Radio Call Book Magazine and Technical Review

Established 1921

25¢

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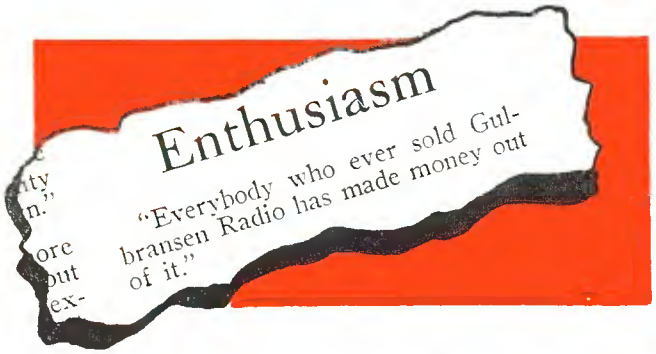
for January, 1932

Performance curves and schematics of following receivers:

Frequency assignments of all broadcast, short wave relay, police and visual stations. Other informative features in every issue

SERVICE - ENGINEERING - SALES



They say we're *enthusiastic*

...and we *are*...we caught it from GULBRANSEN

Dealers and Jobbers

AN unbroken record of "no distress merchandise" . . . a service history, certified by scores of jobbers and dealers, to the effect that Gulbransen Radio very rarely requires a service call after installation . . . these are the reasons why we are "enthusiastic", as a trade magazine commented recently in quoting from a Gulbransen advertisement.

The Gulbransen line, with its background of nation-wide goodwill, is today one of the surest profit producers in the industry. These modern Superheterodynes have *everything* that is new and wanted . . . EVERYTHING.

There is no *cheap* Superheterodyne, because you know and we know that a *good* Superheterodyne cannot be built and sold cheaply. The low-priced Gulbransen receiver is a time-tried TRF set of splendid performance—better than a cheap "Super" could possibly deliver.

Another fact which you know and we know, is that "most service calls start in the factory production line". Gulbransen stops 99% of them there, by the simple means of employing two inspectors for every three producing workers.

That's why Gulbransen dealers are "sitting pretty" . . . and we'd appreciate an opportunity of proving this to you. Wire or write—

GULBRANSEN COMPANY
Factory and General Offices: 816 N. Kedzie Ave.
CHICAGO, ILLINOIS

GULBRANSEN
SUPERHETERODYNE
Radio
TUNED RADIO FREQUENCY

Console De Luxe Model 235. 10-tube Superheterodyne (four '35 Vari-mu, two '47 Pentode in push-pull, three '27 and one '80). Compensating Dynamic Speaker, Visual Tuning meter (simplified distance tuning), Automatic and Manual Volume Controls, Tone Control, Full-floating Tuning Condenser, Power Switch. No "blasting," no fading, no "tube" noises, no cross-talk. Price, complete with R. C. A. tubes, $113.50.

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Mantel Receiver Model 130. Seven-tube Superheterodyne (two '35 Vari-mus, one '47 Pentode, two '24 screen grid, one '27 and one '80). 10-kilocycle separation. Full-floating Tuning Condenser. Completely selective, beautiful in tone. Finest cabinet work. Price, complete with R. C. A. tubes, $69.50.

Mantel Receiver Model 330. Six-tube, tuned radio frequency, including four '24 screen grids, one '45 power tube. Powerful Dynamic Speaker. Selective, sensitive, ample volume and pleasing tone. Price, complete with R. C. A. tubes, $48.00.

'Round the World Reception *Every day,* in all seasons

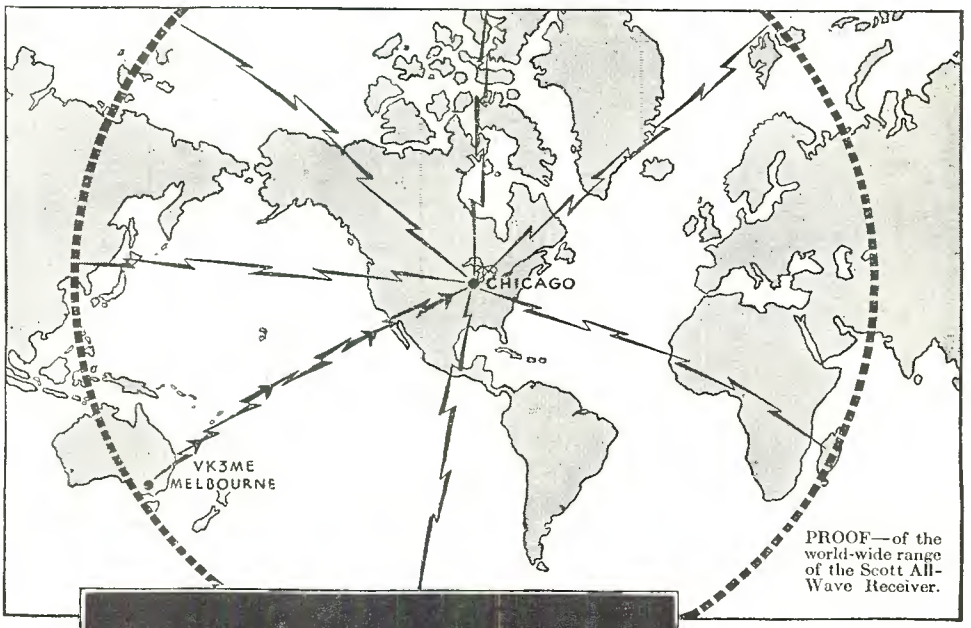
21 weeks, constant reception record from VK3ME proves SCOTT ALL-WAVE capable of tuning in clear 'round the earth regularly—every day, summer and winter.

●

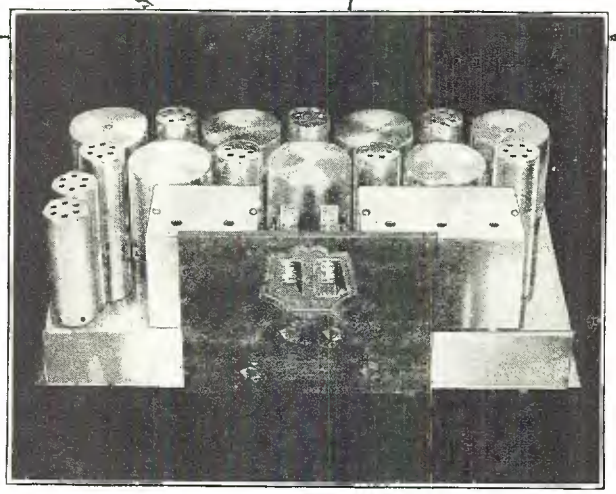
FOR 21 weeks, a Scott All-Wave Reeeiver, located in Chieago has brought in, *and recorded on disc, every* broadeast from VK3ME, Melbourne, Australia. Eaeh broadcast was reeeived with perfeet clarity and full volume—as the disc records decisively prove. Think of it! VK3ME, half way 'round the earth! Not just once in a while. Not just a freak happenstance. As this book goes to press, VK3ME is still being reeeived with perfeet regularity, and recorded. With a Scott All-Wave, *you* could get VK3ME and dozens of other foreign phone stations whenever you choose.

When the distance between Melbourne and Chieago is used as a radius, a circle drawn from Chieago as the center, includes practically the entire world. This establishes the range of the Seott All-Wave Receiver, and steady reception from all points north, south, east and west, *at the extremes of the circle*, PROVE the world-wide range of this remarkable instrument.

The reason for the greater range of the Scott All-Wave is the far greater amplification obtained in its intermediate stages. A new type of transformer, in whieh the primary is shielded from its seeondary, provides sueh an enormous inerease in gain per stage that the sensitivity of the receiver is more than adequate for world-wide reeeption, with the tubes operated below the noise level. Short Wave reception that is ordinarily attended with terrific interference, eomes in clearly on the Scott All-Wave—and with beautiful, full, round, natural tone. Reeeption from VK3ME, from G5SW, Chelmsford, England, from 12RO, Rome and other far off points, invariably has the quality and volume of a loeal station! Actually, in all truth, the Seott All-Wave gives 'round the world reeeption *every* day, in all seasons—between 15 and 550 meters.



PROOF—of the world-wide range of the Scott All-Wave Receiver.



The Beautiful Chrome Plated Scott All-Wave Chassis

FIVE YEAR GUARANTEE

The Scott All-Wave is not a faetory product. Rather, it is built in the laboratory, by laboratory experts and to laboratory standards. For that reason, we can make the most unusual guarantee ever made on a radio receiver. The Scott All-Wave is *guaranteed for full five years against defective material or workmanship.* Any part that fails within that time will be replaeed FREE OF CHARGE.

Mail Coupon Today

Full particulars of the Scott All-Wave will be of immense interest to you. Get them now. Read all about the receiver that challenges the whole realm of radio to any kind of competitive test. The coupon below will bring them. Clip it—fill it in—mail it today.

THE E. H. SCOTT RADIO LABORATORIES, Inc.
(Formerly Scott Transformer Co.)
4450 Ravenswood Avenue - Dept. CB1 - Chicago, Ill.

The SCOTT ALL-WAVE

15-550 METER SUPERHETERODYNE

CLIP—MAIL NOW

THE E. H. SCOTT RADIO LABORATORIES, Inc.
4450 Ravenswood Ave., Dept. CB1, Chicago, Ill.

Send me full details of the Seott All-Wave Reeeiver.

Name.....

Street.....

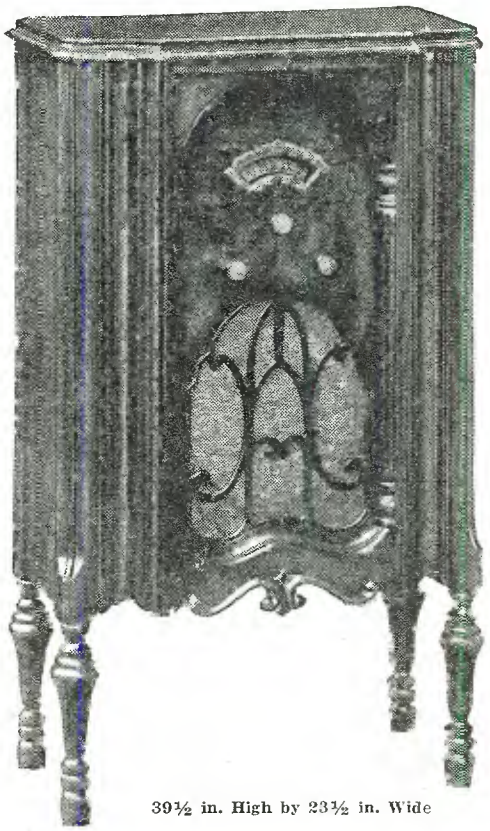
Town..... *State*.....

SUPERHETERODYNE CONSOLES
are the Sets to Sell

Audiola sales are at a high peak for two reasons—1st, Console sets are the big sellers today. 2nd, Audiola Console sets win customer approval. Here are the Audiola features—12 reasons why you should begin an active selling campaign with Audiola Consoles. PENTODE. VARIABLE-MU. FULL RANGE TONE CONTROL. FULL VISION DIAL. PHANTOM LIGHT INDICATOR. R.C.A. TUBES. JENSEN DYNAMIC SPEAKER. BEAUTIFUL CABINETS. SUPERB TONE QUALITY. EXCEPTIONAL PERFORMANCE. EXTREME VALUE. 10 YEARS' EXPERIENCE.

AUDIOLA

Known For Its Tone



39½ in. High by 23½ in. Wide

Model 712 Seven tube FULL SIZE Superheterodyne employing both Pentode and Variable-Mu tubes. Equipped with tone control, full vision dial, phantom light indicator and dynamic speaker. The above Console is FULL SIZE with beautiful front panel of figured stump walnut and decorative panels of lacewood and burl walnut.
Uses the following tubes: 2—35; 2—24; 1—27; 1—47; 1—80.
List price complete with genuine Cunningham or Radiotron tubes..... **$69.95**

42½ in. High by 24½ in. Wide

Model 914 Nine tube FULL SIZE sturdily constructed superheterodyne, employing in addition to two Variable-Mu tubes, also two Pentode tubes in push-pull, preceded by a first audio stage. A powerful receiver with tremendous volume output. Tone control, full vision dial, phantom light indicator and large 12 in. dynamic speaker. Beautiful substantial cabinet. Uses following tubes: 3—35; 1—24; 3—27; 2—47; 1—80. List price complete with genuine Cunningham or Radiotron tubes..... **$89.00**

10 YEARS ago AUDIOLA first made its appearance. AUDIOLA now has this record—10 years of successful manufacturing and merchandising—10 years of good radio business and profit for Audiola dealers and jobbers. Master radio engineers have continued to increase Audiola quality from year to year. Since the 1921-1922 interval, Audiola has made an amazing gain in popularity. Today Audiola is creating and maintaining a strong consumer demand by sheer value and performance.

An Audiola franchise today is of great value—there are territories available for jobbers—don't overlook this outstanding radio opportunity.

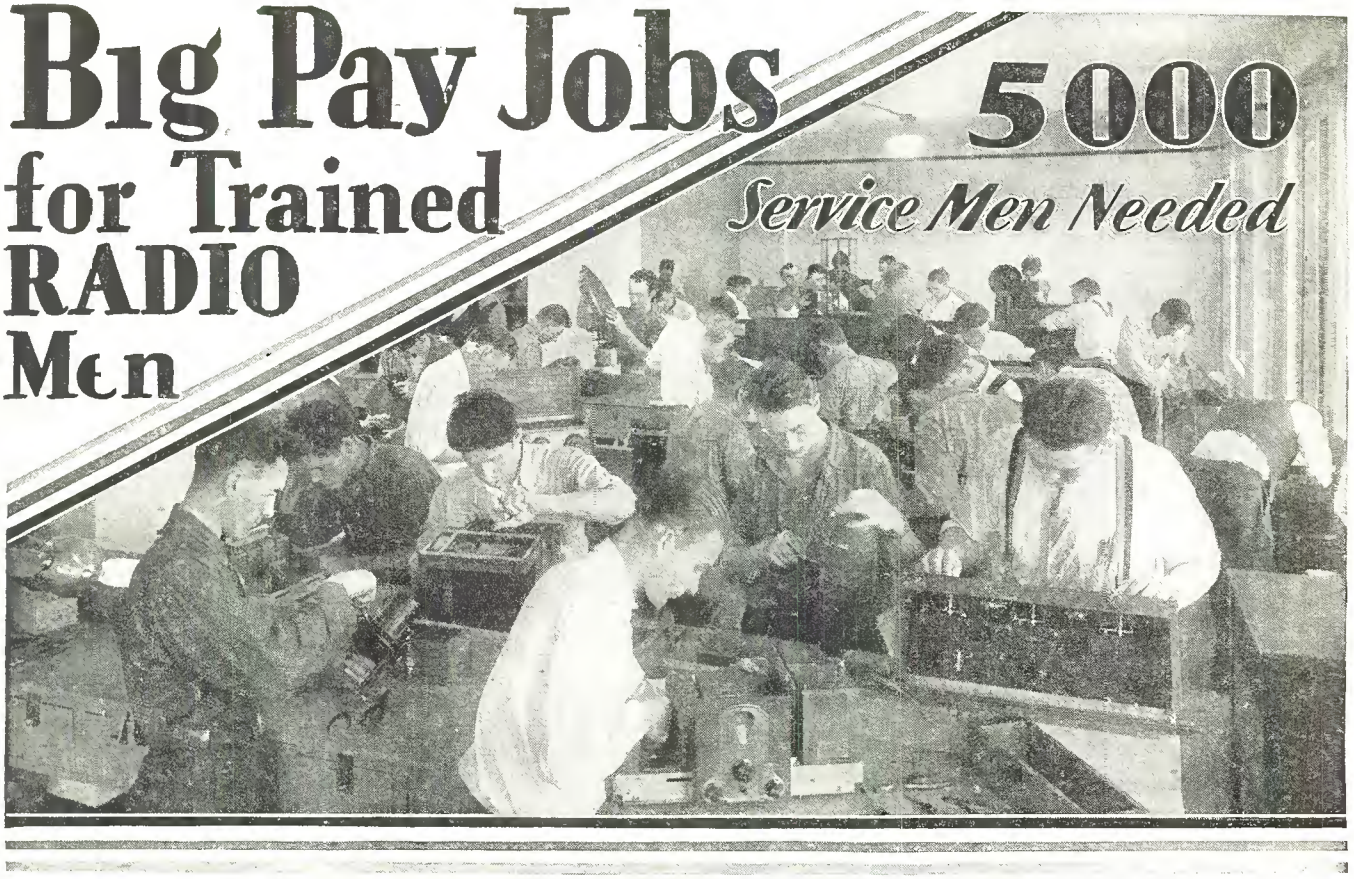
AUDIOLA RADIO COMPANY

430 SO. GREEN ST. CHICAGO

RADIO CALL BOOK MAGAZINE AND TECHNICAL REVIEW, January, 1932. VOL. XIII, No. 1. Published monthly at Chicago, Ill. Subscription price, $2.00 per year. 25 cents per copy. Entered as second-class matter September 3, 1931, at the Post Office of Chicago, Ill., under the Act of March 3, 1879. Citizens Radio Service Bureau, Inc., Publishers, 508 S. Dearborn St., Chicago.

Big Pay Jobs for Trained RADIO Men

5000 *Service Men Needed*



ACTUAL PHOTOGRAPH OF STUDENTS WORKING IN SERVICE DEPT. OF COYNE RADIO SHOPS

LEARN RADIO—TELEVISION TALKING PICTURES AT COYNE

TEN WEEKS of SHOP TRAINING on RADIO EQUIPMENT

Dissatisfied with your job? Not making enough money? Then let me show you how to prepare for a real job and how to make real money, in RADIO—one of the fastest growing, biggest money-making trades on earth.

JOBS LEADING TO BIG PAY

Scores of jobs are open—jobs as Designer, Inspector and Tester—as Radio Salesman and in Service and Installation work—as Operator or Manager of a Broadcasting Station—as Wireless Operator on a Ship or Airplane—with Talking Picture Theatres and Manufacturers of Sound Epuipment—with Television Laboratories and Studios—fascinating jobs, offering unlimited opportunities to the Trained Man.

PRACTICAL Shop Training

Come to Chicago and prepare for these jobs the QUICK and PRACTICAL way—BY ACTUAL SHOP WORK on ACTUAL RADIO EQUIPMENT. Some students finish the entire course in 8 weeks. The average time is only 10 weeks. But you can stay as long as you please, at no extra cost to you. No previous experience necessary.

Broadcasting — Television Sound Equipment

In addition to the most modern Radio equipment, we have installed in our Shops a complete model Broadcasting Station, with sound proof Studio and modern Transmitter with 1,000 watt tubes—the Jenkins Television Transmitter with dozens of home-type Television receiving sets—and a complete Talking Picture installation for both "sound on film" and "sound on disk." We have spared no expense in our effort to make your training as COMPLETE and PRACTICAL as possible. Mail the coupon for full particulars!

Free Employment Service TO STUDENTS

After you have finished the course, we will do all we can to help you find the job you want. We employ three men on a full time basis whose sole job is to help our students in finding positions. And should you be a little short of funds, we'll gladly help you in finding part-time work while at school. Some of our students pay a large part of their living expenses in this way. Get all the facts!

COYNE IS 32 YEARS OLD

Coyne has been located right here in Chicago since 1899. Coyne Training is tested—proven by hundreds of successful graduates. You can get all the facts absolutely free. JUST MAIL THE COUPON FOR A FREE COPY OF OUR BIG RADIO AND TELEVISION BOOK.

H. C. Lewis, Pres. ***Radio Division*** Founded 1899

COYNE ELECTRICAL SCHOOL

500 S. Paulina Street Dept. 12-5A Chicago, Illinois

H. C. LEWIS, President
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Send me your Big Free Radio, Television and Talking Picture Book. This does not obligate me in any way.

Name.....

Address.....

City.....*State*.....

Radio Call Book Magazine

AND TECHNICAL REVIEW

Established 1921

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E. H. Peterson, *Service Dept.*

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JANUARY, 1932 | Vol. 13, No. 1

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Editorial

If the seeondary selling season explained on page 37 and to be launched at the Chieago Radio Electrieal Show, January 18 to 24, is to have its fullest measure of sueeess, it will mean complete and eooperative aeeord between the manufacturers, distributors, dealers, serviee men and all others allied with the industry. No one would more cheerfully welcome such an innovation than the distributor and dealer, for after all if these two ean make a eonsistent profit, the rest of the industry automatieally falls into line. Thus the entire eirele revolves, moving forward and upward. Radio is now out of its swaddling elothes. It behooves every member of the industry to train his eye on the goal, take a deep breath and push hard in unison.

An interesting artiele on adapters and converters for bringing in short wave signals on a standard broadeast reeeiver should do mueh to dispel some of the mysteries surrounding sueh achievements, and at the same time furnish much informative data that will enable a user to get better results. Dealers and service men who sell these deviees should remember that most of the satisfaetion a buyer derives is gained from finding that results equal to or better than those vouchsafed by the dealer can be seeured. Naturally the dealer must be sure of his produet before he makes any elaims for its performance.

A new departure in this issue is the spaee devoted to "Brief Items of Interest to Many." Material that does not warrant mueh space is condensed and by this eondensing proeess a greater number of readers may find a subjeet of interest.

—Editor.

I will train you at home to fill a BIG PAY Radio Job!

Here's Proof

$100 a week

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

E. E. WINBORNE
1414 W. 48th St.,
Norfolk, Va.

Jumped from $35 to $100 a week

"Before I entered Radio I was making $35 a week. Last week I earned $110 servicing and selling Radios. I owe my success to N. R. I. You started me off on the right foot."

J. A. VAUGHN
Grand Radio & Appliance Co.,
3107 S. Grand Blvd.,
St. Louis, Mo.

$500 extra in 6 months

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

HOYT MOORE
R. R. 3, Box 919,
Indianapolis, Ind.,

If you are earning a penny less than $50 a week, send for my book of information on the opportunities in Radio. It is free. Clip the coupon NOW. Why be satisfied with $25, $30 or $40 a week for longer than the short time it takes to get ready for Radio.

Radio's growth opening hundreds of $50, $75, $100 a week jobs every year

In about ten years Radio has grown from a $2,000,000 to a $1,000,000,000 industry. Over 300,000 jobs have been created. Hundreds more are being opened every year by its continued growth. Many men and young men with the right training—the kind of training I give you—are stepping into Radio at two and three times their former salaries.

You have many jobs to choose from

Broadcasting stations use engineers, operators, station managers and pay $1,200 to $5,000 a year. Manufacturers continually need testers, inspectors, foremen, engineers, service men, buyers, for jobs paying up to $7,500 a year. Radio operators on ships enjoy life, see the world, with board and lodging free, and get good pay besides. Dealers and jobbers employ service men, salesmen, buyers, managers, and pay $30 to $100 a week. There are many other opportunities too. My book tells you about them.

So many opportunities many N. R. I. men make $200 to $1,000 in spare time while learning

The day you enroll with me I'll show you how to do 10 jobs, common in most every neighborhood, for spare time money. Throughout your course I send you information on servicing popular makes of sets; I give you the plans and ideas that are making $200 to $1,000 for hundreds of N. R. I. students in their spare time while studying. My course is famous as the course that pays for itself.

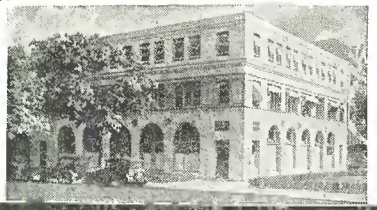
Talking Movies, Television, Aircraft Radio included

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

64-page book of information FREE

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

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



Our Own Home

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

Lifetime Employment Service to all Graduates

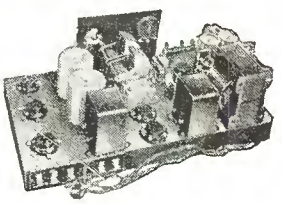
Special Free Offer

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

Act Quickly

I will give You my new 8 OUTFITS of RADIO PARTS for practical Home Experiments

You can build over 100 circuits with these outfits. You build and experiment with the circuits used in Crosley, Atwater-Kent, Eveready, Majestic, Zenith, and other popular sets. You learn how these sets work, how to make them work. This makes learning at home easy, fascinating, practical.



I am doubling and tripling the salaries of many in one year and less Find out about this quick way to BIGGER PAY

Radio Needs Trained Men

FILL OUT AND MAIL THIS COUPON TODAY

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

Dear Mr. Smith: I want to take advantage of your special free offer. Send me your two books, "Rich Rewards in Radio" and "28 Tested Methods for making extra money." I understand this request does not obligate me and that no salesman will call.

Name.....

Address.....

City.....*State*.....

American Broadcasting Stations

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

KABC—1420 kc, San Antonio, Texas, Alamo Broadcasting Co., 100 w, C.
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., Santa Barbara Broadcasters, Ltd., 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.
KECA—1430 kc, Los Angeles, Calif., Pacific Development Radio Co., 1000 w, P.
KELW—780 kc, Burbank, Calif., Magnolia Park, Ltd., 500 w, P.
KEX—1180 kc, Portland, Ore., Western Broadcasting Co., 5000 w, P.
KFAB—770 kc, Lincoln, Nebr., KFAB Broadcasting Co., 5000 w, C.
KFAC—1300 kc, Los Angeles, Calif., L. A. Bdcstg. Co., 1000 w, P.
KFBB—1280 kc, Great Falls, Mont., Buttrey Broadcast, Inc., 1000 w, M.
KFBK—1310 kc, Sacramento, Calif., James McClatchy Co., 100 w, P.
KFBL—1370 kc, Everett, Wash., Leese Bros., 50 w, P.
KFDM—560 kc, Beaumont, Tex., Magnolia Petroleum Co., 500 w, C.
KFDY—550 kc, Brookings, S. D., State College, 500 w, C.
KFEL—920 kc, Denver, Colo., Eugene P. O'Fallon, Inc., 500 w, M.
KFEQ—680 kc, St. Joseph, Mo., Scroggin & Co., 2500 w, C.
GFGQ—1310 kc, Boone, Iowa, Boone Biblical College, 100 w, C.
KFH—1300 kc, Wichita, Kan., Radio Station KFH Co., 1000 w, C.
KFI—640 kc, Los Angeles, Calif., Earl C. Anthony, Inc., 50,000 w, P.
KFIO—1120 kc, Spokane, Wash., Spokane Broadcasting Corp., 100 w, P.
KFIU—1310 kc, Juneau, Alaska, Alaska Elec. Light & Power Co., 10 w.
KFIZ—1420 kc, Fond du Lac, Wis., Reporter Printing Co., 100 w, C.
KFJB—1200 kc, Marshalltown, Iowa, Marshall Electric Co., 100 w, C.
KFJF—1480 kc, Oklahoma City, Okla., National Radio Mfg. Co., 5000 w, C.
KFJI—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, KFJR, Inc., 500 w, P.
KFJY—1310 kc, Ft. Dodge, Iowa, Cedar Rapids Broadcast Co., 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.
KFKB—1050 kc, Milford, Kan., KFKB Brdcstg. Assn., 5000 w, C.
KFKU—1220 kc, Lawrence, Kan., University of Kansas, 500 w, C.
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.
KFOR—1210 kc, Lincoln, Neb., Howard A. Shuman, 100 w, C.
KFOX—1250 kc, Long Beach, Calif., Nichols & Warriner, Inc., 1000 w, P.
KFPL—1310 kc, Dublin, Texas, C. C. Baxter, 100 w, C.
KFPM—1310 kc, Greenville, Texas, The New Furniture Co., 15 w, C.
KFPW—1340 kc, Ft. Smith, Ark., John Brown Schools, 50 w, C.
KFPY—1340 kc, Spokane, Wash., Symons Broadcasting Co., 1000 w, P.
KFQD—1230 kc, Anchorage, Alaska, Anchorage Radio Club, 100 w.
KFQU—1420 kc, Holy City, Calif., W. E. Riker, 100 w, P.
KFQW—1420 kc, Seattle, Wash., KFQW, Inc., 100 w, P.
KFRC—610 kc, San Francisco, Calif., Don Lee, Inc., 1000 w, P.
KFRU—630 kc, Columbia, Mo., Stephens College, 500 w, C.
KFSD—600 kc, San Diego, Calif., Airfan Radio Corp., 500 w, P.
KFSG—1120 kc, Los Angeles, Calif., Echo Park Evan. Assn., 500 w, P.
KFUL—1290 kc, Galveston, Texas, W. H. Ford, 500 w, C.
KFUO—550 kc, St. Louis, Mo., Concordia Theological Seminary, 500 w, C.
KFUP—1310 kc, Denver, Colo., Fitzsimmons General Hospital, 100 w, M.
KFVD—1000 kc, Culver City, Calif., Los Angeles Broadcasting Co., 250 w, P.
KFVS—1210 kc, Cape Girardeau, Mo., Hirsch Battery & Radio Co., 100 w, C.
KFWB—950 kc, Hollywood, Calif., Warner Bros. Broadcasting Corp., 1000 w, P.
KFWF—1200 kc, St. Louis, Mo., St. Louis Truth Center, Inc., 100 w.
KFWI—930 kc, San Francisco, Calif., Radio Entertainments, Inc., 500 w, P.
KFXD—1420 kc, Nampa, Idaho, Service Radio Co., 50 w, M.
KFXF—920 kc, Denver, Colo., Colorado Radio Co., 500 w, M.
KFXJ—1310 kc, Edgewater, Colo., Western Slope Broadcasting Co., 50 w, M.
KFXM—1210 kc, San Bernardino, Calif., Lee Bros. Broadcasting Co., 100 w, P.
KFXR—1310 kc, Oklahoma City, Okla., Exchange Avenue Baptist Church, 100 w, C.
KFXY—1420 kc, Flagstaff, Ariz., Mary M. Costigan, 100 w, M.
KFYO—1420 kc, Abilene, Texas, Kirksey Bros., 100 w, C.
KFYR—550 kc, Bismarck, N. D., Meyer Broadcasting Co., 1000 w, C.
KGA—1470 kc, Spokane, Wash. Northwest Broadcasting System, Inc., 5000 w, P.
KGAR—1370 kc, Tucson, Ariz., Tucson Motor Service Co., 100 w, M.
KGB—1330 kc, San Diego, Calif., Don Lee, Inc., 500 w, P.
KGBU—900 kc, Ketchikan, Alaska, Alaska Radio & Service Co., 500 w.
KGBX—1310 kc, St. Joseph, Mo., KGBX, Inc., 100 w.
KGBZ—930 kc, York, Nebr., Geo. R. Miller, 500 w, C.
KGCA—1270 kc, Decorah, Iowa, Chas. W. Greenley, 50 w, C.
KGCR—1210 kc, Watertown, S. D., Greater Kampeska Radio Corp., 100 w.
KGCU—1200 kc, Mandan, N. D., Mandan Radio Association, 100 w, M.
KGCX—1310 kc, Wolf Point, Mont., First State Bank of Vida, 100 w, M.
KGDA—1370 kc, Mitchell, S. D., Mitchell Broadcasting Corp., 100 w, M.
KGDE—1200 kc, Fergus Falls, Minn., Jaren Drug Co., 100 w, C.
KGDM—1100 kc, Stockton, Calif., E. F. Peffer, 250 w.
KGDY—1200 kc, Huron, S. D., J. A. Loesch, 15 w, C.
KGEF—1300 kc, Los Angeles, Calif., Trinity Methodist Church, 1000 w, P.
KGEK—1200 kc, Yuma, Colo., Beehler Elec. Equip. Co., 50 w, M.
KGER—1360 kc, Long Beach, Calif., Consolidated Bdcstg. Corp., 1000 w, P.
KGEW—1200 kc, Ft. Morgan, Colo., City of Ft. Morgan, 100 w, P.
KGEZ—1310 kc, Kalispell, Mont., Chamber of Commerce, 100 w, M.
KGFF—1420 kc, Shawnee, Okla., KGFF Bdcstg. Corp., 100 w, C.
KGFG—1370 kc, Oklahoma City, Okla., Oklahoma Broadcasting Co., Inc., 100 w, C.
KGFI—1500 kc, Corpus Christi, Texas, Eagle Broadcasting Co., 100 w, C.
KGFJ—1200 kc, Los Angeles, Calif., Ben S. McGlashan, 100 w, P.
KGFK—1500 kc, Moorhead, Minn., Red River Broadcasting Co., Inc., 50 w, C.
KGFL—1370 kc, Raton, N. Mex., KGFL, Inc., 50 w, M.
KGFW—1310 kc, 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, South Coffeyville, Okla., Powell & Platz, 500 w.
KGGM—1230 kc, Albuquerque, N. Mex., New Mexico Broadcasting Co., 250 w.
KGHF—1320 kc, Pueblo, Colo, Ritchie & Finch, 250 w, M.
KGHI—1200 kc, Little Rock, Ark., O. A. Cook, 100 w.
KGHL—950 kc, Billings, Mont., Northwestern Auto Supply Co., 1000 w, M.
KGIQ—1320 kc, Twin Falls, Idaho, Radio Broadcasting Corp.
KGIR—1360 kc, Butte, Mont., KGIR, Inc., 500 w, M.
KGIW—1420 kc, Trinidad, Colo., Leonard E. Wilson, 100 w, M.
KGIX—1420 kc, Las Vegas, Nev., J. M. Heaton, 100 w.
KGIZ—1500 kc, Grant City, Mo., Grant City Park Corp., 100 w, C.
KGJF—890 kc, Little Rock, Ark., First Church of the Nazarene, 250 w.
KGKB—1500 kc, Tyler, Tex., Tyler Commercial College, 100 w, C.
KGKL—1370 kc, San Angelo, Tex., KGKL, Inc., 100 w, C.
KGKO—570 kc, Wichita Falls, Tex., Wichita Falls Broadcasting Co., 250 w, C.
KGKX—1420 kc, Sandpoint, Idaho, 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., 250 w, P.
KGMP—1210 kc, Elk City, Okla., Bryant Radio & Elec. Co., 100 w, C.
KGNF—1430 kc, North Platte, Nebr., H. L. Spencer, 500 w, M.
KGNO—1210 kc, Dodge City, Kans., Dodge City Broadcasting Co., Inc., M.
KGO—790 kc, San Francisco, Calif., National Broadcasting Co., Inc., 7500 w, P.
KGRS—1410 kc, Amarillo, Texas, Gish Radio Service, 1000 w, C.
KGU—940 kc, Honolulu, Hawaii, Marion Mulrony, Advertising Publ. Co., 1000 w.
KGVO—1420 kc, Missoula, Mont., Mosby's, Inc.
KGW—620 kc, Portland, Ore., Oregonian Pub. Co., 1000 w, P.
KGY—1200 kc, Lacey, Wash., St. Martins College, 10 w, P.
KHJ—900 kc, Los Angeles, Calif., Don Lee, Inc., 1000 w, P.
KHQ—590 kc, Spokane, Wash., Louis Wasmer, Inc., 1000 w, P.
KICK—1420 kc, Red Oak, Iowa, Red Oak Radio Corp., 100 w.
KID—1320 kc, Idaho Falls, Ida., KID Broadcasting Co., 250 w, M.
KIDO—1350 kc, Boise, Idaho, Boisc 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.
KJR—970 kc, Seattle, Wash., Northwest Broadcasting System, Inc., 500 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.
KLX—880 kc, Oakland, Calif., Tribune Pub. Co., 500 w, P.
KLZ—560 kc, Denver, Colo., Reynolds Radio Co., Inc., 1000 w, M.
KMA—930 kc, Shenandoah, Iowa, May Seed & Nursery Co., 500 w, C.
KMAC—1370 kc, San Antonio, Texas, W. W. McAllister, 100 w, C.
KMBC—950 kc, Kansas City, Mo., Midland Broadcasting Co., 1000 w, C.
KMED—1310 kc, Medford, Ore., Mrs. W. J. Virgin, 100 w, P.
KMJ—1210 kc, Fresno, Calif., J. McClatchy Co., 100 w, P.
KMLB—1200 kc, Monroe, La., J. C. Liner, 100 w, C.

KMMJ—740 kc, Clay Center, Neb., The M. M. Johnson Co., 1000 w, C.
KMO—860 kc, Tacoma, Wash., KMO, Inc., 500 w, P.
KMOX—1090 kc, St. Louis, Mo., Voice of St. Louis, Inc., 50,000 w, C.
KMPC—710 kc, Beverly Hills, Calif., R. S. Macmillan, 500 w, P.
KMTR—570 kc, Los Angeles, Calif., KMTR Radio Corp., 500 w, P.
KNX—1050 kc, Hollywood, Calif., Western Broadcast Co., 5000 w, P.
KOA—830 kc, Denver, Colo., National Broadcasting Co., Inc., 12,500 w, M.
KOAC—550 kc, Corvallis, Ore., Oregon State Agricultural College, 1000 w, P.
KOB—1180 kc, State College, N. M., N. M. College of Agri. & Mech. Arts, 20,000 w, M.
KOCW—1400 kc, Chickasha, Okla., Oklahoma College for Women, 250 w, C.
KOH—1370 kc, Reno, Nevada, Jay Peters, Inc., 500 w.
KOIL—1260 kc, Council Bluffs, Iowa, Mona Motor Oil Co., 1000 w, C.
KOIN—940 kc, Portland, Ore., KOIN, Inc., 100 w, P.
KOL—1270 kc, Seattle, Wash., Seattle Broadcasting Co., 1000 w, P.
KOMO—920 kc, Seattle, Wash., Fisher's Blend Station, Inc., 1000 w, P.
KONO—1370 kc, San Antonio, Tex., Mission Broadcasting Co., 100 w, C.
KOOS—1370 kc, Marshfield, Ore., H. H. Hanseth, Inc., 100 w, P.
KORE—1420 kc, Eugene, Ore., Eugene Broadcast Station, 100 w, P.
KOY—1390 kc, Phoenix, Ariz., Nielsen Radio & Sporting Goods Co., 500 w, M.
KPCB—650 kc, Seattle, Wash., Queen City Broadcasting Co., 100 w, P.
KPJM—1500 kc, Prescott, Ariz., A. P. Miller, 100 w, M.
KPO—680 kc, San Francisco, Calif., Hale Bros. & The Chronicle, 5000 w, P.
KPOF—880 kc, Denver, Colo., Pillar of Fire, Inc., 500 w, M.
KPPC—1210 kc, Pasadena, Calif., Pasadena, Presbyterian Church, 50 w, P.
KPQ—1500 kc, Wenatchee, Wash., Wescoast Broadcasting Co., 50 w, P.
KPRC—920 kc, Houston, Texas, Houston Printing Co., 1000 w, C.
KQV—1380 kc, Pittsburgh, Pa., KQV Bdcstg. Co., 500 w, E.
KQW—1010 kc, San Jose, Calif., Pacific Agric. Foundation, 500 w, P.
KRE—1370 kc, Berkeley, Calif., First Congregational Church, 100 w, P.
KREG—1500 kc, Santa Ana, Calif., Pacific-Western Broadcasting Federation, 100 w, P.
KRGV—1260 kc, Harlingen, Texas, KRGV, Inc., 500 w.
KRLD—1040 kc, Dallas, Texas, KRLD, Inc., 10,000 w, C.
KRMD—1310 kc, Shreveport, La., Robert M. Dean, 50 w, C.
KROW—930 kc, Oakland Calif., Educational Broadcasting Corp., 500 w, M.
KRSC—1120 kc, Seattle, Wash., Radio Sales Corp., 50 w, P.
KSAC—580 kc, Manhattan, Kan., Kansas State Agricultural College, 500 w, C.
KSCJ—1330 kc, Sioux City, Iowa, Perkins Bros. Co., 1000 w, C.
KSD—550 kc, St. Louis, Mo., Pulitzer Pub. Co., 500 w, C.
KSEI—900 kc, Pocatello, Idaho, Radio Service Corp., 250 w, M.
KSL—1130 kc, Salt Lake City, Utah, Radio Service Corp., 5000 w, M.
KSMR—1200 kc, Santa Maria, Calif., Santa Maria Radio Co., 100 w, P.
KSO—1380 kc, Clarinda, Iowa, Iowa Bdcstg. Co., 500 w, C.
KSOO—1110 kc, Sioux Falls, S. D., Sioux Falls Broadcasting Assn., 2000 w, C.
KSTP—1460 kc, St. Paul, Minn., National Battery Broadcasting Co., 10,000 w, C.
KTAB—560 kc, San Francisco, Calif., Associated Broadcasters, 1000 w, P.
KTAR—620 kc, Phoenix, Ariz., KTAR Broadcasting Co., 500 w, M.
KTAT—1240 kc, Ft. Worth, Tex., S. A. T. Broadcasting Co., 1000 w, C.
KTBR—1300 kc, Portland, Ore., M. E. Brown, 500 w, P.
KTBS—1450 kc, Shreveport, La., Tri-State Broadcasting Co., 1000 w, E.
KTFI—1320 kc, Twin Falls, Idaho, Radio Broadcasting Corp., 250 w, M.
KTHS—1040 kc, Hot Springs, Ark., Chamber of Commerce, 10,000 w, C.
KTLC—1310 kc, Houston, Tex., Houston Broadcasting Co., 100 w, C.
KTM—780 kc, Los Angeles, Calif., Pickwick Broadcasting Corp., 500 w, P.
KTRH—1120 kc, Houston, Tex., Rice Hotel, 500 w, C.
KTSA—1290 kc, San Antonio, Texas, Lone Star Broadcast Co., 1000 w, C.
KTSL—1310 kc, Shreveport, La., Houseman Sheet Metal Works, Inc., 100 w, C.
KTSM—1310 kc, El Paso, Tex., W. S. Bledsoe and W. T. Blackwell, 100 w, C.
KTW—1220 kc, Seattle, Wash., First Presbyterian Church, 1000 w, P.
KUJ—1370 kc, Walla Walla, Wash., Paul R. Heitmeyer, Inc., 100 w, P.
KUOA—1390 kc, Fayetteville, Ark., University of Arkansas, 1000 w, C.
KUSD—890 kc, Vermilion, S. Dak., University of South Dakota, 500 w, C.
KUT—1500 kc, Austin, Tex., Rice Hotel, 100 w, C.
KVI—760 kc, Tacoma, Wash., Puget Sound Radio Broadcasting Co., 1000 w, P.
KVL—1370 kc, Seattle, Wash., KVL, Inc., 100 w, P.
KVOA—1260 kc, Tucson, Ariz., R. M. Riculfi, 500 w.
KVOO—1140 kc, Tulsa, Okla., Southwestern Sales Corp., 5000 w, C.
KVOR—1270 kc, Colorado Springs, Colo, W. D. Corley, 1000 w, M.
KVOS—1200 kc, Bellingham, Wash., KVOS, Inc., 100 w, M.
KWCR—1310 kc, Cedar Rapids, Iowa, Cedar Rapids Bdcst. Co., 100 w, C.
KWEA—1210 kc, Shreveport, La., Hello World Broadcasting Corp., 100 w, C.
KWG—1200 kc, Stockton, Calif., Portable Wireless Tel. Co., 100 w, P.
KWJJ—1060 kc, Portland, Ore., KWJJ Broadcasting Co., Inc., 500 w, P.
KWK—1350 kc, 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, 1000 w, P.
KWWG—1260 kc, Brownsville, Texas, Brownsville Herald Publishing Co., 500 w, C.
KXA—570 kc, Seattle, Wash., American Radio Tel. Co., 500 w, P.
KXL—1420 kc, Portland, Ore., KXL Broadcasters, Inc., 100 w, P.
KXO—1500 kc, El Centro, Calif., Irey & Bowles, 100 w, P.
KXRO—1310 kc, Aberdeen, Wash., KXRO, Inc., 75 w, P.
KXYZ—1420 kc, Houston, Texas, Harris County Broadcasting Co., 100 w, C.
KYA—1230 kc, San Francisco, Calif., Pacific Broadcasting Corp., 1000 w, P.
KYW—1020 kc, Chicago, Ill., Westinghouse E. & M. Co., 10,000 w, C.
NAA—690 kc, United States Navy Department, Washington, D. C., 1000 w, E.
WAAB—1410 kc, Quincy, Mass., Bay State Bdcstg. Corp.
WAAF—920 kc, Chicago, Ill., Drovers Journal Pub. Co., 500 w daytime, C.
WAAM—1250 kc, Newark, N. J., WAAM, Inc., 1000 w, E.
WAAT—940 kc, Jersey City, N. J., Bremer Broadcasting Corp., 300 w, E.
WAAW—660 kc, Omaha, Neb., Omaha Grain Exchange, 500 w daytime, C.
WABC—860 kc, New York City, N. Y., Atlantic Broadcasting Corp., 50,000 w, E.
WABI—1200 kc, Bangor, Maine, Pine Tree Broadcasting Co., 100 w, E.
WABO—See under WHEC.
WABZ—1200 kc, New Orleans, La., Coliseum Place Baptist Church, 100 w, C.
WACO—1240 kc, Waco, Tex., Central Texas Broadcasting Co., Inc., 1000 w, C.
WADC—1320 kc, Tallmadge, Ohio, Allen T. Simmons, 1000 w, E.
WAGM—1420 kc, Mars Hill, Me., Aroostook Bdcstg. Corp., 100 w.
WAIU—640 kc, Columbus, Ohio, Associated Radiocasting Corp., 500 w, E.
WALR—1210 kc, Zanesville, O., Roy W. Waller, 100 w, E.
WAPI—1140 kc, Birmingham, Ala., Alabama Polytechnic Institute, 5000 w, C.
WASH—1270 kc, Grand Rapids, Mich., WASH Broadcasting Corp., 500 w, C.
WAWZ—1350 kc, Zarepath, N. J., Pillar of Fire, 250 w, E.
WBAA—1400 kc, Lafayette, Ind., Purdue University, 500 w, C.
WBAK—1430 kc, Harrisburg, Pa., Pennsylvania State Police, 500 w, E.
WBAL—1060 kc, Baltimore, Md., Consolidated Gas, Elec. Co., 10,000 w, E.
WBAP—800 kc, Ft. Worth, Tex., Carter Publications, Inc., 10,000 w, C.
WBAX—1210 kc, Wilkes-Barre, Pa., John H. Stenger, Jr., 100 w, E.
WBBC—1400 kc, Brooklyn, N. Y., Brooklyn Broadcasting Corp., 500 w.
WBBL—1210 kc, Richmond, Va., Grace Covenant Presbyterian Church, 100 w, E.
WBBM—770 kc, Chicago, Ill., WBBM Bdcstg. Corp., 25,000 w, C.
WBBR—1300 kc, Brooklyn, N. Y., People's Pulpit Association, 1000 w, E.
WBBZ—1200 kc, Ponca City, Okla., C. L. Carrell, 100 w, C.
WBCM—1410 kc, Bay City, Mich., James E. Davidson, 500 w, E.
WBCN—See under WENR.
WBEN—900 kc, Buffalo, N. Y., WBEN, Inc., 1000 w, E.
WBEO—1310 kc, Marquette, Mich., Lake Superior Bdcstg. Co.
WBGF—1370 kc, Glens Falls, N. Y., W. Parker & N. Metcalf, 50 w, E.
WBHS—1200 kc, Huntsville, Ala., Hutchens Co., 50 w.
WBIG—1440 kc, Greensboro, N. C., North Carolina Broadcasting Co., 500 w, E.
WBIS—See under WNAC.
WBMS—1450 kc, Hackensack, N. J., WBMS Broadcasting Corp., 250 w.
WBNX—1350 kc, New York, N. Y., Standard Cahill Co., Inc., 250 w, E.
WBOQ—See under WABC.
WBOW—1310 kc, Terre Haute, Ind., Banks of Wabash Broadcasting Assn., 100 w, C.
WBRC—930 kc, Birmingham, Ala., Birmingham Broadcasting Co., 500 w, C.
WBRE—1310 kc, Wilkes-Barre, Pa., Louis G. Baltimore, 100 w, E.
WBSO—920 kc, Needham, Mass., Babson's Statistical Org., Inc., 250 w, E.
WBT—1080 kc, Charlotte, N. C., Station WBT, Inc., 5000 w, E, shared.
WBTM—1370 kc, Danville, Va., Clarke Elec. Co., 100 w, E.
WBZ—990 kc, Boston, Mass., Westinghouse E. & M. Co., 15,000 w, E.
WBZA—990 kc, Springfield, Mass., Westinghouse E. & M. Co., 1000 w, E.
WCAC—600 kc, Storrs, Conn., Connecticut Agricultural College, 250 w, E.
WCAD—1220 kc, Canton, N. Y., St. Lawrence University, 500 w, E.
WCAE—1220 kc, Pittsburgh, Pa., WCAE, Inc., 1000 w, E.
WCAH—1430 kc, Columbus, Ohio, Commercial Radio Service Co., 500 w, E.
WCAJ—590 kc, Lincoln, Neb., Nebraska Wesleyan University, 500 w, C.
WCAL—1250 kc, Northfield, Minn., St. Olaf College, 1000 w, C.
WCAM—1280 kc, Camden, N. J., City of Camden, 500 w, E.
WCAO—600 kc, Baltimore, Md., Monumental Radio, Inc., 250 w, E.
WCAP—1280 kc, Asbury Park, N. J., Radio Industries Broadcast Co., 500 w, E.
WCAT—1200 kc, Rapid City, S. D., South Dakota State School of Mines, 100 w, M.
WCAU—1170 kc, Philadelphia, Pa., Universal Broadcasting Co., 10,000 w, E.
WCAX—1200 kc, Burlington, Vt., Burlington Daily News, 100 w, E.
WCAZ—1070 kc, Carthage, Ill., Superior Broadcasting Co., 50 w.
WCBA—1440 kc, Allentown, Pa., B. B. Musselman, 250 w, E.
WCBD—1080 kc, Zion, Ill., Wilbur Glen Voliva, 5000 w, C.
WCBM—1370 kc, Baltimore, Md., Baltimore Broadcasting Corp., 100 w, E.
WCBS—1210 kc, Springfield, Ill., Dewing & Meester, 100 w, C.
WCCO—810 kc, Minneapolis, Minn., Northwestern Broadcasting Inc., 5000 w, C.
WCDA—1350 kc, New York, N. Y., Italian Educational Broadcasting Co., 250 w, E.
WCFL—970 kc, Chicago, Ill., Chicago Federation of Labor, 150 w, C.
WCGU—1400 kc, Brooklyn, N. Y., U. S. Broadcasting Corp., 500 w, E.
WCHI—1490 kc, Chicago, Ill., People's Pulpit Association, 5000 w, C.
WCKY—1490 kc, Covington, Ky., L. B. Wilson, 500 w, E.
WCLB—1500 kc, Long Beach, N. Y., Arthur Faske, 100 w, E.
WCLO—1200 kc, Janesville, Wis., WCLO Radio Corp., 100 w, C.
WCLS—1310 kc, Joliet, Ill., WCLS, Inc., 100 w, C.
WCMA—1400 kc, Culver, Ind., General Broadcasting Co., 500 w, C.
WCOA—1340 kc, Pensacola, Fla., City of Pensacola, 500 w, E.
WCOC—880 kc, Meridian, Miss., Mississippi Broadcasting Co., 500 w, C.
WCOD—1200 kc, Harrisburg, Pa., Keystone Broadcasting Corp., 100 w, E.
WCOH—1210 kc, Yonkers, N. Y., Westchester Broadcasting Corp., 100 w, E.

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

WLAP—1010 kc, Louisville, Ky., American Broadcasting Corp. of Kentucky, 1259 w, C.
WLB—1250 kc, Minneapolis, Minn., University of Minnesota, 1000 w, C.
WLBC—1310 kc, Muncie, Ind., Donald A. Burton, 50 w.
WLBF—1420 kc, Kansas City, Kan., WLBF Broadcasting Co., 100 w, C.
WLBG—1200 kc, Petersburg, Va., WLBG, Inc., 100 w, E.
WLBL—900 kc, Stevens Point, Wis., Wisconsin Department of Markets, 2000 w, daytime, C.
WLBW—1260 kc, Oil City, Pa., Radio-Wire Program Corp., 500 w, E.
WLBX—1500 kc, Long Island City, N. Y., John N. Brahy, 100 w.
WLBZ—620 kc, Bangor, Me., Maine Broadcasting Co., 500 w, E.
WLCI—1210 kc, Ithaca, N. Y., Lutheran Assn. of Ithaca, 50 w, E.
WLEY—1370 kc, Lexington, Mass., Lexington Air Station, 100 w, E.
WLIB—See under WGN.
WLIT—560 kc, Philadelphia, Pa., Lit Brothers, 500 w, E.
WLOE—1500 kc, Boston, Mass., Boston Broadcasting Co., 100 w.
WLS—870 kc, Chicago, Ill., Agricultural Broadcasting Co., 5000 w, C.
WLSI—See under WPRO.
WLTH—1400 kc, Brooklyn, N. Y., Voice of Brooklyn, Inc., 500 w, E.
WLVA—1370 kc, Lynchburg, Va., Lynchburg Broadeasting Corp., 100 w, E.
WLW—700 kc, Cincinnati, Ohio, Crosley Radio Corp., 50,000 w, E.
WLWL—1100 kc, New York, N. Y., Missionary Society of St. Paul, 5000 w, E.
WMAC—See under WSYR.
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., National Broadcasting Co., 5000 w, C.
WMAZ—1180 kc, Macon, Ga., Southeastern Broadcasting Co., 500 w, E.
WMBA—1500 kc, Newport, R. I., LeRoy Joseph Beebe, 100 w, E.
WMBC—1420 kc, Detroit, Mich., Michigan Broadcasting Co., Inc., 100 w, E.
WMBD—1440 kc, Peoria Heights, Ill., Peoria Bdcstg. Co., 500 w.
WMBF—See under WIOD.
WMBG—1210 kc, Richmond, Va., Havens & Martin, Inc., 100 w, E.
WMBH—1420 kc, Joplin, Mo., Edwin Dudley Aber, 100 w, C.
WMBI—1080 kc, Chicago, Ill., Moody Bible Institute Radio Station, 5000 w, C, shared.
WMBJ—1500 kc, Wilkinsburg, Pa., Rev. John W. Sproul, 100 w, E.
WMBO—1310 kc, Auburn, N. Y., 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.
WMC—780 kc, Memphis, Tenn., Memphis Commercial Appeal, Inc., 500 w, C.
WMCA—570 kc, New York, N. Y., Knickerbocker Broadcasting Co., Inc., 500 w, E.
WMIL—1500 kc, Brooklyn, N. Y., Arthur Faske, 100 w, E.
WMMN—890 kc, Fairmont, W. Va., Holt Rowe Novelty Co., 250 w, E.
WMPC—1500 kc, Lapeer, Mich., First Methodist Protestant Church, 100 w, E.
WMRJ—1210 kc, Jamaica, N. Y., Peter J. Prinz, 10 w, E.
WMSG—1350 kc, New York, N. Y., Madison Square Garden Broadcast Co., 250 w, E.
WMT—600 kc, Waterloo, Iowa, Waterloo Broadcasting Co., 500 w, C.
WNAC—1230 kc, Boston, Mass., The Shepard Broadcasting Service, 1000 w, E.
WNAD—1010 kc, Norman, Okla., University of Oklahoma, 500 w, C.
WNAX—570 kc, Yankton, S. Dak., Gurney Seed & Nursery Co., 1000 w, C.
WNBF—1500 kc, Binghamton, N. Y., Howitt-Wood Radio Co., 100 w, E.
WNBH—1310 kc, New Bedford, Mass., New Bedford Broadcasting Co., 100 w, E. shared.
WNBO—1200 kc, Silver Haven, Pa., J. B. Spriggs, 100 w, E.
WNBR—1430 kc, Memphis, Tenn., Memphis Broadcasting Co., 500 w, C.
WNBW—1200 kc, Carbondale, Pa., Home Cut Glass & China Co., 10 w, E.
WNBX—1200 kc, Springfield, Vt., First Congregational Church Corp., 10 w, E.
WNBZ—1290 kc, Saranac Lake, N. Y., Smith & Mace, 50 w, E.
WNJ—1450 kc, Newark, N. J., Radio Investment Co., 250 w, E.
WNOX—560 kc, Knoxville, Tenn., WNOX, Inc., 1000 w, C.
WNYC—570 kc, New York, N. Y. Department of Plant & Structures, 500 w, E.
WOAI—1190 kc, San Antonio, Texas, Southern Equipment Co., 50,000 w, C.
WOAN—See WREC.
WOAX—1280 kc, Trenton, N. J., WOAX, Inc., 500 w, E.
WOBU—580 kc, Charleston, W. Va., WOBU, Inc., 250 w, E.
WOC—1000 kc, Davenport, Iowa, Central Broadcasting Co., 5000 w, C.
WOCL—1210 kc, Jamestown, N. Y., A. E. Newton, 50 w, E.
WODA—1250 kc, Paterson, N. J., Richard E. O'Dea, 1000 w, E.
WODX—1410 kc, Mobile, Ala., Mobile Brdcstg. Corp., 500 w, C.
WOI—640 kc, Ames, Iowa, Iowa State College, 5000 w, C.
WOKO—1440 kc, Albany, N. Y., WOKO, Inc., 500 w, E.
WOL—1310 kc, Washington, D. C., American Broadcasting Co., 100 w, E.
WOMT—1210 kc, Manitowoc, Wis., Francis M. Kadow, 100 w.
WOOD—1270 kc, Grand Rapids, Mich., Walter B. Stiles, Inc., 500 w, C.
WOPI—1500 kc, Bristol, Tenn., Radiophone Broadcasting Co., 100 w, E.
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.
WOS—630 kc, Jefferson City, Mo., State Marketing Bureau, 500 w, C.
WOV—1130 kc, New York, N. Y., International Broadcasting Corp., 1000 w, E.
WOW—590 kc, Omaha, Neb., Woodmen of the World, 1000 w, C.
WOWO—1160 kc, Ft. Wayne, Ind., Main Auto Supply Co., 10,000 w, C.
WPAD—1420 kc, Paducah, Ky., Paducah Broadcasting Co., 100 w, C.
WPAP—See under WQAO.
WPAW—1210 kc, Pawtucket, R. I., Shartenberg & Robinson, 100 w, E.
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. Pen Broadcasting Co., 100 w, E.
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.
WPRO—1210 kc, Providence, R. I., Cherry & Webb Bdcstg. Co., 100 w, E.
WPSC—1230 kc, State College, Pa., Pennsylvania State College, 500 w, day, E.
WPTF—680 kc, Ralcigh, N. C., Durham Life Insurance Co., 1000 w, E.
WQAM—560 kc, Miami, Fla., Miami Broadcasting Co., 1000 w, E.
WQAN—880 kc, Scranton, Pa., Scranton Times, 250 w, E.
WQAO—1010 kc, New York, N. Y., Calvary Baptist Church, 250 w, E.
WQBC—1360 kc, Vicksburg, Miss., Delta Broadcasting Co., 300 w, C.
WQDM—1370 kc, St. Albans, Vt., A. J. St. Antoine, 100 w, E.
WQDX—1210 kc, Thomasville, Ga., Stevens Luke, 100 w, E.
WRAK—1370 kc, Williamsport, Pa., C. R. Cummins, 50 w, E.
WRAM—1370 kc, Wilmington, N. C., Wilmington Radio Association, 100 w, E.
WRAW—1310 kc, Reading, Pa., Reading Broadcasting Co., 50 w, E.
WRAX—1020 kc, Philadelphia, Pa., WRAX Broadcasting Co., 250 w, E.
WRBJ—1370 kc, Hattiesburg, Miss., Hattiesburg Bdcstg. Co., 10 w, C.
WRBL—1200 kc, Columbus, Ga., WRBL Radio Station, Inc., 50 w, E.
WRBQ—1210 kc, Greenville, Miss., J. Pat Scully, 250 w, C.
WRBX—1410 kc, Roanoke, Va., Richmond Development Corp., 250 w, E.
WRC—950 kc, Washington, D. C., National Broadcasting Co., 500 w, E.
WRDO—1370 kc, Augusta, Me., Albert S. Woodman, 100 w, E.
WRDW—1500 kc, Augusta, Ga., Davenport's Musicove, Inc., 100 w, E.
WREC—600 kc, Memphis, Tenn., WREC, Inc., 500 w.
WREN—1220 kc, Lawrence, Kan., Jenny Wren Co., 1000 w, C.
WRHM—1250 kc, Minneapolis, Minn., Minnesota Broadcasting Corp., 1000 w, C.
WRJN—1370 kc, Racine, Wis., Racine Broadcasting Corp., 100 w, C.
WRNY—1010 kc, New York, N. Y., Aviation Radio Station, 250 w, E.
WROL—1310 kc, Knoxville, Tenn., Stuart Broadcasting Corp., 100 w, C.
WRR—1280 kc, Dallas, Texas, City of Dallas, 500 w, C.
WRUF—830 kc, Gainesville, Fla., University of Florida, 5000 w, E.
WRVA—1110 kc, Richmond, Va., Larus Bros. & Co., Inc., 5000 w, E.
WSAI—1330 kc, Cincinnati, Ohio, Crosley Radio Corp., 500 w, E.
WSAJ—1310 kc, Grove City, Pa., Grove City College, 100 w, E.
WSAN—1440 kc, Allentown, Pa., Allentown Call Pub. Co., 250 w, E.
WSAR—1450 kc, Fall River, Mass., Doughty & Welch Electrical Co., Inc., 250 w, E.
WSAZ—580 kc, Huntington, W. Va., WSAZ, Inc., 250 w, E.
WSB—740 kc, Atlanta, Ga., Atlanta Journal Co., 5000 w, E.
WSBC—1210 kc, Chicago, Ill., World Battery Co., 100 w, C.
WSBT—1230 kc, South Bend, Ind., South Bend Tribune, 500 w, C.
WSEN—1210 kc, Columbus, Ohio, Columbus Broadcasting Corp., 100 w, E.
WSFA—1410 kc, Montgomery, Ala., Montgomery Brdcstg. Co., 500 w, C.
WSIX—1210 kc, Springfield, Tenn., 638 Tire & Vulcanizing Co., 100 w, C.
WSJS—1310 kc, Winston-Salem, N. C., The Journal Co., 100 w, E.
WSM—650 kc, Nashville, Tenn., National Life & Accident Ins. Co., 5000 w, C.
WSMB—1320 kc, New Orleans, La., WSMB, Inc., 500 w, C.
WSMK—1380 kc, Dayton, Ohio, Stanley M. Krohn, Jr., 200 w, C.
WSOC—1210 kc, Gastonia, N. C., A. J. Kirby Music Co., 100 w, E.
WSPA—1420 kc, Spartanburg, S. C., 100 w, E.
WSPD—1340 kc, Toledo, Ohio, Toledo Broadcasting Co., 1000 w, E.
WSUI—880 kc, Iowa City, Iowa, State Univ. of Iowa, 500 w, C.
WSUN—See under WFLA.
WSVS—1370 kc, Buffalo, N. Y., Seneca Vocational High School, 50 w, E.
WSYB—1500 kc, Rutland, Vt., Weiss Music Co., E.
WSYR—570 kc, Syracuse, N. Y., Clive B. Meredith, 250 w, E.
WTAD—1440 kc, Quincy, Ill., Illinois Broadcasting Corp., 500 w.
WTAG—580 kc, Worcester, Mass., Worcester Telegram Pub. Co., Inc., 250 w, E.
WTAM—1070 kc, Cleveland, Ohio, National Broadcasting Co., 50,000 w, E.
WTAQ—1330 kc, Eau Claire, Wis., Gillette Rubber Co., 1000 w, C.
WTAR—780 kc, Norfolk, Va., WTAR Radio Corp., 500 w, E.
WTAW—1120 kc, College Station, Texas, Agri. & Mech. College of Texas, 500 w, C.
WTAX—1210 kc, Springfield, Ill., WTAX, Inc., 100 w.
WTBO—1420 kc, Cumberland, Md., Associated Brdcstg. Corp., 100 w, E.
WTEL—1310 kc, Philadelphia, Pa., Foulkrod Radio Eng. Co., 50 w, E.
WTFI—1450 kc, Toccoa, Ga., Toccoa Falls Bdcstg. Co., 500 w, E.
WTIC—1060 kc, Hartford, Conn., Travelers Broadcasting Service Corp., 50,000 w, E.
WTJS—1310 kc, Jackson, Tenn., Sun Publishing Co., 100 w, C.
WTMJ—620 kc, Milwaukee, Wis., Milwaukee Journal, 1000 w, C.
WTNT—1470 kc, Nashville, Tenn., Life and Casualty Ins. Co. of Tenn., 5000 w, C.
WTOC—1260 kc, Savannah, Ga., Savannah Broadcasting Corp., 500 w, E.
WWAE—1200 kc, Hammond, Ind., Hammond-Calumet Broadcasting Corp., 100 w, C.
WWJ—920 kc, Detroit, Mich., Evening News Assn., 1000 w, E.
WWL—850 kc, New Orleans, La., Loyola University, 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.
WWSW—1500 kc, Pittsburgh, Pa., Hotel Schenley.
WWVA—1160 kc, Wheeling, W. Va., West Virginia Broadcasting Corp., 5000 w, E.
WXYZ—1240 kc, Detroit, Mich., Kunsky Trendle Broadcasting Co., 1000 w, E.

U. S. Broadcasting Stations by Frequencies

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

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

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

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

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

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

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

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

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

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, WEEU

840 Kilocycles, 356.9 Meters—Canadian Wave:

850 Kilocycles, 352.7 Meters:
KWKH, WWL

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

870 Kilocycles, 344.6 Meters:
WLS, WENR, WBCN

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

890 Kilocycles, 336.9 Meters—Canadian Shared:
WJAR, WMMN, WGST, 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, 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, WLAP

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, KRSC, WDEL, WDBO, KFIO, KTRH, KMSC, KMBC

1130 Kilocycles, 265.3 Meters:
WOV, KSL, WJJD

1140 Kilocycles, 263.0 Meters:
WAPI, KVOO

1150 Kilocycles, 260.7 Meters:
WHAM

1160 Kilocycles, 258.5 Meters:
WWVA, WOWO

1170 Kilocycles, 256.3 Meters:
WCAU

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

1190 Kilocycles, 252.0 Meters:
WOAI

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

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

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

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

1240 Kilocycles, 241.8 Meters:
WACO, KTAT, WXYZ

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1460 Kilocycles, 205.4 Meters:
WJSV, KSTP

1470 Kilocycles, 204.0 Meters:
KGA, WTNT, WLAC

1480 Kilocycles, 202.6 Meters:
KFJF, WKBW

1490 Kilocycles, 201.6 Meters:
WCKY, WJAZ, WCHI

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

LIST OF POLICE BROADCASTING STATIONS

Call	Kilocycles	Meters	Location
WPDO	2,458	122.05	Akron, Ohio
WPDY	2,452	122.34	Atlanta, Ga.
KGPJ	1,712	175.23	Beaumont, Tex.
KSW	2,410	124.50	Berkeley, Calif.
WEY	1,596	187.97	Boston, Mass.
WRDU	1,596	187.97	Brooklyn, N. Y.
WMJ	2,422	123.86	Buffalo, N. Y.
WBR	257	1,165.00	Butler, Pa.
KGOZ	2,470	121.50	Cedar Rapids, Iowa
WPDV	2,458	122.05	Charlotte, N. C.
WPDB	1,712	175.23	Chicago, Ill.
WPDC	1,712	175.23	Chicago, Ill.
WPDD	1,712	175.23	Chicago, Ill.
WKDU	1,712	175.23	Cincinnati, Ohio
WRBH	2,452	122.34	Cleveland, Ohio
WPDI	2,416	124.17	Columbus, Ohio
KVP	1,712	175.23	Dallas, Tex.
KGPN	2,470	121.50	Davenport, Iowa
WKDT	1,596	187.97	Detroit, Mich.
WCK	2,410	124.50	Detroit, Mich.
WPDX	2,410	124.50	Detroit, Mich.
WPDF	2,440	123.00	Flint, Mich.
KGPR	1,712	175.23	Ft. Worth, Tex.
WMP	1,662	180.51	Framingham, Mass.
WPEB	2,440	123.00	Grand Rapids, Mich.
WJL	257	1,165.00	Greensburg, Pa.
WRDR	2,410	124.50	Grosse Point Village, Mich.
WBA	257	1,165.00	Harrisburg, Pa.
WMO	2,410	124.50	Highland Park, Mich.
KGPQ	2,452	122.35	Honolulu, T. H.
WMDZ	2,440	123.00	Indianapolis, Ind.
WRDS	1,662	180.51	Ingham, Mich.
KGPE	2,422	123.86	Kansas City, Mo.
WPDT	2,470	121.50	Kokomo, Ind.
WPDL	2,440	123.00	Lansing, Mich.
KGPL	1,712	175.23	Los Angeles, Calif.
WPDE	2,440	123.00	Louisville, Ky.
WPEC	2,470	121.50	Memphis, Tenn.
WPDK	2,452	122.34	Milwaukee, Wis.
KGPB	2,416	124.17	Minneapolis, Minn.
WPY	438	685.00	New York, N. Y.
WPY	500	600.00	New York, N. Y.
WCE	1,596	187.97	New York, N. Y.
KGPH	2,452	122.34	Oklahoma City, Okla.
KGPI	2,470	121.50	Omaha, Neb.
KGJX	1,712	175.23	Pasadena, Calif.
WPDP	2,440	123.00	Philadelphia, Pa.
WPDU	1,712	175.23	Pittsburgh, Pa.
KGPP	2,416	124.17	Portland, Ore.
WPDH	2,416	124.17	Richmond, Ind.
WPDR	1,712	175.23	Rochester, N. Y.
KGPC	1,712	175.23	St. Louis, Mo.
WPDS	2,416	124.17	St. Paul, Minn.
KGPD	1,596	187.97	San Francisco, Calif.
KGPD	2,410	124.50	San Francisco, Calif.
KGPA	2,416	124.17	Seattle, Wash.
KOPK	2,470	121.50	Sioux City, Iowa
WRDQ	2,470	121.50	Toledo, Ohio
WPDA	2,416	124.17	Tulare, Calif.
KGPG	2,410	124.50	Vallejo, Calif.
WPDW	2,410	124.50	Washington, D. C.
WMB	257	1,165.00	West Reading, Pa.
WDX	257	1,165.00	Wyoming, Pa.
WPDG	2,458	122.05	Youngstown, Ohio

U. S. VISUAL BROADCASTING STATIONS

Call	Kilocycles	Meters	Owner
1XAV	2,850	105.30	Short Wave & Television, Boston, Mass.
W2XAB	2,750	109.10	Atlantic Broadcasting, New York, N. Y.
W2XBC	2,750	109.10	United Research Corp., Long Island City, N. Y.
W2XBU	2,000	150.00	Harold E. Smith, Beacon, N. Y.
W2XCD	2,000	150.00	DeForest Radio Co., Passaic, N. J.
W2XCR	2,100	142.90	Jenkins Television, Jersey City, N. J.
W2XCR	2,000	150.00	Jenkins Television, Jersey City, N. J.
W2XCW	2,100	142.90	General Electric, Schenectady, N. Y.
W2XDA	1,544	194.30	Atlantic Broadcasting, New York, N. Y.
W2XDS	43,000	6.98	Jenkins Television, New York, N. Y.
W2XDS	48,500	6.19	Jenkins Television, New York, N. Y.
W2XDS	60,000	5.00	Jenkins Television, New York, N. Y.
W2XF	43,000	6.97	National Broadcasting, New York, N. Y.
W2XF	48,500	6.18	National Broadcasting, New York, N. Y.
W2XF	60,000	5.00	National Broadcasting, New York, N. Y.
W2XR	2,850	105.30	Radio Pictures, Inc., Long Island City, N. Y.
W3XAD	43,000	6.97	RCA-Victor, Camden, N. J.
W3XAD	48,500	6.18	RCA-Victor, Camden, N. J.
W3XAD	60,000	5.00	RCA-Victor, Camden, N. J.
W3XAD	2,100	142.90	RCA-Victor, Camden, N. J.
W3XK	2,000	150.00	Jenkins Laboratories, Wheaton, Md.
W6XS	2,100	142.90	Don Lee, Inc., Los Angeles, Calif.
W8XAV	2,100	142.90	Westinghouse, East Pittsburgh, Pa.
W9XAA	2,750	109.10	Federation of Labor, Chicago, Ill.
W9XAB	1,564	191.82	Federation of Labor, Chicago, Ill.
W9XAO	2,000	150.00	Western Television Corp., Chicago, Ill.
W9XAP	2,100	142.90	Daily News, Chicago, Ill.
W9XD	43,000	6.97	Journal Company, Milwaukee, Wis.
W9XD	48,500	6.18	Journal Co., Milwaukee, Wis.
W9XD	60,000	6.00	Journal Co., Milwaukee, Wis.
W9XG	2,750	109.10	Purdue University, W. Lafayette, Ind.
W9XR	2,850	105.30	Great Lakes Broadcasting, Chicago, Ill.

U. S. RELAY BROADCASTING STATIONS

Call	Kilocycles	Meters	Owner
W1XAZ	9,570	31.35	Westinghouse Elec., East Springfield, Mass.
W2XAD	15,340	19.56	General Electric, Schenectady, N. Y.
W2XAF	9,530	31.48	General Electric, Schenectady, N. Y.
W2XAG	550	545.00	General Electric, Schenectady, N. Y.
W2XAG	660	455.00	General Electric, Schenectady, N. Y.
W2XAG	790	380.00	General Electric, Schenectady, N. Y.
W2XAG	1,150	260.90	General Electric, Schenectady, N. Y.
W2XAG	1,500	200.00	General Electric, Schenectady, N. Y.
W2XAL	6,040	49.67	Short Wave Bdcstg. Corp., Coytesville, N. J.
W2XAL	11,800	25.42	Short Wave Bdcstg. Corp., Coytesville, N. J.
W2XAL	15,250	19.67	Short Wave Bdcstg. Corp., Coytesville, N. J.
W2XAL	21,460	13.97	Short Wave Bdcstg. Corp., Coytesville, N. J.
W2XE	6,120	49.02	Atlantic Broadcasting, Jamaica, N. Y.
W2XE	11,840	25.34	Atlantic Broadcasting Co., Jamaica, N. Y.
W2XE	15,280	19.63	Atlantic Broadcasting Co., Jamaica, N. Y.
W2XZ	610	491.50	National Broadcasting, Bellmore, N. Y.
W3XAL	6,100	49.18	National Broadcasting, New York, N. Y.
W3XAU	6,060	49.50	Universal Broadcasting, Philadelphia, Pa.
W3XAU	9,590	31.28	Universal Broadcasting, Philadelphia, Pa.
W3XL	6,425	46.70	National Broadcasting, New York, N. Y.
W6XAF	2,938	112.10	Dept. Agriculture, Sacramento, Calif.
W6XAF	5,870	51.11	Dept. Agriculture, Sacramento, Calif.
W6XAL	6,080	49.34	Pacific-Western Broadcasting, Westminster, Calif.
W6XAL	15,250	19.67	Pacific-Western Broadcasting, Westminster, Calif.
W6XAL	21,500	13.95	Pacific-Western Broadcasting, Westminster, Calif.
W6XN	12,850	23.35	General Electric, Oakland, Calif.
W8XAL	6,060	49.50	Crosley Radio Corp., Cincinnati, Ohio
W8XK	6,140	48.86	Westinghouse, East Pittsburgh, Pa.
W8XK	9,570	31.35	Westinghouse, East Pittsburgh, Pa.
W8XK	11,880	25.25	Westinghouse, East Pittsburgh, Pa.
W8XK	15,210	19.72	Westinghouse, East Pittsburgh, Pa.
W8XK	17,780	16.87	Westinghouse, East Pittsburgh, Pa.
W8XK	21,540	13.93	Westinghouse, East Pittsburgh, Pa.
W9XAA	6,080	49.34	Federation of Labor, Chicago, Ill.
W9XAA	11,840	25.34	Federation of Labor, Chicago, Ill.
W9XAA	17,780	16.87	Federation of Labor, Chicago, Ill.
W9XF	6,020	49.83	Great Lakes Broadcasting, Chicago, Ill.
W9XF	11,800	25.42	Great Lakes Broadcasting, Chicago, Ill.
W9XF	21,500	13.95	Great Lakes Broadcasting, Chicago, Ill.
W9XU	6,060	49.50	Mona Motor Oil Co., Council Bluffs, Iowa

SIMPLE TIME CHART

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

← WEST

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

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

EAST → ↓

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

FOREIGN BROADCAST STATIONS

Call	Location	Kc.
	ALGERIA	
.....	Algiers	824
	ARGENTINA	
LP4	Buenos Aires	670
LR1	Buenos Aires	790
LR2	Buenos Aires	870
LR3	Buenos Aires	950
LR4	Buenos Aires	990
LR5	Buenos Aires	830
LR6	Buenos Aires	910
LR7	Buenos Aires	750
LR8	Buenos Aires	1150
LR9	Buenos Aires	1030
LS1	Buenos Aires	710
LS2	Buenos Aires	1190
LS3	Buenos Aires	1270
LS5	Buenos Aires	1070
LS6	Buenos Aires	1350
LS8	Buenos Aires	1230
LS9	Buenos Aires	1390
LT2	Concordia	810
J2	Concordia	1327
LV2	Cordoba	911
LT7	General Pico	...
LT2	La Plata	685
LV8	Los Molinos	...
LT4	Mendoza	759
LT5	Parana	1249
LT3	Rosario	1090
LV5	Rosario	1369
LV6	Rosario	1079
LT6	San Juan	730
LP2	Villaguay	1140
	AUSTRALIA	
5CL	Adelaide	730
5DN	Adelaide	960
5KA	Adelaide	1200
5AD	Adelaide	1310
5AD	Adelaide	720
2AY	Albury	1320
2AY	Albury	1480
3BA	Ballarat	1300
3BO	Bendigo	1450
3BO	Bendigo	980
4QG	Brisbane	760
4BC	Brisbane	1145
4BC	Brisbane	880
4BK	Brisbane	1290
2CA	Canberra	1050
3KZ	Carlton	1350
4CH	Charleville	1170
3GL	Geelong	1400
2GN	Goulburn	1490
2MO	Gunnedah	1500
2MO	Gunnedah	1330
7ZL	Hobart	580
7HO	Hobart	890
7HO	Hobart	1160
7LA	Launceston	1080
7LA	Launceston	1100
2XN	Lismore	1340
4MK	Mackay	1190
3AR	Melbourne	610
3LO	Melbourne	800
3UZ	Melbourne	930
3DB	Melbourne	1180
3KZ	Melbourne	1350
2MV	Moss Vale	1220
2MV	Moss Vale	1460
2NC	Newcastle	1245
2HD	Newcastle	1415
2HD	Newcastle	1110
6WF	Perth	690
6ML	Perth	1010
6ML	Perth	1180
4RK	Rockhampton	930
2FC	Sydney	665
2BL	Sydney	855
2GB	Sydney	950
2UE	Sydney	1025
2KY	Sydney	1070
2UW	Sydney	1125
4GR	Toowoomba	1020
4TO	Townsville	1260
3TR	Trafalgar	1280
3WR	Wangaratta	1260
	AUSTRIA	
.....	Graz	851
.....	Innsbruck	1058
.....	Innsbruck	1376
.....	Klagenfurt	662
.....	Linz	1220
.....	Vienna	581
	BELGIUM	
EB4ED	Antwerp	1200
EB4GT	Bruxells	1150
ON4RB	Bruxells	590
EB4RC	Bruxells	1395
EB4FO	Bruxells	1305
EB4CE	Chatelineau	1365
EB4FG	Dampremy	1430
EB4RG	Gand	1090
EB4RW	Liege	1070
EB4BQ	Marchienne	1035
EB4EX	Ottomont	1335
EB4CF	Verviers	1395
	BERMUDA	
TJW	Hamilton	1480
	BOLIVIA	
.....	La Paz	1713
CPX	La Paz	1000
	BRAZIL	
PRAM	Amparo	1304
PRAH	Bahia	857
PRAF	Belem	1363
PRAQ	Bello Horizonte	1090
PRAN	Curvtiba	882
PRAZ	Franca	1111
PRAJ	Juiz de Fora	857
PRAY	Mogy das Cruzes	1000
PRAD	Pelotas	920
PRAG	Porto Alegre	1090
PRAP	Recife	750
PRAI	Ribeirao Preto	1153
PRAA	Rio de Janeiro	750
PRAB	Rio de Janeiro	934
PRAC	Rio de Janeiro	833
PRAX	Rio de Janeiro	1364
PRAK	Rio de Janeiro	1153
PRAS	Santos	1000
PRAE	Sao Paulo	857
PRAR	Sao Paulo	1016
PRAL	Sao Paolo	750
PRAO	Sao Paolo	934
	CANADA	
CKGW	Bowmanville	910
CJBC	Bowmanville	910
CJSC	Bowmanville	910
CPRY	Bowmanville	910
10AE	Bowmanville	1199
10BQ	Brantford	1199
CKX	Brandon	540
CNRC	Calgary	690
CFCN	Calgary	690
CJCJ	Calgary	690
CHCA	Calgary	690
CFAC	Calgary	690
10BU	Canora	1199
CHCK	Charlottetown	960
CFCY	Charlottetown	960
CFCO	Chatham	1210
CHWK	Chilliwack	1210
CKMC	Cobalt	1210
CHMA	Edmonton	680
CKUA	Edmonton	580
CJCA	Edmonton	930
CNRE	Edmonton	930
CHRW	Fleming	600
CFNB	Fredericton	1210
CHNS	Halifax	930
CNRH	Halifax	930
CHCS	Hamilton	880
CHML	Hamilton	880
CKOC	Hamilton	880
CFJC	Kamloops	1120
10AY	Kelowna	1199
CFRC	Kingston	930
CFRB	King, York Co.	960
CNRX	King, York Co.	960
CJOC	Lethbridge	1120
10BU	Liverpool	1199
CJGC	London	910
CNRL	London	910
CKPR	Midland	930
CNRA	Moncton	630
CFCF	Montreal	1030
CJRM	Moose Jaw	600
10AB	Moose Jaw	1199
CFCH	North Bay	1200
CKCO	Ottawa	890
CNRO	Ottawa	600
CHWC	Pilot Butte	960
CFLC	Prescott	1010
CKPC	Preston	1210
10BI	Prince Albert	1199
CHRC	Quebec	880
CKCI	Quebec	880
CKCW	Quebec	880
CNRQ	Quebec	880
CNRD	Red Deer	840
CKLC	Red Deer	840
CHCT	Red Deer	840
CKCK	Regina	960
CJBR	Regina	960
CNRR	Regina	960
CFQC	Saskatoon	910
CNRS	Saskatoon	910
CJOR	Sea Island	1210
CKAC	St. Hyacinthe	730
CHYC	St. Hyacinthe	730
CNRM	St. Hyacinthe	730
CFBO	St. John	890
10AK	Stratford	1199
CHGS	Summerside	1120
CJCB	Sydney	880
CNRT	Toronto	840
CFCA	Toronto	840
CKOW	Toronto	840
CKCL	Toronto	580
CKNC	Toronto	580
CFCL	Toronto	580
CNRV	Vancouver	1030
CKCE	Vancouver	730
CHLS	Vancouver	730
CKFC	Vancouver	730
CKMO	Vancouver	730
CFCT	Victoria	630
CKCR	Waterloo	1010
10BP	Wingham	1199
CKY	Winnipeg	730
CNRW	Winnipeg	780
CKIC	Wolfville	930
CJGX	Yorkton	630
	CANAL ZONE	
NBA	Panama	845
	CANARY ISLANDS	
EAR5	Las Palmas	1071
	CEYLON	
VPB	Colombo	700
	CHILE	
.....	Asuncion	...
CMAI	Concepcion	870
CMAB	Santiago	625
CMAC	Santiago	804
CMAD	Santiago	938
CMAE	Santiago	1070
CMAF	Santiago	750
CMAK	Santiago	1333
CMAO	Santiago	1016
CMAQ	Santiago	1224
CMAT	Tacna	545
CMAJ	Valparaiso	1034
	CHINA	
CAB	Canton	689
XGY	Chekiang	977
COHB	Harbin	674
COMK	Mukden	731
XGZ	Nanking	1071
XOPP	Peiping	952
KRC	Shanghai	869
KNMS	Shanghai	1083
NKS	Shanghai	952
RSC	Shanghai	1276
XGX	Shanghai	1071
XGAH	Shanghai	937
COTN	Tientsin	625
GEC	Tientsin	1000
	CHOSEN	
JODK	Keijo	690
	COLOMBIA	
HJN	Bogota	684
	COSTA RICA	
TI4NRH	Heredia	980
TIC	San Jose	882
	CUBA	
CMHD	Caibarien	950
CMJA	Camaguey	1200
CMJC	Camaguey	1382
CMJE	Camaguey	856
CMJF	Camaguey	930
CMGE	Cardenas	1375
CMJA	Ciego de Avila	1017
CMHJ	Cienfuegos	645
CMGA	Colon	834
CMCG	Guanabacoa	1345
CMBR	Havana	1500
CMCW	Havana	1285
CMCQ	Havana	1150
CMBL	Havana	1500
CMCU	Havana	1285
CMBY	Havana	1225
CMCD	Havana	925
CMBC	Havana	965
CMBG	Havana	1070
CMQ	Havana	1150
CMCA	Havana	1225
CMK	Havana	730
CMCJ	Havana	620
CMBZ	Havana	1010
CMBI	Havana	1405
CMCB	Havana	1070
CMCH	Havana	1405
CMX	Havana	890
CMC	Havana	840
CMBT	Havana	790
CMBS	Havana	790
CMCF	Havana	890
CMCY	Havana	1345
CMW	Havana	588
CMBD	Havana	965
CMCR	Havana	1345
CMBN	Havana	1405
CMDC	Marianao	660
CMBW	Marianao	1010
CMCM	Havana	1405
CMBQ	Marianao	1500
CMCN	Marianao	925
CMCO	Marianao	660
CMGB	Matanzas	1205
CMGF	Matanzas	977
CMGH	Matanzas	1370
CMAB	Pinar del Rio	1249
CMAC	Pinar del Rio	1375
CMHI	Santa Clara	1110
CMKC	Santiago de Cuba	1034
CMHC	Tuinicu	790
	CZECHOSLOVAKIA	
OKR	Bratislava	1075
OKB	Brunn	878
OKK	Kosice	1024
.....	Moravska-Ostrava	1141
OKP	Prague	616
	DANZIG	
PTB	Danzig	662
	DENMARK	
.....	Copenhagen	1067
OXO	Kalundborg	260
	DOMINICAN REPUBLIC	
HIX	Santo Domingo	625
	DUTCH EAST INDIES	
.....	Bandoeng	968
PFC	Batavia	1364
	EGYPT	
.....	Cairo	869
.....	Cairo	909
	ESTONIA	
.....	Tallinn	1013
.....	Tallinn	747
.....	Tartu	1059
	FINLAND	
.....	Abo	1219
.....	Bjorenborg	1219
OFA	Helsingfors	1357
OFC	Jakobstad	1031
OFB	Lahti	167
OFD	Pori	1373
OFE	Tampere	662
OFG	Turku	1220
OFH	Viipuri	1031
	FRANCE	
F2BD	Agen	963
.....	Beziers	1413
.....	Bordeaux	986
.....	Grenoble	915
.....	Juan les Pino	1206
.....	Lille	1132
.....	Limoges	1020
YN	Lyon	644
YR	Lyon	1051
.....	Marsan	750
.....	Marseille	949
.....	Montpellier	1049
.....	Montpellier	1195
.....	Nimes	1250
FL	Paris	207
FPTT	Paris	671
.....	Paris	919
.....	Paris	174
.....	Paris	1265
.....	Rennes	1103
MRD	Toulouse	1175
.....	Toulouse	787
.....	Vitus	971

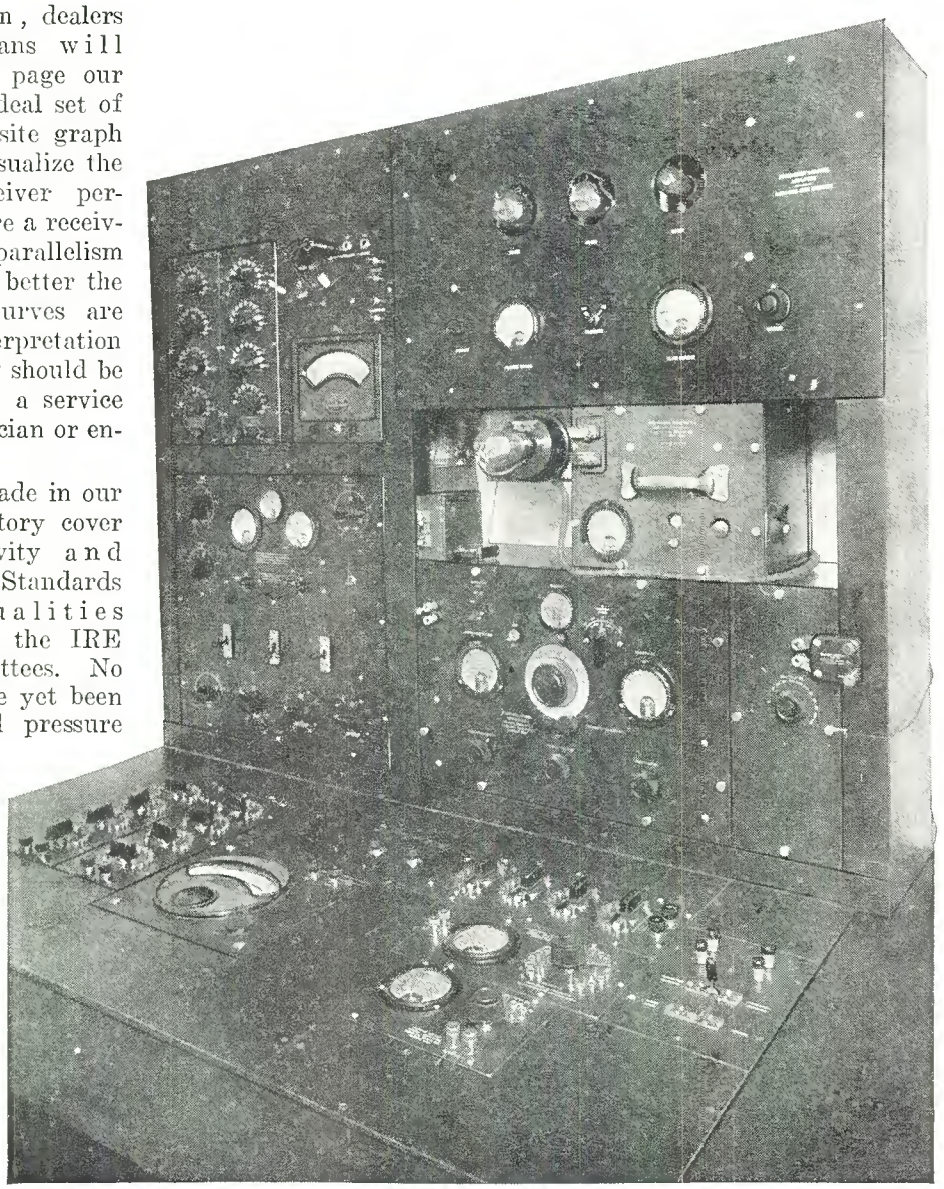
Call	Location	K.
	GERMANY	
.....	Aachen	1319
.....	Aix la Chapelle	662
.....	Augsburg	1112
.....	Berlin I	717
.....	Berlin II	1059
.....	Bremen	950
.....	Breslau	923
.....	Cologne	1319
.....	Dresden	940
.....	Flensburg	1373
.....	Frankfurt	769
.....	Freiburg	524
.....	Gleiwitz	1184
.....	Hamburg	806
.....	Hanover	535
.....	Kassel	1220
.....	Kaiserslautern	536
.....	Kiel	1292
.....	Konigsberg	1382
.....	Langenberg	684
.....	Leipzig	1158
.....	Magdeburg	1060
.....	Muehlacker	833
.....	Munich	563
.....	Munster	1319
.....	Nurnberg	1255
.....	Stettin	1060
.....	Stuttgart	833
	GREAT BRITAIN	
2BD	Aberdeen	995
2BE	Belfast	1238
6BM	Bournemouth	1040
2LS	Bradford	1040
5WA	Cardiff	968
.....	Daventry, Regional	626
.....	Daventry, National	193
2DE	Dundee	1040
2EH	Edinburgh	1040
5SC	Glasgow	752
6KH	Hull	1040
2LS	Leeds	1500
6LV	Liverpool	1040
.....	London, Regional	842
.....	London, National	1150
2ZY	Manchester	796
5NO	Newcastle	1148
5PY	Plymouth	1040
6FL	Sheffield	1040
6ST	Stoke-on-Trent	1040
5SX	Swansea	1040
	GUATEMALA	
TGW	Guatemala City	571
	HAITI	
HHK	Port au Prince	920
	HOLLAND	
.....	Bloemendaal	1220
PFBI	Hilversum	280
.....	Hilversum	1004
PI9	Huizen	160
PCF	Scheveningen	280
	HONDURAS	
HRB	Tegucigalpa	1370
	HONG KONG	
ZBW	Victoria	845
	HUNGARY	
HAL	Budapest	550
	ICELAND	
.....	Akureyri	1563
TFA	Reykjavik	1999
TFU	Reykjavik	250
	INDIA	
VUB	Bombay	840
VUC	Calcutta	810
VUL	Lahore	882
VUM	Madras	769
	IRISH FREE STATE	
6CK	Cork	750
2RN	Dublin	940
	ITALY	
1BA	Bari	...
1BZ	Bolzano	662
1FI	Firenze	...
1GE	Genoa	779
1MI	Milan	599
1NA	Naples	905
1PA	Palermo	1410
1RO	Rome	680
2RO	Rome	...
1TO	Torino	1094
1TR	Trieste	1211
	JAPAN	
JOLK	Fukuoka	680
JOFK	Hiroshima	850
JOJK	Kanazawa	710
JODK	Koijyo	820
JOGK	Kumamoto	790
JONK	Nagano	635
JOCK	Nagoya	810
JOKK	Okayama	700
JOBK	Osaka	750
JOIK	Sapporo	830
JOHK	Sendai	770
JOPK	Shizuoka	778
JOAK	Tokyo	870
	KENYA	
7LO	Nairobi	750
	KWANTUNG	
JQAK	Darien	759
	LATVIA	
YLZ	Riga	571
	LITHUANIA	
RYK	Kaunas	150
	LUXEMBURG	
LOAA	Luxemburg	1344
	MEXICO	
XFC	Aguascalientes	804
XFF	Chihuahua	923
XEQ	Ciudad Juarez	750
XEA	Guadalajara	1200
XEE	Linares	1000
XEY	Merida	547
XEX	Mexico City	1190
XEN	Mexico City	731
XEB	Mexico City	1030
XFG	Mexico City	638
XEG	Mexico City	910
XFI	Mexico City	591
XEO	Mexico City	940
XER	Mexico City	674
XFX	Mexico City	840
XEZ	Mexico City	588
XFZ	Mexico City	860
XEK	Mexico City	990
XEH	Mexico City	1130
XETA	Mexico City	1140
XEFA	Mexico City	1250
XET	Monterey	630
XEI	Morelia	1000
XEFE	Nuevo Laredo	980
XEP	Nuevo Laredo	1400
XEF	Oaxaca	1132
XEV	Puebla	1035
XED	Reynosa	961
XEL	Saltillo	1090
XFA	Tacubaya	500
XFA	Tacubaya	600
XEM	Tampico	841
XES	Tampico	890
XEC	Toluca	1333
XEU	Vera Cruz	800
XETF	Vera Cruz	680
XFE	Villahermosa	804
	MONACO	
.....	Monaco	1266
	MOROCCO	
CNO	Casablanca	983
.....	Rabat	414
	NEWFOUNDLAND	
VOGT	Bell Island	890
VONA	St. Johns	950
VOWR	St. Johns	675
VOX	St. Johns	1400
8WMC	St. Johns	682
8RA	St. Johns	550
	NEW ZEALAND	
1YA	Auckland	900
1ZR	Auckland	1190
1ZJ	Auckland	1420
1ZQ	Auckland	1188
3YA	Christchurch	980
3ZC	Christchurch	1199
2ZU	Dannevirke	1400
4YA	Dunedin	650
4ZB	Dunedin	1079
4ZO	Dunedin	1078
4ZM	Dunedin	1078
4ZL	Dunedin	1219
2ZE	Eketahuna	1210
2ZI	Gisborne	1150
3ZR	Greymouth	820
1ZH	Hamilton	630
2ZI	Hastings	1330
2ZL	Hastings	1330
4ZP	Invercargill	1160
4ZI	Invercargill	1160
1ZM	Manurewa	1210
2ZD	Masterton	1180
2ZH	Napier	1260
2YB	New Plymouth	1230
2ZF	Palmerston North	1049
2ZO	Palmerston North	1120
2ZP	Wairoa	820
2ZK	Wanganui	600
2ZG	Wanganui	600
2ZR	Wanganui	600
2YA	Wellington	719
2ZW	Wellington	1120
	NORWAY	
LKA	Alesund	671
LKB	Bergen	824
LKD	Bodo	662
LKF	Fredriksstad	815
LKH	Hamar	527
LKK	Kristianssand	1274
LKN	Notodden	671
LKO	Oslo	280
LKP	Porsgrund	662
LKR	Rjuken	671
LKS	Stavanger	1247
LKM	Tromso	662
LKT	Trondelag	608
	PERU	
OAX	Lima	790
OA4M	Lima	1428
	PHILIPPINE ISLANDS	
KZRC	Cebu	937
KZRM	Manila	618
	POLAND	
SP3	Krakow	530
SP4	Kattowitz	710
SP7	Lodz	1229
SP6	Lwow	779
SP2	Poznan	875
SP8	Warsaw	1402
SP1	Warsaw	270
SP5	Wilno	690
	PORTUGAL	
CT1AA	Lisbon	942
	ROUMANIA	
.....	Bucharest	759
	SALVADOR	
AQM	Salvador	785
RUS	Salvador	664
	SAMOA	
5ZA	Apia	940
	SIAM	
HSP1	Bangkok	857
HSP3	Bangkok	937
	SPAIN	
EAJ18	Almeria	1195
EAJ13	Barcelona	1119
EAJ1	Barcelona	860
EAJ15	Cartagena	1219
EAJ7	Madrid	708
EA12	Madrid	750
EAJ19	Oviedo	1119
EAJ8	San Sebastian	662
EAJ5	Seville	815
	SWEDEN	
SBE	Boden	250
SCA	Boras	1301
SCB	Eskilstuna	1220
SCC	Fahlm	832
SCD	Gavle	1471
SBB	Goteborg	832
SCE	Halmstad	1389
SCG	Halsingborg	1299
SBH	Horby	1167
SCF	Hudiksvall	1111
SCH	Jonkoping	1490
SCI	Kalmar	1220
SCJ	Karlskrona	1531
SCK	Karlstadt	1376
SCL	Kiruna	1220
SCM	Kristmehamm	1481
SCN	Malmberget	688
SBC	Malmo	1299
SBG	Motala	222
SCO	Norrkoping	1111
SCV	Orebro	1266
SCW	Ornskoldsvik	1376
SBF	Ostersund	389
SCP	Saffle	1220
SBA	Stockholm	688
SBD	Sundsvall	553
SCQ	Trollhattan	1112
SCR	Uddevalla	1058
SCS	Umea	1301
SCT	Uppsla	662
SCU	Varborg	1060
	SWITZERLAND	
HB3	Basel	941
.....	Basel	1229
.....	Berne	744
.....	Berne	1220
.....	Beromunster	653
.....	Geneva	395
.....	Lausanne	441
.....	Sottens	743
HBZ	Zurich	653
	TUNISIA	
TNU	Carthage	162
TUA	Tunis	235
	TURKEY	
TAE	Angora	193
TAL	Istanbul	250
.....	Osmanieh	250
	UNION OF SOVIET SOCIALIST REPUBLICS	
RW19	Achkhabad	333
RW60	Alma-Alta	310
RW36	Arkhangelsk	770
RW35	Astrakhan	435
RW8	Bakou	238
RW43	Bakou	238
RW30	Dnepropetrovsk	511
RW21	Erivan	404
RW40	Gomel	621
RW23	Groznyi	676
RW14	Irkoutsk	187
RW31	Ivanovo-Voznesensk	603
RW46	Karaganda	686
RW17	Kazan	550
RW17	Kazan	644
RW54	Khabarovsk	1052
RW54	Khabarovsk	320
RW4	Kharkov	320
RW20	Kharkov	704
RW9	Kiev	368
RW9	Kiev	290
RW33	Krasnodar	650
RW53	Leningrad	300
RW27	Makhatch Kala	795
RW10	Minsk	429
RW1	Moscow	202
RW2	Moscow	417
RW37	Moscow	792
RW39	Moscow	792
RW58	Moscow	272
RW58	Moscow	268
RW49	Moscow	230
RW51	Naltchik	748
RW42	Nijni-Novgorod	394
RW6	Novosibirsk	238
RW13	Odessa	666
RW44	Omsk	471
RW45	Orenbourg	461
RW22	Oufa	444
RW22	Oufa	617
RW67	Oukhta	354
RW56	Penza	640
RW29	Petrozavodsk	468
RW29	Petrozavodsk	779
RW24	Piatigorsk	468
RW55	Pokrovsk	730
RW12	Rostov-sur-le-Don	353
RW16	Samara	521
RW16	Samara	404
RW18	Samarkand	342
RW3	Saratov	340
RW52	Simferopol	630
RW52	Simferopol	725
RW24	Smolensk	531
RW47	Stalinabad	421
RW26	Stalino	810
RW32	Stavropol	608
RW38	Sverdlovsk	157
RW5	Sverdlovsk	363
RW41	Syktykvaz	560
RW11	Tachkent	256
RW7	Tiflis	280
RW48	Tomsk	645
RW63	Verkhneoudinsk	350
RW64	Vladikavkag	752
RW28	Vladivostok	634
RW28	Vladivostok	725
RW25	Voronej	385
RW25	Voronej	450
	URUGUAY	
CX6	Montevideo	650
CX10	Montevideo	730
CX12	Montevideo	770
CX14	Montevideo	810
CX16	Montevideo	850
CX18	Montevideo	890
CX20	Montevideo	930
CX22	Montevideo	970
CX26	Montevideo	1050
CX30	Montevideo	1130
CX32	Montevideo	1170
CX34	Montevideo	1210
CX36	Montevideo	1250
CX38	Montevideo	1290
CX40	Montevideo	1330
CX44	Montevideo	1410
CX46	Montevideo	1450
CX48	Montevideo	1490
CW40	Paysandu	1340
CW44	Paysandu	1420
CW32	Salto	1180
CW34	Salto	1220
CW36	Salto	1260
CW38	Salto	1300
CW30	Tucuarembo	1140
	UNION OF SOUTH AFRICA	
ZTC	Capetown	800
ZTD	Durban	738
ZTJ	Johannesburg	666
	VENEZUELA	
AYRE	Caracas	800
1BC	Caracas	960
	YUGOSLAVIA	
.....	Belgrade	696
.....	Ljubljano	527
.....	Zagreb	977

FOREIGN SHORT WAVE PHONE STATIONS

Call	Location	Kc.
	ARGENTINA	
LSX	Buenos Aires	10,352
LSG	Buenos Aires	19,900
LSN	Buenos Aires	21,200
	AUSTRALIA	
VK3ME	Melbourne	9,510
VK6AG	Perth	7,194
VK2ME	Sydney	10,526
VLK	Sydney	10,526
	AUSTRIA	
.....	Vienna	13,514
UOR2	Vienna	11,801
OUITH	Vienna	8,060
UOR2	Vienna	6,072
OHK2	Vienna	4,274
	BELGIUM	
	BOLIVIA	
	BRAZIL	
PPU	Rio de Janeiro	6,122
PPU	Rio de Janeiro	19,270
	BRITISH COLONIES	
VRY	Georgetown, Guiana	6,726
TJW	Hamilton, Bermuda	9,500
.....	Mombras, Kenya	13,895
.....	Mombras, Kenya	8,230
VQ7LO	Nairobi, Kenya	6,100
VS6WX	Singapore	7,190
	CANAL ZONE	
	CANADA	
VE9GW	Bowmanville, Ont.	6,095
VE9GW	Bowmanville, Ont.	11,810
VE9GW	Bowmanville, Ont.	24,380
VE9CG	Calgary, Alta.	6,110
VE9CA	Calgary, Alta.	6,030
VE9CA	Calgary, Alta.	11,860
VE9DR	Drummondville, Que.	11,780
VE9CF	Halifax, N. S.	6,050
VE9CL	Middlechurch, Man.	6,150
VE9DN	Montreal, Que.	6,005
VE9DN	Montreal, Que.	9,580
VE9DN	Montreal, Que.	11,895
VE9BA	Montreal, Que.	6,130
VE9BA	Montreal, Que.	11,705
VE9BA	Montreal, Que.	15,190
VE9AK	Red Deer, Alta.	2,830
VE9BJ	St. John, N. B.	6,090
VE9CS	Vancouver, B. C.	6,070
	CURACAO	
PJZ	Curacao	11,718
	CZECHOSLOVAKIA	
.....	Bratislava	5,000
OKIMPT	Prague	5,119
OK1MPT	Prague	4,412
	CHILE	
	CHINA	
XCTE	Shanghai	5,000
	COLOMBIA	
HKA	Barranquilla	5,837
HKD	Barranquilla	6,993
HKF	Bogota	7,194
HKF	Bogota	7,610
HKC	Bogota	6,250
HKX	Bogota	6,977
HKX	Bogota	7,143
	COSTA RICA	
TIH	Heredia	9,734
	CUBA	
CM2LA	Havana	10,007
CM2MK	Havana	9,360
CM6XJ	Tuinucu	15,008
	DANZIG	
EK4ZZZ	Danzig	7,500
	DENMARK	
OXZ	Skamlabaek	9,520
	DOMINICAN REPUBLIC	
HIX	Santo Domingo	4,610
	DUTCH EAST INDIES	
PMB	Bandoeng	20,620
PLE	Bandoeng	18,830
PLG	Bandoeng	15,957
PMY	Bandoeng, Java	5,172
PK2AF	Djocjacorta, Java	6,000
PK6KZ	Makassar	11,765
PK2AG	Semerang, Java	2,609
PK3AN	Surabaya, Java	6,036
.....	Surabaya	2,143
PK1AA	Weltevreden, Java	4,000
	ECUADOR	
.....	Riobamba	7,540
	EGYPT	
	ESTONIA	
	FIJI	
VPD	Suva	14,430
	FINLAND	
	FRANCE	
.....	Agen	9,760
FYR	Lyons	7,463
FYR	Lyons	5,172
.....	Nancy	19,350
FSAV	Nogent	3,750
FLJ	Paris	9,230
FSLH	Paris	7,317
.....	Paris	6,860
FSGC	Paris	4,918
.....	Pontoise-Seine-et-Oise	11,720
.....	Pontoise-Seine-et-Oise	11,905
.....	Pontoise-Seine-et-Oise	15,243
FSBP	Rugles	5,455
FTD	St. Assise	19,840
FRO	St. Assise	19,417
FTE	St. Assise	19,417
FTM	St. Assise	19,355
FTO	St. Assise	18,248
FTE	St. Assise	18,248
FSE	St. Assise	13,441
FQO	St. Assise	12,161
FQE	St. Assise	12,161
FTN	St. Assise	12,265
FTL	St. Assise	9,950
FTF	St. Assise	7,770
FTB	St. Assise	7,490
.....	Touraine	7,500
.....	Toulouse	6,122
	FRENCH COLONIES	
FM8KR	Constantine	7,009
FM8KR	Constantine	3,750
	GERMANY	
.....	Elberswalde	7,407
D4AFF	Kothen	7,042
DHA	Nauen	11,760
DHC	Nauen	15,200
.....	Nauen	6,020
DGW	Nauen	17,760
.....	Nauen	9,560
	GREAT BRITAIN	
GBK	Bodmin	18,105
GBK	Bodmin	9,260
G5SW	Chelmsford	11,750
GBX	Rugby	16,164
GBS	Rugby	18,310
GBW	Rugby	18,138
GBW	Rugby	14,493
GBU	Rugby	12,290
GBX	Rugby	12,195
GBS	Rugby	12,195
GBS	Rugby	9,020
GBS	Rugby	6,993
G2MN	Sonning-on-Thames	14,320
	HAITI	
	GUATEMALA	
	HOLLAND	
PBF5	Hague	6,438
PCJ	Hilversum	9,590
PCJ	Hilversum	15,220
PHI	Huizen	17,775
PCK	Kootwijk	18,400
PCV	Kootwijk	17,836
	HONDURAS	
HRB	Tegucigalpa	6,170
	HUNGARY	
HAT	Szekesfehervar	9,125
	ICELAND	
	INDIA	
VUC	Calcutta	11,870
	INDO-CHINA	
F31CD	Chi-hoa	6,122
FZR	Saigon	16,216
FZR	Saigon	12,043
	IRISH FREE STATE	
	ITALY	
I2RO	Rome	11,811
I2RO	Rome	3,750
1MA	Rome	6,897
I2RO	Rome	3,750
.....	Turin	3,750
HVJ	Vatican City	5,968
HVJ	Vatican City	15,120
	JAPAN	
J1AA	Kemikawa	17,391
J1AA	Kemikawa	8,000
	JUGOSLAVIA	
.....	Belgrade	10,000
	LATVIA	
	LITHUANIA	
	MADAGASCAR	
.....	Tananarive	6,000
	MADEIRA	
CT3AG	Funchal	6,383
	MEXICO	
XDA	Mexico City	14,634
XDA	Mexico City	9,380
XDA	Mexico City	6,818
XFD	Mexico City	6,667
XFD	Mexico City	9,091
XFD	Mexico City	11,111
XFA	Mexico City	5,977
XFA	Mexico City	7,143
XFA	Mexico City	21,249
	MONACO	
	MOROCCO	
CN8MC	Casablanca	6,881
CN8MC	Casablanca	3,882
.....	Rabat	12,610
.....	Rabat	9,300
....	Rabat	12,605
....	Rabat	9,300
	NEWFOUNDLAND	
VO8A	St. Johns	6,800
	NEW ZEALAND	
ZL2XX	Wellington	9,550
	NORWAY	
	PERU	
	PHILIPPINE ISLANDS	
KA1XR	Manila	12,245
KZRM	Manila	11,840
KZRM	Manila	9,570
KZRM	Manila	6,140
	POLAND	
.....	Poznan	11,001
.....	Poznan	8,900
	PORTUGAL	
PT1AA	Lisbon	7,143
.....	Oporto	12,000
	ROUMANIA	
YO1	Bucharest	13,950
	SALVADOR	
	SHIP PHONE STATIONS	
GMJQ	SS. Belgenland	17,650
GMJQ	SS. Belgenland	13,040
GMJQ	SS. Belgenland	8,570
GMJQ	SS. Belgenland	4,762
DDDX	SS. Bremen	11,710
DDDX	SS. Bremen	7,560
IBDX	SS. Electra (Marconi's Yacht)	11,240
.....	SS. Hamburg	13,040
GDLJ	SS. Homeric	12,380
GDLJ	SS. Homeric	4,754
WSBN	SS. Leviathan	8,330
WSBN	SS. Leviathan	6,637
WSBN	SS. Leviathan	4,392
WSBN	SS. Leviathan	3,420
GFWV	SS. Majestic	17,390
GFWV	SS. Majestic	13,228
GFWV	SS. Majestic	4,430
GFWV	SS. Majestic	4,180
GLSQ	SS. Olympic	12,387
GLSQ	SS. Olympic	16,456
GLSQ	SS. Olympic	8,840
	SIAM	
HS2PJ	Bangkok	10,169
HSP2	Bangkok	9,500
HSP2	Bangkok	7,300
	SPAIN	
EAJ1	Barcelona	15,789
EAR96	Barcelona	6,522
EAR25	Barcelona	6,000
EAR58	Las Palmas, Canary Islands	7,210
EAR110	Madrid	7,026
EAR125	Madrid	7,026
EAJ25	Malaga	3000
EAR113	Viscaya	6,522
	SWEDEN	
.....	Motala	6,070
	SWITZERLAND	
HB9OC	Berne	9,130
HB9XD	Zurich	9,380
HB9XD	Zurich	7,229
HB9XD	Zurich	3,488
	TURKEY	
	UNION OF SOVIET SOCIALIST REPUBLICS	
RW15	Khabarovsk	4,273
RW3KAA	Leningrad	8,333
.....	Leningrad	11,111
.....	Leningrad	10,526
RW62	Minsk	6,420
RW61	Moscow	51,724
RW38	Moscow	5,514
RW59	Moscow	6,000
RW65	Peredvijka	3,560
RW19	Tomsk	8,111
	URUGUAY	
	UNION OF SOUTH AFRICA	
ZTJ	Johannesburg	9,380
	VENEZUELA	

Receiver Performance Curve Section

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

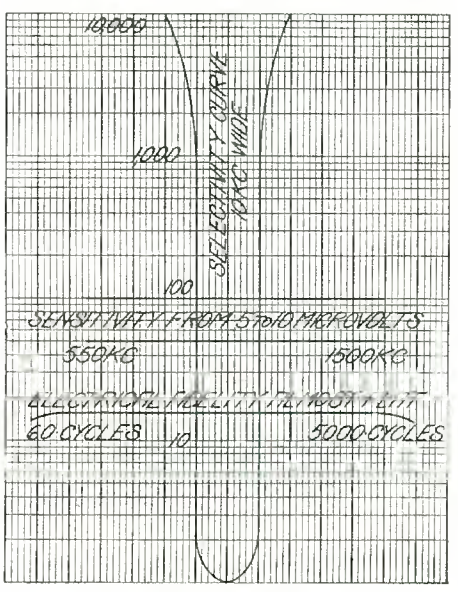


Measurements made in our engineering laboratory cover sensitivity, selectivity and electrical fidelity. Standards for these three qualities have been set by the IRE engineering committees. No standards have yet been adopted for sound pressure measurements. Until a standard is selected, our laboratory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

Definitions of the three major characteristics of a receiver are:

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

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



Ideal Composite Curve

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

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

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

All-American Mohawk Lyric S-8

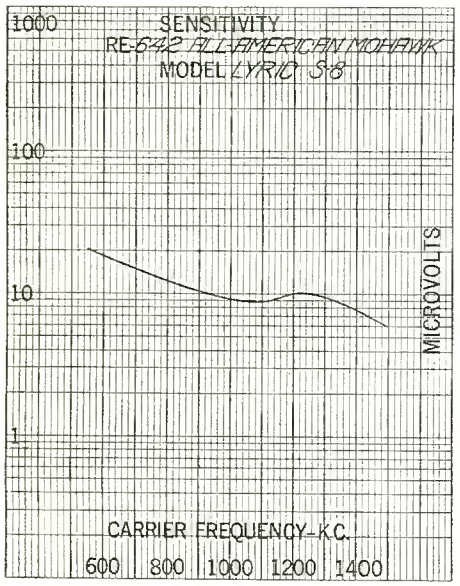
RESULTS of our recent laboratory measurements on the All-American Mohawk Lyric model S-8 when plotted gave the included curves.

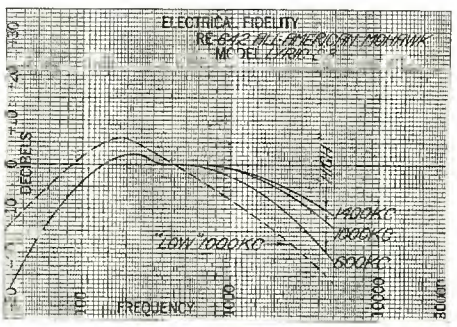
A standard dummy antenna of 20 uh, 200 uuf and 25 ohms was used to couple the signal generator output to the receiver. For all tests the volume control was turned on full for maximum sensitivity, the voice coil of the dynamic speaker was disconnected, and the plates of the output tubes were capacitatively coupled to the output meter, which read the standard audio level of .05 watts. To match the push-pull 247 pentodes, the output load, connected between the plates, was adjusted to 15,000 ohms.

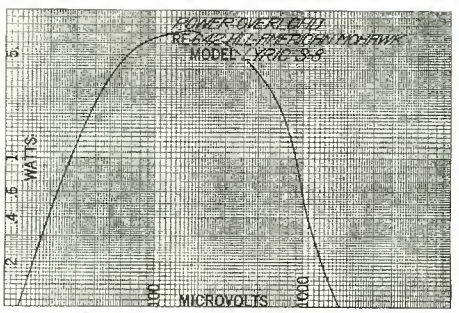
Tuned circuit alignment was not altered from factory adjustment, and the tubes used during measurements were those furnished with the chassis as standard equipment. The line current was .82 amperes, with an impressed line voltage of 110 volts.

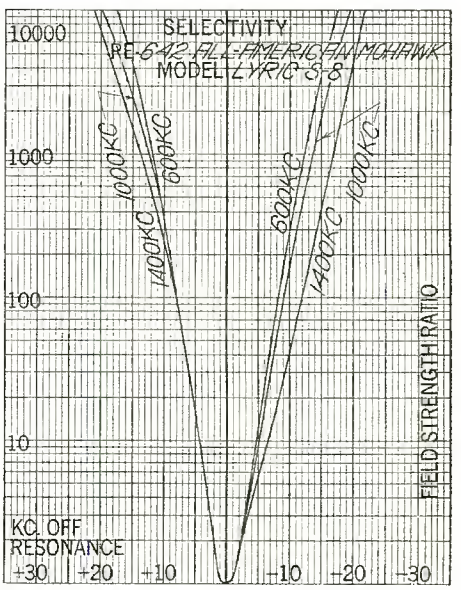
Average sensitivity as found on the sensitivity curve of column 1 is 11.8 microvolts absolute, which is equivalent to 2.9 microvolts per meter when a standard four-meter antenna is employed. Maximum power output to the speaker is found to be 7.06 watts from the curve of column 2. However, no account is taken of the harmonics present in the output wave form at this power level. Noise levels are 1.6 per cent at 600 k-c, the minimum value, and 28 per cent at 1400 k-c, the maximum. Band width taken from the selectivity curves of column 3 will be found listed under them.

A schematic wiring diagram of this superheterodyne receiver will be found at the bottom of the page. Eight tubes are required for operation, a 551 r-f, 224 first detector, 227 oscillator, 551 second i-f, 227 second detector, push-pull 247 pentodes, and the 280 full wave rectifier for B voltage supply to the receiver and speaker field. This receiver has its hum filtering inductance limited to the field coil of the dynamic speaker, which gives the necessary voltage drop from -B to ground for grid bias of the 247 pentodes. Two electrolytic filter condensers are employed, an 8 microfarad unit and a block of 16 microfarads.



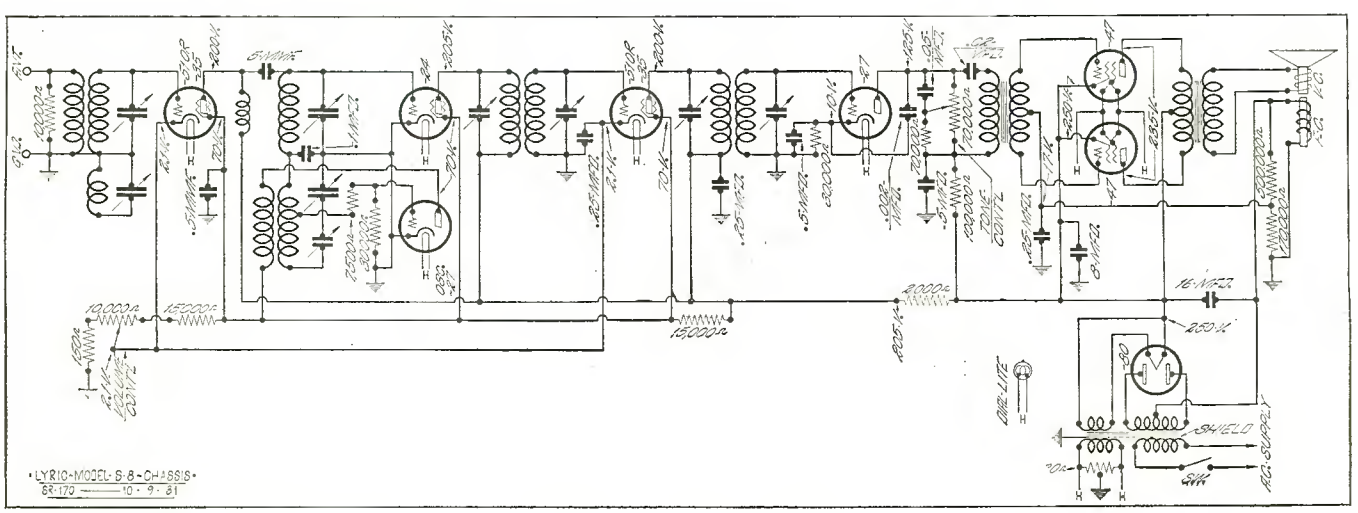






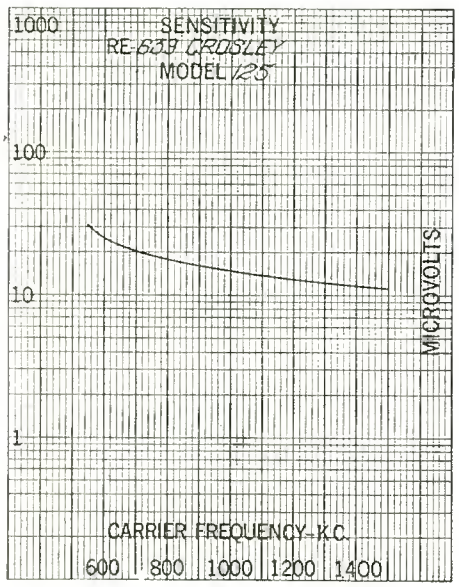
Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	9	9.5	11
100	16.5	17.5	20
1000	24.5	26	31
10000	35	39	43



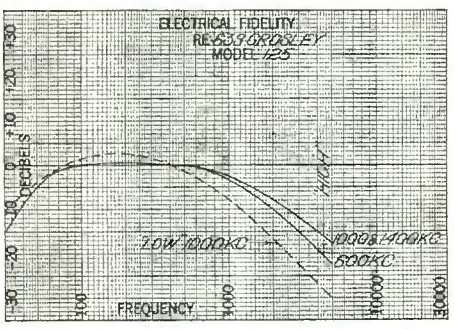
Crosley Model 125

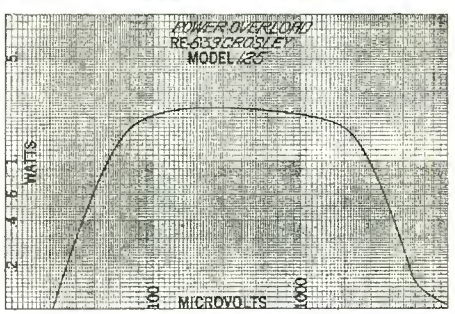
CROSLEY'S model 125 is another five tube superheterodyne which makes use of the first tube in the circuit as a first detector and oscillator. Over all performance curves for this model made in our laboratory will be found on this page.



For receiver antenna circuit input the standard dummy antenna of 20 uh, 200 uuf and 25 ohms coupled the output of the signal generator attenuator to the input circuit. A non-inductive resistance load of 7500 ohms was used on the output of the 247 pentode to match its optimum plate load, and the plate of the tube was capacitatively coupled to the vacuum tube voltmeter, which indicated the standard output power level of .05 watts. To avoid the loading effect of the voice coil, it was disconnected during all measurements.

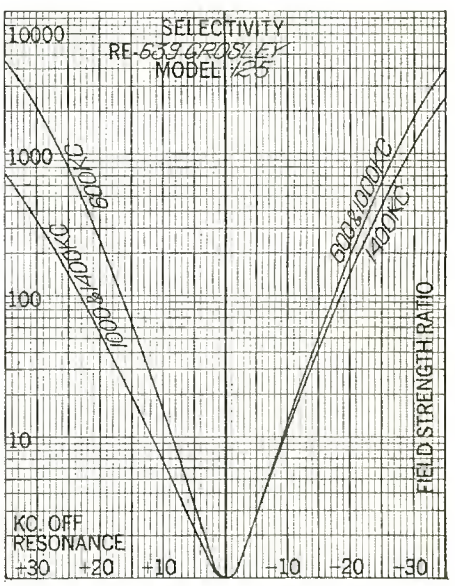
A line current of .5 amperes was drawn with an a-c voltage of 115 volts. Tubes used during tests were those sent with the receiver by the manufacturer, and no changes were made in the receiver alignment from the factory adjustment.





In column 1 the curve of sensitivity gives an average value over the broadcast band of 23.8 microvolts absolute, which is the equivalent of 5.95 microvolts per meter. Image ratio measured at a dial setting of 1000 k-c was calculated to be 2890. A minimum noise level of .4 of one per cent was measured at 600 k-c, while the maximum occurred at 1400 k-c with a value of 1.1 per cent. The power overload curve of column 2 gives a maximum power output of 2.35 watts, but this figure does not take into account the harmonics which were present in the output wave form in the speaker transformer. Band widths were measured from the selectivity curves of column 3 and will be found tabulated under them.

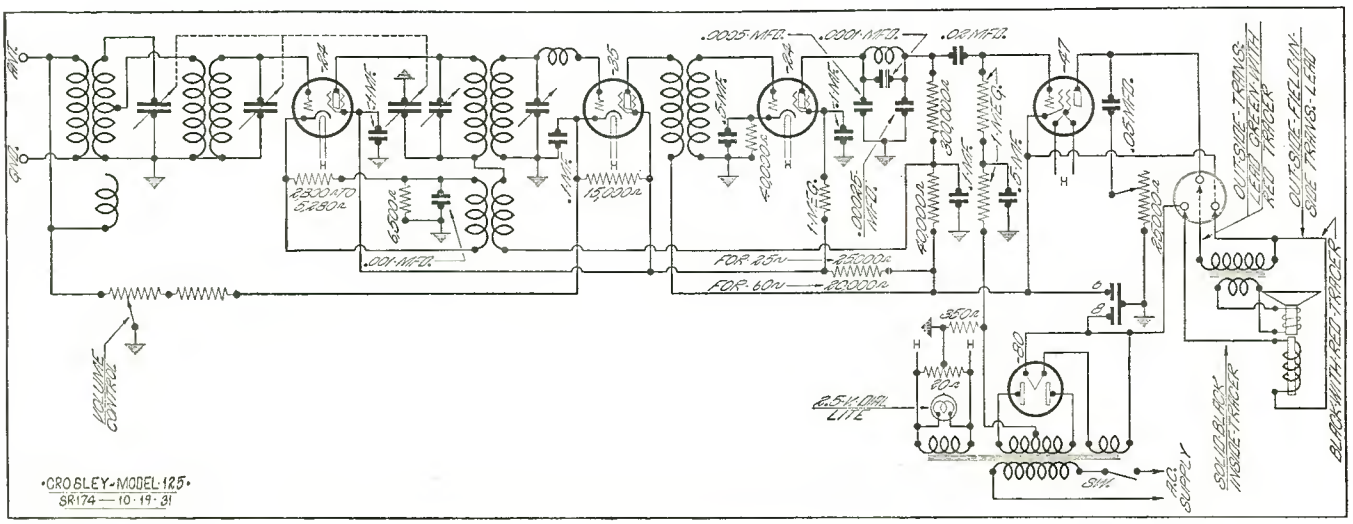
A schematic wiring diagram of this



Crosley receiver will be found under this article. Tubes necessary for operation are a 224 detector-oscillator, 235 second i-f, 224 second detector, 247 output pentode, and a 280 full-wave rectifier for all B voltage supplied in the receiver.

Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	18.5	21.5	22
100	34	40.5	41.5
1000	53	64	66.5
10000	88	——	——



General Electric Model H-32

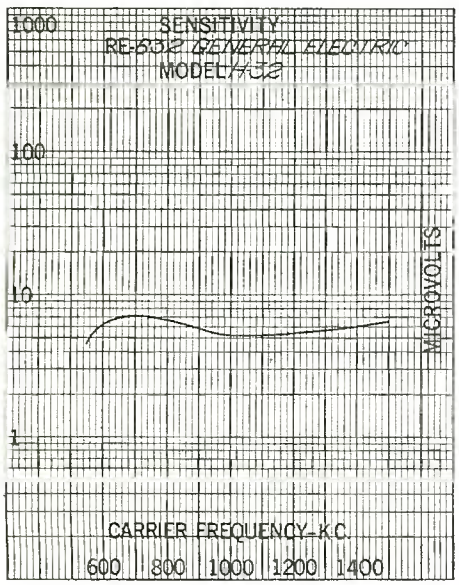
PERFORMANCE curves of the General Electric superheterodyne radio receiver model H-32 taken from our recent laboratory measurements are printed on this page.

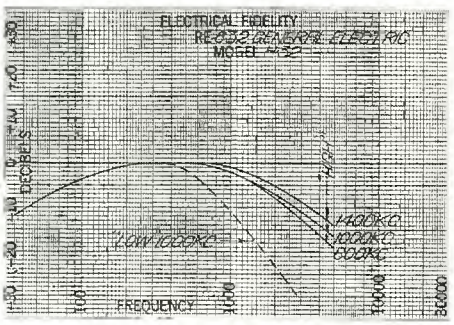
A dummy antenna of 20 uh, 200 uuf and 25 ohms coupled the signal generator output to the receiver input circuit. The push-pull 247 tubes' plate impedance was matched by a 15,000 ohm non-inductive resistance load, and the plates were capacitatively coupled to the output indicating tube voltmeter. For all tests the voice coil circuit was broken, the volume control was turned on full, and an output level of .05 watts was maintained.

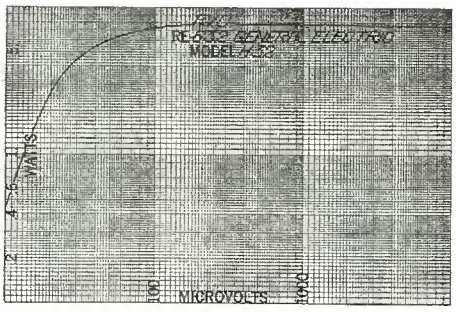
No changes were made in the factory alignment of the receiver, and the tubes employed during measurements were those shipped with the chassis. A line voltage of 112 volts resulted in a line current of 1 ampere to the receiver power transformer primary.

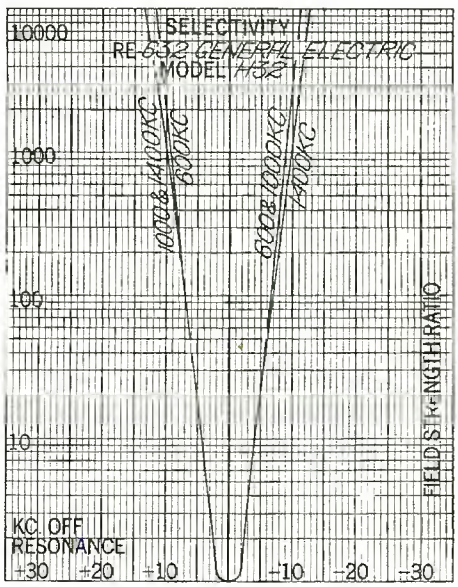
Average sensitivity as taken from the sensitivity curve of column 1 is 5.8 microvolts absolute, which is 1.45 microvolts per meter. Maximum noise level occurred at 1400 k-c and had a value of 40 per cent, while the minimum value was 23 per cent at 600 k-c. Maximum power output to the speaker was 7.2 watts, as taken from the automatic volume control curve of column 2. This figure does not consider the harmonics in the wave form at this power output level. Band widths will be found tabulated under the selectivity curves in column 3.

Tubes required for this superheterodyne, as taken from the schematic wiring diagram below, are a 235 r-f, 224 first detector, 227 oscillator, 235 second i-f, 235 third i-f, 227 automatic volume control tube, 227 second detector, push-pull 247 pentodes, and a 280 rectifier.



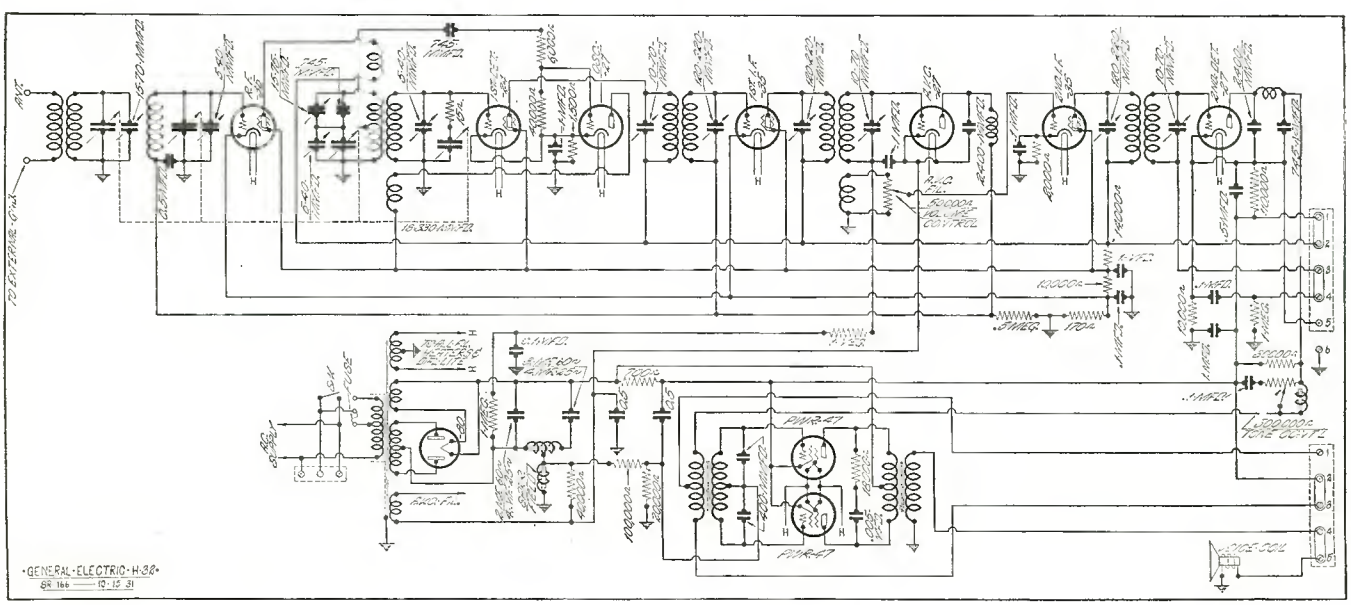






Band Widths

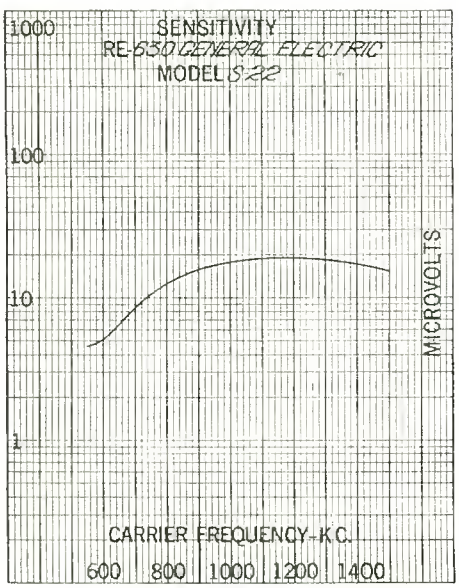
Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	8.5	8.5	8.5
100	13.5	13.5	14
1000	18.5	19.5	20
10000	23	24.5	26



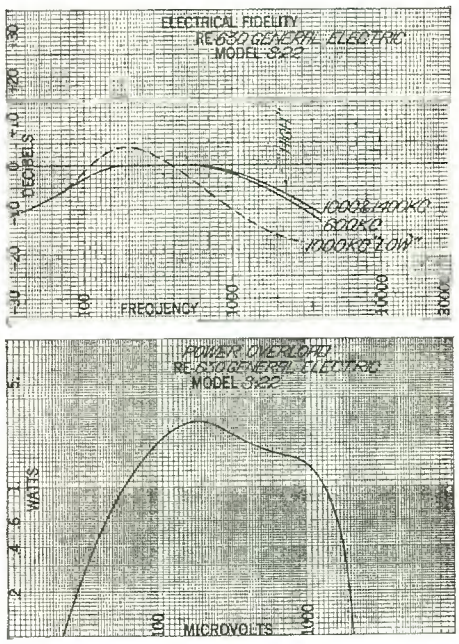
General Electric Model S-22

PERFORMANCE curves of the General Electric model S-22 included in this article were made from recent tests in our laboratory.

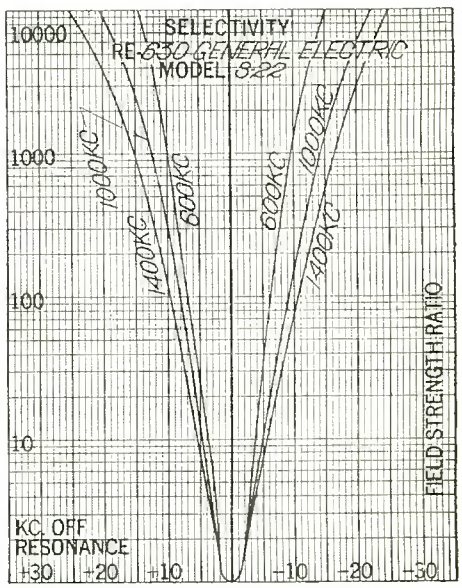
Modulated carrier input to the receiver was through a standard dummy antenna of 20 uh, 200 uuf and 25 ohms, while the output of .05 watts was measured across the 4000 ohm resistance load across the plates of the 245 tubes employed in push-pull. Because the voice coil circuit was opened during the tests, the output tube plates were capacitatively coupled to the measuring device.



With a line voltage of 111 volts, the power transformer primary current was .61 amperes. Alignment of the circuit trimming condensers was not changed from factory adjustment, the tubes used were those furnished by the manufacturer with the set, and at all times the volume control was adjusted for maximum receiver sensitivity.



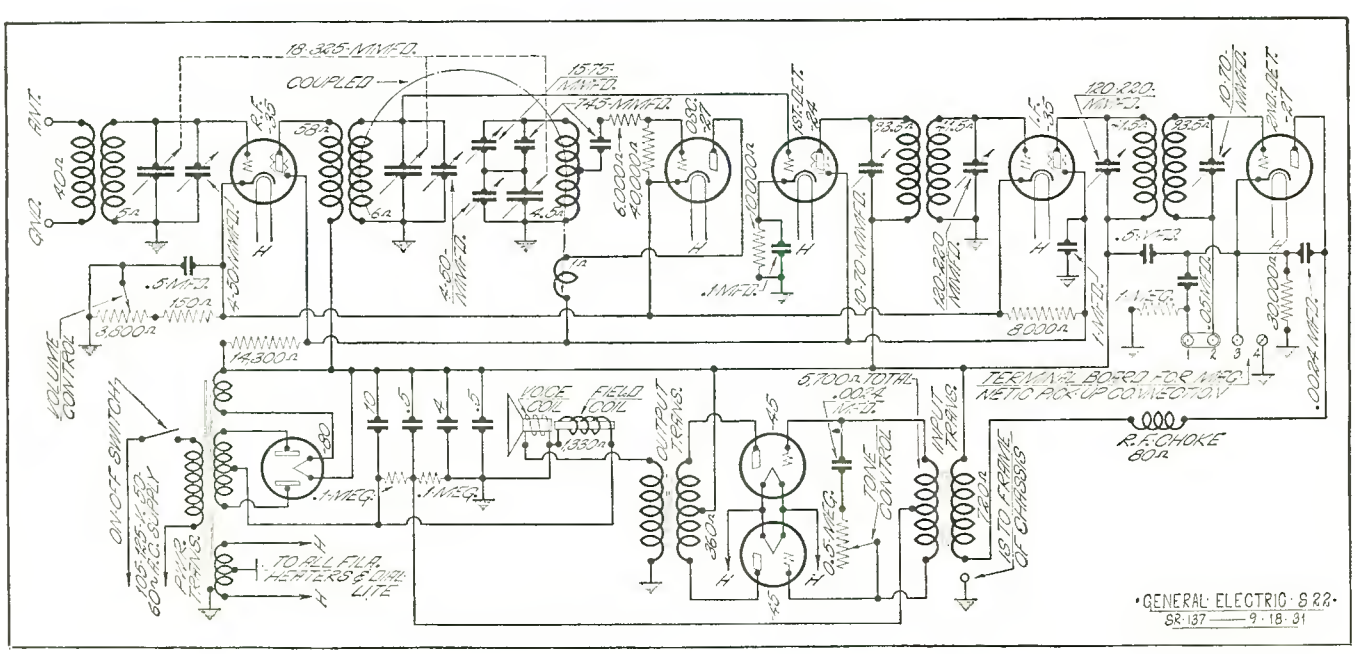
From the curve of column 1 the average measured sensitivity is found to be 23.2 microvolts absolute, which is equivalent to 5.8 microvolts per meter when using a standard four-meter antenna. A value of 2.77 watts of audio power is taken as the maximum from the power overload curve of column 2. This value disregards the harmonic content of the voltage wave form across the primary of the speaker transformer. Under the selectivity curves of column 3 the band widths taken from them will be found.



Below this article is printed the schematic wiring diagram of the model S-22. From it the tube complement is taken as a 235 r-f, 227 oscillator, 224 first detector, 235 second i-f, 227 second detector, push-pull 245 tubes and the 280 full-wave rectifier.

Band Widths

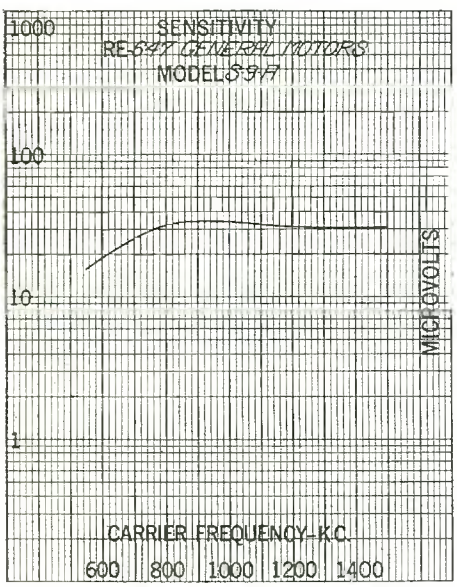
Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	7	9.5	11
100	13	17	20
1000	20	26.5	32
10000	29	43	50

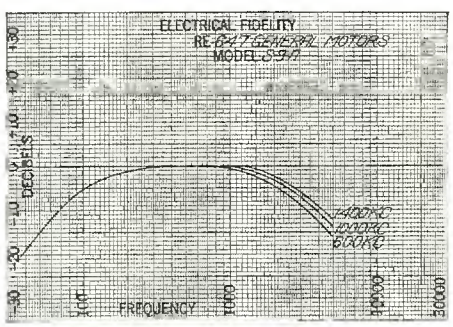


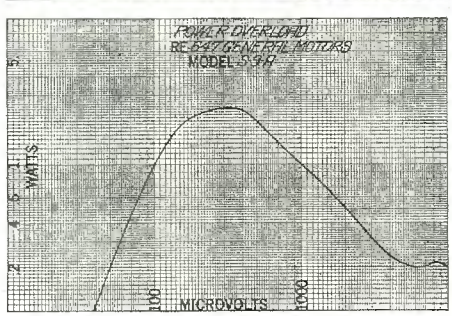
General Motors Model S9A

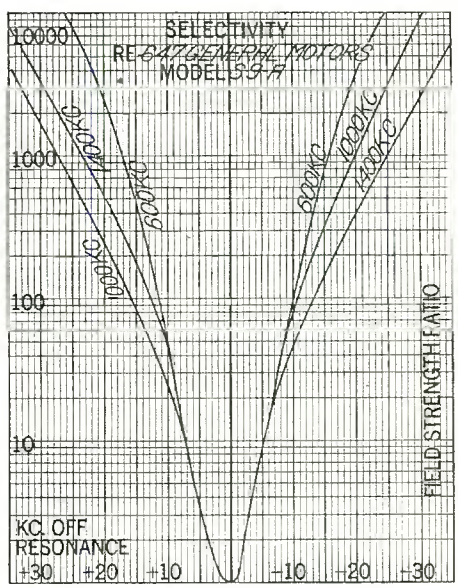
MODEL S-9A, a six tube superheterodyne made by General Motors, when measured in our laboratory gave the included response curves, from which the overall performance of this receiver may be judged.

No circuit adjustments were made to change the alignment of the receiver, and the tubes used in the chassis during tests were included by the manufacturer. With an a-c line voltage of 114, the receiver's drain was .63 amperes.









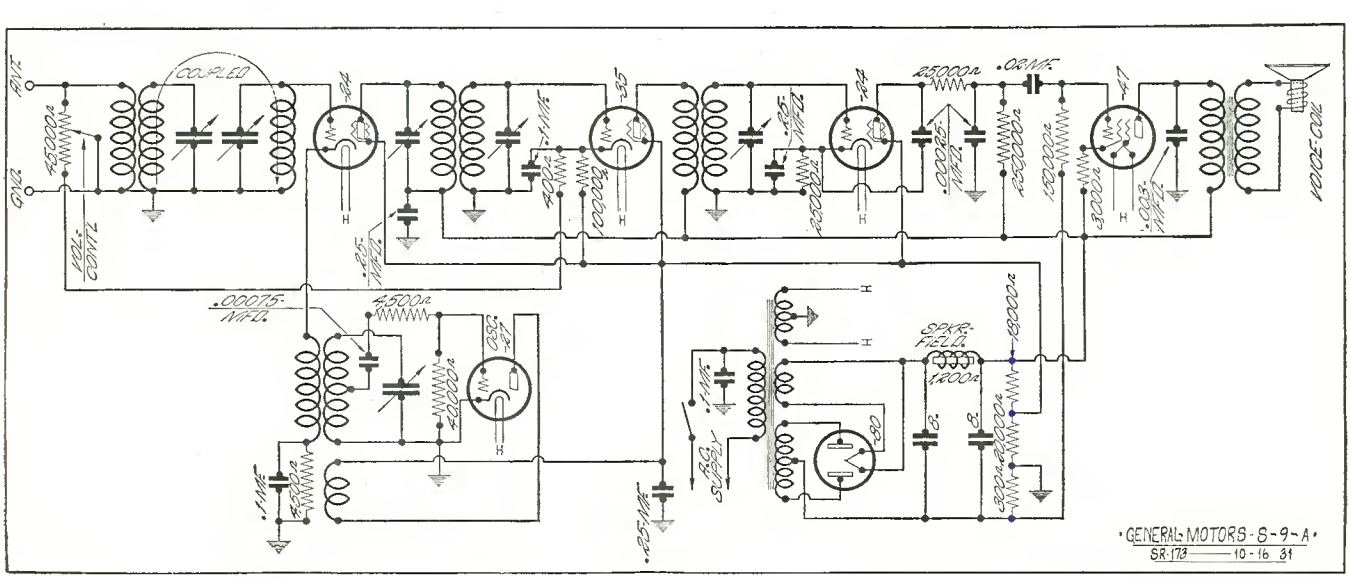
A dummy antenna of 20 uh, 200 uuf and 25 ohms coupled the signal generator to the antenna circuit of the chassis, while the audio output was maintained constant at the standard level of .05 watts. To match the optimum plate load of the single 247 type pentode employed in the last audio, a non-inductive resistance load of 7500 ohms was coupled across the plate circuit of the output tube. The voice coil circuit was broken to prevent the loading effect in the plate circuit while measurements were being made.

Average sensitivity as taken from the sensitivity curve found in column 1 is 50.3 microvolts absolute, which corresponds to 12.56 microvolts per meter, with a standard four-meter antenna. Noise level maximum and minimum levels were 3.4 per cent at 600 k-c and .67 of one per cent of 1000 k-c respectively. At 1000 k-c the measured image ratio was found to be 3130. Power output reached a maximum value of 2.42 watts, but no consideration was made of the harmonic content of the voltage impressed across the output transformer primary. Band widths are tabulated under the selectivity curves in column 3, from which they were measured.

At the bottom of the page will be found a schematic wiring diagram of the model S-9A. The tube complement consists of a 224 first detector, 235 second i-f, 227 oscillator, 224 second detector, resistance coupled to the 247 power pentode, and a 280 full-wave rectifier.

Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	12.5	12.5	12.5
100	21.5	26.5	26.5
1000	32.5	47.5	49
10000	50.5	70	74.5



Philco Model 112

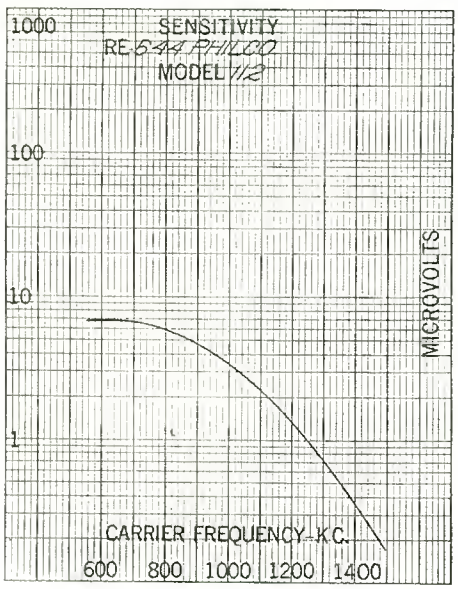
PERFORMANCE curves of the Philco model 112 and 112A superheterodynes made from measurements in this laboratory are given on this page.

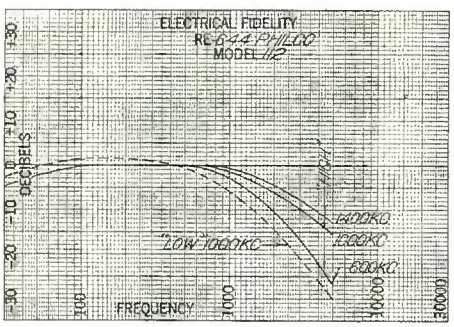
Input to the receiver was through the standard dummy antenna of 20 uh, 200 uuf and 25 ohms, while the output level was maintained at .05 watts for all curves with the exception of the automatic volume control. Matching of the 247 output pentode optimum plate load was by means of a non-inductive resistance of 15,000 ohms. Because the voice coil circuit would have a loading effect on the plates of the pentodes, it was disconnected during all measurements. Output plates were capacitatively coupled to the vacuum tube voltmeter used to indicate the output power.

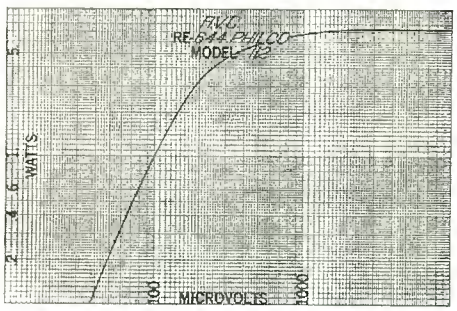
No changes were made in the alignment of the tuned circuits of the receiver from factory adjustment, and the tubes were furnished with it as standard equipment by the manufacturer. An a-c line voltage of 110 volts gave the set a drain of .91 amperes. For all measurements the volume control and the "high-low" switch were set for maximum sensitivity.

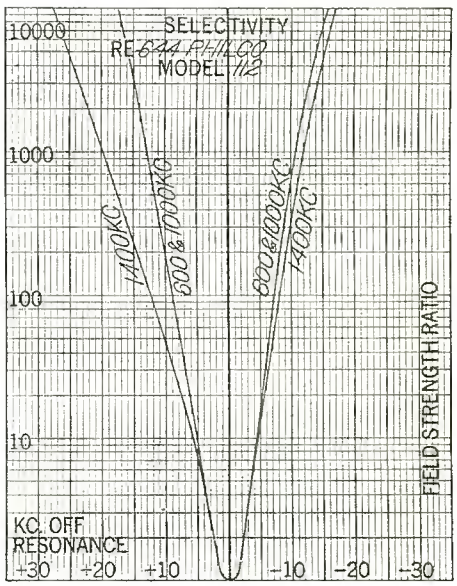
Average sensitivity as computed from the curve of column 1 is 3.55 microvolts absolute, which is equivalent to .88 microvolts per meter, using a standard four-meter antenna. Measured noise level was a minimum at 600 k-c, with a value of 1.3 per cent, and at a maximum at 1400 k-c, the point of greatest sensitivity measurement, with a value of 19.3 per cent. At 1000 k-c dial setting, the image ratio was 1720. Maximum power output was found to be 7.25 watts, from the curve of automatic volume control in column 2. No consideration was taken, however, of the output wave form harmonics developed across the primary of the output transformer. Under the selectivity curves of column 3 are the band widths taken from them.

A schematic wiring diagram of the Philco model 112 and 112A will be seen below. The eleven tubes required for these receivers are a 224 r-f, 224 first detector, 224 second i-f, 224 third i-f, 227 second detector, 227 automatic volume control, 227 second audio, 227 oscillator, push-pull 247 pentodes, and a 280 full-wave rectifier. Oscillator energy is fed to the grid circuit of the mixer by means of a pick-up coil on the oscillator coil. One filter choke and the dynamic speaker field in conjunction with the filter condensers serve to eliminate the ripple voltage in the B supply.



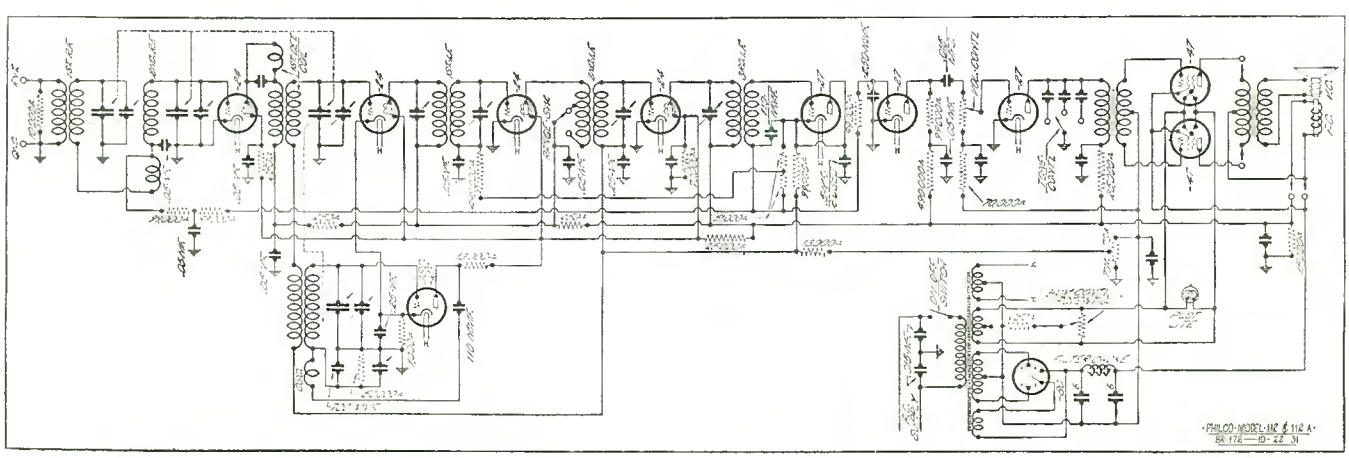






Band Widths

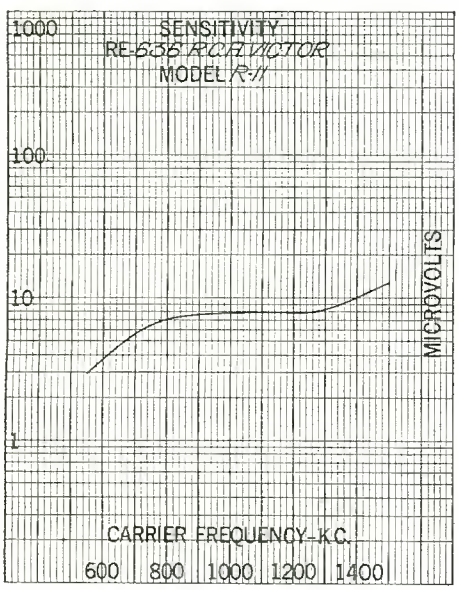
Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	9.5	9.5	10.5
100	16.5	16.5	21
1000	24	24	32
10000	33	33	44

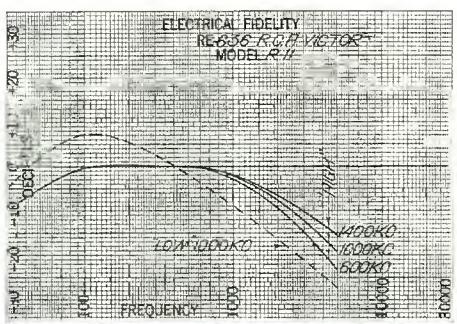


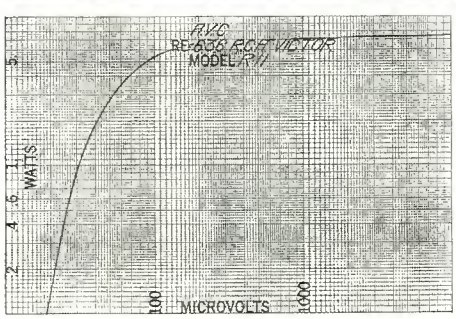
RCA Victor Model R-11

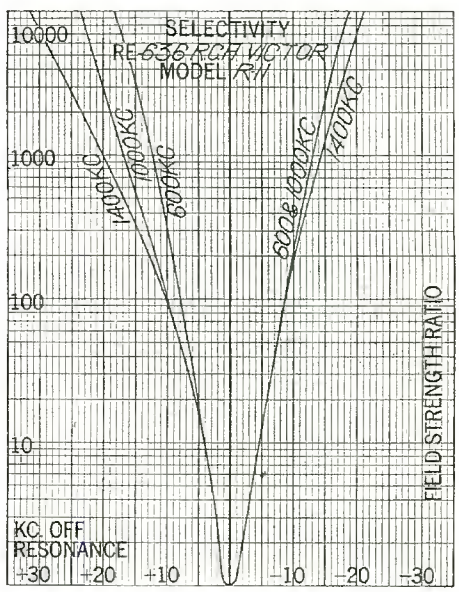
UPON measurement in our laboratory recently, the RCA Victor model R-11 gave the performance curves printed herewith.

For receiver input the signal generator was coupled to the antenna circuit with a dummy antenna standard of 20 uh, 200 uuf and 25 ohms, while the output plates were capacitatively coupled to the output indicating device. To prevent a loading effect, the voice coil circuit was broken during tests, while the optimum load of 15,000 ohms was furnished the 247 pentodes in push-pull by a non-inductive resistance. A level of .05 watts was maintained as standard output.







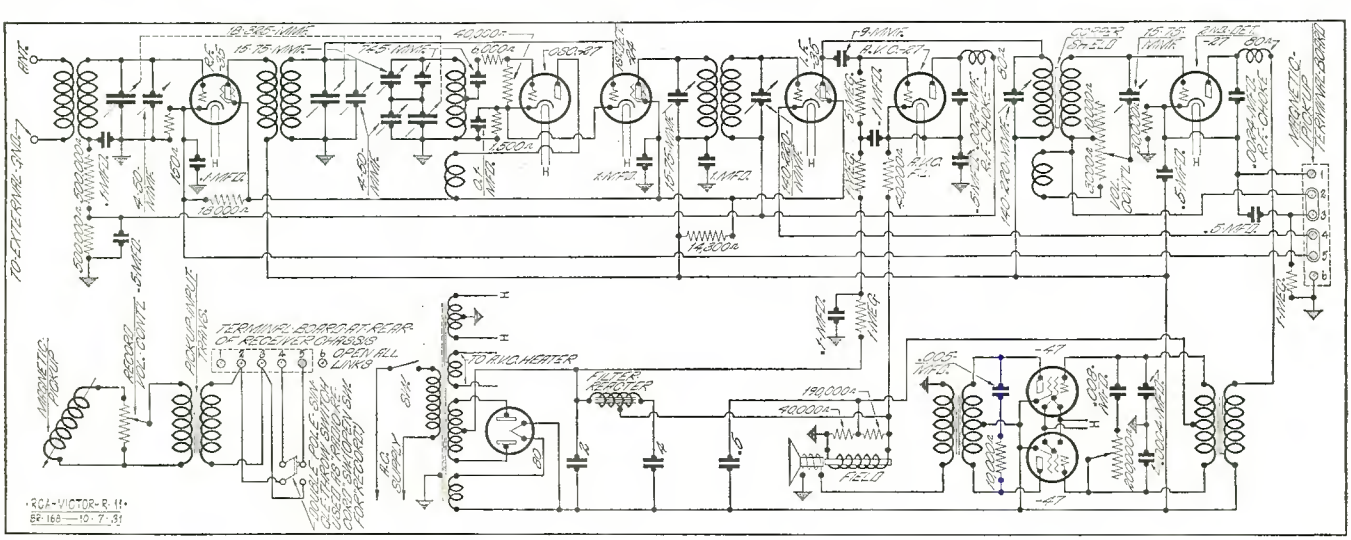


At 115 volts a-c line voltage, the power transformer drew .95 amperes. No changes were made in the alignment of the receiver, and the tubes used during the tests were included with the chassis. From the sensitivity curve of column 1 the average is found to be 7.35 microvolts absolute, which corresponds to 1.84 microvolts per meter. At 600 k-c the maximum noise level of 14.4 per cent occurred, while the minimum of 1.8 per cent was measured at 1400 k-c. At 1000 k-c the image ratio was measured as 1450. Maximum power output taken at 10,000 microvolts input was 7.52 watts, disregarding the harmonics present in the voltage impressed across the primary of the output transformer. Under the selectivity curves of column 3 will be found the band widths in tabular form.

Below is a schematic wiring diagram of the R-11 superheterodyne. Tubes required for operation are a 235 r-f, 227 oscillator, 224 first detector, 235 second i-f, 227 automatic volume control tube, 227 second detector, push-pull 247 pentodes, and the 280 rectifier tube. Antomatic volume control is accomplished by variation of the grid bias on the r-f and second i-f tubes, which are connected in the plate circuit of the automatic volume control tube. The speaker field gives a required voltage drop from ground to -B for the operation of the control tube, and a tapped filter inductance is used in the return lead for hum filtration.

Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	9	9	9
100	16.5	18.5	19
1000	25.5	29.5	34.5
10000	37	42.5	52



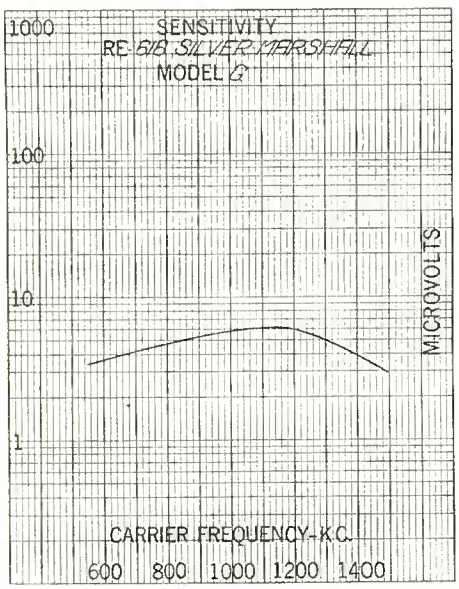
Silver-Marshall Model G

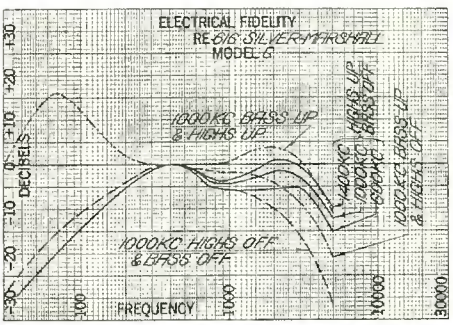
SILVER-MARSHALL, Inc., have made a departure in tone control on the model G superheterodyne which was recently measured in our laboratory. Instead of merely cutting off the higher audio frequencies, it is possible to raise and lower the bass and high frequency response independently and at will. Side band cutting of the higher frequencies may be entirely nullified, as can be seen by the audio response curves in column 2, where any quality of reproduction may be had between the highest and lowest ordinates plotted.

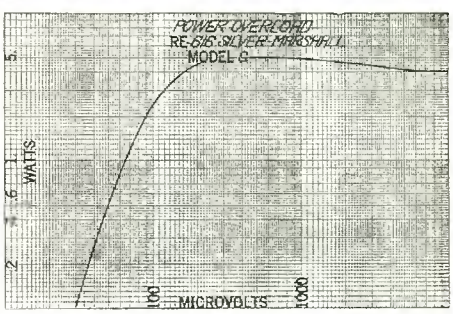
For r-f input, a dummy antenna of 20 uh, 200 unf and 25 ohms was used on the receiver antenna circuit, while the output resistance load was made 15,000 ohms to match the pentodes in push-pull, with a maintained output level of .05 watts. Maximum sensitivity obtained in all measurements, and the 247 plates were capacitatively coupled to the output meter. The voice coil circuit was opened for correct loading of the power tubes.

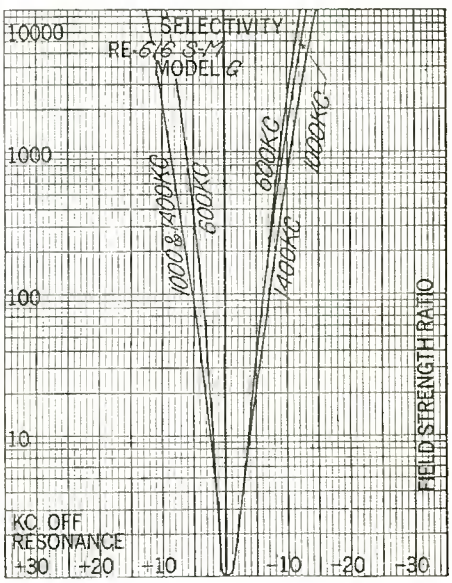
Tubes for this receiver were furnished with it, and factory adjustment of the tuned circuits was unaltered. A line voltage of 115 volts made the receiver drain 1.05 amperes.

From the curve of column 1 the measured average sensitivity is 4.8 microvolts absolute, which is the equivalent of 1.2 microvolts per meter. Power output reached a maximum value of 5.12 watts, not considering the harmonic content of the audio wave. Maximum noise level, occurring at 600 k-c, was 58 per cent, while the minimum was 14 per cent at 1200 k-c. Band widths for the model G are found in column 3 above the receiver schematic wiring diagram included with this article.





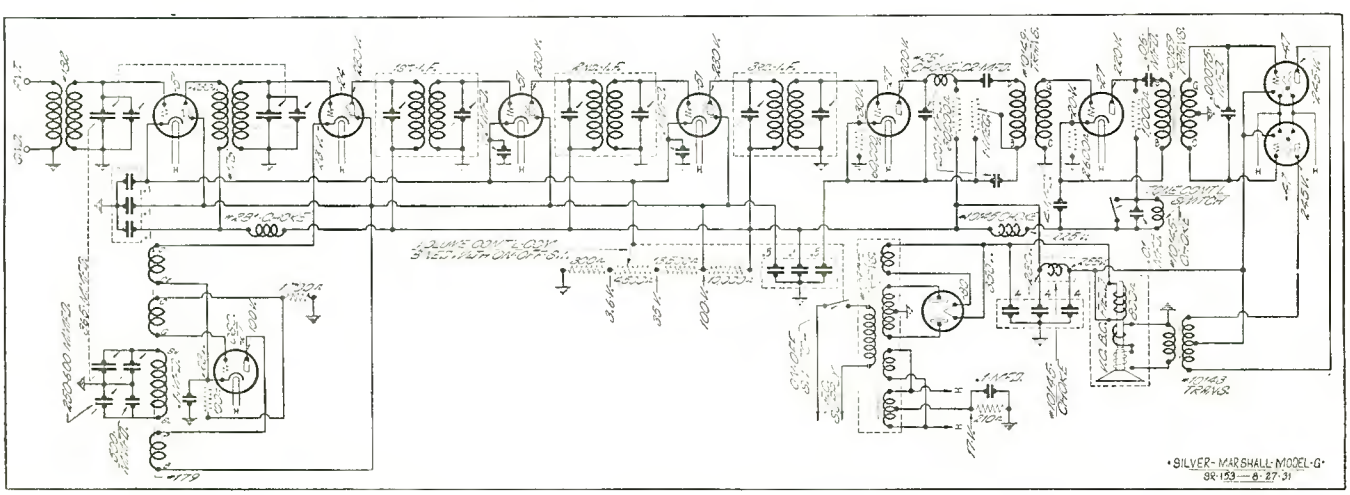




Ten tubes were required for this receiver, a 551 r-f, 224 first detector, modulated in the cathode circuit with a 227 oscillator, 551 second i-f, 551 third i-f, 227 second detector, 227 compensated audio, two 247s in push-pull, and a 280 rectifier for B voltage supply. Volume control is effective on the r-f, second i-f and third i-f cathodes, which are connected to the arm of a 4500 ohm potentiometer. To reduce the hum level the speaker utilizes a bucking coil, and one end of the voice coil is grounded for increased stability of operation at maximum sensitivity. Two filter chokes and the 800 ohm speaker field are used in the hum filter system.

Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	5.5	6	6
100	10	11.5	12.5
1000	15	18	19.5
10000	20.5	25	27



U. S. Radio Gloritone Model 99A

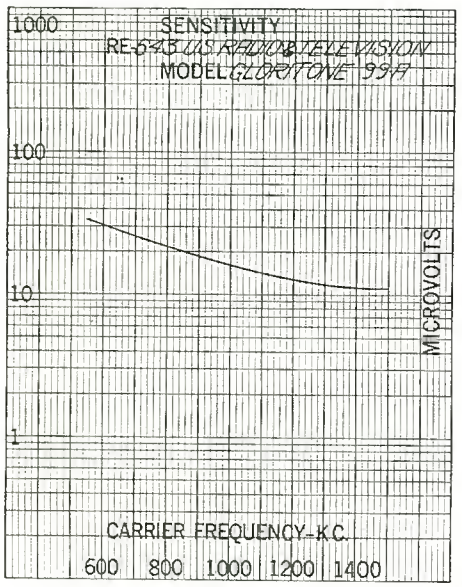
PERFORMANCE curves for the U. S. Radio Television Gloritone model 99-A Superheterodyne, which is another five tube receiver employing a combination first detector and oscillator, are given on this page.

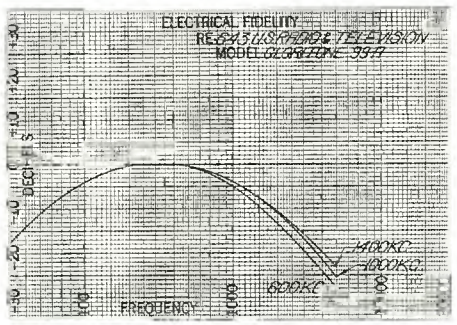
For measurements, the volume control was kept at maximum, no realignment of tuned circuits was made, and the tubes used were those furnished with the set by the manufacturer.

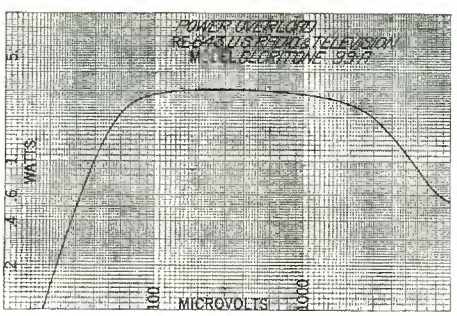
Average sensitivity as found from the sensitivity curve in column 2 is

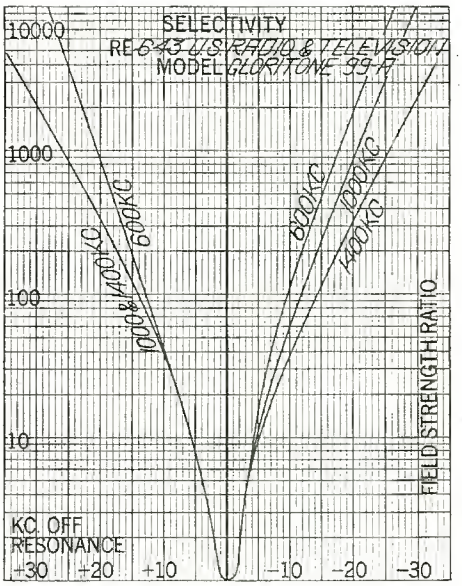
eration the harmonic content of the wave form impressed on the primary of the speaker transformer. Band widths are tabulated in column 3.

At the bottom of the page is a schematic wiring diagram of this superheterodyne. The tube comple-









Input to the receiver was through the dummy antenna standard of 20 uh, 200 uuf and 25 ohms, while the output was kept at a level of .05 watts. To match the single pentode output tube, a resistance load of 7500 ohms was connected to the tube. In order to prevent its loading effect, the voice coil circuit was opened during tests.

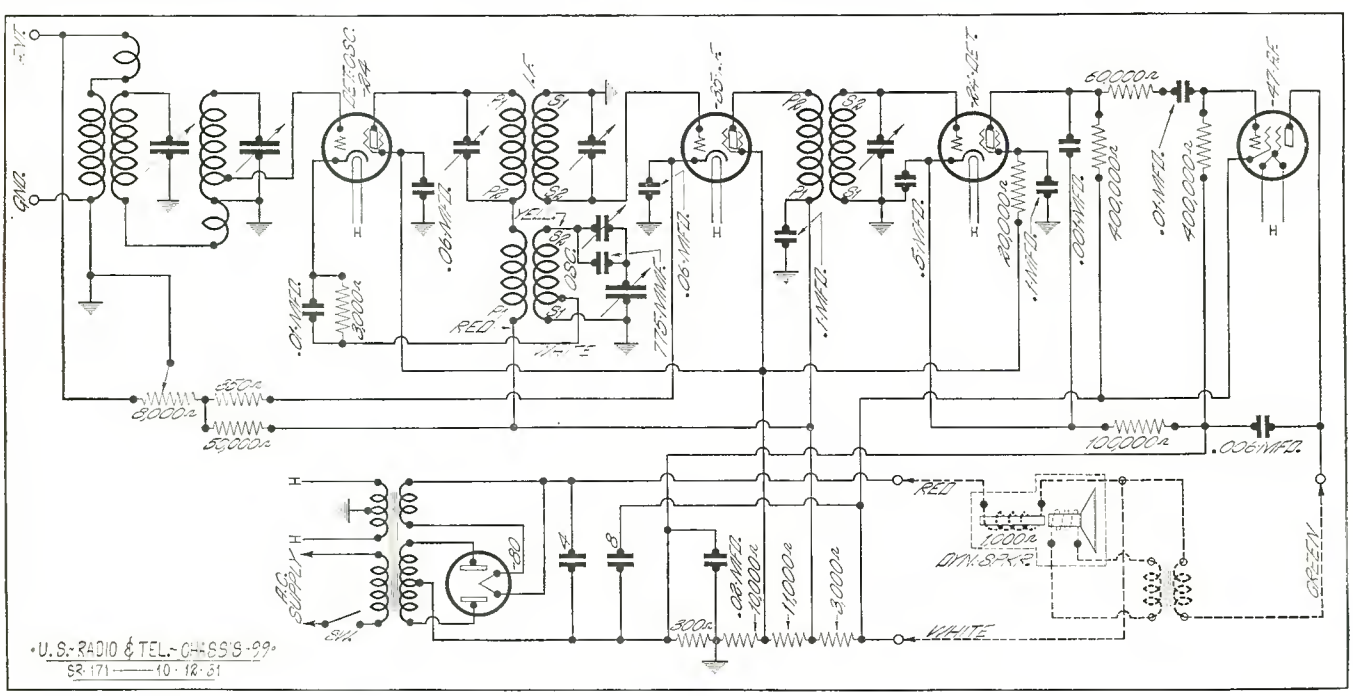
With an a-c line voltage of 115 volts, the primary of the power transformer drew .54 amperes load current.

20.6 microvolts absolute, which is equivalent to 5.15 microvolts per meter. At 1000 k-c the image ratio had a value of 3780 times. The maximum noise level occurred at 1000 k-c with a value of .81 of one per cent, while the minimum was .52 of one per cent at 600 k-c. Power output maximum was reached at 3.07 watts, but this figure does not take into consid-

ment consists of a 224 oscillator-detector, 235 second i-f, 224 second detector, 247 output tube, and the 280 full-wave rectifier for voltage supply.

Band Widths

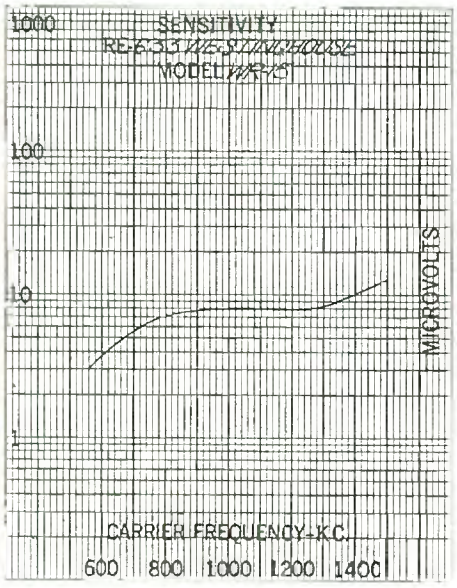
Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	10	10.5	11
100	22.5	25.5	28.5
1000	38	46.5	51.5
10000	54.5	69	77

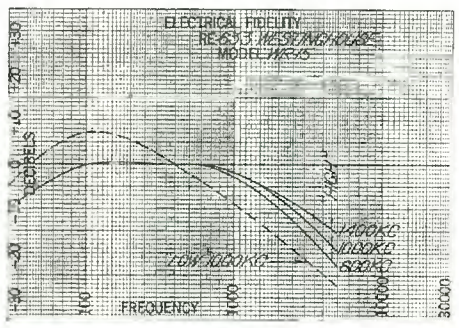


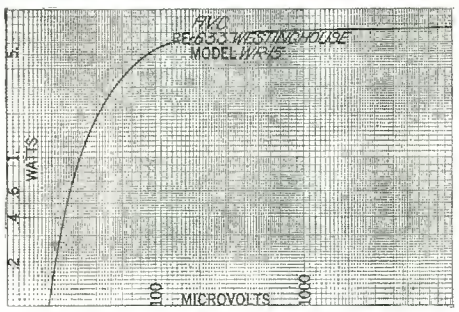
Westinghouse Model WR15

WHEN measured in our laboratory, the Westinghouse model WR-15 superheterodyne chassis gave the included curves as being indicative of its performanee.

For input to the receiver, the signal generator attenuator was coupled to the antenna circuit by means of the standard dummy antenna of 20 uh, 200 nuf and 25 ohms. In matching the optimum plate load of the push-pull pentodes used in this chassis, a non-inductive resistance of 15,000 ohms was connected across the plates, which in turn were capacitatively coupled to the output tube voltmeter. The voice coil circuit was broken to eliminate its loading effect on the primary of the output transformer. A level of .05 watts was maintained as standard output in all curves but the automatic volume control.



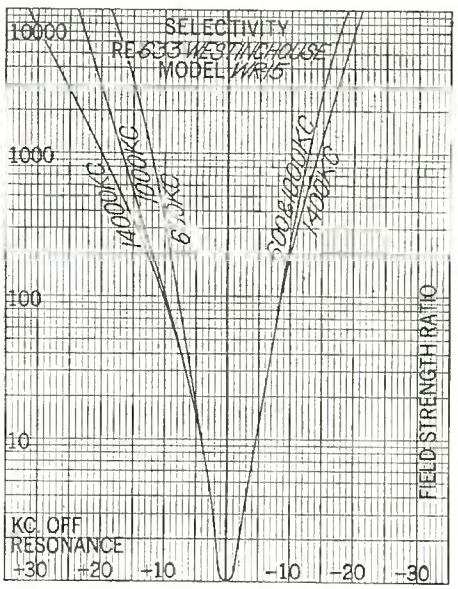




from factory adjustment of the tuned circuits.

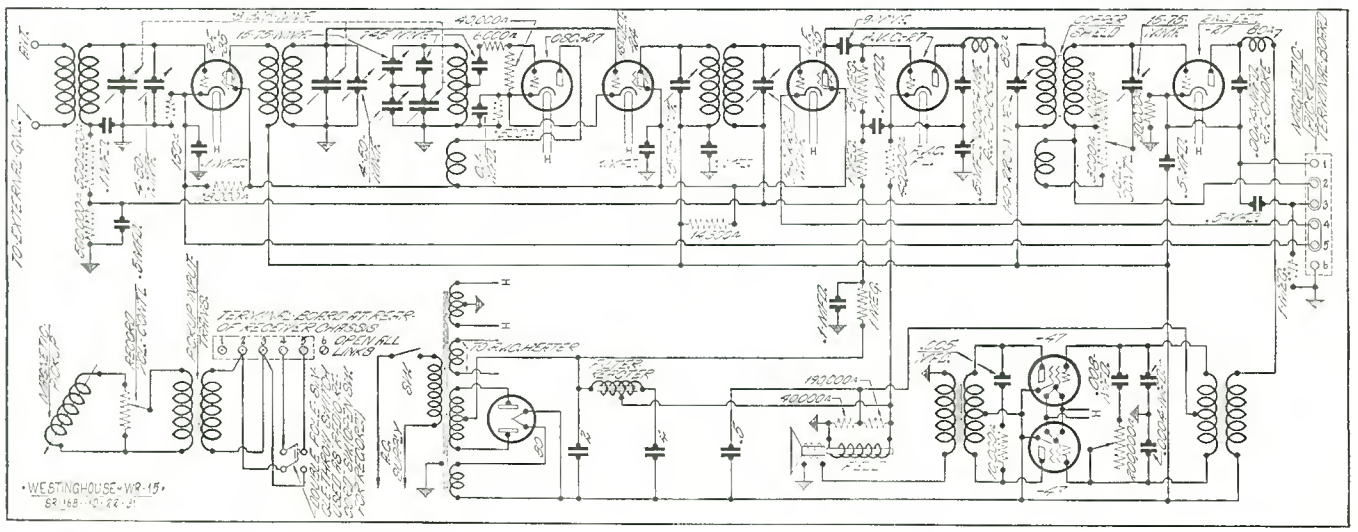
In column 1 is the sensitivity curve, which shows an average value of 7.35 microvolts absolute, corresponding to a sensitivity of 1.84 microvolts per meter. At 600 k-c the measnred noise level was 14.4 per cent, the maximum, and at 1400 k-c it was 1.8 per cent, the minimum value. At 1000 k-c the image ratio was found to be 1450. From colnmn 2, the maximum power output is found at an input of 10,000 microvolts, and its value is 7.5 watts, disregarding the harmonics present in the audio output to the output transformer. Under the seleetivity curves of column 3 are the measured band widths taken from them.

A schematic wiring diagram will be found at the bottom of the page. Tubes necessary for operation are a 235 r-f, 227 oscillator, 224 first detector, 235 second i-f, 227 automatic volume control, 227 second detector, push-pull pentodes, and a 280 rectifier.



Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	9	9	9
100	16.5	18.5	19
1000	25.5	29.5	34.5
10000	37	42.5	52



SCHEMATICS PUBLISHED TO DATE

Model	*Published*	*Drawing No.*
A. C. Dayton		
Navigator	November, 1929	SR24
Acme Mfg. Co.		
AC7	March, 1929	SR3
AC4	March, 1929	SR4
All-American Mohawk		
Lyric 90	November, 1930	SR74
Lyric 6	March, 1929	SR1
Lyric 8	March, 1929	SR2
Lyric J	October, 1931	SR128
Lyric B-7	December, 1931	SR165
Amrad		
70	November, 1929	SR22
81	March, 1930	SR44
84	January, 1931	SR106
Apex		
48	November, 1930	SR80
31 (U. S. Radio)	January, 1931	SR108
Atwater-Kent		
38	January, 1930	SR28
55, 55C (Cap.)	September, 1930	SR51
55, 55C (Ind.)	September, 1930	SR52
66	March, 1931	SR114
H-2	December, 1931	SR131
Audiola		
Series 31 (t.r.f.)	November, 1930	SR79
Super 31	March, 1931	SR111
Junior	March, 1931	SR112
Balkeit		
A	September, 1929	SR12
Bosch		
48	November, 1930	SR73
58	January, 1931	SR109
60	March, 1931	SR117
28-29	November, 1929	SR21
Auto	November, 1930	SR94
7DC	November, 1931	SR160
Bremer-Tully		
7-70	September, 1929	SR10
81-82	November, 1930	SR75
S81-82	October, 1931	SR126
Brunswick		
3KRO	November, 1929	SR23
15, 22, 32 and 42	November, 1930	SR86
S14	November, 1930	SR71
11, 12, 16	October, 1931	SR148
17, 24	December, 1931	SR164
Colonial		
31AC	January, 1930	SR29
33 and 34 a-c	November, 1930	SR95
47-48	December, 1931	SR160
Crosley		
Roamio	September, 1930	SR67
40S, 41S, 42S, 82S	September, 1930	SR57
608 Gembox	March, 1930	SR41
705 Showbox	March, 1929	SR6
Jewelbox 704B	March, 1929	SR5
77	November, 1930	SR83
53, 54, 57	January, 1931	SR103
120	October, 1931	SR133
121-1	November, 1931	SR149
124	December, 1931	SR150
Dayfan		
5080	September, 1929	SR11
Delco		
Auto Radio	September, 1930	SR66
Edison		
R4, R5, C4	November, 1930	SR49
R6, R7	January, 1931	SR99
Erla		
Duo Concerto R-2	January, 1930	SR33
Eveready		
50	March, 1931	SR50
Fada		
7AC	September, 1929	SR13
35-35Z	November, 1930	SR70
KW28-29	December, 1931	SR158
Federal		
H	November, 1929	SR19
Freed-Eisemann		
NR80	November, 1929	SR20
Freshman		
2-N-12	September, 1929	SR14
General Motors		
A	November, 1930	SR68
120-A	November, 1931	SR116
S3A	November, 1931	SR154
Gilfillan Bros.		
100	January, 1930	SR32
Graybar		
600	March, 1930	SR42
Grebe		
7AC	November, 1929	SR17
AH1	November, 1930	SR96
Gulbransen		
Nine-in-Line	March, 1930	SR40
161	March, 1931	SR110
Howard		
S. G. A.	September, 1930	SR56
Green Diamond 8	September, 1929	SR16
H	October, 1931	SR145
SG-B	November, 1931	SR130
O	December, 1931	SR163
Jesse French, Jr.		
G	March, 1931	SR118
Kellogg		
523-528	November, 1930	SR77
Kennedy		
20	March, 1930	SR48
26	November, 1930	SR81
10	January, 1931	SR38
30-32	November, 1931	SR129
King		
J	January, 1930	SR31
Kolster		
K20, K22, K25 and K27	September, 1929	SR8
K21, K23, K24 and K28	March, 1930	SR45
K-43	November, 1930	SR72
K80	November, 1931	SR159
Kylectron		
70	November, 1930	SR65
Majestic		
70	September, 1929	SR7
90B	September, 1930	SR55
130-A	November, 1930	SR84
50	January, 1931	SR98
20	October, 1931	SR124
60	October, 1931	SR138
15	November, 1931	SR157
Philco		
86-82	November, 1929	SR26
95	September, 1930	SR60
90-90A	November, 1931	SR156
Radiette		
F14	January, 1931	SR104
Radiola		
60	January, 1930	SR30
66	September, 1930	SR64
44	January, 1931	SR102
18	October, 1931	SR127
RCA-Victor		
R-7	October, 1931	SR137
R50-55	December, 1931	SR166
Sentinel		
11, 12, 15, 16	March, 1931	SR115
106B	March, 1931	SR113
108A	October, 1931	SR146
108	November, 1931	SR123
111	November, 1931	SR155
Silver		
36A	January, 1931	SR105
30B	September, 1930	SR53
30	January, 1930	SR35
35-A	November, 1930	SR82
782	October, 1931	SR120
726SW	October, 1931	SR144
D-E	November, 1931	SR152
F	December, 1931	SR140
Slagle (Continental)		
9	January, 1930	SR27
R-20	March, 1930	SR46
Sonora		
5R	November, 1929	SR25
Sparton		
AC89	September, 1929	SR9
589	September, 1930	SR63
600, 610, 620	March, 1931	SR91
25-26	December, 1931	SR161

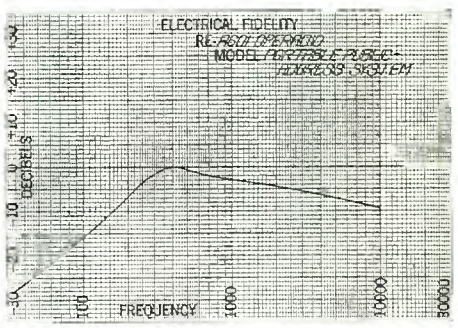
Model	*Published*	*Drawing No.*
Splitdorf		
E175	January, 1930	SR36
Steinite		
261	September, 1929	SR15
70, 80, 95	November, 1930	SR76
600, 605, 630, 635	November, 1931	SR132
Stewart-Warner		
950	September, 1930	SR62
Series 900	January, 1930	SR34
R100	January, 1931	SR85
102A	October, 1931	SR147
Stromberg-Carlson		
846	September, 1930	SR54
635-636	November, 1929	SR18
12-14	November, 1930	SR93
10-11	November, 1931	SR134
19-20	November, 1931	SR151
Transformer Corp.		
50	November, 1930	SR78
80-81	October, 1931	SR139
Temple		
8-60, 8-80, 8-90	March, 1930	SR37
SG 8-61, 8-81, 8-91	October, 1931	SR125
Transitone		
Auto Radio	November, 1930	SR69
Trav-Ler		
C	March, 1931	SR120
U. S. Radio		
37	March, 1930	SR39
26P	October, 1931	SR143
Victor		
R32, RE45, R52	September, 1930	SR61
R35, R39, RE57	January, 1931	SR101
Westinghouse		
WR-5	November, 1930	SR92
WR-4	January, 1931	SR107
WR10-12	November, 1931	SR137
Zaney-Gill		
54	March, 1931	SR119
Zenith		
52, 53, 54, 522, 532 and 542	March, 1930	SR43
71, 72, 73 and 77	November, 1930	SR97
A, B, C, D	November, 1931	SR141

Measurement on Operadio Portable PA

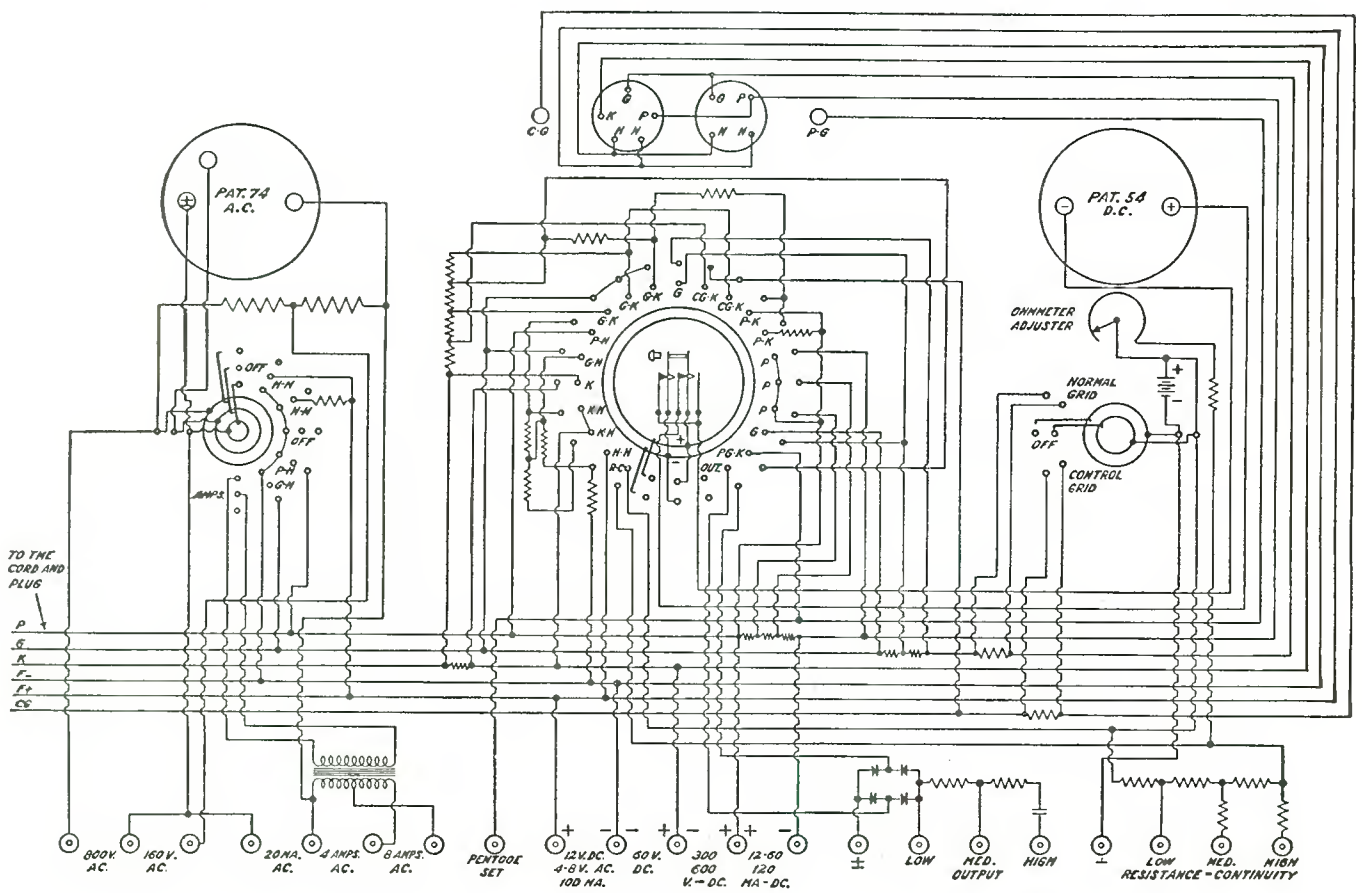
An overall performance curve of the Operadio model 18 Junior portable public address system is given in column 3. Input was to the double button carbon microphone input transformer, and the output was kept at 1.6 watts for standard. With an a-c line voltage of 115, the current consumption was .68 amperes.

It will be noted that the curve drops off rather rapidly below 400 cycles. This is desirable since the greater portion of voice energy lies in the 400 cycle frequency range and upward. Using a cut-off on bass frequencies makes the reproduced speech more intelligible, especially with regard to consonants, which are lost if the output is barrel-like, or predominant with bass. Very good response is held up to 10,000 cycles.

Tubes required for operation are a 227 first audio, 227 second audio, push-pull 245 output audio, and a 280 rectifier. The unit is entirely self-contained and portable.



Wiring Diagram of Jewell 444 Analyzer

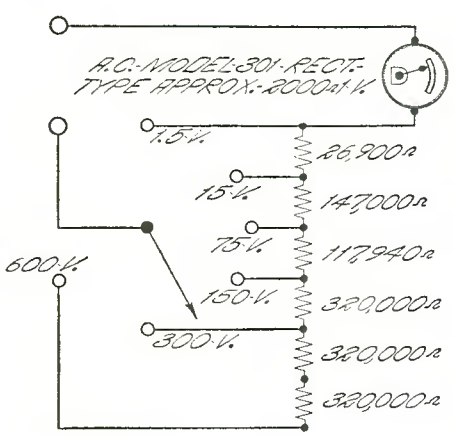


Design of Multi-Range A-C Voltmeter

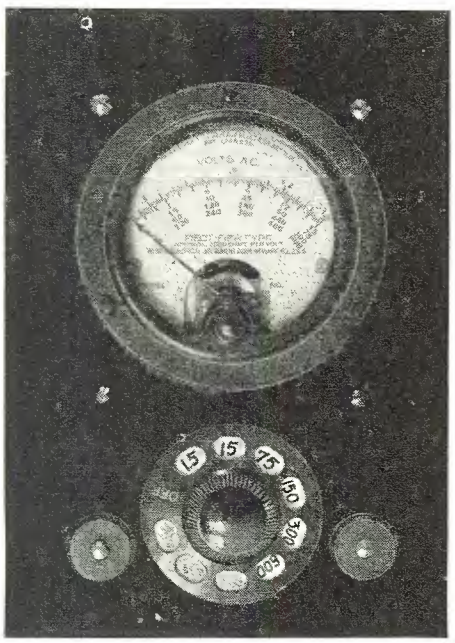
RECTIFIER type a-c instruments are relatively new, and they possess characteristics which make them of inestimable value when compared with the older type measuring devices, but they have some limiting features nevertheless. Commercial instruments such as a-c voltmeters of the thermal, soft-iron and electrodynamometer types have always required considerable current to operate their movements just as d-c meters of the 100 or 200 ohms per volt sensitivity. The rectifier type meter has met with universal approval because it makes possible a voltmeter having a sensitivity of 1000 or 2000 ohms per volt, thus limiting the current to values of 1 ma or less, as is also the case with the high resistance d-c type voltmeters.

Sufficiently Accurate

It must be stated, however, that the accuracy of the rectifier type instrument is not as great as that of other types of good quality, but it is sufficient for most purposes. Two parts make up the rectifier instruments, the direct-current permanent-magnet moveable coil instrument of 1 ma or .5 ma full scale type and the rectifier made up of four sets of copper oxide discs arranged in the four arms of a Wheatstone bridge circuit. In such an arrangement the indicating meter is connected as a galvanometer. This rectifier is of the full wave type, in which both halves of the wave pass through in the same direction. Current measured is, therefore, proportional to the simple average of the wave and not to the squares of instantaneous values. But since all other a-c meters measure r.m.s. values, the meter calibration is figured in these units. This makes necessary the fact that the voltage to be measured must be a pure sine wave or errors will result, which may be as high as 22 per cent. Of all the errors, these are the most serious.



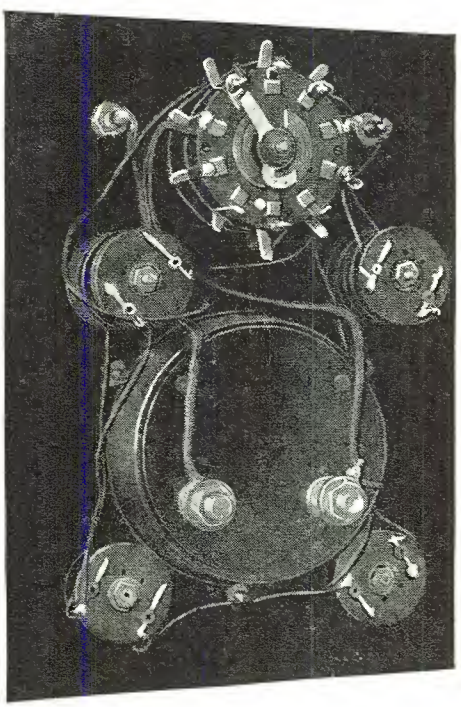
Frequency errors are such that the meter is read low up to 35,000 cycles per second, with approximately one-half of 1 per cent. for each 1000 cycles increase in frequency. Ordinary use with the commercial power lines makes this inaccuracy negligible. Temperature errors will not exceed 2 per cent. in the ordinary variations encountered. The two changes caused by temperature variation very nearly cancel each other. For various current flows through the rectifier, its resistance changes, but this has been taken care of in the calibration of the scale and, therefore, does not cause an error in indication. Permanent changes over a long period of time will seldom reach 1 per cent. of the initial accuracy.



Six Calibrated Scales

An instrument of the voltmeter type is illustrated in this article. The meter is a Weston model 301 type rectifier instrument, with an approximate resistance of 2000 ohms per volt. Six scales are calibrated to cover the commonly encountered conditions of the field. These are 1.5, 15, 75, 150, 300 and 600 volts full scale. Resistors for the instrument built in the laboratory were furnished with the meter, but for convenience in construction the actual values are given on the circuit diagram of column 1. A front view is shown in column 2, illustrating the method of mounting the meter on the panel, the selector switch for the scales, and the two potential binding posts. At the bottom of column 3 is the back panel view, showing the location of the meter, resistors, switch and binding posts. For size this instrument is very convenient, since the panel measures only 7″ long, 5″ wide and the approximate depth need only be 2″. It is not necessary to use a multi-contact bi-polar switch, as illustrated, because any single pole 6-point switch will do the work equally as well. Any good non-conducting panel material may be used, such as bakelite or its counterparts. All resistors must be of the wire-wound type and of at least 1% accuracy. Without any added external resistor, the full scale indication of the instrument is 1.5 volts, resulting from the resistance of the rectifier itself.

Such a meter may be used for measuring audio frequency output voltages of oscillators, common 25 and 60 cycle line voltages, power transformer secondary voltages up to 600 volts for the half winding, alignment of radio sets by placing across the voice coil of the speaker or across the plates, using an isolating condenser, etc. It would be an excellent idea to add permanently to the instrument a condenser of at least 2 microfarads capacity in one of the input leads to prevent direct current potentials across the rectifier unit.



Universal Modulated Oscillator

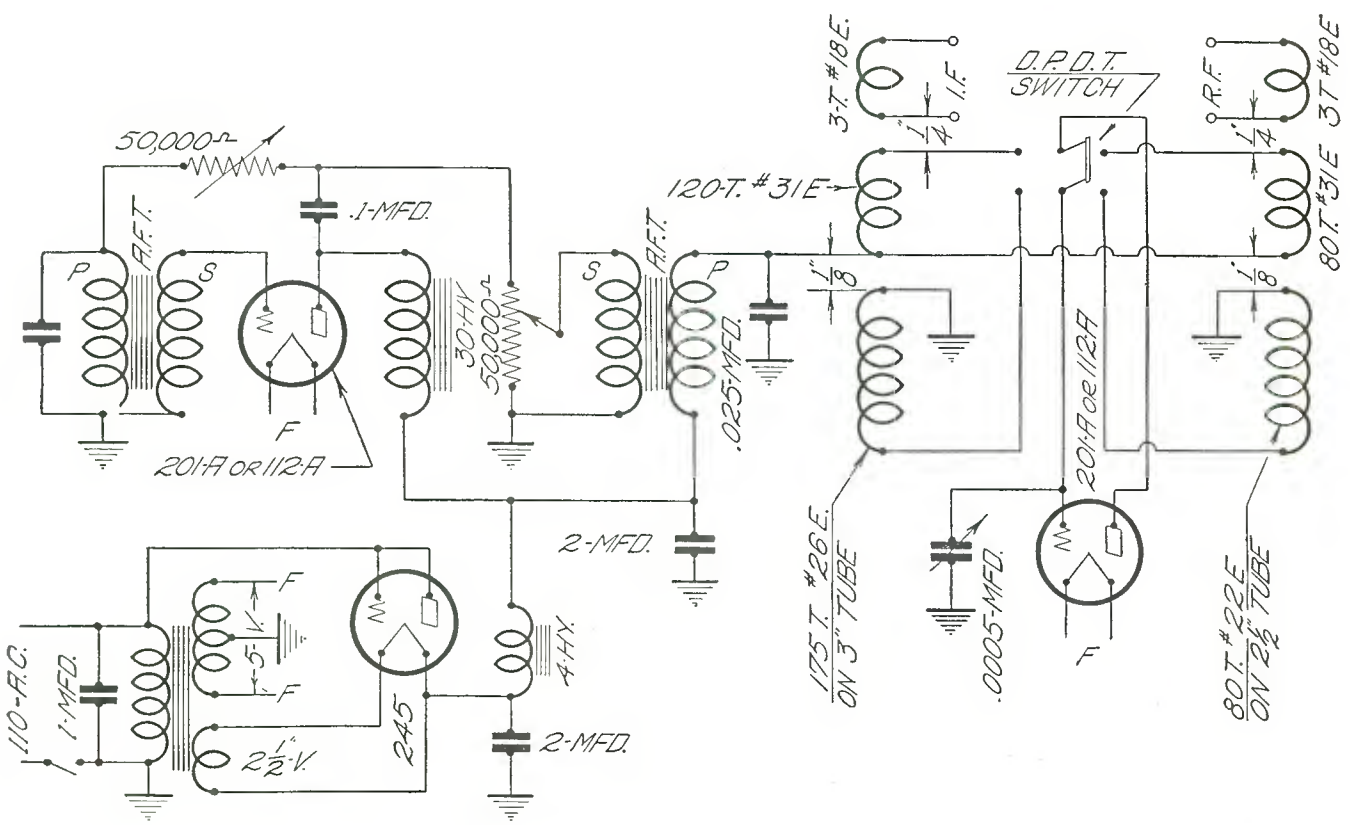
FOR alignment of receivers a test oscillator is a necessity, especially with the universal acceptance of the superheterodyne as the best circuit available today. In such receivers the intermediate frequency amplifier must be aligned at its specified frequency, which may fall anywhere between 130 k-c and 190 k-c, usually at 175 k-c, which is accepted in general as the most desirable frequency from the standpoint of gain and selectivity.

This oscillator has two oscillator coils, which may be alternately used by means of a double-pole double-throw change-over switch. For intermediate radio frequency signals, the coil has a range as given above, and for the broadcast band the coil has a range of 550 k-c to 1500 k-c. Both coils are tuned over their respective ranges by a .0005 mfd variable air condenser of some good manufacture, preferably of the straight line frequency type. For modulating the two bands of frequencies with an audible signal, a separate audio oscillator is used, because it affords a better and more uniform note than any self-modulated system.

Feed-back for the audio oscillator is furnished by an audio transformer, of which the secondary, or high number of turns, is connected to the grid circuit. The audio energy from the plate is coupled to the output circuit by a 1 mfd condenser. For tuning the note to approximately 400 or 500 cycles, a condenser of a size to be determined by trial is connected across the primary of the transformer. For parallel plate feed of the oscillator tube, a choke or one winding of an audio transformer may be connected from the plate to the modulated B supply. Feed-back is controlled by the 50,000 ohm variable resistor in the plate circuit. This rheostat should be adjusted for the clearest note consistent with self-starting of the oscillator. The percentage modulation is controlled by means of a second 50,000 ohm potentiometer connected to the primary of the modulating transformer. The voltage supply through this transformer secondary (low turns) is modulated by the audio voltage induced from the primary into the secondary and hence is carried on the radio frequencies of the radio frequency oscillator.

Complete shielding is very necessary for this instrument, as well as filtration of the incoming a-c line, which has a condenser placed across it of 1 mfd capacity. Pick-up coils are coupled to each secondary coil and binding posts brought to the front panel for convenience. In this manner there is no metallic connection to the oscillators proper or to the power supply or incoming signal. The rectifier employs a 245 tube half-wave rectifier without a high voltage transformer. Such rectifiers were discussed at length on page 48 of the November, 1931 issue of this magazine.

Some filtration is necessary to prevent the rough 120 cycle modulation, due to the ripple after rectification, from over-riding the desired note. A 4 henry choke as shown in the accompanying schematic diagram will have a resistance of only about 100 ohms, which will not materially lower the d-c voltage. In operation the voltage supplied was found to run about 50 volts, which was sufficient for proper operation of both oscillators on both frequency ranges. It might be noted here that if it is found convenient, about one-half of the laminations of the audio oscillator transformer should be removed. The best way is to re-stack the "E" sections all on one side and to eliminate entirely the "I" sections.



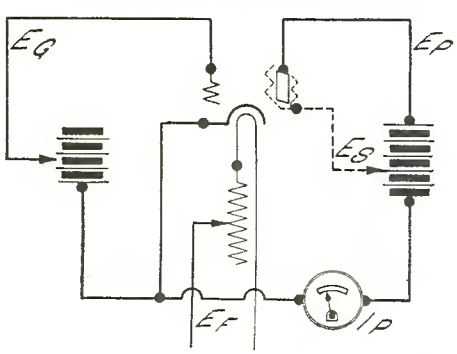
Measuring Tube Characteristics

CONTRARY to common opinion, very good results may be obtained in measuring important tube characteristics without a tube bridge or a set-up requiring more than two meters at the most. Primarily, these characteristics consist of the mutual conductance, the mu or amplification factor and perhaps the plate impedance at the specified operating voltages. Of the three, the first is the factor which determines, in general, the condition of the tube for amplification purposes, and we can predict its performance quite well if we check only this one factor.

A tube has four conductances as follows: Plate conductance is given by $G_p = \frac{dI_p}{dE_p}$, while the grid voltage is kept constant. Grid conductance is $G_g = \frac{dI_g}{dE_g}$, with the plate voltage kept constant. Controlled grid conductance is $G_{cg} = \frac{dI_g}{dE_p}$, with E_g constant. Controlled plate conductance is $G_{cp} = \frac{dI_p}{dE_g}$, with E_p constant. An explanation of the terms used in the above formula follows. I_p is the d-c plate current, E_p is the d-c plate voltage, I_g is the d-c grid current, and E_g is the d-c grid voltage.

Mutual Conductance

The last conductance given above is the term generally known as the mutual conductance of the tube, denoted by G_m, but properly it is called the controlled conductance of



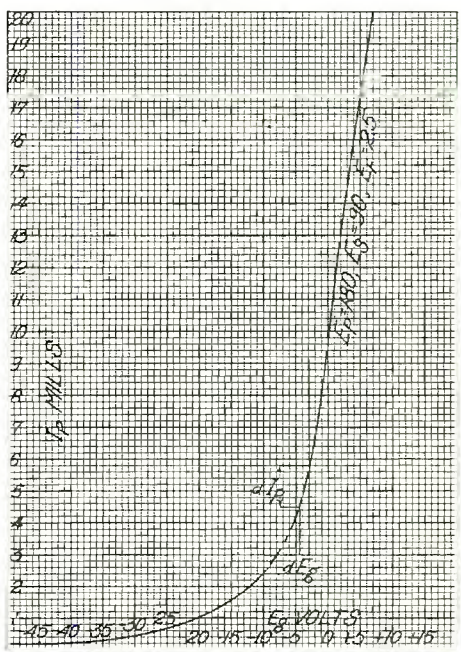
the plate by the grid and denoted by G_{cp}. Measurement of mutual conductance requires only a milliammeter in the set-up if the battery voltages are checked. A schematic diagram of such a set-up is given with this article in column one. From the formula it is found that the plate voltage must remain constant and the change in plate current of the tube with a small change in bias voltage is all that is required. Only 1.5 volts change in bias was used in our laboratory check, which gave a change in the plate current that was easily read. The starting point should be at the specified bias voltage with proper screen and plate potentials, using only a small bias change to prevent the characteristics from varying much from the operating point. When the grid or C voltage is varied widely, a static characteristic of the tubes is obtained as shown on the curve included on this page in column three. In truth, this curve is but one of the family of curves which could be plotted by using a different plate potential for each run. The same applies to various screen voltages. This particular curve is for a 235 or 551 type tube. That of a 224 type would have a much sharper bend at high bias values, the bend being the region used for detection. The variable mu tube does not have a very sharp bend, which illustrates why cross-talk is practically eliminated.

For a change of 1.5 volts of bias the plate current changed 1.3 ma. Dividing the last value by the former gives .000866 or 866 micromhos. This example is illustrated by the curve plotted for the 235 or 551 type used in the experimental set-up. For the operating point, a heavy line is drawn through the abscissa value of —3 volts. Instead of making this the average value and dividing the change in bias so that the minimum and maximum negative values were 2.25 and 3.75 volts respectively, good accuracy resulted in making the change all in one direction, or from —3 to —4½ volts. This increment was read as dE_g. The resultant change in plate current with the given change in bias voltage is from 5.8 ma to 4.5 ma, a difference of 1.3 ma labelled dI_p on the curve. Checks were made on the 224 type and the 227 type, and the results checked within 10 per cent of the tube bridge measurements. For the 224 tube the bias was changed from —3 to —4.5 volts, which resulted in a decrease in plate current from 4.3 ma to 2.7 ma, or a difference of 1.6 ma. Dividing 1.6 by the grid voltage change of 1.5 gives .001066, or a mutual conductance of 1066 micromhos. In the case of the 227 tube the bias value varied from —13.5 to —10.5 volts, a change of 3, which brought about a change in plate current from 5.3 to 9.3 or 4 ma. Dividing 4 by 3 gives .001333 or a G_m of 1333 micromhos.

Determining the Mu

For determining the mu of a tube, a high resistance d-c voltmeter will be required in addition to the milliammeter. In this measurement the grid voltage is changed and the plate voltage varied to a value which gives the same plate current for the two conditions of grid bias. Mu is found directly by substituting the values in the simple formula $mu = \frac{dE_p}{dE_g}$, with I_p kept constant.

Analysis of the tube with reference to the plate impedance results in a very simple expression for obtaining this figure. A small variation of plate



voltage near the operating value gives a change of plate current, and the relation from Ohm's law is $R_p = \frac{dE_p}{dI_p}$, thus giving the result directly.

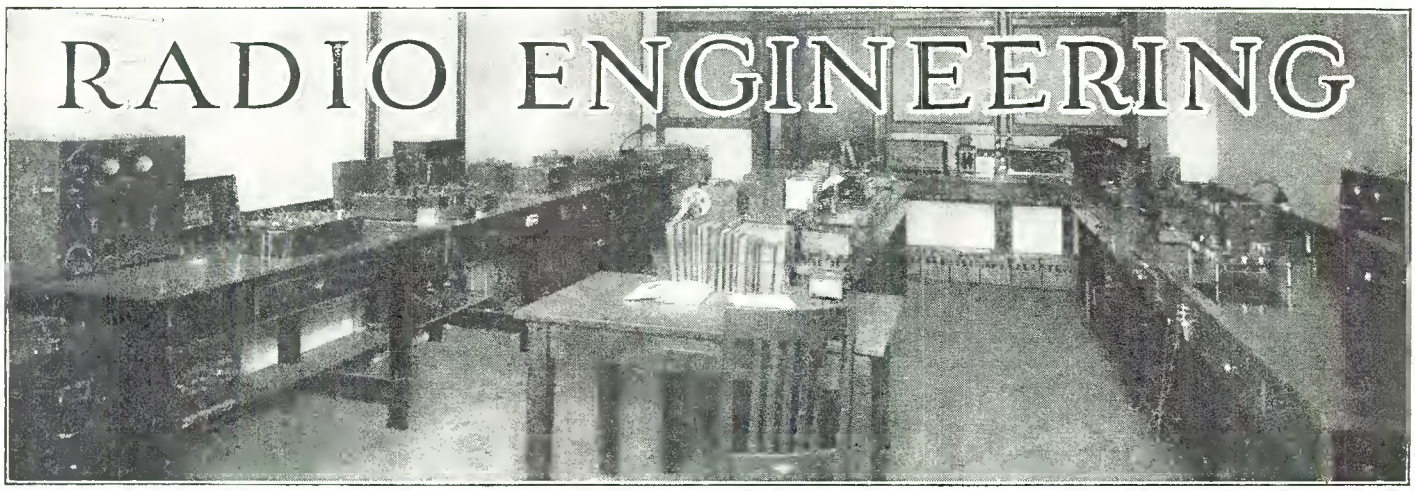
It must be remembered in making these tube measurements that the accuracy of the results depends largely on the accurate reading of the meters.

METERS FOR SALE

After the annual spring housecleaning in our laboratory it is found that we have no use for the following Weston, Model 301 meters, which are offered for sale.

All meters are in good working condition. Price shown in the list. First come—first served. These meters represent duplications in our laboratory inventory:

1—0-7 volts d-c	$4.80
1—0-8 volts d-c	4.80
1—0-150 volts d-c	6.00
1—0-300 volts d-c, less ext. res.	8.40
1—0-500 volts d-c, less ext. res.	9.60
1—0-10 mils. d-c	4.80
1—0-50 mils. d-c	4.80
1—0-20 amp. d-c	4.80



Amplification With Vacuum Tubes

MANY times it is desired to know what a tube is doing in an amplifier either resistance or transformer coupled, and we shall discuss at some length ways and means of determining closely the operating conditions of vacuum tubes in such circuits. Again the presentation will be in the simplest of formulae for practical applications, whereas usually this tube theory is given in cumbersome equations. Later in the article we shall also show how the various tube characteristic formulae can be juggled for most convenient application to the problems at hand.

Tube theory tells us that the voltage amplification of a tube is at maximum when the plate load is infinite and becomes mu in value (amplification constant of the tube) as a limit. Such a condition is only theoretical, however, since no voltage can be applied to the plate through such a resistance. From everyday electrical theory we know that any generator gives its maximum power output when the external load is equal in value to the internal load, so for maximum power output the external impedance should be equal to the tube plate impedance. If a tube is delivering power, the voltage developed in the plate circuit will divide proportionately and for a resistance coupled amplifier it would divide proportionately to the resistances.

We can apply two formulae which reduce to the same thing in the final analysis, which will be given later. These formulae are

$$A = \frac{uR}{R + R_p} \text{ and } A = \frac{G_{cp}}{\frac{1}{R} + G_p}$$

where A = voltage amplification, u = amplification constant of tube, R = external load in ohms, R_p = plate impedance of tube, $G_{cp} = G_m$ = mutual conductance of tube, $G_p = \frac{1}{R_p}$ = reciprocal of plate impedance.

In the following example we shall make the assumption that the amplification does not vary with frequency, and we shall neglect the tube interelectrode capacities. Also we shall assume that the grid circuit of the following tube does not noticeably affect the plate circuit of the tube under study to any great extent. For example we shall use a 227 tube with 180 volts on the plate of the tube itself and a 30,000 ohm load resistance in the plate circuit. For this tube G_{cp} = 1000, u = 9 and R_p = 9000. Using the first formula for finding the voltage amplification, substitution of the values gives

$$A = \frac{(9)\ (30000)}{30000 + 9000} = 6.92$$

From the second formula, substitution gives

$$A = \frac{1000 \times 10^{-6}}{\frac{1}{30000} + \frac{1}{9000}} = 6.92$$

Since the rated plate current is 5ma, we can find the necessary B voltage to give 180 volts on the plate of the tube by substituting in E = IR = (.005) (30,000) = 150 volts, which when added to 180 gives 330 volts of B supply. Any less voltage will give a lower amplification due to the variation of u and G_m of the tube with various plate voltages.

If we wanted maximum power amplification, we would make R = R_p as before stated. Then R = R_p = 9000 ohms.

$$A = \frac{(9)\ (9000)}{9000 + 9000} = \frac{81}{18} = 4.5$$

The voltage supply necessary would be 180 + (.005) (9000) = 180 +45 = 225 volts.

An approximate means of determining the amplification in an impedance coupled amplifier might be used as follows: We wish to use a choke in the plate circuit of a 224 type tube and it will be of 500 henrys inductance. Because the resistance term will be low compared to the reactance term, the former will be disregarded in this approximate calculation. This screen grid tube has 180 volts at the plate and G_{cp} = 1050, u = 420 and R_p = 400,000 ohms. Because the reactance of the choke will vary with frequency, two audio frequencies will be chosen for the calculations. For 400 cycles we have

$$A = \frac{(420)\ (2\ \pi\ 400\ \{500_f)}{400000 + 2\pi\ (400)\ (500)}$$

$$A = \frac{127 \times 10^9}{3024 \times 10^5} = 419$$

which happens to be about the amplification constant of the tube. At 50 cycles we have a voltage gain of approximately 159. The former figure would need to be corrected for the capacity between turns of the choke and probably the amplification curve would then be quite nearly flat and considerably lower than the mu of the tube.

For an estimate of the gain of a transformer coupled audio stage, we can change our formulae to fit by adding the nominal transformation ratio in the numerators. Let us take the transformer with a radio of 4:1. Using a 227 tube and assuming the primary acts as a matching load, we have

$$A = \frac{(9)\ (4)\ (9000)}{9000 + 9000} = 18$$

The practice is to make the plate impedance twice the tube impedance. In this case we would have

$$A = \frac{(9)\ (4)\ (18000)}{9000 + 18000} = 24$$

Suppose we were given a problem such as this. A 245 type tube is

transformer coupled to the voice coil of a speaker, which has an average resistance of 10 ohms. What would be the wattage in the voice coil if 10 volts a-c is impressed on the grid of the power tube? The output impedance of a 245 tube is given as 2000 ohms. From this we find the impedance ratio is $\frac{2000}{10}$ or 200 step-down. Then the voltage transformation would be $\sqrt{200}$ or 14.14, which is also the turns ratio. If 10 volts were impressed upon the tube grid, we would have 10u as the voltage across the plate circuit. This is

$$E_p = \frac{(10)\ (3.5)\ (2000)}{2000 + 2000} = 17.5$$

Dividing this by 14.14 gives 1.24 volts across the voice coil impedance of 10 ohms. If we class it all as resistance, the power will be $\frac{E^2}{R} = \frac{(1.24)^2}{10} = \frac{1.53}{10}$ = .153 watts.

If the transformer matched twice the plate impedance or 4000 ohms, the turns ratio would be 20 and the voltage across the primary would be

$$E = \frac{(10)\ (3.5)\ (4000)}{2000 + 4000} = 23$$

and $\frac{E^2}{R} = \frac{(163)^2}{10} = .265$ watts

On page 30 of this issue, tube characteristics are defined at some length. Showing that the tube formulae we have used are identical will make quite clear the relationship between various tube characteristics. We shall first define the terms to be used.

$$u = \frac{G_{cp}}{G_p} = \frac{G_m}{G_p} = G_m R_p = \frac{dE_p}{dE_g};$$

$$G_{cp} = G_m = \frac{dI_p}{dE_g};\ G_p = \frac{1}{R_p} = \frac{dI_p}{dE_p}$$

$$A = \frac{G_{cp}}{\frac{1}{R} + G_p} = \frac{uR}{R_p + R}$$

Cross multiplying we have

$$G_{cp}\ (R_p + R) = \frac{uR}{R} + uRG_p$$

$$G_{cp}\ R_p + G_{cp}\ R = \frac{uR}{R} + uRG_p$$

Substituting we have

$$\frac{dI_p dE_p}{dE_g dI_p} + \frac{dI_p R}{dE_g} = \frac{dE_p R}{dE_g R} + \frac{dE_p dI_p}{dE_g dE_p}$$

Cancelling terms gives the equality

$$\frac{dE_p}{dE_g} + \frac{dI_p R}{dE_g} = \frac{dE_p}{dE_g} + \frac{dI_p R}{dE_g}$$

which proves our case.

Other interesting facts are also evident. If we know the plate resistance of the tube and mutual conductance, we can find the amplification factor because $u = \frac{G_m}{G_p} = G_m R_p = \frac{dE_p}{dE_g}$, because $R_p = \frac{1}{G_p}$. And as we know the amplification factor and plate resistance, to find the mutual conductance, rearranging the formula gives,

$$G_m = uG_p = \frac{u}{R_p} = \frac{dE_p dI_p}{dE_g dE_p} = \frac{dI_p}{dE_g}$$

which checks by definition. Also if the mutual conductance and amplification factor are known, the plate resistance of the tube can be found by putting the same formula in this form

$$R_p = \frac{u}{G_m} = \frac{dE_p dE_g}{dE_g dI_p} = \frac{dE_p}{dI_p}$$

which also checks by definition.

We come now to the problem of using tubes in resistance coupled amplifiers, where the plate voltage at the plate itself falls below the value for which the characteristics are known. First a set-up should be made simulating the operating conditions as to voltage, and the characteristics secured from the same formulae as given in this issue of this magazine on page 30. An experimental check on a 227 audio stage resulted in the following figures:

Cathode Resistor 1800 ohms
Plate current 5 ma
External plate load 13,000 ohms
B Voltage 200 volts

From this we find the effective plate voltage to be 200 — (.005) (13,000) = 200 — 65 = 135 volts. Do not measure the plate voltage with even a high resistance voltmeter because of the attendant inaccuracies due to the shunt offered by the meter. The set-up for characteristics then was made with E_p = 135 and E_g = (.005) (1800) = 9 volts. For R_p, change in plate voltage from 135 to 112½ volts resulted in the plate current changing from 5 ma to 2.4 ma. Then R_p is

$$\frac{dE_p}{dI_p} = \frac{135 - 112.5}{.005 - .0024} = 8660 \text{ ohms}$$

For G_{cp} or G_m change in bias from — 9 volts to — 7.5 volts resulted in a plate current change from 5 ma to 6.9 ma.

$$\text{Then } G_m = \frac{.0069 - .005}{9 - 7.5} = 1267$$

micromhos. Then the amplification is found by substituting in the regular formula.

$$A = \frac{1267 \times 10^{-6}}{\frac{1}{13000} + \frac{1}{8660}} = \frac{(1267)(112.5)}{21660}$$

= 6.57. Under these conditions the amplification factor of the tube, substituting $u = G_m R_p$ is found to be

$$u = (1267 \times 10^{-6})\ (8660)$$

and u = 10.9, which is higher than average and obviously due to the high mutual conductance of this tube.

Formula for Characteristic Surge Impedance

WE have had several recent requests from readers for a formula by which to calculate the surge impedance of a single wire untuned feeder used with a voltage fed horizontal Hertz fundamental antenna.

We are indebted to H. E. Hallborg of the Centralized Frequency Bureau of the Radio Corporation of America, for a formula which he has worked up from fundamental relations and which follows:

$$Z = 91.2\sqrt{(2.303 \log \frac{4L}{D} - 1)\ (\log \frac{2L}{D} - \log \left\{\frac{L}{4H} + \sqrt{1 + \left(\frac{L}{4H}\right)^2}\right\})}$$

where L = length of line in cm
D = diameter of wire in cm
H = height above ground in cm

A practical example of the application to a short wave transmitter system is given to show the use of this formula. The height was 20 feet and the line of No. 14 B. S. wire was 45 feet long. Converting these values to cgs units, we have

L = 1371.6 cm.
H = 609.6 cm.
D = .1626 cm.

Substitution in the above formula yields the following result:

$$Z = 91.2\sqrt{(2.303 \log \frac{4\{1371.6\}}{.1626} - 1)\ (\log \frac{2\{1371.6\}}{.1626} - \log \left\{\frac{1371.6}{4(609.6)} + \text{continued } \sqrt{1 + \left(\frac{1371.6}{4\{609.6\}}\right)^2}\right\})}$$

$$Z = 91.2\sqrt{(2.303 \log 33840 - 1)\ (\log 16920 - \log \{.548 + \sqrt{1 + (.548)^2}\})}$$

$$Z = 91.2\sqrt{(\{2.303\}\ \{4.529\} - 1)\ (4.228 - \log \{.548 + \sqrt{1.3}\})}$$

$$Z = 91.2\sqrt{(10.41 - 1)\ (4.228 - \log \{.548 + 1.141\})}$$

$$Z = 91.2\sqrt{(9.41)\ (4.228 - \log 1.689)}$$

$$Z = 91.2\sqrt{(9.41)\ (4.228 - .228)} = 91.2\sqrt{(9.41)\ (4)}$$

$$Z = 91.2\sqrt{37.64} = (91.2)\ (6.13) = 558 \text{ ohms}$$

Brief Items of Interest to Many

"As an old-time subscriber of your magazine, who is in a position to compare your last three monthly issues with the preceding numbers, I am, I think, able to give you a reasonably fair opinion of what I think the change in policy has meant to me, and to fellow service men with whom your new policy has been discussed. First, turn back to your October, 1931, issue, pages 34 to 39 inclusive. Any service man will tell you that the charts giving voltage and current readings, as read on a good set analyzer, are by far the most important information we want—and need—in our work. Next in importance is the wiring diagram. The most important part of the wiring diagram is the listing of values of resistors, volume control, and condensers. Some of your diagrams are not as complete as we would like to have them—too many values are not shown. Then there are some pointers on alignment and adjusting the set. Certain sets seem to 'specialize' in certain troubles. It would be a good idea to list these whenever possible. Please note again that the voltage and current readings are given first place, while values of parts run a close second. If the proper voltages are known we can, if necessary, calculate the values of some of the resistors. We often use a variable resistor, adjusting same until analyzer shows desired reading. An ohmmeter is used to measure setting of variable resistor—and then we use a fixed resistor of the nearest possible size. But it is so much easier to look up the value, if we have this data available. Your 'Receiver Performance Curves' are good, but you waste too much valuable space telling us . . . . '——used dummy antenna of 20uh, 200uuf, and 25 ohms . . . . ,' and so forth. Since practically the same conditions are used in all tests, why not give us these facts in a small chart and use the rest of the space for voltage and current charts? We would be most grateful if you did, and so would the rest of your service men readers. Since you have the set available to get the performance curves, you should have no trouble getting the much-desired voltage and current charts. How about it? We are especially grateful for your monthly list of 'Schematics Published to Date'—a valuable feature!"—N. H. Silverman, Lorain, Ohio.

Announcement is made by Richard E. Smiley, general sales manager of The Ken-Rad Corporation, Owensboro, Kentucky, that James D. Jordan, until recently with Grigsby-Grunow tube plant, has associated himself with The Ken-Rad Corporation as chief engineer of the commercial division.

"Upon examining the December issue of Radio Call Book and Technical Review, I find it consists of the following: 16 pages of advertising, 9 pages of station calls, 13 pages of performance, 1 page table of contents, and 9 pages only of reading matter. It is the last item that I am principally concerned with. I do not dispute the value of the performance curves and station calls, but for goodness sake give us something to *read*. I note in your editorial column that 23 per cent of your readers are experimenters. I see nothing in this issue of especial interest to them. Your magazine could more properly be called a pamphlet, containing only 48 pages as it does. Frankly, I was glad to hear that you were changing over to monthly publication, but I must admit I am very much disappointed in the present issue and would prefer the old quarterly. If I may be permitted, allow me to point to the sad demise of *Radio Broadcast*. Do not cater too much to the service men inasmuch as 72 per cent of your readers fall in other classifications. Now I shall cease my berating and make a request. Please publish a complete technical description of the apparatus shown on page 15 of this issue, including circuit diagrams, etc. Of course, most of us recognize the General Radio standard signal generator, low frequency oscillator, heterodyne wavemeter, VT voltmeter, and output meters, but I am referring to the other equipment."—George F. Platts, Cincinnati, Ohio.

Al Dumont, for many years chief engineer of De Forest Radio Company and Jenkins Television Corporation, has joined the staff of the Perryman Electric Company, it has been announced by Joseph D. R. Freed, president.

"In writing these few lines I wish to express my appreciation of the monthly edition of the 'Call Magazine' over the old idea of the quarterly edition. The monthly editions of the schematics of the various receivers being a large factor of assistance to the service man, and the opportunity for us to read up on how the other fellow is getting along. I am also interested in articles similar to the ones published of Set Testers and the like and am desirous of contributing a Set Tester Model for your approval and publication that I have constructed with success.

"My object in making this request is with the idea in mind that possibly some other service man of limited means may see an improvement over the older tester on hand, and one that can be made to do plenty of work, and best of all, at very small expense. Enclosed I am sending a few sketches of the tester, and a description on how to operate it. While the general outline is not new, I have used some ideas passed along by others and with some of my own added, this is the result. In asking you to publish this article I am expecting nothing in return, but merely showing how a great big instrument can be made small. By doing some home work, the complete model, including the carrying case, can be made under $15.00, with gratifying results. This tester is capable of making all tests required of a tester, including rectifier and pentode tubes. If, on the other hand, it is impossible to publish same, I would be pleased to receive the sketches back again."—Fred C. Clark, Runnemede, N. J.

[Thanks, Mr. Clark. The article is being scheduled for the February issue.—Editor.]

"Will you kindly see that I am mailed via e. o. d. the capacity scale for the standard Weston 0-150 volt

voltmeter you refer to in your recent article in the November issue regarding "Capacity Meter for Service Man" on page 36. I have recently purchased a few late issues of your magazine from the book stand and find them of great value. At the present time I am subscription poor. Very soon a few of my subscriptions to inferior magazines run out and at that time I am going to subscribe to Radio Call Book Magazine. At the present time I am a service man for RCA Photophone, Inc., and one of these meters will come in very handy. Thanking you for your trouble and consideration, I am — Robert A. Lane."

E. A. Schmidt, Columbus, Nebr., wishes information on how to wire a 247 pentode in place of a 171 in the RCA 60. There are several reasons why this should not be done. In the first place, the filament current is insufficient to handle the 247, the bias resistor is wrong, the plate voltage is too low, and the output impedance would be mismatched. We suggest not bothering the RCA 60.

In a recent issue of the service notes for the Westinghouse model WR-15 appears the following data on r-f oscillator and i-f adjustments:

"A reference to the WR-10 Service Notes will give the details for making correct r-f, i-f and oscillator adjustments. However, due to the use of an automatic volume control tube, its action will defeat the use of an output meter. To overcome this, a "dummy" Radiotron UY-227 (one that has one heater prong removed but is otherwise O. K.) should be substituted for the tube in the automatic volume control socket. Do not make any adjustments with this tube removed from the socket. While apparently everything functions in the normal manner, the lack of tube capacity in the circuits will cause an incorrect alignment to be made."

We have had several letters asking for information on an ohmmeter. Such a device is being scheduled for the February issue and will cover from 25 ohms to 2 megohms.

One of our readers asks for the nature of the solution used in Edison cells. The solution is one of 20 per cent potassium hydrate (caustic potash), a small amount of lithium hydrate and distilled water.

One of the reasons why it is preferable to use a quick heater tube in the automatic volume control socket is the fact that the automatic volume control has a lag due to its circuit, and in order to nullify this lag, a tube should be used with a quick heater.

One service man reports getting a reading of 30 or 40 volts positive on the grid of a tube. Investigation showed that it was caused by leakage between the primary and secondary, probably due to soldering paste.

Lewis Harrington, Washougal, Wash.: Does the fact that one receiver has a high noise level and another a low noise level make the latter receiver best for bringing in distant stations? Ans.—If the sensitivities of the receivers are nearly comparable, the noise level of the noisiest receiver makes it less desirable than the one which does not have the high noise level. It is usually the case, however, that the more sensitive receiver will have a higher noise level and receive distant stations in spite of it, whereas a less sensitive receiver with less noise could not. Noise level in a receiver increases with amplification and is made up of such things as electron bombardment of the plates of the tubes, audible as a hiss when the amplification is great, local oscillator noise in superheterodynes, regenerative noises and perhaps noises due to faulty parts, such as resistors or leaky condensers.

A. Roy Theobald, St. Louis, Mo.: Please give the type and resistance of the Weston meter which may be used as a substitute in the combination d-c test meter given on page 30 of the December issue. Ans.—The Weston meter which may be used in place of the Jewell pattern, 54, 0-1 ma d-c milliammeter is the model 301, 0-1 ma milliammeter, which has an approximate resistance of 27 ohms.

Anton Theodos, Minot, N. Dak.: About your new magazine (out every month), it surely is nice to have it every month, but I miss Ampere Andy's hints, the beginner's department and some others. How do you couple the output meter to the set under test? In your October issue you have a simple half wave rectifier using such tubes as the 112-A, 245 and 226. I got the old bean working and made such an outfit for a full wave rectifier using 112-A tubes. I can send you a schematic if you wish to have it. Ans.—With regard to the procedure in connecting the output plates to the output meter, the voice coil is disconnected, as stated in each receiver write-up, and the plates of the power tubes are left connected to the primary of the output transformer. Then each side of the output transformer is connected by an 8 mfd paper condenser to the load resistance, which is chosen to match the particular tubes employed in the chassis. Across a part of this load resistance the tube voltmeter takes its voltage, which has been chosen to give the correct output, namely .05 watts. From this you can see that there is no direct current component in the output matching resistance. We should appreciate very much a schematic diagram of your development of a full wave rectifier system without using a transformer.

Questions and Answers

W. C. Bates, Cleveland, Ohio: What is the voice coil resistance of the Jensen auditorium DA-7 a-c dynamic speaker? Ans.—The d-c resistance is 14 ohms, while the 1000 cycle resistance is 23 ohms.

Gray Electric Co., Springfield, Ohio: What would you suggest for a form for complete receiver checking in a service department? Ans.—The following points should be covered: socket analysis with a good analyzer, individual tube checks, alignment checks with a test oscillator, and an air test.

Jansky & Bailey, Washington, D. C.: How can we obtain separate receiver curves? Ans.—We can furnish letter size blue prints of any pub-

lished receiver performance curves at 6c each.

Daniel J. Smith, Drexel Hill, Pa.: Please compare the Silver-Marshall 726 SW with the Scott model 31? Ans.—Our publication has always been impartial and, therefore, we cannot help you by giving our opinion.

Albert Garinger, Brooklyn, N. Y.: Please tell me what unit is used for the vertical axes of the selectivity curves? Ans.—The ordinates used are ratios of field intensities. This ratio is equal to the field strength for standard output off resonance divided by the normal field strength necessary for standard output at resonance, the latter being the absolute sensitivity at the frequency for which the curve was run. This is also used because it affords a simple means of reducing all curves to the same reference point for direct comparison.

August Steve, Buffalo, N. Y.: Referring to the half wave rectifier, without a power transformer, in the November, 1931, issue: 1, how much greater is the current drain using two tubes in parallel? Ans.—Twice. 2, if two tubes are used in parallel, is it still a half wave rectifier? Ans.—Yes. 3, what tube is most suitable? Ans.—In general the coated filament type, such as the 245 and 226. 4, can the old chokes from the B eliminator be used for filtering? Ans.—Yes, if their resistance does not lower the voltage excessively. 5, can you furnish a diagram for using old power transformers to build a full wave rectifier power supply? Ans.—Almost any receiver schematic will give this data. 6, if chokes and condensers were used for complete filtration in the half wave rectifier, what would the resulting d-c voltage be? Ans.—This depends on the load drawn and the series resistance of the filter system. 7, if the total voltage never exceeds 155 volts in the half wave rectifier, how can it be increased without using a series battery? Ans.—Only by using a step-up transformer on the line. 8, what is the smallest condenser which can be measured with the capacity meter given in the same issue? Ans. —.02 mfd.

Leonard E. Allen, Union Grove, Wis.: How can tone control be added to a receiver with push-pull amplification? Ans.—If you wish to use a 500,000 ohm variable resistance, connect a.1 mfd condenser in series with it and from the detector plate to ground. Another method would be to connect a variable resister in series with a condenser across the two push-pull plates.

R. Kulikowski, Pittsburgh, Pa.: Why is the noise level high in some superheterodynes? Ans.—Noises in receivers in general have indefinite origins, but they are usually greater as the sensitivity of the receiver increases. In a superheterodyne a likely cause for the noise lies in the oscillator circuit. Analysis of noises in superheterodynes would show a large amount due to the local oscillator, another large amount due to the intermediate frequency amplifier, and the remainder due to the radio frequency stages. This assumes, of course, that circuit parts are not defective. Any variable noise, that is, crackling, as distinguished from constant hiss, would necessarily lie outside of the tubes, if they were not defective, in such elements as faulty resistors and condensers with considerable leakage. Actual receiver noise may be checked if the antenna and ground posts of the receiver are connected together and the volume control turned to its maximum position. Excluding noise coming in over the a-c line, any additional noise when the set is in operation must be due to external conditions in the neighborhood.

John J. Stacey, Detroit, Mich.: How is the current drain calculated in an a-c receiver? Ans.—In measuring the current drain on receivers which come into the laboratory for test purposes, we employ an a-c meter connected in series with the primary of the power transformer. If the current drain is to be calculated, the power factor of the transformer and watts input to the transformer must be known. It is far easier to measure the current directly than to calculate it.

J. S. Owen, Atlanta, Ga.: Can you give me the color code of the Silver-Marshall oscillator coil 175-S used in the 726 SW receiver? Ans.—SH is the single terminal at the end of the coil. P is the plate lead which is red-white. SL is the low end of the tuning coil, which is blue. C2, which is the low end of the grid coil, is yellow. C1, which is the cathode of the first detector, is gray, G2, the grid of the oscillator, which is green, and finally B which is the plus B and is red.

Marshall E. Yost, Point Pleasant, Pa.: We would like to know if the dynatron oscillator described on page 39 of the November issue has sufficient output to be used for alignment of broadcast and intermediate frequency circuits of superheterodyne receivers? Ans.—As stated in the article, the output of a dynatron oscillator is never great, and because it is used as a primary standard, this attribute is hardly necessary. It may have sufficient output for the r-f alignment of any receivers which are not less sensitive than about 30 microvolts absolute, assuming that they are not far out of alignment. It is very doubtful that this oscillator may be used on intermediate frequency alignment.

H. R. Fisher, Council Bluffs, Ia.: Can a 25 cycle receiver operate at the same voltage on a 60 cycle line and if it will, why? And will a 60 cycle receiver operate at the same voltage on a 25 cycle line? If so, why? Ans. —A 25 cycle receiver will operate on the same voltage at 60 cycles, with a very slight rise in all of the secondary voltages, and in general this is not serious, because either the turns per volt or the cross-section of the core or both are greater on the 25 cycle transformer than on the 60 cycle transformer. The efficiency will be higher and the heating less. A 60 cycle transformer will not operate satisfactorily on a 25 cycle supply because of the very great increase in eddy current and hysteresis losses incurred by lowering the frequency. Remember that some manufacturers use tuned sections in their hum filters, which would immediately bring up the problem of a change-over in such a filter system, since for 60 cycle models the trap circuit is tuned generally to 120 cycles and probably for 25 cycle supply it would be tuned to 50 or 100 cycles, which makes a very noticeable difference in hum level.

Using Loop to Get Desired Stations

Nearly everyone has desired at some time or other to tune in a distant station operating on a wavelength shared simultaneously with several other stations in other sections of the country. It might be that a set owner wishes to hear a special football broadcast, concert, or it might be just the urge to hear one's hometown friends on the air, as was the case of the owner of Amateur station W-9UG.

Loop Only Solution

This particular problem called for tuning in station WIS on 1,010 kilocycles from a Chicago apartment building while WHN, KGGF, WNAD, KQW and several other stations were on the air. A plotted map showed that all the other stations were at approximate right angles to a line drawn between WIS, in Columbia, S. C., and the Chicago location. Obviously, a loop aerial was the solution, but the set to be used (a stock model Philco) was not designed for loop operation.

Further irritation came from the fact that a powerful Chicago local, KYW, operated on the adjacent wavelength of 1,020 kilocycles. But this, also, was at right angles to the plane of a loop turned toward Columbia, so in theory everything seemed lovely.

The manufactured set, like practically all others of modern design, had sufficient sensitivity to pick up the 500 watt WIS, but if enough aerial was attached to allow it to do so the local stations would crowd too closely to the 1,010 kilocycle spot.

Single Tube Connector

Accordingly, an "adaptor" unit to couple a loop to the set was constructed. This was composed of a single stage radio frequency amplifier using a "230" type tube operating from batteries. The entire equipment was housed in a small metal cabinet so as to shield it from local station pickup. The cabinet was grounded.

Fig. 1, on this page, shows the schematic circuit of this amplifier unit. It was found that such an amplifier was adequate to make up for the smaller signal potential obtained from the loop. In cases where extreme sensitivity is necessary one might use a screen grid tube or even two stages of such tubes.

Hookup Simple

It may be seen that the hookup is simplicity itself. The only necessary apparatus is a loop, a variable condenser of the size called for by the loop for tuning over the broadcast range, a UX type socket, a 230 tube, radio frequency choke, a fixed condenser of .005 Mfd. capacity (or thereabouts), a 20 ohm rheostat and the metal cabinet. No layout will be shown as this will be made according to the shape of cabinet one is able to

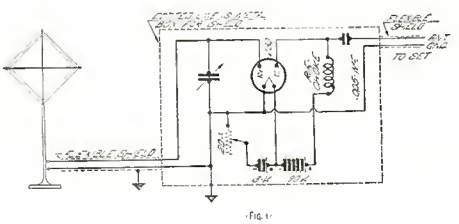


Fig. 1—This diagram illustrates the use of a loop in connection with a tube so as to get the directional effects of the loop, which in many cases will enable the set owner to pick up stations which normally might be overshadowed by local and semi-local transmitters

build or find. The model described used a cabinet formerly occupied by an Aero short wave receiver. It is about ten inches long, eight inches high and seven inches deep.

Loop Outside Window

The loop is placed outside the window nearest set. Leads coming from it to the set should be encased in flexible metal shielding and this sheath grounded. The same treatment should be given the two leads going to aerial and ground binding posts on set. The shielding in this latter case should run clear up to the two posts, then grounded to the set's ground post and water pipe or radiator.

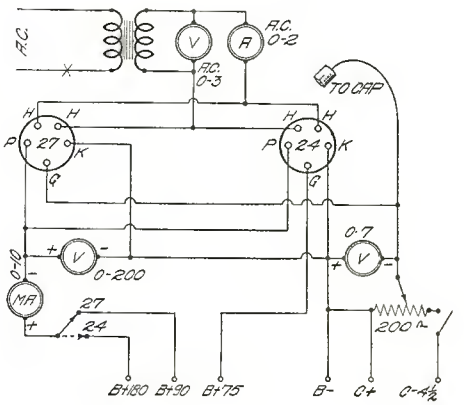
How It Operates

In operation, the loop is turned toward the station desired. This will eliminate others on the same wavelength and at right angles. Next, tune the loop variable condenser at about the correct spot for the station, then tune set in ordinary manner. Re-adjust all three when the station is heard faintly in the loudspeaker.

Of course, this unit will not serve to separate stations in the same plane, but such occasions are rare. It so happened that after this model had been in use some months the federal radio commission, for some reason, decided to place WLAP, in Louisville, on the same 1,010 kilocycle wavelength, killing all the joy of using the device. However, plenty of fun was had with the novel "gadget" while the exclusive "regional" channel did exist down South and this same idea will still solve many problems of other experimenters who want some particular station on their set.

TUBE TEST CIRCUIT

An interesting tube test circuit included in the Kellogg radio service instruction manual is shown in the diagram below. The voltages required are clearly indicated for the two types of tubes which may be measured, namely 227 and 224, but no difficulty should be experienced in applying it to the 235 type or to other tubes with the necessary voltage changes. Only one socket may be used at a time. For the value of mu, divide the difference of plate voltage necessary for constant plate current by the change in grid voltage. For the plate impedance, divide the difference of plate voltage by the change in plate current, and for the mutual conductance divide the difference in plate current by the difference in grid voltage.



Secondary Selling May Help Industry

IT is hoped millions of dollars now lost to the radio industry will be brought into the legitimate channels of radio distribution with the inauguration of a secondary selling season announced concurrently with advance notice on the tenth annual Chicago-Radio-Electrieal Show, Jan. 18 to 24 inclusive.

Vigorous selling will be carried right on through the winter and into the spring under the plan, with more sales and greater profit for all. It is hoped that "dumping" and "gyp" selling will be eliminated. Leaders of the radio industry approve the new merchandising idea which will be launched at the Chicago show.

The secondary selling season for radio begins after the holiday slump and will continue right on into the spring. When the idea has had a chance to prove itself in 1932, there is a real possibility that the secondary season may even surpass the so-called primary selling season in sales volume.

In the early days of radio there was a sound reason to concentrate on sales in the final quarter. But with high class broadcasting programs available all the year around, excellent receivers and high powered stations, the radio set is used and enjoyed, every day, all the year around.

To get the contrast, just think back to the days of battery operated sets and low powered stations with their mediocre programs!

Anyway, the radio industry got into a rut, mentally, until the slump got the brain power of the industry working again. Such leaders as B. J. Grigsby, president of Grigsby-Grunow Company, Comm. E. F. McDonald, president of Zenith, and Eugene R. Farny, president of All-American Mohawk, believe so thoroughly in the benefits of the secondary selling season that they do not contemplate a return of industry prosperity without its adoption.

This view is shared by such nationally known jobbers as Dave Goldman, New York City, president of the North American Radio Corp., and Henry C. Bonfig, Kansas City, vice-president and general manager, Sterling Radio Company.

It is also the view of R. Calvert Haws, nationally known merchandiser, who is president of the Shuman-Haws Advertising Company, Chicago. He states specifically that, "as long as the idea persists in the trade that radios can be sold only in volume in the final quarter of the year, the industry will never come into its own!"

St. Clair Carver, a member of the advertising firm of Henri, Hurst & McDonald, Chicago, approves the idea a hundred per cent. "Radios are used the year around," he remarks, "so radios will sell on a year around basis if the right kind of selling and merchandising effort is expended."

And so it is with scores of others with whom frank discussions have been carried on for months, seeking ways and means to get the radio business on an even keel and on the most profitable basis.

The secondary selling season will be publicly launched for the benefit of the entire nation, the week of the Chicago Radio-Electrical Show, Jan. 18-24, 1932. Newspaper publicity, from coast-to-coast, and network broadcasting will create immediate acceptance for the new selling season.

It was purposely to insure the secondary selling season getting under way without lost motion that the Chicago show was postponed from October. The majority of manufacturers realized that without such a vehicle as a national trade and public show to generate country wide interest, it would be impossible to impress the idea forcefully upon the public.

Both for consumer and trade, the Chicago show is ideally timed—near the end of the holiday slump. Members of the trade will have the time to attend the exposition in January, and the public will have ended its holiday visiting.

With Chicago so centrally located, thousands of members of the trade will find it convenient to come to the show, to exchange views and to inspect new models and to have the benefit of both trade and consumer acceptance in making their own buying decisions.

Many manufacturers are already making plans for trade meetings during show week.

Opinions as to the worth of the secondary buying season to the industry have been sought from prominent jobbers, manufacturers, advertising and merchandising experts. Their brief endorsements appearing below would indicate that acceptance of this new idea for greater profits will be industry wide.

"The secondary selling season will benefit entire industry is logical outgrowth of past selling practice."—B. J. Grigsby, Chicago, President, Grigsby-Grunow Company.

"I am in accord with the idea of a secondary selling season for Radio, because it strikes the shackles from an industry-wide handicap, which keep manufacturers, dealer and jobber alike, from achieving the greatest results from their efforts.

"Secondary selling season should be adopted nationally; radio now has sales opportunity it lacked in infancy."—Dave Goldman, New York City, President, North American Radio Corp.

"Curtailing radio promotion after holidays has injured radio industry; Tenth Annual Chicago Radio-Electric Show will correct definite faults."—Comm. E. F. McDonald, Chicago, President, Zenith Radio Corp.

"All-American plans to make outstanding sales record in secondary selling season of 1932."—Eugene R. Farny, Chicago and North Tonawanda, N. Y., President, All-American Mohawk Corp.

"A definite effort will be made on our part to produce sales during the secondary selling season of radio.

"From our experience, when radio was in its infancy there was a definite selling season, lasting only during the months of September, October, November and December. Then at the first of each year, manufacturers, distributors and dealers figured that there was very little radio business left and failed to exert the effort necessary to produce sales. Consequently, the sale of radio sets that could have been forced during the early months of the year were never made.

"But in our case, this situation is changed and tremendous effort will be put back of our selling plans in order to create the sales that should come in the secondary selling season of January, February, March and April of 1932.

"Tentative plans have been made in regard to what we shall do to produce these sales and we are determined to make this secondary selling season an outstanding quarter on our sales sheet.

"Secondary selling season will eliminate dumping and gyp selling industry must eliminate self-imposed seasonal restriction if it is to come into its own."—R. Calvert Haws, Chicago, President, Shuman-Haws Advertising Co.

"Radios will sell on year around basis; public will buy at any time if they are reminded it is always buying time."—St. Clair Carver, Chicago, Member of the firm, Henri, Hurst & McDonald Advertising Agency.

"The breaking-down of seasonal sales curves can be accomplished by

(Continued on page 41)

Improving Reception in Apartments

Every city has its apartment or business buildings where clear radio reception is a myth held fit for Baron Munchausen's famous book of tales. Such spots are veritable factories of man-made interference. Every good concert has its staccato accompaniment of elevator and ice-box clicks and pops. All the dealers in the vicinity have the spot tagged as a sure location for dissatisfied customers. People who already have their radios and move into the building without first learning of its radio reputation are sorely regretful.

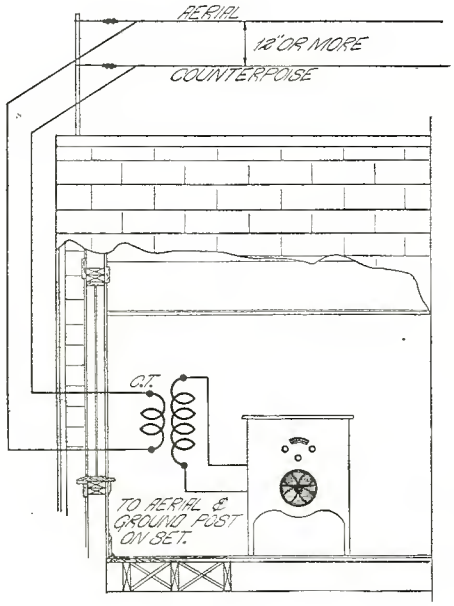
Realizing that such a condition affected their sales, several Chicago dealers set two engineers working on the problem recently. The technicians discovered some interesting things about these bad radio reception buildings, including at least two systems that greatly minimize the noise picked up. No doubt, their results will interest others in a like predicament.

First of all, it was found that most of the interference came from the lead-in. It was picked up on the way down from the roof. This was particularly true where lead-in wires were three or more stories in length.

Test radio sets installed on the roof brought in far less noise. In like manner it was discovered that when a set was connected to the water or radiator pipes of the buildings more noise generally resulted.

Thus, the problem was to design some sort of lead-in which would not pick up noise on the way down and also some method of obtaining great enough signal strength without using the common ground of the building which was also used by telephones, ice machinery and other devices.

The old Zeppelin type lead-in used in many amateur stations proved just the thing for a lead-in. This utilizes two wires, one the actual lead-in and the other a dummy running to the top of the building. The two wires are twisted together and when they pass through an "interference area" pick up identical charges of static. At the lower end the currents are passed through a coil and here the

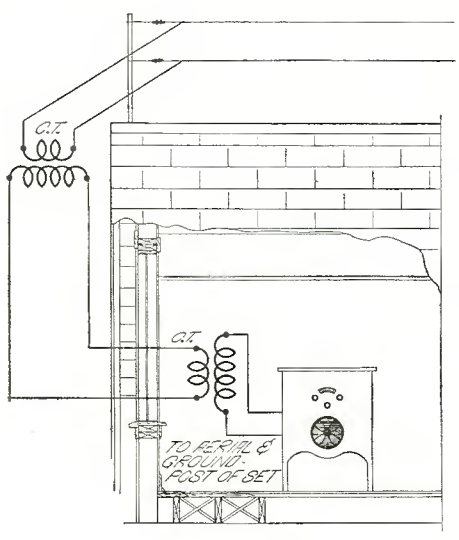


·Fig. 1·

This diagram shows the usual radio frequency feeder line, using a single coupler at the set end

equal static charges, being of unlike polarity, cancel themselves. The signals from the aerial, on the other hand, are unequal and pass through the coil, inducing radio frequency signals in a second coil, which is coupled to the aerial and ground posts of the set.

Such a system still leaves the set without a ground connection, however, and would not work very well on



·Fig. 2·

In this drawing may be seen one of the methods outlined in the article showing the use of two coupling transformers, one at the antenna end and the other at the set end

broadcast waves with the average length aerial. So, a counterpoise was tried. This consisted of a wire some twelve or fifteen feet under the aerial wire and of the same length, running parallel with it.

The combined ideas, representing the final assembly, are shown in Fig. 1. For an average large city installation where there are several powerful local stations the aerial and counterpoise wires should each be about sixty feet long. This may be increased to eighty or ninety feet where the set is fifty or more miles from a 5,000 watt station.

The lead-in pair should be of some weatherproof twisted pair and kept short as possible. However, it is possible to make such a lead-in much longer than the old style single wire type as the wavelength of this section is not added to that of the aerial.

The coupling transformer, CT, is made of two coils of No. 22 wire wound on a 3 inch tube. Each coil contains about 24 turns closely wound. The two coils are placed side by side with not more than one-sixteenth of an inch separating them. When placed in the circuit the leads should be reversed at both, aerial and set, sides for best operating polarity.

The above system was found to eliminate some 50 to 80 per cent of the man-made static in the average set. Results vary with each building and make or set. While this might not sound like sufficient noise reduction, anyone who has heard a demonstration of it is highly pleased.

One more "brute force" method may be used in very obstinate cases. This uses another coupling transformer of similar design in the upper section of the lead-in, as shown in Fig. 2. The design of this transformer is identical to the first mentioned one. One of its coils is connected to the aerial and counterpoise wires while the other two ends go to the downward bound lead-in. The wires of the lead-in are twisted in this system, also, and one must continue to use the set coupling transformer.

This latter transformer, incidentally, should be placed near the aerial binding post of the radio receiver so that its link circuit will be short as possible. In this way it is generally found that even the turning on of electric lamps in the same room fails to produce a "plop" in the set as formerly, without the system described.

The coupling transformer on the roof should be placed in a weatherproof box.

Short Waves Heard on Broadcast Sets

The urge to explore still exists in modern Americans. All the globe-trotting tendencies our fathers showed in "Yankee Clipper" days returned to tug at our hearts when someone discovered several years ago that the whole world could be explored via armchair in a single night by using a short wave radio receiver.

Many Things to Know

Publicity on short wave possibilities has led most broadcast fans to believe that all one needs to do is go to the store and get short wave equipment and take it home to hear Rome, London or Nauen the same evening. Unfortunately, there are several other things a fan should know in order to get the most out of his short wave equipment.

Four Receiving Methods

First of all, there are four distinct ways to receive short waves, or high frequencies. One of these is by a regular short wave set, another is by a combination short and broadcast wave set such as several manufacturers now offer. There is little to go wrong on when buying such complete units. Most fans run into trouble in the two remaining methods.

The Adapter

The third method is by what is known as a short wave "adapter." Strictly speaking, this is really a one-tube short wave receiver that is plugged into the regular broadcast receiver in such manner as to utilize the broadcast set's audio amplifier to make the weak signals strong enough to operate a speaker.

Most times these "adapters" are simple regenerative detector circuits and may be identified by their one tube. More efficient "adapters," however, have a radio frequency amplifier ahead of them, in which case there are two tubes, seldom more.

These "adapters" work splendidly with sets that have sufficient audio amplification in them to make the signals loud as desired. This includes some of the newer manufactured models and practically all the models sold before 1929. BUT . . . about

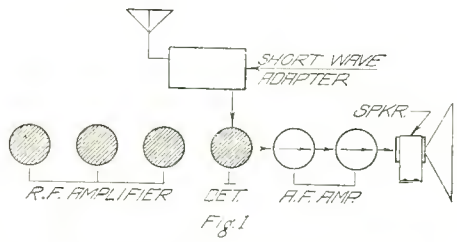


Fig. 1

This system of using a short wave adapter is excellent for sets having two or more audio amplifier stages. The dark tubes indicated are those not in use when the short wave adapter is employed

that time the screen grid tube became popular in the United States and manufacturers began building more efficient radio frequency amplifiers, thus delivering such a "sock" to the audio amplifier that the latter did not have to have such a high amplification, but was made to handle powerful signals coming from the detector.

Uses Only Part of Tubes

It is easy to imagine what happens when a short wave "adapter" is plugged into such a set. Fig. 1 depicts the position of the adapter in a typical six tube circuit. Taking away one of the audio amplifier tubes shown in light circles leaves but one to amplify the weak short wave signals delivered by the adapter . . . and this is not sufficient. Result, a dissatisfied fan who sincerely believes he has been "oversold" on what short waves can do. In reality what he has done is use improper apparatus.

Some radio doctor should have prescribed what we will call the fourth form of short wave equipment for this fan. Something that would utilize those three radio frequency amplifier tubes and the detector shown in dark circles as wasted in the former circuit.

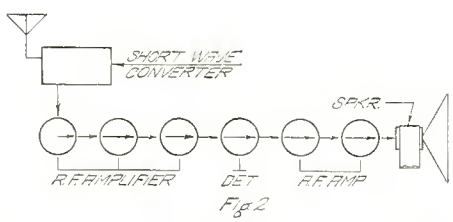


Fig. 2

With the short wave converter illustrated in this diagram, all tubes are used in the receiver system and as a consequence much better results are secured

The Converter

This fourth piece of equipment for reaching down to the short waves is called a "converter" because it takes the short waves and changes, or converts them to waves in the broadcast band. As a given example, it might take a 100 meter signal (3,000 kilocycle) wave and turn it out as a 1,000 kilocycle (300 meter) wave. This 300 meter wave is then fed into the aerial binding post of the regular broadcast set as though it had always been a 300 meter station . . . and goes the usual route of any broadcast signal through the set.

Converter Is Oscillator

Just how the short waves are changed will be of interest to some fans and prove a bore to others. Suffice it to say that the converter is really a small oscillator and that it "beats against" the incoming wave of 3,000 kilocycles with a 2,000 or 4,000 kilocycle wave. Either will do, as the idea is to make a difference of 1,000 kilocycles . . . which is the wave we wish. Really simple, after all.

So, it can be seen that when a fan possesses a modern set having only one stage of "audio" amplification a converter must be used. Such a converter has from two to four or five tubes in it, depending upon its design.

Dealer Should Know

Price has, no doubt, lured many fans to purchase a simple "adapter" when what they really required was an efficient converter in order to take full advantage of their modern set. Neither the fan nor the manufacturer is to blame in such cases. Perhaps the manufacturer could have made his claims a bit more detailed but the real responsibility lies on the dealer, who should see that the devices he sells will work on the apparatus the fan has in his home.

Other Factors

Aside from using the proper short wave apparatus, one must realize that tuning a short wave receiver is an art not inherent in most broadcast fans.

These listeners are used to twirling a dial and getting the station they wish. There are only 99 possible station locations on the broadcast dial so there is reasonable separation between the various channels, despite what most fans might think when two stations are interfering. Consider the short wave dial where several times as many stations are crowded into a single dial rotation! One must tune ever so carefully in order that he not pass over the weak foreign signals.

Instances have been known where a station powerful enough to fill a whole room with music could not be heard at all if passed over with fair speed in tuning. The signals must be enticed in with gradual, hairsplitting adjustments.

Station Must Be on Air

Another vital factor often overlooked by fans is the fact that foreign stations MUST be on the air when they are tuned in. That is to say, there is little use in tuning for a London station at 10 P. M. Central Standard Time in this country. At that time it would be 4 A. M. in London and the English find it most convenient to operate their stations in the daytime and early evening hours, reserving from midnight on to sleep, just as we do.

Likewise with the other countries. One might even discover that he has to get up at 5 A. M. to hear the Vatican station in Rome, Italy. Other short wave broadcasters will come in at noon our time.

One interesting fact to bear in mind is that when the zones to be covered are mostly in broad daylight wavelength from 40 meters down are used, the reverse being true of dark zones. So, if you tune for a London station at Noon, Central Standard Time, which would be 6 P. M. in the English capital, use 40 meters or lower. The broadcast stations will probably be using the proper frequencies for best coverage. Of course, the surest method is to use a log showing waves used at certain hours, if this is obtainable.

Now that the proper set and the proper time and tuning methods have been discussed, there remain one or two other items that will aid considerably in hearing those foreign programs.

Need Good Aerial

An inside aerial such as some fans use with their broadcast set will seldom produce sufficient signal strength on short waves. The waves below 200 meters have an uncanny dislike to coming indoors, anyway, particularly if they have to penetrate metal walls in doing so. The best antenna is an outside one as high as possible, away from any obstructions and from sixty to eighty feet long.

Forms of Interference

If any "cross talk" or interference from local broadcast stations is heard on the short waves it must be due to one of two things. If the set is oscillating one might be hearing a harmonic. There is little cure for this other than a wavetrap in the aerial circuit to trap out the interfering harmonic. Fortunately, such interference comes in at but three or four spots. The second form of interference is most common. It is the hearing of one or two local broadcasters in the background, at all dial settings. This is due to too long an aerial or too close coupling to the set. Either case may be improved by moving the "primary" or aerial coil in the short wave tuner farther away from the other coils next to it. This adjustment is provided for in most sets by a simple hinge.

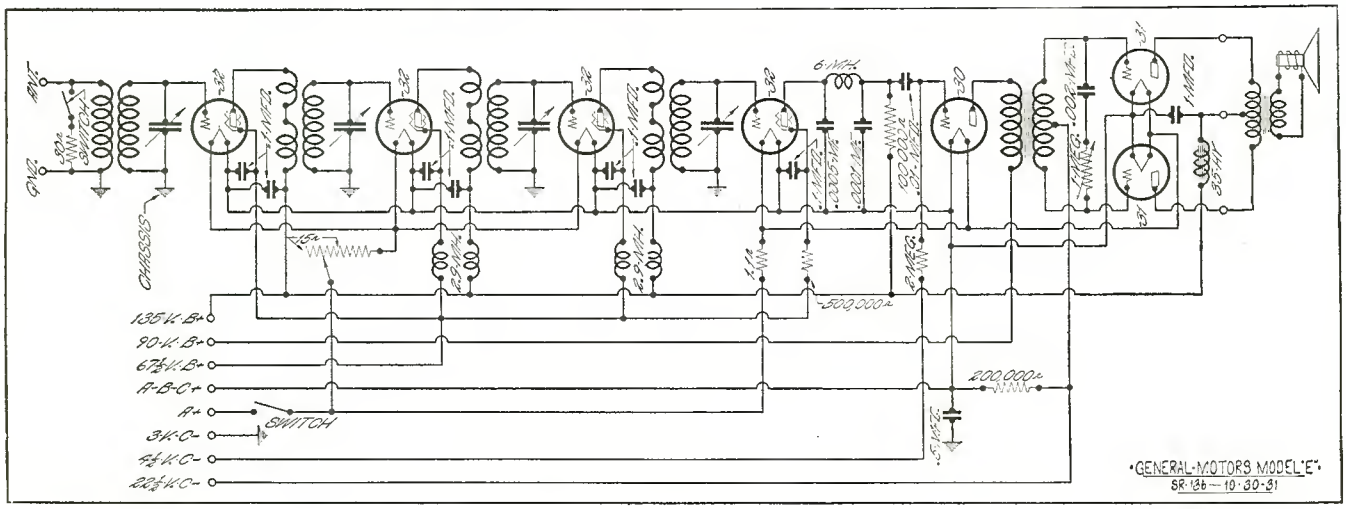
One form of interference is peculiar to the "converter." That is the tendency of one particular station to interfere. Suppose, in the case of the 1,000 kilocycle conversion depicted before we find a broadcast station is interfering badly. Investigation will likely show this station has a wavelength close to the 1,000 kilocycle "intermediate frequency" being used to convert. In this case one should carefully shield the leads coming from the converter unit to the aerial and ground posts of the set. The shield should be grounded. The line also should be as short as possible as it has a tendency to act as a short antenna and allow the set to pick up local broadcast stations.

For Code Signals

So far, we have assumed listeners were interested in receiving only telephone or music stations. Fortunately, the "code hounds" will know sufficient means to render their signals audible. Suffice it to remind them that in the case of a converter, the 1,000 kilocycle signal should be again heterodyned with a slightly lower or high frequency to produce an audible note in the headphones.

It is hoped these facts will help to clear up some of the mysterious maladies that have kept many short wave sets from doing all their owners had hoped they would when purchased. If several of these fans show up at the office with that "I knew it" expression on their faces these words will not have died in vain.

GENERAL MOTORS MODEL E



Reasons for Automatic Volume Control

WITH the advent of the supe heterodyne receiver, followin the licensing of radio manfacturers, all competitive receiver circuits were swept from the field because their performance could not be made comparable to the super without making the cost prohibitive. Once a type has gained popularity and becomes established as a household word, nothing remains in its life but refinement on the original idea until, of course, it is superseded by a new principle. Superheterodynes are now in such a category along with motor cars, which have not been changed basically for years, but with some new wrinkles and gadgets usually of definite benefit added on each new model.

Radio receivers have been refined from year to year and many such refinements were not discarded with the coming of the now popular double-frequency amplifying system. Cathode type tubes, screen grid tubes, illuminated kilocycle scales, and combination power switches and volume controls will be used until something more suitable replaces them, at which time they will be discarded in line with progress. There are other things of doubtful benefit but of great sales value, such as tone control and pentode power tubes.

One principle which has been used on receivers before the acceptance of superheterodynes by the public has found a definite place on the newer receivers and on a much wider scale. The fan who plays for distant stations usually knows how to tune a set, due to an understanding of its workings and more or less constant practice. But a woman, let us say, who wants to get a program with one hand, holding a book with the other, will shake the house on its foundations when she runs through local stations. Even an experienced fan will forget and tune from a DX station through a local and rattle the windows. On older receivers the local stations could be heard approaching for 30 channels, but the superheterodyne's abruptness makes it a more difficult task to prevent sudden blasting on some 5 kw station only two miles away.

One other problem is solved to greater or lesser degree by the principle mentioned at the beginning of the preceding paragraph. Isn't it annoying to have to jump up every five minutes and either turn up the volume or cut it down because the station to which you are listening is fading badly?

There is a refinement on almost all of the superheterodynes today, which is quite effective in controlling the volume on a receiver to maintain it at a definite output level. It is known by the simple descriptive, self-explanatory term "automatic volume control."

There are many variations of the application of an added tube to perform the function above named, but in general it works on the same principle in all receivers, namely, that it raises or lowers the grid bias voltage on one or more radio frequency stages. The excitation originates perhaps in the second detector, where the variation of cathode voltage due to the signal may actuate the tube, which in turn acts on the radio frequency grids. A simple explanation is that an increase in signal gives the detector a greater bias due to greater current drain, whereupon the automatic volume control makes the radio frequency grids more negative with respect to their cathodes, and the signal in the speaker decreases. When the antenna input decreases, the reverse takes place.

There are many satisfactory automatic volume controls; there are a few good ones, and there are still fewer that may be placed in the "excellence" class. Two points must be considered in every case. First, how sensitive is the control, and second, how fast does it act? Sensitivity of the volume control tube is a measure of amplitude of change in signal permitted by the tube before it controls. In other words, it would be impracticable to build such a control which gave no perceptible volume change between the local station and one 2,000 miles away. However, the difference should not be more than two to one, which would not cause discomfort. The other point is the lag of the control. Because of the circuit elements and the time constants of the circuits involved, it is almost an impossibility to have an action without a perceptible time interval, though the writer has seen at least two that seemed to act instantaneously.

A set equipped with an automatic volume control may be identified primarily by the rise in noise level when the set is detuned from a carrier. As far as it is able, the control tube is attempting to increase the amplification enough to bring the signal up to the level setting, but it is limited sometimes by noise and always by the overall amplification of the receiver.

Because of this automatic feature, a receiver apparently tunes broadly because as you tune from the peak of the signal, the automatic volume control is increasing the amplification to maintain the same output level and thus one side band is lifted. Such discrimination leads to very poor quality, and it is an impossible task to tune the receiver. Therefore, some means of electrical resonance indication is used, such as a visual tuning meter or a neon column, both of which eliminate all guess work in the operation of the station selector. Both of these indicating devices are quite satisfactory and definitely sharp in showing the point of resonance. The meter is probably of about 10 ma full scale and measures the plate current of the radio frequency stages. With the neon column, the bleeder system to the radio frequency tubes is designed with bad regulation and the column height in the tube depends upon the voltage variation at the plates as the signals are impressed. It might be well to suggest that in spite of the really good features of automatic volume control, reception will not always be what it should, through no fault of the receiver. Many times when a station fades, there is side band destruction, which causes the unintelligible gibberish, though the volume is maintained. Such factors as these are beyond the control of the circuits of the receivers and therefore perfection cannot even be approached until the actual transmission obstacles have been overcome.

Secondary Selling Season

(Continued from page 37)

logical and aggressive advertising and merchandising.

"Much has been accomplished along this line in the electrical refrigeration field and winter sales are pressing close on summer sales. Where formerly it was assumed that the public would not buy "out-of-season," it has been found that the public will buy at practically any time if they are reminded that it is always "buying-time," and are given the opportunity to buy, even such an item as electric refrigerators!

"The refrigeration field is not alone in this sales discovery.

"The same results can be accomplished in many other fields including radio. Radios are in use the year around; therefore, radios will sell on a year around basis instead of on a seasonal basis if the right kind of selling and merchandising effort is expended."

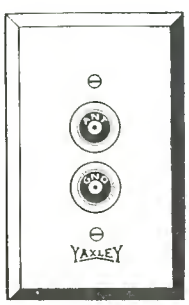
Set Manufacturers and Brand Names

Manufacturer	Address	Brand
Acme Mfg. & Elec. Co.	1440 Hamilton Ave., Cleveland, Ohio	Acme
Advance Elec. Co.	1260 W. 2nd St., Los Angeles, Calif.	Falck
All-American Mohawk Corp.	North Tonawanda, N. Y.	Lyric
Amrad Division	Crosley Radio Corp., Cincinnati, Ohio	Amrad
Andrea, F. A. D., Inc.	Long Island City, N. Y.	Fada
Atchison Radio Mfg. Co.	125 N. 6th St., Atchison, Kans.	Atchison
Atwater-Kent Mfg. Co.	4700 Wissahickon Ave., Philadelphia	Atwater-Kent
Audiola Radio Co.	430 S. Green St., Chicago	Audiola
Automatic Radio Mfg. Co.	332 A St., Boston, Mass.	Tom-Thumb
Brown & Manhart	6219 S. Hoover St., Los Angeles, Calif.	Ranger
Browning-Drake Corp.	224 Calvary, Waltham, Mass.	Browning-Drake
Brunswick Radio Corp.	120 W. 42nd St., New York City	Brunswick
Cardinal Radio Mfg. Co.	2812 S. Main St., Los Angeles, Calif.	Cardinal
Cardon-Phonocraft Corp.	E. Michigan & Horton, Jackson, Mich.	Cardon-Sparks
Carteret Radio Lab.	254 W. 18th St., New York City	Carteret
Champion Radio Mfg. Corp.	1865 W. Gage Ave., Los Angeles, Calif.	Champion
Cleartone Division	Cincinnati Time Recorder Co., 1731 Central Ave., Cincinnati, Ohio	Cleartone
Colonial Radio Corp.	254 Rano St., Buffalo, N. Y.	Colonial
Columbia Phonograph Co.	1819 Broadway, New York City	Columbia
Continental Radio Corp.	Ft. Wayne, Ind.	Star-Raider
Crosley Radio Corp.	Cincinnati, Ohio	Crosley
Davison-Haynes Mfg. Co.	1012 W. Washington Blvd., Los Angeles	Angelus
De Forest Radio Co.	Passaic, N. J.	DeForest
Delco Radio Corp.	Dayton, Ohio	Delco
Echophone Radio Mfg. Co.	104 Lake View Ave., Waukegan, Ill.	Echophone
Edison, Thos. A., Inc.	Orange, N. J.	Edison
Electrical Research Lab.	1731 W. 22nd St., Chicago	Erla
Elmore-Lambing Radio Co.	1205 S. Olive St., Los Angeles, Calif.	Singer
Flint Radio Co., Inc.	3446 S. Hill St., Los Angeles, Calif.	Flint
French, Jesse, & Sons Co.	New Castle, Ind.	Jesse-French
General Electric Co.	Bridgeport, Conn.	General Electric
General Motors Radio Corp.	Dayton, Ohio	General Motors
Gilfillan Bros., Inc.	1815 Venice Blvd., Los Angeles, Calif.	Gilfillan
Gray & Danielson Mfg. Co.	2101 Bryant St., San Francisco, Calif.	Remler
Graybar Elec. Co.	Graybar Bldg., New York City	Graybar
Grebe, A. H., & Co., Inc.	70 Van Wyck Blvd., Richmond Hill, N. Y.	Grebe
Griffin Smith Mfg. Co.	1224 Wall St., Los Angeles, Calif.	Royale
Grigsby-Grunow Co.	5801 Dickens Ave., Chicago	Majestic
Gulbransen Co.	3232 W. Chicago Ave., Chicago	Gulbransen
Herbert H. Horn	1629 S. Hill St., Los Angeles, Calif.	Tiffany Tone
High Frequency Laboratories	3900 N. Claremont Ave., Chicago	Minuet
Howard Radio Co.	South Haven, Mich.	Howard
Howard, Austin A., Corp.	1725 Diversey Pkwy., Chicago	Austin
Hyatt Elec. Corp.	406 N. Madison St., Woodstock, Ill.	Hyatt
Jackson-Bell Co.	1682 W. Washington St., Los Angeles, Calif.	Jackson-Bell
Jewel Mfg. Co.	222 S. West Temple St., Salt Lake City	Jewel
Keller-Fuller Mfg. Co.	1573 W. Jefferson, Los Angeles, Calif.	Radiette
Kellogg Switchboard & Supply Co.	1066 W. Adams St., Chicago	Kellogg
Kemper Radio Corp., Ltd.	1236 Santee St., Los Angeles, Calif.	Kemper-Kompak
Kennedy, Colin B., Corp.	South Bend, Ind.	Kennedy
King Mfg. Co.	254 R St., Buffalo, N. Y.	King
Kolster Radio Corp.	360 Thomas St., Newark, N. J.	Kolster
Long Radio Co.	2810-12 S. Main St., Los Angeles	Cardinal
Marti Radio Corp.	Ampere, N. J.	Marti
Mid West Radio Corp.	Cincinnati, Ohio (410 E. 8th St.)	Miraco
Mission Bell Radio Mfg. & Distr. Co.	1125 Wall St., Los Angeles, Calif.	Mission
National Transformer Mfg. Co.	5100 Ravenswood Ave., Chicago	Balkeit
National Transformer Mfg. Co.	5100 Ravenswood Ave., Chicago	National
Patterson Radio Corp.	239 S. Los Angeles St., Los Angeles	Patterson
Philadelphia Storage Battery Co.	Ontario & C Sts., Philadelphia, Pa.	Philco
Pierce-Airo, Inc.	510—6th Ave., New York City	Pierce-Airo
Pierce-Airo, Inc.	510—6th Ave., New York City	De Wald
Pilot Radio & Tube Co.	Lawrence, Mass.	Pilot
Pioneer Radio Co.	Plano, Ill.	Pioneer
Plymouth Radio Corp.	2625 N. Main St., Los Angeles, Calif.	Plymouth
Powell Mfg. Co.	6121 S. Western Ave., Los Angeles, Calif.	Powell
Premier Elec. Co.	Grace & Ravenswood Ave., Chicago	Premier
RCA Victor Co., Inc.	Camden, N. J.	Radiola
RCA Victor Co., Inc.	Camden, N. J.	Victor
Republic Radio Co.	3940-46 Grand Ave., Chicago	Republic
Roth-Downs Mfg. Co.	2512 University Ave., St. Paul, Minn.	Orpheus
Seeley Elec. Co.	1818 West 9th St., Los Angeles, Calif.	Lark
Silver-Marshall, Inc.	6401 W. 65th St., Chicago	Silver
Simplex Radio Co.	Monroe & King Sts., Sandusky, Ohio	Simplex
Sparks-Withington Co.	Jackson, Mich.	Sparton
Stein, Fred W.	1200 Main St., Atchison, Kans.	Aztec
Steinite Mfg. Co.	Ft. Wayne, Ind.	Steinite
Sterling Mfg. Co.	2831 Prospect Ave., Cleveland, Ohio	Sterling
Stewart-Warner Corp.	1826 Diversey Pkwy., Chicago	Stewart-Warner
Story & Clark Radio Corp.	173 N. Michigan Ave., Chicago	Story & Clark
Stromberg-Carlson Tel. Mfg. Co.	Rochester, N. Y.	Stromberg-Carlson
Transformer Corp. of America	Keeler & Ogden Ave., Chicago	Clarion
Trav-Ler Mfg. Co.	1818 Washington Blvd., St. Louis	Trav-Ler
United Air Cleaner Corp.	9705 Cottage Grove Ave., Chicago	Sentinel
United American Bosch Corp.	Springfield, Mass.	Bosch
U. S. Radio & Television Co.	Marion, Ind.	Apex
Vaga Mfg. Corp.	718 Atlantic Ave., Brooklyn, N. Y.	Vagabond
Waltham Radio Corp., Ltd.	4228 S. Vermont Ave., Los Angeles	Waltham
Ware Mfg. Corp.	Trenton, N. J.	Ware
Westinghouse Elec. & Mfg.	Mansfield, Ohio	Westinghouse
Zenith Radio Corp.	3620 Iron St., Chicago	Zenith

NEW PRODUCTS FOR THE TRADE

New Wall Radio Outlet

In keeping with the spirit of the day for high quality at a low price, the Yaxley Mfg. Co., Chicago, Illinois, announces a new radio convenience outlet for aerial and ground connections.



The receptacles consist of two specially designed jacks that mount on a strap separate from the cover plate which serves as a face plate only. The strap has plaster ears. Two plugs of a new design also for quickly and easily attaching the aerial and ground wires of the set are provided. The whole unit makes a very handsome and useful radio outlet.

Use Self-Synchronizing Motor

Ira Green, vice president and director of merchandising for the Television Mfg. Co. of America, 23-25 Park Place, New York City, has just announced that See-All televisor kits are now being equipped with self-synchronizing and self-starting motors.

By this improvement, it is now unnecessary to start the motor with a spin of the hand. The television unit automatically goes into synchronization when the motor reaches 1200 r. p. m.

These improvements are exclusive with the Television Mfg. Co.'s products and were developed in their laboratory.

There is no increase in price on either the See-All televisor kits, short wave receivers or the combined unit.

Tube-Seller for Small Stores

A smaller and lower priced tube-seller for the small store has been developed by the Jewell Electrical Instrument Co., 1650 Walnut Street, Chicago, Illinois.

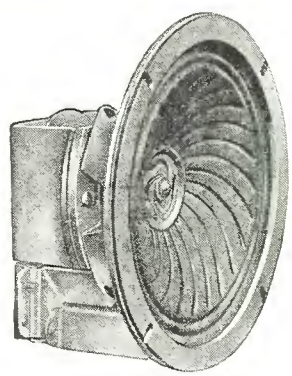
The pattern 533 tube-seller measures tube value on a three-color scale similar to that used on the larger Jewell tube-sellers. Indications are direct in terms easily understood by the customer—satisfactory, doubtful, and unsatisfactory. No reference to tables and no calculations are necessary.

A short-checker with indicating lights, line voltage indicating meter and adjustment, and separate test sockets for each type of tube, are some of the features.

Provision is made for testing—without adapters—all standard tubes, including pentodes and variable-mus in a-c and two and six volt d-c types.

Magnavox No. 150 Speaker

The latest addition to the Magnavox family of speakers is the No. 150 model shown here. This has a cone diameter of 5½ inches. The outside diameter of the cone housing is $6\frac{17}{32}$ inches and the transformer, mounted on the rear of the housing, does not protrude beyond this diameter. The mountaing holes in the housing are slotted so that the mounting hole circle may be anywhere from $5\frac{15}{16}$ inches to $6\frac{5}{32}$ inches in diameter for the hole centers.



The terminal strip is arranged to be easily accessible from directly back of the speaker and is fitted with a proper cover to guard against electrical hazards. The terminal cover is essentially flush with the level of the field coil casing, thus giving the whole assembly a neat compact appearance. The magnetic structure is of the U-type.

While designed primarily for use in four and five tube sets, it will reprodnce the low notes in the very small cabinet or baffle in which this type set us usually housed. Made by the Magnavox Co., Ltd., 155 E. Ohio St., Chicago.

NEW PRODUCTS ITEMS

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

Unified Direction Announced

E. T. Cunningham, president of the RCA Radiotron Co., Inc., and G. K. Throckmorton, president of E. T. Cunningham, Inc., have announced the unified direction of Radiotron and Cunningham sales activities, effective immediately.

In announcing these changes, Mr. Cunningham said: "During the past two years the sales divisions of E. T. Cunningham, Inc. and the RCA Radiotron Co., Inc. have been concentrating their efforts on the development of the radio tube renewal market. As a result, today hundreds of radio tube distributors and thousands of dealers are using aggressive methods for increasing their radio tube business.

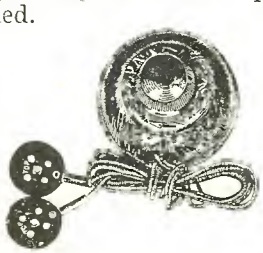
"Although we can point with pride to the change in the attitude of distributors and dealers toward the volume and profit possibilities of the radio tube market, we know that the surface of this market has only been scratched. Our experiences with test sales activities have indicated that the radio tube business of the country could be doubled by the proper application of proven sales methods. To speed up the development of this market is a problem to which we have given considerable study. The result was the recommendation, by the sales executives of RCA Radiotron Co., Inc., and E. T. Cunningham, Inc., that certain sales activity should be unified so that our combined forces would be working for the accomplishment of a common objective. It is our belief that the new sales organization will speed the application by dealers and distributors of the many fine sales development programs which we have to offer.

"The individuality of both the Radiotron and Cunningham brands will be maintained by two distinctive sales promotion programs. Distributors and dealers can look forward to the same fine degree of co-operation on sales promotion programs that they have received in the past."

Super Tone Control

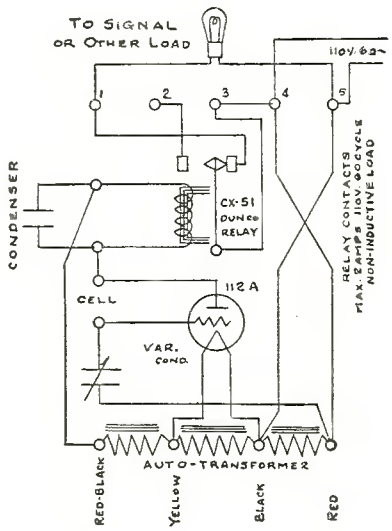
In this illustration is shown the Super Tone Control, one of the products made by the Fillermatic Mfg. Co., 4458 Frankford Ave., Philadelphia, Pa.

The device is installed in a few seconds without tools. It is inserted in the output stage where tone quality is controlled.



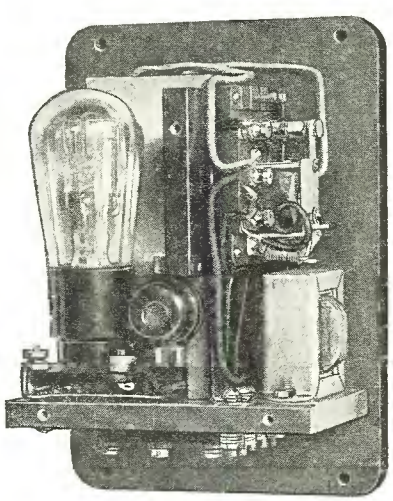
Dunco Light Sensitive Unit

The Dunco unit, whose schematic is shown here, is housed in a case 6x5x3 inches over all, having an attractive aluminum finish which in many cases matches other equipment being used. Ideal for both the amateur experimenter and the industrial user, this set is filling a long felt want for a low cost, dependable unit.



Signal operates when light cell is decreased. Hook signal to No. 2 terminal instead of terminal No. 1 if it is desired to have signal operate upon increase of light.

Adjustment at factory—operation required with a ten-watt lighted lamp placed one foot away from cell without using any reflecting device.



Standard voltage is 110 volts 60 cycles. Sets can be built to order for special voltages both a-c and d-c.

Catalog P. L. 10 available to those writing the makers, Struthers Dunn, Inc., 144 N. Juniper St., Philadelphia, Pa.

Holyoke Tennacord

The use of this cord simplifies the installation of the radio in the home through the elimination of the necessity of providing and connecting the aerial and ground wires. The salesmen or dealer can sell the prospect more quickly on a demonstration, and the results will be unaffected by most bad aerial and ground conditions. The pick-up provided by this cable is approximately equal to an equivalent length of antenna wire, and, because of the special construction of the cable, the antenna wire does not pick up the usual line noises brought in by the lamp socket connection. Besides this convenience, the appearance of the radio installation is neater, lends itself to portability of a receiver, and besides, costs comparatively little more because it substitutes for the usual line cord and the antenna and ground binding post assembly.

The copper shield is the ground for the receiver, and is connected within the receiver with the chassis frame or whatever is used for the ground point in the set. The antenna line, of course, is connected wherever the antenna is connected in the circuit. The other two wires are the a-c or house current lines. At the plug end the latter two are connected to the plug, and the shield wire is left unconnected unless the customer desires, for some reason, separate ground connection; this, however, is almost totally unnecessary because the shield forms a perfect ground in itself. The antenna wire is merely stretched along the baseboard or under the rug, or any suitable place for an inside antenna wire, or it may be connected to an outside antenna in the usual way. The unit is made by the Holyoke Co., Inc., 621 Broadway, New York City.

How Analyzers Work

A new book on radio set analyzers and how to use them, written by L. Van der Mel and published by the Gernsback Publications, Inc., 98 Park Place, New York, has just been announced.

The booklet is replete with diagrams and explanations covering operation of all types of commercial set analyzers. This information, in the hands of the service man, enables him to make the very best use of such set analyzers through absolute familiarity with their many features.

(NOTE: Do not read this advertisement unless you are interested in establishing yourself in a permanent, attraetive position.)

Hundreds of Men Have Asked Us —But We Want YOU!

THINK BACK

Fifty years ago the safety razor was unknown.
Twenty-five years ago radio broadcasting was unknown.
Ten years ago iceless refrigeration for the masses seemed an idle dream.
A year ago a time switch for home use was unheard of!

Be a MARK-TIME *Control Specialist*

A Brand New Profession Calling for the Training You May Already Have!

THINK AHEAD

History repeats itself. Three years from now—how many of the 20,000,000 wired homes in America will be using Mark-Time Switches? And who will be reaping the benefit? Will it be you? Send the coupon below today if you think you can qualify as a Mark-Time Control Specialist.

TRADE THE MARK MARK-TIME SWITCH

MARK-TIME *Is a Magic Servant*

It controls lighting, appliances and other electrically operated equipment automatically. It turns ON. It turns OFF. Set it and forget about it. Lights will turn on when they are needed and shut off before they become a needless expense. Forgotten appliances will cease to be a fire hazard. Percolators, toasters, flat irons, curling irons, grills, heaters, fans, warming pads, sun lamps, oil burners and ventilators—all of these will work as long as they wanted to but no longer. Radios will automatically turn on at a favorite program or turn off after they have played you to sleep. Various models of Mark-Time Switches provide timing intervals from as short as 15 seconds to as long as 12 hours. Wall switches are easily installed. List prices of portable and receptacle models range from $2.50 to $9.50. And MARK-TIME costs nothing to run.

Ever since the Mark-Time Switch was first put on the market, we have been literally besieged by direct selling organizations and individual canvassers. All of them realize the sales possibilities of the Mark-Time Switch. All of them have wanted us to allow them to sell it.

But we don't want them all.

We want only men of a special type and a more stable background—men who are not merely canvassers—men who have had the experience and training that we feel *you* have acquired.

The successful Mark-Time Control Specialist will be the man who has a talent for salesmanship and, in addition, the following: a practical knowledge of electricity, familiarity with appliances of all kinds and an understanding of electrical wiring regulations. His will be a profession that is dignified, interesting and unlimited in opportunity. He will have a recognized place in the community, and he will be given a generous territory right where he lives.

You too will agree that the sales opportunities of Mark-Time are tremendous. But do not be misled by your own enthusiasm. Mark-Time is destined to be a money maker for everyone connected with it, but hard work is required even though there is no competition and this new invention sells practically on sight. You can share in the fortunes it will create if you are the right man—and if you develop your opportunities with intelligence and patience.

When you have decided that you are fitted to be the Mark-Time Control Specialist in your community, fill out and mail the coupon below. But do not delay!

M. H. RHODES, Inc.
American-Industrial Building
Hartford, Conn.

From your description of the necessary qualifications, I believe that I would be a successful Mark-Time Control Specialist.

Please write me in detail about the opportunities that this new profession offers.

Name .....

Street .....

City ..... *State* .....

Train *with* R.T.A. *for* Radio *Service* Work

Important and far-reaching developments in Radio create sudden demand for specially equipped and specially trained Radio Service Men.

This excellent set analyzer and trouble shooter included with our course of training

MANY skilled Radio Service Men are needed now to service all-electric sets. By becoming a certified R. T. A. Service Man, you can make big money, full time or spare time, and fit yourself for the big-pay opportunities that Radio offers.

We will quickly give you the training you need to qualify as a Radio service man . . . certify you . . . furnish you with a marvelous Radio Set Analyzer. This wonder instrument, together with our training, will enable you to compete successfully with experts who have been in the radio business for years. With its help you can quickly diagnose any ailing Radio set. The training we give you will enable you to make necessary analysis and repairs. Serving as a "radio doctor" with this Radio Set Analyzer is but one of the many easy ways by which we help you make money out of Radio. Wiring rooms for Radio, installing and servicing sets for dealers, building and installing automobile Radio sets, constructing and installing short wave receivers . . . those are a few of the other ways in which our members are cashing in on Radio.

As a member of the Radio Training Association, you receive personal instruction from skilled Radio Engineers. Upon completion of the training, they will advise you personally on any problems which arise in your work. The Association will help you make money in your spare time, increase your pay, or start you in business. The easiest, quickest, best-paying way for you to get into Radio is by joining the Radio Training Association.

This amazing Radio Set Analyzer plus the instructions given you by the Association will transform you into an expert quickly. With it, you can locate troubles in all types of sets, test circuits, measure resistance and condenser capacities, detect defective tubes. Knowing how to make repairs is easy: knowing what the trouble is requires expert knowledge and a Radio Set Analyzer. With this Radio Set Analyzer, you will be able to give expert service and make big money. Possessing this set analyzer and knowing how to use it will be but one of the benefits that will be yours as a member of the R. T. A.

Write for No-Cost Membership Plan

Fill Out and Mail Today!

RADIO TRAINING ASSOCIATION OF AMERICA,
Dept. RCB-1, 4513 Ravenswood Ave., Chicago, Ill.

Gentlemen: Send me details of your No-Cost Membership Enrollment Plan and information on how to learn to make real money in radio quick.

Name .....

Address .....

City .....State .....

We have worked out a plan whereby a membership enrollment need not cost you a cent. Our thorough training and the valuable Radio set analyzer can be yours. Write at once and find out how easily both of these can be earned.

Now is the time to prepare to be a Radio Service Man. Greater opportunities are opening up right along. For the sake of extra money in your spare time, bigger pay, a business of your own, a position with a future, get in touch with the Radio Training Association of America now.

Send for this No-Cost Membership Plan and Free Radio Handbook that will open your eyes as to what Radio has in store for the ambitious man. Don't wait. Do it now.

RADIO TRAINING ASSOCIATION OF AMERICA

Dept. RCB-1 4513 Ravenswood Ave. Chicago, Ill.

THORDARSDN TRANSFDRMERS—LATEST TYPE

Plate Supply Transformers. All Fully Mounted

T-2008—1100 c. t. and two 7½ volt c. t. fil. windings, special..... $ 7.00
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T-2385—550 and 750 volts each side of c. t. List $16.50, net price..... 9.25
T-2387—1000 and 1500 volts each side of center tap, special..... 12.70
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T-2230—One 7½ volt c. t. fil., winding 35 watts, special..... 4.25
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T-2383—12 volts center tapped 175 watts, special..... 8.75
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Thordarson Microphone Transformers.

T-2357—Single button to match all microphones, special..... 2.35
T-3180—Double button microphone transformer of highest quality obtainable for use with Western Electric, Kellogg and other high grade mikes, special..... 8.75

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T-3475—Line to tube, special..... 7.50
T-3476—Line to line, special..... 7.50

Thordarson Choke Coils for Xmitter, etc.

T-2376—Key click choke, 1½ henry, 200 mill., special..... 2.95
R-196 —30 henry, 80 mill..... 2.35
T-2071—30 henry, 150 mill., 3000 volt, ins..... 8.25
T-2027—30 henry, 300 mill., 3000 volt, ins..... 10.75
T-2073—30 henry, 500 mill, 3000 volt, ins..... 11.85
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Arsco U.X. 852 sockets..... 1.35
Slightly used 860's..... 22.00
One only, new U.X. 851 tube, guar..... 250.00
Used U.X. 851 tube, guar..... 125.00
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Zenith 30 henry, 85 mill. choke..... .89
Receiver type R.F. chokes, unmounted..... .25
Kodel microphone cases, unassembled..... 2.25
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Assorted pigtail resistors, all sizes in stock, dozen..... 1.00
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Flechtheim 2 mfd. 1500 volt trans., cond. pigtail leads..... 4.00
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Hardwick-Hindle 10,000 ohm 60 watt trans., grid leak resistor..... .60
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G.E. oil immersed, 40-45 mfd., 2000 volt working voltage..... 20.00
Arsco new U.X. 866's, guaranteed 1000 hours..... 3.35
Arsco fil. transformer, wire leads, two 7½ c. t. 2½ amps windings and 1½ and 2½ fil. windings, special..... 3.00
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Arsco calibrated wave meters..... 6.25
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Arsco 50 watt sockets..... .95
Arsco 75 watt sockets..... 1.35
Arsco 204-A sockets..... 1.95
Arsco sockets for 212-A or D tubes..... 3.50
Arsco 2 mfd. 1000 volt condensers..... .70
Arsco 3½ mfd. 1000 volt condensers..... .90
Arsco 4 mfd. 1000 volt condensers..... 1.00
Arsco 2 mfd. 1150 volt, sealed in fiber box. Beautiful job..... 1.50
Arsco 4 mfd. 1250 volt oil impregnated condensers, working voltage..... 3.25

600 Volt		800 Volt	
1 mfd.	$0.20	1 mfd.	.30
2 mfd.	.25	2 mfd.	.40
3½ mfd.	.35	3½ mfd.	.50
4 mfd.	.40	4 mfd.	.60

Above condensers all unmounted but sealed in paraffin. Sturdy leads.

Arsco 1 mfd. 3500 volt transmitting filter condensers..... 9.50
Arsco 2 mfd. 3500 volt transmitting filter condensers..... 14.00
Arsco 1 mfd. 3000 volt transmitting filter condensers..... 8.50
Arsco 2 mfd. 3000 volt transmitting filter condensers..... 12.50
Arsco 4 mfd. 2000 volt transmitting filter condensers..... 9.50
Arsco 8 mfd. 2000 volt transmitting condensers..... 12.50
Arsco 16 mfd. tapped at 8 mfd. 1250 volts D.C..... 8.50
Arsco 1 mfd. 1500 volt condensers..... 2.00
Arsco 2 mfd. 1500 volt condensers..... 3.50
Arsco 4 mfd. 1500 volt condensers..... 5.75

All above transmitting condensers are working voltage. Arsco high voltage condensers guaranteed unconditionally one year.

Universal Microphones, Model BB..... 14.50
Universal Microphones, Model KK..... 28.00
Universal Microphones, Model LL..... 40.00
Universal Baby Mikes, Q.R.Q..... 2.85
Universal Baby Mikes with switch, 25 ft. cord..... 4.35
Universal handi-mikes—single button..... 5.85
Universale handi-mikes—double button..... 8.85

Samson Pam Amplifiers, New and in Original Cartons

Pam 19-20 uses two 281, two U.X. 250, two U.Y. 227. List $175, net price..... 59.50
Pam 16-17 uses one 281, two 210, one 227. List $125, net..... $49.50
Genuine R.C.A. U.X. 852 tubes, new orig. carton..... 25.00
G.E. five watt 1162 navy tubes..... .50
U.X. 230 or 231 non-microphonic R.C.A. licensed tubes..... .90
U.X. 232 screen grid tubes..... 1.25
Baldwin type G phones. List $12.00, net price..... 4.95
Flechtheim 4 mfd. 1500 volt porc. ins. condensers..... 7.00
Tested and functioning, not guar., 250 tubes..... .95
U.X. or U.Y. sockets, each..... .12
Crystal blanks, finished and oscillating..... 2.75
Crystal blanks, unfinished..... 1.75
Crystals, specify anywhere in the 80 meter band, guar. to oscillate..... 4.75
Sangamo .00025, .0005, .002, .001, 5000 volt condenser..... 1.12
Enameled aerial wire No. 12, 100 ft., solid..... .90
Enameled aerial wire No. 12, 200 ft., solid..... 1.65

Stand-off insulators, similar to General Radio, each $0.10; dozen, this month only, for..... $0.75

The National A.C. short wave five. List $79.50, net..... $46.00
National power pack for same. List $34.50, net..... 19.65
Factory wiring, net..... 5.75
The above set, when ordered complete with power pack, wired and assembled for.. 70.00
The National D.C. short wave five, kit form..... 42.25
Wired and assembled for, extra..... 5.75
Slightly used R.C.A. 204-A's, each..... 50.00
Slightly used R.C.A. U.V. 211..... 17.00
Slightly used W.E. 211-E in original cartons..... 15.00
Weston 0-50 mills. D.C..... 4.00
Weston new 0-150 volts A.C. meter, original cartons..... 5.00
Mercury vapor R-4 for high power rectobulbs, prepaid..... 18.75
New type R-3 rectobulbs, each..... 6.95
New type R-81 rectobulbs, each..... 3.50
R.C.A. two henry 300 mill. 20 ohm key click and filter chokes; weight 14 pounds, special..... 1.75
R.C.A. licensed 233 D.C. pentode..... 1.65
R.C.A. licensed 247 A.C. pentode..... 1.14
1 Used A.C. Pilot super wasp with band spread..... 34.50
Genuine National .0005 23-plate var. condensers. List $5.00..... 1.65
R.C.A. U.X. 210 new, original cartons..... 4.00
R.C.A. U.X. 250 new, original cartons..... 3.40
Genuine DeForest 510 tubes..... 5.20
New CeCo 866 tubes, unconditionally guar..... 4.35
R.C.A. U.X. 240 hi-mu tube, new..... 1.00
G.E. oil immersed filter condensers, unconditionally guaranteed six months, slightly used.
.2 mfd. 20,000 volt, 2 mfd. 4000 volt, 3 mfd. 3500 volt, 5 mfd. 3300 volt, special, each..... 20.00
20-40-80 meter band spread coils for National sets, per set..... 3.75
National precision dials, type N..... 3.75
R.C.A. U.X. 232 tube..... 1.38
Cardwell .00023 mfd. 3000 volt variable condensers..... 3.25
Teleplex with three tapes..... 13.00
Crosley double chokes, 175 mills..... 1.75
Aerovox 8 mfd. 500 volt dry elect. condensers..... 1.18
Victor A.B.C. power transformers for that November, 1930, transmitter..... 2.45
Monitor cans, 5x6x7, drilled with removable cover..... 1.20
Latest Ward-Leonard transmitting grid leaks for 210, 211, 203-A, 10,000 ohm..... .90
Ward-Leonard No. 507-51 for U.V. 204-A..... 2.70
Ward-Leonard No. 507-37 grid leak for U.X. 852 tube..... .96
Ward-Leonard No. 507-68 grid leak for U.X. 245..... 1.20
Aerovox .004 midget fixed condensers..... .27
Cardwell midway 105 mmfd. type 404-B..... 1.40
Cardwell 15 mmfd. balanced midget condensers..... .75
New U.X. 860 tubes—R.C.A. 29.00
Dongan power transformer, 3 volt C. T., 10 volt C. T., and one ten volt and one twenty volt winding not c. t. 1000 volt 300 watt rating..... 5.95
Sprague 8 mfd. single anode electrolytic condensers, new type inverted..... 1.00
Microphone Stands. Adjustable floor model, brass parts adjustable to 78 inches. Statuary bronze finish..... 7.00
R.C.A. U.X. 874 voltage regulator tube, special..... 2.75
Dubilier .00025, .0005, .0001, .002 fixed condensers..... .20
Pilot or Silver-Marshall coil forms, each..... .39
National S-101 screen grid couplers..... 3.25
Thordarson 30 henry 250 mill. filter choke, 104 ohms resistance, mfrs. model insulated 2000 volts..... 3.75
Arborphone A.C. amplifier, two units power pack with binding post strip; uses one 227 ahead of two 171-A push-pull. Beautiful job, idcal for speech amplifiers, a pair..... 7.00
Signal sematic bug, special..... 10.25
Gold Seal 227 tubes, first quality, special for four..... 1.50
R.E.L. transmitting inductances for 20-40-80 meter, specify band wanted, each.... 3.50
Electrad large 50,000 ohm bleeder, 45 mill., 100 watt. List $5.50, net..... 3.50
Weston A.C. operated new precision type microfarad meter. List $150. Model No. 372 calibrated in .1 mfd. scale reads to 1.5 mfd., special price..... 65.00
New Jewell 0-1 milliammeter, new type bakelite case..... 6.65
New Jewell 0-1½ mills..... 6.25
New Jewell 0-2 mills..... 5.85
Crystals, anywhere in 160 meter band, guar..... 5.00

Aluminum Panels, No. 14 Gauge

7x10, net	$0.50	8x14	.75
7x14 inches	.66	8x18	.92
7x18	.82	8x24	1.20
7x24	1.06	24x72	10.00
8x10	.57	Special sizes cut to order.	

Double slot corner strip, 2 ft. for..... .35
Aluminum cabinets made to order.

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INCLUDE PDSTAGE WITH ALL ORDERS AND 20% DEPDSIT AGAINST C.D.D. SHIPMENTS
VISIT UNCLE DAVE'S NEW RADID SHACK WHEN IN TDWN. GDDD TIME ASSURED, hi! Four Story Building with over 35,000 square feet of space, devoted to nothing but parts. For Goodness sake, what do you need? We sure got "it."—What have you for sale or trade? WANTED: USED TELEPLEXES AND DMNIGRAPHS.
WE CARRY EVERYTHING FDR THE HAM IN STDCK MORE FDREIGN TRADE SDLICITATED

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ALBANY, NEW YORK

Phone 4-5746

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

OF RADIO CALL BOOK MAGAZINE AND TECHNICAL REVIEW, published monthly at Chicago, Illinois, for October 1, 1931. State of Illinois, County of Cook, ss.

Before me, a notary public in and for the state and county aforesaid, personally appeared F. A. Hill, who, having been duly sworn according to law, deposes and says that he is the Editor of the 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, Citizens Radio Service Bureau, 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 1 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 copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is (this information is required from daily publications only).

F. A. HILL,
Editor.

Sworn to and subscribed before me this 25th day of September, 1931.

FRANK W. McVICKER, Notary Public.

(My commission expires December 1st, 1931.)

INDEX TO ADVERTISERS

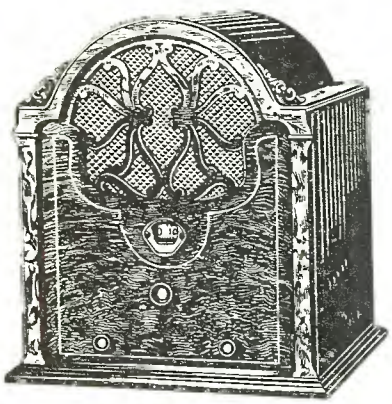
HOWARD

with its 10 Years of Solid, Substantial, and Continuous Growth Now Offers You the Finest Sales Opportunity in Howard History

TWO NEW ITEMS

A SHORT AND LONG WAVE RECEIVER the snap of a switch changes the tuning from one band to another—it works!

A SHORT WAVE CONVERTER with built-in power supply—the only connections to make to a standard receiver are to the antenna and ground.



No. 20. Compact Model

$69.50 Including 7 Tubes
Triple Variable-Mu and Pentode

New Superheterodyne circuit with Special Howard Dynamic Speaker and Tone Control. Artistic Walnut Compact Cabinet, 17½ in. high, 14⅞ in. wide and 11½ in. deep. Tubes employed: 2—27's; 1—80; 3—51's Variable-Mu; and 1—47 Pentode.

No. 40. Console Model

$119.50 Including 8 Tubes
Triple Variable Mu and Double Pentode

New Superheterodyne circuit with Special Howard Dynamic 12-inch Speaker and Tone Control. Exquisite Walnut Console Cabinet 39½ in. high, 22½ in. wide and 16¾ in. deep. Tubes employed: 2—27's; 1—80; 3—51's Variable Mu; and 2—47's Pentodes.

YOUR 1931-1932 radio season is destined for greater selling activity than Howard has ever before made possible. Howard has, since 1921, accomplished the unusual in radio quality. This long Howard experience, ability, and success has led to the present 1931-1932 line. Our latest receiver attainments are outstanding. Present favorable customer comment promises lively sales and dependable profit. We now offer you the highest Howard quality at the lowest prices in our ten years of receiver design and production. Howard has established a very fine name in the radio world—likewise have its dealers—now dealers can carry on with that name Howard behind them and a new Howard line that's bound to produce greater net profits than ever before.

HOWARD RADIO COMPANY

Factory and General Offices

SOUTH HAVEN MICHIGAN

THE 1931-1932 HOWARD LINE

No. 10, Compact Model, TRF Circuit, with 5 tubes, complete.....	$ 39.50
No. 20, Compact Model, Superheterodyne, with 7 tubes, complete....	69.50
No. 32, Console Model, Superheterodyne, with 7 tubes, complete....	79.50
No. 35, Console Model, Superheterodyne, with 8 tubes, complete....	99.50
No. 40, Console Model, Superheterodyne, with 8 tubes, complete....	119.50
No. 45, Console Model, Superheterodyne, with Automatic Volume Control and 9 tubes, complete.....	129.50
No. 60, Combination Model, Superheterodyne, with Automatic Volume Control, Automatic Record Changing Device, and 9 tubes, complete....	259.50

We are ready now to give you complete details on the new Howard line. It is well to remember that Howard has never entered into a program of over production. All models represent the latest developments in Radio Engineering in the scientific employment of the Pentode and Variable-Mu tubes.

No. 60. Combination Model

$259.50 Including 9 Tubes
Triple Variable-Mu and Double Pentode

New Superheterodyne circuit with Automatic Volume Control, Special 12-inch Howard Dynamic Speaker, Tone Control and automatic phonograph record changing device. Walnut Console Cabinet, 44 in. high, 30 in. wide and 16¾ in. deep. Tubes employed: 3—27's; 1—80; 3—51's Variable-Mu; and 2—47's Pentodes.

Can You Service Every Se Accurately • Quickly • Profitably?

These two Jewell Service Instruments provide Every facility for servicing all modern receivers

The Pattern 444 Set Analyzer

1. Tests easily, quickly every circuit in all receivers. Direct tests of all variable-mu and pentode circuits.

2. Accurately tests all types of A.C. and D.C. tubes under actual working conditions.

3. Any socket test requires setting of but a single switch.

4. Self-contained triple-range output meter.

5. Self-contained triple-range ohmmeter with battery compensator adjustment located on instrument panel.

6. Twenty-four instrument ranges for use with test leads.

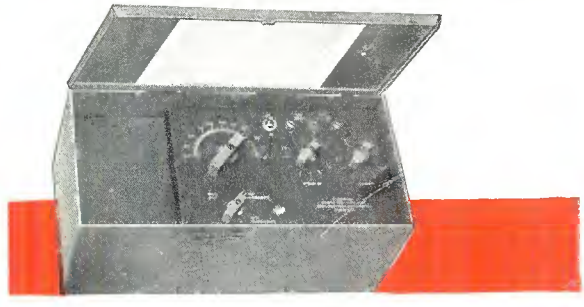
7. Test leads connect to pinjacks molded in panel. All binding posts are eliminated.

8. Complete meter ranges for accurately measuring all receiver voltages and currents.

9. Socket test cord is instantly removable at the panel.

Price to Servicemen.....$84.00

The Pattern 563 Oscillator



Output adjustable to any frequency in the broadcast band from 550 to 1,500 K. C., and in the two intermediate bands of 125 to 135 K. C. and 175 to 450 K. C.

Completely shielded. Metal carrying case and panel form effective shield. The radio frequency coils are separately shielded from rest of the unit.

Operates from self-contained batteries. These are carried within the case for complete shielding.

Output continuously variable from maximum to zero. A separate high output is provided for adjustments such as neutralizing.

Single control adjusts output frequency. Three-position switch allows instant change to any of the three frequency bands.

Calibration curve for each wave band carried in the cover.

Filament rheostat and tapped "A" battery provide proper filament voltage for tube at all times and greatly increase the life of the battery.

Trimmer adjustment permits spotting any much used intermediate frequency at a convenient point on the dial.

Completely equipped with shielded output lead, calibration curves, instruction chart, '30 type tube, and batteries.

Jewell Pattern 563 Oscillator, including tube and batteries, Price to Servicemen.....$35.63

Jewell Pattern 559 Output Meter. Price to Servicemen. $15.00

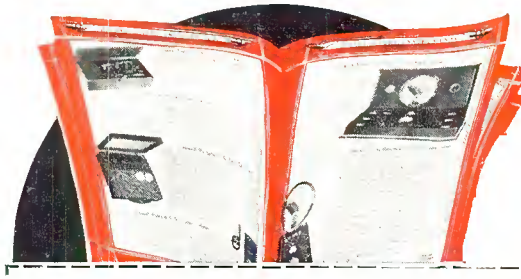
31 YEARS MAKING GOOD INSTRUMENTS

JEWELL

Get the Complete Jewell Radio Instrument Catalog

Every serviceman should have this new catalog, containing the most complete line of radio test equipment ever offered.

Write for your copy today and learn what remarkable equipment is now available to speed and simplify radio work. Find how your store can add to its profits by developing the lucrative tube replacement field through new store and home selling methods.



Jewell Electrical Instrument Co.
1612-G Walnut St., Chicago, Ill.

Please send me the new Jewell Radio Instrument Catalog.

Name.....

Address.....

City.....State.....

$59.95 LIST PRICE

COMPLETE WITH TUBES

A full-size 8-tube super in a full-size heavy walnut console. It is an unbeatable item for dealers.

Proven Radio's Great Value

These receivers are being sold in huge quantities by the biggest stores in the country. And in each case, it has been the biggest "buy" in the city.

You can have it, too—to sell at the same price.

It is a "hot" full-size 8-tube superhet with Vario-Mu tubes and a Pentode power tube.

Sensitivity ranges from 0.8 to 1.2 microvolts per meter, which with average atmospheric conditions, will bring in a station on practically every channel over the entire range.

Selectivity is absolute 10KC by Call Book curves, allowing all stations to be received without interference from nearby channels.

Output, due to the power pentode tube, is over three watts.

The fidelity, with the use of the tone control, can be varied from a flat response curve of fifty to four thousand cycles, to either a predominance of the bass responses and cut-off of the high frequency or a predominance of the high frequencies with the bass response in the background.

Tubes: 3-'51, 1-'24, 2-'27, 1-'47, 1-'80.

Speaker is a 10 1/2" Jensen electro-dynamic.

Tubes are Eveready Raytheans.

Cabinet is a handsome full-size walnut console, actually 42 inches high.

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