CITIZENS

Radio Call Book Magazine

N.S.E.

and TECHNICAL REVIEW

50¢

FALL EDITION

SERVICE - REPAIR - ENGINEERING

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

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

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

Special Attention to Radio Service Work

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

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

Expert Supervision Lifelong Consultation Service

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

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

Mail Coupon for *No-Cost* Training Offer

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

Radio Training Association of America
Dept. RCB-9, 4513 Ravenswood Ave., Chicago, Ill.

Fill Out and Mail Today!

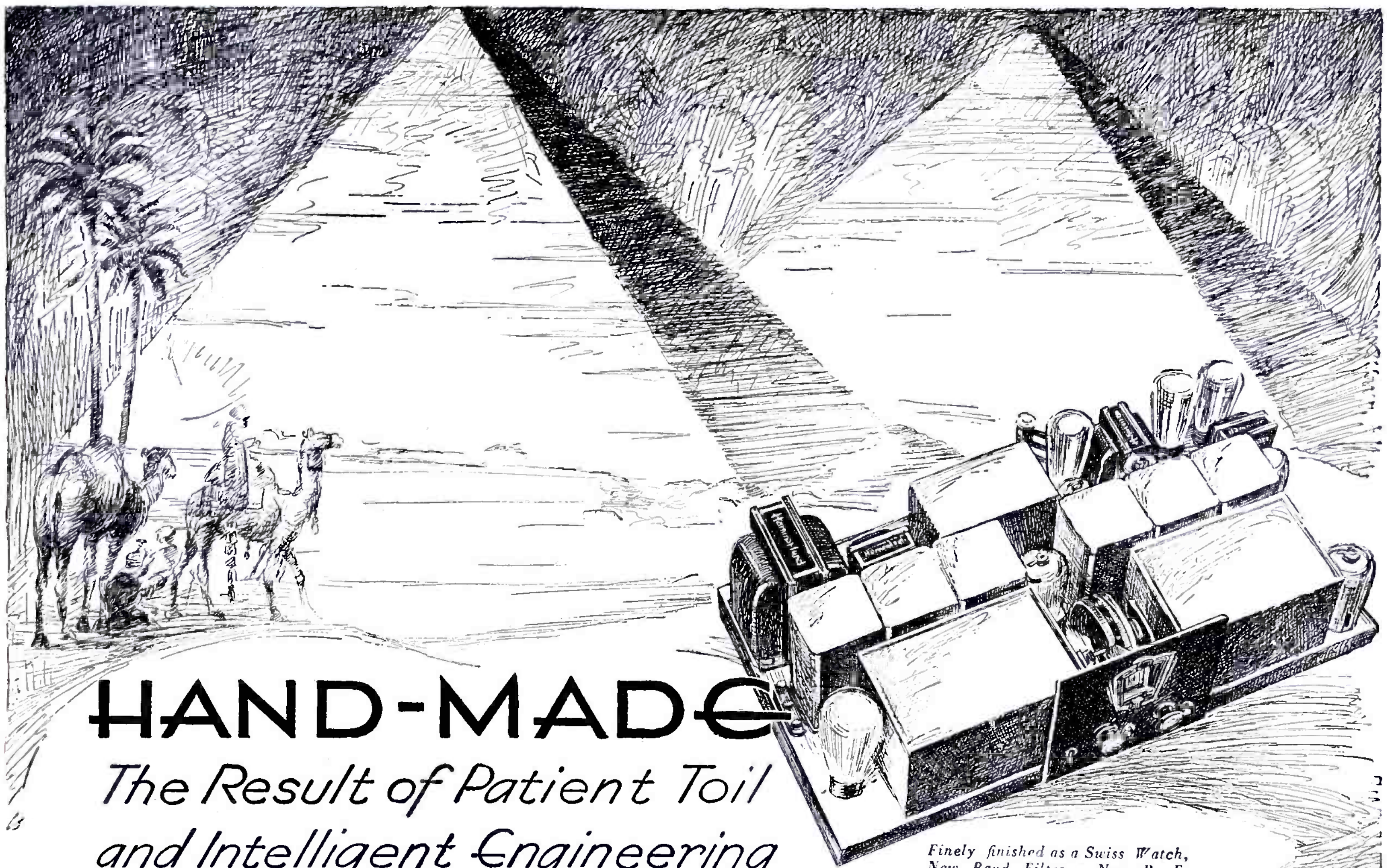
RADIO TRAINING ASSOCIATION OF AMERICA
Dept. RCB-9, 4513 Ravenswood Ave., Chicago, Ill.

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

Name ....

Address ....

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



HAND-MADE

The Result of Patient Toil and Intelligent Engineering

Finely finished as a Swiss Watch, New Band Filter - New R. F. Amplifier - New Detector System - New Power Supply - New Audio Amplifier - New Tone Control, with Noise Filter - New Volume Control - New Phonograph Hook-up - Amazingly Selective - Thrilling in Performance.

History records no greater engineering feat than the building of the Pyramids—tombs of ancient kings—towering through the ages, majestic monuments to human ingenuity, persistence and thoroughness.

Radio, too, has its noble achievements—its testimonials to the skill and purposefulness of its pioneers.

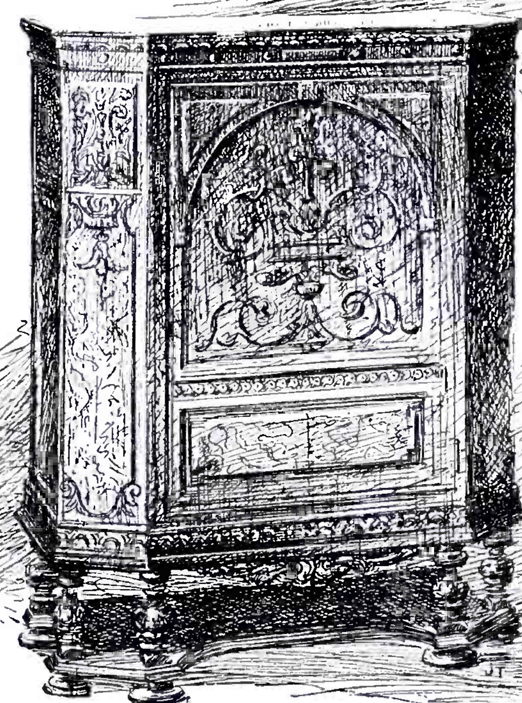
For six years, Hammarlund Receivers have stood in the forefront of radio. They have embodied the very essence of all that is good in design and performance.

Adjectives may describe, but only by seeing, hearing and operating the new Hammarlund HiQ-31 Receiver can you accurately gauge its superiority over anything the radio world has as yet presented.

Custom-built, of course, as all really fine things must be, it appeals to those who appreciate quality.

Whatever your interest in radio—as designer, builder or buyer—you will welcome a copy of the 48-page HiQ-31 Manual, Profusely illustrated and containing a 12-page gravure insert of cabinet designs, it tells the complete HiQ-31 story. Mailed postpaid, upon receipt of 25 cents (stamps or coin).

HAMMARLUND-ROBERTS, INC.
Dept. CB-9, 424-438 West 33rd St., New York



Cabinets of Rare Distinction and Acoustical Accuracy. Radio and Radio-Phonograph Combinations—styled and priced for the needs of cottage or castle.

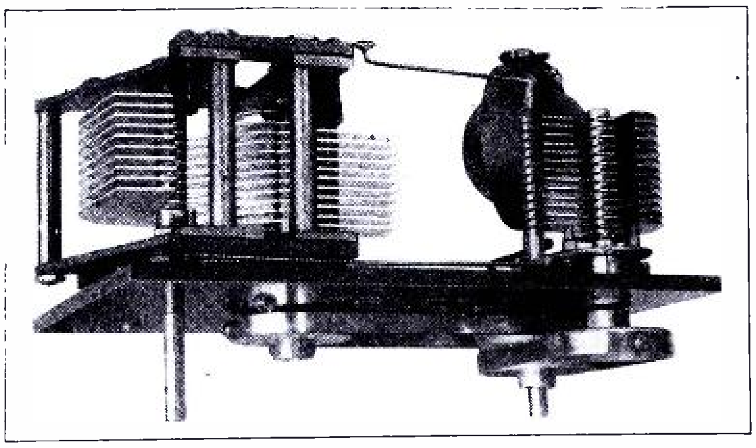
HiQ-31

Custom-Built Radio by HAMMARLUND

AERO AUTOMATIC TUNER

(Protected by Patents Pending)

Revolutionizes Short-Wave Reception



DESIGNED BY HOFFMAN & MIX

Internationally Famous Short-Wave Engineers

Convenient for various Short-Wave Hookups

Price only $19.50 NET

Aero Model T-30 Automatic Tuner, Price Net....$19.50
Aero INT-L Attachment 90 to 200 Meters, Net.. 5.90

The Aerotuner makes the easiest tuning short-wave receiver known. The tuning unit consists of two controls. The right-hand control, which will be termed the shift control, and the left-hand control, the actual tuning device. In addition to these two controls it will, of course, be necessary to have a regeneration control. No plug-in coils are used in the automatic range.

For those who desire to employ it for television or the upper phone band, a special attachment may be secured.

Aerotuners may be used with any of the standard short-wave hook-ups or with the hook-ups suggested by QST or by the Citizens Radio Call Book in their article. Those who prefer to have us supply the necessary parts are urged to write us as to type of receiver desired. Foreign customers may send their remittance and entrust us with filling their orders.

EASIEST TUNING UNIT KNOWN

The tuner is operated in the following manner. As a specific example, with the right-hand dial set at nine degrees, revolving the left-hand dial through 180 degrees, you will cover from 19.1 to 22.6 meters. The next step will be to move the shift dial to 13 and tuning over 180 degrees, as before, this time covering from 21.9 to 25.7 meters. This process is continued through 180 degrees on the shift dial until you have reached the maximum automatic wave length, which is 90 meters.

You will note that the tuning dial, in the first instance, when tuned through 180 degrees, covers only 3½ meters, whereas ordinarily when using plug-in coils your tuner, when passing through 180 degrees, generally covers at a minimum of 25 meters. This same speed of tuning is maintained throughout the entire short-wave spectrum, and it is for this reason that this tuning arrangement surpasses any known method. This unit is furnished completely assembled to the amateur, and may be built into either a short-wave converter or receiver.

For those desiring to go from 90 to 200 meters a special device may be had, making its range then from 15 to 200 meters. Net price, $5.90.

A general chart is furnished with each unit, specifying the settings for the shift dial, which will enable you to approximate the wave length for each setting on the shift dial.

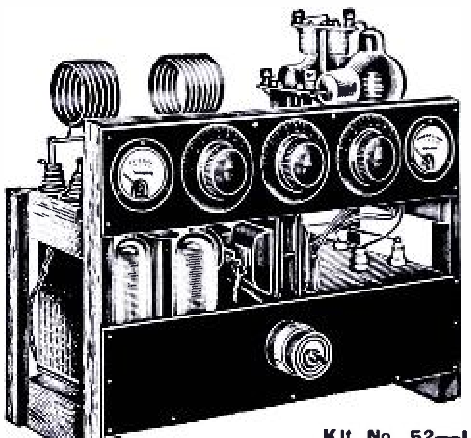
Order Direct from Our Factory

In order to make this tuner available at small cost to the public it is not sold through the usual trade channels, but is sold to amateurs and experimenters only direct from factory at special low net price. Be sure to send post office or express money order for $19.50 with your order and save up to 50% by so doing. Shipments will be made in the order received. Be first to order. Attach your money-order to coupon below and mail today—NOW!

Read These Unusual Aero Features

Automatic range of Aero tuner, 15 to 90 meters; full range, up to 200 meters. No plug-in coils used in automatic range. Easiest tuning device known. Tunes even more slowly than broadcast receiver. Special attachment enables it to reach 200 meters. Anyone can operate it. The days of fooling with plug-in coils are over. Amateurs and experimenters can now have a real short-wave thrill by this new automatic tuning device. Did you read the complete story in February QST, Radiocraft and Citizens Radio Call Book? Mail your order to Aero Products, Inc. for the complete built-up unit. Get this remarkable short-wave apparatus now. Get real satisfaction and results from short-wave radio—the biggest thriller in radio today.

OTHER AERO SHORT-WAVE EQUIPMENT



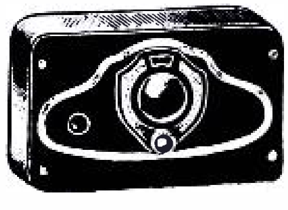
Aero High-Power Xmitter and 150-Watt Amplifier

For operation on 10-20-40-80-100M. Bands. The first high-power amplifier to use the UX-860 screen grid tubes. **New in every detail. 150 Watts of pure D.C. signals with a stability which has caused favorable remarks everywhere. Flexibility that fills every Ham need.**

Kit No. 52—Including the power supply, but not including tubes.
List Price $259.00
Kit No. 53—Less power supply and tubes.
List Price $114.00
Aero Built-up Short-Wave Sets.
D.C. Model, Complete, List......$60.00
A.C. Model, Complete, List....$125.00

Only $15

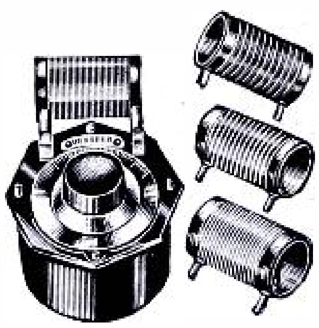
Aero Listening Monitor



Enables any amateur transmitter to check his own note, to know whether it is pure D.C. or not. It is a safe, sure and accurate way of knowing your station without depending upon the reports of others.

Model M-29 Aero Monitor, including Dry Batteries, but no tube. List Price........**$15.00**
Aero Short-Wave D.C. Converter, List Price..........$25.00
Aero A.C. Short-Wave Converter, List Price..........$25.00

Aero Wavemeter



Using the principle of the "series gap," condensers, and having a definite fixed maximum capacity, the amateur wavelength bands are spread over a great many dial divisions. The velvet vernier dial has 100 divisions, each of which may be read to one-tenth of a division.

List Price, each....**$24.00**

Aero Shield-Grid Coils
LWT-11 Kit of 3 coils (16 to 90 meters) **$11.50**
LWT-10 Kit of 3 coils. List **$10.50**

Aero Transmitting Coil Kits
2040-K—16 to 52 meter kit. List Price................**$12.00**
4080-K—36 to 90 meter kit, List Price................**$12.00**
9018-K—72 to 190 meter kit, List Price..............**$12.00**

Aero Short-Wave Kits

Send for List of Aero Short-Wave Kits

PRICE ONLY $19.50 NET

AERO PRODUCTS INCORPORATED
4611 E. Ravenswood Ave., Dept. 1060, Chicago

Dear Sirs:
I want to be one of the first to secure the new Aero Short-Wave Automatic Tuning Unit. Enclosed is money order for $19.50 which is your low opening net price to amateurs and experimenters only. (Add $5.90 extra for 90 to 200 meter attachment.)
I am also interested in the following Aero Products:

Name..

Street and No...

City and State...

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

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

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

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

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

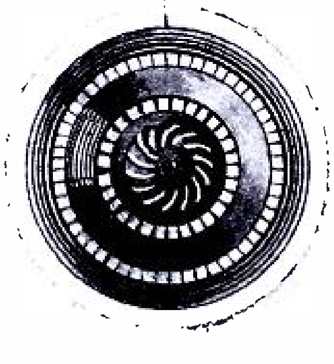
The test was made in a room in a hotel located only a few blocks away from the broadcasting station.

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

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

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

PIN-POINT SELECTIVITY IS A FEATURE OF THE NEW BRUNSWICK



Brunswick RADIO

Citizens Radio Call Book Magazine

AND TECHNICAL REVIEW

Registered in U. S. Patent Office
Established 1921

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

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PICTORIAL RADIO

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SERVICE AND REPAIR

RESPONSE CURVES

SERVICE AND REPAIR SCHEMATICS

RADIO ENGINEERING

MISCELLANEOUS INFORMATION

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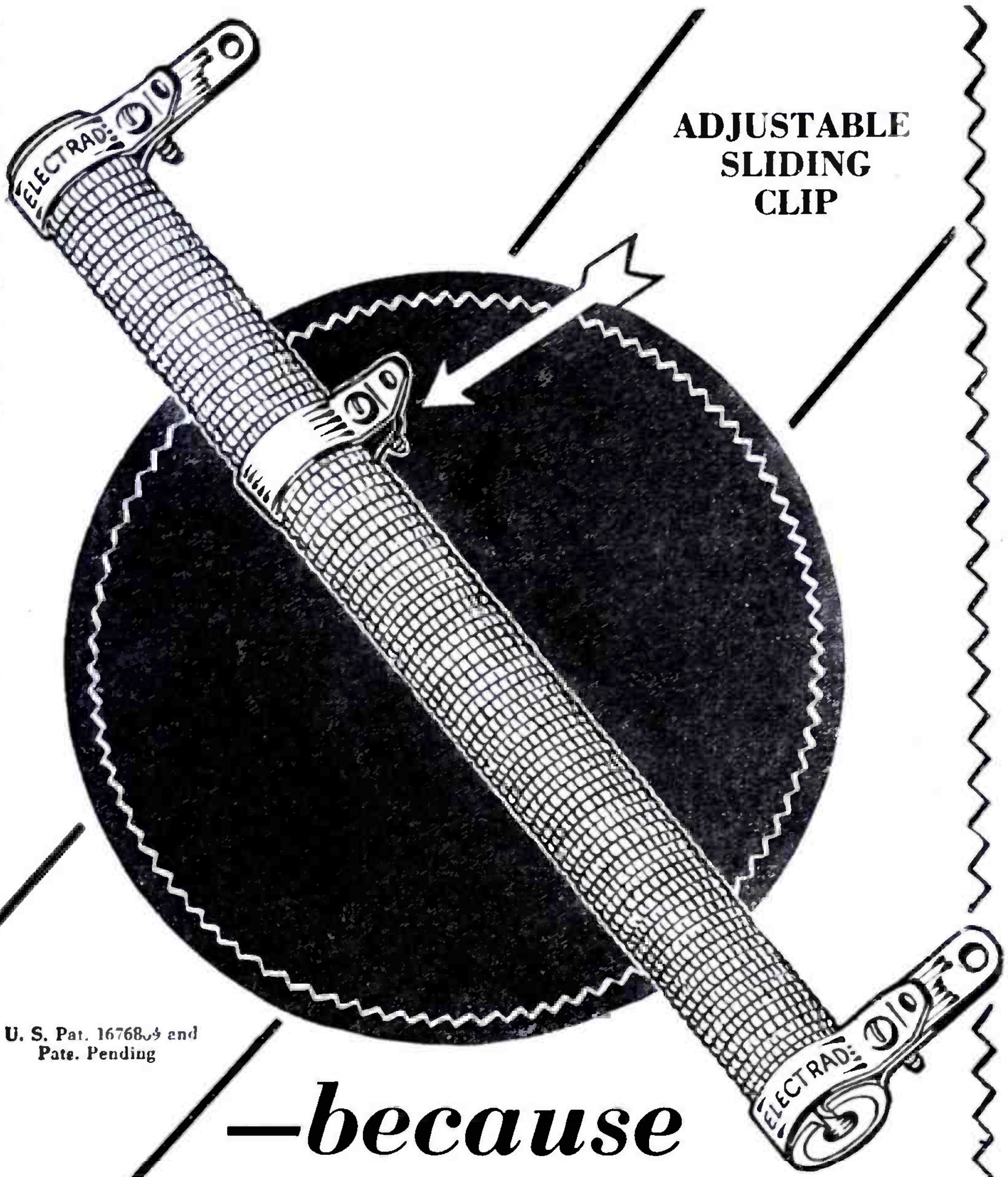
Distribution of Broadcast Chains by Cities

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



ADJUSTABLE SLIDING CLIP

U. S. Pat. 1676869 and Pats. Pending

—because they're BETTER!

ELECTRAD Resistors and Voltage Controls are moderately priced—but the big reason why you should use them is because they're *BETTER*. The superiority of the ELECTRAD Line of Resistors and Voltage Controls is no accident—it is the result of intelligent engineering, ideal facilities and long experience.

The ELECTRAD Line is a *complete* line—containing just the resistor or voltage control for every radio or power supply purpose, including Television.

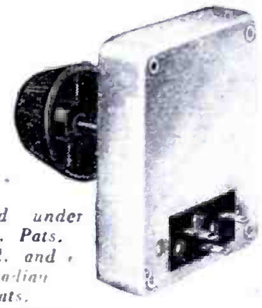
Use ELECTRAD Resistors once, and you will see why they are first choice of manufacturers, engineers, service men, custom-builders and experienced fans—men who *must* have quality when they build.

Mail Coupon for Data on Complete ELECTRAD Line

175 Varick St., New York, N.Y.

ELECTRAD
INC.

Super-TONATROL
Heavy Duty
Volume Control

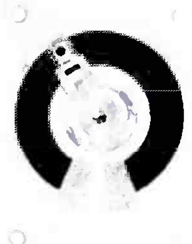


Licensed under U. S. Pats. Pend. and Canadian Pats. 281172-28677

The famous Electrad long-lived volume control built for use with the heavy currents of modern receivers. Safely dissipates 5-watts.

Special resistance element permanently fused to a vitreous enameled metal plate. Pure silver multiple contact provides delightfully smooth operation and *stepless* variation. Metal cover firmly riveted for strength. Practically immune to changes in temperature or humidity.

Made in these 7 standard types



Cover Removed Showing Resistance Element and Contact

Type No. 1. 25,000 ohm potentiometer recommended for antenna volume control.

Type No. 2. 10,000 ohm potentiometer recommended for screen grid or plate voltage volume control.

Type No. 3. 50,000 ohm rheostat recommended for R.F. grid bias control.

Type No. 4. 10,000 ohm rheostat recommended for R.F. plate voltage shunt control.

Type No. 5. 100,000 ohm potentiometer recommended for grid voltage control from secondary of audio transformer.

Type No. 6. 25,000 ohm potentiometer recommended for volume control of output from one electrical phonograph pickup.

Type No. 7. 50,000 ohm four terminal potentiometer with 25,000 ohms tapered from each side of center terminal, recommended as fader and volume control with two electrical phonograph pickups.

All above types have resistance tapers that are particularly adaptable when used in circuits recommended by us. Special resistance values and tapers can be made on order.

Types No. 1 to No. 6	$2.40
Type No. 7	$3.50

Circular on Request

ELECTRAD, INC., Dept. CB9, 175 Varick Street, New York, N. Y.
Please send ☐ TRUVOLT and Super-TONATROL Circulars.
☐ Check here for folder describing all products.
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.

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

KBTM
1200 kc, Paragould, Ark., Beard's Temple of Music, 100 w, C.

KCRC
1370 kc, Enid, Okla., Champlin Refining Co., 100 w, C.

KCRJ
1310 kc, Jerome, Ariz., C. C. Robinson. 100 w.

KDB
1500 kc, Santa Barbara, Calif., D. Faulding, 100 w, P.

KDFN
1210 kc, Casper, Wyo. D. L. Hathaway. 100 w, P.

KDKA
980 kc, Pittsburgh, Pa., Westinghouse E. & M. Co., 50,000 w, E.

KDLR
1210 kc, Devils Lake, N. D., KDLR, Inc., 100 w.

KDYL
1290 kc, Salt Lake City, Utah, Intermountain Broadcasting Corp., 1000 w, M, "On the Air, Goes Everywhere.

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

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

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

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

KFBB
1280 kc, Great Falls, Mont., Buttrey Broadcast, Inc., 1000 w, M.

KFBK
1310 kc, Sacramento, Calif., James McClatchy Co., 100 w, P.

KFBL
1370 kc, Everett, Wash., Leese Bros., 50 w, P, "The Voice of Puget Sound."

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

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

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

KFEQ
680 kc, St. Joseph, Mo., Scroggin & Co., 2500 w, C.

KFGQ
1310 kc, Boone, Iowa, Boone Biblical College. 100 w, C.

KFH
1300 kc, Wichita, Kan., Radio Station KFH Co., 1000 w, C, "Kansas' Finest Hotel, in the Very Heart of God's Country."

KFHA
1200 kc, Gunnison, Colo., Western State College of Colorado, 50 w.

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

KFIO
1120 kc, Spokane, Wash., Spokane Broadcasting Corp., 100 w day, P.

KFIU
1310 kc, Juneau, Alaska, Alaska Elec. Light & Power Co., 10 w.

KFIZ
1420 kc, Fond du Lac, Wis., Reporter Printing Co., 100 w, C.

KFJB
1200 kc, Marshalltown, Iowa, Marshall Electric Co., 100 w, C, "Marshalltown, the Heart of Iowa."

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

KFJI
1370 kc, Astoria, Ore., KFJI Broadcasters, Inc., 100 w, P.

KFJM
1370 kc, Grand Forks, N. D., University of North Dakota, 100 w, C.

KFJR
1300 kc, Portland, Ore., Ashley C. Dixon & Son, 500 w, P.

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

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

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

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

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

KFKX
See under KYW.

KFLV
1410 kc, Rockford, Ill., Rockford Broadcasters, Inc., 500 w, C.

KFLX
1370 kc, Galveston, Texas, Geo. Roy Clough, 100 w, C.

KFMX
1250 kc, Northfield, Minn., Carleton College, 1000 w, C.

KFNF
890 kc, Shenandoah, Iowa, Henry Field Seed Co., 500 w, C, "Known for Neighborly Folks."

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

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

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

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

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

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

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

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

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

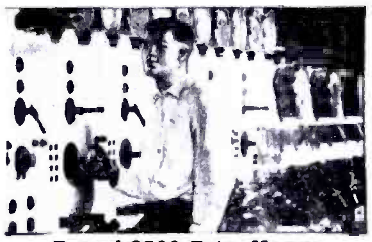
R. T. I. QUALIFIES YOU TO MAKE MONEY AND ITS SERVICE KEEPS YOU UP-TO-THE-MINUTE ON THE NEWEST DEVELOPMENTS IN RADIO, TELEVISION, AND TALKING PICTURES **R. T. I.**

GOOD JOBS *Right at Your Finger Tips*

WHEN YOU ARE R.T.I. TRAINED IN

RADIO-TELEVISION-*Talking Pictures*

R.T.I. Training Brings Big Jobs Like These!



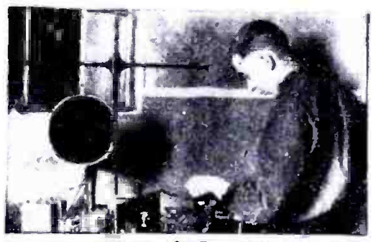
Earned $500 Extra Money in Two Months

Your radio course has enabled me to earn over $500 in two months' spare time work. Understand that this is all spare time work, as I have a permanent position with my father in our store. I give you all the credit for the above and as I said before, I wish to finish the entire course as soon as I can.—Your student, J. NOFFSINGER, Greenville, Ky. R 1, Box 37.

Salary Raised 33 1-3% Since Enrolling

You may be interested to know that I am now Radio Service Manager for the H. N. Knight Supply Co. who are distributors for Eveready Radio Receivers in the State of Oklahoma, and Texas Panhandle, with an increase in salary of about 33 1-3%, since I enrolled with your school.

Thanking you for your interest you have shown in me, and your wonderful course, I am, EARL P. GORDON, 618 East 6th St., Oklahoma City. Okla.



Makes $25 a Day

Haven't forgotten you. How could I when I make as high as $25.00 per day and have made $600.00 in two months from Radio work. That's not so bad when I'm only 19 and in a small town. I just looked over the catalog you sent me before I enrolled, and you did about all you said you would and about as much more.—FLOYD KNISELY, R. F. D. 2, Box 91, St. Joe, Ind.

BIG PAY JOBS! SPARE TIME PROFITS! A FINE BUSINESS OF YOUR OWN! They're all open to you and other live wire men who answer the call of RADIO. The fastest growing industry in the world needs more trained men. And now come Television and Talking Movies—the magic sisters of Radio. Will you answer this call? Will you get ready for a big pay job Now and step into a BIGGER ONE later on? You can do it EASILY now.

R. T. I. Home Training Puts You In This Big Money Field

Radio alone, pays over 200 MILLION DOLLARS a year in wages in Broadcasting, Manufacturing, Sales, Service, Commercial Stations and on board the big sea going ships, and many more men are needed. Television and Talking Movies open up other vast fields of money-making opportunities for ambitious men. Get into this great business that is live, new and up-to-date, where trained service men easily earn $40 to $50 per week, and trained men with experience can make $75 a week, and up.

Easy To Learn At Home—In Spare Time

Learning Radio the R. T. I. way with F. H. Schnell, the "Ace of Radio" behind you is EASY, INTERESTING, really FUN. Only a few spare hours are needed and lack of education or experience won't bother you a bit. We furnish all necessary testing and working apparatus and start you off on practical work you'll enjoy—you learn to do the jobs that pay real money and which are going begging now for want of competent men to fill them.

Amazingly Quick Results

You want to earn BIG MONEY, and you want some of it QUICK. R. T. I. "Three in One" Home Training—Radio-Television-Talking Movies—will give it to you, because it's easy, practical, and is kept right up-to-date with last minute information. In a few weeks you can be doing actual Radio work, making enough EXTRA MONEY to more than pay for your training. In a few short months you can be all through—ready to step into a good paying job or start a business of your own. A BIG JOB—BIG MONEY—A BIG FUTURE. There is no other business in the world like it.

FRED H. SCHNELL
Chief of R. T. I. Staff

Twenty years of Radio Experience. First to establish two-way amateur communication with Europe. Former Traffic Manager of American Radio Relay League. Lieut. Commander U.S.N.R. Inventor and Designer Radio Apparatus. Consultant Radio Engineer. Now in charge of R. T. I. Radio Training—and you will like his friendly manner of helping you realize your ambition.

Investigate—Send For R. T. I. Book Now

Don't waste a minute. Find out what the great Radio Industry, which has grown faster than the Automobile and Motion Picture business, has to offer you. Find out what other men are earning. SEE HOW EASILY YOU CAN GET STARTED. Get the facts about Radio, Television and the Talking Pictures, first hand, in the big R. T. I. FREE BOOK. Learn what this R. T. I. "Three in One" Home Training can do for you. Mail the Coupon for FREE BOOK NOW.

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

R. T. I. TRAINS YOU AT HOME FOR A GOOD JOB OR A PROFITABLE PART TIME OR FULL TIME BUSINESS OF YOUR OWN

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

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

KFSD
600 kc, San Diego, Calif., Airfan Radio Corp., 500 w, P.

KFSG
1120 kc, Los Angeles, Calif., Echo Park Evan. Assn., 500 w, P, "The Church of the Air."

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

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

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

KFUP
1310 kc, Denver, Colo., Fitzsimmons General Hospital, 100 w, M.

KFVD
1000 kc, Culver City, Calif., Los Angeles Broadcasting Co., 250 w, P.

KFVS
1210 kc, Cape Girardeau, Mo., Hirsch Battery & Radio Co., 100 w, C, "The City of Opportunity."

KFWB
950 kc, Hollywood, Calif., Warner Bros. Broadcasting Corp., 1000 w, P.

KFWF
1200 kc, St. Louis, Mo., St. Louis Truth Center, Inc., 100 w.

KFWI
930 kc, San Francisco, Calif., Radio Entertainments, Inc., 500 w, P.

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

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

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

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

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

KFXR
1310 kc, Oklahoma City, Okla., Exchange Avenue Baptist Church, 100 w, C.

KFXY
1420 kc, Flagstaff, Ariz., Mary M. Costigan, 100 w, M.

KFYO
1420 kc, Abilene, Texas, T. E. Kirksey, 100 w, C, "Breckenridge, the Dynamo of West Texas."

KFYR
550 kc, Bismarck, N. D., Meyer Broadcasting Co., 500 w, C.

KGA
1470 kc, Spokane, Wash., Northwest Broadcasting System, Inc., 5000 w, P.

KGAR
1370 kc, Tucson, Ariz., Tucson Motor Service Co., 100 w, M, "Way Out on the Desert."

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

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

KGBX
1310 kc, St. Joseph, Mo., Foster-Hall Tire Co., 100 w.

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

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

KGCI
1370 kc, San Antonio, Texas, Radio Sam Broadcast Co., 100 w, C, "Radio Sam at San Antonio."

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

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

KGCX
1310 kc, Wolf Point, Mont., First State Bank of Vida, 100 w, M.

KGDA
1370 kc, Mitchell, S. D., Mitchell Broadcasting Corp., 100 w, M.

KGDE
1200 kc, Fergus Falls, Minn., Jaren Drug Co., 100 w, C.

KGDM
Corp., 100 w.
1100 kc, Stockton, Calif., E. F. Peffer, 250 w.

KGDY
1200 kc, Oldham, S. D., Loesch & Wright, 15 w, C.

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

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

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

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

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

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

KGFG
1370 kc, Oklahoma City, Okla., Faith Tabernacle Assn., 100 w, C, "The Whole Gospel to the Whole World."

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

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

KGFK
1200 kc, Moorhead, Minn., Lautzenheizer Mitchell, 50 w, C.

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

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

KGFX
580 kc, Pierre, S. D., Dana McNeil, 200 w, C.

KGGC
1420 kc, San Francisco, Calif., Golden Gate Broadcasting Co., 100 w, P.

KGGF
1010 kc, Picher, Okla., Powell & Platz, 500 w.

KGGM
1230 kc, Albuquerque, N. Mex., New Mexico Broadcasting Co., 250 w.

KGHF
1320 kc, Pueblo, Colo., Ritchie & Finch, 250 w, M.

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

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

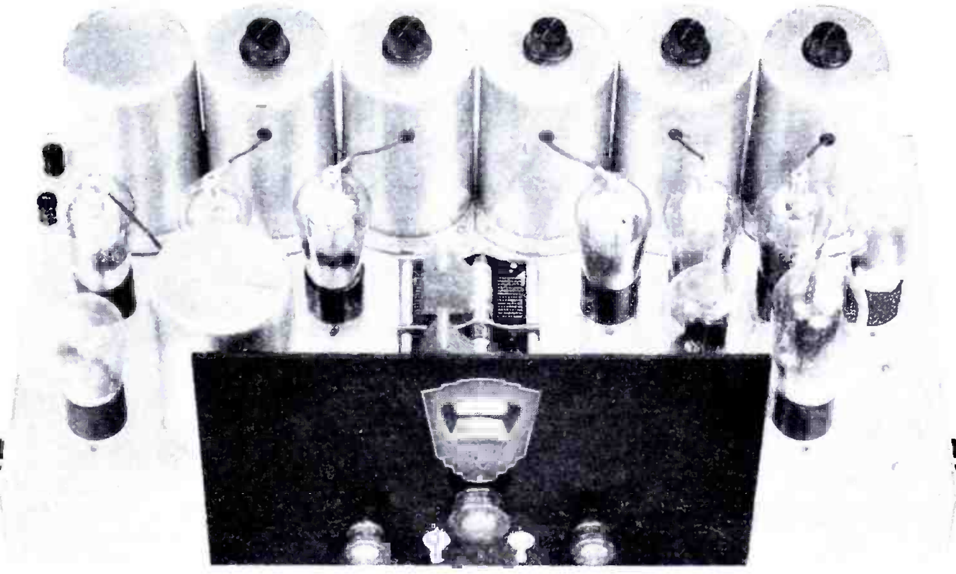
KGIQ
1320 kc, Twin Falls, Idaho, Radio Broadcasting Corp., 250 w, M.

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

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

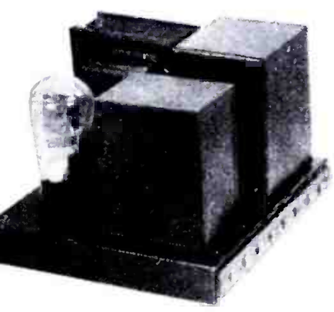
Write Your Own Menu

The New Lincoln De-Luxe 31 will "fill your order" with stations on every channel of the Broadcast Band!



VERIFIED by actual performance in the hands of hundreds of super critical radio fans
CHOSEN by many men of international fame
PROVEN by unbiased laboratory reports to give:
PERFECT REJECTIVITY ON A 10 KC BAND WITH TREMENDOUS AMPLIFICATION

SUPPLEMENTING the verified performance of the famous DE LUXE 10, the DE LUXE 31 goes another step ahead towards the goal of radio perfection. NOTHING NEW NOR REVOLUTIONARY. Lincoln equipment years ago gave amazing performance. Sound basic principles and a steady improvement in design has brought the standards of performance to a degree of perfection far in advance of any known receiver.



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

Think of over 300 verified stations received in the heart of New York City! (This amazing performance was repeatedly written up in New York papers.) Think of 700 miles reception with full volume across the Western deserts at noon, where no other receiver would perform! Think of an owner of Lincoln equipment complaining of foreign stations interfering with his reception in this country!

Six Screen Grid Tubes with high gain perfectly controlled brings signals, you have never heard before, into your home with a local volume that is simply amazing.

CAPABLE OF AMPLIFYING THE WEAKEST SIGNAL TO ANY DEGREE DESIRED WITHOUT BACKGROUND FROM ADJACENT CHANNELS
REGULATION OF FIDELITY, ELIMINATING ANY POSSIBILITY OF SIDEBAND CUTTING
SEVEN TUNED CIRCUITS PRODUCING A FILTER SYSTEM NEVER BEFORE EQUALLED
TUNED PLATE SYSTEM (originated on the Lincoln 8-80 in 1928)
CADMIUM PLATED STEEL CHASSIS WITH GENERAL REFINEMENTS THROUGHOUT

Hundreds of LINCOLN owners can show you what a small percentage of radio performance you are getting from your factory built receiver.

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

LINCOLN RADIO CORPORATION

329 SOUTH WOOD ST. — CHICAGO - ILLINOIS.

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

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

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(Print plainly)

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

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

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

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

KGKB
1500 kc, Brownwood, Tex., Eagle Publ. Co., 100 w, C.

KGKL
1370 kc. San Angelo, Tex., KGKL, Inc., 100 w, C.

KGKO
570 kc. Wichita Falls, Tex., Wichita Falls Broadcasting Co., 250 w, C.

KGKX
1420 kc, Sandpoint, Idaho, C. E. Twiss and F. H. McCann, 100 w, P.

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

KGMB
1320 kc, Honolulu, Hawaii, Honolulu Broadcasting Co., 500 w, P.

KGMP
1210 kc, Elk City, Okla., Bryant Radio & Elec. Co., 100 w, C.

KGNF
1430 kc, North Platte, Nebr., H. L. Spencer, 500 w, M.

KGNO
1210 kc, Dodge City, Kans., M. A. McCollum, M.

KGO
790 kc, San Francisco, Calif., General Electric Co., 7500 w, P.

KGRS
1410 kc, Amarillo, Texas, Gish Radio Service, 1000 w, C. Shared.

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

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

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

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

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

KICK
1420 kc, Red Oak, Iowa, Red Oak Radio Corp., 100 w.

KID
1320 kc, Idaho Falls, Ida., KID Broadcasting Co., 250 w, M.

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

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

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

KJR
970 kc, Seattle, Wash., Northwest Broadcasting System, Inc., 5000 w, P.

KLCN
1290 kc, Blytheville, Ark., C. L. Lintzenich, 50 w, C.

KLO
1400 kc, Ogden, Utah, Peery Building Co., 500 w, M.

KLPM
1420 kc, Minot, N. D., John B. Cooley, 100 w, C.

KLRA
1390 kc, Little Rock, Ark., Arkansas Broadcasting Co., 1000 w.

KLS
1440 kc, Oakland, Calif., Warner Bros., 250 w, P, "The City of Golden Opportunity."

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

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

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

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

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

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

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

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

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

KMO
860 kc, Tacoma, Wash., KMO, Inc., 500 w, P.

KMOX
1090 kc, St. Louis, Mo., Voice of St. Louis, Inc., 5000 w, C.

KMPC
710 kc, Beverly Hills, Calif., R. S. Macmillan, 500 w, P.

KMTR
570 kc, Los Angeles, Calif., KMTR Radio Corp., 500 w, P, "Your Friend in Hollywood."

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

KOA
830 kc, Denver, Colo., General Electric Co., 12,500 w, M.

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

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

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

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

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

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

KOL
1270 kc, Seattle, Wash., Seattle Broadcasting Co., 1000 w, P.

KOMO
920 kc, Seattle, Wash., Fisher's Blend Station, Inc., 1000 w, P.

KONO
1370 kc, San Antonio, Tex., Mission Broadcasting Co., 100 w, C.

KOOS
1370 kc, Marshfield, Ore., H. H. Hanseth, 50 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, "Kind Friends Come Back."

KPCB
1210 kc, Seattle, Wash., Wescoast Broadcasting Co., 100 w, P. Shared.

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

KPO

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

KPOF

880 kc. Denver, Colo., Pillar of Fire, Inc., 500 w. M.

KPPC

1210 kc, Pasadena, Calif., Pasadena Presbyterian Church, 50 w. P

KPQ

1500 kc. Wenatchee, Wash., Wescoast Broadcasting Co., 50 w. P.

KPRC

920 kc, Houston, Texas, Houston Printing Co. 1000 w., C, "Kotton Port Rail Center."

KPSN

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

KPWF

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

KQV

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

KQW

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

KRE

1370 kc, Berkeley, Calif., First Congregational Church, 100 w. P.

KREG

1500 kc, Santa Ana, Calif., Pacific Western Broadcasting Federation, 100 w, P.

KRGV

1260 kc, Harlingen, Texas, KRGV, Inc., 500 w.

KRLD

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

KRMD

1310 kc, Shreveport, La., Robert M. Dean, 50 w, C.

KROW

930 kc, Oakland, Calif., Educational Broadcasting Corp., 500 w, M.

KRSC

1120 kc, Seattle, Wash., Radio Sales Corp., 50 w P.

KSAC

580 kc, Manhattan, Kan., Kansas State Agricultural College, 500 w, C.

KSCJ

1330 kc, Sioux City, Iowa, Perkins Bros. Co., 1000 w, C.

KSD

550 kc, St. Louis, Mo., Pulitzer Pub. Co., 500 w, C.

KSEI

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

KSL

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

KSMR

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

KSO

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

KSOO

1110 kc. Sioux Falls, S. D., Sioux Falls Broadcasting Assn., 2000 w, C.

KSTP

1460 kc, St. Paul, Minn., National Battery Broadcasting Co., 10,000 w, C.

KTAB

560 kc, San Francisco, Calif., Associated Broadcasters, 1000 w, P. "Knowledge, Truth and Beauty."

KTAP

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

KTAR

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

KTAT

1240 kc, Ft. Worth, Tex., Texas Air Transport Broadcasting Co., 1000 w, C.

KTBI

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

KTBR

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

KTBS

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

KTHS

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

KTLC

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

KTM

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

KTNT

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

KTRH

1120 kc, Houston, Tex., Rice Hotel, 500 w, C.

KTSA

1290 kc, San Antonio, Texas, Lone Star Broadcast Co., 1000 w, C.

KTSL

1310 kc. Shreveport, La., Houseman Sheet Metal Works, Inc., 100 w, C.

KTSM

1310 kc. El Paso, Tex., W. S. Bledsoe and W. T. Blackwell, 100 w, C.

KTUE

1420 kc, Houston, Texas, Uhalt Electric, 100 w, C.

KTW

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

KUJ

1500 kc, Longview, Wash., Columbia Broadcasting Co., Inc., 10 w, P.

KUOA

1390 kc. Fayetteville, Ark., University of Arkansas, 1000 w, C.

KUSD

890 kc, Vermilion, S. Dak., University of South Dakota, 500 w, C.

KUT

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

KVI

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

KVL

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

KVOA

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

KVOO

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

KVOS

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

KWCR

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

KWEA

1210 kc, Shreveport, La., Hello World Broadcasting Corp., 100 w, C.

KWG

1200 kc, Stockton, Calif., Portable Wireless Tel. Co., 100 w, P.

KWJJ

1060 kc, Portland, Ore., KWJJ Broadcasting Co., Inc., 500 w, P, "The Voice from Broadway."

KWK

1350 kc, St. Louis, Mo., Greater St. Louis Broadcasting Corp., 1000 w, C.

KWKC

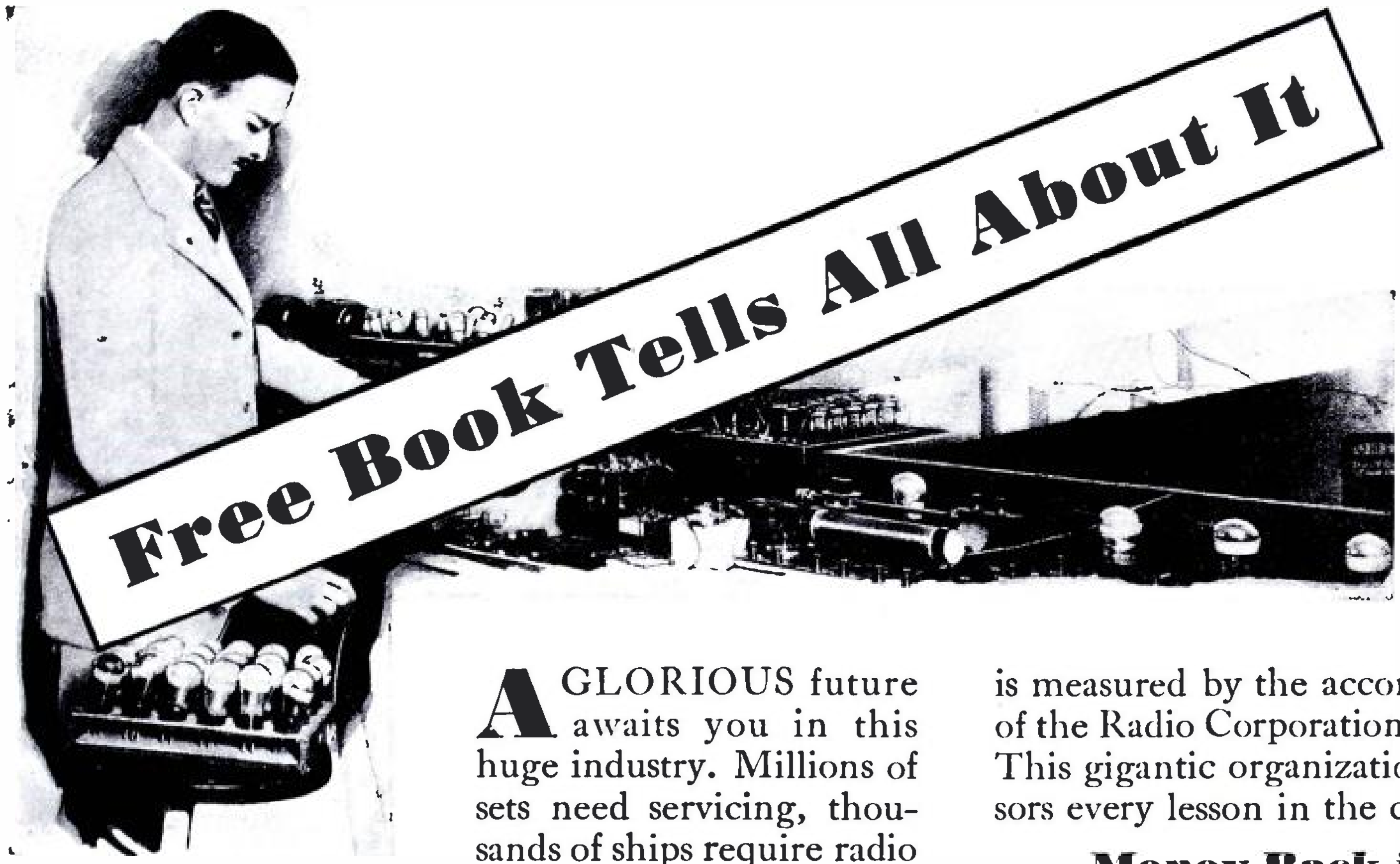
1370 kc, Kansas City, Mo., Wilson Duncan Broadcasting Co., 100 w.

KWKH

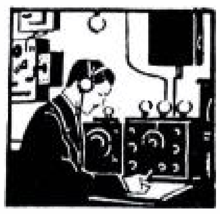
850 kc, Shreveport, La., Hello World Broadcasting Corp., 10,000 w, C.

FREE PROOF

you can make real money in RADIO



A GLORIOUS future awaits you in this huge industry. Millions of sets need servicing, thousands of ships require radio operators... manufacturers and broadcasting stations throughout the land are eagerly seeking trained men ... and now, nation-wide radio telegraph service, telephony, sound motion pictures, open up thousands of new and amazing opportunities.



Radio Operator $90—$200 per month with all expenses paid.

Broadcast Operator $1,800—$4,800 a year.

Radio Repair Mechanic $1,800—$4,000 a year.

Radio Inspector $2,000—$4,500 a year.

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By means of this marvelous, simplified home-training course, sponsored by the Radio Corporation of America, you can now prepare for success in every phase of Radio. The remarkable outlay of apparatus given to you with this course enables you to learn by actual practice how to solve every problem in radio work. That's why you, too, upon graduation can have the confidence and ability to command good money.

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Graduates of this school are always posted in newest developments in Radio. That's why they are always in big demand. The progress of Radio is measured by the accomplishments of the Radio Corporation of America. This gigantic organization . . . sponsors every lesson in the course.

Money Back if not Satisfied

As a student you will receive an agreement signed by the president of this school assuring you of complete satisfaction upon completion of your training—or your money instantly refunded.

Free!

This fascinating book on Radio's glorious opportunities... written by one of America's well-known radio experts.

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A Division of
Radio Corporation of America

RCA INSTITUTES, Inc.
Dept. RC-9, 75 Varick Street, New York

Gentlemen: Please send me your FREE 40-page book which illustrates the opportunities in Radio and describes your home laboratory method of instruction.

Name...

Address...

....

Occupation...

RCB. 9

KWLC
1270 kc, Decorah, Iowa, Luther College, 100 w, C.

KWSC
1220 kc, Pullman, Wash., State College of Washington, 500 w, P, "The Voice of the Cougars."

KWWG
1260 kc, Brownsville, Texas, Chamber of Commerce, 500 w, C, "Good Night, World."

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

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

KXO
1200 kc, El Centro, Calif., Irey & Bowles, 100 w, P.

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

KYA
1230 kc, San Francisco, Calif., Pacific Broadcasting Corp., 1000 w, P.

KYW
1020 kc, Chicago, Ill., Westinghouse E. & M. Co., 10,000 w, C.

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

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

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

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

WAAT
940 kc, Jersey City, N. J., Bremer Broadcasting Corp., 300 w, E.

WAAW
660 kc, Omaha, Neb., Omaha Grain Exchange, 500 w daytime, C, "Pioneer Market Station of the West."

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

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

WABO
See under WHEC.

WABZ
1200 kc, New Orleans, La., Coliseum Place Baptist Church, 100 w, C.

WACO
1240 kc, Waco, Tex., Central Texas Broadcasting Co., Inc., 100 w, C.

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

WAGM
1310 kc, Royal Oak, Mich., Royal Oak Broadcasting Co., 50 w, E.

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

WALR
1210 kc, Zanesville, O., Roy W. Waller, 100 w, E.

WAPI
1140 kc, Birmingham, Ala., Alabama Polytechnic Institute, 5000 w, C.

WASH
1270 kc, Grand Rapids, Mich., WASH Broadcasting Corp., 500 w, C.

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

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

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

WBAP
800 kc, Ft. Worth, Tex., Carter Publications, Inc., 10,000 w, C.

WBAX
1210 kc, Wilkes-Barre, Pa., John H. Stenger, Jr., 100 w, E, "In Wyoming Valley, Home of the Anthracite."

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

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

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

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

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

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

WBCN
See under WENR.

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

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

WBIS
See under WNAC.

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

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

WBOQ
See under WABC.

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

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

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

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

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

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

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

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

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

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

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

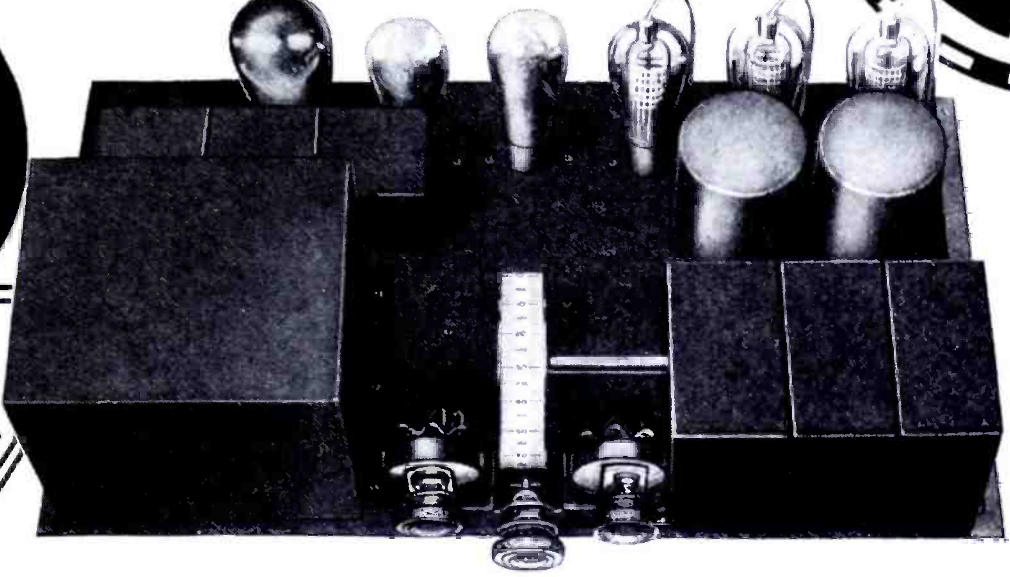
WCAH
1430 kc, Columbus, Ohio, Commercial Radio Service Co., 500 w, E.

The First "AC" ELECTRIC RADIO FOR $27.50

Screen Grid

6 TUBES

Hum-less



NEVER in the history of radio has there been such a startling offer—a well made, long distance "AC" radio for $27.50. Just what everybody has been waiting for. Every owner of an old style electric or battery set will throw it away and buy. Agents can make more money than they ever dreamed of.

Just think—

The very latest in "AC" radio, three stages of SCREEN GRID and yet the price is only $27.50. Can you imagine how many of these you could sell in the next 30 days?

EXCLUSIVE TERRITORY

Be in business for yourself—all the profits will be yours. This hum-free radio will outsell all others regardless of price. Today, without quitting your present job you can start on the way to a comfortable fortune by working a few hours each evening. Not a cheap part anywhere—everything high grade. Illuminated single drum dial control. Plug in a socket and demonstrate—when they see and hear this radio and learn the price, it's a sure sale.

THE NEWEST TYPE RADIO

This "right up to the minute" radio represents the very latest in receiver design. Its three stages of screen grid are an indication of what we offer in this marvelous radio value. A man who can't sell this set can't sell anything, for its perfection in design and the quality of its tone and distance getting ability are apparent at once. It is impossible to give a complete description here but it will cost you only a two cent stamp to find out ALL about it. Send us your name and address and let us give you complete details without cost. There are many facts which you will find tremendously interesting, for I say again without any reservation that it is the most marvelous offer in radio history.

MAKE $50.00 A WEEK

When you examine the cable wiring and construction of this radio you will agree there is nothing finer and your prospects will appreciate its neat clean-cut appearance. Forget about college educations, special training and luck. You don't need any of them, just the will to do—demonstrations will make up for lack of experience—two drops of perspiration will equal a ton of inspiration. Write for information, learn more about this radio and my extra value offer, and then decide whether or not you want to grab this money-making opportunity. If you do, come with us; I will give you absolutely free special training in radio selling and a course in radio servicing that any radio man would be glad to pay for. This training in selling and servicing does not cost you one cent and the possibilities of earning for spare time work are enormous.

SPARE TIME EVENINGS *You don't have to lose a minute from your work. Keep your regular job or business but don't fail to write me and give me a chance to tell you of the thousands of dollars our men are making in spare time.*

Agents Wanted

The finest agent's proposition my company has ever offered is waiting for you if you are the kind of salesman who can sell extra quality at a low price. Think of a radio with three screen grid, six tubes—a radio as perfect in mechanical detail as any, regardless of price, and one which you can offer your customers with the full knowledge that its quality will **keep it sold.**

I want some more men. I want men to take unfilled territory, but I want only men who recognize a good thing when they see it and have confidence enough in their own ability to make the most out of a marvelous opportunity.

A two-cent stamp will bring you complete details of my offer together with beautiful illustrations of this radio, which I say again anybody can sell. Here is your chance right now. Don't put it off; send in the coupon, give your name and address and name of your county. Or better still, telegraph and make the most of the one chance of a lifetime.

P. H. WILCOX, Sec., 4925 N. Crawford Ave., Chicago, Ill.

You may send me complete details of your guaranteed screen grid radio for $27.50. I am interested in .... county. It is understood that I do not obligate myself in any way and that this information is not to cost me one cent.

NAME .... ADDRESS ....

CITY .... COUNTY .... STATE ....

WCAJ
590 kc, Lincoln, Neb., Nebraska Wesleyan University, 50 w, C

WCAL
1250 kc, Northfield, Minn., St. Olaf College, 1000 w, C, "The College on the Hill."

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

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

WCAP
1280 kc, Asbury Park, N. J., Radio Industries Broadcast Co., 500 w, E.

WCAT
1200 kc, Rapid City, S. D., South Dakota State School of Mines, 100 w, M.

WCAU
1170 kc, Philadelphia, Pa., Universal Broadcasting Co., 10000 w, E, "Where Cheer Awaits U."

WCAX
1200 kc, Burlington, Vt., University of Vermont, 100 w, E.

WCAZ
1070 kc, Carthage, Ill., Superior Broadcasting Co., 50 w.

WCBA
1440 kc, Allentown, Pa., B. B. Musselman, 250 w, E.

WCBD
1080 kc, 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 Bdcstg., Inc., 7500 w, C, "Service to the Northwest."

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

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

WCGU
1400 kc, Brooklyn, N. Y., U. S. Broadcasting Corp, 500 w, E.

WCKY
1490 kc, Covington, Ky., L. B. Wilson, 500 w, E.

WCLB
1500 kc, Long Beach, N. Y., Arthur Faske, 100 w, E.

WCLO
1200 kc, Janesville, Wis., WCLO Radio Corp., 100 w, C.

WCLS
1310 kc, Joliet, Ill., WCLS Inc., 100 w, C.

WCMA
1400 kc, Culver, Ind., General Broadcasting Co., 500 w, C, "The Voice of Culver."

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

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

WCOD
1200 kc, Harrisburg, Pa., N. R. Hoffman Co., 100 w, E.

WCOH
1210 kc, Yonkers, N. Y., Westchester Broadcasting Corp., 100 w, E

WCRW
1210 kc, Chicago, Ill., Clinton R. White, 100 w, C.

WCSC
1310 kc, Charleston, S. C., Jordan & Burk, 100 w, E.

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

WCSO
1450 kc, Springfield, Ohio, Wittenberg College, 500 w, E.

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

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

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

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

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

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

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

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

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

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

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

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

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

WDZ
1070 kc, Tuscola, Ill., James L. Bush, 100 w.

WEAF
660 kc, New York, N. Y., National Broadcasting Co., Inc., 50,000 w, E.

WEAI
1270 kc, Ithaca, N. Y., Cornell Univ., 1000 w, E

WEAN
780 kc, Providence, R. I., Shepard Broadcasting Service, 250 w, E, "We Entertain a Nation."

WEAO
570 kc, Columbus, Ohio, Ohio State University, 750 w, E.

WEBC
1290 kc, Superior, Wis., Head of The Lakes Broadcasting Co., 1000 w, C.

WEBQ
1210 kc, Harrisburg, Ill., First Trust & Savings Bank, 100 w, C.

WEBR
1310 kc, Buffalo, N. Y., Howell Broadcasting Co., 100 w, E, "We Extend Buffalo's Regards."

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

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

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

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

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

WELK
1370 kc, Philadelphia, Pa., Howard R. Miller, 100, E.

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

WEMC
590 kc, Berrien Springs, Mich., Emmanuel Missionary College, 1000 w, C, "The Radio Lighthouse."

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

WEPS
See under WORC.

WEVD
1300 kc, New York, N. Y., Debs Memorial Radio Fund, 500 w, E.

WEW
760 kc, St. Louis, Mo., St. Louis University, 1000 w, C.

WFAA
800 kc, Dallas, Texas, Dallas News and Journal, 50,000 w, C, "Working for All Alike."

WFAN
610 kc, Philadelphia, Pa., Keystone Broadcasting Co., Inc., 500 w, E.

WFBC
1200 kc, Knoxville, Tenn., First Baptist Church, 50 w, E.

WFBE
1200 kc, Cincinnati, Ohio, WFBE, Inc., 100 w, E.

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

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

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

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

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

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

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

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

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

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

WFJC
1450 kc, Akron, Ohio, W. F. Jones Broadcasting, Inc., 500 w, E.

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

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

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

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

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

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

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

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

WGCM
1210 kc, Gulfport, Miss., Great Southern Land Co., Inc., 100 w, C.

WGCP
1250 kc, Newark, N. J., May Radio Broadcast Corp., 250 w.

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

WGH
1310 kc, Newport News, Va., Hampton Roads Broadcasting Corp., Inc., 100 w, E.

WGL
1370 kc, Ft. Wayne, Ind., Allen-Wayne Co., 100 w, C.

WGMS
See under WLB.

WGN
720 kc, Chicago, Ill., Tribune Co., 25,000 w, C.

WGR
550 kc, Buffalo, N. Y., WGR, Inc., 1000 w, E,

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

WGY
790 kc, Schenectady, N. Y., General Electric Co., 50,000 w, 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, "Ohio's Highest Point."

WHBF
1210 kc, Rock Island, Ill., Beardsley Specialty Co., 100 w, C.

WHBL
1410 kc, Sheboygan, Wis., Press Pub. Co., 500 w, C.

WHBQ
1370 kc, Memphis, Tenn., Broadcasting Station WHBQ, Inc., 100 w, C.

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

WHBY
1200 kc, Green Bay, Wis., St. Norbert's College 100 w, C.

WHDF
1370 kc, Calumet, Mich., Upper Michigan Brdcstg Co., 100 w, C.

WHDH
830 kc, Boston, Mass., Matheson Radio Co., Inc., 1000 w, E.

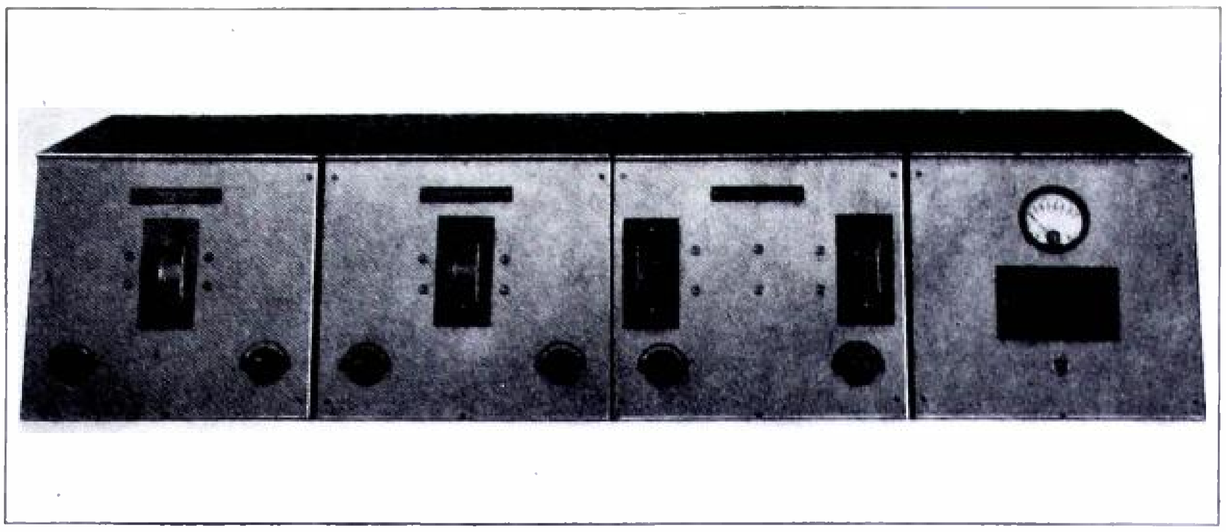
WHDI
1180 kc, Minneapolis, Minn., Wm. Hood Dunwoody Ind. Inst., 500 w, C.

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

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

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

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



Treat your customers to a concert direct from Hawaii!

Then watch them buy this amazing short-wave receiver

A set designed, built and sold for one purpose only—The clear, perfect reproduction of short wave transmission. So amazing is its sensitivity, that stations in remote parts of the world come in clearly and strong.

The New Leutz Short Wave Receiver is of unit construction throughout permitting the use of detector and Audio Frequency alone for local reception, with one or more stages of Radio Frequency for the reception of weak or very distant signals.

Shielding is of a new high efficiency, permitting high amplification without distortion.

Sooner or later every radio owner will be going after the short wave programs and television. Get in on the ground floor with this up-to-the minute set.

You will want complete particulars of course. We are ready to give you the whole story. Write or wire for it now.

C. R. LEUTZ INC.

RADIO ENGINEERS AND MANUFACTURERS
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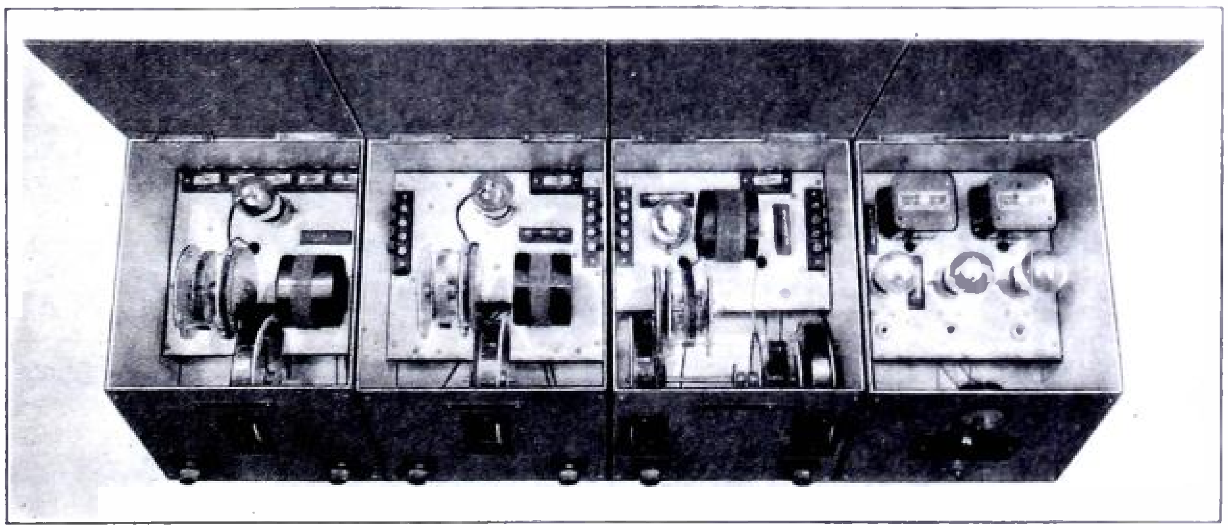
B. J. HOWDERSHELL
412 W. 6th St., Los Angeles



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

WJBC
1200 kc, LaSalle, Ill., Hummer Furniture Co., 100 w, C.

WJBI
1210 kc, Red Bank, N. J., Monmouth Broadcasting Co., 100 w, E.

WJBK
1370 kc, Ypsilanti, Mich., J. F. Hopkins, 50 w, C.

WJBL
1200 kc, Decatur, Ill., Commodore Broadcasting Co., 100 w, C.

WJBO
1420 kc, New Orleans, La., Valdemar Jensen, 100 w, C.

WJBT
See under WBBM.

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

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

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

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

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

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

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

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

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

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

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

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

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

WKBB
1310 kc, Joliet, Ill., Sanders Bros., 100 k, C.

WKBC
1310 kc, Birmingham, Ala., R. B. Broyles Furniture Co., 100 w, C.

WKBF
1400 kc, Indianapolis, Ind., Indianapolis Broadcasting Corp., 500 w, C, "We Keep Building Friendships."

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

WKBI
1420 kc, Chicago, Ill., Fred L. Schoenwolf, 50 w, C.

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

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

AMERTRAN

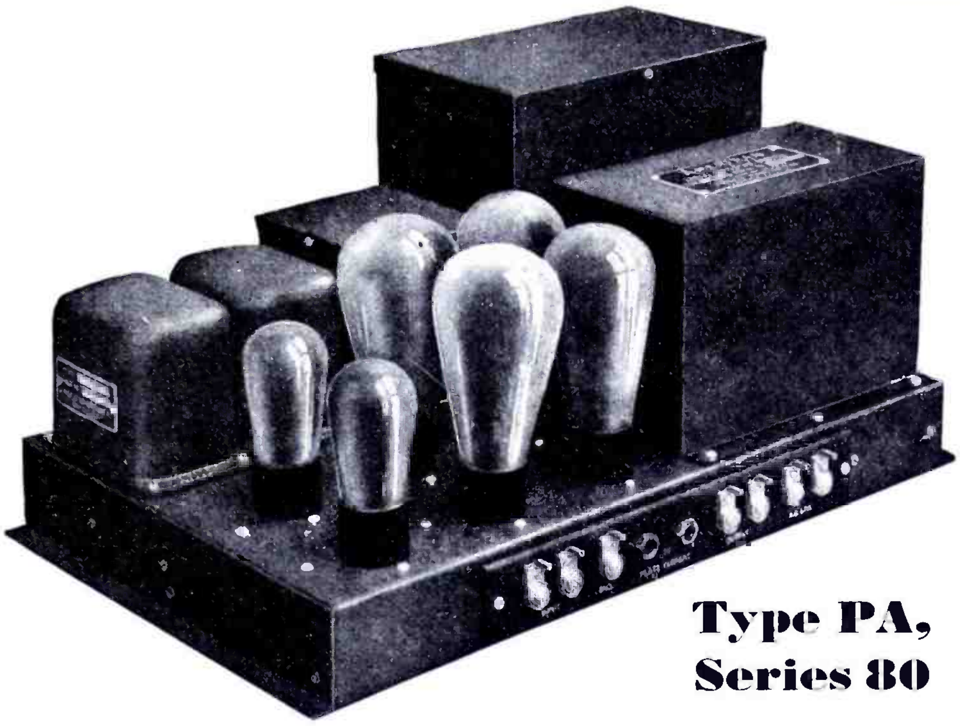
announces

2

NEW ADDITIONS

to a

famous line



Type PA, Series 80

AMERTRAN POWER AMPLIFIERS

An economical means of obtaining flawless reproduction of sound in large volume is available in a new series of Amertran Power Amplifiers, the result of months of laboratory experimentation and exhaustive field tests.

There are four sizes in the new Series 80, one to fill every requirement. The big Type PA-86, shown in the illustration will flood an auditorium with a full volume of music or speech without distortion. Smaller models are made for installations in restaurants, clubs, dance halls, schools and homes—wherever exceptional fidelity of reproduction at high volume is desired.

The mounting and construction is such that they are installed easily, with no bothersome wiring and connections, and are proof against tampering or damage. Simple controls and easy portability are added features that contribute to the popularity of Amertran Power Amplifiers whose record of performance has won the distinction of being considered the "Standard of Excellence" for Audio Reproduction.

AMERTRAN AUDIO TRANSFORMERS

In announcing the new and improved Amertran DeLuxe Audio Transformers, it is again shown that Amertran sets the "Standard of Excellence".

Redesigned for even greater protection from moisture—constructed to live a still longer, more useful and trouble-free life, with perfect fidelity of tone—Amertran DeLuxe Audio Transformers are always demanded when the best is required.

For perfect satisfaction—for long-lived economy—Amertran equipment is everywhere recognized as the wisest choice.

Licensed under patents of R.C.A. and Associated Companies

AMERICAN TRANSFORMER COMPANY
178 EMMET STREET
NEWARK, N. J.

For Complete Details Write for Following Bulletins:

No. 1000—The complete Amertran line—prices and specifications.

No. 1050—Amertran Audio Transformers. Describing 34 designs.

No. 1077—Amertran Concert Hall Amplifiers—Type 25-A.

No. 1079—Amertran Power Amplifiers—Type PA, Series 80.

No. 1088—Amertran Power Transformers and Blocks—Type 245.

No. 1060—Amer-Chokes-audio,filter and modulation chokes.

No. 1066—Amertran Rectifying Equipment for Radio Transmission.

C. B.-8-30

Please send following bulletins—check (v) those you want.
Bulletin 1000 ( ); 1050 ( ); 1060 ( ); 1066 ( ); 1077 ( ); 1079 ( ); 1088 ( ).

Name..

Street & No..

Town............................ State......................

WKBQ
1350 kc, New York, N. Y., Standard Cahill Co., Inc., 250 w, E.

WKBS
1310 kc, Galesburg, Ill., Permil N. Nelson, 100 w, C.

WKBV
1500 kc, Connersville, Ind., Knox Battery & Electric Co., 100 w, C.

WKBW
1480 kc, Buffalo, N. Y., WKBW, Inc., 5000 w, E.

WKBZ
1500 kc, Ludington, Mich., K. L. Ashbacker, 50 w.

WKJC
1200 kc, Lancaster, Pa., Kirk Johnson & Co., 100 w, E.

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

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

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

WLAP
1200 kc, Louisville, Ky., American Broadcasting Corp. of Kentucky, 30 w, C.

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

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

WLBF
1420 kc, Kansas City, Kan., WLBF Broadcasting Co., 100 w, C, "Where Listeners Become Friends."

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

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

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

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

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

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

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

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

WLIB
See under WGN.

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

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

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

WLSI
See under WDWF.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

WMBD
1440 kc, Peoria Heights, Ill., Peoria Heights Radio Laboratory, 500 w.

WMBF
See under WIOD.

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

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

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

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

WMBO
1310 kc, Auburn, N. Y., Radio Service Laboratories, 100 w, E.

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

WMBR
1370 kc, Tampa, Fla., F. J. Reynolds, 100 w, E, "WMBR, Everything for Radio at Tampa, Fla."

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

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

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

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

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

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

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

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

WNAD
1010 kc, Norman, Okla., University of Oklahoma 500 w, C, "The Voice of Soonerland."

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

WNBF

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

WNBH

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

WNBJ

1310 kc, Knoxville, Tenn., Stuart Broadcasting Corp., 50 w, C.

WNBO

1200 kc, Silver Haven, Pa., J. B. Springs, 100 w, E.

WNBR

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

WNBW

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

WNBX

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

WNBZ

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

WNJ

1450 kc, Newark, N. J., Radio Investment Co., 250 w, E, "The Voice of Newark."

WNOX

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

WNRC

1440 kc, Greensboro, N. C., Wayne M. Nelson, 500 w, E.

WNYC

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

WOAI

1190 kc, San Antonio, Texas, Southern Equipment Co., 5000 w, C, "The Winter Playground of America."

WOAN

See WREC.

WOAX

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

WOBT

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

WOBU

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

WOC

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

WOCL

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

WODA

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

WODX

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

WOI

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

WOKO

1440 kc, Poughkeepsie, N. Y., Hudson Valley Broadcasting Corp., 500 w, E.

WOL

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

WOMT

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

WOOD

1270 kc, Grand Rapids, Mich., Walter B. Stiles, Inc., 500 w, C, "The Voice of the Whispering Pines."

WOPI

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

WOQ

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

WOR

710 kc, Newark, N. J., L. Bamberger & Co., 5000 w, E.

WORC

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

WORD

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

WOS

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

WOV

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

WOW

590 kc, Omaha, Neb., Woodmen of the World, 1000 w, C, "The Omaha Station."

WOWO

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

WPAD

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

WPAP

See under WQAO.

WPAW

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

WPCC

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

WPCH

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

WPEN

1500 kc, Philadelphia, Pa., Wm. Penn Broadcasting Co., 100 w, E, "First Wireless School in America."

WPG

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

WPOE

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

WPOR

See under WTAR.

WPSC

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

WPTF

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

WQAM

560 kc, Miami, Fla., Miami Broadcasting Co., 100 w, E.

WQAN

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

WQAO

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

WQBC

1360 kc, Vicksburg, Miss., Delta Broadcasting Co.,

WQDM

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

WQDV

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

WQDX

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

WRAF

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

WRAK

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

WRAW

1310 kc, Reading, Pa., Avenue Radio & Electric Shop, 50 w, E, "The Schuylkill Valley Echo."

WRAX

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

WRBI

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

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

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

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

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

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

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

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

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

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

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

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

WRHM
1250 kc, Minneapolis, Minn., Minnesota Broadcasting Corp., 1000 w, C, "Welcome Rosedale Hospital, Minneapolis."

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

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

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

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

WRVA
1110 kc, Richmond, Va., Larus Bros. & Co., Inc., 5000 w, E, "Carry Me Back to Old Virginny."

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

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

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

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

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

WSB
740 kc, Atlanta, Ga., Atlanta Journal Co., 5000 w, E, "The Voice of the South."

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

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

WSDA
See under WSGH.

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

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

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

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

WSM
650 kc, Nashville, Tenn., National Life & Accident Ins. Co., 5000 w, C, "We Shield Millions."

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

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

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

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

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

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

WSUN
See under WFLA.

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

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

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

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

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

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

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

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

WTAX
1210 kc, Streator, Ill., Williams Hardware Co., 50 w.

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

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

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

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

WTNT
1470 kc, Nashville, Tenn., Tenn. Pub. Co., 5000 w, C.

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

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

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

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

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

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

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

Consolidated Broadcast List

Call Town

KBPS—Portland, Ore.
KBTM—Paragould, Ark.
KCRC—Enid, Okla.
KCRJ—Jerome, Ariz.
KDB—Santa Barbara, Calif.
KDFN—Casper, Wyo.
KDKA—Pittsburgh, Pa.
KDLR—Devils Lake, N. D.
KDYL—Salt Lake City, Utah
KECA—Los Angeles, Calif.
KELW—Burbank, Calif.
KEX—Portland, Ore.
KFAB—Lincoln, Neb.
KFBB—Great Falls, Mont.
KFBK—Sacramento, Calif.
KFBL—Everett, Wash.
KFDM—Beaumont, Tex.
KFDY—Brookings, S. D.
KFEL—Denver, Colo.
KFEQ—St. Joseph, Mo.
KFGQ—Boone, Iowa
KFH—Wichita, Kans.
KFHA—Gunnison, Colo.
KFI—Los Angeles, Calif.
KFIO—Spokane, Wash.
KFIU—Juneau, Alaska
KFIZ—Fond du Lac, Wis.
KFJB—Marshalltown, Iowa
KFJF—Oklahoma City, Okla.
KFJI—Astoria, Ore.
KFJM—Grand Forks, N. D.
KFJR—Portland, Ore.
KFJY—Fort Dodge, Ia.
KFJZ—Fort Worth, Tex.
KFKA—Greeley, Colo.
KFKB—Milford, Kans.
KFKU—Lawrence, Kans.
KFKX—Chicago, Ill.
KFLV—Rockford, Ill.
KFLX—Galveston, Tex.
KFMX—Northfield, Minn.
KFNF—Shenandoah, Ia.
KFOR—Lincoln, Neb.
KFOX—Long Beach, Calif.
KFPL—Dublin, Tex.
KFPM—Greenville, Tex.
KFPW—Ft. Smith, Ark.
KFPY—Spokane, Wash.
KFQD—Anchorage, Alaska
KFQU—Holy City, Calif.
KFQW—Seattle, Wash.
KFRC—San Francisco, Calif.
KFRU—Columbia, Mo.
KFSD—San Diego, Calif.
KFSG—Los Angeles, Calif.
KFUL—Galveston, Tex.
KFUM—Colorado Spgs., Colo.
KFUO—St. Louis, Mo.
KFUP—Denver, Colo.
KFVD—Culver City, Calif.
KFVS—Cape Girardeau, Mo.
KFWB—Hollywood, Calif.
KFWF—St. Louis, Mo.
KFWI—San Francisco, Calif.
KFWM—Richmond, Calif.
KFXD—Nampa, Idaho.
KFXF—Denver, Colo.
KFXJ—Edgewater, Colo.
KFXM—San Bernardino, Calif.
KFXR—Oklahoma City, Okla.
KFXY—Flagstaff, Ariz.
KFYO—Abilene, Tex.
KFYR—Bismarck, N. D.
KGA—Spokane, Wash.
KGAR—Tucson, Ariz.
KGB—San Diego, Calif.
KGBU—Ketchikan, Alaska
KGBX—St. Joseph, Mo.
KGBZ—York, Neb.
KGCA—Decorah, Ia.
KGCI—San Antonio, Tex.
KGCR—Watertown, S. D.
KGCU—Mandan, N. D.
KGCX—Wolf Point, Mont.
KGDA—Mitchell, S. D.
KGDE—Fergus Falls, Minn.
KGDM—Stockton, Calif.
KGDY—Oldham, S. D.
KGEF—Los Angeles, Calif.
KGEK—Yuma, Colo.
KGER—Long Beach, Calif.
KGEW—Fort Morgan, Colo.
KGEZ—Kalispell, Mont.
KGFF—Alva, Okla.
KGFG—Oklahoma City, Okla.
KGFI—Corpus Christi, Tex.
KGFJ—Los Angeles, Calif.
KGFK—Moorhead, Minn.
KGFL—Raton, N. M.
KGFW—Ravenna, Neb.
KGFX—Pierre, S. D.
KGGC—San Francisco, Cal.
KGGF—Picher, Okla.
KGGM—Albuquerque, N. M.
KGHF—Pueblo, Colo.
KGHI—Little Rock, Ark.
KGHL—Billings, Mont.
KGHX—Richmond, Tex.
KGIQ—Twin Falls, Idaho
KGIR—Butte, Mont.
KGIW—Trinidad, Colo.
KGIX—Las Vegas, Nev.
KGIZ—Grant City, Mo.
KGJF—Little Rock, Ark.
KGKB—Brownwood, Tex.
KGKL—San Angelo, Tex.
KGKO—Wichita Falls, Tex.
KGKX—Sandpoint, Idaho
KGKY—Scottsbluff, Nebr.
KGMB—Honolulu, Hawaii.
KGMP—Elk City, Okla.
KGNF—North Platte, Nebr.
KGNO—Dodge City, Kans.
KGO—San Francisco, Calif.
KGRS—Amarillo, Tex.
KGU—Honolulu, T. H.
KGW—Portland, Ore.
KGY—Lacey, Wash.

Call Town

KHJ—Los Angeles, Calif.
KHQ—Spokane, Wash.
KICK—Red Oak, Ia.
KID—Idaho Falls, Idaho
KIDO—Boise, Idaho
KIT—Yakima, Wash.
KJBS—San Francisco, Calif.
KJR—Seattle, Wash.
KLCN—Blytheville, Ark.
KLO—Ogden, Utah
KLPM—Minot, N. D.
KLRA—Little Rock, Ark.
KLS—Oakland, Calif.
KLX—Oakland, Calif.
KLZ—Denver, Colo.
KMA—Shenandoah, Ia.
KMBC—Kansas City, Mo.
KMED—Medford, Ore.
KMIC—Inglewood, Calif.
KMLB—Monroe, La.
KMJ—Fresno, Calif.
KMMJ—Clay Center, Neb.
KMO—Tacoma, Wash.
KMOX—St. Louis, Mo.
KMPC—Beverly Hills, Calif.
KMTR—Los Angeles, Calif.
KNX—Hollywood, Calif.
KOA—Denver, Colo.
KOAC—Corvallis, Ore.
KOB—State College, N. M.
KOCW—Chickasha, Okla.
KOH—Reno, Nev.
KOIL—Council Bluffs, Ia.
KOIN—Portland, Ore.
KOL—Seattle, Wash.
KOMO—Seattle, Wash.
KONO—San Antonio, Tex.
KOOS—Marshfield, Ore.
KORE—Eugene, Ore.
KOY—Phoenix, Ariz.
KPCB—Seattle, Wash.
KPJM—Prescott, Ariz.
KPO—San Francisco, Calif.
KPOF—Denver, Colo.
KPPC—Pasadena, Calif.
KPQ—Wenatchee, Wash.
KPRC—Houston, Tex.
KPSN—Pasadena, Calif.
KPWF—Los Angeles, Calif.
KQV—Pittsburgh, Pa.
KQW—San Jose, Calif.
KRE—Berkeley, Calif.
KREG—Santa Ana, Calif.
KRGV—Harlingen, Tex.
KRLD—Dallas, Tex.
KRMD—Shreveport, La.
KROW—Oakland, Calif.
KRSC—Seattle, Wash.
KSAC—Manhattan, Kans.
KSCJ—Sioux City, Ia.
KSD—St. Louis, Mo.
KSEI—Pocatello, Idaho
KSL—Salt Lake City, Utah
KSMR—Santa Maria, Calif.
KSO—Clarinda, Ia.
KSOO—Sioux Falls, S. D.
KSTP—St. Paul, Minn.
KTAB—San Francisco, Calif.
KTAP—San Antonio, Tex.
KTAR—Phoenix, Ariz.
KTAT—Ft. Worth, Tex.
KTBI—Los Angeles, Calif.
KTAB—San Francisco, Calif.
KTBS—Shreveport, La.
KTLC—Houston, Tex.
KTHS—Hot Springs, Ark.
KTM—Los Angeles, Calif.
KTNT—Muscatine, Ia.
KTRH—Houston, Tex.
KTSA—San Antonio, Tex.
KTSL—Shreveport, La.
KTSM—El Paso, Tex.
KTUE—Houston, Tex.
KTW—Seattle, Wash.
KUJ—Longview, Wash.
KUOA—Fayetteville, Ark.
KUSD—Vermillion, S. D.
KUT—Austin, Tex.
KVI—Tacoma, Wash.
KVL—Seattle, Wash.
KVOA—Tucson, Ariz.
KVOO—Tulsa, Okla.
KVOS—Bellingham, Wash.
KWCR—Cedar Rapids, Ia.
KWEA—Shreveport, La.
KWG—Stockton, Cal.
KWJJ—Portland, Ore.
KWK—St. Louis, Mo.
KWKC—Kansas City, Mo.
KWKH—Shreveport, La.
KWLC—Decorah, Ia.
KWSC—Pullman, Wash.
KWWG—Brownsville, Tex.
KXA—Seattle, Wash.
KXL—Portland, Ore.
KXO—El Centro, Calif.
KXRO—Aberdeen, Wash.
KYA—San Francisco, Calif.
KYW—Chicago, Ill.
KZM—Hayward, Calif.
WAAF—Chicago, Ill.
WAAM—Newark, N. J.
WAAT—Jersey City, N. J.
WAAW—Omaha, Neb.
WABC—New York City, N. Y.
WABI—Bangor, Me.
WABO—Rochester, N. Y.
WABZ—New Orleans, La.
WACO—Waco, Tex.
WADC—Tallmadge, Ohio
WAGM—Royal Oak, Mich.
WAIU—Columbus, Ohio
WALR—Zanesville, Ohio.
WAPI—Birmingham, Ala.
WASH—Grand Rapids, Mich.

Call Town

WBAA—Lafayette, Ind.
WBAK—Harrisburg, Pa.
WBAL—Baltimore, Md.
WBAP—Fort Worth, Tex.
WBAX—Wilkes-Barre, Pa.
WBBC—Brooklyn, N. Y.
WBBL—Richmond, Va.
WBBM—Chicago, Ill.
WBBR—Brooklyn, N. Y.
WBBZ—Ponca City, Okla.
WBCM—Bay City, Mich.
WBCN—Chicago, Ill.
WBEN—Buffalo, N. Y.
WBGF—Glens Falls, N. Y.
WBIS—Boston, Mass.
WBMS—Hackensack, N. J.
WBNY—New York, N. Y.
WBOQ—New York, N. Y.
WBOW—Terre Haute, Ind.
WBRC—Birmingham, Ala.
WBRE—Wilkes-Barre, Pa.
WBSO—Wellesley Hills, Mass.
WBT—Charlotte, N. C.
WBTM—Danville, Va.
WBZ—Springfield, Mass.
WBZA—Boston, Mass.
WCAC—Storrs, Conn.
WCAD—Canton, N. Y.
WCAE—Pittsburgh, Pa.
WCAH—Columbus, Ohio
WCAJ—Lincoln, Neb.
WCAL—Northfield, Minn.
WCAM—Camden, N. J.
WCAO—Baltimore, Md.
WCAP—Asbury Park, N. J.
WCAT—Rapid City, S. D.
WCAU—Philadelphia, Pa.
WCAX—Burlington, Vt.
WCAZ—Carthage, Ill.
WCBA—Allentown, Pa.
WCBD—Zion, Ill.
WCBM—Baltimore, Md.
WCBS—Springfield, Ill.
WCCO—Minneapolis, Minn.
WCDA—New York, N. Y.
WCFL—Chicago, Ill.
WCGU—Brooklyn, N. Y.
WCKY—Covington, Ky.
WCLB—Long Beach, N. Y.
WCLO—Janesville, Wis.
WCLS—Joliet, Ill.
WCMA—Culver, Ind.
WCOA—Pensacola, Fla.
WCOC—Meridian, Miss.
WCOD—Harrisburg, Pa.
WCOH—Yonkers, N. Y.
WCRW—Chicago, Ill.
WCSC—Charleston, S. C.
WCSH—Portland, Me.
WCSO—Springfield, Ohio
WDAE—Tampa, Fla.
WDAF—Kansas City, Mo.
WDAG—Amarillo, Tex.
WDAH—El Paso, Tex.
WDAY—Fargo, N. D.
WDBJ—Roanoke, Va.
WDBO—Orlando, Fla.
WDEL—Wilmington, Del.
WDGY—Minneapolis, Minn.
WDOD—Chattanooga, Tenn.
WDRC—New Haven, Conn.
WDSU—New Orleans, La.
WDWF—Providence, R. I.
WDZ—Tuscola, Ill.
WEAF—New York, N. Y.
WEAI—Ithaca, N. Y.
WEAN—Providence, R. I.
WEAO—Columbus, Ohio
WEBC—Superior, Wis.
WEBQ—Harrisburg, Ill.
WEBR—Buffalo, N. Y.
WEDC—Chicago, Ill.
WEDH—Erie, Pa.
WEEI—Boston, Mass.
WEHC—Emory, Va.
WEHS—Evanston, Ill.
WELK—Philadelphia, Pa.
WELL—Battle Creek, Mich.
WEMC—Berrien Springs, Mich.
WENR—Chicago, Ill.
WEPS—Worcester, Mass.
WEVD—New York, N. Y.
WEW—St. Louis, Mo.
WFAA—Dallas, Tex.
WFAN—Philadelphia, Pa.
WFBC—Knoxville, Tenn.
WFBE—Cincinnati, Ohio
WFBG—Altoona, Pa.
WFBJ—Collegeville, Minn.
WFBL—Syracuse, N. Y.
WFBM—Indianapolis, Ind.
WFBR—Baltimore, Md.
WFDF—Flint, Mich.
WFDV—Rome, Ga.
WFDW—Talladega, Ala.
WFI—Philadelphia, Pa.
WFIW—Hopkinsville, Ky.
WFJC—Akron, Ohio
WFKD—Philadelphia, Pa.
WFLA—Clearwater, Fla.
WGAL—Lancaster, Pa.
WGBB—Freeport, N. Y.
WGBC—Memphis, Tenn.
WGBF—Evansville, Ind.
WGBI—Scranton, Pa.
WGBS—New York, N. Y.
WGCM—Gulfport, Miss.
WGCP—Newark, N. J.
WGES—Chicago, Ill.
WGH—Newport News, Va.
WGL—Fort Wayne, Ind.
WGMS—Minneapolis, Minn.
WGN—Chicago, Ill.
WGR—Buffalo, N. Y.
WGST—Atlanta, Ga.
WGY—Schenectady, N. Y.
WHA—Madison, Wis.
WHAD—Milwaukee, Wis.

Call Town

WHAM—Rochester, N. Y.
WHAP—New York, N. Y.
WHAS—Louisville, Ky.
WHAT—Philadelphia, Pa.
WHAZ—Troy, N. Y.
WHB—Kansas City, Mo.
WHBC—Canton, Ohio
WHBD—Mt. Orab, Ohio
WHBF—Rock Island, Ill.
WHBL—Sheboygan, Wis.
WHBQ—Memphis, Tenn.
WHBU—Anderson, Ind.
WHBY—Green Bay, Wis.
WHDF—Calumet, Mich.
WHDH—Boston, Mass.
WHDI—Minneapolis, Minn.
WHDL—Tupper Lake, N. Y.
WHEC—Rochester, N. Y.
WHFC—Cicero, Ill.
WHIS—Bluefield, W. Va.
WHK—Cleveland, Ohio
WHN—New York, N. Y.
WHO—Des Moines, Iowa
WHOM—Jersey City, N. J.
WHP—Harrisburg, Pa.
WIAS—Ottumwa, Ia.
WIBA—Madison, Wis.
WIBG—Elkins Park, Pa.
WIBM—Jackson, Mich.
WIBO—Chicago, Ill.
WIBR—Steubenville, Ohio
WIBS—Elizabeth, N. J.
WIBU—Poynette, Wis.
WIBW—Topeka, Kans.
WIBX—Utica, N. Y.
WICC—Bridgeport, Conn.
WIL—St. Louis, Mo.
WILL—Urbana, Ill.
WILM—Wilmington, Del.
WIOD—Miami Beach, Fla.
WIP—Philadelphia, Pa.
WIS—Columbia, S. C.
WISJ—Beloit, Wis.
WISN—Milwaukee, Wis.
WJAC—Johnstown, Pa.
WJAG—Norfolk, Neb.
WJAK—Marion, Ind.
WJAR—Providence, R. I.
WJAS—Pittsburgh, Pa.
WJAX—Jacksonville, Fla.
WJAY—Cleveland, Ohio
WJAZ—Chicago, Ill.
WJBC—LaSalle, Ill.
WJBI—Red Bank, N. J.
WJBK—Ypsilanti, Mich.
WJBL—Decatur, Ill.
WJBO—New Orleans, La.
WJBT—Chicago, Ill.
WJBU—Lewisburg, Pa.
WJBW—New Orleans, La.
WJBY—Gadsden, Ala.
WJDX—Jackson, Miss.
WJJD—Chicago, Ill.
WJKS—Gary, Ind.
WJR—Detroit, Mich.
WJSV—Alexandria, Va.
WJW—Mansfield, Ohio
WJZ—New York, N. Y.
WKAQ—San Juan, P. R.
WKAR—E. Lansing, Mich.
WKAV—Laconia, N. H.
WKBB—Joliet, Ill.
WKBC—Birmingham, Ala.
WKBF—Indianapolis, Ind.
WKBH—La Crosse, Wis.
WKBI—Chicago, Ill.
WKBN—Youngstown, Ohio
WKBO—Jersey City, N. J.
WKBP—Battle Creek, Mich.
WKBQ—New York, N. Y.
WKBS—Galesburg, Ill.
WKBV—Brookville, Ind.
WKBW—Buffalo, N. Y.
WKBZ—Ludington, Mich.
WKJC—Lancaster, Pa.
WKRC—Cincinnati, Ohio
WKY—Oklahoma City, Okla.
WLAC—Nashville, Tenn.
WLAP—Louisville, Ky.
WLB—Minneapolis, Minn.
WLBC—Muncie, Ind.
WLBF—Kansas City, Kans.
WLBG—Petersburg, Va.
WLBL—Stevens Point, Wis.
WLBW—Oil City, Pa.
WLBX—Long Island City, N. Y.
WLBZ—Bangor, Me.
WLCI—Ithaca, N. Y.
WLEX—Lexington, Mass.
WLEY—Lexington, Mass.
WLIB—Chicago, Ill.
WLIT—Philadelphia, Pa.
WLOE—Boston, Mass.
WLS—Chicago, Ill.
WLSI—Providence, R. I.
WLTH—Brooklyn, N. Y.
WLVA—Lynchburg, Va.
WLW—Cincinnati, Ohio
WLWL—New York, N. Y.
WMAC—Cazenovia, N. Y.
WMAF—S. Dartmouth, Mass.
WMAK—Buffalo, N. Y.
WMAL—Washington, D. C.
WMAN—Columbus, Ohio
WMAQ—Chicago, Ill.
WMAY—St. Louis, Mo.
WMAZ—Macon, Ga.
WMBA—Newport, R. I.
WMBC—Detroit, Mich.
WMBD—Peoria Heights, Ill.
WMBF—Miami Beach, Fla.
WMBG—Richmond, Va.
WMBH—Joplin, Mo.
WMBI—Chicago, Ill.
WMBJ—Wilkinsburg, Pa.
WMBO—Auburn, N. Y.
WMBQ—Brooklyn, N. Y.
WMBR—Tampa, Fla.

Call Town

WMC—Memphis, Tenn.
WMCA—New York, N. Y.
WMMN—Fairmont, W. Va.
WMPC—Lapeer, Mich.
WMRJ—Jamaica, N. Y.
WMSG—New York, N. Y.
WMT—Waterloo, Ia.
WNAC—Boston, Mass.
WNAD—Norman, Okla.
WNAT—Philadelphia, Pa.
WNAX—Yankton, S. D.
WNBF—Binghamton, N. Y.
WNBH—New Bedford, Mass.
WNBJ—Knoxville, Tenn.
WNBO—Silver Haven, Pa.
WNBR—Memphis, Tenn.
WNBW—Carbondale, Pa.
WNBX—Springfield, Vt.
WNBZ—Saranac Lake, N. Y.
WNJ—Newark, N. J.
WNOX—Knoxville, Tenn.
WNRC—Greensboro, N. C.
WNYC—New York, N. Y.
WOAI—San Antonio, Tex.
WOAN—Memphis, Tenn.
WOAX—Trenton, N. J.
WOBT—Union City, Tenn.
WOBU—Charleston, W. Va.
WOC—Davenport, Ia.
WOCL—Jamestown, N. Y.
WODA—Paterson, N. J.
WODX—Mobile, Ala.
WOI—Ames, Ia.
WOKO—Poughkeepsie, N. Y.
WOL—Washington, D. C.
WOMT—Manitowoc, Wis.
WOOD—Grand Rapids, Mich.
WOPI—Bristol, Tenn.
WOQ—Kansas City, Mo.
WOR—Newark, N. J.
WORC—Worcester, Mass.
WORD—Chicago, Ill.
WOS—Jefferson City, Mo.
WOV—New York, N. Y.
WOW—Omaha, Neb.
WOWO—Ft. Wayne, Ind.
WPAD—Paducah, Ky.
WPAP—New York, N. Y.
WPAW—Pawtucket, R. I.
WPCC—Chicago, Ill.
WPCH—New York, N. Y.
WPEN—Philadelphia, Pa.
WPG—Atlantic City, N. J.
WPOE—Patchogue, N. Y.
WPOR—Norfolk, Va.
WPSC—State College, Pa.
WPTF—Raleigh, N. C.
WQAM—Miami, Fla.
WQAN—Scranton, Pa.
WQAO—New York, N. Y.
WQBC—Vicksburg, Miss.
WQDM—St. Albans, Vt.
WQDV—Tupelo, Miss.
WQDX—Thomasville, Ga.
WRAF—La Porte, Ind.
WRAK—Williamsport, Pa.
WRAW—Reading, Pa.
WRAX—Philadelphia, Pa.
WRBI—Tifton, Ga.
WRBJ—Hattiesburg, Miss.
WRBL—Columbus, Ga.
WRBQ—Greenville, Miss.
WRBT—Wilmington, N. C.
WRBU—Gastonia, N. C.
WRBX—Roanoke, Va.
WRC—Washington, D. C.
WRDO—Augusta, Me.
WRDW—Augusta, Ga.
WREC—Memphis, Tenn.
WREN—Lawrence, Kans.
WRHM—Minneapolis, Minn.
WRJN—Racine, Wis.
WRNY—New York, N. Y.
WRR—Dallas, Tex.
WRUF—Gainesville, Fla.
WRVA—Richmond, Va.
WSAI—Cincinnati, Ohio
WSAJ—Grove City, Pa.
WSAN—Allentown, Pa.
WSAR—Fall River, Mass.
WSAZ—Huntington, W. Va.
WSB—Atlanta, Ga.
WSBC—Chicago, Ill.
WSBT—South Bend, Ind.
WSDA—Brooklyn, N. Y.
WSFA—Montgomery, Ala.
WSGH—Brooklyn, N. Y.
WSIX—Springfield, Tenn.
WSJS—Winston-Salem, N. C.
WSM—Nashville, Tenn.
WSMB—New Orleans, La.
WSMK—Dayton, Ohio
WSPA—Spartanburg, S. C.
WSPD—Toledo, Ohio
WSSH—Boston, Mass.
WSUI—Iowa City, Ia.
WSUN—Clearwater, Fla.
WSVS—Buffalo, N. Y.
WSYR—Syracuse, N. Y.
WTAD—Quincy, Ill.
WTAG—Worcester, Mass.
WTAM—Cleveland, Ohio
WTAQ—Eau Claire, Wis.
WTAR—Norfolk, Va.
WTAW—College Station, Tex.
WTAX—Streator, Ill.
WTBO—Cumberland, Md.
WTFI—Toccoa, Ga.
WTIC—Hartford, Conn.
WTMJ—Milwaukee, Wis.
WTNT—Nashville, Tenn.
WTOC—Savannah, Ga.
WWAE—Hammond, Ind.
WWJ—Detroit, Mich.
WWL—New Orleans, La.
WWNC—Asheville, N. C.
WWRL—Woodside, N. Y.
WWVA—Wheeling, W. Va.

U. S. Broadcasting Stations by Frequencies

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

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

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

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

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

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

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

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

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

640 Kilocycles, 468.5 Meters:
WAIU, KFI, WOI

650 Kilocycles, 461.3 Meters:
WSM

660 Kilocycles, 454.3 Meters:
WEAF, WAAW

670 Kilocycles, 447.5 Meters:
WMAQ

680 Kilocycles, 440.9 Meters:
WPTF, KPO, KFEQ

690 Kilocycles, 434.5 Meters—Canadian Wave:

700 Kilocycles, 428.3 Meters:
WLW

710 Kilocycles, 422.3 Meters:
WOR, KMPC

720 Kilocycles, 416.4 Meters:
WGN, WLIB

730 Kilocycles, 410.7 Meters—Canadian Wave:

740 Kilocycles, 405.2 Meters:
WSB, KMMJ

750 Kilocycles, 399.8 Meters:
WJR

760 Kilocycles, 394.5 Meters:
WJZ, WEW, KVI

770 Kilocycles, 389.4 Meters:
KFAB, WBBM, WJBT

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

790 Kilocycles, 379.5 Meters:
WGY, KGO

800 Kilocycles, 374.8 Meters:
WBAP, WFAA

810 Kilocycles, 370.2 Meters:
WPCH, WCCO

820 Kilocycles, 365.6 Meters:
WHAS

830 Kilocycles, 361.2 Meters:
KOA, WHDH, WRUF

840 Kilocycles, 356.9 Meters—Canadian Wave:

850 Kilocycles, 352.7 Meters:
KWKH, WWL

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

870 Kilocycles, 344.6 Meters:
WLS, WENR, WBCN

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

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

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

910 Kilocycles, 329.5 Meters—Canadian Wave:

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

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

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

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

960 Kilocycles, 312.3 Meters—Canadian Wave:

970 Kilocycles, 309.1 Meters:
KJR, WCFL

980 Kilocycles, 305.9 Meters:
KDKA

990 Kilocycles, 302.8 Meters:
WBZ, WBZA

1000 Kilocycles, 299.8 Meters:
WHO, WOC, KFVD

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

1020 Kilocycles, 293.9 Meters:
KYW, KFKX, WRAX

1030 Kilocycles, 291.1 Meters—Canadian Wave:

1040 Kilocycles, 288.3 Meters:
WKAR, KTHS, KRLD, WMAK

1050 Kilocycles, 285.5 Meters:
KNX, KFKB

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

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

1080 Kilocycles, 277.6 Meters:
WBT, WCBD, WMBI

1090 Kilocycles, 275.1 Meters:
KMOX

1100 Kilocycles, 272.6 Meters:
WPG, WLWL, KGDM

1110 Kilocycles, 270.1 Meters:
WRVA, KSOO

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

1130 Kilocycles, 265.3 Meters:
WOV, KSL, WJJD

1140 Kilocycles, 263.0 Meters:
WAPI, KVOO

1150 Kilocycles, 260.7 Meters:
WHAM

1160 Kilocycles, 258.5 Meters:
WWVA, WOWO

1170 Kilocycles, 256.3 Meters:
WCAU, KTNT

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

1190 Kilocycles, 252.0 Meters:
WICC, WOAI

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

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

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

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

1240 Kilocycles, 241.8 Meters:
WACO, KTAT

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1420 Kilocycles, 211.1 Meters:
WTBO, WKBI, WIBR, WEDH, WMBC, KGFF, WHIS, KTAP, KTUE, KFYO, KICK, WIAS, KGGC, WLBF, WMBH, KFIZ, KORE, WILM, KGIW, KGKX, KFQW, KLPM, KXL, WHDL, WHFC, WEHS, KFQU, KFXD, KGIX, WJBO, WELL, WFDW, WPAD, WSPA, KBPS, KFXY

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

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

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

1460 Kilocycles, 205.4 Meters:
WJSV, KSTP

1470 Kilocycles, 204.0 Meters:
KGA, WTNT, WLAC

1480 Kilocycles, 202.6 Meters:
KFJF, WKBW

1490 Kilocycles, 201.6 Meters:
KPWF, WCKY, WJAZ, WORD

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

U. S. Broadcasting Stations Listed by States

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

ALASKA
Anchorage, KFQD
Juneau, KFIU
Ketchikan, KGBU

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

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

CALIFORNIA
Berkeley, KRE
Beverley Hills, KMPC
Burkank, KELW
Culver City, KFVD
El Centro, KXO
Fresno, KMJ
Hayward, KZM
Hollywood, KNX, KFWB
Holy City, KFQU
Inglewood, KMIC
Long Beach, KFOX, KGER
Los Angeles, KFI, KFSG, KGEF, KGFJ, KHJ, KTBI, KECA, KMTR, KPWF, KTM
Oakland, KLS, KLX, KROW
Pasadena, KPPC, KPSN
Richmond, KFWM
Sacramento, KFBK
San Bernardino, KFXM
San Diego, KFSD, KGB
San Francisco, KFRC, KFWI, KJBS, KPO, KGGC, KYA, KGO, KTAB
San Jose, KQW
Santa Ana, KREG
Santa Barbara, KDB
Santa Maria, KSMR
Stockton, KGDM, KWG

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

CONNECTICUT
Bridgeport, WICO
Hartford, WTIC
New Haven, WDRC
Storrs, WCAC

DELAWARE
Wilmington, WDEL, WILM

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

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

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

HAWAII
Honolulu, KGU, KGMB

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

ILLINOIS
Carthage, WCAZ
Chicago, KYW, WAAF, WCFL, WCRW, WEDC, WENR, WGES, WKBI, WPCC, WGN, WMAQ, WMBI, WBBM, WSBC, WBCN, WIBO, WJAZ, WJBT, WLIB, WLS, WORD, KFKX, WJJD
Cicero, WHFC
Decatur, WJBL
Evanston, WEHS
Galesburg, WKBS
Harrisburg, WEBQ
Joliet, WCLS, WKBB
La Salle, WJBC
Peoria Heights, WMBD
Quincy, WTAD
Rockford, KFLV
Rock Island, WHBF
Springfield, WCBS
Streator, WTAX
Tuscola, WDZ
Urbana, WILL
Zion, WCBD

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

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

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

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

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

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

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

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

MICHIGAN
Battle Creek, WELL
Berrien Springs, WEMC
Calumet, WHDF
Detroit, WMBC, WWJ, WJR
East Lansing, WKAR
Flint, WFDF
Grand Rapids, WASH, WOOD
Jackson, WIBM
Lapeer, WMPC
Ludington, WKBZ
Royal Oak, WAGM
Ypsilanti, WJBK

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

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

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

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

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

NEVADA
Las Vegas, KGIX
Reno, KOH

NEW HAMPSHIRE
Laconia, WKAV

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

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

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

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

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

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

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

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

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

PORTO RICO
San Juan, WKAQ

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

SOUTH CAROLINA
Charleston, WCSC
Columbia, WIS
Spartanburg, WSPA

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

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

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

UTAH
Ogden, KLO
Salt Lake City, KDYL, KSL

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

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

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

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

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

WYOMING
Casper, KDFN

SHORT WAVE RELAY BROADCASTING STATIONS

United States

Call	Owner	Kilocycles	Meters
W2XAO	General Electric, Schenectady, N. Y.	8,690	34.5
W2XAD	General Electric, Schenectady, N. Y.	15,340	19.56
W2XAF	General Electric, Schenectady, N. Y.	9,530	31.48
W2XAL	Aviation Radio, Coytesville, N. J.	6,040	49.67
W2XAL	Aviation Radio, Coytesville, N. J.	11,800	25.42
W2XAL	Aviation Radio, Coytesville, N. J.	15,250	19.67
W2XAL	Aviation Radio, Coytesville, N. J.	21,460	13.97
W2XBR	Baruchrome Corporation, New York, N. Y.	6,020	49.83
W2XCX	L. Bamberger, Newark, N. J.	6,080	49.34
W2XE	Atlantic Broadcasting Co., Jamaica, N. Y.	11,840	25.34
W2XE	Atlantic Broadcasting Co., Jamaica, N. J.	15,280	19.63
W3XAL	Radio Corporation, New York, N. Y.	6,100	49.18
W3XAL	Radio Corporation, New York, N. Y.	9,570	31.35
W3XAL	Radio Corporation, New York, N. Y.	11,720	25.6
W3XAL	Radio Corporation, New York, N. Y.	15,130	19.83
W3XAL	Radio Corporation, New York, N. Y.	17,780	16.87
W3XAL	Radio Corporation, New York, N. Y.	21,500	13.95
W3XL	Radio Corporation, New York, N. Y.	6,020	49.83
W3XAU	Universal Broadcasting Co., Philadelphia, Pa.	6,060	49.5
W3XAU	Universal Broadcasting Co., Philadelphia, Pa.	9,590	30.1
W6XAL	Pacific-Western Broadcasting Fed., Westminster, Calif.	6,080	49.34
W6XAL	Pacific-Western Broadcasting Fed., Westminster, Calif.	15,250	19.67
W6XAL	Pacific-Western Broadcasting Fed., Westminster, Calif.	21,500	13.95
W6XN	General Electric, Oakland, Calif.	12,850	23.35
W8XAL	Crosley Radio Corporation, Cincinnati, Ohio	6,060	49.5
W8XK	Westinghouse, East Pittsburgh, Pa.	6,140	48.86
W8XK	Westinghouse, East Pittsburgh, Pa.	9,570	31.35
W8XK	Westinghouse, East Pittsburgh, Pa.	18,880	15.89
W8XK	Westinghouse, East Pittsburgh, Pa.	15,210	19.72
W8XK	Westinghouse, East Pittsburgh, Pa.	17,780	16.87
W8XK	Westinghouse, East Pittsburgh, Pa.	21,540	13.93
W9XA	General Electric, Denver, Colo.	9,530	31.48
W9XAA	Federation of Labor, Chicago, Ill.	6,080	49.34
W9XAQ	Chicago Daily News, Chicago, Ill.	6,040	49.67
W9XU	Mona Motor Oil Co., Council Bluffs, Iowa	6,060	49.5
W9XF	Great Lakes Broadcasting Co., Chicago, Ill.	6,020	49.83
W9XF	Great Lakes Broadcasting Co., Chicago, Ill.	11,800	25.42
W9XF	Great Lakes Broadcasting Co., Chicago, Ill.	21,500	13.95

Foreign

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

VISUAL BROADCASTING STATIONS

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

FOREIGN BROADCAST STATIONS

ARGENTINA

Call		Meters
LOZ	Buenos Aires	330
LOS	Buenos Aires	291.2
LON	Buenos Aires	210
LOR	Buenos Aires	344.8
LOV	Buenos Aires	361.5
LOY	Buenos Aires	315.2
LOX	Buenos Aires	380
LOQ	Buenos Aires	261.8
LOO	Buenos Aires	252
LOJ	Buenos Aires	270
LOW	Buenos Aires	303
LOT	Buenos Aires	400
LOL	Buenos Aires	236
D3	Buenos Aires	253.3
B2	Buenos Aires	275
H5	Cordova	275
H6	Cordova	250
LOP	La Plata	425
LOU	Mendoza	380
M6	Mendoza	348
F2	Rosaria	270
F1	Santa Fe	279

AUSTRALIA

Call		Meters
5CL	Adelaide	409
5DN	Adelaide	313
5KA	Adelaide	250
2MK	Bathhurst	275
4QG	Brisbane	385
7ZL	Hobart	516
3AR	Melbourne	484
3LO	Melbourne	371
3UZ	Melbourne	319
3DB	Melbourne	255
2HD	Newcastle	288
6WF	Perth	440
2KY	Sydney	280
2FC	Sydney	451
2BL	Sydney	353
2BE	Sydney	316
2GB	Sydney	316
2UE	Sydney	293
2UW	Sydney	267
4GR	Toowoomba	294

AUSTRIA

Call		Meters
	Graz	352
	Innsbruck	283
	Insbruck	218
	Klagenfurt	453
	Linz	246
	Vienna	517

BELGIUM

Call		Meters
EB4ED	Anvers	250
EB4GT	Bruxells	260
EB4RB	Bruxells	508.5
EB4RC	Bruxells	215
EB4FO	Bruxells	230
EB4CE	Chatelineau	220
EB4FG	Dampremy	210
EB4RG	Gand	275
EB4RW	Liege	280
EB4BQ	Marchienne-Docherie	290
EB4EX	Ottomont	225
EB4CF	Verviers	215

BOLIVIA

Call		Meters
	La Paz	175
	La Paz	300

BRAZIL

Call		Meters
PRAM	Amparo	230
PRAH	Bahia	350
PRAN	Curytiba	340
PRAZ	Franca	270
PRAJ	Juiz de Fora	350
PRAY	Mogy das Cruzes	300
PRAD	Pelotas	326
PRAG	Porto Alegre	275
PRAF	Belem, Para	220
PRAP	Recife	400
PRAI	Ribeirao Preto	260
PRAA	Rio de Janeiro	400
PRAB	Rio de Janeiro	320
PRAC	Rio de Janeiro	360
PRAK	Rio de Janeiro	260
PRAS	Santos	300
PRAE	Sao Paulo	350
PRAL	Sao Paulo	400
PRAO	Sao Paulo	320
PRAR	Sao Paulo	295

BRITISH COLONIES

Call		Meters
TJW	Hamilton, Bermuda	545
ZBW	Victoria Peak, Hong Kong	350
7LO	Narobi	90
1SE	Singapore	330

BRITISH INDIA

Call		Meters
VUB	Bombay	357.1
VUC	Calcutta	370.4
VPB	Colombo	480
VUR	Rangoon	398

CANADA

Call		Meters
CKCR	Brantford	296.9
CFAC	Calgary	434.5
CKCN	Calgary	434.5
CHCA	Calgary	434.5
CJCJ	Calgary	434.5
CNRC	Calgary	434.5
CFCY	Charlottetown	312.3
CHCK	Charlottetown	312.3
CHWK	Chilliwack	247.8
CKMC	Cobault	247.8
CJRW	Fleming	296.9
CFNB	Fredericton	247.8
CHMA	Edmonton	516.9
CJCA	Edmonton	516.9
CKUA	Edmonton	516.9
CNRE	Edmonton	516.9
CHNS	Halifax	322.4
CHNS	Halifax	322.4
CKOC	Hamilton	340.9
CHCS	Hamilton	340.9
CFCH	Iroquois Falls	499.7
CFJC	Kamloops	267.7
CFMC	Kingston	267.7
CFRC	Kingston	267.7
CJOC	Lethbridge	267.7
CNRL	London	329.7
CJGC	London	329.5
CKPR	Midland	267.7
CFCF	Montreal	410.7
CHYC	Montreal	410.7
CKAC	Montreal	410.7
CNRM	Montreal	410.7
CJRM	Moose Jaw	296.9
CNRA	Moncton	475.9
CHML	Mt. Hamilton	340.9
CKCO	Ottawa	434.5
CNRO	Ottawa	434.5
CFLC	Prescott	296.9
CKPC	Preston	247.8
CKCI	Quebec	340.9
CKCV	Quebec	340.7
CNRQ	Quebec	340.9
CHRC	Quebec	340.9
CFCR	Regina	312.5
CHWC	Regina	312.3
CJBR	Regina	312.3
CNRR	Regina	312.3
CKCK	Regina	312.3
CHCT	Red Deer	356.9
CKLC	Red Deer	356.9
CNRD	Red Deer	357.1
CJHS	Saskatoon	329.5
CFQC	Saskatoon	329.5
CNRS	Saskatoon	329.5
CJOR	Sea Island	291.1
CKSH	St. Hyacinthe	296.9
CFBO	St. John	336.9
CHGS	Summerside	267.7
CJCB	Sydney, N. S.	340.9
CFRB	Toronto	312.3
CHNC	Toronto	516.9
CKNO	Toronto	516.9
CKGW	Toronto	434.8
CJBC	Toronto	517.2
CNRT	Toronto	356.9
CJSC	Toronto	516.9
CKCL	Toronto	516.9
CKOW	Toronto	356.9
CFCA	Toronto	356.9
CHLS	Vancouver	410.7
CKCD	Vancouver	410.7
CKFC	Vancouver	410.7
CKMO	Vancouver	410.7
CKWX	Vancouver	410.7
CNRV	Vancouver	291.1
CFCT	Victoria	475.9
CKY	Winnipeg	384.4
CNRW	Winnipeg	384.4
CJGX	Yorktown	475.9

CHILE

Call		Meters
CMAO	Antofagasta	
	Asuncion	
CMAI	Concepcion	345
CMAD	Santiago	320
CMAE	Santiago	280
CMAT	Tacna	550
CMAK	Temuco	245
	Valparaiso	400

CHINA

Call		Meters
COHB	Harbin	445
COMK	Mukden	425
	Shanghai	342
XGAH	Shanghai	328
XOL	Tientsin	480
GEC	Tientsin	280

COSTA RICA

Call		Meters
NRH	Heredia	306

CUBA

Call		Meters
CM6EV	Calbarien	250
CM6LO	Caibarien	325
CM7AZ	Camaguey	225
CM7LO	Camaguey	230
CM6YR	Camajuani	200
CM7BY	Ciego de Avila	235
CM7FU	Ciego de Avila	200
CM7HS	Ciego de Avila	192
CM6BY	Cienfuegos	260
CM5EV	Colon	360
CM1PK	Guanajay	190
CMI	Habana	376
CMC	Habana	357
CM2AB	Habana	250
CM2AR	Habana	248
CM2AZ	Habana	334
CM2CP	Habana	280
CM2HP	Habana	205
CM2JP	Habana	270
CM2OH	Habana	300
CM2OK	Habana	360
CM2RK	Habana	326
CM2UF	Habana	208
CM2SE	Habana	255
CM2TW	Habana	228
CM2WX	Habana	341
CM2XA	Habana	230
CM2XX	Habana	225
CM2BX	Habana	312.5
CM2JK	Habana	342.5

Call		Meters
CM2LC	Habana	315
CM2LP	Habana	359
CM2LR	Habana	215
CM2MC	Habana	243
CM2MG	Habana	292
CM2PC	Habana	212
CM2RC	Habana	258
CM2FG	Hershey	226
CM2WD	Marianao	274
CM2XX	Marianao	225
CM2JF	Marianao	252
CM2JL	Marianao	294
OM2MA	Marianao	278
CM2SW	Marianao	274
CM1AZ	Mariel	275
CM7NM	Nuevitas	264
CM6HS	Sagua la Grande	200
CM6KP	Sancti Spiritus	280
CM6MN	Santa Clara	210
CM8HS	Santa Clara	200
CM6WT	Santiago	200
CM8BY	Santiago	150
CM8KW	Santiago	250
CM6KW	Tuinucu	368

CZECHOSLOVAKIA

Call		Meters
OKR	Bratislava	279
OKB	Brno	342
	Kosice	293
	Moravska-Ostrava	263
OKP	Praha	487
	Prague	250

DANZIG

Call		Meters
	Danzig	453

DENMARK

Call		Meters
	Kalundborg	1153.8
	Kobenhavn	281
	Soro	1153.8

DUTCH EAST INDIES

Call		Meters
PFC	Batavia	220.7
PLE	Bandoeng	31.86
PLE	Bandoeng	15.93
	Bandoeng	310
PLF	Malabar	17
	Surabaya	140

EGYPT

Call		Meters
SRE	Cairo	255

ESTONIA

Call		Meters
	Tallinn	401
	Tartu	285

FINLAND

Call		Meters
OFA	Helsinki	221
OFC	Jakobstad	291
OFB	Lahti, Suomi	1796
OFD	Pori	218
OFE	Tampere	453
OFG	Turku	246
OFH	Viipuri	291

FRANCE

Call		Meters
	Bordeaux-Lafayette	304.3
PTT	Ecole Superieure	447
	Grenoble	328.2
	Lille	265.5
	Limoges	293.6
	Lyon La-Doua	465.8
	Marseille	315.8
	Montpellier	286
	Petit Parisien	326
	Radio-Agen	311.5
	Radio-Beziers	212
	Radio Juan-les-Pins	248
	Radio L. L.	368.1
	Radio Lyon	285.8
	Radio-Mont-de-Marsan	400
	Radio-Montpellier	250.1
	Radio-Nimes	240
	Radio Normandie	213.5
	Radio-Paris	1724
	Radio-Sud-Quest	237.2
	Radio Toulouse	380.7
	Eiffel	1444
	Radio Vitus	309
	Rennes	22
	Strasbourg	345.2
	Toulouse-Pyrenees	255.3

FRENCH COLONIES

Call		Meters
8DB	Algiers	363.7
8KR	Constantine	42.8
	Haiphong	320
	Radio S. Denis, Reunion	500
TUA	Tunis	1450

GERMANY

Call		Meters
	Aachen	453
	Augsburg	560
	Berlin I	419
	Berlin II	284
	Bremen	319
	Breslau	325
	Dresden	319
	Flensburg	218
	Frankfurt	390
	Freiburg	569
	Gleiwitz	253
	Hamburg	372
	Hanover	560
	Kaiserslautern	270
	Kassel	246
	Kiel	246
	Koln	227
	Konigsberg	276
	Konigswusterhausen	1635
	Langenberg	473
	Leipzig	259
	Magdeburg	283
	Munchen	533
	Munster	234
	Numberg	239
	Stettin	283
	Stuttgart	360
	Zeesen	1635

GREAT BRITAIN

Call		Meters
2BD	Aberdeen	301
2BE	Belfast	242
6BM	Bournemouth	288.5
2LS	Bradford	288.5
5WA	Cardiff	310
5GB	Daventry	479
5XX	Daventry	1553
2DE	Dundee	288.5
2EH	Edinburgh	288.5
5SC	Glasgow	399
6KH	Hull	288.5
2LS	Leeds-Bradford	200
6LV	Liverpool	288.5
2LO	London	356
2ZY	Manchester	377
5NO	Newcastle	261
5PY	Plymouth	288.5
6FL	Sheffield	288.5
6ST	Stoke-on-Trent	288.5
5SX	Swansea	288.5

HAITI

Call		Meters
HHK	Port au Prince	361.2

HOLLAND

Call		Meters
	Bloemendaal	245.9
HDO	Hilversum	1071
	Hilversum	298
	Huizen	1875
	Scheveningen	1071

HONDURAS

Call		Meters
HRB	Tegucigalpa	399.5

HUNGARY

Call		Meters
	Lakihegy	550

ICELAND

Call		Meters
	Akureyri	192
	Reykjavik	

IRISH FREE STATE

Call		Meters
6CK	Cork	225
2RN	Dublin	413

ITALY

Call		Meters
1BO	Bolzano	445.9
1GE	Genoa	385.1
1MI	Milan	500.8
1NA	Naples	331.4
	Palermo	209.8
1RO	Rome	441.1
1TO	Torino	275.2
	Trieste	256.4

JAPAN

Call		Meters
JQAK	Dairen	395
JOFK	Hiroshima	353
JOJK	Kanazawa	423
JODK	Keijo	366
JOGK	Kumamoto	380
JOCK	Nagoya	370
JOBK	Osaka	400
JOIK	Sapporo	361
JOHK	Sendai	390
JOAK	Tokyo	345

JUGOSLAVIA

Call		Meters
	Belgrade	429
	Ljubljano	566
	Zagreb	308

LATVIA

Call		Meters
YLZ	Riga	525

LITHUANIA

Call		Meters
RYK	Kaunas	1935

MEXICO

Call		Meters
XFF	Chihuahua	325
XEA	Guadalajara	250
XFC	Jalapa	475
XES	Lerdo	250
XEY	Merida	548.6
XEX	Mexico City	825
XFX	Mexico City	357
XEN	Mexico City	410
XEB	Mexico City	450
XFG	Mexico City	470
XFI	Mexico City	507
XFA	Mexico City	600-500
XEO	Mexico City	254
XER	Mexico City	254
XEH	Monterey	311
XEI	Morelia	300
XEF	Oaxaca	265
XEE	Puebla	312

MONACO

Call		Meters
	Monaco	237

MOROCCO

Call		Meters
CNO	Casablanca	250
AIN	Casablanca	51
	Rabat	416
	Rabat	724.6

NEW ZEALAND

Call		Meters
1ZB	Auckland	275.2
1ZQ	Auckland	252.1
1YA	Auckland	333.3
3ZC	Christchurch	250
3YA	Christchurch	306.1
4ZB	Dunedin	277.8
4ZO	Dunedin	277.8
4ZL	Dunedin	245.9
4ZM	Dunedin	277.8
4YA	Dunedin	461.5
2ZE	Eketahuna	247.9
2ZM	Gisborne	260.9
4ZI	Invercargill	258
4ZP	Invercargill	258
2ZD	Masterton	254.2
2ZQ	Masterton	254.2
2ZH	Napier	238
2YB	New Plymouth	254.9
2ZF	Palmerston	285.7
2ZG	Wanganui	500
2ZK	Wanganui	500
2YA	Wellington	416.7

NORWAY

Call		Meters
LKA	Alesund	453
LKB	Bergen	364
LKF	Fredriksstad	394
LKH	Hamar	570
LKN	Notodden	283
LKO	Oslo	493
LKP	Porsgrund	453
LKR	Rjuken	447
LKM	Tromso	453
	Trondihen	1072
LKT	Trondelag Kringkoster	453.1

PERU

Call		Meters
OAX	Lima	380

PHILIPPINE ISLANDS

Call		Meters
KZRC	Cebu	230.8
KZIB	Manila	260
KZKZ	Manila	270.3
KZRM	Manila	413

POLAND

Call		Meters
	Krakow	313
	Krakow	244
	Kattowitz	408
SP6	Lodz	233.8
	Poznan	335
SP6	Lwow	385.1
SP8	Warsawa II	214
	Warszawa	1411
	Wilno	385.1

PORTUGAL

Call		Meters
PIAA	Lisbon	305

ROUMANIA

Call		Meters
	Bucharest	394
	Bucharest	226
	Jassy	211

SALVADOR

Call		Meters
AQM	Salvador	482

SPAIN

Call		Meters
EAJ18	Almeria	251
EAJ13	Barcelona	462
EAJ1	Barcelona	344.8
EAJ12	Barcelona	268
EAJ9	Bilbao	434.8
EAJ3	Cadiz	400
EAJ16	Cartagena	246
EAR5	Las Palmas	250
EAR5	Las Palmas	350
EAJ7	Madrid	375
EAJ2	Madrid	424
EAJ25	Malaga	100
EAJ19	Oviedo	268
EAJ27	Salamanca	453
EAJ8	San Sebastian	349
EAJ17	Seville	368

SWEDEN

Call		Meters
SBE	Boden	1200
SCA	Boras	231
SCB	Eskilstuna	246
SCC	Falum	322
SCD	Gavle	204.1
SBB	Goteborg	322
SCE	Halmstad	216
SCG	Halsingborg	231
SBH	Horby	257
SCF	Hudiksvall	270
SCH	Jonkoping	202
SCI	Kalmar	246
SCJ	Karlskrona	196
SCK	Karlstadt	218
SCL	Kiruna	246
SCM	Kristnehamm	203
SCN	Malmberget	436
SBC	Malmo	231
SBG	Motala	1348
SCO	Norrkoping	270
SCV	Orebro	237
SCW	Ornskoldsvik	218
SBF	Ostersund	770
SCP	Saffle	246
SCP	Stockholm	436
SBA	Sundsvall	542
SBD	Trollhattan	270
SCQ	Uddevalla	283
SCR	Umea	231
SCS	Uppsla	453
SCT	Varborg	283
SCU		

SWITZERLAND

Call		Meters
HB3	Bale	1010
	Berne	403
	Geneva	760
	Lausanne	680
HBZ	Zurich	459

TURKEY

Call		Meters
	Angora	1806
TAL	Istanbul	1200
	Osmanieh	1200

UNION OF SOVIET SOCIALIST REPUBLICS

Call		Meters
RV19	Achkhabad	899.1
RV26	Artemovsk	370
RV35	Astrakhan	690
RV8	Bakou	1380
RV30	Dnepropetrovsk	383
RV21	Erivan	750
RV40	Gomel	483
RV23	Groznyi	577
RV14	Irkoutsk	1600
RV31	Ivanovo-Voznesensk	337
RV17	Kazan	486
RV4	Kharkov	1304
RV20	Kharkov	426
RV9	Kiev	800
RV33	Krasnodar	461.5
RV3	Leningrad	1000
RV36	Leningrad	351
RV27	Makhatch Kala	443.8
RV10	Minsk	700
RV1	Moscow	1481
RV2	Moscow	720
RV37	Moscow	379
RV39	Moscow	379
RV42	Nijni-Novgorod	406
RV43	Nikolaev	366
RV6	Novosibirsk	1250
RV13	Odessa	411
RV44	Omsk	636
RV45	Orenbourg	650
RV22	Oufa	554.7
RV46	Petropavlovsk	437
RV29	Petrozavodsk	778
RV34	Piatigorsk	347
RV12	Rostov-sur-le-Don	848.7
RV16	Samara	417
RV18	Samarkand	875
RV24	Smolensk	565
RV32	Stavropol	545
RV49	Stchelkovo	938
RV5	Sverdlovsk	825
RV11	Tachkent	712
RV7	Tiflis	1060
RV48	Tomsk	465
RV41	Veliki Oustug	535.7
RV28	Vladivostok	480
RV25	Voronej	468.8

URUGUAY

Call		Meters
CWOA	Montevideo	428.4
CWOH	Montevideo	300
CWOO	Montevideo	294.1
CWOR	Montevideo	394.6
CWOS	Montevideo	380
CWSK	Montevideo	250
CWSC	Montevideo	277.8
CWOB	Montevideo	290
CWOW	Montevideo	450
CWSI	Paysandu	268
CWOI	Salto	246
CWOJ	Salto	250

UNION OF SOUTH AFRICA

Call		Meters
ZTC	Capetown	375
ZTD	Durban	406.5
ZTJ	Johannesburg	450
ZTJ	Johannesburg	32
	Pretoria	323

VENEZUELA

Call		Meters
AYRE	Caracas	375

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

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

AIR-LINE DISTANCES IN STATUTE MILES

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

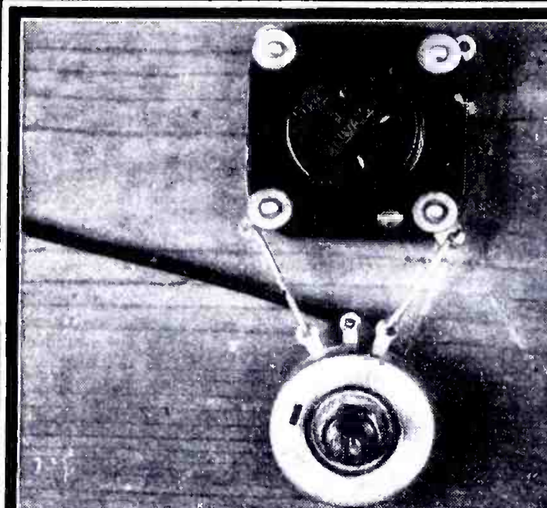
AIR-LINE DISTANCES IN STATUTE MILES

FROM/TO	Miami, Fla.	Minneapolis, Minn.	Missoula, Mont.	Nashville, Tenn.	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma, Okla.	Omaha, Nebr.	Philadelphia, Pa.	Phoenix, Ariz.	Pittsburgh, Pa.	Portland, Me.	Portland, Ore.	Richmond, Va.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Schenectady, N. Y.	Seattle, Wash.	Shreveport, La.	Spokane, Wash.	Springfield, Mass.	Vermillion, S. Dak.	Washington, D. C.
Albuquerque, N. Mex.	1710	980	895	1117	1030	1810	1696	518	718	1748	330	1498	2015	1107	1628	938	483	893	1823	1178	764	1028	1889	742	1648
Atlanta, Ga.	610	905	1790	218	427	747	507	753	815	653	1592	520	1022	2172	470	467	1580	2133	840	2180	548	1960	863	917	542
Baltimore, Md.	958	948	1947	597	1001	170	167	1173	1026	90	2202	194	446	2367	128	731	1858	2451	278	2341	1064	2110	282	1083	33
Boise, Idaho	2368	1140	252	1631	1713	2153	2137	1138	1044	2113	733	1863	2282	349	2060	1389	292	516	2120	405	1433	290	2196	973	2045
Boston, Mass.	1258	1125	2124	941	1359	188	467	1490	1280	268	2295	478	100	2553	471	1036	2099	2696	150	2508	1410	2279	79	1314	392
Brownsville, Tex.	1100	1335	1706	952	536	1695	1465	659	1061	1614	1023	1424	1961	1944	1428	975	1317	1675	1770	2015	510	1852	1805	1161	1493
Buffalo, N. Y.	1184	733	1740	626	1087	291	435	1117	883	278	1904	178	438	2167	375	662	1701	2298	249	2130	1080	1900	325	916	290
Chicago, Ill.	1190	356	1348	394	831	711	696	689	432	664	1451	411	892	1765	618	250	1260	1855	702	1743	725	1514	774	479	594
Cincinnati, Ohio	957	603	1578	239	708	568	474	755	620	501	1578	258	802	1987	399	308	1450	2037	605	1974	688	1746	659	694	403
Cleveland, Ohio	1088	632	1640	456	922	404	429	946	738	343	1745	115	603	2063	353	490	1567	2163	408	2035	904	1804	473	785	303
Denver, Colo.	1732	699	670	1018	1079	1628	1562	503	485	1575	585	1320	1803	985	1488	793	372	946	1618	1020	799	827	1692	468	1490
Des Moines, Iowa	1338	235	1074	523	825	1023	983	469	122	972	1154	718	1197	1479	905	270	952	1547	1012	1470	624	1243	1085	187	895
Detroit, Mich.	1156	542	1552	468	938	483	522	905	666	444	1685	208	657	1975	445	452	1490	2087	467	1945	891	1715	540	705	397
El Paso, Tex.	1662	1156	1115	1169	986	1902	1755	578	875	1834	347	1592	2126	1286	1695	1033	689	993	1930	1373	752	1238	1990	920	1726
Fargo, N. Dak.	1721	219	819	900	1221	1213	1258	786	390	1186	1225	952	1313	1248	1180	658	865	1447	1157	1206	1002	976	1240	284	1141
Fort Worth, Tex.	1150	870	1312	643	470	1398	1226	188	590	1324	858	1097	1642	1612	1170	568	977	1454	1445	1658	209	1470	1495	689	1210
Galveston, Tex.	941	1087	1595	666	288	1415	1195	456	828	1335	1065	1140	1678	1885	1154	697	1249	1693	1487	1938	233	1753	1524	938	1214
Hastings, Nebr.	1468	399	891	697	870	1275	1216	357	135	1222	901	967	1454	1271	1142	455	708	1297	1267	1288	615	1061	1340	167	1139
Hot Springs, Ark.	983	722	1385	370	358	1125	955	260	490	1051	1094	825	1371	1733	897	325	1116	1648	1175	1759	142	1552	1224	605	936
Houghton, Mich.	1545	272	1208	760	1187	849	946	926	547	827	1550	630	924	1638	870	591	1242	1833	776	1588	1043	1360	860	510	813
Jacksonville, Fla.	328	1192	2070	502	511	838	548	988	1098	758	1800	703	1113	2442	953	755	1840	2375	960	2450	733	2239	957	1203	647
Kansas City, Mo.	1247	413	1117	472	678	1097	1009	293	165	1037	1045	784	1300	1397	937	238	922	1500	1107	1505	326	1286	1173	280	943
Los Angeles, Calif.	2355	1522	910	1777	1675	2446	2352	1182	1312	2388	357	2135	2631	825	2283	1585	577	345	2445	956	1420	939	2515	1291	2295
Louisville, Ky.	923	605	1550	153	623	650	528	675	579	580	1512	345	892	1953	457	242	1400	1983	695	1945	598	1720	745	663	473
Memphis, Tenn.	878	700	1483	195	358	953	778	422	529	878	1264	660	1205	1852	722	242	1250	1800	1010	1867	279	1652	1055	642	763
Miami, Fla.	......	1516	2359	821	681	1095	802	1233	1402	1023	1998	1014	1357	2716	831	1067	2098	2603	1229	2740	950	2528	1210	1510	927
Minneapolis, Minn.	1516	......	1010	695	1050	1019	1047	692	291	985	1279	745	1145	1435	968	464	988	1585	975	1403	859	1173	1056	238	936
Missoula, Mont.	2359	1010	......	1582	1733	2030	2045	1162	978	1997	932	1754	2133	430	1967	1331	435	762	1978	395	1457	170	2060	887	1940
Nashville, Tenn.	821	695	1582	......	470	758	586	602	604	683	1445	472	1015	1970	526	253	1390	1958	820	1973	470	1752	863	704	567
New Orleans, La.	681	1050	1733	470	......	1173	932	575	845	1090	1318	923	1445	2063	899	599	1433	1923	1259	2098	280	1898	1287	960	968
New York, N. Y.	1095	1019	2030	758	1173	......	293	1324	1144	83	2142	313	277	2455	287	873	1972	2568	142	2419	1230	2190	120	1189	204
Norfolk, Va.	802	1047	2045	586	932	293	......	1186	1095	220	2027	316	565	2458	79	771	1925	2510	426	2440	1037	2211	411	1166	145
Oklahoma, Okla.	1233	692	1162	602	575	1324	1186	......	405	1256	843	1013	1550	1488	1122	456	862	1386	1354	1523	297	1324	1412	502	1150
Omaha, Nebr.	1402	291	978	604	845	1144	1095	405	......	1094	1032	837	1318	1373	1020	352	833	1425	1133	1372	617	1149	1205	115	1012
Philadelphia, Pa.	1023	985	1997	683	1090	83	220	1256	1094	......	2079	254	360	2419	205	808	1923	2518	205	2388	1153	2159	201	1143	122
Phoenix, Ariz.	1998	1279	932	1445	1318	2142	2027	843	1032	2079	......	1829	2345	1007	1960	1270	504	652	2152	1112	1067	1020	2220	1043	1980
Pittsburgh, Pa.	1014	745	1754	472	923	313	316	1013	837	254	1829	......	545	2174	242	561	1670	2264	350	2145	939	1918	400	891	188
Portland, Me.	1357	1145	2133	1015	1445	277	565	1550	1318	360	2345	545	......	2563	565	1094	2127	2725	197	2513	1484	2285	159	1345	480
Portland, Oreg.	2716	1435	430	1970	2063	2455	2458	1488	1373	2419	1007	2174	2563	......	2381	1723	636	536	2405	143	1783	295	2488	1293	2360
Richmond, Va.	831	968	1967	526	899	287	79	1122	1020	205	1960	242	565	2381	......	699	1850	2436	406	2362	985	2133	407	1089	96
St. Louis, Mo.	1067	464	1331	253	599	873	771	456	352	808	1270	561	1094	1723	699	......	1158	1738	898	1722	466	1500	958	450	710
Salt Lake City, Utah	2098	988	435	1390	1433	1972	1925	862	833	1923	504	1670	2127	636	1850	1158	......	592	1950	697	1155	548	2027	785	1845
San Francisco, Calif.	2603	1585	762	1958	1923	2568	2510	1386	1425	2518	652	2264	2725	536	2436	1738	582	......	2548	680	1655	730	2625	1383	2437
Schenectady, N. Y.	1229	975	1978	820	1259	142	426	1354	1133	205	2152	350	197	2405	406	989	1950	2548	......	2363	1290	2139	86	1165	313
Seattle, Wash.	2740	1403	395	1973	2098	2419	2440	1523	1372	2388	1112	2145	2513	143	2362	1722	697	680	2363	......	1820	229	2445	1282	2335
Shreveport, La.	950	859	1457	470	280	1230	1037	297	617	1153	1067	939	1484	1783	985	466	1155	1655	1290	1820	......	1621	1333	726	1035
Spokane, Wash.	2528	1173	170	1752	1898	2190	2211	1324	1149	2159	1020	1918	2285	295	2133	1500	548	730	2139	229	1621	......	2216	1055	2105
Springfield, Mass.	1210	1056	2060	863	1287	120	411	1412	1205	201	2220	400	159	2488	407	958	2027	2625	86	2445	1333	2216	......	1242	321
Vermillion, S. Dak.	1510	238	887	704	960	1189	1166	502	115	1143	1043	891	1345	1293	1089	450	785	1383	1165	1282	725	1055	1242	......	1073
Washington, D. C.	927	936	1940	567	968	204	145	1150	1012	122	1980	188	480	2360	96	710	1845	2437	313	2335	1035	2105	321	1073	......

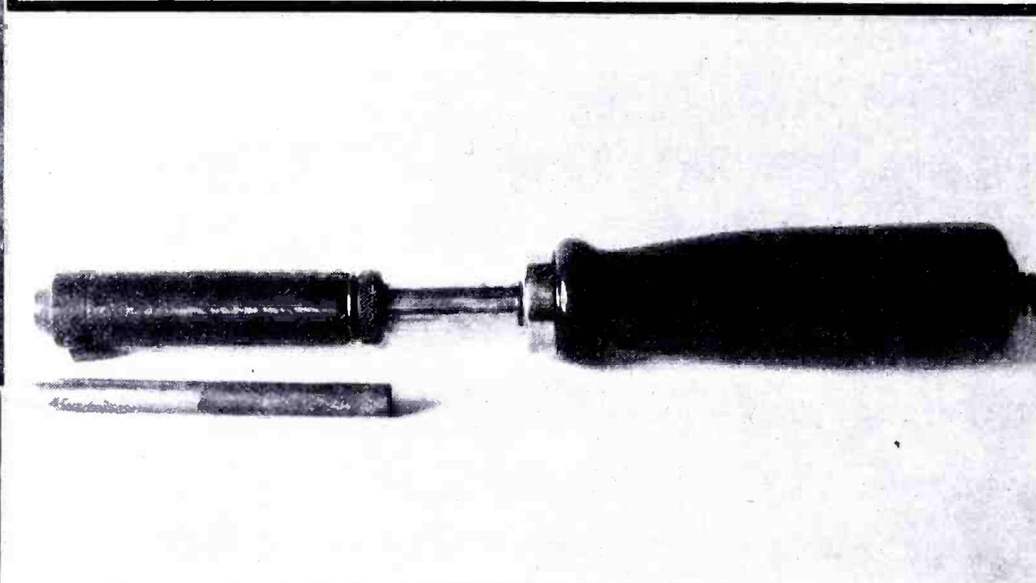
—Compiled by Department of Commerce.

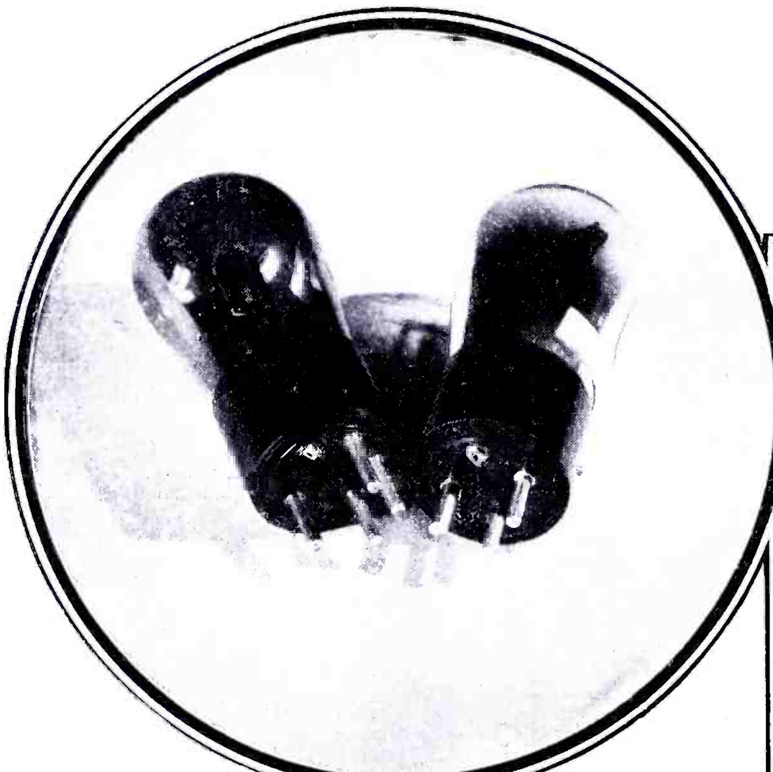
PICTORIAL RADIO

Here's a trick that will appeal to the repairman. Instead of using the regular solder for tinning the tip of your iron, take the tip to a jeweler and have him tin about two inches of it with regular silver solder, which has an extremely high melting point and does not oxidize readily. This eliminates filing and retinning constantly.

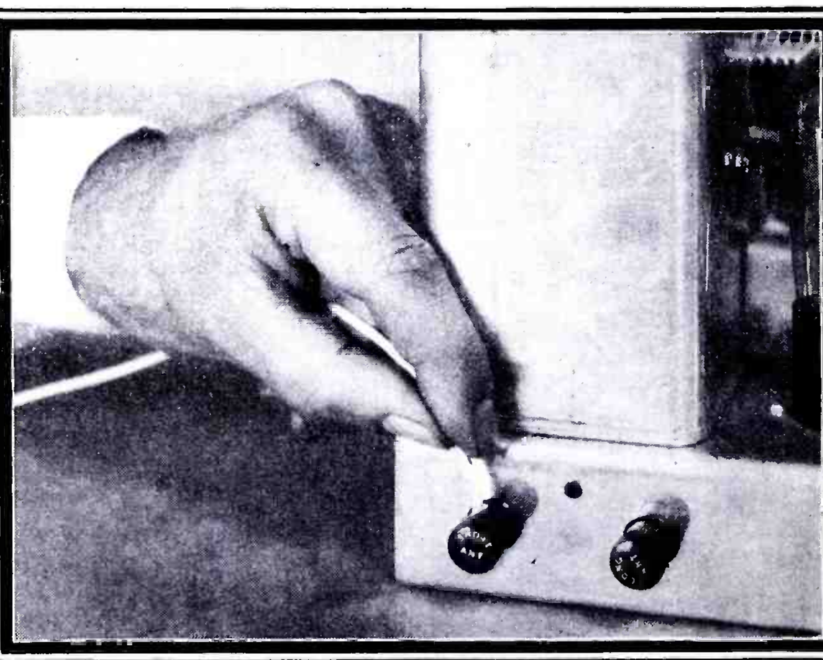


Adding a 25 ohm potentiometer to the filament circuit of the detector tube in A eliminator operated sets may stop the hum that is usually encountered. The potentiometer is placed across the filament terminals and the center tap goes to the grid return of the detector. By moving the arm the point of minimum hum can be found.

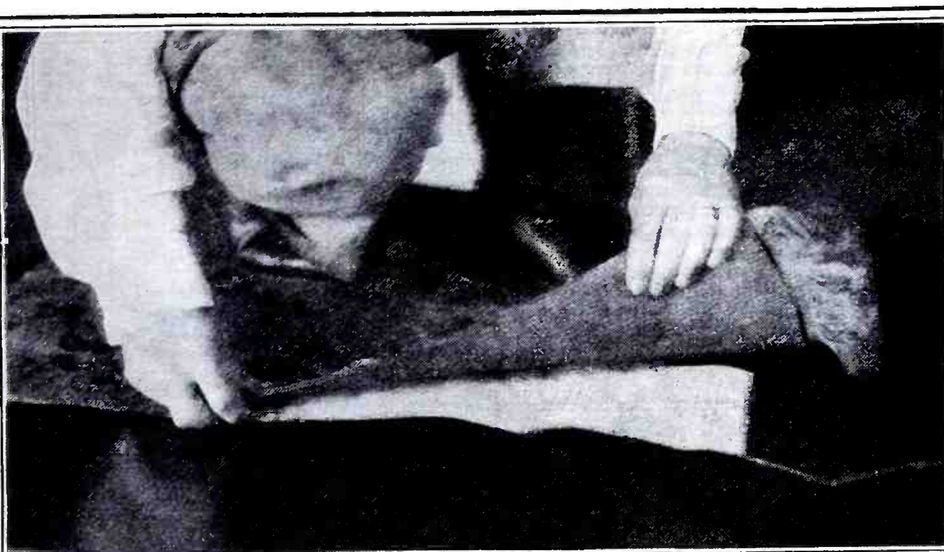




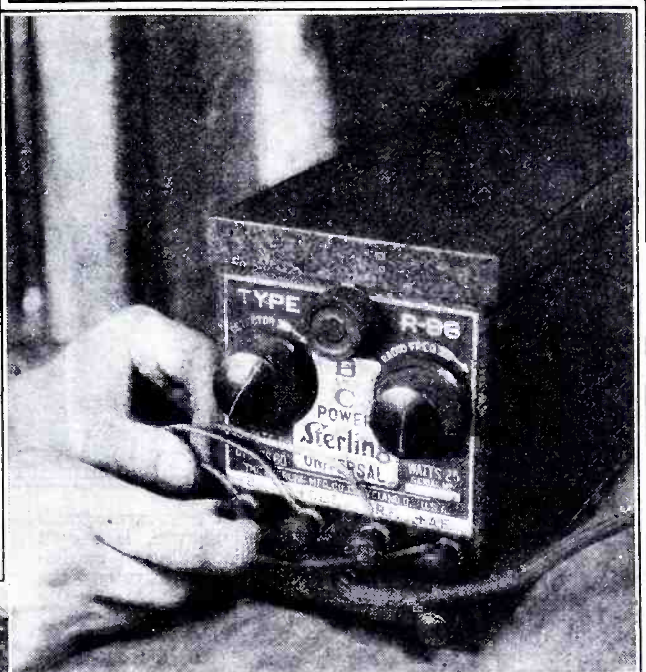
Left: When neutralizing a receiver using 227 tubes and not desiring to remove a 227 on account of the increased voltage on the remaining tubes, take a good 227 and cut off the cathode prong, slipping this tube into the socket and neutralizing that particular stage. When a 226 is used, merely cut off one of the filament prongs and use this tube when neuthalizing the 226 stages.



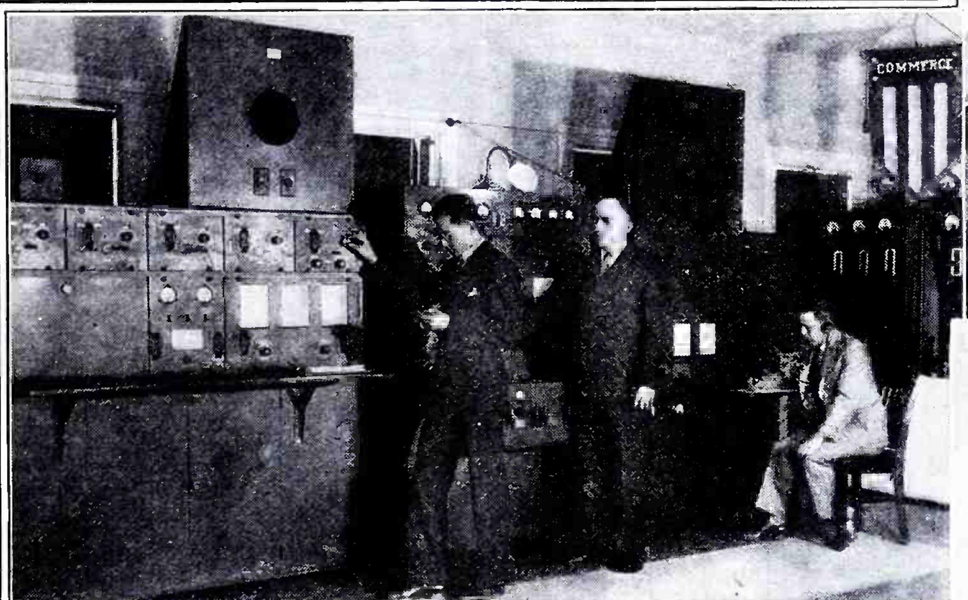
Right: Substituting the ground lead of a receiver for the antenna in case the latter is broken or short circuited will help the listener out for the time being. The ground lead should be attached to the short antenna post, since by that connection the greatest amount of winding in the primary is employed.



To the left we see an enterprising service man installing one of the Potter rug aerials in a home where a screen grid set is being demonstrated. This saves the service man's time, and if the demonstration is a success undoubtedly he will profit by the sale of the rug aerial. Thus it might be a good idea for a service man to carry one of these devices in his repair kit.

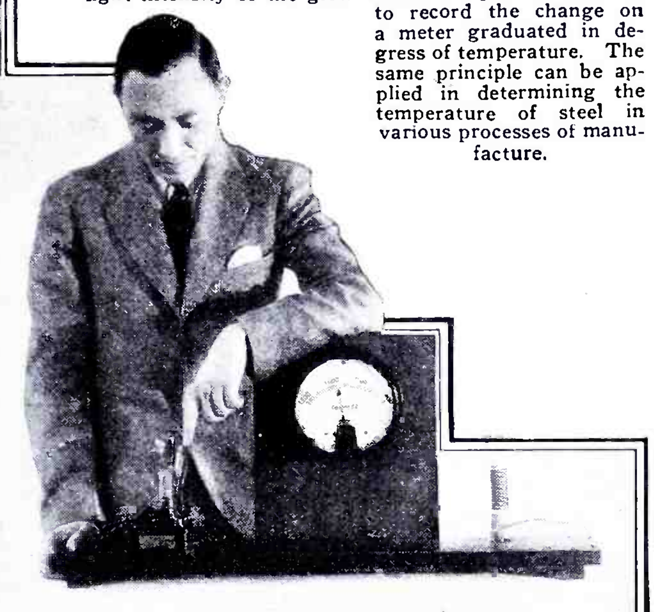


At the right is shown a stunt for getting a C bias from an eliminator not so equipped. Merely shift the B minus terminal up from that position to the plus detector terminal. This leaves the old B minus as the C minus terminal, which can be varied with the detector control. The overall voltage of the eliminator, however, will be reduced by the amount of the C bias.



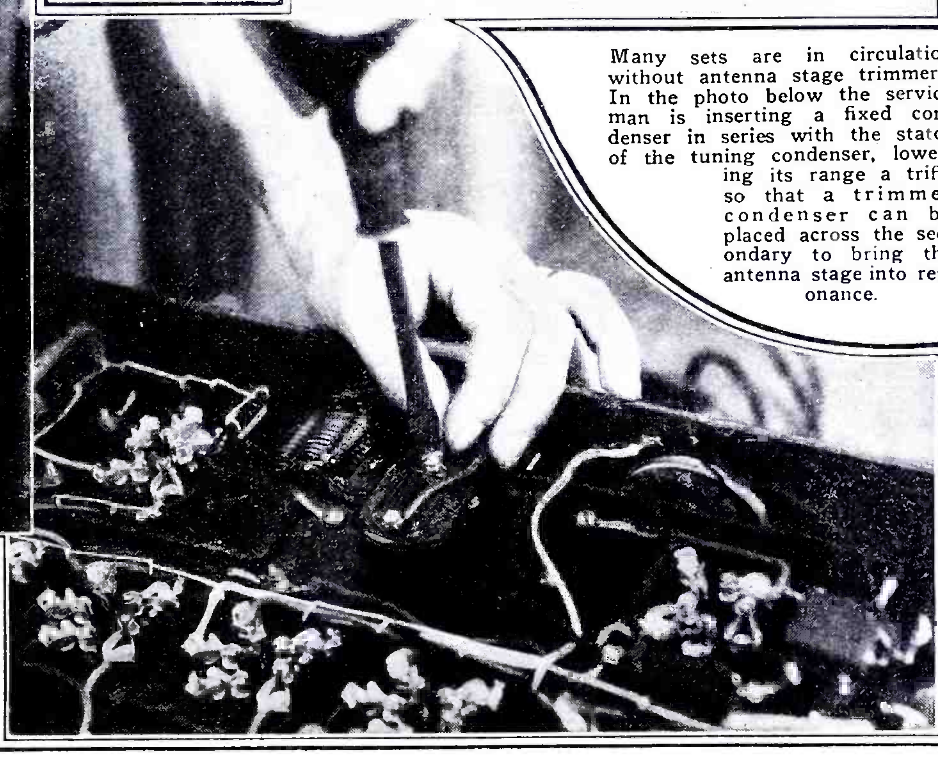
In the photograph above may be seen the monitor station used by the Department of Commerce radio supervisor with headquarters at Boston. With the equipment shown here inspectors can check wavelengths of ship, shore, broadcast, amateur and plane transmitters. At the left is the long wave apparatus for work up at 3,000 meters, while the short wave monitor for use down to 10 meters is at the right. Radio Supervisor Charles C. Kolster in center.

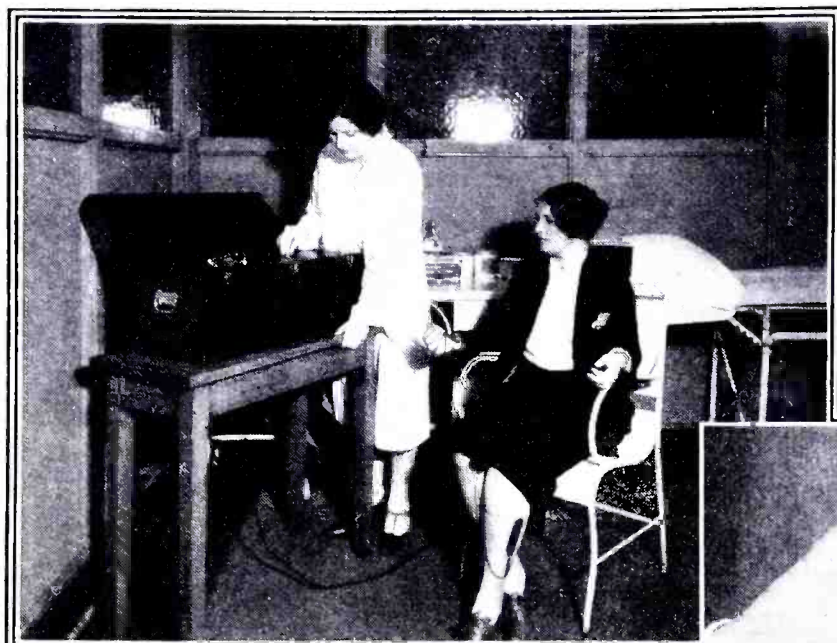
J. V. Breisky (below), Westinghouse research engineer, demonstrating the use of the photo-electric cell in a tmperature control. As the current is varied in the electric heater at the right, the change in the light intensity of the glow causes the photo-cell (left) to record the change on a meter graduated in degress of temperature. The same principle can be applied in determining the temperature of steel in various processes of manufacture.



Where springs in tube sockets do not make electrical contact with the tube prongs on account of oxidization, a pair of diagonal cutters, as shown above, may be used to cut a ring around the end of each prong. This ring, being raised, cleans off contact corrosion when the tube is worked up and down in the socket.

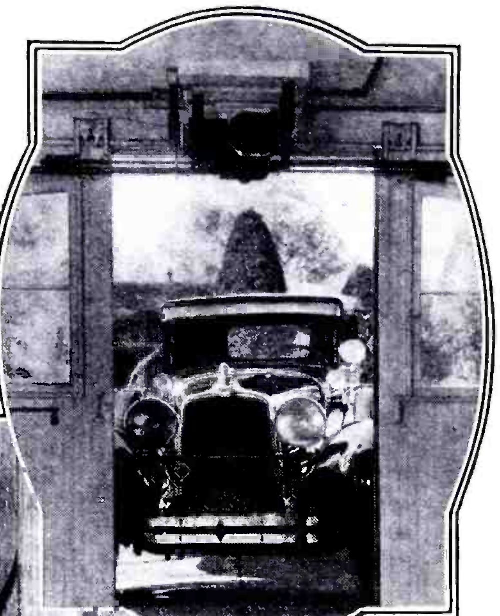
Many sets are in circulation without antenna stage trimmers. In the photo below the service man is inserting a fixed condenser in series with the stator of the tuning condenser, lowering its range a trifle so that a trimmer condenser can be placed across the secondary to bring the antenna stage into resonance.

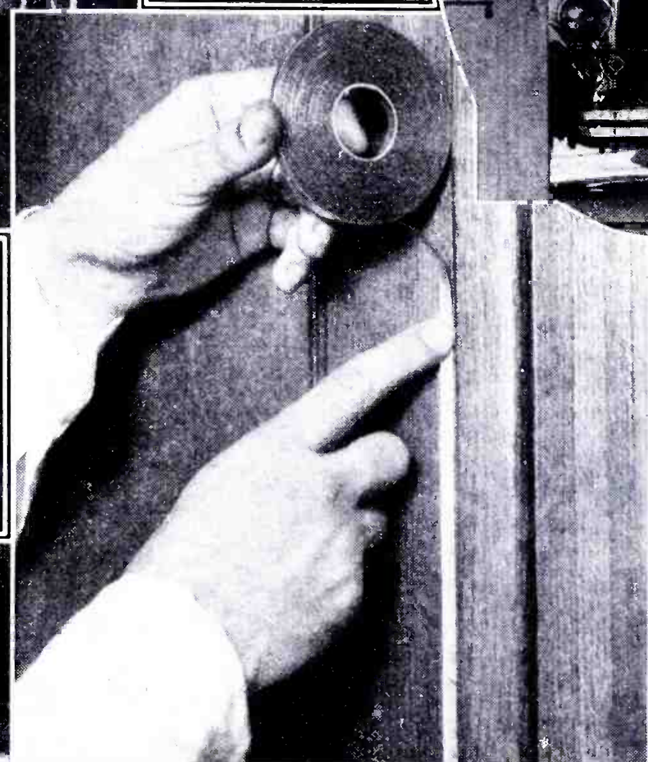




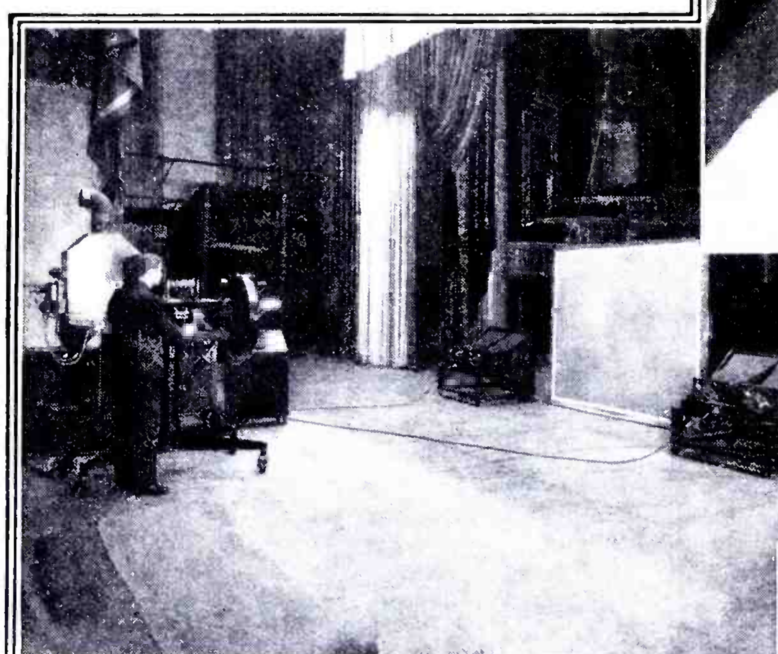
The latest of the several versions of electrocardiograph machines, this one attributed to Westinghouse, is shown in the photograph above. The nurse is taking a cardiogram of the patient's heart action. Simply stated, the heart generates a voltage which may be recorded visually and photographically. The latter process gives the doctor a record of the patient's heart action which is quite valuable in diagnostic work. The radio angle to such a device is the voltage amplifier necessary to step-up the weak heart action voltage to a value capable of actuating a galvanometer

Here's a radio garage door opener illustrated at the right. It is one of the products of the Barber-Colman Co., Middle West manufacturers. A miniature transmitter is attached to your automobile. When approaching your garage, simply press a button; the door opens automatically and you drive in, by day or night. Safety devices prevent the door closing prematurely

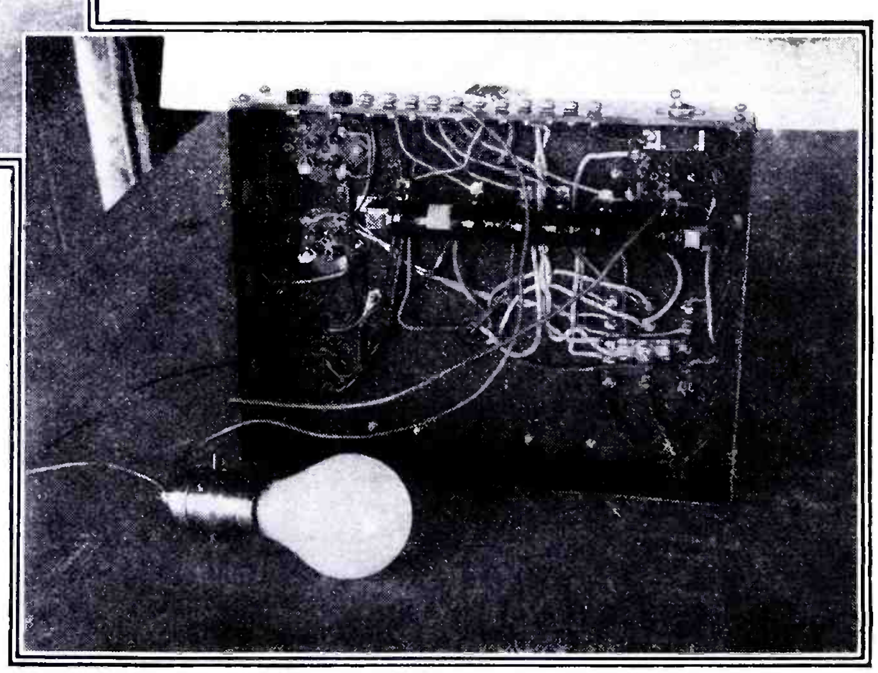




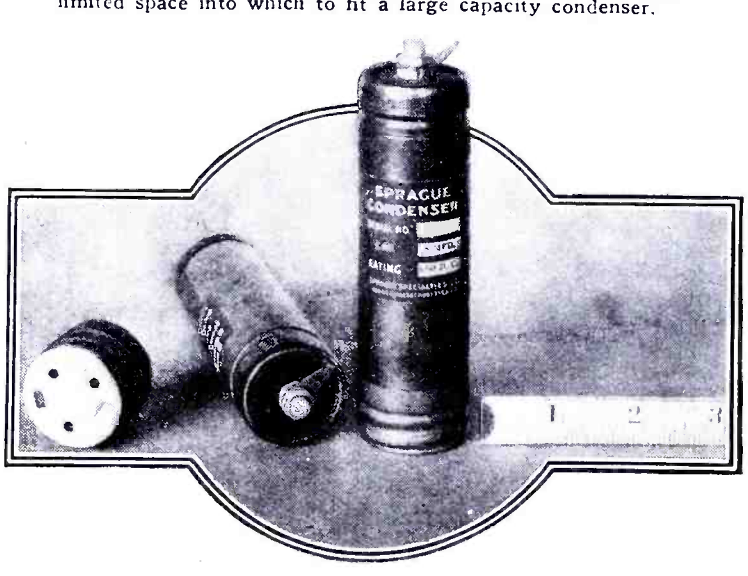
At the left we illustrate a means of putting up an aerial in the room without a great deal of trouble. Simply run the desired length of antenna in the form of a Stik-tape aerial, one of the products recently announced by the Sampson Industries, Inc.



The stage shown at the left is one of the new television set-ups for a public demonstration recently made in Schenectady, when Dr. Alexanderson of General Electric fame projected a picture on a screen 6 by 7 feet, which was clearly visible to all in the audience. Speakers at the sides reproduced the voice which accompanied the picture.



Radio design trends point to greater compactness than ever before, as is indicated in the electrolytic condenser illustrated below, where a large capacity is available in small space. This is also desirable from the standpoint of a repairman who has only a limited space into which to fit a large capacity condenser.



When a filter condenser blows in a power pack it does not give you its street address. Consequently you have to find out for yourself which one of three or four condensers has blown. A simple way is shown above, where a 110-volt lamp is placed in series with the a.c. line and two test points brought out to be placed across the extremities of the voltage divider. If the lamp lights it will indicate one of the condensers is shorted. Remove, one at a time, filter condenser pigtails until light goes out. The condenser which caused light to go out is the shorted one

Pilot Auto Radio Permits Mounting On Running Board of Car

Receiver is Controlled From Inside of Car by Means of Flexible Cable: Kit Easily Assembled

PRACTICALLY all of the automobile radio receivers that have appeared so far are intended for concealment behind the instrument board or under the engine covers. A new set in kit form, recently placed on the market by the Pilot Radio & Tube Corporation, is rather unusual in that it is designed only for mounting on the running board, or possibly in the rumble seat of roadsters and coupés. The new outfit, bearing the name "Auto Pilot," must be assembled, wired and installed by the individual purchaser, who will find the work easy, interesting and enjoyable.

Remote Control

The receiving unit itself is contained in a black japanned steel case. This is 22 inches long, 8 inches wide and 6⅞ inches high, and is flat enough to let the doors of all makes of cars clear it by a comfortable margin. The set is controlled from the inside of the car by means of a flexible cable which terminates at a neat little control box 5½ inches square and 2 inches deep. The cable is 6 feet long and is enclosed in a protective sheath of waterproof fabric. It may be cut down if the distance between the set and the control box in any particular car is less than 6 feet.

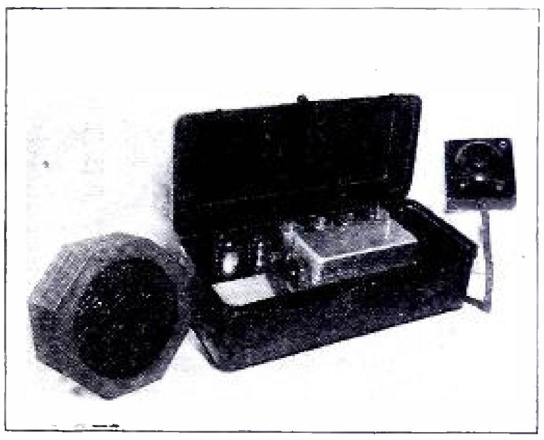


Fig. 1. ***The complete Pilot auto receiver is shown in this photograph; the speaker at the left, receiver in center, and the tuning control at the right***

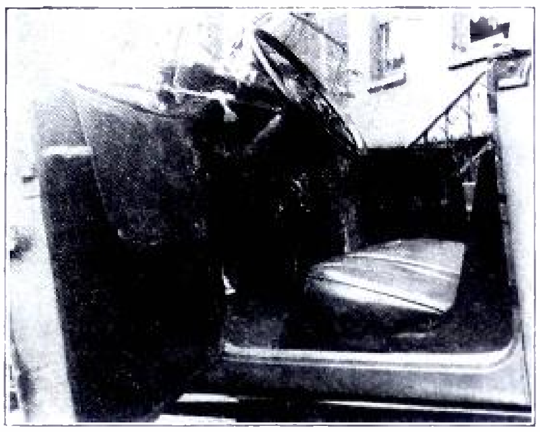


Fig. 2. ***As may be seen in this picture the tuning control is mounted at the right under the dash where it is easily accessible***

The movement of the dial on the control panel is transmitted to the shaft of the variable condenser by means of two brass chains fastened to molded bakelite pulleys at both ends. These chains slide in separate flexible tubes, and run quite smoothly in spite of their length. The other devices on the control panel are the usual volume control, filament switch and pilot light. The volume control is a potentiometer that regulates

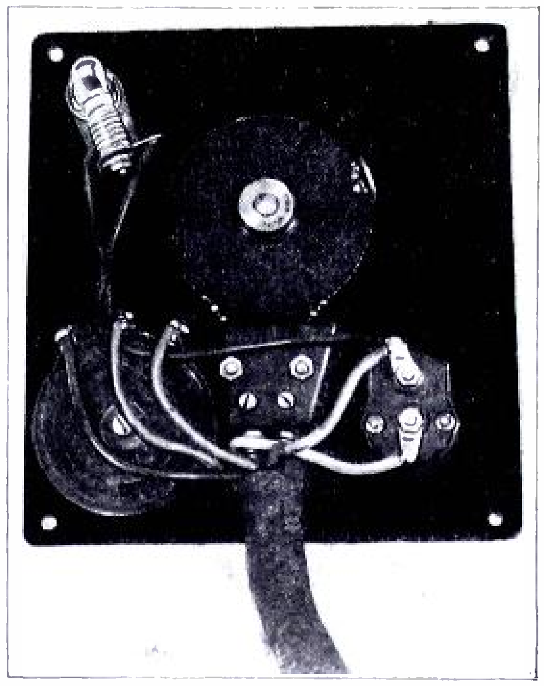


Fig. 3. ***This photograph shows the rear of the tuning control panel***

the voltage applied to the screens of the r.f. amplifying tubes.

Reliable Design

Electrically, the receiver is of simple but reliable design. It makes use of three stages of tuned r.f., a screen-grid detector, one resistance-capacity coupled audio stage and one transformer coupled stage. All the parts are mounted on a formed and drilled aluminum chassis or foundation unit. Six tubes are employed: four 224's, one 227 and one 245. They are wired in series-parallel to work off the regular six-volt storage battery in the car. Plate voltage must

(Continued on page 100)

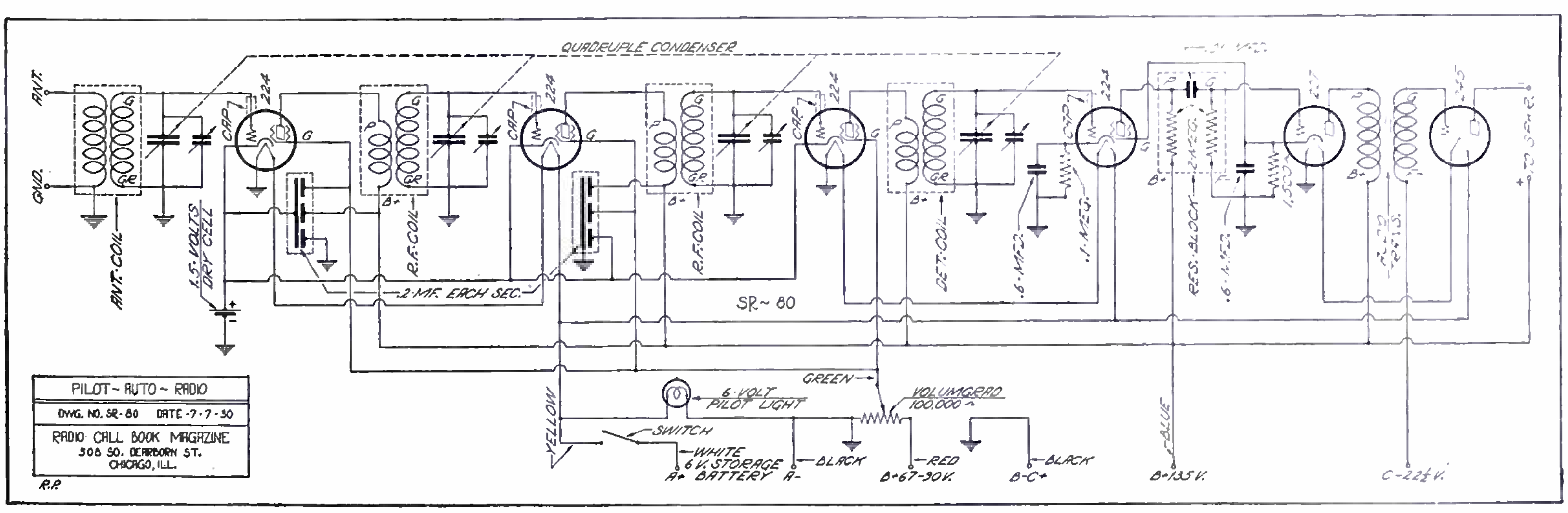


Fig. 4. ***The schematic diagram of the automobile receiver described in this article may be seen above***

Direct Current Power Transmission Is Seen With New Thyratrons

Interesting Possibilities for Employment of New Tubes as Rectifiers and Inverters

FROM a series of original investigations of electron discharges in gases which Dr. Irving Langmuir carried out in 1914 in the research laboratory of the General Electric Company has come the thyratron tube. one of the most recent additions to the tube family. It has inherent advantages as a means of controlling electric power, and has begun to be used most effectively in this manner in such unique applications as the system of operating the stage lighting of the Chicago civic opera house from in front of the footlights, and the spectacular method of decorating with light the walls and ceilings of rooms, known as colorama.

Dr. Irving Langmuir (left) and Dr. A. W. Hull, both of the General Electric laboratory, shown with the new tube which is slightly larger than the vacuum tubes employed in your receiver

But scientists believe that the possibilities of the thyratron tube are not confined to the function of control. The men who have been responsible for its creation and development believe it may also become the means at some future time of accomplishing power transmission under more advantageous electrical conditions than those at present prevailing. This idea is based on the expectation that the thyratron tube may make it possible to transmit electrical energy over relatively long distances by means of direct current instead of alternating current.

Transmission Experiment

Seeking to develop this proposition, an experimental miniature transmission line has been set up in the General Electric research laboratory and equipped with thyratron tubes. The artificial transmission line itself was represented by a copper bar about seven or eight feet in length. Electrical conditions were imposed, in the matter of ohmic resistance, which made this line equivalent to 400 miles of transmission conductor in a commercial system. As the longest commercial system now in existence is 250 miles in length, this experimental line, in its electrical characteristics, was more than 50 per cent beyond present practice.

At the sending end of the line was installed a bank of thyratron tubes functioning as rectifiers, to convert alternating current into direct current for transmission purposes. At the receiving end of the line were installed other thyratron tubes which functioned, in pairs, as inverters. They inverted, or changed back, the direct current into alternating current. The source of current-supply for the experimental system was a bank of transformers which furnished alternating current at 15,000 volts.

When this interesting experiment was tried it was found that transmission of the power was accomplished without difficulty, and that the thyratrons, operating at one end as rectifiers and at the other end as inverters, handled successfully the current at 15,000 volts. At the receiving end the tubes delivered the energy to transformers, which reduced the pressure to the voltage of the working circuits in the laboratory shop, and through these circuits it was put to work in motors, just as is done in every-day practice everywhere.

As a further demonstration the experiment was later repeated with the addition of a double-conversion process at the receiving end of the experimental line. After having been inverted and sent through "step-down" transformers, the current was passed through a motor-generator set and reconverted again into direct current at working voltages. Thence it was supplied to shop circuits which required direct current, for regular work in direct-current motors.

The experiment was regarded as significant of what may be in store at some future period in electrical engineering developments. It is quite possible, from the present trend as revealed by this experiment, that within the next decade — precisely how soon, laboratory men do not care to speculate— direct-current transmission on a scale comparable with or at least approaching the present practice with alternating current will go into commercial usage.

D. C. Possibilities

Not since the earliest days of commercial application of electricity has direct-current transmission been considered practicable. In the electrical beginning of things, when arc lights first came into use, followed a few years later by Edison's incandescent lamp, almost all transmission in commercial systems was by direct current. That was fifty years ago, before the era of widespread electrical networks which serve an overwhelming majority of the nation's population. The arc-lamp systems operated on the series circuit and started in 1879 and 1880 with pressures of 2,000 volts, although in more recent times they have gone as high as 8,000 volts. The incandescent system utilized the multiple circuit and transmission

(*Continued on page* 105)

Home Built Set Analyzer May Be Made From Schematic Given Here

Flexibility, Adaptability and Ruggedness Are Features of Design For Service Men and Builders

THROUGH insistent demand we are herewith publishing the schematic circuit of a radio set analyzer which should suffice all ordinary servicing needs of the service man or professional set builder.

The requisites taken into consideration in the design of a radio set analyzer are flexibility, adaptability and ruggedness. We believe that the outlined analyzer covers these points as well as is possible from a home built standpoint.

The parts of the analyzer consist of four major meters which serve the following purposes:

M is an 0-3 volt a. c. voltmeter and having an external multiplier by which the range may be increased to 9 volts.

M_1 is an 0-8 volt d. c. voltmeter which is used when a battery operated receiver is being tested.

M_2 is an 0-20 milliampere milliameter being used in the measurement of plate current of the tubes being tested.

M_3 is a three range 1,000 ohm per volt voltmeter for the measurement of B battery voltages and C battery voltages. This meter having the 10-volt scale self contained and the 250-volt and 750-volt scales obtained by the use of an external multiplier.

There are seven control switches of the double acting anti-capacity type to control the position of the meters in their respective circuits. This type of switch, while more bulky and expensive than the smaller type switches, will be found to give a longer uninterrupted service.

There are two sockets in the analyzer. A four-prong and a five-prong in which are placed the tubes being tested. There are also two plugs that connect to the socket of the receiver. A four-prong and a five-prong. There are binding posts provided so that the meters may be externally and individually connected. Binding posts 8 and 10 are for the 9 volt a. c. range of the voltmeter and 9 and 10 are for the 3-volt range. Binding post 11 is the positive of the 8-volt d. c. voltmeter and 12 is the negative of this meter. Binding posts 18 and 19 are for the high resistance high voltage d. c. voltmeter 18 being negative and 19 being positive. With the switch in position 15 the range is 10 volts, in position 16 the range is 250 volts and in position 17 the range is 750 volts. When switch 1 is in position A the a. c. voltmeter is connected to the 3-volt range, in position B it will read on the 9-volt range. Switch number 2, position A, the four-prong socket is connected into the circuit. Position B, the five-prong socket, is connected into the circuit. Switch number 3, position A for a. c. tubes, and connects center tapped resistance R_1 across the filaments of the sockets. Position B for d. c. tubes, being tested and disconnects the resistance from the sockets. Switch number 4, positions A and B, a filament reversing switch to reverse the polarity of the d. c. filament voltmeter. Switch number 5, position A, 40 milliameter range of the milliameter. Position B 20 milliameter range of the milliameter. Switch number 6 position A meter M_3 reads the screen grid voltage of a screen grid tube under test. Position B meter M_3 reads the grid bias voltage. Switch number 7 position A meter M_3 reads the plate voltage applied to the tube. Position B the meter reads the grid bias voltage of a four or five element tube under test. Resistance R_1 should be 20

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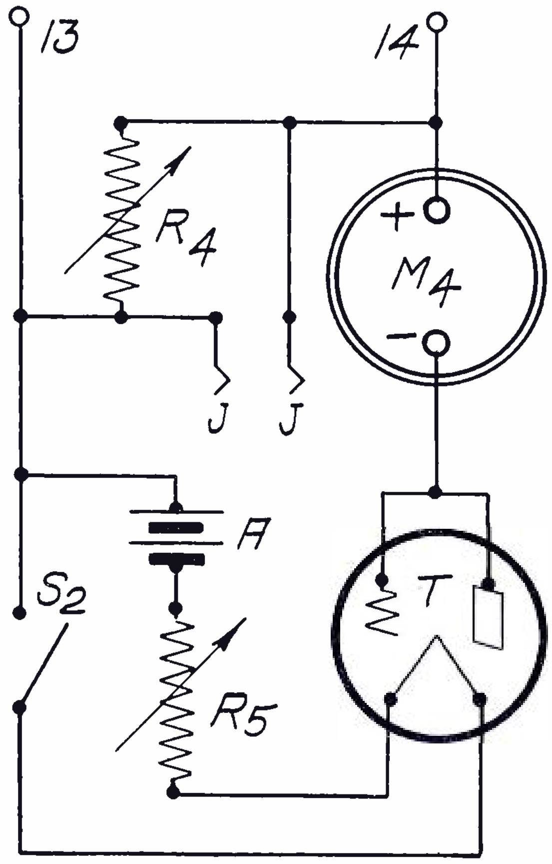

Fig. 2. Details of a Fleming valve resonance meter are given in this schematic diagram

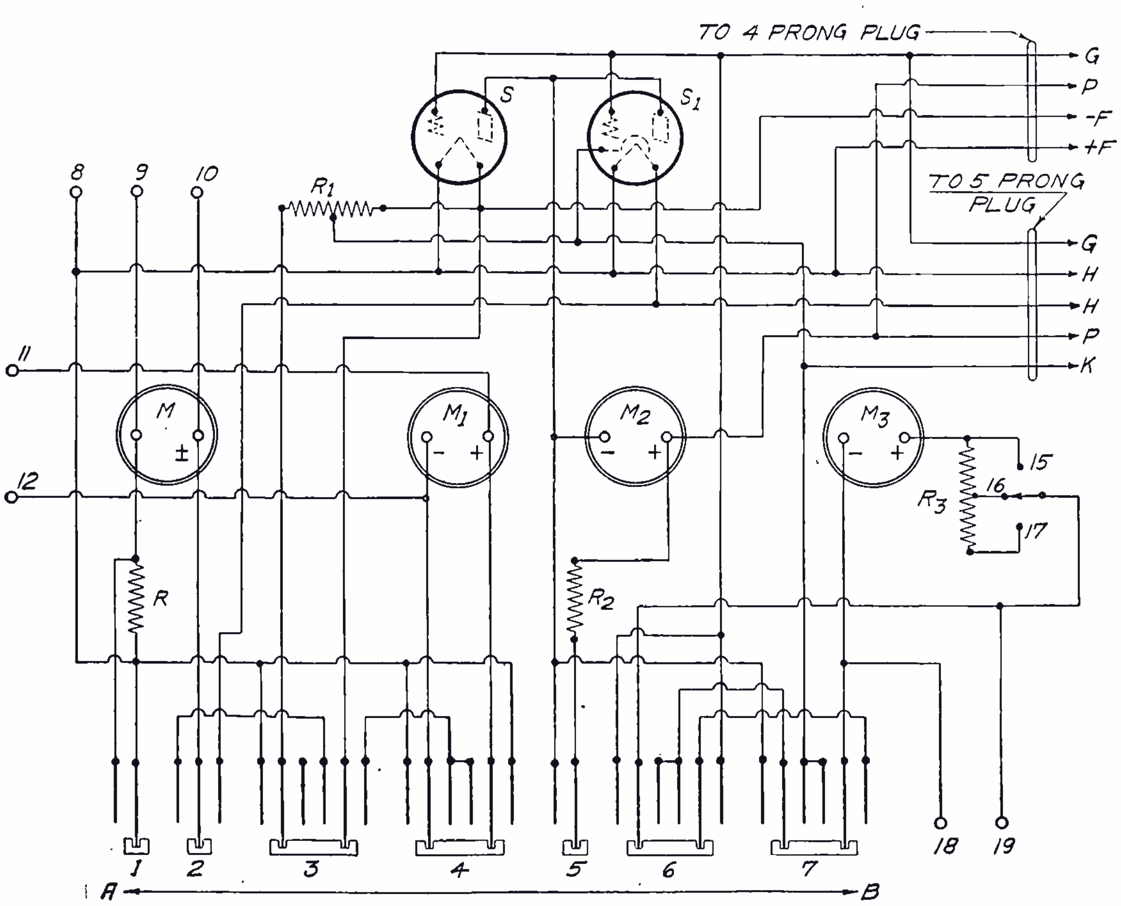

Fig. 1. This is a complete schematic of the analyzer described in the accompanying article

Good Fidelity Is Found in Electrad Loftin-White Combination

Tuner and Amplifier Kits May be Wired Separately and Then Merged

SINCE the publication in the March, 1930, issue of this magazine of the details of the Electrad Loftin-White amplifier, the Electrad interests have added a tuner kit to their line which now enables direct-coupled enthusiasts to make up a complete receiver at a nominal cost.

The amplifier described on page 63 of the March issue is merely added on behind the tuner portion shown in this article and the result is a three tube set, not including rectifier, which in the words of our laboratory report "should make an exceptionally good receiver for local reception, having selectivity better than fifty kilocycles and exceptionally good fidelity."

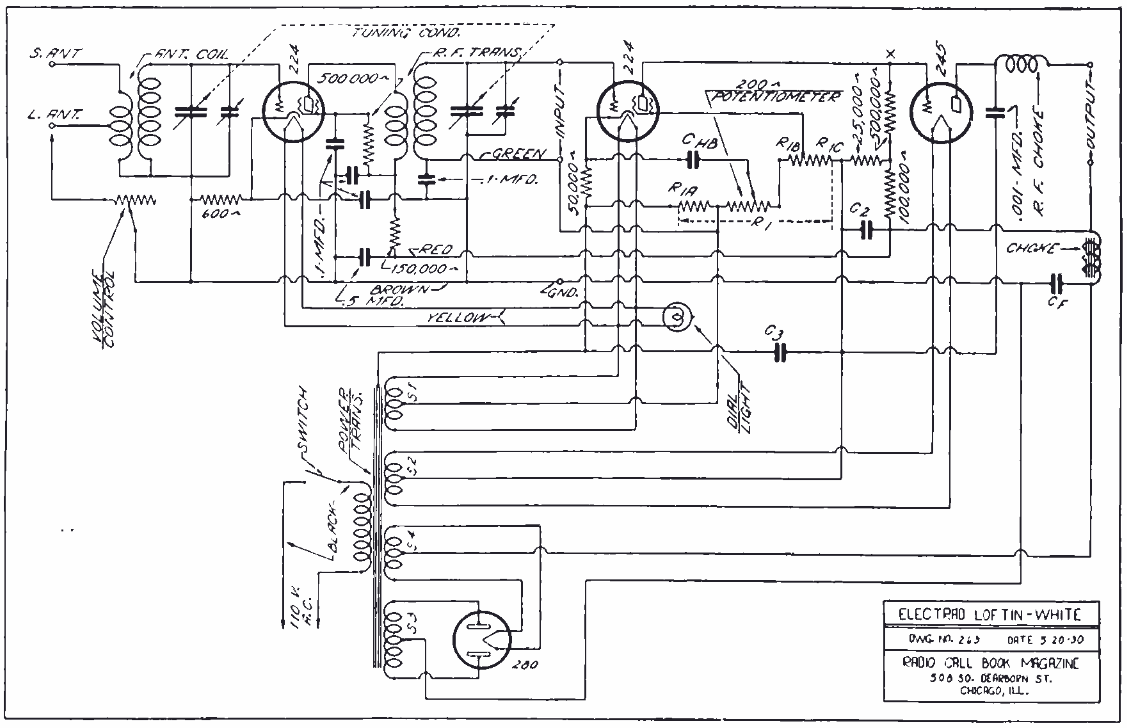

Fig. 1. This diagram is the schematic of the combined tuner and amplifier kits made by Electrad. The amplifier section was described on page 63 of the March, 1930, issue

Curves Given

The photograph of the two units is shown in Figure 2, while Figure 1 gives the combined schematic of the tuner and the amplifier. The three graphs on this page are the sensitivity, selectivity and fidelity curves as recently measured in our laboratory.

In the schematic Figure 1 all the parts appearing to the left of the two input terminals of the second 224 tube comprise the tuner, while the remainder represent the amplifier, detector and the power supply. It can be seen that the input of the first r.f. tube is tuned with one condenser while the input circuit of the detector is tuned with the second variable section. On account of detection occurring in the amplifier section it is necessary that a radio frequency choke be included in the output stage of the amplifier with its by-pass condenser. This is shown in the diagram.

Phono-Amplifier

The amplifier can be used as a phonograph amplifier while connected to the tuner by substituting the proper control grid clip on the 224 tube in the amplifier. The phonograph is left permanently connected although only in the circuit when the phono control grid clip is employed.

The antenna input consists of a tapped primary coil so the receiver may be used with either a long or a short antenna. The volume control is placed across the antenna and ground connections.

Tuner Parts

Parts required for the construction of the tuner are shown below:

- 1 Electrad chassis
- 1 Antenna coil in shield can
- 1 R. F. transformer in shield can
- 1 Dual tuning condenser
- 1 Mica fixed condenser .001 mfd
- 1 R.f. by-pass condenser, 200-volt, dual .1 mfd
- 1 R.f. by-pass condenser, 600-volt, dual .1 mfd
- 1 Filter condenser, 600-volt, .5 mfd
- 1 Wire wound resistor, 150,000 ohms
- 1 Metallic leak, 500,000 ohms
- 1 Flexible wire wound resistor, 600 ohm
- 1 Set screws, nuts, washers and connecting wire
- 1 Electrad volume control with power switch
- 1 R.f. choke coil for use in amplifier
- 2 224 sockets

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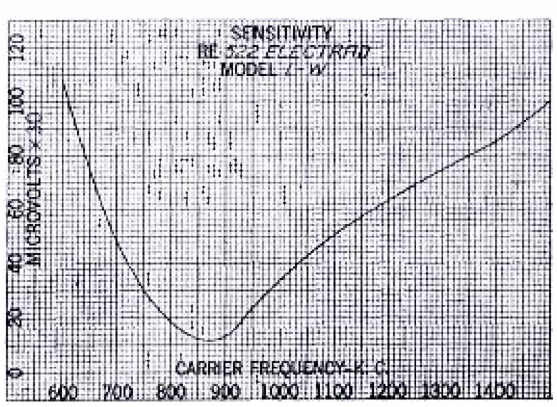
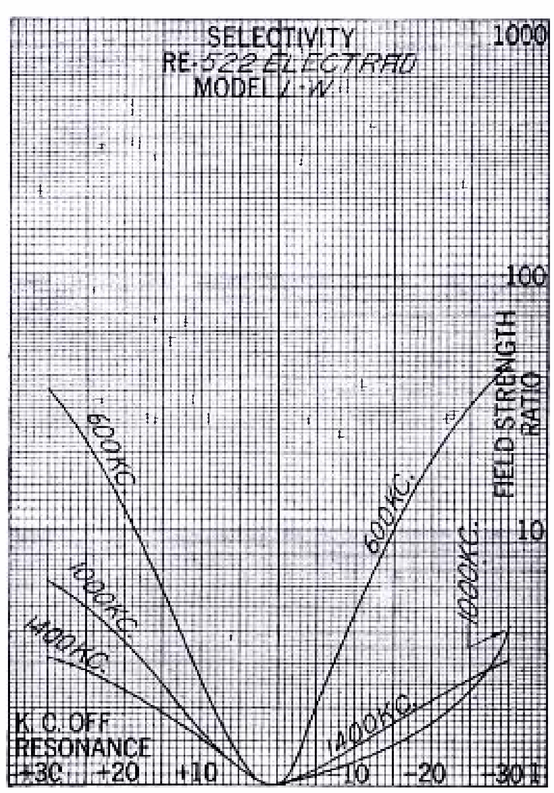
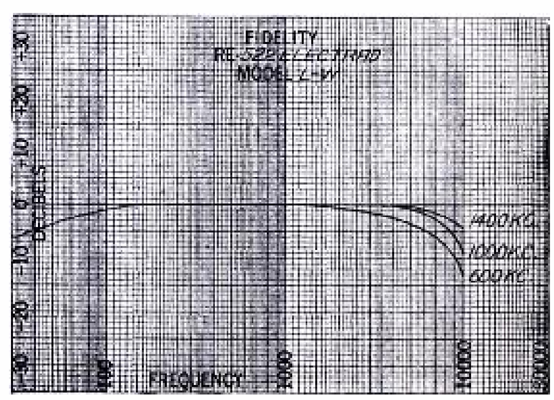






Slide Wire Bridge Is Simple Device for Resistance Measurement

Details Given in Article on Construction and Operation of Handy Unit for the Home Laboratory

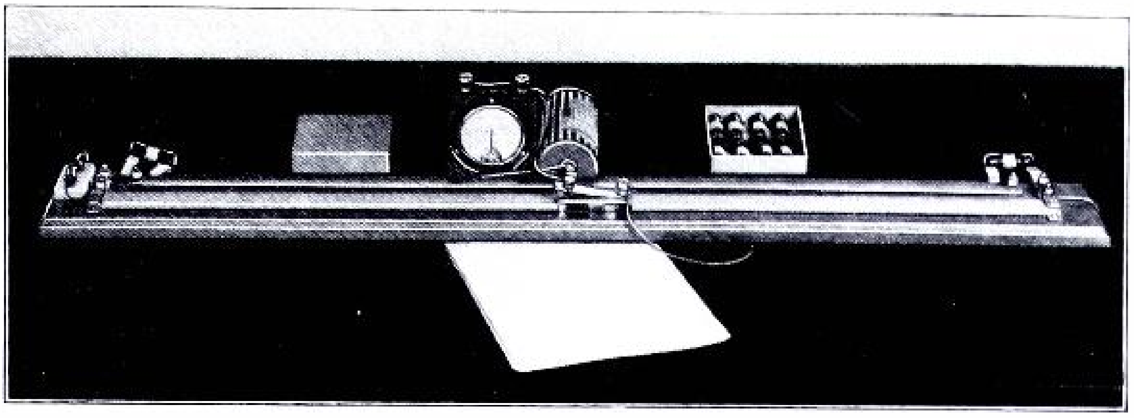


Fig. 1. This photograph shows a simple slide wire bridge. The galvanometer, slider and battery are shown at the center; at the left and right rear are the resistance standard R and the unknown X, respectively, as shown in the circuit, Fig. 2. A box containing the standard resistors is shown to the right of the dry cell

READERS interested in gradually acquiring the necessary apparatus for a home laboratory have expressed a desire for an article on the construction and operation of a slide wire bridge that is both simple and inexpensive. Such a unit has recently been assembled and photographed. Its operation will be described in the article to follow.

Designed originally as a means of measuring only resistance of a d. c. circuit there are adaptations to follow in subsequent issues which will permit the use of the bridge in the measurement of inductance and capacity as well as resistance of alternating current circuits. For the start it was thought best to indicate only its employment as a means of measuring d. c. resistance.

What It Is

Briefly the slide wire bridge consists of a length of resistance wire, a 1000 millimeter stick (1 meter in length), a galvanometer, a dry cell, a slider, a switch and two sets of clips. A photograph of the unit is shown in Figure 1. Its schematic circuit is shown in Figure 2.

An unknown resistance is measured by the ratio a portion of the slide wire bears to the remainder of the slide wire. By having a number of standards, almost any value of resistance may be quite accurately measured, with the possible exception of the megohm region where the accuracy is likely to be somewhat off.

Looking at the diagram in Figure 2 we find that if a known resistance (say 1000 ohms) is inserted in the clips at R, an unknown value of resistance clipped in at X, and the slider S moved back and forth on the slide wire until there is no deflection of the galvanometer, we will find the ratio which the A portion of the wire bears to the B portion. Since the wire is stretched on a meter stick divided into 1000 millimeters the pointer of the slider will indicate a value of millimeters where zero reading is obtained on the galvanometer. The section to the left of the pointer is the A arm of the bridge,

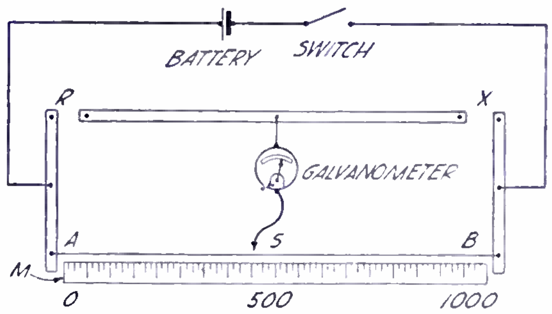


Fig. 2. The schematic circuit of the slide wire bridge is shown here

while that to the right is the B portion of the bridge. A simple calculation, later described, will show the resistance value of X.

Operating Notes

With a true slide wire bridge, finding the value of X, the unknown, is merely a matter of closing the switch, inserting a standard resistance across terminals R, placing the unknown resistance across terminals X, moving the slider S to left or right along wire AB with button 1 on the galvanometer depressed, until pointer on the galvanometer rests at zero in the center of the scale; then release button 1 and depress button 2, carefully moving the slider S until the pointer of the galvanometer is exactly on zero at the center of the scale. Button 1 is for coarse adjustments and 2 is for fine adjustments of galvanometer zero reading.

When zero setting is found on the galvanometer, read on the 1000 millimeter scale of the slide wire, at the end of the wire the number of millimeters at which the slider S touches, and note this reading, which value corresponds to the A ratio in millimeters. Subtract this value from the 1000 millimeter total which gives the remaining millimeters for the B ratio. For example, if zero setting on the galvanometer finds

(Continued on page 96)

TABLE I

Error of Slide Wire Bridge with Varying Ratios; with R Small, Medium and Large Resistance Value

A Arm	B Arm	Ohms R	Ohms X	Ohms X Measured	Ohms Resistance Deviation	Per Cent Error	Arm Ratio
500	500	1.007	1.007	1.007	None	Zero	1–1
91	909	1.007	10.055	10.06	.005	.0497	1–10
19	981	1.007	51.99	49.95	2.04	4.08	1–50
9	991	1.007	110.88	99.65	11.23	11.26	1–100
1	999	1.007	1005.99	502.20	503.79	100.31	1–1000
500	500	999.000	999.00	999.00	None	Zero	1–1
164	836	999.000	5092.46	5065.00	27.46	.54	1–5
90	910	999.000	10101.00	10030.00	71.00	.70	1–10
19	981	999.000	51579.54	50100.00	1479.94	2.95	1–50
9	991	999.000	110001.00	100000.00	10001.00	10.001	1–100
500	500	100000.000	100000.00	100000.00	None	Zero	1–1
290	710	100000.000	244827.5	250000.00	5172.5	2.06	1–2.5

Mutual Conductance Meter Useful in Finding Tube Efficiency

Excellence of a Tube as Power Amplifier, Detector, Modulator or Oscillator Is Readily Measured

A VERY important adjunct to any laboratory, and especially in these days of screen grid tubes used either as r.f. amplifiers or bias detectors, is a mutual conductance meter, direct reading, such as the type 443 made by General Radio and illustrated photographically in Figure 1 and schematically in Figure 2.

Such a meter in the laboratory or the shop will enable one to readily determine the excellence of a tube either as a power amplifier, a detector, modulator or an oscillator. In the laboratory, when running sensitivity, selectivity and fidelity curves on a receiver, it is extremely important that the mutual conductance of the tubes used in the receiver under measurement be known, since this factor will have considerable to do with the sensitivity of the receiver.

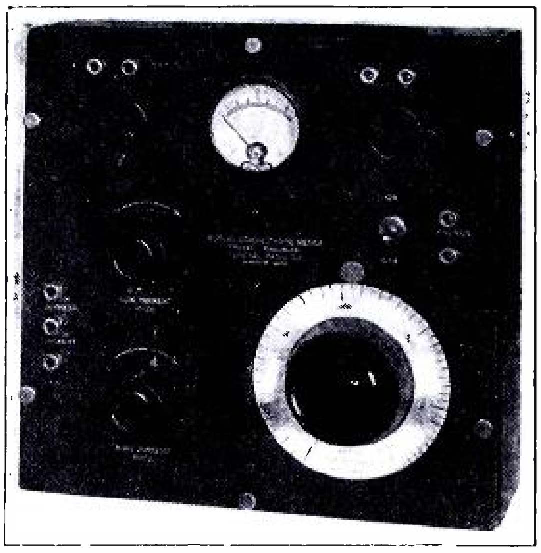


Fig. 1. The type 443 mutual conductance meter made by General Radio may be seen in this photograph

Burke Explains

Charles T. Burke, writing on the importance of mutual conductance in testing vacuum tubes in the General Radio Experimenter, Vol. 4, No. 2-3, July, August, 1929, shows why mutual conductance is so important:

"The plate impedance of a vacuum tube may be defined as the ratio of the change in plate voltage to a corresponding change in plate current when the control grid potential is held constant. It depends upon the area, nature and temperature of the filament (electron emitting surface), upon the area of the plate, and upon the spacing of the elements. Except at very high frequencies when the inter-electrode capacitances introduce appreciable amounts of reactance it may be considered to be pure resistance.

"The amplification factor μ, defined as the change in plate potential produced by a unity change in the grid potential when the plate current is maintained constant, depends only upon the spacing of the elements and upon the fineness of the grid mesh. It would be the all-important parameter for a tube delivering power to a load whose impedance was large as compared with the internal plate impedance, and it is, therefore of great importance in so-called potential amplifiers (i. e., amplifiers which are supposed to magnify voltage variations and deliver little or no power to the load circuit). If such a circuit be well designed, the amount of voltage amplification (the ratio of the voltage appearing across the load in the plate circuit to the voltage applied to the grid of the tube) should approximate μ, the amplification factor of the tube.

"Physically g_m, the mutual conductance of a tube, is the ratio of the change in plate current that is produced by a given change in grid potential when the plate potential is held constant, assuming of course there is no load in the plate circuit. Thinking of the mutual conductance as the effectiveness of grid voltage changes in producing plate current changes emphasizes the physical meaning of that quantity.

"In circuits using the screen grid tube the plate impedance is usually much greater than any value of load impedance that can be readily realized in practice. In the ideal screen grid tube circuit the only tube parameter of importance is the mutual conductance. The plate impedance of the 224 type tube now in quite general commercial use, averages about 800,000 ohms, which is large enough as compared with most circuit impedances, so that they need seldom be taken into account when making gain computations.

Index of Excellence

"For the reasons set forth in the foregoing discussion, the mutual conductance of a tube may be measured and the resulting value taken as an index of the excellence of a given type of tube. Some care must be taken in saying that one type of tube is better than another because it has a greater mutual conductance, but one can say without hesitation that among tubes of the same type the greater the value of mutual conductance, the better is the tube.

"This fact makes it possible to use a measurement of mutual conductance

(*Continued on page* 95)

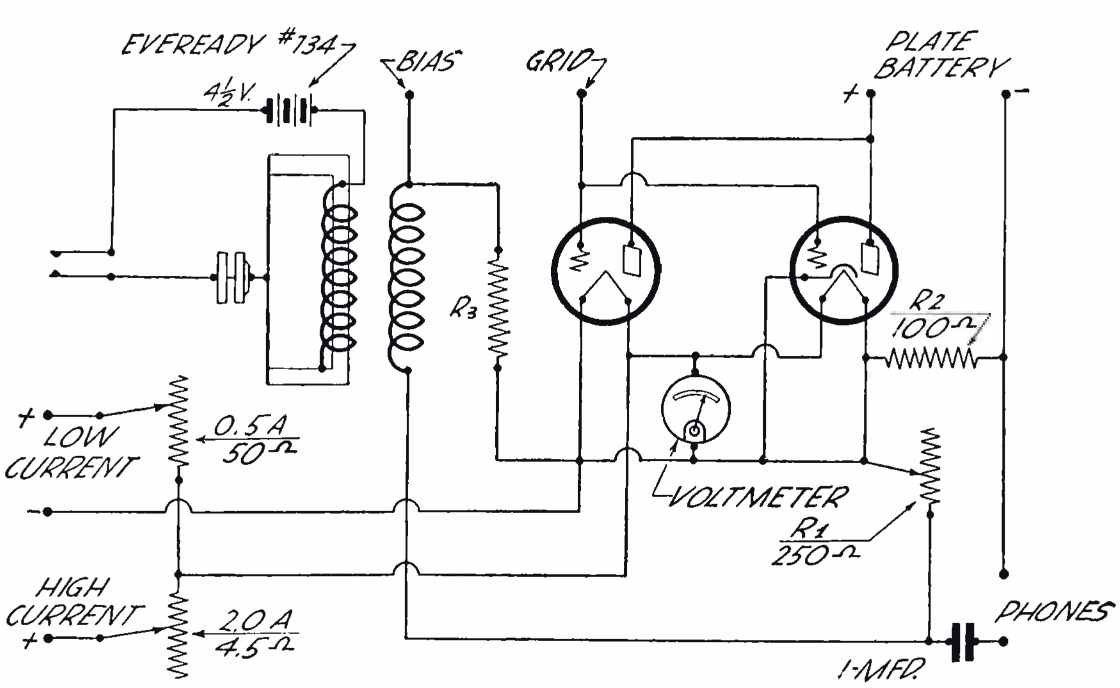


Fig. 2. This schematic wiring diagram shows the connections in the General Radio type 443 mutual conductance meter used in our laboratory

Reader Gives Victoreen Fans a New Lease on Receiver Life

Modern Features of Set Operation May Be Had at Low Cost Without Impairing Good Quality

Many Victoreen owners did not convert their receivers to a. c. operation because many of the required parts were unnecessarily expensive, according to the author of this article, J. H. Gockel, of Chicago, Ill. Mr. Gockel believes many Victoreen owners will welcome an article and diagram showing how their receivers can be modernized with inexpensive yet good parts. After reading his article we feel sure the suggestions will be more than gladly received by our readers.—Editor.

ALTHOUGH Victoreen coils are no longer on the market, there are hundreds if not thousands of Victoreen superheterodynes still in use.

The writer knows of some cases—and undoubtedly there are enough more to justify this article—where Victoreen owners are still using batteries, two dials, and 112-type power tubes because the parts recommended for attaining a. c. operation and single-dial control and for a power supply for power tubes with a greater undistorted output called for a far greater outlay of funds than these fans had at their disposal.

These modern features can be had at low cost without using cheap parts and without impairing the original good quality of the receiver in the least.

One Dial Control

Take first the much-desired one-dial control. This is not a problem with a receiver having two tuning condensers whose rotors are at common ground potential. But in the Victoreen the rotors are not common; they must be insulated from one another. This problem is easily and inexpensively solved by connecting the two tuning condensers to a drum dial with Hammerlund insulated flexible couplings. One coupling is really all that is necessary, though an insulated coupling for each condenser permits the grounding of the frame of the drum dial, thus obviating hand capacity troubles. The same results can be obtained if tuning condensers are available with removable shafts (such as one type of Pilot condensers). The metal shafts can then be replaced by bakelite shafts or by one long bakelite shaft connecting the drum dial and both tuning condensers. A .0001-mfd variable midget condenser across the antenna tuning condenser keeps the latter in step with the oscillator tuning condenser.

Turning now to the requirements for a. c. operation: There is a transformer (Pilot No. 407) which has three windings, one for two 227-type tubes, another for six 227-type tubes, a third for two ¼-ampere 5-volt tubes. This will supply all the filament voltage required in the Victoreen except that required for 210- and 250-type power tubes, and the power transformers needed for these tubes usually have the necessary 7½-volt windings. Also the filament voltage for either a 2½-volt or 5-volt pilot light can be taken from this Pilot transformer.

The C-bias for the various tubes is obtained with resistors, as indicated on the diagram. For the three intermediate tubes a 5000-ohm variable resistor is used, to be set for greatest volume without oscillation, and left there. Undoubtedly if the recommended 25,000-ohm variable resistor were used here as a volume control there would be need of voltage regulator tubes in the power supply. But in a later paragraph a volume control is described which does not change the plate voltage or increase the current drain on any tube.

There is no bias-resistor for the oscillator tube, but a 50,000-ohm resistor

(*Continued on page 94*)

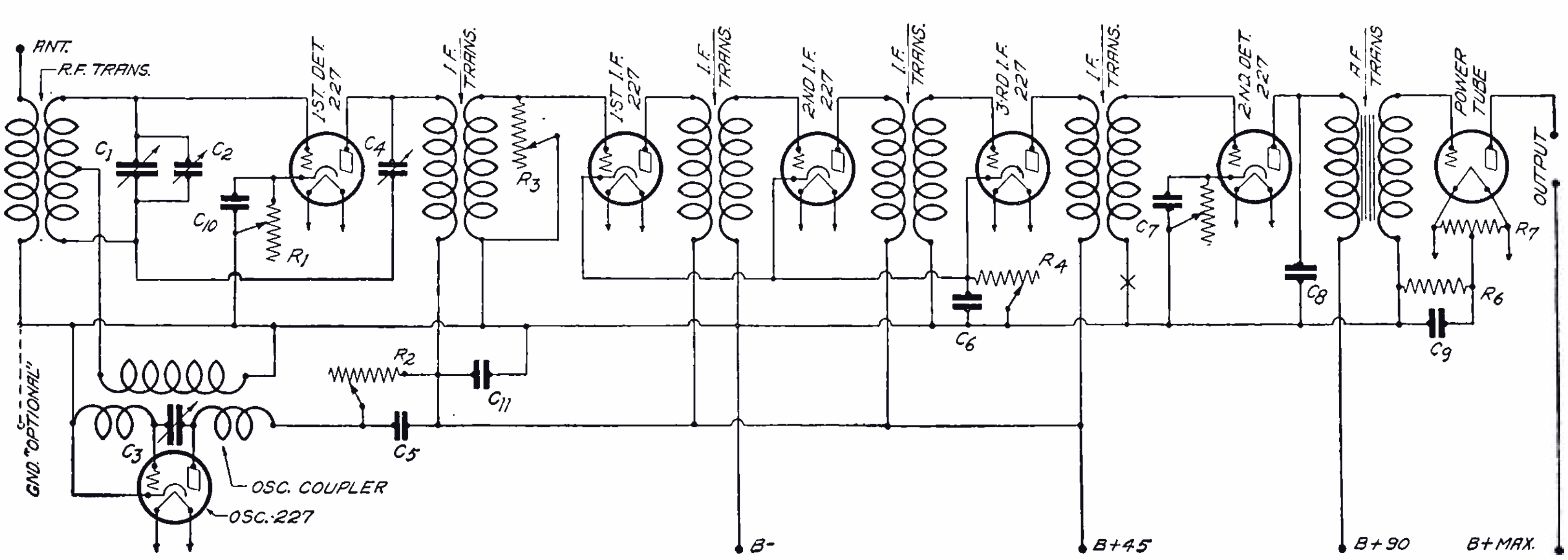


Fig. 1. Note that 45 volts used for old type Victoreen coils, No. 170; for new type, No. 172, 90 volts has been recommended; insert closed-circuit jack at "X" in diagram for phonograph pick-up, using "extra-loud" needles when only one audio stage is employed. Constants are C1, C3, Pilot tuning condensers, .0005-mfd; C2, Pilot midget condenser, .0001-mfd; C4, Pilot midget condenser, .000025 (for regeneration control); C5, C6, C7, C10, Tobe by-pass condensers, 0.1-mfd; C8, Sangamo fixed condenser, .002-mfd; C9, C11, Tobe by-pass condensers, 1.0-mfd; R1, R5, Electrad variable resistors, 25,000-ohm; R2, Electrad variable resistor, 50,000-ohm; R3, CRL modulator, 500,000-ohm; R4, Electrad variable resistor, 5,000-ohm (a value as low as 1,000 ohm can be used); R6, value depends on type and number of power tubes; R7, center-tapped 30-ohm resistor (not necessary if filament winding for power tube or tubes is center-tapped).

Method Discovered for Measuring Radiation of Ultra-Violet

Portable Indicator Designed Using Photoelectric Cell to Integrate Amount of Light in Given Time

ULTRA-VIOLET rays formerly were but a name strayed from the physics laboratory, even to persons of some education. However, within a few years these rays have achieved popularity if one is to judge from the amount of illustrative and descriptive material found in the press on this subject.

These rays are reputed to increase the resistance of the body to colds and infections, to pneumonia and grippe, to be a cure for the rickets of the infants and the baldness of the aged. Besides these claims it is certain these rays produce sun tan, the current vogue of beauty. A considerable traffic has appeared in devices to produce ultra-violet rays artificially, and in glass, or its substitutes, which will allow passage to the natural supply from the sun.

How to Measure Rays

According to the recent pamphlet covering Westinghouse engineering achievements in the year past, it has been noteworthy that there has been until 1929, no convenient means for measuring this ultra-violet radiation.

Such a portable indicator, or meter, is now available in a case nine by eleven by twelve inches, and operating from dry cells within the case. The indicator is equipped with a photoelectric cell. Whenever this cell has received a definite quantity of radiation there is a slight snapping sound which is rung up on a counter. Thus the intensity of the radiation can be judged by the frequency of the sounds and the total amount received by their number.

According to the engineering bulletin issued by Westinghouse, the photoelectric cell, developed by Dr. H. C. Rentschler, is made with an active material sensitive only to that part of the spectrum whose wavelengths are believed to have effects on vitality, that is, from 3100 to 2900 angstrom units, or wavelengths from .00031 to .00029 millimeters.

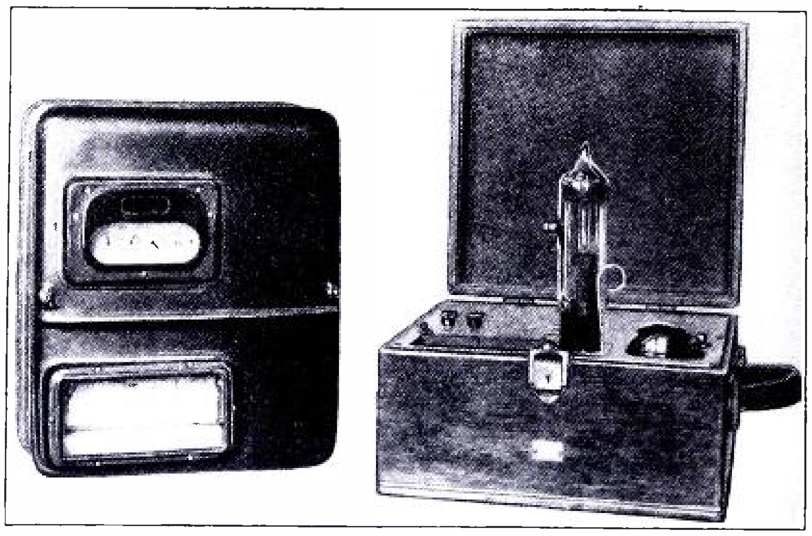


Fig. 1. In this photograph at the right is the portable ultra-violet light integrating meter by means of which the amount of radiation in a given time may be found for ultra-violet lamps. The device at the left is a graphic meter which records the impulses from the ultra-violet indicator

Uses Photo-Cell

The indicator measures the quantity or integrates the amount of light over a given period of time. The rays falling on the cell allow a small amount of current to pass through it. This current is proportional to the intensity of the rays. The current through the cell charges a condenser and when this condenser is fully charged it trips a counter. After this impulse operates the counter, the condenser is again charged and the operation is repeated. Each impulse measures a definite quantity regardless of the rate of intensity.

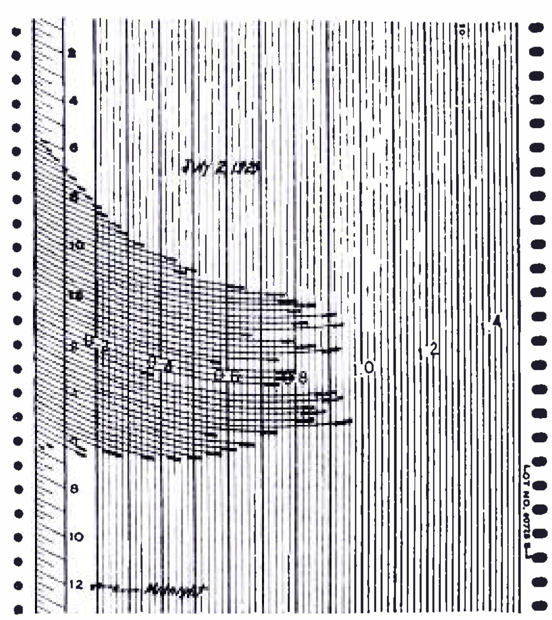


Fig. 2. This illustration is a specimen of the record taken with the graphic meter in conjunction with the light indicator described in the accompanying text as one of the contributions of the Westinghouse research laboratories

Where the ultra-violet source is known to be constant the intensity can be determined or compared to another source by counting the impulses per minute. This unit, or impulse, at the present time, has no name, and the value taken is arbitrary.

Makes Graphic Record

A graphic meter can be supplied that records the impulses from the ultra-violet indicator, a photograph of the two units being shown on this page. In this case a relay is furnished with the indicator instead of a counter, and each impulse notches up the pen of the recorder. At five or fifteen minute intervals the pen is automatically reset to zero. This chart then gives a continuous graphic chart of the impulses that occur in periods of five or fifteen minute intervals. The graphic meter operates from light circuit of 110 volts and will give a continuous record for thirty days. In the study of sunlight or smoke regulation the graphic recorder will be necessary.

While medical science is somewhat cautious about giving an opinion as to the effects of ultra-violet radiation, the known results appear to hint at extraordinary possibilities affecting human well being in many aspects. Whatever these possibilities may develop, the researchist is at least now armed with the primary tool—a means of measuring the force with which he deals.

WATCH FOR IT!

The November issue of this magazine will have additional response curves of the factory built receivers. Eight families of curves are shown in this number, beginning on page 64. As fast as our laboratory completes the measurements of the new models the reports will be published.—Editor.

Amazing Invention Is Uncovered by World's Greatest Scientist

Astounding Phenomena Produced by Eminent Researchist Who Asks Experimenters to Help Improve Technique

By MAJ. HEDD AKE*

(**Ph.D., L.I.R.E. and PbS04, Chief Research Executive, Research Radio Corporation, Research, Ill.*)

(Editor's Note: As we go to press we are in receipt of a most remarkable scientific document from Maj. Hedd Ake, who in addition to the degrees quoted above also holds several from Centigrade. His technical report is of such transcendental importance that we are presenting it, without change, as it dripped from the pen of this distinguished physicist.)

"HAVING heard from various sources that the radio experimenters in the United States have sunk into a lethargic stupor induced by the high mortality among parts manufacturers; these demises having deprived the experimenters of a means and an incentive for tinkering with circuits of all kinds, the author, feeling deeply sympathetic towards these experimenters whose romance has been blighted by commercial receivers, hastens to announce the fruit of his two years' intensive research for the company named above at our palatial quarters at Research, Ill. (4.3 miles due south of WGN, and ¾ mile ENE of WEAF).

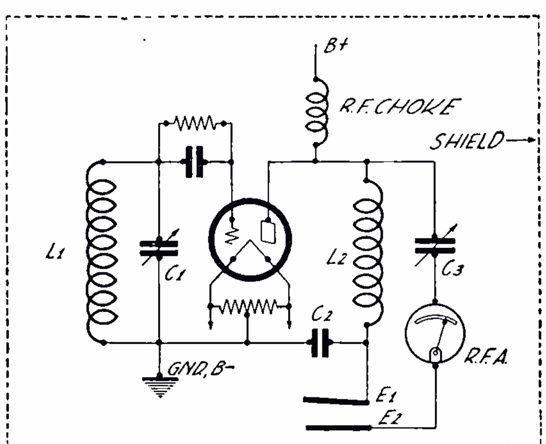
Needs Help

"Although ready to announce all my findings, nevertheless I must confess there are several minor points in connection with my discoveries on which I must beseech the aid of the genus experimenter. To give immediate impetus to experimental work on the part of my readers I am releasing through the publicity department of our corporation the details of this great discovery so that those who have dropped soldering irons and pliers may again take up their weapons in the cause of civilization, convenience and cussedness.

"Briefly stated, my discovery is this: Utilization of high frequency energy to cook, bake, boil water and heat the home. (Those living south of the Mason & Hamlin line may omit the last mentioned attribute.)

"The magnitude of this breath-taking achievement is not immediately apparent to the reader unless he realizes the years of time, the sums of money and the kinetic energy spent in cooking, baking, boiling water and heating the home. Just think of it. For the last thousands of years fire has always been the chief agent in these functions. But now, thanks to my untiring work, the world is presented with a new principle.

"In making public this soul-stirring invention I can safely say that it does not interfere in any manner with the Federal Radio Commission assignment of high frequency channels to the press associations and the RCA. On the contrary, we do not require any license for the operation of our device because its



radiation does not enter into interstate commerce, except in the event the owner resides at Cumberland Gap, where he eats in Tennessee, sleeps in West Virginia, and works in Kentucky. In addition to that, my marvelous system utilizes very little power for operation. On the basis of energy expended and its attendant cost, we find my device costs but an infinitesimal fraction of the cost involved in beating your wife, or spring house cleaning. This cost factor has been very carefully considered and forms a part of our guarantee that once an owner of our system you will have no other.

Not a Transmitter

"For the benefit of the technically minded readers I am showing in this article a simple schematic diagram of the circuit employed in my invention. The trained technician will immediately see this diagram bears a startling resemblance to an oscillator or transmitter. But such is far from the case. Although some of the symbols used may so indicate, nevertheless the diagram covers the basic details of my famous high frequency stove which is proving such a boon to the housewives of Mesopotamia and the Bronx.

"This basic circuit is susceptible of many interesting variations, such as my justly famous bath-water heater on which I now have Pat. Pending and other experts, working for me. This variation will be explained in due course, or possibly subsequent issues of this estimable publication.

"Looking at the schematic circuit in Figure 1 we see that it consists of a grid inductance L1 and a plate inductance L2. There are three capacities used in the stove model. C1 across the grid-filament circuit, C2 the blocking condenser, and C3 the tank condenser. The reason for the name of the last mentioned condenser is revealed by the relation of an interesting episode which occurred in my laboratory. Seeing Axel Swenson, my 37th assistant, working on the model, in a spirit of joviality I asked him 'What is it?' To which he immediately replied, after several minutes' study, 'I tank condenser.' So this quaint manner of speech really was responsible for the naming of the tank circuit.

"The R.F.C. in the plate circuit is a radio frequency choke used for parallel feed, the latter term denoting two Irishmen eating side-by-side at a table (so I am informed reliably by my librarian, than whom there is no other Carnegie).

"The R.F.A. is a radio frequency ammeter with a calibrated scale and three ranges: Raw, Medium and Done. The reason for this calibration will become obvious as my description proceeds apace.

"Now any student of radio frequency phenomena surely knows that if the grid circuit is excited (or even mildly impassioned, for that matter) this excitation is communicated to the plate circuit in a greatly magnified manner. Thus if the grid excitation is caused by reading any true confessions magazine, there will immediately be a large change of plate circuit conditions, giving rise to radio

(*Continued on page* 92)

Super Stages a Comeback in Battle for Popularity of Public

Silver-Marshall Announces Their S-M 724 A.C. in Wired Kit Form; Receiver is Described

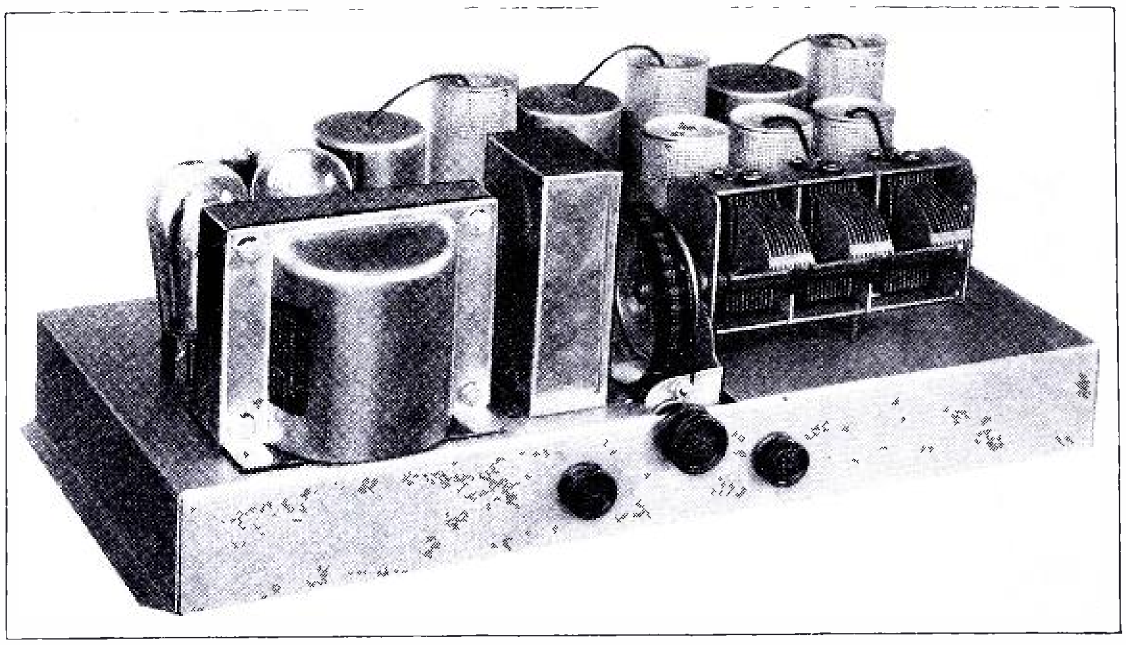


Fig. 1. This photograph shows the chassis of the new S-M 724 a.c., a description of which is found in the accompanying article

TO those even reasonably familiar with the gradual development of radio receiver design over the past six or eight years, it is only too apparent that the superheterodyne system of reception has enjoyed less and less popularity each year from, say, 1925 to 1930. To the keen observer, the reasons for this trend away from superheterodyne and to tuned radio frequency receivers for broadcast reception are relatively obvious. Looking back to the introduction of the first popular superheterodyne receiver design in 1923, and the rapid increase in popularity of supers thereafter, the reason therefor can be seen to have lain in the very great sensitivity which could be obtained with the superheterodyne receiver as compared to the then popular regenerative and t.r.f. sets, as well as the relatively higher order of selectivity obtainable from a superheterodyne using five or more tuned circuits as against the then popular single or dual tuned circuit regenerative sets or two or three tuned circuit t.r.f sets. However, as broadcast conditions became more congested and as broadcast station powers were very greatly increased, the inherent problems of image frequency interference (usually called repeat points or harmonics) of the superheterodyne system became more and more aggravating, so that the effective selectivity of a good superheterodyne often appeared less than that of a three or four circuit t.r.f. receiver. The additional problems of electrification and single dial control mitigated much more against the further development of superheterodyne receivers than they did against the development of t.r.f. receivers and, with the advent of the screen-grid tube which made possible the building of t.r.f. receivers of as high an order of sensitivity as superheterodynes or, at any event, as high an order of sensitivity as could practically be utilized, the majority of engineers turned their attention definitely away from superheterodynes and to t.r.f. development. This condition was further aggravated by the patent situation and it is only with the recent release of superheterodyne and other patents to a number of manufacturers that development work on superheterodynes which has been going on quietly for the past several years, can be com-

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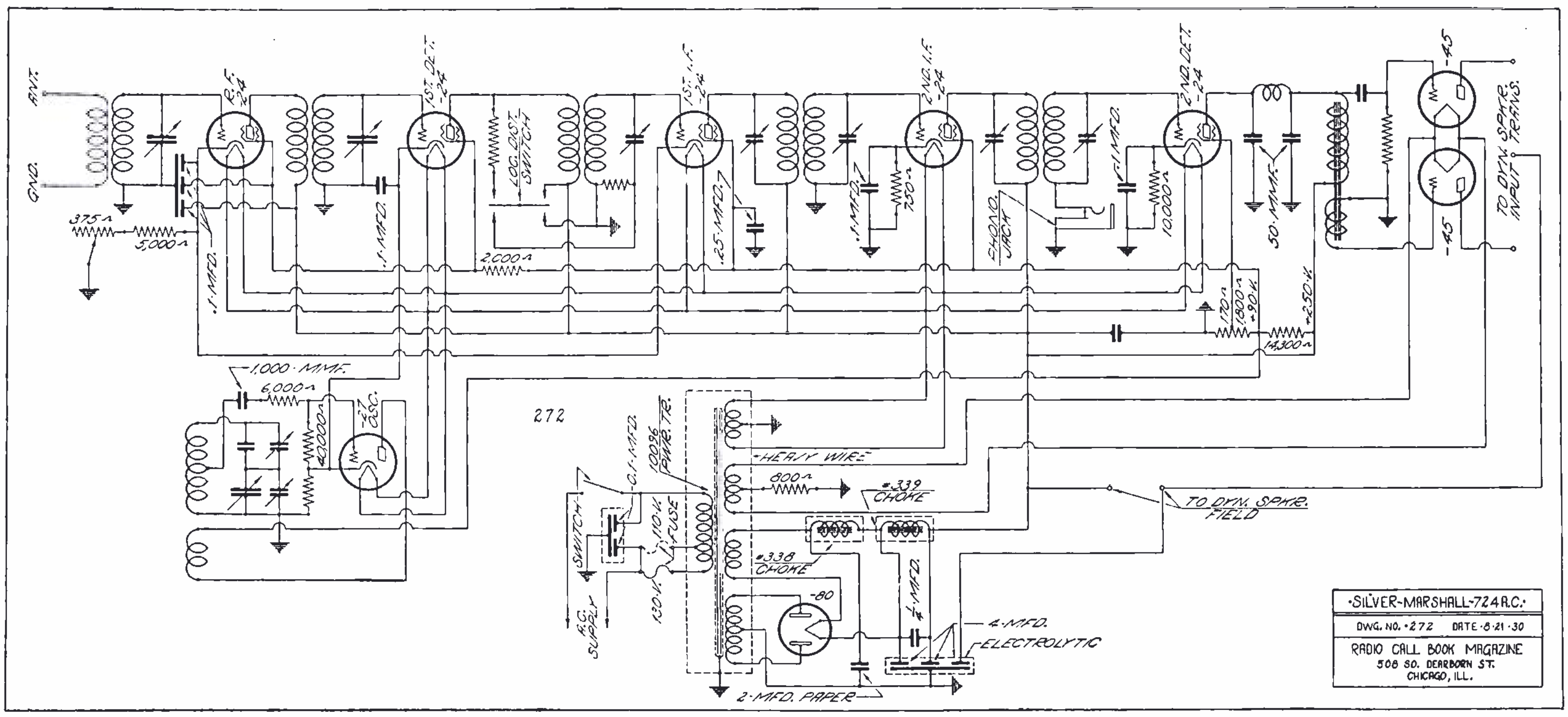

Fig. 2. The schematic diagram of the superheterodyne in wired kit form just announced by Silver-Marshall is found above

Delco Makes Fixed Tune Short Wave Receivers for Police Cars

Three Screen Grids, 112-A and Output Pentode Arranged in Compact Regenerative Circuit

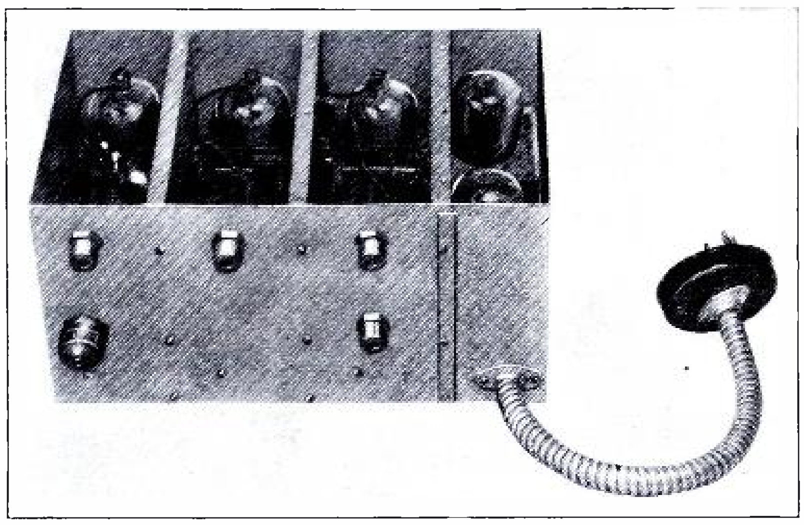

***Fig. 1.** This photograph shows the Model 3003 Delco police radio, schematic details of which are shown on this page*

ALMOST everyone is acquainted with the amount of interest being displayed by police departments in the operation of their own short wave police broadcast transmitter, and already many of the state and municipal police departments have made requests for licenses from the Federal radio commission. So it is not surprising to find the General Motors Radio Corporation and the Delco Corporation allied in the production of radio receivers for the use of police cars.

One of the most recent instances of such receivers is the model 3003 announced by the Delco Radio Corporation, a photograph of which may be seen at the head of this page, with the schematic diagram at the bottom.

As will be seen from the schematic diagram, Fig. 2, two stages of r.f. are used, employing 224 screen grid tubes. The detector is of the regenerative type and also uses a 224 screen grid. The first audio stage is a 112-A tube and the power stage utilizes an output pentode. Coupling between the first audio and the output stage is resistive and capacitative as indicated.

Fixed Tuning

The tuning of the two radio frequency and the detector stage is fixed. The receiver is adjusted to the desired frequency with the use of an oscillator tuned to the transmitting station frequency, and the controls then locked by means, of shaft clamps to keep the controls from shifting out of adjustment due to vibration of the car. The regenerative control is set just out of the oscillation point and locked there.

According to the instructions covering the model 3003 the set may be installed in almost any location on the car, depending upon the design. An efficient installation may be made by mounting the set on the running board, in which case a special waterproof case is furnished with the set. The switch and volume control are mounted on a special panel which is fastened to the steering column.

A horn speaker is used for the reproduction of the voice and is designed so it may be easily understood above the noise of outside traffic and other interference.

To install an aerial on a closed car, the headlining must be removed so the aerial screen wire can be fastened under the bows. Use copper screen wire and keep six inches from the metal of the car. Solder a cross wire to the screen at a point where the leadin is attached.

In car tops where wire netting is used as part of the construction, the netting should be connected to cross wires, soldering each wire to the cross wire. Make sure the netting is not grounded. This may be determined by connecting a lead to the wire netting and touching it to the battery side of the ammeter; if no spark occurs the wire is not grounded and is suitable for use as an aerial. If it is grounded the top deck must be removed and the wire investigated to determine the point at which it touches the metal of the car. In cases where the wire netting construction is used, it must be used as the aerial. Never attempt the installation of a different aerial.

In open cars, use copper screening, placing it over the bows and under the top deck. Fasten the front end to the front cross bow and the rear end to the rear bow. Solder a cross wire to the screen at the point where the leadin is attached.

For leadin No. 18 r.c. should be used, connecting it to the aerial at point nearest the aerial terminal on the receiver. Leadin should be just long enough to reach the set, and should be kept as far as possible from other wires.

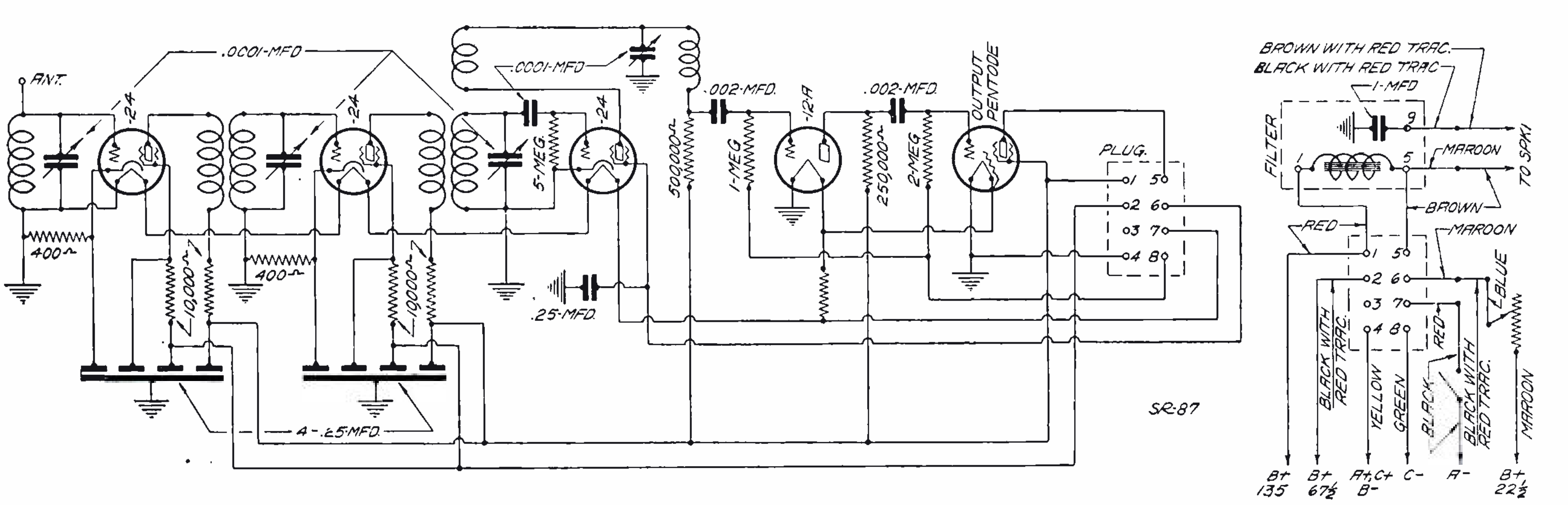

***Fig. 2.** Electrical details of the Delco police radio, Model 3003, are to be found in the drawing above*

Norden-Hauck Super DX5 Designed For Quiet A. C. Operation

Compactness One Feature; Efficient Shielding Prevents Pickup of Hum; Control is Simple

FOLLOWING is a description of the Super Dx-5 receiver, a recent commercial development, by Norden-Hauck, Inc., giving the points of particular interest to the short wave enthusiast. This receiver was designed with the following points in mind: complete a.c. operation without hum, increased sensitivity and selectivity, ease of control and ability to hold calibration, good tone quality and sufficient power output, and ability to cover a wide frequency range. The completed set has fulfilled these points with a high degree of satisfaction.

The accompanying photograph shows the type of construction employed resulting in an efficient set that is fairly compact (9 inches high, 18 inches long, 10 inches deep), and one that has an appearance of which the owner may be justly proud.

A power transformer with three 2½ volt secondaries, has resulted in the suppression of those tunable hums that are encountered on the higher frequencies. Each secondary has a 20 ohm center tap resistance shunted across it with the centertap connected to ground. These resistances are located right at the respective sockets and the grounds are made to the common point for that stage. Grid and plate wires do not run near the resistance, hence no pick-up of hum.

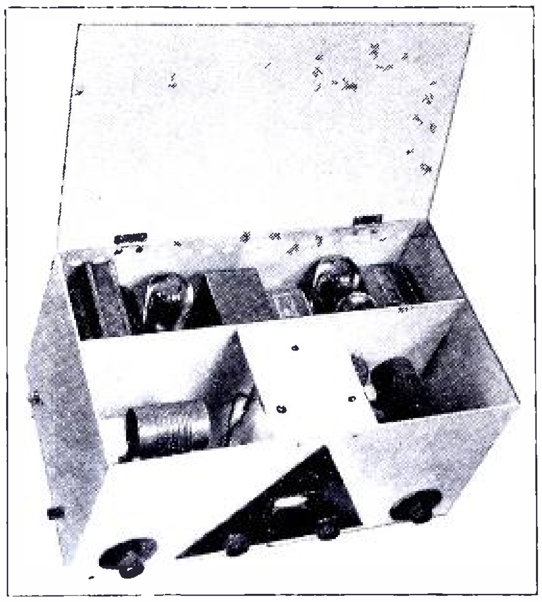

Fig. 1. In this photograph may be seen the Super DX5 recently designed by Norden-Hauck, Inc. Many of its features are given in this article

Avoiding Pickup

The antennae binding post is on the left side of the set, near the front, which position was chosen to avoid coupling between the antennae lead-in and the power supply. One side of the line is grounded through a ½ microfarad condenser. Inserting the power supply plug in the light socket so that the ungrounded side of the line is connected to this condenser usually results in the quietest operation. A type 80 tube is used as rectifier for the plate supply.

The speaker is connected by plugging into a new type of socket similar to a UY socket but with an extra prong which controls a switch closing the field terminal contacts when the speaker is removed. In this set the switch is so connected that when the speaker is removed a 500 ohm resistance is connected in place of the field winding resulting in no change in voltage and eliminating the possibility of damaging the set by high voltage. The set may also be operated with a magnetic speaker with the plug removed with a slight increase in hum. It is intended however that a choke coil be plugged in when the dynamic speaker is not used.

Using R. F. Pentode

The use of a tuned radio frequency incorporating a pentode tube provides a marked increase in sensitivity and selectivity. At frequencies lower than 10,000 kilocycles the gain obtained from a pentode tube was noticeably greater than that obtained from a screen grid tube. The extra gain is not obtained from the pentode tube unless the tube is worked at its maximum plate potential, that is 250 volts. When the pentode is worked at 180 volts plate potential the gain over a screen grid tube is hardly worth while. The greatest gain was obtained when the detector coil was used as a tuned plate impedance.

No Body Capacity

The design of the Super DX-5 is such that there is no hand capacity effect on even the highest frequencies. This has been accomplished by complete shielding and by double shielding between the controls and the front panel. As can be observed in the photograph there is an inner shield upon which the antenna coupling condenser, the radio frequency compensating condenser, the detector trimmer condenser and the regeneration condenser are mounted. These controls are grounded on this shield, except for the antennate condenser, and are insulated from the front shield. This prevents all currents from flowing in the front shield. The two main tuning condensers are mounted on the same shaft and mounted in the set in a vertical position with an knurled aluminum

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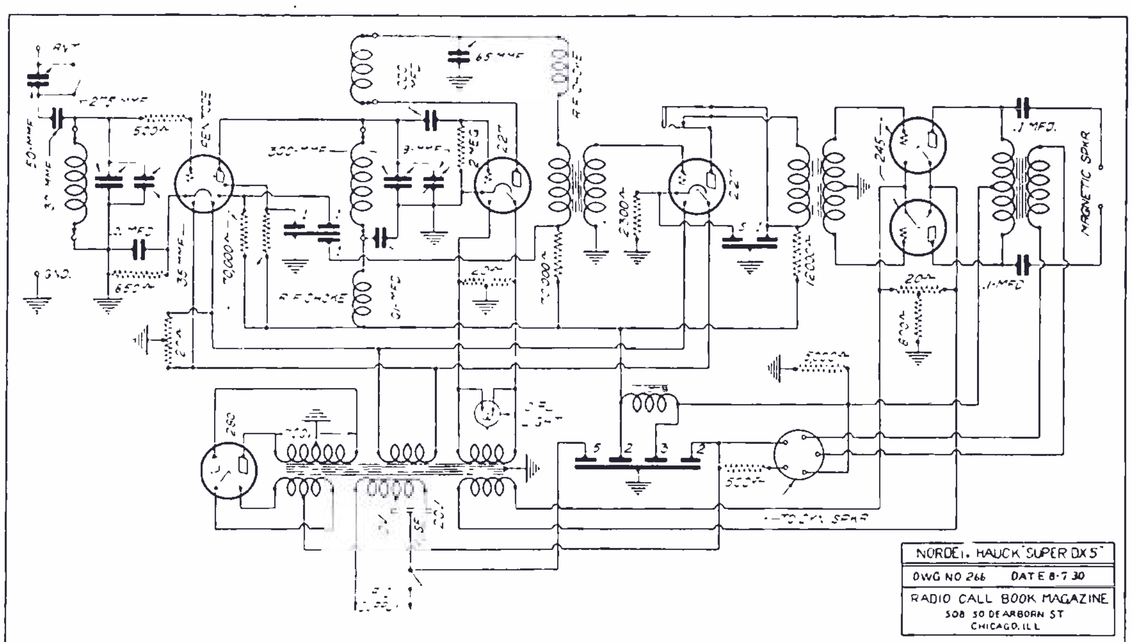


Fig. 2. The schematic diagram of the Norden-Hauck Super DX5 is given in the above illustration

Measurements on Lincoln DeLuxe 31 Show Extreme Sensitivity

Practically no Changes Made in Circuit of Superheterodyne That Has Many Adherents

ASIDE from minor circuit changes and the adoption of a metal subpanel instead of insulating material, there are practically no alterations in the Lincoln receiver described on this page, the designers evidently taking the stand that since this receiver was quite successful last season they see no real reason for making any radical changes in the Lincoln DeLuxe 31. Three curves recently taken in the laboratory of this magazine accompany this article.

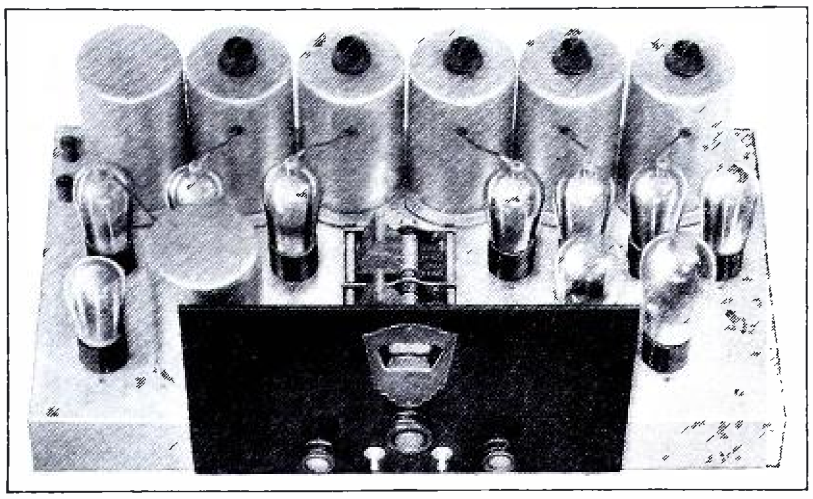


Fig. 1. *Lincoln fans will recognize this receiver without being told its model number*

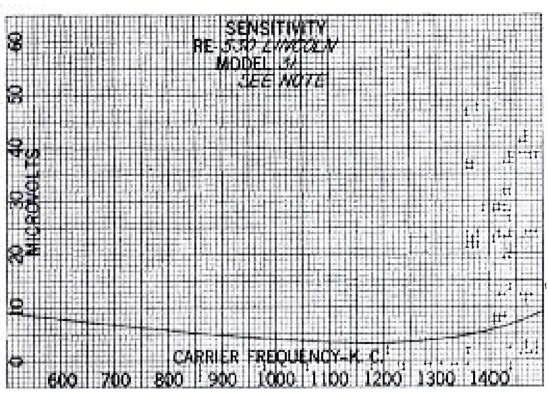
Schematically the receiver will be found in Figure 2 and superheterodyne fans will recognize the tunable intermediates which have long been a favorite feature of this receiver. The power supply of the DeLuxe 31 is found in Figure 3, while a photograph of the power pack is in Figure 4. The receiver itself is illustrated at the heading of this page.

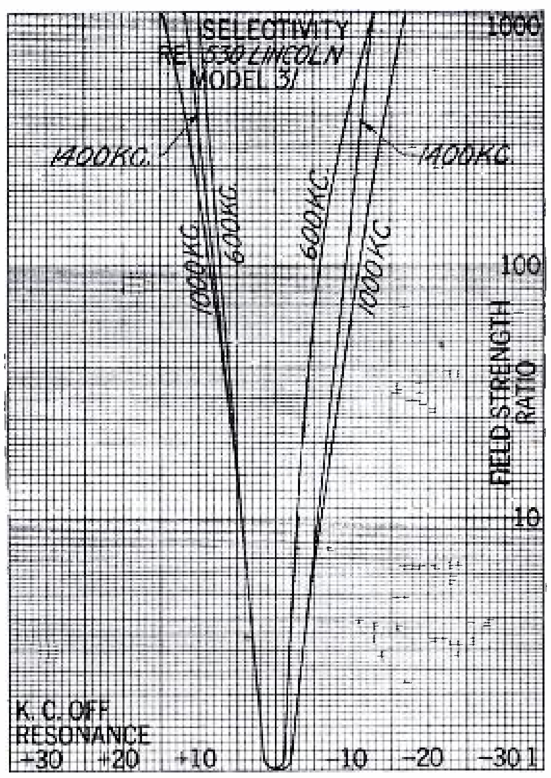
Sensitivity, selectivity and fidelity curves which are printed in this article require very little explanation since most of our readers have by this time become accustomed to reading and comparing these curves. However it might be interesting to note that in order to bring the sensitivity of the receiver into the measurable range in the laboratory it was necessary to cut out two of the intermediate stages. The regeneration was adjusted to the same amount on all frequencies. According to the laboratory report the probable actual sensitivity of the complete receiver is in the neighborhood of one microvolt absolute. This explanation refers to the sensitivity curve on which it is stated "See note," and is made so that the curve as drawn will not be misinterpreted.

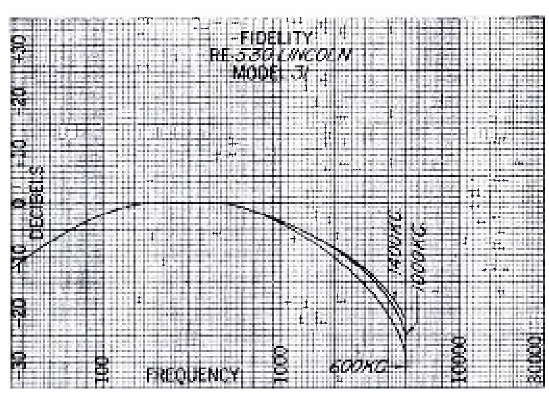
Variable Selectivity

On the score of selectivity little need be said, and the tables of interference ratios and band widths at the end of this article are very interesting to en-

(*Continued on page* 109)







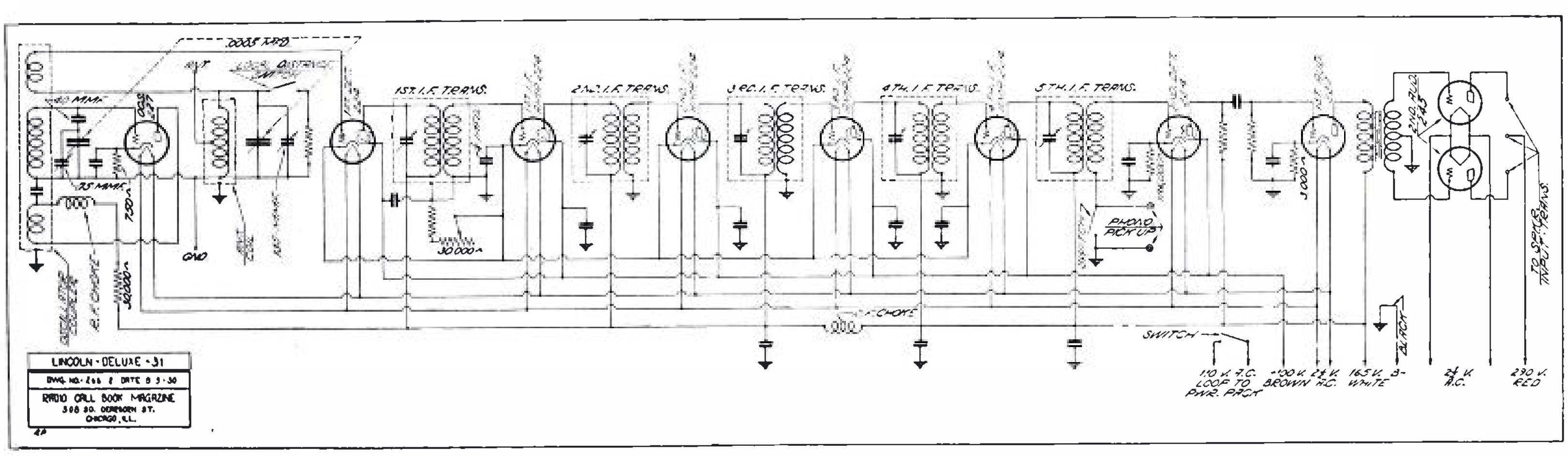


Fig. 2. *The electrical circuit of the receiver portion may be seen above*

Aero Automatic Tuning Unit Covers Band From 15 to 90 Meters

Three Interesting Methods of Employing Tuner Are Illustrated Schematically

FOR many individuals the operation of a short wave receiver either for code or broadcast reception has had a drawback in that in jumping from one band to another it has been necessary to plug in a number of different sized coils. If operation of the receiver is confined to a single band this does not involve the objection just mentioned.

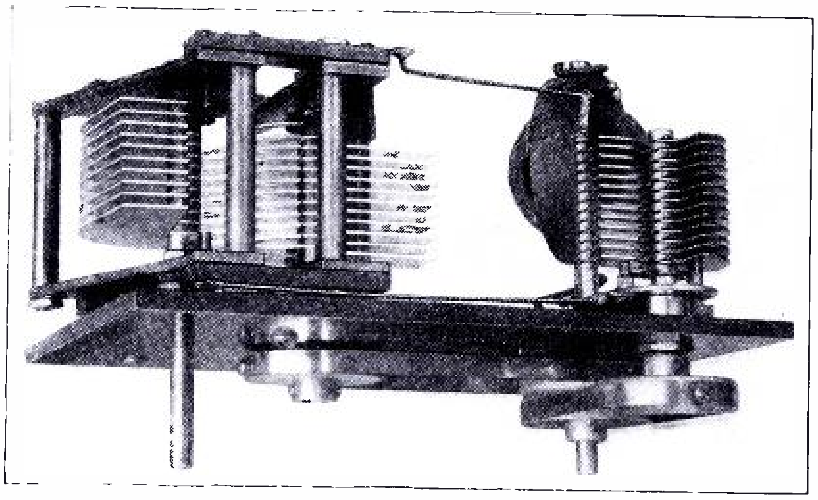


Fig. 1. The automatic tuning unit made by Aero is shown here. A description of its functions will be found in this article

Automatic Tuner

When it became evident that a great deal of amateur and phone work was to be found on the 20, 40 and 80 meter bands Aero Products, Inc., designed what is known as their short wave automatic tuning unit. This unit which may be seen in the photograph Figure 1 consists of the left rotor which is the station selector (this operating independently); and two variable condensers and a variometer operating in conjunction with each other, linked by the belt and pulley arrangement shown at the front of this protograph. This is called the frequency shift dial (corresponding to a tank condenser). The third control (not included in the photograph) is merely a variable resistance of about 10,000 ohms and a fixed condenser of .0005 mfd, arranged as a regeneration control. The tickler winding shown in the schematic diagrams is wound in inductive relation to one winding of the variometer and is therefore fixed inductively, so control of regeneration must be either by capacity or resistive change. The method here mentioned is the cheapest.

Briefly the idea underlying the Aero automatic tuning unit is that the station selector corresponds to a vernier or station-spreader, while the frequency shift dial corresponds to the tank condenser and gives large values of frequency shift, eliminating the plug-in coils as a means of covering the band from 15 to 90 meters. As previously stated most of the amateur work is performed in the range covered by the automatic tuning unit, and the same may be said for the short wave relay broadcasting stations. After listening to the stations between 6020 and 6140 kilocycles for something like a week the experimenter will come to the conclusion that the majority of broadcast work is performed between the frequencies previously mentioned, and that not much may be gained by desiring to cover a higher range.

Extending the Range

However for those who are never satisfied it may be stated that by means of an Aero Int. 104 coil and a Yaxley No. 760 double pole double throw switch the range of the unit may be extended from 15 to 204 meters. When the 90 meter top of the automatic tuning unit has been reached, the switch is thrown and the Int. 104 coil shunted into place instead of the variometer. So even here while a plug-in coil is used to cover the extreme range the mere flip of a switch does the trick.

Experimentally inclined readers will find in the diagrams shown on this page three means of utilizing the Aero automatic tuning unit.

The first scheme is shown in Figure 2 where the automatic tuner is used in the grid circuit of a r.f. and regenerative 2 tube receiver arranged for head phone reception. The input circuit of the first tube which is a 224 is made aperiodic through the r.f. choke shown. With this type of receiver only the detector circuit is tuned.

In Figure 3 is the Aero automatic tuning unit used as a short wave plug in adapter which goes into the detector socket on any tuned radio frequency receievr, or the second detector of a superheterodyne.

Figure 4 is the most interesting since it shows how two Aero units may be combined in a two tube superheterodyne adapter, which may be operated ahead of any tuned r.f. receiver, enabling the operator to tune in short wave broadcast programs on the long wave broadcast receiver. This arrangement brings to mind the old superheterodynes with the left hand control being the antenna and the right hand becoming the oscillator control. Here the Aero units again come in handy since the majority of the short wave phone work may be found between the 15 to 90 meter range.

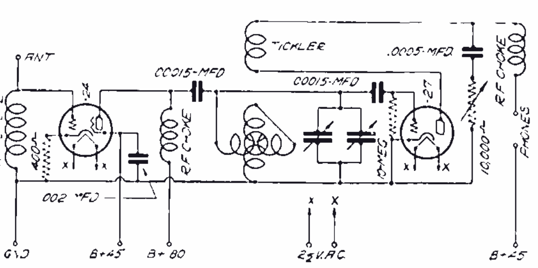


Fig. 2. Here the automatic tuner is used in a r.f. and regenerative circuit for headphone reception

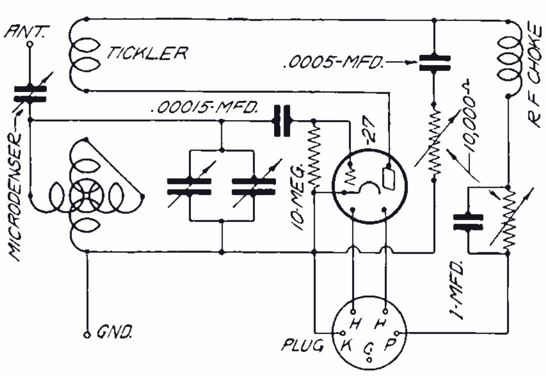


Fig. 3. Those wanting to make up an a.c. short wave adapter of the plug-in variety may see how the automatic tuner fits in

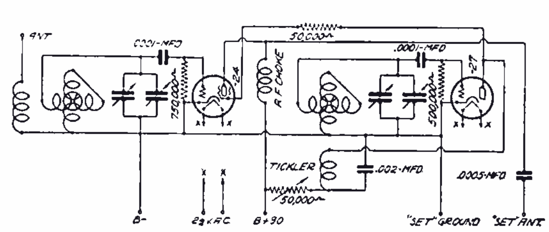


Fig. 4. A short wave superheterodyne adapter, consisting of the r.f. and oscillator stages, is seen here

Superheterodyne Circuit Adapted for Automobile Radio Receiver

Good Volume, Simplicity of Tuning, Compactness in Recent Design by Scott

SUPERHETERODYNES have been used for all kinds of reception purposes but only recently has the circuit been incorporated in an automobile receiver according to a recent statement covering the design by the Scott Transformer Co., of an automobile set. The schematic circuit of the job is shown on this page, while a photograph of the receiver and its metal cabinet is shown at the heading of this page.

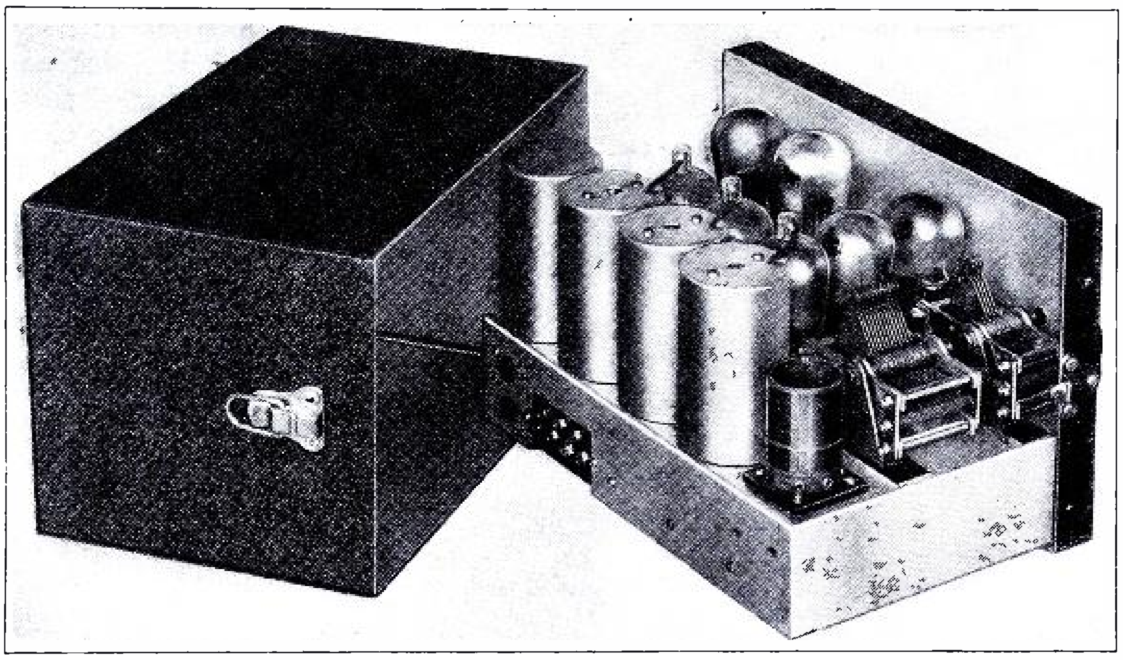


Fig. 1. Rear view of the superheterodyne auto receiver is seen in this photograph. The metal cabinet acts as a shield for the receiver. The current drain is 3.5 amperes A, and 25 milliamperes total B

A Compact Super

It is evident from an examination of the schematic diagram that the same general idea is followed in the automobile receiver as was done in the later versions of the World's Record series of superheterodynes, except of course a reduction in the number of intermediate stages and the reduction in the amount of space occupied by the chassis and its parts. Consequently not a great deal of attention need be given the electrical details, whereas some data on general installation work might be of help to those desiring to make a similar installation.

While in the beginning it was found that an antenna under the running board was satisfactory, this was later changed to be an antenna consisting of copper screen in the top of the car (coupe or sedan). In cases where there is already wire netting in place this may be used, although in some cases it may be necessary to unground this wire netting from the frame of the car. As a rule (if no screen is provided in the car) copper screen about 3 by 3 feet will suffice for antenna.

Special Speaker

The speaker used in this case is a special Utah magnetic that is both water and dust proof. The dry B batteries in the coupe installations are placed in the back, whereas in the sedan the batteries are placed in the rear of the vertical back cushion. The A battery is the one used for ignition, the filament wire being brought in on one side of the ammeter so that radio current consumption can be registered by the ammeter. Allen-Bradley spark plug resistors are placed in each of the distributor leads and in each of the spark plug leads. In addition there is a bypass across the generator, and one across the battery side of the high tension coil.

Grounding of A Battery

It is stated that it does not matter which side of the A battery is grounded to the chassis of the machine, as the two filament lines are marked red and black. If the A minus is grounded to the chassis, then the red lead goes to the ammeter and the black to the frame. On the other hand if the A positive is grounded, the black lead goes to the ammeter and the red to the frame. The B negative wire is always hooked to the black wire in the cable.

The tuning of the receiver is single control. The volume control is a 75,000 ohm variable resistor between the first, second and third cathodes and the ground. As indicated in the schematic the grid returns are made through the frame of the car. Alternating tubes have been employed for their ability to stand rough treatment.

On one particular installation where the machine was a Peerless coupe there was more than ample volume.

Later models of the receiver show change in that a 227 tube is used for the first audio, and a 171A for the output tube instead of the combination shown in the diagram. The total A current drawn under these conditions is 3.5 amperes, and B current total of 25 milliamperes.

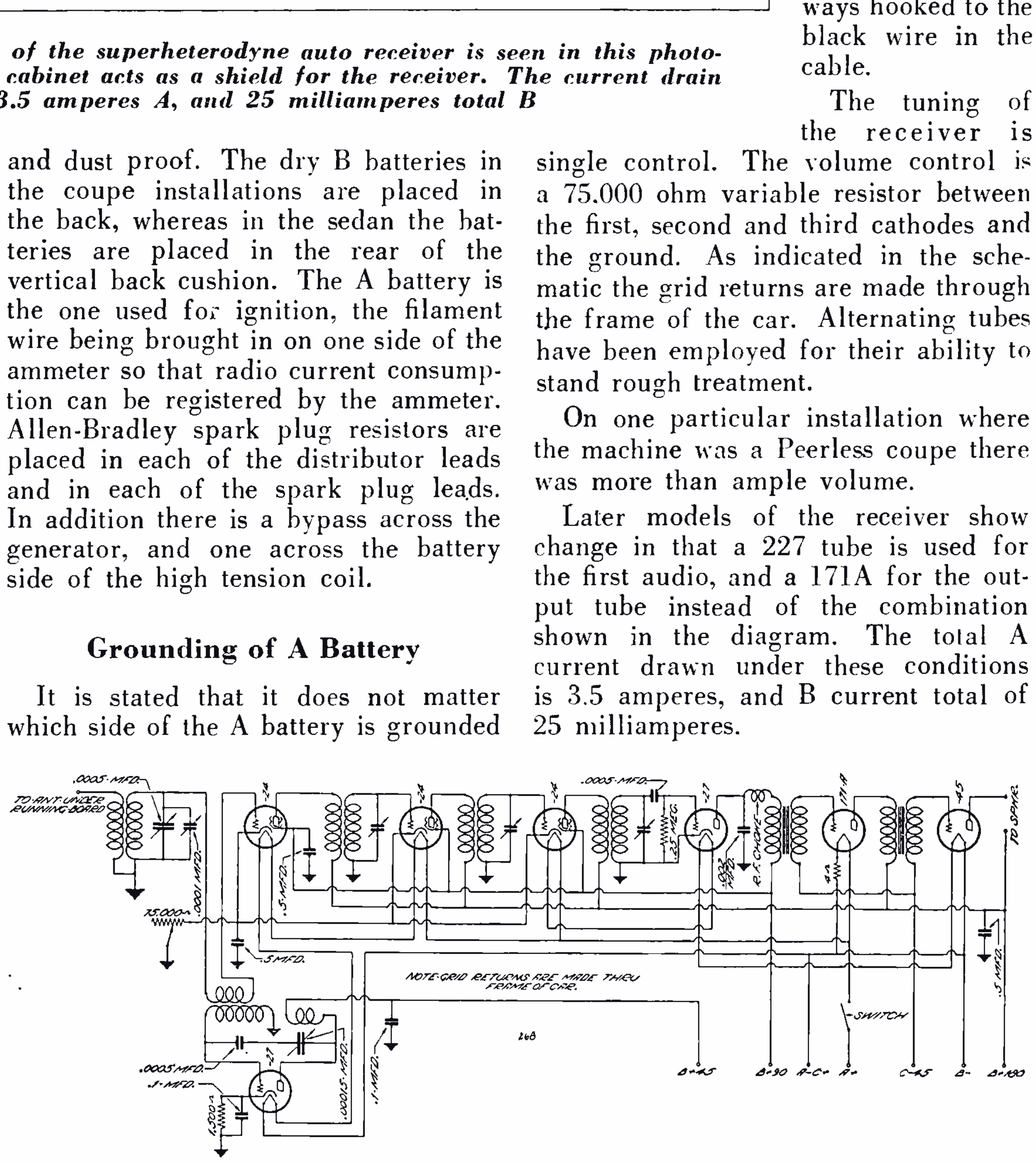


Fig. 2. The electrical details of the auto receiver made by Scott are shown in this drawing

Walker Goes Into a New Season With His Versatile Flexi-Unit

Improved Version of Unit Now Available to Setbuilders, Servicemen and Experimenters

CHAIN broadcasting companies in the past year have been largely responsible for an increased public interest in the reception of short wave programs, especially if these programs emanate from foreign shores. While the majority of the listeners would rather have their foreign programs brought in over a chain network, nevertheless until such a time as the chains can provide foreign programs every day or night, there will be a steady demand for a means to pick up these programs without too great an expense.

Designs Flexi-Unit

In the past two or three seasons an adapter arrangement having a great variety of circuit possibilities has been merchandised by the George W. Walker Co. This season the model has been changed in quite a number of points, its scope of usefulness widened, and it is now presented to short wave enthusiasts under the name of the Walker Flexi-Unit. It is shown photographically in Figue 1, and three schematic diagrams are given of as many methods of employment for the Flexi-Unit. There are eight other circuit connections possible, but lack of space preevnts the reproduction of more than those shown on this page.

Due to the flexibility of the circuit the unit may be operated with either battery or a.c. receiver, or as an individual a.c. or d.c. single tube receiver. By removing the grid leak mounted on the top of the panel and shorting the grid condenser with a link furnished for that purpose, the unit is ready for use as an extra stage of tuned radio frequency permitting regeneration. But a few moments are required to attach the Flexi-Unit to any receiver.

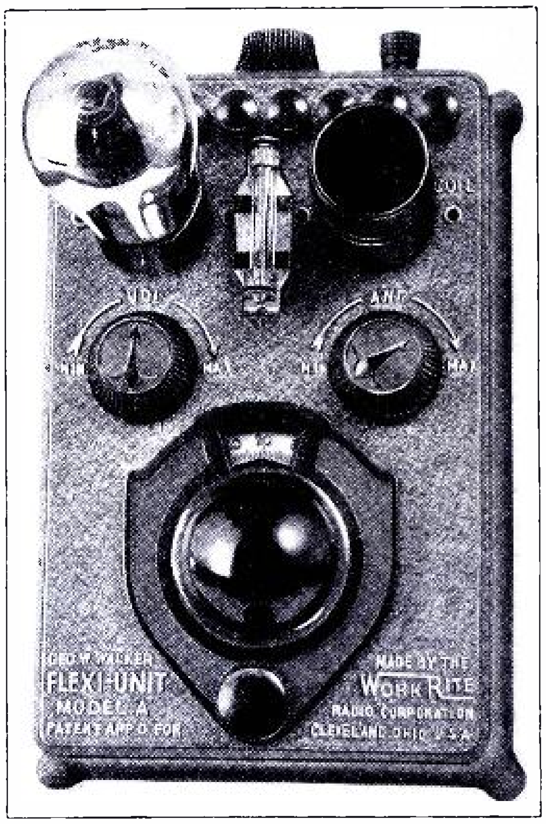


Fig. 1. This illustration shows the model A Flexi-Unit made by the Workrite interests and merchandised under the name of George W. Walker

Used as Oscillator

When connected as an r.f. oscillator many valuable uses for the unit will be found, such as in checking and calibrating your receiver, or transmitting a signal to determine the sensitivity of a circuit. The radio service man and experimenter can rearrange the circuit to meet any of their requirements, or any new idea that may occur to them. With a calibrated short wave oscillator it is very easy to chart or log new receivers to determine the exact setting of the dials without the need of fishing for the signals. The use of the Flexi-Unit as a short wave pre-amplifier will prove an interesting experiment.

Four Plug-in Coils

To avoid unnecessary losses and insure good electrical contact the plug-in type of coil has been selected. Four plug-in coils, covering the range from 15 to 550 meters, are provided with the unit, each coil being numbered and readily distinguishable from the other. One of the coils covers the broadcast band from 200 to 550 meters, another the band from 100 to 200 meters, while two other coils cover the popular band from 15 to 100 meters. There is sufficient overlap on each coil so that orderly progression may be followed in tuning.

The schematic diagram in Figure 2 shows the unit when connected as an alternating current pre-amplifier or booster, the grid leak being pulled out and the metal link shorting the terminals G and B. This connection serves to pep up a receiver that may not be delivering as much r.f. energy as would be desired, either on the short or the long waves.

In the diagram shown in Figure 3 the service man will find a mean of using the oscillator as an r.f. oscillator to cover a range of 15 to 550 meters, using either a 199 or 201-A tube. Dry batteries can be used and the unit made portable.

(Continued on page 110)

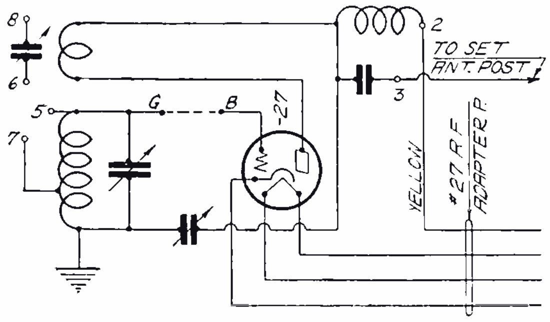


Fig. 2. When connected as an a.c. pre-amplifier or booster the schematic above is followed

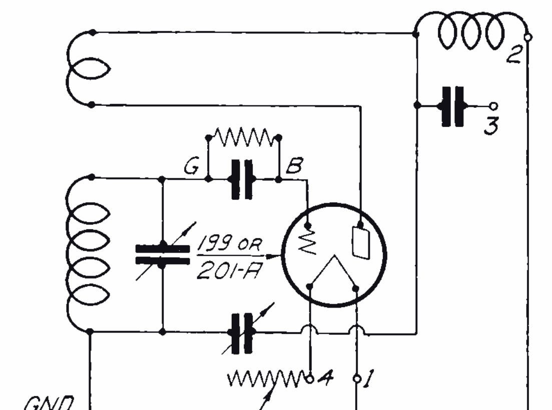


Fig. 3. Service men will be able to use the unit as an r.f. oscillator if the connections shown here are followed

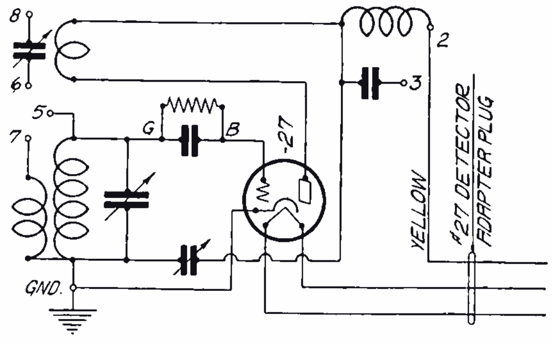
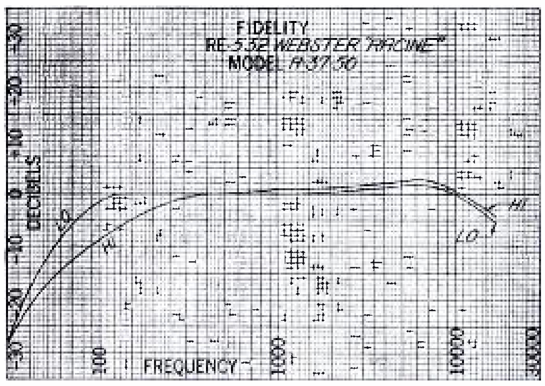


Fig. 4. This diagram shows the unit used as a short wave a.c. adapter for covering the range from 15 to 200 meters in conjunction with your regular broadcast receiver

Measurement of Public Address Units Shows Interesting Data

Products of Silver-Marshall, Webster of Racine and Webster of Chicago Recently Checked in Laboratory



SO many requests have come into the engineering department for data on public address systems along the same idea as the response curves that are appearing exclusively in this magazine, that arrangements have been made to have a number of representative systems measured in our laboratory and the data published from issue to issue. In this number we are therefore glad to include the curves and data of the three amplifiers recently measured, in the hope that such information will be of material aid to our readers. Other measurements will follow in the November issue.

Three public address jobs are shown on this page, both photographically and accompanied by the amplifier's fidelity curve. One is Silver-Marshall 692, using a 224, a 245, two 250 and two 281 tubes; the other the Webster (Racine) A-37-50 using two 227, two 250 in pushpull, and two 281. The other is the Webster (Chicago) model DH, using one 227 followed by two 227 in pushpull, then two 250 in pushpull, with two 281 as rectifiers. Schematic diagrams of these models will appear in a later issue of this magazine.

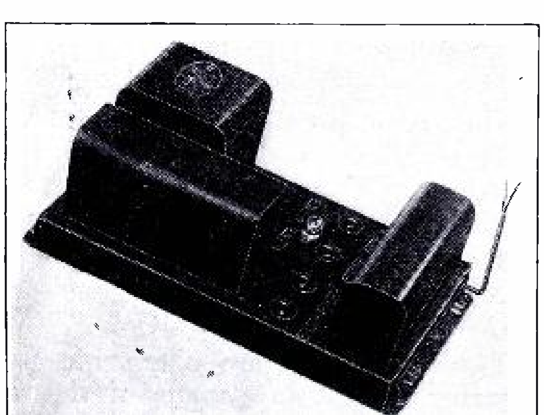


Fig. 1. This photograph shows the Webster (Racine) model A-37-50, whose fidelity curve is shown on this page

Silver 692

In measurements on the S-M 692 output impedance load was adjusted to 125 ohms, and coupled to taps 1 and 5 of output transformer. An output of 1 watt was maintained on all measurements. Volume control was turned on full, and no hum was measurable at output meter connections. Mutual conductance of tubes used: 1 a.f. 930; 2 a.f. 2300; p.p. 1700; p.p. 1700 micromhos.

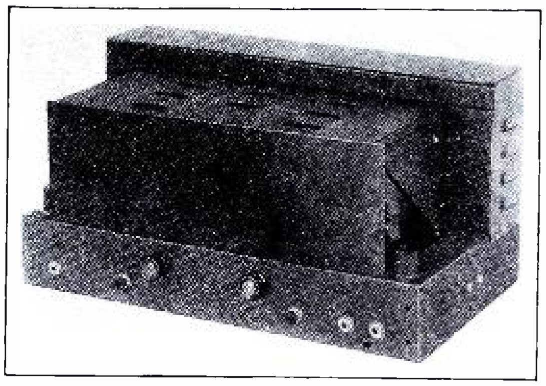
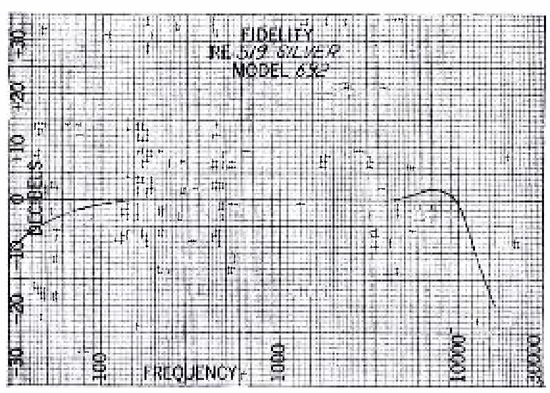


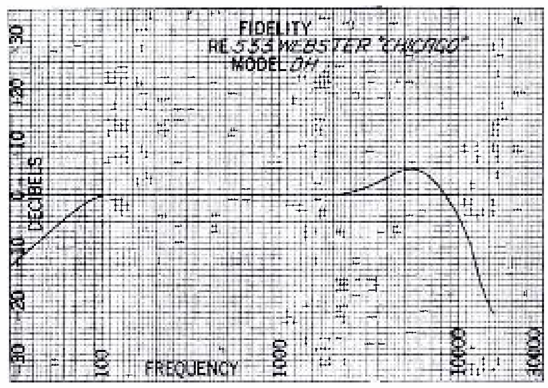
Fig. 2. The Silver-Marshall 692 job is illustrated in this photograph. The fidelity curve for this model is also on this page

The following table gives the loss or gain in decibels as measured at the various audio frequency inputs:



f	DB	f	DB
30—	10.00 Loss	2,000—	0.00
60—	2.20 Loss	4,000—	0.00
90—	1.10 Loss	6,000—	1.10 Gain
120—	0.80 Loss	8,000—	3.60 Gain
250—	0.65 Loss	10,000—	0.65 Loss
400—	0.00 Ref.	12,000—	8.20 Loss
800—	0.00	14,000—	14.60 Loss
1000—	0.00	16,000—	19.90 Loss

The voltage amplification at the reference level of 400 cycles was 2450.98.



Webster (Racine)

When measuring the Webster (Racine) A-37-50 the output impedance load was adjusted to 4000 ohms, and coupled capacitatively to the 250 plates. An output of 1 watt was maintained on all measurements. Input taps 1 and 2 were used, giving an input transformer ratio of 5:1. The hum delivered to the output meter connections was .0113 watts. Mutual conductance of tubes: 1 a.f. 1500; 2 a.f. 1550; p.p. 2100; p.p. 2100 micromhos.

The following table gives the loss or gain in decibels as measured as the various frequencies; this measurement being made on the LO switch on:

f	DB	f	DB
30—	28.00 Loss	2,000—	0.30 Gain
60—	8.50 Loss	4,000—	1.20 Gain
90—	2.50 Loss	6,000—	1.80 Gain
120—	0.200 Loss	8,000—	1.20 Gain
250—	0.00	10,000—	0.00
400—	0.00 Ref.	12,000—	1.80 Loss
800—	0.00	14,000—	3.20 Loss
1000—	0.00	16,000—	5.50 Loss

The voltage amplification at the reference level was 4170.0 with the switch on the LO side; with it on the HI side the voltage amplification was 2976.19.

(*Continued on page* 111)

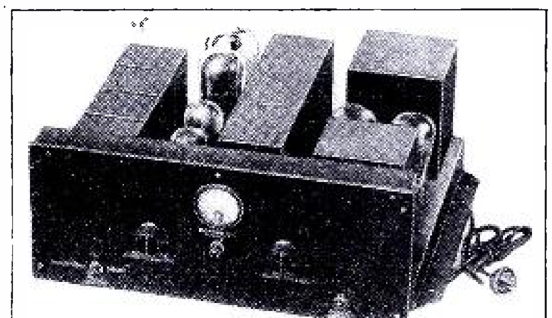


Fig. 3. Here is seen the Webster (Chicago) model DH, equipped with microphone current meter and control. Its fidelity curve is given here

Three Tube Adapter Makes Superhet Out of Any T. R. F. Receiver

Self-Contained, A, B and C Powered Units Available in New S-M 738 Model

THOUSANDS of owners of tuned r.f. receivers may now make a superheterodyne out of their set by the addition of a compact 3 tube super adapter along the lines of the Silver-Marshall 738 adapter illustrated photographically and schematically on this page, and recently tested out in our laboratory.

By looking at the diagram in Figure 2 it will be immediately seen that the greatest feature of the adapter is the fact it provides its own filament, plate and bias voltages instead of depending upon the receiver to which it is attached to supply these voltages. This makes it possible for the adapter to be used with any receiver regardless of the types of tubes used or the voltages supplied.

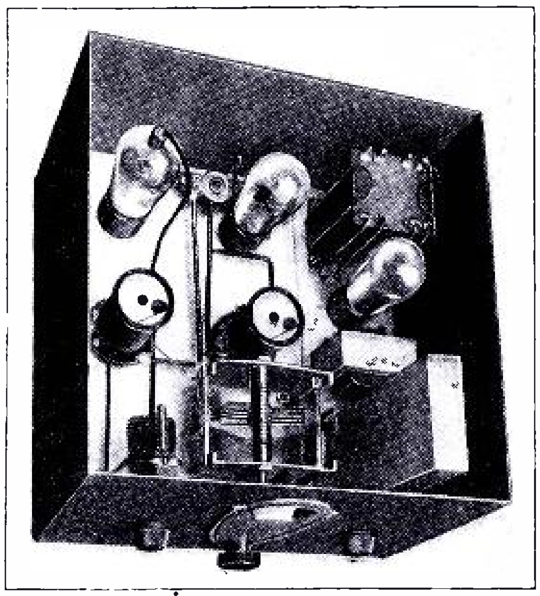


Fig. 1. This photograph shows the S-M 738 super adapter described here

Tune on Short Waves

All that is necessary to do is to connect the adapter to the input of your t.r.f. receiver, set the tuning dials at some frequency between 800 and 1000 kilocycles (depending upon local interference) and tune with the two tube adapter across the short wave bands. Phone stations on the higher frequencies can be brought in over the t.r.f. job with quality and volume that is out of question with the ordinary short wave receiver. Tuning is simplicity itself. The left hand knob controls the antenna stage, the center dial controls the short wave oscillator, and the right hand knob is the on-off switch for turning on the adapter. Readers who have played with superheterodynes will immediately see the resemblance to the old time supers, except that the tuning is done at short waves and the radio frequency stages of your regular receiver act as the intermediate frequency amplifier.

The unit which is shown in Figure 1 is quite compact and can be placed next to the regular broadcast receiver. The only precaution is to see that the lead from the plate circuit of the 224 in the adapter to the antenna connection on the broadcast receiver is short as possible to cut down loss. The other two terminals on the rear of the adapter are the antenna and ground binding posts. It will be seen that a 226 tube becomes the rectifier in this unit and since the amount of current drawn by the 224 and 227 tubes is not of a very great order, the 226 works nicely for that purpose. A choke and filter condenser is also supplied in the unit.

After testing the unit out thoroughly at night and in a good location for reception, it was found to bring in enough short wave broadcasting stations to permit one to be entertained nicely, with the possible exception of rapid fading on some of the shorter channels.

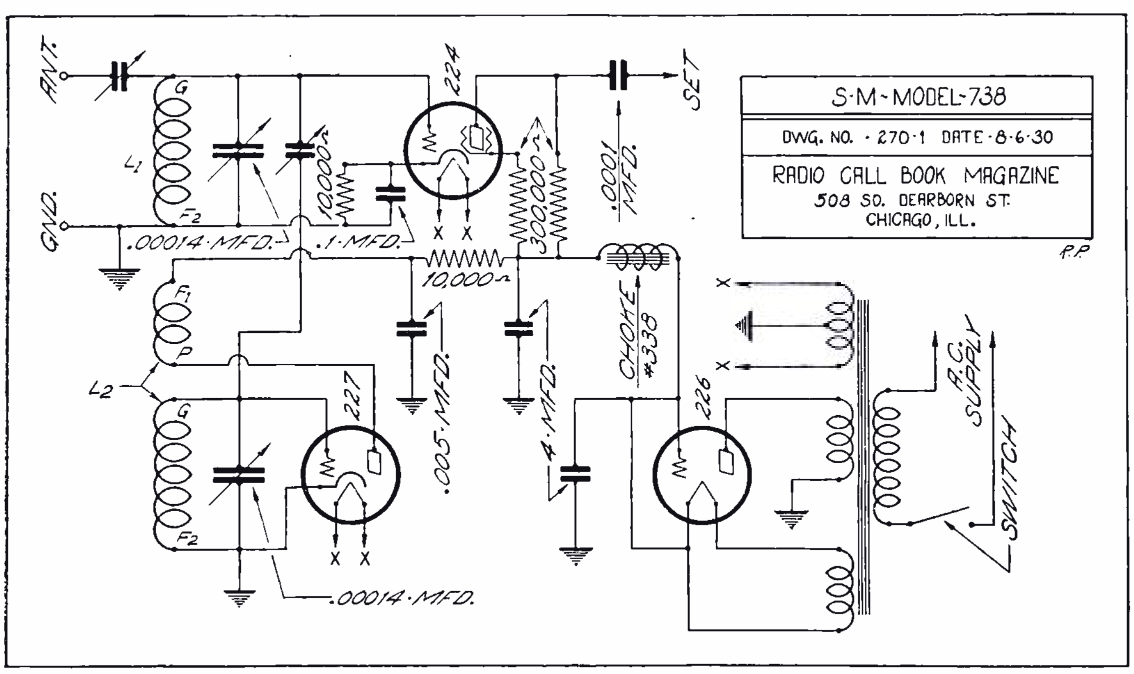


Fig. 2. The schematic diagram of the 738 shows a simple adapter can be evolved in a small space

Pick of Stations

A great many of the interesting stations may be found between 6140 and 6020 kilocycles as indicated in the following table. Of course there are a number of stations not in this list that might be of interest to listeners but they can be picked up on other coils:

W9XF	6,020	49.83
W3XL	6,020	49.83
W2XBR	6,020	49.83
W9XAQ	6,040	49.67
W2XAL	6,040	49.67
W3XAU	6,060	49.50
W8XAL	6,060	49.50
W9XU	6,060	49.50
UOR2—Vienna	6,070	49.40
W6XAL	6,080	49.34
W2XCX	6,080	49.34
OXQ—Copenhagen	6,090	49.26
W3XAL	6,100	49.18
FL—Paris	6,120	49.02
W8XK	6,140	48.86

The set is provided with 4 sets of coils with ranges of substantially the wavelengths shown below:—

L—16.6 to 31.0 meters.
M—30.0 to 56.7 meters.
N—55 to 104 meters.
O—103 to 195 meters.

Two other coils are obtainable for covering higher wavelengths if this is desired, although such a range is hardly necessary.

Parts used in the construction of the

(*Continued on page* 110)

Braxton-King Superhet Changed for the New Radio Season

Variometer Type Antenna Coil Automatically Adjusts Tracking of R.F. and Oscillator Stages

CHANGES have been made in the design of the Braxton-King tuner according to recent advices from the Mississippi Valley Radio Co. These changes are embodied in the schematic diagram of the Model C Five which is printed on this page. A photograph of the superheterodyne tuner itself is also shown here.

One of the advantages of the C Five tuner is the fact it may be used with any two stage amplifier which will supply plate voltages of 75 and 180 volts. Of course it may also be used with the standard Model D amplifier made by the same company.

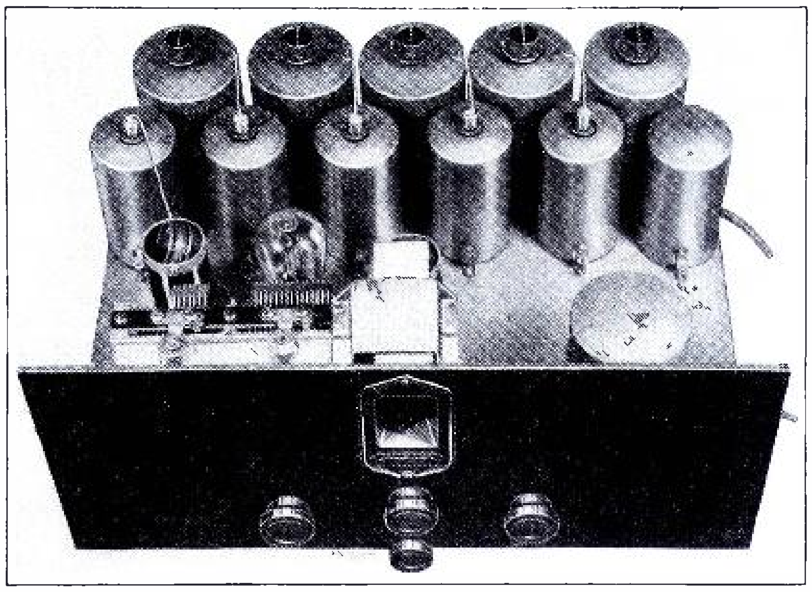


Fig. 1. In this picture may be seen the Model C Five tuner as recently photographed. The circuit used in the tuner is shown at the bottom of this page

Circuit Changes

The model C Five is an improvement over the previous model in that the construction and shielding employ heavier material, while various improvements have been made in the circuit itself, such as the use of individual shielded r.f. chokes in the plate leads.

The new model also incorporates an antenna coil of variometer type, the rotor of which is connected to and rotated by the main tuning condenser shaft. This gives automatic adjustment of inductance and permits extremely close tracking of the antenna and oscillator circuits so that the midget condenser is only necessary for extreme distance work.

The antenna stage is equipped for short or long aerials. The oscillator tuning is across the grid circuit so the rotor can be at ground potential. Bias on the oscillator to hold down the plate potential is provided by a 1,500 ohm resistor with its bypass between the cathode and ground circuit. Plate circuits of all the intermediate stages are provided with trimmers so that each stage may be lined up with its predecessors. This allows changing at will the shape of the selectivity curves, although the curve shown on page 121 of the March, 1930, issue of this magazine, was taken with a common setting of the plate circuit trimmers. Copies of those curves are obtainable from the manufacturer.

Phono Pickup

In the detector circuit where a 227 tube is employed, there are two tip jacks into which may be plugged a phonograph pickup unit. Volume control is provided by the employment of a 2,500 ohm variable resistor in series with a 1,500 ohm fixed resistor placed between the common cathode line and ground. The schematic diagram in Figure 2 shows a filament transformer with a single winding to carry all of the heater type tubes used in the tuner, a 20 ohm center tap resistor across the secondary winding.

Response curves of the tuner alone have not been taken for this article because such measurements would hinge largely on the type of audio amplifier used for the test. However, the curves taken on the entire unit were shown in the March issue.

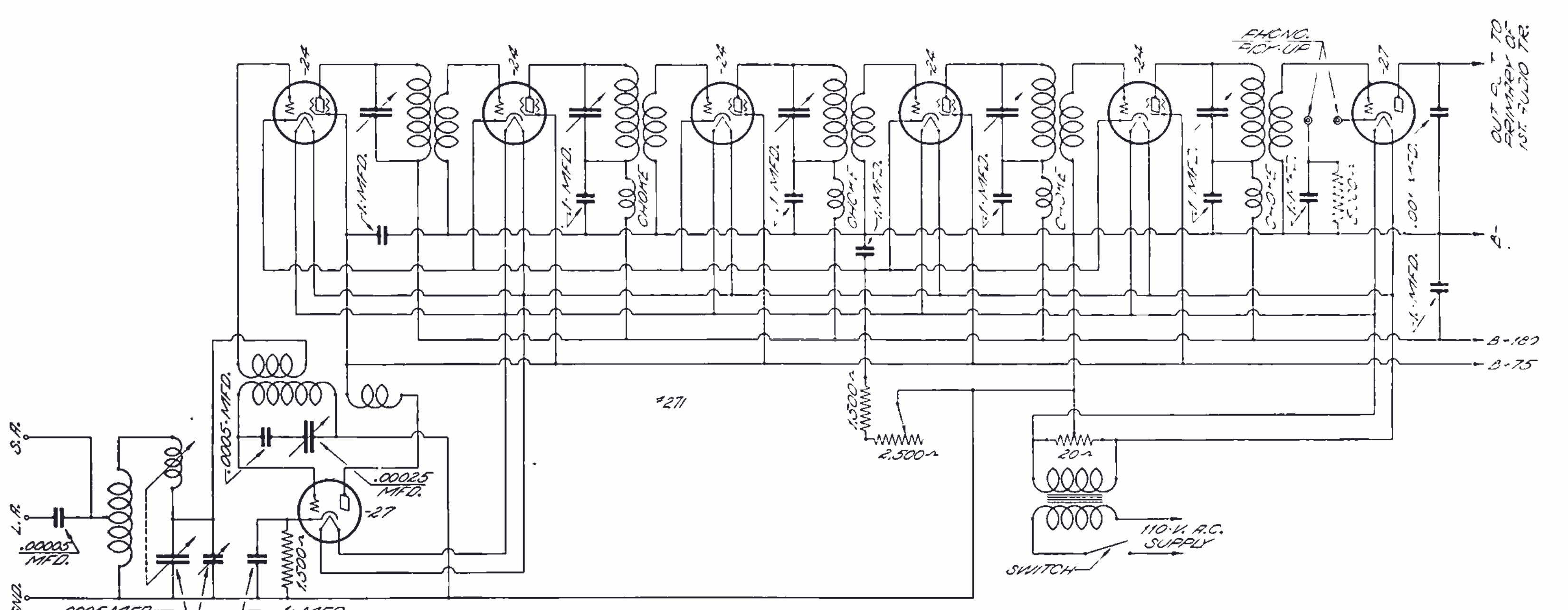


Fig. 2. Several changes of a circuit nature have been made in the Braxton-King tuner described on this page, the circuit being as drawn here

Leutz Model C Short Wave Radio Set Designed for Battery Use

Unit Construction Permits Double Shielding and Extreme Flexibility of Circuit Arrangement

ADDING a new model to its line, C. R. Leutz, Inc., has announced its Model C short wave radio receiver, using the unit construction idea which may be seen in the photograph of the receiver itself. The picture is taken with all the lids open as indicated in Figure 1.

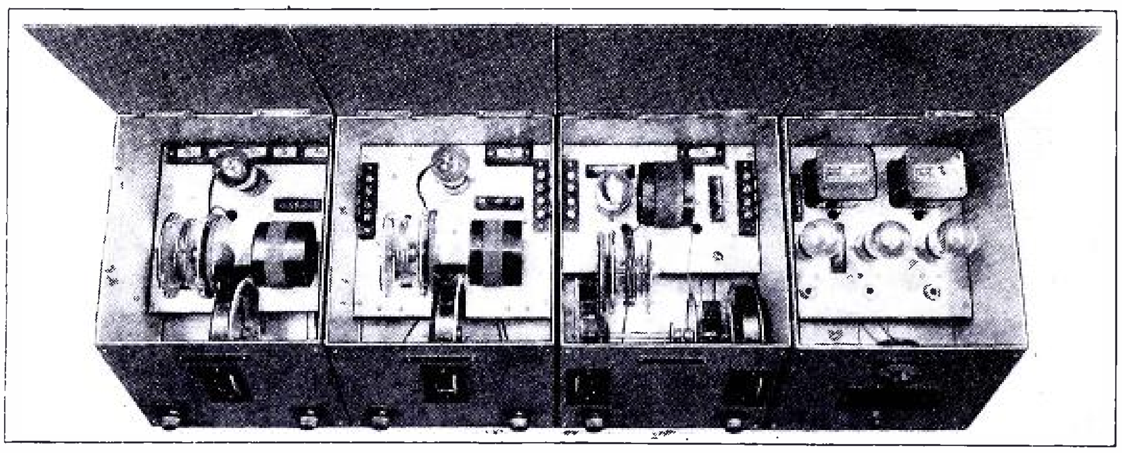


Fig. 1. A photograph of the interior of the Leutz Model C is shown above. The lids of the separate units are raised

Schematically the circuit is shown in Figure 2 which consists of two r.f. amplifier units, a regenerative detector unit, and the audio unit this being the most desirable combination for all around work. Using one less r.f. stage is probably the best for those not interested in extreme distance with maximum volume.

6 Coils Cover Range

In order to cover the band from 15 to 200 meters in an efficient manner and secure the greatest voltage step-up the Model C tuner is provided with a series of 6 plug in coils with ranges as shown below:—

	Meters
Coil 1	200-100
Coil 2	110- 70
Coil 3	75- 50
Coil 4	55- 30
Coil 5	35- 20
Coil 6	25- 15

The tuning dials on the new Leutz Model C have a 360 degree dial movement, which together with the small tuning capacities employed, permit the logging of the receiver to a considerable degree.

Double Shielding

It should be observed that the unit construction possesses two advantages, one being the double shielding, and the other flexibility of arrangement. Due to obvious technical limitations the power output stage of the audio unit is not pushpulled. By having three cascaded stages of audio sufficient volume is available and the amplifier is sensitive to even the weaker signals that might not be audible with less audio amplification. Jacks are provided so headphones or speaker can be used in any of the stages.

As will be seen in the diagram the detector unit is arranged with a two-winding coil, one winding of which is the detector grid circuit and the other the regenerative winding. The coupling between these two coils is fixed, and therefore the regenerative control must be by capacity or resistance change. In this case one condenser is used as a regeneration control.

The antenna or first r.f. stage unit is also contained in an individual shielded case. One tuned inductance is required and it has two windings. The first winding tunes the grid circuit of

(*Continued on page* 110)

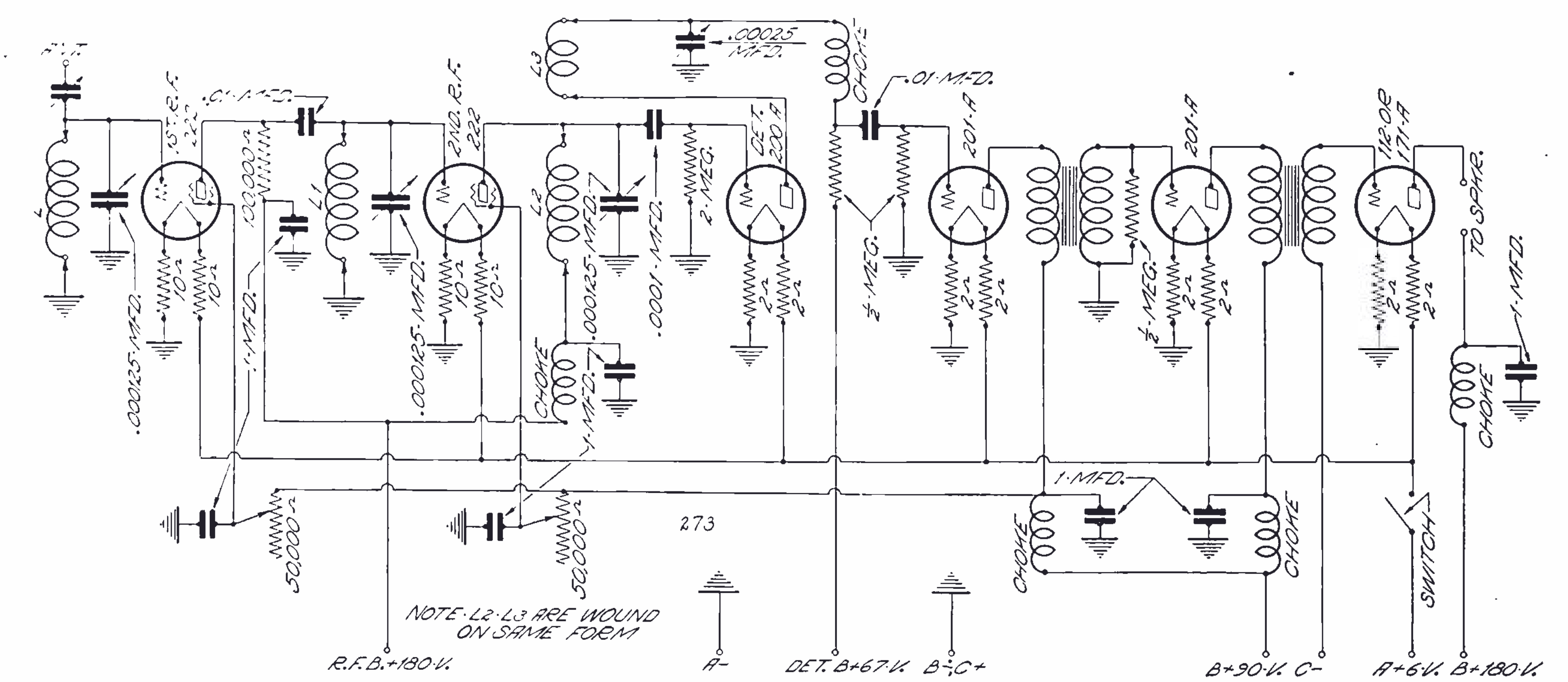


Fig. 2. The schematic diagram of the Model C short wave receiver may be seen above

Makes A.C. Addition to Jewell 133 Set Tester

An alternating current addition to the Jewell 133 d.c. test kit has been worked out by one of our readers, E. C. Baker, who maintains the Baker Radio Service at 7012 Whittaker Ave., Detroit, Mich. Mr. Baker is passing the information along for the benefit of other service men who have need for such equipment.

Photo and Diagram

A photograph of the addition is shown in Figure 1 while the schematic drawing of the circuit is set forth in Figure 2.

According to the data accompanying the drawing there are three switches used. Switch 1 is a single pole double throw switch. In position C1 it is used for testing the 280 tubes (with Switch 2 open to prevent short circuit). When the switch is on C1 the plate of the 280 on the grid terminal of the socket (S 2) is tested, with Switch 2 open. When testing the 280 plate that is on the plate terminal of the socket S 2, then Switch 2 should be closed.

When the Switch 1 is thrown on the C2 side it also tests the plate of a 281; or a 210 or 250 power tube. The switch Sw2 must be closed when the plate

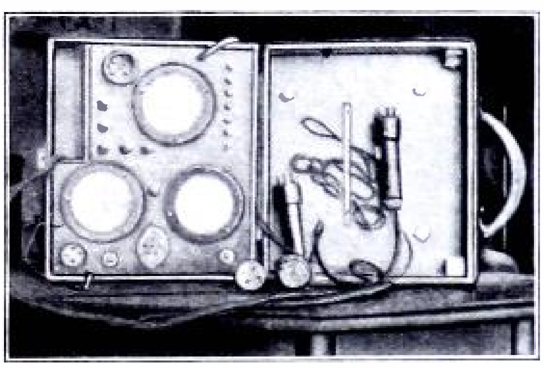
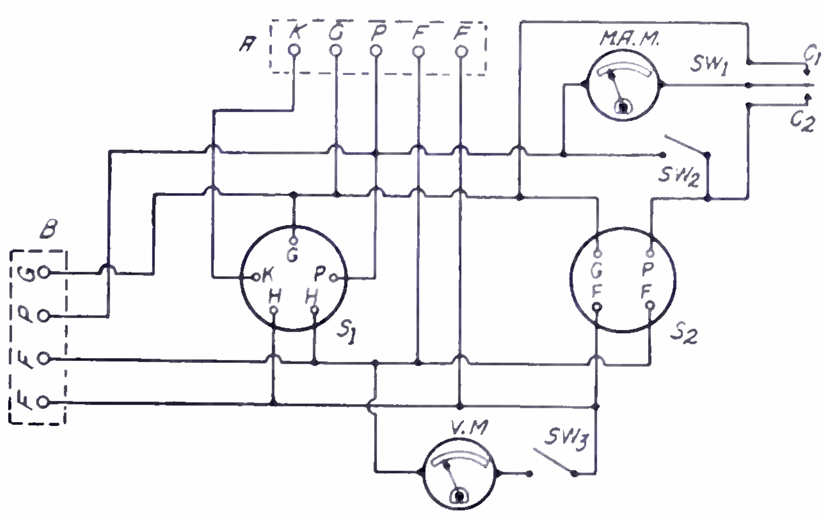


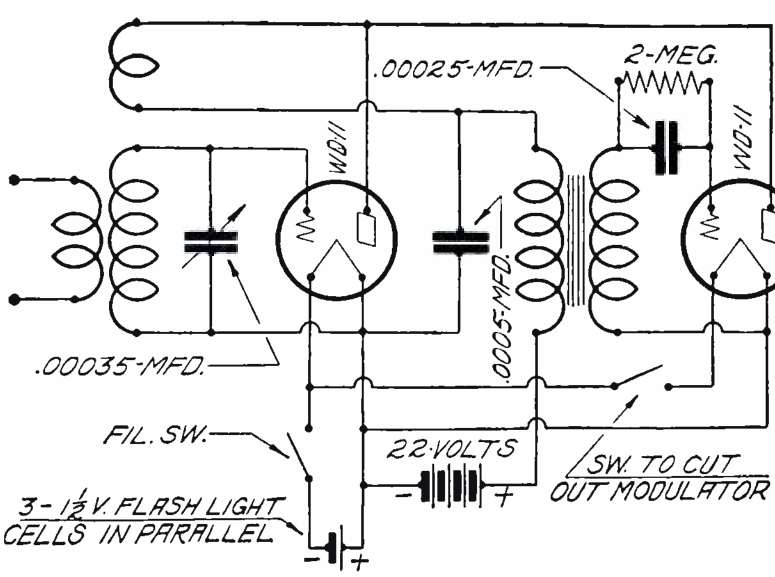
Fig. 1. This photograph shows the a.c. addition to the Jewell 133 set tester developed by E. C. Baker of Detroit, Mich.

FACTORY SCHEMATIC INDEX

Name	Model	Vol.	No.	Month	Year	Page	SR. No
A. C. Dayton	Navigator	10	4	Nov.	1929	94	21
Acme Mfg. Co.	AC7	10	2	March	1929	92	3
Acme Mfg. Co.	AC4	10	2	March	1929	93	4
All-American Mohawk	6	10	2	March	1929	94	1
All-American Mohawk	8	10	2	March	1929	93	2
American Bosch	28-29	10	4	Nov.	1929	91	21
Amrad	70	10	4	Nov.	1929	92	22
Amrad	81	11	2	March	1930	81	44
Atwater Kent	38	11	1	Jan.	1930	72	28
Atwater-Kent (cap.)	55, 55 C	11	3	Sept.	1930	82	51
Atwater-Kent (Ind.)	55, 55-C	11	3	Sept.	1930	82	52
Balkeit	A	10	3	Sept.	1929	85	12
Bremer-Tully	7-70	10	3	Sept.	1929	83	10
Brunswick	3KRO	10	4	Nov.	1929	93	23
Colonial	31AC	11	1	Jan.	1930	73	20
Crosley	Roamio	11	3	Sept.	1930	71	67
Crosley	408, 418, 428, 828	11	3	Sept.	1930	70	57
Crosley	608 Gembox	10	2	March	1929	95	5
Crosley	705 Showbox	10	2	March	1929	96	6
Crosley	Jewelbox 704B	11	2	March	1930	78	41
DayFan	5080	10	3	Sept.	1929	84	11
Delco Auto. Radio		11	3	Sept.	1930	70	66
Edison	R4, R5, C4	11	3	Sept.	1930	69	49
Erla	DuoConcerto	11	1	Jan.	1930	77	33
Fada	7AC	10	3	Sept.	1929	86	13
Federal	H	10	4	Nov.	1929	89	19
Freed-Eisemann	NR80	10	4	Nov.	1929	90	20
Freshman	2-N-12	10	3	Sept.	1929	87	14
General Motors		11	3	Sept.	1930	69	68
Gilfillan Bros.	100	11	1	Jan.	1930	76	32
Graybar Electric Co.	600	11	2	March	1930	79	42
Grebe	7AC	10	4	Nov.	1929	87	17
Gulbransen	Nine-in-Line	11	2	March	1930	77	40
Howard	S.G.A.	11	3	Sept.	1930	72	56
Howard	8	10	3	Sept.	1929	89	16
Kennedy, Colin B.	20	11	2	March	1930	75	48
King Mfg. Co.	J	11	1	Jan.	1930	75	31
Kolster	4	10	3	Sept.	1929	81	8
Kolster	21-23	11	2	March	1930	82	45
Majestic	70	10	3	Sept.	1929	80	7
Majestic	90B	11	3	Sept.	1930	80	55
Philco	86 82	10	4	Nov.	1929	96	26
Philco	95	11	3	Sept.	1930	78	60
RCA	60	11	1	Jan.	1930	74	30
RCA	66	11	3	Sept.	1930	81	64
Silver-Marshall	30B	11	3	Sept.	1930	73	53
Silver-Marshall	30	11	1	Jan.	1930	79	35
Slagle	9	11	1	Jan.	1930	71	27
Slagle (Continental)	R-20	11	2	March	1930	83	46
Sonora	5R	10	4	Nov.	1929	95	25
Sparton	AC89	10	3	Sept.	1929	82	9
Sparton	589	11	3	Sept.	1930	76	63
Splitdorf	E175	11	1	Jan.	1930	80	36
Steinite	261	10	3	Sept.	1929	88	15
Stewart-Warner	950	11	3	Sept.	1930	74	62
Stewart-Warner	Series 900	11	1	Jan.	1930	78	34
Stromberg-Carlson	846	11	3	Sept.	1930	75	54
Stromberg-Carlson	635 636	10	4	Nov.	1929	88	18
Temple	8-60	11	2	March	1930	74	37
U. S. Radio & Television	37	11	2	March	1930	76	39
Victor	R32, RE45, R52	11	3	Sept.	1930	77	61
Zenith	52	11	2	March	1930	80	43

Fig. 2. The schematic diagram of the connections in Mr. Baker's a.c. addition is given in the drawing at the right. The various parts of the circuit are described in the text





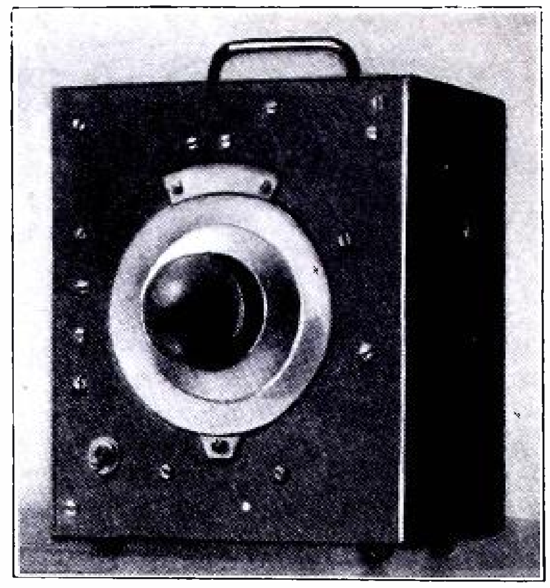


Fig. 2. At the right may be seen how small and compact the portable modulated oscillator can be made if one follows the ideas employed by Mr. Ferguson

Fig. 1. The drawing at the left is the schematic diagram of the modulated oscillator using battery supply for plate and filament. The schematic is based on the general idea shown in Fig. 2 on page 69 of the March, 1929, issue of this magazine

reading is low enough to be read on the d.c. tester on the 0-20 ma. scale, such as the 201-A, 226, etc. For testing d.c. tubes; these may be tested in the usual manner in the 133 Jewell outfit. All switches should be left open when using the d.c. tester.

One may also run a.c. voltmeter leads to binding posts for external use. The switch marked Sw3 in the drawing is a single pole single throw switch for cutting the a. c. voltmeter in and out of the a.c. filament line.

Parts Used

The parts used and their designations are shown below:

SW2	S.P.D.T. switch
SW3	S.P.D.T. switch
SW1	D.P.D.T. switch
B	Connection block from Jewell d.c. tester
A	Connection block from a.c. tester
M.A.m	Zero to 100 m.a. milliameter
VM	Zero to 7½-volt voltmeter a.c.
S1	Five prong socket, subpanel
S2	Four prong socket, subpanel

Mr. Baker made up a five-prong plug from an old tube base of the a.c. type and a broomstick end for a handle, using a five-wire cable about three feet long, by means of which the adapter is plugged into the set. Some radio service men may have a multiple scale a.c. voltmeter they could use in place of the one designated.

Portable Case

The case in which the instruments are mounted came from a Corona portable typewriter, and may be seen in the photograph, Figure 1.

We shall be glad to hear from other service men who develop handy units for simplifying their work on receivers and power amplifier systems.

Makes Compact and Portable Oscillator

USING the article on page 69 of the March, 1929, issue of this magazine as a basis, a compact and inexpensive portable modulated oscillator has been made by Robert G. Ferguson, of the Nineteenth Airship Company, at Langley Field, Va., according to a recent letter received.

Mr. Ferguson states the oscillator uses two WD-11 tubes, two flashlight cells and a National type N precision vernier dial. The tubes, sockets and the cabinet were taken from a Radiola III found in the junk pile.

The instrument is all contained in a cabinet eight by six and a half by five inches. There are no outside connections other than two terminals for the pickup coil. Even the external connections, states Mr. Ferguson, are optional, since the oscillator is unshielded.

Photographs were taken by the contributor and these are shown in Figures 2 and 3. The former is a view of the completed job in its cabinet. The reader may readily see how portable the job is from the picture. The latter photograph shows the inside of the modulated oscillator with its self-contained power supply for plate and filament circuits.

The schematic diagram of the oscillator is shown in Figure 1.

Although the original model described in the March, 1929, issue showed the necessity for shielding of the unit, in many of the variations of this job shielding has not been employed, generally because the work required of the oscillator did not require complete shielding. Also the power output from a pair of WD-11 tubes is rather small and many of the users of the equipment have desired greater output by means of which they could use a grid dip oscillator working against the signal from the oscillator induced in an adjacent circuit. For ordinary test work and for use as a simulator of a broadcast station the job described on this page and made by Mr. Ferguson works admirably. We will be interested in hearing from others who have made variations of the unit in the March, 1929, issue.

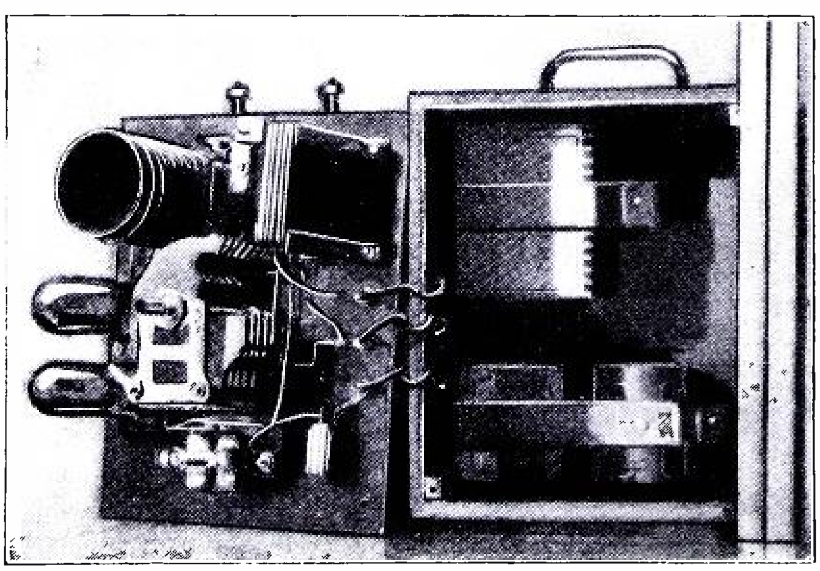


Fig. 3. At the left may be seen a photograph of the inside of the modulated oscillator described on this page

Breaking in on Auto Radio

By Bob Ellis

Manager, Service Department, Silver-Marshall, Inc.

IN summer, for many radio service men, the goose that lays the golden eggs goes on a strike. The summer profits of many service men and servicing organizations are practically nil. As much as we dislike to admit it, radio has a tendency to be seasonal.

(Continued on page 99)

Portable Signal Generator Provided for Howard Distributors

Can Be Used to Check Alignment of Condensers and to Determine Output of Different Tubes

A PORTABLE signal generator by means of which alignment of tuning condensers can be checked and other tests made, has recently been made available to distributors and dealers at a nominal cost by the Howard Radio Co., South Haven, Mich.

A description of the generator is given in this article for the benefit of service men and dealers. The photograph of the job is shown in Figure 1, the front panel layout is shown in Figure 2 while the schematic wiring diagram is shown in Figure 3.

According to the instructions accompanying the generator the instrument can be used to check the alignment of the gang condensers in the Howard or other types of receiving sets. It can also be used to determine the sensitivity of the various receivers being tested. Likewise it can be used to check the output of different types of tubes, speakers, or the various audio transformers in a receiver, as well as check the calibration of a receiver.

The instrument comprises a shielded box which is divided into three separate compartments (shielded), the various compartments housing the following parts:

Oscillator

The oscillator comprises a radio frequency generator which operates over a range from 550 to 1500 kilocycles. A 199 tube is used in this oscillator and means are provided to modulate the output of this oscillator over the required musical range. A place is provided in the lower section of this compartment for necessary batteries with which to operate the oscillator. A fractional part of the output of the oscillator is tapped off, and by means of a shielded cable, this output is carried over into the attenuator compartment.

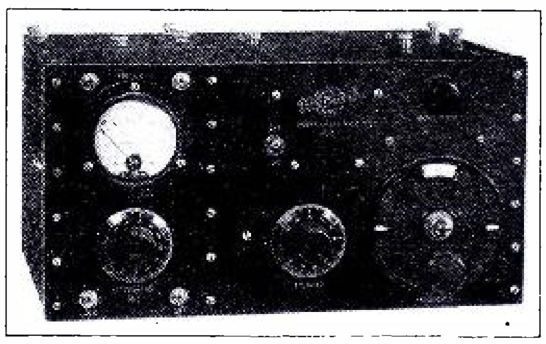


Fig. 1. The portable signal generator made by Howard for his distributors and dealers is shown in this photograph

Attenuator

The voltage, or output, which is derived from the oscillator is connected across a non-inductive potentiometer, which is of the Tonatrol type and which provides a means for varying the output from zero to a maximum value. The output leads of this attenuator are connected to tip jacks on the lower left-hand side of the generator box that are marked "Ant" and "Gnd."

Output Meter

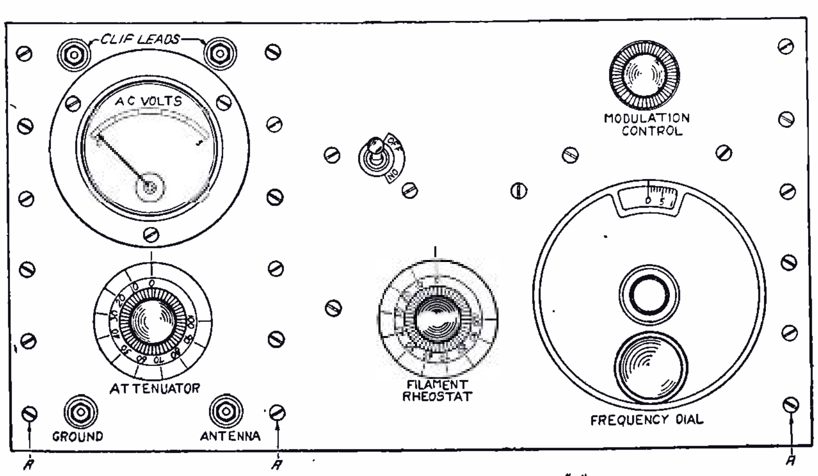
An output meter is furnished with this instrument and this meter is connected by means of two rubber covered leads having clips on one end and phone tips on the other, directly across the voice coil terminals of the dynamic speaker. In other words, this meter, when connected across the voice coil of the speaker, indicates the output in volts of the radio receiver. This meter can also be used for purposes of measuring low a. c. voltages as its range is from 0 to 3 volts a. c.

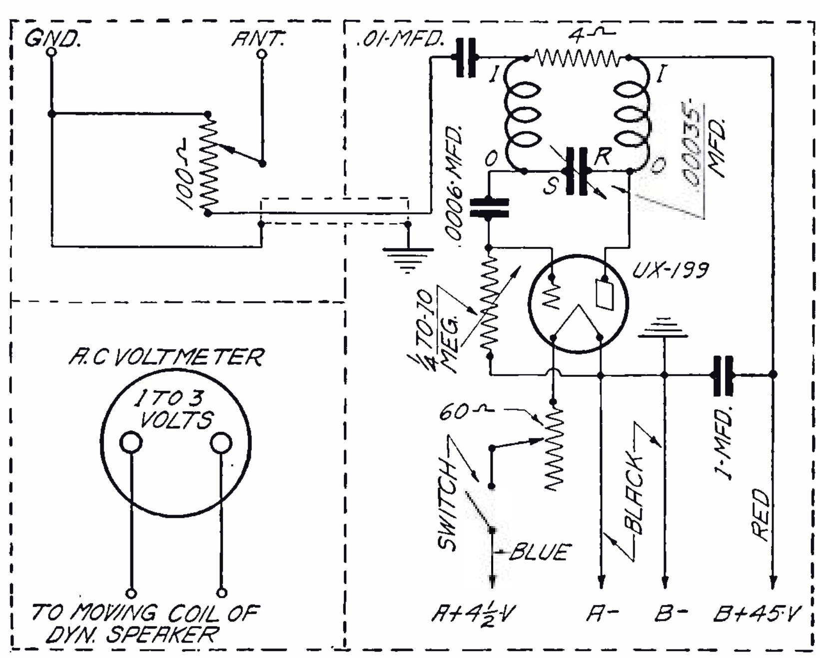
Suitable markings are made opposite each control on this generator to indicate the component parts. For instance, the word "modulator" is next to the grid lead resistor which provides the means for varying the frequency of the modulating system. The switch which turns the current on the filament circuit is marked "On and Off." Be certain this switch is turned off after finished testing with the instrument. With proper care the dry batteries should last approximately three months. If care is not taken the batteries may be run down within a week's time.

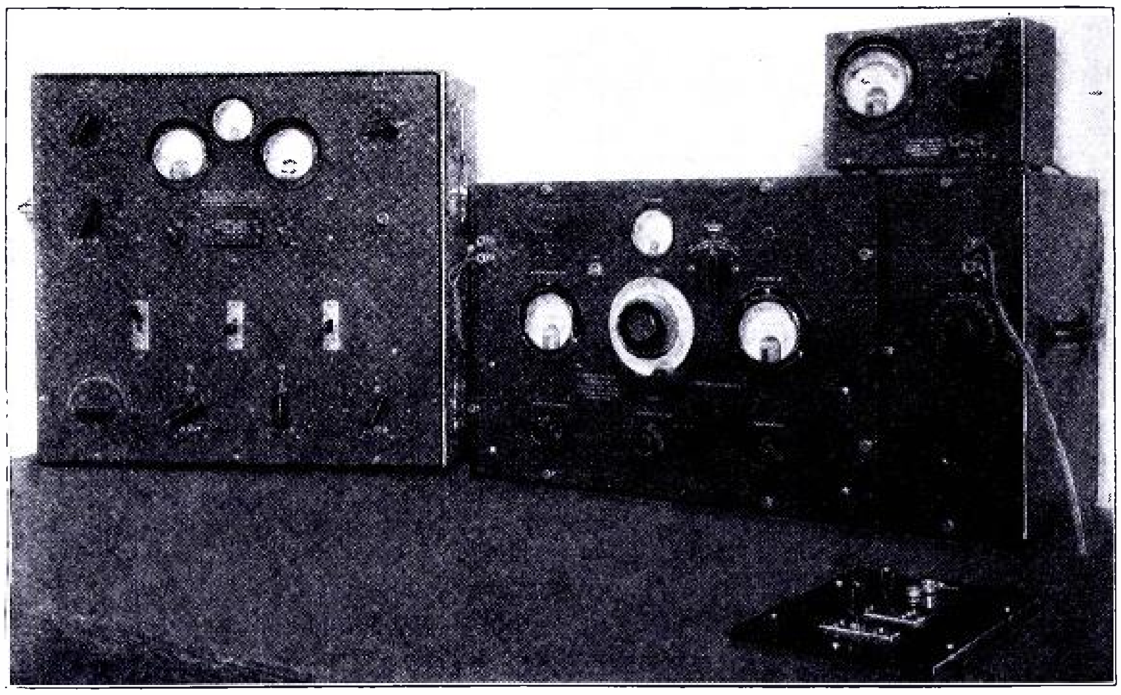
There is furnished with the oscillator a frequency chart which when used with the vernier dial assists in showing the relation of the dial markings to the frequency of the oscillator. A rheostat is provded for increasing or decreasing the filament current for the 199 tube. As the batteries run down it will be

(*Continued on page* 92)

Figure 2, which is a layout diagram of the front panel, is shown below, while the schematic diagram, Fig. 3, is shown at the right







RESPONSE CURVES

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

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

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

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

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

Equipment Used

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

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

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

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

Mutual conductance of tubes used:

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

Radio frequency overload:

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

Sensitivity

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

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

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

Selectivity

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

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

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

Interference Ratio

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

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

Band Widths

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

Fidelity

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

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

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

Curves on the Silver 30-B Receiver

CURVES were taken on the Silver 30-B in accordance with the standards set forth in the text on page 64.

Receiver was phased at 1280 kc. Volume control full on. Audible regeneration began at 600 kc. and stopped at 1500 kc. Hum voltage delivered to output meter connections was .09 milliwatts.

Mutual conductance of tubes: 1 r.f. 1000; 2 r.f. 1050; detector 950; 1 a.f. 1160; PP 2000; PP 2300.

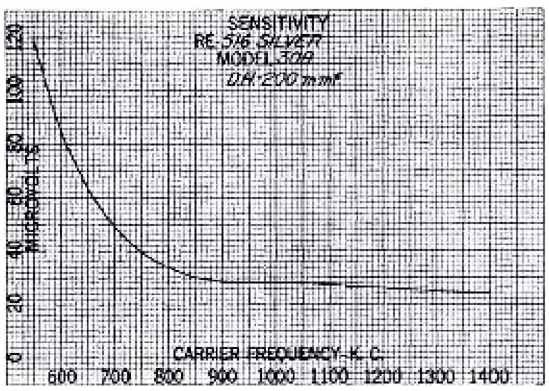
Output impedance load adjusted to 4000 ohms and coupled capacitatively to the 245 plates. Dummy antenna not standard, consisting of 200 micromicrofarads capacity. These measurements do not consider the frequency response of the speaker. The schematic of this receiver will be found elsewhere in this section.

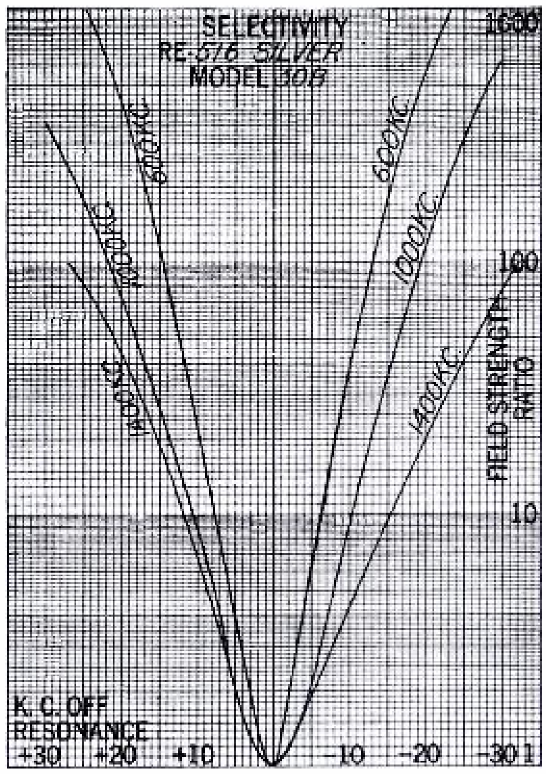
Interference Ratio

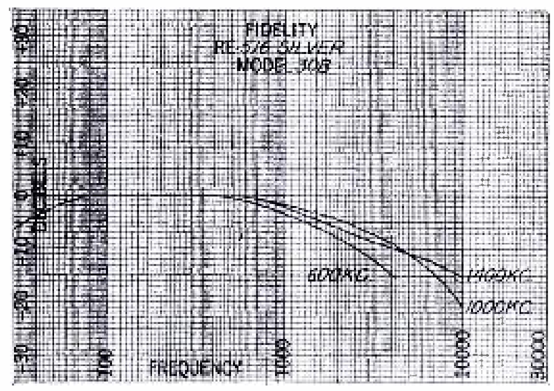
Resonance	*Kilocycles off resonance*		
600 kc.	25.60	428.	1932
1000 kc.	9.12	70.2	354.3
1400 kc.	6.50	46.0	-------
	Minus 10	Minus 20	Minus 30
600 kc.	36.95	560.	-------
1000 kc.	8.25	119.4	631.5
1400 kc.	4.00	17.0	86.0

Band Widths

Times field strength	*Kilocycles wide* 600 kc.	1000 kc.	1400 kc.
10	14	21	27.5
100	28	41	59
1000	48	----	----







Howard S. G. A. Response Curves

RESPONSE curves on the Howard S.G.A. were taken in accordance with the standards indicated on page 64. Receiver phased at 970 kc.; volume control maximum; no audible regeneration, no oscillation; no measurable hum.

Mutual conductance of tubes: 1 r.f. 1050; 2 r.f. 1040; 3 r.f. 1050; detector 1280; p.p. 2050; p.p. 1770.

Standard dummy antenna used in measurements. Output impedance load adjusted to 4000 ohms, coupled capacitatively to 245 plates.

Sensitivity curve shows a maximum at about 23 microvolts and a minimum at 48 microvolts. In the selectivity curves the 1000 and 1400 kc. curves are slightly lopsided, but not sufficiently to cause trouble.

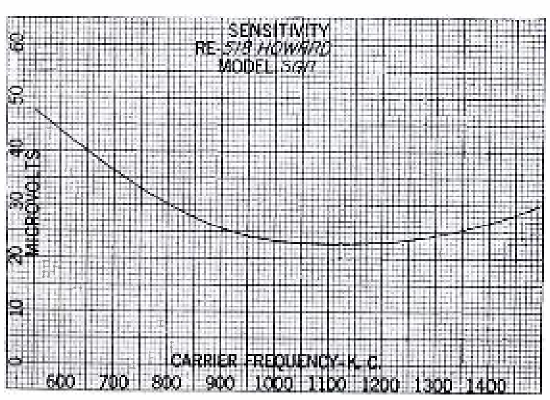
The schematic diagram of this model Howard is published in the latter part of the Service and Repair department for the benefit of service men.

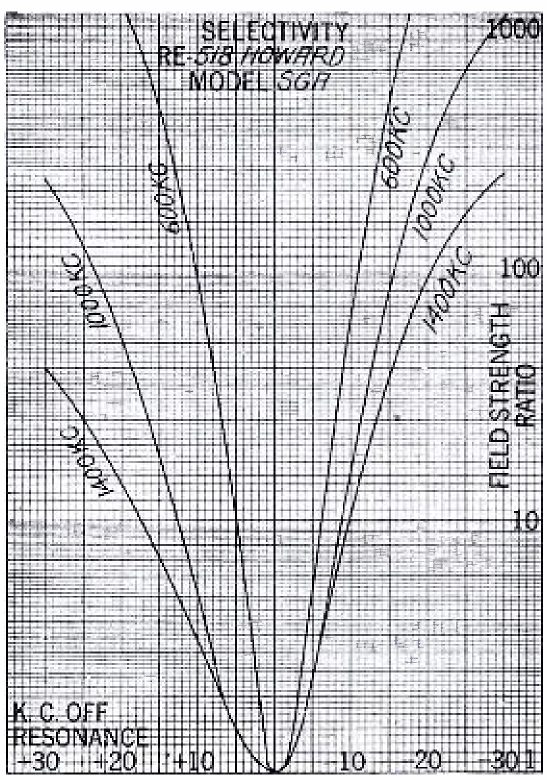
Interference Ratio

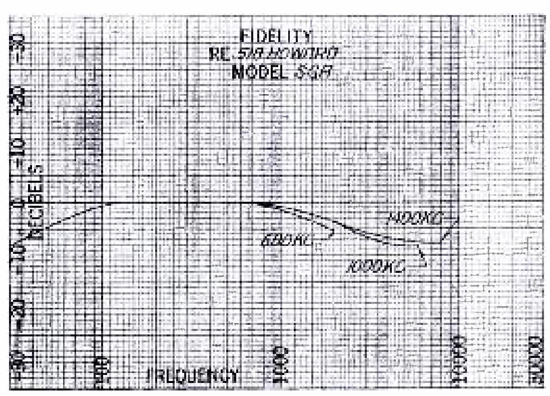
Resonance	*Kilocycles off resonance*		
	Plus 10	Plus 20	Plus 30
600 kc.	67.50	1070.	1744.1
1000 kc.	3.26	50.	223.0
1400 kc.	3.00	14.	39.3
	Minus 10	Minus 20	Minus 30
	Plus 10	Plus 20	Plus 30
600 kc.	82.50	1163.	------
1000 kc.	15.00	284.	982.0
1400 kc.	13.65	91.	233.0

Band Widths

Times field strength	*Kilocycles wide* 600 kc.	1000 kc.	1400 kc.
10	11.0	21.5	27.0
100	21.5	40.0	-----
1000	36.5	-----	-----







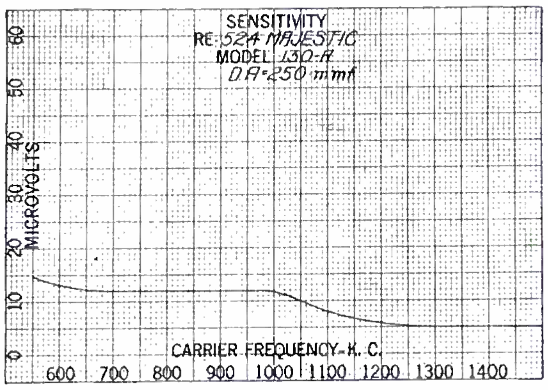
Response Curves on Majestic 130A

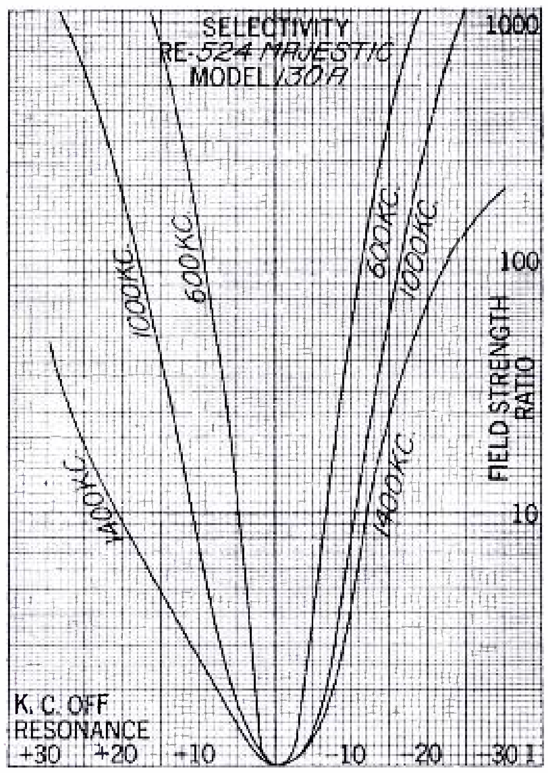
AMONG the receivers recently measured in the laboratory of this magazine is the Majestic 130-A, whose response curves are shown in this page. Antenna dummy was not standard, being only 250 micromicrofarads.

Receiver was phased at 1280 kilocycles. Volume control set at maximum. No measurable hum was encountered at the output meter connections.

Mutual conductance of the tubes when used in testing the set was: 1 r.f. 1110; 2 r.f. 1050; 3 r.f. 1070; detector 1030; PP 1690; PP 1760 micromhos.

Least sensitivity is shown at 600 kc. with 15 microvolts, while greatest sensitivity is indicated from 1200 to 1500 kc. with about 5 microvolts, the average being about 7 microvolts. Interference ratio and band widths are given in the table following:



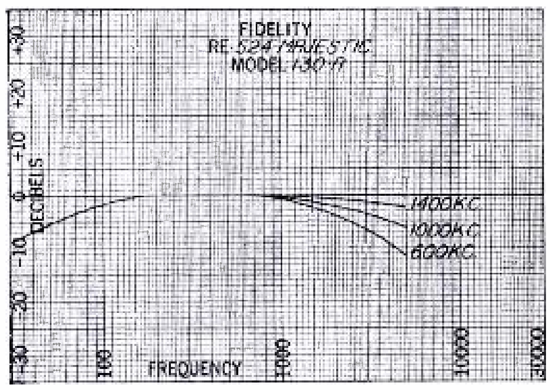


Interference Ratio

Resonance	*Kilocycles off resonance*		
	Plus 10	Plus 20	Plus 30
600 kc.	118.1	3850	....
1000 kc.	5.0	147.	1393.2
1400 kc.	2.5	9.	48.7
	Minus 10	Minus 20	Minus 30
600 kc.	23.6	1290.9	11,818.2
1000 kc.	7.35	363.2	2565.0
1400 kc.	3.75	76.1	198.

Band Widths

Times field Strength	*Kilocycles wide*		
	600 kc.	1000 kc.	1400 kc.
10	12	21	32.5
100	21	34.5	....
1000	35	53	....



Colonial Radio Set, Model 33 A. C.

ON this page will be found the sensitivity, selectivity and fidelity curves of the model 33 a. c. made by the Colonial Radio Corporation.

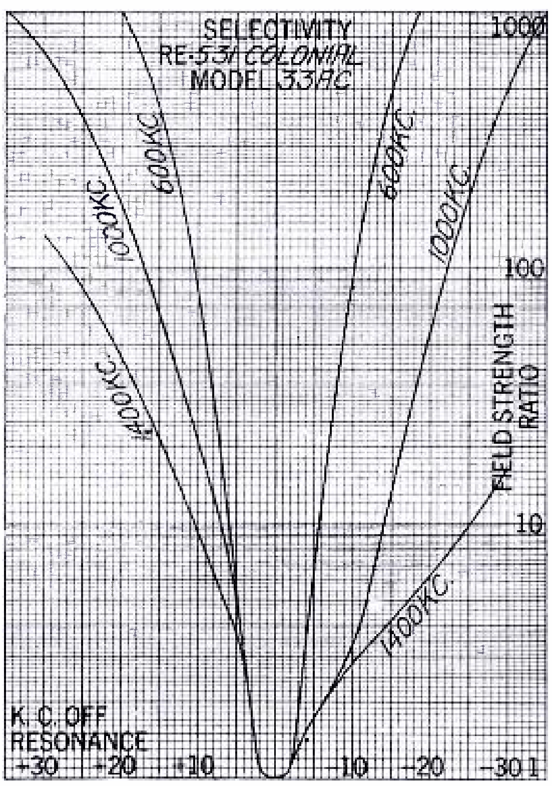
Output input impedance was adjusted to 4000 ohms and coupled capacitatively to the 245 plates. Output of .050 watts was maintained. The standard dummy antenna was employed.

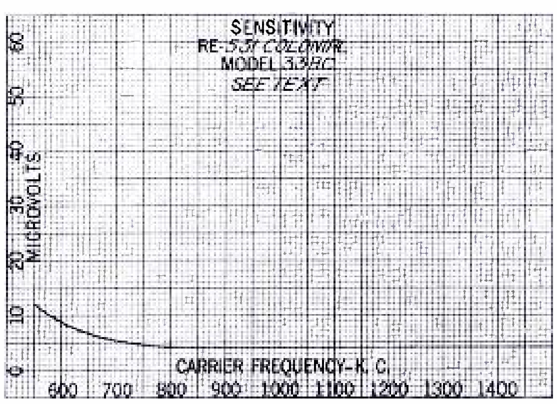
The receiver was phased at 1400 kc. The volume control was set just below point of oscillation on frequencies above 1100 kc. On other frequencies volume control wide open. Oscillation between 1100 and 1500 kc.

Mutual conductance of tubes used: 1 r.f. 900; 2 r.f. 910; 3 r.f. 920; detector 1100; P. P. 1660; P. P. 1840 micromhos.

The sensitivity curve was quite flat, as indicated, although the setting of the volume control must be borne in mind.

Interference ratios and band widths are given in the tables following:



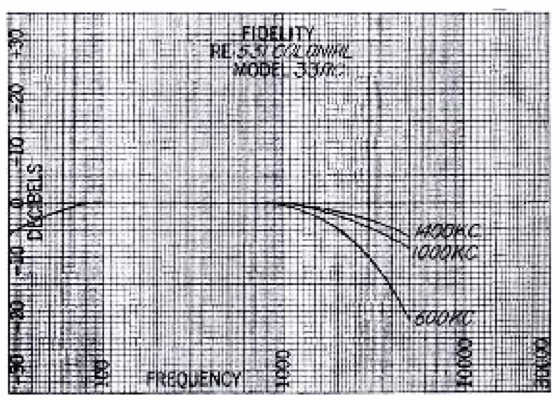


Interference Ratio

Resonance	*Kilocycles off resonance*		
	Plus 10	Plus 20	Plus 30
600 kc.	80.8	1179.0	5641.0
1000 kc.	31.6	176.6	683.3
1400 kc.	8.6	42.5	133.3
	Minus 10	Minus 20	Minus 30
600 kc.	83.3	1308.0	8000.0
1000 kc.	2.9	55.8	500.0
1400 kc.	2.8	6.0	16.3

Band Widths

Times field strength	*Kilocycles wide*		
	600 kc.	1000 kc.	1400 kc.
10	12.0	21.0	36.0
100	21.0	39.0	.....
1000	38.5	69.5	.....



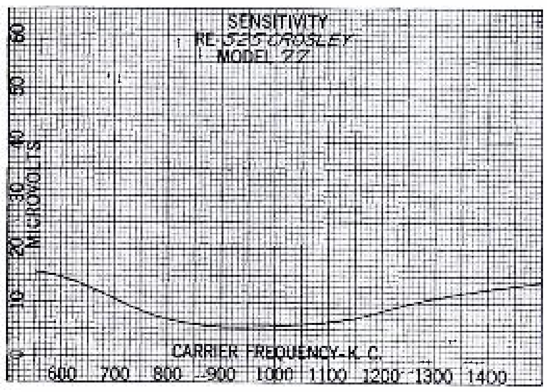
Family of Curves on the Crosley 77

AUTOMATIC volume control is afforded in the Crosley 77 model receiver recently measured in the laboratory of this magazine. The response curves for this model appear on this page.

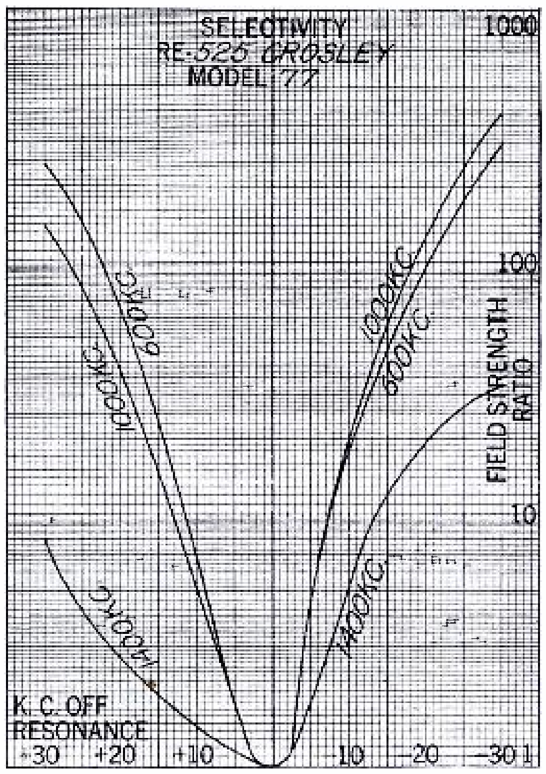
Output impedance load was adjusted to 4000 ohms and coupled capacitatively to the 245 plates. Standard output of .050 watts was maintained. Standard dummy was employed.

Receiver was phased at 1000 kc. and volume control turned on full. No hum voltage could be measured at output meter connections.

Mutual conductance of tubes used in testing this model: 1 r.f. 990; 2 r.f. 980; detector 1000; 1 a.f. 1100; PP 1980; PP 1700 micromhos.



Greatest sensitivity on this model was between 800 and 1100 kilocycles with about 5 microvolts, while least sensitivity was at 600 and 1400 kilocycles, with 15 microvolts. While the volume control is at maximum for these measurements the automatic feature has not begun to function.

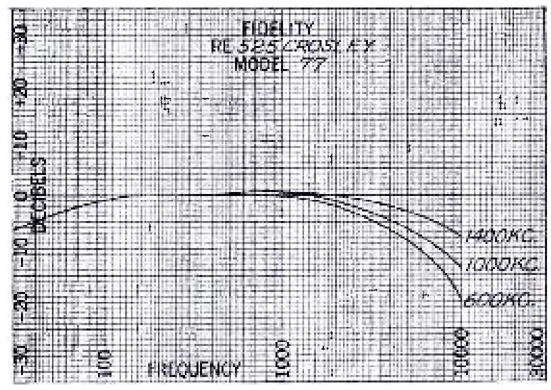


Interference Ratio

Resonance	*Kilocycles off resonance*		
	Plus 10	Plus 20	Plus 30
600 kc.	6.4	63.0	213.0
1000 kc.	4.9	33.8	138.0
1400 kc.	1.4	2.7	7.9
	Minus 10	Minus 20	Minus 30
600 kc.	18.4	92.5	290.0
1000 kc.	19.3	118.0	382.0
1400 kc.	5.0	19.0	32.2

Band Widths

Times field Strength	*Kilocycles wide* 600 kc.	1000 kc.	1400 kc.
10	19	20.5	--
100	41	45.5	
1000	----	----	



Response Curves on Sparton No. 620

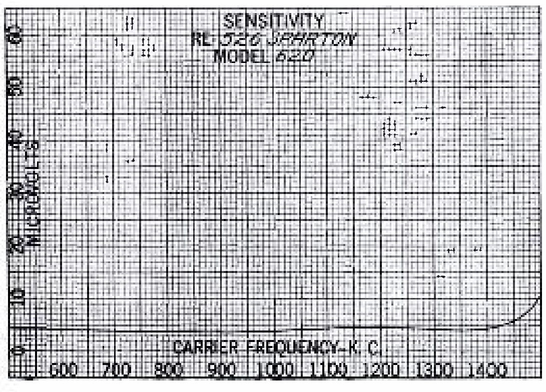
THE most interesting feature of the three curves taken by our laboratory on the Sparton model 620 may be seen in the sensitivity curve which is practically a straight line from 600 to 1400 kilocycles.

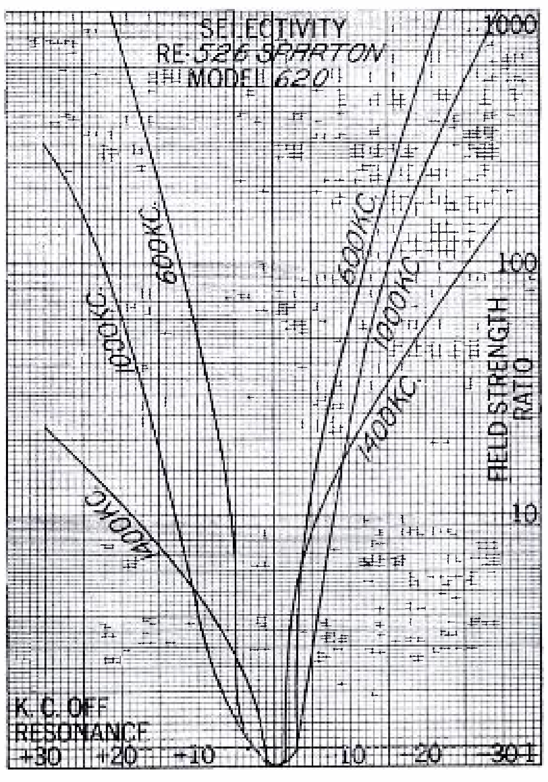
Standard procedure followed in making the measurements. Output impedance load was 4000 ohms coupled capacitatively to the 245 plates. Standard output of .050 watts. Standard antenna dummy used.

Receiver phased at 1250 kilocycles and volume control turned on full. No hum could be measured at the output meter connections.

Mutual conductance of tubes: Cardon specials for this receiver.

From the selectivity curves it will be seen there exists a slight lopsidedness, but not sufficient to cause a decided decrease in tuning efficiency. As will be seen the sensitivity curve is quite remarkable. Electrical fidelity suffers due to selectivity where considerable attenuation of high frequencies exists.



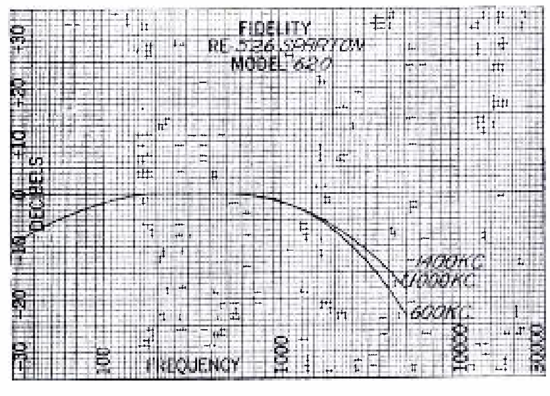


Interference Ratio

Resonance	*Kilocycles off resonance*		
	Plus 10	Plus 20	Plus 30
600 kc.	50.0	710.	3520.0
1000 kc.	3.8	57.0	296.0
1400 kc.	4.0	10.8	22.2
	Minus 10	Minus 20	Minus 30
600 kc.	45.	570.0	3360.0
1000 kc.	16.0	230.0	1010.0
1400 kc.	16.0	66.0	150.0

Band Widths

Times field Strength	*Kilocycles wide* 600 kc.	1000 kc.	1400 kc.
10	10	21	24.5
100	24.5	38	
1000	43	----	--



Stewart-Warner No. R-100A Curves

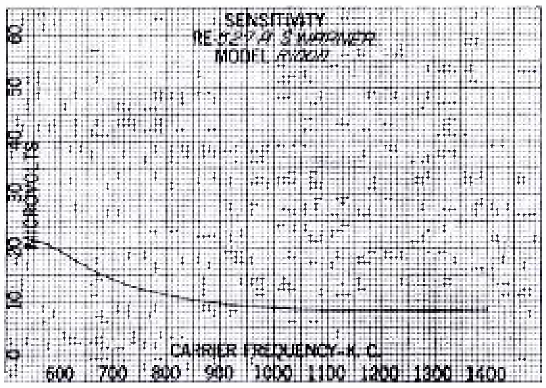
MEASUREMENTS recently made on the Stewart-Warner R-100 A are indicated in this column.

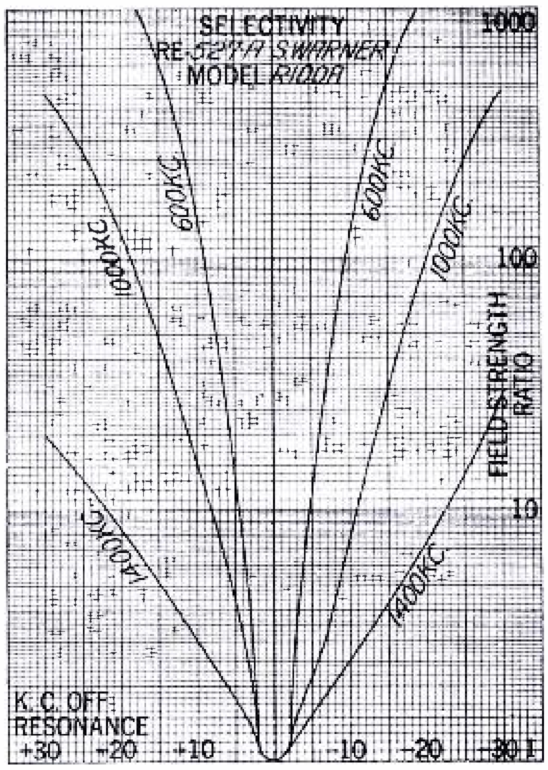
Output impedance load was adjusted to 4000 ohms and coupled capacitatively to the 245 plates. Standard output of .050 watts was maintained. Standard dummy antenna was employed.

Receiver was phased at the factory, this setting being maintained. The volume control turned on full. No hum was measurable at the output meter connections.

Mutual conductance of the tubes used: 1 r.f. 1040; 2 r.f. 910; 3 r.f. 910; detector 1500; 1 a.f. 1200; P.P. 1660; P.P. 1810 micromhos.

Interference ratios and band widths are shown in the following table:



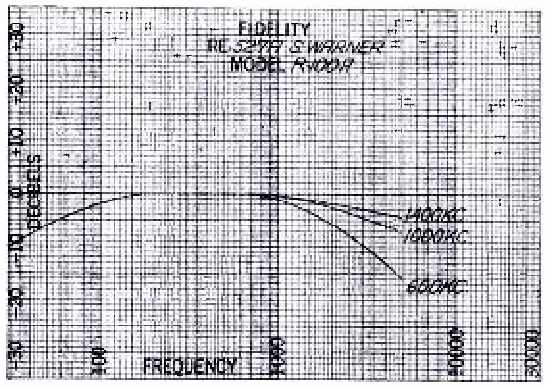


Interference Ratio

Resonance	*Kilocycles off resonance*		
	Plus 10	Plus 20	Plus 30
600 kc.	144.	1978	......
1000 kc.	15.7	128.5	442.8
1400 kc.	2.52	8.23	20.0
	Minus 10	Minus 20	Minus 30
600 kc.	81.0	1368	....
1000 kc.	4.65	92.8	464.2
1400 kc.	2.15	3.70	28.6

Band Widths

Times field strength	*Kilocycles wide* 600 kc.	1000 kc.	1400 kc.
10	9.5	19.0	44.5
100	18.5	38.5	....
1000	37.0	....	....



Brunswick Radio Receiver Model 15

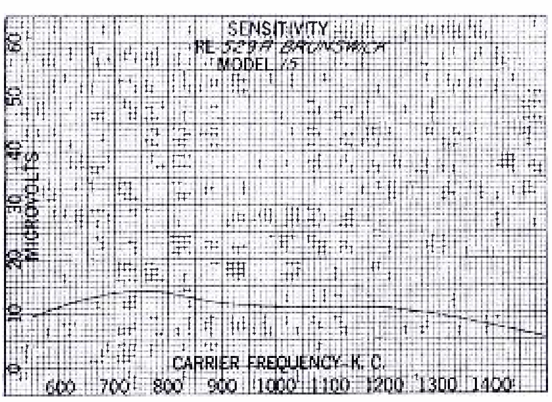
AMONG the several receivers recently passing through our measurement laboratory is the Brunswick model 15, the sensitivity, selectivity and fidelity curves of which are shown on this page.

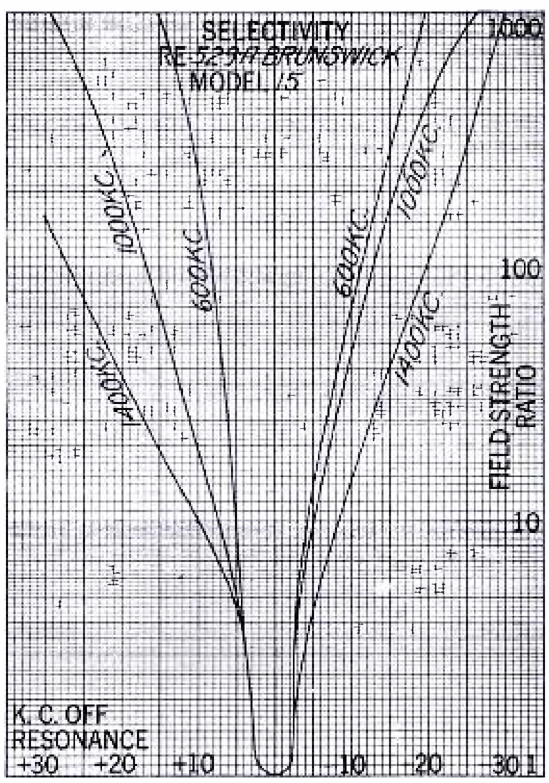
Output impedance load in this case was adjusted to 1000 ohms and coupled to the plates of the 245 tubes placed in parallel. Standard output of .050 watts was maintained. The dummy antenna of 20 uh, 200 mmf and 25 ohms was employed.

Phasing frequency set at the factory was maintained. The volume control was turned on full. No hum could be measured at the output meter connections.

Mutual conductance of tubes used: 1 r.f. 920; 2 r.f. 940; 3 r.f. 910; detector 1210; 1 a.f. consisting of 245 tubes in parallel, one 1660 and other 1810 micromhos.

Interference ratios and band widths are indicated in the two columns following:



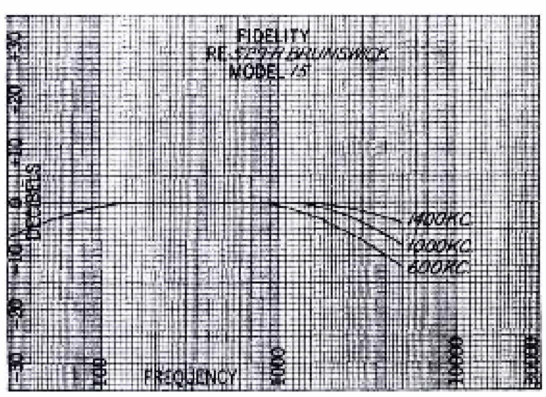


Interference Ratio

Resonance	*Kilocycles off resonance*		
	Plus 10	Plus 20	Plus 30
600 kc.	203.6	2772.7	12,000.0
1000 kc.	19.0	190.9	1109.0
1400 kc.	10.0	37.	154.0
	Minus 10	Minus 20	Minus 30
600 kc.	66.3	1145.4	6000.0
1000 kc.	37.2	454.5	2409.0
1400 kc.	14.2	90.0	1200.0

Band Widths

Times field strength	*Kilocycles wide* 600 kc.	1000 kc.	1400 kc.
10	9.5	12.5	18.0
100	20.0	29.5	47.0
1000	34.5	55.0	....



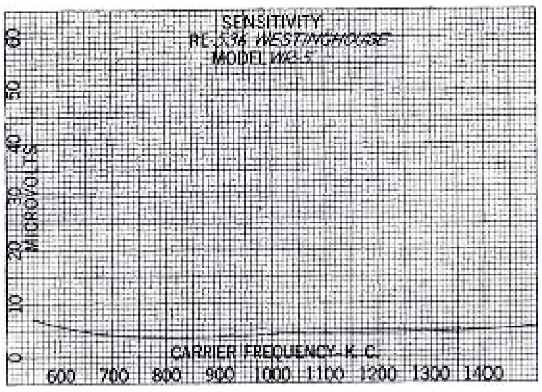
New Westinghouse Super, No. WR-5

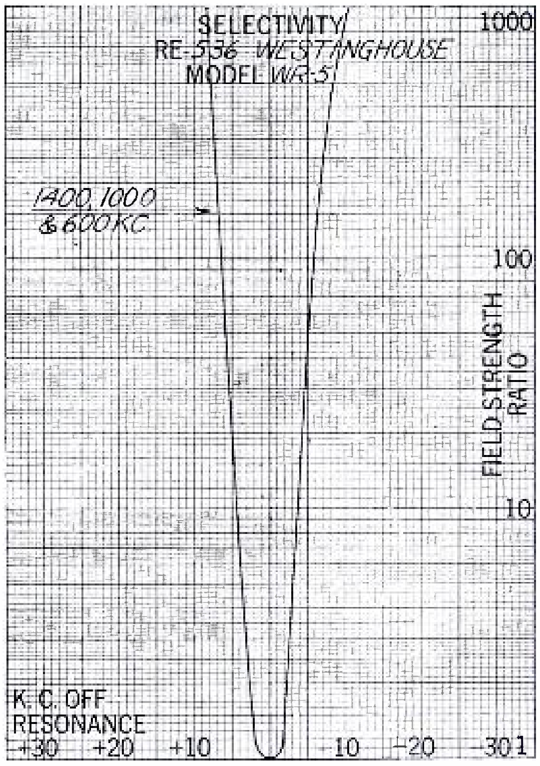
JUST as this issue goes to press our laboratory has finished measuring the Westinghouse superheterodyne model WR-5 whose curves are presented on this page. Since it is the first of the superheterodyne models to be run in our laboratory, the curves should be of more than passing interest to all.

Output impedance load was adjusted to 4000 ohms and coupled capacitatively to the plates of the 245 tubes. Standard output of .050 watts was maintained. Dummy antenna was the standard one of 20 uh, 200 mmf and 25 ohms. Phasing frequency set by factory was maintained. Volume control on full. No oscillation. No hum.

Mutual conductance of tubes used: 1 r.f. 940; 1 i.f. 1020; 2 i.f. 900; 1 detector 1000; p.p. 1850; p.p. 1850; 2 detector 1030, and oscillator 1300 micromhos.

It should be observed that in drawing the selectivity curve only the 600 kc curve is shown, since both the 1000 and 1400 kc curves were within a kilocycle of these values at one thousand times the field strength.



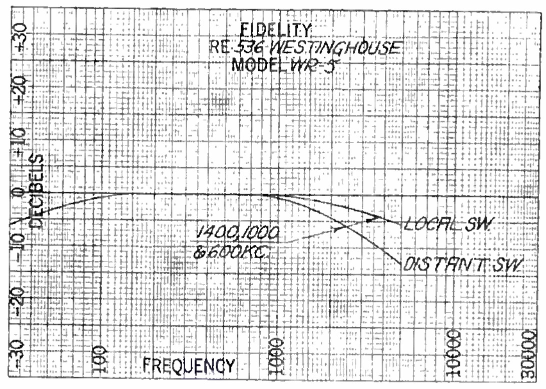


Interference Ratio

Resonance	*Kilocycles off resonance* Plus 10	Plus 20	Plus 30
600 kc.	900	----	----
1000 kc.	900	----	----
1400 kc.	900	----	----
	Minus 10	Minus 20	Minus 30
600 kc.	----	----	----
1000 kc.	----	----	----
1400 kc.	----	----	----

Band Widths

Times field strength	*Kilocycles wide* 600 kc.	1000 kc.	1400 kc.
10	8.0	8.0	8.0
100	12.5	12.5	12.5
1000	18.0	18.0	18.0



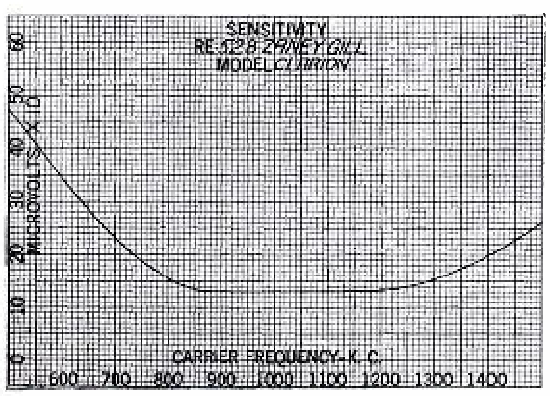
Zaney-Gill Music Box Clarion Curves

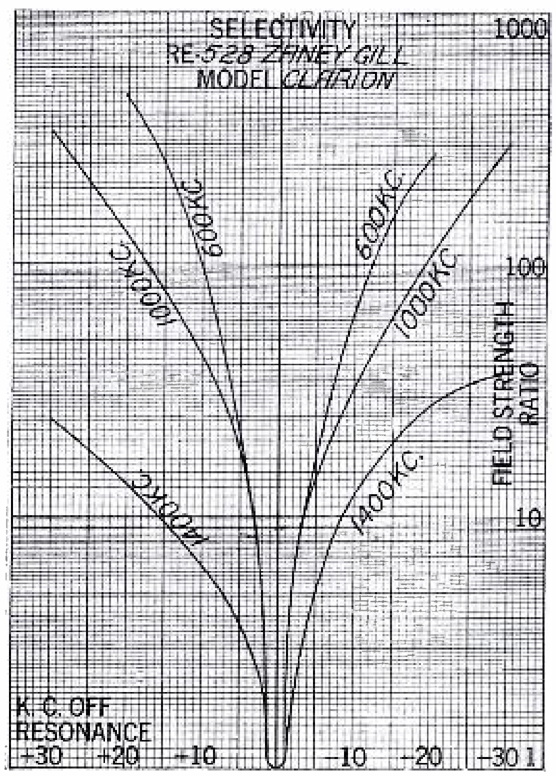
READERS may be interested in the response curves on one of the mantle sets so popular in certain sections of the country. We are showing on this page the measurements on the Zaney-Gill model known as the Music Box Clarion which is manufactured in Los Angeles.

As usual, the output impedance load is adjusted to 4000 ohms and coupled capacitatively to the plates of the 245 tubes. The standard output of .050 watts is maintained on all measurements. Standard dummy antenna is used.

The receiver was phased at the factory and this phasing maintained. The volume control was turned just below the oscillation point. Oscillation began at 550 kc. No hum was measurable at the output meter connections.

Mutual conductance of the tubes used: 1 r.f. 1100; 2 r.f. 1150; detector 1200; 1 a.f. 995, 2 a.f. 2300 micromhos.



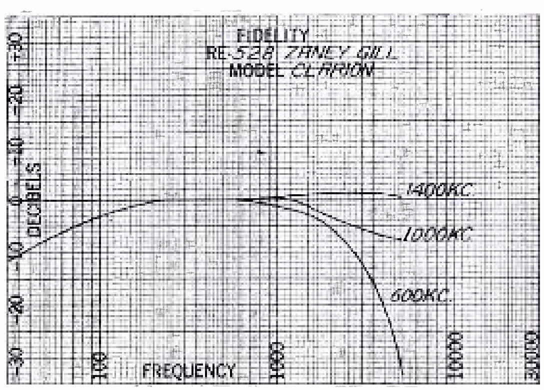


Interference Ratio

Resonance	*Kilocycles off resonance* Plus 10	Plus 20	Plus 30
600 kc.	98.3	478.6	....
1000 kc.	39.6	102.7	336.3
1400 kc.	5.5	14.7	23.6
	Minus 10	Minus 20	Minus 30
600 kc.	30.5	728.6	..
1000 kc.	31.8	81.8	309.0
1400 kc.	15.6	26.2	34.8

Band Widths

Times field strength	*Kilocycles wide* 600 kc.	1000 kc.	1400 kc.
10	6.5	22.5	----
100	6.5	36.5	----
1000	24	----	----



Delco Automotive Radio Receiver

According to a release from the Delco Radio Corporation after a long period of research and experimentation, General Motors has announced a radio receiving set for automobiles together with complete plans for servicing and national distribution. The set has been called the Delco Automotive Radio and is manufactured by the Delco Radio Corporation at Dayton, Ohio. National sales and service are under the direction of United Motors Service with 27 branches and 3,000 authorized service stations.

The Delco automobile radio is a five-tube receiver, using three screen grid tubes, and operated by remote control from the instrument panel. It can be installed without changing a single unit of the car.

Flexible Cable Used

Simplicity and neatness are features of the set, which is entirely out of sight beneath the car's cowl. Only three devices are to be found on the instrument panel—mounted in an attractive manner, at the right, where they do not interfere in the slightest degree with the other instruments. They are a tuning dial, a volume control and a key switch. The tuning dial is connected to the set of a flexible cable and operates three variometers, all mounted on a single shaft.

In the Delco automotive radio, two tuned radio frequency stages are used with 224 amplifier tubes, connected in series. A similar screen grid tube is used as a detector. For radio frequency a 227 tube is used in the first stage and a 112-A in the second. A voltage regulator tube is employed to keep the voltage constant in spite of varying engine speeds or extra drain on the battery when the lights are turned on. This is a desirable feature and prevents surging of volume, keeping the tone even under all conditions.

Variometer Tuning

Old timers in the radio game will recognize the variometer tuning of the radio frequency and detector grids, the three variometers being on a common shaft arranged for single control. Bias for the grid of the first 224 tube is secured through the drop across a single resistor, properly bypassed, between the cathode of the 224 and ground. The plate circuit of the 224 detector and the grid of the first audio is direct coupled so that automatic volume control is afforded, while a manually operated volume control is also provided for separate control of volume. Detection is by means of the conventional grid leak and condenser. In the audio stage the coupling between the first audio and the 112 output tube is by means of resistance and capacity coupling. The plate circuit of the output tube has an r. f. choke bypassed at each end, and leading into a 100 henry choke coil, the magnetic speaker being capacitatively coupled across the top of the choke and ground.

Interference from passing objects is offset by an automatic volume control to increase the amount of current when the car passes steel buildings or overhead wires, which normally would bring about a reduction of current.

Current is supplied by the car's storage battery and by four vertical type standard size 45-volt "B" batteries and one 22.5 volt "C" battery. The "B" batteries are carried in a specially-designed metal box placed under the floor boards and fully protected against mud and water. The "C" battery is conveniently located, depending on the type of car.

A cone speaker—found to give the best tone value and speech reproduction—is mounted on the dash, out of sight, and protected by a screen across its face.

Reduced Interference

Electrical interference from the ignition system has been guarded against by the use of specially-designed spark resistors on each plug and on the coil, and by by-pass condensers across the generator contacts and on the starting motor. These spark resistors are designed to prevent oscillations in the ignition circuit and have no effect on the running of the motor.

To protect the tubes against the jars and jolts of road shocks a special cushioning device is used and the dial is held secure in any position by a reduction gear.

Antenna Concealed

The antenna is concealed in the top of the car. Cars of leading makes are now factory-equipped with this aerial, including Cadillac, La Salle, Studebaker, Pierce-Arrow, Marmon, Jordan, Peerless, Packard and Franklin.

In bringing out the Delco automotive radio, General Motors wished to present a set that would produce a reception comparable with the best stationary sets. For many months engineers have been conducting research experiments and testing out every part under all conditions. As a result, the Delco automotive radio is a set which will perform equally well under all running conditions. At the same time, it was realized that a national service was necessary to provide adequate service for owners in all parts of the country. United Motors was selected for this as it offered a nationally established organization, noted for its high-class service in the automotive field and having an organization all equipped to offer service throughout the United States.

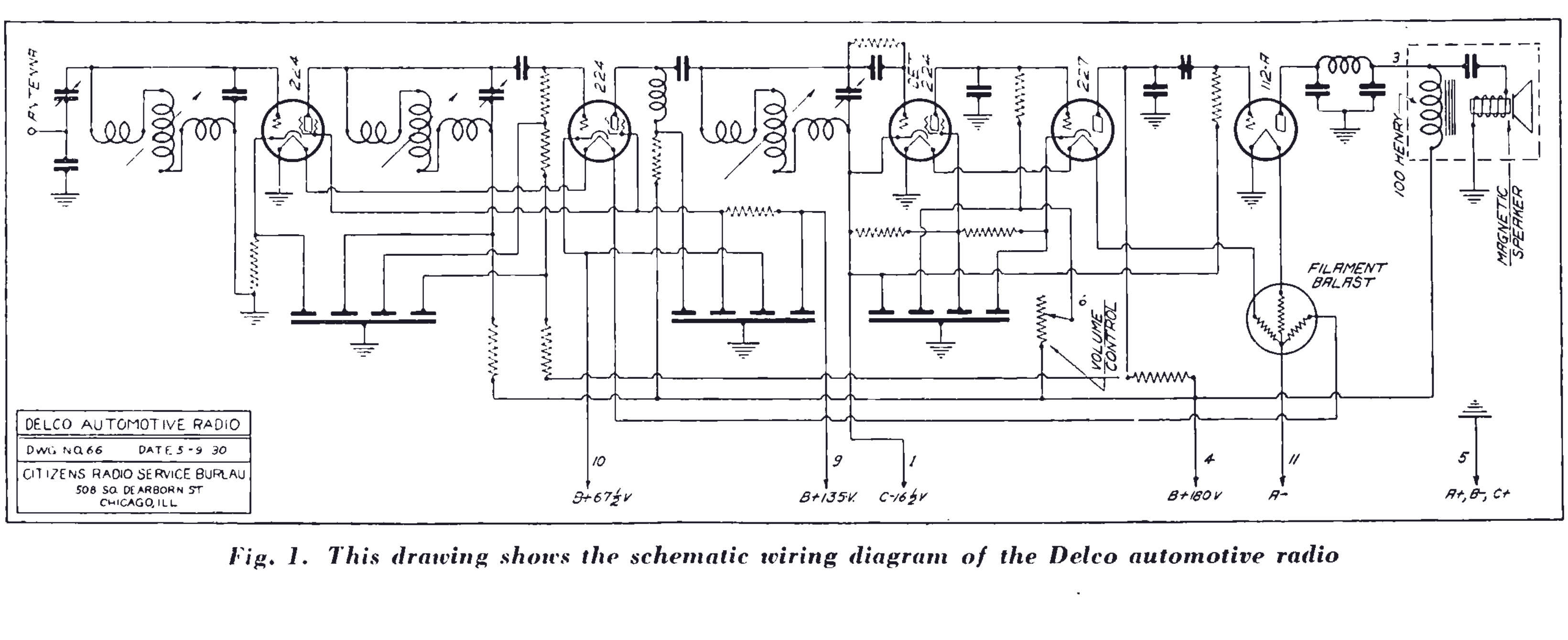


Fig. 1. This drawing shows the schematic wiring diagram of the Delco automotive radio

Crosley "Roamio" Auto Receiver

SERVICE men will be interested in the auto-radio set made by Crosley and known as the "Roamio" model, a schematic diagram of which is shown on this page. The receiver has two stages of r. f. using 224 tubes, a detector using the 227, and two stages of audio using the 112-A tubes; the filaments of the r. f. and detector tubes being in series and those of the a. f. stages in parallel, all operated from the car battery.

Grid circuits of the r. f. and detector stages are tuned with a three section gang condenser with single control. Individual aligning condensers are provided. The antenna coil and the interstage r. f. coils are wound to provide a slight amount of extra capacity coupling to make the response of the receiver more uniform throughout the band.

Automatic Volume Control

The detector stage acts both as a detector and as an automatic volume control keeping the level of reproduction as constant as practical while the automobile moves through areas in which the signal strength varies. The automatic control of volume is accomplished by a circuit arrangement which increases the negative bias on the radio frequency and detector grids as the signal becomes stronger, and decreases the bias as the signal becomes weaker. The necessary biasing voltage is obtained from the voltage drop in the 60,000 ohm detector plate resistor located between the D lead and ground. With increased signal more current flows through the detector plate circuit increasing the drop in this resistance and increasing the bias applied to the grids of the first three tubes. This results in a decrease of r. f. amplification tending to maintain the signal current as finally obtained from the audio system, at a comparatively constant level. In addition to the biasing resistor for automatic volume control, there is a manual control which is a variable 80,000 to 100,000 ohm resistor in the detector plate circuit itself. This variable resistor is operated from the panel by means of a knob.

Battery Operated

Both A and B supply is from batteries, the former from the car battery, and the latter from dry B blocks. The plates of all tubes but the detector are connected to the red plus B lead to which 135 volts is applied. A separate plate battery known as the D battery is used for the detector;; it furnishes 22½ volts of potential through the blue lead for the detector plate circuit. Potential for the screens of the two 224 tubes is furnished through the white lead, connected to the 90 volt terminal of the B battery. The audio tubes are bias by means of a C battery, the green lead being connected to the minus 12 volts. The minus B and plus C leads are connected to the middle of a 50 ohm potentiometer shunted across the filament leads so that the polarity of the A supply does not affect the biasing or plate voltage of these tubes. This method of connection is necessary because in some automobiles the negative is grounded while in others the positive is grounded.

Suppressing Noises

Two types of suppressors are available from Crosley for use in damping out ignition interference. One is the type for installation in spark plug leads, and the other for use in distributor leads. A spark plug suppressor should be mounted in each spark plug lead at the plug, and a distributor suppressor should be mounted in the center lead of each distributor at the distributor. If difficulty is encountered in installing standard suppressors on some cars special suppressors may be obtained.

It is frequently helpful to ground all oil lines, speedometer cables, control rods, etc., which run through the engine bulkhead. They should be grounded to the metal engine bulkhead, or metal covering of the bulkhead, where they pass through it. Some service men make a practice of grounding these units as a regular routine part of every installation. None of the methods of interference control cited above have any effect upon the operation of the automobile itself.

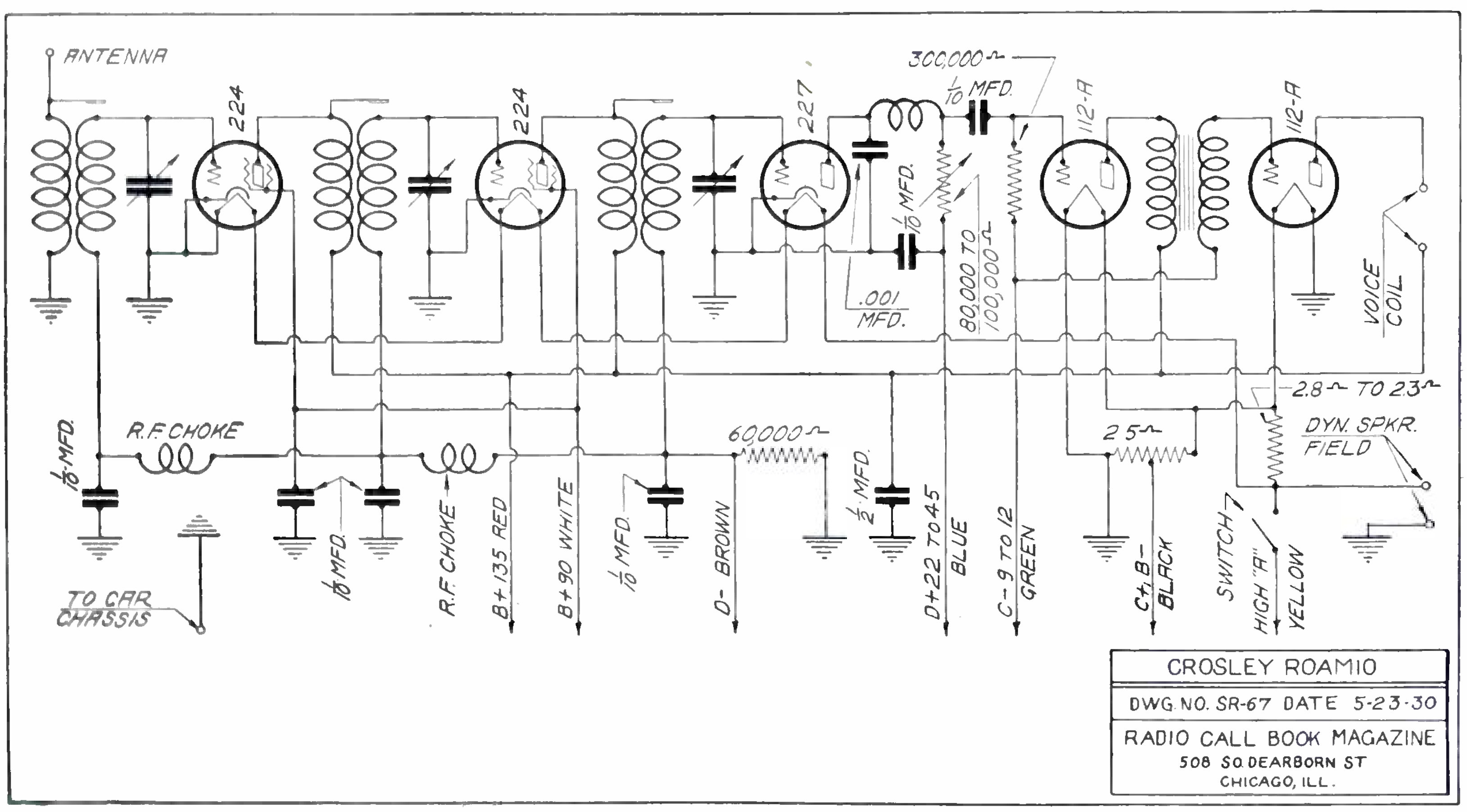


***Fig. 1.** The schematic diagram of the "Roamio" automobile radio set made by Crosley is shown in this illustration*

Howard Radio Receiver Model S.G.A.

ELSEWHERE in this magazine appear the sensitivity, selectivity and fidelity curves of the Howard S. G. A. receiver described on this page. The receiver schematic is Figure 2, the power supply Figure 3 and the analysis of tube voltages and current in Figure 1.

Some interesting points are to be found in the service manual supplied to Howard dealers. Due to non-uniformity of tubes the set may oscillate with certain tube combinations. A quick remedy is to shift the r. f. tubes around.

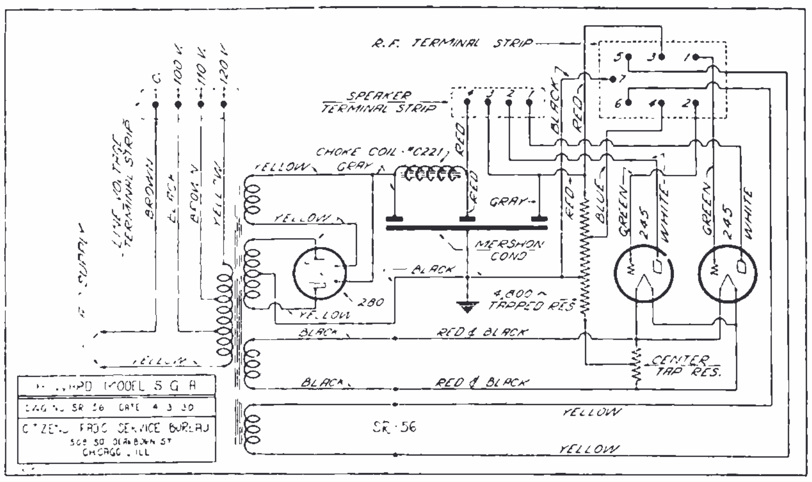


Figure 3. This drawing is that of the separate power supply for the Howard S. G. A.

There are two approved methods of testing tubes. The first is to remove the tube from the chassis and place the plug from the Jewell or Weston analyzer in the tube socket, then place the tube in the analyzer and measure its plate current under normal operating conditions It has been determined in the laboratory that tubes having a plate current from 2.5 to 3.1 milliamperes are normal tubes and operate to best advantage in this receiver.

The second and better method of the two is to measure the mutual conductance of the tube by means of the mutual conductance bridge made by General Radio. (This is described elsewhere in this issue—Editor). It has been found that to give best results with this particular receiver the mutual conductance of the tubes should measure 1000 micromhos. Tubes may be used with a mutual conductance as low as 750 micromhos with a corresponding decrease in amplification. The upper limit of mutual conductance is 1050 micromhos, beyond which values tubes should not be used as they have a tendency to break into oscillation which tendency cannot be curbed in this particular receiver.

Response curves on this receiver were recently taken by our laboratory and appear elsewhere in this magazine.

Howard Model S. G. A.

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R.F.	2.2	162	3.5	3.5	68	3.3	4.7	1.4
224	2 R.F.	2.2	162	3.6	3.5	68	3.2	4.0	.8
224	3 R.F.	2.2	165	2.9	2.9	68	3.4	5.1	1.7
227	Det.	2.2	155	15	15	..	1.0	1.2	.2
245	P.P.	2.1	238	45	....	....	24.4	28.4	4.0
245	P.P.	2.1	238	45	....	....	24.4	28.4	4.0
280	Rect.	4.5	..	..	..	..	58	..	....

Line voltage 110, set on 110-volt tap. Volume control maximum.

Variable condenser at maximum capacity. Detector coil shorted to give correct voltage when measuring detector.

Figure 1. In this table may be found typical voltages for the Howard S. G. A. as indicated in the service manual of the company. The readings were taken with a Jewell set analyzer

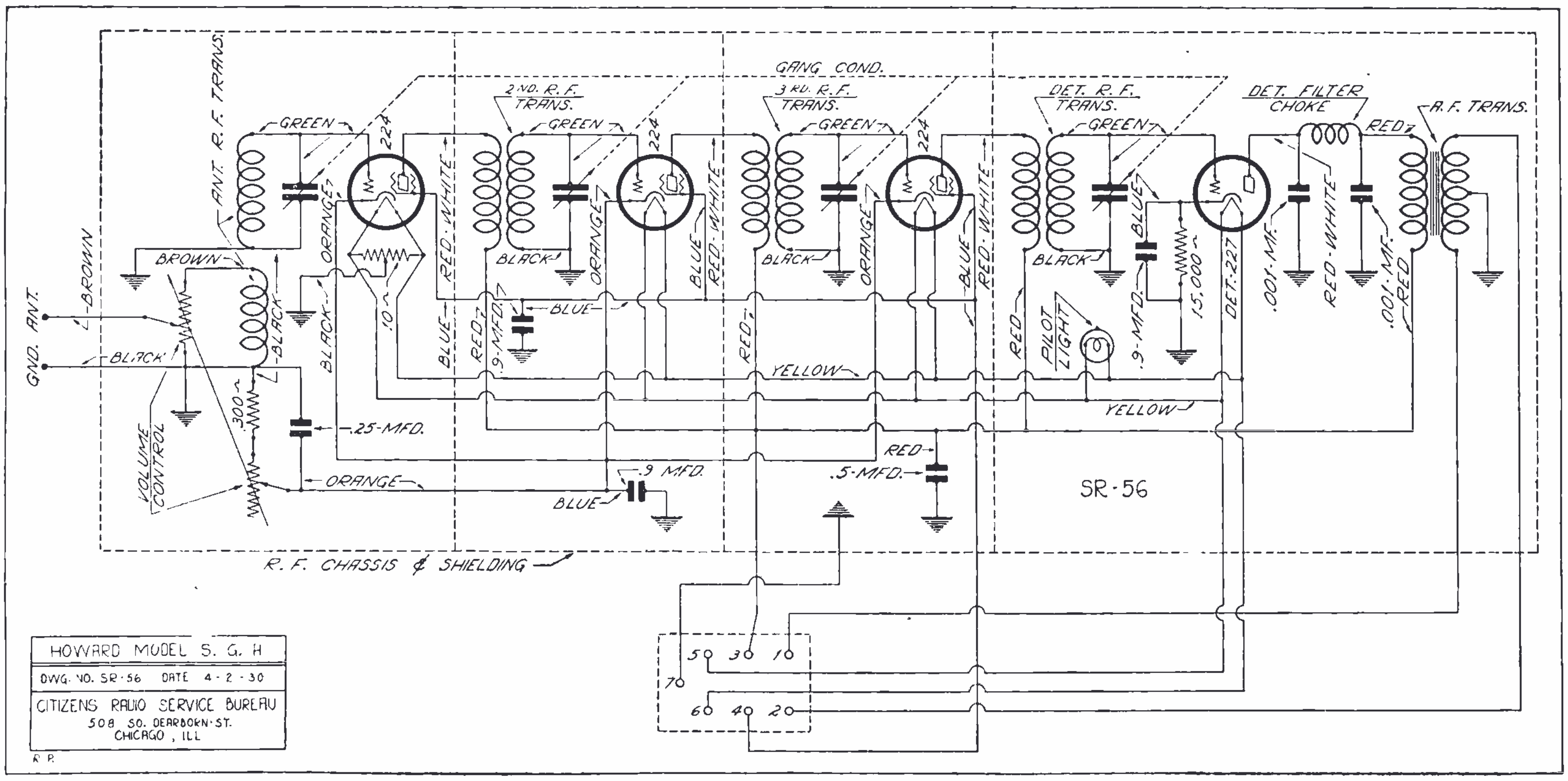


Figure 2. In this drawing may be seen the schematic circuit of the Howard screen grid receiver described on this page

Silver Radio Receiver Model 30-B

SERVICE data on the Silver 30-B receiver whose schematic is shown on this page, is practically the same as that given on the 30 and the 30-A which preceded the 30-B. According to the bulletin from the makers, a good modulated r.f. oscillator is desirable if the service department is to properly test receivers for sensitivity and alignment.

The leads from the oscillator to the receiver under test should be shielded, and when used on the 30-B should be connected through a .0001 mfd condenser to the short antenna post. A good ground connection is essential. Oscillator output should be cut down to secure a weak signal when volume control is turned on full. Set oscillator at about 1280 kc. and tune in on receiver. With a long wrench (or screwdriver if panel is removed) adjust the fourth (left) trimmer screw for maximum volume. With a screwdriver inserted through hole in tube shield adjust the third (next to left) trimmer screw for maximum volume. With screwdriver through hole in tube shield adjust the second (next to right) trimmer screw for maximum volume. With screwdriver through hole in tube shield adjust the first (right) trimmer screw for maximum volume.

If during the above operations a vacuum tube voltmeter can be connected across the voice coil of the speaker, or a 100 m.a. thermoammeter inserted in series with the voice coil, visual indication of volume can be obtained and more accurate adjustments effected. During the above operations the drum dial and volume control adjustments must not have been changed. All adjustments should be made on the trimmers exactly in the order named. It will be noted that in the 30-B it is not necessary to disconnect any of the selector leads as was necessary in the model A. After these operations have been made the service man should make sure the receiver will tune up to 1500 kc. and down to 550 kc. If it fails to read 1500 kc. all aligning condensers have been set too far in.

Calibration of the selector dial may be checked as follows: If the dial does not read correctly: that is, if 1300 kc does not tune in at that point, the reading may be corrected. Tune in a good station of definitely known and maintained frequency at approximately 1300 kc. With station tuned in not loudly, and dial hub set screws loosened, the dial only may be turned to read correctly and the set screws re-tightened. Check this adjustment at 700 and 600 kc.

When reganging the model 30-B care should be taken to see that all trimmers are not initially set so far in as to prevent the receiver tuning up to 1500 kc. In general, ganging should be done so the fourth, or left hand, aligning screw will be about one-sixteenth of an inch out from the condenser frame, and the three aligning screws to the right screwed in no further than absolutely necessary to secure peak volume. If this caution is not observed the receiver may not tune up to 1500 kc.

Silver Model 30-B

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R.F.	2.4	168	4	4	69	5	----	----
224	2 R.F.	2.5	164	4	4	72	5	----	----
224	Det.	2.4	28	8	8	60	.5	----	----
227	1 A.F.	2.5	150	----	10	----	6	----	----
245	1 P.P.	2.4	264	44	----	----	30	----	----
245	2 P.P.	2.5	264	44	----	----	30	----	----
280	Rect.	4.9	310	----	----	----	50	----	----

Line voltage 110. Volume control maximum.

Fig. 1. Typical tube voltages as taken with a Jewell analyzer on the Silver 30-B are shown in the above table

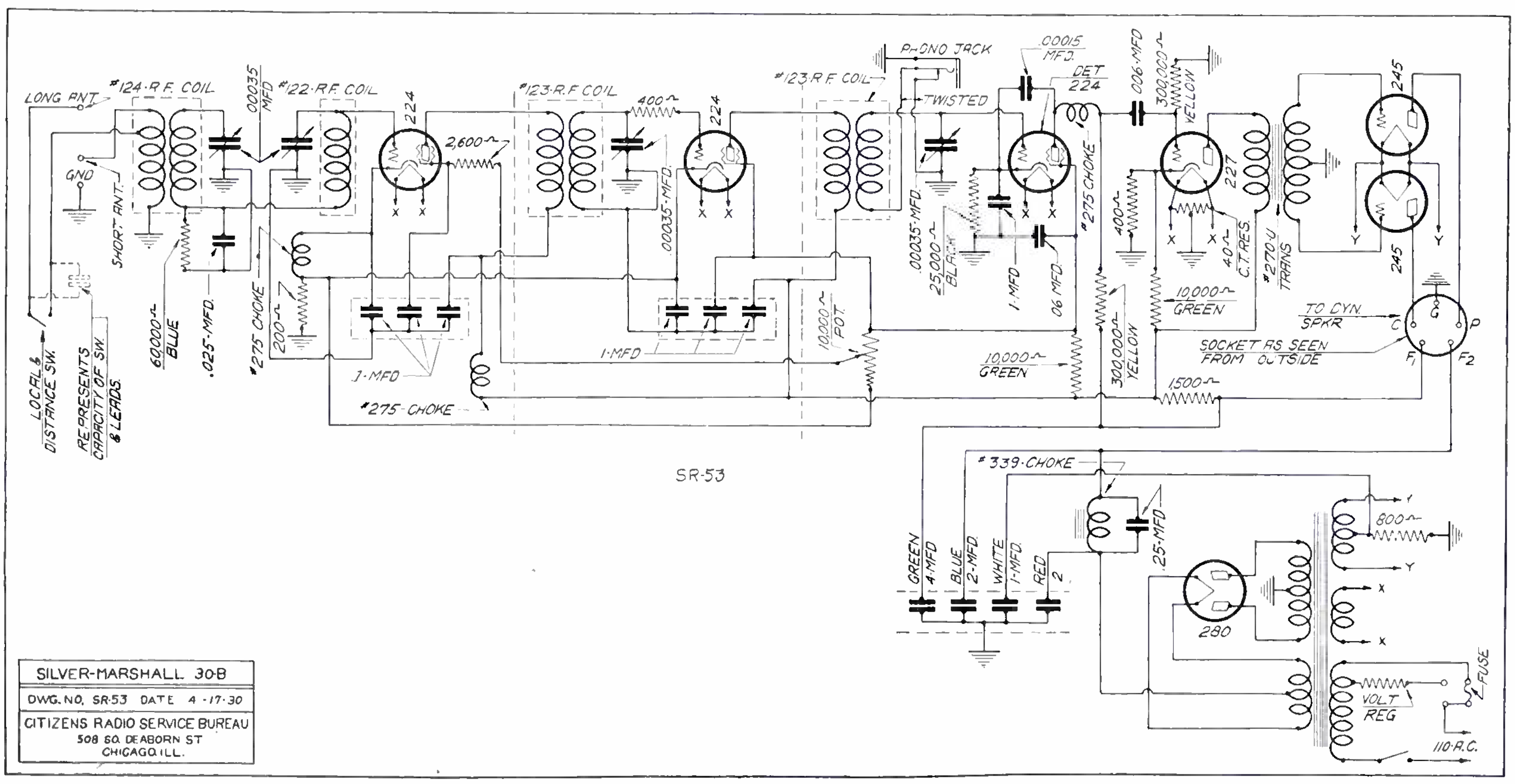


Fig. 2. Details of the model 30-B made by Silver may be seen in the schematic drawing shown here

Stewart-Warner Series 950 Receivers

EIGHT tubes in all are employed in the Stewart-Warner series 950 receiver illustrated schematically on this page in Figure 2, while the table of tube voltages is given in Figure 1.

The circuit used in the 950 series is the screen grid type but is somewhat unusual in that it involves a combination of inductive and capacitative coupling in the radio frequency stages. The former coupling is most effective at the lower frequencies while the latter serves best for transfer of energy at the higher frequencies. The coupling capacities are the small adjustable condensers on the right side of the main tuning condensers. Under no conditions should they be touched since these capacities are originally set at the factory for a value of 16 mmf and any alteration of this capacity will affect the performance of the receiver.

Power detection is used in the detector stage, a plate voltage of 180 volts being applied, a 40,000 ohm resistor cathode and ground supplying the required 18.5 volts bias for the 227 detector.

Coupling from the plate circuit of the detector to the grid of the first audio is resistance-capacity through a .1 mfd coupling condenser while a 1 megohm is used from grid to ground of the first audio tube. The bias for this grid is supplied through the drop across a 2400 ohm resistor between cathode and ground of the first audio tube. By-passes for the various bias resistors are included in a block containing six by-pass capacities each with a colored pigtail. The bias resistor for the 245 tubes in pushpull is of 850 ohms between ground and centertap of the 20 ohm resistor across the 245 filament circuit.

While operating under normal conditions the 950 will not oscillate. A set of this type however may oscillate due to either a defect in the set itself or improper environment for the receiver. Oscillation due to defect in the set itself may be due to an open screen grid bypass condenser, an open r. f. bypass condenser, an open r. f. grid bias condenser, excessive screen grid voltage, or poor contact at the clips between sections of the variable condensers. Oscillation due improper environment may come under the head of feedback caused by a poor ground, or feedback in the external wiring of the receiver, the latter being caused by having the aerial close to the terminal strip in back of the set, or crossing either the speaker cord or the 110 volt cord. An imperfect ground is almost certain to cause oscillation. In this case the usual tests for grounds are insufficient. A very simple, yet infallible test that will definitely establish whether or not the ground is poor, or feedback is present, is to connect a fixed condenser of from .006 to .1 mfd capacity inside the set from the frame to one of the 110 volt wires at the soldering lug on the resistor terminal strip to which the 110 volt cord is connected. If, after reassembling the set carefully all traces of oscillation are gone, the original cause was unquestionably either feedback or poor ground.

Stewart-Warner Model 950

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R.F.	2.3	166	1.5	—1.3	78	3.9	7.2	3.3
224	2 R.F.	2.3	168	2	—2	75	5.9	9.6	3.7
224	3 R.F.	2.3	167	2	—2	75	6.2	9.8	3.6
227	Det.	2.3	180	18.5	—20	----	6.	.65	.05
227	1 A.F.	2.3	182	2.5	—13.5	----	5.8	6.8	1.0
245	2 A.F.	2.35	260	46	----	----	24	28	4
245	2 A.F.	2.35	260	46	----	----	27	31	4
280	Rect.	4.6	--	--	--	----	----	----	----

Line voltage 115. Volume Control Maximum.

Figure 1. Tube voltages as taken with a Jewell set analyzer are shown here for the Stewart-Warner series 950 receivers

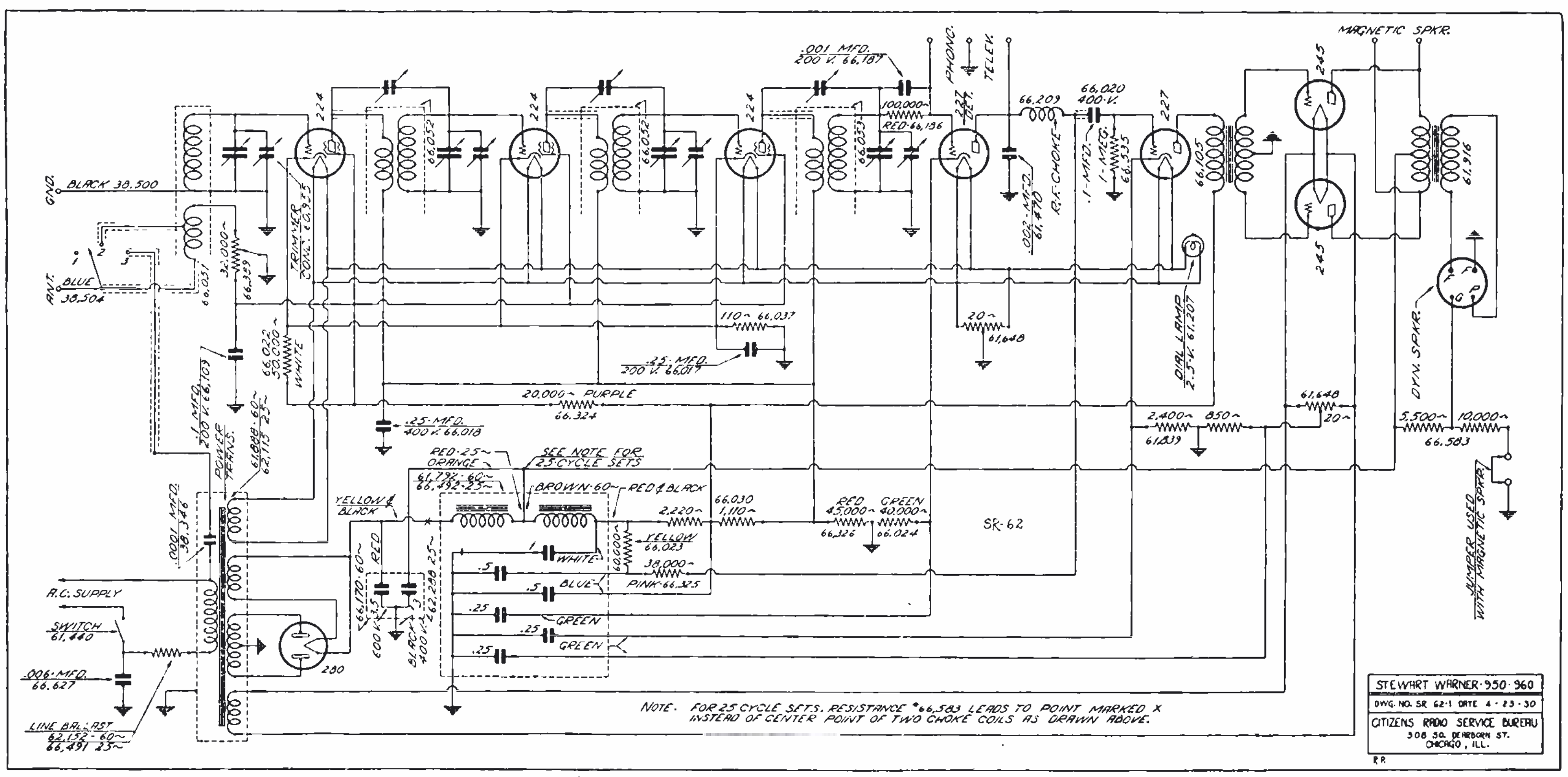


Figure 2. The receiver and power supply schematic of the series 950 Stewart-Warner is illustrated in this drawing

Stromberg-Carlson Receiver, No. 846

STROMBERG-CARLSON'S 846 is an art console model with built-in dynamic. The chassis, according to the engineering data book issued by that company, has a radio amplifying system similar to that in the 642 art console with the addition of an automatic volume control circuit. Three 244 Radiotrons are used in the r.f. portion and a 227 employed in the automatic volume control. A linear power detector is incorporated in these receivers and it also makes use of a 227 type tube. The audio amplifier consists of a low gain first stage, the output of which is used to operate the push-pull output stage where a pair of 245's are employed. One rectifier of the 280 type is used for plate supply for the receiver itself, and another rectifier of the same kind is utilized in the power supply unit for the dynamic speaker.

Automatic Volume Control

The amplification of the radio amplifier is automatically regulated to the strength of the carrier wave being received when the signal is above a certain level. The control circuit increases the control grid bias of the first two r.f. tubes when the strength of the carrier is increased, which action tends to establish a uniform signal level at the detector input. Such an action compensates for fading as long as the signal does not drop below the level at which the automatic volume control starts to function.

Visual Tuning Meter

This automatic volume control necessitates a visual resonance indicator, which is provided in the form of a milliammeter through which flows the plate current of the second r.f. amplifier tube, the meter being placed in the cathode-ground circuit.

One 227 ube is used as a linear power detector with automatic bias. This type of detector operates at high r.f. voltages provided by the r.f. amplifier and prevents distortion common to the ordinary square law detector particularly when signals are received from broadcast stations using high percentage modulation, such as the 100 per cent modulated stations. The grid bias is automatically adjusted to the proper value for the strength of the signal received to obtain the linearity mentioned.

Stromberg-Carlson Model 846

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Screen Current	Normal Plate M. A.	Plate M.A. Grid Test
224	1 R.F.	2.4	150	.2	+3	58	.8	2.4	3.6
224	2 R.F.	2.4	150	.3	+3	58	.8	2.5	3.7
224	3 R.F.	2.4	155	.7	+3	60	.6	1.7	4.0
227	Det.	2.1	220	22	+22			.1	.2
227	1 A.F.	2.1	110	6	+7			4.4	6.3
227	Vol.Con.	2.5	25	2	—50				----
245	P.P.	2.5	270	50	----	----		35	40
245	P.P.	2.5	270	50	----			35	40
280	Rect.Set	5	----	----	----			50	----
280	Rect.Spkr.	5	----	----	----			17	----

Line voltage 120, set on high tap. Volume control maximum.

Figure 2. A table of typical tube voltages and currents is shown in this chart, readings having been taken with a Weston set tester

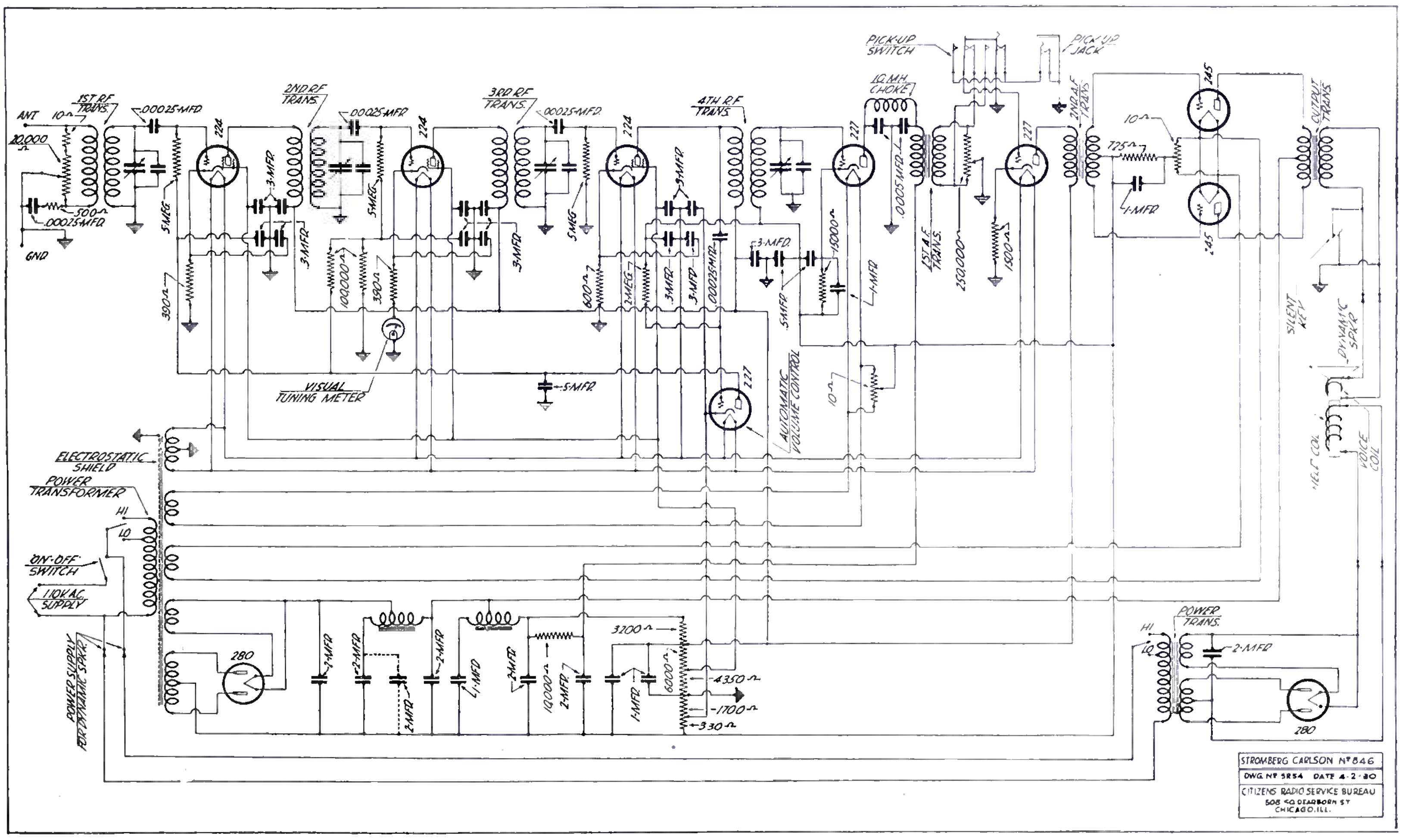


Figure 1. The complete schematic diagram of the Stromberg-Carlson 846 receiver is shown in this drawing

Sparton Equasonne Receiver No. 589

ANOTHER model made by the Sparks-Withington Co., and known as their model 589 is illustrated schematically in Figure 1 on this page. An earlier model, known as the AC-89, was shown in the September, 1929, issue of this magazine, on page 82.

Technidyne Circuit

The model 589 uses the same Technidyne circuit described in the September, 1929, issue, but employs a total of ten tubes, including the rectifier. One tuned stage of r. f. precedes the two-stage selector which is followed by another tuned r. f. stage, then followed by four untuned stages. The detector is the last tube at the right of Figure 1 and works directly into a transformer whose secondary feeds the two power tubes placed in push-pull.

Bias for the detector is provided by the drop across the 20,000 ohm resistor between the detector cathode and ground, while the bias for the output tubes in push-pull is secured through the drop across the 1,250 ohm resistor between ground and the center of the 5-volt filament supplying the power tubes. Grid bias for all of the radio frequency stages is secured through the drop across the 110-ohm fixed resistor in series with the 15,000-ohm volume control resistance (variable) between the common cathode line and ground.

In a recent service sheet sent out by Sparton for its service men we note several items of interest which are being passed on to service men readers.

Full Volume Test

All tests on the receiver should be made with the volume control full on, and the voltage adjuster on the proper tap. The line voltage should be tested and the voltage adjuster set at the corresponding voltage or higher. For this test a 0-160 a. c. voltmeter is required to read the voltage.

There are two tests that can be made with the 0-300 d. c. voltmeter. The first is for the detector plate voltage. Measure detector plate voltage between terminals 1 and 2. Normal voltage here should be 140 volts without phonograph pickup in jack, and 135 with pickup. The limits of variation are 120 to 160 volts without pickup, and 110 to 150 with pickup. More or less than this indicates a defective plate circuit, possibly in the 20,000-ohm resistance.

The second measurement is for the plate voltage of the r. f. and selector tubes. Measure between terminals 5 and 6. Voltage should be 145. Limits 130 to 170. More or less than this value indicates plate circuit trouble, possibly caused by 15,000-ohm resistor, or speaker field.

Two measurements may be made with the 0-75 d. c. voltmeter. The first is the detector bias voltage which should be measured between terminals 2 and 9. Normal bias 12 negative; allowable limits of variation are —10 and —17. Voltages above or below this value indicate defective resistance 20,000 ohms or connections. Detector bias voltage with pickup plugged in should read between 3 and 5 volts. More or less than these voltages indicate defective circuit, probably in the 1,000-ohm resistance.

Bias Voltages

The second measurement is for the bias voltage on the r. f. and selector tubes. Measure between terminals 5 and 9. Normal r. f. bias —4.5 volts. Limits —6 to —3. More or less than this indicates defective resistance, 110 ohms, or abnormal r. f. plate current, and results in loss in volume. With volume control off a wide variation of the above voltages is obtained, but this fact is of no consequence.

With respect to the heater voltages, using 0-4 a. c. voltmeter, measure detector, selector and radio frequency heater voltage between terminals 3 and 4. Normal is 2.97 volts; more than this dangerous to tubes. Maximum allowable on these terminals is 3.1. If voltage higher than this place voltage adjuster on another tap to lower this excessive value.

Aerial Compensator

To adjust the aerial compensating condenser turn volume control full on, tune set to station of 1,250 kc. or higher, and adjust compensating condenser for maximum volume.

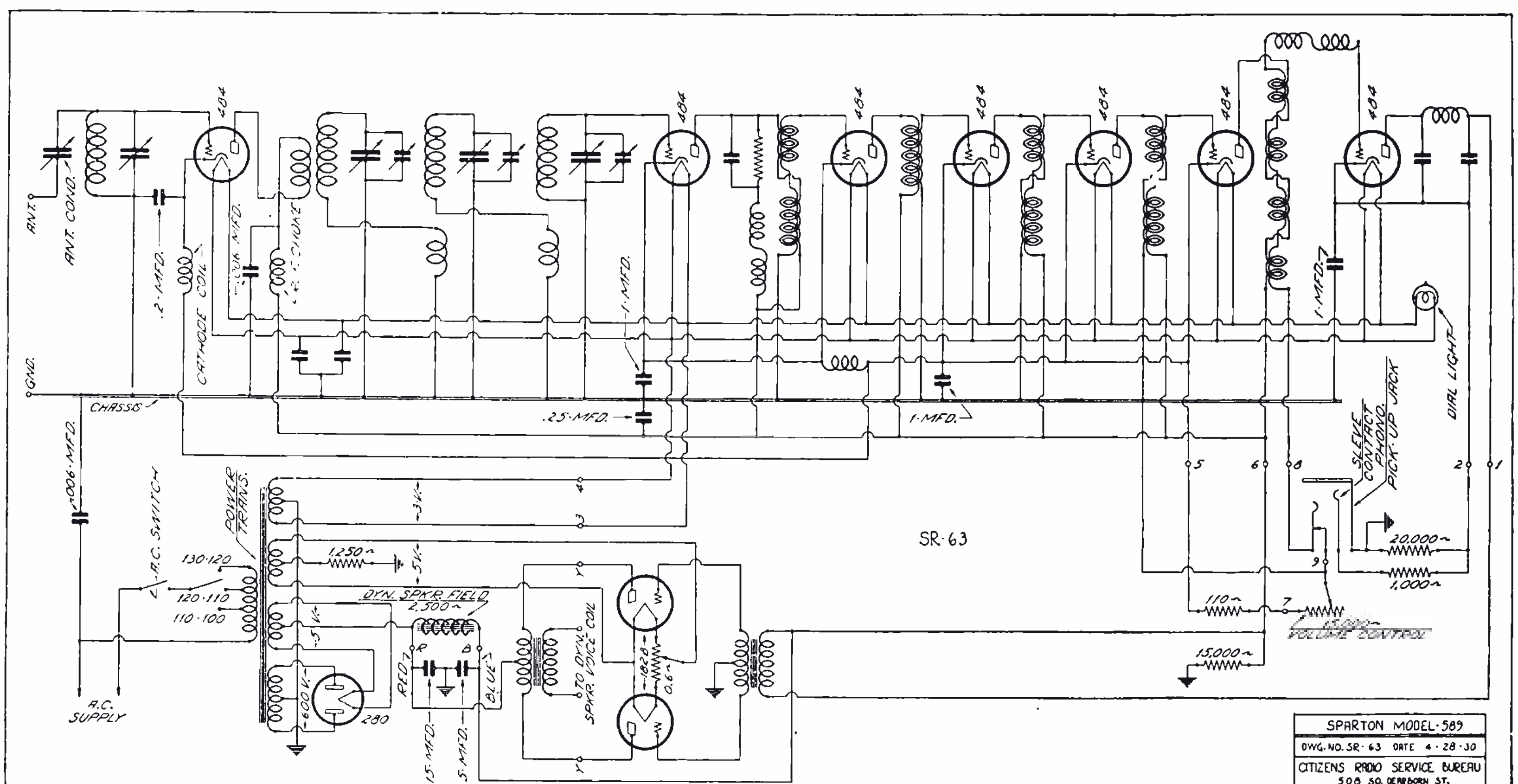


Figure 1. The schematic diagram of the receiver and power supply of the model 589 Sparton is illustrated above

Victor Receivers No. R32, RE45, R52

ON this page will be found the schematic diagrams of the Victor models R32, RE45 and R52 together with typical voltage analysis of the tubes used as taken with a standard set analyzer. The radio frequency and detector portion of the receiver is indicated in Figure 2 while the power supply and audio amplifier is shown in Figure 3.

There are five radio frequency stages, each using a 226 tube, four of these stages being bridge tuned and provided with balancing or neutralizing condensers. The antenna input stage is untuned, using an r. f. choke from grid to ground. The volume control is placed across the r. f. choke; the second section of the dual volume control being placed across a tertiary winding coupled to the plate circuit of the second 226 where it acts as an absorption circuit.

Bias for the radio frequency grids is through a common resistor, 500 ohms, between ground and the center tap of the filament resistor across the supply for the 226 filaments. The detector uses grid leak and condenser of the values indicated in the schematic. The plate circuit has the usual r. f. choke and bypass condenser.

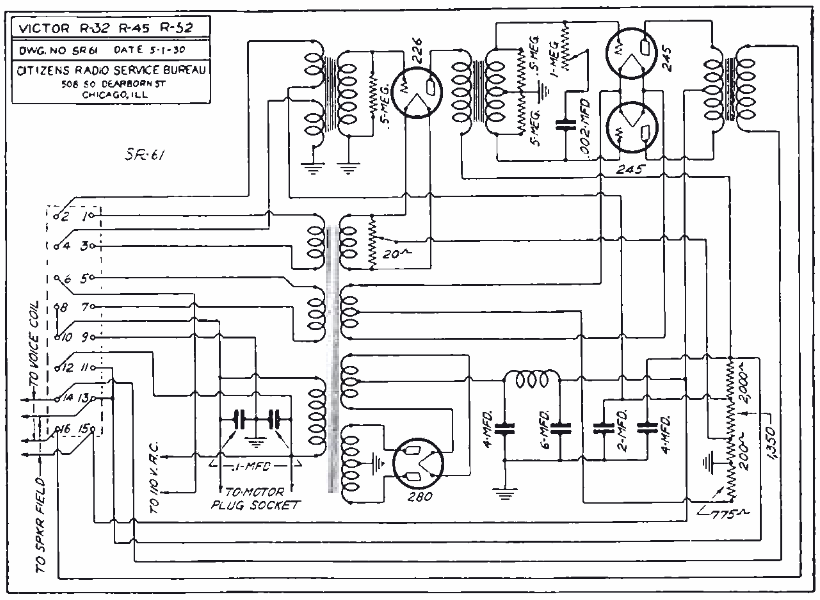


Fig. 3. The power supply and the audio amplifier for the Victor models described on this page are shown schematically in the drawing to the right

A switch allows change-over from radio to record, a 500 ohm volume control being provided across the terminals to which is connected the phonograph pickup. The primary of the first a. f. transformer has a special winding for the pickup output so that proper impedance is secured for that unit.

Connection between the r. f. and a. f. sections is by means of terminal blocks into which fit the necessary multi-terminal plugs. The receiver is made in three units consisting of the r. f. end, the audio amplifier and the speaker.

In the audio amplifier are found the first a. f. tube and the two 245 tubes in pushpull. The secondary of the first a. f. transformer has a .5 megohm resistance across it, while the secondary of the pushpull input is also provided with .5 megohm resistors across each side of the winding. Across the two extremities of the pushpull input will be found a combination of a 1 megohm variable resistance in series with a .002 mfd condenser, this serving as a variable tone control.

Victor Model R32-RE45

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
226	1 R.F.	1.3	105	9	----	----	3.9	7.3	3.4
226	2 R.F.	1.3	105	9	----	----	3.9	7.3	3.4
226	3 R.F.	1.3	105	9	----	----	3.9	7.3	3.4
226	4 R.F.	1.3	105	9	----	----	3.9	7.3	3.4
226	5 R.F.	1.3	105	9	----	----	3.9	7.3	3.1
227	Det.	2.1	40	----	----	----	3	3.4	.4
226	1 A.F.	1.3	100	6	----	----	4.5	7.4	2.9
245	P.P.	2.1	230	40	----	----	37	41	4
245	P.P.	2.1	230	40	----	----	37	41	4
280	Rect.	4.4	----	----	----	----	57	----	----

Line voltage 110. Volume Control Maximum.

Fig. 1. Average tube voltages as indicated by a standard test set are shown in this table

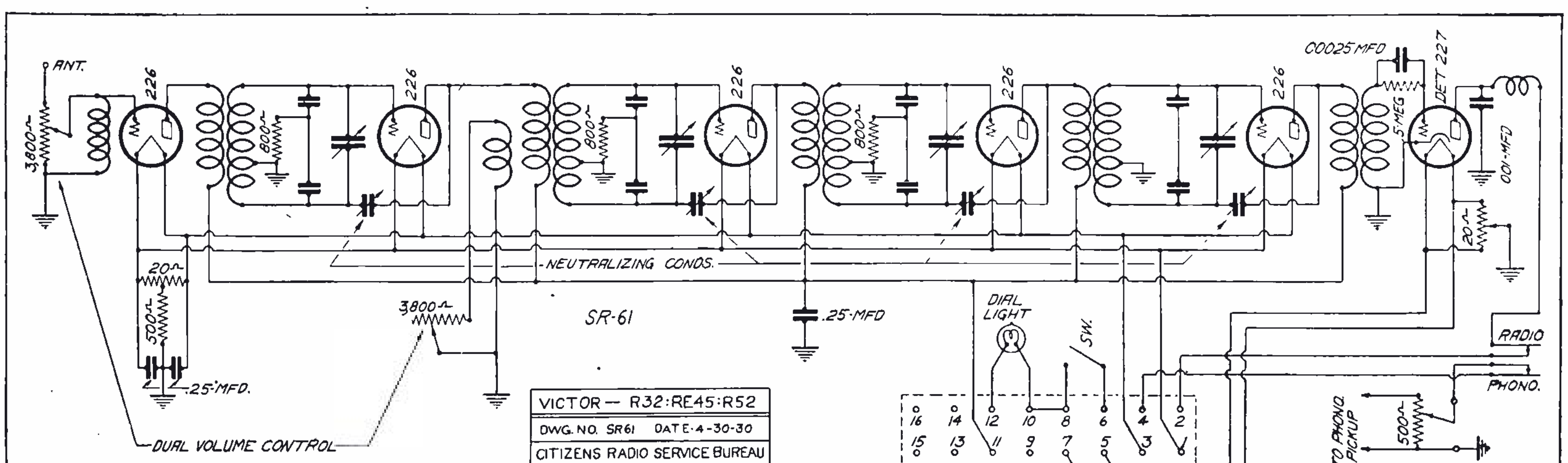


Fig. 2. The radio frequency and detector portion of the Victor models R32, RE45 and R52 is illustrated in this schematic diagram

Philco Balanced Unit Radio Model 95

ONE of the receivers of which a schematic circuit was desired by service men readers as indicated in our annual questionnaire is that of the Philco model 95 illustrated on this page, the circuit in Figure 2 and the table of tube values in Figure 1.

Probably the most interesting feature of this receiver is the multiplex detector circuit which is thus described by Walter E. Holland, chief engineer of the Philadelphia Storage Battery Co., makers of the receivers:

"The two type 227 tubes which are used in our 'multiplex detector circuit' separate the rectifying and amplifying functions of the usual single detector tube, and provide the necessary means for automatically changing the bias of the control grids of the radio frequency tubes to give automatic volume control.

"The first of these tubes has the grid and plate coupled together and acts as a true two-element rectifier, while the second has its grid directly coupled through a resistance to the grid and plate of the first tube so that it fulfills the audio amplifying functions of a detector independently of the first tube.

"It is for this reason that we call the second tube a 'detector amplifier.' The first tube might be called a 'detector rectifier' but we prefer to merely call it the 'detector tube.' Since it is a two-element rectifier it gives true linear detection without overloading on all signals impressed on it by the radio frequency amplifier."

In the section on testing and servicing in the Philco manual we find 7 headings covering troubles and possible causes, which we produce below:

No signal: Defective tubes; no voltage on receiver; incorrect voltages on one or more tubes; grounded antenna; open antenna circuit; poor contact; grounded compensator; open r. f. coil.

Weak signal: Defective tubes; incorrect voltage on one or more tubes; open antenna circuit; open ground circuit; poor contact; unmatched coils. compensating; bypass condensers.

Broad tuning: Unmatched coils; compensating.

Fading: Defective tubes; poor contact; station and atmospheric condition.

Distortion: Defective tubes; incorrect voltage on one or more tubes; grounded filament; arrangement of wires and shielding; poor contact; defective speaker; bypass condensers.

Hum: Defective tubes; incorrect voltages; grounded filament; arrangement of wires; poor contact; a. c. plug.

Noisy: Defective tubes; incorrect voltages; poor contact; a. c. attachment plug; compensating and external interference.

Philco Model 95

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Screen Current	Plate M. A. Plate M. A.	Change
224	1 R.F.	2.15	155	0	5.3	95	.8	4	----
224	2 R.F.	2.15	155	0	5.3	95	.8	4	----
224	3 R.F.	2.15	155	0	5.3	95	.8	4	----
227	Det.	2.15	0	—.5	.7	----	----	----	----
227	Det.Amp.	2.15	27	—.5	5.5	----	----	----	----
227	1 A.F.	2.15	85	—2.0*	5.5	----	----	2.5	----
245	2 A.F.	2.2	250	41	----	----	----	28	----
245	2 A.F.	2.2	250	41	----	----	----	28	----
280	Rect.	4.5	----	- -	----	----	----	43	----

Line voltage 115. *Read with volume control off. With it on reading will be .2 volt. Do not allow receiver to oscillate when taking readings. Keep R.F. shield on and tune to eliminate oscillator. Have antenna and ground connected.

Fig. 1. Data on tube voltages and currents as given in the Philco service manual for the model 95 is indicated above

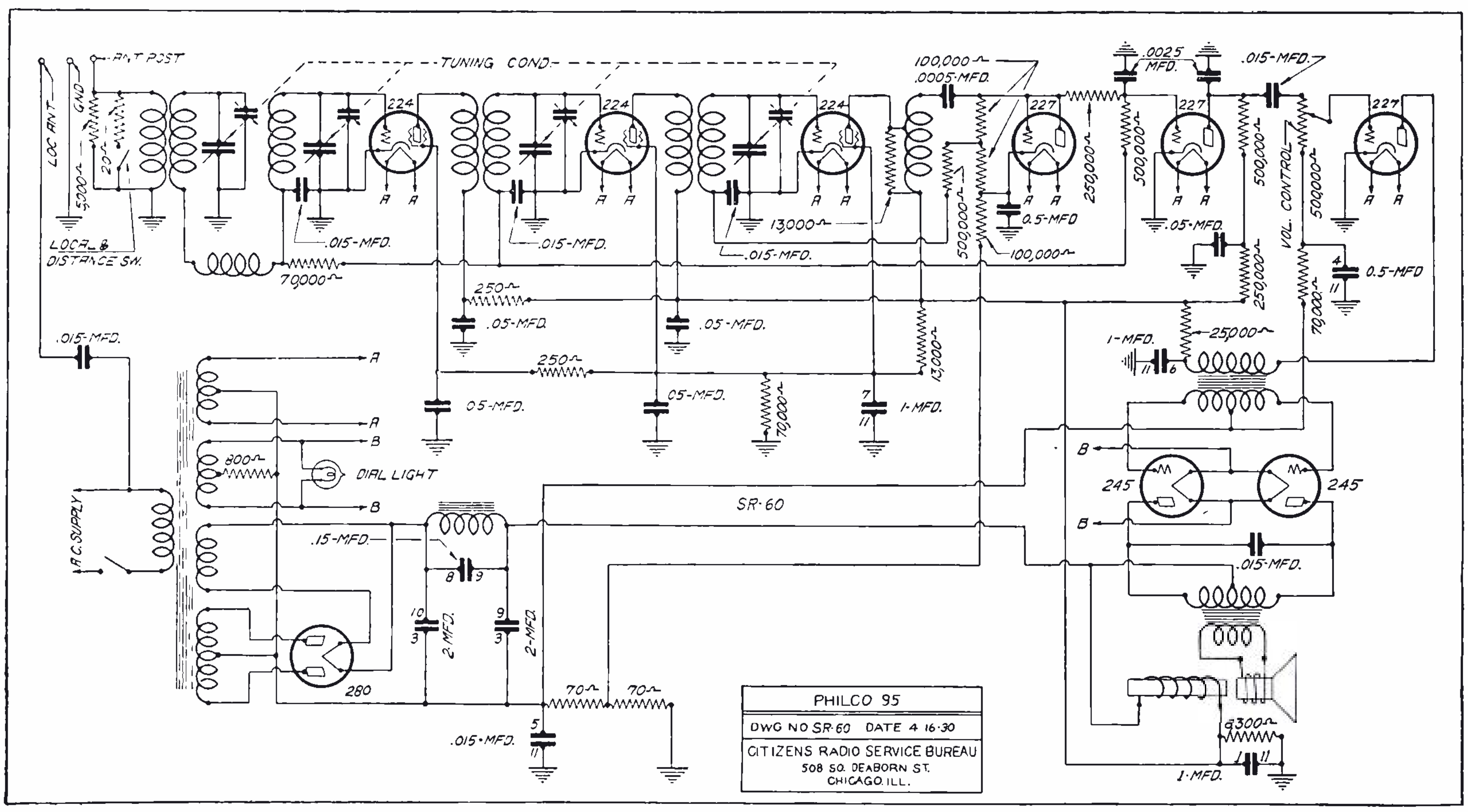


Fig. 2. Schematically we illustrate above the receiver and power supply circuit of the Philco model 95

Crosley Models 40-S, 41-S, 42-S, 82-S

RESPONSE curves of the Crosley models 40-S, 41-S, 42-S and 82-S were printed on page 85 of the March, 1930, issue of this magazine, to which reference should be made for any performance data on these receivers.

The schematic diagram of the receiver and power supply of these models is shown on this page in Figure 2, while the table of tube voltages is illustrated in Figure 1.

Eight tubes, including rectifier, are used in these models, the same chassis being employed in 110 volt 60 cycle, 110 volt 25 cycle and the 220 volt 25 cycle jobs.

Double Volume Control

Receivers of serial numbers with a prefix GC, GCA, GCB or GCC have volume controls composed of two rheostats operated simultaneously. One of these is shunted across the antenna coupling coil primary so as to regulate the strength of signal passing through the antenna coil primary. The other is used to control the potential of the screen grids of the r. f. tubes. Receivers of serial numbers other than those mentioned above have a volume control consisting of but one rheostat which controls the screen grid potential of the r. f. stages.

The detector is of the C bias type, the plate voltage being 100 volts, which through the 60,000 ohm biasing resistor between the cathode and the chassis, provides a bias of 12 volts for the grid of the tube.

Biasing System

Bias for the first 227 audio tube is secured by the drop across the 3500 ohm resistor between cathode and chassis. The biasing resistor for the output stage has a value of 850 ohms and is connected between the chassis and the midpoint of the potentiometer shunted across the filament leads of these tubes. The control grid bias for the screen grid tubes is obtained through a resistance shunted between their emitter circuits and the chassis. In this circuit there is a bleeder current as well as the normal tube current flowing in the biasing resistors. Bleeder current is supplied from the high line through a 100,000 ohm resistance.

The first audio stage is resistance coupled to the output of the detector stage. The 150,000 ohm resistance unit in the plate circuit of the detector tube serves as the coupling unit. A 1/2 mfd condenser couples the plate circuit of the detector circuit to the grid circuit of the first audio stage.

If trouble is experienced due to oscillation in the r. f. stages, try different tubes in these sockets, or shift r. f. tubes from one socket to another. Normally when these tubes are of the same grid-plate capacity no oscillation will occur. An abnormal increase in the grid-plate capacity will cause the tubes to oscillate. If receiver oscillates it would be well to examine all connections and soldered joints, and to test all bypass condensers common to the radio frequency circuits. Also try other tubes, and examine the wiring for unusual grid-plate coupling.

The circuit shown in Figure 2 indicates both the old and the new method of antenna connection for the first r. f. stage.

Crosley Models 40-S, 41-S, 42-S and 82-S

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
224	1 R.F.	2.40	175	1.5	1.5	70	1.5	4.0	2.5
224	2 R.F.	2.40	175	1.5	1.5	70	1.5	4.0	2.5
224	3 R.F.	2.40	175	1.5	1.5	70	1.5	4.0	2.5
227	Det.	2.45	100	12	12	----	.2	.3	.1
227	1 A.F.	2.45	180	15	15	----	4.	5.	1.0
245	2 A.F.	2.30	240	48	----	----	26	30	4.
245	2 A.F.	2.30	240	48	----	----	26	30	4.
280	Rect.	5.00	----	----	----	----	100	----	----

Line voltage 117. High top. Volume control maximum.

Fig. 1. A table of typical tube voltages as taken with a Jewell set analyzer is shown here

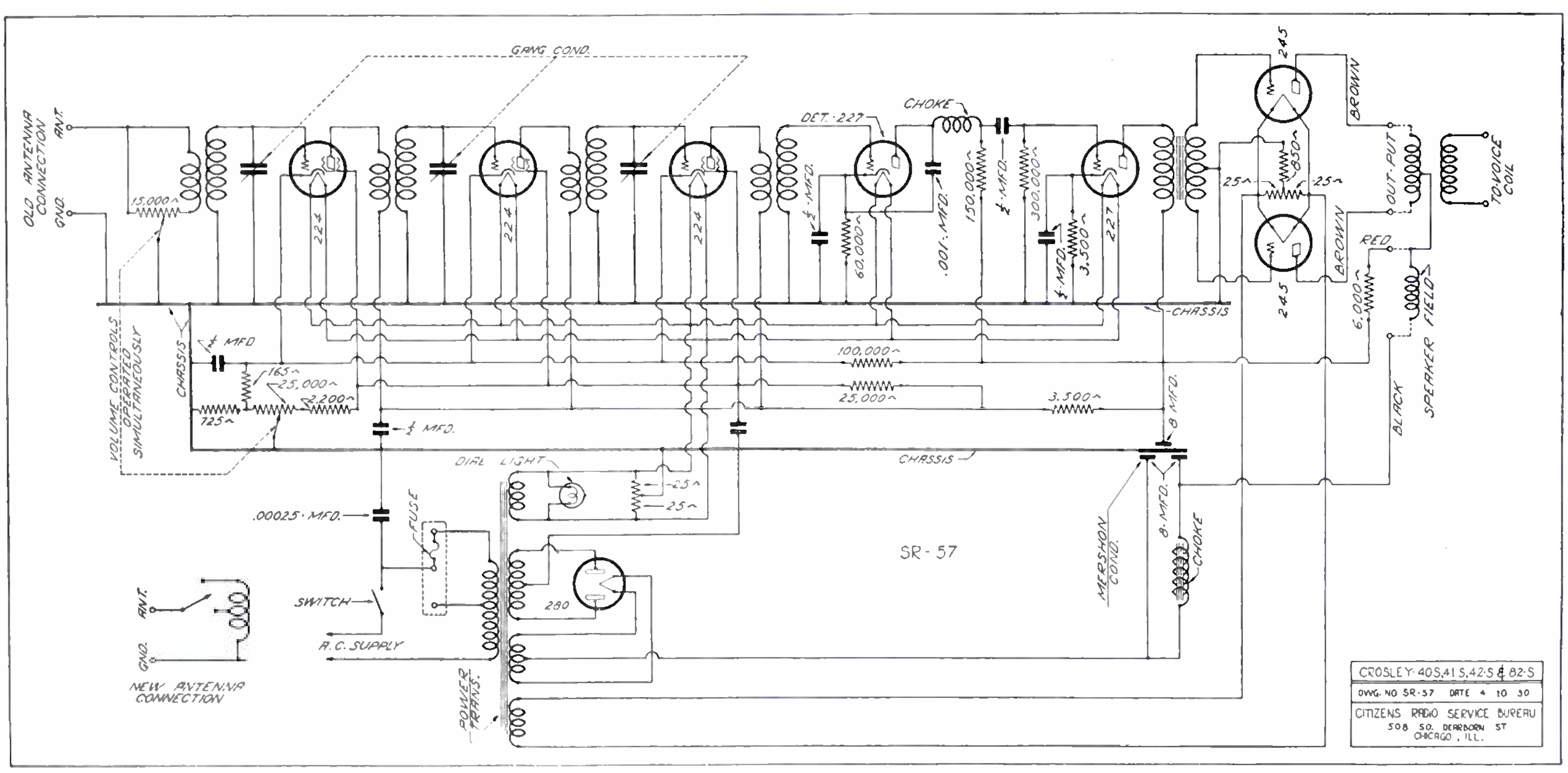


Fig. 2. The complete schematic of the Crosley models mentioned in this article is illustrated in this drawing

The Majestic Model 90-B Receiver

SCHEMATICALLY on this page is shown the diagram of the Majestic model 90-B, the response curves on which were run on page 84 of the March, 1930, issue of this magazine. The diagram is illustrated in Figure 1 and a table of tube voltages is shown in Figure 2.

Uses 227 Tubes

The receiver itself comprises five 277 tubes, a pair of 245 power tubes and the 280 rectifier. Four of the 227's are in the radio frequency stages and the fifth in the detector circuit. In this latter tube the bias for plate rectification is secured by the drop across the 35,000-ohm resistor placed between cathode and ground and by-passed with a 1 mfd condenser. Bias for the grid of the fourth r. f. stage is secured through the drop across the 1,800-ohm resistor between ground and cathode of that 227 tube.

Volume Control

In the case of the first, second and third 227's used, a 75,000-ohm variable resistance used as a volume control, and the 2,500-ohm equalizer serve to give the bias for these three r.f. stages. Bias for the pair of 245's in push-pull is secured across the 800-ohm resistor between the center tap of the 2.5-volt filament secondary and ground.

The detector plate voltage is secured from the 306-volt maximum through a 50,000-ohm fixed resistor, while the r.f. plates are given 144 volts through one end of the speaker field winding.

Local-Distance Switch

The receiver is equipped with a local-distance switch. When the switch is closed distance reception is secured. For local work the switch is left open.

Antenna Compensator

In the antenna input stage the trimmer, or compensator is a metal shield on a shaft, altering the position of the shield with respect to the secondary of that circuit, thus increasing or decreasing the inductance of the circuit to maintain the input stage in resonance with the remainder of the tuned circuits at all times.

25 and 60 Cycle

Twenty five-forty cycle and fifty-sixty cycle models of this receiver are marketed, the filter capacities A and B shown at the bottom of the schematic diagram being different for the two frequencies, their values being indicated on the diagram.

Response Curves

Those interested in response curves on the Model 90-B will find them on page 84 of the March, 1930, issue of this magazine.

Sensitivity, selectivity and fidelity curves on the latest model, the 130-A, will be found on page 66 of this number.

Majestic Model 90-B

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
227	1 R.F.	2.3	150	14	19	....	3.4	6	2.6
227	2 R.F.	2.3	150	13	17	....	3.5	6	2.5
227	3 R.F.	2.3	150	13	18	....	3.6	6	2.4
227	4 R.F.	2.3	158	12	12	....	6.6	8	1.4
227	Det.	2.3	290	29	28	....	.8	1	.2
245	P.P.	2.4	285	50	....	....	35	40	5
245	P.P.	2.4	285	50	....	....	35	40	5
280	Rect.	4.8	....	....	....	....	60	....	....

Line voltage 114. Volume control maximum.

Figure 2. A table of typical tube voltages as taken with a Weston set tester is seen above

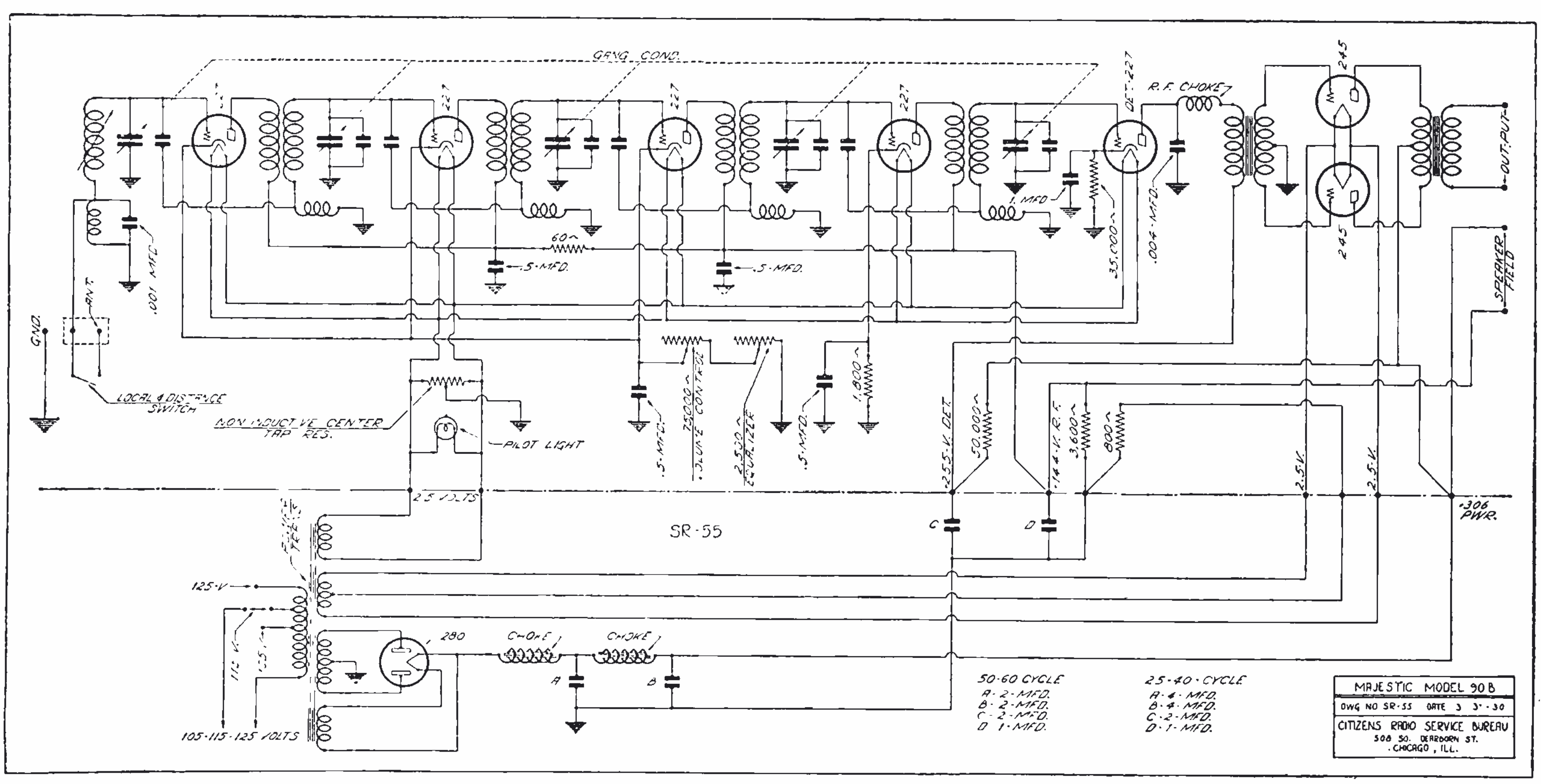


Figure 1. The receiver and power supply schematic of the Majestic 90-B is shown in this drawing

Radiola Superheterodyne Model 66

On this page is shown the schematic diagram of the receiver and power supply contained in the Radiola 66 model, this superheterodyne using only one power output stage in the form of a 245 tube.

Altogether there are eight tubes in the 66, six of which are 227 type, one a 245 and the last a 280 full wave rectifier. The diagram of the set is shown in Figure 1 while a table of tube voltages and currents is illustrated in Figure 2.

One R. F. Stage

Only one stage of tuned r. f. is employed, this being the antenna input stage. By looking at the schematic diagram it will be seen this r. f. stage can be made partly regenerative by means of the r. f. compensating condenser between the plate of the first 227 and the lower section of the secondary inductance which is grounded. In practice this condenser is set at a value for best operation with a particular 227 and then left untouched. The output of the first 227 plate circuit feeds into the grid circuit of the first detector, mixing current from the oscillator being introduced in the detector cathode circuit of this tube.

Bridge Type I. F. Stages

Only two intermediate stages are used in the model 66. It will be noticed that both of the intermediate frequency secondaries are of the bridge type, the center of the coil being grounded, the tuning condenser spanning the extremities of the coil, with a compensating condenser going from the lower end of the secondary inductance to the plate of each intermediate frequency tube. This type of balanced input permits more stable operation of the two intermediate tubes with a greater amplification than is possible with the conventional coupling.

Power Second Detector

Input to the second detector which is of the power detection type is of the conventional kind, a plate voltage of 210 volts being applied, which when passed through the BC section of the resistor at the center of the diagram furnishes a 27 volt C bias for the grid of the second detector. The primary of the second detector circuit is resonated with a 40,000 ohm resistance and a .05 mfd condenser placed in parallel to the winding. The secondary of that audio transformer is also resonated with a .00016 mfd condenser. The bias for the 245 is supplied by the drop across the 1470 ohm fixed resistor between the negative of the system and the center of the 60 ohm resistor across the 2.5 volt filament winding for all tubes. In series with the secondary return of the audio transformer is a 250,000 ohm resistance as indicated in the schematic.

Plate supply for all of the r. f., oscillator, i. f. and first detector is from a common voltage tap of about 70 volts. Slightly less than 70 volts is applied to the plates of the first detector and the oscillator on account of the drop in the windings in those circuits.

Oscillator Input

The oscillator input circuit is also of the balanced type, the center of the inductance going through a .0008 mfd condenser and a 3000 ohm resistor to the grid of the oscillator, a 40,000 ohm resistor between grid and the cathode supplying a direct return for the grid. No bias is indicated on the table of tube voltages in Figure 2. The cathode of that tube returns to the negative of the system.

Power for the dynamic speaker is provided by the field coil being placed in series with the high voltage system at the low potential end. The output transformer from the 245 plate connects to the end of a 515 ohm output choke at the filter; its secondary going into the voice coil of the dynamic.

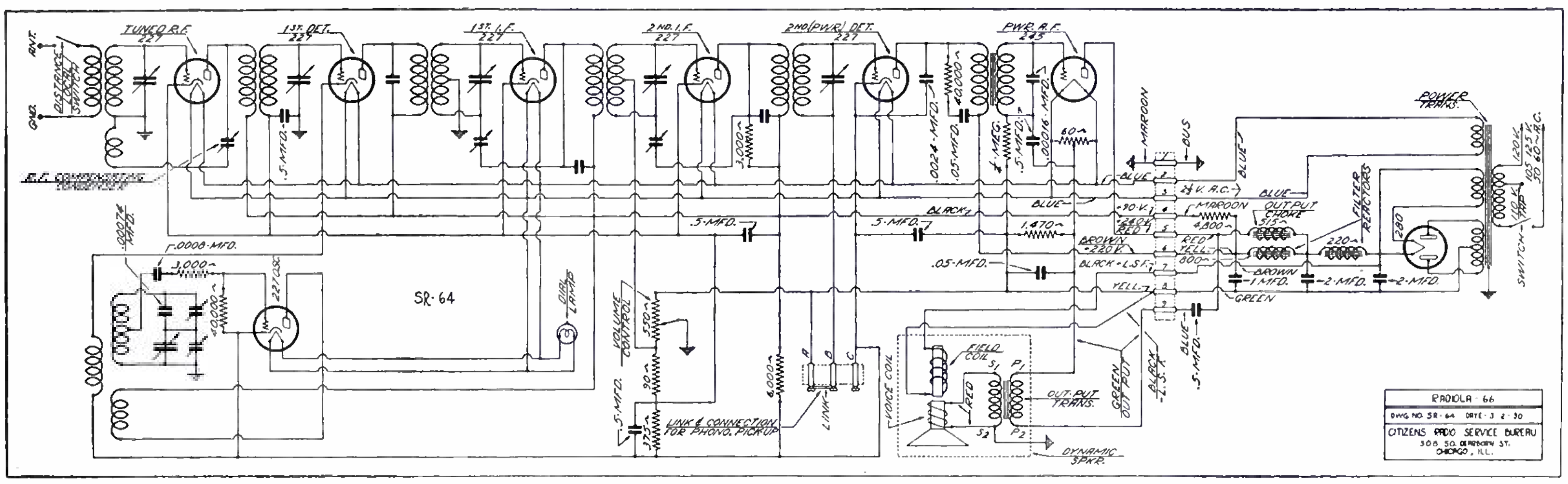


***Fig. 1.** The schematic of the combined receiver and power supply of the Radiola 66 is shown in this drawing*

Radiola Model 66

Tube Type	Position in Set	A Volts	B Volts	C Volts	Cathode Volts	Screen Volts	Normal Plate M. A.	Plate M. A. Grid Test	Change
227	1 R.F.	2.3	70	1.5	—21	....	4	8.5	4.5
227	Det.	2.3	65	7	14	....	.4	2.5	2.1
227	1 I.F.	2.3	70	3	—21	....	3.8	7.2	3.4
227	2 I.F.	2.3	70	3	—21	....	4.0	8.0	4.0
227	Osc.	2.3	61	....	....	....	6.0	11.0	5.0
227	2 Det.	2.25	210	27	—15	....	1.0	2.0	1.0
245	A.F.	2.3	200	12*	....	....	27.0	30.0	3.0
280	Rect.	4.6	....	....	....	....	50	....	....

Line voltage 114, high top. Volume control maximum. *This not true bias voltage, but reading obtained at socket due to series resistance.

***Fig. 2.** A Table of typical tube voltages as taken with a Weston set tester is indicated above for the guidance of service men*

Atwater-Kent Models No. 55 and 55-C

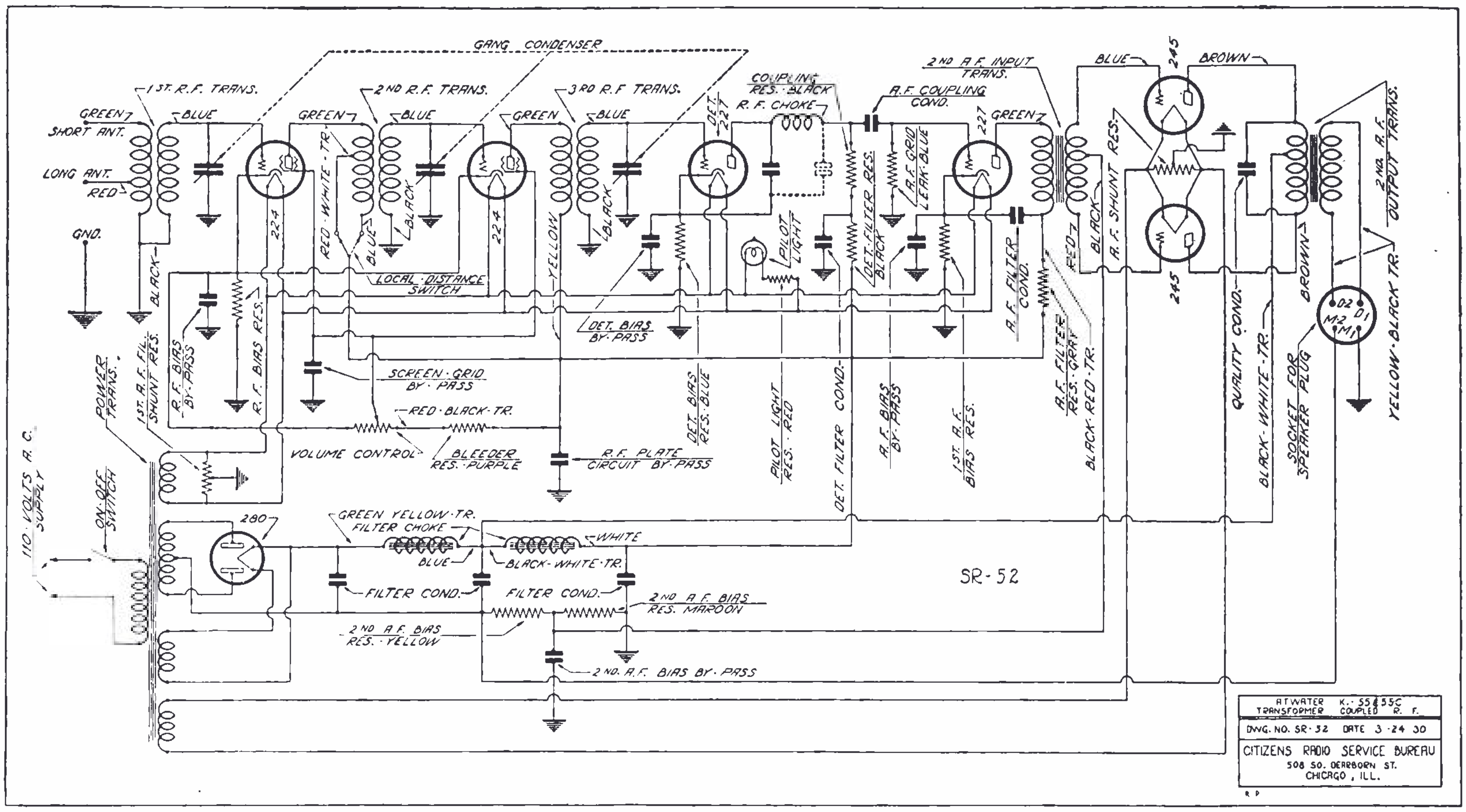


Figure 1. The transformer coupled r.f. early version of the Atwater-Kent 55 and 55-C is shown in this diagram

TWO designs of the Atwater-Kent 55 and 55-C receivers are illustrated on this page, the first being shown in Figure 1, and representing an early version of these models in which transformer coupling was employed for the radio frequency stages. The second is shown in Figure 2 and represents a later design of the 55 and 55-C embodying capacity coupling between the r. f.

Two 224 screen grids are used in the r.f.; a 227 in the detector which is of the plate rectification type, a 227 first audio stage, and two 245 tubes in push-pull for the output stage. Rectifier is a type 280 full wave.

Connections for the socket plug for the speaker are different in the two models, the wiring having been simplified in the later model shown in Figure 2.

In the early model Figure 1 the volume control governs the screens of the 224's, while in the last model the volume control is across the input primary, although a control is still left for the screens as in the previous model.

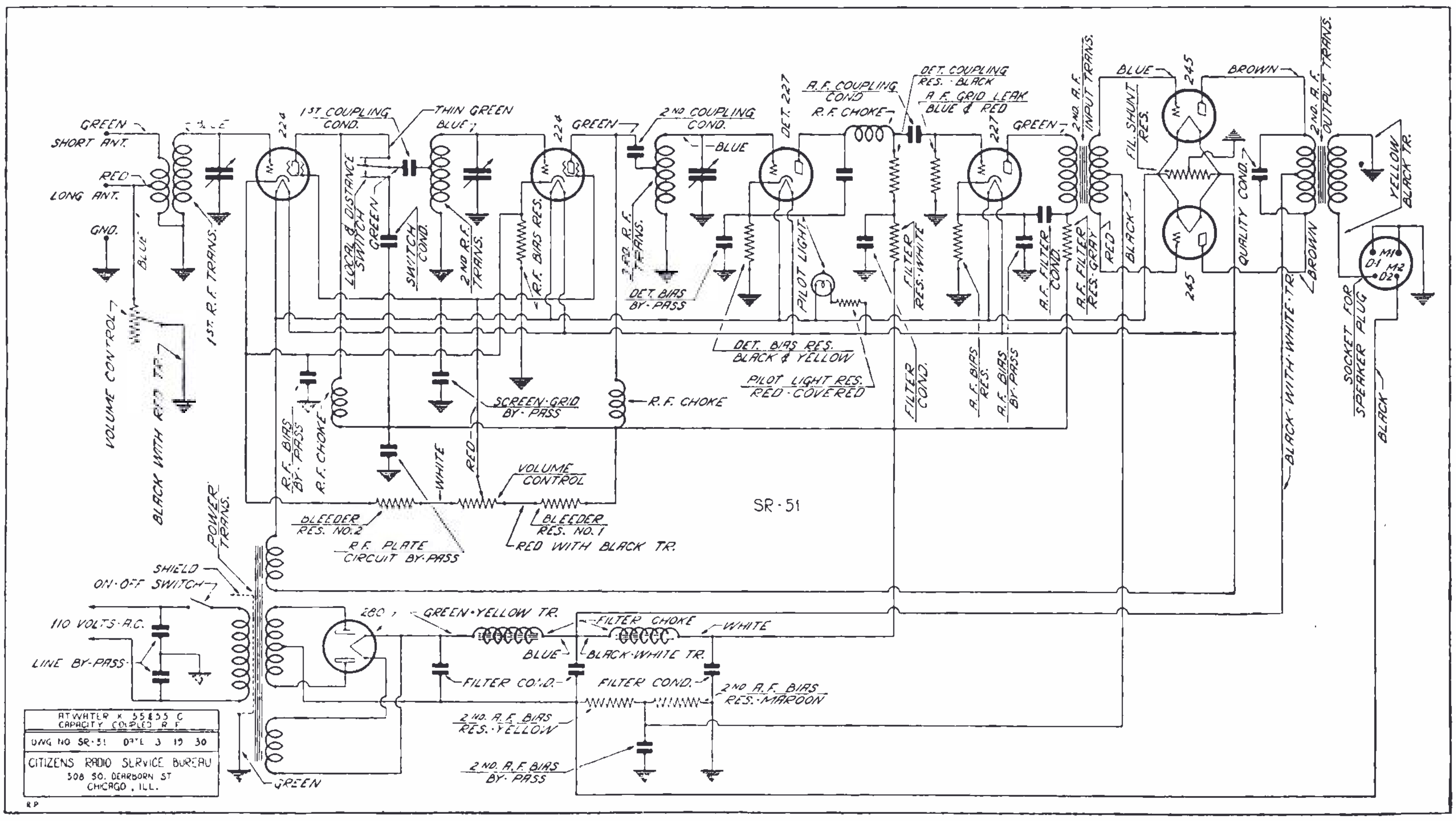
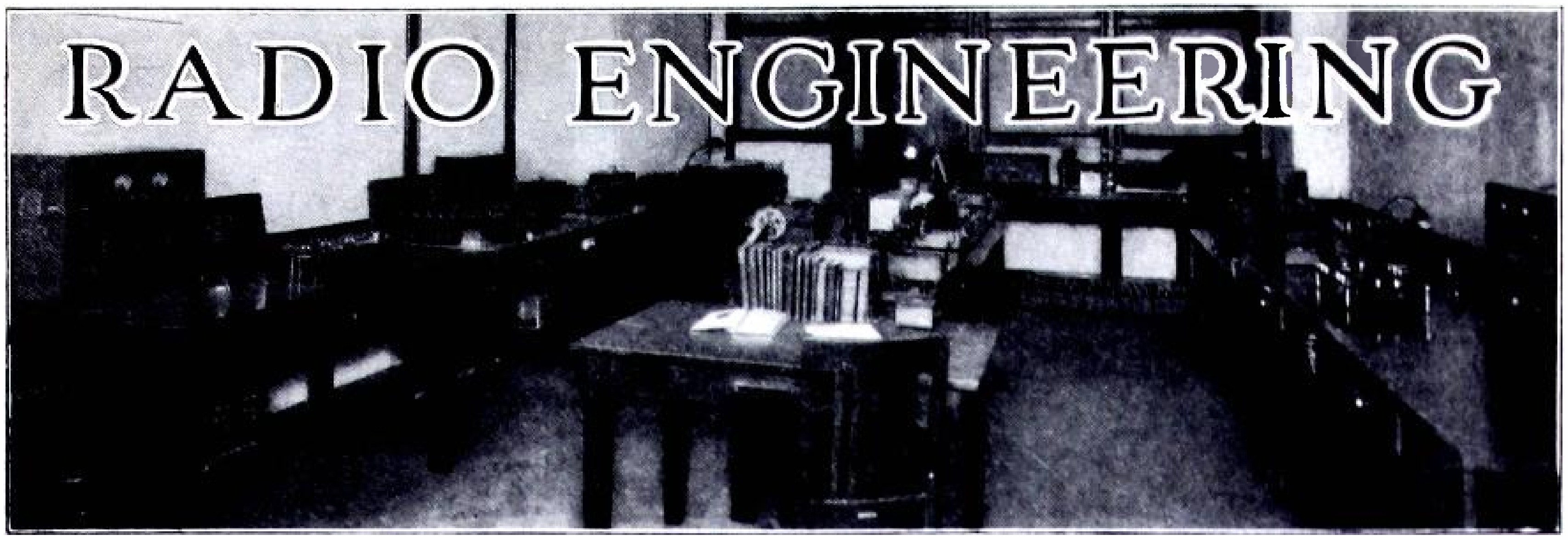


Figure 2. *In this schematic is found the later design capacity coupled r.f. job made by Atwater-Kent*



JUDGING from indications in the industry, engineers and others who for the past several years have been working mostly with the tuned radio frequency circuits, will now be faced with the necessity of looking carefully into the superheterodyne situation.

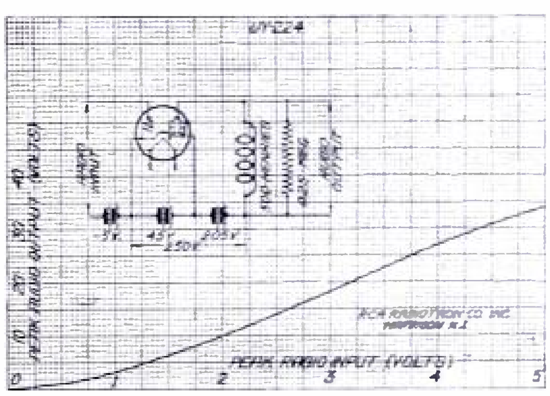
Since the announcement of the R. C. A. on July 7 that it was throwing open its super license to all the t.r.f. licensees on the customary royalty basis, many engineers have been working out super designs which can supplant the t.r.f. jobs they have been accustomed to manufacturing.

According to advices from a number of engineers of the various companies their super designs are completed, and all that remains is for the policy of their company to be expressed regarding whether its lot will be cast with the tuned r.f. or the superheterodyne. From this it would appear that the engineers have not been caught napping. In their work, it is understood, they have been helped considerably by the R. C. A., who turned over to the engineers of the licensees quite a bit of theoretical and design data covering the superheterodyne.

It is expected the forthcoming issue of this publication will contain a number of curves taken on the 80 series. The curves taken on the laboratory model 80 were quite interesting. Engineers and others will be more than anxious to see how these same curves turn out on the production models, since production seems to be the crux of the whole matter.

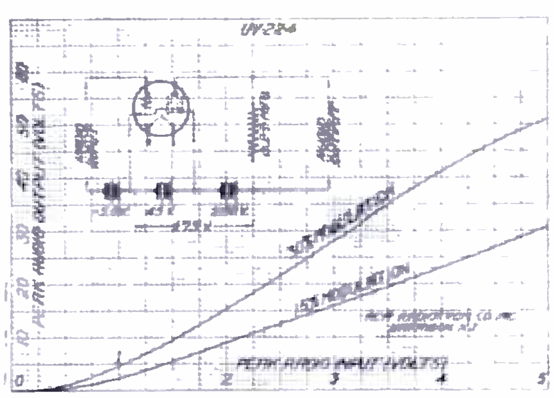
As we go to press it appears from department store advertisements that many of the licensees are already getting rid of the tuned r. f. jobs which they contemplated using as their leader in the 1931 season, which sets have been orphaned by the superheterodyne. It is quite possible that a price war may ensue between super manufacturers, one belonging to the independent camp and the other to the licensed crowd.

Use of 224 as High Output Screen Grid Detector



In this graph are shown the characteristics of the 224 used as a high output detector, peak r.f. input versus peak audio frequency output.

$E_f = 2.5$ volts
$E_{c1} = 5$ volts
$E_{c2} = 45$ volts
$E_b = 250$ volts
$Z_p = 500$ henries shunted by 0.25 megohms.
Modulation 15 per cent.



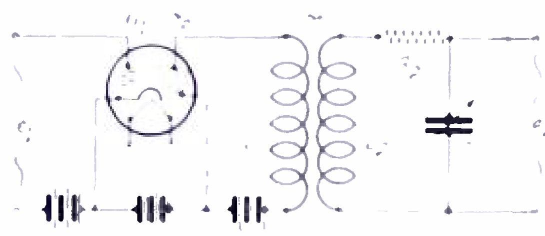
Here is shown the 224 used as high output detector, peak r.f. input versus peak audio frequency output.

$E_f = 2.5$ volts
$E_{c1} = 5$ volts
$E_{c2} = 45$ volts
$E_b = 275$ volts (supply)
$R_p = 250{,}000$ ohms
Modulation 15 and 30 per cent.

Handy Formulas

Frequently readers of this section may have occasion to use some of the simpler formulas covering either design or shop work. To save having to dig into a number of references for these formulas, we have combined a number in the pages following so that they may be kept for ready reference:

Amplification



With conditions above:—

Amplification at any frequency =

$$A = \mu \frac{\omega^2 M L_2}{\left[\left(R_p R_2 + \frac{L_1}{C_2} - \omega^2 L_1 L_2 \sigma\right)^2 + \left(\omega L_1 R_2 + \omega L_2 R_p - \frac{R_p}{\omega C_2}\right)^2\right]^{\frac{1}{2}}}$$

Where $\sigma = 1 - K^2 = 1 - \frac{M^2}{L_1 L_2}$

Amplification at resonance

$$A_r = \mu \frac{\omega^2 M L_2}{(R_p R_2 + \omega^2 M^2)}$$

Or more conveniently

$$A_r = \mu \frac{M L_2}{\left[\frac{R_p R_2}{\omega} + M^2\right]}$$

Amplification is at maximum when

$$\omega M = \sqrt{R_p R_2}$$

And is equal to

$$A_r \text{ optimum} = A\mu \frac{\omega L_2}{2\sqrt{R_p R_2}}$$

In the above the resistance apparently added to the secondary by the presence of the primary =

$$R_2^1 = \frac{\omega^2 M^2 R_p}{R_p^2 + \omega^2 L_1^2}$$

At optimum coupling $R_2^1 = R_2$ or

the apparent resistance is doubled and the selectivity halved. This gives a complete picture of the tuned r. f. amplifier stage.

In tuned impedance stages $L_1 = M = L_2$.

Capacity

Distributed capacity of a coil

$$C_D = C_R - \frac{3\ C_H}{4}$$

Where

C_D distributed capacity of coil
C_R capacity of condenser at resonance
C_H capacity of condenser at second harmonic

where C_D, C_R, and C_H are expressed in the same terms, micromicrofarads, microfarads, or farads.

Example:—

C_R equals 50 micromicrofarads
C_H equals 25 micromicrofarads

From the formula multiply C_H by 3, which will be 75 micromicrofarads divided by 4 which equals 18.75 as value for $3C_H$. Subtract this value from C_R of 50 micromicrofarads which leaves 31.25 micromicrofarads as the distributed capacity of the coil.

A quick method for measuring the distributed capacity of a coil is to tune the coil with a calibrated condenser to the fundamental of a fairly strong oscillator, noting the capacity value at resonance. Now tune the same coil to the second harmonic of the oscillator and note the capacity value at the second harmonic. The capacity value at the second harmonic multiplied by 3 and the result divided by four should be subtracted from the capacity value at resonance, the remainder being the distributed capacity of the coil.

Capacity

Capacity of condensers in parallel

$$C = C_1 + C_2$$

Where

C total capacity
C_1 capacity of first condenser
C_2 capacity of second condenser

where C, C_1, and C_2 are expressed in the same terms, micromicrofarads, microfarads, farads.

Example:—

$C_1 = .0003$ microfarads
$C_2 = .00017$ microfarads

From the formula, merely add the capacity value of the first condenser to that of the second, and the sum of the condenser values added will be the total capacity. Thus .0003 plus .00017 equals .00017 microfarads.

Capacity

Capacity of condensers in series

$$C = \frac{1}{\dfrac{1}{C_1} + \dfrac{1}{C_2}}$$

Where

C total capacity
C_1 capacity of one condenser
C_2 capacity of added condenser

where C, C_1, and C_2 are expressed in the same terms, micromicrofarads, microfarads, farads.

Example:—

$$\frac{1}{C_1} = \frac{1}{.005} \text{ or } 200$$

$$\frac{1}{C_2} = \frac{1}{.002} \text{ or } 500$$

$$\overline{\quad 700 \quad}$$

$$C = \frac{1}{700} \text{ or } .00142 \text{ mfd}$$

Or more conveniently

$$C = \frac{C_2\ C_1}{C_2 + C_1}$$

Capacity

Capacity reactance: See under Reactance.

Conductance

Of vacuum tube (reciprocal of impedance).

$$G_m = \frac{\mu}{R_p}$$

or of any circuit $G = \dfrac{1}{R}$

Where

G_m mutual conductance in mhos
μ amplification constant
R_p plate resistance in ohms

Example:—

μ 420
R_p 400,000

From the formula, divide the amplification constant 420 by the plate resistance 400,000 which equals 1050 micromhos, the mutual conductance.

Conversion

Factors for conversion, alphabetically arranged.

Multiply	By	To Get
Amperes	× 1,000,000,000,000	micromicroamperes
Amperes	× 1,000,000	microamperes
Amperes	× 1,000	milliamperes
Cycles	× .000,001	megacycles
Cycles	× .001	kilocycles
Farads	× 1,000,000,000,000	micromicrofarads
Farads	× 1,000,000	microfarads
Farads	× 1,000	millifarads
Henrys	× 1,000,000	microhenrys
Henrys	× 1,000	millihenrys
Horsepower	× .7457	kilowatts
Horsepower	× 745.7	watts
Kilocycles	× 1,000	cycles
Kilovolts	× 1,000	volts
Kilowatts	× 1,000	watts
Kilowatts	× 1,341	horsepower
Megacycles	× 1,000,000	cycles
Mhos	× 1,000,000	micrombos
Mhos	× 1,000	millimhos
Microamperes	× .000,001	amperes
Microfarads	× .000,001	farads
Microhenrys	× .000,001	henrys
Micromhos	× .000,001	mhos
Micro-ohms	× .000,001	ohms
Microvolts	× .000,001	volts
Microwatts	× .000,001	watts
Micromicrofarads	× .000,000,000,001	farads
Micromicro-ohms	× .000,000,000,001	ohms
Milliamperes	× .001	amperes
Millihenrys	× .001	henrys
Millimhos	× .001	mhos
Milliohms	× .001	omhs
Millivolts	× .001	volts
Milliwatts	× .001	watts
Ohms	× 1,000,000,000,000	micromicro-ohms
Ohms	× 1,000,000,000	micro-ohms
Ohms	× 1,000	milliohms
Volts	× 1,000,000	microvolts
Volts	× 1,000	millivolts
Watts	× 1,000,000	microwatts
Watts	× 1,000	milliwatts
Watts	× .001	kilowatts

Coupling

Coefficient of direct or inductive coupling.

$$k = \frac{M}{\sqrt{L_1 L_2}}$$

Where

k coefficient (always less than unity)
M mutual inductance between two circuits
L_1 total self inductance of first circuit
L_2 total self inductance of second circuit

where M, L_1, and L_2 are expressed in the same terms, millihenrys, microhenrys, henrys.

Example:—

M = 1 millihenry
L_1 = 2 millihenrys
L_2 = 2 millihenrys

From the formula multiply L_1 2 millihenrys by L_2 2 millihenrys, which equals 4 millihenrys. Square root of 4 is 2. M is 1 millihenry divided by 2, which is .5, or the coefficient of direct or inductive coupling.

Coupling

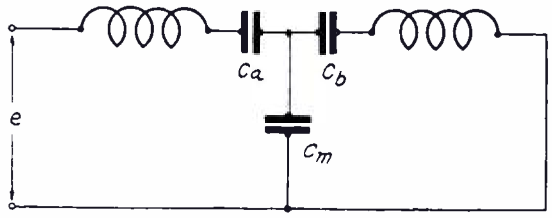
Coefficient of capacitative coupling

$$k = \frac{\sqrt{C_1 C_2}}{C_m}$$

Where

k coefficient (always less than unity)
C_1 total capacity of first circuit
C_2 total capacity of second circuit
C_m mutual capacity between two circuits

where C_1, C_2, and C_m are expressed in the same terms, micromicrofarads, microfarads, or farads.



$$K = \frac{\sqrt{C_1 \times C_2}}{C_m}$$

Where

$$C_1 = \frac{C_a \times C_m}{C_a + C_m}$$

$$C_2 = \frac{C_b \times C_m}{C_b + C_m}$$

Example:—

C_a = 100 mmf
C_b = 300 mmf
C_m = 200 mmf

$$C_1 = \frac{100 \times 200}{300} = \frac{200}{3} \text{ mmf}$$

$$C_2 = \frac{300 \times 200}{500} = \frac{600}{5} \text{ mmf}$$

$$K = \frac{\sqrt{\frac{200}{3} \times \frac{600}{5}}}{200} = .444 \text{ or } 44.4\%$$

Current

Various formulas for current.

$$I = \frac{E}{R}$$

$$I = \frac{P}{E}$$

$$I = \sqrt{\frac{P}{R}}$$

$$I = \frac{E}{Z}$$

$$I = \frac{E}{X}$$

$$I = \frac{P}{E \text{ p.f.}}$$

Where
- I in amperes
- E in volts
- R in ohms
- P in watts
- Z in ohms
- X in ohms
- p.f. power factor

Current

In counter e.m.f.

$$I = \frac{E_c}{\omega L}$$

Where
- I in amperes
- E_c counter e.m.f. in volts
- L inductance in henrys
- ω $2 \pi f$
- π 3.1416
- f cycles per second

Current

In parallel circuits (Kirchoff's law).

$$I = I_1 + I_2$$

Where
- I in amperes
- I_1 in amperes
- I_2 in amperes

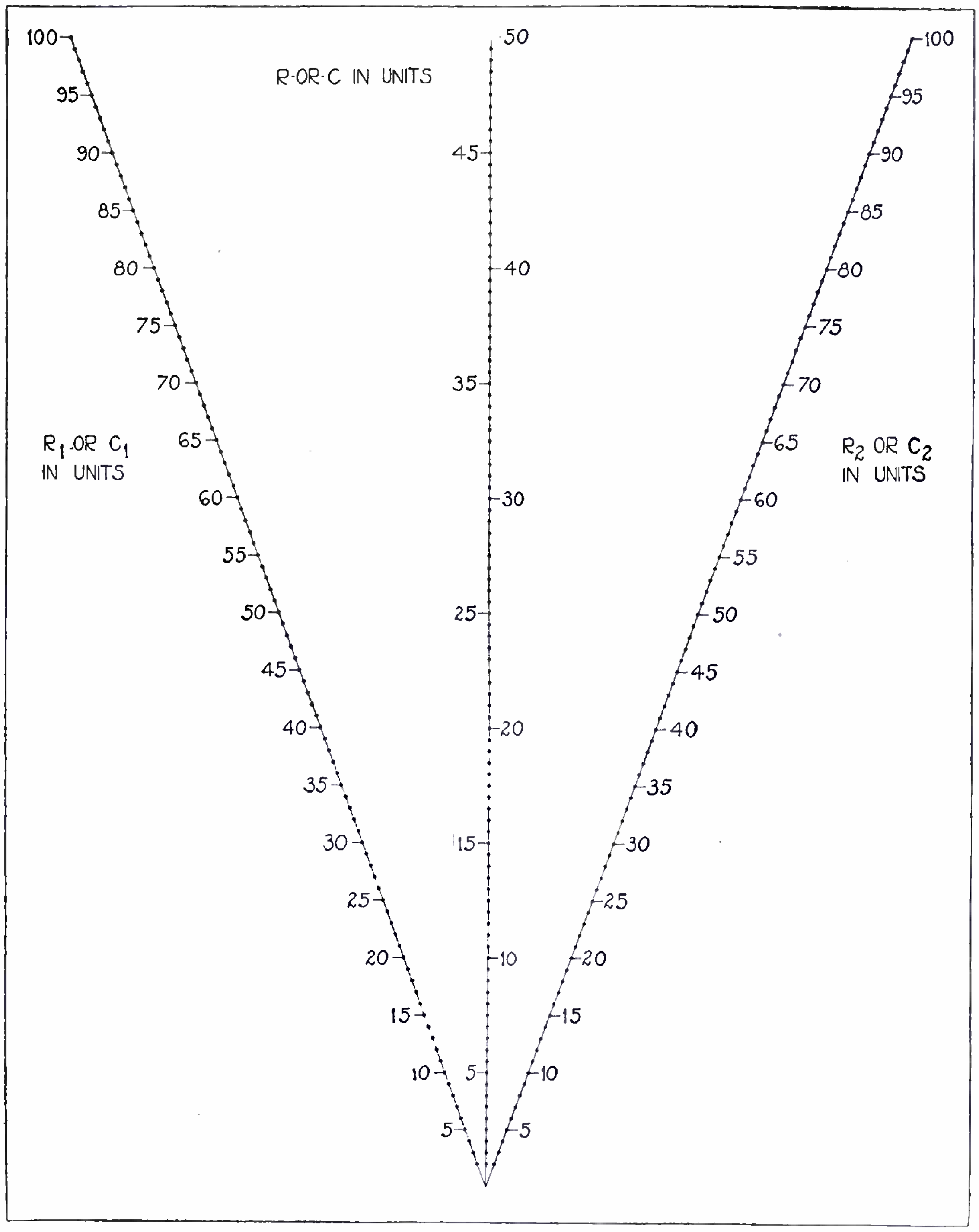
At any point in a circuit the sum of the current directed toward a point is equal to the sum of the currents directed away from the point.

Current

In series resonant circuit

$$I_r = \frac{E}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$

Parallel Resistances, Series Capacities Chart



This chart suffices for both resistances in parallel and capacities in series since the formula for each is the same.

Lay a straight-edge from unit desired on the left oblique line to unit desired on right oblique line. Point at which straight edge intersects the vertical line is the resultant value in units.

To increase range of the scale multiply or divide all values by the factor desired, such as one-thousandth, one hundredth, one tenth; ten, one hundred or one thousand, etc.

Where
- I_r current in amperes at resonance
- E in volts
- R in ohms
- L in henrys
- C in farads
- ω $2 \pi f$
- π 3.1416
- f cycles per second

Decibel

Formerly called transmission unit TU.

$$Db = \log 20 \frac{I_2}{I_1}$$

$$Db = \log 20 \frac{E_2}{E_1}$$

$$Db = \log 10 \frac{P_2}{P_1}$$

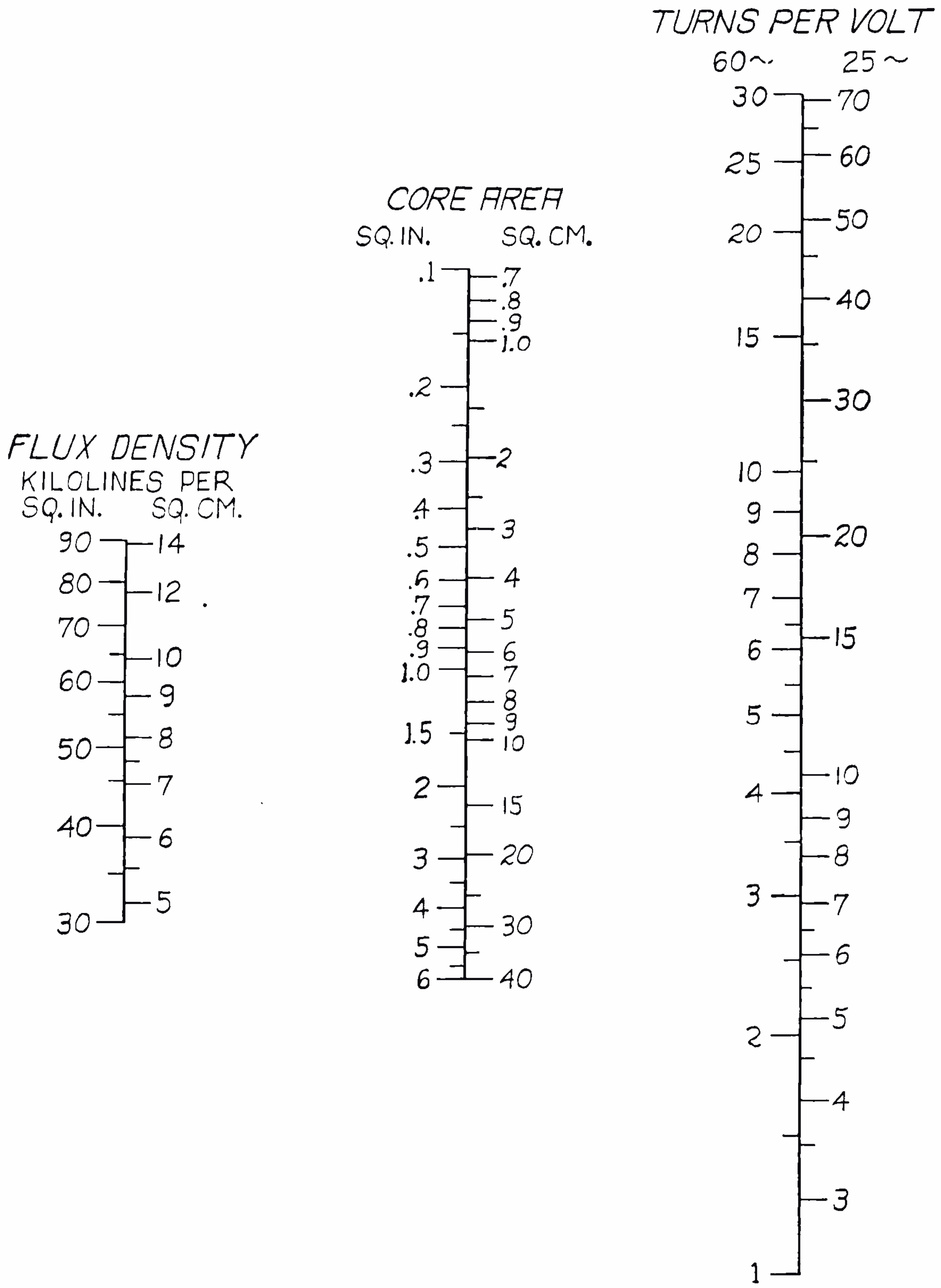
$$Db = \log 10 \frac{E_2^2}{E_1}$$

$$Db = \log 10 \frac{I_2^2}{I_1}$$

Where
- I_2 output in amperes
- I_1 input in amperes
- E_2 output in volts
- E_1 input in volts
- P_2 output in watts
- P_1 input in watts

A Db is the number of decibels by which any circuit's output and input

Transformer Turns-Per-Volt Chart



Knowing the flux density and the core area, the turns per volt for either a primary or secondary may be determined by merely drawing a straight line the flux density column through the core area column, the extension of the line terminating in the turns per volt column.

Flux density is a quality of the kind of iron used. The flux density of different types of core material may be found by referring to any of the standard works on electricity.

For convenience the flux density column is divided into kilolines per square inch and kilolines per square centimeter. The core area is also divided into square inches and square centimeters. The turns per volt column gives values for sixty cycle on the left of the column and for twenty-five cycle on the right.

ratio differs, provided that circuit does not contain vacuum tubes or rectifiers.

Efficiency

Efficiency is the ratio which the input bears to the output of any circuit and is expressed in percentage of efficiency. Output and input values must be in the same units.

Example:—

$$\text{Efficiency } \frac{P_2}{P_1}$$

Where
- P_2 output power in watts
- P_1 input power in watts
- P_2 400 watts
- P_1 600 watts

Dividing 400 by 600 equals .66 percentage of efficiency.

Frequency

At resonance in series circuit

$$f = \frac{1}{2\pi}\sqrt{LC}$$

in parallel circuit

$$f = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{4L}}$$

Where
- f cycles per second
- π 3.1416
- L in henrys
- C in farads
- R in ohms

Inductance

In counter e.m.f.

$$L = \frac{E}{\omega I}$$

Where
- L in henrys
- E in volts
- I in amperes
- ω $2\pi f$
- π 3.1416
- f cycles per second

Impedance

Of inductance and resistance circuit in series

$$Z = \sqrt{R^2 + (\omega L)^2}$$

Where
- Z in ohms
- R in ohms
- L in henrys
- ω $2\pi f$
- π 3.1416
- f cycles per second

Impedance

In capacitative circuit, resistance and capacity in series

$$Z = \sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}$$

Where
- Z in ohms
- R in ohms
- C in farads
- ω $2\pi f$
- π 3.1416
- f cycles per second

Impedance

Resistance, inductance and capacity in series

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

Where
- Z in ohms
- R in ohms
- L in henrys
- C in farads
- ω $2\pi f$
- π 3.1416
- f cycles per second

Impedance

$$Z = \frac{E}{I}$$

$$E = IZ$$

$$I = \frac{E}{Z}$$

Where
Z in ohms
E in volts
I in amperes

Inductance

Mutual inductance measurement.

$$M = \frac{L_1 - L_2}{4}$$

M = mutual inductance in uh
L_1 = inductance fields aiding
L_2 = inductance fields opposing

A quick method of measuring the mutual inductance is to measure inductance of the two coils assisting, then measure inductance of two coils bucking. Divide the difference by 4, which gives the mutual inductance between the two coils.

Inductance-Capacity Ratio

Finding LC of any wavelength when LC at 100 meters is known.

$$L\,C\,\lambda_2 = \left(\frac{\lambda_2}{\lambda_1}\right)^2 L\,C\,\lambda_1$$

Where
$LC\,\lambda_2$ = LC ratio wanted
λ_2 = Any given wavelength
λ_1 = 100 meters
$LC\,\lambda_1$ = .002816

Example:—
For λ_2 substitute 450 at which LC desired
For λ_1 substitute 100 at which LC is known
For $LC\lambda_1$ substitute .002816

Dividing 450 by 100 equals 4.5, which squared is 20.25, times .002816 equals .05702, which is desired LC ratio at 450 meters.

For convenience of shop workers the following table of wavelengths, frequencies and LC ratios is given from 209 to 600 meters:

Meters	Cycles	LC Ratio
200	1,500,000	.01126
210	1,429,000	.01241
220	1,364,000	.01362
230	1,304,000	.01489
240	1,250,000	.01621
250	1,200,000	.01759
260	1,154,000	.01903
270	1,111,000	.0205
280	1,071,000	.0221
290	1,034,000	.0237
300	1,000,000	.0253
310	968,000	.0270
320	938,000	.0288
330	909,000	.0306
340	883,000	.0325
350	857,000	.0345
360	834,000	.0365
370	811,000	.0385
380	790,000	.0406
390	769,000	.0428
400	750,000	.0450
410	732,000	.0473
420	715,000	.0496
430	698,000	.0520
440	682,000	.0545
450	667,000	.0570
460	652,000	.0596
470	639,000	.0622
480	625,000	.0649
490	612,000	.0676
500	600,000	.0704
510	688,000	.0732
520	577,000	.0761
530	566,000	.0791
540	556,000	.0821
550	546,000	.0852
560	536,000	.0883
570	527,000	.0915
580	517,000	.0947
590	509,000	.0980
600	500,000	.1013

Power

$$P = I\,E$$

$$P = \frac{E^2}{R}$$

Self-Indicating Resistance Chart

RESISTANCES — IN — OHMS

VOLTAGE — IN — VOLTS										
10	10,000	5,000	3,333	2,500	2,000	1,666	1,428	1,250	1,111	1,000
9	9,000	4,500	3,000	2,250	1,800	1,500	1,285	1,125	1,000	900
8	8,000	4,000	2,666	2,000	1,600	1,333	1,142	1,000	888	800
7	7,000	3,500	2,333	1,750	1400	1,166	1,000	875	777	700
6	6,000	3,000	2,000	1,500	1,200	1,000	857	750	666	600
5	5,000	2,500	1,666	1,250	1,000	833	714	625	555	500
4	4,000	2,000	1,333	1,000	800	666	572	500	444	400
3	3,000	1,500	1,000	750	600	500	428	375	333	300
2	2,000	1,000	666	500	400	333	286	250	222	200
1	1,000	500	333	250	200	166	143	125	111	100
CURRENT — IN — AMPERES	.001	.002	.003	.004	.005	.006	.007	.008	.009	.010

When volts and amperes are known, intersection of voltage and current lines gives resistance in ohms. To extend scales: When multiplying voltage by any factor with current remaining fixed, multiply resistance by same factor. When multiplying current, voltage remaining fixed, divide resistance by same factor. When dividing voltage by any factor, current remaining fixed, divide resistance by same factor. When dividing current by any factor, multiply resistance by same factor.

$$P = I^2 R$$

$$P = I\,E\cos\phi$$

$$P = I\,E\ \text{p.f.}$$

Where
P in watts
I in amperes
E in volts
cos ϕ angle
p.f. power factor

Reactance

Capacitative.

$$X = \frac{1}{\omega C}$$

$$f = \frac{X}{2\pi C}$$

$$C = \frac{X}{\omega}$$

Where
X in ohms
C in farads
ω $2\pi f$
π 3.1416
f cycles per second

Reactance

Inductive.

$$X = \omega L$$

$$f = \frac{X}{2\pi L}$$

$$L = \frac{X}{\omega}$$

Where
X in ohms
L in henrys
ω $2\pi f$
π 3.1416
f cycles per second

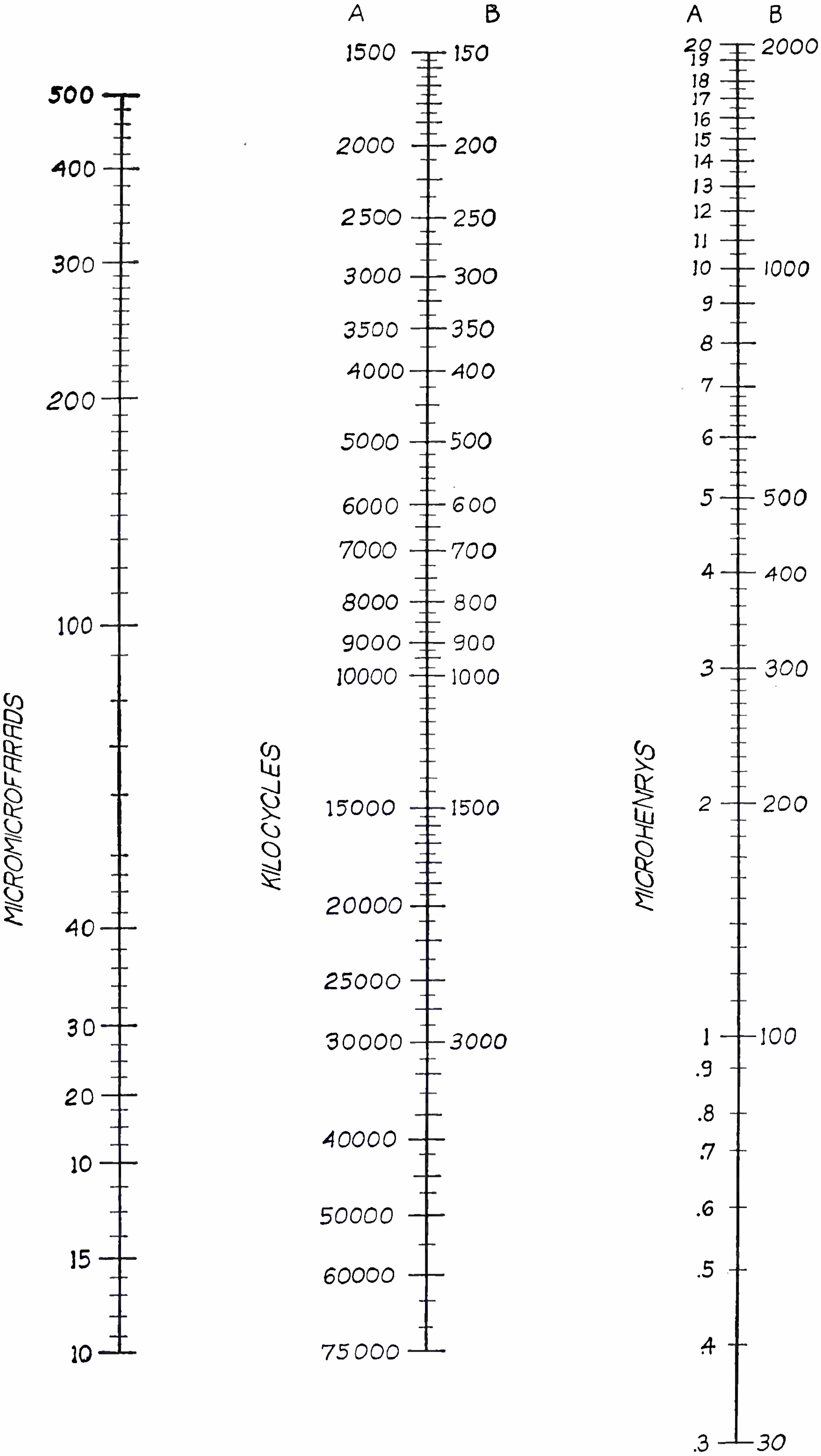
Reactance

Net reactance.

$$X = X_L - X_c$$

Where
X in ohms
X_L in ohms
X_c in ohms

Capacity, Frequency and Inductance Chart



Knowing capacity in micromicrofarads and the frequency in kilocycles to be covered by a condenser at maximum capacity the inductance required for a coil may be found by running a straight line from the micromicrofarads column through the kilocycle column, the line intersecting the inductance column.

Knowing the condenser capacity and the inductance of the coil, the frequency to which the coil will tune can be found by running a line from the micromicrofarads column to the microhenries column, the point of intersection on the kilocycle column will be the frequency of coil and condenser.

Knowing the kilocycles and the inductance, the size of condenser to be used to cover that frequency can be found in the same manner indicated; extension of a straight line from microhenries through kilocycles will terminate on the micromicrofarads line.

Resistance

Measurement of r.f. resistance by reactance variation using undamped c.w and varying the capacity.

$$R = X_1 \sqrt{\frac{I_1^2}{I_r^2 - I_1^2}}$$

X_1 = change of reactance between two observations of current
I_r = current at resonance in amperes
I_1 = current off resonance in amperes
R = resistance in ohms

Resistance

$$R = \frac{E}{I} \quad \text{(d.c. only)}$$

or at series resonance

$$R = \frac{E^2}{P}$$

$$R = \frac{P}{I^2}$$

Where
R in ohms
E in volts
I in amperes
P in watts

Resistance

In parallel.

$$R = \frac{R_2 \times R_1}{R_2 + R_1}$$

Where
R in ohms
R_1 in ohms
R_2 in ohms

Resistance

In series.

$$R = R_1 + R_2$$

Where
R in ohms
R_1 in ohms
R_2 in ohms

Resonance

Wavelength of series resonance

$$\lambda = \omega\sqrt{LC}$$

Where
λ wavelength in meters
ω $2 \pi f$
π 3.1416
f 300,000 cycles conversion factor
L inductance in henrys
C capacity in farads

Variants:

$\lambda = 1.884 \sqrt{LC}$
where L in microhenrys, C in micromicrofarads

$\lambda = 1884 \sqrt{LC}$
where L in microhenrys, C in microfarads

$\lambda = 59{,}570 \sqrt{LC}$
where L in millihenrys, C in microfarads

$\lambda = 1{,}884{,}000 \sqrt{LC}$
where L in henrys, C in microfarads

Resonance

Frequency of series resonance.

$$f = \frac{1}{2\pi\sqrt{LC}}$$

Where
- f frequency in cycles per second
- π 3.1416
- L inductance in henrys
- C capacity in farads

Variants:

$$f = \frac{159.2}{\sqrt{LC}}$$

where L in henrys, C in microfarads

$$f = \frac{5033}{\sqrt{LC}}$$

where L in millihenrys, C in microfarads

$$f = \frac{159{,}200}{\sqrt{LC}}$$

where L in microhenrys, C in microfarads

Resonance

Oscillation constant of series resonance.

$$\omega = \frac{1}{\sqrt{LC}}$$

Where
- ω $2\pi f$
- π 3.1416
- f cycles per second
- L inductance in henrys
- C capacity in farads

Variants:

$$\omega = \frac{1000}{\sqrt{LC}}$$

where L in millihenrys, C in millifarads

$$\omega = \frac{31{,}620}{\sqrt{LC}}$$

where L in millihenrys, C in microfarads

$$\omega = \frac{1{,}000{,}000}{\sqrt{LC}}$$

where L in microhenrys, C in microfarads

Voltage

$E = IR$ d.c. only

$E = \frac{P}{I}$ d.c. only

$E = RP$ d.c. only

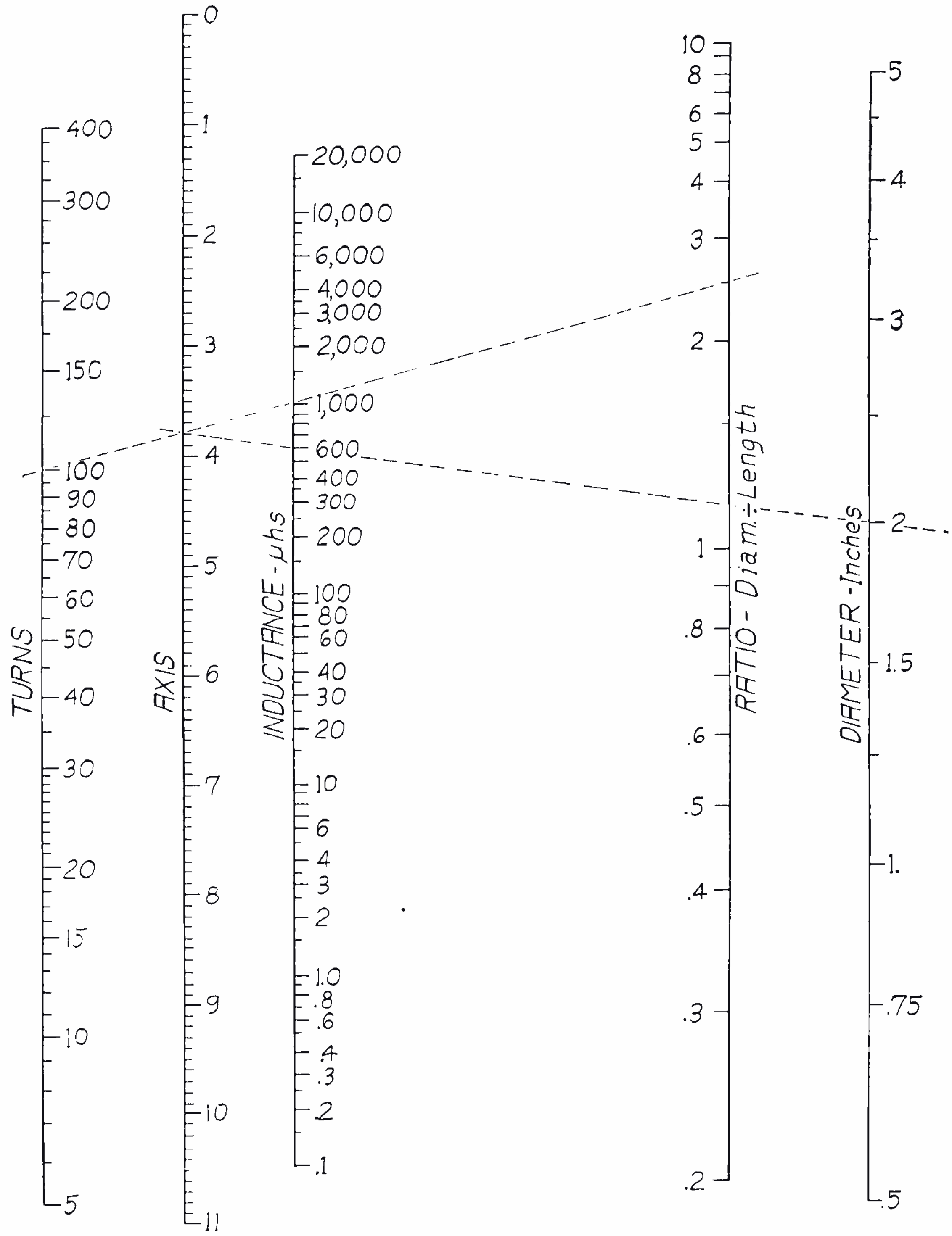
$E = IX$

$E = IZ$

$E = \frac{P}{I\ p.f.}$

Where
- E in volts
- I in amperes
- R in ohms
- P in watts
- X in ohms
- Z in ohms
- p.f. power factor

Coil Turns, Inductance and Diameter Chart



Knowing the turns of a coil, its length of winding, and the diameter, the inductance may be found by using a straight edge from the turns column to the ratio (length of winding) column, intersecting the axis column; then a second line from the intersection of the axis column to the diameter column. The inductance in microhenries will be the point where the second line intersects the inductance column. In the above chart the first line is laid from 100 turns to 2.5 ratio (which is length of winding) this first line intersecting the axiss at 3.8 on the scale. The second line is from 3.8 on the axiss scale to the 2 inch diameter, intersecting the inductance column at 600 microhenries.

Knowing the diameter, ratio and the inductance, the number of turns may be found by reversing the process. As shown in the chart, draw a line from 2 inch diameter through the 600 microhenries intersecting axis at 3.8 on the scale; then run line from 3.8 on axis scale to 2.5 on ratio (length of winding) the extension of this line cutting the turns scale at 100 whcih is the number of turns.

After finding number of turns, consult wire table to determine size of wire which will permit given number of turns in a given length of winding.

Voltage

In counter e.m.f.

$$E = \omega L I$$

Where
- E in volts
- ω $2\pi f$
- π 3.1416
- f cycles per second
- L in henrys
- I in amperes

When capacity present.

$$E = \frac{1}{\omega C}$$

Where
- E in volts
- I in amperes
- C in farads
- ω $2\pi f$
- π 3.1416
- f cycles per second

Synthetic Organ Is Created by Westinghouse Worker

ORGAN selections produced by electrical means rather than by conventional wind pipes have been played over one of the large broadcasting stations.

Some time ago KDKA broadcast selections played by Dr. Charles Heinroth, noted organist of Carnegie music hall, using the electric organ developed by R. C. Hitchcock, of the research laboratories of the Westinghouse Company. The electric organ, about one-hundredth the size of the conventional pipe organ, produced tones clear and pleasing.

"No oscillating circuits are being used in radio sets today," said Mr. Hitchcock, "because public opinion is very strong against a radio set that squeals. But although a squealing radio tube is undesirable when running wild, such a tube under proper control has rather interesting uses. By regulating the pitch of the squeal and using several tubes, each controlled by a key, pleasing musical effects can be produced.

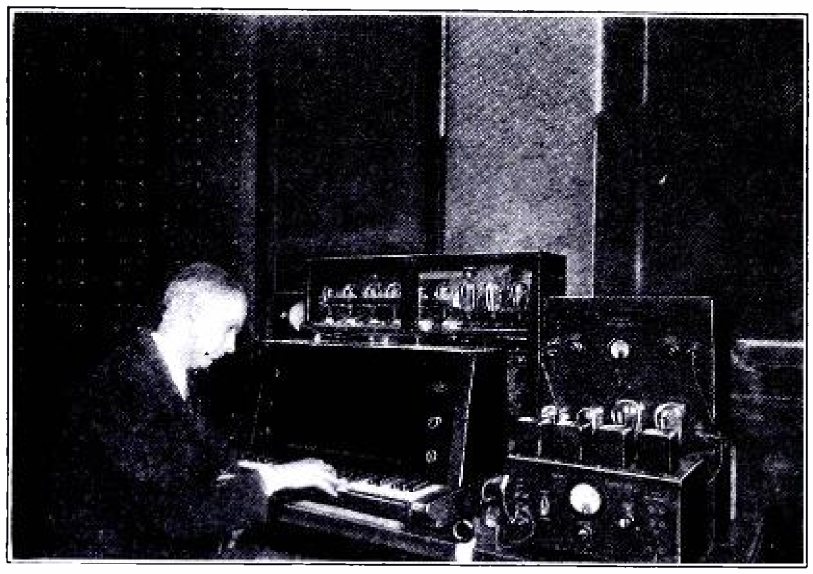


Fig. 1. This photograph shows R. C. Hitchcock of the research staff of the Westinghouse Elec. & Mfg. Co. and his electric organ, by means of which notes of this musical instrument are produced electrically

Synthetic Bell Tones

"One of the first experiments was the making of a synthetic bell. An investigation showed that a low pitched bell had over ten recognizable tones, and when these ten tones were produced synthetically a quite good impression of a bell was given. Subsequently it was found that fewer electrical tones could be used, the higher frequencies found in a bell added little to the desirable timbre of the tone, and in several cases added confusion and discord. Of course in a bell all the frequencies are mechanically present, so that when one is struck all the rest appear. In the electrical counterpart only the characteristic tones, and those most pleasing musically, need be used. This is one of the advantages of the synthetic music over the original; the relative intensities of the harmonic tones are each under definite control. This means that if to some ears the higher harmonics are disturbing, they can be left out entirely, completely changing the tinny quality of the note to a rich, deep resonant quality.

"Another distinct advantage of the synthetic tone is the possibility of tuning each harmonic separately. In a bell the frequencies are inter-related and it is difficult to tune just one and leave the other unaffected.

Easy Volume Control

"A third advantage of the synthetic tone is the main volume control. The amplifier and speaker can easily be controlled to give the right volume level without changing the relative timbre of the tone. In simulating a bell the tone must die away, and this is incorporated in the volume control so that the attack is very loud, the volume rapidly decreasing at first, and then more gradually like a bell. It was found possible to obtain very pleasing musical effects by having more than one tone controlled by the key. Some stops on a pipe organ can be closely imitated by suitably tuning several frequencies, and giving the right intensities to each.

"The range of the electric organ comprises over three octaves of musical tones and can be extended to any desired limit. Middle C on the present keyboard is approximately in center. A tremolo, or vox humana, is used to make the upper tones more pleasing when played in pieces where the upper note carries the air. The keyboard is surmounted by a sloping, mahogany grained micarta panel containing a music rack and the controls which are the electrical equivalent of pipe organ stops. The volume in either the bass or treble can be controlled separately, and a foot pedal when pressed causes the tones to become louder.

All Electrical Impulses

"A high gain audio amplifier and dynamic speaker on a large baffleboard complete the present arrangement. A definite advantage of this type of instrument over a regular pipe organ is the ease with which this newer instrument can be played over the air. As the impulses are electrical the use of a microphone and the difficulty of placing it where it will hear all notes equally well, is obviated. The electrical tones can be sent directly to the radio station without ever being heard as sound waves. The tones are only electrical impulses from keyboard to broadcasting station and at the home of the listener the first audible note is heard in the loud speaker."

Dolling Up the Radio Room

IN the photograph shown above may be seen the radio receiving installation at the home of Dr. O. C. Clemens, D.D.S., 4753 Broadway, Chicago, Ill. At the left of the photograph is a view of the closet door with an art panel placed on the door by Dr. Clemens at considerable expense. The center picture shows the rear of the closet door with the

H.F.L. Mastertone receiver on the lower shelf, the power supply for the Mastertone and the Jensen d.c. field dynamic on the upper shelf. The right photograph shows the little door at the top for the dynamic speaker and the lower little door for the controls of the radio receiver. The receiver is a.c. operated from a supply line run inside the closet.

In modern city life the average individual is hard put for a place in which to locate his set. But Dr. Clemens being of an experimental and utilitarian turn of mind, tinkered around until he found the ideal combination as expressed in the three photographic views given here.

Portable Signal Generator Provided for Howard Distributors

(*Continued from page* 63)

necessary to vary this resistor to make up for the battery voltage drop. Do not use greater filament current than required to secure satisfactory operation.

For operation the following instructions are given by the Howard engineers:

Operating Instructions

1. Connect the antenna and ground leads of the receiver to the jacks on the lower left-hand corner of the signal generator marked "Ant" and "Gnd."

2. Turn on the filament switch, turn on the receiver, and set attenuator to 100. Next adjust filament rheostat to about 50 on the dial and then tune the radio receiver to a given frequency, say 1000 kilocycles.

3. Now move the dial on the signal generator to a point equivalent to 1000 kilocycles (see graph furnished with the instrument). When the frequency of the oscillator is identical with that of the receiver a musical note or a swish will be heard in the receiver.

4. Adjust modulation control until the desired musical note is heard, and adjust attenuator until about 1.5 reading is secured on output meter. It will be observed that on low frequencies the output will be less than obtained on the higher frequencies. It will also be noted that the frequency of the oscillator has a certain effect upon the modulated note so that when going from one end of the dial to the other, it will be necessary to make a slight adjustment on the modulator to obtain the required modulated note.

5. Having picked up the signal in the radio set, the service man can now proceed to make any adjustments desired, such as re-tuning the r. f. circuits, changing tubes, etc. Screen grid and other tubes can be compared by noting the output value with a set of standard tubes and the one by one testing unknown tubes to see if the output reading is maintained.

Should it be found the batteries are run down, it will be necessary to remove the nine knurled thumb nuts on the side of the generator and take out the old batteries, replacing with batteries of the same type number and size. If it is found necessary to replace the 199 tube, remove six screws from the end of the panel, and the six screws to the right of the output meter, and lift the top panel clear of the box. First be sure to disconnect all batteries. The great number of screws used in the generator is necessary to properly shield the generator and make it as foolproof as possible.

Amazing Invention Uncovered by the World's Greatest Scientist

(*Continued from page* 49)

frequency currents in the tank circuit, consisting of the variable condenser C3, the R.F. ammeter and the two electrodes E1 and E2.

"In any ordinary oscillating circuit this holds true. But in my invention the r.f. currents do not rise until the Star Spangled Banner is played by the U. S. Marine Band. The reason for this is the fact that there is a slight variation in the resistance of the dielectric. I have checked this dielectric resistance against the Austin-Cohen attenuation formula and find that it absolutely coincides, even down to the commas and the hyphen.

Major's First Experiment

"My first experiment with this revolutionary type of cooking device was to cautiously insert between the electrodes E1 and E2 a slice of bacon. Then the cooker was started by turning on the filament switch and gently dropping electrode E1 down on top of the bacon reposing on electrode E2. You can easily imagine my astonishment when 2 and 17/94 seconds later I had a beautifully broiled piece of bacon. At the impact of electrode E1 upon the bacon the radio frequency ammeter registered Raw, then Medium and finally Done. This was because of the change in the dielectric resistance which is proportional to the population of Coatzacoalcos times the square of Amos and Andy. As you can readily see, simplicity abounds.

"From bacon I moved to eggs, since these two are practically inseparable in any well ordered home. But here I encountered a slight difficulty in that the egg could not be efficiently cooked without recourse to one of two expedients. The first was to compress the egg between the two electrodes, accompanied by considerable egg loss, which was eggsactly what I anticipated. The other method was to prepare the egg for cooking by a tandem cleaver arrangement synchronously operated from a telechron clock donated by Mr. Insull. The twin cleaver arrangement served to lop off simultaneously the top and bottom of the egg, which was then rushed by parcel post into the space between the two electrodes. Here it was cooked in about three seconds so that even its own progenitor would not recognize it. Contrast this with the three-minute cooking of an egg and you will see how I have conserved time two hundred fold for humanity.

"As my research continued I found that a number of obstacles were cropping up. For example, one evening while working on a side of beef with my cooker I observed that two of my assistants hurriedly left the room, each with a hand at mouth and stomach. Later I offered one of the high frequency cooked steaks to another assistant who confided to me after eating it that he didn't know that Mr. Florsheim had left the shoe business. But after arduous work this obstacle was overcome. We simply provided a shield with a centrifugal pump attached to one end which served to convey away the odors of burning horse flesh, the outlet of the shield line terminating at the Union Stockyards at Chicago. A coating of paraffin brushed on the steak before cooking served to keep the electrodes from encrusting and at the same time prevented a diner from discriminating between filet mignon and filet of sole. A further appetizing touch may be had by crumbling a Lucky Strike cigarette over the steak, since these cigarettes are already toasted and save you that much time and trouble.

Patent Interference

"So much for the fundamental principles and applications. Now I need the experimenters' help on this point. While pursuing my patent application down the corridors of the Patent Office at Washington (the darn thing nearly got away from me in one of the dark corners) I found to my dismay that the examiners believed my claims conflicted with those of Mr. Alexanderson on cascaded radio frequency stages, and the claims of the late Mr. Lowenstein on the use of a biasing battery for the grid. If I can get my friends in the radio business to think over my invention carefully I am hoping that mass intelligence will enable me to find a way around Mr. Alexanderson's patent and further enable me to get complete protection on this device which I desire to merchandise through the vacuum tube division of the Sing Sing Sewing Machine Co.

"I will be glad to hear from my friends on this subject. The editor of this publication has kindly reserved one of the ampler wastebaskets in his office for my voluminous correspondence, and if you so desire in future issues I will relate my experiences with Little Red Riding Hood together with other ingenious radio frequency applications."

Reader Gives Victoreen Fans a New Lease on Receiver Life

(*Continued from page* 47)

reduces its plate voltage to about 20 volts. This low voltage does not reduce the volume of the receiver appreciably, but it does confine "repeat points" to powerful local stations and eradicates the nuisance of code and amateur stations formerly picked up by the receiver. A variable resistor was used in order to obtain the lowest possible voltage without making the oscillator inoperative on the higher wavelengths. Twenty volts seems to be the minimum for the average tube. Incidentally, the variable resistors mentioned throughout this article can be mounted on the base panel in such a way that the knobs appear between the tube sockets. None are needed on the front panel except, of course, the volume control mentioned later.

Grid Bias Detection

Grid-bias detection is used on both the first and second detectors. If this has decreased the sensitivity of the receiver, our ears have failed to note it. For both detectors a 25,000-ohm variable resistor is used, set for greatest volume in the case of the first detector, and for greatest volume-handling capacity in the case of the second detector. Different voltages and resistor values for the second detector were tried, and it was found that ninety volts with the 25,000-ohm resistor turned almost all the way in gave the second detector an undistorted output sufficient to overload a 250-type power tube—even though only one audio stage was used!

One audio stage was discarded because after the Victoreen had been converted into an a. c. receiver it was found to have greater sensitivity than could be utilized in a locality with a rather high noise level. The first audio stage was therefore omitted, also in the interest of tone quality and to eradicate what little a. c. hum had been present. In the original receiver AmerTran audio transformers had been used, and the second-stage transformer was retained when the audio system was reduced to a single stage. If the two stages of audio are desired, the first audio tube, 227-type, should receive 90 volts, and the value of its bias-resistor should be 2,000 ohms. Feedback troubles in the first audio stage can be eliminated by either or both of two ways: By connecting a 1.0-mfd by-pass condenser between B-minus and the B-plus terminal on the first audio transformer; by placing a .25-megohm metalized resistor across the secondary winding of the first audio transformer.

The power supply will depend on the type of power tube or tubes used. As stated above, if the bias-resistor for the intermediate tubes is not used as a volume control, there should be no need of an expensive power supply incorporating voltage regulator tubes.

There is nothing mysterious about the writer's volume control. It consists merely of a 500,000-ohm variable resistor across the secondary winding of the first intermediate transformer. This effects neither the voltage nor the current drain of the receiver, nor does it detune the receiver nor impair the quality of its output.

Loop Is Passe

Originally the receiver was used with a loop aerial. Controlled regeneration had likewise been added, not only to increase the sensitivity and selectivity of the receiver, but to eradicate certain peculiarities that had appeared in tuning. But the loop seems to have gone out of style. Still, we wished to retain the advantages of the center-tapped loop. What was there to prevent the center-tapping of the secondary winding of the antenna coupler? Nothing whatever, especially since this winding is conveniently located on the outside of the case. The antenna coupler had in effect become a small centerapped loop with a few turns of aerial wire placed in its field o increase its sensitivity—as is often suggested for the usual oop aerial. The oscillator coupler connection was changed o the center tap of the antenna coupler, as shown in the liagram.

Operating Results

The aerial used for the writer's receiver consists of twenty eet of fine stranded wire laid back of the picture moulding in he room. What results could be obtained if a really efficient ıerial and a good ground connection were available remains to)e seen; but this is what is done with an inside aerial and one audio stage: Stations from the Atlantic to the Rockies and rom Canada to the Gulf are brought in regularly with good olume through Chicago's many local stations. Good days or reception and a little more careful tuning bring in many Pacific Coast stations with volume satisfactory to any DX-er. As for selectivity, there is all that can be had without impairng tone quality. With the regeneration control turned up no ıigher than is good for side-bands, one can bring in WEAF, one channel removed from WMAQ, a powerful local station, or KDKA, one channel removed from WCFL, another local tation, though in both cases the higher frequencies of the local program can be heard. But there is complete 20-kilocycle eparation between local and distant stations, and 10-kilocycle eparation between distant stations. Greater selectivity than hat should not be asked for by anyone interested in tone quality.

Thus we hope to have been of some service to old Victoreen ans who disliked discarding a receiver so easily constructed, equiring no shielding, and possessing the three fundamental qualities of sensitivity, selectivity, and good tone quality, but who wished to have their receivers possess also the latest improvements and refinements in radio construction, without, however, paying too great a price for their desire to be in tyle.

Mutual Conductance Meter Useful in Finding Tube Efficiency

(*Continued from page 46*)

s an inspection and acceptance tests for tubes. Improper pacing of the elements and faulty emission will both produce lowering in the value of mutual conductance. This test will not show what is wrong, but it will show whether or not the ube is defective. That is why it makes a good test for the manufacturer's production test line.

"The General Radio Company has developed for commercial use a bridge for measuring the dynamic mutual conductance. Suitable fixed values of R2 and R3 are provided and he adjustment of R1 is made by means of a dial which is alibrated directly in micromhos. Sockets are provided for he 4 and 5 prong tubes. A low-resistance, high-current, and high resistance low-current rheostat are included in the ssembly, as is a direct current voltmeter for measuring filanent voltage.

Quick Reading

The type 443 mutual conductance meter is suitable for naking measurements on all types of tubes with an accuracy f 5 per cent, depending somewhat upon the skill exercised y the operator. It is simply necessary for him to insert the ube in the proper socket, check the filament voltage, and djust the dial until he hears a minimum signal in the telephone head-set. A true null balance is never obtained because he bridge makes no provision for eliminating the out-of-phase oltages caused by the inter-electrode capacitances of the tube ınder test.

"The error in measurement introduced by neglecting the voltage drop across R2 is greater for tubes having a small plate impedance, but if desired this error may be calculated and a correction applied. The meter reading is less than the true value by the product of $\frac{100}{r_p}$ into the meter reading."

According to the instructions when new plate batteries are used, the impedance drop through them will be small enough to be negligible. The internal impedance of the battery, however, increases with age and especially when measuring tubes with a low plate impedance, there may be an error due to this fact. It can be practically eliminated by shunting the plate battery with a condenser having a capacitance of about 2 mfd.

The current carrying capacity of R2 is great enough to make the mutual conductance meter available for measuring tubes having plate currents of as much as 250 milliamperes. High plate currents, of course, usually mean high plate voltages, and inasmuch as the telephone receivers are connected into the plate circuit of the tube, it is important that the operator be protected against coming in contact with any of the plate battery terminals.

Test for Shorts

It is desirable that tubes be tested for short-circuited elements before being placed in the mutual conductance meter. A glance at the schematic diagram in Figure 2 will show that when any of the elements in the tubes are shorted, the entire plate battery is impressed across R2, and although R2 will carry 250 milliamperes, it will not withstand the heavy short-circuit current from the plate battery. If it is not practical to make a preliminary test for short-circuited elements a protective relay or a fuse may be inserted in series with the plate battery.

Slide Wire Bridge Is Simple Device for Resistance Measurement

(*Continued from page* 45)

the slider S resting on 90 millimeters at the left end of the meter stick, then 90 is the ratio for A, and 910 is the ratio for B.

Simply stated, B multiplied by value of R, and divided by A will give X in ohms. Another way of stating this is: A is to B, as R is to X. Short-cutting on the proportion figuring

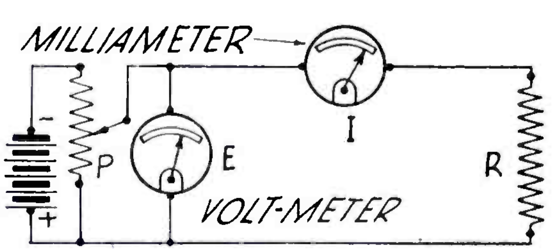


Fig. 3. Another method of determining the value of any resistance is illustrated in this diagram

this indicates that multiplying the means (B and R) and dividing by the extremes (A and X) will give the value of X.

When pushing the slider S along the wire AB do not hold down the slider contact more than a fraction of a second to observe the direction of the pointer deflection; tap the slider contact momentarily until the swing of the galvanometer

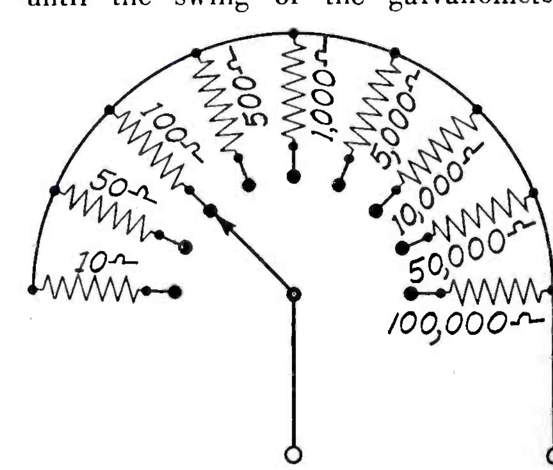


Fig. 4. A simple standard resistance box may be made up with a nine point switch and the necessary resistances

needle is dampened. Damage will result to the meter if the contact is kept down and the meter allowed to swing wildly to the right or left of the scale. After the needle is brought near the center of the scale the contact may be kept down without damage because the bridge will be nearly in balance and the excursions of the needle greatly limited.

By reversing the polarity of the dry cell the slider can be moved so its direction of travel is opposite to the swing of the galvanometer needle. This will materially aid the operator in instinctively knowing which way to move the slider to stop the needle at zero center.

Do not leave the switch closed any longer than necessary to get readings, as the slide wire AB resistance is such that with a 1.5 volt cell the current drawn is a little in excess of 500 milliamperes.

Also be sure to keep buttons 1 and 2 on the galvanometer up in order to protect the meter against burnout. The only time the buttons are depressed is when galvanometer readings are being taken.

Accuracy Allowed

While an ideal bridge of this type should permit ratios of 1000 to 1 to be secured with a single resistor as standard for R, nevertheless the ideal is not reached in actual practice without very grave errors occurring in the measurement of X due to inequalities in the wire AB and to multiplication of the original error when a ratio of 1 to 1 is employed. Thus if an error of .11 ohms occurs when the bridge is balanced at a 1 to 1 ratio, this error will be inordinately magnified if the ratio is changed to 1000 to 1. Table I shows the slide wire bridge error due to changing ratios of A and B and will indicate approximately what accuracy may be expected for the ratios given. Then if the operator wishes to use a 1000 to 1 ratio he does so with the full knowledge that considerable error is introduced in the measurement of the unknown X.

Thus it is seen that while the ideal arrangement might be the use of only one standard, in practice it is cheaper and safer to use ten standard resistors, which permits a variety of ratios to be used in measurement of X, and at the same time gives greatest amount of accuracy. For general purposes in d. c. resistance measurements these ten standard resistors which have been supplied especially for this particular bridge by the Ohmite Manufacturing Co., will suffice:

1 1 ohm Ohmite standard resistor.
1 10 ohm Ohmite standard resistor.
1 50 ohm Ohmite standard resistor.
1 100 ohm Ohmite standard resistor.
1 500 ohm Ohmite standard resistor.
1 1,000 ohm Ohmite standard resistor.
1 5,000 ohm Ohmite standard resistor.
1 10,000 ohm Ohmite standard resistor.
1 50,000 ohm Ohmite standard resistor.
1 100,000 ohm Ohmite standard resistor.

For direct current resistance measurements we find that the parts shown below will constitute the basis of a home laboratory which may be added to from time to time. The slide wire bridge may be made at home, but since the slide wire unit costs only $5.00 it is easier to buy it ready made.

1 Slide wire bridge (name of maker supplied on request).
1 Center pivoted galvanometer (Jewell model No. 51 or Weston model No. 375).
1 Set of 10 Ohmite standard resistors.
1 Dry cell.
1 S. P. S. T. switch.
4 Mueller battery clips.
10 Feet rubber covered stranded flexible wire.

In succeeding articles will be given data on making other measurements with this slide wire bridge or simple rearrangements of the same thing.

Using Ohm's Law

Another means of finding resistance is to employ the circuit shown in Figure 3 and employ Ohm's law for finding resistance: $R = \frac{E}{I}$. However, to secure great accuracy the meter and milliameter used should be extremely delicate, and it is not likely such delicate meters will be found in the average home laboratory. The process here is quite simple: Put the unknown at R, using a known voltage for the battery. Then read the current shown on the milliameter and merely divide the voltage by the current (in amperes). The result will be the resistance in ohms.

Resistance Box

A simple resistance box can be made with the ten standards mentioned above and a No. 90 Yaxley 9 point inductance switch connected in the manner shown in Figure 4. This variable standard may be left permanently connected to the R arm of the bridge if desired.

Home Built Set Analyzer May Be Made From Schematic Given Here

(*Continued from page* 43)

ohms. R_2 1.5 ohms when a Weston Model 301 milliameter is used. R and R_3 will depend on what make and type meters are used for this purpose. When screen grid tubes are tested place the tube in the socket in the analyzer, place the plug in the empty socket in the receiver and extend the cap connection to the cap of the tube in the analyzer. In Fig. 2 is illustrated a Fleming type output meter which may be used as a resonance indicator in the balancing or tuning of a receiver. It consists of a 199 tube with the plate and grid tied together and a 0 to 1.5 d. c. milliameter in the plate circuit. R_5 is a 25-ohm rheostat. R_4 is a 5,000-ohm rheostat. A is a 4½-volt C battery which is used to light the filament of the tube. Binding posts 13 and 14 are to be connected to the loudspeaker terminals or the voice coil of the speaker or to the detector output. Jack J may be used to connect a pair of headphones while testing. The rheostat R_4 is to vary the amount of voltage delivered to the tube and meter. When this instrument is connected to the output of a receiver and a station is tuned in the meter will read and give a maximum reading when absolute resonance is reached. This output indicating device may be built directly into the set analyzer and may be found to be very valuable.

The schematic of the analyzer is shown in Fig. 1.

Good Fidelity is Found in Electrad Loftin-White Combination

(*Continued from page* 44)

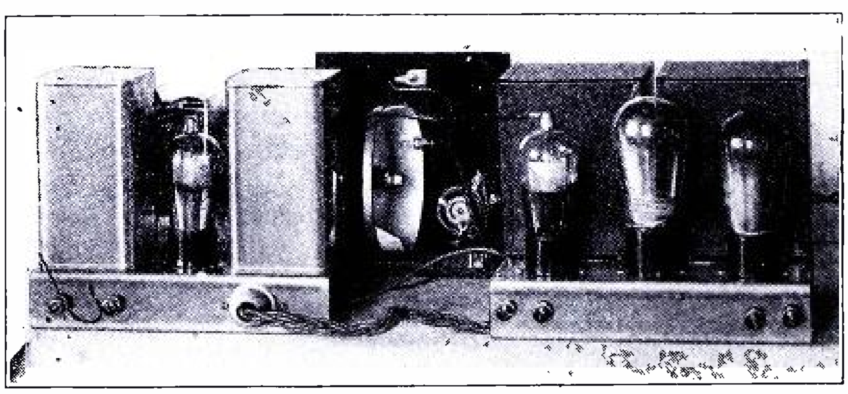


Fig. 2. This photograph shows the rear of the combined tuner and amplifier described in this article

1 Cable plug
1 Antenna binding post "short"
1 Antenna binding post "long"
1 Single resistor mounting
1 Drum dial
1 Drilled bakelite panel
1 Cable clamp
2 Variable condenser mounting spacers

Amplifier Parts

For the amplifier and power supply the following parts are needed:

1 Electrad chassis
1 Power transformer
1 Choke and condenser bank in can
1 Potentiometer, 200 ohms
1 Electrad tapped resistor V-580-D-20
1 Metallic leak, 25,000 ohms
1 Metallic leak, 50,000 ohms
1 Metallic leak, 100,000 ohms
1 Metallic leak, 500,000 ohms
1 Ground binding post
2 Input binding posts
2 Output binding posts
1 224 socket
1 245 socket
1 280 socket
2 Single resistor mountings
1 Double resistor mounting
1 Clip for 224
18 6 32 screws
23 Lock washers
14 Metal washers
4 Fibre washers
2 Feet black Celatsite wire

Breaking in on Auto Radio

(Continued from page 62)

During the last few months there has appeared a new radio development that promises to be an equalizer which will enable many service men to earn as much *or more* in the summer months as they do during the busiest part of the winter season. We are referring to automobile radio, of course. The service man's problem then is, how to make the most money out of this opportunity.

Many Customers

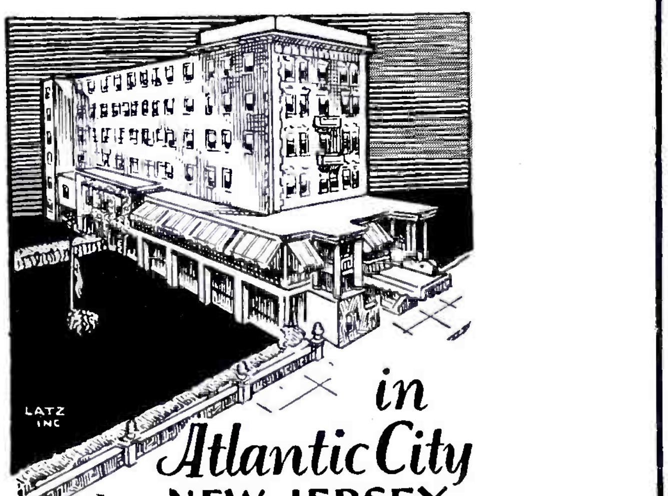
Prospective customers for automobile receivers are much more extensive than would appear at first glance. One is inclined to view only the novelty feature of auto receivers and imagine that the sales would be confined to the limited well-to-do who insist on having the latest thing simply because it is the latest thing. A careful analysis discloses that there is an enormous field for automobile receiver sales to people for whom the auto radio will be more of a necessity than a luxury.

There are at least five large fields of sales:

a. Traveling salesmen
b. Tourists
c. Taxi cabs
d. Busses
e. Motor boats and small yachts.

Many traveling salesmen are compelled to be in their cars practically all day long, day after day. Of course it is extremely monotonous and a good auto radio would certainly furnish relief.

The field of sales to the taxi cab company is vast. While it is true that the radio-equipped cab will have a certain value from a sales standpoint and that people are apt to hesitate before a cab in which a radio is softly crooning, the big appeal will undoubtedly be to the driver, who must remain parked



sometimes hour after hour monotonously waiting for customers.

The competition in bus transportation is immense, and bus companies are quick to sieze upon any device which will give them an advantage over a rival company. The slogan "Radio Equipped Busses" is sure to be heard loudly and insistently before long.

While designed primarily for automobile use, the splendid features of a high grade automobile receiver—sensitivity, ruggedness, and the ability to perform satisfactorily on a small antenna, render the set ideal for use on motorboats, airplanes and yachts where an aerial of insignificant length must be employed.

How to Make Money

There are several ways to make money from automobile receivers. If you have a shop or store, you can obtain a service station franchise or agency for a high grade automobile receiver and install the receivers at your shop.

If you do not have the advantage of a fairly pretentious looking store or laboratory it would perhaps be better to make an arrangement with a large garage in your neighborhood to rent a portion of their display space with the privilege of working on the garage floor.

Or you can arrange with an up-to-date garage to stock automobile receivers and to turn the installation work over to you.

Working in conjunction with a garage will have the advantage that you will have access to heavy tools which the average radio man does not possess.

Another way—you can always make arrangements to sell and install receivers for a dealer on a commission basis. In addition to the profits to be made from sales, the returns from automobile installation work are considerably greater than corresponding work with console a.c. receivers used in the home. The installation of an auto set involves either the mounting of an antenna in the top of the car or the fastening of a metal plate beneath the car, the former method being preferred because of the greater signal strength available. A battery box must be bolted to the chassis of the car and the set mounted to suit the owner's convenience. Ignition noises must be suppressed by installing suitable resistors and condensers which are available and which will reduce such interference to zero. Because of the greater labor involved, your returns will be quite substantial—from ten to twenty dollars per installation.

Of the various automobile receivers available on the market, the types employing '24 tubes in series across the car battery are to be preferred, as such tubes are more rugged than the corresponding d.c. types, and are more sensitive. The element of high sensitivity must not be overlooked since the minute pick-up obtainable from the miniature aerial and ground system requires a sensitivity of the highest order for satisfactory results. Old d.c. battery sets, when installed in an automobile are usually a complete "flop."

When summer comes, don't look for a job selling vacuum cleaners—climb on the auto-set band wagon!

Pilot Auto Radio Set Permits Mounting on Running Board of Car

(Continued from page 41)

be supplied by three 45-volt "B" batteries. The 245, used as an output tube, works quite satisfactorily with only 135 volts on the plate and 22½ on the grid, being more convenient than a 171A in this position because its 2½-volt filament can be ganged nicely with that of the preceding 227.

The radio-frequency gain in this receiver is pushed quite high and little attention is given to selectivity, as this matter is

(Continued on page 105)

NEW PRODUCTS FOR THE TRADE

New Hickok SG-4600 Set Tester

THE new Hickok SG-4600 radio set tester embodies all the special features of construction employed in the previous models, and in addition, reads directly both ohms and microfarads.

The a.c. voltmeter is employed when the apparatus is used to measure capacity, and operates directly from 110 volt a.c. supply line. It measures values accurately from ½ to 25 microfarads, and its indications are independent of line voltage fluctuations.

When used to measure resistance, the d.c. milliammeter is used in conjunction with 9-volt "C" battery. It indicates directly on the scale of the milliammeter, resistance values from 5 ohms to 20,000 ohms. Provision is also made to make adjustment for variation in the "C" battery voltage.

The above features combined with the use of five meters in the tester enables the user to get simultaneous readings of all voltages entering a tube from the receiver under test. When testing screen grid tubes such as the 224 tube, all the voltages including the screen grid and control grid volts are indicated simultaneously without the use of switches or push buttons.

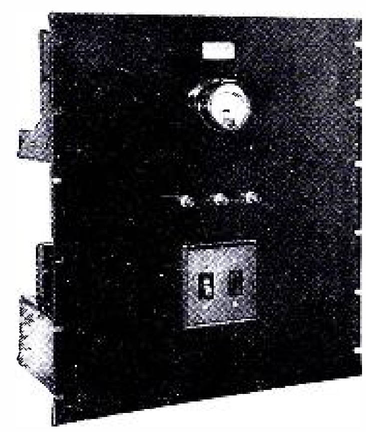
There has been no increase in the price of this apparatus on account of the added features of the ohmmeter and capacity meter.

Resistor Replacement Guide

UNDER the title of "Resistor Replacement Guide," the Service Department of International Resistance Company, 2006 Chestnut Street, Philadelphia, Pa., has prepared a most important piece of practical radio literature for the radio service man. In loose-leaf form so as to be kept constantly up to date by inserting new sheets issued by the organization from time to time, there is now available a vast fund of data dealing with resistance fundamentals, formulas, and requirements of standard radio sets for several years past. Standard radio sets are covered in handy tables which include indications of faulty resistors, the purpose of each resistor, resistor connections, color code of original, resistance value, and recommended resistor for replacement. A copy may be obtained by radio workers who send in 50 cents in stamps or coin, to defray actual cost of initial sheets, binder and subsequent sheets, to the company direct.

Rauland Announces Amplifiers

A COMPLETE line of power amplifiers for public address and centralized radio systems is announced by the Rauland Corporation, 3341 Belmont Avenue, Chicago. In addition to amplifiers in portable form and also panel types for mounting on channel racks, the line includes portable and panel mixers, pre-amplifiers, and microphone current supply units and other equipment for complete sound system installation.



It is stated by the manufacturer that in the design and building of Rauland amplifiers special emphasis has been placed on producing scientific sound equipment which combines quality and dependable operation with unusually moderate prices. The wide variety of units comprising the new Rauland line enables sound engineers to select exactly the apparatus needed for the particular requirements of any installation.

The panel amplifier, Type 55F (illustrated), uses seven tubes: One No. 227, two 112A, two No. 250, and two No. 281. Its maximum undistorted output in low impedance circuit is rated at 17 watts. It is said that this model will operate from 4 to 10 auditorium type dynamic speakers, or as many as 300 magnetic speakers, at their full-rated capacity. The output is designed for high or low impedance and the latter may be had in either "fixed" or "variable" type.

Corwico Super Braidite

THE Cornish Wire Company, 30 Church Street, New York City, announce a new hook-up wire known as Corwico Super Braidite.

In tests, Super Braidite was shown to have an average voltage breakdown of 1340 volts against 1000 volts for the ordinary hook-up wire.

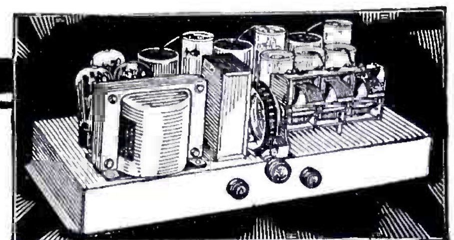
Super Braidite can be readily stripped back with any automatic stripper, and the neat appearing, glossy, flame-proof insulation does not bunch up nor fray when pushed back. Corwico Super Braidite is made with a solid or stranded core in 15 different color combinations.

To manufacturers using Super Braidite, the Cornish Wire Company supplies one of their Model A stripping machines.

(*Continued on page* 111)

SM ERODYNES

Silver-Marshall (Licensed) Custom-Built



S-M 724 Superhet Receiver

S-M 724AC and 724DC Screen-Grid Superhets

There's no doubt about it—the 724 is a superheterodyne custom-built receiver that will make a DX bug of you again. It has six tuned circuits (three dual selector circuits) in the i.f. amplifier, preceded by two tuned r.f. circuits, plus the oscillator circuit—making a total of *nine tuned circuits* in an unusually moderate priced receiver.

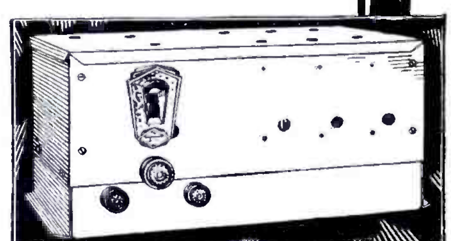
Uniform selectivity and sensitivity over the entire broadcast band are to be expected, of course, and you *get them*. And there is absolutely no trace of second "spot" or repeat points—decidedly a super innovation.

Tubes required (in the 724 AC model): 5—'24, 1—'27, 2—'45, 1—'80.

Tubes required (in the 724 DC model): 5—'32, 1—'30, 2—'31.

S-M 724AC Superhet, completely factory-wired and RCA licensed, $99.50 *List*. Parts total $87.50 *List*.

S-M 724DC factory-wired, tested, and licensed, $82.50 *List*. Parts total $68.50 *List*.



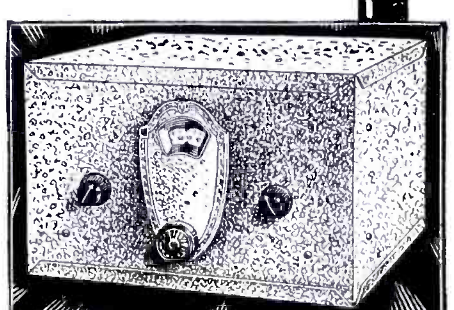
S-M 714 Superhet Tuner

S-M 714—Dual Pre-Selector Screen-Grid Superhet Tuner

The 714 Tuner—successor to the famous Sargent-Rayment 710 and the 712—accomplishes a perfection of design never before attempted: the building of a double pre-selector tuned-radio-frequency circuit into a single-control screen-grid superheterodyne for all a.c. operation. Amazing sharpness of tuning is achieved through the use of *eleven* tuned circuits. The two dual-selector r.f. circuits absolutely prevent the cross-modulation usually encountered in ultra-sensitive supers, and insure complete suppression of the second resonance "spot". The 714 Tuner is ideal for use with the best amplifiers in any installation, or where interference is at its worst.

Tubes required: 4—'24, 2—'27.

S-M 714 Superhet Tuner (only), completely factory wired, tested and RCA licensed, $87.50 *List*. Component parts total $76.50 *List*.



S-M 738 Superhet Converter

S-M 738—Short-Wave Superhet Converter

Here is the newest and most interesting of all sensations—a self-contained all-a.c.-operated converter which makes a powerful short-wave *superheterodyne* out of *any* broadcast receiver. The antenna lead is merely removed from the broadcast receiver and connected to the antenna post of the 738; two leads are then run from the converter to the antenna and ground posts of the broadcast set. Tuning control is by a single dial which tunes the oscillator circuit, and an auxiliary midget condenser. All the sensitivity and selectivity possessed by the broadcast receiver contribute to the short-wave performance, giving results never before achieved. Operation is much simplified by the absence of any critical regenerative control. Included in the list price are eight coils (four pairs) covering the wave length range of from 18 to 206 meters.

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(*Continued from page* 100)

taken care of automatically by the necessarily small antenna that is used. For an aerial, a pair of wires strung between the front and rear axles, under the car, has been found to be very effective. Where the shielding effect of the chassis is too great, a piece of copper screening may be tacked to the inside top of the car, or a wire run around the edges of the running board.

The "Auto Pilot" kit does not include a loud speaker, a "B" battery container or spark-plug interference eliminators. A special flat loud speaker of the cone type is supplied as a separate accessory, however. The Pilot people feel that every car presents an individual problem as far as the placement of the "B" batteries is concerned, and they leave its solution to the owner of the vehicle. The batteries may be placed under the rear seat, in the rumble seat or luggage carrier, or in a box suspended from the rear floorboard. The size and construction of this box will depend on the particular batteries on hand and the number of obstructions under the board.

The choice of the ignition attachments is also left to the purchaser of the kit.

The left running board has been found to be the best place for the "Auto Pilot," as the left doors are used very much less frequently than the right ones. Holes are merely cut in the step-plate and the floorboard to pass the control cable, and the case is bolted down. When the cover is closed the case looks like a perfectly innocent tool box, and will not invite tampering by the inevitable small boys.

The right running board may be used just as well as the left, as the accompanying illustrations show.

The control box may be placed in any convenient position, the instrument board being the preferred place. The box should be mounted as close to the sides of the car as possible, to prevent the cable from interfering with the movement of the driver's or passengers' legs.

The "Auto Pilot" has been tested thoroughly and has proved to be sensitive, selective and sturdy. Sample sets have been driven many thousands of miles without breakdown in four representative cars: a Ford sedan, an Oakland coupé, a Hudson roadster, and a LaSalle coach.

Direct Current Power Transmission Is Seen with New Thyratrons

(*Continued from page* 42)

was at the low pressure of 110 or 220 volts. These represent two methods of transmitting economically by direct current, but their disadvantages would be so pronounced if employed under present-day conditions that the development of the transformer and the alternating-current systems that came in shortly before 1890 was little less than the salvation of electrical practice at that period. If transmission by direct current at high voltages can be accomplished, with the aid of the thyratron tube, the benefits, both electrically and economically, will be decidedly noteworthy.

The thyratron tube has been 15 years in reaching its present state of development as a perfected and effective control device, with latent possibilities in transmission mentioned above. After Dr. Langmuir had conceived the idea of making use of the characteristics displayed by electron discharges in gases for controlling an electric arc by means of a grid, Toulon, in France, experimented in 1922 with Langmuir's process and devised an improvement on his method. Later Langmuir and his assistants made other improvements. About 1926 Langmuir envisioned the broad practical possibilities of the principle, and thereafter Dr. A. W. Hull, in the same laboratory, developed the tube in its present status, making its commercial use in controlling power supply a reality. The tube, of the three-electrode type, differs from the familiar pliotron tube in being an arc rectifier in which a power arc is controlled electrostatically by the grid. In its control function it will economically handle relatively large amounts of electric power.

Super Stages a Comeback in Battle for Popularity of Public

(*Continued from page* 50)

mercially taken advantage of and made public.

Super vs. T. R. F.

There are two advantages to the superheterodyne system of reception which can never be attained in any t.r.f. receiver. These are the so-called "arithmetical" selectivity and the extreme ease of obtaining high amplification at relatively low radio frequencies (usually called intermediate frequencies), which may be utilized in the superheterodyne amplifier. The matter of so-called "arithmetical" selectivity can best be illustrated by considering the problem of selecting a wanted station at, say, 1000 kc. and yet completely eliminating an unwanted station at 1010 kc. The frequency separation is seen to be 10 kc. or 1 per cent, and such separation presents problems which no t.r.f. receiver, even one employing five or six tuned circuits, can completely satisfactorily meet. In the case of the superheterodyne, however, where the intermediate amplification frequency may, for this purpose, be considered as the disadvantageously high frequency of 175 kc., it is apparent that when the wanted and unwanted signals are both heterodyned, they will still appear 10 kc. apart to the intermediate frequency amplifier. That is, the wanted station will appear at 175 kc. and the unwanted station still will be 10 kc. away. The percentage difference in this case is seen to be about 5.7 per cent and it is apparent, therefore, that the relative selectivity problem is approximately six times simpler for the super with 175 kc. i.f. amplifier than for the t.r.f. set which must perforce discrimination between original signals of 1000 and 1010 kc.

The relative simplicity of obtaining high amplifications at low radio frequencies is so generally well-known as to require little detailed explanation. Suffice it to say, however, that commercially satisfactory and stable amplifications of an order of sixty to eighty times may be obtained from a single i.f. stage operating at 175 kc., whereas, about the highest practical commercial gain which may be obtained in the broadcast band will be on the order of forty to fifty per stage. This is because of the less serious effects of stray, and even tube, capacities at the lower frequencies.

Image Frequency

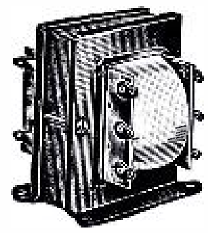
The matter of image frequency interference is probably the most serious drawback of the superheterodyne system. By this is meant the condition where to receive a 1000 kc. signal, the oscillator must be set at, say, 1175 kc., at which setting it will, of course, heterodyne not only the wanted signal at 1000 kc. but possibly an unwanted signal 175 kc. further away from the oscillator, or at 1350 kc. Under such a condition if the 1350 kc. signal is allowed to reach the first detector along with the 1000 kc. signal, interference will result. A corollary of this type of interference is that wherein two broadcast signals separated by the frequency of the intermediate amplifier reach the first detector, one serving to heterodyne the other, and the modulation of one or both stations appearing at the loud speaker. Both of these conditions can be obviated by a high order of selectivity before the first detector—sufficient to result in the interfering signal appearing at the first detector with a relative intensity of only one-five-thousandth or less of the wanted signal. Thus, the requirement for selectivity to precede the first detector will be seen to be what might be termed a high order of off-channel selectivity rather than a high order of adjacent-channel selectivity; for this latter can be much more easily obtained in the i.f. amplifier than in the preceding r.f. circuits, plus the further benefits of the "arithmetical" selectivity above referred to.

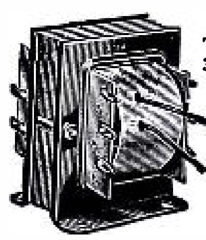
The selection of the intermediate frequency in the past has seemed to be a matter largely of personal preference with superheterodyne designers, though a consideration of the problems involved indicates that today there is really but one practical choice of the intermediate frequency. The lower the intermediate frequency, the higher the stable amplification per stage it is possible to obtain; whereas, on the other hand, the higher the intermediate frequency, the further apart will be two stations which may be heterodyned by one setting of the oscillator and, in consequence, the smaller will be the problem of image frequency interference. On the other hand, as the intermediate frequency is increased, the problem of harmonics of it leaking back from the second detector plate circuit to the first detector or oscillator becomes serious. As with screen-grid tubes it is relatively simple to obtain satisfactorily high amplifications at any frequency up to 200 kc., it is obvious that selection of the intermediate frequency must be determined almost entirely by the desire to keep image frequency interference down. In practice, 175 kc. has been found to be the most satisfactory intermediate frequency; first, because it is high enough to simplify the problem of image frequency selectivity, secondly, because it is just low enough so that the third harmonic, which is the highest harmonic which need be considered as causing any leakage trouble, is just below the broadcast band and, consequently, will not cause trouble if there should be a slight leak from second detector plate to first detector or oscillator and, thirdly, because it is perfectly possible to obtain extremely high amplifications at this frequency.

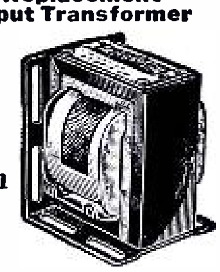
Requirements of Super

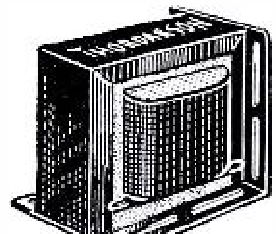
Translated into practical terms, the requirements of a thoroughly satisfactory modern superheterodyne would involve a relatively high order of off-channel selectivity preceding the first detector, which can best be obtained through the use of a single r.f. stage preceding the first detector, an oscillator which may be ganged with the first detector and r.f. circuits. followed by an extremely sharp intermediate frequency amplifier and, of course, a satisfactory second detector and audio channel. By the term "satisfactory intermediate amplifier" is meant an amplifier combining all the best points of modern t.r.f. design which, briefly, would involve dual tuned transformers, or selector circuits, between each i.f. tube, in order to provide a relatively flat-topped resonance curve coupled with extremely steep sides to this resonance curve. This condition can be obtained with relative ease in the i.f. amplifier—as a matter of fact, far more simply than in the attempt to provide dual selector or so-called "siamese" circuits for operation in the broadcast frequency band, where the commercial tolerances of both coils and condensers must be such as to, in a large measure, mitigate against the complete effectiveness of the so-called "siamese" circuit. This is not the case with the intermediate frequency amplifier, where the "siamese" circuit may be aligned once for a definite frequency and never disturbed after that, not being required, as in a broadcast receiver, to be tunable over an extremely wide broadcast frequency range.

Illustrated and diagrammed herewith is a superheterodyne receiver announced by Silver-Marshall, the design of which has just been completed and which incorporates all the features necessary to definitely and positively make the superheterodyne today, as in the past, the Rolls-Royce of radio. While performance curves of this receiver are not presented herewith, it may be stated that the overall selectivity of the entire receiver is such that, taking the average for the entire broadcast band (the selectivity being practically constant over









a range of 550 to 1500 kc.), a signal 10 kc. away from a wanted signal or, more simply stated, on an adjacent channel, would have to be nearly one thousand times as strong as the wanted signal in order to appear with equal volume at the loud speaker—an order of selectivity utterly unequalled by

(*Continued on page* 114)

Norden-Hauck Super DX5 is Designed for Quiet A.C. Operation

(*Continued from page* 52)

drum dial projecting through the panel. The vertical mounting results in a minimum of friction and equal pressure on the bearings giving smooth and noiseless operation coupled with great ease of adjustment. An illuminated celluloid scale enables accurate logging and serves as a pilot light. The radio frequency compensating condenser provides a ready means for lining up the radio frequency stage and compensating for changes in capacity produced by variation of the antennae coupling condenser.

The detector trimmer condenser provides a fine tuning adjustment equivalent in 180 degrees adjustment to from one to three degrees on the main tuning dial.

Variation in the radio frequency compensating condenser has only a slight effect upon the tuning of the detector stage, not enough to lose the beat note of a signal, and the detector trimmer condenser provides a ready means to bring the detector in line again. For amateur band receputation the main tuning control can be set at predetermined points and all the tuning done with the lower controls. The regeneration control is noiseless and very smooth in operation and has only a slight effect on tuning so that when reduced to stop oscillation for reception of a modulated signal the readjustment is tuning will never be greater than a slight change of the detector trimmer condenser and usually none at all is needed.

Chart Furnished

An individual calibration chart is furnished for each set and when the tubes are supplied this calibration is made with the tubes that are to be used. An accuracy of 1 per cent or better is obtained and due to the rigid construction of coils and set there is very little change in use. This tuning chart is of great advantage to the newcomer to the short wave field as it enables him to locate the stations desired or identify the stations heard in spite of the tremendous span of frequencies covered.

Tone Quality

No sacrifice in tone quality was made in lieu of more difficult means of reducing hum. Low ratio high quality audio transformers are used with two type 45 tubes and a dynamic speaker enabling an output to be obtained which in audio range and undistorted power equals the standard set by the finest broadcast receivers. There are plenty of short wave phone signals on the air which with an efficient set will supply enough power to load up push pull 45's. A headphone jack is provided which taps in the plate of the first audio stage, cutting out the loudspeaker, or if desired phones may be connected to the magnetic speaker terminals.

Standard equipment includes three sets of coils, six coils in all, which cover a range of from 1500 to 15,000 kilocycles with generous overlap between coils. Extra coils can be obtained to cover from 15,000 to 25,000 kilocycles. For reception in the ordinary broadcast band coils may be obtained which cover from 540 to 700 to 1600 kilocycles in two steps by means of a switch provided on the base of the coil which cuts in an auxiliary condenser for the lower frequencies. On special order coils can be provided to cover from 100 to 550 kilocycles, two sets of coils being used. When operating on frequencies lower than 550 kilocycles an adjustable tickler is provided on the coil and a .005 fixed condenser is shunted across the regeneration condenser.

Measurements on Lincoln DeLuxe 31 Show Extreme Sensitivity

(Continued from page 53)

thusiasts who wish selectivity. Incidentally the degree of selectivity may be altered to some extent by the setting of the trimmers on the intermediate stages.

According to report No. 530 covering this receiver, dummy antenna used was 100 mmf; regeneration adjusted to same

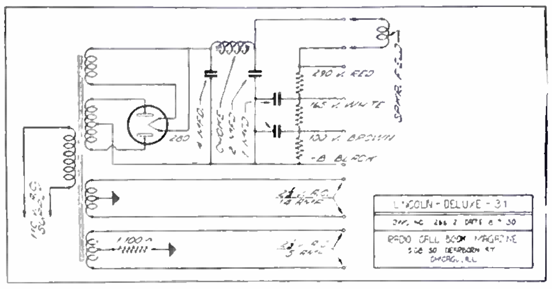


Fig. 3. Details of the power supply wiring may be traced from this drawing

amount on all frequencies; no hum being measured at the output terminals. Mutual conductance of tubes used: 1 i.f. 1000; 2 i.f. 1010; 3 i.f. 1000; 4 i.f. 920; 1 detector 1110; 1 a.f. 1200; PP 1500; PP 1510; 2 detector 1100, and oscillator 1000 micromhos.

Juding from the selectivity curves the fidelity curves show a drop towards the higher audio frequencies, although considerable of this drop is compensated for by the special speaker

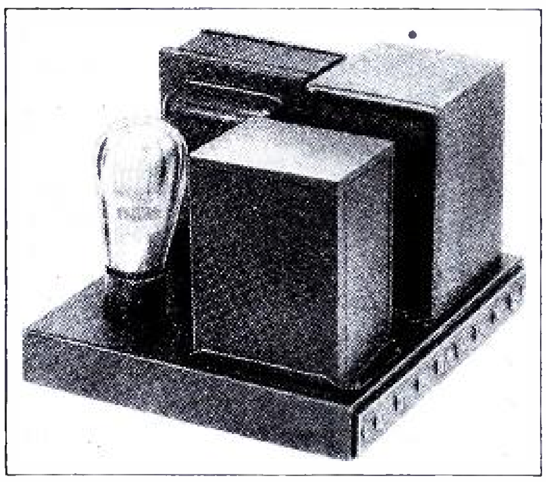


Fig. 4. Photographically is shown here the power pack for the Lincoln DeLuxe 31, described in this article, the schematic diagram of which may be found in Fig. 3

used with the Lincoln job. The fidelity measurements made are only electrical and do not take into account the sound energy as heard by the ear from the speaker.

Interference ratios and band widths are given below:—

Interference Ratio

	Kilocycles off resonance		
Resonance	Plus 10	Plus 20	Plus 30
600 kc.	896.5		----
1000 kc.	194.0	18,400.0	----
1400 kc.	313.0	6500.0	----
	Minus 10	Minus 20	Minus 30
600 kc.	432.0	20,000.0	----
1000 kc.	60.0	13,000.0	----
1400 kc.	183.3	3333.3	----

Band Widths

Times field strength	Kilocycles wide 600 kc.	1000 kc.	1400 kc.
10	7.5	10.5	10.0
100	13.0	19.5	7.0
1000	23.0	32.0	25.0

Three Tube Adapter Makes Superhet Out of T.R.F. Receiver

(*Continued from page* 58)

S-M 738 super adapter are listed below:—

- 1 Silver-Marshall 738 chassis and shield assembly
- 1 Silver-Marshall 344 dual trimmer condenser
- 1 Silver-Marshall 314 .00015 variable condenser
- 1 Silver-Marshall 317 variable condenser
- 1 Silver-Marshall 672 8 mfd condenser bank
- 2 Silver-Marshall 131 L coils
- 2 Silver-Marshall 131 M coils
- 2 Silver-Marshall 131 N coils
- 2 Silver-Marshall 131 O coils
- 1 Silver-Marshall 338 U choke
- 1 Silver-Marshall 280 power transformer
- 2 Silver-Marshall 512 sockets
- 1 National E dial
- 1 Polymet .005 fixed condenser
- 1 Polymet .00015 condenser
- 2 Durham 10,000 ohm 1 watt resistors
- 2 Durham 300,000 ohm 1 watt resistors
- 1 CR 224 tube socket
- 1 CR 227 tube socket
- 1 CR 226 tube socket
- 1 5174 H & H rotary on-off switch
- 3 Eby Binding posts
- 1 10 ft. cord and plug
- 1 Set of hardware.

Leutz Model C Short Wave Radio Set Designed for Battery Use

(*Continued from page* 60)

the tube which is capacitatively tuned to the antenna circuit. The second winding may or may not be used as desired. It is provided to permit using a dirigible type antenna if the user is so inclined.

Battery Operation

According to the information made available by the designers, battery operation of the receiver for best results is recommended, although prices will be quoted by Leutz on an alternating current operated set if desired by interested individuals. Mention is made in the instruction covering the models that army, navy and commercial companies prefer battery operation for their short wave, long range reception since it gives greatest freedom from extraneous interference on the higher frequencies.

Walker Goes into a New Season with His Versatile Flexi-Unit

(*Continued from page* 56)

Short Wave Adapter

In the last diagram, Figure 4, the Flexi-Unit is arranged as a short wave a.c. adapter for covering a range from 15 to 200 meters. Under these conditions the adapter plug is put into the detector socket position of the regular broadcast receiver and the short wave tuning done on the Flexi-Unit, utilizing the broadcast receiver's amplifier and speaker system for the reproduction of music.

The parts used in the construction of the Flexi-Unit are shown in the list following:

1—.0003 Tuning Condenser
1—.000045 Antenna Midget Condenser
1—.0001 Regeneration "VOL"

Midget Condenser
1—Bakelite Vernier Tuning Dial
1—30-ohm Rheostat
1—4-Prong Tube Socket
1—5-Prong Coil Socket
1—R.F. Choke Coil
1—By-Pass Condenser
1—Grid Leak
1—.00015 Grid Condenser
1—Cast Aluminum Shield
4 Plug-in Coils
Binding Posts

Measurement of Public Address Units Shows Interesting Data

(Continued from page 57)

Webster Model DH

Measurements on the Model DH of Webster of Chicago were made in the laboratory; the output impedance load being adjujsted to 4000 ohms and coupled capacitatively to the plates of the 250 tubes. An output of 1 watt was maintained on all measurements. Mutual conductance of tubes used: 1 a.f. 1500; 2 a.f. 1550; 3 a.f. 1200; p.p. 2100; p.p. 2100 micromhos.

f	DB	f	DB
30—	13.2 Loss	2,000—	0.00
60—	4.80 Loss	4,000—	3.00 Gain
90—	0.80 Loss	6,000—	4.50 Gain
120—	0.00	8,000—	1.00 Gain
250—	0.00	10,000—	4.00 Loss
400—	0.00 Ref.	12,000—	10.50 Loss
800—	0.00	14,000—	18.70 Loss
1000—	0.00	16,000—	22.50 Loss

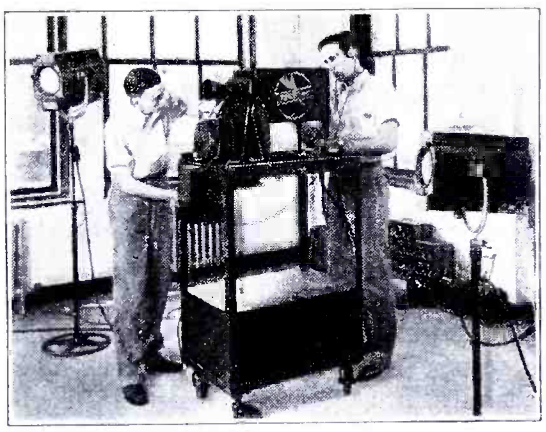
The voltage amplification at the reference level of 400 cycles was 5681.81.

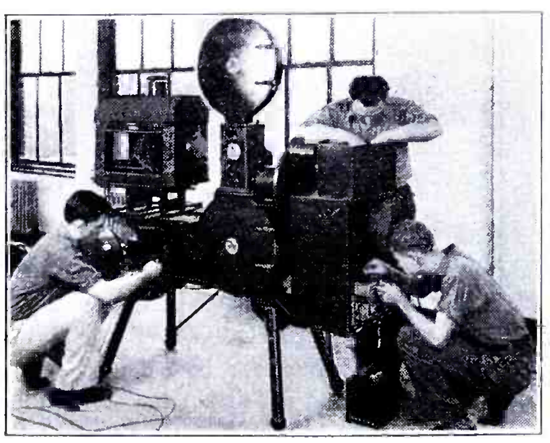
NEW PRODUCTS FOR THE TRADE

(Continued from page 101)

Coyne Electrical School Announces New Radio Division

THE Coyne Electrical School of Chicago recently announced the establishment of a new radio division, to be devoted exclusively to the teaching of radio, television and sound reproduction, by actual shop work. The school has installed a great amount of modern radio equipment, including radio sets of all kinds and types, a complete commercial broadcasting transmitter, the very latest Jenkins television transmitting and receiving apparatus, code practice equipment, etc.





The Coyne School has been teaching electricity since 1899 and the industry now welcomes its advent into the radio field.

Wellston Tone Control

THE Wellston Radio Corporation of St. Louis, Mo., has perfected and placed on the market a new type tone control known as the Wellston Gold Test tone control. This new product, created largely through the inventive genius of F. J. Grenzer, president of the Wellston firm, is all that is said to be needed by radio owners to bring their present sets up to the standard of tone perfection produced by the very latest models now being shown in retail establishments.

The Gold Test tone control is made of emerald green Condensite and is very compact—measuring but 3 by 2½ inches in size. By the simple turning of a little knob one is able to control the tone of radio reception to suit his own individual tastes and moods. Through the use of the Gold Test tone control the pitch of tone can be adjusted to any shade desired—brilliant, high, mellow or deep. Annoying interference such as background noises, buzzes and crackles are also easily eliminated.

Another feature of the Wellston Gold Test tone control is that it is simple to install. No tools are needed in attaching it to the receiver.

The Wellston Radio Corporation also manufactures the Wellston Gold Test aerial. This aerial is of the filtered type and measures but 2½ by 5 inches in size and is designed to eliminate all present cumbersome indoor and outdoor aerials.

Polymet Engineering Manual

Copies of the Polymet engineering manual, recently completed, are now available gratis to executives following a request made on their letterheads. Requests should be made to the Polymet Mfg. Corp., 829 East 134th St., New York.

The manual contains many suggestions regarding the obtaining of desired results for the least expenditure, in the use of paper and mica condensers, resistors, coils, volume controls, magnet wire and similar parts.

The section on coils in this manual contains considerable data not heretofore published.

New Miles Microphone

One of the latest products announced by the Miles Reproducer Co., 45 West 17th St., New York, is the type M-1000 two button carbon microphone. The circuit measures 100 ohms resistance each side of the button. Special polished carbon granules are used, with a special carbon disc. A range of 30 to 8,000 cycles is claimed for the new unit, which has a current rating of from 8 to 12 milliamperes.

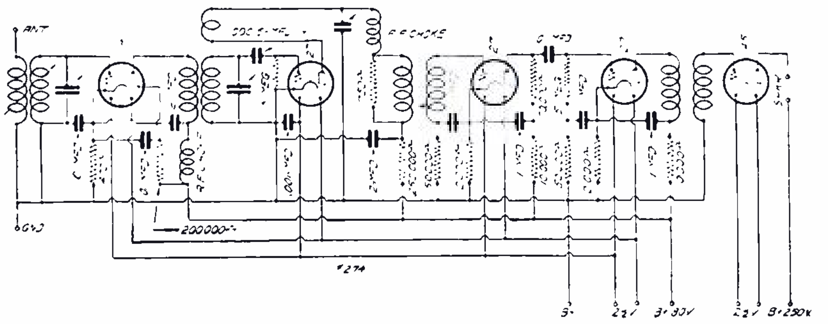
This company also makes a type M-100 dynamic air column unit for public address and theatrical work. It operates on either d.c. or a.c. from an exciter. Voice coil resistance is 6.5, 8.5, 10 and 16 ohm as desired.

New A.C. Short-Wave Receiver

A SHORT-WAVE set that is said to be different—and better—than anything of its kind heretofore produced, now makes its début under the sponsorship of the Insuline Corporation of America, 70-80 Cortland Street, New York City.

Extreme distance-getting ability, all-electric operation, wonderful tone quality, plenty of volume on far-away stations, screen grid sensitivity—all these features are claimed in the new I. C. A. Conqueror.

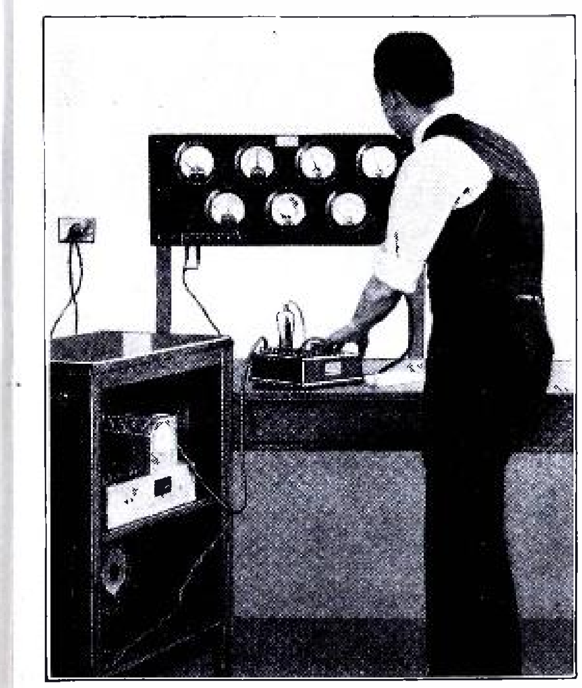
The Conqueror kit consists of several laboratory-built *units*, each of which comes to the constructor already assembled, wired, tested and adjusted. These units are mounted by the builder on a drilled metal chassis and interconnected by means of marked, measured leads, which are secured to their respective terminals by small fastening nuts. No soldering is necessary and the entire job can be completed with a screwdriver. Instructions, diagrams, photographs and working drawings are furnished with each kit.



Naturally, the circuit design contributes materially to the efficiency of the Conqueror. For the technically minded, a few of the design details are given. The receiver uses a circuit which includes a special development of the tuned radio frequency amplifier, a tuned regenerative detector and three stages of high-grade audio amplification. Capacitatively-shielded inductive coupling to the antenna system is used to prevent the loading effects of the antenna from affecting the efficiency of the tuned radio frequency amplifier. This permits the use of any size or type of antenna as a means of pick-up. The screen grid tube used in the r.f. amplifier is inductively coupled to the detector through a specially designed tuned transformer, insuring high gain and a minimum of reflected tuning effect.

Jewell Test Panel

IN the Pattern 579 remote control analyzer panel, Jewell has again taken the initiative and anticipated the requirements of radio service work by providing equipment that gives greater accuracy, speed, and convenience in testing radio equipment than anything on the market today. This new unit comprises the popular 581 test panel redesigned and equipped with a remote control box.



The panel with its seven large instruments is mounted on a wall or on supports from the workbench. It may be seen in the illustration. The remote control box is attached to the panel by a long flexible cable. The control box is not attached to the table and may be moved about to the most convenient position for operation with relation to both the receiver under test and the test panel.

All switches, sockets, binding posts, and cords used in normal receiver testing are contained in the control box. There is no occasion to reach up to the panel when testing. The result is outstanding facility and speed.

Super Stages a Comeback in Battle For Popularity of Public

(*Continued from page* 108)

any known type of t.r.f. receiver. The sensitivity is on the order of 1½ to 3 microvolts per meter, to which value some of the best t.r.f. sets ever made have attained, and beyond which it is not desirable to go, as this represents a higher order of sensitivity than may be used in ninety out of one hundred locations because of prevailing noise levels and static. The fidelity is such that all audio frequencies within the range of 400 to 4000 cycles are reproduced with practically no discrimination—an extremely unusual feature when the high order of selectivity is considered, and attained through the use of a compensated audio frequency amplifier.

Examining the super-structure photograph, a 3-gang condenser will be seen at the right front of the chassis, controlled by a centrally located illuminated vernier dial. The right hand condenser tunes the screen-grid r.f. amplifier, the shielded tube itself being located directly behind the gang condenser section. The center section of the gang condenser tunes the first detector circuit, with the screen-grid first detector tube located directly behind this section. The left hand condenser section tunes the oscillator with the 227 oscillator tube located directly behind it. The i.f. amplifier and second detector is a complete sub-assembly, assembled and aligned at exactly 175 kc. at the factory. This assembly, on a channel, approximately 15 inches long and 3½ inches wide, is mounted along the rear of the chassis, with the first i.f. stage at the right end and second detector at the left end. Through a special audio choke mounted on the chassis directly below the second detector, the 224 second detector feeds directly into a pair of 245 tubes in push-pull. At the left front of the chassis can be seen the power supply transformer and the filter condenser bank with the two audio tubes and the rectifier tube at the left rear of the chassis.

Examining the circuit diagram, the antenna coil will be seen at the left of the diagram, feeding into the 224 r.f. amplifier which, in turn, is coupled to the first detector coil by a choke and a small condenser on the order of 4 to 5 mmf., this low value being selected to prevent any derangement of the detector coil characteristics which might result in difficult ganging and difficulty of alignment of the gang condenser. At the lower left of the diagram appears the oscillator tube with its associated circuits. The oscillator grid is tapped in at the middle of the oscillator coil for two purposes; first, to keep the oscillator output at no higher than the required value to avoid possible re-radiation and, secondly, to permit of easy alignment by keeping the tube capacity across the coil as low as possible. The resistance seen in series with the oscillator grid is similar to the conventional t.r.f. grid suppressor, its purpose being to maintain the oscillator output relatively constant over the entire range. Shunting the oscillator coil is a group of four condensers, one the oscillator tuning condenser, one a fixed condenser and the other two variable.

This apparently peculiar combination is necessary in order that the oscillator may be made to track exactly 175 kc. away from the first detector and r.f. circuits as they are tuned over the broadcast band. In practice, one trimmer is used to align the oscillator at low frequencies and the other to align it at high frequencies. The second detector feeds into the first i.f. transformer which can be seen to have a tuned primary and a tuned secondary. This first i.f. transfomer is essentially similar to the two following it and consists of a pair of small universal wound coils tuned by compression type mica condensers having a capacity of 100 to 220 mmf., the whole mounted upon a porcelain head as it has been found that bakelite is unsuitable because it will warp sufficiently with temperature and humidity changes to result in serious dis-alignment of the i.f. tuning condensers.

A switch, actually the local-distance switch, is seen close to the second i.f. transformer. In one position, it throws a resistance across the primary of the i.f. transformer and another resistance in series with the secondary, this being the local or broad tuning position. In the other position, these two resistances are cut out of the circuit and the maximum selectivity and gain of the i.f. amplifier is obtained. By this method tuning to local stations of relatively high field strength where reduced gain in the receiver, as well as slightly reduced selectivity, is a distinct convenience, is greatly facilitated. The first i.f. amplifier and 224 tube feeds into the second and the second i.f. amplifier tube feeds into the second detector through essentially similar transformers. Volume of the receiver is controlled by means of a variable resistance which controls the grid bias on the r.f. amplifier and on the first i.f. amplifier tube in an extremely smooth and satisfactory manner. The second detector is biased automatically and a phonograph jack inserted in the grid return of the tuned circuit so that when a phonograph pickup is plugged in, the second detector is used as a first stage audio amplifier.

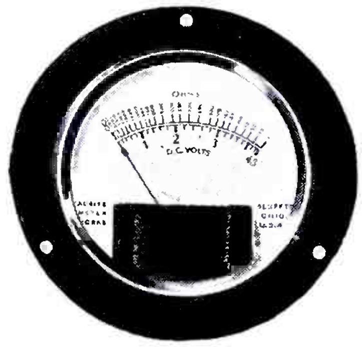
The second detector plate circuit is isolated by a choke coil and two .00015 mfd. by-pass condensers, the placing of which is relatively critical as it is extremely important that no harmonics of the carrier frequency, in this case the intermediate frequency, such as would be generated by any detector, should leak back into the first detector or preceding circuits. The second detector is impedance coupled, by what would appear to be a new method, to the two 245 type push-pull tubes, though it will be found in quite a few commercial receivers this season. As it is extremely difficult to obtain a constant impedance throughout the audio frequency range for the 224 second detector plate circuit, the impedance is in effect made constant by a 40,000 ohm resistance across one section of the coupling choke. The selectivity of the intermediate amplifier is, in itself, sufficient to somewhat suppress the higher audio frequencies in the range of 2000 to 4000 cycles and, in order to obtain a higher order of fidelity, these frequencies must be reinforced in the audio amplifier. This is accomplished by the small resonating circuit, consisting of a small condenser shunting a coil and seen in series with the 40,000 ohm equallizing resistor across the 245 grid circuit. This resonating circuit is so proportioned that it will "boost" the higher audio frequencies which are somewhat suppressed by the i.f. amplifier, to exactly the extent to which they were suppressed.

The power supply consists of a large power transformer with the usual filament windings for 245 and 224-227 tubes with, of course, a high voltage secondary winding and filament winding for the 280 rectifier tube.

The filter circuit consists of a 1 mmf. input condenser followed by a choke coil resonated by a .25 mfd. condenser connected across it to approximately 120 cycles, thus effectively increasing the filtration of the filter as compared to the ordinary or conventional untuned filter. The filter choke is followed by a 4 mmf. dry electrolytic condenser and 2500 ohm field of the dynamic speaker, this field, in turn, being followed by another 4 mmf. condenser. The balance of the circuit will be readily understood by any service man or setbuilder, inasmuch as it consists only of bleeder circuits and by-pass condensers. There is one point, however, which should be stressed and that is the method of biasing the second detector. The second detector is semi-automatically biased by a resistance in the grid-plate return, but in order to insure maintenance of desirable bias, the oscillator plate current is bled through the second detector biasing resistor. The oscillator tube itself has no bias as it has been found that a more constant output is obtained without it. All other tubes in the receiver are automatically biased, the bias on the r.f. and first i.f. being available for volume control, as previously mentioned.

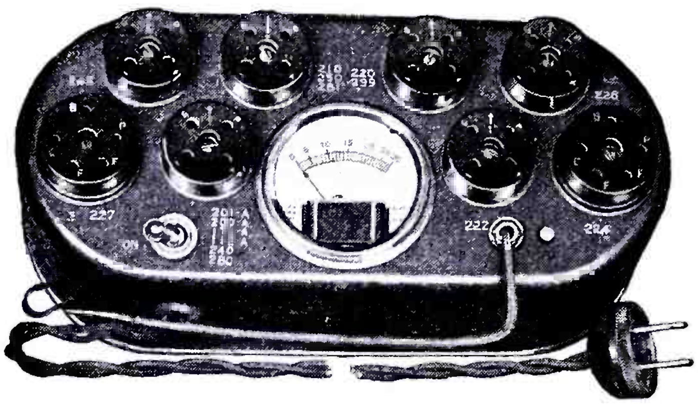
Three Readrite Items

Three items manufactured by the Readrite Meter Works, at Bluffton, Ohio, are of interest to service men and small dealers. Illustrations of these products are shown in this column.



Model 501 resistance meter is shown at the right; it is furnished either with wide flange as shown or narrow rim type for clamping. Requires three small flashlight cells which, with resistance to be measured, are connected in series with meter. Used for testing resistances in radio receiving sets and circuits generally.

Dealers will find the model 400 counter tube tester an ideal instrument for testing all tubes handled over the counter. It



provides a quick and easy way for any ordinary clerk to check the tubes in front of the customer. Equipped with an accurate milliammeter in a shielded metal case which gives all tube readings in a single scale. Push button gives second reading for mutual conductance test.

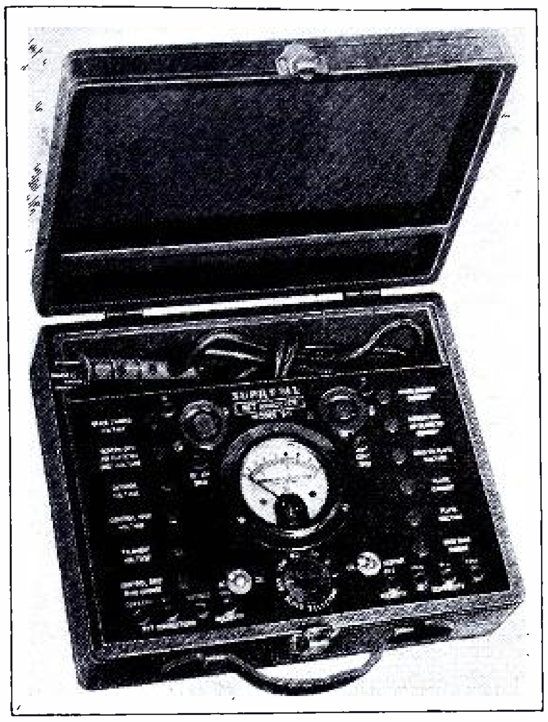
A complete direct reading ohmeter is illustrated at the left, being the Readrite model 500. It tests resistances up to 10,000 ohms, also d.c. volts from zero to four and a half. It contains a small three cell flashlight battery, current drain of which is negligible. Meter adjusts to zero reading by shorting the two jacks and turning the rheostat knob. Unit is supplied with two wire leads five feet long for continuity and resistance testing.

Heavy Duty Rheostats

TO meet the exacting requirements of the talking movies and other photo sound reproducing systems, and to provide an added degree of perfection in the power control of many other circuits and systems to which the wire wound variable resistor is adapted, the DeJur-Amsco Corporation, Broome & Lafayette Streets, New York City, have introduced a new line of heavy duty rheostats and potentiometers. They have made several types to provide for the various requirements in this new field.

Only One Meter to Read

One of the recent announcements made by Supreme Instruments Corp., Greenwood, Miss., covers the Supreme set analyzer, model 90, which uses a single meter by means of which a multiplicity of measurements may be made by the service man.



The single meter employed is a special design of the copper oxide rectifier type. In straight analytical work the Model 90 provides five distinct ranges for readings of plate current, grid current, screen grid current, second plate of 280 rectifiers, space charge current; while six ranges are available for d.c. voltage, a.c. plate voltage, a.c. filament voltage, d.c. filament voltage, cathode voltage, space charge voltage, grid voltage, screen grid voltage, a.c. voltage, and second plate 280 rectifiers.

All voltage readings, both a.c. and d.c. are available in the following ranges: 0-3, 0-9, 0-30, 0-90, 0-300 and 0-900. All current readings both a.c. and d.c. are read in milliamperes in the following ranges: 0-3, 0-9, 0-30, 0-90 and 0-300.

All the voltage and current ranges are available through the insulated pin jacks located on the face of the instrument panel, making available for all purposes six distinct voltage ranges and five milliampere ranges.

Portable Sound Installation

THE accompanying photograph was taken August 3 at the 317th Cavalry Polo Field in Evanston, Illinois, during a game played between the 317th Cavalry and the Silver-Marshall polo teams.

The installation covered voice amplification of the announcer who described the game play by play, amplifying his voice one hundred yards across the field to about three hundred people. Automobiles lined the opposite side of the field for a distance of two hundred yards.

Silver - Marshall, Inc., made the portable installation which consisted of a microphone, their latest 692 type auditorium amplifier, and one of their 862 auditorium dynamic speaker chassis with a six foot trumpet to give the desired directional effect. The announcer's voice could be heard without difficulty all over the playing field and at the clubhouse, a hundred yards beyond.

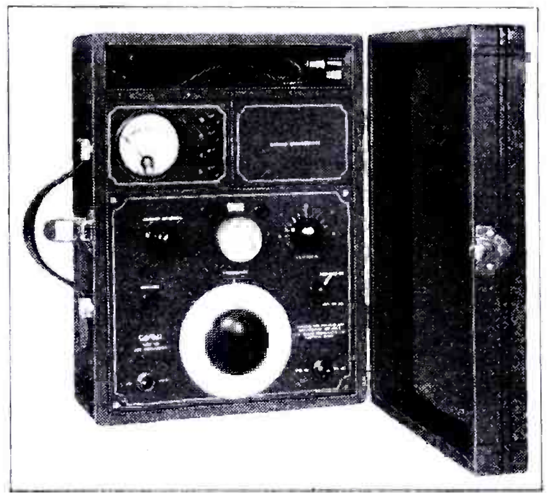
In addition to the above equipment, there was also a turn-table with pickup used for entertainment between chukkers. The local ball game in Chicago was also picked up on one of the Silver-Marshall 770 auto receivers installed in one of the cars and the score given at various intervals during the game.

There are great possibilities for dealers, service men, and other members of the radio fraternity, not only to advertise themselves and the radio material they are selling, but also to pick up a considerable income, by having an inexpensive installation of this type available for renting to all kinds of public enterprises.

DayRad Test Oscillator

THE Radio Products Co., Fifth and Norwood, Dayton, Ohio, announce the Type 180 DayRad test oscillator.

The DayRad Type 180 test oscillator consists of a variable frequency oscillator covering the broadcast band with extreme accuracy at 600 and 1400 kilocycles; there are two fixed frequencies, 180 and 175 kilocycles, available by simple switching arrangement. The 175 kilocycle setting may be further varied from 170 to 180 kilocycles by means of a vernier.



This instrument is necessary for aligning, neutralizing and ganging radio frequency circuits in superheterodyne receivers.

An output meter of the copper-oxide rectifier type is included. This provides for visual indications of adjustments when using the oscillator.

The instrument is well shielded and has an ingenious method for controlling the signal output. The tube filament operates from 110 volts or 2 dry cells; the plate is supplied from a small 4156 Burgess battery, or equivalent, for which compartment is provided.

A NEW AMPLIFIER by FERRANTI

Another great advance in amplification is made by the Ferranti 250-D3 amplifier. A higher quality of reproduction is achieved; the frequency band has been widened; temperature rises have been reduced; condenser breakdowns have been eliminated; voice and music are reproduced with equal clarity . . . and . . . ***no compound of any kind is used in the power section.***

Months and months of intensive laboratory work were necessary to perfect such an amplifier. Here it is . . . a tested, finished product ready to ***do better*** any work where a QUALITY amplifier is required. Ferranti offers this amplifier secure in the knowledge that its outstanding performance will add to the already fine reputation of the name it bears. Lastly, it is moderately priced.

New and Exclusive Features

FERRANTI

250-D3

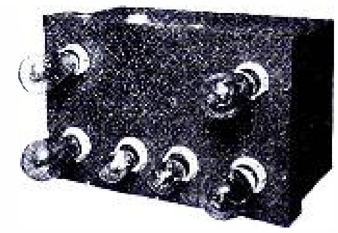
Amplifying Unit

(1) Unusually high amplification . . . completely fills largest auditoriums.
(2) High efficiency.
(3) Low hum.
(4) No overheating . . . temperature rise never exceeds 25 degrees centigrade.
(5) No compound of any kind used in power section.
(6) Electrolytic condensers and dry type transformers and chokes.
(7) No distortion . . . wide frequency range . . . clarity and timbre on BOTH voice and music.
(8) Top and bottom units interchangeable without changes in wiring.
(9) Single or double channel. with any specified input or output impedance.

COMPLETE DETAILS SENT ON REQUEST

Do you use single and double channel amplifying units? Are you *sincerely* interested in a high QUALITY product sensibly priced? Then, by all means, get the complete details of this latest FERRANTI achievement.

(Above) 250-D3 DOUBLE Channel Amplifier Unit



(Left) 250-D3 SINGLE Amplifier for home and other uses

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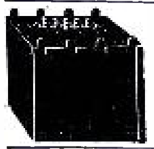
BAL-RAD
Replacement Block for Atwater-Kent No. 37

This unit contains the proper chokes and high voltage condensers. All flexible wire colored leads identical to the original. Fully guaranteed. **Each** **$4.95**

BAL-RAD
Replacement Block for Majestic "B" Eliminator

The condensers in this block are composed of High Voltage Condensers. Guaranteed for 1 year. **Each** **$2.95**



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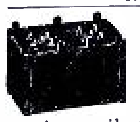


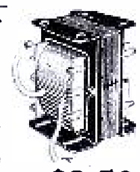
VICTOR PUSH-PULL TRANSFORMER
Input and Output

Can be used with 171A—245 or 250 type tubes. Output matches moving coil on all dynamic speakers.
With Metal Jacket.................... **$2.50**
Without Metal Jacket.................... **1.50**

PIGTAIL CARBON RESISTANCES

500 ohm	15000 ohm	**$1.25**
1000 ohm	25000 ohm	Per doz.
4700 ohm	2 megohm	

THORDARSON Power TRANSFORMERS
For Replacement in Zenith Sets



Models ZE 10-33-33X-34. This transformer can also be used for circuits employing the following type tubes: 5-227—1-171A—1-280. **Our price**.............. **$3.50**

EARL & FREED Power TRANSFORMERS

For Models 78-79-95 using 5-127's—1-180—2-145 tubes. 25 cycle, **$5.50,** 60 cycle **$4.95**

For Model 22 using 3-26's—2-171—2-127—1-180. 25 cycle, **$3.95,** 60 cycle **$3.75**

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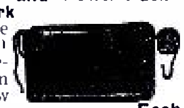
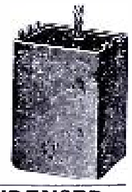
For General Repair and Power-Pack Work



We guarantee these condensers for 100 per cent. free replacement. Repair man should carry a few dozen in stock.

				Each
One Mfd.	600	Working Volts		30c
Two Mfd.	600	"	"	40c
Four Mfd.	600	"	"	60c
One Mfd.	800	"	"	50c
One-half Mfd.	300	"	"	25c

R.C.A. DOUBLE FILTER CHOKES
Part No. 8336



R.C.A. Replacement Part No. 8336 contains two 30 henry 80 mil chokes. Each choke insulated for **1,000** volts **95c**

R.C.A. BY-PASS CONDENSER
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Comprising one ½, and three .1 Mfd. condensers. List $3.00, **Each** **35c**

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By John F. Rider

PRACTICAL TESTING SYSTEMS is the first complete collection of accurate and practical testing circuits of interest to the service man, professional set builder and experimenter. This work contains test circuits which have been used in operation, consequently full details are provided with each circuit.

Nothing is left undone! All specifications of electrical values are quoted. Operating instructions and possible uses of the testing systems are stated.

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RADIO TREATISE COMPANY, INC.
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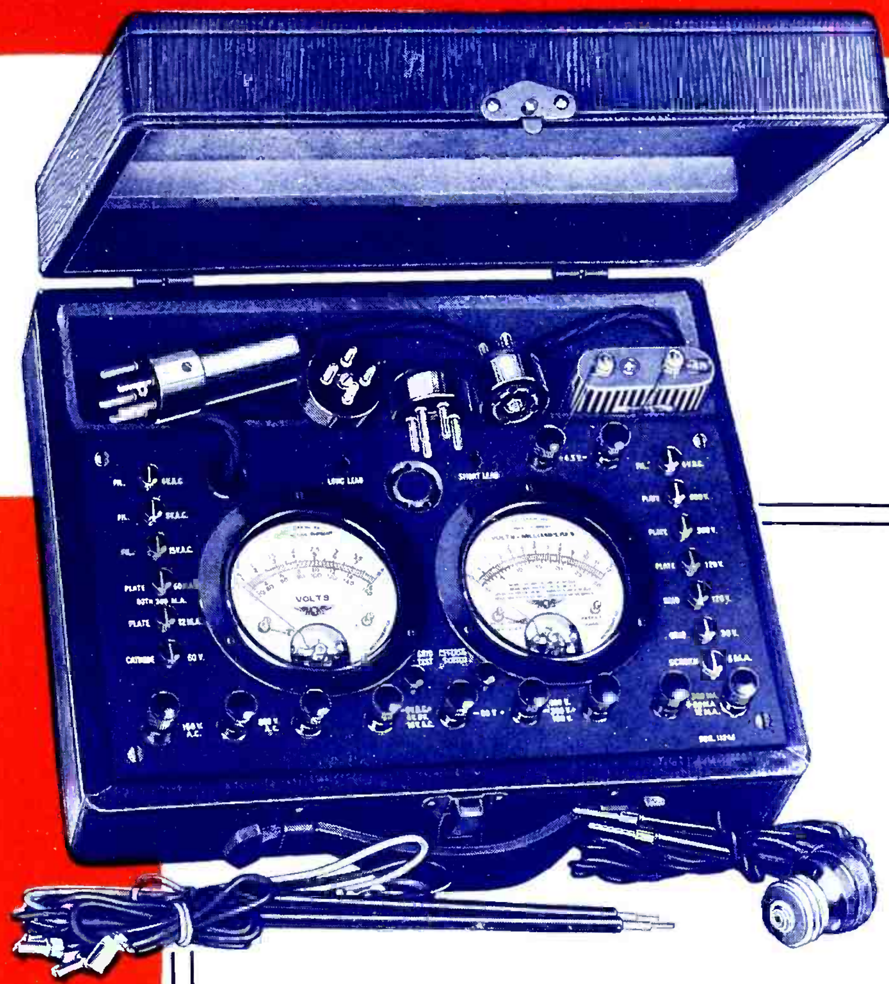

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Accuracy is vital in a radio service instrument. The large meters of the Pattern 199 are inherently accurate. These meters have been proved on thousands and thousands of industrial applications. Their clearly marked legible scales are easy to read accurately.

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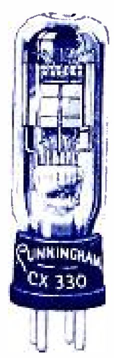
In all instances where low consumption is required, these new Cunningham Radio Tubes should find an increasing use. They are constructed to the high standards of in-built quality which have characterized Cunninghams for the past fifteen years.



CX-330:

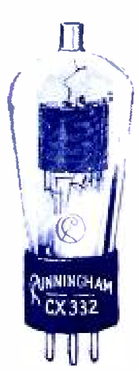
2 volt, .06 Ampere Detector and Amplifier. This general purpose tube has been developed for dry battery and single cell storage battery operation. The filament requires only .06 ampere and therefore is recommended for use in battery sets where extreme economy of filament power is desirable. It is similar to the CX-299 in external appearance but has greatly improved electrical characteristics and therefore is not directly replaceable in sets at present employing CX-299 tubes. The small standard CX base is used.

Operating voltages: filament 2.0 volts, plate 90 volts maximum, grid 4½ volts.

CX-331:

2 volt, .130 Ampere Power Amplifier. This power amplifier or loud speaker tube is intended for operation with the CX-330 and CX-331. Although it is similar in external appearance with improved electrical characteristics, to the CX-220, it is not interchangeable due to the lower filament voltage of 2 volts. The power output is 170 milliwatts which is sufficient for portable sets and when used in push-pull circuits is sufficient for ordinary home reception. This tube employs the small standard CX base.

Operating voltages: filament 2 volts, plate 135 volts maximum, grid negative 22½ volts.



CX-332:

2 volt, .06 Ampere Screen Grid Amplifier. This tube is intended to be used with the CX-330 and CX-331 tubes for portable and battery operated receivers. It is similar in appearance to the CX-322 but has greatly improved electrical characteristics. Because of the lower filament voltage it is not directly interchangeable with CX-322 tubes. This tube is capable of high radio frequency amplification resulting in sensitive portable and battery sets. It employs the standard CX base with a fifth connection at the top of the bulb.

Operating voltages: filament 2 volts, plate 135 volts maximum, screen grid voltage 67½ volts maximum, control grid voltage 3 volts.

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