causes the alarm bell to ring

Tear Gas Barrage

It is predicted that with the invisible ultra violet rays, it will be possible for jewelers, bankers and other custodians of valuable properties, to greatly add to the security of their charges. These ultra violet rays are invisible both in lighted and darkened rooms and therefore it is impossible for the intruder to move about without being detected, as the rays can be placed at various angles in the room. They could be made to asphyxiate a victim with a barrage of tear gas, set of silent alarms, etc. In other words, the burglar is put completely at the mercy of this ingenious device.

Cannot Fool Rays

In demonstrating the invisible light as a burglar alarm, a five-foot safe was placed in the center of the stage facing the audience. Two ordinary tables about waisthigh were placed twelve feet apart; on one was the light source, and on the other were two types of cells; one cell sensitive to visible and infra red light, and the other responsive only to the invisible rays of ultra violet light.

The invisible rays were projected just across the front or door of the safe at the combination, so that any attempt to touch or open the door would immediately sound the alarm.

There were three demonstrations of this burglar alarm system. In explaining these demonstrations, Mr. McCoy said his reason for first sending the visible light message was to show how an educated burglar might fool the device by turning the beam of his flash light on the photo-electric cell or "electric eye" while he was interrupting the original beam to open the safe. The next message was to fool the infra red cell by using a mazda light, the ordinary light used for general illumination, shining on the cell while he was interrupting the beam of the infra red light, as there is sufficient infra red light produced in the mazda lamp to operate the cell. The third was to show how impossible it would be for the burglar to open the safe due to his inability to produce the invisible ultra violet light.

(*Continued on page 93*)

Acme 1931 Chassis Model 98

DESIGNED by the Acme Electric and Mfg. Co., of Cleveland, Ohio, the Acme model 98 kit fills a demand among radio technicians, custom set builders, service men and small manufacturers for an inexpensive and easily assembled eight tube screen grid receiver covering the broadcast band.

The photograph shown in Figure 1 indicates the top view of the chassis after the chassis has been wired. The schematic diagram in Figure 2 gives the electrical connections and values of the component parts.

As indicated in the schematic diagram, the receiver uses three screen grid 224 tubes, two 22,7 a pair of 245's in pushpull and a 280 rectifier. The antenna input is divided into two sections, one of the connections for the long antenna where the full antenna winding is in series with a fixed condenser, and the short antenna connection where a half of the inductance is used with a series condenser in that lead.

A four gang condenser tunes the three screen grid secondaries and the grid of the detector circuit where a 227 is employed. While not shown in the photograph there is a shield over the top of the four gang condenser, with holes in one side over each trimmer condenser so the stages may be aligned. In the photograph also one of the coil shields has been left off to indicate the coil beneath.

Plate circuits of the screen grid stages have a portion of the primaries resonated with a condenser as shown in the schematic circuit, a .00035 mfd. condenser being employed on each for this purpose. The detector plate is coupled resistively to the grid of the first audio 227 tube, the circuit being adequately choked and bypassed. The grid circuit of the first audio is stabilized with a 250,000 ohm resistance from grid to ground, the bias for this stage being supplied by the drop across the 2,500 ohm resistor between cathode and ground, bypassed with the 1 mfd. condenser.

Bias for the power detector is secured through the drop across the 75,000 ohm fixed resistor between detector cathode and ground, a bypass of 5. mfd. being used across this resistor. Volume control is an 800 ohm variable resistor in series with a 100 ohm fixed between the cathodes of the first and second radio frequency stages and ground. The cathode of the third r.f. stage has a 300 ohm fixed between it and the cathode of the second r.f. tube.

For the two pushpull 245 tubes the bias is supplied by the 875 ohm fixed resistor between ground and the center tap of the secondaries marked Y and Y in the schematic diagram.

The rectifier using a 280 is of the conventional type, the 4300 ohm field coil forming a portion of the filter circuit. An electrolytic condenser is used in the filter circuit. The circuit is designed for use in connection with a d.c. dynamic whose field coil has the resistance indicated above.

Condenser blocks are used with a section for each of the positions where bypassing is required.

The 110 primary is tapped for two voltage positions, 110 volts and 120 volts to compensate for a line deviation in outlying districts.

The photograph shows the position of the tubes at the rear of the chassis in a line. Appropriate shields are provided for the tubes.

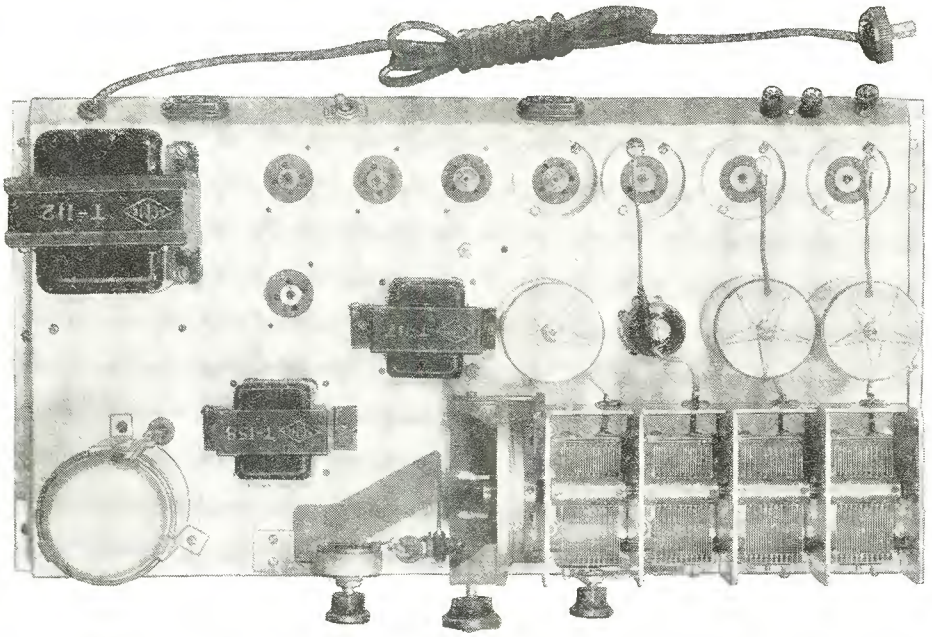


Fig. 1. The top view of the Acme 98 chassis available in unwired form is shown in this photograph

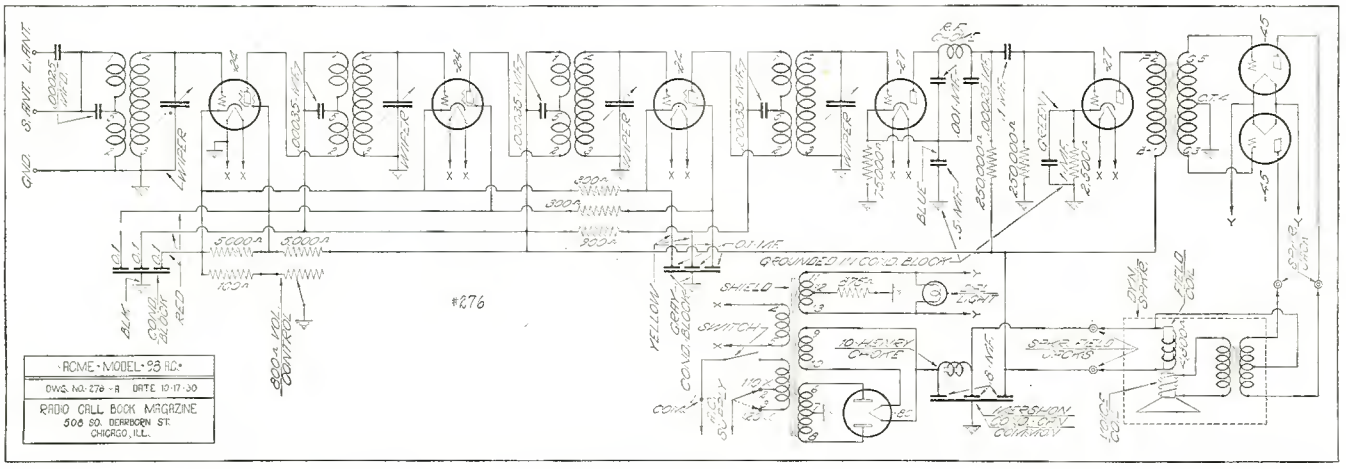


Fig. 2. The electrical details of the receiver described on this page may be traced by following this schematic circuit

SERVICE *and* REPAIR

Average characteristics of the three recent tubes announced by R. C. A.:

230 General Purpose

Filament Voltage ..... 2.0 Volts
Filament Current ..... 0.06 Amperes
Plate Voltage (maximum) ..... 90 Volts
Grid Voltage (C-bias) ..... —4.5 Volts
Plate Current ..... 2.0 Milliamperes
Plate Resistance ..... 12,500 Ohms
Amplification Factor 8.8
Mutual Conductance ..... 700 Micromhos
Direct inter-electrode capacitances:
Grid to Plate ..... 6 Mmf.
Grid to Filament ..... 3.5 Mmf.
Plate to Filament ..... 2 Mmf.
Maximum over-all dimensions:
Length ..... 4¼ Inches
Diameter ..... 1⅛ Inches
Socket ..... UX

231 Power Output

Filament Voltage ..... 2.0 Volts
Filament Current ..... 0.150 Amperes
Plate Voltage, Maximum and Recommended ..... 135 Volts
Grid Voltage (C-bias) ..... —22.5 Volts
Plate Current ..... 8 Milliamperes
Plate Resistance ..... 4,000 Ohms
Amplification Factor 3.5
Mutual Conductance ..... 875 Micromhos
Undistorted Power Output ..... 170 Milliwatts
Direct Inter-Electrode Capacitances:
Grid to Plate ..... 6 Mmf.
Grid to Filament ..... 3.5 Mmf.
Plate to Filament ..... 2 Mmf.
Maximum Over-all Dimensions:
Length ..... 4¼ Inches
Diameter ..... 1⅛ Inches
Socket ..... UX

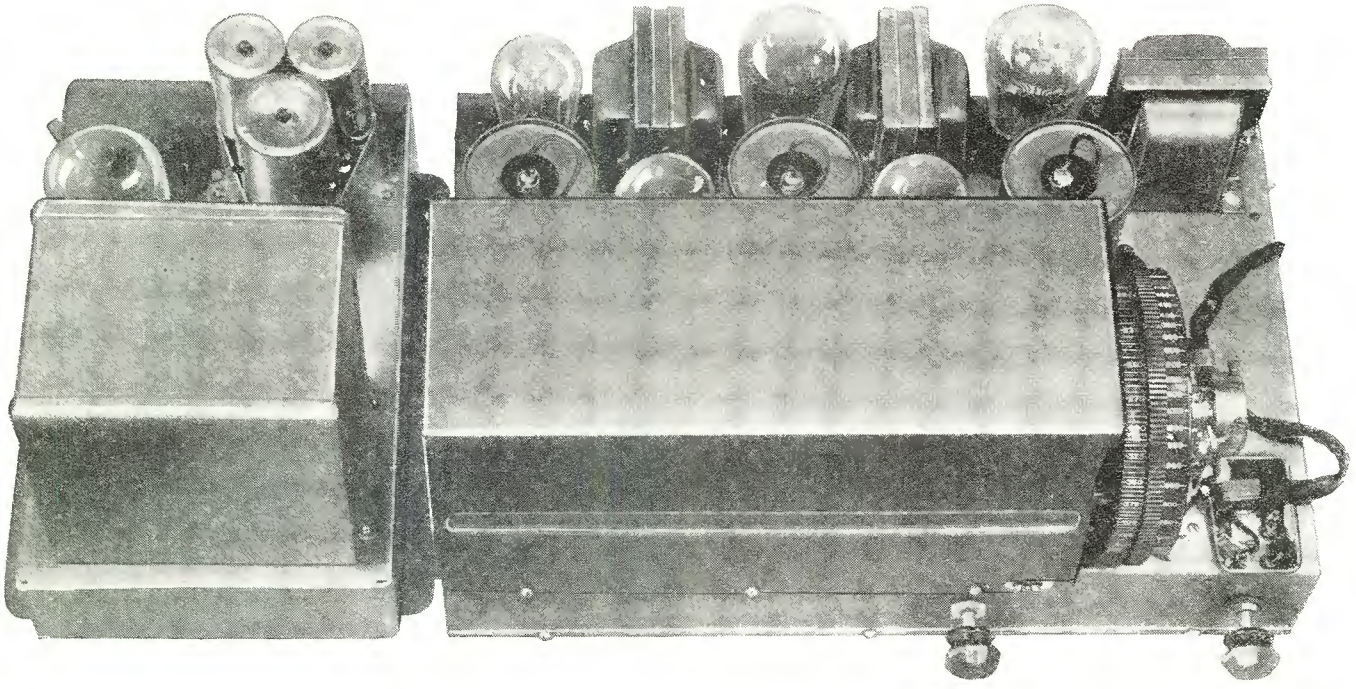
232 Screen Grid

Filament Voltage ..... 2.0 Volts
Filament Current ..... 0.06 Amperes
Plate Voltage, Maximum and Recommended ..... 135 Volts
Grid Voltage (C-bias) ..... —3 Volts
Screen Voltage, Maximum ..... 67.5 Volts
Plate Current ..... 1.5 Milliamperes
Screen Current ..... Not over ⅓ of plate current
Plate Resistance ..... 800,000 Ohms
Amplification Factor 440
Mutual Conductance ..... 550 Micromhos
Effective Grid-Plate Capacitance ..... 0.02 Mmf. Maximum
Dimensions:
Maximum Over-all Length ..... 5¼ Inches
Maximum Diameter ..... 1 13/16 Inches
Control Grid Contact Cap (Diameter) ..... .346 In.—.369 In.
Socket ..... UX

FACTORY SCHEMATIC INDEX

Name	Model	Vol.	No.	Month	Year	Page	SR. No.
A. C. Dayton	Navigator	10	4	Nov.	1929	94	24
Acme Mfg. Co.	AC7	10	2	March	1929	92	3
Acme Mfg. Co.	AC4	10	2	March	1929	93	4
All-American Mohawk	90	11	4	Nov.	1930	80	74
All-American Mohawk	6	10	2	March	1929	94	1
All-American Mohawk	8	10	2	March	1929	93	2
American Bosch	28-29	10	4	Nov.	1929	91	21
Amrad	70	10	4	Nov.	1929	92	22
Amrad	81	11	2	March	1930	81	44
Apex	48	11	4	Nov.	1930	79	80
Atwater Kent	38	11	1	Jan.	1930	72	28
Atwater-Kent (cap.)	55, 55-C	11	3	Sept.	1930	82	51
Atwater-Kent (Ind.)	55, 55-C	11	3	Sept.	1930	82	52
Audiola	31	11	4	Nov.	1930	79	79
Balkeit	A	10	3	Sept.	1929	85	12
Bosch	48	11	4	Nov.	1930	81	73
Bosch Auto	80	11	4	Nov.	1930	82	94
Bremer-Tully	7-70	10	3	Sept.	1929	83	10
Bremer-Tully	81-82	11	4	Nov.	1930	80	75
Brunswick	3KR0	10	4	Nov.	1929	93	23
Brunswick	S15	11	4	Nov.	1930	76	86
Brunswick	S14	11	4	Nov.	1930	81	71
Colonial	31AC	11	1	Jan.	1930	73	29
Colonial	33 AC	11	4	Nov.	1930	74	95
Crosley	Roamio	11	3	Sept.	1930	71	67
Crosley	40S, 41S, 42S, 82S	11	3	Sept.	1930	79	57
Crosley	60S Gembox	10	2	March	1929	95	5
Crosley	705 Showbox	10	2	March	1929	96	6
Crosley	Jewelbox 704B	11	2	March	1930	78	41
Crosley	77	11	4	Nov.	1930	69	83
DayFan	50S0	10	3	Sept.	1929	84	11
Delco Auto. Radio		11	3	Sept.	1930	70	66
Edison	R4, R5, C4	11	3	Sept.	1930	69	49
Edison	R4, R5, C4	11	4	Nov.	1930	77	49
Erla	DuoConcerto	11	1	Jan.	1930	77	33
Fada	7AC	10	3	Sept.	1929	86	13
Fada	35-35Z	11	4	Nov.	1930	78	70
Federal	H	10	4	Nov.	1929	89	19
Fread-Eisemann	NR80	10	4	Nov.	1929	90	20
Freshman	2-N-12	10	3	Sept.	1929	87	14
General Motors		11	3	Sept.	1930	69	68
General Motors		11	4	Nov.	1930	82	68
Gilfillan Bros.	100	11	1	Jan.	1930	76	32
Graybar Electric Co.	600	11	2	March	1930	79	42
Grebe	7AC	10	4	Nov.	1929	87	17
Grebe	AH1	11	4	Nov.	1930	75	96
Gulbransen	Nine-in-Line	11	2	March	1930	77	40
Howard	S.G.A.	11	3	Sept.	1930	72	56
Howard	8	10	3	Sept.	1929	89	16
Kellogg	523-528	11	4	Nov.	1930	73	77
Kennedy, Colin B.	20	11	2	March	1930	75	48
Kennedy, Colin B.	26	11	4	Nov.	1930	71	81
King Mfg. Co.	J	11	1	Jan.	1930	75	31
Kolster	4	10	3	Sept.	1929	81	8
Kolster	21-23	11	2	March	1930	82	45
Kolster	K-43	11	4	Nov.	1930	70	72
Kylectron	70	11	4	Nov.	1930	78	65
Majestic	70	10	3	Sept.	1929	80	7
Majestic	90B	11	3	Sept.	1930	80	55
Majestic	130-A	11	4	Nov.	1930	68	84
Philco	S6-82	10	4	Nov.	1929	96	26
Philco	95	11	3	Sept.	1930	78	60
RCA	60	11	1	Jan.	1930	74	30
RCA	66	11	3	Sept.	1930	81	64
Silver-Marshall	30B	11	3	Sept.	1930	73	53
Silver-Marshall	30	11	1	Jan.	1930	79	35
Silver-Marshall	35-A	11	4	Nov.	1930	72	82
Slagle	9	11	1	Jan.	1930	71	27
Slagle (Continental)	R-20	11	2	March	1930	83	46
Sonora	5R	10	4	Nov.	1929	95	25
Sparton	AC89	10	3	Sept.	1929	82	9
Sparton	589	11	3	Sept.	1930	76	63
Splitdorf	E175	11	1	Jan.	1930	80	36
Steinite	261	10	3	Sept.	1929	88	15
Steinite	70-80-95	11	4	Nov.	1930	81	76
Stewart-Warner	950	11	3	Sept.	1930	74	62
Stewart-Warner	Series 900	11	1	Jan.	1930	78	34
Stromberg-Carlson	846	11	3	Sept.	1930	75	54
Stromberg-Carlson	635-636	10	4	Nov.	1929	88	18
Stromberg-Carlson	12-14	11	4	Nov.	1930	67	93
T. C. A. Clarion	50	11	4	Nov.	1930	79	78
Temple	S-60	11	2	March	1930	74	37
Transitone Auto Radio		11	4	Nov.	1930	80	69
U. S. Radio & Television	37	11	2	March	1930	76	39
Victor	R32, RE45, R52	11	3	Sept.	1930	77	61
Westinghouse	WR-5	11	4	Nov.	1930	66	92
Zenith	52	11	2	March	1930	80	43

Servicing the



FOLLOWING our policy of presenting service material for our readers we are now enabled through the courtesy of the Zenith Radio Corporation to give in this issue data covering their 70 chassis.

It may be interesting to know that on our annual questionnaire Zenith stood eighth on a list of 46 manufacturers of whose receivers our readers were requesting schematic diagrams and service helps.

Grid and Plate Tuning

Briefly the circuit used in the 70 series consists of two stages of tuned plate, tuned grid, screen grid r.f., a screen grid power detector, one stage of resistance coupled a.f. using a 227, a second stage of pushpull audio using two 227's, and a third or power stage using a pair of 245's pushpulled. Schematically the receiver is shown in Figure 5; the power supply in Figure 4, the dynamic speaker circuit in Figure 2, and the photograph of the power and receiver chassis in Figure 1. A table of operating voltages for the tubes appears in Figure 3.

Continuing our reading of the service manual Zenith has prepared for this series we find the electrolytic condenser, the voltage divider and the by-pass condenser for the grid bias of the third audio stage are placed in the power unit. The separate type condensers have been incorporated in this pack. A

Zenith has always maintained a strict service policy during the first 120 days of the receiver's life in the field; their own service men are adequately prepared to look after the set during that time. After that time, however, independent service men may be called on to handle such receivers, and the information given here through co-operation with Zenith is intended for those not in possession of the Zenith instructions.

cover has been placed over both the terminal strips on the chassis and the fuse clips on the power pack. All possible wiring has been cabled. All cabled wire has a definite color code. The double volume control has been adopted as standard. Provision has been made

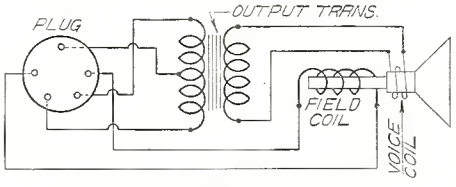


Fig. 2. This shows the dynamic speaker circuit connections

for use of a short antenna with excellent results.

Sensitivity and Selectivity

Tuning both grid and plate circuits of the r.f. and the grid circuit of the detector gives a total of five tuned stages and accounts for the selectivity and sensitivity of the circuit although only using two r.f. stages. Grid and plate coils are bank wound with Litz wire to reduce r.f. resistance. Each coil is shielded from the other by aluminum cans. Coupling between stages is accomplished by a small 12-turn coil, about ¾ inch in diameter, placed on the bottom of the r.f. coil assembly. Six interlocking turns of this coil are placed in series with each tuned coil, and the only coupling between the various circuits is made through these coils. In certain remote sections of the country where selectivity is not a main factor, chassis having 18-turn (9 double turn) coupling coils may be used. A 25-turn coil is placed inside the grid coil of the first r.f. amplifier and is connected directly to the short antenna post, which allows the use of a very short antenna.

Use Good Tubes

Laying stress on the use of good tubes of the 224 type, mention is made in the manual that the receiver will not operate efficiently unless good tubes are used. The use of one poor emission tube in either the r.f. or detector sockets, will

Zenith Series 70

result in considerable lack of sensitivity and poor general reception. A poor tube in the detector socket will also cause an audible hum in the receiver. Service men are cautioned to first test the tubes in these positions before judging the receiver faulty. Voltage charts given in the manual show readings obtained when using average good tubes.

Special Tips

A number of special tips for service men are given, some of which we are including here. For example, a grounded filament will give every evidence of a shorted or grounded bias resistor and the service man should determine to his entire satisfaction that the filament is not grounded, either through a piece of solder, a defective dial light, or automatic tuner pilot light. He should bear in mind that a grounded dial light circuit will not affect the heater type tubes, but will remove the bias from the grids of the 245's only. Another point to remember is that if there is plate voltage on the screen grid tubes, then there is no short or ground in any plate resistance or lead of any circuit. In a set where distortion is present such trouble can easily be located in either the audio or r.f. system by simply connecting the output from a magnetic pickup to the set and playing some record that is familiar to the service man. If distortion is still present, then the trouble is logically in the audio system; but if not present, then it lies elsewhere.

Exclusive of tubes, several things may cause lack of selectivity or sensitivity without anything else being radically wrong. The most common difficulty experienced is the lack of resonance in the five tuned stages. To obtain maximum results it is necessary that each circuit be tuned to approximately the same frequency. To determine whether a receiver is in resonance proceed as follows:

Zenith Model 70

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R.F.	2.5	185	2	2.5	55	2.5	----	----
224	2 R.F.	2.5	185	2	2.5	55	3.0	----	----
224	Det.	2.5	100	5	5.0	*	.1	----	----
227	1 A.F.	2.5	65	25	5.0	----	1.5	----	----
227	2 A.F.	2.5	160	13	13	----	3.4	----	----
227	2 A.F.	2.5	160	13	13	----	3.4	----	----
245	P.P.	2.3	260	52	----	----	38.0	----	----
245	P.P.	2.3	260	52	----	----	38.0	----	----
280	Rect.	----	----	----	----	----	----	----	----

Line voltage 110, fuse in 110-volt clip. Volume control maximum.

*Actual voltage same as r.f. screens, but can only measure with electrostatic voltmeter.

Fig. 3. A table of operating tube voltages as taken with a Jewell set analyzer is shown above

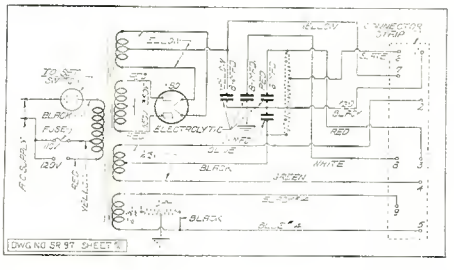


Fig. 4. The power supply of the Zenith 70 is shown here

Aligning Stages

Tune the receiver to a station under 300 meters. If necessary remove the aerial and replace with a piece of wire four or five feet long. This short aerial is used to permit setting the volume control at maximum. After tuning in the station, with the shields on the tubes, carefully turn the adjusting nuts on the four trimming condensers to the point of greatest signal response. This should be done slowly and carefully. It is important that the rotor of the gang remain in exactly the same position during this operation. A slight jar might disturb the setting of the rotor. Once the circuits have been placed in resonance the dial should be checked for calibration at three points. Zenith's

(*Continued on page* 101)

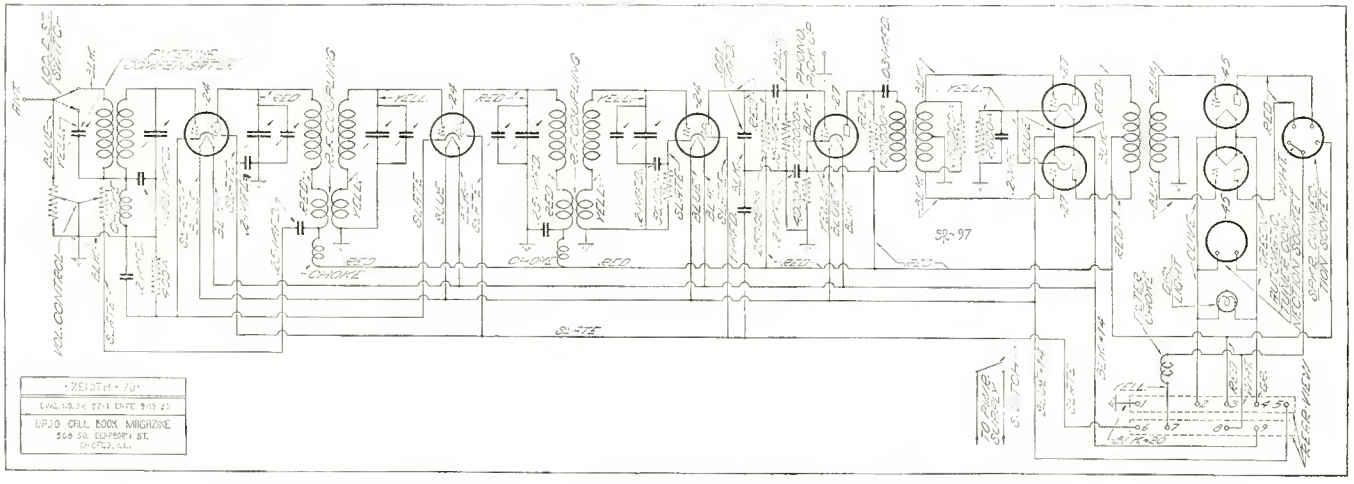


Fig. 5. The electrical details of the Zenith 70 series may be traced from the drawing shown above

Obscure Causes of R. F. Oscillation in High Gain S. G. Receivers

By R. M. Ellis
Manager, Service Dept., Silver-Marshall, Inc.

MODERN screen grid receivers with r.f. gains of thirty to seventy per stage have brought new problems which were not experienced when three element tubes were employed and we had to be contented with gains of eight to twelve. The limiting factor of gain in a receiver is not only dependent on the characteristics of the tubes employed, but upon the ability of the designer to isolate each r.f. stage to prevent feedback and consequent oscillation. The development of high gain receivers is a problem for experienced laboratory engineers equipped with the finest of testing apparatus.

Fortunately, engineers have succeeded remarkably well and modern screen receivers are even more stable and reliable than the older sets without a fraction of their amplification. Even the finest of apparatus will occasionally require adjustment and the best of modern receivers require service. One difficulty encountered is r.f. oscillation.

Common Causes

The common causes of r.f. oscillation in screen grid receivers such as open by-pass condensers, shorted r.f. chokes, etc., are so well known by servicemen as to be scarcely worthy of comment. There are, however, several rather obscure types of r.f. oscillation which may baffle even the most experienced serviceman, and it is the purpose of this article to take up some of these causes in a practical way.

Potential Differences

It may come as a surprise to some readers that a decided r.f. potential difference may originate between various points in a solid conductor. Many have observed that if the shielding on a receiver is not bolted or riveted tightly together oscillation would result. The feed-back is not due to the fact that the shielding is "leaking" but is caused by a potential difference that has built up in the shield, causing regeneration. This fact can be verified by grounding the loose shielding at various points with wire jumpers which will stop the oscillation.

It will frequently be noticed that while the gang condenser in a t.r.f. receiver is grounded by being bolted to the cadmium plated steel or aluminum subpanel, and the grid return ends of the r.f. coils grounded to the chassis, the manufacturer has also run short wire jumpers between the grid returns and the rotors of the gang condenser. It would be thought that as long as both the condensers and the coils were attached to the subpanel that the two would be connected electrically, and that no other connection would be required. They are connected together; but at radio frequencies, current may wander all over the chassis before completing the circuit. The little wire jumpers grounded at both ends serve the very useful purpose of confining the radio frequency currents to the proper paths, preventing oscillation.

Another Odd One

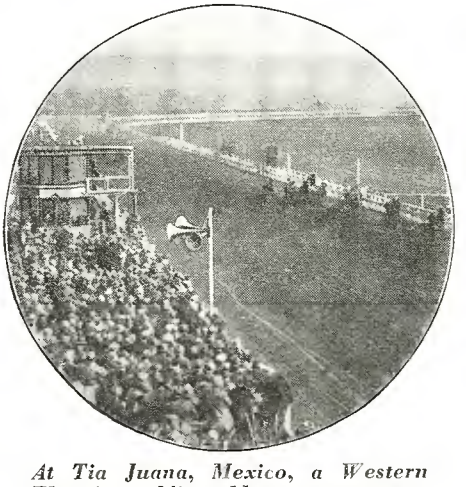
Did you ever try to service a set which would oscillate when turning the dial from zero to one hundred, but not vise-versa? It's our old friend, "potential difference" again. The rotors in a gang condenser are usually grounded by phosphor bronze wipers fastened to the condenser frame and rubbing on the condenser shaft. In the annoying case just presented the wipers make a good contact when the shaft turns in one direction, but loosen up when the condenser is revolved in the other. The remedy is, of course, to tighten the wipers. If this is not possible the rotor of each condenser section should be "pigtailed" to the frame of the condenser with a piece of flexible wire.

Over-All Feedback

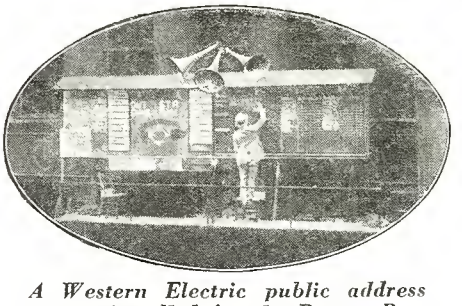
Another cause of oscillation which has made some servicemen and custom set builders wish they were sweeping the streets or washing dishes for a living is over-all feedback. This effect is not likely to be noticed in a manufactured receiver or a carefully engineered kit, but is likely to pop up in a home designed brain-child. When no signal is tuned in the set is stable. When a station is tuned in the set oscillates with a frequency which may be a flutter, a growl, or a squeal. This effect must be distinguished from true motorboating which is caused by poor power supply regulation or common impedances and has no connection with the r.f. end of the set.

As the name implies, the trouble is caused by radio frequency that has leaked into the audio channel feeding back into the input. The trouble is somewhat difficult to remedy because it is not always possible to immediately tell where the regeneration is occurring. As a starter, let's add an r.f. choke in the detector plate lead, if the set is not already equipped with one. Next try by-passing the B + detector lead to B — with a 1 mfd. condenser.

If you are using a dynamic speaker and the speaker is placed in the console be sure to connect a wire between the speaker frame and the receiver chassis. Ground both sides of the 110 volt line to the receiver chassis with 1/10 or ¼ mfd. condensers. A thousand to one, your overall feedback has stopped by now. If not, a .002 mfd. condenser between the power tube plate and ground will do the trick. With push-pull, connect the condenser between the plates of the two power tubes.



At Tia Juana, Mexico, a Western Electric public address system was used to give track fans results of the races. Note the horns in the center of the photograph



A Western Electric public address system installed for the Boston Post for use during a world's series is shown in this picture

Servicing the Speaker

By H. G. Cisin

THE efficient radio service man realizes that a thorough knowledge of commercial types of loud speakers is absolutely essential. The really proficient service man will supplement his practical experience with a certain amount of theoretical information.

No attempt should be made to service a loud speaker without being conversant with its principle of operation. A knowledge of the various methods used to couple loud speakers to the output of a vacuum tube should also be well understood by the service man.

Once the above elementary theoretical considerations have been mastered, practical problems will present no difficulties whatsoever. It will then be easy to decide which type of speaker will give the best results under a given set of conditions. The steps necessary to remedy specific speaker troubles will no longer remain a mystery, but will be arrived at with the least expenditure of time and effort.

All loud speakers now in general use may be classified under two headings—magnetic and dynamic. A third type, known as the electrostatic speaker, is seldom used in this country, due perhaps to its inherent limitations as to range and also due to mechanical difficulties in construction. As a matter of information, however, the principle of operation of this type of speaker will be outlined very briefly. The electrostatic speaker is in reality a special form of condenser, consisting of a fixed plate, a dielectric and a movable or vibrating plate. In one form of electrostatic speaker, the dielectric consists of varnished linen, treated with a wax compound. The front plate is composed of tin foil, similar to that used in ordinary condensers. The rear plate consists of an extremely flexible material made of silver-plated copper strips, woven into cloth, with silk thread as a binder.

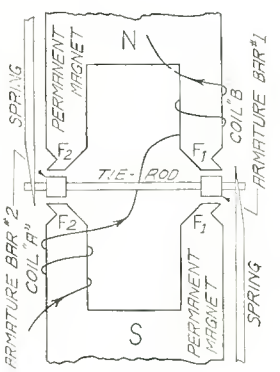


FIG. #1

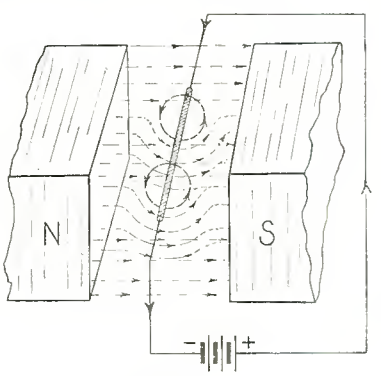


FIG. #2

Magnetic speakers consists essentially of a strong permanent magnet, required to supply a magnetic field of unvarying strength and an electromagnet through which the audio current flows. This is a fluctuating current, which causes corresponding fluctuations in the magnetic field and results in vibrations of the iron armature. In one type of magnetic speaker, the armature is in the form of a thin metallic disc, which acts directly as the diaphragm. In the other type, the armature is reduced in size and transmits its movements through suitable lever action to a separate diaphragm made of mica, paper, or wood. In magnetic speakers, the coils on the pole pieces are wound in opposite directions. When a current flows through them in one direction, the field of the permanent magnet is strengthened. The audio current is fluctuating. Hence when the current flows through the speaker magnet coils, the field produced by the joint effects of the permanent magnet and the electromagnet, is alternately strengthened and weakened. This naturally causes the vibration of the armature, which acts either directly as the diaphragm or indirectly to actuate a diaphragm. The result is reproduction of sounds.

When the field is strengthened, the armature is attracted towards the pole pieces. When the current ceases, the armature assumes its normal position. When the field is weakened (that is, when the electromagnetic field opposes the field of the permanent magnet) the armature moves further away from the pole pieces. The permanent magnets are necessary to increase the sensitivity. In addition, they must be used, since if omitted, the armature would be attracted towards the poles of the electromagnets, regardless of the direction in which the current flowed through the coils. Furthermore, the armature would spring entirely back with cessation of current. Too rapid vibration would also occur, giving lack of distinctness in the resulting sounds.

Magnetic speakers are sometimes classified as "horn" speakers and "cone" speakers. The magnetic horn speaker generally employs an armature which also serves as the diaphragm. The horn is used to build up a vibrating air column. The cone speaker utilizes a paper diaphragm, which is actuated by means of levers, as described above. This type of magnetic speaker is the one in most general use and hence is the most important from the standpoint of the service man. The cone speaker shown in the illustration, Figure 3, is a Wright-DeCoster product, known as the Hyflux. It employs a balanced armature having exceptionally high efficiency and it covers the complete audible range. It has a rich mellow tone, not usually found in magnetic-type speakers. An entirely new method of arm suspension and lever action, in combination with an exceptionally fine adjustment of spring tension result in superior quality of reproduction.

A sub-classification of the *magnetic* type of speaker is the inductor type, sometimes incorrectly termed a dynamic speaker. While this type is of comparatively minor importance, its working principle should be understood. As in

(*Continued on page* 93)

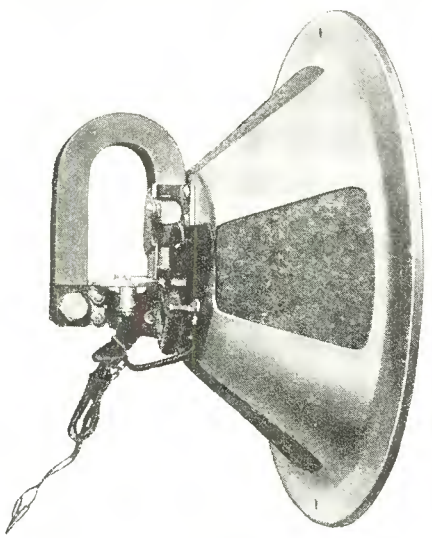


Fig. 3

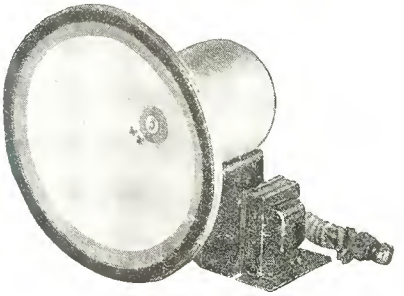
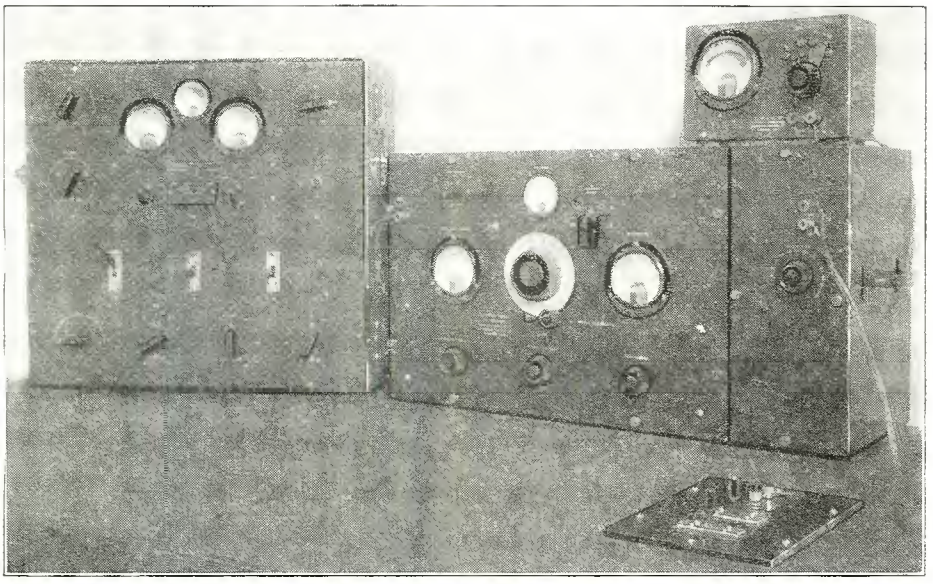


Fig. 4



RESPONSE CURVES

Data appearing on this page sets forth all conditions of measurement as used by our laboratory in the preparation of the sensitivity, selectivity and fidelity curves appearing in this issue

IN presenting the response curves on these pages it is desired to obviate as much as possible repetition of the conditions of measurement which will apply to each set of curves.

Accordingly this page is devoted to a recital of the measurement conditions and other data enabling the reader to readily interpret these curves without having to refer to articles in past issues of this magazine.—Editor.

First appears model, then serial number, followed by a note as to engineer making the measurements, and the date.

Three measurements are indicated, these being sensitivity, selectivity and fidelity.

Equipment Used

General Radio type 377-B low frequency oscillator; General Radio type 403-C standard signal generator; General Radio type 486 output meter.

All measurements, with the exception of fidelity, are made with 400 cycle 30 per cent modulation. Fidelity measurements are made with a varying modulation frequency of 30 to 10,000 cycles, 30 per cent modulation being maintained at all frequencies. The output load impedance is adjusted to ..... (this value of impedance varies with different receiver output systems) and coupled ..... (method of coupling also varies with each type of receiver).

An output of .050 watts is maintained on all measurements. A dummy antenna having 20 uh inductance, 200 mmf. capacity and 25 ohms resistance is used. (Departure from standard is indicated on the sensitivity graphs.)

The receiver was phased at ..... kc. The volume control was turned ..... Audible regeneration began at ..... kc. and stopped at ..... kc. Oscillation began at ..... kc. and stopped at ..... kc. The hum voltage delivered to the output meter connections was ..... volts, or ..... milliwatts.

Mutual conductance of tubes used:

1st r. f.	.....	micromhos
2nd r. f.	.....	micromhos
3rd r. f.	.....	micromhos
4th r. f.	.....	micromhos
5th r. f.	.....	micromhos
Detector	.....	micromhos
1st a. f.	.....	micromhos
PP a. f.	.....	micromhos
PP a. f.	.....	micromhos
2nd Det.	.....	micromhos
Oscillator	.....	micromhos

Radio frequency overload:

..... microvolts at 600 kc.
..... microvolts at 1000 kc.
..... microvolts at 1400 kc.

Sensitivity

The sensitivity curve as plotted shows the sensitivity under the specified conditions in microvolts field strength plotted against carrier frequency in kilocycles. The interpretation of this curve is as follows: A station will cause standard output when it has a local field strength equal to the microvolts indicated on the curve directly above the frequency of the station.

To find the sensitivity of the receiver in microvolts-per-meter, based on a four meter antenna, divide any point on the curve in microvolts, by four.

The curve is also indicative of the overall gain of the receiver. Thus 14.1 volts divided by the microvolts at any point on the curve will give the receiver overall gain at that frequency.

Selectivity

The selectivity curves are plotted in field strength ratios vertically versus frequency plotted horizontally. The field strength ratio is determined by the input in microvolts required to obtain standard output at resonance, and at various frequencies off-resonance.

The curves may be analyzed as follows: A station on any frequency off resonance will cause equal volume interference when its vertical line intersects the curve of the station at resonance. The point of intersection indicates field strength greater than resonance which will produce equal volume interference.

The following table gives field strength greater than resonance to produce equal volume interference:

Interference Ratio

Resonance	*Kilocycles off resonance*		
	Plus 10	Plus 20	Plus 30
600 kc.	.....	.....	.....
1000 kc.	.....	.....	.....
1400 kc.	.....	.....	.....
	Minus 10	Minus 20	Minus 30
600 kc.	.....	.....	.....
1000 kc.	.....	.....	.....
1400 kc.	.....	.....	.....

The following table gives width of selectivity curves at 10, 100 and 1000 times the field strength at resonance:

Band Widths

Times field strength	*Kilocycles wide* 600 kc.	100 kc.	1400 kc.
10	.....	.....	.....
100	.....	.....	.....
1000	.....	.....	.....

Fidelity

The fidelity of a receiver is measured as the faithfulness with which the audio component of the carrier frequency is carried through the receiver and delivered to the output indicating device, wherever it may be connected.

The measurements are made with the various modulation frequencies and varying the radio frequency input to maintain standard output.

The ratio of the voltage input at the modulation frequency of 400 cycles, to the voltage input at other modulation frequencies is calculated in decibels and plotted as loss or gain from 400 cycles as the case may be. These measurements do not consider the frequency response curve of the speaker used.

Response Curves on Grebe No. AH-1

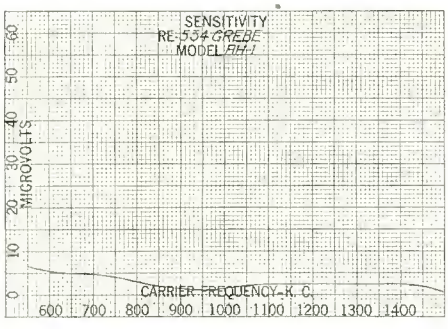
CURVES on the Grebe model AH-1 recently measured in our laboratory are shown on this page, being taken on a production, or stock chassis.

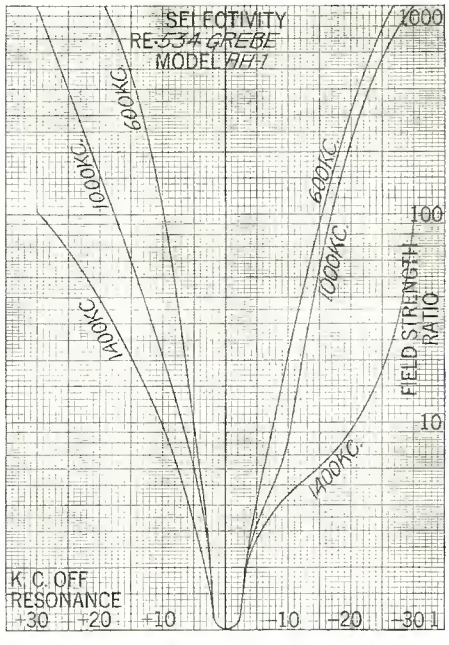
Output impedance load adjusted to 4000 ohms and coupled capacitatively to the 245 tubes. Output was maintained at .050 watts. Standard dummy antenna of 20 uh, 200 mmf and 25 ohms was employed in these measurements.

Phasing frequency set at factory was maintained, with the volume control set at maximum. No oscillation observed over range. Hum level could not be measured.

Mutual conductance of tubes used follows: 1 r.f. 1040, 2 r.f. 1020, 3 r.f. 1200, detector 1400, P.P. 1200, P.P. 1200 micromhos.

A table of interference ratios and the band widths of this chassis is given at the end of this measurement:



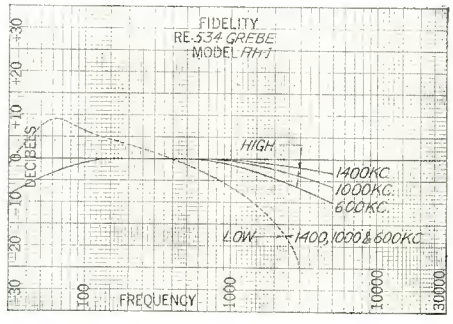


Interference Ratio

Resonance	Kilocycles off resonance Plus 10	Plus 20	Plus 30
600 kc.	105.0	1005.0	.....
1000 kc.	21.0	155.0	1000.0
1400 kc.	9.7	39.0	102.0
	Minus 10	Minus 20	Minus 30
600 kc.	21.0	315.0	.....
1000 kc.	8.2	230.0	.....
1400 kc.	4.5	9.1	90.0

Band Widths

Times field strength	Kilocycles wide 600 kc.	1000 kc.	1400 kc.
10	12.5	17.5	31.0
100	25.0	34.5	59.5
1000	46.0	66.0	.....



Clarion Model by T.C.A. Is Measured

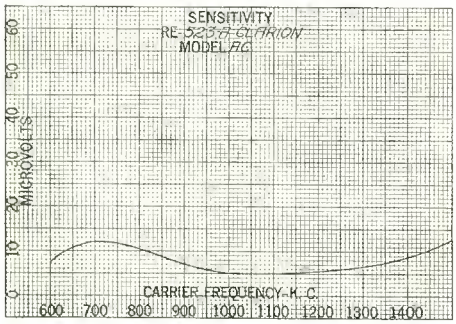
SENSITIVITY, selectivity and fidelity measurements completed by our laboratory on the T. C. A. Clarion model 50 production chassis are shown on this page.

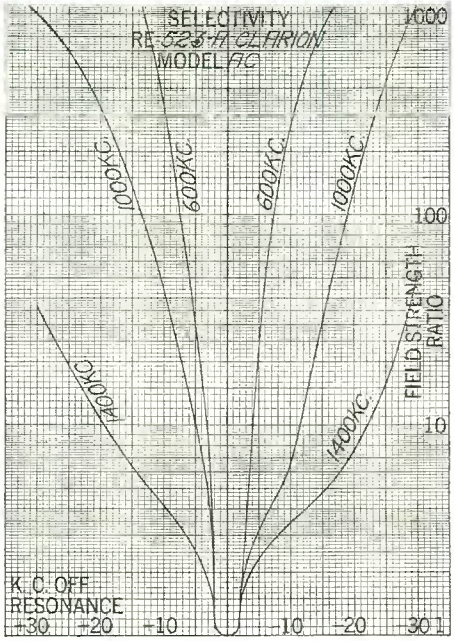
Output impedance load was adjusted to 4000 ohms and coupled capacitatively to the plates of the 245 tubes. Standard output of .050 watts was maintained on all measurements. The dummy antenna used was that of 20 uh, 200 mmf and 25 ohms.

Phasing frequency as set at the factory was maintained. Volume control was turned on maximum. No oscillation took place over the band covered. No hum could be measured.

Mutual conductance of the tubes used were: 1 r.f. 1040; 2 r.f. 920; 3 r.f. 1100; detector 1200; 1 a.f. 1100; P.P. 1310, P.P. 1300 micromhos.

In the tables following may be seen the interference ratios and the band widths as developed from the measurements taken:



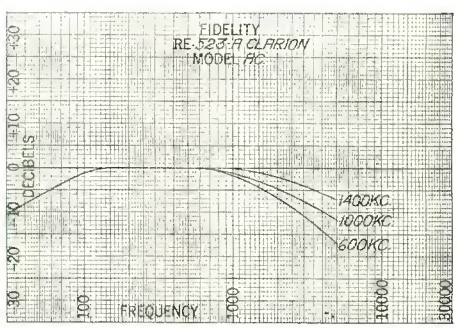


Interference Ratio

Resonance	Kilocycles off resonance Plus 10	Plus 20	Plus 30
600 kc.	305.5	4222.0	.....
1000 kc.	41.7	305.0	873.0
1400 kc.	4.5	10.5	36.0
	Minus 10	Minus 20	Minus 30
600 kc.	270.0	2361.0	.....
1000 kc.	5.6	139.5	1000
1400 kc.	3.5	7.5	54

Band Widths

Times field strength	Kilocycles wide 600 kc.	1000 kc.	1400 kc.
10	7.0	17.0	42.0
100	14.0	32.0	.....
1000	30.0	62.0	.....



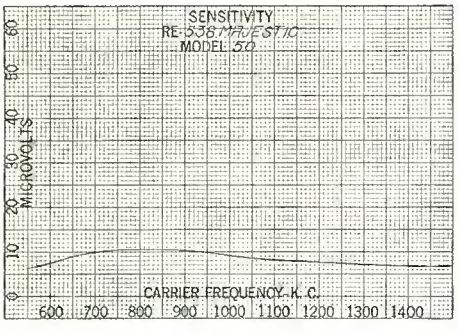
Majestic Model 50

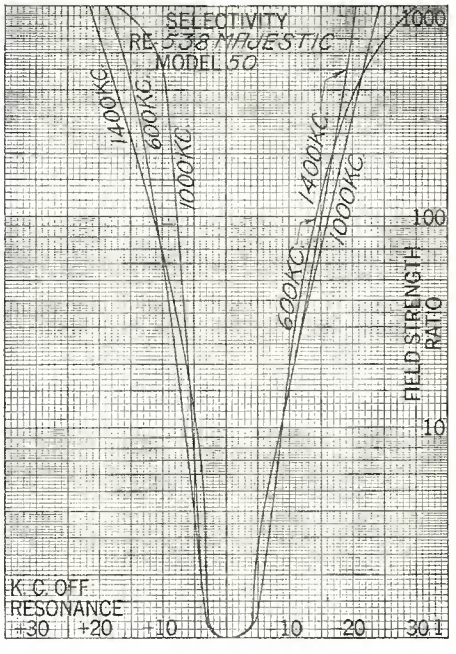
MAJESTIC model 50, serial 5A22931, measured September 17, 1930, with the results shown in the three curves on this page. Data shown below is that abstracted from the laboratory work sheet covering this particular receiver.

Impedance load adjusted to 4,000 ohms and coupled capacitatively to the plates of the 245 tubes. Standard output of 50 milliwatts maintained. The standard dummy antenna was employed in this measurement. Phasing of the receiver was at 1,000 kc for the antenna stage. Volume control turned on maximum. No oscillation, no hum measured.

Mutual conductance of the tubes used: 1 r.f. 990; 1 i.f. 1,080; detector 1,000; p.p. 1,250; p.p. 1,300; second detector 1,400, and oscillator 1,350 micromhos.

Below are found the interference ratios and the band widths:



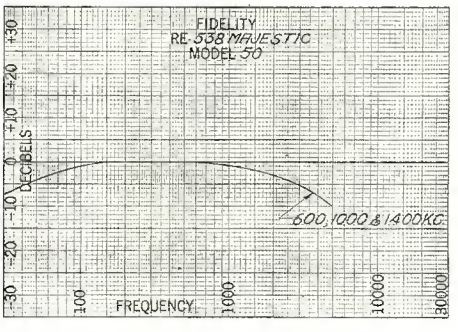


Interference Ratio

Resonance	Kilocycles off resonance		
	Plus 10	Plus 20	Plus 30
600 kc.	500.	-------	-------
1000 kc.	68.	-------	-------
1400 kc.	66.	700.	-------
	Minus 10	Minus 20	Minus 30
600 kc.	20.	370.	1,000
1000 kc.	14.5	300.	-------
1400 kc.	14.5	800.	-------

Band Widths

Times field strength	Kilocycles wide		
	600 kc.	1000 kc.	1400 kc.
10	15	14.	14.
100	27.5	24.	26.5
1000	49.	41.5	42.0



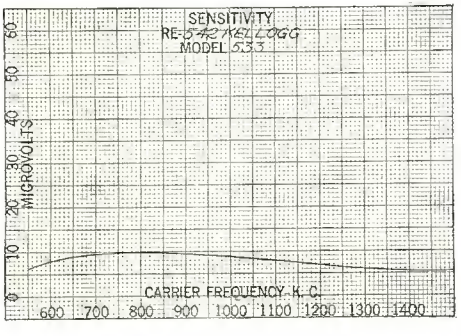
Kellogg Model 533

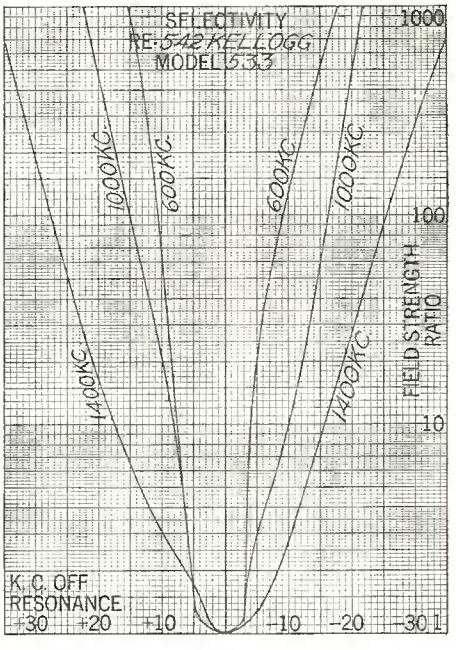
ANOTHER receiver recently passing through our laboratory is the Kellogg model 533, serial 152211, which was measured for sensitivity, selectivity and fidelity on September 18, 1930.

Output impedance load was adjusted to 4,000 ohms and coupled capacitatively to the plates of the 245 tubes. An output of .050 watts was maintained on all measurements. A dummy antenna having 20 uh, 200 mmf and 25 ohms resistance was used. The receiver was phased at 1,400 kc. The volume control was turned full on.

Mutual conductance of the tubes used: 1 r.f. 1,080; 2 r.f. 1,100; detector 1,200; 1 a.f. 1,460; p.p.a.f. 1,400; p.p.a.f. 1,400 micromhos.

The data on interference ratios and band widths is abstracted from the work sheet made in the laboratory.



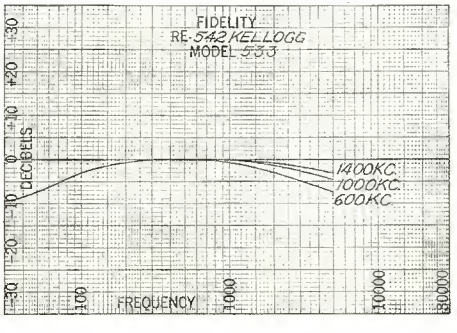


Interference Ratio

Resonance	Kilocycles off resonance		
	Plus 10	Plus 20	Plus 30
600 kc.	65.0	-------	-------
1000 kc.	20.0	450.	-------
1400 kc.	3.0	16.	190.
	Minus 10	Minus 20	Minus 30
600 kc.	130.	-------	-------
1000 kc.	10.	480.	-------
1400 kc.	2.7	27.5	275.

Band Widths

Times field strength	Kilocycles wide		
	600 kc.	1000 kc.	1400 kc.
10	11.5	18.0	33.
100	19.5	31.5	53.
1000	33.0	44.0	-------



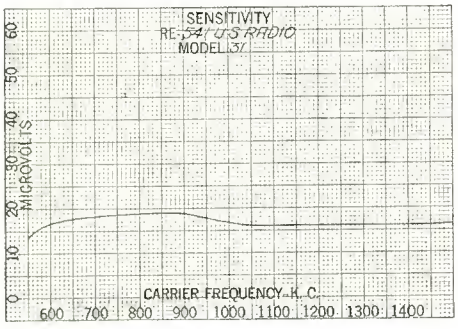
U. S. Radio and Television Model 31

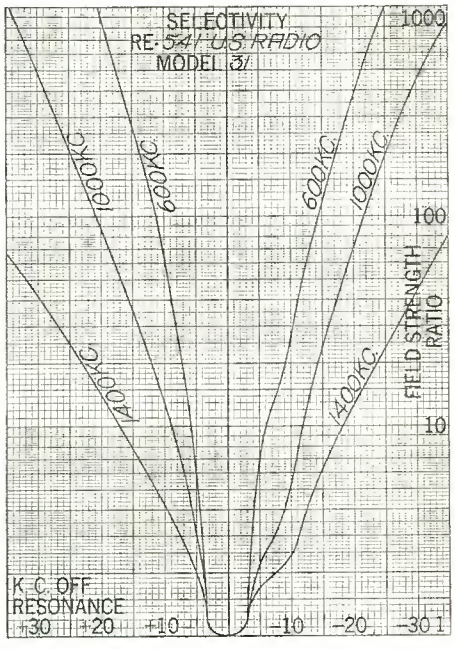
DATA given here covers the recent measurement of the U. S. Radio and Television model 31 chassis, serial 387905, passing through the laboratory on September 22, 1930.

From the work sheet we find the output impedance load was adjusted to 8,000 ohms and coupled capacitatively to the 245 plates. The output of .050 watts was maintained, while a dummy antenna having 20 uh, 200 mmf and 25 ohms was employed. The receiver was phased at 1,400 kc and the volume control turned on full when making the measurements. No oscillation, no hum measured.

Mutual conductance of the tubes used is shown as follows: 1 r.f. 1,000; 2 r.f. 1,080; 3 r.f. 1,050; detector 1,400; 1 a.f. 1,350; p.p.a.f. 1,250; p.p.a.f. 1,300 micromhos.

In the two tables below may be seen the interference ratios and the band widths:



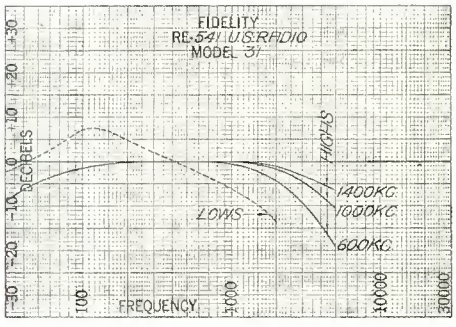


Interference Ratio

Resonance	Kilocycles off resonance		
	Plus 10	Plus 20	Plus 30
600 kc.	61.0	880.	.....
1000 kc.	12.5	87.	490.
1400 kc.	4.2	14.	42.
	Minus 10	Minus 20	Minus 30
600 kc.	26.	380.	.....
1000 kc.	5.2	71.	440.
1400 kc.	2.4	12.7	43.

Band Widths

Times field strength	Kilocycles wide		
	600 kc.	1000 kc.	1400 kc.
10	12.	21.	35.2
100	26	43.	.....
1000	45.5	72.	.....



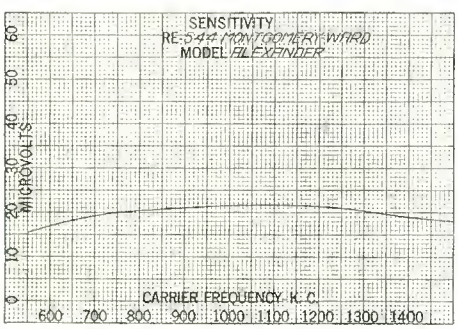
Montgomery-Ward Alexander Model

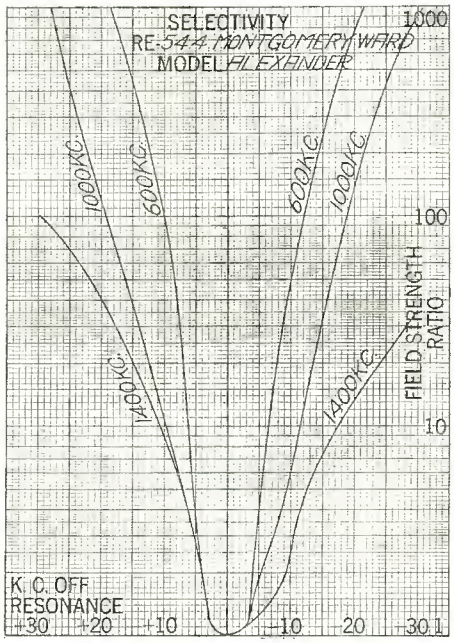
MEASUREMENTS on the Alexander model made for Montgomery Ward Co., were completed on September 30, 1930, when No. 74285 was checked in our laboratory with the results as shown in the three curves shown here.

Output impedance load was adjusted to 4,000 ohms and coupled capacitatively to the plates of the 245 tubes. Output of .050 watts was maintained. The dummy antenna used was one having 20 uh, 200 mmf and 25 ohms. The receiver was phased at 1,400 kc. and the volume control turned on maximum. No hum, no oscillation measured.

Mutual conductance of the tubes used: 1 r.f. 1,040; 2 r.f. 1,020; 3 r.f. 1,100; detector 1,200; 1 a.f. 1,400; p.p.a.f. 1,300 and p.p.a.f. 1,200 micromhos.

Interference ratios and band widths will be found in the tables of figures given below:



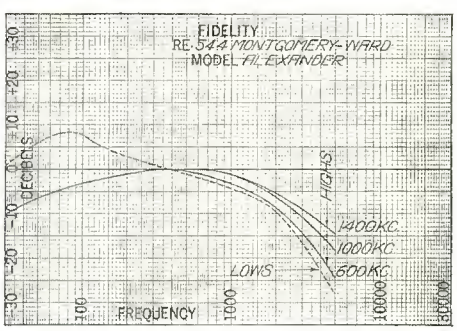


Interference Ratio

Resonance	Kilocycles off resonance		
	Plus 10	Plus 20	Plus 30
600 kc.	890.	.....	.....
1000 kc.	11.	115.	.....
1400 kc.	3.8	40.	100.
	Minus 10	Minus 20	Minus 30
600 kc.	480.	760.	.....
1000 kc.	5.7	130.	900.
1400 kc.	2.4	13.	35.3

Band Widths

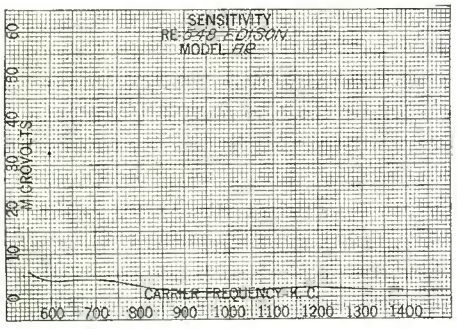
Times field strength	Kilocycles wide		
	600 kc.	1000 kc.	1400 kc.
10	13.	21.	28.5
100	22.	38.5	.....
1000	40.	59.	.....



Edison Receiver Models R6, R7

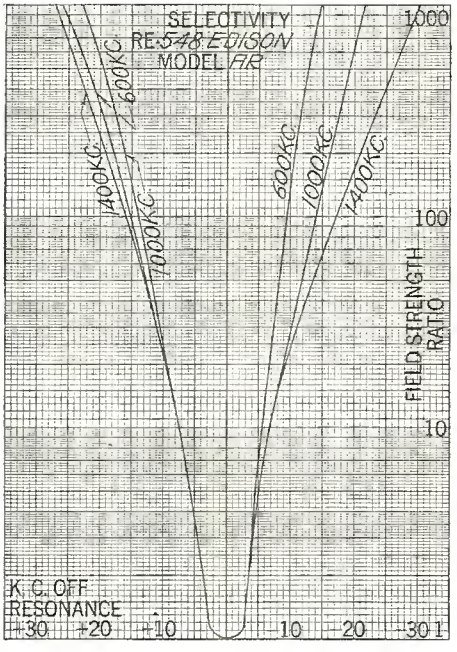
ANOTHER receiver recently passing through the measurement laboratory of this magazine is the Edison model R6, R7 (which in error is shown on the graphs as Model AR). The schematic diagram of this model is shown elsewhere in the Service and Repair section of this issue.

Under measurement the output impedance load is kept at 4000 ohms, coupled capacitatively to the plates of the 245 tubes used in the pushpull output. An output is maintained of .050 watts. The standard dummy antenna of 20 uh, 200 mmf and 25 ohms is employed. The receiver was phased at 1400 kc. and the volume control turned on full. No oscillation was apparent nor was hum encountered.



The mutual conductance of the tubes used in these measurements are shown below: m.m. 1 r.f. 1030; 2 r.f. 980; 3 r.f. 1070; 4 r.f. 1080; detector 1020; 1 a.f. 1130; p.p. 1980; p.p. 1970 micromhos.

The data covering the interference ratios and the band widths may be found in the tables following:

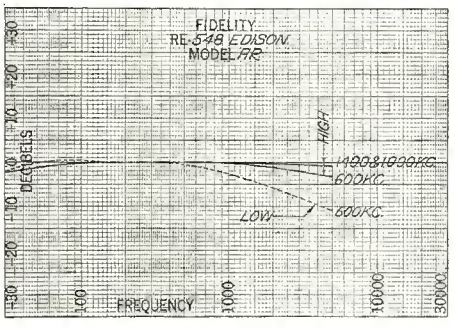


Interfcrence Ratio

Resonance	*Kilocycles off resonance*		
	Plus 10	Plus 20	Plus 30
600 kc.	22.0	330.0	.....
1000 kc.	25.0	550.0	.....
1400 kc.	22.0	240.0	.....
	Minus 10	Minus 20	Minus 30
600 kc.	140.0	.....	.....
1000 kc.	28.5	640.0	.....
1400 kc.	23.5	1700	960

Band Widths

Times field strength	*Kilocycles wide*		
	600 kc.	1000 kc.	1400 kc.
10	13.0	14.0	140.0
100	25.0	28.0	33.0
1000	37.0	44.0	57.0



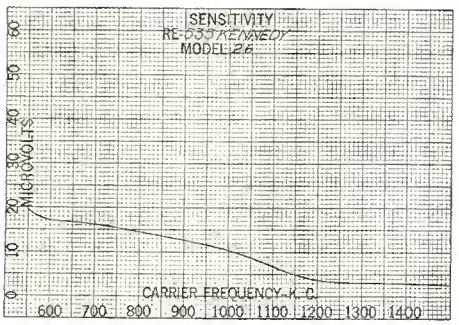
The Colin B. Kennedy Model 26

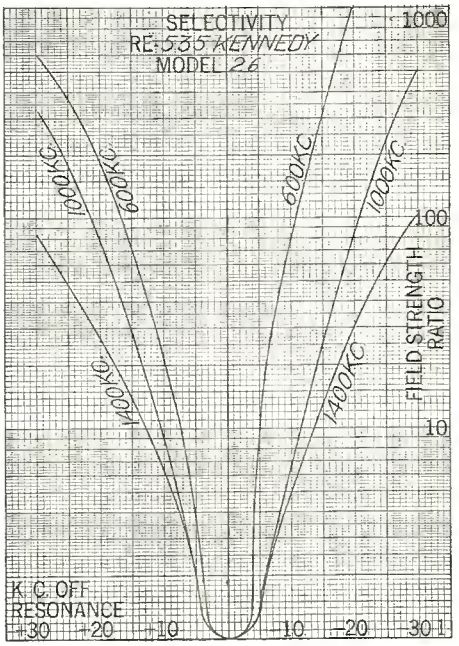
ON this page will be found the sensitivity ,selectivity and fidelity curves of the Kennedy model 26 recently measured in the laboratory of this magazine.

As usual in these measurements the output impedance load was kept at 4000 ohms, coupled capacitatively to the plates of the 245 tubes. Output was maintained at .050 watts which is the standard value for receiver output measurement. The dummy antenna used was one consisting of 20 uh, 200 mmf and 25 ohms. The receiver was phased at the frequency value set by the factory. Volume control was turned on full. No oscillation was encountered nor was hum measured.

The mutual conductance of the tubes used in this measurement is shown by the following: 1 r.f. 1050; 2 r.f. 1210; 3 r.f. 1140; detector 1030; 1 a.f. 1130; p.p. 1980 and p.p. 1970 micromhos.

In the two tables following will be found the data covering the interference ratios and the band widths, this information being secured from the work sheet and the curves.



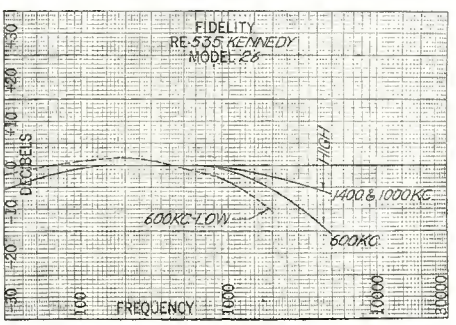


Interference Ratio

Resonance	*Kilocycles off resonance*		
	Plus 10	Plus 20	Plus 30
600 kc.	21.5	180.0	600.0
1000 kc.	9.0	77.0	330.0
1400 kc.	6.2	27.0	83.0
	Minus 10	Minus 20	Minus 30
600 kc.	78.0	1002.2	.....
1000 kc.	6.4	85.0	510.0
1400 kc.	4.8	30.5	1050.0

Band Widths

Times field strength	*Kilocycles wide*		
	600 kc.	1000 kc.	1400 kc.
10	12.2	19.0	26.5
100	27.6	42.0	.....
1000	.....	.....	.....



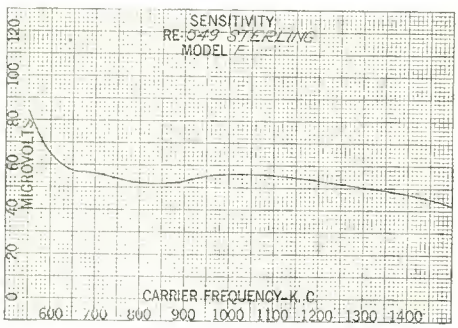
Sterling Receiver Model F

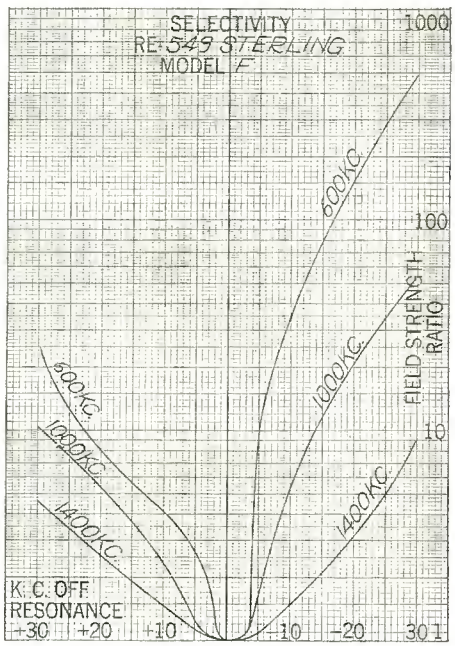
STERLING receiver, Model F, serial F2608 is the last receiver that passed through the measurement laboratory of this magazine at press time, the sensitivity, selectivity and fidelity curves being shown on this page.

Output impedance load was 4,000 ohms coupled capacitatively to the plate of the single 245 used in the output stage. The standard output of .050 watts was maintained on all measurements. The dummy antenna used was one consisting of 20 uh, 200 mmf and 25 ohms. Volume control was turned on full. Neither hum nor oscillation was apparent and hence not measured.

The mutual conductance of the tubes used in measuring the receiver is shown by the following figures: 1 r.f. 1140; 2 r.f. 1210; detector 1220 and the output stage 1970 micromhos.

A table of the interference ratio and the band widths is shown in the material shown below, the data for which is obtained from the laboratory work sheet and the curves themselves.



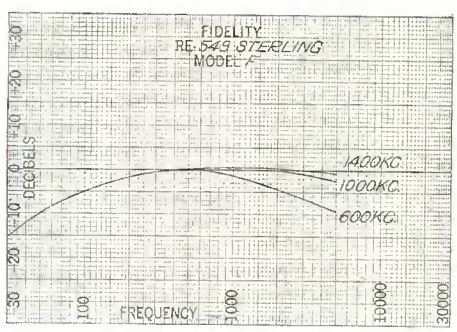


Interference Ratio

Resonance	Kilocycles off resonance		
	Plus 10	Plus 20	Plus 30
600 kc.	4.10	8.0	25.0
1000 kc.	2.35	5.4	10.5
1400 kc.	1.15	2.55	4.6
	Minus 10	Minus 20	Minus 30
600 kc.	34.5	155.0	480.0
1000 kc.	5.3	21.0	55.0
1400 kc.	1.5	3.15	9.0

Band Widths

Times field strength	Kilocycles wide		
	600 kc.	1000 kc.	1400 kc.
10	27.5	43.5	----
100	----	----	----
1000	----	----	----



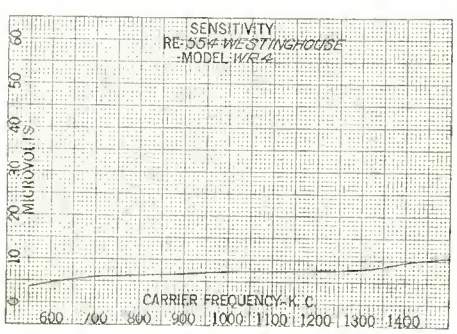
Westinghouse WR 4 T. R. F. Receiver

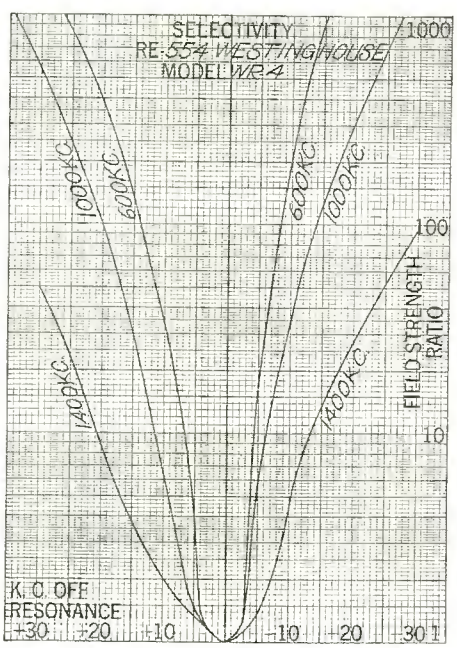
THE second of the Westinghouse receivers measured in our laboratoryis the t.r.f. model WR4, response curves of which are shown on this page.

The output impedance load was 4000 ohms coupled capacitatively to the plates of the 245 tubes. The output was maintained at the standard .050 watts, and the volume control turned on maximum. The dummy antenna used was one having 20 uh, 200 mmf and 25 ohms. The receiver was phased at the frequency for which it was set at the factory. No oscillation encountered, nor was hum found.

The mutual conductance of the tubes used in this measurement is shown by the following figures: 1 r.f. 1040; 2 r.f. 1080; 3 r.f. 1070; detector 1050; p.p. 1980 and p.p. 1970 micromhos.

In the two tables following will be found the interference ratios and band widths of receiver under measurement.



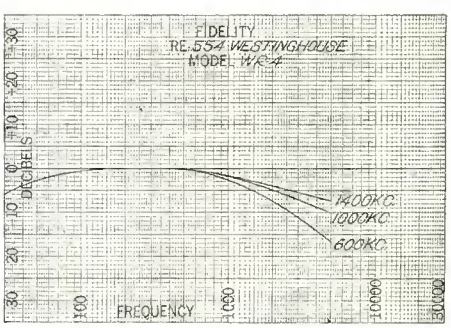


Interference Ratio

Resonance	Kilocycles off resonance		
	Plus 10	Plus 20	Plus 30
600 kc.	34.0	380.0	----
1000 kc.	6.2	98.0	540.0
1400 kc.	2.0	87.0	50.0
	Minus 10	Minus 20	Minus 30
600 kc.	200.0	310.0	----
1000 kc.	34.0	320.0	----
1400 kc.	4.5	27.5	95.0

Band Widths

Times field strength	Kilocycles wide		
	600 kc.	1000 kc.	1400 kc.
10	10.0	18.0	34.0
100	22.5	34.0	----
1000	42.0	61.0	----



Westinghouse Superheterodyne No. WR-5

ELECTRICAL details of the Westinghouse superheterodyne, WR-5, response curves on which were given on page 69 of the September, 1930, issue of this magazine, may be found in the schematic diagram, Figure 2, at the bottom of this page.

As will be seen the antenna is coupled to a tuned link circuit by means of a high inductance concentrated coil connected from antenna to ground. The inductance is of sufficient value that variations in the antenna system have little effect on tuning of this circuit.

The tuned circuit consists of a coil and condenser which tunes exactly with the tuned r.f. and first detector. There is no amplification gain in this circuit, it being merely a selection circuit, whose purpose is to eliminate any cross-modulation from stations to which the set is not tuned. or heterodyne whistles as far as possible, and to improve the selectivity of the receiver.

A tuned radio frequency stage follows which uses a 224, this stage giving about the same amplification as obtained from two r.f. stages of an average good receiver. The output of this stage is coupled capacitatively to the grid circuit of the first detector, or mixing tube by means of a small condenser. The plate circuit of the r.f. stage has a high inductance coil which provides a high impedance into which it is necessary to have the tube work in order to get good amplification.

Output of the oscillator is inductively coupled to the grid circuit of the first detector. The oscillator is grid tuned, uses a 227, and has a closely coupled plate coil which gives sufficient feedback to provide stable operation. The grid circuit is so designed that by means of a correct combination of capacity and inductance a constant frequency difference between the oscillator and the tuned r.f. stages throughout the range is maintained.

First detector is tuned by one of the sections of the gang condenser to the signal frequency. In the grid circuit is the incoming signal frequency and the oscillator signal, the latter being 175 kilocycles different from the former. First detector is biased to operate as a plate rectification detector, and its purpose is to extract the beat frequency produced by combining the signal and oscillator frequencies. The beat frequency, 175 kc, appears in the plate circuit of the first detector, which is accurately tuned to 175 kc.

The next two circuits are the first and second intermediate stages which give a high degree of amplification, the grids and plates of both stages as well as the plate circuit of the first detector and the grid circuit of the second detector are tuned to 175 kc.

Two resistances are arranged for connecting to the first i.f. transformer, the connection or disconnection of which constitutes the action of the local-distant switch. At the local position a 40,000 ohm resistor is connected across the primary of this transformer and a 500 ohm resistor in series with the secondary and one side of the tuning condenser. The effect of these resistors is to decrease the sensitivity, broaden the selectivity and thus improve the fidelity of the set. At the distant position the resistance is out of both circuits and the original sensitivity and selectivity is obtained. After the high amplification of the intermediate stages the signal appears in the grid circuit of the second detector.

Westinghouse Model WR-5

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Screen Grid Current	Change
224	1 R.F.	2.2	240	2.2	34	80	3.2	.5	----
227	Osc.	2.2	60	----	22	----	6.5	----	----
224	1 Det.	2.2	230	9.5	25	72	.25	.1	----
224	1 I.F.	2.2	240	2.2	34	78	4.0	.5	----
224	2 I.F.	2.2	240	4.2	31.5	78	1.6	.5	----
227	2 Det.	2.2	212	22	12	----	.25	----	----
245	P.P.	2.2	200	19*	----	----	25.0	----	----
245	P.P.	2.2	200	19*	----	----	25.0	----	----
280	Rect.	5.0	----	----	----	----	----	----	----

Line voltage. Volume control maximum.

*Not true reading due to resistor in circuit.

Fig. 1. Voltages and current values of the tubes in the WR-5 are those shown in this table as taken with a Weston set tester

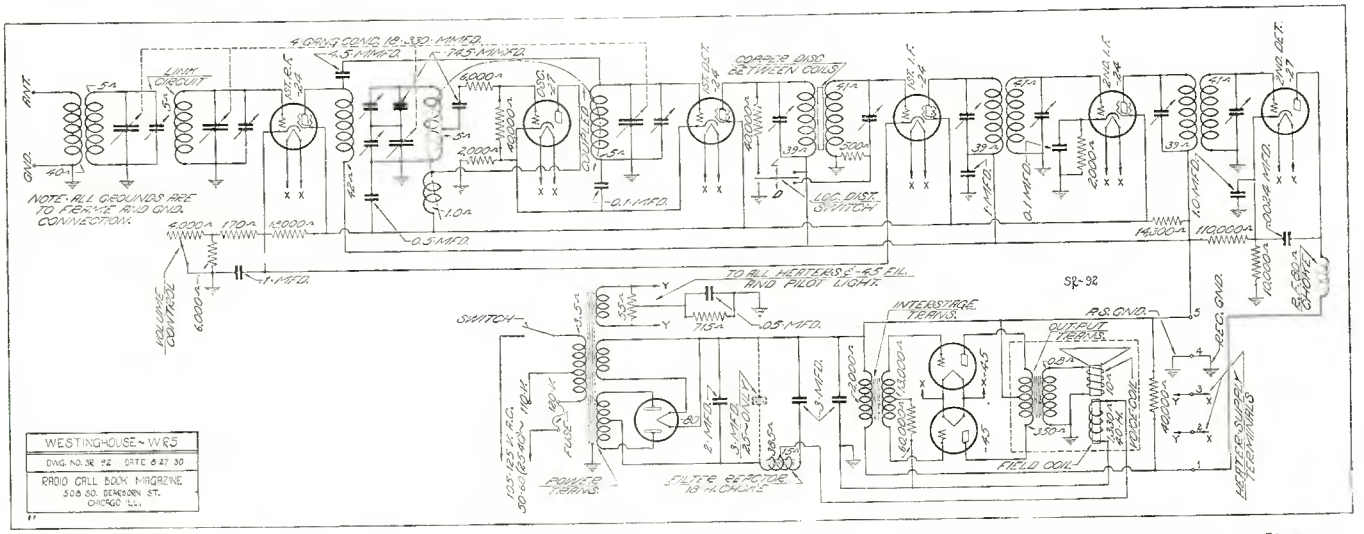


Fig. 2. All electrical details of the Westinghouse WR-5 receiver and power supply are given in this schematic diagram

Stromberg-Carlson Models 12 and 14

ON this page is presented the schematic diagram of the Stromberg-Carlson models 12 and 14, together with a table of tube operating values as indicated in the service manual for these receivers.

The radio amplifier employs a total of five tuned circuits as well as a broad band interstage coupling transformer. Four of these tuned circuits are used in two "bi-resonators," while the fifth is used to couple the radio amplifier to the detector. A highly effective automatic volume control circuit is employed, using a 227 tube. The detector also uses a 227 tube and is coupled to the first audio 227 by means of a low ratio transformer. The first audio tube is coupled to the push-pull 245's by a special large transformer. One of the 280 rectifiers supplies direct current for the tubes and the second 280 supplies rectified current for the speaker field.

There is a single station selector knob operating an illuminated dial. The volume control and phonograph switch operate from one knob, which is located at the left of the control panel. The on-off switch and the range control (local-distance) are operated by the knob at the right of the panel. The silent key is located directly beneath the selector knob and is illuminated by the same dial lamp. The chassis of the models 12 and 14 receivers are identical.

The antenna coupling system is designed so that absolute single selector operation is obtained without trimming or vernier controls on the first tuning circuit. An arrangement of a cord with pin tip and two pin jacks is provided to adapt the receiver to the type of antenna used.

The automatic volume control operates by varying the control grid biases of the first two radio amplifier tubes in proportion to the strength of the received signal. When an extremely strong signal, which cannot be handled by the automatic control, is received, the range control should be pulled out to the local position to decrease the signal input from the antenna to the radio amplifier. Normally the range control should be left in the distance, or pushed in position.

Stromberg-Carlson Models 12 and 14

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Where Plate Voltages Measured
224	1 R.F.	2.4	130	.2-3.0		85	Between r.f. plates and chassis.
224	2 R.F.	2.4	130	.2-3.0		85	Between r.f. plates and chassis.
224	3 R.F.	2.4	130	.2-3.0		85	Between r.f. plates and chassis.
227	Det.	2.4	195	25.	----	----	Between cathode and plate.
227	Vol. Con.	2.4	40	8.	----	----	Between cathode and chassis.
227	1 A.F.	2.4	115	8	----	----	Between cathode and plate.
245	P.P.	2.4	250	50	----	----	Between plate and mid-tap of 10 ohm resistor.
245	P.P.	2.4	250	50	----	----	Between plate and mid-tap of 10 ohm resistor.
280	Rect.	4.8	350	----	----	----	Between plate and mid-tap of H. V. secondary.
280	Rect.	4.8	350	----	----	----	Between plate and mid-tap of H. V. secondary.

Line voltage 120, set on "hi." Volume control maximum.

Fig. 1. The tube operating values shown in this table are those abstracted from the service manual for the Stromberg-Carlson 12 and 14

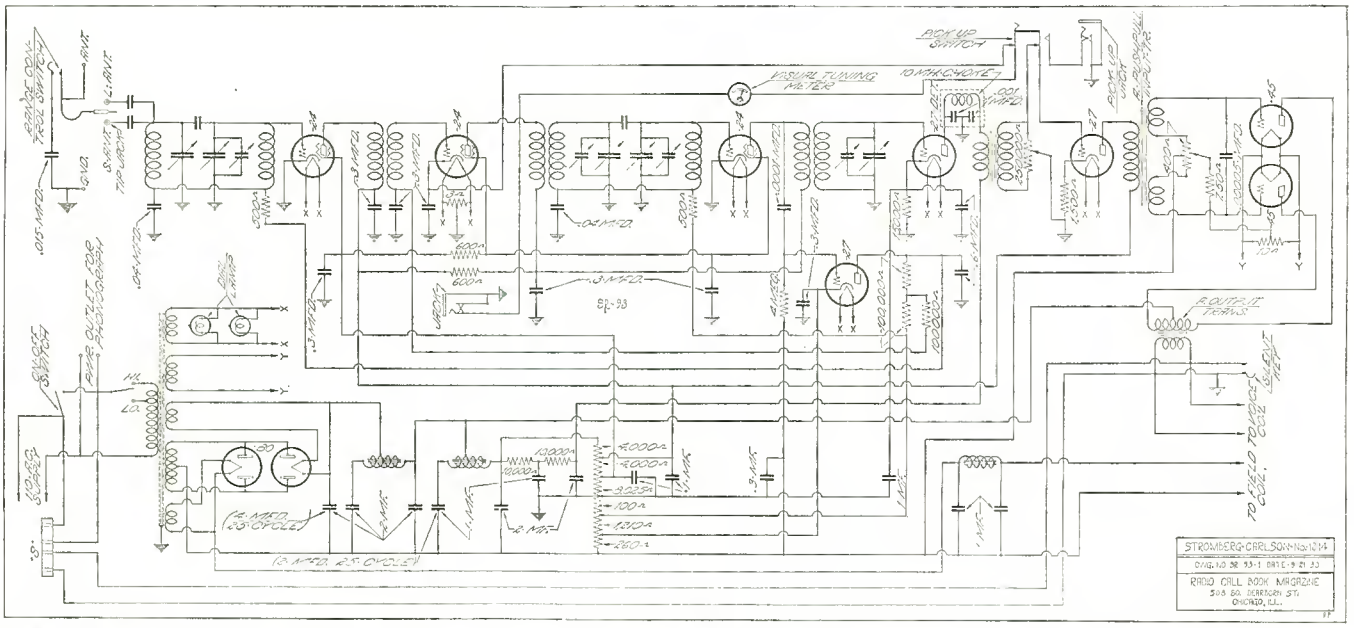


Fig. 2. All details of the receiver and its power supply of the models 12 and 14 Stromberg-Carlson are shown in this illustration

Majestic Radio Receiver Model 130-A

MAJESTIC 130-A and 230-A models incorporate several new and distinctive features, such as the use of the screen grid type of tubes instead of the previously used 227 type. Three screen grids, a power screen grid detector, two 245 type tubes in pushpull and a full wave 280 type rectifier represent the tube quota.

The three controls on the panel are: the left knob is the line switch; the center the tuning control, and the right the volume control. Equalized sensitivity is effected throughout the tuning range by the unique design of the amplifier coupling circuits. Two tuned circuits precede the first amplifier; a fixed tuned transformer precedes the second amplifier; two tuned circuits precede the third amplifier, and one tuned circuit precedes the power detector. A normal pushpull input transformer couples the screen grid power detector to the single stage pushpull power amplifier. The sensitivity, selectivity and fidelity of the 130-A is much improved over previous models. Response curves of this model appeared on page 66 of the September issue of this magazine.

The first and second r.f. tubes are biased by a variable resistor of 1,260 ohms, plus a fixed 154 ohm. Variance of the grid bias voltage on these tubes controls the volume of the receiver. Biasing of the third r.f. is taken care of by the 154-ohm (double orange) resistor. Bias for the detector comes from the drop across the 35,000 ohm (green) resistor. The power tubes in the pushpull stage are biased by an 800 ohm (white) resistor. Cathodes of the first and second r.f. tubes are bypassed to ground with a .3 mfd paper condenser, and the detector cathode bypassed through a 1 mfd condenser.

The screen grid detector operates directly into the pushpull stages. Better quality, reduced a.c. hum and tube noise is attributed to the use of the power detector.

In cases where low sensitivity is encountered, first check all r.f. tubes and the detector. Tubes having a low amplification factor in any of these positions will seriously affect the sensitivity of the receiver.

A small compensating condenser is provided to adjust the reflected capacity of the antenna being used. Adjustment of this condenser is possible through the hole in the rear of the condenser gang housing. When the set is installed, a station between 1000 and 1400 kc should be tuned in, the volume control set to low volume; then adjust the compensating condenser by turning the black knob until maximum volume is secured. Further adjustment is not necessary unless antenna length or position is changed.

Majestic Model 130-A

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
G24	1 R.F.	2.35	180	3	3	90	3	----	----
G24	2 R.F.	2.35	180	3	3	90	3	----	----
G24	3 R.F.	2.35	180	3	3	90	3	----	----
G24	Det.	2.35	263	12	12	125	.5	----	----
G45	P.P.	2.45	250	50	----	----	32	----	----
G45	P.P.	2.45	250	50	----	----	32	----	----
G80	Rect.	4.6	----	----	----	----	----	----	----

Line voltage 115, on 115 tap. Volume control maximum.

Figure 1. The tube operating values shown in this chart are those indicated in the service manual for this receiver

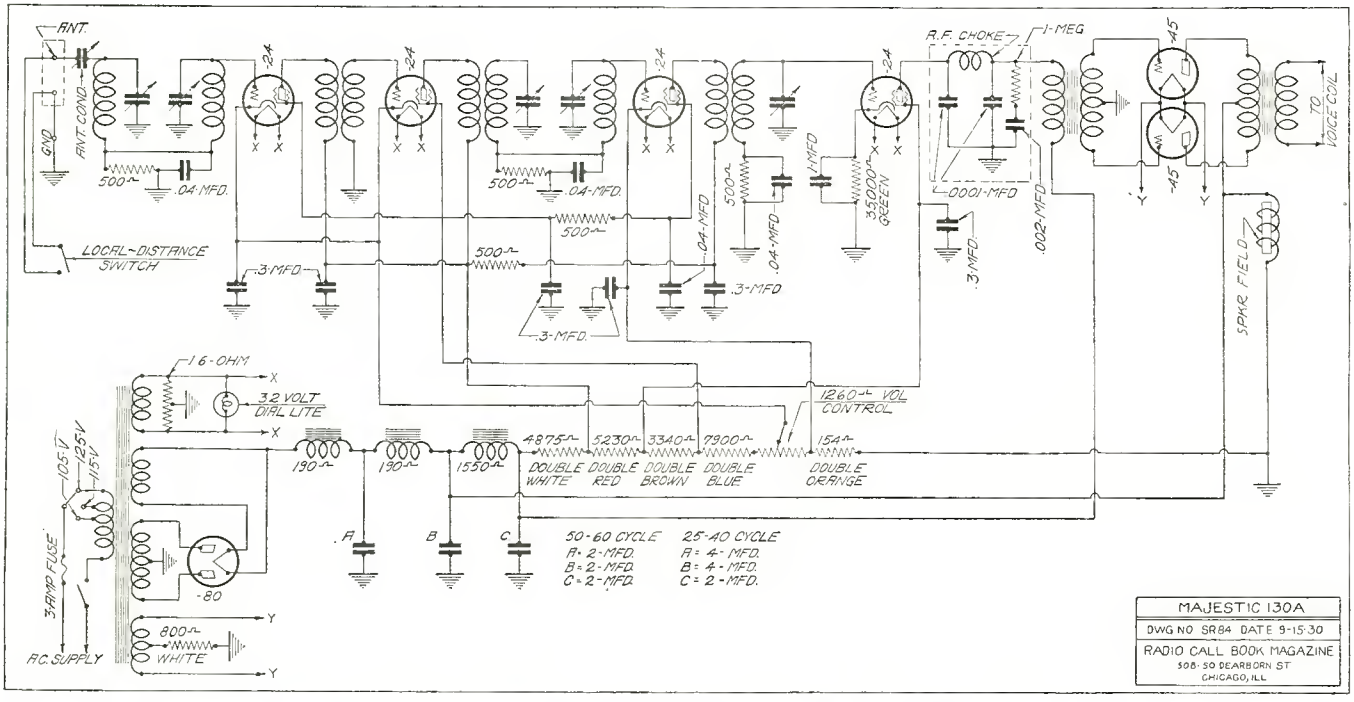


Figure 2. Electrical details of the receiver and power supply covering the Majestic model 130-A are shown in this illustration

Crosley Radio Receiver Model No. 77

HAVING published response curves of the Crosley model 77 in our September issue, the schematic circuit of this receiver is here presented, with a table of tube operating voltages as indicated in the Crosley service supplement dated September 1. The table is in Figure 1 and the schematic in Fig. 2.

Air core r.f. transformers are used for coupling the antenna stage to the first r.f., the first r.f. to the second r.f. stage, and the second r.f. to the detector. These transformers are of special design, introducing sufficient capacity coupling as well as inductive coupling to insure uniform amplification over the broadcast range. The detector stage is resistance coupled to the first audio stage. The first audio stage is transformer coupled to the output stage.

A local-distance switch in the antenna circuit provides a means of adjusting the energy transfer from the antenna circuit to compensate for the vast difference in signal strength from different stations.

The screen grid of the detector tube is connected to the plate supply through a 1 megohm resistor which reduces the voltage to the proper value. The screen grids of the r.f. stages are connected to the plate supply through 10,000 and 1,750 ohm resistors. After passing through the 1,750 ohm resistor, the plate supply is grounded through a 2,000 ohm resistor and a 225 ohm resistor in series.

The emitter of the first audio tube is connected to the junction of the 2,000 and 225 ohm resistors in the bleeder circuit. Thus the flow of plate current and bleeder current through the 225 ohm resistor serves to maintain the emitter of this tube at a positive potential with regard to the chassis, supplying the bias for this stage. The manual volume control on the receiver operates by adjusting the 300,000 ohm variable coupling resistor connected to the grid of this tube.

The normal bias on the r.f. and detector tubes is obtained by means of a 320 ohm biasing resistor in the r.f. emitter circuit, and a 20,000 ohm biasing resistor in the emitter of the detector circuit.

In addition to the above mentioned biasing resistors in the r.f. and detector circuits, there are three resistors in the grid circuits of these tubes. Two of these marked 37,000 ohms in the circuit diagram have a value of 60,000 ohms in later chasses. The third is a 60,000 ohm resistor connecting all three grids to the chassis. This third 60,000 ohm resistor also acts as an automatic volume or response control, reducing the amplification of the receiver for signals of strength greater than a certain value.

If a signal is received of sufficient strength to cause grid current to flow in the detector circuit, the resulting voltage drop in this resistor increases the negative bias on the r.f. and the detector tubes, thus decreasing the amplification in these stages.

Crosley Model 77

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R.F.	2.3	160	3.2-	---	90	---	---	---
224	2 R.F.	2.3	160	3.2	---	90	---	---	---
224	Det.	2.3	110	3.2	---	55	---	---	---
227	1 A.F.	2.3	150	10.	---	---	---	---	---
245	P.P.	2.3	260	65	---	---	---	---	---
245	P.P.	2.3	260	65	---	---	---	---	---
280	Rect.	4.6	280	---	---	---	---	---	---

Line voltage. Volume control.

Fig. 1. The operating voltages indicated in this table are those noted in the Crosley service supplement

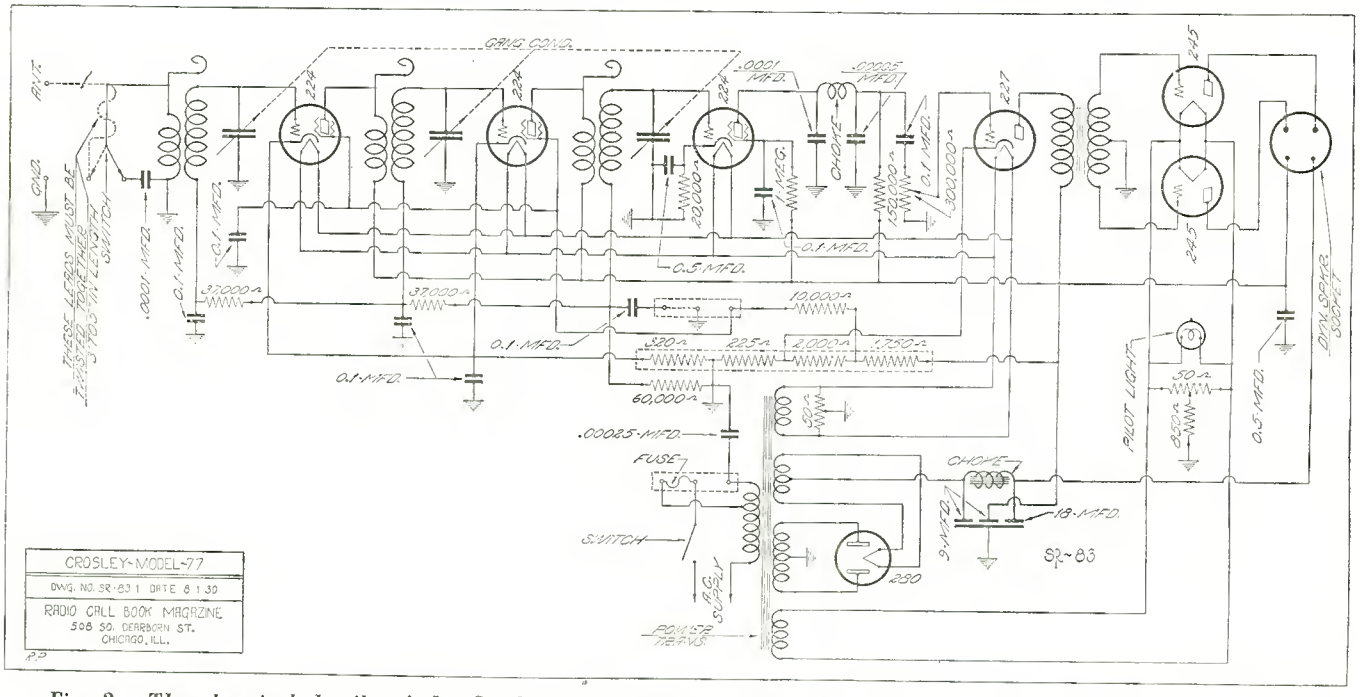


Fig. 2. The electrical details of the Crosley model 77 receiver and power supply are shown in this illustration

Kolster Radio Receiver Model K43

ON this page will be found the schematic diagram of the Kolster K-43, the r.f. chassis and the power supply. A table of average tube values will be found in the chart, Figure 1.

The K-43 uses three 224 and one 227 tubes in four tuned r.f. stages, followed by a first stage 227 working into a pair of 245 tubes push-pulled. The power supply uses a full wave 280 rectifier.

Antenna Input

Antenna input is through a 25,000-ohm variable resistor across the antenna winding with a .0001 mfd fixed condenser. The plate circuit of the first 224 r.f. tube has a 10,000-ohm fixed resistor in series with the primary and a 50-mmf condenser across this resistor. The detector circuit uses the conventional grid leak and condenser detection, while its plate circuit is choked and bypassed. A pair of phono jacks are provided across the primary of the first audio transformer so that a pick-up may be used when desired.

Volume control on the receiver is by means of a 10,000-ohm variable resistance between ground and the plus 45-volt terminal of the power supply, this resistor feeding the three screens of the 224 tubes. For hum control there is provided a 6-ohm variable resistor across the filament circuit of the first audio 227, the arm of the resistor being common with ground. A fixed resistor of 250,000 ohms is placed in series with the secondary of the first audio transformer, while a 3,000-ohm resistor in the cathode-ground circuit of that stage provides the bias for the 227 grid. A 108-volt field with 1,800 ohms is used for the dynamic and is included in the filter circuit.

At the bottom, right, of the schematic in Figure 2, may be seen the detail drawings of the condenser block and its numbered connections; also the detail of the cable connector and its numbered terminals.

Kolster Model K43

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R.F.	2.2	125	1.5	—	45	1.3	3.5	2.2
224	2 R.F.	2.2	125	1.5	—	45	1.3	3.5	2.2
224	3 R.F.	2.2	125	1.5	—	45	1.3	3.5	2.2
227	Det.	2.2	25	—	—	—	1.5	—	—
227	1 A.F.	2.2	105	6	—	—	4.0	5.5	1.5
245	P.P.	2.3	191	39	—	—	23	27	4.0
245	P.P.	2.3	191	39	—	—	23	27	4.0
280	Rect.	4.8	—	—	—	—	—	—	—

Line voltage 112. Volume Control Maximum.

Fig. 1. The table of typical tube characteristics for the Kolster K-43 is shown here as taken with a Weston test set

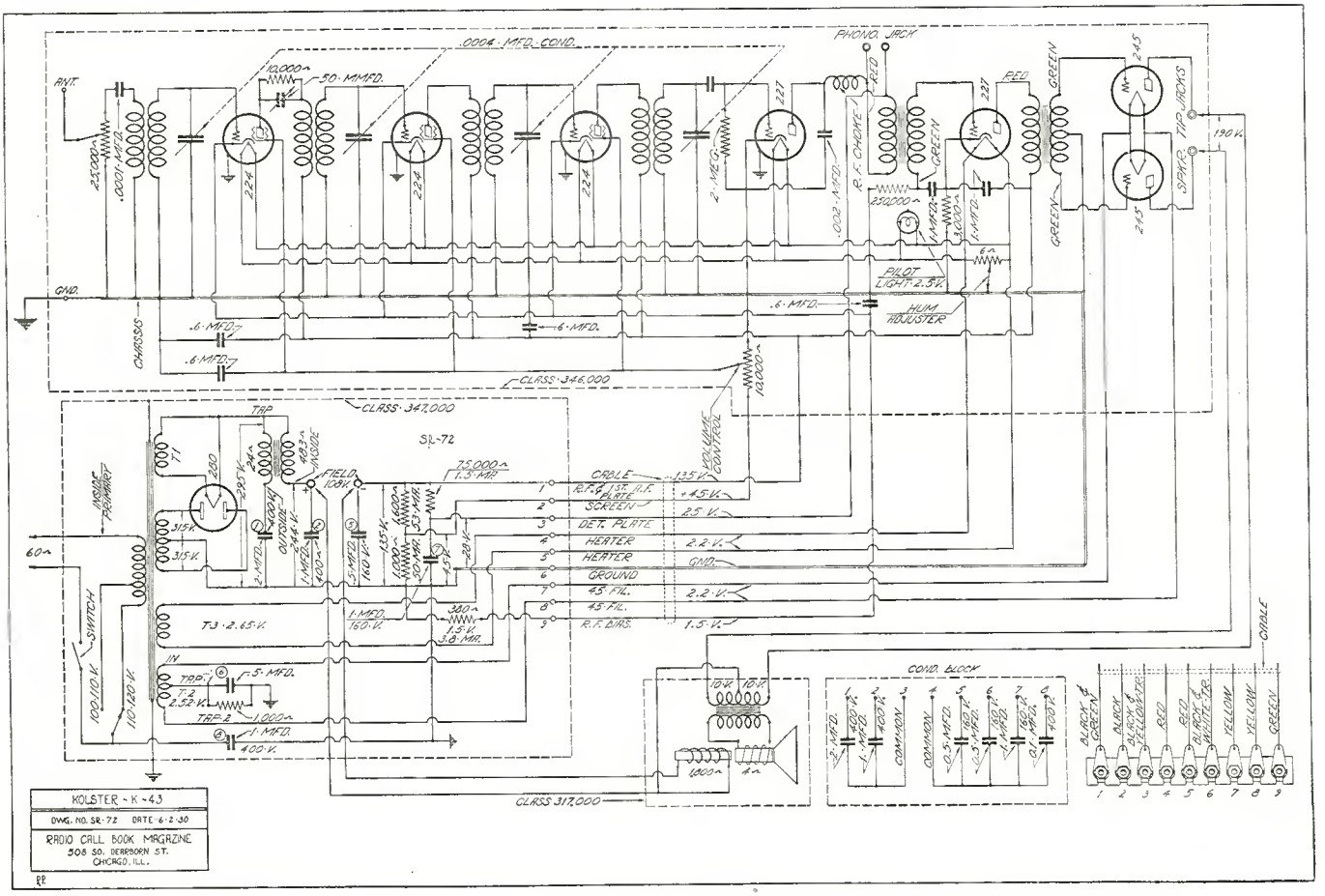


Fig. 2. Receiver and the power supply of the Kolster K-43 are shown in this schematic drawing

Kennedy Screen Grid Set Model 26

IN this article is described the model 26 screen grid Colin B. Kennedy model. the schematic of which is shown in Figure 2, while a table of tube operating values as abstracted from the service manual is shown in Figure 1.

Two Parts

This model is constructed on two bases. one the receiver and the other the power supply. These are connected together by means of a plug and cable. The double unit assembly permits a more flexible design of cabinets and the installation of plain and automatic phonograph units and short wave receivers.

Usual Instructions

General instructions for locating any trouble that may occur, faulty reception of various kinds and unusual conditions that may arise are similar to the general instructions for servicing any standard well designed receiver. Modern makes of tube testing devices and set analyzers are equipped to check screen grid tubes and test out circuits for their use. In cases of trouble. tubes should be tested and if no tube tester capable of checking screen grid tubes is available. these tubes should be replaced one by one with tubes that are known to be good.

Check Voltages

Set voltages may be checked with a set analyzer outfit or, by inverting the units and removing the base plate from the r.f. unit, with voltmeter and test leads. The units are removed from the cabinet by removing the connections from the rear terminal panels, clearing the a.c. cord, removing the knobs and taking out the cabinet mounting screws in the corners of the bases.

Peppy Tubes Used

According to the service instructions the model 26 receivers are tested with particularly peppy screen grid tubes to prevent them from reaching the user in an unstable condition. Due to the care in testing few sets should be encountered that tend to oscillate. If the set oscillates over the entire dial range it is possible that the detector output filter is defective and a new one may be tried. Excessively high screen voltages may cause oscillation. The intermediate B voltage in the r.f. unit is dropped by means of a graphite resistor before feeding to the screen voltage section of the volume control. Check the resistor for shorts or breakdown.

Caution

The r.f. tubes have individual biasing resistors and by replacing one or more of these resistors with resistors of higher resistance value the oscillation may be stopped. Under no condition should the detector biasing resistor be changed in value.

Kennedy Model 26

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R.F.	2.3	160	3.5	....	85	....	....	....
224	2 R.F.	2.3	160	3.5	....	85	....	....	....
224	3 R.F.	2.3	160	3.5	....	85	....	....	....
227	Det.	2.3	125	10	....	....	....	....	....
227	1 A.F.	2.3	155	9	....	....	....	....	....
245	P.P.	2.3	230	45	....	....	....	....	....
245	P.P.	2.3	230	45	....	....	....	....	....
280	Rect.	4.8	....	....	....	....	....	....	....

Line voltage 120. Volume control maximum.

Fig. 1. The operating values of the tubes in the Model 26 Kennedy are shown in this table as abstracted from the service manual for that receiver

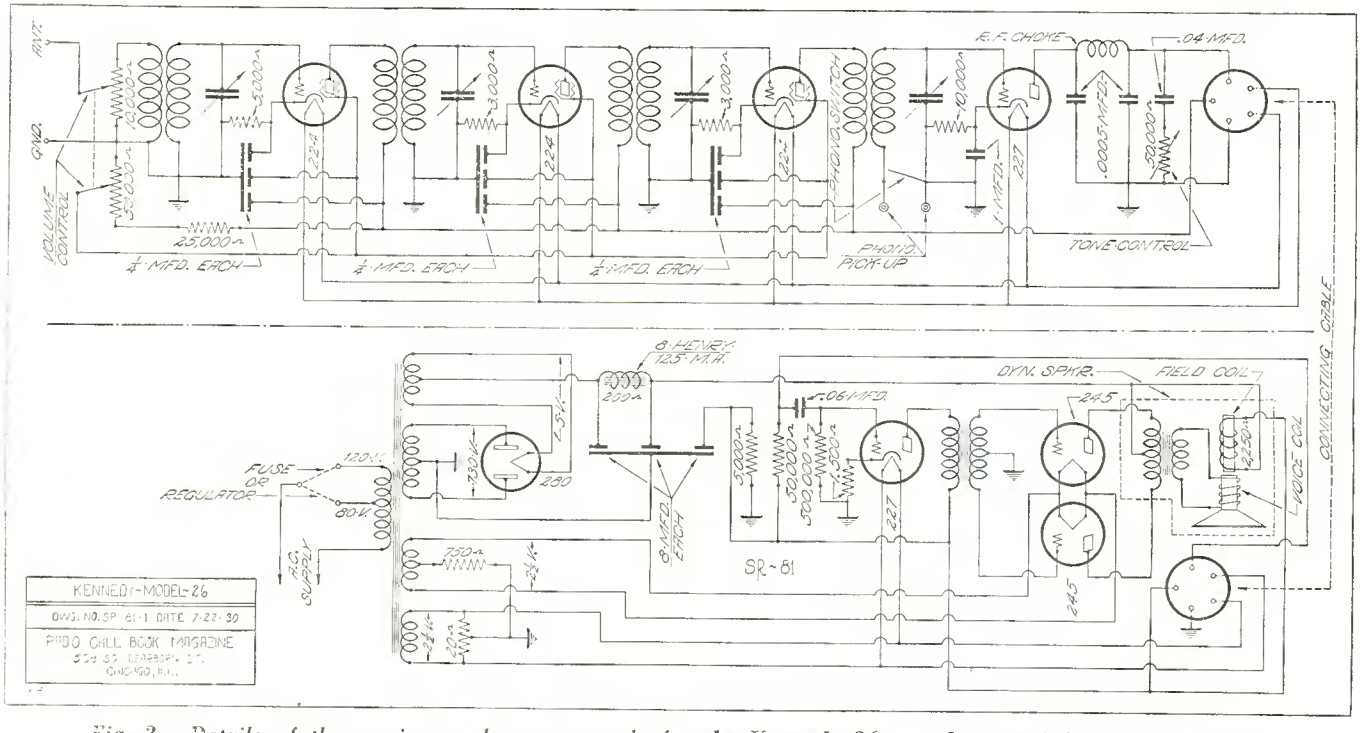


Fig. 2. Details of the receiver and power supply for the Kennedy 26 may be traced from this drawing

Silver Radio Receiver Model 35-A

SHOWN here is the schematic diagram of the Silver model 35-A receiver and its power supply, the receiver in Figure 3, the power supply in Figure 2, while a table of operating tube voltages may be seen in Figure 2.

Service notes covering this receiver re-aligning are: The leads from the oscillator should be shielded and connect through a .001 mfd condenser to the short antenna post of the 35-A. A good ground connection is essential. The oscillator signal should be cut down or attenuated to give a very weak signal with the volume control of the receiver turned on full. Turn the tuning dial to 550 kc. Be sure the condenser rotor plates are fully meshed at this point and that the tuning dial hits the stop pin.

Now turn the dial to 1500 kc, where it should also hit the stop pin. With the test oscillator set at 1500 kc use a wide blade screwdriver to adjust the fifth (left) trimmer screw for maximum volume. With the screwdriver adjust each succeeding trimmer for maximum volume. Repeat the above adjustment a second time for finer adjustment.

Next turn the oscillator to 1280 kc and tune the receiver to exactly that frequency. With the screwdriver tune each trimmer to maximum volume. It should only be necessary to make minor adjustments at this point.

If during these operations a vacuum tube voltmeter can be connected across the voice coil of the speaker, or a 100 m.a. thermoammeter inserted in series with the voice coil, visual indications of the volume can be obtained and more accurate adjustments effected.

During the operations mentioned the volume control must be left strictly alone, and alignment adjustments made on the aligning screws exactly in order as given above. The above operations performed make sure the receiver will tune up to 1500 kc. If the dial fails to read properly for 1400 to 1500 kc signals, all aligning condensers have probably been set too far in.

If no oscillator is available, the procedure is exactly as outlined except that a broadcast signal at 1500 and 1280 kilocycles is tuned in instead of the oscillator signal. However, this method of re-aligning is not recommended where an oscillator can be had.

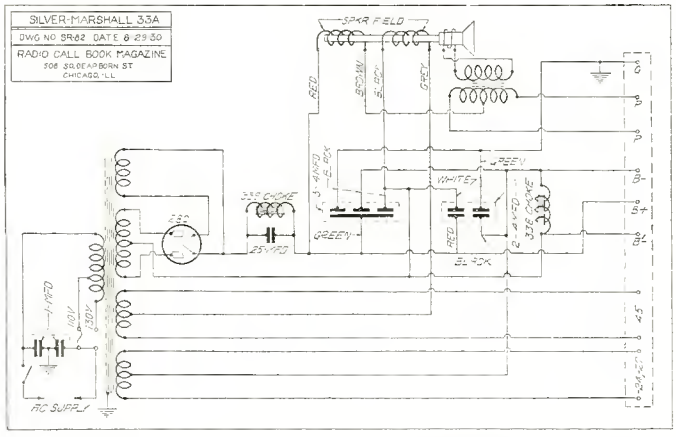


Fig. 1. The schematic of the power supply for the Silver 35-A is shown in the drawing to the right. It should be noted that the number for the power pack is 33-A regardless of whether intended for the 60 or the 25 cycle current

Silver Model 35-A

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R.F.	2.15	176	....	66	74	3.7	....	....
224	2 R.F.	2.15	176	....	66	73	3.5	....	....
224	3 R.F.	2.17	188	3	60	73	2.0	....	....
224	Det.	2.19	118	11	11	40	.2	....	....
227	1 A.F.	2.20	176	3	14	....	2	....	....
245	P.P.	2.30	216	40	....	....	20	....	....
245	P.P.	2.30	216	40	....	....	20	....	....
227	Vol. Con.	2.15	15	8	38	....	....	....	....

Line voltage. 115 volts. Volume control.

Fig. 2. The voltages indicated in this table are given as a guide for service men and are taken with a Jewell set analyzer

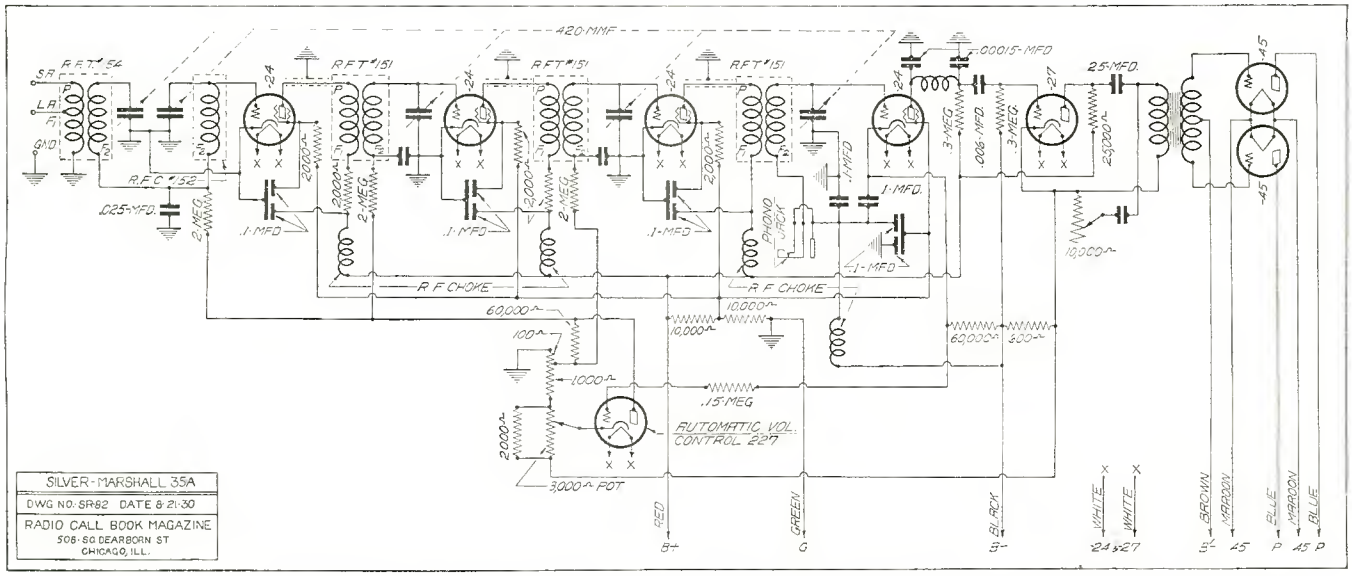


Fig. 3. The electrical circuit of the receiver marketed by Silver as 35-A may be traced from the above drawing

Kellogg Radio Receivers 523 to 528

GENERAL description of the Kellogg models 523 to 528 inclusive, will be found on this page, the schematic circuit being Figure 2, while a table of typical operating voltages is to be seen in Figure 1.

According to the Kellogg manual the radio amplifier has been designed to utilize the high amplification of screen grid tubes and also to provide a satisfactory degree of selectivity. Each stage is tuned and completely shielded to prevent pickup of any signals except by the antenna, or the transfer of energy from one stage to another except through the desired circuit, thus giving maximum amplification and preventing oscillation. Including the detector input there are four tuned circuits, insuring selectivity.

Condenser Units Separate

Each unit of the gang condenser is in a separate compartment with its associated tube. The coils are completely enclosed in seamless copper cans inside of the steel base. All resistors are non-inductive. All capacitors in the radio frequency circuits are the non-inductive low resistance type.

The antenna coil is so constructed as to eliminate any necessity for trimming devices, insuring a single selector control. The antenna coil input is controlled by a potentiometer to prevent overloading the first r.f. tube when tuning a powerful nearby station.

Automatic Volume Control

The plate circuit of the third radio frequency tube is coupled through a condenser to the grid circuit of an automatic volume control tube. This tube automatically changes the grid bias of the first and second r.f. tubes, which bias governs the amplification of these tubes and tends to produce a constant radio frequency voltage output. A manual setting of the volume control tube is provided so that any desired level of volume may be maintained at any setting within certain limits of the antenna input control. The extreme counter-clockwise movement of the volume control knob operates a switch with which the phonograph binding posts are connected to the audio amplifier, and the detector disconnected. The detector is of the linear type.

The first audio tube and transformer are mounted on the chassis. The input push-pull transformer and power tubes are part of the power unit. An output push-pull transformer is mounted alongside the loud speaker.

Kellogg Model 523

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R.F.	2.4	128	1	1	40	1.2	----	----
224	2 R.F.	2.4	128	1	1	40	1.2	----	----
224	3 R.F.	2.4	128	1	1	40	1.2	----	----
227	Det.	2.3	128	12	12	....	1.2	----	----
227	Vol. Con.	2.3	24	1	40	....	..	----	----
227	1 A.F.	2.3	128	8	8	....	4.4	----	----
245	P.P.	2.2	228	40	....	....	28	----	----
245	P.P.	2.2	228	40	....	....	28	----	----
280	Rect.	4.6	....	....	....	....	100	----	----

Line voltage, 112. Volume control full on.

Fig. 1. Operating voltages on the Kellogg 523 receiver are those shown in this table as taken with a Jewell set analyzer

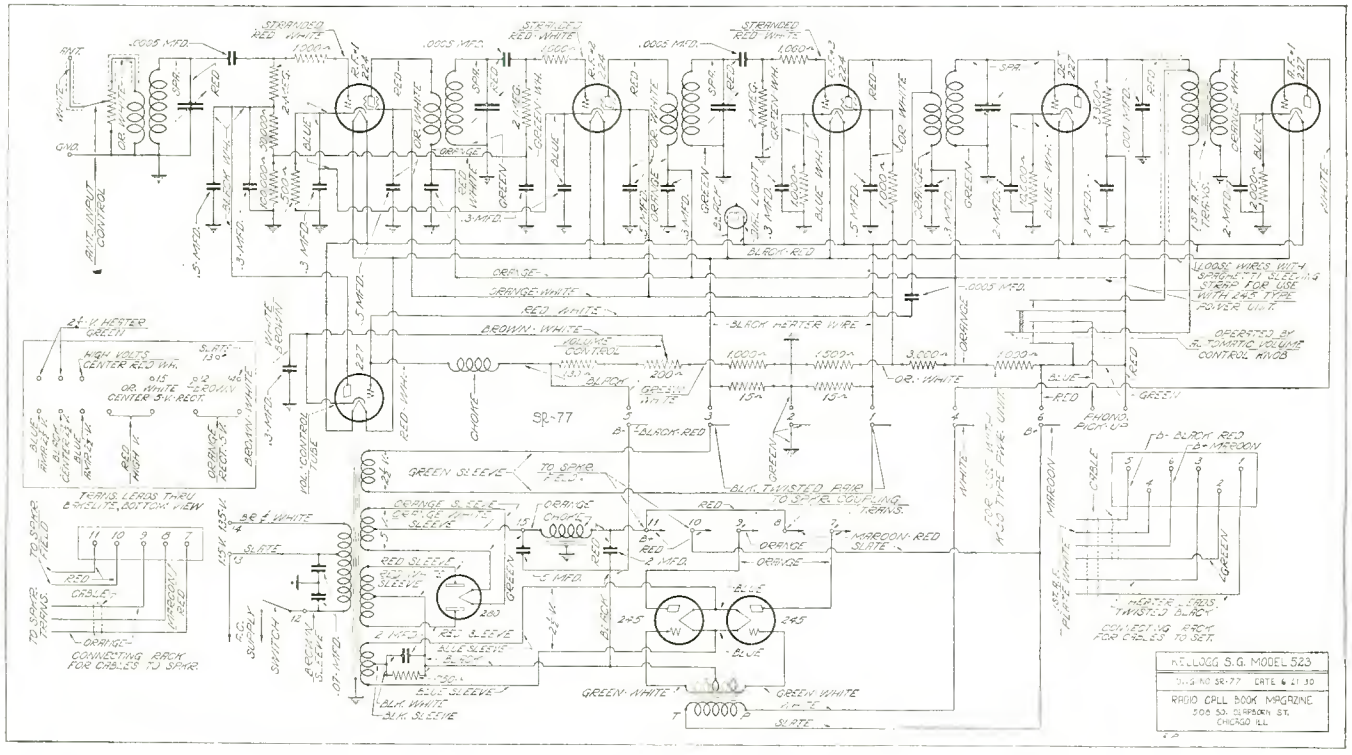


Fig. 2. The electrical details of the receiver and power supply for the Kellogg models 523 to 528 inclusive are shown in this drawing

Colonial Models 33-34 AC

IN the Colonial models 33 and 34 a.c. illustrated schematically on this page, a band pass filter precedes the two screen grid r.f. stages, giving a substantially flat topped resonance curve and precluding the possibility of distortion due to sideband cutting.

Automatic Coupling

The coupling system used keeps the coupling automatically at the optimum value for all broadcast frequencies, giving excellent amplification so that the average sensitivity runs around 5 microvolts, as will be seen in the response curves published on this model in the September issue, page 66.

Inductive Volume Control

An inductive volue control is used, its operation being completely free from noise since it contains no contacts nor variable resistor elements. The two models 33 a.c. and 34 a.c. are identically the same electrically, except that model 34 has a more sensitive speaker, capable of finer reproduction. The push-pull output of this model is mounted on the speaker frame instead of in the receiver chassis, as is the case with the 33. These models can be had with and without the remote control automatic tuning unit. This unit can easily be installed in these receivers not having it as an integral part. It does not interfere with the manual operation of the receiver if that is desired.

Colonial Model 33-34 A.C.

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R.F.	2.5	180	3	----	90	3.	----	----
224	2 R.F.	2.5	180	3	----	90	3.	----	----
224	Det.	2.5	150	2	----	35	.2	----	----
227	1 A.F.	2.5	100	6	----	----	3.	----	----
245	P.P.	2.5	240	45	----	----	28.	----	----
245	P.P.	2.5	240	45	----	----	28.	----	----
280	Rect.	4.8	-----	----	----	----	50	----	----

Line viltage, 120. Volume control.

Fig. 1. The average voltage values found under operatiou iu the Colonial 33 are shown in the above table aud are abstracted from their service manual

Line Compensation

The fuse in the double mounting on the rear of the chassis provides a means of compensating for deviation of line voltage from normal. Normally the fuse is left in the left side of the mounting, facing the rear of the chassis. It should be put in the right side only when the line voltage is known to be consistently below 110 volts. It is important that this adjustment be made since excessive voltage will shorten the life of the tubes and insufficient voltage will make the set insensitive.

A poor detector tube will create an objectionable hum in the speaker. For this reason it may be necessary to try one or more 224's in the detector socket.

Detector Hum

Should it ever be necessary to replace the tuning condensers, or any of the r.f. coils, the tuning condensers will have to be realigned. Service men are cautioned against changing the compensating condenser adjustment unless it has been made necessary by replacement of the tuning condenser or r.f. coils.

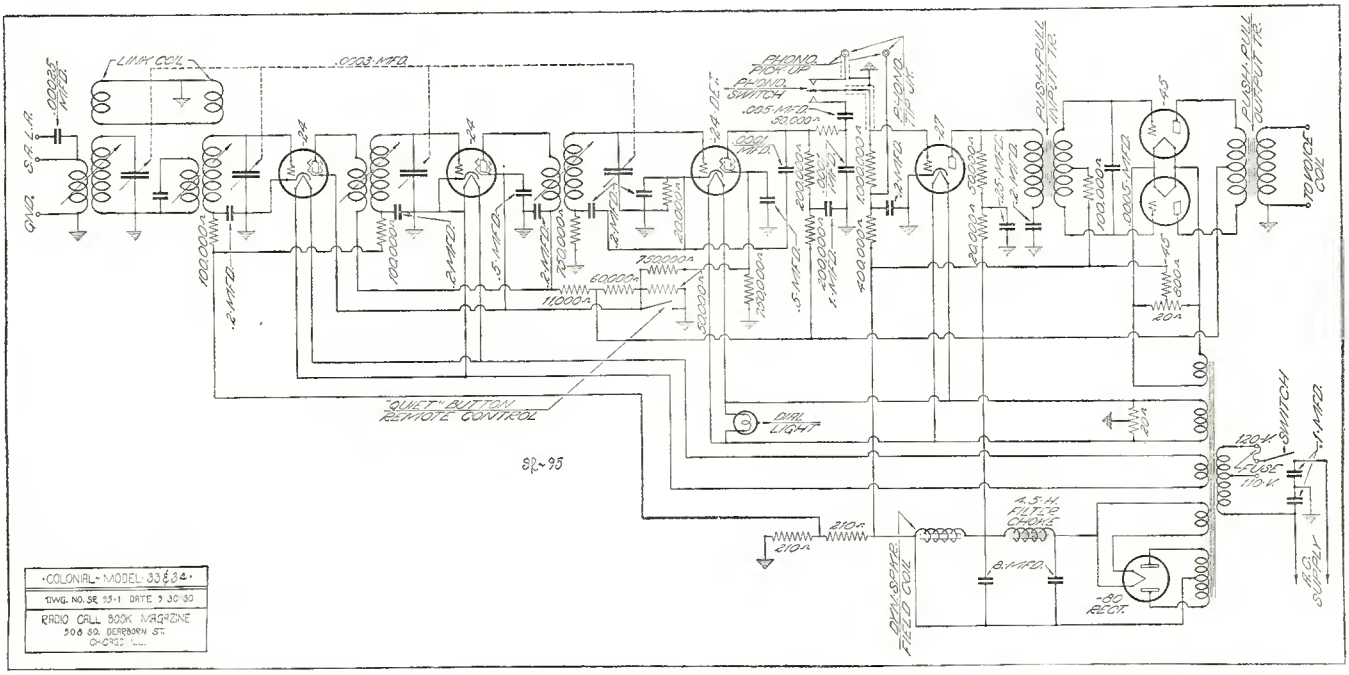


Fig. 2. The electrical details of the Colonial models 33 and 34 are shown in the schematic diagram shown here

Grebe Receiver Model AH 1

SERVICE data covering the Grebe model AH1 whose response curves will be found in the Response Curve section of this issue, is given in this article, together with a schematic diagram of the receiver and a table of average tube operating voltages. the schematic in Figure 2 and the tube data in Figure 1.

Suggested Antenna

The model AH1 will ordinarily give best results with a 50 to 75-foot antenna, erected as high above the noise level is very high very long antennas have given better results than short ones. A good ground connection is highly important. Avoid using radiators for ground connections. Preferably run the ground wire into the basement to the point where the cold water pipe enters the house. In apartments and hotels a ground connection to the steel frame of the building may be more satisfactory than the water pipe nearest the receiver.

Service Calls

The majority of service calls arise from defective tubes. Adjustment of the set should only be made after the service man is certain that all of the tubes are satisfactory. Operating a receiver on a line voltage higher than designed for will result in shortened tube life. A line voltage too low will result in a sacrifice in receiver performance. Always measure the customer's line voltage and make set adjustments accordingly. All sets leaving the factory are adjusted for 60 cycles, 115 to 125 line volts. When line is between 100 and 115 remove the fuse cover by loosening the holding screw and change the two ampere fuse from the 120 to the 110 terminal. The above voltage range is typical of the great majority of installations. For lines from 125 to 135 volts (rare cases) service men should install a Clarostat automatic line voltage regulator, type A, or a Ward Leonard line resistor No. 507,109 G in series with the line. Be sure to remove the ground plug before doing anything to the fuse in order to avoid a shock or a flash due to accidental short to grounded chassis.

Oscillation

If the receiver oscillates, the following should be investigated before adjustments on the set are altered: a good ground connection is essential; the antenna lead should approach the set in the most direct manner possible; the receiver has been designed to operate with maximum efficiency with the Cunningham or RCA tubes and was so adjujsted at the factory. A complete set of new tubes may have higher emission than usual, causing the set to oscillate when the volume control is wide open. However, after several days of aging the emission of the tubes will become normal and the receiver will have stabilized itself without necessity of adjustments to the set.

Loose Brakes

Poor contact between the contact brakes and the rotor of the gang condenser may cause oscillation between 550 and 700 kc. Lift out the brakes from the gang condenser frame and increase the curvature of the bow spring by bending slightly. Under no conditions should oil be used, as this will completely ruin contact.

Grebe Model AH1

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R. F.	2.4	160	2.5	---	80	2.5	---	---
224	2 R. F.	2.4	160	2.5	---	80	2.5	---	---
224	3 R. F.	2.4	160	2.5	---	80	2.5	---	---
227	Det.	2.4	200	20	---	---	2.0	---	---
245	P. P.	2.4	250	14	---	---	50	---	---
245	P. P.	2.4	250	14	---	---	50	---	---
280	Rect.	4.8	---	---	---	---	50	---	---

Line voltage 115. Volume control maximum.

Fig. 1. In this table are given the voltage readings according to a recent measurement made with a Jewell set analyzer

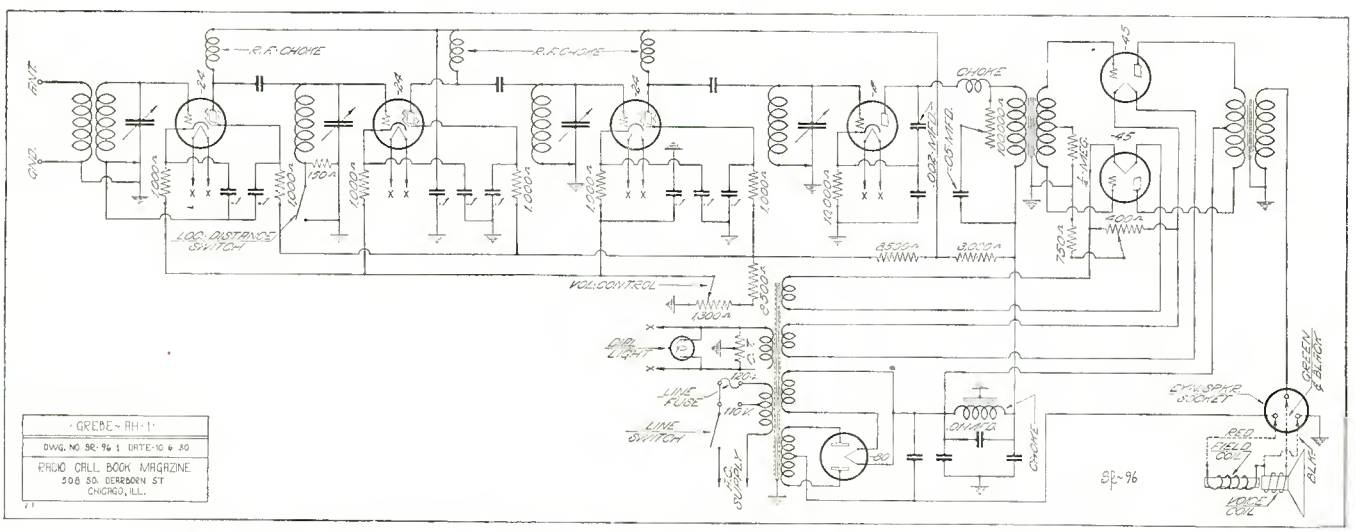


Fig. 2. The schematic diagram of the Grebe AH1 receiver is shown in this illustration

Brunswick Models 15 and 22

RESPONSE curves of the Brunswick models 15 and 22 which are illustrated on this page, appeared in the September, 1930, issue of this magazine on page 68, to which reference should be made for any data concerning sensitivity, selectivity and fidelity.

In this brief article will be found material of interest to servicemen and technicians, much of which is indicated in the manual prepared by the Brunswick Radio Corporation. A table of average tube characteristics appears in Figure 1, while the schematic diagram covering the models 15 and 22 is shown in Figure 2.

Hum

Under general service data we find in the case of hum that it may be traced directly to a gassy or otherwise defective detector tube. Try each of the –24's in the detector socket (the one nearest the cabinet) and use the tube having least hum. Excessive hum may also be encountered by a poor or entire lack of ground connection. Try reversing the house lighting plug. Other and more severe causes of excessive hum may be due to a shorted filter choke, defective center tap filament resistor, leaky, open or shorted filter condensers, or an open detector screen grid by-pass condenser.

Oscillation

Oseillation may be caused by an open radio frequency by-pass condenser.

Brunswick Models 15-22

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R. F.	2.5	178	2.5	2.5	60	2.2	----	----
224	2 R. F.	2.5	178	2.5	2.5	60	2.2	----	----
224	3 R. F.	2.5	178	2.5	2.5	60	2.2	----	----
224	Det.	2.5	180	----	8	24.3	.36	----	----
245	P. P.	2.5	242	12	----	----	30	----	----
245	P. P.	2.5	242	12	----	----	30	----	----
280	Rect.	4.8	385	--	--	----	40	----	----

Line voltage 110, fuse clip in 120 volt. Volume control maximum.

Fig. 1. Data appearing in the service manual is used to compile the above table of average operating values for use by the serviceman in checking the receiver

The connections to these parts should be thoroughly inspected. An open condenser may be easily found by connecting with two short pieces of wire a .5 mfd condenser (known to be good) across the terminals of the condenser under suspicion. This should be done with the set turned on, adjusted to oscillate and with the chassis in an inverted position with the bottom plate removed so that the testing condenser may be momentarily applied across each of the r.f. by-pass condensers. A defective condenser is indicated when the test stops or reduces oscillation. Other causes of oscillation are: r.f. tube shield making poor contact with inter-tube sheilds or chassis; leaky or shorted detector grid bias by-pass condenser, or poor contact of gang condenser grounding springs on the rotor shaft.

Other Trouble

Complete absence of any sound in the speaker would indicate the possible source of trouble is in any one of the following points: antenna connections shorted to chassis; defective r.f. coil or plate choke; short circuited by-pass or filter condenser; defective output transformer or speaker voice coil, and defective volume control.

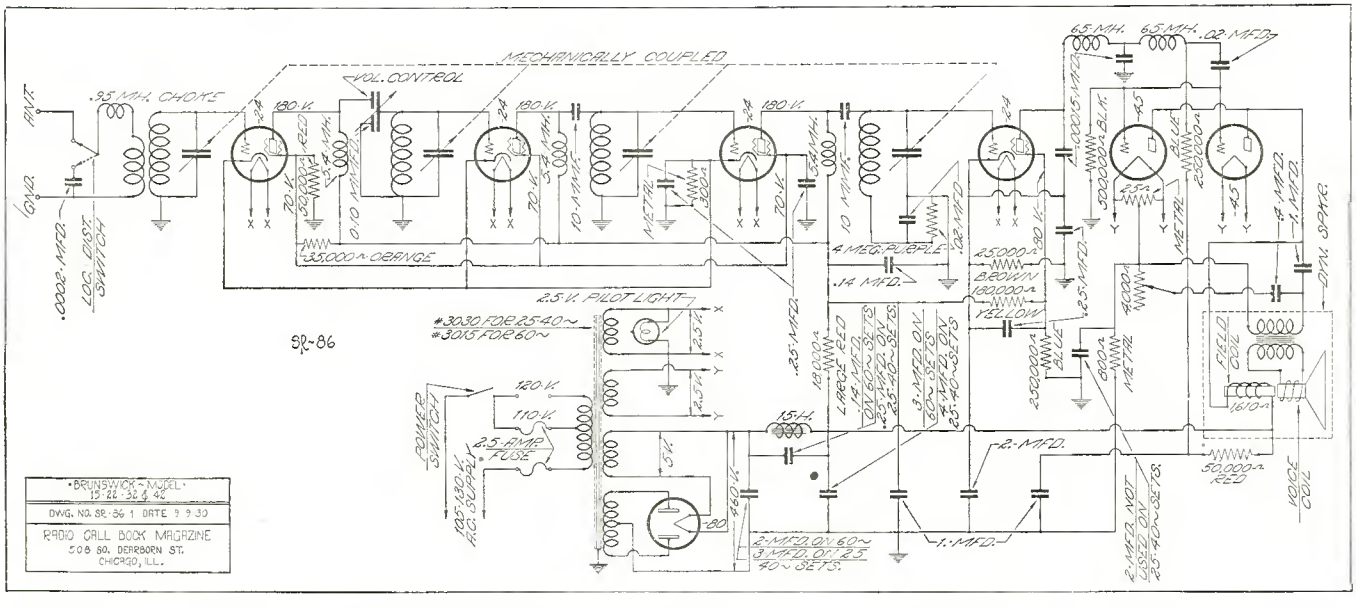


Fig. 2. In this diagram may be seen the schematic details of the models 15 and 22 made by Brunswick. Note in particular the type of volume control which is unique

Edison Receiver Models R4, R5, C4

EDISON receiver models R4, R5 and C4, the schematic diagram of which is shown in Figure 1 on this page, consist of three tuned, neutralized r.f. stages, a tuned input, grid leak and condenser detector, a conventional first audio amplifying stage, a pushpull second audio stage feeding a dynamic speaker, a full wave rectifier and its filter system supplying plate current to the entire receiver and excitation for the dynamic speaker field; and alternating current heater and filament supply for all the receiver. All models are equipped with a switch for transfer of the audio amplifying system to use for phonograph reproduction, pin jacks being provided for the connection of a high impedance magnetic pickup.

Edison Models R4, R5, C4

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
227	1 R.F.	2.35	114	6	6	....	5.6	8.2	....
227	2 R.F.	2.35	114	6	6	....	5.6	10	....
227	3 R.F.	2.35	114	6	6	....	6.2	10.5	....
227	Det.	2.35	28	....	....	....	2.0	....	....
227	1 A.F.	2.35	112	6.5	7	....	3.7	5	....
245	P.P.	2.35	250	46	....	....	27.5	32	....
245	P.P.	2.35	250	46	....	....	27.5	32	....
280	Rect.	4.0	....	....	....	....	50.4	....	....

Line voltage, 105. Volume control, maximum.

Constant Gain R. F.

It will be noted the r.f. amplifying circuit uses a constant gain system where two primaries are used in each r.f. transformer, one resonated below and one above the broadcast frequency spectrum. These four r.f. transformers are identical, the secondaries being tuned with equal tuning condensers sections. Stabilization of the r.f. amplifier is accomplished with grid circuit neutralization.

Stability Controlled

Substantial resonance of the first r.f. input circuit to the resonant frequency of the second and third r.f. and the detector circuits is maintained by holding the effective ground-antenna capacity to a value of less than 100 micro microfarads. Antenna of less than this capacity goes on the binding post marked "antenna" whereas antennas of greater than this capacity should be connected to the post marked "long antenna." The latter connection places a condenser in series with the antenna-ground capacity, reducing the effective value of the latter to less than 100 micromicrofarads for antenna capacities up to 500 micromicrofarads.

Dual Volume Control

The volume control is a dual arrangement controlling antenna input with the resistance section shown at the left in the diagram, and the grid bias for the second and third r.f. stages with the section shown at the right in the schematic.

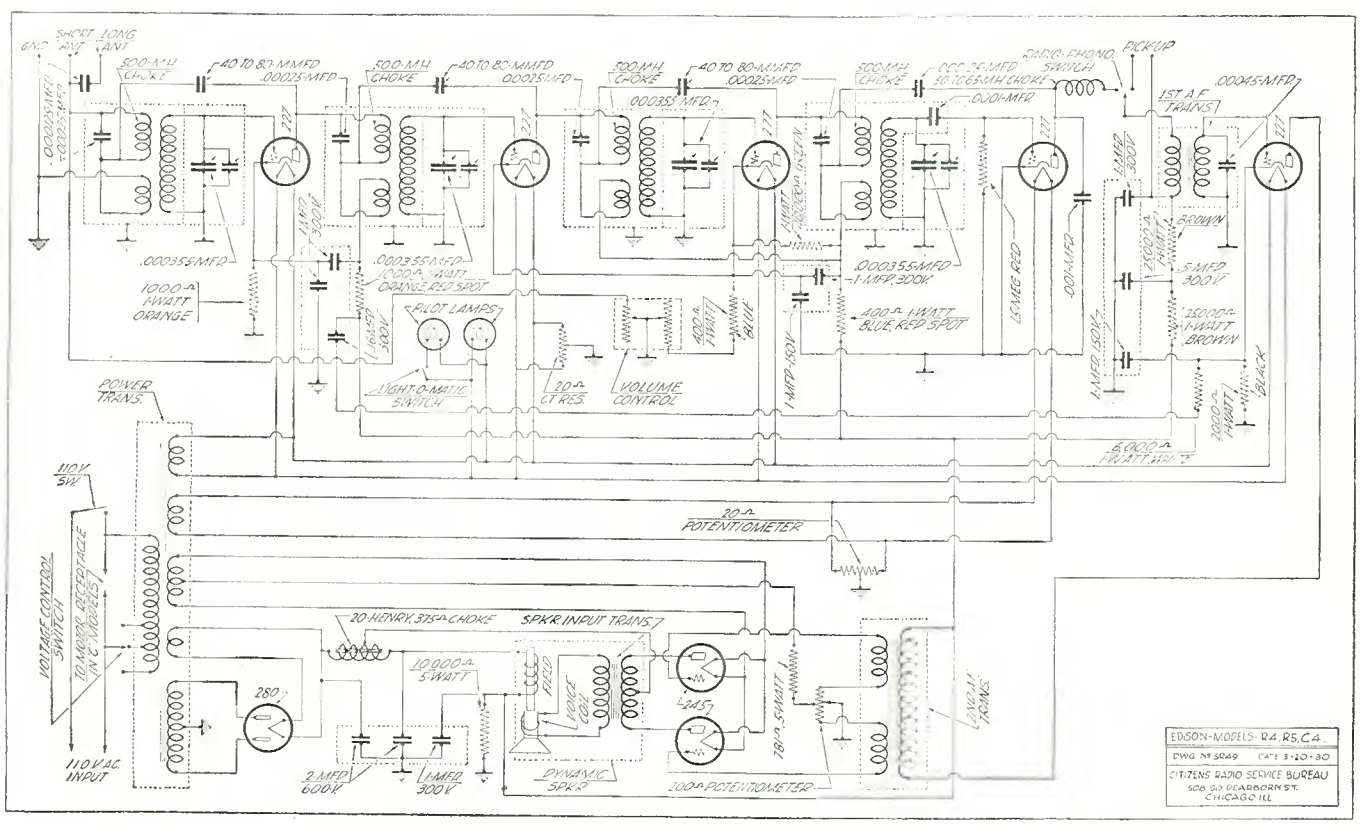
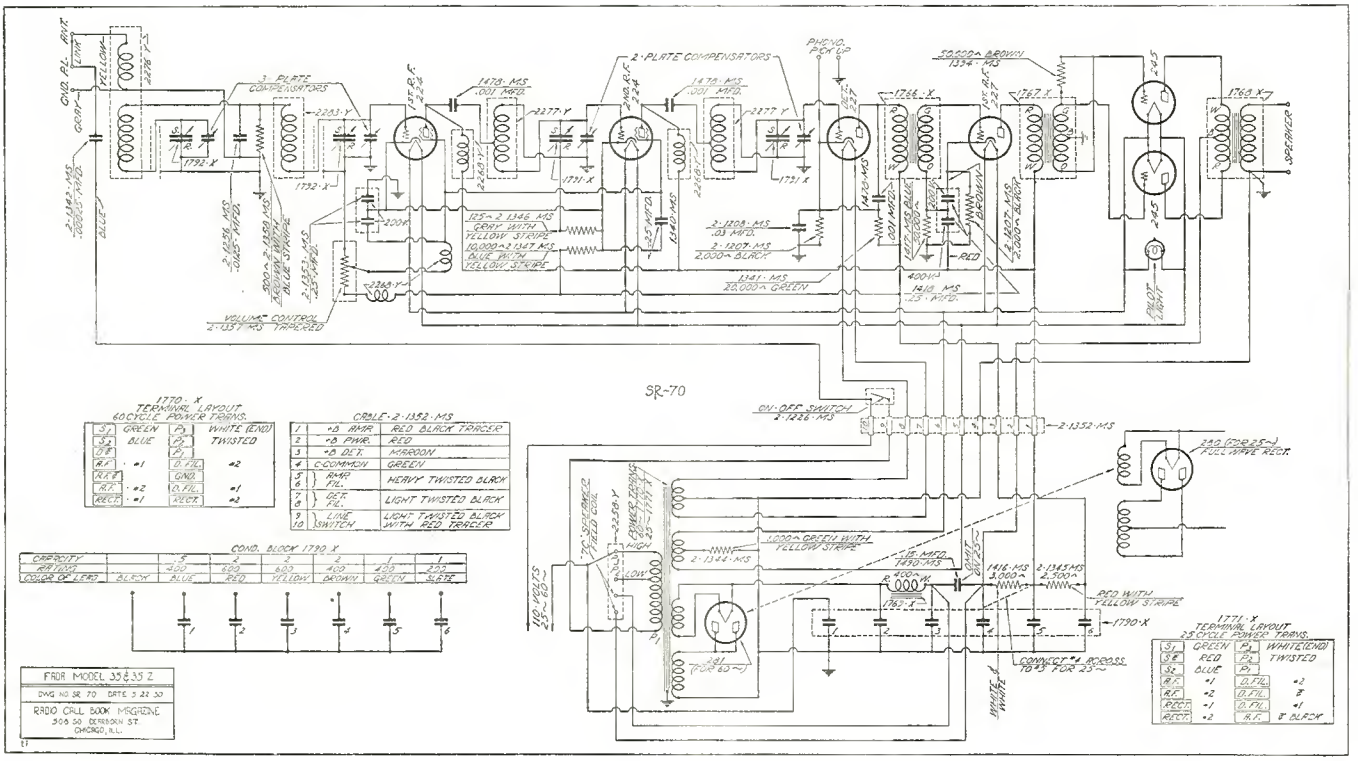
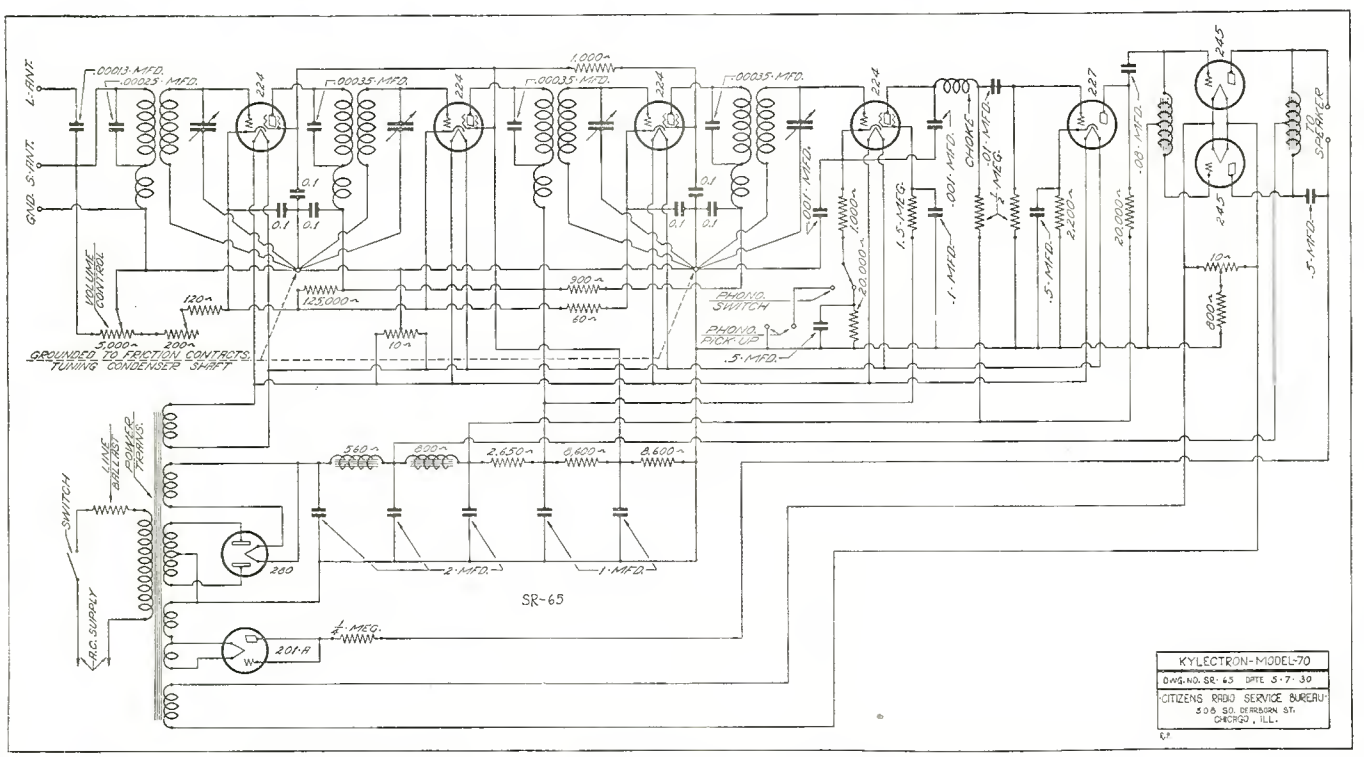


Fig. 1. In this illustration is shown the schematic diagram of the Edison receiver models R4, R5 and C4

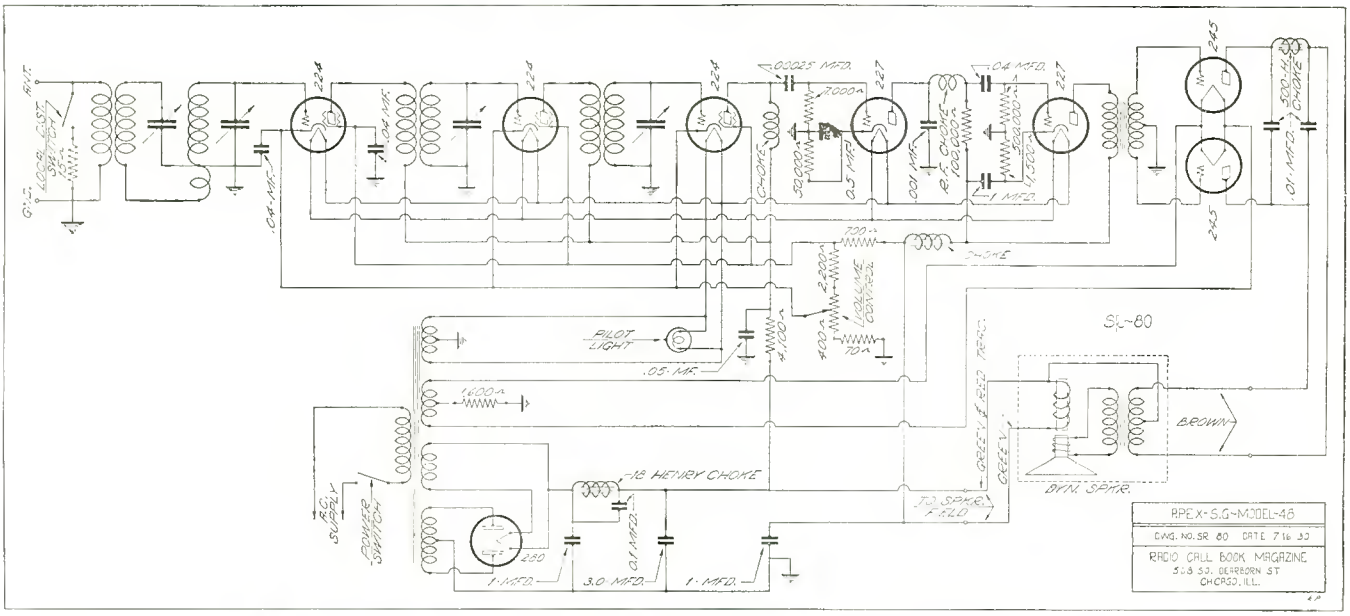
Fada Radio Models 35 and 35Z



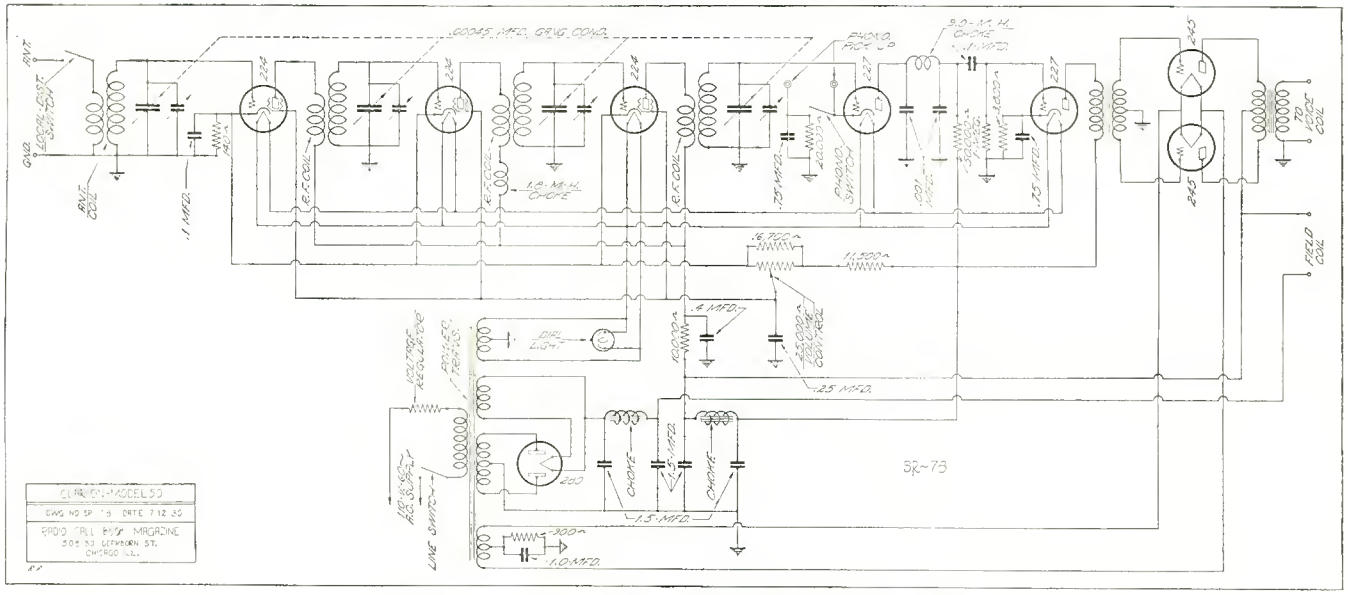
Kylectron Radio Model 70



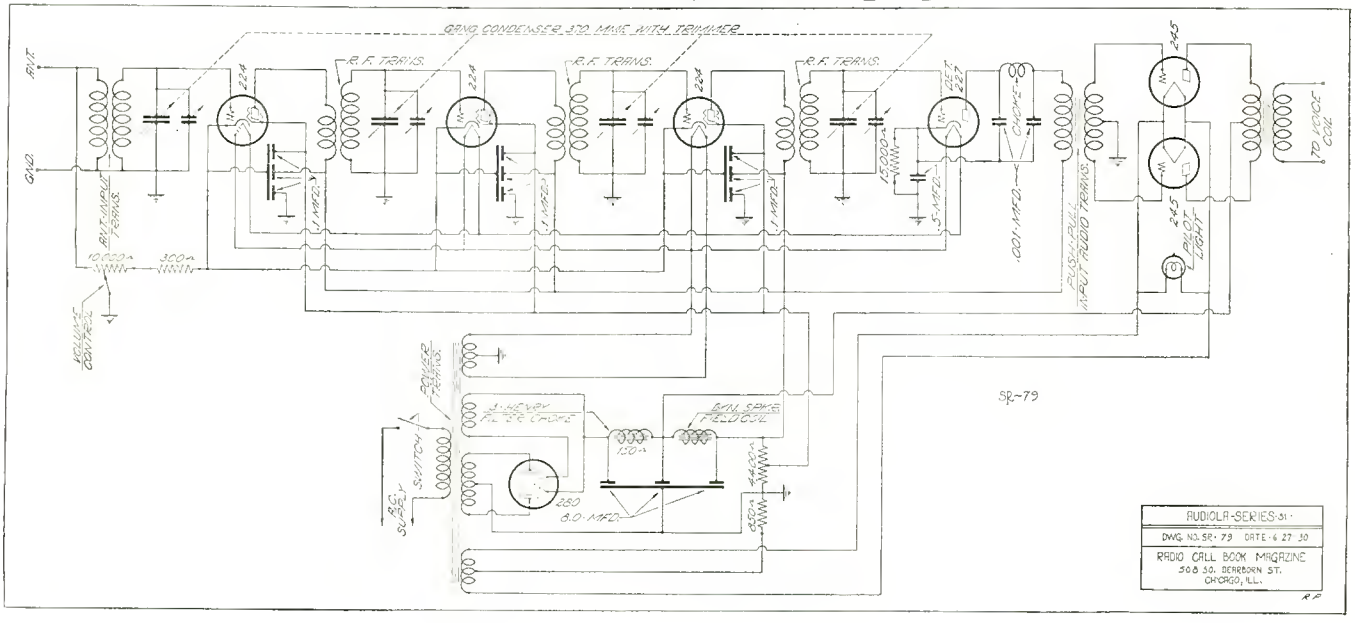
APEX S. G. MODEL 48



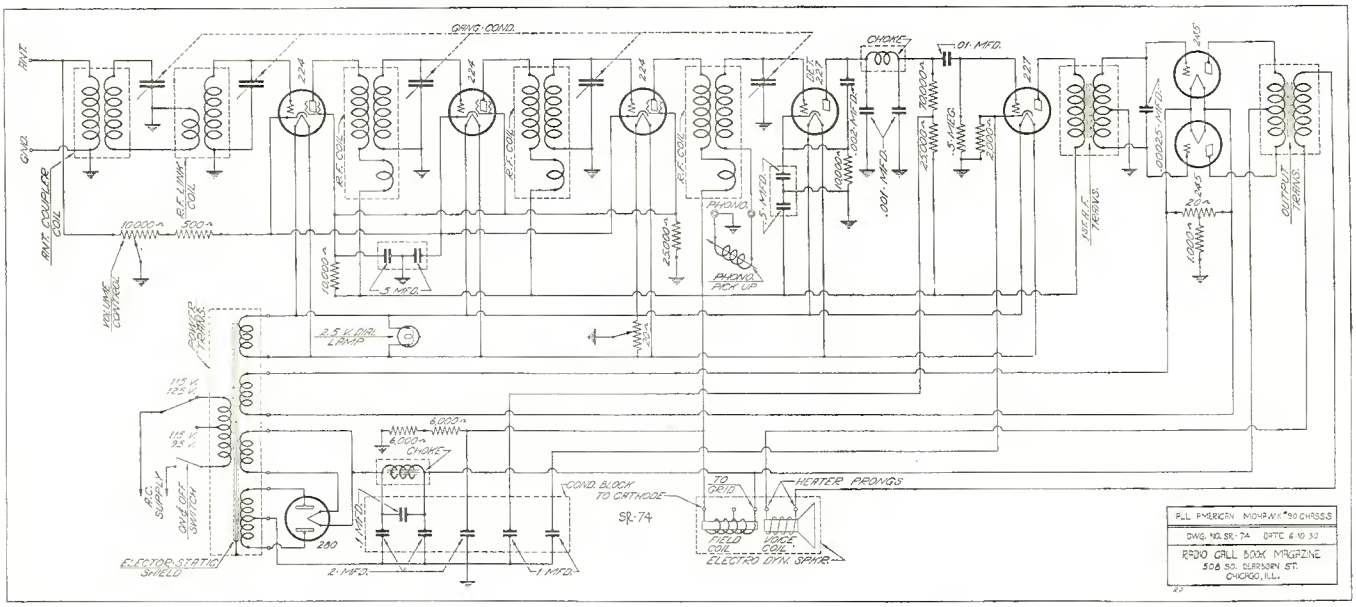
T. C. A. CLARION MODEL 50



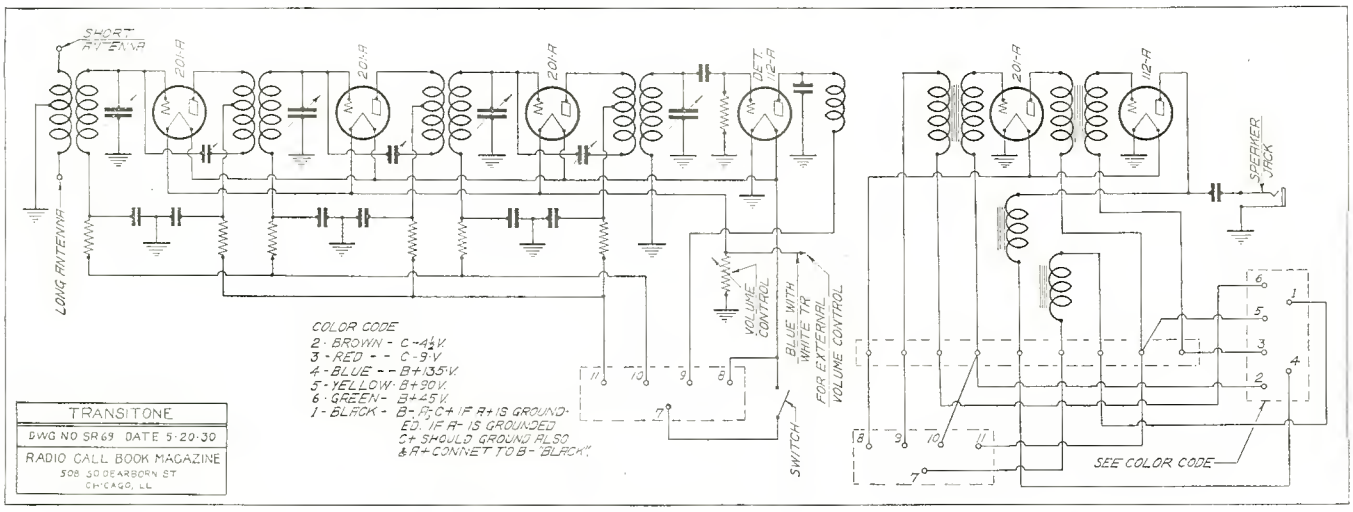
AUDIOLA SERIES 31



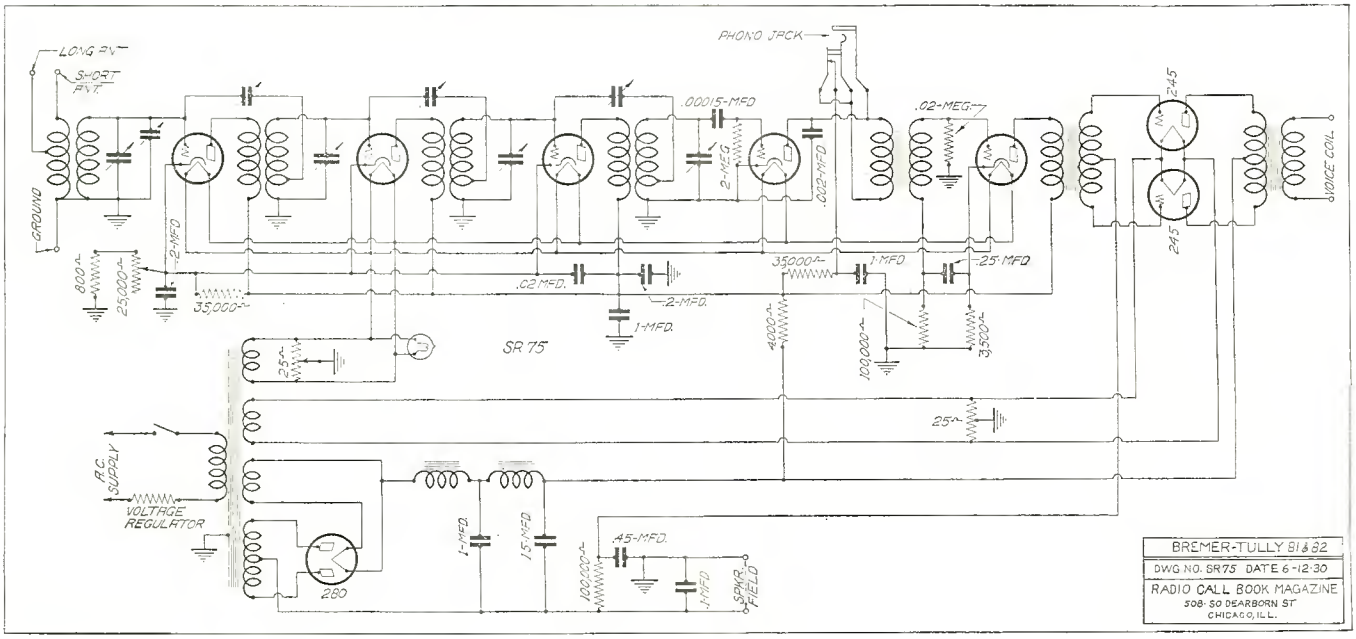
ALL AMERICAN-MOHAWK 90



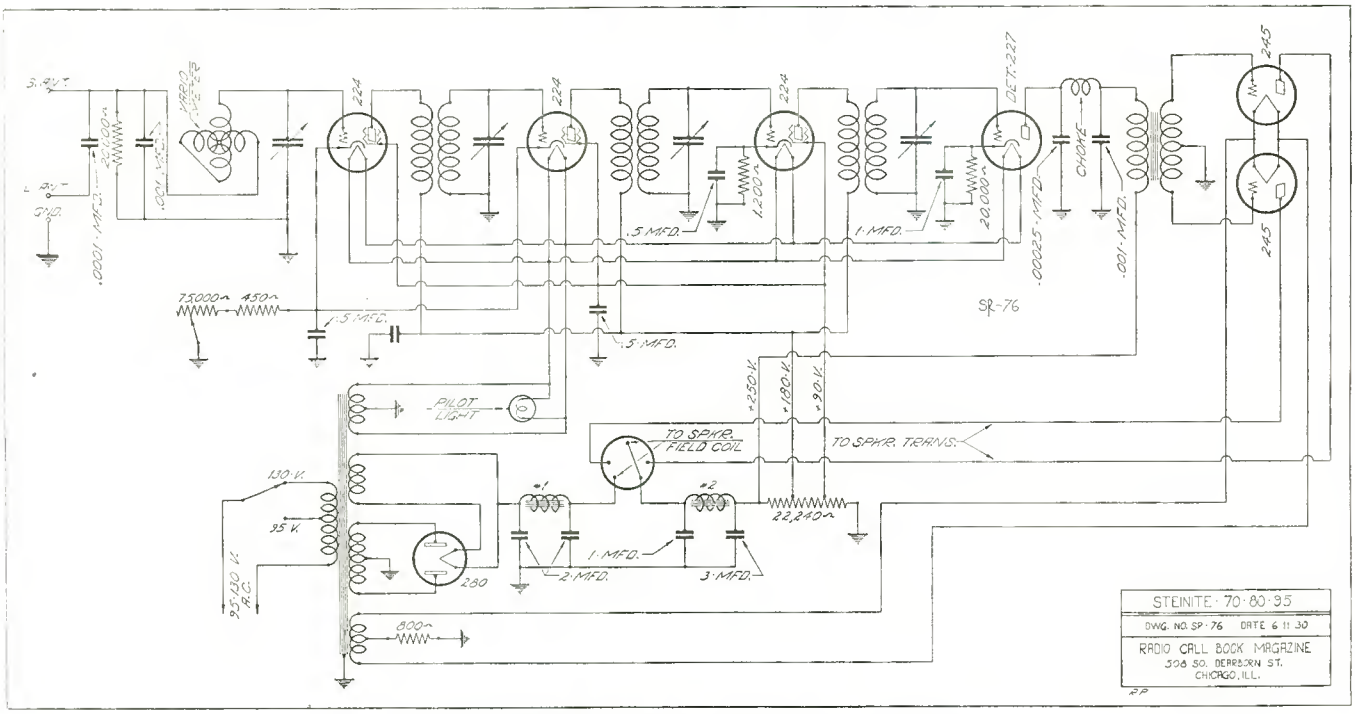
TRANSITONE AUTO RADIO



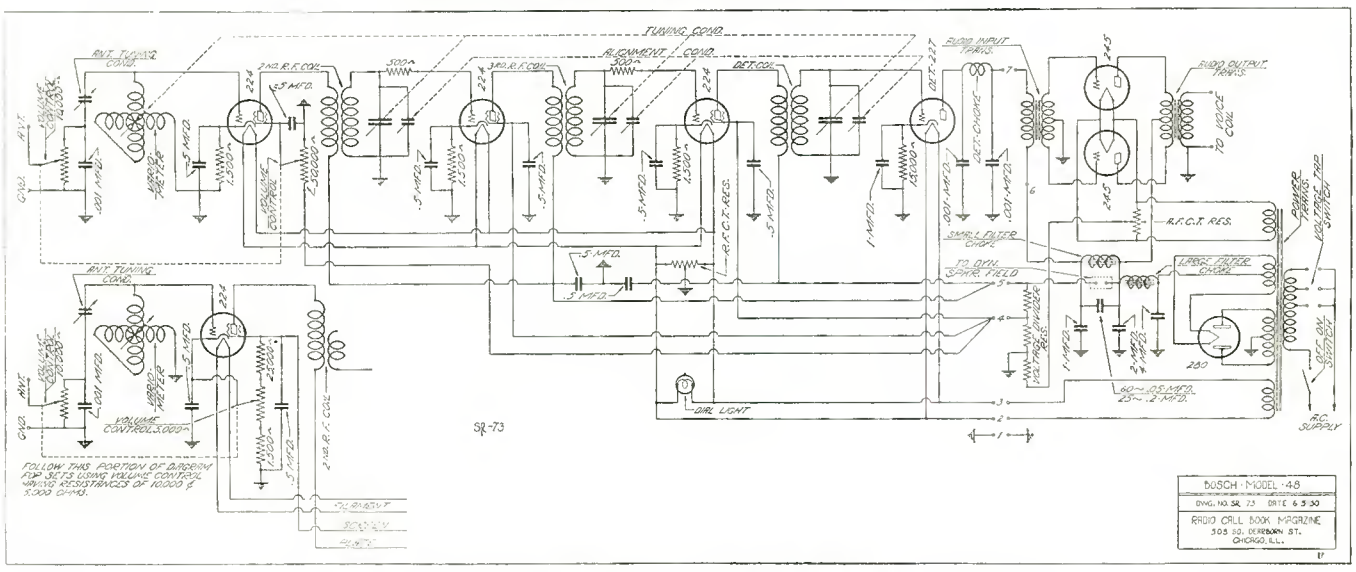
BREMER-TULLY 81 and 82



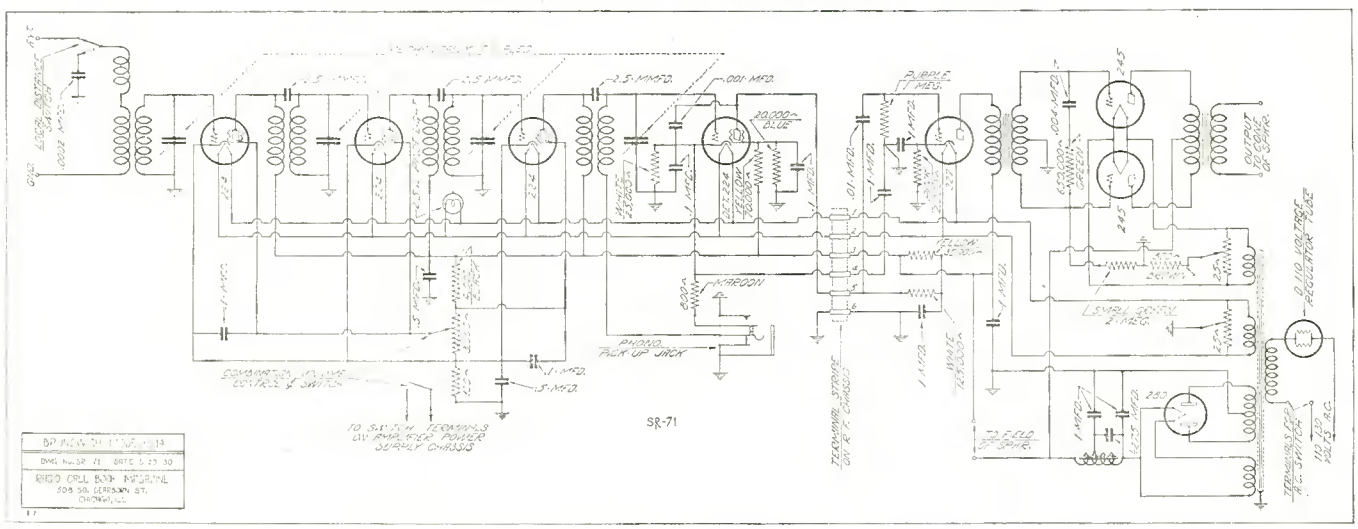
STEINITE MODELS 70, 80, 95



BOSCH MODEL 48



BRUNSWICK MODEL S14



Schematic of the General Motors Set

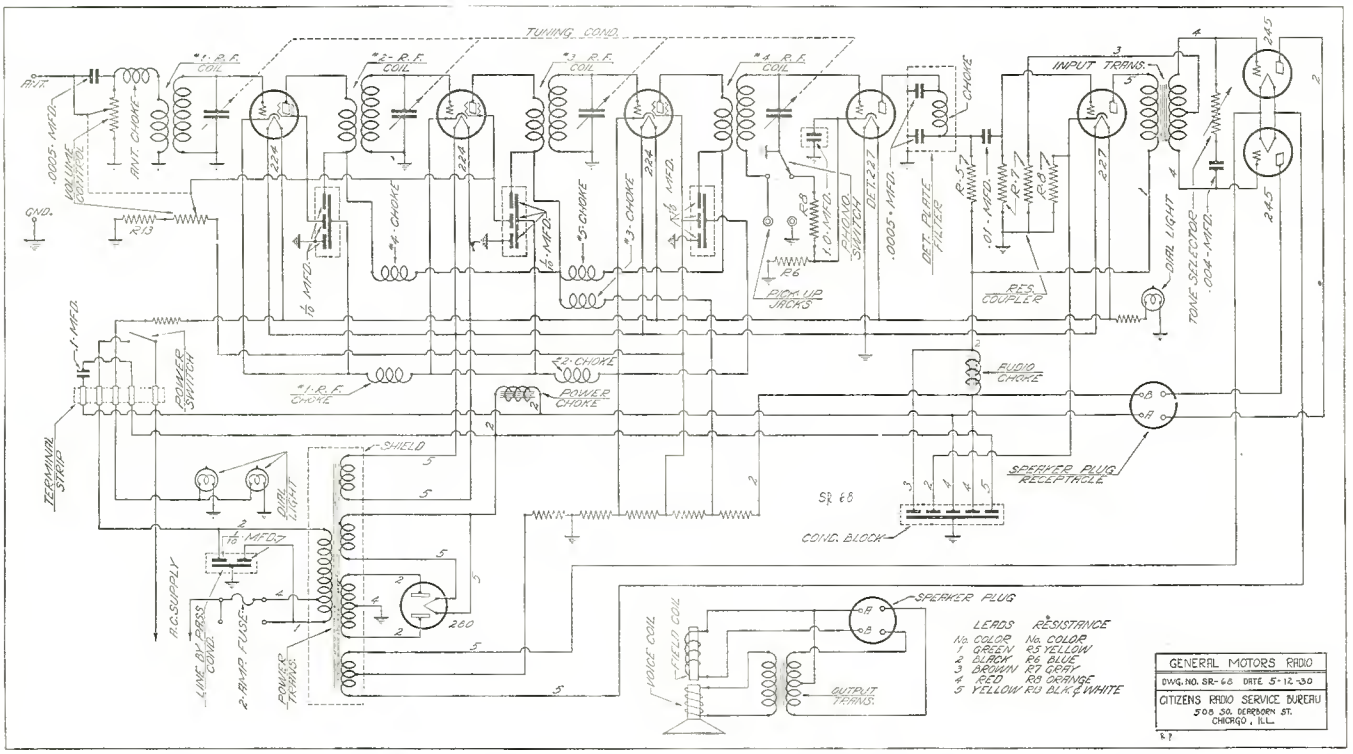


Fig. 2. Details of the General Motors radio set recently announced are shown schematically in the diagram above

Circuit Diagram of Bosch Auto Radio

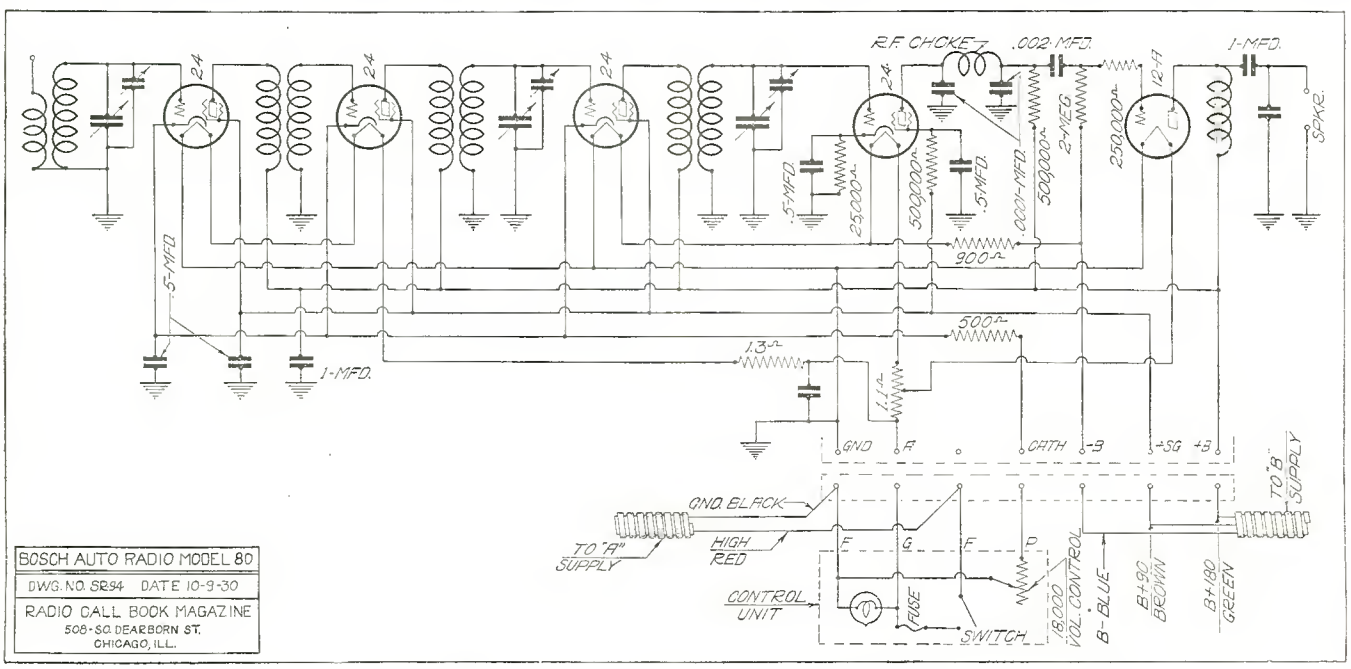
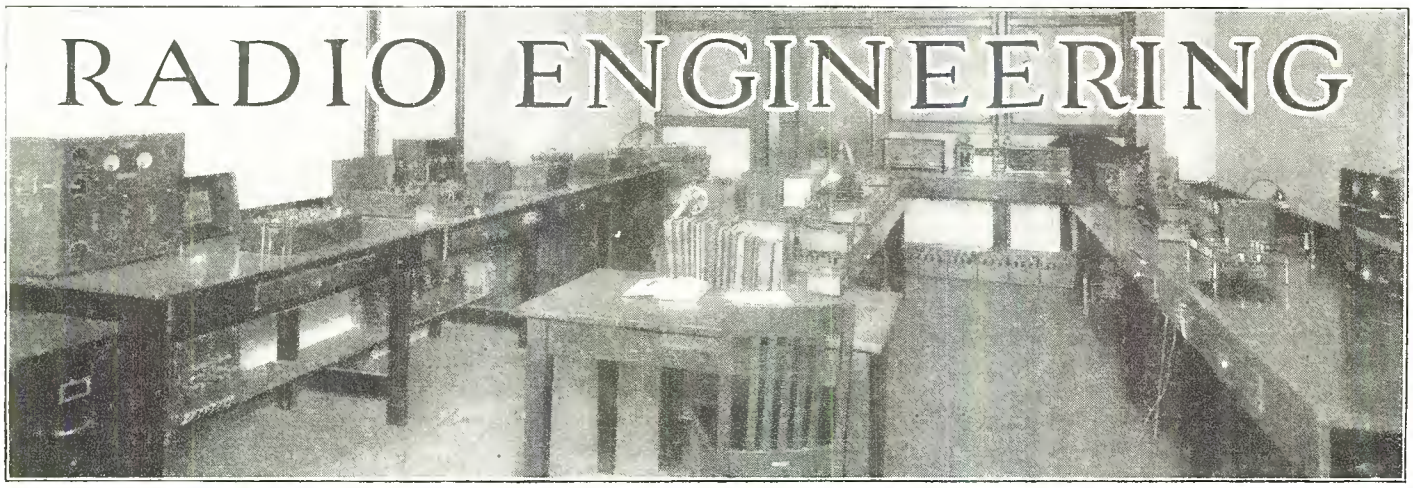


Fig. 1. In this drawing are the electrical details of the Bosch auto radio model 80



Rectifier Type Instruments

By W. N. Goodwin, Jr.
Chief Engineer, Weston Electrical Instrument Corp.

General

THIS type of instrument is used principally for the purpose of measuring alternating currents of such small magnitude that they cannot be measured readily by means of the ordinary types of A.C. instruments such as thermal, soft iron and electrodynamometer types.

It is also useful where accuracy is not of so much importance as ruggedness and ability to withstand heavy overloads without damage.

Construction

It consists of a sensitive direct current permanent magnet movable coil instrument used in connection with a rectifier made of four sets of copper oxide discs arranged in the four arms of a Wheatstone bridge circuit, the instrument being connected as the usual galvanometer in the bridge circuit. The copper oxide discs are so arranged that both halves of the A.C. wave pass through the instrument in the same direction as shown in the sketch.
cut coming

Principle of Operation

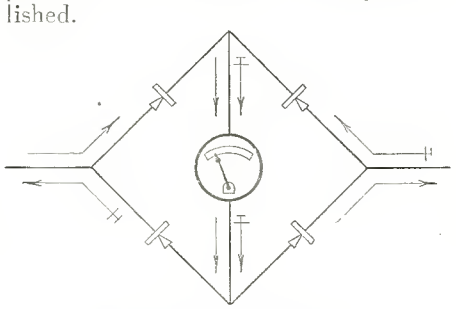
As stated above, each half of the A.C. wave is rectified and passes through the instrument in the same direction, and since the instrument is a permanent magnet movable coil type the indications are proportional to the simple average value of the wave, and not to the squares of instantaneous values as is the case in A.C. instruments of the ordinary type, which are universally calibrated in root mean square values (R.M.S.).

As it is very desirable, however, to measure alternating currents in the conventional R.M.S. values, the rectifier instruments are calibrated by using an alternating current having a pure sine wave shape, and the scale figured in R.M.S. values.

It is obvious, therefore, that if the alternating current to be measured has any other shape than sinusoidal, errors will result, since the relation existing between R.M.S. and average values for sine waves in general is quite different from the corresponding relation for other wave shapes. This and other sources of error will be considered below.

Accuracy

The principal sources of error in the rectifier type instrument are temperature, frequency, wave form, and the fact that the resistance of the rectifier varies with the amount of current passing through the discs. In addition to these, there may be permanent changes which may take place in time, but which experience thus far has not fully established.



Temperature Errors

Errors due to temperature changes depend upon the resistance of the circuit and upon the current passing through the rectifier. In voltmeters this is equivalent to stating that temperature errors depend upon the range in volts and upon the resistance in ohms per volt.

Temperature errors are the result of two changes which occur in copper oxide, when the temperature increases the rectifying property, diminishes, or stated technically, the rectification ratio is reduced, and at the same time the resistance of the rectifier is reduced. These two effects are in opposite directions upon the instrument indications, and fortunately, in most practical instances, actually neutralize each other near room temperature.

For voltmeters of the usual resistance of 1000 or 2000 ohms per volt, and for ranges from 1.5 to 20 volts, if used between temperatures of 18 deg. C. and 35 deg. C. (64 deg. F. to 95 deg. F.), errors due to temperature alone will probably not exceed 2 per cent.

For ranges above 20 volts, and for milliammeters, the temperature range may be 18 deg. C. to 30 deg. C. (64 deg. F. to 86 deg. F.) without exceeding an error of 2 per cent.

As the temperature effects increase rapidly for temperatures outside the above limits, it is very desirable to make all measurements within the temperatures stated.

These errors are of course in addition to the usual scale calibration and adjustment errors.

Frequency Errors

Up to 35,000 cycles per second the instrument indications decrease at a substantially uniform rate of approximately ½ of 1 per cent for each 1000 cycle increase in frequency. For example, at 4000 cycles per second the instrument would indicate $4 \times \frac{1}{2} = 2$ per cent low.

Current Density Errors

The resistance of a given rectifier depends upon the magnitude of the cur-

rent passing through it, or in other words, upon the voltage drop across it. The resistance increases as the current density or voltage drop decreases. An instrument, therefore, has a lower resistance for full scale current or voltage than at any lower part of the scale.

In voltmeters, this resistance change is calibrated in the scale and, therefore, results in no error as far as the instrument indications are concerned. However, since the resistance changes, the instrument acts as a varying load on the circuit tested and if the circuit has a relatively high resistance, the instrument resistance variations may affect the terminal voltage in the circuit being tested, although the instrument will correctly measure the actual voltage applied to its binding posts.

When a rectifier type milliammeter is connected in a circuit, it affects the circuit conditions on account of its added resistance like any other type of instrument except that the effect depends upon the magnitude of the current passing, and the error will depend upon the total resistance of the circuit including the instrument, and also upon the current, that is, upon the scale indication.

For example, the rectifier usually used in a 500 microampere instrument of the 3½ inch size (Model 301) will have a resistance of approximately 710 ohms including the D.C. instrument at full scale, 500 microamperes, and 1540 ohms at 0.3 scale or 150 microamperes.

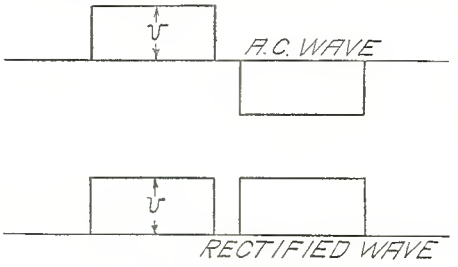
If the circuit resistance is relatively very high then this change will result in negligible errors. If, however, the circuit under test has a low resistance, say 1000 ohms, then the total circuit resistance for a current of 500 microamperes would be 1000 + 710 = 1710 ohms and the current indicated will be 1000/1710 × 100 = 58.8 per cent of that which would have resulted if the instrument had not been in circuit. For a current of 150 microamperes, the circuit resistance would be 1000 + 1540 = 2540 ohms and the current indicated is, therefore, 1000/2540 × 100 = 39.4 per cent of that which have resulted had the instrument not been in circuit.

It must be remembered, however, that the instrument correctly indicates the actual current passing at any time, but the magnitude of this current depends partly upon the presence of the instrument in the circuit, as in the case of any other type of milliammeter.

Another effect produced by the varying resistance of the rectifier is to slightly distort the wave form of the current in the circuit, which may cause a slight error.

As a guide in estimating the effects of the varying resistances of the rectifier type instrument, the following tabulated values are given for Model 301 instruments:

Range	Approx. Res. at Full Scale Ohms	Approx. Res. at 0.3 Scale Ohms
500 Microamperes	710	1540
1 Milliampere	440	930
2 Milliamperes	290	590
5 Milliamperes	180	325



Wave Form Errors

As stated above, since a D.C. instrument is used, the rectifier type instrument actually measures the average values of the rectified wave.

The conventional manner of designating alternating currents or voltages is to state them in terms of their root mean square (R.M.S.) or effective values, for the reason that the ordinary A.C. instruments indicate three values, and power is proportional to these values.

For this reason, rectifier instruments are calibrated with currents or voltages having a sinusoidal wave form and the scale is figured in R.M.S. values. It is obvious, therefore, that the instrument indicates eorrectly only if the currents or voltages measured have sine wave shapes. For other wave shapes errors will result, of varying magnitudes depending upon the variation from the true sine wave shape.

As a simple illustration to show the possible magnitude of errors due to wave form, consider the rectangular wave shown in the sketch below. This shape of wave is that which would be produced by commutating the voltage of a battery or other D.C. source.
cut coming

From simple inspection it is seen that the maximum, R.M.S. and average values of the rectified wave are all equal and equal to v.

If, however, a voltage of this wave form is measured on the rectifier instrument it will indicate the R.M.S. value of a pure sine wave which has the same average value v that the actual wave has. Now it is well known that the R.M.S. value of a sine wave, whose average value is v, is 1.11 v so that the instrument will indicate about 11 per cent too high for this wave form.

Any wave form can be expressed as the sum of a series of pure sine waves consisting of a fundamental and of harmonics, each harmonic having frequencies of 2, 3, 4, 5, etc., times the fundamental frequencies.

Pure A.C. waves can consist of the odd harmonics only, 3, 5, 7, etc.

For example, the above rectangular wave consists of a fundamental wave of a magnitude of say 100 per cent, and the following series of harmonics, 33⅓ per cent third, 20 per cent fifth, 14.3 per cent seventh, etc.

The errors produced by distorted wave shapes depend not only upon the magnitude of the harmonic, but upon its phase relation. The effective or R.M.S. value of any distorted wave is equal to the square root of the sum of the squares of the R.M.S. values of the fundamental and each harmonic, that is

$$V = \sqrt{v_1^2 + v_3^2 + v_5^2 + \ldots}$$

whereas the average value of a rectified distorted wave is the average value of the fundamental plus or minus the value of each harmonic averaged over a half fundamental cycle, depending upon the phase.

The following tabulated values give some idea as to the magnitude of errors produced in measuring distorted wave shapes.

Harmonic	Magnitude in Per Cent of Fundamental	Phase Displacement	Ratio of Indication to True R.M.S. Value
3rd	10	180	0.961
3rd	20	180	0.927
3rd	30	180	0.862
3rd	33 1/3	180	0.840
3rd	33 1/3	0	1.052
5th	10	180	0.970
5th	20	180	0.943
5th	30	180	0.900
3rd & 5th	30 & 30	0 & 0	1.063
3rd & 5th	30 & 30	0 & 180	0.952
3rd & 5th	30 & 30	180 & 0	0.877
3rd & 5th	30 & 30	180 & 180	0.775

Conclusion

It is quite evident from the above discussion that among the errors which may be encountered in the use of rectifier type instruments, those resulting from wave form are the most serious.

There is also the possibility that a permanent change may take place in time in the copper oxide itself, but observations to date indicate that such changes are small, probably of the order of 1 per cent or less.

In general it may be stated that if the instrument is used on wave forms closely approximating sine waves, such as found on lighting circuits, and if used at room temperature, the indications may be relied upon to within about 5 per cent of full scale value. Errors due to frequency can be corrected.

Power Line Telephony

A BULLETIN describing and listing the Dubilier Type 670 coupling condensers for power line telephony, has been issued by the Dubilier Condenser Corporation, 342 Madison Avenue, New York City. The bulletin covers the capacities, prices, number required in series for different line voltages, and other details.

Symposium, Audio Amplifier Measurements

IN order to get a definite expression from audio amplifying system manufacturers regarding their choice of the methods of measurement for public address and other audio amplifying systems, our editorial department addressed letters and telegrams to ten of the manufacturers most likely to be interested in this subject.

Our desire in this matter was to adopt a standard method of measuring these amplifiers in our laboratory, so that results would be as nearly in accord with the majority opinions of the manufacturers.

Up to the time of going to press all had replied except three. The statements of those who replied are printed in this article, while the chart shown on this page indicates their views for quick reference.

As soon as the laboratory has reconciled all views and added its own, measurements on public address amplifiers will be made in accordance with the standards thus adopted. The January issue of this publication will contain a number of amplifier measurements made under the conditions set by that time, and the data secured from such measurements will undoubtedly be interesting.

The replies were made on the basis of manufacturers' preference for the measurement methods outlined below:

1—Constant input
2—Variable input
3—Decibel plotting
4—Percentage plotting
5—Decibel and percentage plotting
6—Fifty milliwatt output level
7—One watt output level
8—Maximum undistorted output level
9—Preferred input voltage

The following statements were received from those shown below:

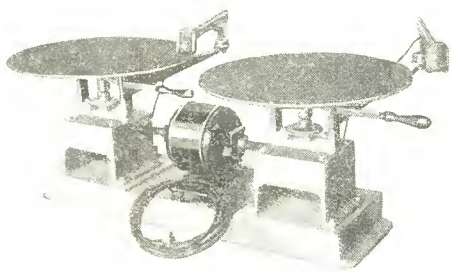


Fig. 1. This is a motor drive, clutch operated duplex phonograph turntable designed by Doolittle and Falknor for use in broadcasting stations. Each table is provided with its own tone arm

Audio Amplifier Symposium Data

Participants	1 Constant Input	2 Variable Input	3 Decibels	4 Percentage	5 Decibels and Percentage	6 50 Milliwatts	7 1 Watt	8 Maximum Undistorted	9 Input Voltage
Amer Tran	×	—	—	×	—	—	—	½ and ¾ of above	—
Ferranti	—	—	—	—	—	—	—	—	—
General Radio	×	—	—	×	—	—	—	—	—
Jenkins & Adair	—	—	—	—	—	—	—	—	—
Operadio	×	—	×	—	—	—	×	—	—
Rauland	—	—	—	—	—	—	—	—	—
Samson	—	×	—	—	×	One-fifth of sum of tube ratings			—
Silver	×	—	×	—	—	×	—	×	—
Webster, Chicago	×	—	×	—	—	—	—	×	—
Webster, Racine	×	—	×	—	—	—	—	×	—

J. L. SCHERMERHORN

American Transformer Co.

"Replying to your telegram of September 26th we have no preference as to the methods of making fidelity measurements so long as they conform to R. M. A. standards. In general we would prefer one fidelity curve taken at an input voltage which will give maximum undistorted output for the tubes used in the output stage and based on the low frequency which will produce this result. The applied input voltage at this frequency can then be used for all other frequencies in the audio range.

It will be interesting to have a similar fidelity curve made at one-half and three-quarters of the rated maximum undistorted output of the tubes. If the fidelity is plotted in percentage it will probably be better understood by the majority of your readers."

J. W. HORTON

Chief Engineer, General Radio Company

"This is in reply to your night letter of September 24, requesting my preference regarding the measurement of audio amplifiers.

I have naturally been obliged to give considerable thought to this problem, and have participated in the discussions of the Standardizing Committee of the Institute of Radio Engineers. The present recommendations of that organization as published in the August, 1930, issue of the *Proceedings* represent what I believe to be the most desirable method of carrying out such tests."

HAROLD H. SHOTWELL

Chief Engineer, Operadio Manufacturing Company

"Referring to yours of September 26th relative to the symposium on the most desirable method of making fidelity measurements on audio amplifiers, please be advised that we prefer and use wherever possible the constant input variable output system with our results plotted in decibels with an output level of approximately 1 watt and an input voltage sufficient to give this 1 watt output at 1,000 cycles."

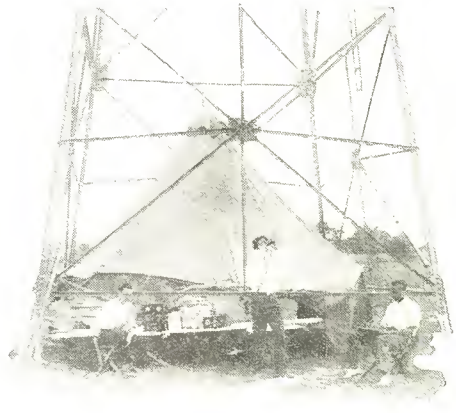


Fig. 2. During the recent National Air races held in Chicago the amateurs were kept busy taking care of communication from pylon to pylon, plane to ground and otherwise keeping the palpitating public apprised. In this picture at the left is Louis Fohr, W9DCQ; in the center, Mr. Weiss, and at the right, none other than Art C. Bates, editor of the Radio Amateur Call Book and presiding genius behind W9FO

GILBERT SMILEY

Samson Electric Company

"I am in receipt of a telegram from you and a communication from our sales manager, Mr. Cotton, both concerned with the measurement of gain in audio frequency amplifiers. I shall first endeavor to answer your numbered questions as embodied in the telegram.

1 and 2. Frankly, neither method—constant input, or constant output, seems desirable. Of the two, however, the method numbered 2 in your telegram, incorporating variable input with constant output seems preferable. The input voltage, of course, should be measured back of the amplifier source impedance, in order that the behavior of the amplifier with rated source impedance may be accurately determined. Though resistive source and load impedances are not strictly accurate, in view of the fact that, in most cases, actual sources and loads embrace reactive components in which inductive reactance predominates, there seems to be no satisfactory method of using other than resistance at these points. Measurements should be made with instruments indicating r.m.s. values. The level should be selected to avoid errors from appreciable hum power and distortion, both of which give an indication of better response characteristics than is actually the case, which selection, in many cases, can best be made as the test is taken, and which may vary during the test because of too close an approach to either the hum power or distortion limits. Both of these conditions, of course, can be readily detected owing to the fact that, if the limit is too closely approached, a change in level will result in a change in measured gain.

3 and 4. Personally, I prefer characteristic response curves in decibels. However, to many people, the decibel is entirely meaningless, and, for this reason, the percentage curve is probably more generally applicable.

5. The double plot, both db and per cent, seems to present the most satisfactory solution and should be used if possible.

6 and 7. Output level seems to be entirely a matter of the amplifier power. Probably a good point, if one must be selected, is about one-fifth of the sum of the power tube ratings at the actual plate and grid voltages used. See also comments under 1 and 2 above.

8. While a gain measurement made by operating the power stage to its maximum undistorted output might be very valuable, it would also be very difficult, and could not possibly fall under the category of either constant input voltage or constant output power. We have been, recently, rating amplifiers on a basis of power output necessary to introduce sufficient distortion to decrease the gain by one decibel from the level where distortion is negligible. This measurement is made at each frequency point taken, and the amplifier must maintain a power output at least up to rating over the entire advertised region of faithful response. In a properly designed amplifier, this figure will roughly coincide with the sum of the power output ratings of the power tubes, whether the amplifier be push-pull or parallel. As the maximum power output is taken at the point at which gain decreases one decibel, the response curve taken under such conditions will parallel a curve taken in the region of negligible harmonic generation, being, of course, exactly one db lower.

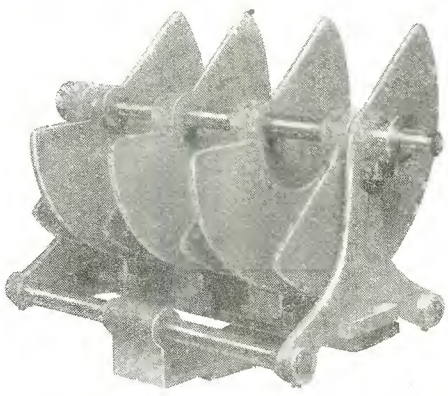


Fig. 3. You might mistake this for a vernier on a broadcast tuner, but it's not. It's designed for use on broadcast stations from 5,000 watts and up and is used as a neutralizing condenser on 20 kw. power amplifier stages. It is one of the designs by Doolittle and Falknor

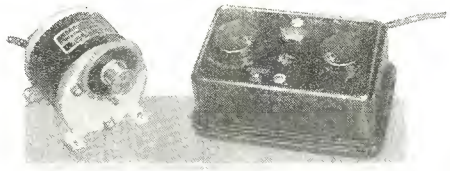


Fig. 4. Made by the National Company, here we see a remote control motor at the left and the tuning mechanism at the right. It is called the National kinematic multiple control

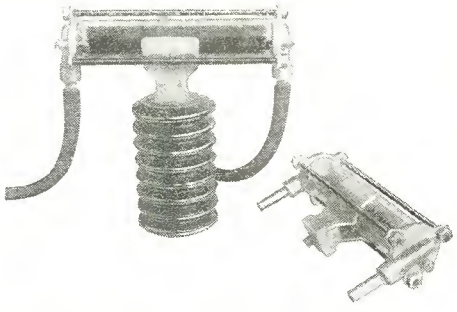


Fig. 5. At the left in this picture is one of the water-cooled resistors made by Doolittle and Falknor for broadcast station operation. The unit at the right is the resistance element. Water enters at one end and comes out the other. The left unit is shown with the water hoses and the mounting

9. Rated input voltage, like power output, is subject to considerable variation in anything but a perfect amplifier. Perhaps a curve of input volts required to produce maximum power output over the response region would be most valuable. Other than this the figure might be given in r.m.s. volts at, say, 1,000 cycles per second, though it has been our practice to give the voltage required at 100 c.p.s. rather than that at 1,000 c.p.s. The voltage should *not* be measured across the input terminals of the amplifier, but should be the generated source impedance, measured back of the source impedance."

KENDALL CLOUGH

Chief Engineer, Silver-Marshall, Inc.

"I will reply to your questionnaire of September 27th by referring to your subjects by your own numbers:

1—I feel that it is preferable to make tests on audio amplifiers at constant input voltage rather than constant output power. However, my preference is primarily one of convenience in measurement.

2—Also covered by answer to No. 1.

3, 4, 5—Plotting of the curves in decibels is always desirable, due to the logarithmic response of the ear to sound pressures. This gives a more accurate picture, therefore, than plotting the curves in percentage, as in paragraph 4. It is customary with us to use the constant input voltage, taking the response at 400 cycles as zero decibels and plotting the curve in negative or positive decibels as required. In order to make the data complete, this, of course, calls for a statement on the curve as to the input voltage and output power at 400 cycles, to which zero decibels refers.

6—The number of levels at which the response may be plotted depends, to a great extent, upon the nature of the equipment being tested. In any event, it is always desirable to run a curve at some low value of output, for, in many cases, certain iron cored devices in the amplifier will be operated at very low flux densities where the effective permeability of the material will be low and the response of the amplifier at the bass frequencies will be at its poorest. Whether or not this should be 50 milliwatts, as you suggest, will depend upon a great many considerations, principal among which is the hum produced from the a.c. supply, and, second, the possible noise in high gain amplifiers due to the shot effect in the input tube, of the hissing introduced by the resistors, and so on. Provided that neither of these disturbances are of sufficient amplitude in the output circuit to prove troublesome, 50 milliwatts output at

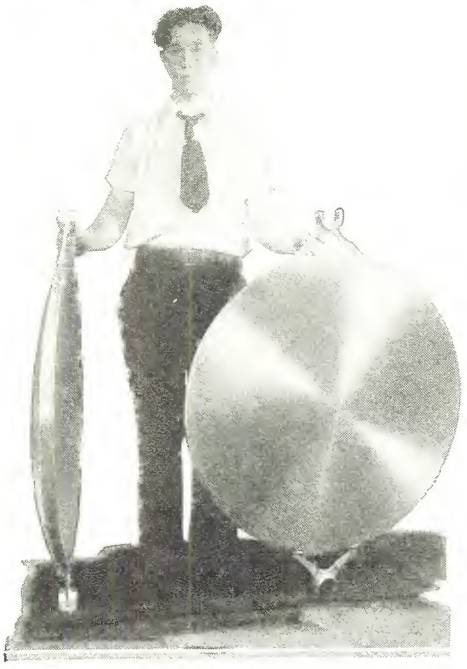


Fig. 6. Here a man is holding up one of the condenser plates that fits into the tank condenser shown in Figure 7

400 cycles should be a satisfactory level at which to run the curve.

7—The one watt level would represent nothing in particular except in specific cases, while

8—A curve taken at the maximum undistorted output of the last stage is useful as an indication of possible overloading of preceding stages when compared with the curve taken at a very low value of power output."

JOHN ERWOOD

Chief Engineer, The Webster Company, Chicago, Illinois

"In reply to your questionnaire, we would suggest that amplifiers under test be tested using the constant input and that the input voltage be the value that the manufacturer states to be the value to give the maximum output.

We would also suggest that harmonic measurements be made at this output.

We are in favor of plotting the output in D.B. However, this is more or less optional and either the percentage or the D.B. would be satisfactory for a person understanding the equipment. To others the curves would mean little anyway."

W. H. HUTTER

Chief Engineer, Webster Electric Company, Racine, Wis.

"I am very sorry to have delayed answering your letter of the 26th so long but was called out of the city.

However, the consensus of opinion around the laboratory is as follows:

Input voltage kept constant at all frequencies and at a value which will not overload any of the tubes. Convert output voltage to d.b. plus or minus from reference level using resistance load, the resistance of which is equal to twice the plate impedance of the output tubes.

The curve should be taken at the maximum undistorted output."

A SINGLE AC-DC SET ANALYZER

By **CHARLES E. SARGEANT**

THE recent development of a copper oxide rectifier which when used with a DC meter movement will cause it to read either AC or DC has enabled the Supreme Instruments Corporation to produce a simple and efficient set analyzer using a single meter. The elimination of other meters has not limited the scope of the instrument. On the contrary, there are twenty-two ranges available, some of which are new to radio trouble shooting. The following list of scales will show how comprehensive it is possible to make a meter of this type: Voltage, AC or DC: 3, 9, 30, 90, 300, 900 volts. Current, AC or DC: 3, 9, 30, 90, 300 milliamperes.

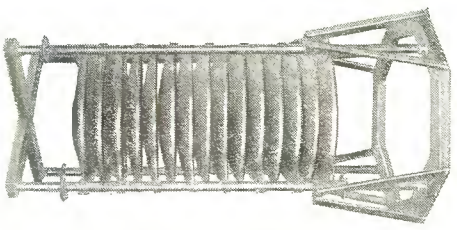


Fig. 7. This tank condenser is one of the type made by Doolittle and Falknor. To get an idea of the size of the plates see Figure 6.

The idea of using a DC meter movement with a suitable rectifier for measuring AC is not new, but in the past the apparatus has been too bulky and inefficient to be commercially practical. The General Electric Company has overcome these objections with a very small and efficient copper oxide rectifier.

Figure 1 shows the DC meter connected in the rectifier bridge circuit, and how the necessary shunts and multipliers are added for current and voltage readings. It is characteristic of this system that instead of taking the usual root-mean-square, or effective value, of AC, the meter will indicate the average

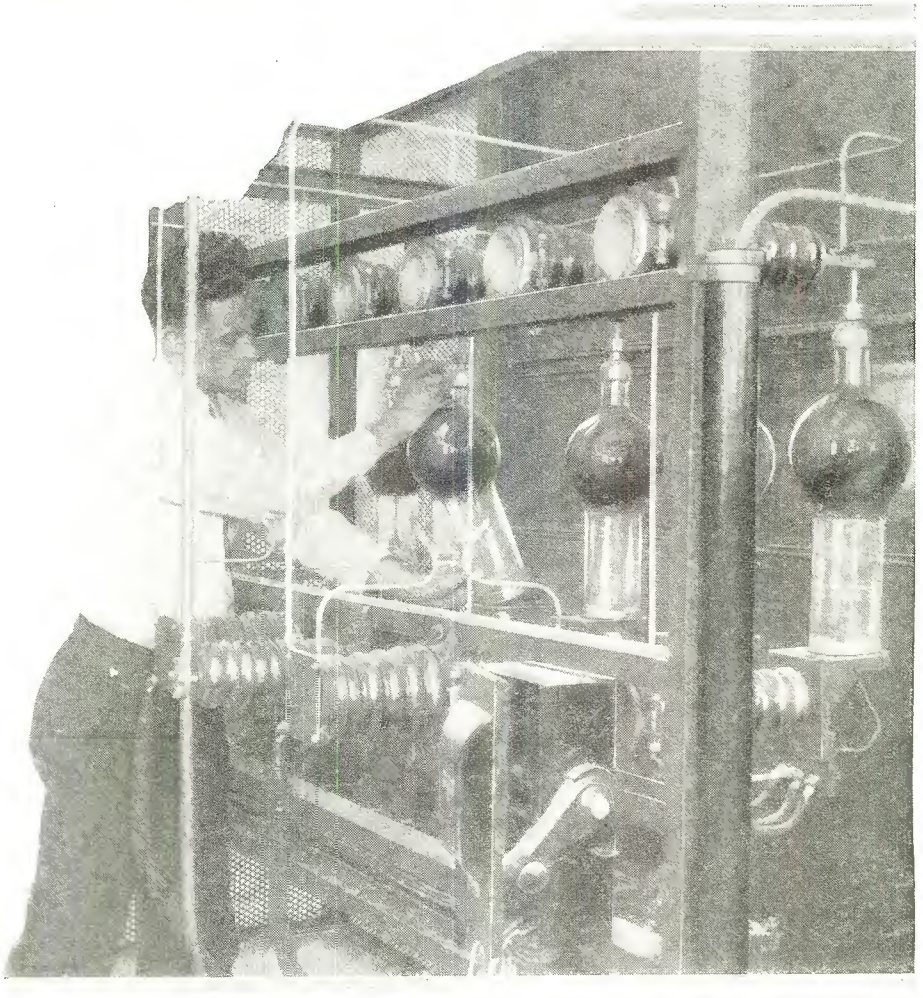


Fig. 8. R. Johannssen, Westinghouse test man, inserting a hot cathode mercury vapor tube in the main rectifier at KYW

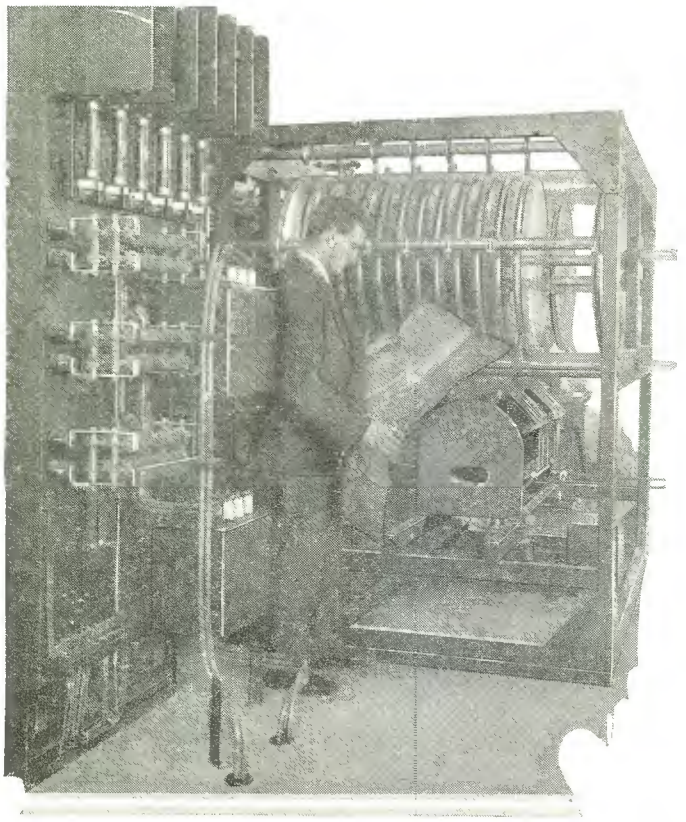


Fig. 9. Left is shown the rear of the power control panel. G. V. Bate, test engineer is standing beside the 50 kilowatt power amplifier stage

Fig. 10. John J. Michaels, diminutive dynamo of energy at KYW, longest in Westinghouse service at Chicago with the exeeption of Plant Manager Randol. Johnny was a seagoing "op" when this photo was taken

valuc which is somewhat lower. It is necessary to multiply this by 1.11 to obtain the effective value with which service men usually work. This is automatically taken care of by a toggle switch that corrects the needle deflection.

While the meter is designed primarily for use at 60 cycle the accuracy is well maintained at much higher frequencies. For example, at 2000 cycles the frequency error will not exceed 1 per cent, at 4000 cycles, 3 per cent, and at 8000 cycles 6 per cent. The effect of aging of the rectifier will be negligible, for on tests at full load for two years the variation has never exceeded 1 per cent. The normal current through the rectifier is only 0.4 milliamperes at full scale deflection, but it is designed to carry 15 mils continuously and even up to 20 mils for short periods. This means that 50 times the normal load may be passed through the rectifier without damaging it.

The zero adjustment is under the glass where it is not likely to be disturbed. This arrangement permits the use of a stronger glass and the elimination of the zero adjustment hole removes a major cause of meter glass breakage. In the event that it becomes necessary to reset the needle to zero, or to replace a broken glass, the glass may be unscrewed in the same manner as some watch crystals, and it therefore is not necessary to send the entire meter away to have a glass replaced.

Simplicity has been achieved by the use of one meter, non-locking push buttons, and three connections for external use of any of the twenty-two available scales. The reading of the meter has also been greatly simplified, by the use of only two scales on the dial. These run from 0 to 3 and 0 to 9, the higher ranges being read by multiplying these readings by 10 or 100 as may be necessary.

Flexibility has been attained by providing that all of the ranges included are available for use in taking any reading, and by the seven wire cable with the analyzer plug, arranged to handle all connections to pentodes or top-heater tubes, which removes the difficulties that are sometimes encount-

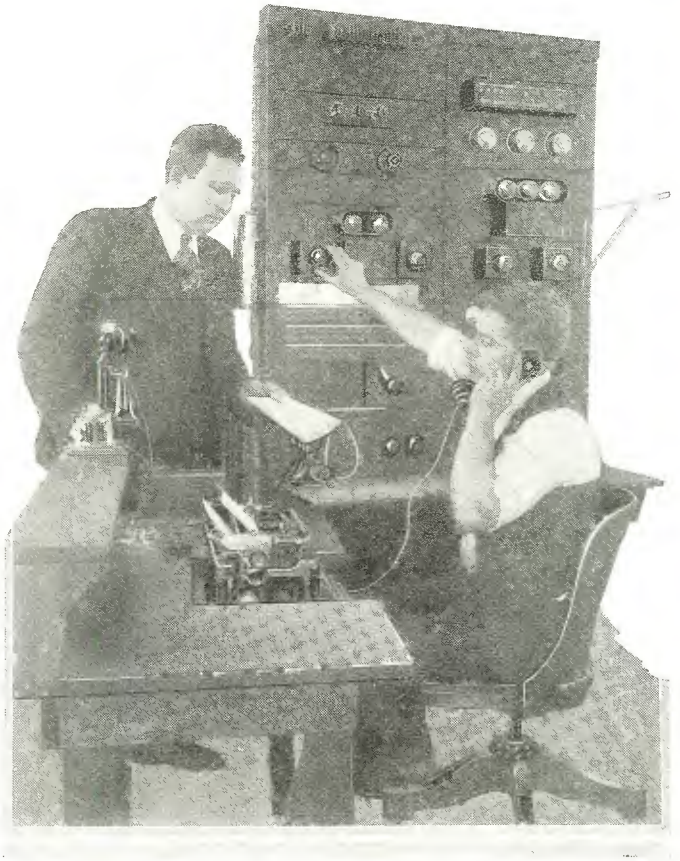


Fig. 11. H. E. Randol, plant manager (standing), and H. Giles, operator, in the station control room. This audio control aets as a link between the studio and the KYW transmitter

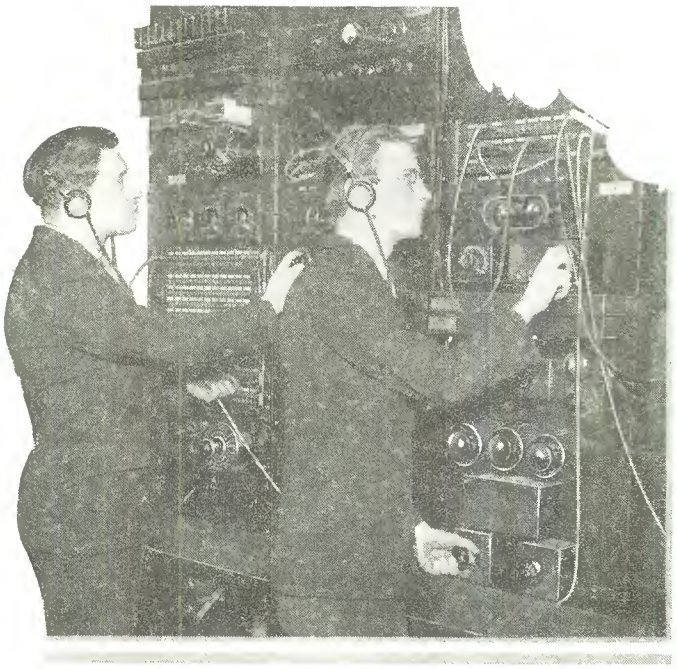


Fig. 12. Studio control board at the downtown Chicago studio of KYW. Operators Ferris (left) and Howser (right). This is the focal point where the different pick-ups converge and from which they are sent out to the transmitter near Glen Ellyn, Ill.

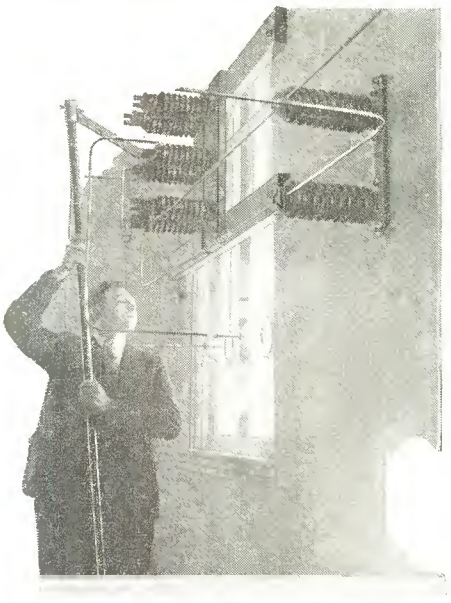


Fig. 13. H. E. Randol, plant manager of KYW, throwing switch to connect transmitter to the antenna

ered in working with tubes of those types. The adapter for changing the plug base from the UX to the UY type is held in place with a thumb catch so that while it cannot come off in the socket it is easily removed when necessary. The very flexibility of the instrument, and its inclusion on pentode tests, form a safeguard against obsolescence.

The two pinjacks at the top of the panel are for the heater connections on the top-heater type of tube. In front of the left hand-socket which is of the UY type, is another pinjack for connection to the space charge grid contact of pentodes, while the corresponding pinjack on the right is for the control grid of both pentode and screen grid tubes. The red push buttons on both sides of the meter have been given the following self-explanatory markings:

Space Charge Voltage, Screen Grid 2nd Plate, '80 Grid Voltage, Cathode Voltage, Control Grid Voltage, Filament Voltage, Control Grid Bias Change, Space Charge Current, Screen Grid 2nd Plate, '80 Current, Grid to Plate Voltage, Plate Current, Plate Voltage, Grid Bias Change.

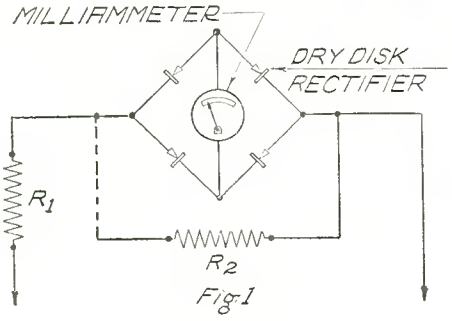


Fig. 1

Directly below the meter is a scale selector switch with points marked 3, 9, 30, 90, 300 and 900. This switch controls both the voltage and current range on all the test buttons and pinjacks. The scale system has the advantage that if a reading is found on the lower third and the dial where meters are least accurate the next lower scale may be used to make the needle deflect to the upper portion of the scale where accuracy and readability are highest.

To the left of the scale selector is a toggle switch marked AC-DC, and this is thrown to the correct side for the type of voltage or current being measured and the scale selector is set to the proper range. This provides either a DC or an AC voltmeter with six ranges and a resistance of 1000 ohms per volt, and also a DC or AC milliammeter with five ranges. Only three connections are necessary for external use of the meter on any range, and they are the pinjacks shown in the lower left of the illustration.

The toggle switch to the right of the scale selector ties the cathode to the heater on tubes of the UX type, and separates them when the analyzer is being used with heater tubes. This is necessary to prevent the shorting out of

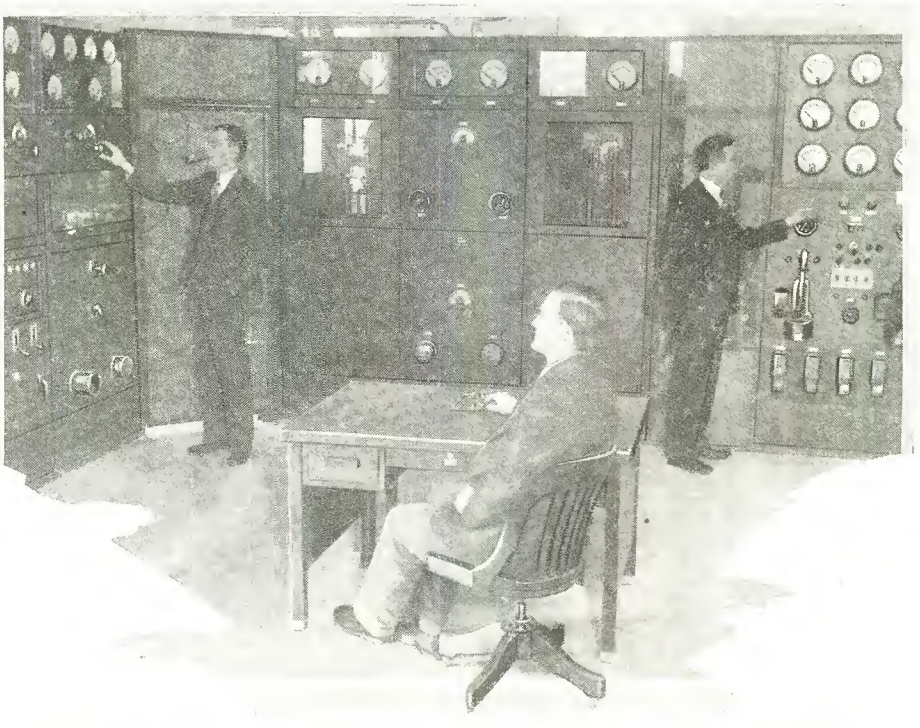


Fig. 14. General view of the new KYW transmitter. H. M. Smith, traveling construction engineer, tuning the 5 kilowatt stage. G. E. Bate at operator's desk, H. E. Randol, plant manager, at right, adjusting filament voltage

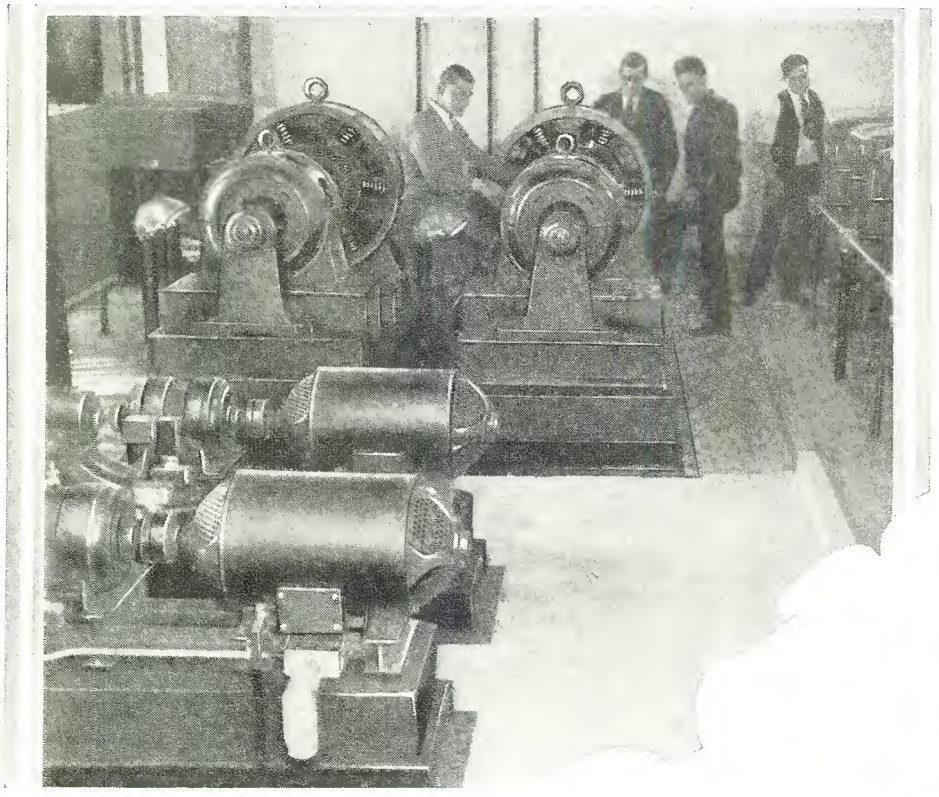


Fig. 15. Bias generators (left foreground) filament generators (left background) and main rectifier transformers (right background). These are the station C, A and B supplies respectively

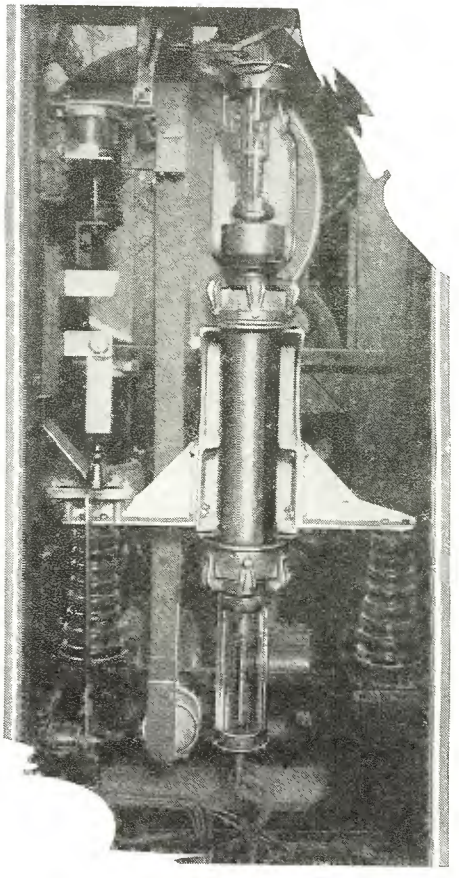


Fig. 16. One of the 150 kw water cooled tubes, two of which are employed in a push-pull linear power amplifier at KYW

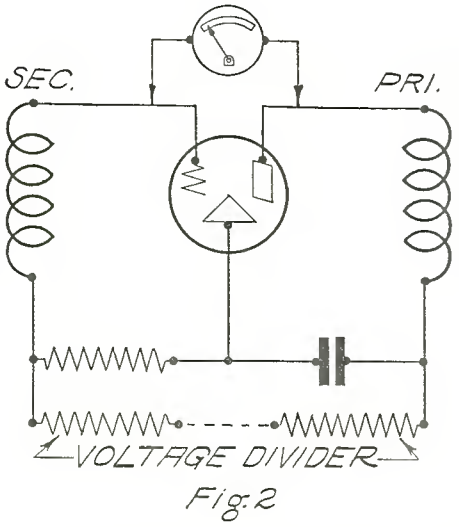


Fig. 2

One of the unusual features of the copper oxide meter is that it will read independently of the polarity of the applied voltage, so that no reversing switch is necessary. In order to take care of the rare instance when the polarity of the voltage must be determined, two pinjacks have been included, one on each side of the scale selector. When connections are made to the polarity testing pinjacks, the needle will deflect in the normal direction, but if the connections are reversed, the needle will tend to back off the scale. The polarity of EMF of less than one volt may be determined by this test.

(*Continued on page* 102)

any cathode bias that may be placed on the tube under test. The three pinjacks at the lower right are used for continuity testing through either high or low resistances, and are energized by three standard flashlight unit cells, which are also used to provide the standard 4.5 volt grid swing for tube testing. The cells are dropped into the case under a metal plate near the handle.

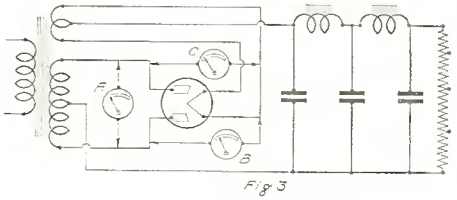


Fig 3

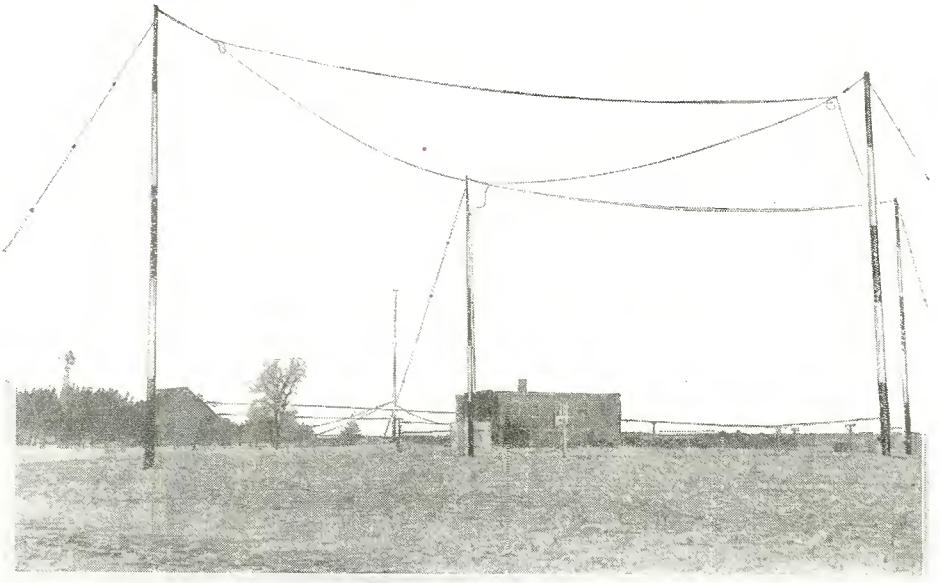


Fig. 17. Station in center with antenna tuning house (white) at base of antenna pole in center. KYW operates on a frequency of 1,020 kilocycles and at present authorized to use 10,000 watts. Wooden poles were used to get away from power absorption. This particular form of antenna construction gives a strong sky wave with relatively little interference locally

Station W2XAF at Schenectady, N. Y.

(*Continued from page* 46)

maximum power of the transmitter, to an equivalent power of 240 kilowatts. When used for telegraph purposes this outfit, combined with a directive antenna, will give a signal equal in strength to that picked up from a 1,000 kilowatt transmitter using a simple antenna.

W2XAF, located at the South Schenectady transmitter laboratory of the General Electric Company, five miles south of Schenectady, is licensed by the Federal Radio Commission for experimental relay broadcasting on 40 kilowatts.

The carrier frequency of 9,530 kilocycles is generated by a quartz crystal oscillating at one-fourth the carrier frequency or 2,382.5 kilocycles. Effective operation of the crystal is possible only when the temperature surrounding it is constant. To gain this uniformity of temperature an ingenious automatic temperature-controlled oven has been devised. The oven consists of a number of compartments arranged one within the other. Each compartment acts as an insulating chamber to protect the crystal from the temperature variations of the transmitter room. The crystal is housed in the final compartment in a metal box where the temperature deviation is so slight as to have no effect on its efficiency.

The output of the crystal oscillator is amplified and multiplied in frequency until a power of one kilowatt is available at 9,530 kilocycles. At this point modulation takes place. The modulation equipment is unique in that frequencies from 25 to 50,000 cycles may be used and the maximum variation throughout the band is less than 10 per cent—an amount so small as to be negligible. The result is incomparable fidelity over an exceptional range of frequencies. The modulation equipment is so arranged as to make possible the modulation of one kilowatt radio frequency amplifier 100 per cent without distortion. The unit is then coupled to an intermediate amplifier whose output voltage varies rectilinearly with the input voltage. The output of this stage is about four kilowatts. This stage, in turn, is used to excite the large power amplifier which is connected to the antenna system. The power amplifier utilizes six 30-kilowatt vacuum tubes arranged in a push-pull circuit with three tubes on each side. The last amplifier has been tested up as far as 134 kilowatts continuous antenna output, such as might be used in c. w. telegraphic communication.

W2XAF'S new transmitter employs thirteen different types of tubes, or 27 tubes in all. Twenty gallons of water per minute are pumped through the set to cool the plates of the tubes.

W2XAF, using 20 kilowatts of power on its old set, was capable of reaching Europe, Australia and South America, with exceptional reliability and generally with a fair signal. When directional antennas were used the signal invariably reached the country to which it was addressed. For example, for months, special two-way conversations were carried on one day a week with Sydney, Australia. During the period Admiral Byrd and his expedition were at Little America, Antarctica, W2XAF, using a directive antenna, put its program to the explorers fortnightly, on a Saturday night.

With the new transmitters, and 35 kilowatts of power, W2XAF should put an exceptionally strong signal east, west or south. In fact engineers believe that the ratio of signal to noise or static should be such that the station may be held continuously by a listener during a broadcast.

Lightning!

(*Continued from page* 52)

seen that Californians and West Coasters in addition to being blessed with a special kind of weather also seem to have been given the "breaks" in the matter of lightning, since the Pacific region has the lowest average number of thunder-

storm days per season, while the Florida gulf side of the continent has the greatest. Other sections of the country are shown with values ranging from 10 days on the Pacific to 90 days on the Florida gulf coast.

Invisible Ultra Violet Rays Used as Sure-Fire Burglar Alarm

(*Continued from page* 53)

The light sensitive apparatus used consisted of a photo-electric cell in turn connected to a starting anode tube which was tuned to operate the bell used to give the alarm, and turn on the Auditorium lights.

When the beam of light was interrupted by the burglar attempting to open the safe, the light falling on the photo-electric cell was interrupted, thus in turn causing the anode tube to glow. When this occurred, it energized the alarm relay. This starting anode tube continued to glow, thus sounding a gong which continued to ring until a concealed switch was manually operated to turn the alarm off. This function is very desirable from an alarm standpoint.

"Electric Eye"

J. V. Breisky, research engineer of the Westinghouse Electric and Manufacturing Company's laboratories at East Pittsburgh, demonstrated other devices developed by the Westinghouse Company where the photo-electric cell or "electric eye" is used. Everyone entering the room was automatically counted as he crossed a beam of light which was thrown across the doorway. The shadow of a passing body caused the "electric eye" to communicate with a counting machine. An automatic sorting machine was able to detect differences in the appearance of packages. A related device operated a fire extinguisher as soon as a whiff of smoke appeared. The ingenuity of modern research engineers is bringing a quick solution to many difficult problems. It is interesting to observe how many uses have already been found for the practical application of a machine which can see.

Servicing the Speaker

(*Continued from page* 59)

other types of magnetic speakers, there is a fixed magnetic field due to a pair of permanent magnets, and a fluctuating field due to the audio current flowing through a pair of electromagnets. The interaction between these two magnetic fields energizes a pair of armature bars connected by tie rods, each bar working between its respective pole faces. As shown in Figure 1, the armature assembly rides freely between the pole faces of the pair of permanent magnets. The electromagnet coils "A" and "B" are connected in series. A current flowing through the windings in the direction indicated by the arrowheads, will increase the flux through the pole face F1, and decrease the flux through the pole face F2. The flux, seeking a path of least reluctance, exerts a greater force on the armature bar No. 1, than on bar No. 2, thus moving the armature in the direction indicated. On the reverse of the cycle, the armature is moved in the opposite direction. The pole legs are cut to the shape indicated to reduce leakage flux and to concentrate the magnetic field. The opposite forces on the two armature bars cause the armature to rest at mid-magnetic position. The flow of signal current in the coils shifts the magnetic center, thus moving the armature to the new magnetic center. In a way, this action is similar to that taking place in an induction motor when the rotor revolves under the influence of changing magnetic flux in many pole pieces.

It is generally conceded, both by radio engineers and highly trained musicians, that the modern perfected dynamic speaker represents the last word in faithfulness of sound reproduction.

Where range, tone quality and volume are of supreme importance, a good dynamic speaker is specified as a matter of course. The principle of the dynamic speaker can be explained very easily by referring to Figure 2. This shows a conductor carrying a current of electricity and placing in a strong magnetic field. The direction of the current is towards the observer and hence the direction of the surrounding magnetic flux is counter-clockwise, as indicated by the dotted circles. The main magnetic flux flows from the "N" (north) to the "S" (south) pole piece, as shown by the straight dotted arrows.

It will be seen that beneath the conductor, the magnetic field due to the current adds to or intensifies that due to the main magnet, while above the conductor the two fields oppose or weaken each other. As a result, there is a tendency for the conductor to be pushed upwards at right angles, and if it is free to move, this upward motion will take place. Conversely, with current flowing in the opposite direction, but with the direction of the main magnetic field unchanged, the conductor will be forced downward. This action is known as *motor action*. It is the basic principle governing the action of the dynamic speaker.

In the dynamic speaker, the permanent magnets are replaced by a powerful electromagnet capable of supplying a constant, concentrated magnetic field. The single conductor is replaced by a rotable coil known as a "voice coil," which moves or vibrates in this magnetic field. The fluctuating audio current flows through the voice coil, which is rigidly attached to a cone-shaped paper diaphragm. The magnetic field due to the fluctuating current in the voice coil interacts with the constant magnetic field in exactly the same manner as shown for a single conductor (Fig. 2). The resultant vibration of the diaphragm reproduces the desired sounds.

The above discussion explains the theory of the dynamic speaker and it will be noted that this is extremely simple. On the other hand, a perfected type of dynamic speaker is anything but elementary. Of course, there are crude dynamic speakers, consisting of little more than the parts outlined in explaining the working principles. Such dynamic speakers could not be expected to give very good performance.

The Wright-DeCoster Reproducer illustrated in Figure 4 is a typical example of the highly-developed, perfected dynamic speaker. It is instructive to note some of the features which characterize this speaker. A circular cross-section oversize field core is utilized, made of special magnetic steel. The air gap at the center of this core is also of circular cross-section and within this gap there is a cylindrical shaped pole piece. The entire core, with the exception of the front, is enclosed in a magnetic steel casing, providing a continuous path for the magnetic flux. This is concentrated in the air gap, which has a flux density of 120,000 lines per square inch, thus insuring great sensitivity and freedom from distortion at great power.

The voice coil, which is very light, is wound about the front end of the pole piece and is suspended so that it can move freely. The slightest movement of the voice coil is transmitted to a ten-inch paper diaphragm, since the coil is rigidly fastened to a leather apex, which in turn is secured to the diaphragm. The paper used for the diaphragm has been selected because of its non-rattling qualities after thousands of selective tests. The external connections are brought into the speaker by means of two eyelet terminals placed on the cone toward the apex. The exact position of these eyelets for most satisfactory operation was determined after extensive experimentation.

The outer edge of the diaphragm is stitched to a cloth ring and the latter is held by a "spider" frame. The inside circumference of the frame is fastened to the casing of the field core. The entire diaphragm is free to move, within the necessary predetermined limits, with hardly any perceptible inertia.

A copper shading ring serves as an equalizer and to reduce hum. An additional coil, called a "hum buck" coil, is connected in series with the voice coil, making the speaker absolutely humless.

In the a.c. models, a full-wave, long-life dry rectifier is provided with a filter system including choke and filter condenser for giving smooth, humless direct current for field excitation. An output transformer is also provided with the speaker, to match the impedance of the voice coil with that of the amplifier.

It is readily apparent from a consideration of the above-mentioned features, that there is indeed a vast difference between the early crude types of dynamic speakers and the modern highly developed ones. To obtain the fine results only the finest materials can be employed in construction and these must be used without skimping. Furthermore, sound engineering practice must be adhered to in design and the actual construction must be performed by master craftsmen. Add to the above, numerous inspections during the process of assembling, and rigid tests. Thereafter, superb performance is no longer to be regarded as a miracle, but rather as a thing which must follow as a matter of course.

Howard Remote Control System

(*Continued from page* 42)

arm. Only one brass rod is shown though there are actually two. This spring, together with a 10/24 screw permits a variation in tension on the chain drive, which in turn will make the unit work easily or very hard. If the proper tension is on the chain drive, obtained by this spring adjustment, the remote control unit knob will turn very easily. But if in shipment, or due to faulty adjustment, the tension on the chain drive is too great, then a load will be reflected to the remote control unit and it will be hard to turn the knob of this unit. To take care of adjustments in the field these spring adjustments are provided.

On top of the bracket which supports the driving rotoformers will be observed a metal cap. This cap covers the terminal strip in accordance with underwriters' specifications, also eliminating any accidental short-circuit when the set is operating, should metallic objects fall on this exposed unit. The cap for this terminal strip can easily be removed by unscrewing the two special hexagon screws.

In the schematic circuit diagram in Figure 5 are shown the

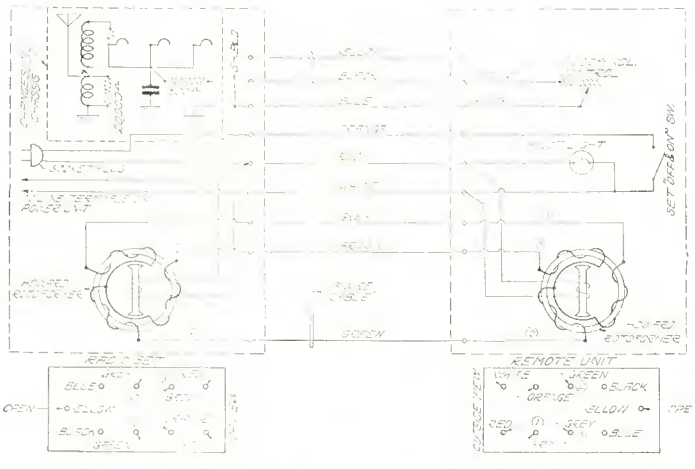


Fig. 5. The schematic here shown is of the Howard remote control unit with all electrical details

connections for the Howard remote control system. This shows the rotoformer windings and their proper connection to the terminal strips, both at the chassis and at the remote control unit.

With good soldered connections and the rotoformer brushes making good contact with the collector rings there is nothing to prevent entirely satisfactory operation for an indefinite period. If one of the phases of the rotoformers becomes opened, there will be a jerky movement at the receiver end.

In the drawing the Howard chassis is shown with the remote control driving mechanism. It can be readily seen that with proper mechanical connections the driving mechanism can be applied to other types of chassis. It must be understood that the gear ratio, or the rate of rotation should be equal at the remote control end to that at the chassis end. Also the dial strip which has the kilocycles on it should be made to correspond with that of the particular receiver in use. If these precautions are observed, the driving mechanism may be used with any type of chassis.

From the service man's standpoint the beauty of the remote control idea is the fact it does not become obsolete. If it is necessary to change chassis it is a simple matter to change over from the old to the new chassis and still use the remote control system.

The ideal method of employing the remote control system, and one which should interest service men and dealers from the cash return standpoint, is to furnish a home with the chassis fitted with a remote control driving mechanism, placing this chassis on a shelf in the basement or attic, or any other out of the way place. Then wire the house with special outlets, also providing a number of speakers, placing them in special cabinets in the walls or ceilings of the home, and then have a remote control unit with a short length of cord that can be plugged into any of the various sockets. Thus the owner can take the remote control unit to any desired place in his home and still operate the radio set satisfactorily. This method is now in effect in Minneapolis and it appears to the Howard Co. as the coming type of radio installation which will meet with favor in the better home.

Due to the special nature of such installations the dealer can charge an extra amount which will permit him a nice profit on the installation. The fact that a dealer can do this type of work throws him into contact with a class of purchasers who are willing to pay for this type of service.

Submariner Adapter Is Described

(*Continued from page 47*)

80 only one dial C1 tunes short wave signals and the volume control is the same as when using the receiver alone. Of course the tuning dial on the super is not used. The condenser C2 in the Submariner is adjusted once so the tube V1 oscillates properly and its setting is not critical. When a station is tuned in it may be used effectively as a vernier tuner.

Only 3 Coils

Windings L1, L2 and L3 are placed on one coil and inserted into a socket at the rear of the Submariner. To change from one wave band to another means only changing one coil. As previously stated Figure 5 shows a set of the coils, these covering the wave band from 13 to 145 meters on which bands will be found the most signals of interest to short wave enthusiasts.

DeForest Radiophone Receiver

(*Continued from page* 43)

at the center, this turning the 50 mmf section of the plate tuning condenser circuit. Regeneration is by the control knob at the right attached to the 500,000 ohm variable resistor. To cover the range the CS-5 has been provided with four coils of the plug in type, marked 1, 2, 3 and 4. Coil 1 covers from 93 to 190 meters; 2 from 49 to 95 meters; 3 from 25 to 50 meters and 4 from 15 to 26 meters, each coil allowing an overlap so as not to skip any portion of the band.

The knob at the left of the front panel is marked A, B, C, D. This turns the 100 mmf tuning section across the plate coil, and divides the tuning range of each coil into four sections so that the main tuning dial covers a relatively short frequency range with the full sweep of the dial. This allows extremely clean-cut tuning and in short wave work this feature is desirable.

Government Checks Frequency Deviation

(*Continued from page* 51)

switches mentioned above.

Thus, we are able to obtain maximum sensitivity as well as selectivity over a wide band of frequencies. In fact, this receiver is capable of covering from 100 to 1500 kilocycles by means of the plug-in coils as well as interchangeable loops.

It might be imagined that it would be quite a difficult proposition to tune in a particular station. However, this is not true inasmuch as the receiver is calibrated and by referring to the charts shown on the face of the panel it is possible to set the dials to a predetermined frequency, the entire operation being completed by one proficient in the handling of these adjustments in a very few seconds.

"For those who are technically inclined, it might suffice to state that the selectivity of this receiver is such that it is possible to receive without interference stations on each of the ten kilocycle channels throughout the broadcast band, while the sensitivity of the receiver is such that it will respond to signals of less than one microvolt per meter level and furnish a good loud speaker signal at this value. The audio frequency characteristics of the receiver furnish reproduction throughout the entire audio range of frequencies up to ten thousand cycles, giving an extremely natural quality through a special dynamic type of loud speaker mounted on top of the receiver compartment.

High Frequency Receiver

"The high frequency receiver which operates over a range of 1,500 to 30,000 kilocycles, is quite similar to the unit above described inasmuch as plug-in coils are used to cover this wide range of frequencies, also to the extent that each stage is individually tuned. However, in this receiver screen grid tubes are used in the three radio frequency stages as well as a regenerative detector. Of the two receivers, this unit is less pretentious, although just as capable of doing anything that the other receiver will do and to all appearances, considerably more, which makes this unit the more interesting of the two, especially in view of the extremely large number of code and phone radio stations both near and far which can be picked up at any time of the day or night. The audio frequency portion of the receiver, as well as its loud speaker, is identical with that previously described.

Secondary Standards

"In discussing frequency standards it might be well to mention the fact that primary standards are based on time as a unit, while secondary standards depend upon some fundamental source of frequency such as a tuning fork, magneto-

striction oscillator, or piezo electric crystal oscillator. A thirty kilocycle quartz crystal, carefully temperature controlled, is made use of in this instance. This crystal is electrically connected with a ten kilocycle multivibrator, which device, being rich in harbonics, produces a known frequency calibration point between the limits of 10 and 30,000 kilocycles. Inasmuch as these frequencies are furnished by the oscillator which is controlled by the crystal, their accuracy is of the same order as that of the fundamental controlled frequency of secondary standard. Thus, by comparing an incoming signal with the nearest harmonic of the controlled oscillator, we are able not only to determine the nearest channel to which the station is tuned, but in the event of any variation, definitely determine the amount of the same, whether one cycle or 5000 cycles.

"Once the radio frequency channel is known, it is then only required to determine the audio frequency difference between the incoming carrier and the particular harmonic of the controlled oscillator with which it is beating. Inasmuch as these harmonics, as previously stated, are ten kilocycles apart, the greatest frequency difference of the incoming carrier from any harmonic is but 5000 cycles. It is, therefore, possible to compare this audio frequency difference with an audio frequency oscillator, which oscillator is in turn calibrated by means of a 100 cycle multivibrator, which in turn is controlled by the fundamental frequency standard which, as previously mentioned, is our thirty kilocycle crystal. Thus, by merely varying the frequency of the audio oscillator, until its frequency is exactly the same as that of the beat frequency mentioned above, we know exactly the difference between the standard frequency and the transmitter frequency. In other words, the complete procedure is simply a matter of comparing known with unknown frequencies by means of zero beat, whether between audio or radio frequencies, and in order to obtain precision measurements, each step is carefully checked by means of a zero beat indicator furnishing visual indication, supplementing the audible indication obtained by means of the loud speaker.

Power Supply

"The power supply for the above mentioned equipment is derived entirely from storage batteries. All batteries are supplied in duplicate, both for filament and plate supply and are kept in a constant state of charge by means of two high voltage motor generators and one low voltage motor generator. All charging and discharging is accomplished through a switchboard which furnishes indications of the various rates of charge and discharge.

In General

"The secondary standard of frequency installation described above is a complete unit for the reception and measurement of any frequency between 100 and 30,000 kilocycles and as indicated in the annual report of the Radio Division for 1929, the accuracy of measurement is such that a result of at least one part in 100,000 may be secured.

H. F. L. 1931 Mastertone Is Described and Measured

(*Continued from page* 45)

is the voltage drop across the choke, 15, that is impressed on the second tube.

If the adjustment of the trap is such that its reactance is inductive, it is apparent that it will tend to cancel out the capacitive reactance of the choke coil in the same manner as discussed in connection with the circuit of Fig. 1, but it is fundamental that when a capacity and an inductance are brought into series resonance for a given frequency, a very

great voltage drop occurs across either of these reactance elements.

If the circuit shown in Fig. 3 is set up and the condenser is rotated, the signal strength will change in just the same manner as it did in the case of the arrangement shown in Fig. 1, except that the steep cut-off occurs on the other side of the "hump." The curve for this second stage is shown in Fig. 4. In this case the reason for the drop in the response curve is that the trap circuit, 16, 17, blocks or rejects signals of the frequency to which it is tuned. The parallel tuned circuit, instead of being in a path which is common to the plate circuit and the grid circuit, is in but one of these circuits, and it, therefore, prevents the signal current from flowing in the choke. As a consequence of this trapping action there is no current in the common impedance element (the choke) and, therefore, no voltage drop to be impressed on the next tube.

Resultant Is Ideal

Suprimposing the curves shown in Figs. 2 and 4, one upon the other, the resulting curve will be as shown in Fig. 5. The portion of the spectrum which is transmitted through the tubes is seen to form a comparatively straight-sided, narrow band.

The width of the band or channel can be narrowed or widened by adjusting the settings of the condensers 12 and 17. Experiments have shown that the band can be made so narrow that the quality of the reproduction is greatly impaired by side-band trimming, to such an extent, in fact, that a violin can nearly be tuned out due to the narrowness of the band, which will not allow the higher frequencies of the violin to pass through. Therefore, it will be seen that it is readily adjusted so as to obtain ten kilocycle station separation. The shape of the curve of Fig. 5 shows plainly that an adjustment for band width of 10 kc. will afford extremely high rejectivity for channels on each side of the desired one. It will also be seen that the top of the curve maintains practically the full band width, which means that the fidelity will not suffer even with such great station separating ability.

When the amplification of the stages is taken into account the response curve of the two stages combined will be somewhat different from what is shown in the curve, Fig. 5. Fig. 6 shows what might be expected from two stages, and it will be seen that the cut-off at each side of the signal becomes steeper as the high part of the curve goes up. The low or no-signal parts of the curve remain fixed at the same distance from the signal frequency, regardless of the amplification or the strength of the signal. This is because the low points *a* and *b* are positioned by the wave traps, and these points cannot be moved apart or nearer each other by changes in signal strength.

It will be seen that we have here a means for eliminating undesired signals which are on frequencies close to the frequency of the desired signal, and that strong signals do not broaden the response curve, but merely raise it.

Important Factor

This fact, which was referred to in the beginning of this article, is easily the most important factor to be considered if actual 10 kc. selectivity is wanted. To accomplish it by means of regenerative circuits is obviously out of the question where fidelity of output is of any importance. Many weeks of painstaking experiments in the laboratory with numerous other methods which seemed promising all resulted in the same outstanding disadvantage; namely, the rapid widening of the effective transmission band with large increases of input level. To the super fan, this merely means that with the well known coupled circuits, 10 kc. selectivity is obtained in practice when the desired station has sufficient field strength to permit a decrease in sensitivity of the whole receiver. But is seldom possible, near the large locals, to tune the set to the desired channel 10 kc. from local when the DX station is extremely

weak, thus requiring that the full sensitivity of the receiver be used. With the Hopkins system, the tuning of the trapping circuits effectively blocks out the local energy, whether the signal level be low or high.

The completed super will be most readily understood by reference to the wiring diagram shown in Figure 10, which indicates the use of 5 -24 type tubes as detectors and RF and IF amplifiers. A -27 type is used as oscillator and another as 1st AF. Output pair are -45 type in a purely conventional connection.

A capacity coupled pre-selector ahead of the r.f. tube effectively prevents the troubles due to carrier modulation experienced when set is used near high frequency local. Due to the natural increase in attenuation of such a pre-selector with increasing frequency the succeeding r.f. coupling is so arranged that its response characteristic is almost the complement of the pre-selector's, resulting in substantially "flat" transmission over the broadcast band from antenna to mixer tube. Also, the r.f. coupling is of the type offering a condensive load to the tube at all frequencies in the broadcast band, thus making the r.f. amplifier free from troubles due to r.f. oscillation.

The Hopkins i.f. amplifier is tuned to 182.5 kc. before its insertion into the chassis. Its physical construction is pictured in accompanying photograph, Figure 9. A conventional tuned plate-tuned grid coupling will be seen to form the last stage of the amplifier. A study of the fundamentals of the system will indicate the necessity of using the Hopkins couplings in pairs or even numbers, two of them being already in use, and the use of two *more* providing an amplification entirely too great for commercial usage, the stage pictured was chosen as a most suitable termination for the amplifier.

The photograph of the complete receiver in Figure 8 discloses that its power plant is built into the receiver proper. Of this unit little need be said, except that filtration of the B current is accomplished by a single choke and the dynamic speaker field, with three units of the "Electrofarad" filter condenser. This is an electrolytic device free from freezing troubles, and having a rising capacity with increasing temperature, room temperature capacity being about 8 mfd. while at operating temperatures each unit measures about 12 mfd. This results in perfect freedom from B supply hum.

Service Data

Data for service men covering this receiver is shown below:

Circuit Testing

No set analyzer readings are given as quicker and more accurate results will be obtained by the use of a high resistance voltmeter, measuring all voltages with respect to frame or "ground."

	RF	Mixer	Osc.	IF	IF	Det.	AF	AF
	224	224	227	224	224	224	227	245
Plate	170	165	40	165	165	135	160	280
Screen	*80	40	---	*80	*80	*80	---	---
Cathode	5	5	2	3	3	12	12	46

*Varies with volume control setting. These readings at maximum line voltage 112 volts, 60 cycles. "Cathode" on 245 stage measured from filament C.T. to ground. These voltages are typical but will vary with tubes and with voltmeter resistance.

Phasing

There is small likelihood that any circuits will ever get out of phase accidentally. The trimmer condensers are of a type not susceptible to change through vibration or other normal causes. Should it ever become necessary to rephase a set, observe carefully the following precautions:

Order of Phasing

A. The i.f. amplifier must be "in line" before any other circuits are adjusted. Also all four trimmers of i.f. must be tight. *Any weak signal* will suffice to line up the i.f.—the weaker the more accurate settings are possible. Remember this lineup is *independent* of dial calibration or any other consideration. Any station that can be heard will suffice. If trimmers line up, but are loose, shift main dial upward (numerically) a small amount, still retaining *some* signal from station. All four trimmers may now be tightened to restore volume and relined up. Repetition of this procedure, or reversal of it, will serve to line up i.f. with all trimmers just off the "tight" position.

B. With i.f. amplifier "peaked" correctly, tune set over broadcast band and observe whether stations follow the kilocycle calibration with reasonable accuracy. The trimmer on the right hand variable oscillator condenser controls the calibration. It must never be reset except on a station (or preferably a local oscillator) whose frequency is greater than 1200 kc. To tighten the trimmer will drop dial settings and vice versa. *It is critical*—make only minute changes and observe results each time.

Note that these trimmers "tighten" as their screws are loosened. (Screw driver turns counter clockwise.)

C. To reset the minimum adjustment trimmers of the 3 r.f. condensers, a station or oscillator signal of 200 meters or 1500 kc. is required and the "Local-Distant" switch set on "Distant." Volume may be reduced to keep output normal.

Rotate antenna vernier clockwise so that the front edge of 3 gang condenser tilts *upward* as far as it will go. With a 200 meter signal received, adjust each trimmer until maximum volume is attained. The second and third trimmers may be set with "Local-Distant" switch on "Local" side but phasing of No. 1 trimmer requires switch on "Distant" side.

Be careful not to tighten too far, as this will result in vernier mechanism having to turn to extreme counter clock position for frequencies between 700 and 950 kc., which is not desirable. When stations in middle range are tuned there should be some "leeway" between resonance position and the mechanical stop of vernier.

Tube Trouble

A. Unsuitable 224 in second socket will cause set to be noisy. Tapping set with knuckles will result in same noise. Replace 224 tube.

B. Unsuitable 224 in sixth socket may result in low volume on "Phono" side, even though volume on "Radio" is o.k. Will also cause howling at high volume levels.

C. Overheating of 280 rectifier caused by either (1) 245 tube gone bad (gassy), (2) electrolytic filter condenser developed electrical leak, (3) short to ground in wiring.

D. Microphonic noises and speaker "howl" caused by use of tubes with poor element assembly.

E. Unsuitable oscillator tube (227) will prevent reception on lower frequencies. Will also cause dial shifting for distant stations.

Servicing the Zenith Series 70

(*Continued from page* 57)

manual suggests 201, 294 and 461 meters for this purpose, and cautions that the check for calibration should be on distant stations, the reading should be in meters rather than kilocycles and the three points should be at extreme positions of the dial.

A Single A.C.-D.C. Set Analyzer

(*Continued from page* 90)

It may be interesting to consider a few of the more unusual tests that the rectifier-meter analyzer affords. Figure 2 shows where the meter is connected when the Grid-to-Plate voltage button is pressed. It is obvious that if the grid bias resistor is open there will usually be a reading on the meter, depending upon the method of obtaining grid bias, while if the transformer winding is at fault no reading can possibly result. This simple test is a great convenience in locating the cause of lack of plate voltage on any one tube. The value of the reading obtained is not important in this case, as the continuity of the circuit is the thing to be established. If the tube is being used in a resistance coupled amplifier, it is possible that the grid resistor might act as a multiplier and the grid-to-plate voltage read considerably less than the plate voltage alone, although the tube might still be properly biased.

Another interesting use for this button is shown in Figure 3. In the socket of an '80 tube, with the tube left out of the analyzer, it is possible to read the voltage delivered by the secondary of the power transformer by using the 900 volt AC scale, and the Grid-to-Plate voltage button, which would connect the meter as shown at A. Readings may then be taken of each half of the winding, through the filter system and voltage divider, by using the Grid voltage button and the Plate voltage button, the meter being connected during these tests as shown at B and C. The tube may then be inserted in the analyzer and the current flow through each plate read. If these voltages and currents are well balanced the power transformer and rectifier tube will not cause hum. In passing, it is interesting to note that if you are reading Plate or Grid voltage on the '80 socket and then place the tube in the analyzer without releasing the button, the voltage reading will increase. This is not due to any weird transformer action, but simply to the back action from the filter condensers, which are charged to the peak voltage instead of the RMS voltage. A check with the Grid-to-Plate voltage button will show that the voltage across the entire secondary is normal.

The unusual flexibility of the device is again called into service when work is being done on B eliminators which use the Raytheon BH or similar type of tube. Using the Filament voltage button with the 900 volt AC scale will permit the measurement of the secondary voltage of the power transformer in the eliminator, and the plate current may also be real by putting the tube in the analyzer socket and pressing the appropriate button.

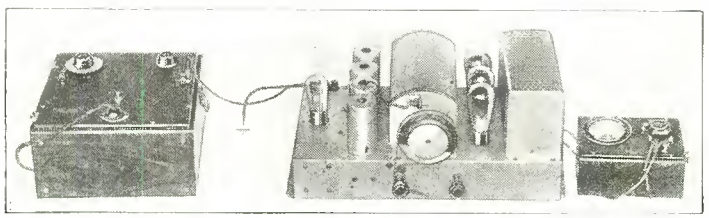
G-M Dealer Uses Service Truck

NEW PRODUCTS FOR THE TRADE

Dealer's Signal Generator

WITH the increasing complication of commercial receivers a signal generator of simplified type is becoming a requirement in radio service work. A generator of this type need not set an exact standard of radio-frequency output, but should present a means of reliable comparisons between receivers, and of the same receiver under different conditions. Such a generator may be used for neutralizing and alignment of receivers, as a check of the receiver's initial condition, and to provide a means of knowing quantitatively the improvement made by means of any changes or adjustments in the receiver.

The comparative sensitivity of a receiver may be measured by means of an adjustable source of radio-frequency voltage.



The method is to connect the test generator to the input of the receiver and to connect some sort of output indicator, e. g., the General Radio Type 486 output meter, to the output of the receiver. The test generator is then adjusted to give a standard reading on the output meter, and the output of the test generator taken as a measure of the comparative sensitivity of the receiver. The presence of defects will be indicated by the low sensitivity, and conversely, normal sensitivity is definite evidence that the set is not defective, or that defects have been successfully repaired.

The General Radio Type 404 test-signal generator has been designed with the requirement of service testing in mind. It is portable, provides accurate comparisons and operates from the alternating-current line. The generator consists of a modulated oscillator, tuning over the broadcast band, with a calibrated dial, and an attenuator. The circuits are carefully shielded, and filters prevent leakage into the alternating-current lines.

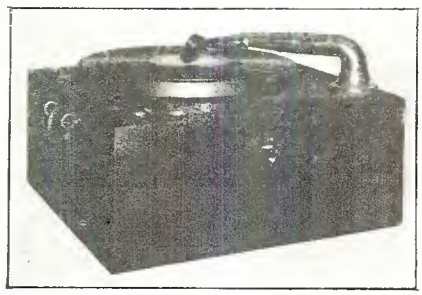
The Type 404 test-signal generator will be found useful in the usual aligning and neutralizing adjustments. A further wide range of usefulness is in assaying the condition of a receiver in question. Since it is portable, it may be taken to the job, and will indicate at once whether or not there is any radical difficulty with the receiver, or whether the trouble is in location, antenna or ground installation, or is only imaginary.

It can further be used to check on the improvement resulting from changing tubes, or making adjustments in the receiver. The test signal generator may also be used as a test on receivers in factory production.

Turntable For Low-Speed Records

FOR the faithful rendition of the large 16-inch disc records employed for theatre and broadcast purposes, at a minimum investment, the Stevens Manufacturing Corporation of Newark, N. J., has developed a giant electrical turntable and companion electromagnetic pick-up.

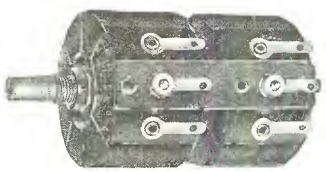
Briefly, the new Stevens product comprises an 18-inch turntable operating at 33⅓ r.p.m. Instead of using an elaborate system of driving shafts and gears, the new turntable is driven by a silent and constant speed Stevens-Sibley motor, through a friction drive applied directly to the inner face of the turntable rim. The motor is mounted with a pivotal spring tension, so that the friction drive makes positive contact at all times. An automatic governor is included inside the motor's cast metal shell, thereby maintaining a constant motor speed despite line voltage fluctuations within 25 per cent plus or minus of normal. The motor operates on low-voltage rectified current, supplied by means of a step-down transformer and dry-disc rectifier. For emergencies, a throw-over switch is incorporated in the general assembly, together with a set of dry cells. In order to prevent a nautical roll or wobble, the 18-inch turntable is mounted on a ball thrust shaft which is sunk in a deep well. Due to the fact that there is no drive or strain of any kind on this shaft, the turntable cannot become wobbly or off center. Any desired type of electromagnetic pick-up may be employed.



Thus at a relatively low cost, the necessary precision has been introduced by means of novel design and construction, for a slow-speed turntable.

Duo Type Volume Control

IN meeting the requirements of radio assemblies calling for the simultaneous control of two circuits, the Clarostat Mfg. Co., Inc., Brooklyn, N. Y., now announces the Duo Type wire-wound volume control clarostat. This device is made up of two standard volume control units, with tapered windings if so desired to match any resistance curve. The units are mounted in tandem, so as to operate with a single knob. Each resistance unit may be arranged for any



(*Continued on page* 106)

New Products For the Trade

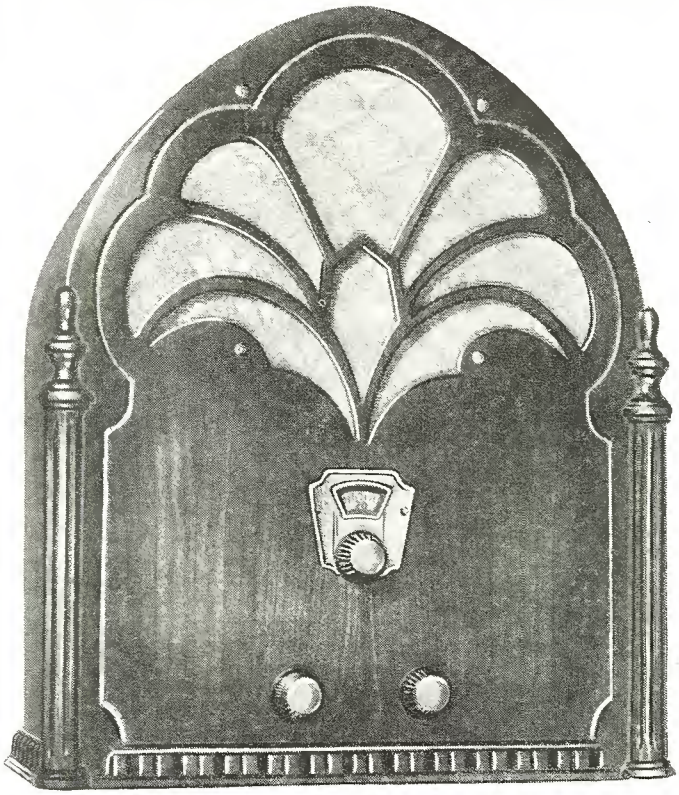
(*Continued from page* 103)

resistance and may be electrically insulated from the other. A power switch can also be included in the assembly, so as to turn the power on and off by means of the single volume control knob. Due to the unique winding and contact member of the volume control clarostat, the knob of the duo type turns with a smooth, velvety action, and without noise even in the most critical radio circuits.

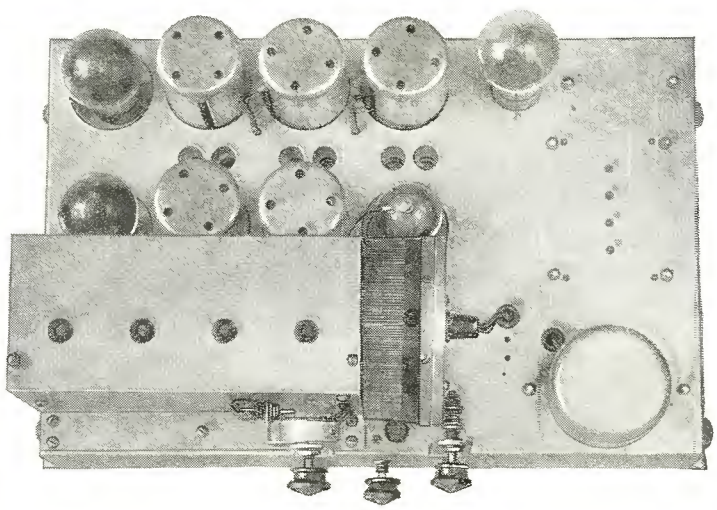
Two New Audiola Sets

Audiola announces new Junior type receiver in a handsome cabinet, uses triple screen grid, and has full tone control and standard dynamic speaker.

Audiola also advises it has released a new Superheterodyne



model, using 9 tubes, including 4 screen grid. Has local-distance switch and personal tone control, very selective, highly sensitive, with fine tonal quality. The receiver is installed in console and standard dynamic speaker.



Auto-Craft Radio Has Remote Control

RECENT developments in automobile radio have produced in the Auto-Craft Radio several outstanding features that make car radio a real contender with the home radio for time on the air.

Auto-Craft Radio, manufactured by the Auto-Craft Radio Co., Michigan Avenue at 28th St., Chicago, Ill., uses remote control which permits placing the radio chassis under the rear floor board in sedans or under the seat in either sedans or coupes, operated by a cable running through copper tubing to the instrument board. This not only aids in eliminating motor noises and vibration but does not interfere with leg room under the cowl or the installation of dash type heaters. This remote control is practically essential in Model A Ford installations where the gas tank occupies the space behind the instrument board.

All that appears in view is the station dial, power and station selector knobs and key for turning on and off, which locks the set against use.

This is a very neat installation and occupies little space on the instrument board, matching up with other instruments. For Ford Model A, this control assembly is mounted on a steel plate, chromium plated, which is mounted below the instrument board without interfering with leg room.

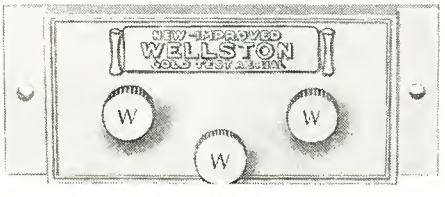
Auto-Craft Radio also includes a dynamic speaker which gives maximum volume and tone-range similar to the new sets in the home. A five-tube set, with three screen-grid and two power tubes is solidly packed in a steel case, tightly sealed against dust and moisture.

Auto-Craft Radio comes complete in every detail, ready for installation, including steel plate antenna for installation under each running board, eliminating the necessity for tearing down top upholstery. Where car is already equipped with antenna in top the set may be hooked up to that. Auto-Craft Radio is designed especially for use in the automobile and for installation that will not mar the car in any way or occupy needed space.

Wellston Gold Test Aerial

F. J. GRENZER, president of the Wellston Radio Corporation of St. Louis, Missouri, reports his company has perfected and introduced, through its nation-wide dealer organization, a new filtered type aerial and a tone control which are fully efficient on any radio set.

The new improved aerial—known as the "genuine Wellston Gold Test Aerial"—follows closely upon the popularity attained by its predecessor—the Original Wellston Gold Test Aerial. Thousands of th eoriginal model are in use on radio sets throughout this and many foreign countries at present.



This amazing little aerial—it measures but 2½ by 5 inches in size—contains the equivalent of 54 feet of aerial, is absolutely non-directional, non-corrosive and will never wear out. It takes the place of all present type cumbersome, unsightly indoor and outdoor aerials. Exhaustive tests indicate that it also improves radio reception to an appreciable degree. Installing the Gold Test Aerial is a very simple matter—even a child can do it in less than a moment's time—no extra tools are necessary—once installed no further attention is needed. It is fully efficient at all times.

The new Wellston Tone Control, like the aerial, is small but mighty and undoubtedly will be welcomed by radio enthusiasts everywhere.

Mr. Grenzer, whose inventive genius created both the aerial and the tone control, said that his company has swung into full production on both items and would have no trouble in filling orders.

New International Resistance Unit

TYPES W. W. 2 as shown here is the latest type of precision wire wound resistor manufactured by the International Resistance Company of Philadelphia. This resistor is made in ranges up to and including 2½ megohms.

The unit has a number of unique features, in that it has a moulded cap, as against a soldered wire contact and the wire itself is carefully tested and properly insulated. These resistors are held to accuracies as close as one-fourth of 1 per cent. They are adaptable to test meter equipment, voltage amplifiers and as standards in laboratory equipment. A special folder has been printed on these wire wound resistors that will be sent free of charge by writing to the Engineering Department of the International Resistance Company, 2006 Chestnut Street, Philadelphia, Pa.

Deutschman Interference Film

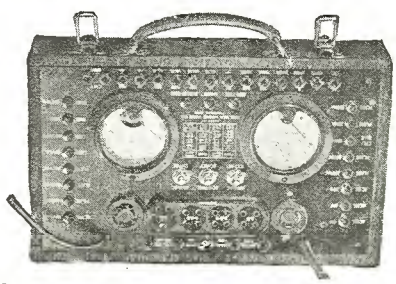
"RADIO Interference"—a one thousand foot moving picture, both silent and in sound, has just been produced by the Radio Interference Committee of California through courtesy of the Tobe Deutschmann Corporation of Canton, Mass., Filterette Div.

Radio clubs, service organizations, cities and towns may obtain the use of this picture by writing the Tobe Deutschmann Corporation direct or communication with this publication. A qualified interference engineer is available to address such assemblies.

Combination Set Analyzer and Tube Checker

E. T. "Ted" Flewelling's latest contribution to the radio instrument field is the new Flewelling combination analyzer and tube checker, manufactured by the Van Horne Tube Company, Franklin, Ohio.

This instrument combines a complete analyzer and a.c. tube checker in a single leather carrying case. It will make a



complete analysis of all circuit conditions existing in any radio receiver or electrical apparatus within the limits of 800 volts a.c. or d.c., and current up to 100 milliamperes.

It is manufactured for use on 60 cycle 110-115 volt a.c. circuits and can also be furnished for use on 25 cycle 110-115 volt and 60 cycle 220 volt a.c. circuits.

A complete tube checker is included, together with a panel chart of tube ratings, as an integral part of the instrument,

thus permitting a complete analysis of any radio receiver and an independent check on its tubes.

The instrument is operated by means of push buttons, and eleven meter ranges are available through the use of pin jacks for external testing.

The meters used are large size bakelite case, three-inch Weston or Jewell. D.c. meter is 1,000 ohms per volt and a.c. meter is a double movement instrument to permit lowest current consumption.

The instrument is fully protected by circuit arrangement so that no damage may result from incorrect operation, accidental or otherwise.

Resistor Replacement Guide

UNDER the title of "Resistor Replacement Guide," the service department of International Resistance Company, 2006 Chestnut St., Philadelphia, Pa., has prepared a most important piece of practical radio literature for the radio service man. In loose-leaf form so as to be kept constantly up to date by inserting new sheets issued by the organization from time to time, there is now available a vast fund of data dealing with resistance fundamentals, formulas, and requirements of standard radio sets for several years past. Standard radio sets are covered in handy tables which include indications of faulty resistors, the purpose of each resistor, resistor connections, color code of original, resistance value, and recommended resistor for replacement. A copy may be obtained by radio workers who send in 50 cents in stamps or coin, to defray actual cost of initial sheets, binder and subsequent sheets, to the company direct.

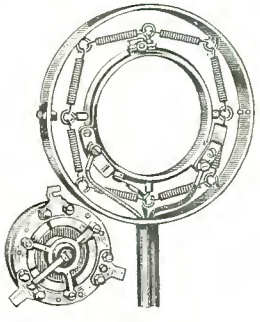
Neuer Compact Aerial

THE Neuer aerial made by the Peoples Service Co. at 475 Jackson Avenue, Jersey City, N. J., is an outside type aerial using hard drawn spring tension phospor bronze. It can be erected in a few minutes in or outdoors where space is limited. On account of the aerial being in a coiled form the desired amount of inductance is crowded into a relatively small space. It may be used horizontally between two supports either inside or outside or it may be used vertically from the cornice of the house to the ground. It is also suitable for an antenna on launches or yachts on account of its compactness.

Ellis Demountable Microphones

THIS invention is the latest achievement of the engineers of the Ellis Electrical Laboratory, 337 West Madison Street, Chicago, Ill. This demountable feature is obtainable in the standard models of the now famous Ellis Models Nos. 29N and 30N.

The Ellis Demountable Microphone was designed for convenience and safety—safety from theft and from exposure to the elements. These purposes are attained by making the microphone unit easily and quickly removable or "demountable" from the supporting fixtures and easily replaceable.



The value of this improvement in the microphone field will be appreciated by those whose patience has been taxed by the

clumsy and burdensome task of removing a microphone, locating a screw driver to disconnect and reconnect the wires, unlacing and relacing a tight set of springs, and being careful to avoid mistakes in reconnecting the cable.

How It Works

The illustration at the left shows the microphone unit completely mounted. It is tightened in its position by the wing nut at the top. The illustration shows how the button connection is drawn from the center of the microphone down to the left by a strip of nickeled brass to a strong switch-blade. A pair of switch-clips makes firm contact with this switch-blade. One of the connections of the cable is securely fastened by a slotted hexagon nut to the switch-clips. The other button connection is taken from the back of the microphone in exactly the same way. A screw insulated through the body of the microphone connects with a similar switch-blade and pair of switch-clips on the front of the microphone, to which, in turn, is connected a second cable connection. The third or "common" terminal of the cable is connected to the frame of the inner ring.

The illustration to the right shows more clearly how all the cable connections are entirely independent of the microphone unit itself. All the connections and fixtures remain intact when the Demountable unit is removed or replaced.

Hickok Ohm-Capacity Meter

ANOTHER of the offerings of the Hickok Electrical Instrument Co. is illustrated in this column, being an ohm-capacity meter.

The apparatus is designed to give the service man an accurate and comparatively inexpensive portable ohmeter and capacity meter.

The Ohmmeter is operated from 4½-volt "C" battery, which is contained in the bakelite case, and has sufficient capacity to operate the Ohmmeter for at least 6 months' ordinary service, and is easily replaceable by removing small plate on bottom of apparatus. In order to take care of changes in battery voltage, a suitable resistance is supplied so that correct readings may be obtained with voltages as low as 4 volts. A push button is provided, which gives instantaneous checks for correct battery voltage.

The scale of the Ohmmeter, which is of the double type, the low range being from 5 to 5,000 ohms and the high range from 500 to 500,000 ohms is of sufficient range in ohms to measure practically all resistors encountered in a modern radio receiver.

Continuity Tester:

The Ohmmeter makes an exceedingly desirable continuity tested, as it not only indicates continuity of all circuits, but at the same time, the actual resistances in ohms of the circuits may be direcly observed.

Leads:

A pair of insulated leads are supplied with each tester, which are very convenient in making continuity and other tests.

Accuracy:

The accuracy of the Ohmmeter is guaranteed within 1 per cent, and in most cases is within ¼ of 1 per cent.

Capacity Meter

The capacity meter operates directly from 110 volts, 60 cycle a.c. line current, and a suitable pair of leads are supplied for connection to the a.c. line.

Range:

The range of the capacity meter is from ¼ to 15 microfarads, with the maximum sensitivity from 1 to 4 microfarads, which is the average value of by-pass condensers encountered in modern radio receivers.

Accuracy:

Its accuracy is within 1 per cent, and the indications of the instrument are independent of line voltage fluctuations, as a suitable rheostat is supplied together with push button, whereby the line voltage adjustment may be easily checked by simply pressing the push button.

Leaky Condensers:

Leaky condensers is a most frequent source of trouble encountered in by-pass condensers in radio receivers, and these can be instantly checked, not only by reading the capacity, but by using the ohmmeter and measuring the actual resistance in ohms of the condenser.

Cornish Has New Hookup

A NEW product announced by Cornish Wire Co., 30 Church St., New York City, is known as Paralac, a moisture-proof hook-up wire with the slide back feature. The Paralac coating is applied between the copper conductor and the outer sleeve, insuring moisture protection and adding greatly to the voltage breakdown.

In use the Paralac coating and the outer sleeve push back wtihout bunching.

Among some of the merits stated for the new product are the following: high voltage breakdown, insures slide back readily, good tinning insuring easy soldering, insulation is flame proof, insulation is moisture proof and no premium in cost.

Engineers may secure samples of the new Paralac wire by writing to the company at the address given above.

F. & H. Has Two New Items

THE F. & H. Radio Laboratories at Fargo, N. D., announce two new products, one being a tone control and noise eliminator; the other a capacity aerial eliminator. Both are shown here.

As a tone control the unit shown will permit varying the tone of the set so as to conform to the musical taste of the listener. It will bring out the deep mellow bass so greatly desired by many. It will also materially reduce the high frequency noises coming in from the line.

The capacity aerial eliminator is quickly installed and enables the set to be moved from room to room, it only being necessary to disconnect the ground wire and the customary 110 volt supply.

Proper Type Amperites Listed

SERVICE men and engineers may be interested in a recent release by The Amperite Corp., 561 Broadway, New York City, in which are set forth the type Amperite self-adjusting line voltage controls required for use in the majority of the factory receivers.

In a table contained in "Dealers Descriptive Price List Effective September 15, 1930," will be found the type numbers covering about seventy-five factory receivers and a large number of the kit receivers. For service men this particular list should be especially valuable as it will permit them to use the proper size Amperite for the models mentioned.

New Cardwell Condensers

THE Allan D. Cardwell Mfg. Corp., 81 Prospect St., Brooklyn, N. Y., is announcing redesigned Cardwell condensers for amateur use and medium powered commercial stations.

In the models T-199 and T-183 much heavier plates than have been previously used by any one for condensers of this class are employed and the edges are carefully rounded off and the whole job brought to a very high degree of polish.

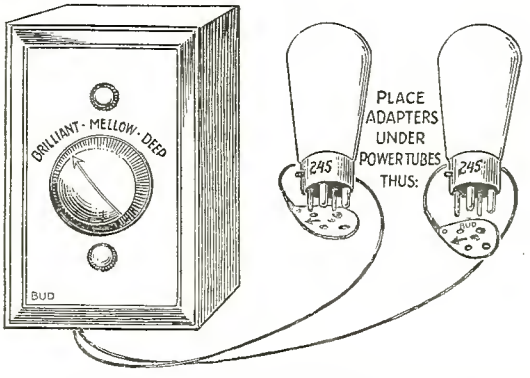
As a result of this type of construction the condenser will withstand about 60 per cent more voltage before flashing over than would be the case if plates of the ordinary variety were used. In addition to this extra heavy plates give a freedom from vibration which makes their use for tuning on wavelengths below 30 meters very advantageous, as only a very small amount of variation on such high frequencies is necessary to throw the wave off and make signals difficult to read.

A self-cleaning brush contact is used rather than a pig tail. Variance in inductance and capacity caused by the movement of the pig tail as the rotor revolves very frequently causes a great deal of trouble on short waves and consequently Cardwell condensers are made with the improved contact.

Interesting data giving condenser types, general specifications, individual characteristics and suggestion for selecting transmitting condensers are contained in a circular covering Cardwell transmitting condensers for amateur and medium power commercial installations, which circular will be sent by the manufacturer to those writing for it at the address given above.

Bud Tone Control Announced

One of the radio products recently announced by Bud Radio, Inc., 2744 Cedar Ave., Cleveland, Ohio is shown in the illustration below.



As can be seen from the illustration the tone control is across the pushpull tubes and the tone is varied as desired by the listener. It is easily attached to the radio set.

Leutz Has Book on Short Waves

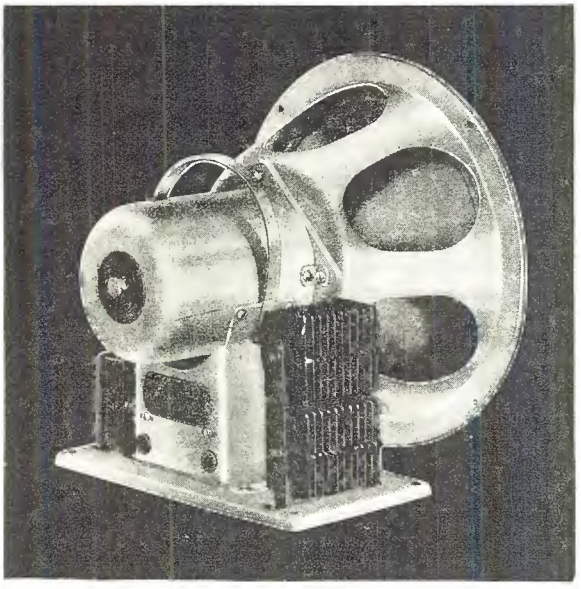
A BOOK on short waves, giving many diagrams, photos and the operating theory has been announced by C. R. Leutz of that company at Altoona, Pa.

Among the subjects covered are ship-to-shore radiophone and trans-Atlantic radio telephony, world wide amateur communication, television, etc. The book has 250 illustration with 384 pages.

Oxford Auditorium Speaker

SHOWN in this column is the model 71 auditorium speaker made by the Oxford Radio Corporation, 2035 W. Pershing Place, Chicago, Ill.

Its height is 12⅝ inches, and weighs 31 pounds. The baffle



opening is 11 inches; it has a 15 watt field and is equipped with a double Kuprox 110 volt plate rectifier. It will operate on 25, 30, 50, and 60 cycles.

Falck Claroceptor

THE electric lighting wires of a city are endless antenna which collect not only signals from broadcast stations but also electrical interference noises caused by telephones, street cars, elevators, electric motors and countless electric devices used within and outside the home. These disturbances flood into a.c. radio sets through the wall socket connection and are heard as blare, squel, fry and scratch—"Man-made static."

But now it is possible to block out these noises from the set by means of the Falck Claroceptor. By plugging in a Claroceptor between the wall socket and set, the disturbing foreign noises are grounded and only the current passes through to the radio. Lowering the noise level permits the signals of distant stations, that were previously drowned out by the disturbing noises, to be heard and tuned in. Thus the distance range is increased. By keeping out of the set the broadcast station signals picked up by the lighting wires, tuning is refined and thus selectivity is improved.

The unit is made by the Advance Electric Co., 1260 W. 2nd St., Los Angeles, Calif.

Rochester Reproducer Units

FOUR new products are announced by the Rochester Reproducers Corp. of which I. B. Serge is president. at 45 Halstead St., Rochester, N. Y.

Three arc sound projector units, models 37, 38 and 39, while the fourth is a sound projector unit for use with automobile radio sets.

Models are available either for a.c. or d.c., the model 39 being for theaters, public address systems, clubs, apartments and hotel installations.

Perma-Charge for Autos

A NEW battery charger designed to be permanently attached to the motor car has been announced by Perma-Charge, Inc., 4390 Pearl Road, Cleveland, Ohio.

The Perma-Charge has no bulb, acid or vibrator but uses a new patented dry metallic rectifier element having a long life. The unit can be installed in a few minutes by any service man, being fastened to the engine separating board. The electrical connections go to the metal work (ground) and the ammeter of the car, the latter indicating when the Perma-Charge is in operation. When driving into the garage the motorist attaches one end of the cord furnished to the light socket and simply inserts the special plug on the other end into the charger, assuring himself of a peppy battery the next time the car is used.

Miles Reproducer Line

ANNOUNCING its complete line the Miles Reproducer Co., 45 W. 17th St., New York City, has issued its catalog M-50 covering sound amplifying equipment.

Included in the line are 3½ foot exponential trumpets, square baffles for cone speakers and baffles for dynamic cones. In addition to that are 9 and 10 foot exponential horns, the 10 foot model being square.

The newest type is the M-18, which is a reflex 5 and 1 horn.

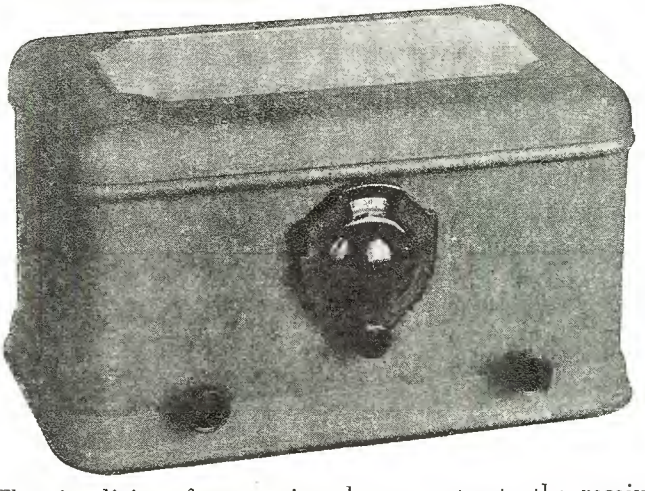
In this literature will also be found data covering the giant dynamic horn unit as well as the Junior dynamic horn unit and a line of single and double button microphones and microphone stands.

Those interested in this type of material may secure a copy of this catalog by writing the manufacturers at the address given above.

George W. Walker Super-Converter

IN keeping with the rapid progress of short wave developments, the particular radio fan insists upon a reliable means of receiving the alluring foreign programs.

With the new Walker Super-Converter one need only plug into the electric light socket, disconnect the antenna from his present a.c. or battery R.F. receiver, and attach same to the converter. A wire connection is then made from the converter to the antenna post of the receiver and all is ready to tune in on the short wave stations.



The simplicity of connecting the converter to the receiver, plus the ease of truly single dial control, will impress the novice. There is nothing to learn about the operation and all tuning is done with the converter. The signal is picked up by the unit and is passed through the T. R. F. stages of your receiver, which now functions as an intermediate circuit, for greater amplification. All of the tubes in your present receiver

are utilized, as well as the speaker, and great volume naturally results. There is now no need to purchase a regular short wave receiver as the method of tuning and amplification described represents the last word in short wave receiver design. It is this principle of reception that is used by all commercial trans-oceanic phone stations in their communication with foreign countries.

The Walker Super-Converter is furnished completely assembled and wired. Nothing is required but the connection to your receiver and the necessary tubes. Years of experience in the manufacture of short wave equipment is embodied in this device. Each part used is carefully selected of the highest quality material to insure long life and satisfactory performance. Every converter is tested in actual operation and does not pass inspection at the factory until the efficiency indicates foreign reception.

A four tube converter, including a stage of screen grid radio frequency ahead of the detector, requiring 1—No. '24, 2—No. '27 and 1—No. '80 type tube. The No. '80 type rectifier is selected due to its long life, low cost and the advantage of furnishing a truly reliable and adequate power supply. There are no camouflaged tuning controls. Both tuning and oscillator condensers are ganged and controlled by a vernier dial, insuring simplicity and ease of operation.

The converter is especially designed to cover a wave band of 15 to above 200 meters. One of the coils furnished with the converter covers the popular wave band of 15 to 50 meters. All the popular short wave programs, including foreign stations, are confined to a wave band of about 15 to 50 meters. This makes the changing of coils almost unnecessary.

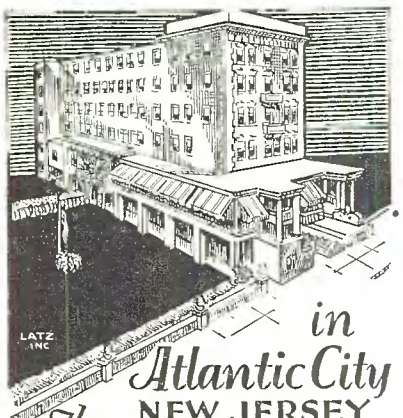
Clearatuner Loading Coils

THE Radio Clearatuner is a two-tuned circuit consisting of an inductance coil working in conjunction with a special fixed condenser. It is controlled by a variable arm on the coil and when attached to an aerial wire at the receiving set, tunes the aerial circuit, for which the manufacturers claim more volume, greater distance, greater selectivity and less interference.

According to the instructions the Clearatuner is rather sensitive so the user should tune accordingly. The movable arm is adjusted to the point where best results are secured but it is not necessary to move the arm every time a new station is tuned in. In some cases by simply moving the arm up on the coil two or three wires, it will be possible to separate two stations and bring in the one desired.

The Clearatuner can be used in two methods of connection. In one it is used in series with the antenna circuit where it becomes a loading coil. Another one of the uses shown on the descriptive literature is a parallel with the antenna and ground.

It is manufactured by the Radio Clearatuner Co., 311 Gardner Bldg., Toledo, Ohio.



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THORDARSON HIGH-VOLTAGE POWER TRANSFORMER—250 Watts—for 2 UX-250's or 210's, and 2-UX-281 Tubes **$4.75**

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DUBILIER 11¾ Mfd. HIGH VOLTAGE FILTER CONDENSER BLOCK. D. C. Working Voltages 1,000, 600 and 160.....**$2.75**

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The Big Sensation of the Year

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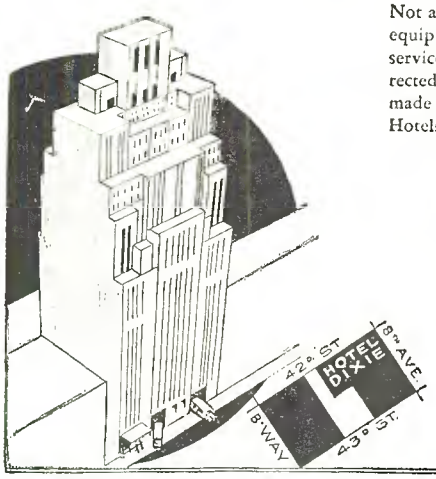
A New and Better Hotel for Times Square



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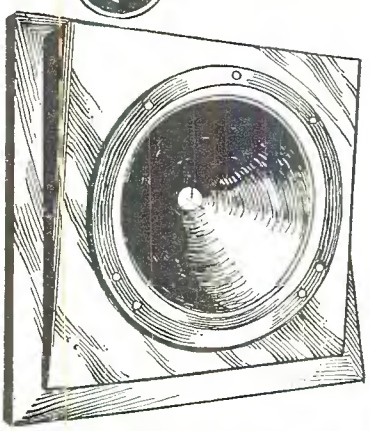

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Never before was such an astounding value offered. Every carnival owner, motion picture house, theater, church, fair, American Legion Post, club, sound engineers and radio experimenters will want one.

12-inch Dynamic. Field Supply, 110 volts D. C.; Field Resistance, 1000 Ohms; Voice Coil, 8 Ohms; Mounting, Steel angle frame. For adaptation to A. C. operation, $6.50 additional.

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Factory Built Receiver Schematics

Drawings listed below are intended for Service purposes only. If the schematic you desire is not shown here, write us for it.

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No. SR3	Acme AC7	.50
No. SR4	Acme AC4	.50
No. SR1	All-American Mohawk 6	.50
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No. SR74	All-American Mohawk 96	.50
No. SR21	American-Bosch 28 and 29	.50
No. SR73	American-Bosch 48	.50
No. SR22	Amrad 70 A. C.	.50
No. SR44	Amrad S1	.50
No. SR80	Apex 48 Chassis	.50
No. SR28	Atwater-Kent 38	.50
No. SR51	Atwater-Kent 55 & 55C (Cap. Coupled)	.50
No. SR52	Atwater-Kent 55 & 55C (Inductive Coupled)	.50
No. SR79	Audiola 31	.50
No. SR12	Balkeit A	.50
No. SR94	Bosch Auto Radio 80	.50
No. SR10	Bremer-Tully 7-70	.50
No. SR75	Bremer-Tully S1 & S2	.50
No. SR23	Brunswick 3KRO	.50
No. SR71	Brunswick S-14	.50
No. SR86	Brunswick 15, 22, 32, 42	.50
No. SR78	Clarion 50	.50
No. SR29	Colonial 31AC	.50
No. SR95	Colonial 33 & 34 A. C.	.50
No. SR47	Columbia SG-8	.50
No. SR103	Crosley 53 & 54	.50
No. SR5	Crosley 60S Gembox	.50
No. SR6	Crosley 705 Showbox	.50
No. SR41	Crosley Jewelbox 704B	.50
No. SR57	Crosley 40S, 41S, 42S & 82S	.50
No. SR67	Crosley "Roamio" (Auto Radio)	.50
No. SR83	Crosley 77	.50
No. SR11	DayFan 5080	.50
No. SR66	Delco Auto Radio	.50
No. SR87	Delco Police Short Wave Receiver 3003	.50
No. SR99	Edison R6 & R7	.50
No. SR49	Edison R4, R5, C4	.50
No. SR33	Erla DuoConcerto R-2	.50
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No. SR13	Fada 7AC	.50
No. SR70	Fada 35 & 35Z	.50
No. SR19	Federal H	.50
No. SR20	Freed-Eisemann NR-80	.50
No. SR14	Freshman 2-N-12	.50
No. SR68	General Motors	.50
No. SR32	Gilfillan 100	.50
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No. SR16	Howard Green Diamond 8	.50
No. SR56	Howard SG. A	.50
No. SR77	Kellogg 523	.50
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No. SR81	Kennedy 26	.50
No. SR31	King Model J	.50
No. SR8	Kolster 4	.50
No. SR45	Kolster 21-23	.50
No. SR72	Kolster K43	.50
No. SR65	Kylectron 70	.50
No. SR98	Majestic Super. "Chassis" 50	.50
No. SR7	Majestic (Grigsby-Grunow) 70	.50
No. SR55	Majestic (Grigsby-Grunow) 90B	.50
No. SR84	Majestic (Grigsby-Grunow) 130-A	.50
No. SR26	Philco 86-82	.50
No. SR60	Philco 95	.50
No. SR104	Radiette F-14	.50
No. SR102	RCA 44	.50
No. SR30	RCA 60	.50
No. SR64	RCA 66	.50
No. SR35	Silver-Marshall 30	.50
No. SR53	Silver-Marshall 30-B	.50
No. SR82	Silver-Marshall 35-A	.50
No. SR27	Slagle (Continental) 9	.50
No. SR46	Slagle (Continental) R-20	.50
No. SR25	Sonora Delux 5R	.50
No. SR91	Sparton 600; 610 & 620	.50
No. SR9	Sparton AC89	.50
No. SR58	Sparton 931	.50
No. SR63	Sparton 589	.50
No. SR36	Splitdorf E-175	.50
No. SR15	Steinite 261	.50
No. SR76	Steinite 70, 80, 95	.50
No. SR34	Stewart-Warner 900	.50
No. SR62	Stewart-Warner 950	.50
No. SR85	Stewart-Warner R-100A, B & E	.50
No. SR93	Stromberg-Carlson 12 & 14	.50
No. SR18	Stromberg-Carlson 635 & 636	.50
No. SR54	Stromberg-Carlson S46	.50
No. SR37	Temple S-60, S-80 & S-90	.50
No. SR69	Transitone Auto Radio	.50
No. SR39	U. S. Radio & Television 37	.50
No. SR101	Victor Micro-Synchronous R-35; R-39 & RE-57	.50
No. SR61	Victor R-32, RE45 & R52	.50
No. SR92	Westinghouse WR-5	.50
No. SR97	Zenith 71; 72; 73 & 77	.50
No. SR43	Zenith 52	.50

Public Address Systems

No. SR100	Amer-Tran PA-86	$0.50
No. SR90	Silver-Marshall 692	.50
No. SR88	Webster (Racine, Wis.) A37-50	$0.50
No. SR89	Webster (Chicago) DH-250	.50

Kit Receiver Blueprints

Full sized blueprints are available of any circuit ever published in the Call Book. Space permits listing only a few of the more popular ones. Write us if the desired print is not shown here.

No. 14	Browning-Drake 4 Tube Receiver Using Audio Frequency Amplification	$1.00
No. 32	Scott "World's Record" Super Eight	1.00
No. 37	Madison-Moore "One-Spot" Receiver	1.00
No. 56	Improved Browning-Drake	1.00
No. 58	"World's Record" Super Nine	1.00
No. 68	Improved Remler 45 K. C. Super-heterodyne Receiver (5 drawings)	1.00
No. 73	Magnaformer Super-heterodyne Receiver (5 drawings)	1.00
No. 99	Magnaformer 9-S A. C. (5 drawings)	1.00
No. 123	World's Record Super Ten & Power Pack (6 drawings)	$1.00
No. 147	Custom-built Model Madison-Moore International One-Spot A. C.—Sub-panel Job (6 drawings)	1.00
No. 167	Scott World's Record SG Nine "Power Pack Operated" (4 drawings)	1.00
No. 179	Lincoln S-80 One-Spot Super—(3 drawings)	1.00
No. 218	Aero International Four Receiver (4 drawings)	1.00
No. 231	Custom-built Model World's Record Shield Grid A. C. 10 (4 drawings)	1.00
No. 246	Pilot Super-Wasp Short Wave Receiver (3 drawings)	1.00

Graphic Wiring Diagrams

No. 101	World's Record Economy Super 8	$0.60
No. 174	Sargent-Rayment Seven Receiver	.60
No. 193	Junior 2 Tube Receiver	.10
No. 196	Aero A. C. Short Wave Converter	.60
No. 202	Silver-Marshall 730 Four Tube Receiver	.60
No. 204	Sangamo Push-Pull Lab. Amplifier	.60
No. 210	Silver-Marshall 6 Tube Receiver (using output choke)	.60
No. 213	Junior 4 Tube Receiver	$0.10
No. 221	Modulated Oscillator	.60
No. 225	Hollister A. C. Super Eight	.60
No. 236	S-M 722 A. C. Screen Grid Receiver	.60
No. 237	S-M 735 Short Wave Receiver, A. C.	.60
No. 244	S-M S. G. A. C. 712 Rec. (to be used with 677 Power Pack)	.60
No. 245	S-M 677 Power Pack (to be used with 712 Receiver)	.60

Schematic Wiring Diagrams Primarily for Service Work

No. 174a	Sargent-Rayment Seven Receiver	$0.50
No. 187a	Citizens Special Short Wave Receiver	.50
No. 191a	Scott World's Record SG Nine "Battery Operated"	.50
No. 206a	HFL Special Nine A. C. Super	.50
No. 211a	Magnaformer 1929 A. C. Super	.50
No. 221a	Modulated Oscillator	.50
No. 223a	Silver-Marshall 720 A. C. Shield Grid Six	.50
No. 225a	Hollister A. C. Super Eight	.50
No. 234a	HFL Mastertone Receiver, A. C.	.50
No. 236a	S-M 722 A. C. Screen Grid Receiver	.50
No. 237a	S-M 735 Short Wave A. C. Receiver	.50
No. 238a	Lincoln S-40 Screen Grid A. C. Super	.50
No. 293a	C. R. Leutz "Seven Seas" Console Receiver	.50
No. 242a	National Screen Grid MB-29 Receiver	$0.50
No. 244a	S-M S. G. A. C. 712 Rec. (to be used with 677 Power Pack)	.50
No. 245a	S-M Power Pack (to be used with 712 Receiver)	.50
No. 249a	Hammarlund-Roberts Hi-Q 30	.50
No. 250a	Braxton-King A. C. S. G. Super, Model A	.50
No. 254a	Lincoln DeLuxe Ten A. C. S. G. Receiver	.50
No. 255a	Silver-Marshall 722 S. G. D. C. Receiver	.50
No. 257a	Hammarlund-Roberts HiQ-30 D. C.	.50
No. 266a	Lincoln DeLuxe 31	.50
No. 268a	Scott Auto Super	.50
No. 270a	Silver-Marshall 738	.50
No. 271a	Mississippi Valley 5C	.50
No. 274a	Hammarlund Hi-Q 31 A. C.	.50

Any of the above blue prints will be sent postpaid by return mail upon receipt of the proper amount. C. O. D. orders not accepted.

CITIZENS RADIO SERVICE BUREAU 508 SOUTH DEARBORN STREET 7TH FLOOR—CHICAGO, ILLINOIS

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of CITIZENS RADIO CALL BOOK MAGAZINE AND TECHNICAL REVIEW, published four times yearly at Chicago, Illinois, for April 1, 1930. State of Illinois, County of Cook, ss.

Before me, a notary public in and for the state and county aforesaid, personally appeared Chas. O. Stimpson, who, having been duly sworn according to law, deposes and says that he is the Publisher of the CITIZENS RADIO CALL BOOK MAGAZINE AND TECHNICAL REVIEW and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Chas. O. Stimpson, Chicago, Ill.; Editor and Managing Editor, Fred A. Hill, Chicago, Ill.; Business Manager, H. Anheiser, Chicago, Ill.

2. That the owner is (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given): Citizens Radio Service Bureau, Chicago, Ill.; Chas. O. Stimpson, Chicago, Ill.; H. Anheiser, Chicago, Ill.; F. A. Hill, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding one per cent or more of total amount of bonds, mortgages, or other securities are (if there are none, so state): There are none.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

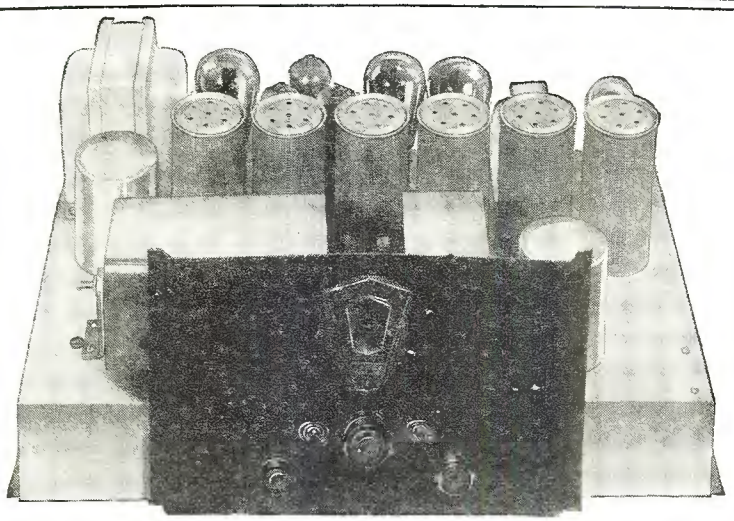
5. That the average number of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is (this information is required from daily publications only).

CHAS. O. STIMPSON,
Publisher.

Sworn to and subscribed before me this 31st day of March, 1930.

(SEAL) NELLIE E. RYAN.
(My commission expires July 25, 1932.)

Index to Advertisers



H·F·L

MASTERTONE SUPER 10 WITH THE HOPKINS BAND-REJECTOR SYSTEM

POSITIVE 10-KILOCYCLE STATION SEPARATION

IN THE FIELD OF FINE RADIO THIS AMAZING SUPER-HETERODYNE IS NOW A RECOGNIZED RADIO ENGINEERING TRIUMPH!

IT now stands out as the preiminently fine receiver in all the field of super-heterodynes. It actually affords reliable, definite 10-kilocycle separation and does that without sacrifice of quality. It reproduces with a fidelity, clarity and volume that has hitherto been unknown. It is laboratory, engineer-built. It is made of the finest units the art affords. Electrically and mechanically, it is distinguished as radio's first really great receiver.

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"Have always owned a high grade radio, but find I missed a lot of enjoyment by not having owned a Mastertone before. The clearness with which it performs is simply amazing and the ease with which distant stations roll in is almost miraculous"—L. M. M., Detroit.

"My last Mastertone customer has verified report showing reception of WEEI Boston at 12:30 PM (noon) and program held for half hour, loud and clear..."—E. P. C., Exeter, Cal

"Received over 132 distant stations in all parts of country, not counting locals in 100 miles. Also KGU, Honolulu a number of times. West Coast comes in wonderfully. Am only 20 air miles from New York City! Pull in Chicago one point from WJZ and others one point from WOR and WABC!—A. H. H., Mahwah, N. J.

Hundreds of such spontaneous expression from users everywhere are eloquent proof of the superior performance on this amazing receiver.

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Be satisfied with nothing less than the marvelously efficient operating characteristics, the magnificent tone and surging power of a supetheterodyne. The difference in cost is negligible. The difference in enjoyment is unmeasurable. But, make certain of a good superheterodyne by purchase of an H. F. L., the product of an organization with years of specialized experience in this field. There are marked differences in supers, as you will readily determine the moment you have seen, tuned and heard this amazing new 1931 Mastertone 10!

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Give us the opportunity to prove all the unusual claims we make for this masterful set in your own home entirely at our risk. Feel its surging power. Experience the thrill of its sharp tuning, clipping powerful stations apart with a definiteness and reliability that is uncanny. Be carried to new heights of musical enjoyment by hearing your favorite stations with a naturalness of reproduction never before attained. Reach out to the far corners of the earth for a thrilling evening of DX hunting. Prove yourself that here is a receiver that is actually far ahead of anything radio has yet known.

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Pattern 199 Set Analyzer
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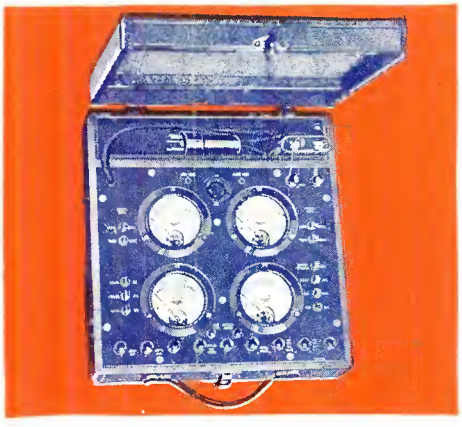

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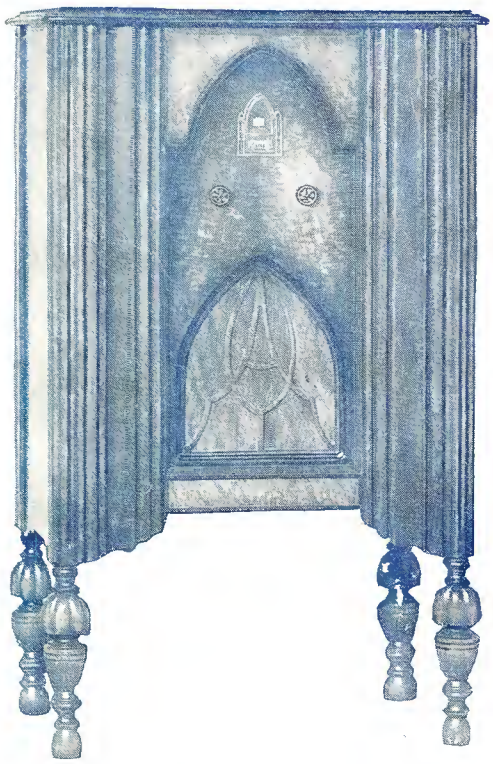

THE new Audiola Superheterodyne represents the most advanced development in radio to date! Not to be confused with the old type superheterodynes employing three gang condensers—the new Audiola is a four gang condenser screen grid super with the latest type of dual pre-selector stage.

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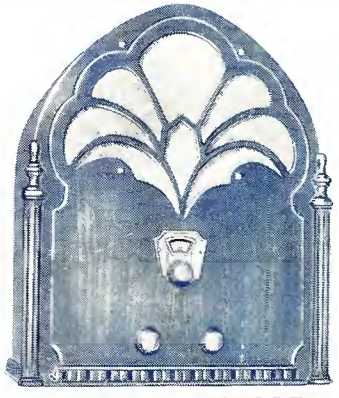
THE new Audiola Superheterodynes are housed in beautiful Gothic design cabinets. Artistic creations that will harmonize with the finest surroundings.

Superheterodyne Model No. 72

Without Tubes, only **$119**



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